Sandy River Riparian Habitat Protection Project Report 2000-2003

The Nature Conservancy, Oregon Field Office

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Addendum regarding stem injection of herbicides For the control of Japanese and giant knotweed

The stem injection method treatments described in this report were conducted by The Nature Conservancy and Metro Parks and Greenspaces as part of an experiment through an Experimental Use Permit granted by the Oregon Department of Agriculture, and as such we cautioned that the use of stem injection without a special permit was illegal.

As of January 30, 2004 however, the Oregon Department of Agriculture received the supplemental label for use of the Monsanto product Aquamaster (53.8% glyphosate; 46.2% water) to control Japanese and giant knotweed by **stem injection method**. The label reflected the changes requested by the US Environmental Protection Agency. The use of Aquamaster as per the supplemental label directions **is approved for use in Oregon**.

For practitioners in the Pacific Northwest: the Monsanto representative in Vancouver, Washington, Ron Crockett, can be contacted at telephone (360) 892-9884. He, his company or distributors should have the supplemental labels available with all the use directions.

We expect a similar approval by EPA for Rodeo (Dow Agrosciences version of the same product) in the near future. Contact the Oregon Department of Agriculture with any questions.

Please note that this decision does not affect the legality of this method in any other state. However, because the EPA decision is a federal one, it is likely that the supplemental label will be approved in most states if a manufacturer requests it.

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Section 1. Introduction, Project Description and Sandy River Physical Geography

Introduction

The Sandy River Watershed (SRW) (Figure 1.0 and 1.2) offers unique opportunities, but also difficult challenges to land managers. Despite its location near Oregon's largest population center, the SRW retains rare and characteristic fish and wildlife. Twenty-two wildlife species of state or federal concern are present. As important as are the rare species, the fact that the Sandy supports the full diversity of more common species that typify the low elevation Pacific Northwest forest is equally noteworthy. Charismatic large animals include bear, cougar, elk, bald eagles, osprey, spotted owl and fox. The SRW also supports diverse neo-tropical migrant and other birds and a high diversity of amphibians. In recognition of the outstanding natural values the Sandy supports, 2 major sections have federal Wild and Scenic River and/or an Oregon State Scenic Waterway designation (Figure 1.1). Numerous areas in the uplands have wilderness designation.

The SRW is particularly important within the Lower Columbia River ESU (ecologically significant unit) for anadromous fish. Among 19 known species of fish present in the SRW are runs of 4 native and one introduced anadromous fish, and 2 native species of trout and whitefish. Anadromous species of regional importance found in the Sandy include federally threatened ESUs of fall and spring Chinook salmon and winter steelhead. The Sandy is almost certainly to be identified by the National Oceanic and Atmospheric Administration as one of only two watersheds (with the Lewis River in Washington) capable of recovering Chinook salmon. The Sandy River Gorge (rm 12-19) is a prime fall Chinook spawning ground. The upper Sandy (above Marmot Dam) is as close to a wild salmonid sanctuary (mostly for spring chinook and winter steelhead) as exists in Northwestern Oregon.

All of these species are still present despite the watershed's locations near Oregon's largest urban area because of the large blocks of native habitat still present along the river, its major tributaries and headwaters. For over 30 years the Sandy River has been a priority acquisition focus of numerous individuals, agencies and private conservation organizations. The list includes the Bureau of Land Management (BLM), the City of Portland, Metro, the River Network (now Western River Conservancy), The Nature Conservancy (TNC) and the United States Forest Service (USFS) among others. About 80% of the upper watershed is in public ownership. In the lower watershed, the Sandy River Gorge (river miles 12-19, Figure 1.1) represents a remarkably successful example of a multi-partner, public - private partnership to protect a landscape level site. The efforts of these and other organizations and individuals (Arch and Sam Diack Sr. for instance) have resulted in this stretch not only being designated a federal wild and scenic river and a state scenic waterway, but also in conservation ownership of most of the area.

The Sandy is also the scene of current large investments by several groups. Millions of dollars continue to be invested in protecting fish runs and wildlife habitat throughout the watershed in expensive culvert replacement (county and city governments), road retirement, dam removal (PGE) and water management and mitigation projects (Portland Water Bureau). Acquisition is ongoing as well. The BLM and the Western River Conservancy are attempting to acquire key parcels in the middle Sandy, and Metro used funding from a bond measure to acquire hundreds of acres in the Sandy River Gorge in the late 1990s.

Figure 1.0 Sandy River Watershed location

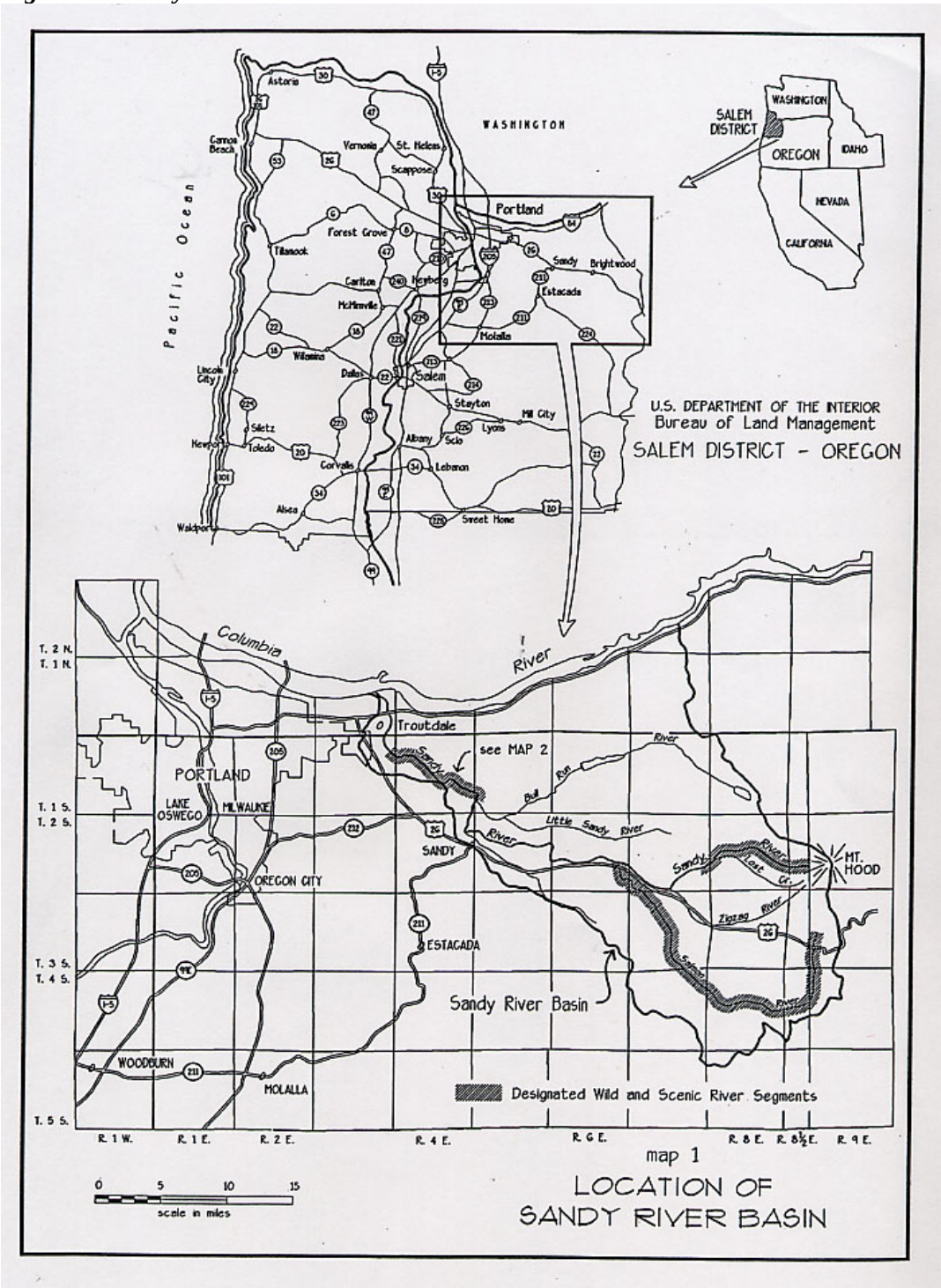
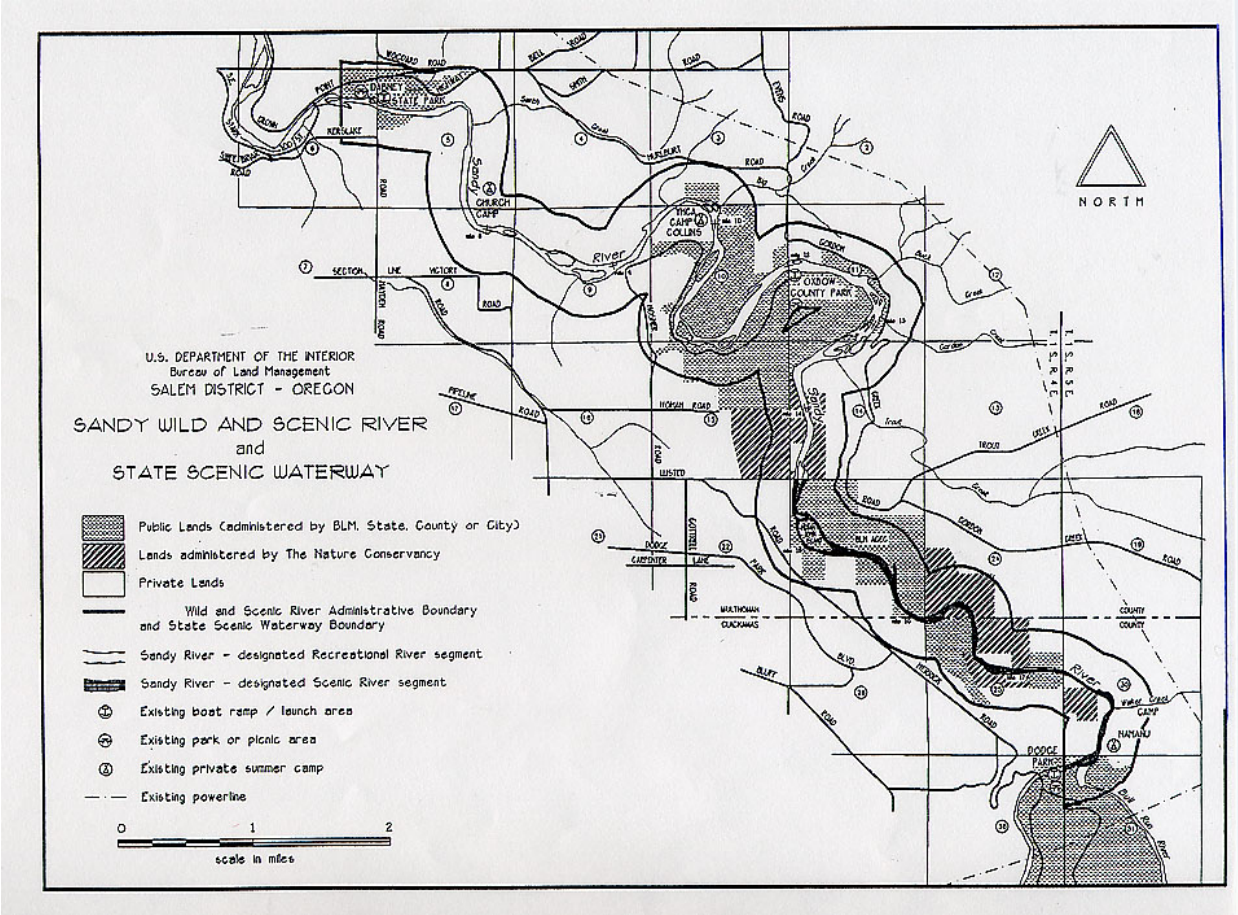


Figure 1.1 Sandy River Gorge location



Despite, and perhaps partially because of the involvement of so many players and so much effort, stewardship of the habitat along the Sandy remains highly fragmented, and thus a major management challenge. Just considering lands along the Sandy River and its major tributaries, ownership and management is divided between many agencies (BLM, Clackamas County, Metro, Multnomah County, ODFW, Oregon State Parks, Portland Water Bureau, USFS, USFWS among others) and more than 4000 individuals and corporations.

Because the Sandy watershed includes the watershed providing the Portland regions water supply (the Bull Run) as a major tributary, and will be subject to immense pressure from the regions growing population, the Sandy not only needs continued conservation attention from each organization, but a team approach, and organizations willing to serve as leaders. Although the potential for great work on the ground exists, there has been no catalytic force to get all the players working in tandem.

Why work on invasive species is a critically important component of effective watershed management, protection and restoration

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

The loss of riparian habitat and function is a critical issue that will help determine the long-term health of the basins aquatic ecosystem and much of its wildlife. Riparian habitat is utilized or depended on by up to 90% of wildlife species and is an important determinant of fish and wildlife success, through its direct influence on habitat, river dynamics and aquatic food chains. Due to the importance of riparian habitat, the Sandy River Watershed Council has identified riparian habitat protection from invasive weeds as a priority action item in their phase 1 watershed assessment and action plan. BLM, Metro and USFS planning documents all include recognition of the threat invasive species pose.

Although not as splashy as planting based or earth moving based restoration projects, control of invasive species protects the vegetation matrix that ultimately supports or directly provides most of the key functions of a river system. Furthermore, because invasive control is preventing a problem rather than fixing one, the benefits are in future money *not spent* and in habitat that is *not lost*. Recognizing these kinds of benefits takes a little more thought, but is much like preventing theft from a bank account. Even at a dollar a day, a vast fortune will eventually be lost.

Why knotweed is a threat to riparian ecosystems

Knotweed's threat is attributed to a peculiar combination of life history features that adapts it perfectly for life in the dynamic riparian and floodplain systems of the Pacific Northwest. Knotweed can cause fundamental changes in the function of the riparian area. It can tolerate long periods of submersion and poor soils, allowing it to establish and grow on the lower banks of rivers and creeks where there is little competition. Our cobble bars are generally sparsely vegetated for a long period of time following initial formation or significant disturbance. Because knotweed evolved as a primary colonizer of volcanic slopes, it can rapidly colonize fresh sediment deposits and other low nutrient, disturbed sites. It grows rapidly to 3-4 meters in the spring, effectively shading and excluding lower and slower growing native vegetation, including many graminoids, shrubs, alders, willows and cottonwoods, the typical riparian dominants of our area. Knotweed has an extensive, but fragile rhizome network, and reproduces vegetatively via root fragments as small as 1 cm. Finally, it has proven to successfully form dense, apparently permanent monocultures in areas with similar or colder climates.

With the loss of native riparian vegetation and the inability of shade intolerant species to reproduce under a knotweed canopy, it is likely that several types of fundamental changes will begin to occur as knotweed dominance increases. Although knotweed has an extensive root system, it has relatively few fine roots and thus provides very poor bank holding capacity. This will lead to more sediment in the water and broader, shallower waterways. Although knotweed can provide dense shade directly along the shoreline, compared to an established forest canopy a knotweed canopy will allow increased solar radiation to penetrate to the water, presumably resulting in higher than normal water temperatures. Because knotweed does effectively exclude reproduction of most tree species, a knotweed-dominated system will eventually be deprived of large wood, a key component of PNW river systems. Finally, a monoculture of any kind is unlikely to be able to provide appropriate habitat for wildlife or support for the aquatic food chain, resulting in loss of aquatic invertebrate biodiversity.

Project and Report Description

This report summarizes the first four years of what was initially planned as a 5 year cooperative, integrated approach to protecting the integrity of riparian habitat in the Sandy River watershed by controlling systems-modifying invasive weed species throughout the riparian areas and floodplains of the Sandy River and its major tributaries*. Because they are still controllable on a watershed and ecoregional scale, the main targets are Japanese and giant knotweed (*Polygonum*

cuspidatum and *P. sachalinense*, henceforth knotweed). At local, high priority sites other species, especially Scots (Scotch) broom are included.

** System (habitat) modifying species have the potential to permanently alter fundamental ecosystem characteristics such as structure, process and ultimately, function on a landscape / watershed scale.*

The scope and scale of the knotweed problem turned out to be much larger than anticipated at the outset. As a result, the project needs to continue for at least one more year at its current size and 2 or 3 more years at somewhat reduced scale and scope to achieve real, lasting gains. After the 2004 field season we are planning for the project to begin both a reduction in size and more importantly, transformation from a TNC led project to a project run through a local weed management entity formed by local partners working together to set objectives and provide funding.

The project included four significant and integrated components:
1) Inventory,
2) On the ground control work, including the offer of free knotweed control to all landowners,
3) Research and monitoring,
4) Public outreach, education and volunteer coordination.

Reasons for inventory, control, research and monitoring are obvious. In order to succeed, we must understand the scope of the problem; develop efficient project structures and effective and environmentally acceptable control approaches. Then, we must make sure they are working or adapt them based on experience and careful science to work better. The outreach aspects, although more nebulous are no less important. By working with multiple public partners and across property boundaries, we increase efficiency and the possibility of success. Because much of the land in the middle and upper middle portions of the watershed (and the source of downstream knotweed) is in private ownership, we must also reach private landowners to succeed. Finally, only by conducting vigorous community outreach can we hope to both educate and motivate local community action. This has resulted not only in an enhanced project in the present, but important progress towards the long-term, overarching goal of protecting the functionality of our ecosystems from all invasive species (or other issues).

Although outreach efforts were focussed on building knotweed awareness, the role of all invasive species and other factors in degrading watershed function (health) is a routine theme in our outreach and education efforts.

Funding and Project Administration

TNC assumed full responsibility for managing the project and absorbed significant administrative costs not reimbursed by grants. TNC also made substantial cash contributions, mostly in the form of salary for the project manager and volunteer coordination. The majority of the funding however, came from cash grants, cost-shares or in-kind contributions from our partners, including the BLM, For the Sake of the Salmon, Metro, the National Fish and Wildlife Foundation, the National Oceanic and Atmospheric Administration, the Northwest Service Academy of the AmeriCorps, the Oregon Department of Agriculture (Oregon State Weed Board noxious weed grant program), the Oregon Watershed Enhancement Board, and the USFWS (metro area restoration grant program). Numerous other organizations and individuals have provided smaller amounts of support or in-kind contributions.

Report Structure

Relatively detailed summaries of project components (field methods and results by year, knotweed biology and treatment, outreach, volunteer and education methods and results, research efforts on control methodology and outreach materials) are included in individual sections of this report. Most of the sections are summaries of full reports or present only a portion of the data. Most of this information has been reported in earlier reports to each of the funding agencies. We have pulled together so much information in one place partially as a record of achievement over 3+ years, but also to serve as a reference to the many nascent knotweed control programs that have sprung up since we initiated this one. Each component report and detailed data tables are included in the appendix section and on the accompanying CD.

Why TNC leadership?
It was clear that with so many landowners and such a widespread weed problem, only a unified effort could possibly succeed. TNC committed to fundraising and managing the project with the hope that this effort, together with such projects as the Marmot Dam removal and the Sandy River Basin Agreement process could serve as a springboard to a long-term solution to the knotty issue of coordinated basin wide management. We are still hopeful. We felt then, as now, that TNC has a unique mix of technical and administrative capacity, coupled with its status as a non-profit that offered us the best chance to succeed. We also had a long history of partnerships with several potential local funding sources and perhaps most importantly, the will and vision to take this project on.

Field work
In order to make maximum use of available funding, the core field team consisted of a variable sized, mix of seasonal TNC staff and AmeriCorps members from the Northwest Service Academy. We offer free knotweed control to any and all landowners, be they private, corporate or agency. We have attempted to treat all known knotweed each year, while simultaneously expanding our area of full inventory through outreach to private landowners. Treatment methodology has been a classic adaptive management process. We began with what we thought would work based on the literature and launched experiments to improve on the literature. The process is continuing into 2004 with experiments on the stem injection of herbicides.

Outreach
Because of the need to access private property we needed to reach many (4100+) landowners. We combine door-to-door outreach, with mass and targeted mailing of an informational brochure, presentations at local and community events and schools, newspaper articles, and posters.

Not all outreach is to landowners in the Sandy River. Our work has also aimed to influence other land managers throughout not only Oregon and the Pacific Northwest, but in fact across the country. As well as speaking at vegetation management based meetings, conferences and trainings; in partnership with the Northwest Oregon Weed Management Partnership we have formed and are leading a knotweed working group that has brought attendees from throughout Northwestern Oregon and Western Washington.

Education
Unfortunately, knotweed will not be the last weed threat, so a major objective was to create “weed literacy" in the next generation, as well as current landowners. In partnership with WOLFTREE and several local teachers, we developed and launched a program (ISSEP) to link classroom education on invasive species and restoration to fieldwork / volunteering / school research projects (so-called service learning) and state learning benchmarks.

We also offer more generic service learning expeditions to community groups or school at local work sites owned or managed by our partners.

Volunteerism / Youth Crews
To stretch project dollars and because the field is the best teacher, we instituted an aggressive volunteer and youth crew / AmeriCorps / Job Corps program. In essence, we trade our natural history knowledge and project management skills with the community in exchange for free or subsidized labor on sites suitable for manual or mechanical treatment. These sites were generally occupied with Scots broom or blackberry, secondary target species for our project. We have averaged more than 1000 hours of volunteer labor and 7-10,000 hours of AmeriCorps or other Youth Crew labor per year.

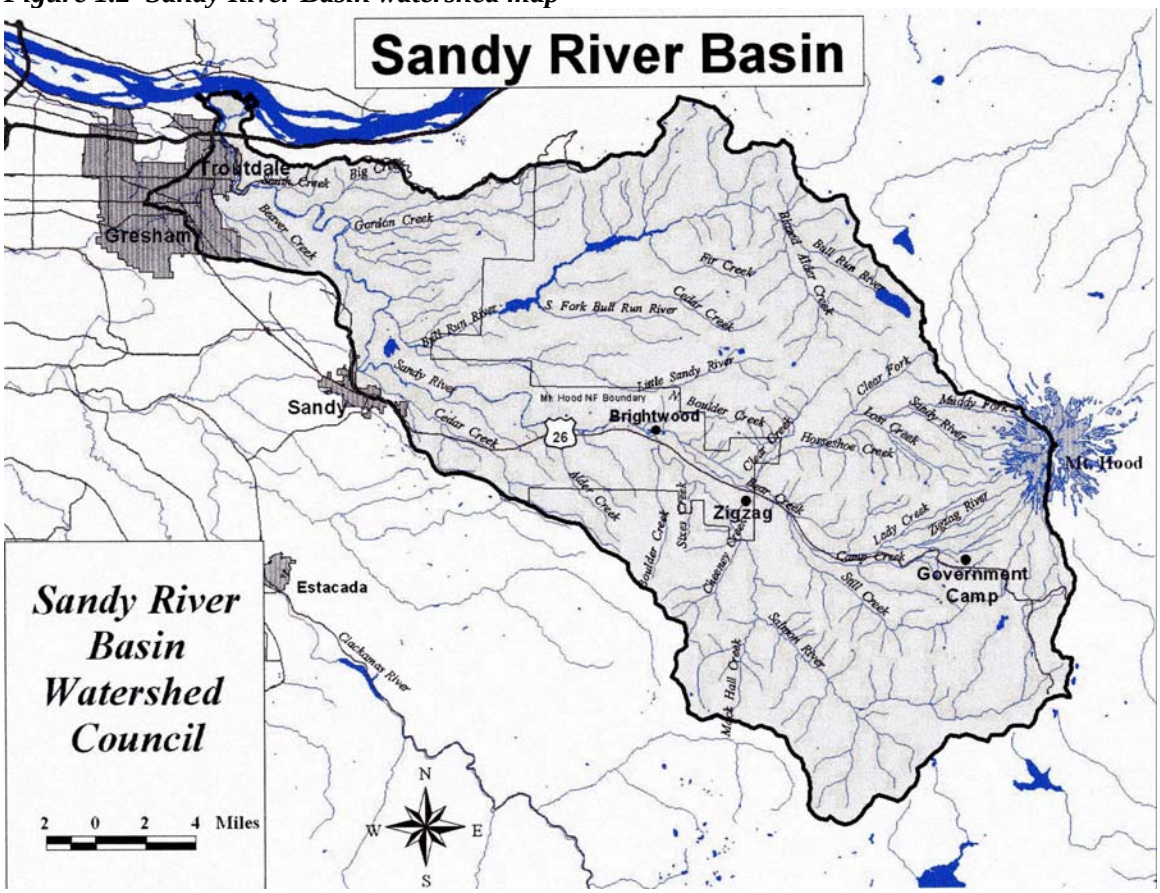
Project Products
Aside from the notable progress we have made protecting vital riparian habitat from noxious weeds on the ground, we have also created a number of products which are available to other projects. Items in bold are included in the appendix and on the CD. All are available by request from The Nature Conservancy, Oregon Field Office.

