Restoration of High Priority Ecological Areas in the Portland Metropolitan Area

Protection is Cheaper than Restoration

Project# 922452

July 2001 - June 2002

Final Report to Metro Greenspaces and United States Fish and Wildlife Service
Metro Greenspaces Restoration Program

Established knotweed patches are difficult to control.

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General Introduction

Funding from the Metro -- United States Fish and Wildlife Service Metro Area Restoration Grants Program supported projects addressing invasive, systems-modifying weed species* between June 2001 and June 2002 at 3 natural areas in the Portland Metro region: 1. Camassia Natural Area, 2. Little Rock Island and the adjacent Willamette Narrows shoreline (collectively referred to as the Willamette Narrows), and 3. The Sandy River Watershed (funds from this program were used specifically within the Sandy River Gorge, river miles 12-19 and on other protected lands throughout the watershed).

* *A system (habitat) modifying species can permanently alter fundamental ecosystem characteristics such as structure, process and ultimately, function.*

Each target area supports unique, rare and/or high-quality natural communities and native habitats that are threatened with degradation or eradication by one or more invasive, system-modifying weed species. The Nature Conservancy (TNC), Metro and the Bureau of Land Management (Sandy only) have each identified these areas as high priorities as part of regional planning processes. Although TNC manages preserves in each of these areas, allocation of restoration effort was based on ecological priority rather than ownership status (see table 1 below). Significant funding or in-kind donations for the project also came from the Bureau of Land Management (BLM), For the Sake of the Salmon (PGE Salmon Friendly Power Program - FSOS) the Northwest Service Academy (NWSA), Oregon Department of Agriculture (ODA), the Oregon Watershed Enhancement Board (OWEB), TNC and US Bank. Numerous small in-kind donations of time, discounted equipment or services and substantial volunteer labor were also received.

Table 1 -- Working Sites

Site name	**Major Ownerships***	**Important Weed Species Present^**
Camassia	TNC, West Linn School District, City of West Linn	English ivy, Himalayan blackberry, Scots broom, reed canarygrass
Little Rock Island and Willamette Narrows Shoreline	Metro, Oregon State Parks, TNC.	Scots broom, Himalayan blackberry, English ivy, reed canarygrass
Sandy River	BLM, Metro, ODFW, Oregon State Parks, private, TNC, USFS.	Japanese knotweed, Scots broom, Himalayan blackberry, Reed canarygrass, English ivy

* Presented in order of ownership area at the site
^ Presented in order of ecological importance at the site

The project integrates fieldwork with outreach, education and research on control methods and costs. Protection efforts addressed threats caused by Japanese and giant knotweed (*Polygonum cuspidatum* and *sachalinense* respectively - i.e. knotweed), English ivy (*Hedera helix*), Scots broom (*Cytisus scoparius*), and Himalayan blackberry (*Rubus discolor*). This report is divided into three sections: I. Camassia, II. Little Rock Island / Willamette Narrows, and III. Sandy River; and includes work conducted between July 2001 and June 2002.

Section 1: Camassia Natural Area

Introduction

General

The Camassia Natural Area (figure 1.1), owned and managed by The Nature Conservancy of Oregon contains some of the finest remaining examples of native oak (*Quercus garryana*) savanna and mixed oak - fir (*Q. garryana / Pseudotsuga menziesii* and *Abies grandis*) woodland habitats in the Portland metropolitan area. Also included in the preserves' 27 acres are fine examples of forested wetland, rocky bluffs and (4) natural ponds (figure 1.2). The result of such habitat diversity is more than 300 species of native plants, including the rare species *Delphinium leucophaeum* (pale larkspur) and *Aster curtis*. At least 39 native bird species have been confirmed to breed at the preserve.

Threats

As in all (sub)urban conservation areas, Camassia's native habitats are threatened with degradation by invasive species. English ivy threatens the forest and the meadow-forest ecotone, Scots broom threatens the meadows and meadow-forest ecotone and Himalayan blackberry threatens meadows, open forests and openings within generally closed canopy forest types. More subtle changes from over-visitation, encroachment or illegal yard waste dumping by neighbors and changes in hydrology are other concerns of note.

Stewardship history

Before the 2000 field season, sporadic ivy removal had been performed, mostly, but not entirely focussed on clearing trees of climbing ivy. Restoration efforts had focussed instead on control of Scots broom in the meadows. The Scots broom control has been an unqualified success. Scots broom has been reduced to pre-reproductive individuals, at a density low enough to not change the structure of the meadow and meadow-forest ecotone habitats. Unfortunately, the multi-years focus on Scots broom and the meadow / savanna systems on the preserve allowed forest dwelling invasive species to increase. English ivy has become well established in at least 12 acres of the forested portions of the preserve (see Camassia vegetation map, figure 1.2). Himalayan blackberry is also apparently increasing, especially in the open oak and oak- fir woodlands. In the first phase of this project approximately 4 acres were cleared of English ivy.

In October 1999, we mapped the distribution of English ivy, blackberry. At least 12 acres were identified as badly infested with English ivy. Blackberry was dispersed over approximately 8 acres, with a smaller area identified as heavily infested.

Throughout late 1999 and calendar year 2000 both weeds were controlled using manual treatment methods using a combination of volunteers and AmeriCorps. Approximately 4 acres were cleared during that time period. A small-scale study of herbicide effectiveness on ivy was initiated in February 2001.

Project summary

The period of July 2001-June 2002 was the second phase in a projected 3-5 year effort. The overall goal is to reduce English ivy and Himalayan blackberry to levels that can be controlled with minimal or no external financial support. The project relies heavily on a partnership with the Northwest Service Academy (Americorps), and other youth groups/crews as well as community based volunteers. This structure leverages grant funds and increases on-the-ground action while providing field-based environmental education opportunities to a diverse mix of youth and adults. Project goals include removal of invasive species, and experimentation with control methods and approaches to linking environmental education and participation in invasive removal and ecological restoration.

Because of the high incidence of poison oak at Camassia, the high cost of manual removal ($5000 / acre or more - see details below) and the need for English ivy removal on hundreds if not thousands of acres throughout the Portland metropolitan area, we have begun to explore alternatives to hand removal of ivy. In February 2001, we initiated a series of controlled experiments comparing the effectiveness and efficiency of manual control versus two herbicides (Garlon 3a and Rodeo). In February 2002, based on preliminary results we expanded the herbicide trials to larger areas. We are tracking control costs, control effectiveness and recovery rate of native vegetation. While the experiment is underway we continue to use only manual removal on ivy on the preserve as a whole.

Methods

English ivy manual removal

Using a combination of Americorps and Youth Corps crews and youth and adult volunteers we manually cleared English ivy, Himalayan blackberry and pre-reproductive Scots broom. Our basic approach is to work from areas with less ivy cover and more native vegetation towards those areas more dominated by ivy (while also avoiding areas with abundant poison oak). This so-called Bradley method (Fuller, T.C. and G.D. Barbe 1985. The Bradley Method of eliminating exotic plants from natural reserves. *Fremontia* 13(2): 24-26) is generally considered to be the most efficient approach for most weed species, especially for those in areas with significant remnant native vegetation. For the most part, we removed blackberry largely on an ad-hoc basis within ivy infested areas. Scots broom is cleared periodically from meadows and meadow-forest ecotones. Each year we make a thorough inventory for broom during the flowering season.

English ivy control experiment

In February 2001, we began comparing the efficacy and efficiency of manual versus chemical control on 5 sets (A-E) of 4, 3*3 meter plots (20 plots total, phase 1) with near total ivy cover. In February 2002 we began phase 2 and tested herbicide use on 5 larger plots (100-200 square meters) with more remnant native vegetation.

Phase 1 (3 meter squares plots)

In each study area of 4 , 3*3 meter plots

- 1 plot was carefully hand cleared, time to clear and weight of ivy removed was recorded
- 1 plot was hand-cleared as above, but follow-up treatment in 2002 was using Rodeo as below
- 1 plot was carefully treated with 5% glyphosate (Rodeo) with 5% Scythe (pelargonic acid, an organic fatty acid used to help break down the waxy covering of the ivy leaf)
- 1 plot was treated with 5% triclopyr (Garlon 3a) with 1% Hasten (a vegetable oil based penetrating agent) and 1% Bronc (ammonium nitrate).

Chemical treatments were performed on 2/28/2001 and 2/25/2002. Manual clearing was performed between 2/21-28/2001 and again on 11/15/2001. Prior to treatment, each plot was photographed, and had the percent cover of ivy visually estimated (1st round only) independently by at least 3 people. Ten of the 20 plots were also sampled using point-intercept methods to test the accuracy of visual estimates of cover. Sampling was repeated in June 2001, November 2001 and June 2002.

Phase 2

5 plots, ranging from 56 to 110 square meters were established in February 2002. Vegetation cover data was collected using point-intercept and photographic monitoring. Each plot was sprayed with 5% glyphosate, 2% scythe and 1% hasten on February 24th and 25th, 2002. Post-treatment plot data were collected and photographs taken in June 2002.

Group Ivy Pull

Since most of the ivy on the preserve is manually cleared by either paid groups or volunteers, an experiment was set up to measure the effectiveness and cost of a large scale group ivy pull. Four different Americorps teams, each led by a member of the Portland Area Preserve Stewardship Team, cleared ivy from measured plots. The plots varied in size, initial ivy cover and density and native plant cover. The plot size was measured and photographs were taken of each plot on November 6, 2001. Visual estimates of cover performed by 4 people were averaged to estimate the percentage cover of ivy for each plot.

On November 8th and 9th, the four Americorps teams were instructed to fill yard debris bags with ivy, and to carefully work within the boundaries of their plot until it was cleared of all visible ivy. Team leaders recorded the number of people pulling, the amount of time it took to clear each plot. Bags were coded by plot to allow measurement of the ivy removed from each plot.

Post-treatment photographs were taken immediately after the completion of work and visual estimates of the ivy were conducted on June 18, 2002.

Macroplot

The effects of manual control are also being followed in a single larger area. Vegetation data are collected via point-intercept sampling in a 30*30 meter macroplot located within a one acre treatment area. This are was the focus of clearing efforts by volunteers and paid youth crews during two intensive periods of time (winter–spring 2000 and winter-spring 2001), with limited follow-up in winter-spring 2002.

Himalayan blackberry manual removal

Because we are working in areas with remnant native vegetation, we typically cut Himalayan blackberry the plants to near ground level using machetes (ideally), loppers or hand-pruning shears (based on maturity and strength level of the individual), then dig out the root crown using a shovel or mattock (pulaski). Smaller individual plants (those with a single stem) can generally be pulled rather than cut and dug. As with English ivy, we typically remove blackberry stems from relatively intact areas and pile it on site in more degraded sections.

Scots broom removal

Scots broom is controlled solely via volunteer labor. During the flowering season (May-June) the entire preserve is surveyed periodically by volunteers who search for and pull-up flowering plants. Outside of the flowering season, volunteers search for and hand pull as many small plants as time permits. Plants are generally scattered and left on site, but may be piled up in areas with a high local density.

Monitoring

Photo-monitoring

Although permanent photo-monitoring points have been established in several locations on the preserve, and at each of our study sites, the combination of low light levels under the forest canopy, multiple work-sites and tall remnant native vegetation make capturing anything but the most gross levels of change impossible. Furthermore, the best time to capture ivy cover in during the winter, but the best time capture native species cover is in June.

Statistical Monitoring

In order to accurately monitor ivy cover and native species recovery we use point-intercept sampling to collect cover data. Each June we collect at least 100 points within a permanent macroplot representative of our larger and dispersed, project area (Figure 1.3), and all of our phase 1 and 2 study plots. Although this requires a total of 6-9 person days to accomplish, it provides an accurate and highly replicable measure of actual plant cover, and thus can be used to track recovery of native species, new invasive arrivals or increases of invasive species already present.

Results

Manual removal of invasive species using Americorps, students and community based volunteers

Preserve wide invasive removal
English ivy -- We manually cleared or re-cleared approximately 7 acres of in 6 locations ivy (see figure 1.3) scattered throughout the preserve.

Himalayan blackberry -- was cleared (but not necessarily eliminated) in each ivy work area in which it was present. Approximately 1 acre had substantial blackberry cover.

Note: early in Phase 3, substantial progress has been made on blackberry in areas not treated for ivy, with more than 300 human hours devoted to blackberry clearing in July 2002 alone.

Scots broom -- Scattered mature Scots broom plants and numerous pre-reproductive individuals were removed from meadows and meadow-forest ecotones throughout the preserve. On two occasions, volunteers removed all Scots broom plants taller than 10 cm from the primary oak meadow complexes. Post flowering season surveys revealed no Scots broom fruits.

English ivy control experiment - summary results

Phase 1 -- 3*3 meter plots (and see table 1.1, figures 1.4 and 1.5a,b and photoseries 1.1 and 1.2)

Ivy Control
Point intercept sampling shows that all methods give a very high rate of control. Garlon showed the best control at 98.3% (n=5, stdev=1.1) (see table 1.1 - mean % ivy cover)). Rodeo gave 94.0% (n=5, stdev=2.4) control. Manual pulling alone gave 97.5% (n=5, stdev=1.67) control, while manual removal followed by spot treatments of Rodeo only gave 92.4% (n=5, stdev=3.3) control.

Herbicide treatments with both Rodeo and Garlon show a decrease in percent ivy cover at each of the four sampling times. The manual treatment initially decreased from 56.2% ivy cover in Feb 2001 to 0.6% in June 2001 and then increased to 3.2% in Nov 2001 (see figure 1.4 - success of ivy removal methods). Manual treatment followed with Rodeo shows similar results, increasing from 1.0% ivy cover in June 2001 to 2.4% in Nov 2001 and again to 4.8% in June 2002.

Native Vegetation Recovery
The data from before and after treatment cannot be directly and fairly compared as only half the plots were sampled in the first year of treatment, and initial sampling was done in February, before most species are above ground (but see figure 1.5a). Native vegetation was compared using only data from June 2001 and June 2002. Data are collected in June because

many native plants are annuals or deciduous and data collected in the winter would not be an accurate indication of recovery.

Manual treatment alone has the fastest native vegetation recovery with a 103% increase from June 2001 to June 2002 (see figure 1.5b - summer native vegetation recovery)). Native vegetation recovery appears to be slow but apparent using herbicides, with a 16.3% increase in native vegetation. Spot treatment with Rodeo after manual pulling shows a much slower rate of recovery than manual pulling alone with only a 12% rate of increase in one year.

Phase 2 (and see table 1.2, figure 1.6 and photoseries 1.3)

Ivy Control

Pretreatment ivy cover ranged from 55 to 84% cover (std = 11.1). Four months after herbicide application, mean ivy cover was reduced to 5.4% (std = 7.9). Two plots had no surviving ivy and two plots had 3% ivy cover. Most of the surviving ivy was in 1 plot (21%) that had a significant component of a different ivy variety (preliminarily identified as 'Glacier') that appears unaffected by either our herbicide formulation or timing.

Effect on Other Species

Note: Although we intended to do the herbicide application before bud break in the early season perennials Indian plum and snowberry, in fact, both species had broken bud by the treatment date. We anticipate treatment before bud break would decrease herbicide impact on native species.

Although pre-treatment cover and variety of native species varied greatly between plots non-ivy plant cover ranged from 15.5 to 52% (mean = 34.4, std = 16.2). 12 species (10 native) were noted in the plots. The most common species were trailing blackberry, sword fern, licorice fern and Salal. Post-treatment non-ivy cover was also highly variable, ranging from 14 to 61% (mean = 29.2 std = 18.8). Reductions in some species were nearly made up for by increases in species not present during winter (Solomon's seal, Trillium etc..). 16 native species were noted during post-treatment sampling.

Himalayan blackberry was greatly reduced in the one plot in which it was present. Trailing blackberry and sword fern also decreased. Salal cover actually increased, as did Poison oak and Oregon grape. Living licorice fern was not present in the post-treatment plots. It is not clear, however, whether the reduction of licorice fern was due to summer dormancy or treatment effects. We will revisit the plots to make subjective assessments after the onset of fall rains.

Group ivy removal (and see table 1.3, figures 1.7 and 1.8 and photoseries 1.4)

Initial ivy cover ranged from 28% to 80% (mean = 62, std = 23.9 - figure 1.3, table 1.2). Post-treatment ivy cover averaged 1.2% (std = 0.5). The total area cleared by 4 crews over two days was 0.404 acres in 282 total working hours. The total weight of ivy removed was

4544 pounds. The average from 9 plots was 807 hours per acre (std = 444) and 13,286 pounds of ivy / acre (std = 6967).

As expected weight of ivy per acre is closely related to initial cover percent (r^2 = 0.98 - figure 1.7). Clearing rate, however, is poorly correlated with initial percent (r^2 = 0.46 - figure 1.8) both because plots with significant native vegetation require much more careful work and possibly because thicker ivy cover may take longer to clear than a single layer.

After clearing, the ground was severely trampled and barren in appearance (photos on files with TNC and see associated photo series 1.4), but by spring, fall / winter dormant perennials such as trillium and Solomon's seal were sprouting.

Macroplot (see figure 1.9)

After two periods of intensive ivy clearing (Winter/Spring 2000, and Winter/Spring 2001) followed by little activity in winter/spring 2002, native vegetation in this 30*30 meter area has become predominant. English ivy cover dropped from 43% in 1999 to 6% in 2000 to 1% in 2001 and is currently at 4% (See figure 1.9). Although native vegetation data was not recorded in 1999, it was measured at 51% in 2000, 80% in 2001 and 88% in 2002.

One downfall of clearing the area of ivy was the apparent increase in Himalayan blackberry. Although it was noted as present in 1999, cover of blackberry was not measured at that time. Blackberry cover reached a maximum of 18% in June 2001, and actually declined with little work being done on it in 2002, possibly from the intense competition from native flora such as snowberry and trailing blackberry, which now occupies the majority of the plot.

Volunteer participation

Youth participation – 10 different youth / school groups and 85 individuals ranging in age from 8 to young adult worked on the project for a total 170 hours. Each was introduced to basic concepts of ecology, conservation biology and weed invasions.

Youth work crews – We have developed an effective partnership with the Northwest Service Academy of the Americorps and the Multnomah Youth Corps. Each of these organizations delivers high quality field work and provides substantial in-kind contributions to the project. During the project period we worked with 6 different work crews for a total of 22 days of fieldwork equaling approximately 1400 hours of labor. All crew costs were met 30-50% by the sponsoring agency. Each crew received training in ecology, conservation biology and weed science. In addition we trained motivated individuals from the youth crews to serve as volunteer leaders both at Camassia and other local work-sites.

Nature Conservancy Volunteers -- Individuals or groups volunteering through TNC contributed more than 563 hours of labor during the project period (some individuals fail to submit time sheets so this number is an absolute minimum). 363 hours were contributed

during 6 work TNC sponsored work events. Two volunteer stewards contributed an additional 120 hours. One individual with the NWSA contributed 80 hours as a part of an individual service project.

TOTAL Volunteer Service = 1963
TOTAL AmeriCorps Service = 1400

Discussion

It is clear from two years of experience at the Camassia Natural Area, including early results from our ivy control experiment, that manual removal is effective for English ivy removal and may allow for more rapid recovery of native vegetation than the herbicide based methods we tested. Manual control is, however, extremely expensive. Estimated costs per acre based on our data range from 300 to over 1000 working hours per acre for vigorous young adults. This is equates to a range of $2000 - $6500 per acre at minimum wage. It is important to note that 4 months after a third careful clearing in our study plots, four of five manually cleared plots had some living ivy present.

All of our studies confirm that multiple removal sessions over a period of 2-3 years and an ongoing maintenance program are necessary to achieve long-term ivy control and recovery of native vegetation.

To be certain, manual control offers the potential for secondary benefits in the form of opportunities for volunteers to connect with local landscapes. Many volunteers say that working on the land gives them greater appreciation and enjoyment than a visit without the service aspect. The value of such benefits must be weighed against the need to accomplish invasive species removal at a reasonable cost, and manual control should always have a place in the natural area manager's tool bag for English ivy control.

Although the early results of the herbicide tests are encouraging and chemically based ivy control costs at most 5-10% of manual control, chemical control approaches will require additional refinement before they can be widely implemented. Of principle concern is the apparent relatively slow recovery rate of native plants in the 3*3 meter plots following herbicide treatment. Although most perennial natives survived the herbicide treatment in Phase 2 plots, the long-term effect of herbicide treatment on native species recovery remains unclear. This statement is equally true for both direct herbicide effects, and possible secondary mulching effects of the dead and dying ivy leaves left in place. That said, the relatively low cost necessitates continued assessment of their potential for wider use.

At present, we recommend herbicides only for situations with little or no remnant native vegetation and for sites without potential for rallying necessary volunteers. Examples might include remote sites and sites with abundant poison oak. A second potential use is spot treatment for patches of ivy resprouting after an initial round of manual removal. This application would both minimize the amount of chemical used, and reduce trampling effects from repeated surveying for and removing ivy.

Based on the data we have at present, hand removal will remain our de facto method of choice at Camassia Natural Area, while we refine herbicide methodology further. We will continue to explore ways to increase the efficiency of hand-removal include focussing on better and more training, and intensifying our use of AmeriCorps and other youth crews that provide matching funds, and integrating an "adopt-a-plot" program to our project.

Another issue to consider when removing this much ivy from an area is the loss of nutrients from the site. The ivy collected from many of our treatment areas was bagged and hauled off site to a composting facility rather than piling or scattering nearby. Although this means less resprouting ivy from the piles, and fewer 'dead spots' underneath ivy piles, it also means fewer nutrients left behind. The costs and benefits of this method needs to be considered more thoroughly to determine what impact if any this has on these sites.

Lessons Learned

Because we are typically removing ivy from areas with significant remaining native vegetation, we train each participating individual to practice low-impact ivy removal. We have developed these guiding principles for effective and efficient ivy removal:

Manual Removal

- **Individuals are encouraged to kneel** rather than stand, and to move as little as possible in any case. This not only reduces trampling, and increases thoroughness, but also reduces worker fatigue. Good project planning, including emphasis on appropriate clothing (possibly including kneeling mats) helps make this approach possible.
- **Individuals are taught to pull individual ivy strands (rather than clumps) from the point at which the stem comes out of the ground**, to occasionally use a "dandelion digging tool" to minimize root breakage and eventual re-growth, and, to use pruning shears (clippers) when tangles are present.
- **Do a better job in a smaller area**, rather than a careless job over a large one. Dividing a large group into several in small groups (2-4 individuals) is a good way to encourage this.
- **Clearly delineate the area to be cleared during the project period**. Most humans are goal oriented and will work harder to complete a job than to make a little more progress against an endless battle. This really helps productivity in the last hour of the day.
- **We conduct the majority our ivy removal between late October and March**. Although this is the period of time with the poorest weather and shortest day length, it provides 3 very important advantages. First, moist soil allows the efficient removal of ivy roots, reducing the need for follow-up treatment. Second, native plants are presumably less vulnerable to physical disturbance outside the primary growing season. Third, the lifecycle of fall germinating weeds is disrupted.

