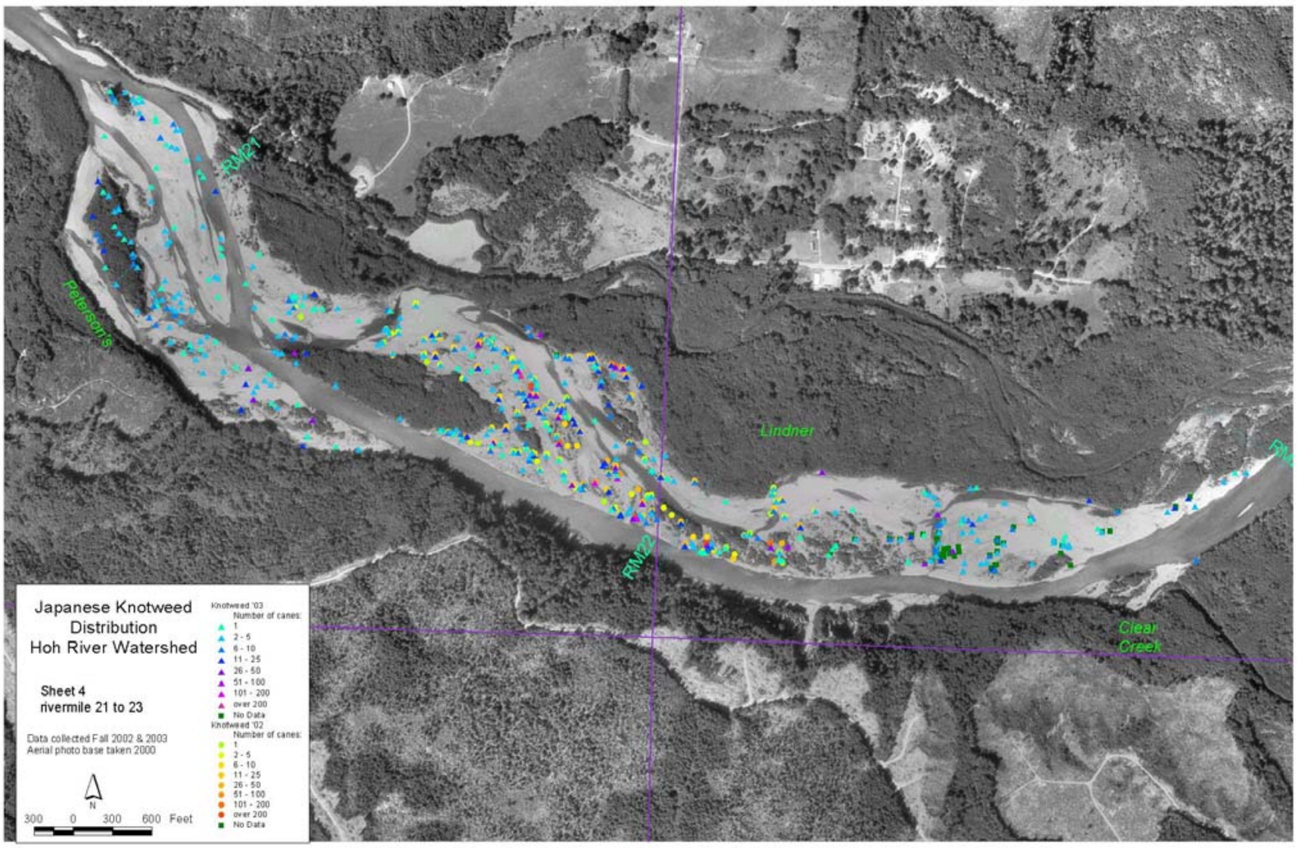
KNOTWEED CONTROL ON THE HOH RIVER SUMMARY REPORT – 2002 TO 2004



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Introduction

In the Pacific Northwest, the replacement of native vegetation by knotweed species poses a threat to the development and growth of riparian forests, recruitment of in-stream woody debris, and nutrient cycling and food production, potentially affecting river function and fish and wildlife habitat and productivity. In many Washington State rivers, dense knotweed thickets completely cover acres of stream-adjacent ground, making control impossible without multiple years of costly control. Because of the adverse effects on the functions of riparian zones upon which salmon and other species depend, control of knotweed is becoming a significant component of salmon recovery efforts in western Washington State.

This report describes the objectives and results of a multi-year project to completely eradicate knotweed in 29.5 river miles of the active Hoh river channel migration zone and adjacent terraces. The Hoh River, located on the west coast of the Olympic Peninsula in Washington State, is one of the few relatively healthy wild salmon-bearing rivers in the lower 48 states. In 1998, one clump of the invasive knotweed (*Polygonum cuspidatum s. lat.*) was observed at the edge of the river's channel migration zone (CMZ) at river mile (RM) 29.5. In 1999, this one plant was transported downstream during a winter storm event, giving rise to a population of knotweed that quickly became widely distributed within the Hoh River CMZ to the river's mouth. Recognizing the potential threat to critical habitats, the Hoh Tribe initiated a project in 2002, beginning the comprehensive river surveys, control, and effectiveness monitoring activities that continue today.