- **East Oxbow Knotweed Control Experiment Research Results**
- **Stem Injection of Knotweed Research Results**
- **Knotweed Outreach Brochure Version 2003**
- **Controlling Knotweed (*Polygonum cuspidatum, P. sachalinense* and *P. polystachyum*) in the Pacific Northwest (Best Management Practice Guide)**
- Scots broom (*Cytisus scoparius*) control in the Pacific Northwest (Best Management Practice Guide - draft version)
- Controlling Blackberry (*Rubus armeniacus*) in the Pacific Northwest (Best Management Practice Guide - draft version)
- **Knotweed Wanted Poster**
- **"I saw knotweed" postcard**
- **Invasive Species Science Education Program Manual**
- Knotweed database and PDA-based field data collection users guide
- Knotweed Recognition and Control PowerPoint presentation (2 lengths)
- General invasive species PowerPoint presentation

Sandy River Geography

(Excerpted and adapted from the Sandy Sub-Basin Draft plan document presented to the Northwest Power Planning Council, 2001)

Figure 1.2 Sandy River Basin watershed map



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 about 508 square miles (330,000 acres). The Sandy River and many of its tributaries originate high on the slopes of Mount Hood. The Sandy River flows about 56 miles in a northwesterly direction and joins the Columbia River near Troutdale at Columbia River mile (RM) 120.5.

The Sandy Sub-basin is comprised of several watersheds, many of which are distinct in terms of hydrology and geomorphology. Principal tributaries include the Zig-Zag River, Still Creek and the Salmon River in the upper sub-basin, and the Bull Run River, Little Sandy River, Gordon Creek, Cedar Creek and Beaver Creek in the lower sub-basin. Many other smaller tributaries located throughout the sub-basin contribute significantly to stream flows, and provide habitat for a wide array of fish and wildlife assemblages.

The headwaters of the Sandy and Zig-Zag Rivers are greatly influenced by glaciers and steep unstable slopes on the western flank of Mount Hood, an active volcano with an elevation of 11,235 feet. During summer, glacier ice melts and large quantities of sediments trapped in the ice flush into associated headwater streams (primarily the Muddy Fork and the upper Sandy River), and the mainstem Sandy River often remains turbid until high elevation temperatures drop in

early fall. Glacial sediment and sand deposits are evident throughout the mainstem Sandy River. Snow pack accumulations and glaciers at higher elevations on Mount Hood also maintain favorable flows and cool water temperatures for fish throughout summer.

The Salmon River and Still Creek are two large-order tributaries in the upper sub-basin and are recognized for providing high quality spawning and rearing habitat (both have knotweed present). The Salmon River originates on the south slope of Mount Hood and empties into the Sandy River at RM 38. Still Creek also heads on the south-facing slopes and is a tributary to the Zig-Zag River. Since most glaciers on the south-facing slopes have mostly vanished due to climatic changes over the past several thousand years, these streams are not presently glacially influenced and do not receive the sediment loads that streams originating from the west and north facing slopes do. The Salmon River usually runs clear all year and provides significant miles of spawning and rearing habitat for both anadromous and resident fish species. Final Falls is a 60-foot high cascade located at about RM 14 on the Salmon River and is the upstream limit of anadromous fish distribution.

The Bull Run River is a large, clear water tributary that enters the Sandy River at Dodge Park (RM 18.5) near the City of Sandy. The mainstem is approximately 25 miles long, and originates from Bull Run Lake (elevation 3,160 feet), a large natural lake to the northwest of Mount Hood. Many large tributary streams also contribute significantly to the flows produced in the Bull Run watershed. Historically, flows from this watershed represented a significant amount of the average annual flow in the Sandy River entering the Columbia River, and about 32 miles of stream habitat was available to large runs of migratory fish, especially fall chinook salmon. However, in 1892 President Benjamin Harrison proclaimed the Bull Run watershed as a reserve for the City of Portland's domestic water supply. Though the first water diversion structure was built in 1891, it is believed that the Headworks Dam (RM 6; 20 feet high) was the first facility in the Bull Run watershed to prevent upstream fish passage. In addition, at certain times of the year most of the water draining from this watershed is impounded and transported out of the watershed, primarily for municipal use.

The Little Sandy River is a large tributary stream that empties into the Bull Run River at RM 3. However, fish passage has been blocked since 1911 by a small diversion dam, which is owned and operated by Portland General Electric (PGE) and is located about 1.7 miles upstream from its confluence with the Bull Run River. Other significant tributary streams in the lower basin include Gordon, Beaver, Buck and Cedar Creeks. It is anticipated that with the planned removal of Marmot Dam in 2008, the Little Sandy will once again be available to anadromous fish, especially winter steelhead.

Topography and Geomorphology

(Excerpted and adapted from the Sandy Sub-Basin Draft plan document presented to the Northwest Power Planning Council, 2001)

The upper Sandy River, Zig-Zag River and the upper reaches of the Salmon River are very high gradient and carve through unstable volcanic ash and rock deposits. The Sandy River descends from its source at 6,200 feet on the western flank of Mount Hood to an elevation of 1,600 feet at its confluence with the Zig-Zag River, only 13 miles downstream (NWPPC 1990). The average gradient in the upper sub-basin is about 288 feet per mile (NWPPC 1990), but may exceed 1,000 feet per mile in the upper elevations. Substrates underlying the lower reaches of the upper sub-basin near the towns of Rhododendron and Zig-Zag are typically composed of loose alluvial rock. Substrates in the neighboring Salmon River are composed largely of basaltic lava rock.

The reach of the Sandy River from the confluence with the Zig-Zag River (RM 43) downstream to Marmot Dam (RM 30) is generally broader and less steep than the upper sub-basin. The generally low gradient and wide floodplain has allowed numerous knotweed patches to become established in this area. The gradient is moderate and consistent, and averages about 70 feet per mile (fpm) from the confluence with the Zig-Zag River downstream to the Sleepy Hollow Bridge, and about 33 fpm from the Sleepy Hollow Bridge downstream to the Marmot Dam (Willamette Canoe and Kayak Club 1994). The substrates in this reach are composed largely of small boulders, cobbles and gravel. Glacial sediment deposits may be high where the gradient lessens, and spawning gravels are often entrenched.

Below Marmot Dam, the Sandy River descends for about 5 miles into a scenic narrow gorge that is characterized by steep canyon walls, constrained chutes, and deep trench-like pools, as a result, there are relatively few knotweed patches in this stretch of the river. The substrate evident in the strata of the canyon walls is interspersed with basalts, sandstone sediments and compacted volcanic ash conglomerates. Substrates in the active channel are typically composed of large and small boulders because the narrowness of the canyon manifests strong turbulent flows in winter that moves smaller cobble and gravel downstream.

Below Revenue Bridge (RM 24) the active channel widens and the river begins to meander. As a result the most dense knotweed infestations in the watershed are in this stretch and below. High bluffs, composed of sandstone and sediments, rise over 200 feet in places. In-channel substrates are generally composed of small boulders and cobble with some gravel deposits at the tail end of the larger pools. Further downstream, the Sandy River merges with the Bull Run River at RM 18.5, and descends into the rugged and remote Sandy River Gorge. The reach from Dodge Park downstream 12.5 miles to Dabney State Park (RM 6) is designated both a federal Wild and Scenic River and a State Scenic Waterway. Canyon walls are generally composed of sandstone and other sedimentary rock. However, rock and volcanic ash conglomerates are also evident. Overall, in-stream substrates are composed of small boulders and cobbles with some gravel deposits at the tail end of pools.

Below Indian John Island, the Sandy River lessens in gradient. Overall gradient of the river channel from Dodge Park downstream to Metro's Oxbow Regional Park (RM 13) is about 23 fpm (Willamette Canoe and Kayak Club 1994). The gradient lessens significantly, and large gravel deposits are evident at the tail end of most pools. The gradient of the Sandy River from Oxbow Regional Park downstream to Dabney State Park lessens to about 8 fpm, and below Dabney State Park the river continues to its confluence with the Columbia River at gradients of less than 6 fpm (Willamette Canoe and Kayak Club 1994). As the gradient of the channel lessens, large sand deposits become evident. There is actually relatively little knotweed from this point of the river down, presumably because the extensive floodplains above it act as a filter and reduce the inflow of root material.

Where the Sandy and Columbia Rivers merge, sediments have deposited over the millennia to form a large delta. This is called the Sandy River Delta and covers approximately 1,400 acres (USDA 1996). This land tract was designated a Special Management Area in the 1986 legislature, was purchased by the U.S. Forest Service (USFS) in 1991, and is part of the Columbia River Gorge Scenic Area. The Sandy River Delta was acquired to protect and enhance the natural resource values of the site, particularly the floodplain character and associated wetlands and to provide for compatible recreation uses. The mouth of the Sandy River is typically shallow and underlain almost entirely with sand and other fine sediments. It is unknown how this shallow condition affects fish passage from the Columbia River into the Sandy, especially in summer and

early fall. However, the mouth has some tidal influence and flows from the Sandy are usually adequate for fish passage, even during summer when water levels drop. Knotweed has not been mapped on the delta.

Section 2. Knotweed Introduction

Description

Japanese, giant, and Himalayan knotweed are members of the buckwheat family (Polygonaceae) from Asia with hollow (not true for the Himalayan species), upright, bamboo like stems growing to 1 to 5 meters (3 to 16 feet) (Figures 2.0 and 2.3). The large, smooth-edged leaves range from an elongate triangle (Himalayan knotweed), through heart shaped (Japanese knotweed) to huge, "elephant ear" type leaves (giant knotweed) (Figure 2.1). Hybrids blur the distinctions. The stems are often reddish or red-speckled. Young shoots look similar to red asparagus. The small white or greenish flowers form in July and August and grow in dense clusters from the leaf joints (Figure 2.2). Although it dies back to the ground after hard frosts, the stems may persist through the winter as bare, reddish brown stalks (Figure 2.0). Prostrate knotweed, a common weed in the Polygonaceae family, is not addressed in this document. References to "knotweed" pertain exclusively to Japanese, giant or Himalayan knotweed or their hybrids, unless otherwise noted. For more photographs of knotweed, please refer to the article, "Controlling Knotweed in the Pacific Northwest" located in Appendix 2.0.

Common names include: elephant ear bamboo, Mexican bamboo and fleeceflower.

Scientific names include:
Japanese knotweed (*Polygonum cuspidatum*, *Fallopia japonica*, *Reynoutria japonica*),
giant knotweed (*P. sachalinense*)
Himalayan knotweed (*P. polystachyum*)
Japanese and Himalayan knotweed hybrid (*P. X Bohemicum*).

Basic Knotweed Ecology

In the Pacific Northwest (PNW), at low elevation, knotweed typically starts growth in April, earlier in warm areas, and as late as June at higher elevations. Even at low elevation, stems from deeply buried roots may emerge as late as July or August. Knotweed grows extremely fast during the spring. Giant knotweed can reach 15 feet (4.5 meters) by June. The slightly shorter Japanese knotweed reaches "only" 10 feet (3 meters) or so. The "dwarf" Himalayan variety is shorter still, typically reaching 4-6 feet (1.5 - 2 meters).

Knotweed is a creeping perennial. It dies back to the ground with the first hard frost, and returns each spring from the same root system. The term "creeping" refers to the extensive network of rhizomes (root-like stems that can sprout) spreading at least 23 feet (7 meters), and possibly as far as 65 feet (20 meters) from the parent plant and penetrating at least 7 feet (2 meters) into the soil.

Knotweed can spread rapidly due to its ability to reproduce vegetatively. Root and stem fragments, as small as ½" (1 cm) can form new plant colonies (Figure 2.4 and 2.5). Seasonal high water events and floods sweep plants into rivers and creeks, then fragment and disperse knotweed plant parts throughout the floodplains and cobble bars. The fast growing knotweed then takes advantage of the freshly disturbed soil to become established. Because it grows faster than most other plant species (including native species and most other weeds) it quickly outgrows and suppresses or kills them. Roadside ditches, irrigation canals, and other water drainage systems can be colonized the same way. Cut or broken stems and roots will sprout if left on moist soil or put directly into water, or if moved by beavers (Figure 2.5). Stem or root fragments can also be spread in contaminated fill material.

Although pure strains of Japanese, giant or Himalayan knotweed are not thought to produce fertile seed in the United States, the hybrid varieties (including the newly described hybrid of giant and Japanese knotweed -- *Polygonum X bohemicum*) are able to produce fertile seeds. According to knowledgeable observers, unfortunately, many of the patches in the Pacific Northwest appear to be hybrids of Japanese and giant knotweed. The Nature Conservancy (TNC) has successfully germinated knotweed seeds in a laboratory setting, and seedlings have been confirmed in at least one setting on the Sandy River during spring 2002. Should extensive sexual reproduction be confirmed in the field it would certainly alter strategy for landscape level control projects.

Knotweed resprouts vigorously following cutting, mowing, digging until at least August, and even following some herbicide treatments done in April. Such treatments apparently stimulate the production of shoots from latent buds dispersed on the rhizomes.

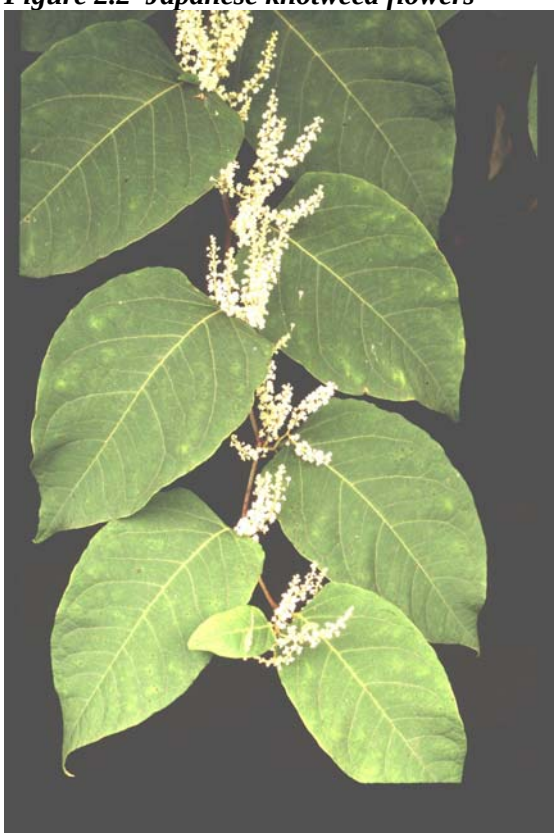
Figure 2.0 Dense stand of knotweed. Note the lack of other vegetation beneath the canopy.

Note the lack of understory vegetation and the accumulation of dead, brown canes from previous years growth. At this particular location, the average depth of dead knotweed canes accumulated from previous years was 24 inches (60 cm) above solid ground.

Figure 2.1 Assorted knotweed leaves

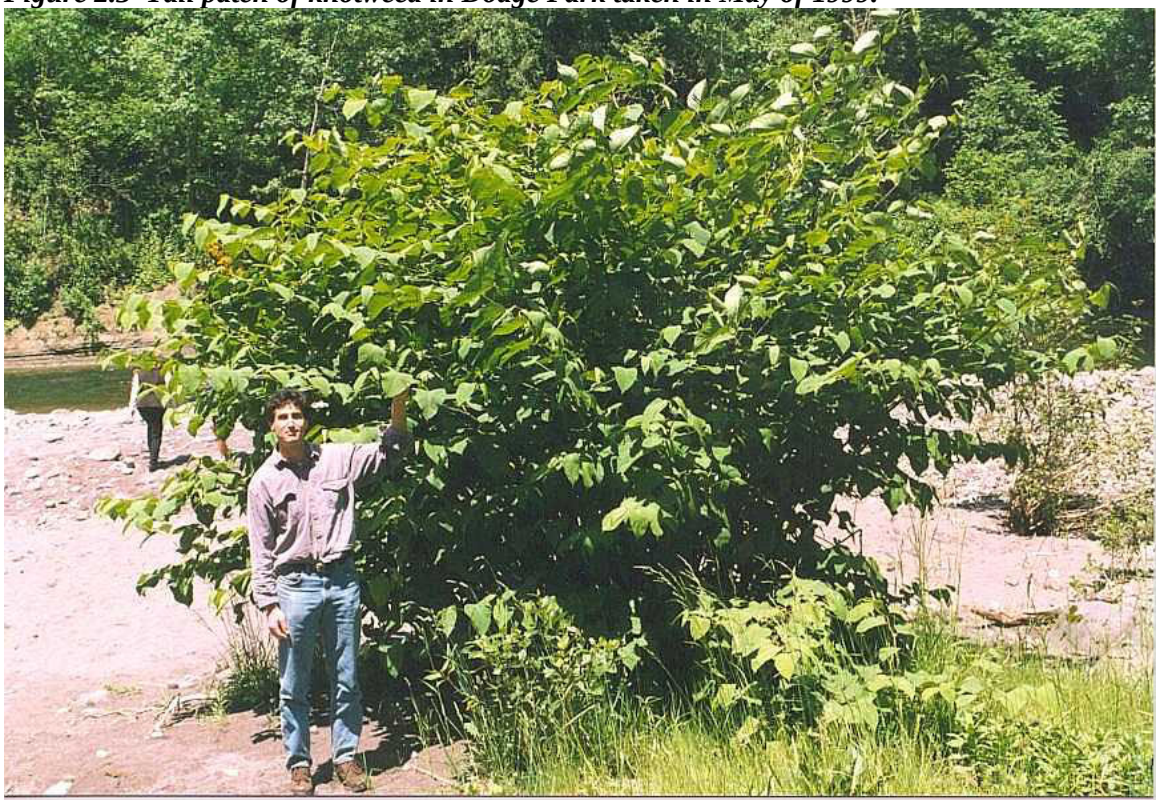
From left to right: giant knotweed, Japanese knotweed, Himalayan knotweed.

Figure 2.2 Japanese knotweed flowers



Knotweed flowers in late July or August, forming sprays of small white flowers from the leaf axil.

Figure 2.3 Tall patch of knotweed in Dodge Park taken in May of 1999.



Note that the knotweed has already grown over 3 meters in height by the end of spring.

Figure 2.4 Root fragment sprout

Knotweed root fragments with a single node, and as small as ½ inch are capable of forming a new plant. This one-inch fragment has three nodes.

Figure 2.5 Beaver cut stem rooted at nodes

Knotweed stems are fully capable of resprouting from the cut end or from stem nodes.

Section 3. Project Methods

Project Structure

Initial Approach: 2000 and earlier

The initial project structure to address the infestation of knotweed as well as other invasives (Scots broom, Himalayan blackberry) in the Sandy River watershed (SRW) combined fieldwork and leadership by TNC staff (project manager, seasonal field biologist and trained volunteers), with work by paid and volunteer youth crews (AmeriCorps NWSA among others), as well as individual volunteers. Outreach was to be performed by TNC staff at schools, agencies and the general public (Appendix 3.0).

The project manager who handed off the project to the current manager (Jonathan Soll) had originally planned to treat nearly knotweed patches manually, using an "adopt a reach" approach, and volunteers supervised or coordinated by TNC. Mr. Soll quickly realized that at least some patches would need to be treated otherwise, but still planned a manual based approach for many sites while using TNC staff to test several herbicide based approaches at difficult to reach sites. By early 2000, after a review of the knotweed control literature, we realized that approach was not feasible due to the larger than anticipated scope of the knotweed infestation. Based on our perception that there was inadequate control data to make good treatment decisions we then began testing a large number of control approaches (see E. Oxbow Knotweed Control Experiment, Section 5 and Appendix 5.0). The goal of the experiment was to create an effective adaptive management framework to determine which methods would be most efficient, effective and environmentally friendly, while continuing to allow us to inventory, map, and most importantly effectively treat knotweed patches in the Sandy River watershed.

2001

For the 2001 field season, TNC sponsored a 4-person, full-time AmeriCorps team, rather than periodically working with the standard 10 person teams (see Summary below and Appendix 3.1). The team was trained and supervised by permanent and seasonal TNC staff until they were able to work independently. Because our own knotweed research clearly indicated manual control to be ineffective, and because most volunteers could not apply herbicides, volunteer labor was shifted from hand cutting knotweed to control of Scots broom or Himalayan blackberry. When individual volunteers were available (especially repeat volunteers and interns) they accompanied the seasonal biologist and/or field team and provided support services (data recording, GPS data collection, and in special cases treatment of knotweed).

The attractiveness of AmeriCorps sponsored staff is that they provide 1760 hours of labor over 11 months at a cost of roughly $5000 per individual. On the other hand, returning seasonal staff provide invaluable and irreplaceable memory of field sites and project operations.

2002

In 2002 the 4-person AmeriCorps team from 2001 was hired as seasonal employees and another 4-person AmeriCorps team was co-sponsored by TNC and Metro, working half time each on the Sandy and Clackamas Rivers. This structure took advantage of the original team's experience gained during the 2001 field season while adding additional human power at reasonable cost (Appendix 3.2).

2003
In 2003 field season, 3 of the seasonal employees returned and a short-term (May through October) 3-person AmeriCorps team was hired. This structure utilized the expertise of the returning seasonal employees to effectively organize, lead and execute the outreach and field work while adding additional human power during the knotweed field season (Appendix 3.3).