Herbicide Treatment

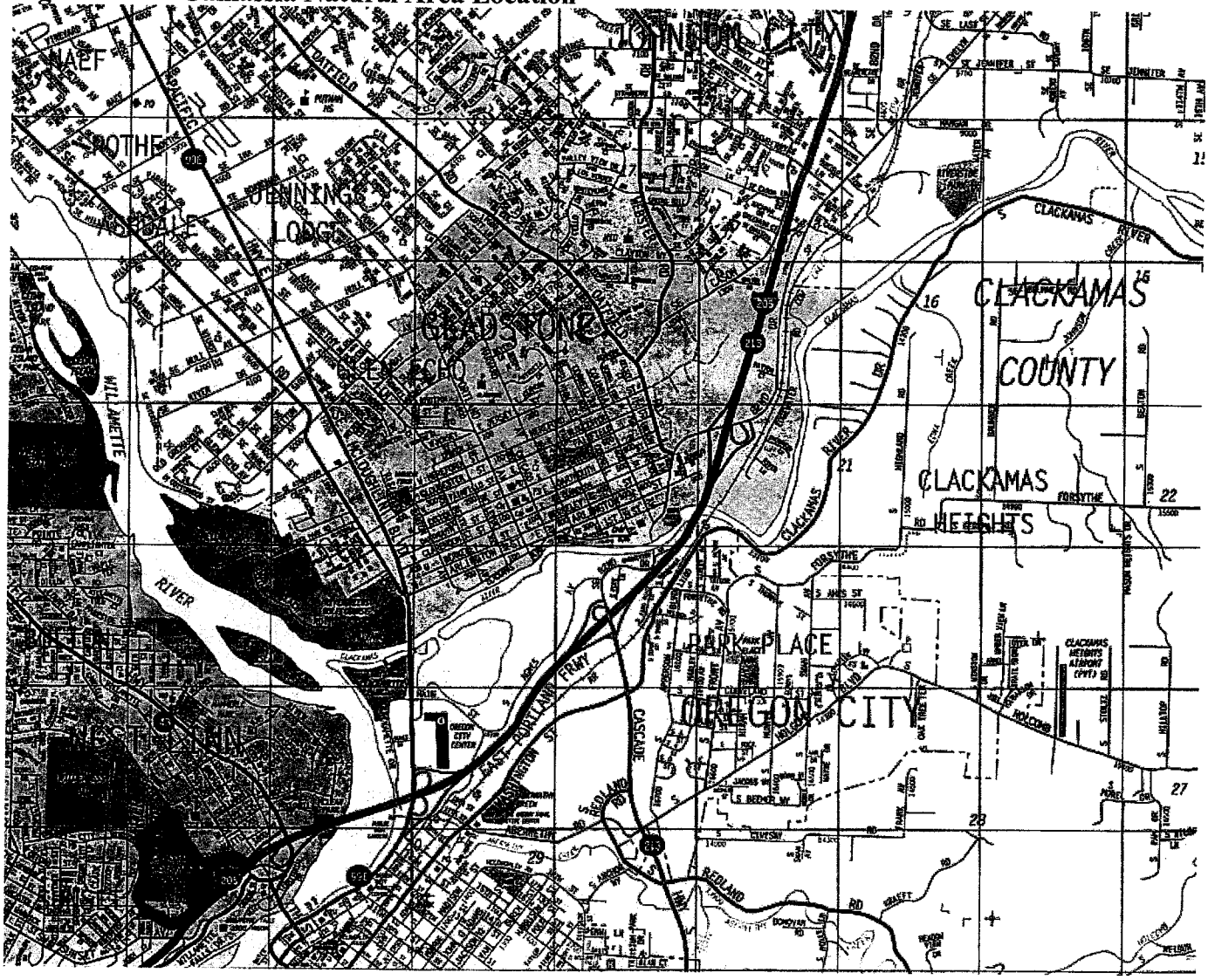
- **Herbicide application should be made before bud break** in the late winter to minimize chemical impact on early growing species such as snowberry and Indian plum.

- **English ivy responds slowly to winter herbicide treatment** and will continue to die over 12 weeks or more.
- **Not all strains of English ivy respond equally** to herbicides.

Next Steps

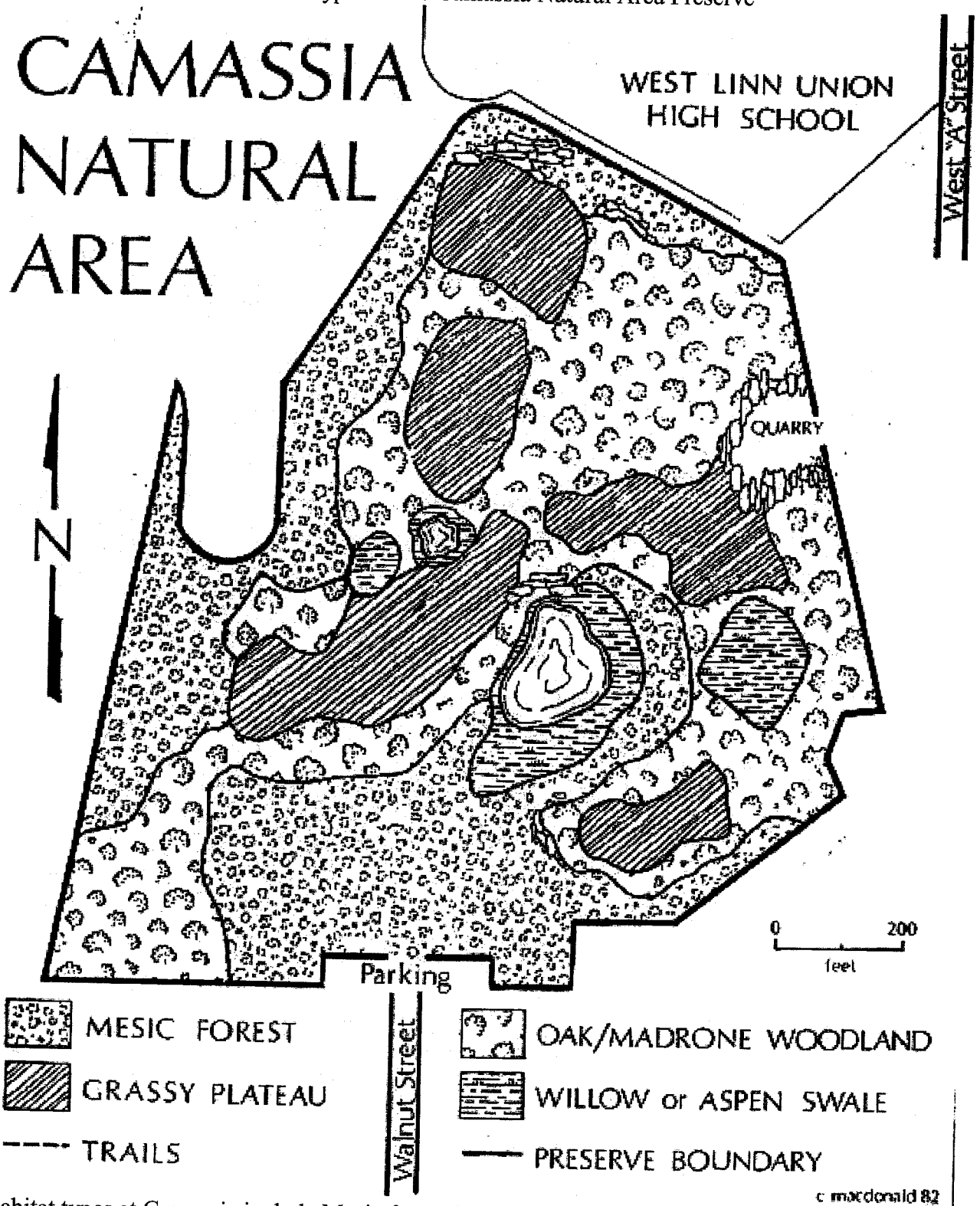
- We will use manual control to expand the "ivy free zone in Camassia to 9 acres during phase three of the project 6/2002 - 6/2003
- We will continue to experiment with herbicide formulation and application timing to improve the recovery rate of native vegetation following herbicide treatment. Next treatment variations will include eliminating Scythe from the spray mix and trying fall application (to avoid killing fall germinating native annuals).
- We will test integrating the use of Garlon 3a, following cutting and re-growth of Himalayan blackberry in order to reduce ground disturbance and increase efficiency.
- We will experiment with planting native seed in areas showing slow recovery.

Figure 1.1 Camassia Natural Area Location



The 27 acre Camassia Natural Area Preserve, owned and managed by The Nature Conservancy is located in West Linn, Oregon on a bluff 200 feet above the Willamette River. The preserve protects mixed Douglas fir and white oak woodlands, wetlands, ponds and meadows that support more than 300 native plant species. Included is the Oregon State Endangered plant *Delphinium leucophaeum* and *Aster curtis*. Adjacent to open space owned by the West Linn school district and a West Linn city park, and less than 2 miles or from the Willamette Narrows it is one of a series of open spaces scattered along the Willamette shoreline in the southern portion of the Metro area.

Figure 1.2 Habitat Types of the Camassia Natural Area Preserve

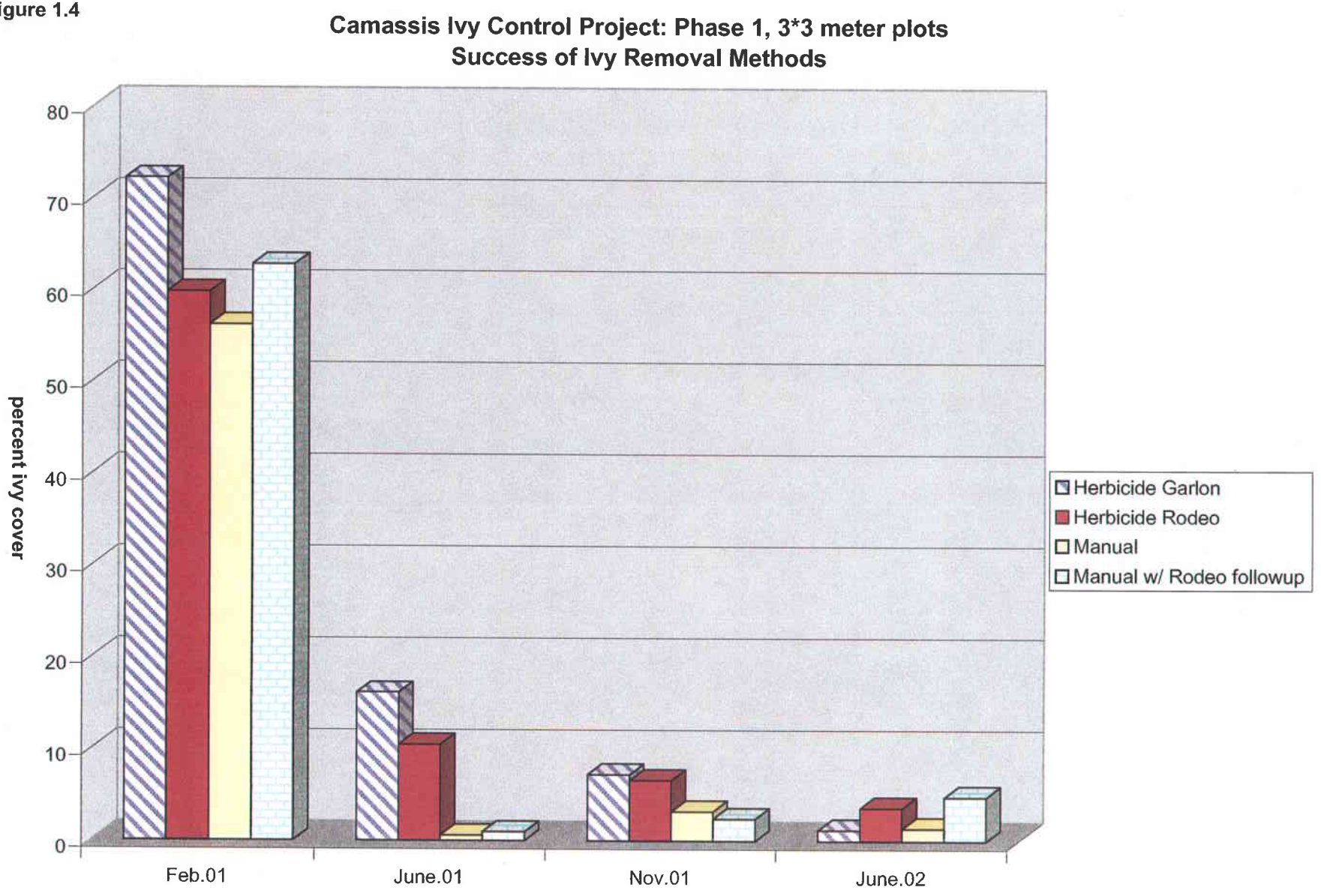


Habitat types at Camassia include Mesic forest (Douglas fir - grand fir - Oregon ash - big leaf maple forest), oak / madrone Woodlands (mixed fir - Oregon white oak - madrone forest), Grassy plateaus (Oregon white oak - madrone - meadow complexes) and 4 natural ponds. English ivy has invaded much of the forest and forest meadow ecotones. Mature Scots broom has been cleared from meadow complexes and meadow forest ecotone.

Figure 1.3 Camassia Natural Area: Major work sites winter 2001and early spring 2002

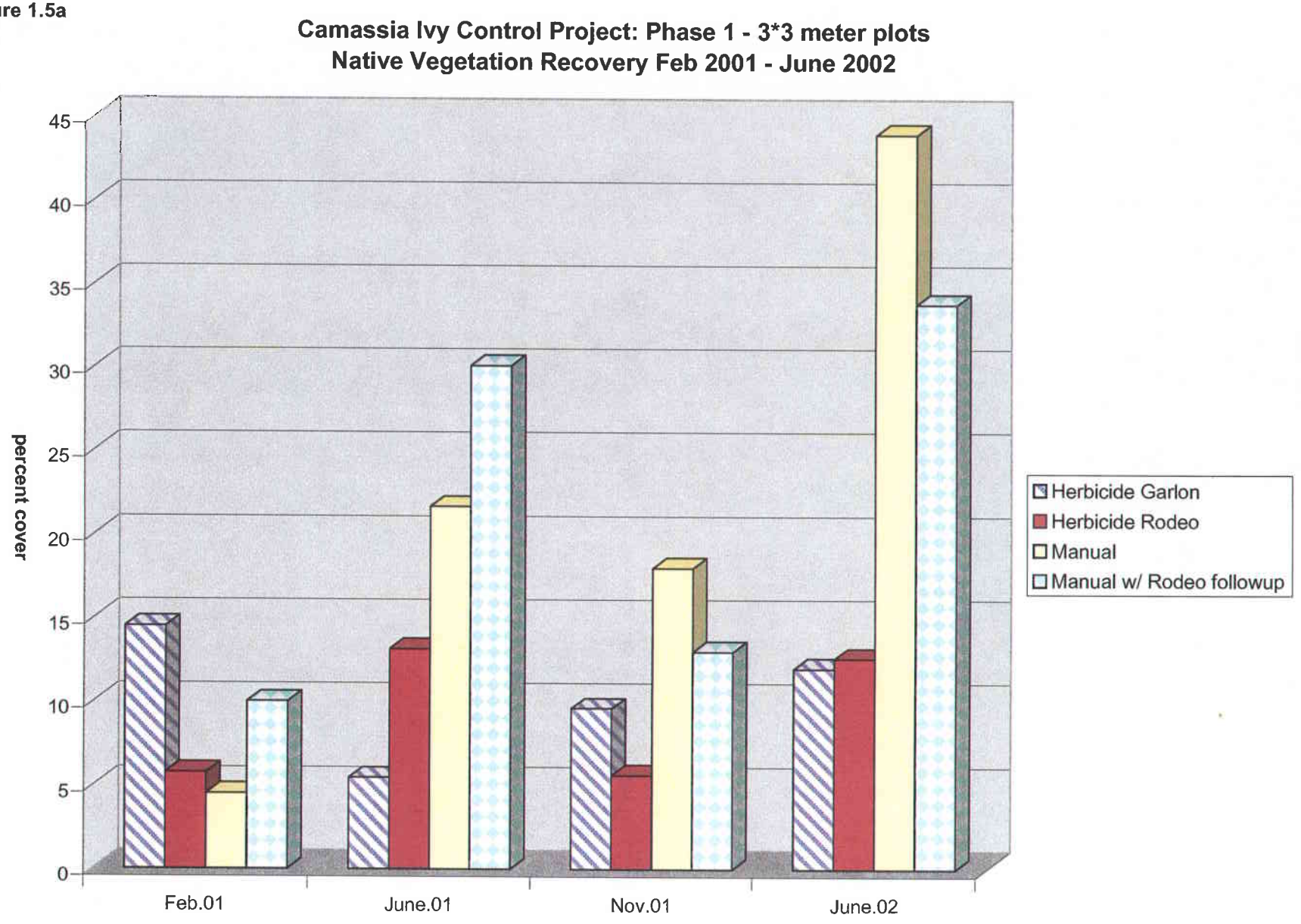
Ivy was hand cleared or re-cleared from approximately 6 acres during the project period. Herbicides were used to treat an additional 1/2 acre as part of an experiment.

Figure 1.4



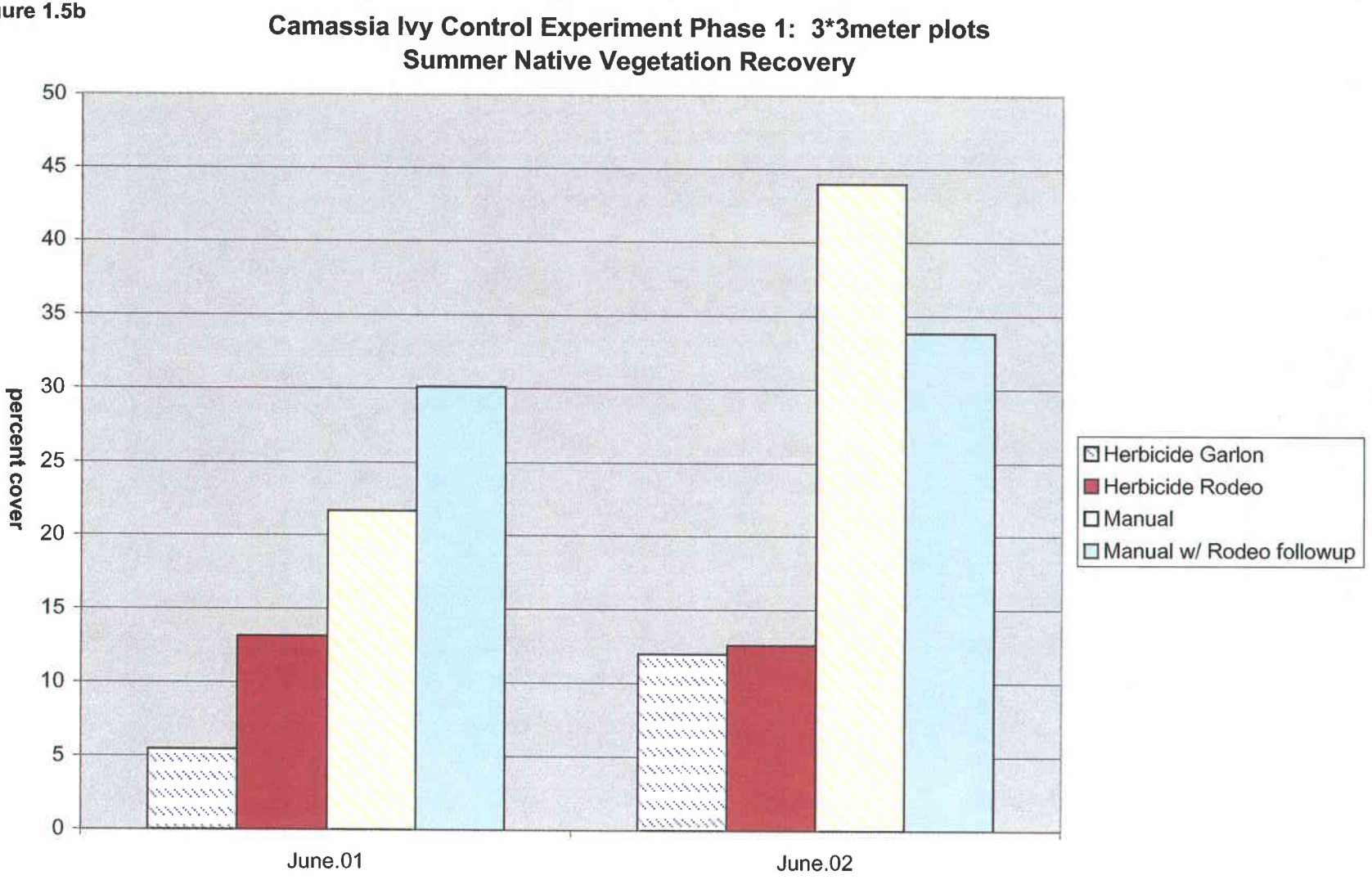
All treatment methods produced good but not complete control during theproject period. As of June 2002 Garlon 3a delivered the best control. Hand cleared plots will be treated again in Nov. 2002. Herbicide plots will be treated again in January 2003.

Figure 1.5a



Small sample size and plant phenology in Feb. 2001 limits comparisons from pre-treatment levels, but all plots show increased or stable native cover from 2001 to 2002. Manual plots show the greatest recovery.

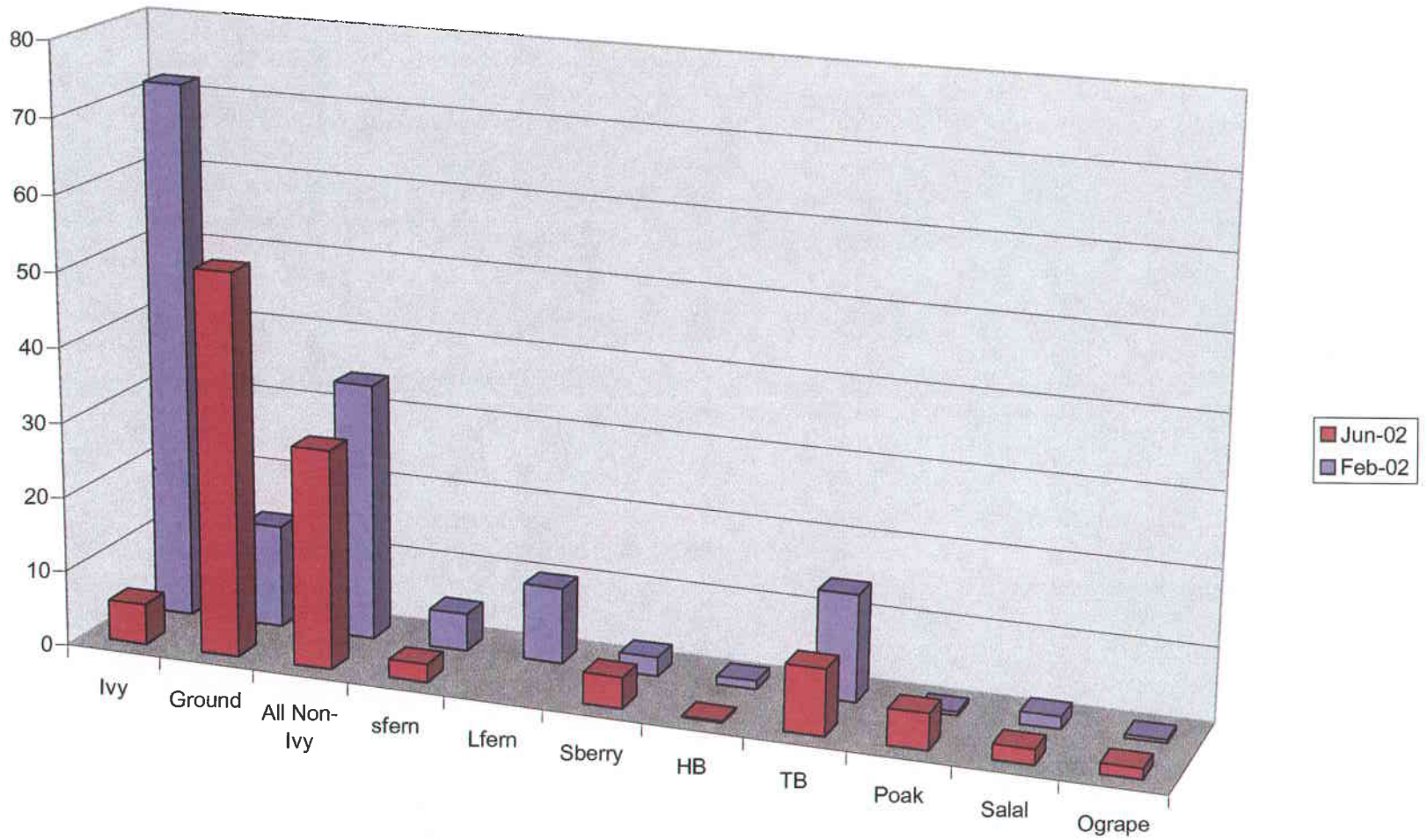
Figure 1.5b



Point-intercept data shows that although all plots have some native vegetation, those plots treated by manual methods have more native vegetation than herbicide treated plots 15 months after initial treatment.

