KNOTWEED CONTROL ON THE HOH RIVER:

2008 SUMMARY REPORT

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Contents

Introduction

This report describes the objectives and results of work conducted in 2008 as part of a multi-year project to completely eradicate invasive knotweed (*Polygonum spp.*) species in 29.75 river miles of the active Hoh River channel migration zone and adjacent terraces.

Located on the west coast of the Olympic Peninsula in Washington State, the Hoh River is one of the few rivers in the lower 48 states maintaining five species of relatively healthy wild salmon and steelhead populations. The riparian forest and floodplain is largely native compared with most other rivers in the state – with relatively small populations of non-native invasive plants (e.g. reed canarygrass, Scotch broom, and knotweeds) known to impact fish, wildlife, and native plant habitats. However, rapidly-expanding populations of non-native blackberry (*rubus spp*.) and Canada thistle (*cirsium arvense*) are of increasing concern within the riverine corridor where they had previously not been distributed. Butterfly bush (*buddleja davidii Franch.)* is planted on the north side of the river on private property within the channel migration zone, and poses a threat comparable to knotweed.

Project History

In 1998, one clump of knotweed was observed at the edge of the river's channel migration zone (CMZ) at river mile (RM) 29.75. In the winter of 1999 or 2000, this single clump was transported downstream during one of several winter storm events, giving rise to a population of knotweed that rapidly became widely distributed within the Hoh River CMZ to the river's mouth, with over 18,000 canes in the upper 15 miles of river by 2003.

Recognizing the potential threat to critical aquatic and riverine habitats posed by this aggressively invasive species, in 2002 the Hoh Tribe initiated a knotweed project, beginning the comprehensive river surveys, control, and effectiveness monitoring activities that continue today as a partnership between the non-profit 10,000 Years Institute, Hoh Tribe, Hoh River Trust, private landowners, the Department of Natural Resources, Olympic National Park, and the U.S. Forest Service.

Project objectives, methods, and results through 2008 are described in previous reports available from 10,000 Years Institute – **www.10000yearsinstitute.org** or **info@10000yearsinstitute.org**:

Knotweed Control on the Hoh River: Summary Report – 2002-2004
Knotweed Control on the Hoh River: Summary Report – 2005
Knotweed Control on the Hoh River: Summary Report – 2006
Knotweed Control on the Hoh River: Summary Report - 2007

2008 Project Staff and Training

For the second year, the field crew leader and data manager was Allison Fawcett, a trained and licensed noxious weed professional. A new field crew comprised of a supervised community service crew was hired from Washington Department of Corrections. The crew was trained in survey and control methods during a week in early July at the Lindner Creek bar (RM 23), in

order to be able to find the small, well-hidden plants that predominate after six years of control work in this river system. A number of new crew members were added throughout the season, necessitating frequent re-training and oversight.

2008 Survey and Control Summary

River miles (RM) 27 to RM 17 were completely surveyed between July and October, with one exception – Tower Creek between RM 24 and 25 on the south side of the river. In the lower river, below the Hoh Oxbow (RM 16), we surveyed Nolan Bar (RM 7 to 8.5 on the south side) and Cottonwood (RM 5 on the north side). Olympic National Park conducted repeat surveys at the mouth of the river on the north side, and staff from the Hoh Tribe conducted spot surveys over the season in the lower river below the Oxbow at RM 17 during the conduct of other responsibilities.

We covered 1063 acres from RM 30 to RM 7, including mature coniferous forested terraces, alder forested floodplains and willow stands, and many miles of cobble and gravel river bars; combing shrubby thickets and climbing over and through log jams. The river migration zone is almost a mile wide in some areas (Elk Creek – RM 19.5, Schmidt Bar – RM 20, Peterson – RM 21, Lindner Bar – RM 23,), and constricted within bedrock canyons in others (Spruce Canyon – RM 26 and the Hoh Oxbow – RM 17). A total of 0.11 (4733 ft 2) acres were treated. There were 383 plant sites in all; the number of stems was a maximum of 2734 stems and a minimum of 2037 (Appendix 1).

