KNOTWEED CONTROL ON THE HOH RIVER:

2011 SUMMARY REPORT TO WSDA

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Contents

Introduction

This report describes the objectives and results of work conducted in 2011 during the tenth year of the Hoh River Knotweed Project. The project's goal is to completely eradicate invasive knotweed (*Polygonum spp.*) species in 30 river miles of the Hoh River's 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 sustaining five species of relatively healthy wild salmon and steelhead populations. Bull trout are listed as 'threatened' under the Endangered Species Act.

With high rainfall in the Olympic Mountains and many tons of gravel moving downstream from mountain glaciers, the Hoh River has an active channel migration zone and floodplain that extends to a mile wide in some reaches. The CMZ widens in depositional reaches at RM 19.5, RM 20, RM 21, and RM 23, and is constricted within bedrock canyons at RM 17 and RM 26, as well as at RM 0.3 at the mouth of the river between the Hoh Indian Reservation and the Olympic National Park coastal strip. Precipitation averages 125 inches per year (USBOR 2003). Flows fluctuate from 500 cubic feet per second (cfs) and 2 feet in depth in summer, to over 50,000 cfs and 18 feet in depth in severe winter storm events, when the river flows through floodplain forests and over terraces.

While timber harvest and agricultural conversion have replaced mature forest in many reaches, the riparian forest and floodplain is largely undeveloped, with comparatively small populations of non-native invasive plants impacting fish, wildlife, and native plant habitats (e.g. reed canarygrass, Scotch broom, herb Robert, and knotweeds). However, annual flood events and channel migration provide a mechanism for the movement and spread of the noxious weeds present in the river valley.

Project History

In 1998, one clump of knotweed was observed at the upland edge of the river's channel migration zone (CMZ) near a historic homestead location at river mile (RM) 29.75. In 1999 or 2000, the river avulsed into a side channel during a winter storm event, capturing and transporting this single clump downstream. In the next several years, knotweed became widely distributed within the Hoh River CMZ to the river's mouth, with over 18,000 canes counted between RM 30 and 15 by 2003.

Realizing the potential threat to aquatic and riparian habitats posed by this aggressively invasive species, the Hoh Tribe initiated a knotweed project in 2002. This began 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.

Over the years, direct funding has been provided by the Hoh Tribe through the Pacific Coast Salmon Recovery program, followed by the National Fish and Wildlife Foundation, and the Washington Department of Agriculture (WSDA), with additional in-kind assistance from the Hoh Tribe, Hoh River Trust, the weed boards of Clallam and Jefferson counties, and 10,000

Years Institute. In 2011, funding was provided by WSDA, with additional donations from the Pacific Coast Salmon Coalition, Hoh River Trust and 10,000 Years Institute.

Project objectives, methods, and results from 2002 through 2010 are described in previous reports available for download at: **http://www.10000yearsinstitute.org/10k_asp/knotweed.asp.**

2011 Project Crew and Training

The 2011 project field crew consisted of 2 to 6 field technicians from Pacific Coast Salmon Coalition (PACSAC), the local regional fisheries enhancement group. The crew received instruction in survey and control methods, noxious weed identification, pesticide application best management practices (BMPs), and safe survey practices, as well as watershed and river ecology and geomorphology, and native plant and bird identification. Jill Silver performed project coordination and acted as field crew leader, data manager, and primary licensed applicator. The field team included PACSAC director Carl Chastain, who acquired his pesticide license and aquatic endorsement this year.