1. Project Objectives

The primary objective of this project is the complete eradication of knotweed in order to protect the natural processes that support functional riparian and aquatic habitats and associated species, including Pacific salmon. Additional objectives are to provide data for analysis of this plant's ecology and behavior in Pacific Northwest riverine ecosystems.

2. Background of the Hoh Project

The Hoh Tribe conducted field inventories using Geographic Information System (GPS) technology in the summer and fall of 2002 – approximately four years after the source plant first moved - mapping 9,600 knotweed canes (stems) between RM 29.5 and RM 9.5. In the following year, 2003, 18,585 canes were mapped in the river floodplain between the original location at RM 29.5 and RM 9.5. Knotweed control began in late summer 2003, and covered the area mapped in previous surveys. In 2004, the non-profit 10,000 Years Institute continued the control work in partnership with the Hoh Tribe, Olympic National Park, the Department of Natural Resources, and Clallam and Jefferson County noxious weed control staff. During the summer of 2004, the entire river corridor from RM 29.5 to the river's mouth was mapped or remapped, and treated.

The Hoh Tribe provided funding for the project in 2002 and 2003. Outreach and education generated support from local, state, and federal agencies and private landowners in the watershed. 2004 funding was provided by the National Fish and Wildlife Foundation through the North Olympic Community Salmon Fund. In-kind donations were received from the Wild Salmon Center for GIS work, the Northwest Indian Fisheries Commission for public education, the Hoh Tribe in the form of current aerial photos and GIS equipment, and Clallam County Noxious Weed Board for equipment, coordination and public outreach. An additional in-kind donation came from Olympic National Park, whose staff surveyed and treated knotweed found in the coastal strip on the north side of the Hoh River.

3. Knotweed Control Methods

A number of noxious weed experts were consulted and all available methods were considered for the Hoh River project. Through this process, we determined that herbicide application was the only feasible method to control knotweed in an active CMZ. The Hoh River knotweed control project employed three methods of herbicide application. The first two methods consist of injection of herbicide directly into the cane of large plants; the third method involves spraying foliage of small plants.

Control methods in 2003 consisted of injection of 5 cc herbicide using veterinary syringes for canes larger than ¾", and targeted spray (10% active ingredient concentration) for canes smaller than ¾".

Control methods in 2004 consisted of injection using the JK Injection Tool® and 3 cc Aquamaster® per cane for large plants, and targeted spray of Aquamaster® and LI 700® (5% concentration) for small plants. *(Note: LI-700 is no longer recommended as a surfactant for aquatic use.)*

4. Planning and Logistics

To establish where knotweed was located in the Hoh River floodplain, we began surveys at the most upstream location and worked downstream. Logistics of knotweed control efforts for the Hoh project included:

- Field surveys
- Mapping
- Effectiveness monitoring
- Obtaining permits, agency approvals and insurance
- Contacting landowners for permission to access private lands
- Organization of vehicles
- Herbicide application and maintenance of equipment

Field Surveys

The Hoh River CMZ is particularly wide and active, over a mile wide in some reaches; and is complicated by multiple active and relict channels, forested islands, and vegetated and open gravel bars. Well-established knotweed plants often grow in large clumps that are easily seen on bare gravel bars, but in the forested terraces and vegetated bars, finding small individual knotweed plants hidden in a matrix of native vegetation and woody debris is similar to 'looking for a needle in a haystack', and requires extensive and diligent survey efforts.

2002

The initial 2002 Hoh River knotweed survey was accomplished by rafting the river in sections, beginning above the uppermost point of infestation at RM 29.5, and stopping at each meander to survey the floodplain complex using a Trimble Pro XL GPS unit. The GPS unit contained a data dictionary describing knotweed and location attributes (e.g., plant size, location, substrate, erosion hazard, and treatment method; see Appendix 1). Large clumps of knotweed were frequently visible from the river, but others were mixed with native vegetation on either side of the wetted channel, often a significant distance from the channel. Recent aerial photos were an invaluable tool in documenting the area surveyed each day. In certain reaches confined by bedrock or requiring a very long overland hike to reach, access by boat is the only reasonable way to reach the site. We ended surveys at RM 9.5 in late September.

2003

Surveys in 2003 were conducted in conjunction with treatment, and covered the same distance on the river, from RM 29.5 to RM 9.5. Access was only by land, and we were unable to survey the two canyon reaches accessible only by boat. We employed a 15-person DNR Olympic Correctional Camp (OCC) crew accompanied by two OCC supervisors and two project field crew leaders, who also conducted the GPS mapping. The project was implemented in September, relatively late in the growing season, and most plants were fully developed - tall and brightly-colored against the paler greens of the native willow, alder, maple and cottonwood.

Our 2003 survey methods generally followed the low flow channel patterns up and across floodplain complexes. Log jams or single logs on gravel bars are especially prone to catching floating debris including knotweed fragments, and often had knotweed along them. Low islands of willows and alders performed the same trapping function, and were generally infested with knotweed plants. Due to time constraints in 2003, higher conifer-forested terraces were not surveyed. We believed at the time that the likelihood of knotweed infestation of those areas was very low, and thus gave those areas a lower priority to the high erosion hazard open channel areas.