Many floodplain complexes experienced significant channel changes or bank erosion from 2007 (Elk, Schmidt, Clear, Lindner, Spruce, Canyon, Fletcher Island, Richmond). In the case of Clear Creek, the river moved most of the main channel from the north side (Canyon) to the south (side channel behind the Clear Creek floodplain complex). Spruce Creek had significant flow and widening of side channels across the high spruce terrace, and lost a considerable amount of river bank. Linder Bar lost almost a quarter of a forested island once heavily infested with knotweed. Deposition and scour were significant in a number of locations – up to 6 feet of fine sediment deposited in a number of places. No old root crowns were observed this year as in past years – but this may be a result of the deep deposition we observed.

The downward trend in size and distribution of the knotweed infestation observed in 2006 and 2007 continues (Appendix 2). Lindner Bar shows a 91% decrease from the original infestation between 2002 and 2007, (3299 stems in 2002 to 303 stems in 2007); and a 94% decrease from 2003 to 2008, (3717 stems in 2003 to 394 stems in 2008). Lewis Channel populations are reduced 89% from 505 stems in 2002 to 45 stems in 2008.

Spruce Creek, a mature spruce forest located on a rarely flooded high terrace, showed no significant decrease in stem count in the previous two years but stems have been reduced 94% since 2004 (1078/115 stems) and are much smaller, e.g.1-5 stems and less than 3 feet tall; representing less biomass to spread to new locations during river migration. As in 2007, the 2008 site locations within Spruce Creek are located farther inland on the terrace than the previous year this year; evidence that winter floods deposited knotweed plant material out to the upland edges of the floodplain – at least 12 feet above the summer river surface elevation. This site is a prime example of the highly unstable and dynamic characteristics of this river, and demonstrates that new infestations can be found in originally knotweed-free areas.

Other than a small stand of Giant knotweed (*Polygonum sachalinense)* at the mouth of the river, all plants found up to this time have been Bohemian knotweed (*Polygonum bohemicum)*. Giant knotweed was documented far upriver for the first time this year at two locations - Brandeberry and Peterson's Bar West. We do not know how to interpret this finding but speculate that the original infestation at Brandeberry may have been Giant which has since hybridized.

Olympic National Park's Exotic Plant Management Team conducted another round of control on the 1/3 acre infestation of Giant knotweed on Park land at the mouth of the Hoh River, north bank, treating 5 single-stem plants; and one plant that had 2-5 stems. All were less than 3 feet in height – a massive change from the original dense infestation.

Referring to Appendix 2, some areas had an increase in plant numbers from 2007. The reasons for this an be attributed to lack of access in 2007, plants missed the previous season, expanded survey areas, and new gravel bars formed by winter river migration.

Mapping Discussion

Sites were logged with a Thales (Magellan MobileMapper CX) GPS unit when there were satellites available, or hand-applied to a map and later digitized into the GIS. Clipped raster data was loaded onto to the GPS unit, and managed on the unit using Arc Pad (a smaller version of Arc View). This allowed us to manage our data in the field without having to transfer the data to Arc View or a similar program later. In lay terms, we were able to view aerial photos and parcel data, as well as past year's knotweed site data, which was useful in identifying old plant sites.

Hoh River Trust provided 2007 orthophotos covering the entire river floodplain and channel migration zone from the initial infestation to the mouth which we used as our base maps. We've divided the river into sections based on contiguous floodplain complexes or river bars or river reaches. As shown in Appendix 2, these sections are named for adjacent tributaries, campgrounds, and historic or current landowners. These names are used to locate each plant site in order to distinguish section characteristics such as river mile and landowner throughout the life of this project. A Data Dictionary contains a complete list of mapping attributes, and variants of this dictionary are used by all cooperators on the Olympic Peninsula.

Olympic National Park was contracted to process the GPS data into GIS layers and maps. A series of maps from RM 27 – 29 - Owl Creek and Brandeberry Lots - are appended as an example of the project's results (please see Appendix 2).