Inventory, Control, and Monitoring

Conducting invasive species control in remote areas is different from, and more difficult than in areas easily accessible by vehicle. Many areas within the lower Sandy, the Sandy River Gorge, and the middle Sandy are difficult to reach by foot, and many of those that are theoretically reachable by foot require walking 1-3 miles or more from the nearest road access. Some sites can be reached on foot only during low water periods, thus outside some important treatment windows. Regardless of the distance and location, travel along heavily vegetated river and creek shorelines is extremely difficult, and often limits access to a short stretch of a single side of the river on a given day. Although the presence of water adds significantly to the challenge, it also offers a solution. The Oregon Department of State Lands has declared the Sandy River a navigable waterway. This allows us to freely travel in the water and on land within the area of mean high water. Traveling on rafts (early in the season) or inflatable kayaks (especially after June) allows many more sites to be visited, mapped and /or treated per day, as well as allowing easier river crossing. This is especially true in areas where we do not have prior consent of landowners, access to private roads or where access is by trails of 1-2 miles or more. By traveling the river we can also quickly determine which areas deserve prioritization and can thus better focus direct outreach efforts to obtain permission to cross and / or treat the property.

Water travel does however mean that it is critically important to have trained staff for safety and efficiency. Although the summertime Sandy is not a roaring river, there are significant technical and navigational challenges, especially when the transportation of herbicides is involved.

Japanese Knotweed

Survey
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 patches were numbered, flagged and mapped onto aerial photographs and/or by using a GPS unit. Because river levels decline throughout the field season, many areas need to be surveyed twice.

Summary of Sandy River Knotweed Project by Field Season

2001
In 2001 we attempted to comprehensively survey the 19 river miles from the Sandy River delta with the Columbia River to Dodge Park, and to survey as much of the upper watershed as time and access allowed.

Project Structure	1 seasonal, 4 person AmeriCorps team (April – November)
Treatment Methods Employed (spring/fall)	Foliar Garlon /Foliar Garlon Stem-cut Rodeo / Foliar Garlon Manual cut / Foliar Garlon Foliar Garlon (1x)
Number of new microsites established	609
Number of patches treated	2,990
Number of stems treated	48,198
Treatment Work Focus	Sandy River Rm (0 – 19), various private lands
Outreach & Survey	Sandy River Rm (19 –23), Cedar Creek, Salmon River, Gordon Creek

2002
In 2002 we attempted to comprehensively survey the upper and middle watershed in addition to completely resurveying and treating the lower 19 river miles. We expanded the complete inventory area on the Sandy River upstream to the Salmon River junction (rm 37), and surveyed significant portions of the Salmon River, Cedar Creek and all BLM lands on other tributaries.

Project Structure	4 seasonals, 4 person AmeriCorps team (50% time April – November)
Treatment Methods Employed (spring/fall)	Manual cut / Foliar Rodeo Manual cut (1x) Foliar Rodeo (1x)
Number of new microsites established	122
Number of patches treated	5,043
Number of stems treated	87,853
Treatment Work Focus	Sandy River (Rm 6 – 23), various private lands including tributaries
Outreach & Survey	Sandy River (Rm 23 –38), Cedar Creek, Salmon River, Trout Creek, Still Creek, Wildcat Creek, Big Creek, Whiskey Creek

2003
In 2003, with work effort in the lower 19 miles greatly reduced, we focussed intensively on the middle and upper Sandy River and major tributaries with a special effort to expand our ability to access private lands. We continued to intensify and expand our survey efforts along the Salmon River, Cedar Creek as well as other significant upper watershed tributaries including Hackett Creek and Still Creek. With the acquired permission and assistance of private landowners in 2003, additional river and foot access locations should lead to the completion of knotweed surveys along the upper Sandy River (to Mt Hood National Forest), and both the entire Salmon River and Cedar Creek tributaries in the 2004 field season.

Project Structure	3 seasonals, 3 person AmeriCorps team (May - October)
Treatment Methods Employed	Foliar Rodeo (1x) Stem injection Rodeo w/ foliar Rodeo (1x)
Number of new microsites established	112
Number of patches treated	4,245
Number of stems treated	55,866
Treatment Work Focus	Sandy River Rm (6 – 38), Cedar Creek, Salmon River
Outreach & Survey	Sandy River Rm >38, Cedar Creek, Salmon River, Hackett Creek

Treatment

Knotweed treatment methods varied with landowner, patch size, patch location, time of the year and field season (see Summary above). With the exception of BLM managed lands beginning in October 2003, legal restrictions on the use of herbicides have limited knotweed treatments on all federal lands to only using hand removal techniques. Manually treated stems were cut to the ground level as often as possible, up to once per month, but in most cases only once, in order to prevent flowering.

Herbicide treatment of patches along waterways was limited to glyphosate (Rodeo by Dow Agrosciences or Aquamaster by Monsanto, both with Oregon registration for aquatic use). In 2001 only, sites more than 10 feet from surface water were treated with Garlon 3a (triclopyr in a water base, with registration in Oregon for near but not adjacent to surface water). Though the majority of sites in 2001 were treated with 2 (spring and fall) foliar spray aqueous solutions (5% Garlon 3a and 1% Hasten surfactant), several other methods were employed including Rodeo foliar spray, cut stem wicking, and manual cutting combinations. Wicking methods include the application of 50% herbicide (Rodeo or Garlon 3a) solution in water directly onto the freshly cut stem.

In 2002 National Marine Fisheries Service (now the National Oceanic and Atmospheric Administration - Fisheries Department) consultation limited our herbicide use to glyphosate with Li-700 as a surfactant. Adjustments to treatment methodology due to our research program and NOAA consultation in 2002 included treating most knotweed sites with a spring (April – July) manual cut followed by a fall (July – October) foliar herbicide spray solution (3% glyphosate with 1% Li-700 non-ionic surfactant). Of necessity, precise treatment timing varied with location.

The main treatments methods utilized on knotweed sites in 2003 were: one application of foliar spray herbicide spray solution (5% glyphosate with 1% Li-700 non-ionic surfactant), the promising stem injection method developed by Clark County Weed Management, and a combined technique of stem injection of large diameter stems / foliar spray of small stems. The stem injection method involves poking a small hole through both sides of a knotweed stem just below the 2nd or 3rd node and injecting a small amount (1 to 5 ml) of undiluted glyphosate into the hollow chamber of each capable stem in a knotweed patch. Because this method was not label approved in the State of Oregon, an Experimental Use Permit (EUP) from ODA was obtained together by The Nature Conservancy and Metro Parks and Greenspaces to assess the efficacy of the stem injection method in 2 controlled experiments and on a limited landscape level on both the Sandy River and Clackamas River (for details, please see Stem Injection Experiment Summary Results in Section 6 and the full report in Appendix 6.0). After completing relevant legal processes in October 2003, the BLM approved the use of glyphosate to treat knotweed on their lands in the Sandy River watershed.

Monitoring and Some Terminology

The location of each knotweed site is recorded using an integrated GPS PDA device (Personal Digital Assistant), and on an aerial photograph when applicable (See Appendix 3.0). We have divided the main stem Sandy River into about 80 macrosites, or river sections, roughly corresponding to divisions between aerial photographs. Within a macrosite boundary, we have established knotweed microsites. A microsite is 1 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 (4800 patches identified through 2003 field season). Sites are numbered with a two-ranked code, macrosite-microsite (i.e. 20-01) in sequential order based on discovery within a given macroplot. The size or area of a microsite varies depending upon the boundaries set forth when the microsite was first established. For example, a microsite could consist of 1 patch with 1 shoot in a 1m2 area or 80 patches on a distinct floodplain with a total of 900 shoots in a 1000m2 area.

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

A site visit is any time data is collected at a microsite. Treatment is the application of some control methodology. Thus, sites with zero stems can be visited but not treated.

Between the 2001 and 2003 field seasons we collected data on 843 individual microsites within the Sandy River watershed containing more than 4800 individual knotweed patches, totaling over 105,000 stems. The most intensive monitoring is within the Sandy River Gorge, where we have maintained a 417 microsite database. Analysis of this data, combined with the intensive research done in two locations is considered to give a fair representation of our progress on the landscape as a whole (Section 4 Results).

Scots broom

Treatments

Despite of, or perhaps because of the widespread distribution of Scots broom in the Sandy River Gorge and the greater watershed, work has been limited to 12 key areas of ecological importance (Table 4.2). Infestations on floodplains, meadows, and riverbanks were identified, and subsequently treated using manual removal methods. We treat each priority site as time, funding, and volunteer availability allows. Control efforts focus first on reproductive individuals, and then on plants of younger age.

Mature plants are cut using loppers, machetes, or if small enough, uprooted by hand. Once mature plants have been removed, efforts are made to remove the seedlings that are present at the site. Following up on initial Scots broom removal is critical due to its capabilities to produce thousands of seedlings. Scots broom seeds are extremely long-lived, persisting in the soil up to 50 years. Seedlings typically begin to produce seeds within four years. Hand removal of the seedlings is an essential part of restoring an infested meadow, riverbank, or floodplain. Areas capable of the highest Scots broom seed production are cleared initially before moving on to areas with scattered, smaller plants. We direct our volunteers and workers to pull and uproot all Scots broom plants over 12 inches tall when working in areas cleared of mature Scots broom.

Monitoring

To document progress at a priority Scots broom site, The Nature Conservancy has set up photo points at the Cornwell Meadow complex, located near river mile 17. The site is owned by ODFW, Metro, and TNC, and represents the largest natural meadow in the lower Sandy River. Photo monitoring has been conducted at this site to document our progress at Cornwell, and to represent overall work on Scots broom in the Sandy River Watershed. Sixteen photo markers were established in 1998, and photos were taken in two directions at each marker each year, with the exception of 2003 (see Appendix 4.5 for complete photo series). Photos will be taken in alternate years for the foreseeable future. In 2003, a volunteer took photos at the photo markers in the meadows, replicating photos taken in 1998. These photos clearly show the progress of the removal work that has taken place at the Cornwell meadow.

Sampling is another method of documenting progress of Scots broom removal. Sampling done at Cornwell in 2001 indicated that the population of Scots broom seedlings was between one and four million. Removal work by work groups, employees, and volunteers of The Nature Conservancy since 2001 has made significant progress, and sampling will be done in 2004 to determine the approximate population of the remaining Scots broom seedlings.

Himalayan blackberry

Because blackberry is so widespread, we have not, and will not attempt to map its distribution, and will continue to limit work efforts on this species to sites at which we are already engaged on other species or a small number of specific, high priority locations. Blackberry was controlled using manual removal techniques. Living or accumulated dead stems were cleared using machetes or loppers. Root crowns were then dug out with shovels, mattocks or pulaskis. Single stem plants were frequently hand-pulled. In some cases we will consider integrating the careful use of herbicides to achieve cost savings.

Section 4. Project Results

Summary Knotweed Treatment 2001-2003

Extensive survey efforts by foot, raft and inflatable kayak over 50 miles of waterways in the Sandy River Watershed (SRW) from 2000 through 2003 have yielded the identification of 843 "microsites" (please see methods section for details of terminology) containing more than 4800 individual knotweed patches, totaling over 105,000 stems. These sites in total encompass over 300 acres of riparian and floodplain habitat and are distributed over land owned by private individuals or corporations (PGE, Banks Lumber) and public entities (including BLM, USFS, ODFW, City of Sandy, Oregon State Parks, Metro, Multnomah and Clackamas Counties). Nearly all of these entities have given permission to access and treat knotweed on their land (see Table 7.0, Section 7). Although approximately 45% of the known knotweed sites (2620 patches, 63,923 stems) are located on private lands (Table 4.0), roughly 15% of the patches are in a gray area of property ownership close to or within the normal high water level of the Sandy River.

Important tributaries of the Sandy River known to contain knotweed include Cedar Creek, the Salmon River, Beaver Creek, the Zigzag River, Badger Creek, the lower Bull Run River and Still Creek. At present, knotweed is known from riparian areas as high up in the watershed as on Henry Creek (a tributary to the Zigzag River) near Rhododendron. A visual representation of treated microsite locations with the most recent stem count data (2003 field season or last visit) is displayed in Figure 4.0 and Appendix 4.8. A summary by field season (2001, 2002, 2003) highlighting the treatment methods, project structure, stems treated, work areas, etc, is displayed in Section 3.

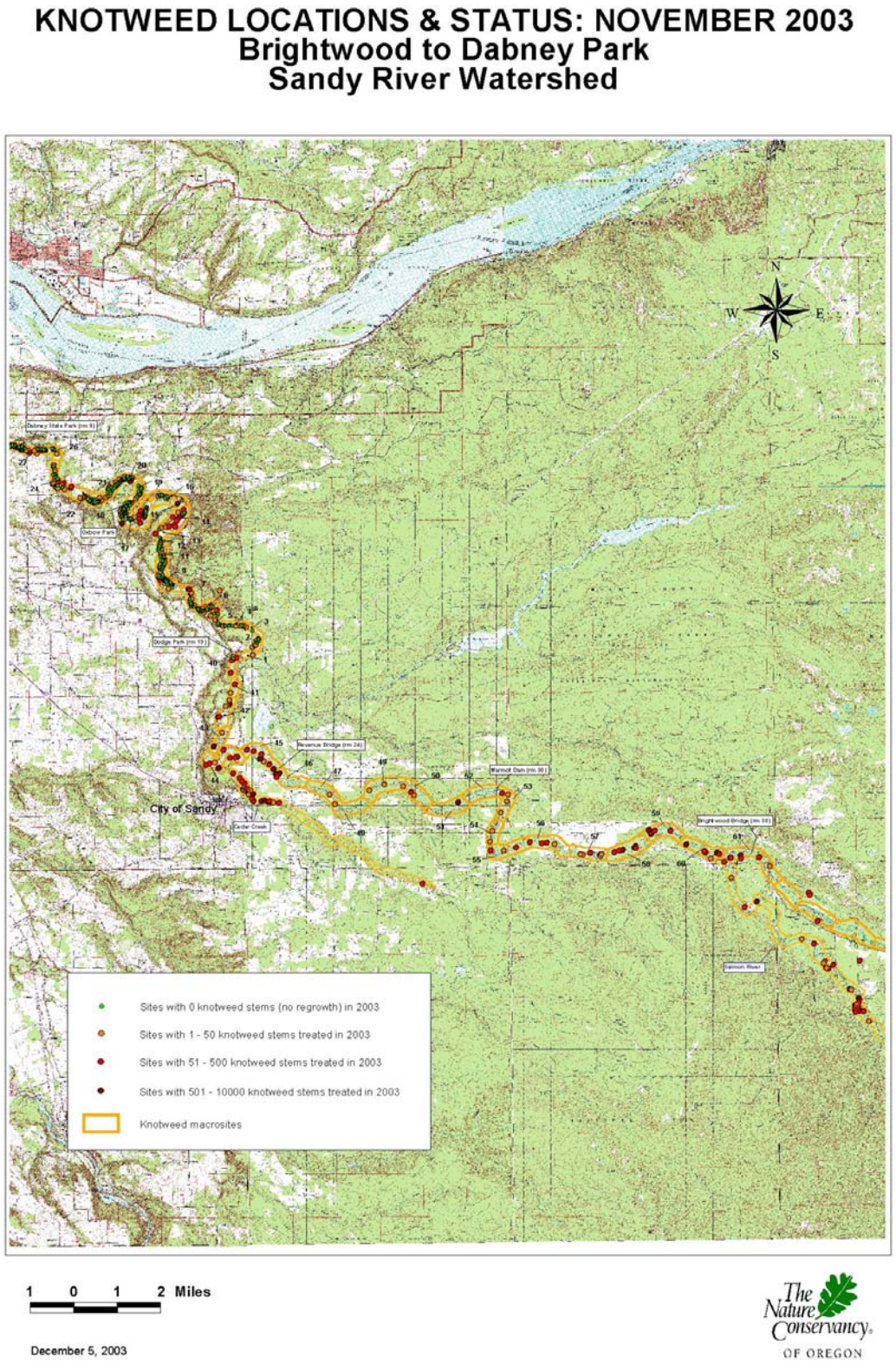
Table 4.0 Property ownership status of knotweed site locations in the Sandy River Watershed

	Public Lands	Private Lands
Number of microsites	459	384
Number of initial knotweed patches	2255	2620
Number of initial knotweed stems	41826	63923

The property location status of all 4,875 initial knotweed patches within all established microsites are displayed above by land ownership (total stem count = 105,749). Approximately 45% (63,923 stems) of the 843 identified knotweed sites are located on private land within the Sandy River watershed. Of the 2620 knotweed patches listed under private land ownership, 15% are estimated to be within a gray area of property ownership close to or within the normal high water level of the Sandy River.

Among 417 sites in the Sandy River Gorge (rm 0 –19) that were established and treated at least once during 2001 and 2002, and positively re-identified in 2003, 247 microsites (59%) had zero regrowth (0 stems) in the 2003 field season. The total initial stem count for these same 417 sites in 2001 of 36,050 was reduced to 7443 stems by 2003 (79.4%).

Figure 4.0 Map insert: Sandy River Watershed knotweed locations and status, November 2003



Status of Knotweed in Sandy River Watershed 2003

Foliar spray of Rodeo herbicide (please see Section 3 for details), along with the promising stem injection method developed by Clark County Weed Management (described in Stem Injection Results, Section 6 and in detail in Appendix 6.0) were the main treatments methods employed in 2003.

Table 4.1 summarizes the data from all knotweed microsites treated in the 2003 field season. Microsite stem counts in 2003 field season ranged from 0 stems (no regrowth since 2002) to an estimated 10,000 stems at one site in the upper watershed first recorded in 2003. Because of access limitations to private property for survey, the estimate of percentage of stems treated is derived from what we believe is the total number of knotweed stems in that river stretch, based on available survey data, and on the main-stem Sandy, scouting from the river and shoreline.

Table 4.1 - Status of 2003 knotweed treatments by river stretch

River Stretch	2003 Microsites Treated	Number of Stems Treated in 2003	Estimated % Stems Treated Stems vs. Actual
Sandy RM 0 - 19	499	14,199	> 95 %
Sandy RM 19 - 24	31	7,297	> 85 %
Sandy RM 24 - 29	7	2,048	60 %
Sandy RM 29 - 38	35	14,685	80 %
Sandy RM > 38	5	355	< 10 %
Salmon River	30	7,950	70 %
Cedar Creek	27	9,332	90%
TOTAL	634	55,866	

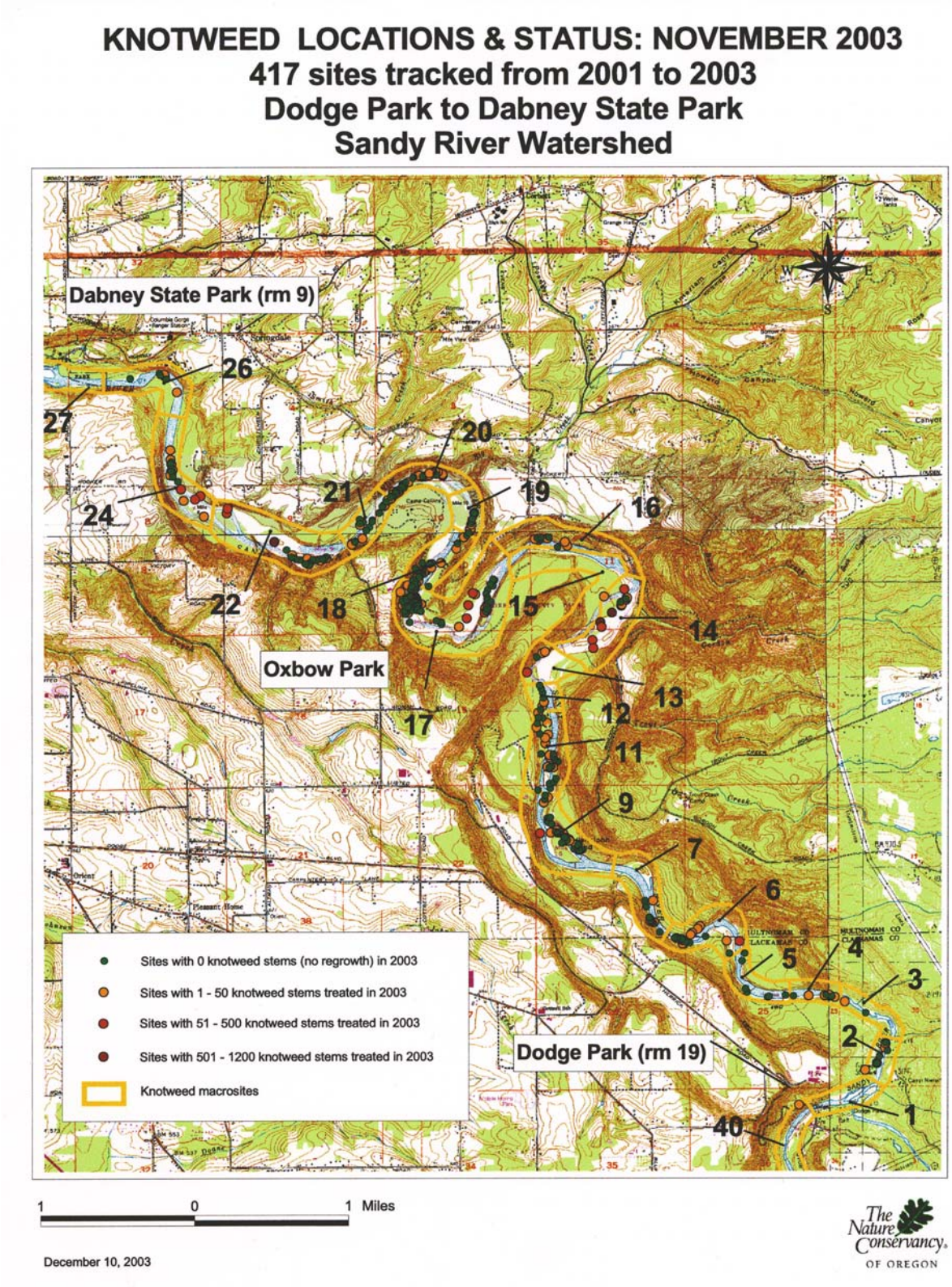
During 2003, treatment data were collected for 634 of the 843 established microsites totaling 4245 patches and 55,866 stems (Appendix 4.0). Data for sites treated by partner agencies (Oregon State Parks) and deterioration or loss of site labels prevented positive re-identification of some sites that resulted in 209 unrecorded microsites in 2003. All of the unrecorded sites, however, fall within the Sandy River Gorge from Dodge Park to Dabney State Park stretch (rm 6 –18) within which we believe our partners or ourselves treated 95% or more of the knotweed stems in 2003.

Since the Salmon River and Cedar Creek waterways represent the two greatest knotweed upstream tributary threats to the watershed, significant outreach efforts to landowners to gain access to infested private lands were made. These efforts resulted in the treatment of 30 sites (520 patches, 7950 stems) along the Salmon River and 27 sites (511 patches, 9332 stems) along Cedar Creek in 2003.