2004

Fieldwork began in July, 2004 and ended in September. We covered the entire river corridor to the mouth, except one area that was inaccessible due to riverbank revetment construction underway by the Washington Department of Transportation. 2003 treatment was apparently so successful that we found mostly very small plants – less than 2 feet high with one or two stems. This change in visibility required a change in survey methods to an intensive tightly-spaced grid covering every foot of floodplain or terrace. Ten OCC crew members were spaced between 15 and 30 feet apart, moving slowly up and down or across the river corridor, covering ground ranging from open to densely vegetated. Crew members were required to be in visual and verbal contact with the person on their right and left. The crew was monitored by one OCC supervisor and two project field supervisors. Large log jams were especially difficult to survey, and slowed the progress of the survey line considerably. To mark the outer edge of each survey line, the two outer crew members hung flagging when reversing the direction of the line upon reaching the survey area boundary. We extended our surveys to river-adjacent terraces and fully-shaded forested floodplains, and discovered some mature and immature knotweed in these areas.

Mapping

We used the most recent aerial photos available provided by the Hoh Indian Tribe covering the entire river floodplain and channel from the initial infestation to the mouth. We divided the river into sections based on ease of access to river bars. Each bar or section was named (using some known attribute such as a tributary, campground, landowner, or local name), and these names were used during GPS mapping. The Data Dictionary in Appendix 1 contains a complete list of mapping attributes. River migration resulted in many changes to the floodplain and valley bottom. Some river bars located on the left bank in 2003 are now on the right. Others have either disappeared or became larger. Thus, the locally-named river bar areas reported in our data analysis are not exactly comparable, but this will be corrected by a GIS analysis based on UTMs.

Maps were constructed from the GPS data to depict changes in plant distribution and results of treatment, and plotted over new aerial photos also showed evidence of channel migration (Figure 1, following). The effectiveness of treatment was determined retrospectively by evaluating trends in distribution and abundance over time. The location maps were used to determine whether the plant was previously detected and what treatment was received.

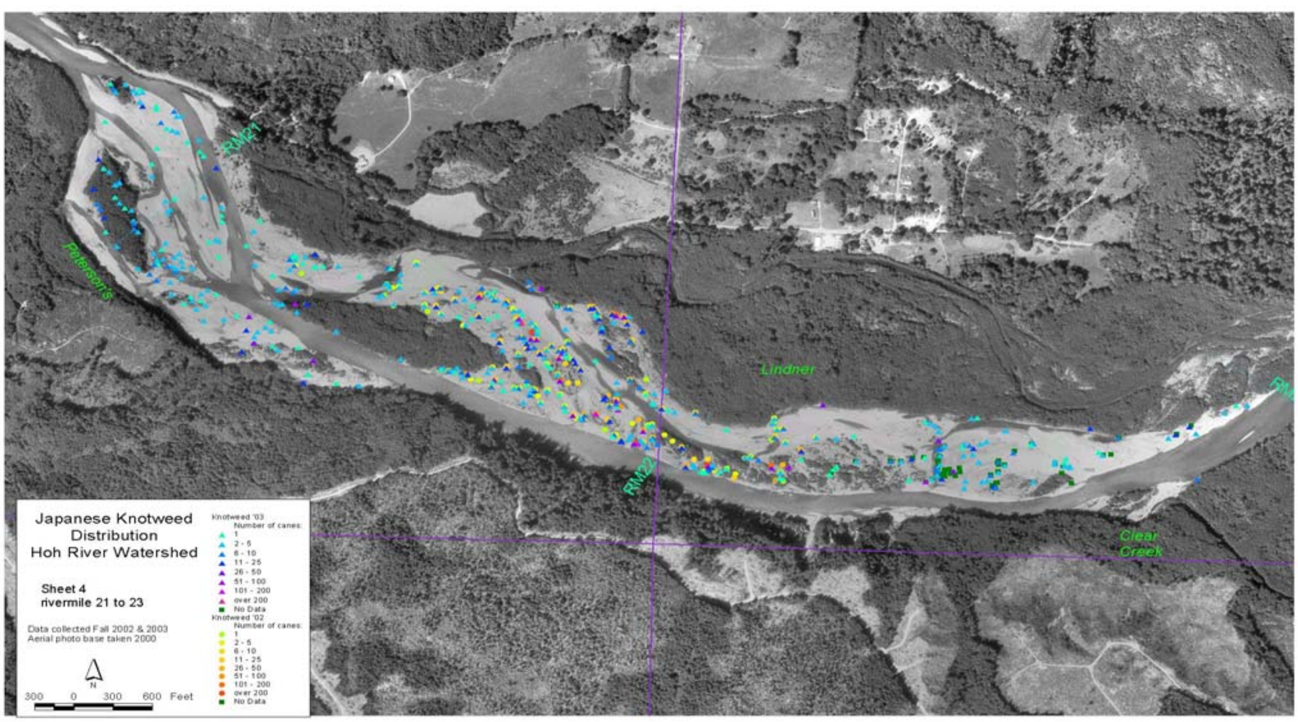


Figure 1. Cane counts from 2003 and 2004 GPS data points plotted onto an aerial photo.

Effectiveness Monitoring and Treatment Documentation
Project coordinators conducted repeat visits to specific treated sites to ascertain treatment effectiveness. It was not feasible to revisit every treated plant, or even every treatment locality. Surveys focused on areas with particularly high erosion hazard, and where treatments were potentially less active (eg: crew training area, cane splitting, dew, poor weather conditions). Effectiveness surveys consisted of visually checking treated areas for plant die back.