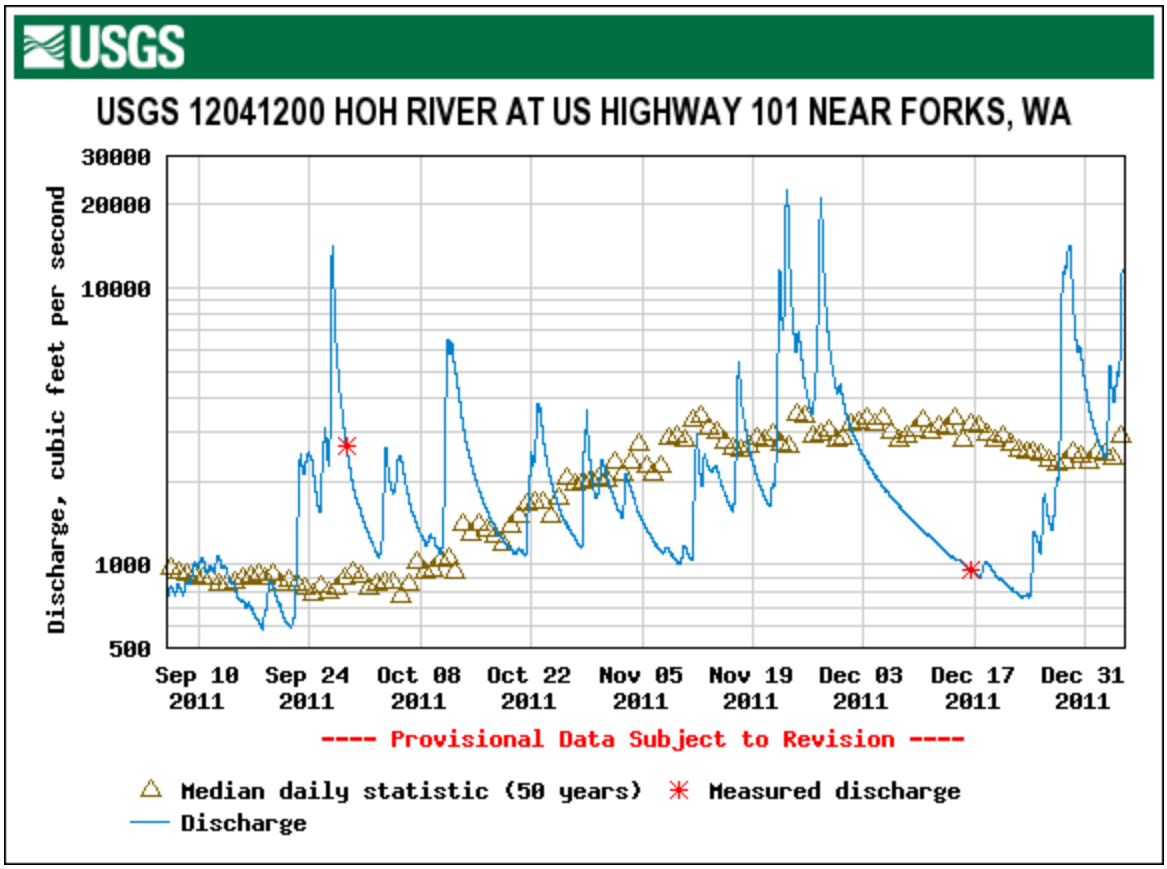
2011 Survey and Control Summary

As the search continues for increasingly fewer and smaller plants each year, the project again started surveys in mid-August to ensure the greatest degree of plant growth possible in dense native plant communities ranging from willow and salmonberry thickets to alder bottoms and mature coniferous forest stands. The project surveyed approximately 2950 acres of 4500 total project area acres in priority reaches between river miles (RM) 30 to RM 5, treating knotweed plants on state, federal, and private lands of which the largest landowner is Hoh River Trust (HRT), and nine others.

In order to cover a very large area with a small crew, strategy and local knowledge were helpful in prioritizing areas for surveys. We focused on priority areas with significant channel changes, bank erosion, over-bank flooding, where deep sediment deposits slow plant emergence, and all areas where plants were found the previous year. Survey lines were spaced widely to cover as much ground as possible, reducing survey effectiveness in finding small plants in dense vegetation or woody debris accumulations.

As in previous years, the surveys covered the mature coniferous forested terraces, alder forested floodplains and willow stands, and many miles of mainstem river cobble and gravel bars with shrubby thickets and extensive log jams, within the river's channel migration zone (CMZ) and 100 year floodplain where winter floods can deposit plant material. Olympic National Park (ONP) 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 Hoh Oxbow during the conduct of other responsibilities.

In late September 2011, the river rose over 10 feet after approximately 4 inches of rain in three days, flooding many knotweed survey areas, and causing delays in survey activities (USGS Hoh River Gage graph shown on following page). These fluctuations in flow are a continuous challenge to the project logistics. Fieldwork ended in early October as the weather turned to more continuous rain and the river rose, flooding survey areas.



Upper River – River Miles 30-16:

In the upper river, surveys started at the two high priority reaches added in 2010. The first, Upper Brandeberry (RM 30) is a historic homestead site that is now on a mid-river island knotweed where in 2010, we received information from a neighboring landowner that knotweed had been sighted there. The second, Lewis (RM 29.75), is on the north side (right bank) of the river. An expanding patch from an ornamental planting had been treated by injection in 2008, but had recently been reported farther out on the gravel bar by the landowner (see the Upper Brandeberry site in the map in Appendix 2). Both of these infestations were largely controlled by 2010 treatment, with only a few re-sprouts and five new sites found. The site where knotweed was first identified in 1999, Brandeberry, located on the south side of the river from these two sites, was determined to be a lower priority this year with no obvious channel changes, and only one small plant found in 2009 and two small plants in 2010, and was not surveyed.

There was concern in 2010 that the Upper Brandeberry infestation was located slightly upriver from what had been considered the uppermost point of infestation, suggesting perhaps there might be additional sources from another point of origin upriver in Olympic National Park. After evaluating the results from this year's surveys, conducting a review of historic homesteads in the Park and interviews with Park staff, we conclude that the slight upriver migration is caused by migration of rhizomes up the side channel that bisects the island in a SE to NW direction.

Knotweed on the channel bisecting the Upper Brandeberry island in 2010:

Same channel bisecting the Upper Brandeberry island in 2011:

In the upper river above the Hoh Oxbow at RM 16, we covered all the reaches on the north side except Alder Creek. Significant channel changes occurred at several of these, Spruce Creek, Fletcher Island, Linder Bar, and Schmidt Bar, either enlarging or reducing the size of the survey reach.