Monitoring Results for Sandy River Gorge Sites (river miles 6-19)

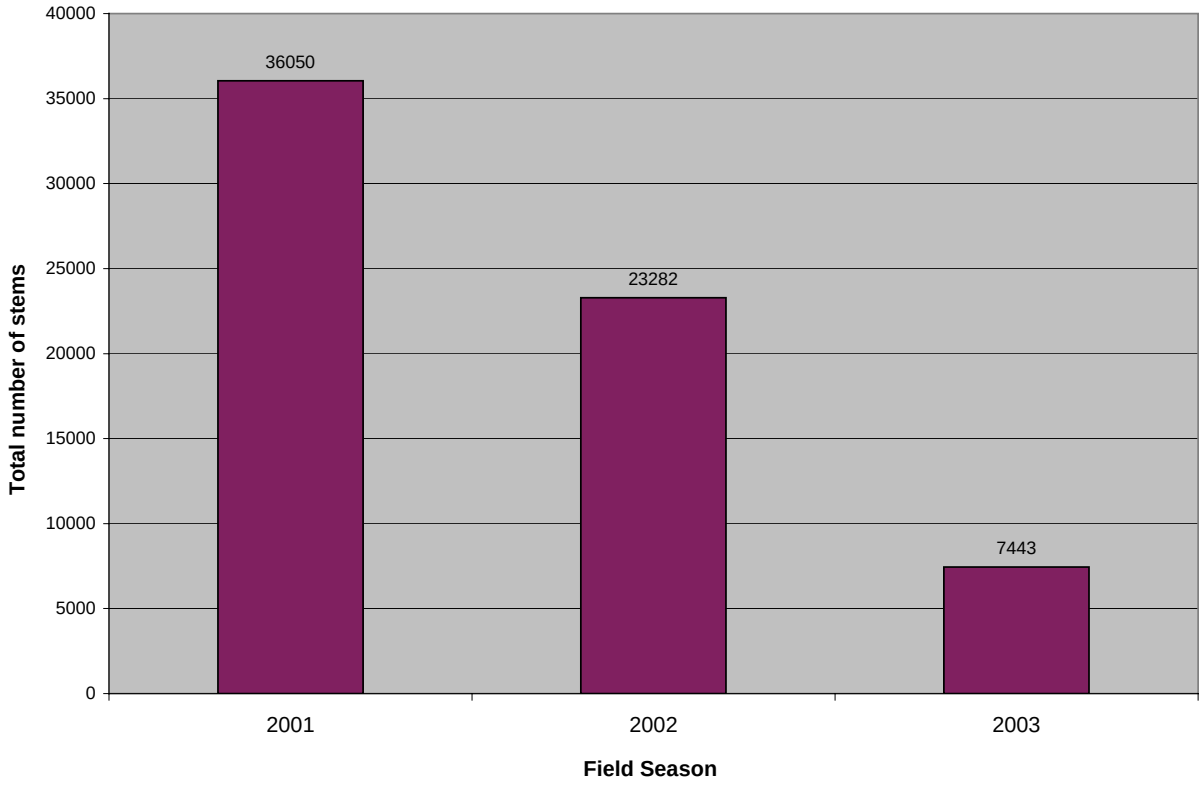
A total of 417 microsites located between Dodge Park (rm 19) and Dabney State Park (rm 6) first treated in 2001 have been successfully tracked through fall 2003 (Figure 4.1 and Appendix 4.6). Prior to the 2003 field season, each of these sites has been treated 3 or 4 times between spring

Figure 4.1 Map insert: Sandy River Gorge knotweed locations and status, November 2003



2001 and fall 2002, with at least one treatment occurring in each field season. On any given field visit, no treatment was performed if there was zero knotweed stems present at that time. Though several different treatment method combinations were utilized (see Section 3 for details), the majority of these sites experienced a spring and fall foliar Garlon herbicide application treatment in 2001 followed by a spring manual cut and fall foliar Rodeo herbicide application treatment in the 2002 field season. The total initial stem count for all 417 sites in 2001 of 36,050 stems (1868 patches) was reduced by 79.35 % to 7443 stems (1100 patches) in summer 2003 (Figure 4.2).

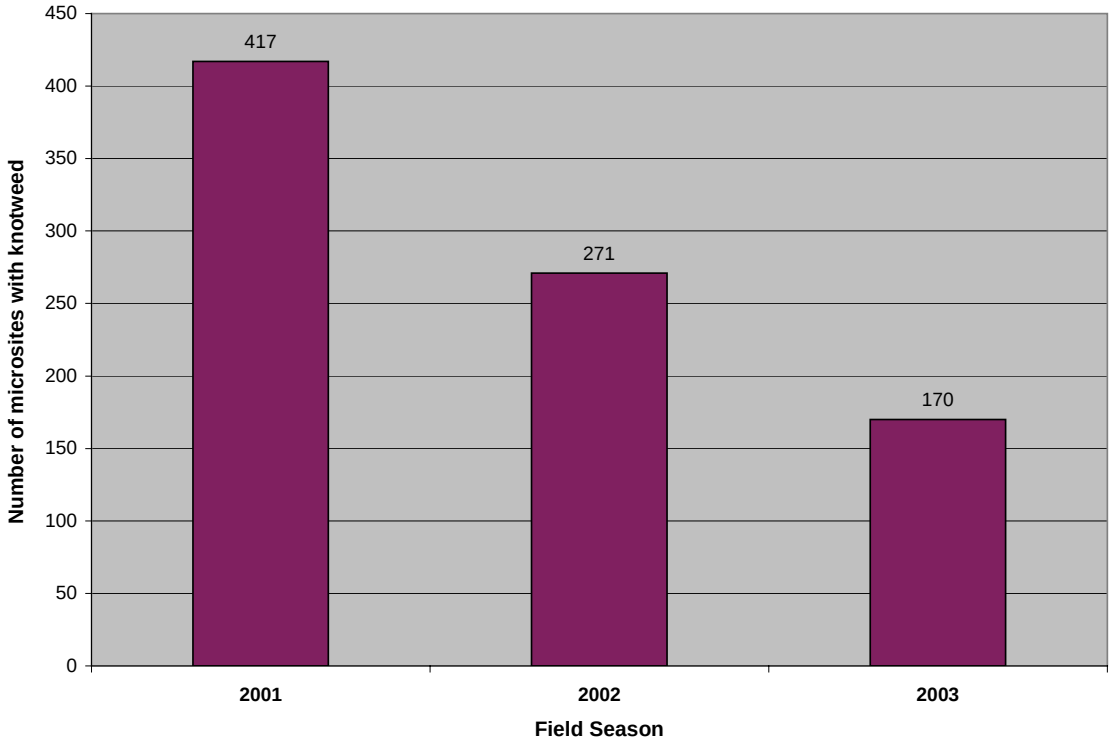
Figure 4.2 Total stem count by year for microsites tracked in Sandy River Gorge (rm 19 to rm 6)



Sandy River Gorge (rm 19 to rm 6) stem count totals by year for all 417 microsites successfully tracked through 2003. The total stem count in 2001 (36,050 stems) was reduced by 79.35 % in 2003 (7443 stems). Each site was treated 3 to 4 times between 2001 and 2002 field seasons with at least one treatment occurring in both years.

These figures represent a minimum total reduction of 28,607 stems over 2 field seasons of treatments for these sites. It is a minimum figure for two reasons. First, because experience has taught us that microsites with initial stem counts greater than 1000 were usually underestimated. Second, because sites that were not relocated may have been eradicated, but were not included in the analysis. Among the 417 sites established in 2001, 247 microsites (60%) were confirmed to have zero knotweed regrowth (0 stems) upon sampling in the 2003 field season visit (Figure 4.3).

Figure 4.3 Number of tracked microsites by year with knotweed in Sandy River Gorge (rm 19 to rm 6)



Among the total of 417 sites successfully tracked in the Sandy River Gorge (rm 19 to rm 6) since 2001, 247 microsites (60%) had zero knotweed regrowth (0 stems) upon sampling in the 2003 field season visit. Each site was treated 3 to 4 times between 2001 and 2002 field seasons with at least one treatment occurring in both years.

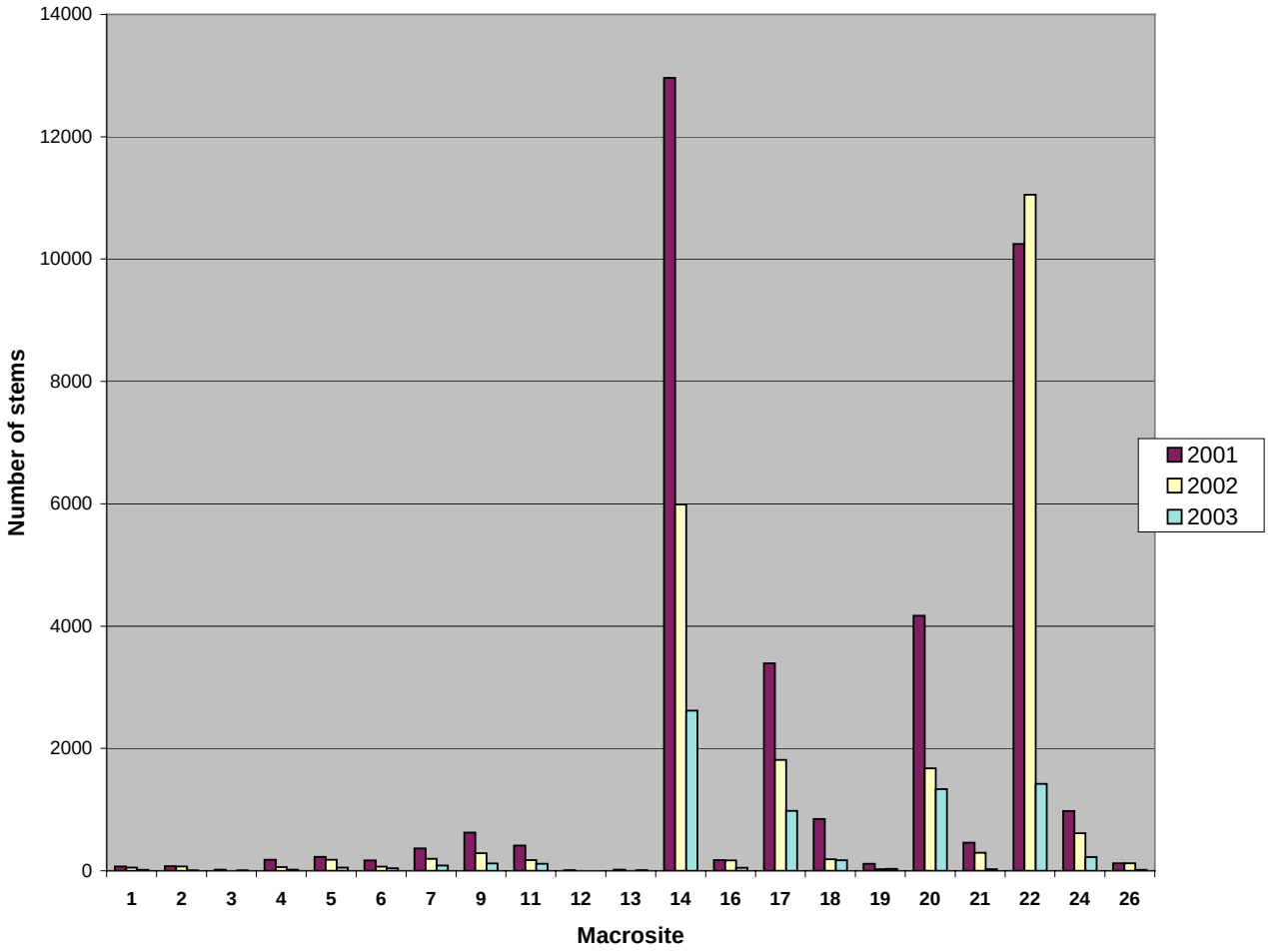
The average initial stem count recorded in 2001 for all sites was 86.45 (stdev= 503.4). The average for sites with no regrowth in 2003 was 14.8 stems per microsite (stdev=24.8). A complete listing of all 2003 field season "no regrowth microsites" with the initial 2001 stem count is displayed in order of macrosite in Appendix 4.2. Although there is no obvious relationship between the initial stem number and achieving knotweed site eradication, no microsite with more than 240 stems in 2001 was eradicated by the end of 2003 field season (Appendix 4.7).

Two graphical representations of each Sandy River Gorge macrosite's total stem count are displayed by year in Figures 4.4 and 4.5. The average number of initial stems per macrosite in 2001 was 1711 stems (stdev=3495). With the exception of 1 macrosite, annual macrosite stem totals decreased each year after the previous field seasons' treatments. The perceived increase in the 2002 stem count observed in macrosite number "22" is almost certainly an artifact based on an stem count underestimate during the initial 2001 stem count at one large (> 8000 stems) floodplain microsite (Figure 4.4).

The average percentage change in total stem count per macrosite was – 47.74 % (stdev=31.4) from 2001 to 2002 and –80.52% (stdev=9.0) from 2001 to 2003. A complete listing of all macrosite stem count totals by field season and percentage change in stem number is displayed in

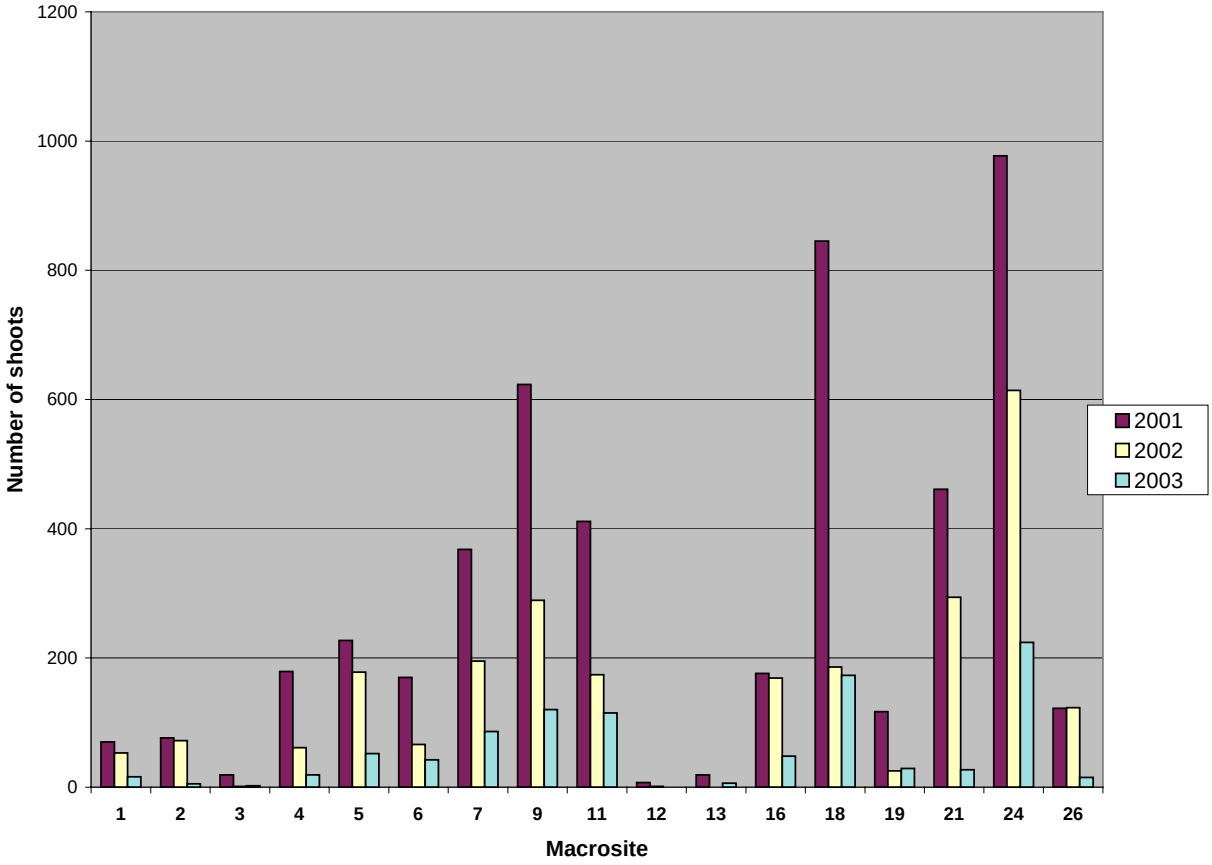
order of macrosite in Appendix 4.1. Macrosites with total initial stem count >3000 stems were excluded in Figure 4.5 to graphically highlight annual macrosite stem total changes.

Figure 4.4 Macrosite stem totals for microsites tracked in Sandy River Gorge from 2001-2003



Sandy River Gorge (rm 19 to rm 6) macrosites stem totals by year for all 417 microsites successfully tracked through 2003. The apparent increase in macrosite 22 between 2001 and 2002 is likely the result of underestimating the initial stem count rather than a true increase. Each site was treated 3 to 4 times between 2001 and 2002 field seasons with at least one treatment occurring in both years.

Figure 4.5 Macrosite stem totals for microsites tracked in Sandy River Gorge from 2001-2003**



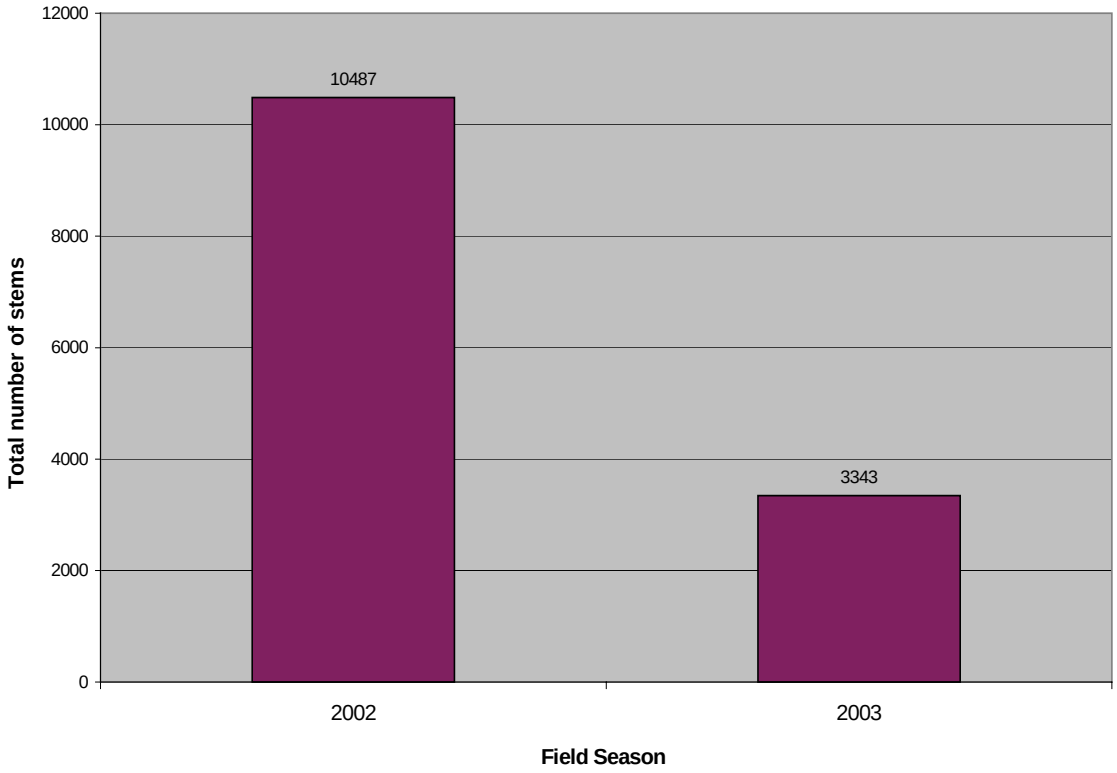
** macrosites with >3000 initial stems in 2001 are excluded from this chart.

Sandy River Gorge (rm 19 to rm 9) macrosites stem totals by year for microsites with an initial 2001 stem count of <3000 stems that were successfully tracked through 2003. These sites were treated 3 to 4 times between 2001 and 2002 field seasons with at least one treatment occurring in both years.

Within the Sandy River Gorge data set (i.e. the 417 sites), 327 sites were treated 4 times (twice in 2001 and twice in 2002 field seasons). The 327 site data subset exhibited a larger total stem reduction of –54.14% from 2001 to 2002 compared with the 417 site data set (-35.42%), but showed little overall difference from 2001 to 2003 with a total stem reduction of 76.66 % versus the 417 site data set (79.4%).

Knotweed Monitoring Results for Sandy River Sites established in Spring 2002
(2 treatments only)
A total of 39 new microsites varying in initial stem count from 3 to 2000 stems were treated with a spring manual cut followed by a fall foliar spray Rodeo treatment in the 2002 field season. Each of these microsites was then positively re-identified and had data collected in the 2003 field season. The total initial pretreatment stem count of 10,487 stems for all sites was reduced by 68.00% to 3,343 stems in 2003 (Figure 4.6 and Appendix 4.4).

Figure 4.6 Total stem count by year for 39 knotweed microsites treated 2x in 2002



Stem totals by year for 39 microsites established in 2002 and successfully tracked through 2003. The total initial pretreatment stem count in 2002 (10,487 stems) was reduced by 68.00% in 2003 (3343 stems). Each site was treated with a spring manual cut followed by a fall foliar spray (5% Rodeo) treatment in the 2002 field season.

The average percent reduction in stem number per microsite from spring 2002 to the 2003 field season was 61.73% (stdev= 73.6). Nine microsites exhibited no regrowth (0 stems). The range in initial 2002 spring stem count for microsites with no 2003 regrowth was from 3 to 63 stems per site. This is consistent with results for other microsites treated with foliar spray combinations, where only small (<75 stems) knotweed sites or patches had no regrowth in the subsequent season after the initial treatments.

The average percent reduction in patch number per microsite from spring 2002 to the 2003 field season was only 6.19% (stdev= 131). Though it is unlikely that larger patches (>200 stems) were completely eliminated by this treatment combination, we believe that the follow-up patch counts are conservatively high. The high degree of variability in an individual's determination of what

defines a patch becomes even more difficult during follow up visits. Scattered regrowth (stems) resulting from a previously treated knotweed patch are easily mistaken and counted as individual plants or patches, thus increasing the likelihood of overestimating microsites patch counts during follow-up visits.

Discussion

With the development of effective control methods based on our control experiments and broader landscape monitoring data, coupled with the documented stem reduction success observed thus far, we are confident of reaching a high level of control of knotweed in the Sandy River Watershed by 2005. We expect to have nearly all knotweed patches identified and at least 90% treated along the Sandy River, Salmon River and Cedar Creek riparian corridors by the end of the 2004 field season with confidence of control along these waterways following 2005 treatments (to be confirmed by 2006 field visits).

Within the Sandy River Gorge section (the 417 site area described above) we expect to confirm reduction since 2001 of > 90% in 2004 and reach near complete eradication by 2005.

Field Results for Scots Broom Removal

Scots Broom (*Cytisus scoparius*) has been identified by the Oregon Department of Agriculture as the single costliest weed in Oregon due to its affects in decreasing forest productivity. Once planted for erosion control, Scots broom has spread to many natural and semi-natural areas of the Pacific Northwest. Because high water, humans, and roads effectively spread its seeds, it is an aggressive and effective invader of floodplains, riparian areas, and meadow habitats as well as upland forests of the Sandy River Watershed (SRW). Once established, it converts open meadow and partly forested habitats into thick shrubland, changing habitat conditions and reducing the amount of native vegetation available for forage. In riparian areas it can alter post-flooding succession and out-compete native vegetation, including the shrubs and the graminoids that truly provide bank integrity. With support from our partners, The Nature Conservancy has been working on removing Scots broom in key ecological areas in the Sandy River Gorge since 1996.