As in previous years, river migration in the winter of 2007 caused significant changes to the floodplain and upper terraces. River bars that were once accessible from one side of the river are now only accessible by the other. Gravel bars that once made up large portions of the infestation are now gone, swept downstream. Section names previously applied to these locations refer to the named area previously treated and are not an exact location. Site specifics will corrected through a GIS analysis based on UTMs, but continue to be the basis of plant population comparisons from the previous seasons. Unless old canes or flagging was found, small plants on gravel bars, along river edges, and in low-lying alder stands were assumed to be new sites -

where root fragments had been deposited by floods or where buried rhizomes were excavated to a viable depth where they could sprout.

Herbicide Application Methodology and Discussion

As in 2007, in 2008, the application of the herbicide glyphosate was accomplished largely by carefully-targeted foliar spray methods, in contrast to earlier years where the injection method was the primary method of treatment. This change is due to the reduction in size of the plants – most canes are now too small to inject. On 1063 total acres surveyed and treated in 2008, we used only 0.64342 gallons of herbicide product.

A hand-held one-liter spray bottle was most often employed to deliver the herbicide directly to plant leaves and stems, and occasionally, a low pressure ***Solo*** backpack sprayer. Injection was used on canes larger than .5 inches. As in prior years, we used the product ***Aquamaster*** which is 48% glyphosate and 52% water, in a mix with water, ***Agridex*** surfactant, and ***BlazeonBlue*** marker dye. Glyphosate acts by attacking three of the 'essential' amino acids made by plants, disrupting the plant's ability to grow.

This year, because we're concerned about deeply buried roots that may not be receiving the ***Aquamaster*** treatments and persist in the floodplain deposits, we added a small amount (1%) of imazapyr, in the formulation ***Polaris***, which is a longer-lasting herbicide intended to provide a better response with the problem of re-sprouting from underground rhizomes some distance from the treated plant. Imazapyr is a soil-persistent herbicide that will move throughout the plant at a slower rate, and attack the root structure and rhizomes of the knotweed plant over a longer period, especially throughout the winter. It also works by affecting essential amino acids in plants.

Knotweed rhizomes have been documented up to 50 feet from the parent plant. Experts surmise that in some cases herbicide cannot travel that distance, depending on a number of factors including the amount of above-ground biomass available to translocate a sufficient amount of herbicide, time of treatment, and plant physiology. Imazapyr is not known to have any effects on salmon populations, and is less toxic to plant species than is glyphosate, but further research into this topic is planned for the following season. This past year, we also added Clallam County and Olympic National Park are both using imazapyr in a mix with ***Aquamaster***.

A National Pollution Discharge Elimination Permit (NPDES), is required for herbicide application in natural areas. This project is covered through joint permitting with Clallam and Jefferson counties. Herbicide records are maintained and reported.

Effectiveness Monitoring of 2007 Control Activities

We conducted effectiveness surveys at Lindner Bar, Spruce, Spruce Canyon, Lewis Channel, and Owl Creek, separately from the 2008 control surveys where we evaluate effectiveness as we survey and treat. The data and notes from the effectiveness surveys show less than 3% live plants found. Old flagging or canes were found in approximately 6% of sites – 11% of these

sites had a re-sprouting stem, usually some feet from the original infestation. Many of the small plants appear to be new sites.

GIS Mapping and Database Update

The database has been updated with 2008 data and is available to researchers interested in the behavior of these species. GIS maps were produced with assistance from ONP, and are available in digital format through the Institute. An example comparing years 2003, 2004, 2007, and 2008 is appended to this report (Appendix 3).

Presentations and Educational Outreach

From late 2007 through 2008, three presentations summarizing results and challenges were made to the Olympic Knotweed Working Group, and one in Forks, Washington to the west end community including west Clallam and Jefferson counties. A copy of that presentation has been provided to NFWF and to the North Olympic Lead Entity Group. 10,000 Years Institute also receives and answers calls from groups interested in developing a knotweed control projects.