Colored biodegradable flagging was used to track plant treatment. Without such flagging system, it would be difficult to ascertain treatment effectiveness as it would be unclear what kind of treatment was applied, or whether a plant was overlooked. Ideally, we would have had time to take positions and notes, but lacking that, we took photos and made notes in field notebooks and transferred those to our Access database.

Our flagging system follows:

Hot Pink*:	Mapped in 2002	(*not available in biodegradable materials)
Red:	Not Treated, Not Mapped	(temporary flagging only)
Yellow:	Mapped	
Orange:	Injected	
Blue:	Sprayed	
Striped flagging	* used for grid edge	(*not available in biodegradable materials)

Flagging made the survey and monitoring system more flexible and effective, and prevented accidental duplication of treatment. Depending on the field conditions or staffing for a certain day, the mapping crew could be either ahead or behind the treatment crew. If the mapper were ahead, a yellow flag was attached, and the anticipated treatment for a cluster would be recorded (no treatment, inject, inject and spray, or spray). If the crew located unmarked plants, they would call back the mapper. In most cases the mapping crew would work behind the treatment crew. The flagging left by the treatment crew indicated the treatment that was applied. If a knotweed plant was encountered by the mapper that had not been flagged, it would be assumed that crew had missed the plant, and crew would be called back. This provided additional incentive for the crew to do a good job, and overall, there was greater assurance that the job was done correctly.

Although much of it disappears with floods and animals, flagging found from previous years is also helpful in determining effectiveness of treatment.

Permits, Approvals and Insurance
We contacted all agencies and public landowners in the watershed to ensure that the project would be in compliance with all permitting requirements and regulations. The bed of the Hoh River is largely owned and managed by the State Department of Natural Resources, and on the Hoh River, some sections are owned by families who homesteaded before statehood.

The field crew leader for the Hoh project is a private licensed pesticide operator. Depending on proximity to water, application of herbicides may require a permit from USDA and/or State

Department of Ecology. The Hoh River project avoided situations where herbicide would enter water, and thus, permits were not required.

Non-profits or other non-governmental organizations using herbicides to control invasive weeds on private lands require either a use agreement with the landowner or insurance to cover possible damages. "Volunteer and Use Agreements" were developed for the Hoh project between private landowners and 10,000 Years Institute.

Private Landowner Outreach and Property Access
Landowner outreach was critical to the success of this project. Outreach included communications with and education of local landowners and community members, who were important for gaining access to infested areas and for developing community support for the project. We reviewed county records to establish the identity and addresses of landowners controlling important access routes and contacted them via letter, phone, or personal visit. We developed a short summary brochure to describe the plant and the problem it represents, and to provide contact information, as well as using the brochure distributed by Clallam County. To provide public information about the project and problem, several newspaper articles on the project and the problem were printed in area newspapers over a six-month period, including one accompanied by a noxious weed insert from the State Weed Control Board.

All landowners we contacted were supportive of the project with the exception of a few in the lower portion of our 2003 project. These citizens expressed concern within the local community (not directly to us) about herbicide spray, and subsequently did not provide access across their lands. A number of attempts were made to meet with these citizens to explain the project, unfortunately without success. Because these were not homesteading landowners, in 2004, we gained access from the river, thereby avoiding the need for permission at these sites.
In addition to landowner permission, one or more established routes to each survey reach greatly simplified logistics.

Vehicles
We used (and recommend) a ventilated closed-canopy pickup or crew bus that separated herbicide from crew.

Herbicide Application Methods and Equipment Maintenance
There are four general types of herbicide applications recommended for knotweed species: injection, spray, cut/spray, and cut/wipe. We used injection and spray methods. Two injection methods were employed - in 2003, we used veterinary syringes and hypodermic needles; in 2004, we used the injection gun developed specifically for knotweed.

We selected herbicides based on recommendations from noxious weed experts and specific applicability for knotweed and the riparian corridor setting. In 2004, we used undiluted Aquamaster® for injection, and Aquamaster® with LI-700® as a spray mixture.

Because storage of herbicide requires a secure, frost free, and well-ventilated shed or outdoor building, we coordinated with Olympic Region Washington Department of Natural Resources (DNR) in Forks for use of their herbicide shed.

At the end of each day, equipment such as the injection guns, extra canisters, and hand sprayers, and supplies such as gloves were triple-rinsed in a gravel driveway miles away from flowing water, and the rinsate captured in a plastic bucket for use in the spray mixture. We wore hip waders and rubber gloves while rinsing. DNR triple-rinsed our herbicide containers for disposal.

Crew Training

Oversight of crew, and crew motivation and training were crucial to the success of treatment. As we assumed a more informed crew is also more motivated, crew training covered all facets of the control project, including river ecology, knotweed ecology, safety, and control methods.

We often followed a crew member from a short distance, to make sure treatments were properly applied, and no knotweed plants were missed. If treatments were improper, or plants were missed, we would call back crew, and follow up with individualized training.

Several plants can be mistaken for small knotweeds (seedlings of bigleaf maple, young cottonwood, and Rumex spp., etc.), and knotweed plants with herbicide damage from the previous treatment season, are often so modified that they may not be recognized.