Other than Richmond Island, and Owl Creek, we did not survey any of the south side of the river above the Oxbow. Please see Appendix 1 for river miles and named survey areas, and median cane counts.

Lower River – River Miles 16 - 5:

In the lower river, below the Hoh Oxbow, Allen's Bar had several large stands which were treated. Other lower river survey areas with significant infestations in 2010 were resurveyed including Old Joe's Slough at RM 14 and Baker Bar at RM 13, and Hoh Humm Ranch at RM 10 on the left bank. Large clumps and a number of scattered individual plants found in 2010 at these sites were either eliminated or greatly reduced. In 2010, we did not treat plants found on agricultural lands at G & L and Lower Hoh due to concerns over organic certification of beef cattle that might come into contact with the herbicide – these areas were not accessed in 2011, except for the open river bar along Nolan Creek where a large number of plants were found and treated. The gravel bar and willow/alder thickets had expanded at the mouth of Nolan Creek immediately downstream of Nolan Bar, and there were many plants, some well-established, found and treated in this area. Most were hidden inside willow and alder stands, or along large woody debris accumulations.

At Old Joe's Slough, a dense stand treated in 2010 when it was damp exhibits re-sprouts.

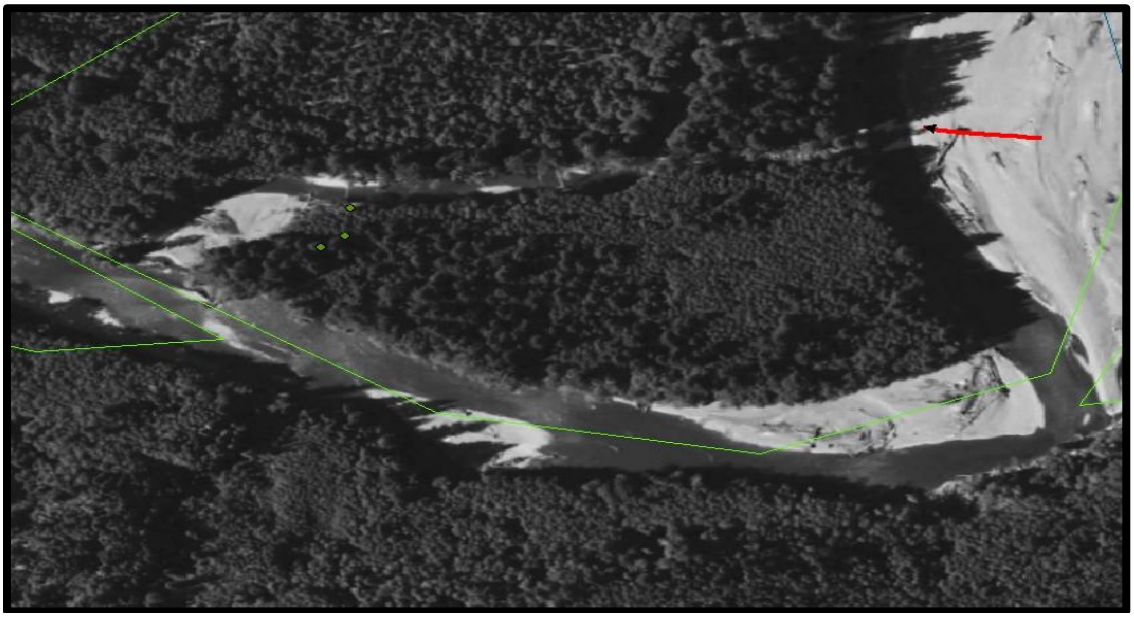
General Trends:

The project surveyed 2950 acres in 2011, 1050 more than 2010. 147 plant sites were documented, an increase from 108 in 2010, and reduced from 295 in 2009, 383 in 2008, and 1464 in 2004 (Appendix 1). The total treated area was 0.016 acre. The mean number of stems logged in the 'binned' data category in the GPS data dictionary was 2050, shown compared with previous years in Appendix 1 – 1775 in 2010. While there was a small increase from 2010 due to a few large stands in new survey areas (e.g. Allen's and Nolan Creek), a continued reduction in plant height translate to less biomass (stem and root fragments) available to spread to new locations during river migration. In 2010, a total of 0.0070 acres (304 ft^2) in 1,900 surveyed acres was treated, down from .025 acres (1,085 ft^2) in approximately 1,000 surveyed acres in 2009.

ONP staff reported the Giant knotweed population at the mouth of the river continues to produce plants, and there remain untreated knotweed plants upstream of the ONP boundary in RM 1 due to the concern with organic certification of beef which could be moving into the ONP downstream.

We observed three subspecies including Bohemian (*Polygonum bohemicum)*, Giant and Japanese knotweeds. We are tracking species in the GIS as we are able to make a clear determination. There may be varying forms of hybridization occurring.