Landowner and Partner Outreach

Letters and brochures informing landowner participants of project plans were sent in July to twelve primary landowners in the upper river, above the Hoh Oxbow Bridge on Highway 101. Personal visits and calls were made to six of these landowners, and another six at Brandeberry Lots. Past reports, maps, and herbicide information were provided over the course of the project. Summaries and maps for activities on specific parcels have been developed for each landowner who provided access. Project information is being shared with staff from the Department of Natural Resources, the Department of Fish and Wildlife, the US Forest Service, Hoh River Trust, Olympic National Park, the Northwest Indian Fisheries Commission, the Clallam and Jefferson County Noxious Weed Board staff, Jefferson County Commissioners, and during discussion at Olympic Knotweed Working Group meetings. Informative posters were placed at all Hoh River public boat launches and campgrounds.

Ideas for Improvement

The current management strategies have proven highly successful; but annual winter floods in the Hoh river watershed continue to pose challenges to the project as they move buried rhizomes and plant parts to new, unknown locations, and bury other areas with deep deposits that may take some time for knotweed to push up through – requiring repeat surveys in all river floodplain and terrace locations that receive flood waters each year.

We've had to balance the need to cover a lot of difficult terrain with a low budget – which in the past has necessitated using relatively inexpensive but inexperienced correctional crews. It would be helpful to increase the size of the crew as the knotweed becomes smaller and more widely distributed, and therefore more difficult to locate; requiring even more intensive and careful

surveying. We are evaluating the option of switching to a crew made up of fewer people with greater survey and botanical experience.

The cooperation of private landowners in the Hoh River valley is imperative to the success of this project. Support of the project has increased since 2007. Concern over herbicide application is an ongoing issue, and plans to address these concerns include a series of continuing outreach and education projects in the local community with public and private meetings with landowners, question and answer sessions, and re-distribution of informative brochures and articles.

Knotweed and other invasive plants impact all of the river-adjacent landowners, the recreational public, and the Hoh Tribe – and we are working to communicate the importance of this project to the sustainability of Hoh River resources they enjoy.

Conclusions and Future Plans

Our control methods have proven to be highly effective – we can see from data analysis and surveys that a huge proportion of living knotweed plants on the Hoh River has been successfully eradicated. The remaining population is largely made up of small single-stemmed plants, significantly reducing the biomass available to start new plants. The challenge of locating widely spaced, very small plants on a wide and complex river floodplain over a distance of 30 miles in length remains, and since a single missed plant is capable of spreading to many new locations when eroded during a flood event, annual surveys of the entire river and floodplain continue to be required in order to locate translocated fragments that may have produced new plants. Large rhizomes buried deeply in flood deposits may express only one small stem in a season, which after herbicide application that kills the single stem, often retains the ability to resprout. Some of these large rhizomes are found at edge of the river, and a strategy for removing or treating these masses without breaking off rootlets and increasing plants, or causing impact to the water through herbicide application is needed. We are collaborating with the Olympic Knotweed Working Group to come up with a solution for this phenomenon.

Based on evidence of the persistence of plant fragment in floodplain deposits and the ability of plants to maintain very slow growth in completely shaded areas, coupled with the difficulty of locating every plant on the expansive Hoh River channel migration zone (CMZ), knotweed plants are expected to be present in the river corridor for at least another eight to ten years – requiring annual surveys - after which periodic surveys will be necessary to verify that the river remains free of knotweed. A crew of at least ten well-trained and motivated members is necessary to adequately cover the entire floodplain, all the vegetated bars, and the upland terrace forests.

Partial funding has been obtained for the survey season of 2009, and additional funding is being sought. We plan to hire a new crew team, and begin fieldwork in mid to late July 2009, surveying and controlling plants, starting upstream and moving down. We will continue to actively participate in the Olympic Knotweed Working Group, and to share project results with interested parties and in appropriate forums.

Crew survey line in spruce forested terrace – Spruce Creek.

Small plant in deep floodplain deposits – typical size - may have a large root mass below?

Crew survey line in willow and alder thickets at Lewis Channel.

Canada thistle infestation at Lewis Channel.

Single knotweed plant in Canada thistle patch at Owl Creek. This is a big plant!

Crew surveying a 700’ long log jam at Clear Creek.

Giant knotweed single stem.


“Large” stand of Bohemian knotweed – Brandeberry Lots.