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

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

The Nature Conservancy has identified 12 priority sites in the Sandy River Gorge where we have focused our efforts on Scots broom removal (see Appendix 4.9 and Table 4.2).

Table 4.2 - Sandy River Scots broom priority sites

Site	Ownership	Size (acres)	Priority	Status
BLM ACEC Floodplain	BLM	3	High	All mature plants removed 2001-2003, and some small plants 2003
Bluehole Floodplain	TNC, BLM	4	High	Mature plants removed 2000-2002
Bluehole Meadow	TNC, BLM	2	High	Mature plants removed, 2000-2002 Small plants 2003
Cornwell Meadow	TNC, Metro, ODFW	30 18	High	Mature plants removed 1997-1998 Small plants 1999-2003
Diack, Kingfisher tracts	TNC	10	High	Scattered Mature Plants removed 1999-2003
Dispersed Sandy River Shoreline	BLM, Metro, ODFW, TNC, various private	1.5 1.5	Medium High	Scattered patches 1997-1999 Scattered patches 2000-2003
East Oxbow Floodplain	Metro	6	High	Mature Plants removed 2000-2003
East Oxbow State Lands Floodplain	Metro, ODFW, Oregon State Parks	0.5	High	Some mature plants removed 2001, and again in 2002, 2003
Indian John Island	Metro	1.5	High	Mature plants removed 2000-1, on southern portion of the island
Jones Property Floodplain	Private - upriver seed source for Oxbow, Diack	2	Medium	Some mature plants removed 2001 and 2002
Main Oxbow Floodplain	Metro		High	Oxbow staff working on this site
Sandy River Islands (between Oxbow and E.Oxbow State Lands)	Metro, BLM , Oregon State Parks	2	High	Some mature plants removed 2000-2002

All sites are located in the Sandy River Gorge (River miles 12-19), TNC = The Nature Conservancy, BLM = Bureau of Land Management, ODFW = Oregon Department of Fish and Wildlife

Example Site: Cornwell Meadow

The site that has received the most attention during this project is the Cornwell Meadow, a 30+ acre site located near river mile 17, (T1S, R4E, Section 24, see Appendix 4.91). Parts of the site have been acquired by ODFW, Metro, and TNC over the last 20 years, and it represents the largest natural meadow in the lower SRW. Due to its deep layer of volcanic sand, the site supports a plant community more characteristics of middle elevation montane meadows than a typical low elevation site. In 1996 most of the meadow was choked with so called “old-growth” Scots broom. Some plants exceeded 3 meters in height. All mature Scots broom plants were removed from the site by 1998 (Figure 4.7, a comprehensive photoseries is included in Appendix

4.5). As expected, a huge crop of seedlings came up in 1999. As thousands of new seedlings emerge each year, work continues in the meadow removing all flowering plants and as many immature plants as time permits. Our goal is to steadily reduce and eventually exhaust the seed bank at this site. This is a large undertaking, and will take many more years of hard work. Sampling completed in 2001 indicated that the population of Scots broom seedlings was between one and four million.

Our plan circa 1999 - 2000 was to only pull flowering plants. Scots broom matures in no more than 4 years in most cases. By 2001, however, we realized we would likely soon be faced with a situation of needing to remove literally hundreds of thousands of flowering plants in a single year. Rather than wait, we began a massive effort to get ahead of the curve. We directed our volunteers and workers to pull all Scots broom plants over 12 inches tall when working in designated areas within the meadow. In a coordinated effort to work thoroughly throughout the meadow complex, priority areas with dense clusters of tall Scots broom plants were identified. These areas, capable of the highest Scots broom seed production, were cleared initially, before moving on to areas with scattered, smaller plants.

It is reasonable to expect that one person can pull approximately 500 small Scots broom plants in an hour. Using that number, we estimated that it would take between 2,000 and 8,000 hours to complete the removal of all the Scots broom plants present in 2001 in the Cornwell meadow. The Nature Conservancy staff has utilized AmeriCorps teams, volunteer organizations, school groups, and volunteer work parties to remove the remaining seedlings (Figure 4.8). Efforts are underway to allow groups or individual volunteers to adopt certain portions of the meadow where they will return to pull seedlings without direct supervision by TNC. Progress is being made, and sampling will be done in 2004 to determine the approximate population of the remaining Scots broom seedlings. We will attempt to work with school groups through the ISSEP (Section 8.0, Appendix 8.0) to determine the remaining seed bank.

Photo-Monitoring

Photo monitoring has been conducted to document our progress at Cornwell and to represent overall work on Scots broom in the Sandy River Watershed. Sixteen photo markers were established in 1998, and photos were taken in two directions at each marker each year, with the exception of 2003 (see Appendix 4.5 for complete monitoring series). Photos will be taken in alternate years for the foreseeable future. In 2003, a volunteer took photos at seven points in the meadows, replicating photos taken in 1997. These photos clearly show the progress of the removal work that has taken place at the Cornwell meadow (Figure 4.7). Areas once covered with thick Scots broom are now filled with Oregon grape (*Mahonia nervosa*), salal (*Gaultheria shallon*), kinnikinnik (*Arctostaphylos uva-ursi*), and many different kinds of mosses and lichens (Figures 4.7 and 4.8).

Removal work by The Nature Conservancy will continue at Cornwell as well as the other areas listed in Table 4.2 as volunteer time and funding allow. Scots broom removal is also taking place in other areas of the Sandy watershed by other groups in part due to outreach and education work done by The Nature Conservancy. Individual landowners, summer camps, government agencies such as Metro and BLM, as well as various youth groups such as project YESS, and Multnomah Youth Corps are all working on clearing areas of Scots broom within the Sandy River Watershed.

Figure 4.7 Cornwell Meadow in 1997 before Scots broom clearing:

Cornwell Meadow in 2003 after Scots broom clearing:

Figure 4.8 Volunteers help to clear immature Scots broom plants from the Cornwell meadow in 2001.

Note the trees in the background for reference, as well as the Oregon grape, now easily seen in the foreground of the photograph.

Section 5. Seventeen Treatment Method Knotweed Control Experiment: Summary

(Please see Appendix 5.0 for the full report.)

Introduction

Between April 2000 and June 2003 The Nature Conservancy compared 17 treatment combinations for controlling Japanese knotweed (*Polygonum cuspidatum, Fallopia japonica* or *Reynoutria japonica*) on the Sandy River at river mile 13, Multnomah County, Oregon, USA. Treatments included manual control, 2 herbicides (glyphosate and triclopyr), 2 application methods (spray and wick), 3 application timings (spring, summer, fall) in various combinations. After two field seasons, herbicide based methods provided statistically significantly better control than manual ($p < 0.1$, power = 90%). Although triclopyr (Garlon 3a) yielded generally better control than glyphosate (Rodeo), and foliar application was generally better than cut-stem/wicking, several treatment combinations provided greater than 90% control after one, two or three growing seasons. Only foliar treatment with Garlon 3a proved full control in all cases in two seasons. Foliar treatment with Rodeo took three seasons to deliver full control. Even after three years and 17 separate cuttings, manual control failed to provide full control in two out of three sites. Based on these results we now recommend foliar application of herbicide, either alone or integrated with a single spring cutting in most cases for most established knotweed stands.

Methods

We tested 17 herbicide and/or manual treatment combinations (Table 5.0). Treatments included:
Manual control only -- monthly cutting at ground level,
2 herbicides (glyphosate and triclopyr),
2 application methods -- foliar spray and wicking the freshly cut stem surface,
3 treatment timings -- spring and fall, summer only, fall only
Combinations of manual treatment with herbicides -- spring cut and fall herbicide, early fall cut and herbicide treatment of resprouting stems, late fall cutting and wicking, and late fall cutting to 1.5 meters tall and foliar herbicide).

In April 2000, 45 individual knotweed patches were identified within a 0.5 square mile area. Each patch was isolated from other patches and contained between 20 and 239 stems. Patches were numbered, permanently marked and had their location recorded using a global positioning system. Each patch was randomly assigned to one of 15 treatment groups (See Table 5.0 for list).

Spring treatment: Done in April (2001), May (2000, 2002) or June (2003) when most if not all stems are presumed to be above ground, except for the manual only treatment (MM) which began in April in both 2001 and 2002.

Fall treatment: done in September, except for cut and treat resprout (XHrXX) treatment group, which was cut in August and allowed to re-grow until October.

Summer only treatment: done in July.

Manual (MM): We used loppers or pruning shears to cut each stem at the top of root crown (if visible) or at the soil surface. Cutting occurred monthly. At each treatment, a photograph was

taken, the individual stems were counted, the patch size was measured and the typical stem height recorded.

Table 5.0 Knotweed treatment key

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

Foliar application (XXFX): Upper leaf surfaces were sprayed using a low-pressure spray unit to "just wet" with a 5% solution of either glyphosate (Rodeo) or triclopyr (Garlon 3a, reduced to 3% after year 1). A non-ionic surfactant (R-11 for Glyphosate in 2000 and 2001, Li-700 in 2002), Hasten for Garlon3a) was added at a rate of 1 ounce per gallon. A small amount of herbicide dye was also added.

Cut-stem (wicking) application (XXSX): Using a weed wand (Ben Meadows) in 2000 and a hand type plant mister in 2001 and 2002, a 50% solution of triclopyr or glyphosate in water was applied to the stem surface immediately following cutting.

Late Season Cut, Spray Resprouting stems (NHrXX): plants were cut in August and the resprouting stems were treated with herbicides in October.

True No Cut herbicide application (NHcFX): Treatment was done in September. Foliar treated plants were cut to 1.5 meters in height and sprayed as above. Stem treatments were done as above.

Results

At the final data collection date (June 30, 2003), 25 individual patches had zero stems. Sixteen were from foliar treatment groups, 8 from stem treatment groups and 1 from the manual control group. Four foliar treatment groups provided total control: HHFG, MHFG, HHFR and NHcFR (Figure 5.0 below). A fifth group (MHFR) had 2 zero stem values and it is likely that the one patch with stems present had stems from a nearby patch counted and actually was zero. We believe this is so because that patch had no stems present throughout 2001 and 2002. Three groups exhibited control greater than 95%: NHSR, HHSG, MHFR (but see above). Increases were found in two of the SFG plots after two years of near zero (1, 0 in both cases) counts, resulting in overall control levels of only 79 + 23.8. Again, this is possibly due to data collection error rather than actual plant survival.

There was also a great deal of variation among stem treatment groups. HHSG (95 + 8.6), NHSR (98.5 + 2.6), provided the best overall results. Overall HHSX patches had good control. Individual patches in HHSR, HHSG, NHSR adversely affected the overall mean result. In particular the HHSR patch was strange because after two years of 6 and 5 stems, it suddenly had 21.

Even after three years and 17 individual cuttings, the MM gave mediocre control (80.8% + 22.3). One of three patches (initial stem number = 25) was eliminated.

Within the context of our initial patch sizes response does not appear to be strongly linked to initial patch size, although the one manual only patch (MM) that was successfully eradicated had the lowest initial stem count.

Discussion

As suggested by the literature, the extensive root system of established knotweed patches makes it extremely difficult it control. None of the methods we tested were able to provide total control in a single year, even with the relative small sizes of the patches we tested. Fortunately, several methods if continued over two or sometimes three years did give full control and this gives hope to those trying to contain this threat to the integrity of North American waterways.

The results of this experiment suggest four noteworthy conclusions:
1) At least for the reasonably small patches that we tested, knotweed can be effectively controlled within two field seasons of foliar spray treatment with Garlon 3a, but may require three seasons of treatment with Rodeo, because of survival of a few, badly mutated stems that would likely recover if left untreated.

2) Although wicking type, cut-stem treatments can give good control, they are less effective and more time consuming than foliar type applications, and do not appear to give total control, even within three field seasons in many cases.

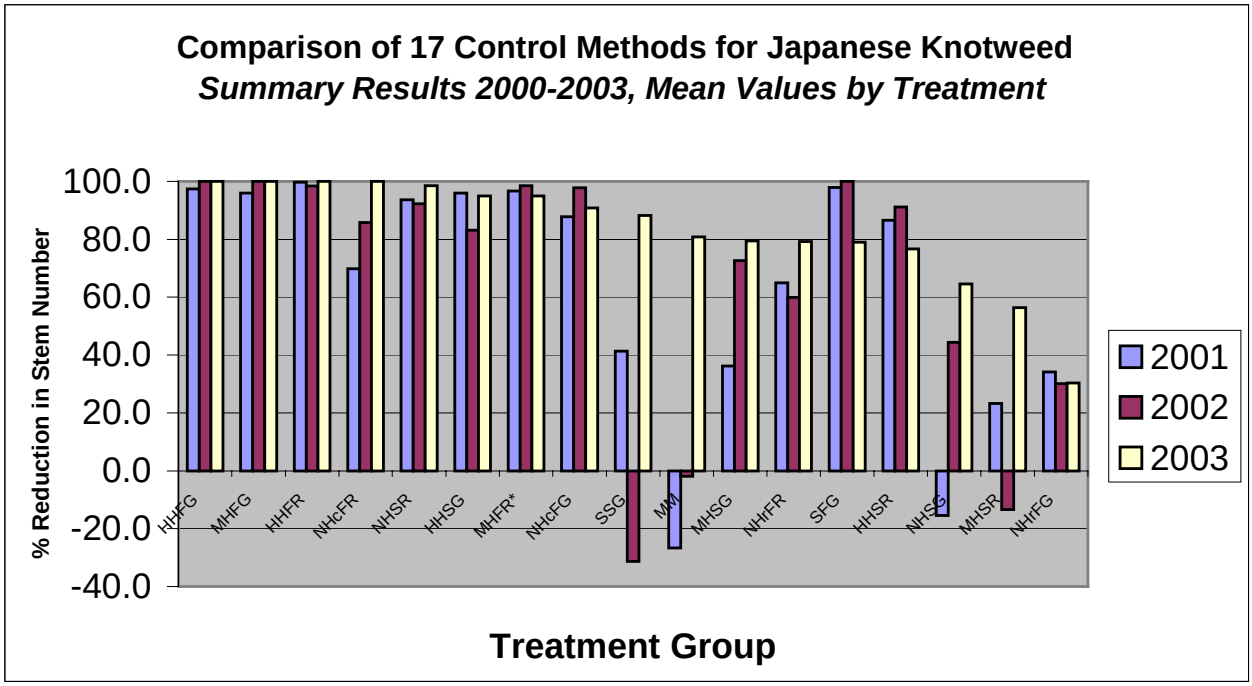
3) Late summer / early fall foliar herbicide treatment can be combined with spring manual control without loss of treatment effectiveness as compared to two herbicide treatments. And at least for Rodeo herbicide, a late season cutting to 1.5 meters followed by foliar spray can deliver effective control if repeated for several seasons.

4) Successful control based on cutting alone will generally require more than 3 years, and/or involve cutting stems more than monthly for all but the smallest, least well established patches. It is possible that more frequent cutting or replacing cutting with uprooting stems and shallow roots could give effective control more quickly.

It is also clear from these data that herbicide treatment timing is important. The failure of the spring-fall foliar herbicide treatment to deliver benefits beyond manual - herbicide combination is not surprising since translocated herbicides generally do not give good control of deep-rooted perennial plants when applied during the early phase of rapid spring growth.
Although time consuming, the success of some of the cut-stem (wicking) treatment offers a middle ground for individuals with particularly strong objections to herbicide spraying, or for spots in which herbicide spraying is not appropriate (i.e. presence of rare or sensitive species). Care must be taken however, to treat every stem, and multiple treatments will be necessary.

The results of this admittedly limited experiment for foliar treatments have also been "tested" and largely confirmed as part of a landscape level control project managed by The Nature Conservancy in the Sandy River Watershed. After two years of mixed manual and foliar herbicide treatment (first Garlon 3a then Rodeo due to legal issues) spread out throughout the field season, about 2/3 of 417 patches were eliminated within a 12 mile stretch of the Sandy River, and total stem number was reduced by about 80%. Large patches have been more persistent than small ones. Results from a third year of treatment will be available in fall 2004.

Figure 5.0 Treatment results graph



Seventeen control approaches were tested, each on 3 individual knotweed patches. Treatment was initiated in May 2000 and data were collected through June 2003. These data suggest that foliar spray approaches are the most effective, with little difference between patches cut in the spring and sprayed in the fall or those sprayed both times.

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

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

Section 6. Stem Injection Experiment: Summary

Introduction

In July of 2003, The Nature Conservancy and Metro Parks and Greenspaces began an experiment to test the effectiveness of the stem injection method of herbicide application on Japanese and giant knotweed (*Polygonum cuspidatum* and *P. sachalinense*) using a glyphosate based herbicide (Rodeo by Dow Agrosciences or Aquamaster by Monsanto Inc.). Initial post-treatment data has been collected, however, reliable results will not be available until data can be collected during the 2004 field season. The full report on this study with complete data tables and photoseries can be found in Appendix 6.0.

Stem injection is a method of applying herbicide directly into the stem of a living knotweed plant (Figure 6.0). After using a probe to poke a 0.1 inch (0.2cm) hole through both sides of the stem, undiluted herbicide is carefully injected downwards into the hollow of the first node using a 14 gauge needle and a 60 ml syringe. This method was pioneered by the Weed Management Team in Clark County, Washington, and information regarding their data can be found at the website http://www.co.clark.wa.us/environ/Knotweed.pdf.

Figure 6.0 Injecting knotweed stem with glyphosate

The stem injection experiment was divided into three phases. Phase 1 addressed several issues, including determining a likely minimum dose to use for wider, landscape level testing, and to compare no treatment on stems too small to inject to supplemental foliar spraying. Treatments were performed in July of 2003.

Phase 2 addressed determining the efficacy of the stem injection method for wider, landscape level application, and to compare 3ml treatment to 5ml treatments on both a larger scale and over an extended time period. Treatments were performed starting on August 13th, 2003 and continued until October 28th, 2003.

Phase 3 was a late season repeat of phase 1 and addressed three main issues: 1) whether a late season stem injection application is effective; 2) comparing no treatment on small stems to supplemental foliar spraying, 3) determining if dosing needs were similar at the end of the season vs. the middle. Phase 3 treatments took place on September 15th, 2003.

Methods

Phases 1 and 3
Knotweed sites were identified along the Clackamas River. Phases 1 and 3 included 30 individual patches of knotweed each, and had 4 treatment groups plus a control group. The treatment amounts included 1.5ml, 3ml, 5ml, as well as 5ml injection plus a foliar spray of 5% glyphosate and 1% li-700 of the knotweed stems too small to hold the injection amount. Data, including stem number, number of stems injected, typical diameter, typical height, patch size, shading and general soil type was collected before and during treatments. In addition to data collection, each individual patch in Phases 1 and 3 was photographed before, and three weeks after treatments (see the full report in Appendix 6.0 for complete data and photos).

Phase 2
Knotweed sites were identified along the Clackamas and Sandy Rivers, as well as some tributaries to these rivers. Individual sites were randomly assigned to one of two treatment groups, either 3ml or 5ml of undiluted Rodeo (glyphosate) were injected into each stem large enough to hold the appropriate volume of herbicide. Many stems in each patch were below the minimum diameter to be injected. These stems were foliar treated with a low-pressure hand sprayer. The tank mix was 5% Rodeo Herbicide with 1% Li-700 surfactant and a small amount of blue dye. Leaves were sprayed to just wet but not to drip.

Data collected for Phase 2 included: patch location, patch size, treatment area, site area, stem count (which included number of stems injected and number of stems sprayed), treatment type, and general notes about the work site.

Results

Phases 1 and 3
Data was collected three weeks after treatments were performed. After training as a group on two patches, individual stems were ranked into 4 condition class categories (ranks) by a single individual (or two working independently) at each patch.

Condition Classes:
0: apparently healthy, no discoloration (chlorosis) or leaf death (necrosis)
1: some minor damage, small spots of necrosis or minor general chlorosis but clearly alive
2: clearly damaged and not healthy, with patches of necrosis, but some green leaves or partial leaves remain. Some flower buds still green
3: All leaves on the stem are gone or apparently dead, buds are brown.

Lastly, at least 3 people per patch made an independent overall estimation of the vigor of the entire plant on a continuous 0-3 scale based on the ranked scale above.

Table 6.0 Summary statistics for Phase 1 preliminary results

Treatment Group	**Shoot Number**	**Shoot Number**	**Injected Number**	**Injected Percent**	**Treatment Score by Percent**	
	MEAN	STDEV	MEAN	MEAN	MEAN	STDEV
Control	53.00	26.96	0.00	0.00	0.14	0.20
1.5	53.67	27.62	40.50	0.75	2.58	0.52
3	83.50	79.41	49.17	0.57	2.32	0.33
5	65.17	35.54	37.83	0.68	2.64	0.61
5+S	47.67	38.32	26.67	0.60	2.99	0.29
Overall Average	60.60		30.8	0.52	2.14	
Overall Stdev	44.55		29.4	0.31	1.22	
Avg. Treated Groups	62.5	48.2	38.5	0.65	2.64	0.76

n = 6 for all groups, n = 30 total, n-treatment = 24

The overall effect of treatment on a patch was calculated using a formula to produce a single Treatment Score = (% of stems in condition group 1) + (2* percentage of stems in condition group 2) + (4*percentage of stems in condition group 3). A completely dead plant would receive a score of four (4) and a perfectly healthy plant a zero (0). Our treatment score weights condition rank of 3 twice as much as condition rank 2 and 4 times that of rank 1. This was done because anything less than full control is considered an inadequate treatment.

For Phase 3, as in Phase 1, there was minor decline in some of the control patches after three weeks (probably due to drought stress on cobbly, poor soils). However the treatment effect is clearly very strong, but once again only on stems that are actually treated. Much like Phase 1, there was little variation between the results of the different treatments. Average treatment score by percent ranged from 2.36 for the 1.5ml group, to 2.86 for the 5ml + spray group.
The overall effect of treatment on a patch was calculated using the same formula as described above for the Phase 1 summary.

Table 6.1 Summary statistics for Phase 3 preliminary results

Treatment Group	Shoot Number	Shoot Number	Injected Number	Injected %	Treatment Score by Percent	
	MEAN	STDEV	MEAN	MEAN	MEAN	STDEV
Control	65.25	38.47	0.00	0%	0.14	0.15
1.5	58.67	29.80	57.17	98%	2.36	0.37
3	66.17	21.12	59.17	91%	2.39	0.73
5	63.33	34.58	44.83	78%	2.50	0.77
5+S	60.00	28.40	53.67	91%	2.68	0.39
Overall Average	62.34		41.55	71%	2.01	
Overall St. Dev.	28.63		30.14	39%	1.01	
Average of just Treated Groups	62.04	53.71	42.97	89%	3.16	0.59

n =6 for all groups, n = 30 total, n-treatments = 24

Phase 2
Since treatments continued through to the end of the 2003 season, no follow-up data has been collected, and even preliminary results are not available at this time. Follow-up data will be recorded beginning in May of the 2004 field season.

Follow-up plans

Phase 1 and 3 plots will be spot checked periodically through the 2004 field season beginning as early as May, 2004. Stem counts and ranking will be repeated in May or June, and then again in October. Additional photographs will be taken of each site.

Phase 2 sites will be visited again beginning in May of 2004. Data will be recorded in order to provide information on the efficacy of the different treatments. Additional treatments will be performed if necessary.