Some significant river channel avulsions and channel movement occurred in the winter of 2010. The gravel bar at Lewis Channel (RM 28 on the north side of the river) continues to expand to the south, while across the river, Richmond Island (RM 28.5) continues to be eroded on the northeast, as well as the south side as the south side river side-channel widens; reducing the size of the island considerably. The Spruce Creek floodplain experienced the largest change, with a new channel up to 20 feet wide and deep carving deeply into the mature forested floodplain; shown below in an aerial view, and a photo of the upstream inlet channel.



Lindner Bar at RM 23 has grown in width and length as the channel migrates to the south, and the upper river deposits sediment. The largest area of change was just downstream in RM 19-21, including Schmidt Bar, Elk Creek, and Peterson's West – the river moving to the north side of the CMZ, creating a wide gravel bar with alder islands. In 2010, an old homestead site at Schmidt Bar where we'd surveyed and treated knotweed and Hoh River Trust had treated large infestations of non-native blackberry was completely washed downstream. Deposition and scour were also significant in many reaches – deep fine sediment deposited in previous years was eroded to cobble and gravel in some areas, and in others, deep deposits occurred.

There continues to be wide variability in knotweed plant height, leaf size, color, and leaf shape, making it difficult to 'calibrate' our eyes for surveys. Unless old canes or flagging was found, or a site was visible on the GPS unit matching the location, small plants on gravel bars, along river edges, and in low-lying alder stands are assumed to be new sites, where root fragments were deposited by floods or buried rhizomes were excavated to a viable depth where they could sprout. Plants were dying back or drought-stressed much earlier than usual – yellowed and brown leaves indicate less ability to translocate herbicide, and these were found in early September.

Rain was always a challenge, impacting visual abilities in dark shaded floodplains, interfering with GPS use, and making it impossible to spray plants on wet days.

Below, at Upper Brandeberry, the size of re-sprouting plants demonstrates the challenge of simply finding them. Re-sprouts from treated areas were still occurring in September and October, or new plants were still emerging in October.

Mapping Summary

The project's Thale's MobileMapper CX GPS unit was used to track locations and log data. Files on the unit included 2009 orthophotos covering the entire river floodplain and channel migration zone from the initial infestation to the mouth, but were not accurate due to channel changes that have occurred since 2009. 2011 digital orthophotography has been acquired for the project area, and will be loaded on the GPS unit for 2012 fieldwork.

Clipped raster data is loaded on the GPS unit, and managed on the unit using Arc Pad, enabling the crew to view aerial photos and parcel data as well as knotweed site data from previous years, which is useful in identifying old plant sites. A Data Dictionary loaded on the GPS unit contains a complete list of mapping attributes, and variants of this dictionary are used by all cooperators on the Olympic Peninsula, presented in Appendix 3.

Sites were documented with the GPS unit when satellites were available, and when there was no satellite coverage, a point was either plotted on the unit using the ArcPad function, or hand-applied it to a paper copy map and later digitized into GIS.

From the start of the project, we'd divided the river into areas based on contiguous floodplain complexes or river bars or river reaches. As listed in Appendix 1, these reaches are named for adjacent tributaries, campgrounds, and historic or current landowners, and are used to track plant sites throughout the life of this project. In 2010, GIS shape files were created for each reach area to maintain consistency as the river migrates and bars change.

Our 2011 maps have been plotted on the updated 2011 aerials. An example is appended to this report (Appendix 2). Maps (2-4 MB PDF files) are available for download from the 10,000 Years Institute website at http://www.10000yearsinstitute.org.

The database has been updated with 2011 data, provided to WSDA, and is available to researchers interested in the behavior of these species.

Herbicide Application – Permitting, Methodology, Totals, and Discussion

On 2,950 total acres surveyed and 0.16 acres treated in the field season of 2011, just under 1 gallon of herbicide concentrate in 18.5 gallons of foliar spray mix containing 4% ***Aquaneat***, 1% ***Habitat***, 1.5% surfactant, and 1% marker dye was applied at 147 plant sites. We injected a total of 505 ml of ***Aquaneat*** in stems larger than ½" at the training site in the Bogachiel watershed. The amount of spray is 2.5 times what we used last year. We did not use *imazapyr* at sites with wet soils such as wetlands.

All of these products have been carefully vetted through the OKWG and the Department of Agriculture to assure the least toxicity to the surrounding aquatic and terrestrial environment, animals, and people. *Glyphosate* acts by attacking three of the 'essential' amino acids made by plants, disrupting the plant's ability to grow. *Imazapyr* also acts by affecting essential amino acids in plants, but 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.

Knotweed rhizomes have been documented 50 feet from the parent plant. Dr. Tim Miller of Washington State University reported from recent trials that stems of knotweed planted (without any attached rhizome) produced rhizomes up to 15 feet long in one year's time. Experts surmise that herbicide may not 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. *Glyphosate* seems to 'leak' out of the rhizomes, while *imazapyr* is a soil-persistent herbicide that moves through the plant at a slower rate, and attacks the root structure and rhizomes of the knotweed plant over a longer period, especially throughout the winter. *Imazapyr* is not reported to have any direct effects on fish, and is less harmful to a range of plant species than is *glyphosate* – but we continue to advocate using as little as possible, as carefully as possible, so as not to impact other terrestrial or aquatic plants and organisms.