Appendix 1: Point and Cane Count

SITE_ID	# points	max cane count	mean cane count
Alder Creek	5	31.0	23.0
Brandeberry	24	257.0	189.5
Canyon Creek	2	11.0	8.5
Clear Creek	10	54.0	39.5
Cottonwood	3	15.0	10.5
DNR	23	115.0	80.5
Elk Creek	47	504.0	373.0
Fletcher	6	23.0	17.5
Fletcher Island	14	39.0	30.5
Lewis Channel	8	45.0	32.0
Lewis Ranch	2	400.0	301.0
Lindner	80	612.0	456.0
Morgan	28	80.0	60.5
Nolan Bar	1	1.0	1.0
Owl Creek	10	27.0	22.0
Peterson's	24	64.0	49.0
Peterson's 2	18	100.0	76.5
Richmond	21	182.0	135.0
Schmidt Bar	17	58.0	43.5
Spruce Creek	40	116.0	87.5
	383	2734.0	2036.5

The range of number of canes is a result of the 'binning' formula in the data dictionary:

1
2-5
6-10
11-25
26-50
51-100
101-200

Appendix 2: Hoh River Knotweed Control Project Results 2002 – 2008 (ns = no survey in that year)

Number of Canes by Year, River Bar, and River Mile									
River Bar	**River Mile**	**Total # Canes**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Brandeberry	29.75	5019	ns	4108	707	69	135	ns	256
Richmond [a]	28.5	-	-	-	-	-	ns	ns	216
Canyon Creek	28	2479	932	1046	357	31	21	92	55
Lewis Channel	28	1154	ns	505	509	36	104	ns	45
Owl Creek	27	6794	869	4517	1053	238	117	ns	24
Fletcher Island	27	158	ns	ns	ns	ns	158	ns	55
Spruce Creek	27	1644	49	ns	1078	58	239	220	115
Spruce Canyon	26	681	133	336	162	39	8	3	0
Spruce Canyon LB [b]	26	374	326	ns	ns	48	ns	ns	ns
Coontz' Bar	25	30	7	ns	ns	ns	23	ns	ns
Coontz' LB	25	2155	1925	136	47	ns	47	ns	ns
Morgans	24	503	ns	15	215	67	15	191	80
Clear Creek	23	1388	ns	729	556	36	15	52	110
Lindner	23	9668	3299	3717	1227	303	819	303	394
Peterson's Bar	21.5	1405	ns	559	206	387	62	191	99
Peterson's Bar West	21	1908	ns	ns	821	ns	35	1052	18
Schmidt Bar	20	3661	1437	1798	217	35	94	80	1
Elk Creek	19.5	1089	ns	ns	ns	639	384	66	580
Alder [c]	19	544	ns	ns	ns	ns	326	218	0
Allen's Bar	15	25	ns	ns	ns	ns	25	ns	ns
Allen's Bar II	15	60	ns	ns	ns	ns	60	ns	ns
Hell Roaring	15.5	572	ns	ns	ns	ns	572	ns	ns
Old Joe's Slough	14	238	ns	181	ns	14	43	ns	ns
Baker	13	1524	319	ns	857	224	124	ns	ns
Dengate Island	12	217	ns	125	31	50	11	ns	ns
Cottonwood	10.5	1611	326	813	318	119	35	ns	15
Nolan Creek	8	11	ns	ns	ns	11	ns	ns	ns
Nolan Bar	8	286	ns	ns	ns	ns	286	ns	1
Rayonier Bar	7	275	ns	ns	ns	ns	275	ns	ns
G & L	6	113	ns	ns	ns	113	ns	ns	ns
Lower G&L	5.5	132	ns	ns	ns	ns	132	ns	ns
Fletcher Creek	2.5	151	ns	ns	102	ns	49	ns	ns
Lower Hoh	1	731	ns	ns	ns	394	337	ns	ns
		48664	**9622**	**18585**	**8463**	**2911**	**4551**	**2468**	**2064**

a This island and property were included in Brandeberry and/or Owl Creek from 2002 - 2005
b Spruce Canyon LB is Tower Creek from 2006 - 2008
c Alder Creek is greatly reduced in size due to channel migration

Appendix 3: GIS Map: RM 27 - 29 - Stem Count for Years 2004, 2007 and 2008