5. Results and Discussion

2003 Injection Treatment Results

Injections appeared to be very effective in 2003, as observed by changes in distribution and density in the spring and summer of 2004. It appeared that plant biomass was reduced by greater than 98 percent. Rarely, and only in a few areas, an occasional cluster was found that showed dramatically lower treatment success. This was attributed to poorly-applied treatment methods, especially in areas where we had many plant clusters in brushy conditions and visibility was poor.

Exposed plants responded within 7-10 days to injection treatment with leaves yellowing and beginning to fall. Shaded plants did not show much response to treatment within that timeframe. After 21 days, most exposed plants had lost the majority of leaves, and any remaining leaves were yellow. Systematic observations of shaded plants were not made at this time.

It has been reported that each cane has a separate rhizome and therefore if each cane in a clump of canes is not injected, these rhizomes would survive and propagate the plant the following year. Although we did not test this specifically, our field observations do not support this assumption. We only rarely saw large canes surviving, even in the large clusters with hundreds of canes. Either we did a remarkable job injecting every injectable cane, or there is considerable connectivity between clusters. From limited excavations performed in silt soils on the Dickey River, we learned that a single rhizome actually produces multiple canes. We do not know whether this phenomenon is common.

Knotweed experts report that complete knotweed control requires several years in optimal conditions. We also observed that some individual knotweed clumps survived the treatment process. Small sprouts were seen near the some previously treated clumps, although at times moderately sized clumps (fewer than 50 canes) were completely controlled with a single treatment. We observed three different types of survival/regeneration following the injection treatment.

Type 1 Missed plants

It is likely that some plants and some canes in clumps were overlooked during surveys or treatment application. In relatively small clumps with fewer than 10 large canes, it was easy to track treated canes as treatment proceeds. In larger clumps, especially those of more than 100 canes, this became more difficult, especially when plants were growing among dense native vegetation or debris accumulations. Crews attempted to track treated canes as they worked through the clumps by marking with permanent ink pens, but in wet conditions, the ink smeared and disappeared. Long strips of flagging were also pulled behind canes that had been treated as the applicators moved farther into clumps. Bending the canes was attempted, but we found it difficult to do without splitting the canes. Some operators report using spray paint to mark treated canes.

Type 2 Inadequate dosage

We occasionally observed herbicide-damaged sprouts from plants that had received treatment. This condition was not particularly common on the Hoh River; we observed it approximately 20 times during our 2004 fieldwork. When observed, it was generally within the remnants of the original treated clump. It appeared most frequently on large clumps with a large amount of exposed rhizome mass resulting from erosion. We speculate that the rhizome can be so large that treating above-ground vegetation does not kill it.

Type 3 Recently separated rhizomes

We hypothesize a situation where shoots appear to grow from rhizomes that at the time of treatment did not have any above ground parts, and were likely not connected to any rhizome that received treatment in the previous year. Many of the new shoots we observed on smaller and medium sized clumps may be of this type for one of two reasons: 1) Canes are very small (usually smaller than 3 feet), and 2) Resprouting canes show no sign of herbicide damage.

2003 Spray Treatment Results

In 2003, spraying was limited to small plants that were not injectable. In one location where almost all plants were small and exposed, our late season ten percent Glyphosate spray treatment was 100 percent effective in a single application in warm and dry weather. In another area, where plants were more shaded and the leaves were damp, the spray treatment was considerably less effective. During visits made within 12 days of spraying, neither exposed nor shaded plants had responded noticeably to spray applications. Shortly after these effectiveness surveys, the river rose 15 feet at the Hoh Oxbow gauge (RM 19), and systematic observations were not possible after the flood event as most bars had been scoured by the flood event. From these limited observations, along with mid-season observations in 2004 using a five percent

Glyphosate spray, we conclude that it is important that plants be dry, ‘thirsty’, and must remain dry for some time after treatment. Spraying damp leaves, or spraying followed by mist shortly after treatment is very likely to reduce treatment effectiveness substantially.

Table 1 below illustrates the locations and total number of plants and cane counts for 2002 and 2003.

YEAR	Total number plant groups	Anderson	Brandeberry	Canyon Creek	Clear Creek	Coontz Bar	Coontz LB	Cottonwood	Dengate Island	Lewis Channel	Lindner	Morgan's Crossing	Old Joe's Slough	Owl Creek	Owl Creek RB	Peterson's Bar	Schmidt's Bar	Spruce Canyon	Spruce Canyon LB
2002	731	33	42	32	35	3	126	8	-	47	195	26		53	8		99	17	7
2003	1247		175	41	75	-	21	52	49	39	339	4	15	224	-	111	89	13	-
	Total number canes																		
2002	9622	319		932	-	7	1925	326	-	-	3299	-	-	869	49		1437	133	326
2003	18585	-	4108	1046	729	-	136	813	125	505	3717	15	181	4517	-	559	1798	336	-