As in previous years, the application of the herbicide was accomplished largely by carefully-targeted foliar spray method, in contrast to earlier years when plants were large, and the injection method was the primary method of treatment. A hand-held one-liter spray bottle was employed to spray the herbicide directly on plant leaves and stems of small plants, and a backpack sprayer was used on the larger stands found at Old Joe's Slough, Baker Bar, and Upper Brandeberry.

Most canes are now too small to inject. Injection is applied only on canes larger than 0.5 inches, and only a few plant sites with canes this size were found this year, including the crew training site in the Bogachiel watershed, a large stand exposed in a non-native blackberry hedge by river erosion at the Fletcher Ranch (Owl Creek), and at Allen's Bar. At Lewis, one plant site injected in 2008 continues to produce new plant material near a well where there are restrictions for the

use of *imazapyr*, and as these were too small to inject as in previous years, foliar spray was applied. Three additional plants were found to the south on the alder/willow dominated river floodplain and bar – and these were sprayed, but only with *glyphosate* – no *imazapyr* was used at the request of the landowner due to her concern that the herbicide would be harmful to cattle raised for organic beef. Retreatment in 2012 will most likely be necessary.

Very little damage to adjacent native plants at sites where foliar spray had been applied in 2010 was observed. Occasional 'twisting' and partial bleaching of salmonberry leaves was noted, but the majority of sites showed no additional impact to soil or plants. Native shrubs and forbs were present at all sites, except where other invasives such as Himalayan blackberry or Scotch broom were dominant – e.g. at Baker Bar.

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 for each site and application are maintained by the Institute, and reported through the Jefferson County Noxious Weed Board to WSDA.

Effectiveness Monitoring of 2010 Control Activities

Effectiveness surveys were conducted prior to and during training at Upper Brandeberry, Fletcher Island, Lindner Bar, Spruce Creek, and Lewis Channel. Old flagging was found in approximately 20% of sites, but channel changes and flood impacts made locating previously treated sites difficult. Of the sites that could be verified as previously treated, re-sprouts were uncommon. Throughout the survey season, approximately 5% exhibited re-growth. The addition of *impazapyr* appears to significantly increase control effectiveness.

Presentations and Educational Outreach

In 2011, we made a number of presentations summarizing results and challenges to the North Pacific Coast Lead Entity, the Salmon Recovery Funding Board, the Olympic Knotweed Working Group (OKWG), the Jefferson County Noxious Weed Board, the Pacific Coast Salmon Coalition board, and the Hoh Indian Tribe's Natural Resources Department. 10,000 Years Institute also responded to calls from individuals and groups interested in controlling knotweed or developing other control projects, and provided information and training.

The Hoh River knotweed project was chosen as a case study to illustrate best management practices for a document written by researchers at Oregon State University, under contract with the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS). Interviews between researchers and Institute staff added to information gleaned from project reports. The study examines pesticide use in aquatic or riparian environments, highlighting situations where these chemical controls are applied in aquatic or riparian environments and harm to a non-target species is possible, and the development and use of best management practices to minimize harm to non-target species while remaining effective for pest control. (Emanuel, Chan, et al. 2011. ***A Selected Synthesis of Literature and Case Studies on Best Management Practices for Reducing the Impacts of Pesticides in Aquatic Environments and Protecting NOAA Trust Species,*** October 2011, Reference No. NFFKPR00-11-05375)

Landowner and Partner Outreach

Calls were made in July to six key landowners in the upper river above the Hoh Oxbow Bridge on Highway 101. Pacific Coast Salmon Coalition contacted other landowners and obtained several new access agreements in key sites in both the upper and lower river including Allen's Bar, where some large clumps were found and treated.

Past reports, maps, and herbicide information are provided over the course of the project. Summaries and maps for activities on specific parcels are being developed for each landowner who provided access. Project information is being shared with staff from the Department of Natural Resources, the US Forest Service, Hoh River Trust, Hoh Tribe, Olympic National Park, the Northwest Indian Fisheries Commission, Clallam and Jefferson County Noxious Weed Board staff, Jefferson County Commissioners, and during discussion at OKWG meetings. Informative posters are located at all Hoh River public boat launches and campgrounds. New posters targeting fishing and hunting user groups will be created and posted next year to show the range of plant size and growing sites.

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 knotweed must push up through – requiring repeat surveys in all river floodplain and terrace locations that receive flood waters each year. The depth from which knotweed can emerge from a fragment of rhizome, or the time it takes for emergence, remains unknown. However, recent trials at WSU conducted by Tim Miller demonstrated that rhizomes can grow 15 feet laterally in one year. Research related to depth of burial relative to emergence timing also needs to be conducted.

The project has had to balance the need to cover a large expanse of difficult terrain with a low budget – which in the past required the use of relatively inexpensive and inexperienced correctional crews. Starting in 2009, a more professional but much smaller crew was engaged. Survey effectiveness would be improved if the size of the crew could increase as the knotweed becomes increasingly smaller and more widely distributed, and therefore more difficult to locate, and crew size will be increased as possible with additional funding. A crew of at least ten well-trained and motivated workers is necessary to adequately cover the entire floodplain, all the vegetated bars, and the upland terrace forests. A local crew familiar with the terrain and ecosystem is a key ingredient to success.