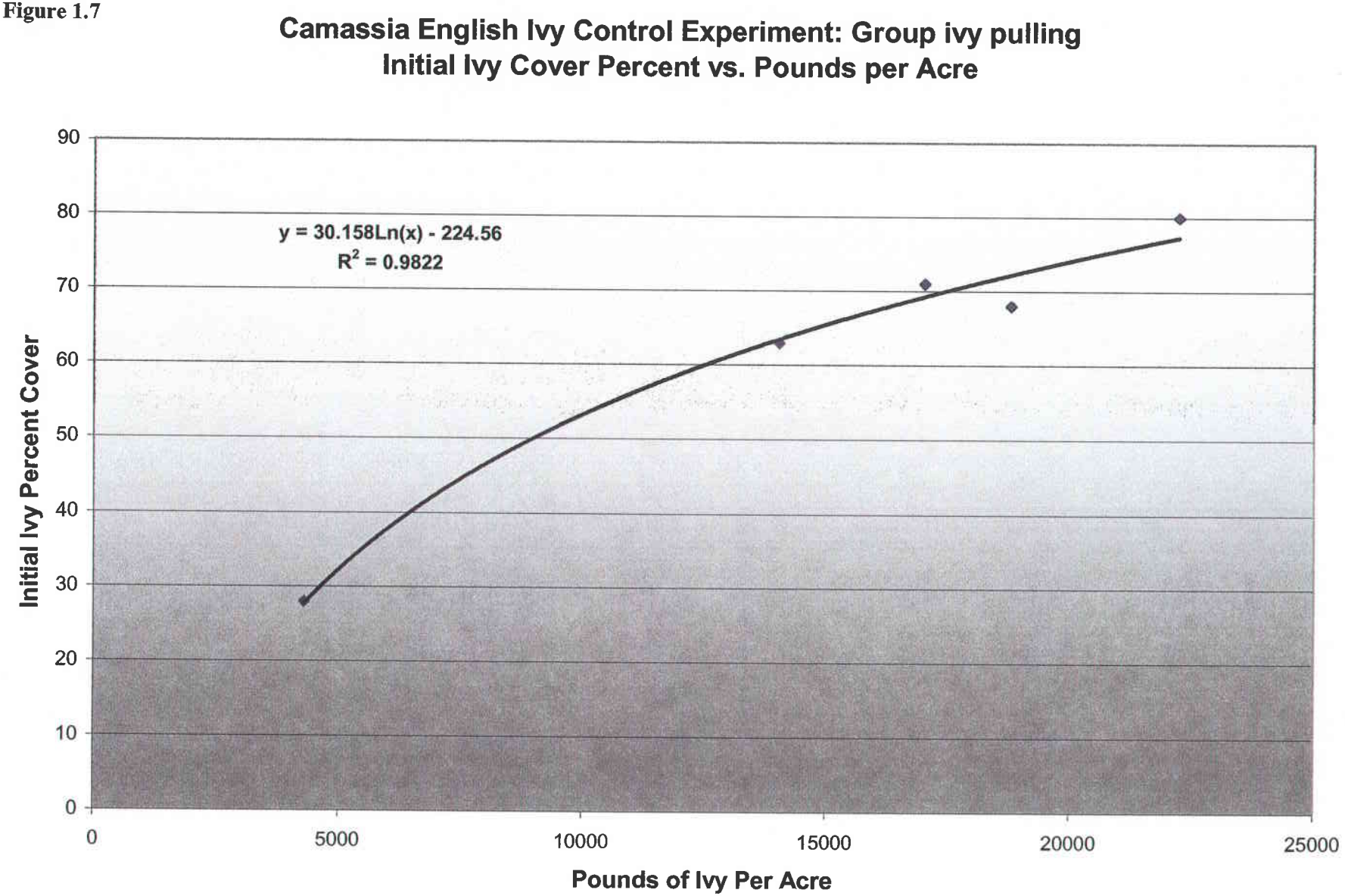
Figure 1.6

Camassia Ivy Control Experiment Phase 2
Summary Results Feb 2002 - June 2002



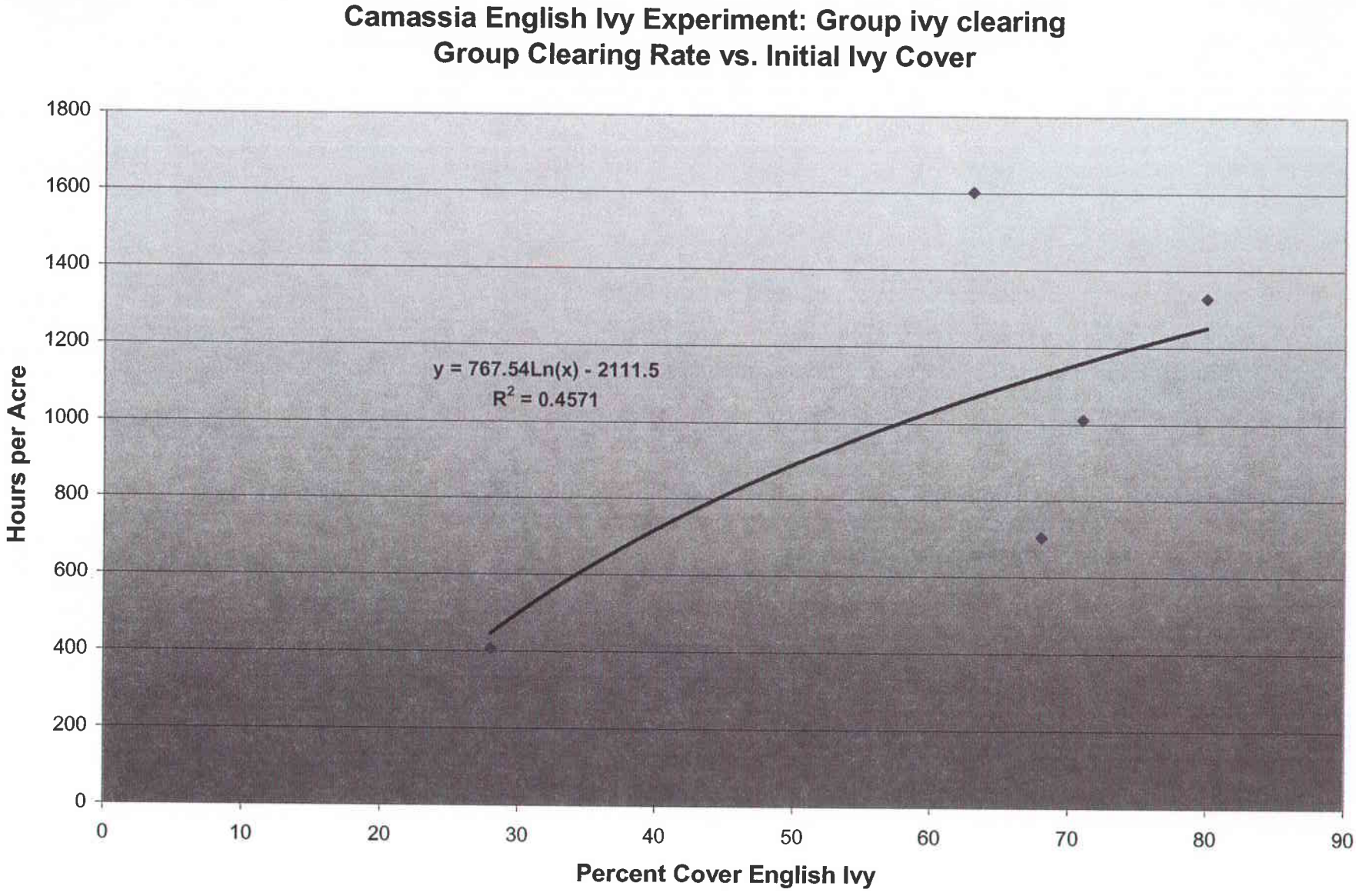
Phase 2 herbicide treatment (5% Rodeo, 2.5% Scythe and 1% Hasten provided good control of ivy. Two of 5 plots had no living ivy and 2 plots had 3% cover. The plot with 21% cover after treatment had a large component of the "glacier' cultivar of *Hedera helix*. Treatment effects on native species were mixed. sfern = swprd fern, lfern =- licorice fern, sberry = snowberry, hb = Himalayan blackberry, poak = poison oak, Salal = Salal, ograpе = Oregon grape.

Figure 1.7



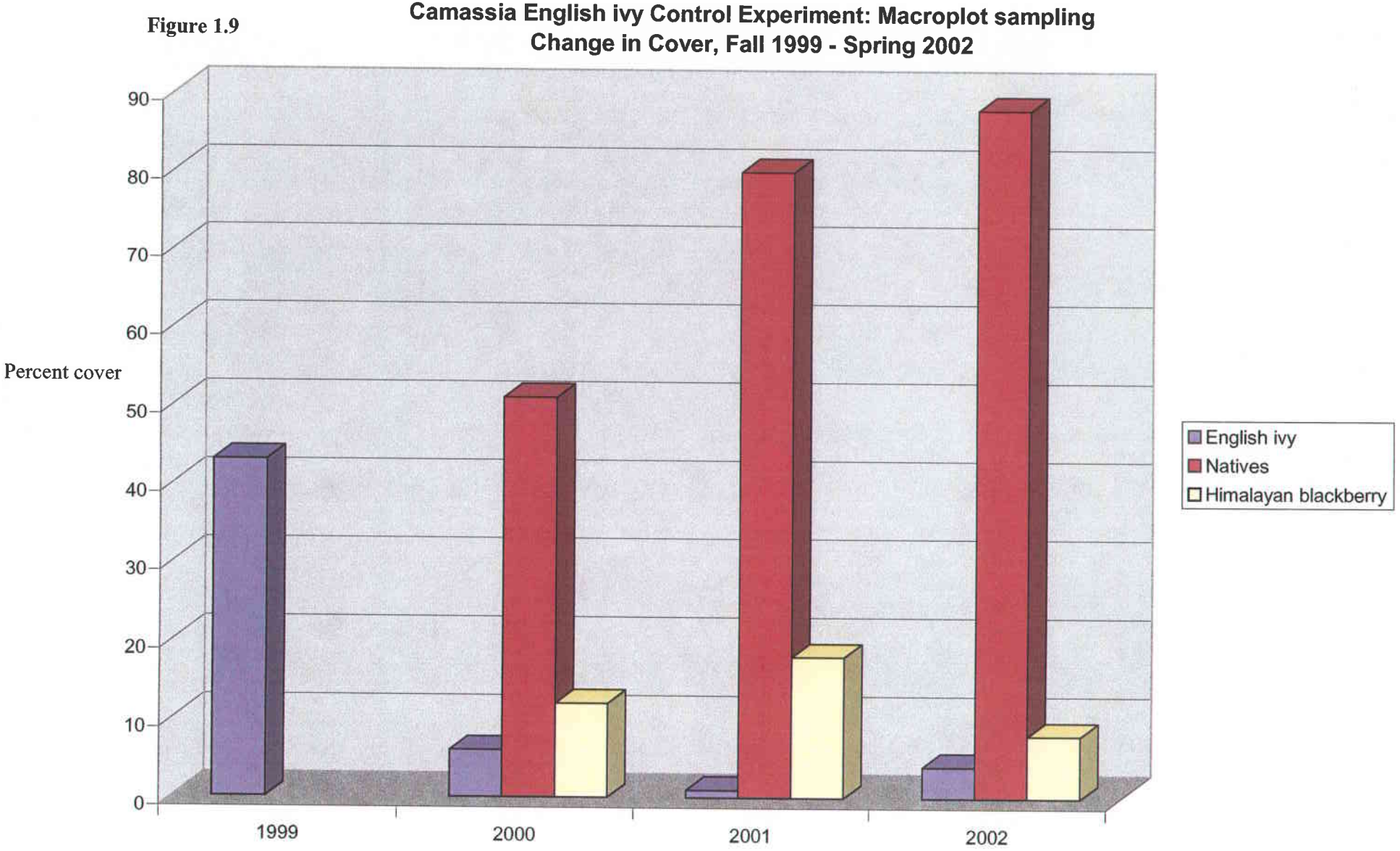
Weight of ivy removed is almost perfectly correlated with initial ivy cover. Estimates of pounds of ivy per acre averaged 13,300 and ranged from 4300 to 22000 among 9 plots.

Figure 1.8



English ivy manual clearing rate is only poorly correlated with initial percent cover of ivy. It is likely that the amount of remnant native vegetation has more effect. Estimated human effort per acre ranges from 400 to 1600 working hours or up to $10,000 per acre at a minimum wage equivalent.

Figure 1.9



Point-intercept results of changes in plant cover after manual clearing within an approximately 1-acre area. Intensive hand clearing by volunteers and AmeriCorps was done in winter 1999-2000 and 2000-2001. Work was light during 2001-2002. Data on Himalayan blackberry and native species cover were not collected until 2000. Blackberry was noted as common in the macroplot during the fall 1999 sampling.

Table 1.1
Camassia Ivy Control Experiment: 3*3 meter plots
Summary results Feb 2001- June 2002

Mean % Ivy Cover

Treament	Feb.01	June.01	Nov.01	June.02	%decrease
Garlon	72.20	16.11	7.20	1.20	98.34
Rodeo	59.80	10.45	6.60	3.60	93.98
Manual	56.20	0.60	3.20	1.40	97.51
Manual w/ Rodeo	62.80	0.96	2.40	4.80	92.36
Average	**62.75**	**7.03**	**4.85**	**2.75**	**95.55**
Standard deviation	6.85	7.58	2.40	1.75	2.84

Mean % Non-ivy cover

Treament	Feb.01	June.01	Nov.01	June.02	June to June % increase
Herbicide Garlon	14.5	5.45	9.6	12	220.1834862
Herbicide Rodeo	5.75	13.15	5.6	12.6	95.81749049
Manual	4.5	21.65	18	44	203.2332564
Manual w/ Rodeo	10	30.1	13	33.8	112.2923588

Table 1-2
Camassia Ivy Control Experiment Phase 2
Before and after - Summary data only; February 2002 - June 2002

Pre-treatment

Plot#	Ivy	Ground	All non-ivy	HB	TB	SF	LF	Salal
1	73	18	15.5	5.5	1	6	0	0
2	84	6	39	0	28	0	3	8
3	55	17.5	52	0	35.5	0	16.5	0
4	79	15	19.5	0	2.5	10	0	0.5
5	69	12	46	0	4	9	31	0
Average	72	13.7	34.4	1.1	14.2	5	10.1	1.7
Standard deviation	11.1	4.9	16.2	2.5	16.3	4.8	13.5	3.5

Post-treatment

Plot	Ivy	Ground	All non-ivy	HB	TB	SF	LF	Salal
1	0	46	14	1	1	7	0	0
2	21	23	61	0	27	0	0	9
3	0	36	31	0	9	4	0	1
4	3	77	19	0	7	1	0	0
5	3	74	21	0	0	0	0	0
Average	5.4	51.2	29.2	0.2	8.8	2.4	0.0	2.0
Standard deviation	8.8	23.7	18.8	0.4	10.9	3.0	0.0	3.9

	Jun-02	Feb-02
Ivy	8.8	72
Ground	51.2	13.7
All non-ivy	29.2	34.4
HB	0.2	1.1
TB	8.8	14.2
SF	2.4	5
LF	0	10.1
Salal	2	1.7

Table 1.3

Camassia Ivy Control Project: Group Ivy Pull
Summary Results as of November 2002

Summary by Teams

NWSA Team	Plot (s)	TNC Leader	Initial Ivy % Cover	Work Time Hours	Weight Pounds	Area (acres)	Comments
Acer and the M's	E/F	Kyle	80 / 63	77.1	956	0.053	Toughest plots, good native cover
Pseudotsuga Tribe	A	Doug	28	69.3	802	0.172	Part of plot had light cover
Bleeding Hearts	B	Brian	68	71.0	1716	0.097	Thick, loose ivy
Beargrass Blues	D	Jay	71	64.8	1070	0.082	Thick well rooted ivy
Total				282.1	4544	0.404	
Average			62	70.5	1136	0.101	
Standard Deviation			23.9	5.1	401.96	0.05	

Note: Work time includes only actual clearing time, including TNC leader time, but not project coordinator time.
At $250/team/day estimated average cost per acre is $4950 plus disposal, bags, set-up time etc...

Summary by Plot

							Pre-trtmnt	Post-trtmnt
Plot	Sq Meters	Acres	Time (hrs)	Hrs/Acre	Weight (lbs)	Lbs / acre	Cover%	Cover%
A	311	0.077	31.3	407	330	4294	28	0.7
A2	387	0.096	38.0	397	472	4936	Not Recorded	
B	165.6	0.041	28.8	704	769	18793	68	1
B2	109.1	0.027	16.4	609	396	14689	Not Recorded	
B3	117	0.029	25.8	891	551	19059	Not Recorded	
D	227	0.056	56.8	1012	955	17026	71	2
D2	103.7	0.026	8.0	312	115	4488	Not Recorded	
E	107	0.026	35.1	1328	588	22240	80	1.5
F	106	0.026	42.0	1604	368	14050	63	0.8
Total	1633.4	0.404	282.1		4544			
Average	181.5	0.045	31.3	807.0	504.9	13286	62	1.2
Standard deviation	104.9	0.026	14.2	444.0	248.9	6967	20.0	0.5

Summary by Plot - Areas with pre-treatment sampling only

Plot	Hrs/Acre	Lbs / acre	Cover%	Sq Meters	Acres	Time (hrs)	Weight (lbs)
A	407	4294	28	311	0.077	31.3	330
B	704	18793	68	165.6	0.041	28.8	769
D	1012	17026	71	227	0.056	56.8	955
E	1328	22240	80	107	0.026	35.1	588
F	1604	14050	63	106	0.026	42.0	368
Total	DNA	76403	DNA	916.600	0.226	193.917	3010
Average	1011	15281	62.000	183.320	0.045	38.783	602
Standard deviation	477	6820	19.987	87.074	0.022	11.212	265

Camassia English Ivy Control Experiment.

Photoseries 1 Phase 1: 3x3 meter plots. Manual treatment. Plot B2.

Before treatment photograph February 2001. White tape shows 3*3 meter area.

May 2001, three months after manual ivy removal. Note two trees in plot for reference.

June, 2002 sixteen months after treatment. Note thriving native vegetation.

Camassia English Ivy Control Experiment.

Photoseries 2 Phase 1: 3x3 meter plots. Herbicide treatment. Plot E2.

February 2001, before treatment. Tape shows 3*3 meter area.

May 2001, three months after herbicide treatment. Note 3 trees in background.

June 2002, sixteen months after treatment. Note returning native vegetation.

Camassia English Ivy Control Experiment.

Photoseries 3 Phase 2: Herbicide Treatment Plot 3 view B

February 2002. Photograph before herbicide treatment.

June 2002. Four months after treatment. Note dead ivy and returning native vegetation.

Camassia English Ivy Control Experiment.

Photoseries 4 Large Group Manual Pull: Plot D View 1.

November 2001, before treatment. Heavy ivy cover and ivy growing up tree.

February 2002, four months after treatment. Ground is bare and tree is cleared.

June 2002, seven months after treatment. Native vegetation is returning in abundance.

Section 2: Little Rock Island / Willamette Narrows

Introduction

The Willamette Narrows area (figures 2.1, 2.2) including Little Rock and Rock Islands and shorelines on both sides of the Willamette River, is a fine example of protection partnerships producing results on a landscape scale. Lands are owned and/or managed for conservation purposes in the narrows by Metro, the State of Oregon and The Nature Conservancy. As well as protecting important anadromous fish habitat in the lower Willamette River, this area contains some of the finest remaining examples of native oak (*Quercus garryana*) savanna and mixed oak - fir (*Pseudotsuga menziesii* and *Abies grandis*) habitats in the Portland Metro area. The Narrows supports several native plant assemblages that have been lost or highly degraded throughout most of the Metro area. Included in this area is one of the largest known populations of the Oregon State endangered plant pale larkspur (*Delphinium leucophaeum*). The goal of this 3-5 year project is reducing Scots broom (*Cytisus scoparius*) and Himalayan blackberry (*Rubus discolor*) cover in the oak meadow system and the associated meadow forest ecotone to a level at which paid work crews will no longer be necessary on an annual basis.

Threats

Oak ecosystems throughout western Oregon, Washington and Canada are threatened by Scots broom. Broom is a classic example of a systems-modifying species*. Untreated, it can convert diverse open oak meadow systems into simplified, dense and highly shaded shrublands in a matter of 10-15 years. Himalayan blackberry is also a threat to these systems wherever soil depth and light levels allow.

> * *A system (or habitat) modifying weed can permanently alter multiple fundamental ecosystem characteristics such as structure, process and ultimately, function.*

Stewardship History

Beginning in 1998, reproductive individuals of Scots broom were removed from Little Rock Island and a small portion of the associated shoreline, mostly by volunteers and volunteer youth crews using weed wrenches and root jacks. In 1999, based on review of control literature we shifted emphasis to the use of loppers and conducting control work during the dry season. Fieldwork was conducted by (mostly) volunteer youth crews. Phase 1 of this project began in 2000, as did a commitment to preventing seed set by Scots broom plants and preventing encroachment by Himalayan blackberry. This report presents results of phase 2 of the project.

Methods

Control work in the Willamette Narrows consisted solely of hand removal. Mature and some immature Scots broom plants were removed using loppers and hand pulling. Control work

during the flowering season first focuses on actively flowering plants. Plants are cut as low as possible above the ground. Previous work and literature review indicate cutting Scots broom during dry times of year minimizes regrowth, so cutting is performed no sooner than the flowering season (May, June) and continues through to the fall rains (October, November). Extra time during flowering season and control work outside the growing season is first allocated to larger immature individuals that can be uprooted by hand.

Himalayan blackberry is either cut to the ground and left to re-grow, or time allowing, the root crown is removed via digging. Beginning in fall 2002, previously cut blackberry plants will be spot sprayed with herbicide to reduce or eliminate regrowth.

Monitoring

Permanent photo-points were established in 4 locations in the project area (figure 2.3). Two locations are on the shoreline and two on Little Rock Island. A series of photographs are taken from the river during the Scots broom flowering season in alternate years.

Results

With the exception of scattered individual plants growing in heavy poison oak (*Rhus toxicodendron*) cover, mature Scots broom plants were removed throughout the primary threatened areas within the entire project area (Metro lands - shoreline only) during both the 2001 and 2002 growing season (figure 2.3, photoseries 2.1). A total of approximately 5 acres were treated. Remaining individual plants in the primary project area will be cleared during winter 2002-3.

Blackberry plants throughout the project area were cut to the ground, but due to concern about harmful effects of ground surface disturbance on sensitive meadow vegetation, only limited root digging occurred.

TNC sponsored 6 youth crew days resulting in 288 working hours.

Discussion

Our work at the three project sites has shown that manual control of Scots broom is a viable, though expensive means of protecting vulnerable habitats (meadows, floodplains, cobblebars, meadow forest ecotones and open forest habitats) in which prescribed fire is not an option for ecological or socio-political reasons. When work can be conducted during summer and early fall, plants can be cut rather than uprooted, which reduces labor costs and soil surface disturbance significantly. Regardless of treatment method, a long-term management plan needs to be in place due to the long life of Scots broom seeds in the soil (up to 80 years), and the tendency of birds to spread blackberry seeds.