Discussion

Short-term results for mid-summer treatment (Phase 1) showed that 1.5ml, 3ml, 5ml, and even 5ml + spray treatments had similar initial effectiveness. Because of the close relationship between herbicide effect and treatment (or lack thereof) of a given stem, we chose to conduct further testing of 3ml and 5ml amounts with the additional foliar treatments of smaller stems in all sites of Phase 2.

Besides treatment amount and rate, treatment timing can have a significant role in determining the effectiveness of any herbicide treatment. By starting Phase 1 in July, Phase 3 in September, and spreading out treatments in Phase 2 from August through October, we hope to obtain valuable information regarding treatment timing. Combined with the work of Clark County, data we collect during the 2004 field season will likely tell us not only how much glyphosate is needed to effectively treat knotweed with the stem injection method, but should also define the window of opportunity for that method.

Section 7. Outreach

Introduction

As part of an integrated approach to successfully achieve project goals, including enhancing community invasive species awareness, access to potential knotweed infestations, and increasing volunteer participation, we undertook an aggressive outreach effort that targeted community members in a variety of ways. Through direct personal contact, media exposure, public speaking events, volunteer recruitment, restoration projects and the Invasive Species Science Education Program, we have helped shape and gain both recognition and active support for knotweed and invasive species control in the Sandy River watershed and other regions.

Outreach Methods

Direct Contact/Mail

As a private non-profit, The Nature Conservancy does not have legal access to private lands. In order to systematically survey, map and treat the knotweed infestation within the Sandy River watershed, which includes at least 4100 private lots within ¼ mile of Sandy River and tributaries, we first have to obtain permission from each landowner. Landowner contact information was obtained from digital tax lot maps (Figure 7.0). Since we have already attempted contact by mass direct mail in previous years (see 2001, 2002 reports), contact through direct mail was generally reserved for properties in areas with confirmed knotweed infestations. In 2003, we increased direct door-to-door contact vigor, especially in those areas with confirmed knotweed infestations. Each tax lot within these areas was visited, in attempts to establish personal contact.

Regardless of the method, the owners name is entered into our database and the property coded based on the outcome on the relevant tax lot map for follow-up. Follow-up is another visit, a phone call or treatment. The flow chart in Figure 7.1 illustrates our general outreach strategy.

Media

We sought to draw attention to the knotweed project through several local and regional media sources. Mass circulated media resources were contacted in order to reach audiences in the community that were missed during direct outreach and to help reach more individuals over a greater area in less time. In addition, we developed several outreach materials intended to promote the SRRHPP and to raise invasive species awareness.

Public Speaking

Numerous presentations, exhibits and discussions on knotweed were given at schools, private and public events, meetings, and conferences. In particular, we targeted pesticide recertification and vegetation management seminars, conferences and workshops.

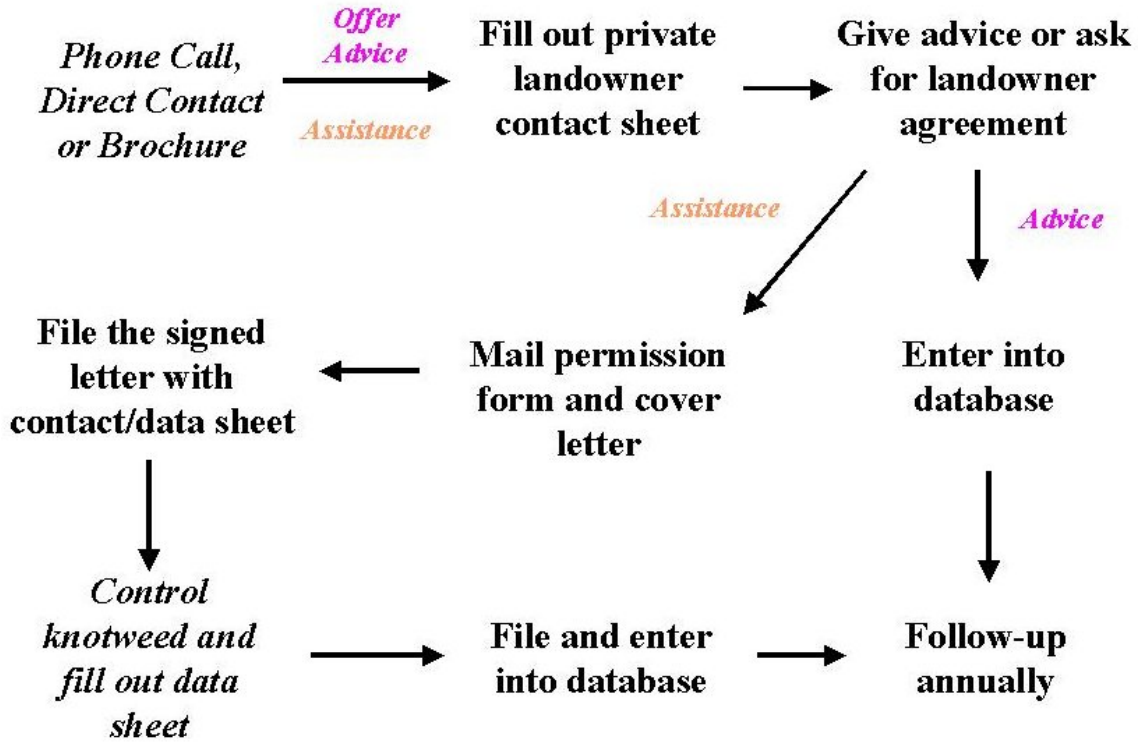
Volunteer Recruiting

We publicized our Youth For Conservation program, including volunteer/internship/service-learning opportunities, through our website, newsletter and e-mail mailing list, and through other volunteer listserves and organizations. Colleges, schools, service learning-based organizations, and camps were also mailed information about our various programs. In addition, we attended several college and school volunteer/service-learning fairs.

Figure 7.0 Sample tax-lot map and landowner reference table

REF#	OWNER1	OWNER2	OWNERADDR	OWNERCITY	OWNZIP	SITEADDR	CONTACT#	STATUS/COMMENTS
1	WILLIAMS KAREN		15930 SE TEN EYCK RD	SANDY OR	97055	15930 SE TEN EYCK RD		
2	DEBOOR EDWARD W & DONNA M		15910 SE TEN EYCK RD	SANDY OR	97055	15910 SE TEN EYCK RD		
3	MARTIN WILLIAM E & LAURA		15944 SE TEN EYCK RD	SANDY OR	97055	15944 SE TEN EYCK RD		
4	OVERTURF DIANE L		PO BOX 845	SANDY OR	97055	15850 SE TEN EYCK RD		
5	PORTLAND GEN ELEC CO		121 SW SALMON ST	PORTLAND OR	97204	NO SITUS		
6	POMERENKE WILLIAM C & CINDY C		3140 RIVER VILLA WY	MELBOURNE BEA	32951	NO SITUS		
7	TOMMASO JANET A		15830 SE TEN EYCK RD	SANDY OR	97055	15830 SE TEN EYCK RD		
8	PUBLIC		902 ABERNETHY RD	OREGON CITY OR	97045	NO SITUS		
9	TURRA ANGELO D & VICTORIA L		43000 SE TRUBEL	SANDY OR	97055	16160 SE DUSTY LN		
10	LANE MICHAEL A		16170 DUSTY LN	SANDY OR	97055	16170 SE DUSTY LN		
11	BARON LAURA JOANN		16230 SE DUSTY LN	SANDY OR	97055	NO SITUS		
12	JENNINGS GARY D & VIRGINIA L	TRUSTEES	PO BOX 1419	SANDY OR	97055	NO SITUS		
13	BOOS DAVID S & REBECCA R		15800 SE TEN EYCK RD	SANDY OR	97055	15800 SE TEN EYCK RD		
14	HADLEY DAVID & LINDA	CORDES-HADLE	14752 SE ROYER RD	CLACKAMAS OR	97015	16404 SE DUSTY LN		
15	PORTLAND GEN ELEC CO		121 SW SALMON ST	PORTLAND OR	97204	NO SITUS		
16	FRANTILA RICHARD W		7331 SE CRYSTAL SPRINGS BLVD	PORTLAND OR	97206	NO SITUS		
17	PORTLAND GEN ELEC CO		121 SW SALMON ST	PORTLAND OR	97204	NO SITUS		
18	PORTLAND GEN ELEC CO		121 SW SALMON ST	PORTLAND OR	97204	NO SITUS		
19	PORTLAND GEN ELEC CO		121 SW SALMON ST	PORTLAND OR	97204	NO SITUS		
20	PORTLAND GEN ELEC CO		121 SW SALMON ST	PORTLAND OR	97204	NO SITUS		
21	PORTLAND GEN ELEC CO		121 SW SALMON ST	PORTLAND OR	97204	NO SITUS		
22	COPHER GENE C & APRIL A		42665 SE ORAL HULL RD	SANDY OR	97055	42695 SE ORAL HULL RD		
23	PORTLAND GEN ELEC CO		121 SW SALMON ST	PORTLAND OR	97204	NO SITUS		
24	SMEJKAL JAMES A		42142 NW PALACE DR	BANKS OR	97106	46552 SE BATY RD		
25	RAYNE STEVEN		520 SW 6TH AVE #600	PORTLAND OR	97204	46766 SE BATY RD		
26	UNITED STATES OF AMERICA		1717 FABRY RD SE	SALEM OR	97306	47240 SE BATY RD		
27	UNITED STATES OF AMERICA		1717 FABRY RD SE	SALEM OR	97306	NO SITUS		
28	RAYNE STEVEN		520 SW 6TH AVE #600	PORTLAND OR	97204	46766 SE BATY RD		
29	UNITED STATES OF AMERICA		1717 FABRY RD SE	SALEM OR	97306	47240 SE BATY RD		
30	ORAL HULL FNDN FOR BLIND		PO BOX 157	SANDY OR	97055	43233 SE ORAL HULL RD		
31	SMEJKAL JAMES A		42142 NW PALACE DR	BANKS OR	97106	46552 SE BATY RD		
32	PORTLAND GEN ELEC CO		121 SW SALMON ST	PORTLAND OR	97204	NO SITUS		
33	SMEJKAL JAMES A TRUSTEE		696 COUNTRY CLUB RD	EUGENE OR	97401	NO SITUS		
34	PORTLAND GEN ELEC CO		121 SW SALMON	PORTLAND OR	97204	NO SITUS		
35	PORTLAND GEN ELEC CO		121 SW SALMON ST	PORTLAND OR	97204	NO SITUS		
36	UNITED STATES OF AMERICA		1717 FABRY RD SE	SALEM OR	97306	NO SITUS		

Figure 7.1 Outreach strategy flow chart



Outreach Results

Direct Contact/Mail

In 2001, we mailed knotweed brochures to 4000 landowners with property within 1/4 mile of the Sandy River and it's major tributaries. All landowners that contacted us were offered either advice or cost-free assistance. When contact was made, the property owner was informed of the project's history and intent. If interested, the landowner was asked to sign a release for surveying/access within their property and offered free control treatment advice or assistance if necessary. Landowners that were not present on the day of a door-to-door visit were left with a knotweed brochure, a letter describing the project with contact information (Figure 7.2), and two landowner agreement forms (Figure 7.3). Landowners not present on our initial visit were later telephoned if their number was available.

Some private landowners were contacted directly by mail indicating that a knotweed infestation had been confirmed by a neighbor or by survey conducted on river or road. When a siting had been confirmed, the landowner was sent a letter explaining the location of the knotweed and our means of confirming its presence on their property. Contact and project information, a brochure, and two landowner agreement forms were sent along with the letter.

Door to door efforts increased the visibility of the integrated and multi-partner project and helped encourage landowners to participate in the partnership. Over 99% of landowners contacted in person gave us verbal or written permission to survey property. Also, personal contact enhanced outreach efficacy so that we could address any concerns, myths or doubts on the spot and thus helped increase the project's significance. In addition, contacted landowners helped build a community of informed eyes and voices in the watershed thus increasing outreach leverage. Some cooperating landowners took some degree of ownership of the project and volunteered to direct outreach efforts within their own community.

Landowner permissions for access were particularly valuable for facilitating or shortening access to hard to reach sites on the Sandy River. Several landowners without knotweed infestations granted us permission to use their properties as exit/entry points for river access. As of December 2003, we had 222 formal cooperating landowners (written permission/verbal permission/self-treating) (Table 7.0).

Figure 7.2 Private Landowner Program Letter

Dear Landowner,

The Nature Conservancy is leading a multi-partner project to rid the Sandy River Watershed of the invasive weed Japanese knotweed (see enclosed brochure). Thanks to support from a variety of agencies like the Oregon Watershed Enhancement Board, Oregon Department of Agriculture, BLM, and Metro, we are able to offer free assistance to landowners. Since knotweed infestations have been confirmed in the area, your property may have knotweed growing on it. With your permission, we would like to survey your property for this destructive weed.

Without cooperation from other private landowners, our effort to protect the Sandy River watershed from these harmful invasive species will surely fail.

Enclosed is a form that would give us permission to access your property, and, IF YOU WISH, treat the knotweed patches. The form protects you from all liability related to our work on your property. If this is acceptable, please sign the original and return it using the self-addressed envelope. We promise to treat your property with as much respect as we treat our own, and abide by whatever rules you set. If we don't meet your rules, you can revoke permission at any time.

If we are treating weeds on your property, we will either be cutting by hand, or spot spraying with Rodeo or Aquamaster, herbicides approved for use near water. Our preferred treatment approach is to cut down the plants in the spring and return in the fall to spray the leaves. Alternative treatment methods are available for small patches.

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

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

Sincerely yours,

Jonathan Soll
Portland Area Preserves Manager
503.230.0707 x 329

Brian Lipinski
Portland Area Preserves Outreach Coordinator
503.230.0707 x 331

Figure 7.3 Landowner Agreement Form

Permission to Access Private Land

Project Number: 201-492 Project Name: Sandy River Riparian Habitat Protection

Land owner name(s):_____

Mailing address:_____

Property* location:_____

Daytime telephone:_____

Is Japanese knotweed growing on Property*? Yes___ No___ Unsure___

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

This agreement is entered into to accomplish the following tasks:

Control of invasive weeds (Japanese knotweed and/or Scots broom and/or Himalayan blackberry and/or English ivy) using hand removal or spot application of Rodeo or Aquamaster (glyphosate).

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

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

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

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

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

_____	_____	_____
Name of cooperating landowner	Signature of landowner	Date
_____	_____	_____
Name of TNC project sponsor	Signature of TNC project sponsor	Date

Table 7.0 Sandy River Watershed cooperating private landowners

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
ALLEN	SUE	YES	23-Jul-00	20373 E. DONNYDELL LN	P.O. BOX 8	BRIGHT WOOD	OR	97011
BUND	GEORGE JR & VIRGINIA	YES	28-Jul-00		37100 SE LUSTED RD	BORING	OR	97009
WILLIAMS	MITCH	YES	30-Jul-00	60160 E BARLOW TRAIL RD	PO BOX 291	BRIGHT WOOD	OR	97011
ESPEDAL	SCOTT	YES	31-Jul-00		9015 NE CLIFF ST	PORTLAN D	OR	97220
MOIR	GLENYCE R	YES	31-Jul-00		37004 SE GORDON CREEK RD	CORBETT	OR	97019
FRANK	WILLIAM W	YES	06-Aug-00		27410 E ELK PARK RD	WELCHE S	OR	97067
JONES	MIKE	YES	10-Aug-00	37710 SE GORDON CREEK RD	P O BOX 264	CORBETT	OR	97019
MCCAFFREY	ANNE K	YES	10-Aug-00		16015 SE TEN EYCK RD	SANDY	OR	97055
WYSS	RICHARD R	YES	15-Aug-00		28432 E CROWN POINT HWY	TROUTD ALE	OR	97060
MARTENSON	JIM	YES	17-Aug-00	67044 E. JERRY'S LANE	P.O. BOX	WILDWO OD	OR	97067
STREETER	SALLY	YES	18-Aug-00		27233 E ELK PARK RD	WELCHE S	OR	97067
ADAMS	DAVID M	YES	23-Aug-00		34444 SE KIMBELY RD	CORBETT	OR	97019
KIEFER	RAYMOND F	YES	23-Aug-00		2211 SE CROWN PT HWY	TROUTD ALE	OR	97060
GILLIN	BARRY J	YES	26-Aug-00	27115 E ELK PARK RD	PO BOX 744	WELCHE	OR	97067

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
						S		
GLASS	JACK V	YES	26-Aug-00		1409 SE CROWN POINT HWY	TROUTD ALE	OR	97060
KRIARA	GUS	YES	26-Aug-00	CAMP ANGELOS AMERICAN-HELLENIC EDUCATIONAL	32100 SE STEVENS RD	CORBETT	OR	97019
SCHWARTZ	TERRY	YES	31-Aug-00		2165 NW 153RD AVE.	BEAVERT ON	OR	97006
STONE	MAGGIE	YES	01-Sep-00	26635 E HENRY CREEK RD	26635 E. HENRY CREEK RD.	RHODOD ENDRON	OR	97049
BURNS	LAWRENC E	YES	03-Sep-00	RIVER ACCESS ONLY	2318 SE 302ND AVE.	TROUTD ALE	OR	97060
TROUT CREEK BIBLE CAMP INC	C/O JOE FAHLMAN	YES	11-Sep-00		38105 SE GORDON CREEK RD	CORBETT	OR	97019
GREVEN	MAURICE M	YES	15-Sep-00	23902 E MIRKWOOD LN	PO BOX 1270	WELCHE S	OR	97067
BOLSTER	LOREN D JR	YES	18-Sep-00	27017 E ELK PARK RD		WELCHE S	OR	97067
MCCONAUGH Y	BETTY	YES	08-May-01	27358 E ELK PARK RD	19815 E SUMMERTIME DR	SANDY	OR	97055
GUDGE	PATRICIA F	YES	19-May-01		37336 SE LUSTED RD	BORING	OR	97009
DUETELL	TOM	YES	29-May-01	BRIGHTWOOD TAVERN	23700 E CEDAR POINT CT	RHODOD ENDRON	OR	97049
GAGER	ELLEN	YES	04-Jun-01		37427 SE LUSTED RD.	BORING	OR	97009
HOFELD	LORNE E	YES	23-Jun-01	BETWEEN BIG CREEK AND POUNDER CREEKS	540 NE LITTLEPAGE RD	CORBETT	OR	97019
CLACKAMAS COUNTY		YES	02-Jul-01		65200 E RIVERSIDE DR	OREGON CITY	OR	97045

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
CLACKAMAS COUNTY		YES	02-Jul-01		902 ABERNETHY RD	OREGON CITY	OR	97045
CLACKAMAS COUNTY		YES	02-Jul-01		9101 SE SUNNYBROOK BOULEVARD	CLACKAMAS	OR	97015
POWELL	J RICHARD & MARGIE	YES	09-Jul-01	59890 E MARMOT RD	5905 REXFORD AVE	CYPRESS	CA	90630
NASH	THOMAS K	YES	03-Aug-01	66701 E CRYSTAL CREEK RD	PO BOX 729	WELCHES	OR	97067
COX	DAVID R	YES	08-Aug-01		40350 SE CEDAR CREEK LN	SANDY	OR	97055
FLORI	JAMES D & DENISE	YES	08-Aug-01	40460 SE BOBTAIL LN		SANDY	OR	97055
SPA	HARVEY	YES	08-Aug-01	40342 CEDAR CREEK LN	40342 CEDAR CREEK LN	SANDY	OR	97055
SPA	HARVEY	YES	08-Aug-01	40342 CEDAR CREEK LN	40342 CEDAR CREEK LN	SANDY	OR	97055
SPA	HARVEY	YES	08-Aug-01	40342 CEDAR CREEK LN	40342 CEDAR CREEK LN	SANDY	OR	97055
JACKSON	EARL R	YES	09-Aug-01	40355 SE ROADS END DR	42774 SE COALMAN RD	SANDY	OR	97055
RUSSELL	L. MAGGIE	YES	10-Aug-01	40200 SE CEDAR CK	40200 SE CEDAR CK	SANDY	OR	97055
PHILLIPS	SANNYE	YES	15-Aug-01	40346 SE CEDAR CREEK LANE		SANDY	OR	97055
YOUNG	ROBERT	YES	16-Aug-01	40250 SE FISH HATCHERY RD	40250 SE FISH HATCHERY RD	SANDY	OR	97055
MARTIN	MICHAEL T	YES	17-Aug-01	40220 SE CEDAR CREEK LANE		SANDY	OR	97055
TENNANT	BETTY L	YES	17-Aug-01	40370 SE CEDAR CREEK LANE		SANDY	OR	97055

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
SHEPPARD	JUDY	YES	30-Aug-01	17360 SE TEN EYCK RD.	PO BOX 669	SANDY	OR	97055
SHEPPARD	LISA	YES	02-Oct-01	BEHIIND 17360 SE TEN EYCK	PO BOX 1336	SANDY	OR	97055
MASSEY	JAMES	YES	03-Oct-01		59400 E HWY 26	SANDY	OR	97055
SCHEAL	MITCH R	YES	05-Oct-01	19560 E SUMMERTIME DR	19560 E SUMMERTIME DR	SANDY	OR	97055
JENSEN	LORINDA	YES	09-Oct-01	40441 SE ROADS END	PO BOX 1357	SANDY	OR	97055
JENSEN	LORINDA	YES	09-Oct-01	40441 SE ROADS END	PO BOX 1357	SANDY	OR	97055
JENSEN	LORINDA	YES	09-Oct-01	40441 SE ROADS END	PO BOX 1357	SANDY	OR	97055
JENSEN	LORINDA	YES	09-Oct-01	40441 SE ROADS END	PO BOX 1357	SANDY	OR	97055
JENSEN	LORINDA	YES	09-Oct-01	40441 SE ROADS END	PO BOX 1357	SANDY	OR	97055
VEENKER	MICHELLE	YES	16-Oct-01	19636 SE SUMMERTIME	19636 SE SUMMERTIME	SANDY	OR	97055
WILSON	TERRY VALE	YES	25-Oct-01	19100 CLUBHOUSE RD	19100 CLUBHOUSE RD	SANDY	OR	97055
HENNING	MARTHA	YES	19-Mar-02	70925 AND 10939 E. JENNY LANE	7430 SW 76TH AVE.	PORTLAN D	OR	97223
JORDAN	LOUISE	YES	12-May-02	40460 SE CEDAR CREEK LANE		SANDY	OR	97055
BARON	LAURA	YES	20-May-02	UPSTREAM FROM REV. BRIDGE	16230 SE DUSTY LN	SANDY	OR	97055
DARNIELLE	BURT	YES	31-May-02	59182 E. CABIN LN				
DARNIELLE	BURT	YES	31-May-02	59182 E CABIN LN			OR	97209
KOKEN	JACK	YES	13-Jun-02	40510 SE CEDAR CREEK LANE	PO BOX 1795	SANDY	OR	97055
HESCOCK	TERRY L & CONNIE SCOTT	YES	19-Jun-02	19380 E SUMMERTIME DR	18601 NE MARINE DR	PORTLAN D	OR	97230
USKOSKI	GLENN	YES	19-Jun-02		38880 SE SERBAN RD	SANDY	OR	97055