Conclusions and Future Plans

Our control methods have proven to be highly effective – we can see from field surveys and data analysis that a large percentage of knotweed plants on the Hoh River have been successfully eradicated over the past eight years. Unlike the dense continuous stands seen along many rivers and roads, it has become quite difficult to find knotweed on the Hoh River.

The remaining population is largely made up of small single-stemmed plants, significantly reducing the biomass available to start new plants – which is an important factor in terms of the project's long term planning. The challenge remains to locate widely spaced, very small plants on a wide and complex river floodplain over a distance of 30 miles in length, 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 re-sprout. 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 new plant growth, or causing impact to the water through herbicide application, is needed. We continue to work on a solution for this phenomenon with the OKWG, and see evidence that the addition of *imazapyr* to the herbicide application is helping.

The cooperation of private landowners in the Hoh River valley is imperative to the success of this project. Support of the project is strong among landowners, and we will continue the outreach and positive results that encourage this cooperation.

The 2012 project will revisit all previous plant locations, work with partners to establish that large tributaries are knotweed-free, and expand our focus in the lower river. We will continue to actively participate in the OKWG, and to share project results with interested parties and in appropriate forums.

Other Species of Concern

A number of other species of concern were noted during our knotweed surveys, and we roughly estimate that by pulling and cutting some of these plants in passing, the distribution of ***billions*** of seeds did not occur. The plants discussed below are listed by the Center for Invasive Plant Management as some of the worst weeds in the west, and are all interfere with native riparian succession necessary to achieve and sustain a healthy native riparian forest. Among those, Scotch broom (C*ytisus scoparius*), non-native blackberry (Himalayan and Evergreen - *Rubus spp*.), reed canarygrass (*Phalaris arundinacea*), herb Robert (*Geranium robertianum*), and Canada thistle (C*irsium arvense*) are increasing in the Hoh river corridor where they had previously not been widely distributed. Each of these species has competitive advantages over native plants, and when not managed, easily become monocultures in nutrient-poor and highly disturbed environments such as river bars. They are joined by numerous other non-native species, also distributed by wind or water, including smartweed (*Polygonum spp.)* and common burdock (*Arctium minus*).

Scotch broom is well-established in areas with high human use - Lindner, Morgan's, Clear Creek, Owl Creek, and Brandeberry - and is often associated with the use of seed-contaminated gravel in construction, roads, or riverbank protection such as at Baker Bar, where there is a solid five acre patch resulting from river construction of an engineered log jam project. It grows over ten feet in height in patches at Lindner Bar. Spreading from Baker Bar and Old Joe's Slough where river stabilization projects were constructed, it is observed to be spreading quickly on other gravel bars in the lower river below RM 15. This species is exhibiting an effect on native forest succession where it is established – at Lindner Bar, there are patches that have not been

replaced by native tree succession in the past decade, and at Baker Bar, there are no other plants growing in a solid stand of over two acres that is more than 6 feet in height. According to weed literature, a mature Scotch broom plant can produce 6,000 seeds that remain viable in soil for 60 or more years. In the Hoh River's active channel and floodplain, new plants are becoming widely distributed as floodwaters deposit seeds. Scotch broom sequesters nutrients such as nitrogen, and with a deep tap root, is able to survive drought and flood conditions that kill or excavate alder and willow, which are critical to beginning the successional process that establishes conifer in riparian forests.

Herb Robert (*Geranium robertianum*), an understory competitor with allelopathic properties, was found spreading in size and distribution in a number of locations. The source location is reported to be a maintenance yard at Snider Creek in Olympic National Park. Expanding populations have been observed at Brandeberry, Lewis Channel, Morgan's, Lindner, Elk Creek, Schmidt Bar, and Cottonwood.

Butterfly bush (*buddleja davidii Franch.)* is planted in the upper river on the north side on private property within the channel migration zone, and on the lower river at the edge of the floodplain. As has been shown on the Dungeness River, this species of Asian origin poses a threat comparable to knotweed.

Foxglove (*Digitalis purpurea*) is exploding in density across wind-exposed bars and along banks and in depositional zones along large wood jams. This species is considered naturalized, but as with the other species listed here, has not been observed as widely in prior years in the Hoh River floodplain. As all parts of the plant are poisonous including the seeds, and each plant can produce 200,000 seeds, and we observed some patches solidly covering hundreds of square feet, we are advocating the pulling of these plants - particularly before they bloom.

Tansy ragwort (*Senecio jacobaea*) was found in many different types of habitats – mostly those with some disturbance - and we pulled every plant we found (approximately 45). We found and pulled one small patch of Common Tansy (*Tanacetum vulgare*).

Bull thistle (*Cirsium vulgare*) was also widely distributed in disturbed sites and we pulled, buried, and kicked down many stalks. Sites where we pulled thistle in previous years were mostly free of plants.