Phase 3 (June 2002 - June 2003) will be the last phase during which work-crews should be needed, and by the summer of 2003, the meadow complexes that have been the focus of our

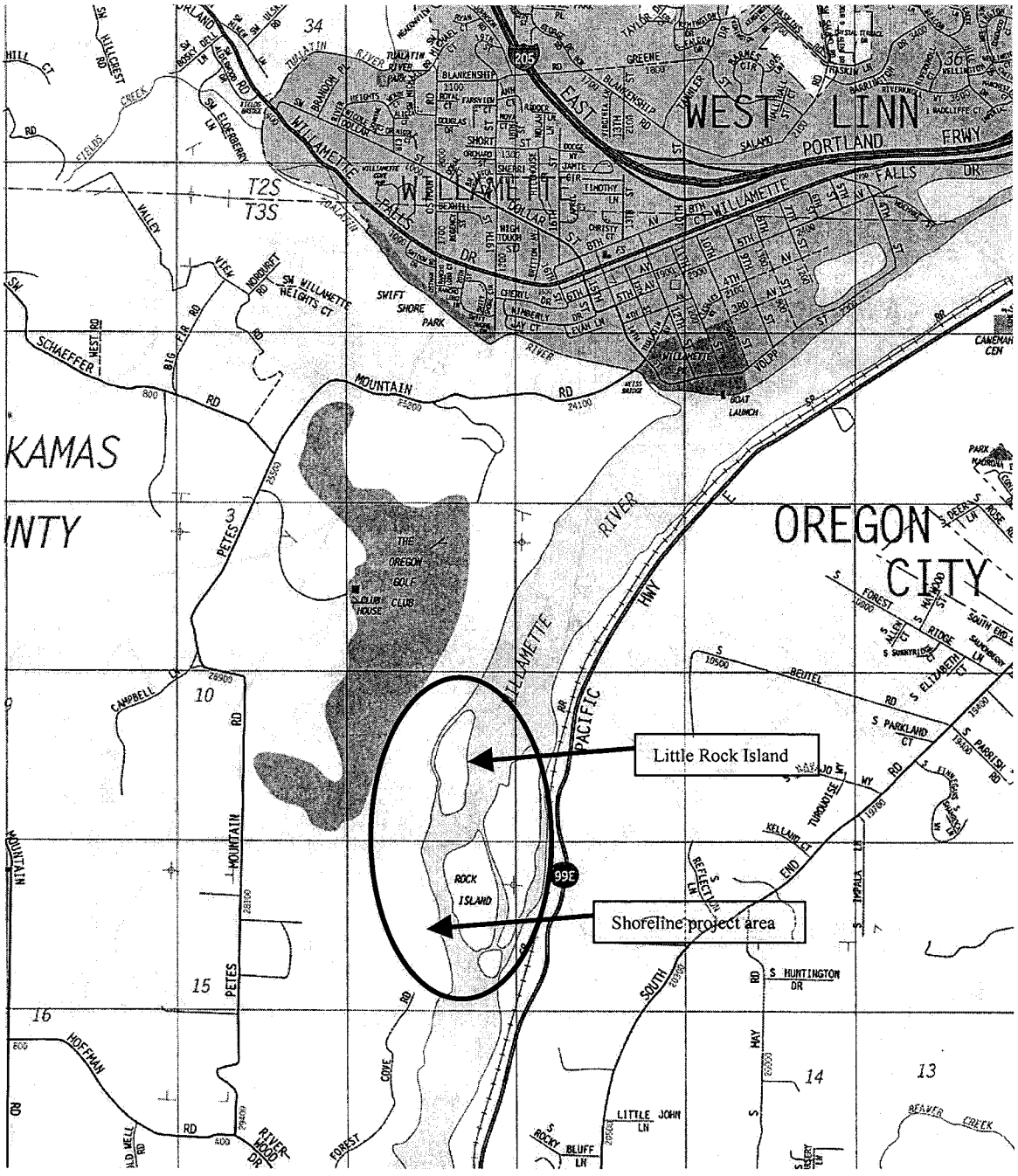
Willamette Narrows restoration efforts for 5 years, should be on an all-volunteer maintenance program or require only small numbers of crew work days.

Effective manual removal of blackberry roots is not only time consuming, but results in significant surface disturbance. For areas where such disturbance is inappropriate, careful use of herbicides should be considered. Although triclopyr (Garlon 3a) following mid-summer cutting of blackberry is the best management practice for blackberry control, limitations set by the National Marine Fisheries Service restricts the use of Garlon within the 100 year flood plain. Glyphosate formulations approved for aquatic and riparian areas (Rodeo or Aquamaster with Li-700 as a surfactant) will be used instead.

Next Steps

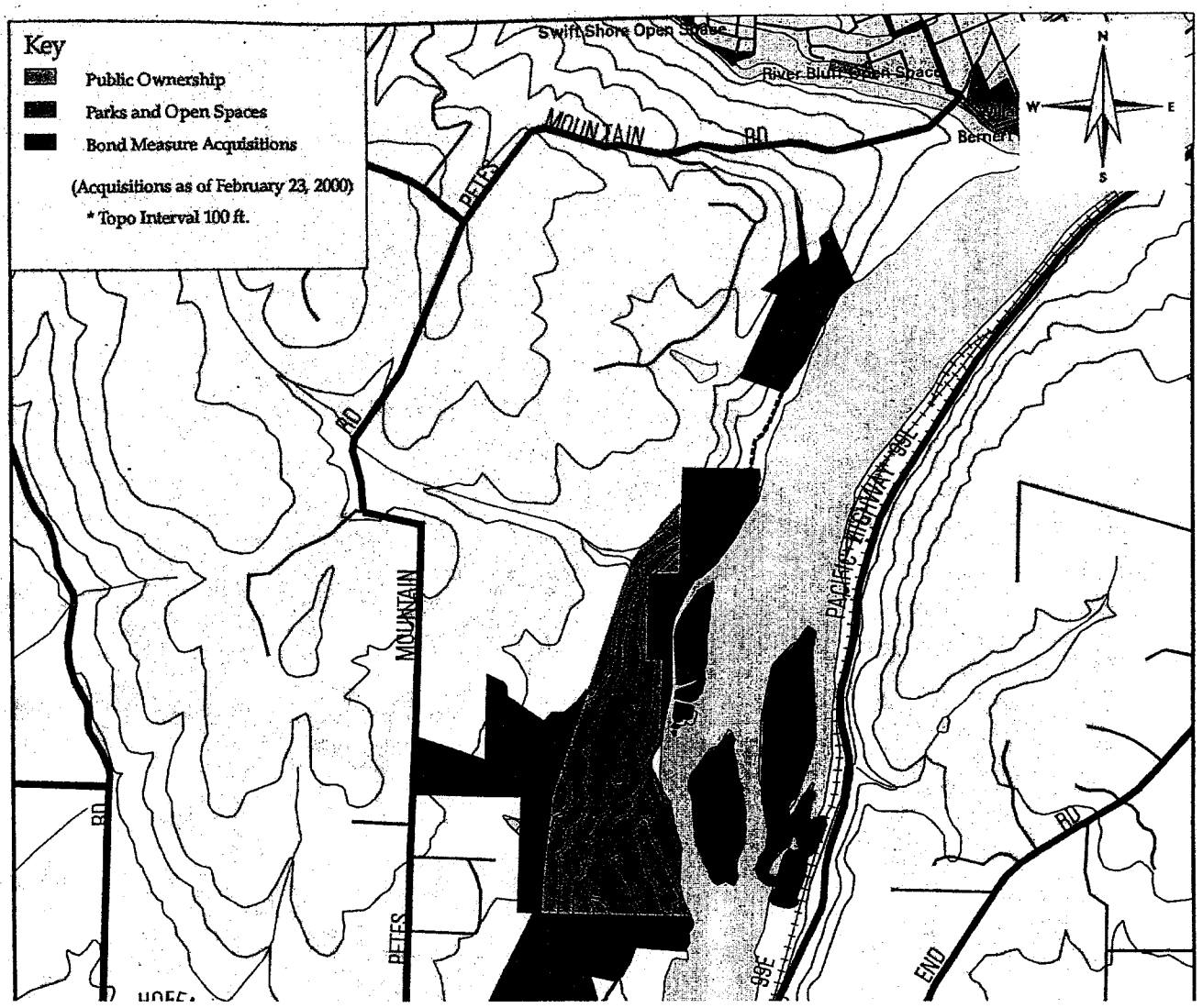
- Finish remove Scots broom within high poison oak cover areas – *Winter 2002-3*
- Continue removing reproductive individuals from all meadows and meadow forest ecotones within the project area – *yearly, ongoing*
- Experiment with herbicide spot treatment of Himalayan blackberry following cutting – summer / fall 2002
- Work with Metro staff to coordinate Scots broom and Himalayan blackberry control within high priority habitats of Rock Island and on Metro managed lands along the Willamette shoreline
- Establish a monitoring program for the State Endangered plant *Delphinium leucophaeum* -- 2003 field season.

Figure 2.1 Willamette Narrows Project Location



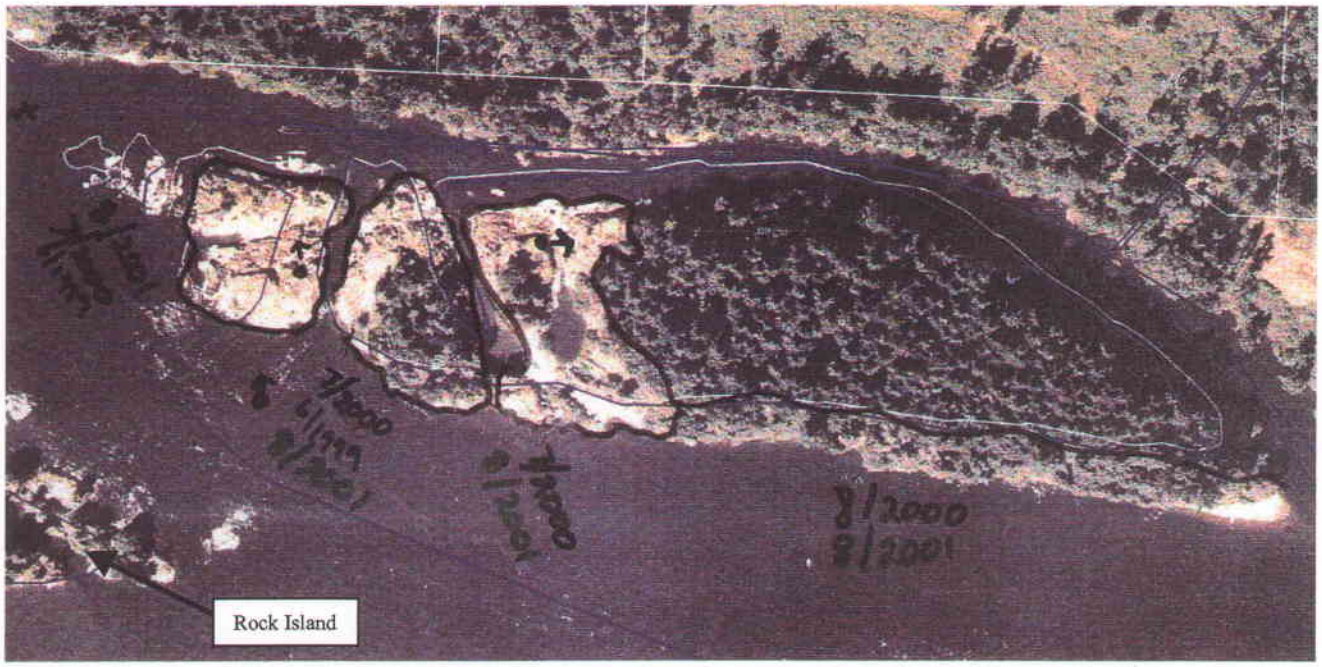
The Willamette Narrows conservation area covers both sides of the river. Lands are owned and managed by Metro, Oregon State Parks and The Nature Conservancy. Figure 2.2 shows ownership pattern.

Figure 2.2 -- Detail of Willamette Narrows project area including land ownership

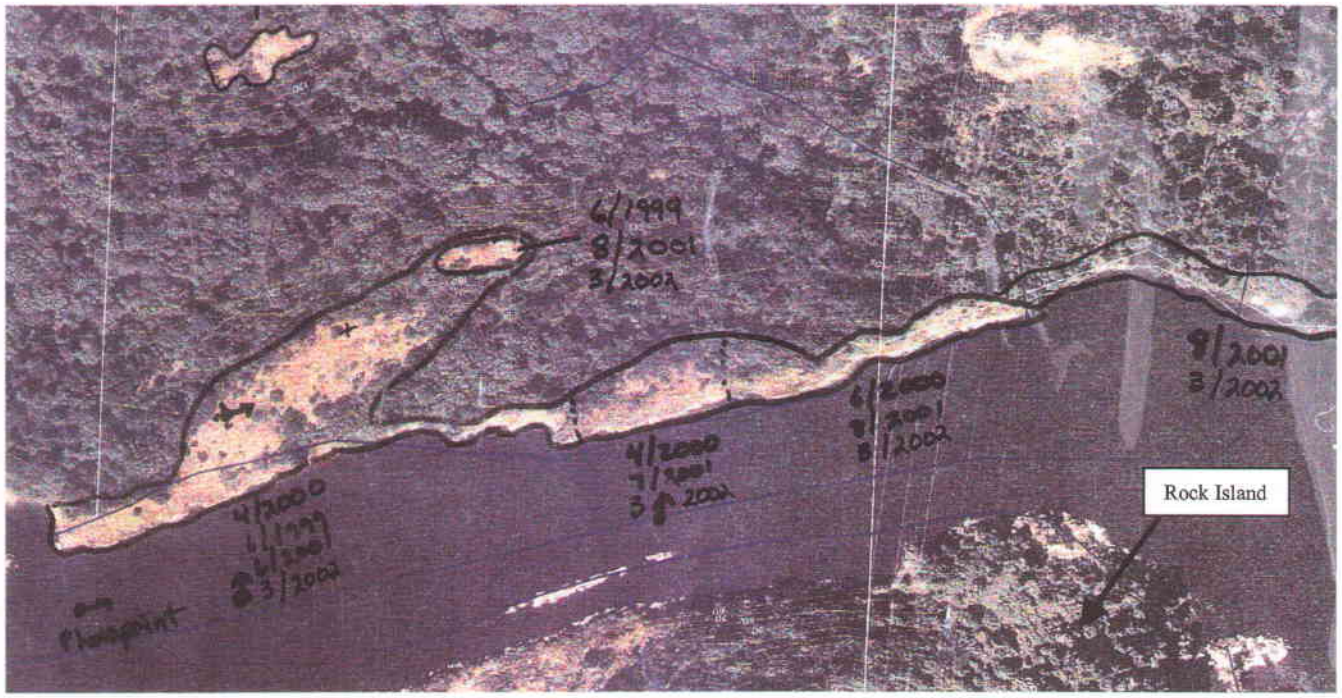


The Willamette Narrows project area includes lands owned or managed by Metro, Oregon State Parks and The Nature Conservancy. In the 2001-2 project period mature and immature Scots broom were cleared from lands in all three ownerships on the west shoreline. Areas with heavy poison oak cover will be cleared in winter 2002-3. Work was not done on Rock Island or the east shoreline.

Figure 2.3 **Work areas and dates Willamette Narrows**



Little Rock Island



Willamette Narrow West Shoreline

Highlighted areas were cleared of mature Scots broom and some immature plants during the project period. Area treated on Little Rock Island is approximately 1 acre, and 4 acres on the Willamette Shoreline.

Photoseries 2-1 Willamette Narrow Photopoint #2, June 2001

North

south

Photopoints of an area formerly dominated by mature Scots broom, only immature individuals are present. Plants this size are easily uprooted and this area was cleared in late summer and spring 2002.

Section 3: Sandy River Riparian Protection Project

Introduction and Project Description

Despite its location near Oregon's largest population center, the Sandy River Watershed (figure 3.1) retains rare and characteristic fish (salmon, steelhead, resident trout) and wildlife (bear, cougar, elk, diverse neo-tropical migrant and other birds amphibians etc...). Rare or declining species of regional importance found in the Sandy include federally threatened fall chinook salmon and winter steelhead, Oregon slender salamander (status unknown but likely rare and declining), and the endangered spotted owl among others. The upper Sandy (above Marmot Dam) is as close to a wild salmonid sanctuary as exists in Northwestern Oregon. As important as the rare species, the Sandy supports the full diversity of more common species that typify the low elevation Pacific Northwest forest. 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 3.1).

The Sandy River Gorge (figure 3.2) represents a remarkably successful example of a multi-partner public - private partnership to protect a landscape level site. For over 30 years the Sandy River has been a priority conservation focus of numerous agencies and private conservation organizations including the BLM, The Nature Conservancy, Metro, the City of Portland, the River Network (River Conservancy), and the USFS. Thousands of acres are in conservation ownership. Millions of dollars continue to be invested in protecting fish runs and wildlife habitat throughout the watershed in expensive culvert replacement, road retirement and water management projects. Because the Sandy watershed includes the watershed providing the Portland regions water supply (Bull Run) as a major tributary, and will be subject to immense pressure from the regions growing population, the Sandy will not only need conservation attention, but a team approach and organizations willing to serve as leaders.

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

Riparian habitat is used or depended on by up to 90% of wildlife species and is an important determinant of fish and wildlife success. 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. This project is the second phase of a planned 5 year cooperative, integrated approach to protecting the integrity of riparian habitat in the Sandy River watershed by controlling systems-modifying invasive

weed species, especially Japanese and giant knotweed (*Polygonum cuspidatum* and *P. sachalinense*, henceforth knotweed).

Significant funding for the Sandy River Riparian Habitat Protection project phase 2 was provided by BLM (challenge cost-share), Metro and USFWS (metro area restoration grant program), Oregon Department of Agriculture (noxious weed grant program), OWEB (watershed enhancement grant) and TNC (private, corporate and foundation funding sources). Numerous other organizations and individuals provided smaller amounts of support or in-kind contributions. The project included four significant components: inventory, on the ground control work, research and monitoring and public outreach/education.

Reasons for inventory, control, research and monitoring are obvious -- to succeed, we must understand the scope of the problem, develop efficient project structures and effective and environmentally acceptable control approaches; and make sure they are working or adapt them to work better. The outreach aspects, although more nebulous are no less important. By working with multiple public partners and across property boundaries, we will 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) are 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 will result not only in an enhanced project now, but progress in the overall goal of protecting our ecosystems from invasive species in the long-term.

On the ground control work was done primarily on knotweed (figure 3.3) and Scots broom (figure 3.4), but incidental work was also done on Himalayan blackberry when it was present at knotweed and broom work-sites. Although outreach focussed on building knotweed awareness, the role of all invasive species in degrading watershed function (health) is a routine theme in our outreach and education efforts.

Threats

Land conversion and water withdrawal aside, habitat degradation caused by invasive species is likely the single greatest threat to Oregon's river systems, especially those near the urban/suburban fringe. Scots broom is a well-known invader of prairies, meadows and floodplains, and causes more than $80,000,000 per year in economic losses to Oregon's economy (ODA Economic Analysis 2001). Although less well established, knotweed is certainly among the most important species to control. It is the single most important weed of Great Britain (also a temperate maritime climate), France, and is a problem in dozens of European countries, and many states in the Northeastern United States. The major difference between infestations in these locations and Oregon is time since establishment. Although Himalayan blackberry is simply too widespread for regional control through direct means, it does needs to be controlled in select high priority areas and prevented from occupying sites cleared of other invasive species. Finally, for good reason, English ivy was recently added to Oregon's noxious weed list, and is being considered for state quarantine. Although it is

currently most noticeable in urban or urban fringe habitats, it poses a real threat to all low elevation forest habitats in western Oregon and Washington.

Knotweed, the least publicly well known species of the group, grows tall extremely rapidly (10-20 feet in 2 months, figure 3.3) and expands laterally via rhizomes (more than 20 feet) very rapidly. Although it has historically not produced viable seed in the U.S. (this appears to be changing), it can spread rapidly via root fragments during floods (figure 3.3). This allows it to quickly occupy sediments deposited by floodwaters or other disturbed sites and to permanently replace slower growing native vegetation, even in undisturbed sites. Prime habitat for knotweed includes shorelines, floodplains, back channels, and flood channels, any place where flood debris is deposited or where river water slows. In Great Britain, France and many areas of the northeastern United States, knotweed has become the dominant species of riparian areas.

Project History

Although knotweed has apparently been present in the upper watershed for 3 decades, Nature Conservancy staff became aware of it in the Sandy River Gorge only following the 1996 floods. By the 1998 field season, it was clear that knotweed represented a potential threat to the biodiversity of the Sandy and initial surveys and control efforts were undertaken. By the end of the 1999 field season it was clear that the scope of the problem was too large to be addressed by TNC alone. We then began to seek funding and partners. In 2000 (following another large flood event on Thanksgiving Day 1999) with financial assistance from BLM, Metro, OWEB and the USFWS (and in-kind support from numerous partners), we began the comprehensive, integrated treatment approach which is described below.

Projects to control Scots broom and blackberry are better established. This work continues projects started in partnership with the Americorps and other youth organizations in 1997 and 1998 at selected high priority ecological areas of the Sandy River Gorge. These sites included (and see table 3.1): Cornwell and Bluehole Meadows (BLM, ODFW, Metro, TNC ownership) and lands near TNCs Diack and Partridge Tract (TNC and BLM ownership).

Methods

Project Structure

For the 2001 field season, TNC sponsored a 4-person, full-time Americorps team, rather than periodically working with the standard 10 person teams (figure 3.5). The team was trained and supervised by permanent and seasonal TNC staff until they were able to work independently. Because research clearly indicated manual control is ineffective and that herbicide use is a necessary component of a successful control strategy, and, because most volunteers should not apply herbicides, volunteer labor was shifted from hand cutting of Japanese knotweed to control of Scots broom, English ivy 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). Full size teams are still used for larger projects such as Scots broom, blackberry and ivy removal.

In 2002 the 4 person AmeriCorps team from 2001 was hired as seasonal employees and an AmeriCorps team was co-sponsored by TNC and Metro, working half time each on the Sandy and Clackamas Rivers (figure 3.6). This structure took advantage of the expertise the original team gained during the 2001 field season while adding the necessary additional human power at reasonable cost.

Outreach

Direct Contact -- Because we don't have legal access to private lands, we must make direct landowner contact to gain permission for access, survey and if necessary, treatment. Below river mile 19 on the Sandy River we contacted every landowner that had knotweed present or potential knotweed habitat not visible from the river. We also contacted landowners whose private roads made river access easier. In nearly every case we gained permission to cross and/or survey and/or actually control any knotweed found within.

Direct Mail -- In the upper watershed, this same completeness of effort was not possible given the scope and scale of the project and the large number of small, privately owned parcels (at least 4100 along the river and major tributaries). In order to locate as many knotweed sites as possible and build a more knowledgeable constituency, we created a full-color informational brochure (included in 2001 report).

The brochure includes basic knotweed identification and ecology, control advice and perhaps most importantly the offer of advice and/or free control assistance from The Nature Conservancy. All landowners that contact us are offered the option of advice or assistance. When our assistance is requested we mail a permission form (Landowner Agreement Form, see 2001 report), and upon receipt of the signed form arrange for treatment (see 2001 report).

Media – In order to reach landowners away from the river or those who failed to receive or read our brochure, we sought publicity for the project through print and video media. Stories about our project appeared in newspapers in Sandy, Gresham, and Portland. Other media coverage included the For the Sake of the Salmon Newsletter, The Conservancy's own newsletter, a Clackamas County mailing, and the Sandy River Basin Watershed Council newsletter. We approached television stations and two versions of a story on our control effort ran on KGW in prime time. In every case we emphasized the multi-partner approach and the financial support of BLM, Metro, OWEB, and the United State Fish and Wildlife Service.