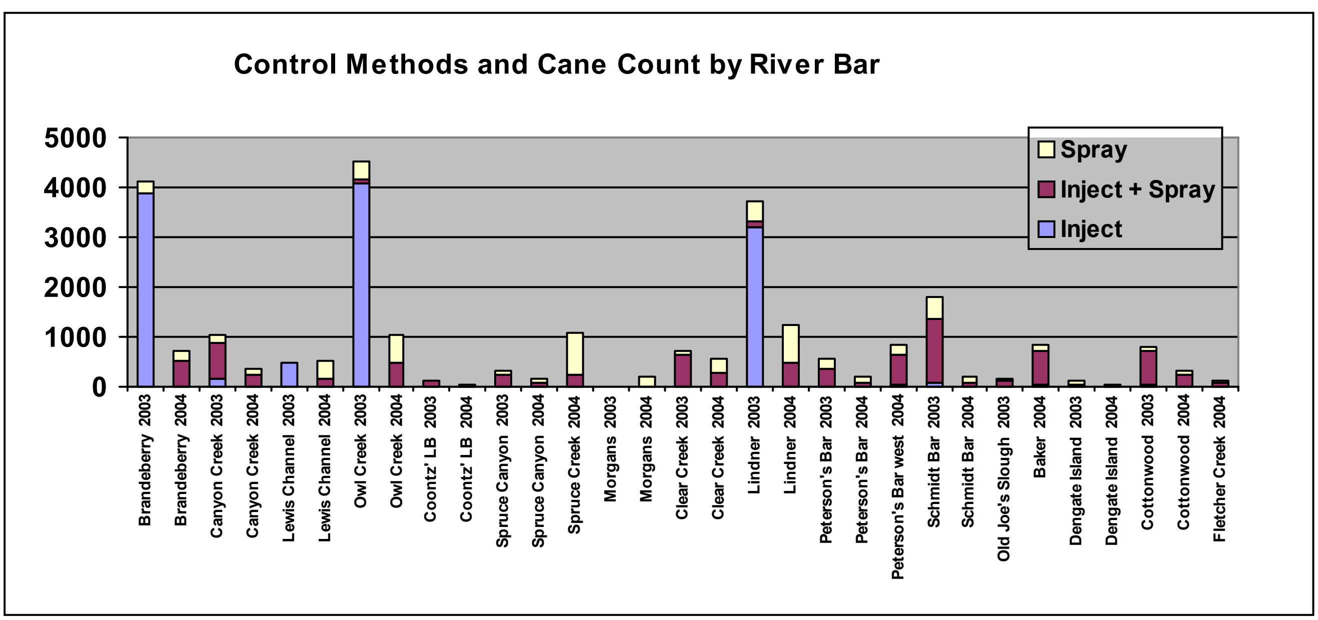
Table 2 below illustrates the distribution of control methods in 2003.

River Mile	River Bar	YEAR	# plant groups	# stems	Inject	Inject & Spray	Spray only
29.75	Brandeberry	2003	175	4108	3883		225
28	Canyon Creek	2003	41	1046	156	720	170
28	Lewis Channel	2003	39	505	463		42
27	Owl Creek	2003	224	4517	4063	93	361
26	Coontz LB	2003	21	136		107	29
26	Spruce Canyon	2003	13	336	18	225	93
24	Morgan's	2003	4	15			15
23	Clear Creek	2003	75	729	12	623	94
23	Lindner	2003	339	3717	3206	110	401
21.5	Peterson's Bar	2003	111	559	14	358	187
20	Schmidt's Bar	2003	89	1798	78	1302	418
14	Old Joe's Slough	2003	15	181	1	127	53
12	Dengate Island	2003	49	125		11	114
10.5	Cottonwood	2003	52	813	30	690	93
TOTAL			**1247**	**18585**	**11924**	**4366**	**2295**

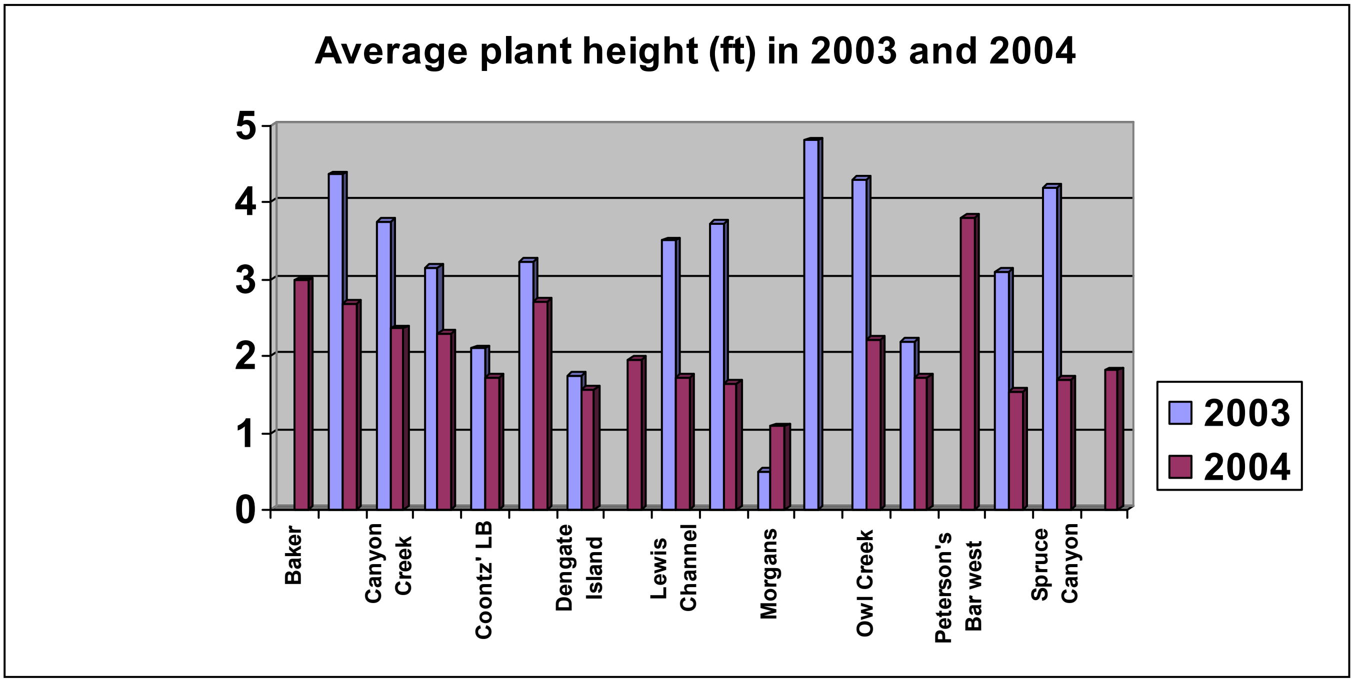
Table 3 below includes a summary of plant and cane numbers for all three years. The net increase in the number of treated plants in 2004 was due to the addition of additional areas containing over 300 plants which were not surveyed in 2002 or 2003.