Outside of the knotweed project, we are working with WSU to distribute biocontrols for certain species (Tansy ragwort, Canada thistle and Scotch broom). Pacific Coast Salmon Coalition deployed an Olympic Correctional Camp crew in two of the most heavily infested sites for four days of pulling.

Knotweed and other invasive plants impact all of the river-adjacent landowners, the recreational public, and the Hoh Tribe – and while knotweed requires the use of herbicide in complex habitats like the Hoh River – the others do not. We encourage each person to '*pull that ONE plant – before it goes to seed'* (and report the knotweed when seen)! Expanding the knotweed project to implement Early Detection/Rapid Response to address these other invasive plants makes sense, as in combination, they pose as much of a threat to fish and wildlife habitat as does knotweed.

Appendix 1: Project Results – 2002-2011

River Bar	RM	Total # Canes	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Upper Brandeberry	30	789	-	-	-	-	-	-	-	-	789	**690**
Brandeberry	29.75	5280	ns	4108	707	69	135	ns	256	1	4	**ns**
Richmond[a]	28.5	410	a	a	A	a	ns	ns	216	170	24	**1**
Lewis	28.5	231	ns	ns	ns	ns	ns	-	150	ns	81	**97**
Canyon Creek	28	2555	932	1046	357	31	21	92	55	21	0	**0**
Lewis Channel	28	1239	ns	505	509	36	104	ns	45	35	5	**0**
Owl Creek	27	6857	869	4517	1053	238	117	ns	24	28	11	**3**
Fletcher Island	27	240	ns	ns	ns	ns	158	ns	55	8	19	**351**
Spruce Creek	27	1807	49	ns	1078	58	239	220	115	41	7	**10**
Spruce Canyon	26	1027	133	336	162	39	8	3	0	346	0	**0**
Tower Creek[b]	25	385	326	ns	ns	48	ns	ns	ns	11	ns	**3**
Coontz' Bar[c]	25	30	7	ns	ns	ns	23	ns	ns	c	c	**ns**
Coontz' Bar LB[c]	25	2155	1925	136	47	ns	47	ns	ns	c	c	**ns**
Morgan's	24	649	ns	15	215	67	15	191	80	58	8	**47**
Clear Creek	23	1542	ns	729	556	36	15	52	110	19	25	**6**
Lindner	23	10350	3299	3717	1227	303	819	303	394	109	179	**29**
Peterson's Bar	21.5	1511	ns	559	206	387	62	191	99	7	0	**ns**
Peterson's Bar West	21	2039	ns	ns	821	ns	35	1052	18	91	22	**ns**
Willoughby	20	2	ns	ns	ns	ns	ns	1	0	1	0	**0**
Schmidt Bar	20	3662	1437	1798	217	35	94	80	1	0	0	**18**
Elk Creek	19.5	1939	ns	ns	ns	639	384	66	580	250	20	**ns**
Alder	19	544	ns	ns	ns	ns	326	218	0	0	0	**ns**
Hell Roaring	15.5	572	ns	ns	ns	ns	572	ns	ns	ns	ns	**ns**
Allen's Bar	15	25	ns	ns	ns	ns	25	ns	ns	ns	ns	**326**
Allen's Bar II	15	60	ns	ns	ns	ns	60	ns	ns	ns	ns	**ns**
Old Joe's Slough	14	447	ns	181	ns	14	43	ns	ns	ns	209	**67**
Baker	13	1626	319	ns	857	224	124	ns	ns	ns	102	**84**