Public Speaking -- We gave numerous presentations on knotweed to community (NW Steelheaders, Sandy Chamber of Commerce, Garden Clubs etc..) and school and natural resource management groups (private and public meetings, conferences etc…). We participated at the Mt. Hood National Forest songbird celebration, Metro's Salmon Festival and SOLV's Watershed Weeks community events. Examples of presentation materials were included as appendices in the 2001 report.

Volunteer Recruiting
As part of our youth for conservation program we mailed information about volunteer / service learning /internship opportunities to area colleges, high schools and camps. We also publicized volunteer opportunities through TNC's volunteer newsletter and e-mail mailing list.

Inventory and Control Methods

Conducting invasive species control in remote areas is different from, and more difficult than doing it in areas easily accessible by vehicle. The presence of water adds to the challenge. 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 reachable by foot require walking more 1-3 miles from the nearest road access. Some sites can be reached on foot only during low water periods, thus outside some necessary treatment windows. Regardless of the location, travel along heavily vegetated river and creek shorelines is extremely difficult, and often limits access to a short stretch of single side of the river on a given day. Travelling 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. By travelling the river we can also determine which areas deserve prioritization and can thus better focus direct outreach efforts to obtain permission to cross and / or treat property there.

Japanese knotweed survey – 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. Surveys took place from rafts, inflatable kayaks and by foot throughout the project period. 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 surveyed twice. In spring 2002 we expanded the complete inventory area upstream to Revenue Bridge (rm 25) and river bank surveys to Marmot Dam (rm 30).

Japanese knotweed treatment -- Knotweed treatment method varied with landowner, patch size, patch location and time of the year. Because of current restrictions on the use of herbicides, knotweed on federal lands is treated 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 Rodeo (glyphosate by Monsanto, with Oregon registration for aquatic use). More than 10 feet from surface water we used Garlon 3a (triclopyr by Wilbur-Ellis in a water base, with registration in Oregon for near but not adjacent to surface water). We used both foliar spray and wicking methods. Foliar sprays were 5% solutions with 1% non-ionic surfactant added. Wicking methods were

the application of 50% herbicide solution in water directly onto the freshly cut stem. Treatment timing varied with location.

Scots broom – Work on Scots broom in this phase of the project was done at previously known sites of high ecological importance (table 3.1) and we did not map Scots broom locations throughout the watershed. We did, however, identify locations of large Scots broom infestations on islands and in floodplains. We treat each priority site as time, funding and volunteer availability allow. Scots broom was controlled using only manual removal techniques. Plants were cut with loppers, or, if small enough were uprooted by hand. Control efforts focus on reproductive individuals if they are present.

Himalayan blackberry – Because blackberry is so widespread, we did not, and will not attempt to map its distribution, and will limit work efforts to sites at which we were already engaged on other species or 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.

Japanese knotweed control experiment – Beginning in May 2000 we initiated a controlled experiment in order to determine the best treatment methods for knotweed. We compared 17 treatment variations and combinations in both method and timing in a controlled experiment at Oxbow Park on 51 knotweed patches. Applications of the herbicides Garlon 3a and Rodeo were tested at different times of the year. We compared wicking vs. foliar spray. We tested pure manual control and manual control combined with herbicides.

Monitoring

Landscape locations -- The location of each patch is recorded using GPS and/or on an aerial photograph. In most cases, the patch size and height are measured and the number of stems counted. In areas with very extensive knotweed infestations (thousands of stems, in dozens or hundreds of patches), stem numbers were conservatively estimated and individual patches were not measured or labeled. Patches are numbered with a two ranked code, macrosite-microsite. Each site is identified by a piece of plastic flagging with the date and plot identification number. The Sandy is divided into 80 macroplots based on the breaks between aerial photographs, and microsites are numbered sequentially based on discovery order. Between 2001 and 2002 we collected data on more than 400 individual sites. This data is considered to give a fair representation of our progress on the landscape as a whole.

Knotweed control experiment -- Photopoints have been established at every plot in our experimental site (please see sample photopoint series following the figures section. At a minimum, photographs are taken of every plot each spring, at each treated plot on the treatment date and of every plot in the fall, and stem number, patch size and height are measured.

Results

Inventory / Mapping

Survey work in early 2002 suggested that only a few sites in the Sandy River Gorge were missed in 2001, most likely due to difficult terrain and limited time rather than new sites appearing. Furthermore, deterioration of the ink and/or the flagging material prevented positive re-identification of some microsites. Between June 2001 and June 2002, however, we believe we have identified, mapped and labeled 95% or more of knotweed sites between river miles 0 and 19 on the Sandy River, about 66% from rm 19 to rm 23 (Revenue Bridge and an unknown but smaller percent in the upper reaches.

Table 3.2 Status of knotweed Survey on the Sandy River

Stream Reach	Known Locations	Estimated % of actual	Survey Status
Sandy RM 0-18.5	555*	95%	Complete
Sandy RM 19-23	14^	66%	Some private lands remain unsurveyed, all public lands are surveyed
Sandy RM 23-30	(>20)^	50%	Surveys from river and shoreline only.
Sandy RM 30-38	>70^	33%	Many private lands remain unsurveyed, all public lands are surveyed
Sandy RM > 38	0	0	Not surveyed

* many locations represent multiple sites or patches
^ each site represents one floodplain with few to many patches or sites - see figure 3.8

We are currently tracking 569 sites on the Sandy River (plus 51 in our controlled study) that we are actively controlling (table 3.3), plus more than 80 sites on private lands on tributaries (table 3.4). Partners (private landowners, Oxbow Park, City of Troutdale, Multnomah and Clackamas County) are controlling many additional sites. Farther upstream on the Sandy, site identification has been limited by lack of access and human power. We have, however, surveyed the middle Sandy between the Salmon River and Marmot Dam, and between Marmot Dam and Dodge Park, much of the Salmon River, lower Gordon Creek, much of Beaver Creek, lower Trout Creek and much of lower Cedar Creek. Time and manpower did not allow for treatment during 2000-1, however all known patches will be treated during 2002.

Many of the known knotweed locations in the upper watershed are the result of individuals reporting sites in response to receiving our informational brochure, hearing from someone who has received a brochure or by attending one of the many presentations we have made about knotweed in the Portland Metro Area. Other have come from our casual (road based) surveys of area where we have gotten specific reports from others.

Large stretches of the upper Sandy and its tributaries remain to be surveyed. Some will be surveyed during 2002, others will probably not be surveyed until 2003.

Treatment / Control Efforts

Knotweed

Between July 1, 2001 and the end of the 2001 field season we treated 502 sites and approximately 8667 stems, mostly from Dabney Park to Dodge Park but including scattered sites in the upper watershed as well (Figure 3.8). These were almost entirely second treatments following the spring 2001 treatment (23,000+ stems) reported in last years' report.

Between April, 2002 and June 30, 2002 we treated 569 sites and approximately 41,000 stems on the Sandy River from Dabney Park to Revenue Bridge (Table 3.3a) adding approximately 5 river miles to our treatment area. Stem numbers are conservative approximations because in the largest sites we do not take time to count all stems and treat entire floodplains or cobble bars with numerous patches as single sites.

An additional 10,000 stems were treated at 60+ private landowner sites (table 3.4).

Among 401 sites in the Sandy River Gorge that were labeled, had their stem number accurately counted and were treated in 2001, and then were positively relocated in 2002, 184 (46%) had zero regrowth. No obvious relationship exists between initial stem number and achieving total knotweed control (figure 3.9). The total number of shoots coming up in the spring in these sites was reduced 64%, from 22,438 in 2001 to 8101 in 2002 (table 3.3).

Knotweed Control Methodology Research - East Oxbow Park Controlled Experiment

Manual Treatment -- It is clear from literature review, this experiment and our broader experience in the field that manual control as practiced here does not work for established knotweed colonies (figure 3.10 and table 3.5). No significant site, treated only by manual control has been eliminated during the project period. After two years and 12 monthly cuttings during the growing season, stem number in our manual control plots has been reduced by only 17% (stdev = 94). Although 2 of 3 plots showed some reduction (36 and 40%), one plot has increased stem numbers by 25%.

Herbicides -- The herbicides Rodeo (glyphosate) and Garlon 3a (triclopyr), alone or in concert with manual treatment, appear to be effective (figure 3.10, tables 3.5, 3.6), but Garlon 3a was found to be more effective ($p = 0.07$) than Rodeo. Foliar sprays were more effective than stem treatment ($p < 0.0001$). All 9 plots treated with foliar sprays of Garlon 3a (either Spring and Fall treatment, Fall treatment following Spring cutting or Summer spray only) had zero living shoots in June 2002 (fig 3.10, table 3.5). Plots that were cut to 1.5 meters in height then sprayed in the fall were greatly reduced (mean = 98% stdev = 1), but not eradicated after two years of treatment.

Although two years of Rodeo foliar treatment gave high levels of control, at least 1 of 3 plots in each Rodeo foliar treatment group had living stems after two years of treatment (figure

3.10, tables 3.5, 3.6). Many of the surviving stems in these groups were badly mutated, with abnormal growth patterns (figure 3.11), but field observation and the literature suggest that without additional treatment, these stems would recover normal growth patterns and allow the plant to survive. The treatment method of cutting large plants down to 1.5 meters in the Fall and then spraying the remains was less effective with Rodeo than Garlon. Although one patch was eliminated, the other two had greater then 20% survivorship after two years (table 3.5).

Cut-stem treatment -- Although Spring and Fall stem treatments with Garlon eradicated some patches, results were inconsistent and in general this technique was less effective than foliar spray ($p = 0.001$). Stem treatment with Rodeo failed to eradicate any patches although stem number was significantly reduced in most cases (figure 3.10 and tables 3.5, 3.6). As with Garlon, foliar application was found to be significantly more effective ($p = 0.0018$). Regardless of herbicide type, Spring and Fall herbicide treatment is superior to a single Fall treatment ($p = 0.0043$).

No other treatment method / combination gave reasonable control, even after two years of treatment (Figure 3.10, Table 3.5).

Discussion of knotweed treatment approaches

Although several herbicide-based approaches yield good control after 2 years of treatment. Our work has made several cautionary lessons clear. Patches containing hundreds to thousands of stems require treatment over three or more years. More typical sized, isolated sites sprayed with herbicides have almost always been significantly reduced or eliminated in two seasons of foliar treatments. Preliminary data and field observation suggest that cut stem type applications, though extremely slow, may also be effective on smaller patches (figure 3.10), and can present a viable option for landowners who are philosophically opposed to spraying herbicides.

Although the herbicide Rodeo gave generally similar results to Garlon 3a, the frequent survival of 1 or more stems from a patch after two years of treatment suggests that an additional year of treatment with Rodeo will be necessary to achieve eradication.

Herbicide application is difficult to control when plants are taller than 1.5 meters. It is also limited by senescence of post-flowering individuals in October. Unfortunately, most knotweed patches exceed 1.5 meters in height by mid or late May. Fortunately, plants cut manually once during the middle of the active growth period resprout vigorously, but do not grow as tall and generally do not flower. As a result, they senesce at both a smaller size and more slowly in the fall than uncut plants. Plants cut after early August however, do not apparently resprout adequately to allow effective herbicide treatment. To take advantage of these facets of knotweed autoecology and maximize the more effective herbicide option, we have developed an integrated control approach that maximizes the active control period (figure 3.12), while allowing our field team to cover the greatest number of sites. Herbicide use is emphasized in summer and fall, manual treatments are emphasized in spring and early summer.

Other variations in control which yield less satisfactory results but which may be used for biological, social or political reasons include: manual treatment (landowner self-treatment only), cut-stem treatment (presence of fish near patches in the river), or cutting to 1.5 meters and spraying.

We now only recommend manual treatment if a landowner believes that they can cut the plants down at least every two weeks from late April to the end of July, then periodically through the summer to ensure the plants never exceed 6 inches (15 cm) in height.

NOTE: Due to results of a consultation with the National Marine Fisheries Service as of May 2002 we are unable to use Garlon 3a within the 100 year floodplain.

Scots Broom Control

Mature and (time permitting) some immature Scots broom plants were removed at 12 priority locations (see table 3.1) within the Sandy River Gorge totaling approximately 70 acres. A much larger ~200 acre area is surveyed annually and scattered individuals are removed. In general, work effort focussed on natural meadows, cobble bars and floodplains of the Sandy River Gorge.

The two areas of highest priority are two natural meadow complexes that together straddle the Sandy River at RM 16. The sites are co-owned by BLM, Metro, ODFW and TNC, and together form the largest natural meadow system on the lower Sandy River. Bear and elk sign are regularly seen in both locations. Large mature broom plants were removed in 1998 but a huge flush of seedlings was and continues to be produced. Our efforts focus on first removing all mature individuals (not a trivial task when the area covers 40 acres and 2 million seedlings), then systematically removing all plants as time allows.

Volunteers -- Nearly all of 2008 volunteer and youth volunteer hours (from over 400 individuals) and 1600 AmeriCorps crew hours spent on the Sandy were used for Scots broom control.

Staffing needs / Project Structure

It is clear that our decision to hire and train a full-time 4-person field crew in 2001 was sound. Very few knotweed sites are large enough to justify using a full size (9-12 people is typical) youth crew, because of travel / work time proportion issues, but the job is simply too big for 2 people. Furthermore, typical crews are not able or willing to apply herbicides, and can not be effectively trained to handle the myriad and sometimes complex tasks that are part of this project. Because they work on the project every day, a smaller crew is more trainable and thus more independent and flexible. For smaller and dispersed sites a small team can be effectively divided into sub-groups. Finally, the cost of Americorps individuals is very favorable. Including a vehicle and mileage costs, the 4-person team costs only $30,000 for over 7000 service hours.

In phase 3 (calendar year 2002) we dropped the field biologist position (done in summer 2001), kept the current 4-person field crew trained in 2001 as seasonal employees, and added a half-time 4-person crew (2002) to allow us to create 3 field teams during intensive treatment periods.

Community / Private Lands Outreach

Over the short-term we had 5 primary objectives related to outreach efforts.

1. Self-inspection by landowners or via permitted inventory team access to 75% of private lands within the project area.
    - The scope of the infestation, the difficulty of control and low response rate to our mailing prevented us from achieving this goal on the entire watershed but we reached nearly 100% between river miles 0 and 24

2. Control of at least 5 knotweed "macro-sites" using volunteers.
    - Because manual control turned out to not be feasible, we abandoned this goal in nearly 2000. We worked with volunteers and youth crews on 12 Scots broom and blackberry sites.

3. Increased recognition of the danger knotweed poses among citizens, agencies and nurseries.
    - This goal was met, please see below.

4. Action by public agencies to control the plant on their own land.
    - This goal was partially met, please see below.

5. Upgrading the status of knotweed to one that is actively controlled by the local weed board.
    - No local weed board with control authority exists. TNC is now participating in a regional effort to form and fund one. Our activities have helped initiate knotweed control programs in many location s in the Pacific Northwest, including Clark County, Clackamas County and Lincoln County.

Our ultimate "social" objective was a more educated and motivated citizenry and action by public agencies to match the urgency of the threat.
    - This goal was clearly met, although it (of course) remains an ongoing objective

Although we did not reach all of these goals completely, we did make significant progress on each. Public awareness and participation was enhanced in at least four ways.

1) We produced and distributed a brochure (figure 3.13a,b) about the problem and our proposed solution that was mailed to landowners with property adjacent to the Sandy and

major tributaries. Not only did this lead us to establishing many landowner agreements / partnerships, but it helped increase our awareness of problem locations/areas that we can target for more intensive direct outreach efforts. Lastly and perhaps most nebulously, it helped create a word of mouth exchange of knowledge that we believe will continue to increase awareness independent from our direct efforts.

Free copies of the brochure were made available to any and all interested parties. Brochures were eventually distributed by BLM, Metro, Clackamas County, Multnomah County, USFS – Zig-Zag Ranger District, Soil and Water Conservation Districts as well as numerous private individuals, businesses and non-profit organizations. By June 30, 2002 we had 85 formal cooperators (signed permission forms or commitment to self-treat, table 3.4) and several who would not sign a form but granted permission verbally for entry or crossing of their onto their property (signed forms on file at TNC and OWEB).

2) We sponsored, participated or helped catalyze several community events that will both highlight the problem and the achievements of our work teams. For example prior to our initiative neither SOLV, Dabney State Park, Glenn Otto City Park, nor Oxbow Regional Park included knotweed work in their volunteer or control programs. Now both have active control and volunteer efforts specifically addressing knotweed sites.

3) Through the mentoring/leadership building aspect of the program we not only have built up a larger (volunteer and AmeriCorps) staff that can lead volunteer work events at little cost, but hope we have both a direct and "trickle-up" effect as children bring information about the program home to their parents and schools.

4) We worked in the field with more than 20 school or youth groups, totaling more than 300 individuals and more than 1300 hours. Dedicated individual volunteers and interns contributed approximately another 800 hours. AS part of our invasive species curriculum and education outreach we had 13 classroom / field events that reached over 300 students.

Knotweed Working Group and exporting our efforts to other areas

Not only have our efforts to raise agency awareness paid off in terms of agency action in the Sandy, but, have begun to spread to other watersheds within and outside of Oregon. Thanks in large part to our efforts, Metro, PGE, the USFS, Oregon State Parks, the City of Troutdale, Clackamas, and Multnomah County Roads departments, and the Oregon State Dept. of Transportation are actively undertaking knotweed control. Based on our research the BLM is conducting an environmental assessment to allow the use of herbicides for knotweed control. We intend to work with the US Forest Service to do the same.

Brochures have been incidentally and/or strategically distributed in other watersheds within Oregon (Clackamas, Tualatin, Nehalem among others) and in Washington (Skagit, Washougal) and Alaska. Our efforts have helped galvanize awareness and action in each of

those locations. For example, a revised version of our brochure will be distributed in the Skagit River Watershed in Washington as part of a new landscape level control program.

Our basic methodology is designed to be adaptable to other areas and the problem of non-native plants destroying fish and wildlife habitat is found everywhere. Knotweed in specific promises to be one of the most important restoration problems in western Oregon. Project leadership develops the basic information and methodology and trains mid-level leaders who work for Americorps or similar organizations. Mid-level leaders have primary responsibility for carrying the message into the field, by conducting volunteer work events and other activities. In the first example of our success in this area, our model of using a well trained 4-person AmeriCorps team to lead control efforts is being adopted by Metro and the Clackamas River Watershed for use in the Clackamas River Watershed (they are also adopting our specific control approach).

Discussion

Habitat protection and weed control programs do not succeed or fail overnight. If a given ecological problem or invasive species were easy to control, it wouldn't be a problem in the first place. Although knotweed is an extremely tough species to control, our data suggest that all but the largest patches in the Sandy River Gorge should be greatly reduced, if not eliminated following 2002 treatments. Data collected in the spring of 2003 (to be reported in July 2003) however, will yield more conclusive information on our progress over the entire landscape.

Our carefully executed experiments, monitoring data and broader field experience demonstrate that by practicing thoughtful adaptive management, we have developed both effective control approaches and an efficient project structure. With these two elements in place, regardless of potential setbacks remaining to be discovered, we are confident of meeting our goal of controlling knotweed in the Sandy River Gorge in 2003, and within the broader Sandy River Watershed 2-3 years later.

That said, there is much work to be done. The next year and a half represents a bellwether. At current staff/funding levels, unless we are able to greatly reduce the need for our time within the Sandy River Gorge, we will not be able to adequately survey and treat the majority of the upper watershed. The project model tested in 2002 was very successful (a 4-person field crew working largely independently, with field oversight from the project manager, and with half-time field support from another 4-person team). It allows us to create 2-3 field teams on a given day and, we believe this will allow us to quickly re-survey and treat the Sandy River Gorge in the spring of 2003 and shift our efforts to inventory and control in the upper watershed.

Part of the project's success will come from using the most efficient control methods possible. In 2002, based on a combination of our research and our need for efficiency we used a spring manual cut / fall herbicide approach. Patches accessed for the first time in ate summer will be cut down to 1.5 meters, then sprayed.

We will also continue to try and expand our successful efforts to reach out to youth work crews, schools and diverse public groups to share the mission of restoring the Sandy River Watershed and the relationship of invasive species to changes in watershed function. Volunteer projects will focus on Scots Broom, English ivy, Himalayan blackberry and Policeman's helmet (*Impatiens glandulifera*) control and restoration at high priority sites throughout the watershed. We feel strongly that these sorts of projects instill not only ecological knowledge of place and participation, but a greater understanding and connection to the important processes that maintain Oregon's natural heritage, including anadromous fish.

Next Steps

The following are the major goals we intend to meet during the third phase of this project. The project is currently supported not only by Metro/USFWS, but also by BLM, For the Sake of the Salmon (PGE – Salmon friendly power program), Metro, Northwest Service Academy (Americorps), ODA, OWEB and TNC. Specific grant guidelines vary as do reporting times. Project completion dates range from October 2002 and June 2003. We intend to seek continued funding from all partners to continue this project through 2005.

July 1 to October 30, 2002

- Conduct fall treatments on all sites between Sandy River Miles 0 and 25.
    - A minimum of 41,000 shoots were manually treated in the spring 2002. All will be sprayed with Rodeo between July 1 and the end of the field season.
- Continue clearing mature and immature Scots broom from priority sites
    - Efforts will focus on pre-reproductive individuals at the Cornwell / Vanport site co-owned by Metro, ODFW and TNC and other natural meadows in the Sandy River Gorge
- Conduct fall treatments on all private property owner/cooperator sites in upper watershed.
- Complete third year of knotweed control experiment.
    - Data will be collected monthly through early November. At this point we will probably develop a new experimental framework to continue developing appropriate methods and not waste more time on failed approaches.
- Conduct door-to-door outreach in as much of the upper watershed as possible.
    - Much of the Middle Sandy, lower Cedar Creek, areas within Welches and the Salmon River have been completed. This aspect of the project will be emphasized more strongly in late 2002.

- Complete a revision of our invasive species ecology curriculum to enhance our outreach efforts. Begin second implementation phase.