River Mile	River Bar	Total # canes	2002	2003	2004	# plants	2002	2003	2004
29.75	Brandeberry	4,815		4,108	707	275	42	175	58
28	Canyon Creek	2,335	932	1,046	357	105	32	41	32
28	Lewis Channel	1,014		505	509	186	47	39	100
27	Owl Creek	6,439	869	4,517	1,053	456	53	224	179
26	Coontz' Bar	7	7			3	3		
26	Coontz' LB	2,108	1,925	136	47	167	126	21	20
26	Spruce Canyon	631	133	336	162	45	17	13	15
26	Spruce Canyon LB	326	326			7	7		
25.5	Spruce Creek	1,127	49		1,078	310	8		302
24	Morgan's	230		15	215	101	26	4	71
23	Clear Creek	1,285		729	556	178	35	75	68
23	Lindner	8,243	3,299	3,717	1,227	793	195	339	259
21.5	Peterson's Bar	765		559	206	194		111	83
21	Peterson's Bar West	821			821	70			70
20	Schmidt Bar	3,452	1,437	1,798	217	256	99	89	68
14	Old Joe's Slough	181		181		15		15	
13	Baker	1,176	319		857	115	33		82
12	Dengate Island	156		125	31	66		49	17
10.5	Cottonwood	1,457	326	813	318	91	8	52	31
2	Fletcher Creek	102			102	9			9
Totals		**36,670**	**9,622**	**18,585**	**8,463**	**3,442**	**731**	**1,247**	**1,464**

The graph below illustrates the difference in treatment methods between 2003 and 2004 (two bars for each river bar, first is 2003, second is 2004). Note how spray increased in 2004, indicating the shift to smaller, non-injectable plants. The downstream trend is toward smaller plants, as well. The average is taken from adding together the sum of the median number of canes of each cane count category (1, 2-5, 6-10, 11-25, 26-50, 51-100, 101-200, >200).



The following graph illustrates the change in plant height between 2003 and 2004, indicating the shift from mature plants to younger, shorter plants. Plant height is a surrogate for maturity. This shift is attributed to the effectiveness of treatment on older plants. The treatment graph shows that we injected many more plants in 2003 than in 2004, because we found many more large plants in 2003.



On an overall bar by bar comparison, the number of plant groups generally decreased, and the number of canes has been reduced by fifty percent, even though the survey area was expanded to the mouth of the river. Two exceptions, Clear Creek and Peterson's, increased as a result of enlarging the survey area to include adjacent higher terraces and conifer forest. The average height of the canes was also significantly reduced.

6. Ongoing Concerns and Research Needs

- We may have observed a small number of seedlings in 2004.
- While most injected plants were completely dead, some had one or more small new shoots within the clump or within 10 feet of the clump. These shoots typically showed no signs of herbicide damage, and we therefore believe that the rhizomes of these canes were not connected to any rhizomes that received herbicide. Furthermore, we presume that, in at least some cases, these rhizomes did not have a visible cane at the time treatments were applied. This generates questions about how knotweed rhizomes and fragments spread, separate, or regenerate that will be important to answer.

- We do not know how long fragments of rhizome remain viable. Could a fragment be buried in river deposits so deeply that it would not emerge until the end of the growing season, or even the following growing season? How long can fragments persist in buried deposits? Can they sprout when eroded out of buried deposits and re-deposited at or near the surface after one season? After one year? Two years?

- Single rhizomes can produce multiple canes, and this may be the norm, especially in sandy, silty soils. In dense stands, we probably do not want to inject every cane so as to avoid overuse of herbicide, and recommend a reduction in the amount of each injection.

- Contrary to reports and common assumptions, knotweed is found to grow slowly but persistently in complete shade of alder and willow as well as under dense coniferous canopy.