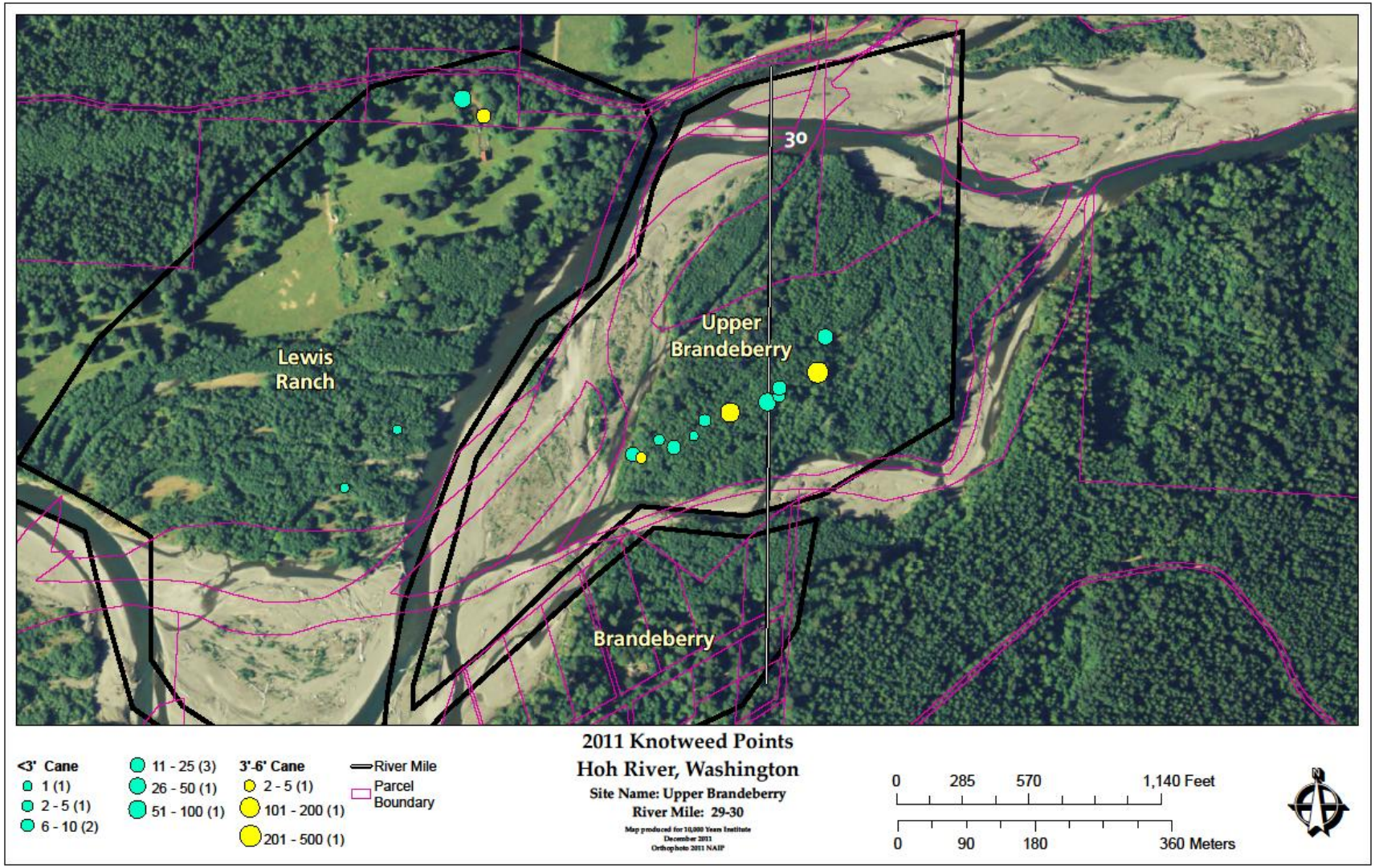
ns = not surveyed

Appendix 1: Project Results - 2002-2011

Dengate Island[d]	12	465	ns	125	31	50	11	ns	ns	ns	248	**ns**
Cottonwood	10.5	1628	326	813	318	119	35	ns	15	1	ns	**1**
Hoh Humm/HRT	9	ns	ns	ns	ns	ns	ns	ns	ns	ns	162	**24**
Nolan Creek	8	11	ns	ns	ns	11	ns	ns	ns	ns	ns	**289**
Nolan Bar	8	287	ns	ns	ns	ns	286	ns	1	0	0	**7**
Rayonier Bar	7	275	ns	ns	ns	ns	275	ns	ns	ns	ns	**ns**
G&L	6	113	ns	ns	ns	113	ns	ns	ns	ns	ns	**ns**
Lower G&L	5.5	132	ns	ns	ns	ns	132	ns	ns	ns	ns	**ns**
Fletcher Creek	2.5	151	ns	ns	102	ns	49	ns	ns	ns	ns	**ns**
Lower Hoh[e]	1	758	ns	ns	ns	394	337	ns	ns	6	21	**ns**
		51793	**9622**	**18585**	**8463**	**2911**	**4551**	**2469**	**2214**	**1203**	**1775**	**2050**

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 on
c Coontz Bar and Coontz Bar LB is included in Tower Creek from 2008 onward
d Dengate Island is Hoh Humm and HRT in 2010
e Lower Hoh (Dickson) was not treated in 2010

Appendix 2: GPS Map – River Miles 27-30



Appendix 3: Data Dictionary

KNOTWEED NUMBER (Automatically assigned)
LOCATION NAME
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 {REQUIRED - canopy closure of shrubs and trees above knotweed}
- 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 members)

Appendix 4 – "Invasives 101" and Species of Concern – Links and Resources:

The Global Invasive Species Team
http://www.invasive.org/gist/methods.html

Center for Invasive Plant Management – Worst Weeds of the West List
http://www.weedcenter.org/inv_plant_info/worst.html

Scotch broom
http://www.nwcb.wa.gov/weed_info/Cytisus_scoparius.html
http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/scotch-broom.aspx

Buddleia (Butterfly Bush)
http://www.nwcb.wa.gov/weed_info/buddleja_davidii.html
http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/butterfly-bush.aspx

Tansy Ragwort
http://www.nwcb.wa.gov/weed_info/Senecio_jacobaea.html
http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/tansy-ragwort.aspx

Canada thistle
http://www.nwcb.wa.gov/weed_info/Cirsium_arvense.html

Bull thistle
http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/bull-thistle.aspx

European blackberry
http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/blackberry.aspx

Herb Robert
http://kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-identification/herb-robert.aspx