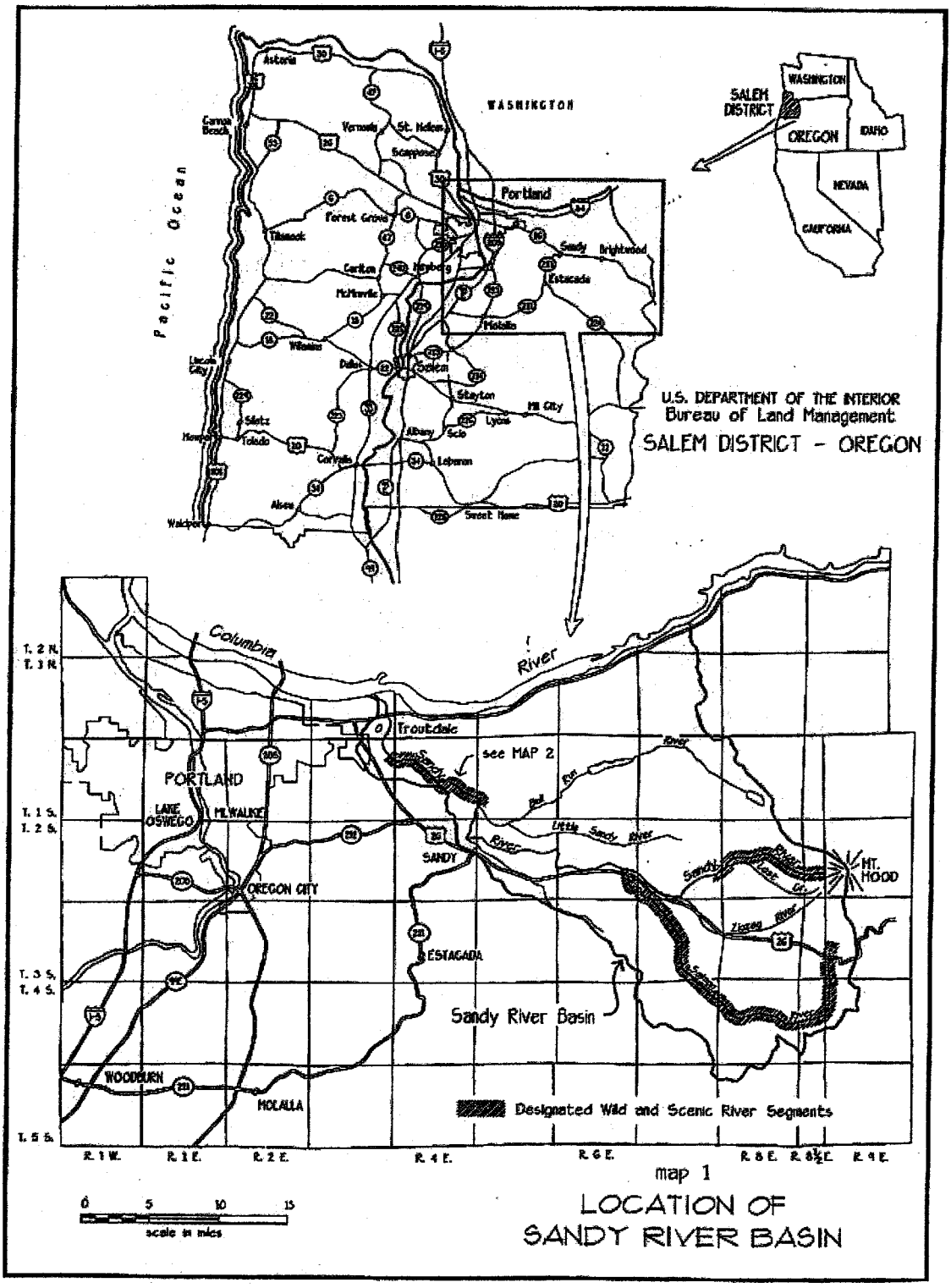
November 2002 to March 2003

- Data analysis and project planning
- Continued outreach for permission to survey
- Submit the results of the knotweed control experiment to a peer-reviewed journal, and publish them on the TNC website.
- Conduct volunteer, education and public speaking outreach efforts.
- Work with BLM and USFS on allowing use of herbicides to treat knotweed on federal lands.
- Fund-raising from new and current partners.
- Train new AmeriCorps field crew.

Spring 2003

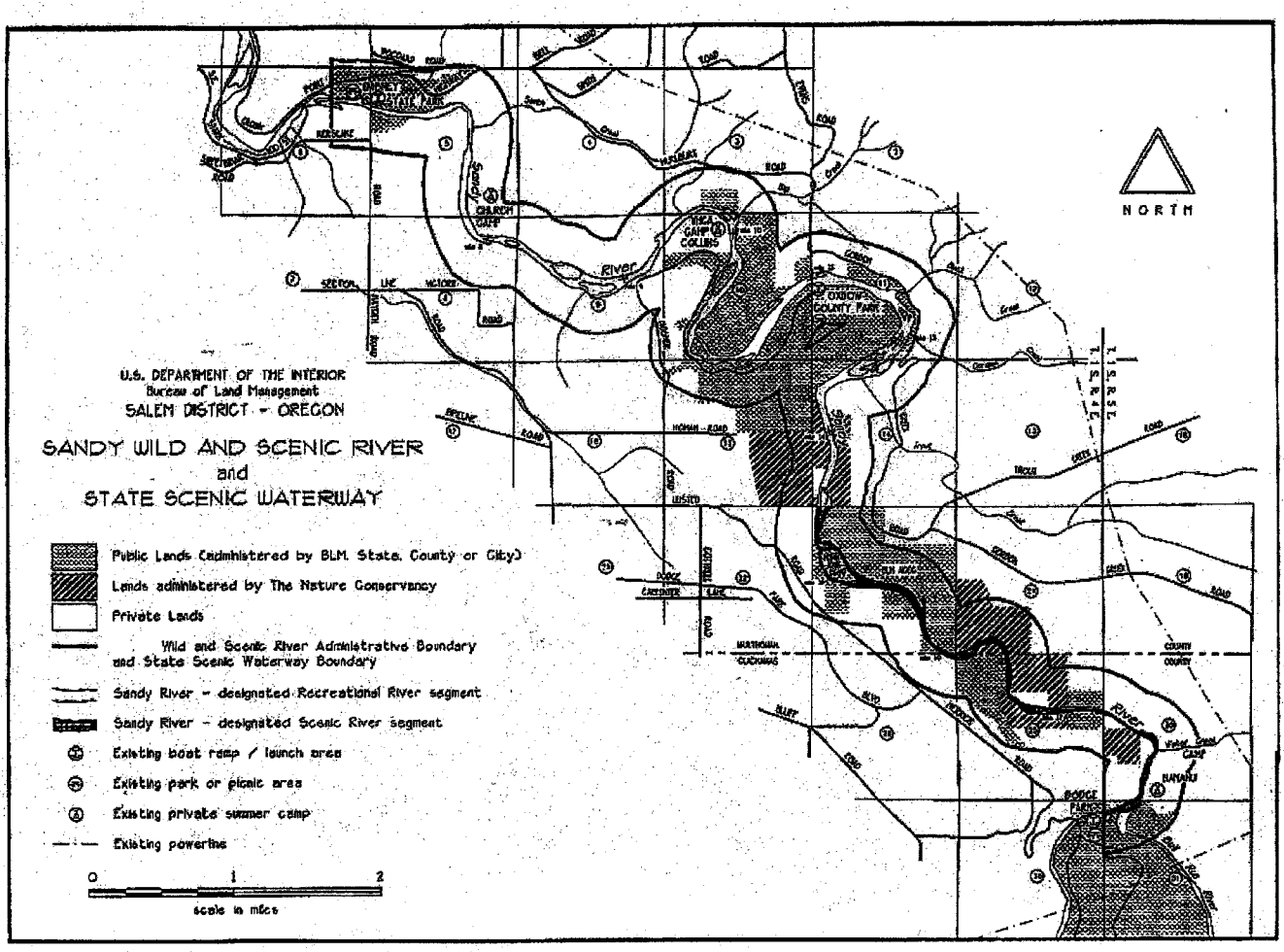
- Collect final (April, May and June) data points for knotweed control experiment
- Conduct spring treatment (method based on latest results of control experiment) and all sites between Sandy River Miles 0-30. Adapt control practices based on results.
- Conduct spring treatment of all private landowner/cooperator sites.
- Complete survey by water of all navigable reaches of the Sandy River

Figure 3.1 Sandy River Watershed Location



The Sandy River runs northwest from glaciers on Mt. Hood to the Columbia River. Shaded portions of the Sandy and tributaries represent federally designated wild and scenic areas.

Figure 3.2 Sandy River Gorge Location



The six miles from Dodge Park to Oxbow Park are federally designated as wild and scenic. The six miles from Dabney Park to Oxbow are designated an Oregon State Scenic Waterway. Shaded areas represent conservation ownership.

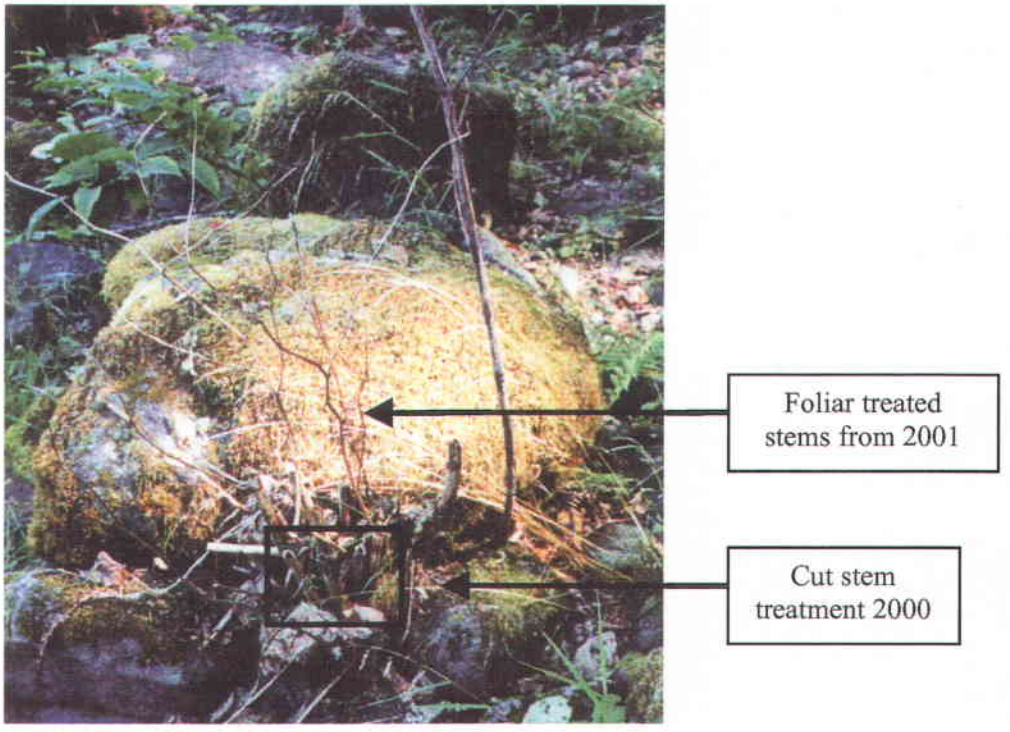
Figure 3.3a - Selected knotweed photographs

Knotweed can grow to more than 4 meters by the end of June and form large monocultures. This photograph is from an upland site created by dumping soil "contaminated" with knotweed roots.

Established knotweed patches are very dense and completely exclude all other vegetation. Note lack of ground cover vegetation and build-up of old knotweed stems.

Figure 3.3b - Selected knotweed photographs

Knotweed root fragments as small as 1 cm (a single node) can produce new plants. This 2.5cm fragment found at Oxbow Park, May 2000, has 3 nodes.



Photomonitoring sample: small patches have been effectively treated using cut-stem (wicking) and foliar spray methods. Note the cut stems (from 2000) and the dead stems killed by foliar treatment in 2001.

Figure 3.3c - Selected knotweed photographs

Knotweed can spread by stem fragments. This stalk shows clear evidence of being cut by beavers and has successfully re-rooted on a cobble bar.

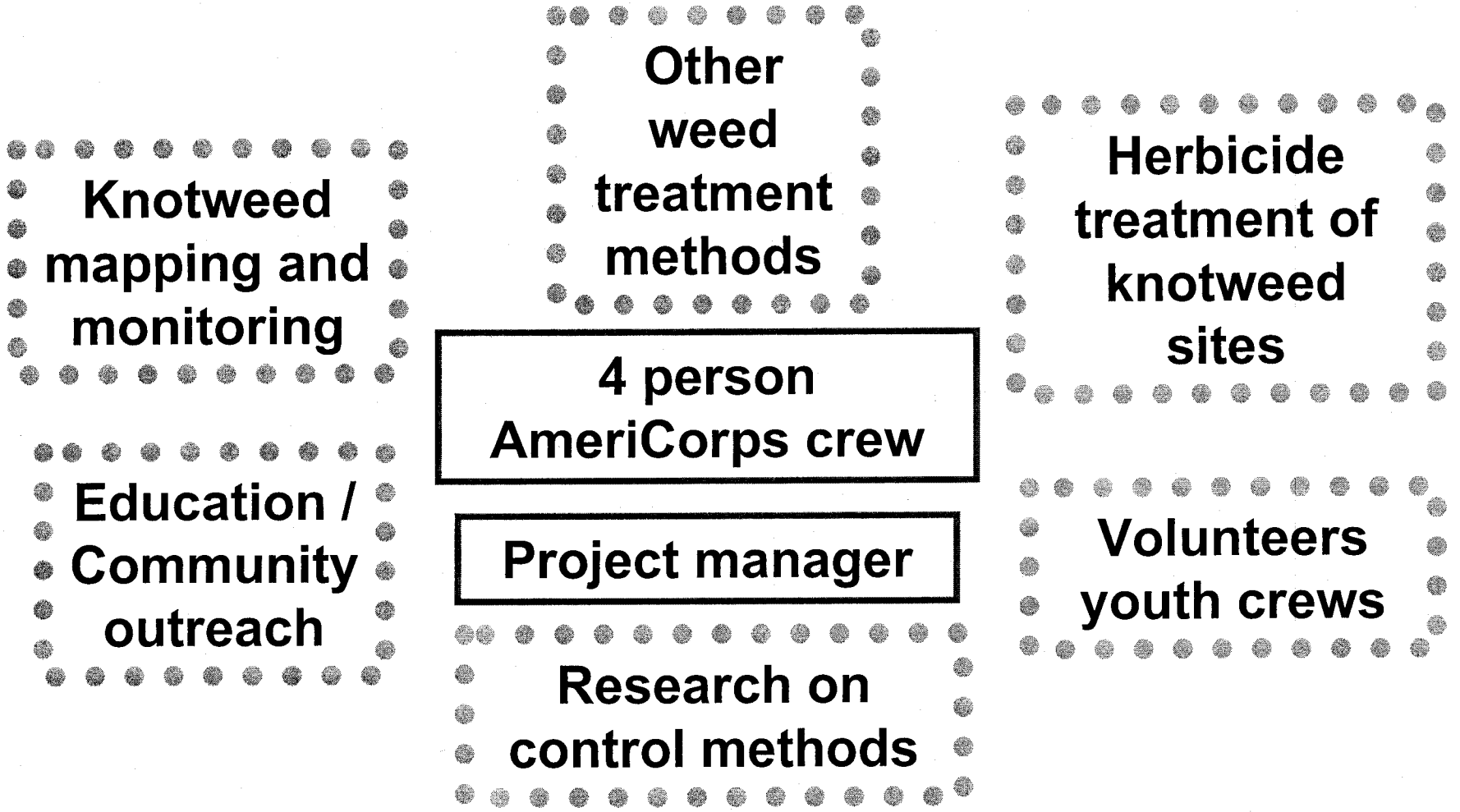
Untreated, knotweed can colonize extensive sections of stream bank, permanently excluding native vegetation and altering the dynamic between the river and the shoreline. This photograph shows more than 100 meters of the Trout Creek shoreline occupied by a knotweed monoculture. Large patches like this one may require several years of multiple treatments before they are suitable for replanting.

Figure 3.4 Scots broom on the Sandy River shoreline

Scots broom invades and occupies floodplain, meadows and open shoreline habitats on the Sandy River. Thick stands reduce plant diversity and prevent regeneration of native shrubs and trees. Seeds are spread by the river, especially during high water events.

Scots broom is easily controlled by cutting. Cutting during summer largely prevents stem resprouting, and is an order of magnitude faster than uprooting. Numerous seedlings emerge after clearing mature plants and long-term control efforts focussing on preventing seed production are essential.

Figure 3.5 Project structure for 2001 field season

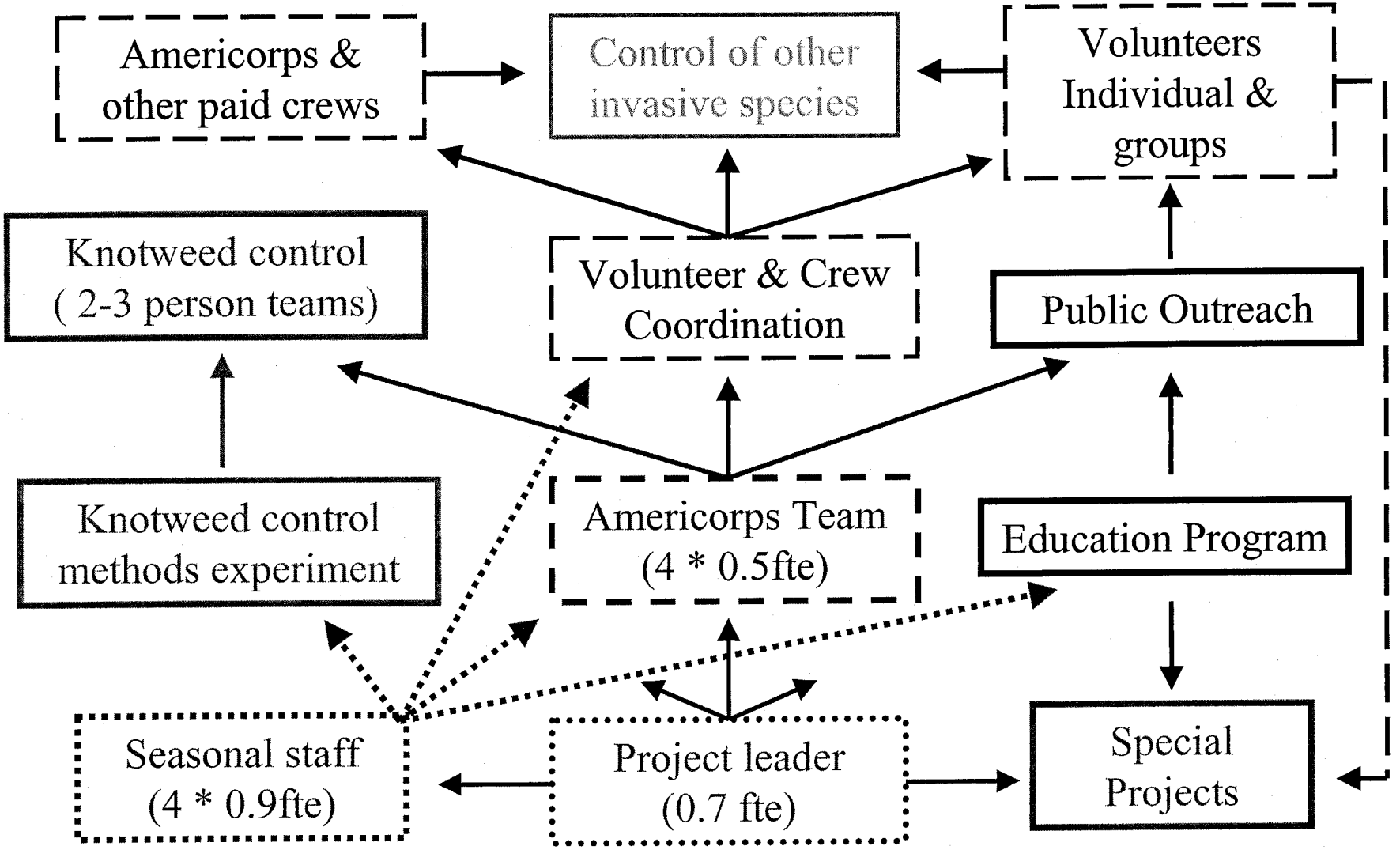


In 2001, we used a full-time 4 person AmeriCorps team for conducting field work.. A highly trained, permanent team has several advantages including making better use of matching funds, being more powerful, adaptable and independent, a better fit for treating dispersed and remote sites. In addition it increased by 250% our ability to lead volunteer events.

Figure 3.6

Sandy River Riparian Protection Project Structure

March-December 2002



Project structure shows 5.2 FTE field staff from March-December. New AmeriCorps team provides1.6 FTE during project period. Supporting 3.6 FTE TNC seasonal staff trained in 2001. This structure greatly enhances capacity to economically inventory, map and treat a very large number of dispersed sites during a limited season. It also allows for necessary expansion of the outreach program.

Figure 3.8

JULY 2002 KNOTWEED LOCATION AND HIGH DENSITY AREAS
Revenue Bridge to Dabney Park
Sandy River Watershed