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
MOE	GARY	YES	22-Jun-02		39011 SE SERBAN RD	SANDY		97055
BANTLE	MARTIN	YES	01-Jul-02	25266 E TREVINO PL.	6741 W MERCER WAY	MERCERISLAND	WA	98040
KITCHEN	JIM	YES	01-Jul-02	39030 & 39020 SE SERBAN RD, SANDY	8028 SE 108TH	PORTLAND	OR	97266
MULLIGAN	MICHAEL	YES	08-Jul-02	25210 ARRAH WANNA	PO BOX 534	WELCHES	OR	97067
KERSLAKE	RICH	YES	24-Jul-02		32544 SE STEVENS RD	CORBETT	OR	97019
ELKINS	NEIL V	YES	09-Aug-02	NEAR TEN EYCK BRIDGE	41200 SE BACON CREEK LN	SANDY	OR	97055
ELKINS	NEIL V	YES	09-Aug-02	NEAR TEN EYCK BRIDGE	41200 SE BACON CREEK LN	SANDY	OR	97055
NEWMAN	HOWARD	YES	09-Aug-02		52870 E CHERRYVULLE DRIVE	SANDY	OR	97055
YANKAUSKAS	JERRY W	YES	09-Aug-02	NEAR TEN EYCK BRIDGE	41400 SE BACON CREEK LN	SANDY	OR	97055
FORMAN	LEROY T	YES	10-Aug-02		25621 SE HWY 224	BORING	OR	97009
MAXSON	BRETT	YES	10-Aug-02	LOT ON KUBITZ RD	11915 SE MADISON ST	PORTLAND	OR	97216
REESE	N. RICHARD	YES	11-Aug-02		3221 SE BROOKLYN ST	PORTLAND	OR	97202
WILLIAMS	STEVEN D	YES	11-Aug-02		40747 SE KUBITZ RD	SANDY	OR	97055
FLYNN	JAMES E	YES	12-Aug-02	52590 E TERRA-FERN		SANDY	OR	97055
RAYNE	STEVEN	YES	12-Aug-02	46766 SE BATY RD	520 SW 6TH AVE #600	PORTLAND	OR	97024
RAYNE	STEVEN	YES	12-Aug-02	46766 SE BATY RD	520 SW 6TH AVE	PORTLAN	OR	97024

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
					#600	D		
NORELL	STEPHAN G	YES	13-Aug-02	T2S R4E SECTION 1 TAX LOT 4303	13511 SE MARSH RD	SANDY	OR	97055
FIMMEL	RICHARD	YES	14-Aug-02	SEE MAP	NO ADDRESS			
OSBORNE TRUST	BARBARA	YES	14-Aug-02	EAST 1/2 OF NE 1/4 OF SECTION 22, TOWNSHIP 2 SOUTH, RANGE 5 EAST, WILLAMETTE MERIDIAN, CLACKAMAS CO, OR				
SUMINSKI	MICHAEL	YES	14-Aug-02	37730 SE DODGE PARK BLVD				
DUBY	CHARLES	YES	15-Aug-02		NONE			
DUBY	CHARLES	YES	15-Aug-02		NONE			
JOSEPH	BRIAN	YES	17-Aug-02		41085 SE KUBITZ RD	SANDY	OR	97055
JOHNSON	L.W.	YES	20-Aug-02		40000 SE THOMAS	SANDY	OR	97055
FREEMAN	TED	YES	28-Aug-02		5147 SE 12TH WAY	GRESHAM	OR	97080
BRADER	DONALD M	YES	03-Sep-02	N OF 62245 TERRA FERN DR		SANDY	OR	97055
HADLEY	LINDA	YES	10-Sep-02	16404 SE DUSTY LN.	14752 SE ROYER RD	CLACKAMAS	OR	97015
HOLLAMONS	MICHAEL	YES	10-Sep-02	40707 SE KUBITZ RD				
MILNER	ELEANOR GILL	YES	10-Sep-02	40697 SE KUBITZ				
SCHLOSSER	MARGARETE	YES	11-Sep-02	40755 SE KUBITZ RD				
JENNINGS	GARY D	YES	13-Sep-02	16300 SE DUSTY LN.	PO BOX 1419	SANDY	OR	97055
DELF	LINDY	YES	15-Sep-02		24600 E OLD			

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
					SMOKEY			
RAYMOND	JOHN	YES	17-Sep-02	BADGER CREEK	52684 E TERRA FERN DR	SANDY	OR	97055
BOLIN	SANDRA	YES	28-Sep-02	40925 SE KUBITZ RD	P.O. BOX 777	SANDY	OR	97055
DENNEY	PRUDENCE	YES	30-Sep-02	59394 E MARMOT RD	5000 SW HEWETT BLVD	PORTLAND	OR	97221
KIEFEL	WENDLIN	YES	01-Oct-02	E. ELK PARK RD, WELCHES	1750 NE 132ND AVE	PORTLAND	OR	97230
KIEFEL	WENDLIN	YES	01-Oct-02	E. ELK PARK RD, WELCHES	1750 NE 132ND AVE	PORTLAND	OR	97230
CASWELL	LARRY	YES	02-Oct-02	41800 SE COALMAN RD		SANDY	OR	97055
MARTIN / XANDERS	CHRIS	YES	13-Oct-02	62211 E SALMON ST	62211 E SALMON ST	BRIGHT WOOD	OR	97011
BOGRAND	MARTA	YES	14-Oct-02	GILBERTSON RD, SANDY RIVER UPSTREAM FROM DODGE PARK	7808 NW BLUE POINT LN	PORTLAND	OR	97229
BOGRAND	MARTA	YES	14-Oct-02	GILBERTSON RD, SANDY RIVER UPSTREAM FROM DODGE PARK	7808 NW BLUE POINT LN	PORTLAND	OR	97229
CHAPMAN	LORNA M	YES	16-Oct-02	27060 E ELK PARK RD GRAY HOUSE PLUS LOTS UPSTREAM 150'	27060 E ELK PARK RD	WELCHES	OR	97067
CHAPMAN	LORNA M	YES	16-Oct-02	27060 E ELK PARK RD GRAY HOUSE PLUS LOTS UPSTREAM 150'	27060 E ELK PARK RD	WELCHES	OR	97067
CHAPMAN	LORNA M	YES	16-Oct-02	27060 E ELK PARK RD GRAY HOUSE PLUS LOTS UPSTREAM 150'	27060 E ELK PARK RD	WELCHES	OR	97067

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
LLOYD	JACK & CAROL	YES	16-Oct-02	SANDY RIVER, JUST BELOW SALMON RIVER CONFLUENCE	20215 E SUNRAE DR			
COOK	ROGER	YES	17-Oct-02	UPPER SANDY RIVER, 1ST GATE (LARGE) SE OF 58885 E MARMOT RD ON SOUTH SIDE OF ROAD	5000 SW HEWETT	PORTLAND	OR	97221
KIPP	RONALD	YES	23-Oct-02	OFF E ELK PARK RD	540 ASPEN DR	PARK CITY	UT	84098
KIPP	RONALD	YES	23-Oct-02	OFF E ELK PARK RD	540 ASPEN DR	PARK CITY	UT	84098
NOVOTNY	TOM	YES	23-Oct-02	4TH DRIVEWAY, NORTH SIDE	41051 SE COALMAN RD			
NOVOTNY	TOM	YES	23-Oct-02	4TH DRIVEWAY, NORTH SIDE	41051 SE COALMAN RD			
NOVOTNY	TOM	YES	23-Oct-02	4TH DRIVEWAY, NORTH SIDE	41051 SE COALMAN RD			
BRITT	STEVEN L	YES	26-Oct-02	26542 ELK PARK RD				
TRACHTA	MARVIN	YES	27-Oct-02	26887 E LK PARK RD	618 NW 12TH AVE #216	PORTLAND	OR	97209
WHITE	WILLIAM	YES	27-Oct-02	61722 E SALMON ST CONFLUENCE OF SANDY AND SALMON RIVERS	PO BOX 247	BRIGHT WOOD	OR	97011
INMAN / LEWIS	JANICE	YES	28-Oct-02	62262 E SALMON + 62282 E SALMON				
INMAN / LEWIS	JANICE / LAVERNE	YES	28-Oct-02	62262 E SALMON + 62282 E SALMON				
BACHMANN	TROY	YES	29-Oct-02	60723 E ALT RD	PO BOX 1172	WELCHES	OR	97055

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
BACHMANN	TROY	YES	29-Oct-02	60723 E ALT RD	PO BOX 1172	WELCHES	OR	97055
STRIKER	WILLIAM	YES	29-Oct-02	60655 E ALT RD	PO BOX 1124	WELCHES	OR	97067
SWAN	BOB	YES	29-Oct-02	60805 E ALT RD	PO BOX 108	BRIGHTWOOD	OR	97011
MERVIN	MITCH	YES	31-Oct-02	41836 SE COALMAN	41836 SE COALMAN			
RICHARDS	SANDY	YES	31-Oct-02	58301 E SLEEPY HOLLOW DR	PO BOX 1012	WELCHES	OR	97067
WASHBURNE	MIKE	YES	31-Oct-02	20702 E CANNON ROAD				
CADMAN	JASON	YES	01-Nov-02	66887 E CRYSTAL CREEK	19000 NW EVERGREEN PKWY	HILLSBORO	OR	97124
EMC MORTGAGE CO.	SHERRY AXT	YES	01-Nov-02	60455 E. ALT RD				
MOWREN	JAMES	YES	01-Nov-02	POND GRAVEL PIT BEHIND BRIGHTWOD STORE	PO BOX 1074	BRIGHTWOOD	OR	97011
LINDGREN	JOHN	YES	05-Nov-02	25400 E FOXGLOVE LANE OFF ARRAH WANNA RD	1075 SW SUMMIT VIEW DR	PORTLAND	OR	97225
YOUTH GUIDANCE ASSOCIATION -SON VILLAGE	MARTIN LOWEN	YES	05-Nov-02	25315 E ARRAH WANNA BLVD.	2730 NE FLANDERS	PORTLAND	OR	97232
LESTER	RALPH	YES	13-Nov-02	63029 E BRIGHTWOOD BRIDGE ROAD	PO BOX 181	BRIGHTWOOD	OR	97011
CARLEY	ROY	YES	15-Nov-02	67102 E CRYSTAL CREEK RD	5575 RIVER ST	WEST LINN	OR	97068

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
HANER	DAVID	YES	24-Nov-02	59902 E SLEEPY HOLLOW	839 SE BROADWAY DRIVE APT 71	PORTLAND	OR	97201
CARMONY	GLEN I	YES	10-Dec-02	ALONG CREEK.. NEAR BRIDGE	40191 SE FISH HATCHERY RD	SANDY	OR	97055
FRITCH	MARK	YES	11-Mar-03	40465 SE BOBTAIL LANE	BOX 1720	SANDY	OR	97055
HOWARD	EMMA JANE	YES	17-Mar-03		460 NW GREENLEAF ROAD	PORTLAND	OR	97229
ADMUNDSEN	KATHY	YES	15-May-03	41141 SE KUBITZ RD	41141 SE KUBITZ RD	SANDY	OR	97055
DAVID	ROBERT	YES	21-May-03	10900 SE GREEN VALLEY DR.				
ANDERSON	DAVID	YES	23-May-03	40949 COALMAN ROAD	40949 COALMAN ROAD	SANDY	OR	97055
MATSON		YES	23-May-03	17966 SE 422ND AVE.	17966 SE 422	SANDY	OR	97055
REID	TRINA	YES	23-May-03	17780 SE 422ND AVE.	17780 SE 422ND AVE.	SANDY	OR	97055
STONE	MARY	YES	23-May-03	17550 SE 422ND AVE	17550 SE 422ND AVE	SANDY	OR	97055
CAMP ARRAH WANNA		YES	06-Jun-03	24075 E ARRAH WANNA BLVD -AT END OF PICADILLY LN OFF ARRAH WANNA BLVD				
CAMP ARRAH WANNA		YES	06-Jun-03	24075 E ARRAH WANNA BLVD -AT END OF PICADILLY LN OFF ARRAH WANNA BLVD	24075 E.ARRAH WANNA BLVD.	WAPATO	OR	97067
ARNOLD	CHARLES	YES	06-Jun-03	41334 SE BEAVERDAM ST.	41334 SE BEAVERDAM ST.	WAPATO	OR	97055
BUCHCO	MARILYN	YES	06-Jun-03	27315 E WELCHES RD	PO BOX 329	WELCHES	OR	97067

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
TENNANT	B.L.	YES	06-Jun-03	40370 CEDAR CREEK LN.	PO BOX 1566			
VANCE	TROY	YES	08-Jun-03	16025 SE TEN EYKE RD.	16025 SE TEN EYKE RD.	SANDY	OR	97055
METZGER	RICHARD	YES	14-Jun-03	24489 E. METZGER ISLAND DRIVE				
ROAD EASMENT		YES	14-Jun-03	25103 TILLICUM	RTISTA ANDERSOM			
SCHUBERG	ROBERT	YES	14-Jun-03	27327/27260 E ELK PK. RD.	2545 SW TERWILLIGER BLVD. #1127	PORTLAND	OR	97201
SCHUBERG	ROBERT	YES	14-Jun-03	27327/27260 E ELK PK. RD.	2545 SW TERWILLIGER BLVD. #1127	PORTLAND	OR	97201
BORGE	STEVE	YES	18-Jun-03	E. ELK PARK RD.	PO BOX 1054	WELCHES	OR	97067
BORGE	STEVE	YES	18-Jun-03	68398 E. DEER PARK RD.	PO BOX 1054	WELCHES	OR	97067
BORGE	STEVE	YES	18-Jun-03	E. ELK PARK RD.	PO BOX 1054	WELCHES	OR	97067
CODY	MJ	YES	18-Jun-03	68914 E. TAWNEY LANE	68914 E. TAWNEY LANE			
HOYT	GEORGE	YES	18-Jun-03	48061 SE HWY 26				
SAMUEL	JIM	YES	18-Jun-03	27275 E. SLERET LN.	1180 NE 43RD PL	KIRKLAND	WA	98033
WOOD	STEVE	YES	18-Jun-03	21100 E. COUNTRY CLUB RD.	PO BOX 208	WELCHES	OR	97067
DUNCAN	ROBERT B	YES	19-Jun-03	28165 E LOST LN	2221 SW 1ST #G22			
FURMAN	SAM	YES	19-Jun-03	68634 E. HUCKLEBERRY DR.	PO BOX 411	WELCHES	OR	97067
MCCRAKEN	JOHN	YES	24-Jun-03	29635 E EDGEWATER	PO BOX 1088			

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
				DR.				
VOGEL	ELLA	YES	24-Jun-03	29425 E EDGEWATER DR	PO BOX 7040	WELCHES	OR	97067
CROW	JULIAN	YES	29-Jun-03	28895 E. ABERNETHY LN.	7513 76TH AVE. SW	TACOMA	WA	98498
BELL	DAVID	YES	02-Jul-03	48770 SE HWY 26	465 NE 181ST AVE PMB 523	PORTLAND	OR	97230
CORBIN	B. WILLIS JR.	YES	03-Jul-03	41224 SE BEAVERDAM ST				
WILLIS	CORBIN B. JR.	YES	03-Jul-03	41224 SE BEAVERDAM ST.	41224 SE BEAVERDAM ST.	SANDY	OR	97055
ESPENEL	MOLLY	YES	07-Jul-03	25295 E HOFELDT				
MASSINGER	TODD	YES	07-Jul-03	22544 E LOLO PASS	4120 SW 25TH CT	GRESHAM	OR	
DE LANDRO	CATHERINE	YES	08-Jul-03					
MARIARTY	PAULA	YES	08-Jul-03	41550 SE BEAVERDAM ST.				
THORNBERG	BRADFORD	YES	08-Jul-03	41520 SE BEAVERDAM ST.				
WHITLOCK	WILLIAM	YES	14-Jul-03	17987 SE 422ND AVE.				
WHITLOCK	WILLIAM	YES	14-Jul-03	17987 SE 422ND AVE.				
WHITLOCK	WILLIAM	YES	14-Jul-03	17987 SE 422ND AVE.	16870 SE TEN EYCKRD	SANDY	OR	97055
WHITLOCK	WILLIAM	YES	14-Jul-03	17987 SE 422ND AVE.				
TORBECK	CAROL	YES	18-Jul-03	41474 SE BEAVERDAM ST				
MACFARLENE	SYDNEY	YES	22-Jul-03	64425 E. BARLOW TR. RD.	PO BOX 429	BRIGHTWOOD	OR	97011
MACKENZIE	KATHY	YES	22-Jul-03	26521 E ROBERTS RD	10505 4TH DR SE	EVERETT	WA	98208

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
MCCORD	MALCOM	YES	08-Aug-03	11000 SE GREEN VALLEY DR.		SANDY	OR	97055
BANKS LUMBER CO.		YES	11-Aug-03	PROPERTY LOT BTW. 27327-27233 E. ELK PARK RD.	BANKS LUMBER CO. PO BOX 8	BANKS	OR	97106
MYERS	VIOLA	YES	11-Aug-03	65982 E. BARLOW TRAIL RD.	935 NW NORMAN AVE.	GRESHA M	OR	97020
BRANDT	CRAIG	YES	13-Aug-03	12181 SE MARSH RD				
ALSTAT	ED	YES	16-Aug-03	36350 SE INDUSTRIAL WAY SECTION 12TZSR4E	36350 SE INDUSTRIAL WAY SECTION	SANDY	OR	97055
ALSTAT	ED	YES	16-Aug-03	36350 SE INDUSTRIAL WAY SECTION 12TZSR4E	36350 SE INDUSTRIAL WAY SECTION	SANDY	OR	97055
ALSTAT	ED	YES	16-Aug-03	36350 SE INDUSTRIAL WAY SECTION 12TZSR4E	36350 SE INDUSTRIAL WAY SECTION	SANDY	OR	97055
ALSTAT	ED	YES	16-Aug-03	36350 SE INDUSTRIAL WAY SECTION 12TZSR4E	36350 SE INDUSTRIAL WAY SECTION	SANDY	OR	97055
TOWNSEND	PAUL	YES	18-Aug-03	26950 ELK PARK RD.				
SAGOR	RICHARD	YES	20-Aug-03	OFF ROBERTS RD	1501 NW IVY	CAMAS	WA	98607
SAGOR	RICHARD	YES	20-Aug-03	OFF ROBERTS RD	1501 NW IVY	CAMAS	WA	98607
BAXTER	CHARLES	YES	26-Aug-03	40360 SE CEDAR CR LN		SANDY	OR	97055
BURCHAK	DOUG	YES	28-Aug-03	41335 SE COALMAN RD.		SANDY	OR	97055
CHESTERFIEL D	ERIC	YES	28-Aug-03	41531 SE COALMAN RD.		SANDY	OR	97055
FACKRELL	MARY	YES	29-Aug-03	26855 E. ELK PARK RD.	11311 SE IDLEMAN RD.	PORTLAN D	OR	97266

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
HERTRICH	ADOLF G.	YES	29-Aug-03	SEE SITE COMMENTS	PO BOX 505	SANDY	OR	97055
HAWLEY	JIM	YES	08-Sep-03	17150 SE TEN EYCK RD.	10792 SE 352 AVE	BORING	OR	97009
BROWN	MARJORIE	YES	13-Sep-03	57250 E. MARMOT RD		SANDY	OR	97055
ARTHUR	LEIGHTON	YES	16-Sep-03	58160 E.MARMOT RD.	58160 E. MARMOT RD.	SANDY	OR	97055
BOWMAN	MOLLY	YES	16-Sep-03	E. METZGER ISLAND DRIVE	1714 MEADOWS DR.	LAKE OSWEGO	OR	97034
SCHNEIDER	HARVEY	YES	22-Sep-03	57232 E MARMOT	PO BOX 43	BRIGHT WOOD	OR	97011
SCHNEIDER	HARVEY	YES	22-Sep-03	57232 E MARMOT	PO BOX 43	BRIGHT WOOD	OR	97011
SCHNEIDER	HARVEY	YES	22-Sep-03	57232 E MARMOT	PO BOX 43	BRIGHT WOOD	OR	97011
SCHNEIDER	HARVEY	YES	22-Sep-03	57232 E MARMOT	PO BOX 43	BRIGHT WOOD	OR	97011
MULLIGAN	MICHAEL	YES	23-Sep-03	23696 E. LOLO PASS RD.	PO BOX 534	WELCHES	OR	97067
STEPHENS	MARY B	YES	23-Sep-03	12919 SE MARSH RD	12919 SE MARSH RD	SANDY	OR	97055
TAYLOR	MIKE	YES	23-Sep-03	13589 SE MARSH RD.		SANDY	OR	97055
WALSH	LARRY	YES	23-Sep-03	55775 E. HWY 26				
WALSH	LARRY	YES	23-Sep-03	55775 E. HWY 26				
WHITNEY	SUSAN	YES	23-Sep-03	66200 E. BARLOW TRAIL				
ELLIOT	SHERIE	YES	25-Sep-03	13999 SE MARSH RD.				
SCHUE?	MELISSA	YES	01-Oct-03	66127 E. BARLOW TRAIL RD.				
SCRIVENS	DEB	YES	02-Oct-03	55373 SE KIRKWOOD	55373 SE KIRKWOOD	SANDY	OR	97055
ROMIE	BERNIE	YES	03-Oct-03	66577 E MOUNTAIN AIR	PO BOX 31	BRIGHT WOOD	OR	97011

Last Name	First Name	Permission	Permission Date	Site Address	Mailing Address	Mailing City	Mailing State	Mailing Zip Code
CLIFF		YES	07-Oct-03	59123 SLEEPY HOLLOW				
SWEENEY	REBECCA	YES	07-Oct-03	19320 E. SUMMERTIME DR.	PO BOX 1123	WELCHES	OR	97067
SABIN	CHRIS	YES	08-Oct-03	41015 SE KUBITZ RD				
LASCHER	TONY	YES	13-Oct-03	RESORT ON THE MOUNTAIN GOLF COURSE	E WELCHES RD	WELCHES	OR	97067
LASCHER	TONY	YES	13-Oct-03	RESORT ON THE MOUNTAIN GOLF COURSE	E WELCHES RD	WELCHES	OR	97067
CHESLA	KEVIN	YES	30-Oct-03	BLUEJAY LN	PO BOX 554	WELCHES	OR	97067
BUDDEAU	KAREN	YES	07-Nov-03	52300 E. TERRA FERN DR	52300 E. TERRA FERN DR	SANDY	OR	97055
ALLEN	BETH	YES	15-Nov-03	45405 SE TAPP RD.	45405 SE TAPP RD	PORTLAND	OR	97055

Media

Highly circulated print media such as The Sandy Profile, and several newsletters from The Nature Conservancy and the Sandy River Basin Watershed Council have printed stories about the project. On January 28, 2004 The Oregonian ran a report about the SRRHPP and Metro's knotweed control efforts. Previously, two versions of a story focused on our efforts in the Sandy River ran on KGW during prime time. Following up with direct outreach after media reports helped increase the project's recognition and reception from the public. The media reports reinforced the project's goals and highlighted the project's successes.