- As the project progresses, finding the smaller remaining plants will likely become more challenging and time consuming, and crew training will be a critical component.

7. Herbicide Translocation and Associated Injury

We recorded signs of herbicide damage to non-target vegetation whenever observed. Although the injection method is purported to be a completely 'contained' method, it appears that in certain conditions, the injected herbicide translocates into soil and water. Once in the soil solution, it can apparently be taken up by the roots of woody plants in the immediate vicinity. This is not a well documented phenomenon, but we have reason to believe it may be more widespread than currently believed. While we did not always have time to make detailed observations of the vegetation adjacent to knotweed clumps injected the previous year, we made the observation twenty times in 2004. The damage involved minor, presumably non-lethal damage to the foliage of alder, willow, salmonberry, willow, and trailing blackberry on four different river bars.

In another knotweed control project we visited, we noted much more extensive damage, including mortality of individual trees within a stand of 20-year old red alder. The entire stand, in which understory knotweed was treated using the 5cc injection method had a much reduced leaf area index due to fewer and much smaller leaves. Under the stand, in early summer, many small stunted leaves were found. Samples of these leaves were sent to a laboratory, and a high Glyphosate dosage was confirmed by Dr. Ron Crockett of Monsanto. Other species showing foliage with classic herbicide damaged foliage were: thimbleberry, snowberry, Himalayan blackberry, and elderberry.

Research into this issue is urgently needed. The knotweed injection method has the potential to release a large volume of undiluted product per square meter in areas with many canes. While drift is an issue, spraying the same clump with a much diluted product will treat a much greater area with much less product.

See page 17 for more photos.

8. Conclusions and Future Plans

The control methods are effective, but do not suffice to eliminate all plants in one application. We've eradicated a huge proportion of living knotweed plants, shifting the remaining population from large many-stemmed clumps to small single-stemmed plants. This has significantly reduced the biomass available to make new plants. In several key areas (Owl Creek, RM 17), treatment was completely successful, and no new material was deposited from upstream, confirming that upstream treatment was also successful. We also did not find a significant increase in plants at RM 9.5 (Cottonwood), which leads us to believe that we were successful in significantly reducing the amount of plant material migrating from upriver.

However, while the 2004 GIS maps show that we've been successful in reducing the overall knotweed population, it still remained well-distributed this past season, albeit in smaller form. All plants shown on the GIS were treated – and 2005 surveys will document success of the 2004 treatments, as well as survey effectiveness. The fact that plants were still widely distributed in 2004 leads us to rethink our earlier optimistic projection that we'd be completed with the project in three years. Uncertainties about how long fragments persist, the manner in which rhizomes multiply, and whether viable seed is being produced complicate our ability to predict success. A single missed plant is capable of spreading to many new locations if eroded during a flood event, and will require a complete river survey to establish where these fragments have produced plants. At this point, we believe ten years may be a more reasonable timeframe in which to successfully eradicate knotweed from the Hoh River – unless fragments can persist longer than a year or two – in which case it could be longer.

Based upon new information about the ecology and persistence of plant fragment in floodplain deposits and the ability of plants to maintain very slow growth in completely shaded areas, plants are expected to be present in the Hoh River CMZ for at least another ten years. In an area as large and complex as the Hoh River CMZ, periodic surveys will be necessary to verify that the river remains free of knotweed.

The infested area will be resurveyed in 2005, and retreated where necessary as funding permits. We will communicate our findings to the WRIA 20 Knotweed Working Group and all partners.

Appendix 1: Data Dictionary

KNOTWEED NUMBER (REQUIRED - automatically assigned, restarts at 1 for each new file!)
CLUSTER TYPE (REQUIRED)
- Individual
- Clump
- Group

CANE COUNT (REQUIRED)
- 1
- 2-5
- 6-10
- 11-25
- 26-50
- 51-100
- 101-200
- over 200

HEIGHT OF PLANT (REQUIRED)
- < 1 foot
- 1-3
- 3-6
- 6-10
- >10 feet

EROSION POTENTIAL (REQUIRED)
- High
- Moderate - High
- Moderate
- Low – Moderate
- Low

COVER (canopy closure of shrubs and trees above knotweed: REQUIRED)
- Open
- Partially open
- Mostly closed
- Closed

PRIMARY SUBSTRATE (REQUIRED)
- VDA Vegetated Debris Accumulation
- C Cobble
- G Gravel
- S Sand
- F Fines
- LWD Large Woody Debris

SECONDARY SUBSTRATE (OPTIONAL)
- VDA Vegetated Debris Accumulation
- C Cobble
- G Gravel
- S Sand
- F Fines
- LWD Large Woody Debris

TREATMENT (REQUIRED)
- Inject
- Spray
- Spray and Inject
- NONE

COMMENTS (OPTIONAL - Anything important to the data collected on the particular cluster)
OBSERVER (REQUIRED - initials of three mapping crew)

Appendix 2: Hoh Project Photos

Above: Small knotweed plant hidden in native floodplain vegetation.

Tiny knotweed hidden in Oxalis patch in conifer forested floodplain terrace.

Above: Large knotweed rhizome deposited by flood waters, at the river's edge.

Successfully treated knotweed clump (injected) with associated mortality of native shrubs.