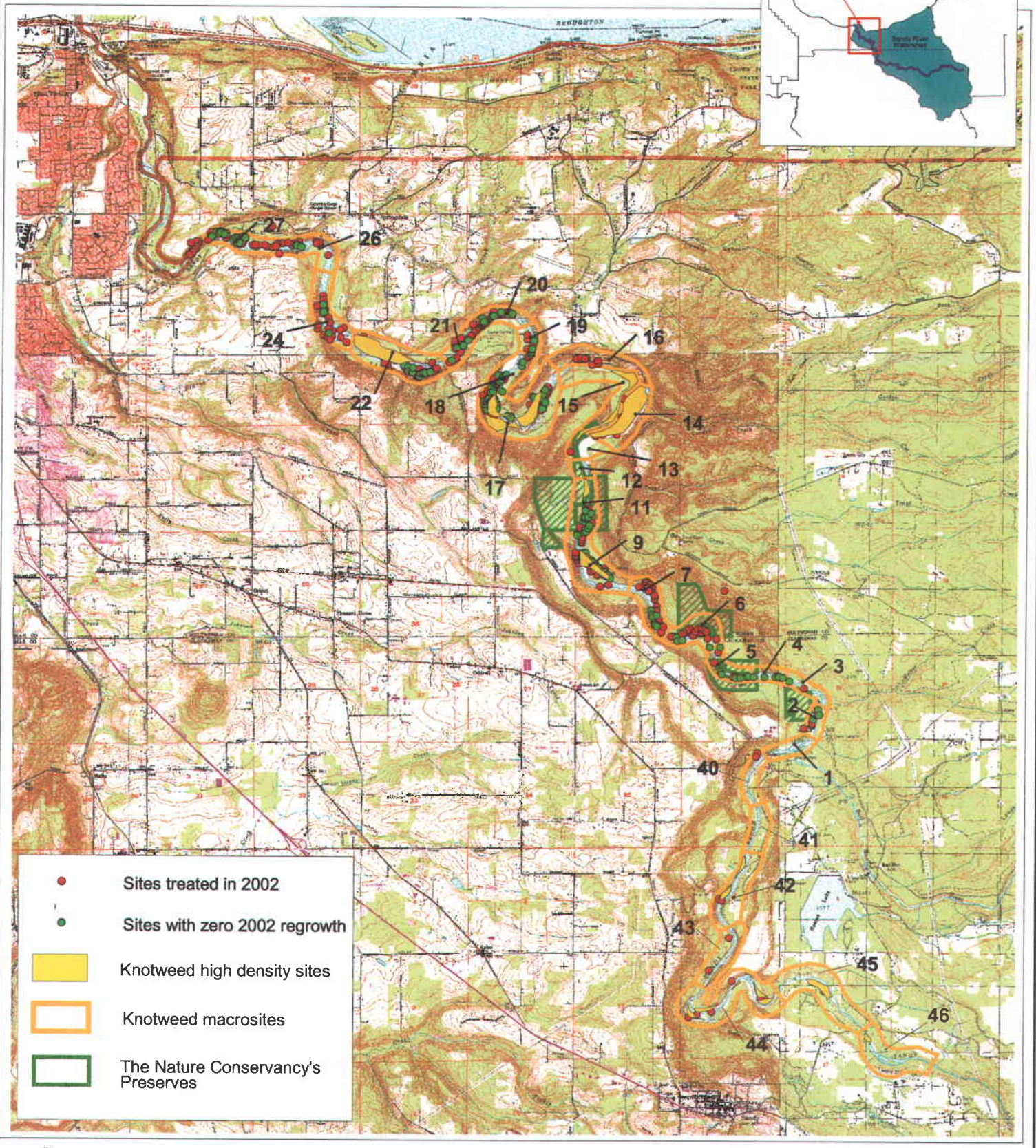
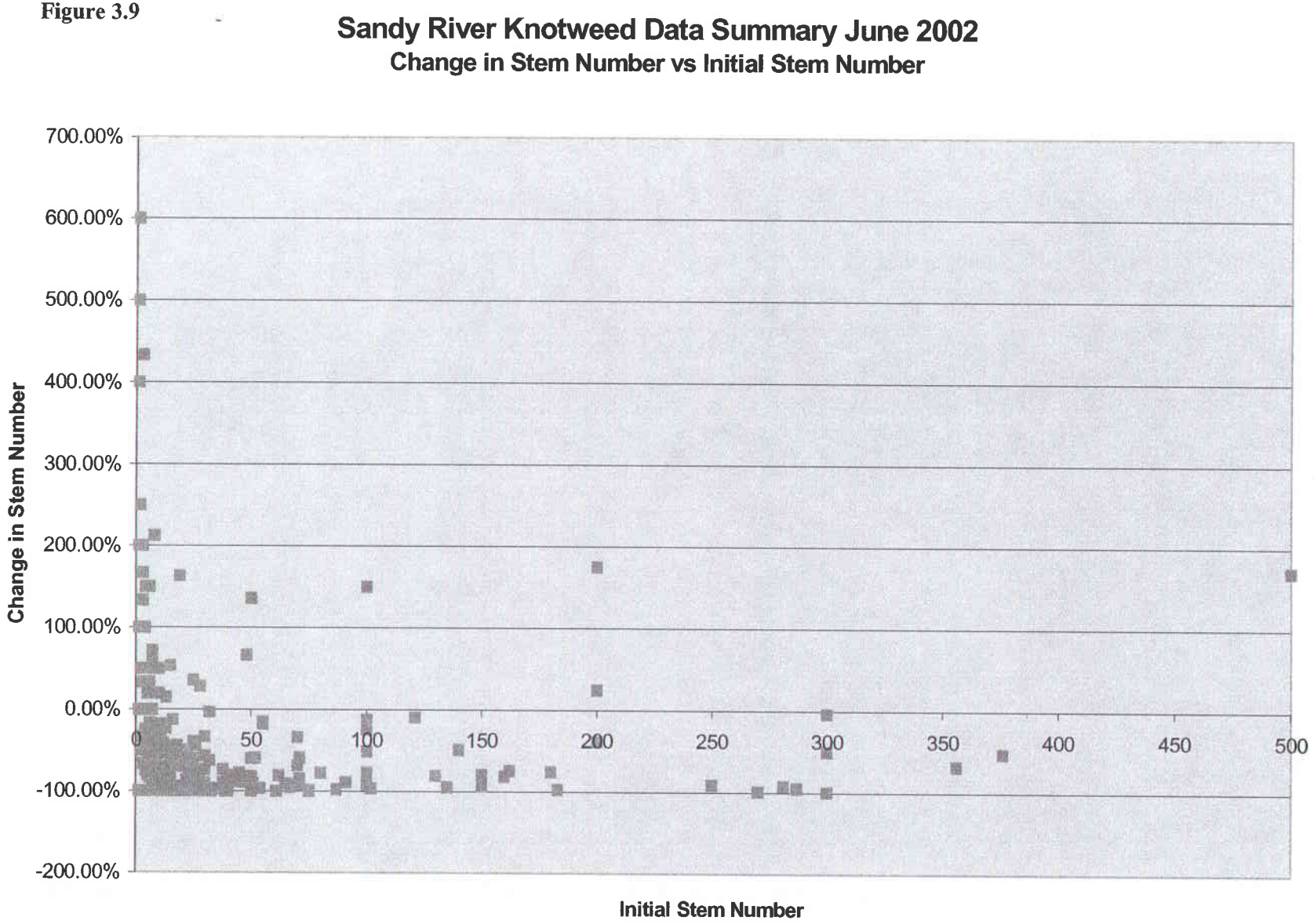
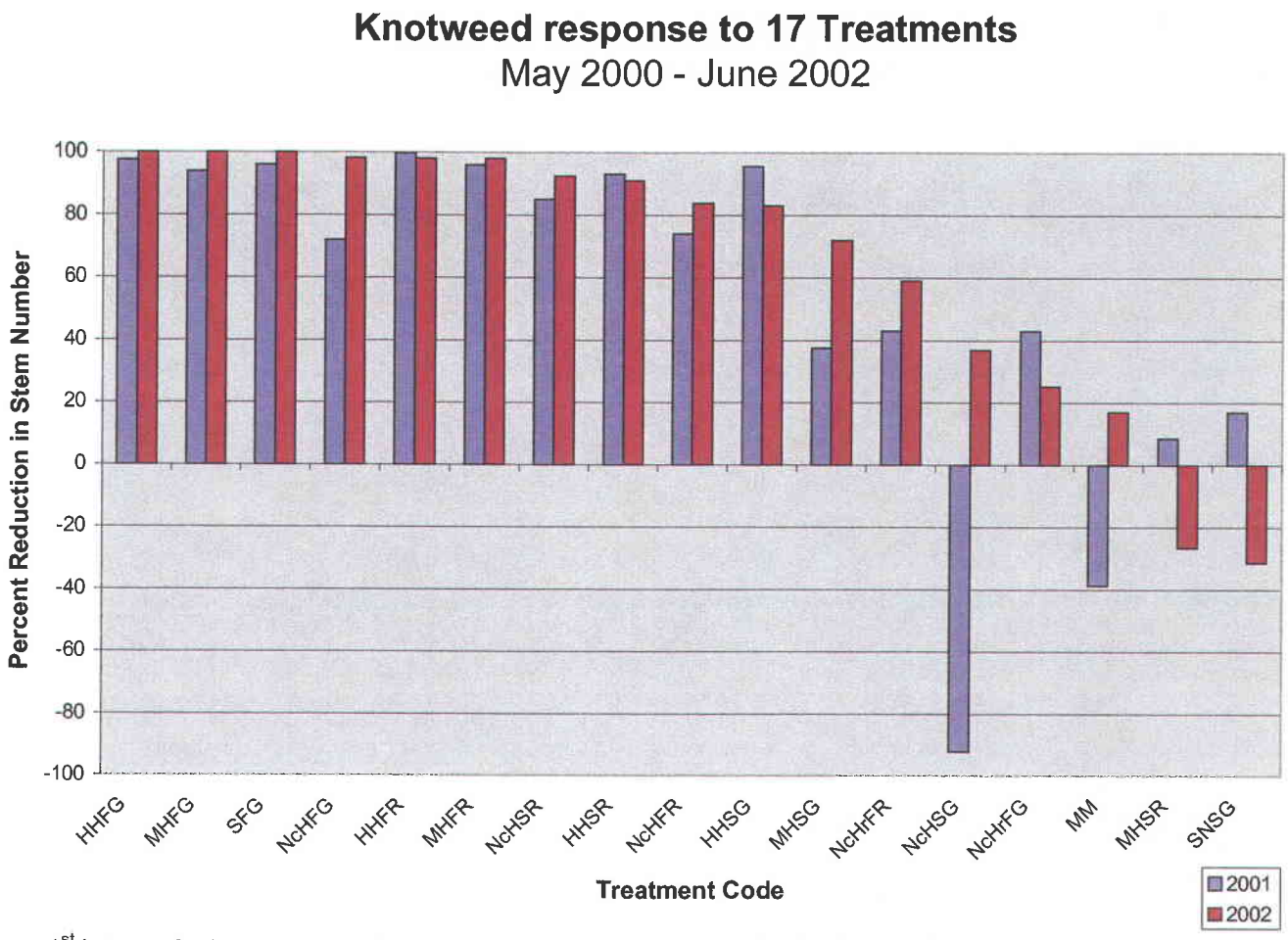


Figure 3.9



Although there is no correlation between initial stem number and response to treatment, no patch with more than 75 stems in 2001 was eradicated by June 2002. Of 401 sites in our study, 183 did not return following 2001 treatments and 352 showed some reduction. Total reduction was 64% for all sites.

Figure 3.10



1st letter = Spring treatment: H = Herbicide, M = Manual, N = No treatment, S = Summer treatment only
2nd letter = Fall treatment: H = Herbicide, cH = cut to 1.5 meters and herbicide, cHr = cut to ground treat resprouted stems, M = manual, N = none
3rd letter = Treatment type: F = Foliar spray, S = Cut stem
4th letter = Herbicide type: G = Garlon3a, R = Rodeo

Each treatment was performed on three separate knotweed patches.

After two full field seasons of treatment, many treatment methods effectively reduced stem number, but only Garlon 3a spray treatments (XXFG) succeeded in eradicating knotweed in every plot. Combining spring cutting and fall spraying was as effective as two spray treatments. Monthly cutting (MM) does not provide meaningful control. Statistical analysis indicates that Garlon is significantly more effective than Rodeo and that foliar treatments are significantly more effective than stem treatments.

Figure 3.11

Photograph shows mutated stems coming up in July following stem treatment by Rodeo the previous year. Note the dense clumps of small stems and leaves. If left untreated, these stems would likely recover, allowing the plant to survive.

Figure 3.12

Knotweed treatment decision tree

Plants ≤ 1.5 meters all year	Manual cut or Foliar spray* Rodeo* or outside of 100 yr floodplain Garlon 3a. In rare cases do stem* or manual treatment.
Plants > 1.5 meters before Aug. 1	Manual cut Spray resprouts after Aug. 15*
Plants > 1.5 meters after Aug. 1	Cut to 1.5 m and spray Spray small patches w/o cutting* Cut-stem*

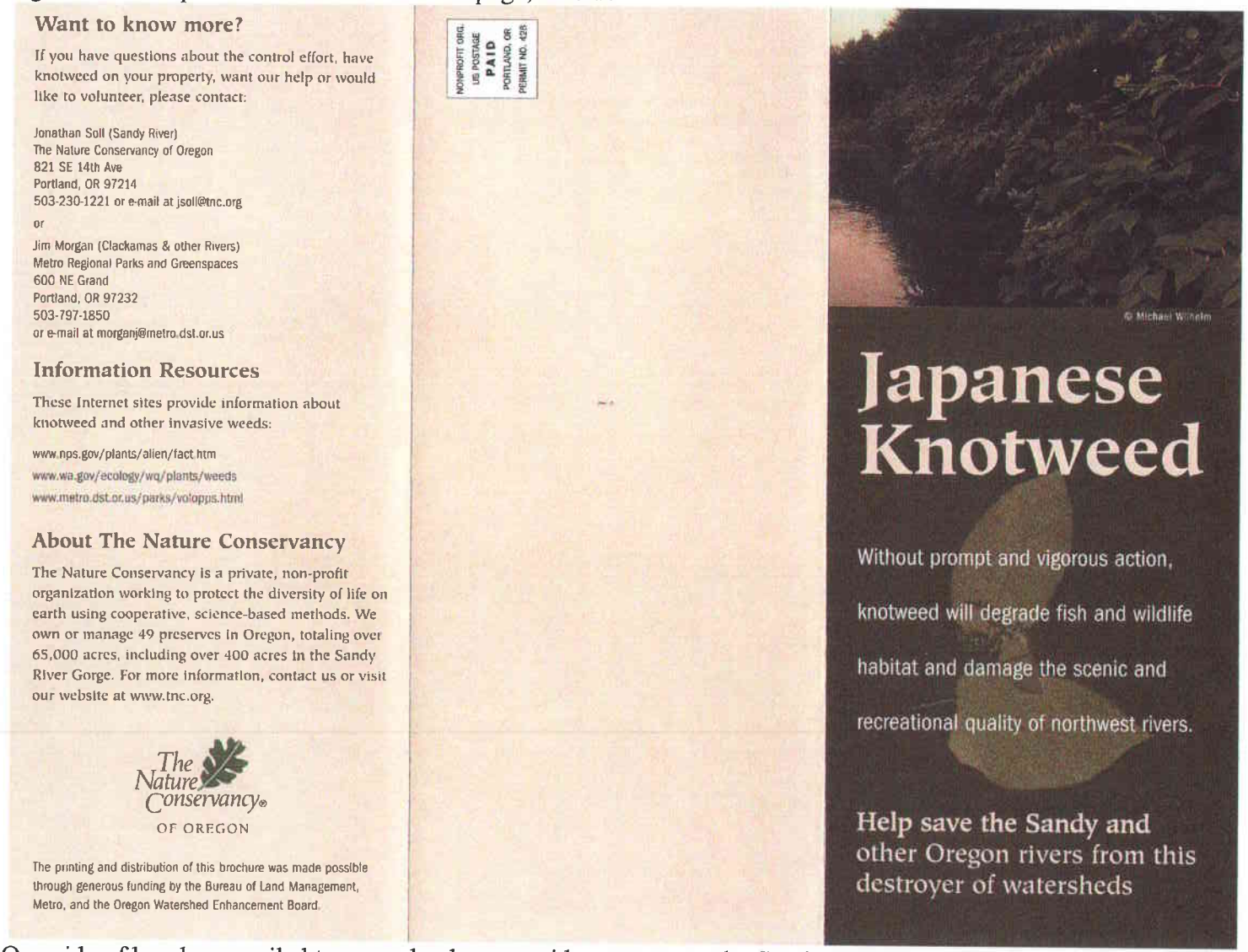
* Depending on public lands herbicide status

Figure 3.12b

When to use non-spray methods

- Landowner insistence, includes federal lands w/o environmental assessment
- Plants > 1.5 meters, after Aug. 1, in a patch that can not be sprayed effectively from the perimeter, and with structure such that cutting plant to 1-2 meters will not leave enough leaves for effective spraying.
- Fish actively spawning

Figure 3.13a Japanese knotweed brochure page, outside



One side of brochure mailed to every landowner with property on the Sandy River in 2000 (1000+ pieces) , to properties within 1/4 mile of the Sandy and major tributaries in 2001(4000+ pieces) and to property owners on upper mainstem Sandy and selected tributaries in 2002 (160 pieces)

Figure 3.13b Japanese knotweed brochure, inside page

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.

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.

Second side of brochure mailed to every landowner with property on the Sandy River in 2000 (1000+ pieces) , to properties within 1/4 mile of the Sandy and major tributaries in 2001(4000+ pieces) and to property owners on upper mainstem Sandy River and selected tributaries in 2002 (160 pieces)

Table 3.1 Sandy River Scots broom priority sites

Site	Site	Ownership	Size (acres)	Priority	Status
BLM ACEC Floodplain	SRG	BLM	3	High	All mature plants removed 2001, 2002
Bluehole Floodplain	SRG	TNC, BLM	4	High	Mature plants removed 2000-2002
Bluehole Meadow	SRG	TNC, BLM	2	High	Mature plants removed, 2000-2002, many immature plants removed 2002
Camp Collins Floodplain	SRG	Private	2	Medium	Mature plants removed 2001 and 2002
Cornwell Meadow	SRG	TNC, Metro, ODFW	30 8	High	Mature plants removed 1998 Small plants 1999, 2000, 2001, 2002
Diack, Kingfisher tracts	SRG	TNC	10	High	Scattered Mature Plants removed 1999-2000. Immature plants removed 2002.
Dispersed Sandy River Shoreline	SRG	BLM, Metro, ODFW, TNC, various private	1.5 1.5	Medium High	Scattered patches 1997-1999 Scattered patches 2000-1 Scattered patched 2001-2
East Oxbow Floodplain	SRG	Metro	6	High	Mature Plants removed 2000-2002
East Oxbow State Lands Floodplain	SRG	Metro, ODFW, Oregon State Parks	0.5	High	Some mature plants removed 2001 and 2
Indian John Island	SRG	Metro	1.5	High	Mature plants removed 2000-1, on southern portion of the island, continued in 2002
Jones Property Floodplain	SRG	Private - upriver seed source for Oxbow, Diack	2	Medium	Some mature plants removed 2001 and 2002
Main Oxbow Floodplain	SRG	Metro		High	Oxbow staff working on this site
Sandy River Islands (between Oxbow and E.Oxbow State Lands)	SRG	Metro, BLM , Oregon State Parks	2	High	Some mature plants removed 2000-2

SRG = Sandy River Gorge (River miles 12-19), TNC = The Nature Conservancy, BLM = Bureau of Land Management, ODFW = Oregon Department of Fish and Wildlife

Table 3.3 Change in Knotweed Stem Number in Sandy River Gorge 2001 to 2002

Macrosite	# of Microsites	2001 Shoot #	2002 Shoot #
01	1	70	46
02	3	23	5
04	8	179	32
05	13	244	140
06	8	73	29
09	42	577	97
11	25	362	60
12	3	5	0
13	1	140	71
14	13	10613	3331
17	87	3222	1768
18	40	839	98
19	12	138	29
20	45	4194	1464
21	17	321	105
22	27	610	236
24	13	276	399
27	43	552	198
TOTAL	**401**	**22438**	**8108**

A Macrosite represents a stretch of river.
A Microsite represents 1 or more patches of knotweed.
A patch represents an individual clump of stems - the smallest treatment unit.

Table 3.3a Sandy River Knotweed Treatment Sites - Spring 2002

Macrosite	# of Microsites	Shoot #
01	1	46
02	4	8
03	2	4
04	8	32
05	13	148
06	15	47
07	29	1070
09	55	261
11	33	108
12	3	0
13	2	86
14	15	3863
17	101	2073
18	41	100
19	15	41
20	49	1518
21	23	297
22	32	18263
24	29	1266
25	1	8
26	16	946
27	58	305
28	10	265
40	1	45
41	1	20
42	2	1750
43	2	560
44	6	4555
45	1	1000
46	1	2000
Total	**569**	**41045**

A Macrosite represents a stretch of river.
A Microsite represents 1 or more patches of knotweed.
A patch represents an individual clump of stems - the smallest treatment unit.

Table 3.4 – Cooperating private landowners as of June 18, 2002

Site#	Permission	Owner	Waterway	Site Location	Address	City	State	Zip Code	Second Name	Phone	Work Phone	Email
1	YES	ADAMS DAVID M &			34444 SE KIMBLEY RD	CORBETT	OR	97019	BARBARA D			
2	YES	ALLEN SUE	CREEK	20373 E. DONNEYDELL LN	P.O. BOX 8	BRIGHTWOOD	OR	97011		503-622-3611		
3	YES	EDUCATIONAL	SANDY	CAMP ANGELOS	32100 SE STEVENS RD	CORBETT	OR	97019	C/O GUS KRIARA			
	YES	BANTLE MARTIN		25286 E TREVINO CT, WELCHES	6741 W MERCER WAY	MERCER ISLAND	WA	98040		206-236-1411		
68	YES	BARON, LAURA	SANDY	UPSTREAM FROM REV. BRIDGE	16230 SE DUSTY LN	SANDY	OR	97055		503-668-4244		
4	TREATMENT	BOLSTER LOREN D JR	SALMON		27017 E ELK PARK RD	WELCHES	OR	97067		503-622-6431		
5	YES	BUND GEORGE JR &	SANDY		37100 SE LUSTED RD	BORING	OR	97009	VIRGINIA	503-663-3845		
6	YES	BURNS LAWRENCE &	SANDY	River access only	2318 SE 302ND AVE.	TROUTDALE	OR	97060	SHELLEY			
7	YES	CARMONY GLEN I &	CEDAR CREEK	along creek.. Near bridge	40191 SE FISH HATCHERY RD	SANDY	OR	97055	MARIAN A	503-668-4731		
	sent form 7/16/02	CHESTNUT, MIKE		66081 E BARLOW TR RD, RHODODEN.	PO BOX 216	BRIGHTWOOD	OR	97011				
8	YES	CLACKAMAS COUNTY			65200 E RIVERSIDE DR	OREGON CITY	OR	97045				
9	YES	CLACKAMAS COUNTY			902 ABERNETHY RD	OREGON CITY	OR	97045				
10	YES	CLACKAMAS COUNTY			BOULEVARD	CLACKAMAS	OR	97015				
11	YES	COX DAVID R &	CEDAR CREEK		40350 SE CEDAR CREEK LN	SANDY	OR	97055	MARY ANN SEKAVEC			
	YES	DARNIELLE BURT &			59182 E CABIN LN		OR		WENDY			
12	YES	DEMPSEY DIANE E	SANDY	26-R1	28536 SE CROWN POINT HWY	TROUTDALE	OR	97060				
13	YES	DOBSON JERRY	CEDAR CREEK	across from 40550 Bobtail Ln. - vacant lot	None	*	*					
26	SELF TREATMENT	DUETELL TOM	SANDY	Brightwood Tavern	23700 E CEDAR POINT CT	N	OR	97049	JUDITH A	503-341-1729		
14	SELF TREATMENT	ELKINS NEIL V &	SANDY	near Ten Eyck bridge	41200 SE BACON CREEK LN	SANDY	OR	97055	MARY L.	503-668-6353		
15	YES	ESPEDAL SCOTT			9015 NE CLIFF ST	PORTLAND	OR	97220				
16	COOPERATING	ESPENEL ANITA P	BEAVER CREEK		1004 E COLUMBIA ST	TROUTDALE	OR	97060	JERRY (son)	503-665-5578		
17	COOPERATING?	FLETCHER SCOTT	SANDY		13435 SE MARSH RD	SANDY	OR	97055			503-669-5275	
18	TREATMENT	FLORI JAMES D &	CEDAR CREEK		40460 SE BOBTAIL LN	SANDY	OR	97055	DENISE			
19	TREATMENT	FRANK WILLIAM W &	SANDY		27410 E ELK PARK RD	WELCHES	OR	97067	JACQUELINE A	503-622-5683		
20	YES	GAGER ELLEN			37427 SE LUSTED RD.	BORING	OR	97009				
21	YES	GILLIN BARRY J &	SALMON RIVER	27115 E ELK PARK RD	PO BOX 744	WELCHES	OR	97067	LAURA D	503-622-3509		
22	YES	GLASS JACK V &	SANDY		1409 SE CROWN POINT HWY	TROUTDALE	OR	97060	SHELLEY J			
23	COOPERATING	GOODWIN VIRGINIA M B	SANDY	HAGAR'S	29311 SE STARK ST	TROUTDALE	OR	97060				
24	SELF TREATMENT	GREVEN MAURICE M &	SANDY		23902 E MIRKWOOD LN	WELCHES	OR	97067	DARLA D	503-622-2666	503-519-8674	
25	YES	GUDGE PATRICIA F	BEAR CREEK		37336 SE LUSTED RD	BORING	OR	97009		503-663-7717		
27	SELF TREATMENT	HENNING MARTHA	SANDY	70925 AND 10939 E. JENNY LANE	7430 SW 76TH AVE.	PORTLAND	OR	97223	PETER STOCK	503-246-9837	503-997-4155	
28	YES	HESCOCK TERRY L	SANDY		19380 E SUMMERTIME DR	SANDY	OR	97055	CONNIE SCOTT	503-622-5754	503-223-8370	
29	YES	HOFELD LORNE E &	not on waterway	between big creek and pounder creeks	540 NE LITTLEPAGE RD	CORBETT	OR	97019	SHANNON M	503-695-3305	503-665-3117	
30	YES	JACKSON EARL R &	CEDAR CREEK	40355 SE Roads End Dr.	42774 SE COALMAN RD	SANDY	OR	97055	JANET ARLENE	503-668-5654		
31	COOPERATING	JENSEN LORINDA	CEDAR CREEK		40441 SE ROADS END	SANDY	OR	97055		503-668-5244		
32	COOPERATING	JONES DONALD M & BEVERLY S	GORDON CREEK	37710 SE GORDON CREEK RD	P O BOX 264	CORBETT	OR	97019		503-695-5491		
33	YES	JONES MICHAEL A &	SANDY		42700 SE TROUT CREEK RD	CORBETT	OR	97019	JONES,KRISTY A			
34	YES	JORDAN, STEVE	CEDAR CREEK		40460 SE CEDAR CREEK LANE	SANDY	OR	97055	LOUISE	503-668-2848		
	COOPERATING	KENNEDY TERRY DR.	NONE	OFFICE	2775 E. POWELL VALLEY RD.	GRESHAM	OR	97080				
35	COOPERATING	Kerslake Dan M	SANDY		32516 Se Stevens Rd	Corbett	OR	97019				
36	YES	KERSLAKE LYDA	SANDY		32544 Se Stevens Rd	Corbett	OR	97019	RICH	503-695-2710		
37	SELF TREATMENT	KERSLAKE RICH	SANDY		14208 SE NORTHWAY RD	CORBETT	OR	97019		503-695-2710		
38	COOPERATING	KESTER LOWELL L &	SANDY, LOWER		28200 E CROWN POINT HWY	TROUTDALE	OR	97060	SONJA K	503-661-6751		
39	YES	KIEFEL, WENDLIN	SALMON RIVER	~2730 ELK PARK RD, WELCHES	1750 NE 132ND AVE	PORTLAND	OR	97230	BERNADINE	503-253-3539		
40	YES	KIEFER RAYMOND F &	SANDY, LOWER		2211 SE CROWN PT HWY	TROUTDALE	OR	97060	PHYLLIS A			
	YES	KITCHEN, JIM	SANDY	39030 & 39020 SE SERBAN RD, SANDY	8028 SE 106TH	PORTLAND	OR	97266		503-775-4993		
	YES	KOKEN, JACK	CEDAR CREEK	40510 SE CEDAR CREEK LANE	PO BOX 1795	SANDY	OR	97055	FAYE MARIE	503-668-9695		
69	verbal yes/forms provided	LANE, MICHAEL (BOREN, MARTHA)	SANDY	UPSTREAM FROM REV. BRIDGE	16170 SE DUSTY LN	SANDY	OR	97055	MARTHA BOREN	503-668-7352		
41	mailed it 5.15.02	LZICAR, BOB		64375 E. BARLOW TRAIL RD	PO BOX 340	BRIGHTWOOD	OR	97011				
42	SELF TREATMENT	MARTENSON, JIM	SANDY	67044 E. JERRY'S LANE	P.O. BOX	WILDWOOD	OR	97067		503-622-4775		
43	YES	MARTIN MICHAEL T.	CEDAR CREEK		40220 SE CEDAR CREEK LANE	SANDY	OR	97055				
44	YES	MASSEY, JAMES &			59400 E HWY 26	SANDY	OR	97055	BETTY	503-622-4658		
	YES	MAXSON, BRETT	SANDY	LOT ON KUBITZ RD	11915 SE MADISON ST	PORTLAND	OR	97216				
45	COOPERATING	MCCAFFREY ANNE K	SANDY		16015 SE TEN EYCK RD	SANDY	OR	97055		503-668-5551		
	COOPERATING	MCCONAUGHY, BETTY	SALMON RIVER	27358 E ELK PARK RD	19815 E SUMMERTIME DR	SANDY	OR	97055		503-622-3852	503-963-7532	Betty.McConaughy@PacifiCorp.com
46	YES	MCNETT, DANIEL			22820 SE BORNSTEDT RD	SANDY	OR	97055		503-668-5938		
	YES	MOE, GARY	SANDY		39011 SE SERBAN RD	SANDY		97055		503-668-5361		tunaguy@msn.com
47	YES	MOIR GLENYCE R &	GORDON CREEK		37004 SE GORDON CREEK RD	CORBETT	OR	97019	DAVID A			
48	COOPERATING	MULLIGAN MICHAEL J	SALMON/SANDY	RENTAL PROPERTIES	23708 E CEDAR POINT CT	N	OR	97049				
	sent form 7/8/02	MULLIGAN MICHAEL		25210 ARRAH WANNA, WELCHES	PO BOX 534	WELCHES	OR	97067			503-622-3212	mike@mtnretreats.com
49	YES	NASH THOMAS K	SALMON		PO BOX 729	WELCHES	OR	97067				
	YES	NASH THOMAS K &	SALMON		66701 E CRYSTAL CREEK RD	BRIGHTWOOD	OR	97011	JANE	503-622-3260		
	YES	NEWMAN, HOWARD &	SANDY		52870 E CHERRYVULLE DRIVE	SANDY	OR	97055	BONNIE			
	YES	NORELL, STEPHAN G	SANDY		13511 SE MARSH RD	SANDY	OR	97055				
50	YES	PHILLIPS SANNYE	CEDAR CREEK		40348 SE CEDAR CREEK LANE	SANDY	OR	97055				
	COOPERATING	PORTLAND GEN ELEC CO		VARIOUS	121 SW SALMON ST	PORTLAND	OR	97204		503-464-8522		
51	YES	POWELL J RICHARD &	SANDY		59890 E MARMOT RD	SANDY	OR	97055	MARGIE	503-622-6325		
	sent form 6/18/02	RATHMAN, VERN			39200 SE SERBAN	SANDY		97055		503-668-7850		
	YES	RAYNE, STEVEN	SANDY	46766 SE BATY RD	46766 SE BATY RD	SANDY	OR	97055				
52	YES	RUSSELL L. MAGGIE	CEDAR CREEK		40200 SE CEDAR CK	SANDY	OR	97055		503-668-9080		
	sent form 7/17/02	SAYOWYCZ, STUART			19364 E SUMMERTIME DR	SANDY	OR	97055		503-622-6435		
53	YES	SCHEEL MITCH R	SANDY		19560 E SUMMERTIME DR	SANDY	OR	97055		503-622-6711	503-229-5618	
	COOPERATING	SCHMAKEL JIM	SANDY		42142 NW PALACE DRIVE	BANKS	OR	97106		503-324-4006	503-781-8601	
54	YES	SCHWARTZ TERRY	SANDY		2185 NW 153RD AVE.	BEAVERTON	OR	97006				
55	2001 ONLY!	SHEPPARD JUDY	CEDAR CREEK	17360 SE TEN EYCK	PO BOX 669	SANDY	OR	97055		503-668-6182	503-668-6242	
56	YES	SHEPPARD LISA	CEDAR CREEK	BEHIND 17360 SE TEN EYCK	PO BOX 1336	SANDY	OR	97055		503-668-6898		