"Wanted" posters and postcards, produced in 2002 (Appendices 7.0 and 7.1), were distributed and placed in public areas within communities surrounding the project site. In addition, we developed and printed a new knotweed brochure in 2003 that highlights the most current information related to the ecology and control of knotweed (Figure 7.4). This revised brochure replaced the previous one we produced (Figure 7.5). The new brochures, along with the posters and postcards, were widely publicized and small numbers were made available to any individual, organization and agency free of cost. For programs seeking quantities in the 100's to thousands, electronic versions of these materials are made freely available as well.

Since it's printing in Summer 2004, over 3000 new knotweed brochures were distributed to individuals, agencies and organizations across Oregon and Washington, and in several Eastern states (Table 7.1). This brochure, including other printed materials, has also served as working models for other similar programs or projects.

Printed materials posted at conspicuous locations within the project area, especially highly frequented community haunts (library, post office) and businesses related to river recreation, helped raise awareness and dispel suspicions related to the control project. Confirmed knotweed sightings and reports increased in 2002 and 2003 based on the rate of postcards returned by and telephone calls received from the public.

Figure 7.4 Knotweed brochure developed and distributed in 2003

We Can Help

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

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

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

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

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

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

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

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

Oregon Department of Agriculture 503-986-4621

Information Resources

These Internet sites provide information about knotweed and other invasive species:
- tncweeds.ucdavis.edu/esadocs/Polycusp.html
- www.co.clark.wa.us/environ/knotweed.pdf
- www.ecy.wa.gov/programs/wq/plants/weeds/aqua015.html

About The Nature Conservancy

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

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

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

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US POSTAGE
PAID
PORTLAND, OR
PERMIT NO. 608

Knotweed

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

Help Save Pacific Northwest Rivers from this destroyer of watersheds.

What is knotweed?

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

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

Why is knotweed a problem?

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

What does it look like?

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

Where does it grow?

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

How does it spread?

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

What is being done?

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

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

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

WHAT CAN I DO?

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

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

HOW CAN IT BE CONTROLLED?

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

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

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

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

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

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

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

Figure 7.5 Knotweed brochure produced and distributed in 2000.

Want to know more?

If you have questions about the control effort, have knotweed on your property, want our help or would like to volunteer, please contact:

Jonathan Soll (Sandy River)
The Nature Conservancy of Oregon
821 SE 14th Ave
Portland, OR 97214
503-230-1221 or e-mail at jsoll@tnc.org
or
Jim Morgan (Clackamas & other Rivers)
Metro Regional Parks and Greenspaces
600 NE Grand
Portland, OR 97232
503-797-1850
or e-mail at morganj@metro.dst.or.us

Information Resources

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

www.nps.gov/plants/alien/fact.htm
www.wa.gov/ecology/wq/plants/weeds
www.metro.dst.or.us/parks/volopps.html

About The Nature Conservancy

The Nature Conservancy is a private, non-profit organization working to protect the diversity of life on earth using cooperative, science-based methods. We own or manage 49 preserves in Oregon, totaling over 65,000 acres, including over 400 acres in the Sandy River Gorge. For more information, contact us or visit our website at www.tnc.org.

The Nature Conservancy® OF OREGON

The printing and distribution of this brochure was made possible through generous funding by the Bureau of Land Management, Metro, and the Oregon Watershed Enhancement Board.

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Japanese Knotweed

Without prompt and vigorous action, knotweed will degrade fish and wildlife habitat and damage the scenic and recreational quality of northwest rivers.

Help save the Sandy and other Oregon rivers from this destroyer of watersheds

What is Japanese knotweed?

Japanese knotweed and its relatives, giant and Himalayan knotweed, are perennial plants native to Asia but planted in gardens here. Other names include Mexican or Japanese bamboo and fleeceflower. By any name it is a state listed noxious weed and a threat to our rivers' health.

Polygonum cuspidatum, *P. sachalinense*, or *P. polystachyum*; and *Reynoutria* or *Fallopia japonica*, are commonly used scientific names.

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Close-up of flowering knotweed: note the, bright color, pointed tip, smooth edge and shape of the leaf and the white spikes of flowers

Why is it a problem?

Since only 1996, hundreds of patches of knotweed, some 1/2 an acre or more, have appeared in the Sandy River Gorge. If unchecked, knotweed will steadily take over riverbanks and beaches, as it has in the Eastern U.S. and Europe. When habitats are lost, fish and wildlife disappear.

What does it look like?

Knotweed grows in dense stands up to 12 feet tall. The thick, hollow, green to reddish stems look similar to bamboo. The large, bright green leaf ranges from egg to heart-shaped, with a pointed tip. When small they can be confused with cottonwood saplings, but have smooth leaf edges, versus the toothed leaf of cottonwoods.

Plants sprout in April. They grow quickly, reaching full size by July. Spikes of white flowers appear from July to September. Dormant by November, the dead, brittle brown stems persist through winter.

Where does it grow?

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

How does it spread?

In the Pacific Northwest, knotweed usually spreads when roots are moved by floods or in contaminated soil. Root fragments as small as 1 inch can produce a new plant. As a result, even one patch can produce dozens, if not hundreds, of new populations.

What is being done about knotweed?

The Nature Conservancy, the Sandy River Basin Watershed Council, the Bureau of Land Management, Metro and local AmeriCorps teams are joining concerned citizens to control knotweed in the Sandy River Watershed. Similar efforts are occurring in other regional watersheds.

We need local support to solve this problem before it is too late, and we need to act fast!

Within just a few years, it will be virtually impossible and extremely expensive to control knotweed.

WHAT CAN I DO?

- If you have knotweed on your land, control it using one of the methods described to the right, or contact us for detailed control advice.
- **If you don't want to control it by yourself, we will help you, at no cost!** Contact us, and we'll do the rest. We can even recommend native plant replacements.
- "Adopt" a section of river, either alone or with a volunteer control team.

How can it be controlled?

Once established, knotweed is extremely hard to eradicate. Its roots can grow down more than 10 feet and spread out more than 20 feet. Here are 3 options:

CUTTING: Even large stands of knotweed are easily cut with hand tools. Although the plant initially re-sprouts vigorously, repeated cutting close to the ground should eventually kill it. Cut at least every 4-6 weeks, including once after mid-September, so the plant cannot send reserves to the roots. This method may require more than 1 year.

HERBICIDES: If repeated cutting is impossible or undesirable, herbicides can be used. Spray on the leaves or better yet, apply in high concentration directly to freshly cut stems. Apply in late summer, ideally following an early season cutting. Products approved for use near water must be used. Garlon3a is best, but Rodeo may also work. Follow the label directions and use carefully. Native plants touched by herbicides will also be damaged or killed.

DIGGING: Small plants in loose soil can be dug up. Remove **ALL** of the root and dispose of it. **Do not throw the stems or roots into the river.** Check to see if the plant returns, because even small root fragments can start new plants.

Table 7.1 Outreach Materials 2003 Distribution

Name	Organization/Agency	Brochure	CD	Poster
Cruz Flores	City of Cannon Beach	100		
David Reid	Johnson Creek Watershed Council	50		
Eddie Huckins	Lincoln Soil and Water Conservation District	200		
Mark Wison	City of PDX Parks	100		
Julie Dileone	East Multnomah SWCD	100		
Clare Vocure	Clackamas SWCD	100		
Shannon Brubake	OR Dept.of Agriculture	100	1	
Jay Schleier	Oregon State Parks and Recreation	50	1	
John Reid	Portland Parks Horticulture Division	100		
Micki Borton	Lincoln Co. Public Works	100		
Laura Geselbracht	TNC FL	100		
Roger Buttermor	Stockton USFW Office	100		
Joanne Steinhart	TNC of Northeast PA	50	1	5
Jack Wiles	Oregon State Parks and Recreation	100		
Melissa Ferry	Marion SWCD	300	1	
Laurie Robertson	Siuslaw SWCD	100		
Carol Horvath	Zigzag Ranger District	100		
Kevin Fitzgerald	Multnomah County		1	
Eddie McCoughnehy	private landowner-distribute to neighbors	25		
Monica Smiley	Tualatin Riverkeepers	100		
Clair Hibler	BLM	200		
Kyle Spinks	Tualatin Hills Parks and Recreation	50		
Kevin Liburdy	City of Sandy	50		
Cindy Dimock	SOLV	30		
Kevin Price	Oregon State Parks and Recreation	50		
Russ Plaeger	Sandy River Basin Watershed Council	50		
Bonnie Harper-Laurel	Federal Highway Administration	150	1	
Karen Strohmeyer	Cascade Pacific RC&D	100		
Michael Fery	Linn SWCD	50		
Mary Jo Seery	Thurston County	100		
Cindy McCain	Siuslaw SO	100		
Denise Hoffert-Hay	Calapooia Watershed Council	100		
Ron Buck	Clackamas County Road Department			6
Matt Dunnahoe	Tualatin SWCD	50		

Public Speaking
Over the last two years, we helped inspire, catalyze or change the management approach of several new knotweed control efforts or programs outside our own region. Examples include the Washougal, Siuslaw, Coos, Lincoln County, Marion County, Clackamas River, Skagit River, and Tualatin River. These new programs will help draw more attention to the invasive species issue. As invasive species like knotweed become vital components to a community's agenda, regional control will become more desirable and therefore more attainable in the future.

Large annual public events we attended attracted 1000's of people from the surrounding community and created a platform on which to personally address the knotweed problem to a larger audience. These events also provided a direct context in which to address other invasive species and the threats they pose to native riparian habitat. Examples of events attended include the Salmon Festival, the Songbird Celebration, Children's Clean Water Festival, Sandy River Aquatic Ecology Camp, Tualatin River Citizen Action Committee and Sandy River Basin Watershed Council meetings, Master Watershed Stewardship Seminars and the Master Gardener Fundraiser Event. Other annual events such as the Children's Clean Water Festival attracted and helped educate 100's of students and teachers from surrounding communities. Over 200 students were educated on the effects of invasive species like knotweed to riparian ecosystems.

With Metro and the Northwest Oregon Weed Management Partnership, we hosted a knotweed working group. Attendees present included representatives from various agencies and conservation organizations ranging from the northern Olympic Peninsula in Washington to Coos County on the Oregon coast. A field training is planned for this group in May, 2004. With Metro, the Society For Ecological Restoration and the Portland Parks Natural Resources Department we hosted a full day workshop in which control of knotweed and other invasive species was brainstormed at 8 separate workshops. Based on those workshops a series of "best practices" documents has been developed including the knotweed document included here as an appendix.

In October 2003, the knotweed control program received public recognition in the form of the annual Salmon Festival Stewardship Award, which drew 1000's of individuals. This recognition enhanced the visibility of this multi-partner project as well as increase public awareness of invasive species and the necessary actions to control them. Earlier in the year we had received the annual stewardship award from the Sandy River Basin Watershed Council.

Volunteer Recruitment
In 2001 and 2002, we worked in the field with more than 20 school or youth groups, totaling more than 300 individuals and more than 1300 hours. Individual volunteers and interns contributed another 700 hours. Throughout 2003, we recruited and worked with over 300 individuals. These individuals contributed more than 8000 hours to invasive species removal. Among these, dedicated volunteers committed over 500 volunteer hours to knotweed control. In addition, we led more than 200 youth from the Greater Portland Area in over 6000 hours of service-learning type projects. Some education-based youth organizations involved in this partnership included AmeriCorps Northwest Service Academy, Multnomah Youth Cooperative, Project YESS, Alpha HS, and Canby Oregon Youth Conservation Corps. Combining habitat restoration with environmental education, these individuals learned about native habitat, conservation and restoration science, and the threats invasive species pose to ecosystem health.

Section 8. Invasive Species Science Education Program (ISSEP) Summary

Program Development

As part of The Nature Conservancy's (TNC) Youth For Conservation program (YFC), the development of the Invasive Species Science Education Program (ISSEP) curriculum began in 2001 by a TNC sponsored seasonal AmeriCorps member under the direction of the TNC project manager. The ½ FTE education program coordinator position was part of the 4-person full-time AmeriCorps field team dedicated to the Sandy River Riparian Habitat Protection Project (SRRHPP). The first outline draft was completed in June 2001. The curriculum outline was later revised to accommodate the anticipated development of working lessons for both the classroom and field (see 2002 report).

The following year, the AmeriCorps member was hired as a seasonal TNC employee. Background text was then written into the four modules to provide a structured format for presenting information to high school aged students during classroom or field discussions that would be consistent with both Oregon and National Science Education standards. The four modules consist of independent, but linked subject areas: Plant Structure and Function, Invasive Plant Ecology, Monitoring and Measuring Plant Populations, and Ecological Restoration. Each module is intended to provide a foundation for learning the next. In addition, several field projects were developed to provide a link to realistic "on-the-ground" and hands-on learning environment. These projects incorporated concepts from the background text and focused on various invasive species in the context of their growing habitat. Sampling and measurements of specific attributes such as basal stem density or percent vegetative cover provided much of the field based examples.

The procedures for these projects were drafted and a field-trial was conducted in the Fall of 2002 with the education program coordinator, TNC project manager, two education directors from an education partner organization, Wolftree, two teachers and 4 classes of students. The descriptions of several of these projects are included in the ISSEP as Activity/Project Examples. Several teachers from the Greater Portland Area, including West Linn High School and Reynolds Natural Resources Academy, were consulted for their feedback and needs for a program. In addition, Wolftree education directors reviewed the final draft in January 2003 and provided additional feedback for the preparation of the final working curriculum. Changes to the curriculum were made to accommodate the anticipated needs and interests of both TNC and educators in the Metro area. In June 2003, the ISSEP final draft was completed (Appendix 8.0).

Classroom Program Methods

Classroom sessions focus on invasive species ecology whereas the information in Module II provided themes for discussion. Students were asked questions throughout the discussion to gage their understanding of the material and to gain more active inclusion and participation from students. Discussions were supplemented with hands-on visual aids in addition to an improvised trivia styled game to test the student's aptitude.

Field Program Methods

Wolftree provided on-the-ground staff assistance as educator/mentors and equipment needs to implement the program's field trials. Two schools with very different student populations were chosen to test the curriculum in the field, West Linn HS and Reynolds HS Natural Resources Academy. The Sandy River Gorge Preserve, Diack Tract, was used as the program's field trial site due to invasive species richness, its large area to minimize impact from use, and diversity of ecosystems to aid in presenting concepts. Students were given several concepts to focus on, diversity and disturbance and several common goals to achieve.

The classes divided into three or four smaller groups of students of 5-7 each to facilitate more one-on-one learning. Some of the groups developed a hypothesis to serve as a platform for their research. Each group focused on a different field project: Reed canary grass, English ivy, Himalayan blackberry, and Canada thistle populations were sampled using density, cover, or frequency attributes. Some of the students also measured forest canopy cover and flora diversity. In addition, the students learned to identify various native plant species as well as common weedy non-natives.

Program Results

Students had fun working in teams and some immediately recognized the value of teamwork. Superb science rigor existed throughout the program as students were asked questions integrating the project, target invasive species, and concepts from the classroom discussion. Students were also exposed to new tools for data collection, for example, densiometers, compasses, maps, and measuring tapes.
After students finished their respective projects and data collection, each group summarized their research and data. The groups then convened for presentation in a "wrap-up" session. Overall, it was agreed that the group size was ideal for field sampling and data collection projects. However, some of the procedures needed to be revised to make them more concise or simple to follow independent of a mentor.

Program Achievements

Overall, the field test demonstrated success in achieving goals in several ways. For example, students learned to identify disturbance, invasive species impacts, ecosystem components, plant structures and functions, and various sampling methods. Students use of the scientific method and the process of science inquiry throughout served as a structure to teach invasive species ecology, conservation biology, and ecological restoration. Students that engaged in a restoration component of the ISSEP asked more questions and were more connected and involved with the restoration effort. Their new level of understanding seemed to facilitate a deeper appreciation for their environment.

Although much of the ISSEP content was written with technical vocabulary, the intention was to provide a language scientists use in the field and to improve science literacy among students. Since students would be exposed to new scientific methodologies, it was expected that the students would draw their experiences from the essence of the material, some of which consisted of a new scientific vocabulary. Students demonstrated their aptitude for this vocabulary during the field program wrap-up sessions when the students summarized their research and presented hypotheses. High level discussions arose from the invasive species focus. Feedback that was received from teachers and students, after their respective programs, indicated that the overall

experience was very positive, fun, and interesting. The projects were both engaging and effective in communicating invasive species ecology and ecological restoration.

The curriculum was also intended to be adaptable to accommodate other age and learning levels besides high school. To demonstrate the adherence to this goal, for example, Module I and II was combined and modified to provide a classroom presentation, Alien Invaders: Enemy Plants of Oregon Watersheds, to over 100 middle school students at the Children's Clean Water Festival. Concepts from plant structures to disturbance were taken from each module to develop a hands-on/brains-on activity-presentation incorporating various invasive plant specimens, herbarium sheets, and a slideshow to demonstrate their impacts in nature.

Overall, 10 classes from 4 schools participated in a structured ISSEP program (Centennial Learning Center, Oregon City High School, Reynolds High School, and West Linn High School) at three field sites (Camassia Natural Area, Diack Tract, and East Oxbow Park) with 367 students in classroom sessions and 131 students in the field.

Program Future

The ISSEP project is intended to be an adaptive resource for educators, program managers, crew leaders or any individual seeking to provide a service learning component to an ongoing field project. The ISSEP can be continuously adapted and improved upon and transferred to other organizations, schools and agencies to supplement existing program curricula or to help create new ones. It is our future intention that the curriculum be provided with additional illustrations and visual aids in 2004 to accompany and supplement the text. As it exists, the ISSEP will be available to any interested individual or organization free of charge. The Nature Conservancy will continue to play an active role in invasive species education but would like to assume more of a supportive role for another willing teacher, school or education-based organization to take on the lead role.

Section 9. Conclusions and Future Directions

General

The four years (3 with the current project structure, and meaningful staffing levels) on this project have produced remarkable progress. Some of this progress has been on the ground achievement in the form of large reductions of knotweed cover. In addition we have learned several important lessons on both the technical and the community outreach side (community outreach, education and volunteerism). Aside from the substantial progress we have made on the ground against a species that has previously defied landscape level control, we have demonstrated that an adaptive management process is necessary, possible and valuable, even while practicing cost-efficient field treatments. We have been able to successfully test and incorporate new treatment methods and technology based on our work in the field, and to modify our outreach efforts to meet the significant challenge that changing public behavior represents. Perhaps most importantly, it is clear that for most landscape level projects, reaching a large number of individual landowners is vitally important and difficult. The knowledge we have gained in both areas has not only improved our performance, but has helped to launch and improve numerous other knotweed control programs. It has also helped to galvanize better communication between weed control practitioners. As a result, our entire region will do better and more efficient work on invasive species control.

Outreach

As successful as are mailings and public speaking at raising the general awareness level, it is clear that if a project does not have a priori access to private property (as ours did not), intensive door-to-door outreach efforts are both essential and extremely time consuming. We estimate that to ensure identification and treatment of all knotweed locations on the Sandy and its major tributaries, we will have to make direct contact to receive permission to survey from as many as 2000-4000 landowners during the next two years. Towards that end, during 2004 we will dedicate at least 150 staff days (roughly 16% of total staff time from March to September) to direct outreach efforts.

It is clear that the offer of free knotweed control is vital to gaining landowner cooperation. It is also apparent that if a priori access for survey and treatment is possible, a landscape level control project can save as much as 33-50% of total project costs.

Volunteerism

Volunteers can play a critical role in stretching project dollars and completing and maintaining field projects. Dedicated individual volunteers and intern type volunteers can play an especially important role, as their long-term commitment justifies a higher degree of training and responsibility. These special individuals aside, volunteer labor provides a questionable cost-benefit relationship compared to contract labor or hired youth crews for many types of tasks. It does however provide corollary benefits in the form of environmental education and awareness that cannot be discounted. Work sites should be chosen to match the physical abilities and time constraints of the volunteers. Careful consideration needs to be given to the relative balance of travel time to work time and the relative benefit of dedicating staff time to volunteer supervision. We recommend at least a 6:1 ratio of volunteers to staff, and no less than 3 actual working hours for a typical volunteer event. Where possible, it is extremely effective to empower individuals or groups to work in the absence of direct supervision from project staff. Careful training is necessary.

Education
Many environmental education curricula exist in one form or the other, and groups like Wolftree provide outstanding field supervision. Prior to the drafting or the ISSEP however, few, if any (that we could find) targeted at 7-12th grade and were specifically tied to established learning benchmarks. Furthermore, none specifically addressed invasive species ecology and control in the larger context of watershed health and conservation biology. A further shortcoming of some curricula was the lack of connection between real, professionally supervised and long-term field projects and classroom based lessons on ecological theory. It is our belief that students learn best when concepts such as math, teamwork building, and biological science are seamlessly integrated so that students view each component as a tool they want to have rather than a lesson they need to learn. It is our hope that the ISSEP can provide the foundation to both link classrooms with real field projects and to link the many core concepts that field science and restoration ecology brings together, with the result that students will learn more skills while having more fun doing so.

Technical Aspects
Two years of intensive treatment delivered an 80% reduction in total stem number and eradication of approximately 2/3 of knotweed sites in our initial primary project area (the Sandy River Gorge). Results of the third year of intensive treatment won't be known until mid-summer 2004, but we expect to produce control levels close to 95%. Eradication of most individual patches appears to generally require 2-3 years of foliar herbicide treatment, although about 15% of our sites were eradicated by two Garlon 3a treatments within a single field season. Large, well-established sites may require 4 or even 5 years of foliar spray treatment. An integrated program combining a spring cutting and a fall foliar Rodeo herbicide treatment eliminated an additional 28% of sites. Although legal limitations force the use of Rodeo in many instances, treatment with Rodeo appears to require one additional year of treatment as compared to Garlon 3a.

Foliar herbicide applications are best made in (late May) June - September. Applications made earlier or later appear to deliver significantly lower mortality. This is probably because some stems are still below the ground surface in April and early May. Early season herbicide applications (before August 1 for sure) can be replaced with manual control without a loss of control efficacy, although it is best to delay the manual treatment until early May for best results.

Although stem injection of herbicide is a promising treatment method, conclusive results on its effectiveness in a landscape setting (i.e. with a wide range of treatment dates in a wide range of settings) will not be well understood until at least mid-summer 2004.

Future Staffing Needs
In order to achieve project goals, we will require a fulltime team of 6 persons for 2004. We expect to visit more than 800 sites dispersed on more than 50 miles of river and tributary frontage and attempt 1000-2000 landowner contacts. Then, depending on the results of the 2003 field treatments (to be determined during 2004) and estimated results of 2004 treatments and our outreach efforts, a 2-4 FTE team will be necessary in 2005. By 2006 however, we anticipate the work level to drop dramatically to spot follow-up treatment on a few trouble spots and on newly discovered spots, mostly away from the riparian area of the Sandy and its major tributaries. It is estimated that no more than 2 FTE will be necessary in 2006, and 1 FTE or less in 2007.

The Future of Weed Management on the Sandy River
We hope that the formation of a weed management area in the Sandy River watershed will lead to consistent, long term, spot follow-up treatment of newly discovered knotweed sites, as well as widespread cooperation on a range of on-the-ground weed management issues. Without this kind

of low level, ongoing effort, a slow regression back towards problem status for knotweed is likely to occur in the watershed. Without interagency cooperation and public-private partnership, it is only a matter of time until the "next knotweed" arrives and is recognized too late to allow for efficient and effective eradication.