Table 3.4 – Cooperating private landowners as of June 18, 2002

57	SELF TREATMENT	SIDEBOTTOM JOSEPH &	SANDY		38228 NE KNIERIEM RD	CORBETT	OR	97019	DIANE M	503-695-5922	
58	SELF TREATMENT	SMITH GARY R &	SANDY	near Ten Eyck bridge.	41590 SE BACON CREEK LN	SANDY	OR	97055	CAROLINE S R		
59	YES	SPA HARVEY	CEDAR CREEK		40342 CEDAR CREEK LN	SANDY	OR	97055			
60	COOPERATING	STONE MAGGIE	EAST HENRY CREEK		26635 E. HENRY CREEK RD.	N	OR	97049		503-622-1500	
61	YES	STREETER SALLY	SALMON		27233 E ELK PARK RD	WELCHES	OR	97067		503-622-5394	
62	COOPERATING	TANNLER ROBERT A	SALMON		PO BOX 202	WELCHES	OR	97067			
	COOPERATING	TANNLER ROBERT A	SALMON		25475 E ARRAH WANNA BLVD	BRIGHTWOOD	OR	97011			
	YES	TENNANT BETTY L.	CEDAR CREEK		40370 SE CEDAR CREEK LANE	SANDY	OR	97055		503-668-0448	
	YES	TROUT CREEK BIBLE CAMP INC	TROUT CREEK		38105 SE GORDON CREEK RD	CORBETT	OR	97019	C/O JOE FAHLMAN		
	COOPERATING	TROUTDALE CITY OF	SANDY	GLEN OTTO	1096 SE BEAVER CREEK LN	TROUTDALE	OR	97060			
	COOPERATING	TROUTDALE CITY OF	SANDY	GLEN OTTO	410 NW 257TH WAY	TROUTDALE	OR	97060			
63	COOPERATING	Urquhart John R	SANDY		28408 E Crown Point Hwy	Troutdale	OR	97060	Patricia B		
	YES	USKOSKI,GLENN	SANDY		38880 SE SERBAN RD	SANDY	OR	97055		503-668-9163	
	YES	VEENKER MICHELLE	SANDY		19636 SE SUMMERTIME	SANDY	OR	97055		503-492-4885	
64	COOPERATING	WAAGE GERALD A &	SANDY		29233 SE STARK	TROUTDALE	OR	97060	DONNA		
65	TREATMENT	WILLIAMS MITCH	SANDY		60180 E BARLOW TRAIL RD	BRIGHTWOOD	OR	97011		503-622-5800	
66	YES	WILSON TERRY VALE &	SANDY	19100 Clubhouse Rd, Sandy, 97055	19100 CLUBHOUSE RD	SANDY	OR	97055	KENNETH J	503-622-5374	503-522-4413
67	YES	WYSS RICHARD R &	SANDY		28432 E CROWN POINT HWY	TROUTDALE	OR	97060	MARGARET G	503-665-6703	
	COOPERATING	Y M C A Of Columbia-willamette			621 Sw Alder St #9	Portland	OR	97205			
	TREATMENT	YANKAUSKAS JERRY W &	SANDY	Near Ten Eyck bridge	41400 SE BACON CREEK LN	SANDY	OR	97055	GLORY A	503-668-3943	
	YES	YOUNG ROBERT &	CEDAR CREEK		40250 SE FISH HATCHERY RD	SANDY	OR	97055	KARON	503-668-7448	503-231-3839

Table 3.5a Knotweed control research - East Oxbow Treatment Site: Summary by treatment

Spring Treatment	Fall Treatment	Method	Herb	Code	Mean Reduction 2001	Standard Deviation 2001	Mean Reduction 2002	Standard Deviation 2002
Herb	Herb	Foliar	G	HHFG	97	4.4	100	0.0
Manual	Herb	Foliar	G	MHFG	94	5.2	100	0.0
Summer Herb	None	Foliar	G	SFG	96	7.5	100	0.0
None	Cut to 1.5m Herb	Foliar	G	NcHFG	72	6.6	98	1.0
Herb	Herb	Foliar	R	HHFR	100	0.5	98	2.4
Manual	Herb	Foliar	R	MHFR	96	3.2	98	2.6
None	Cut and Herb	Stem	R	NcHSR	85	13.2	92	1.2
Herb	Herb	Stem	R	HHSR	93	6.0	91	7.0
None	Cut to 1.5m Herb	Foliar	R	NcHFR	74	25.7	84	14.0
Herb	Herb	Stem	G	HHSG	96	7.8	83	29.3
Manual	Herb	Stem	G	MHSG	37	21.6	72	27.6
None	Cut Herb Resprout	Foliar	R	NcHrFR	43	14.7	59	59.3
None	Cut and Herb	Stem	G	NcHrFR	-92	21.5	37	33.6
None	Cut Herb Resprout	Foliar	G	NcHrFG	43	55.9	25	68.6
Manual	Manual	Cutting	NO	MM	-39	50.7	17	94.3
Manual	Herb	Stem	R	MHSR	8	48.8	-27	152.6
Summer Herb	None	Stem	G	SNSG	17	37	-31	40.9

Table 3.5b

Japanese Knotweed: East Oxbow Treatment Site
Summary results by plot: May 2000 to June 2002

	Spring	Fall			Maximum Shoot Number								
Plot #	Treatment	Treatment	Method	Herb	sp 2000	sp 2001	Spr 2002	Red yr1	Red yr 2	Mean Y1	STD Y1	Mean Y2	STD Y2
6	Manual	Manual	Cutting	NO	25	27	16	-8	36	-38.7	50.68	-17	94.26
13	Manual	Manual	Cutting	NO	239	265	144	-11	40				
17	Manual	Manual	Cutting	NO	71	140	160	-97	-125				
21	Herb	Herb	Foliar	G	79	6	0	92	100	97.5	4.38	100	0.00
25	Herb	Herb	Foliar	G	53	0	0	100	100				
43	Herb	Herb	Foliar	G	20	0	0	100	100				
7	Herb	Herb	Foliar	R	69	0	0	100.0	100	99.7	0.47	98	2.84
12	Herb	Herb	Foliar	R	81	0	0	100	100				
26	Herb	Herb	Foliar	R	122	1	6	99	95				
14	Herb	Herb	Stem	G	22	0	0	100	100	95.5	7.76	83	29.30
18	Herb	Herb	Stem	G	33	0	0	100	100				
19	Herb	Herb	Stem	G	67	9	34	87	49				
4	Herb	Herb	Stem	R	30	4	5	87	83	93.2	5.96	91	6.98
9	Herb	Herb	Stem	R	93	5	3	95	97				
23	Herb	Herb	Stem	R	60	1	4	98	93				
16	Manual	Herb	Foliar	G	50	4	0	92	100	94.1	5.22	100	0.00
22	Manual	Herb	Foliar	G	51	5	0	90	100				
35	Manual	Herb	Foliar	G	31	0	0	100	100				
5	Manual	Herb	Foliar	R	16	1	0	94	100	96.4	3.22	98	2.60
11	Manual	Herb	Foliar	R	111	5	5	95	95				
38	Manual	Herb	Foliar	R	73	0	0	100	100				
15	Manual	Herb	Stem	G	55	45	32	18	42	37.5	21.64	72	27.55
41	Manual	Herb	Stem	G	23	9	5	61	78				
44	Manual	Herb	Stem	G	48	32	2	33	96				
29	Manual	Herb	Stem	R	45	65	25	-44	44	8.5	48.76	-27	152.59
30	Manual	Herb	Stem	R	55	45	166	18	-202				
32	Manual	Herb	Stem	R	31	15	7	52	77				
31	None	Cut and Herb	Stem	G	48	96	28	-100	42	-91.6	21.54	37	33.64
33	None	Cut and Herb	Stem	G	210	351	208	-67	1				
37	None	Cut and Herb	Stem	G	65	135	21	-108	68				
8	None	Cut and Herb	Stem	R	62	6	3	90	95	85.4	13.18	92	9.42
24	None	Cut and Herb	Stem	R	61	18	0	70	100				
45	None	Cut and Herb	Stem	R	22	1	4	95	82				
3	None	Cut and Herb Respro	Foliar	G	91	48	78	47	14	42.5	55.93	25	68.57
20	None	Cut and Herb Respro	Foliar	G	32	37	44	-16	-38				
27	None	Cut and Herb Respro	Foliar	G	123	5	2	96	98				
10	None	Cut and Herb Respro	Foliar	R	34	25	37	26	-9	43.0	14.65	59	59.29
36	None	Cut and Herb Respro	Foliar	R	104	54	12	48	88				
42	None	Cut and Herb Respro	Foliar	R	68	31	1	54	99				
34	None	Cut to 1.5m Herb	Foliar	G	98	22	1	78	99	71.6	6.63	98	1.16
39	None	Cut to 1.5m Herb	Foliar	G	90	32	3	64	97				
40	None	Cut to 1.5m Herb	Foliar	G	220	60	5	73	98				
1	None	Cut to 1.5m Herb	Foliar	R	190	2	50	99	74	74.5	25.69	84	14.00
2	None	Cut to 1.5m Herb	Foliar	R	112	26	24	77	79				
28	None	Cut to 1.5m Herb	Foliar	R	88	46	0	48	100				
46	Summer Herb	None	Foliar	G	25	0	0	100	100	95.7	7.45	100	0.00
48	Summer Herb	None	Foliar	G	31	4	0	87	100				
49	Summer Herb	None	Foliar	G	32	0	0	100	100				
47	Summer Herb	None	Stem	G	34	19	36	44	-6	17.1	36.96	-31	40.92
50	Summer Herb	None	Stem	G	31	21	34	32	-10				
51	Summer Herb	None	Stem	G	28	35	50	-25	-79				

Table 3.6

Statistical comparison of different knotweed treatments May 2000-June 2002

Treatment Comparison	**P value**
Garlon vs Rodeo	0.0688
Herbicide vs Manual	0.0031
Foliar vs Stem	<0.0001
Garlon: Foliar vs Stem	0.001
Rodeo: Foliar vs Stem	0.0018
Spring and Fall vs Fall only	0.0043
Spring and Fall vs Summer	0.038
Fall vs Summer	0.9401

Japanese Knotweed Series
Plot 6, Manual Control

Photo 1, June 2000: One month after first cutting of 25, 1 meter tall stems

Photo 2, August 2000, 26 stems

Photo 3, September 2000: 29 stems

Photo 4, October 2000: 31 stems

Summary: Manual control plots were cut at ground level once a month.

Japanese Knotweed Series
Plot 6, Manual Control

Photo 5, April 2001: 18 stems

Photo 6, May 2001: 27 stems

Photo 7, June 2001: 37 stems

Photo 8, July 2001: 20 stems

Japanese Knotweed Series

Plot 6, Manual Control

Photo 9, August 2001: 23 stems

Photo 10, September 2001: 67 shoots

Photo 11, October 2001: 13 stems

Photo 12, April 2002: 12 stems

Japanese Knotweed Series

Plot 6, Manual Control

Photo 13, May 2002: 16 stems

Photo 14, June 2002: 8 stems

Photo 15, August 2002: 1 stem

Japanese Knotweed Series

PLOT 22, SPRING MANUAL/FALL HERBICIDE, FOLIAR TREATMENT, GARLON

Photo 1, June 2000: One month after cutting 51, 1.5 meter stems. Note cut stems in foreground.

Photo 2, August 2000

Photo 3, September 2000: Date of foliar treatment

Photo 4, October 2000: One month after foliar treatment

Summary: Foliar treatment is low-pressure spray w/ 5% Garlon 3a, w/ 1% surfactant (Sylgard or R-11 in 2000, Hasten in 2001).

Japanese Knotweed Series
PLOT 22, SPRING MANUAL/FALL HERBICIDE, FOLIAR TREATMENT, GARLON

Photo 5, April 2001; 0 stems present

Photo 6, May 2001

Photo 7, June 2001

Photo 8, July 2001: 2 stems

Japanese Knotweed Series

PLOT 22, SPRING MANUAL/FALL HERBICIDE, FOLIAR TREATMENT, GARLON

Photo 9, August 2001: 3 stems

Photo 10, September 2001: 5 stems

Photo 11, October 2001: 2 stems

Photo 12, April 2002: 0 stems

Japanese Knotweed Series

PLOT 26, SPRING HERBICIDE/FALL HERBICIDE FOLIAR TREATMENT, RODEO

Photo 13, May 2002: 6 shoots. Note encroachment of reed canarygrass is controlled by Rodeo.

Japanese Knotweed Series

PLOT 26, SPRING HERBICIDE/FALL HERBICIDE FOLIAR TREATMENT, RODEO

Photo 1, June 2000: 122, 0.3 meter shoots

Photo 2, August 2000: Note dying shoots.

Photo 3, September 2000: No living shoot.

Photo 4, October 2000: 1 living shoot, note dead reed canaraygrass.

Summary: Plot reduced from 122 shoots to 1 shoot in June 2001. Rodeo applied in spring and fall also appears to give good control of reed canarygrass.

PLOT 26, SPRING HERBICIDE/FALL HERBICIDE FOLIAR TREATMENT, RODEO

Photo 5, April 2001: 1 living stem.

Photo 6, May 2001: 1 living stem.

Photo 7, June 2001: 1 living stem.

Photo 8, July 2001: 1 stem

Japanese Knotweed Series
PLOT 26, SPRING HERBICIDE/FALL HERBICIDE FOLIAR TREATMENT, RODEO

Photo 9, August 2001: 2 shoots

Photo 10, September 2001: 1 shoot

Photo 11, October 2001: 0 shoots

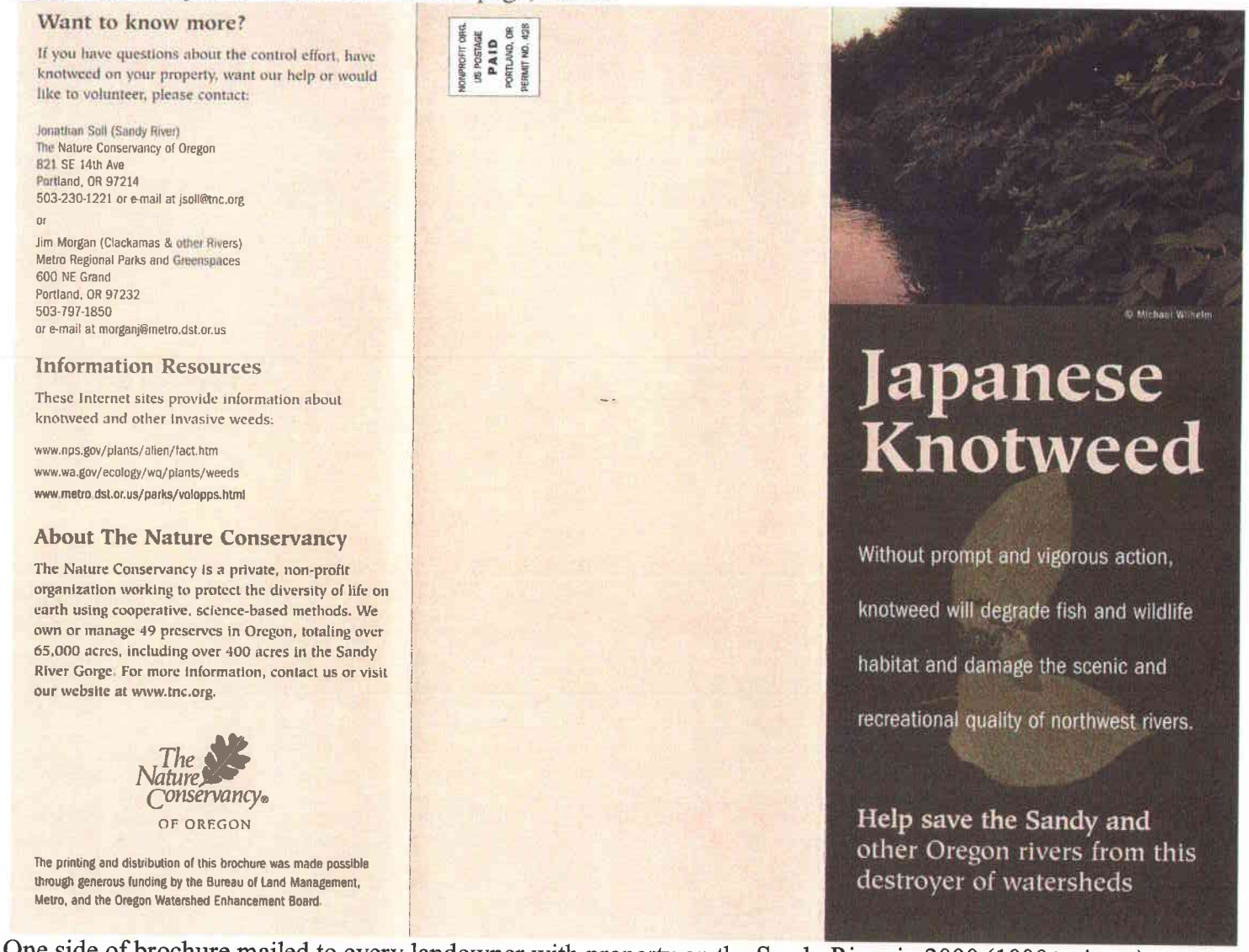
Photo 12, April 2002: 5 shoots

Japanese Knotweed Series

PLOT 22, SPRING MANUAL/FALL HERBICIDE, FOLIAR TREATMENT, GARLON

Photo 13, May 2002: 0 stems

Figure 3.13a Japanese knotweed brochure page, outside



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

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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

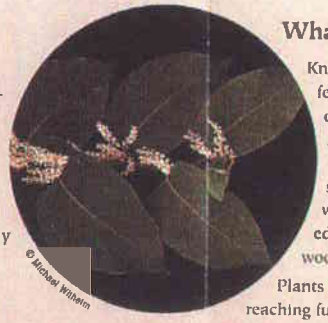
One side of brochure mailed to every landowner with property on the Sandy River in 2000 (1000+ pieces) , to properties within 1/4 mile of the Sandy and major tributaries in 2001(4000+ pieces) and to property owners on upper mainstem Sandy and selected tributaries in 2002 (160 pieces)

Figure 3.13b Japanese knotweed brochure, inside page

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.



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.

Second side of brochure mailed to every landowner with property on the Sandy River in 2000 (1000+ pieces) , to properties within 1/4 mile of the Sandy and major tributaries in 2001(4000+ pieces) and to property owners on upper mainstem Sandy River and selected tributaries in 2002 (160 pieces)