

Salmon River Initiative Project Report



October 2015



St. Lawrence – Eastern Lake Ontario
Partnership for Regional Invasive Species Management

Managing Japanese Knotweed (*Fallopia japonica*)
In the Salmon River and Salmon River Estuary

Final Project Report

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Partnership for Regional Invasive Species Management
SLELO - PRISM

October 2015

Cover photos: all photos by TNC: 1. Mike Parks with stem injector. 2. Benjamin Hansknecht and Caitlin Muller monitoring site restoration efforts. 3. Garrett Brancy on the Salmon River.



"I have fished the Salmon River for many years and have seen this invasive plant change the landscape. After all that the river has given us, it's nice to see local partners joining together to protect and restore this magnificent resource."

~ Fran Verdoliva

Acknowledgements

On behalf of the SLELO partnership, we would like to thank the numerous landowners who gave us permission to access their property along the river for without their permission, this project would have never taken place. We also wish to thank the NYS Dept. of Environmental Conservation, The NYS Environmental Protection Fund, The Salmon River Fish Hatchery, Millers Turf Inc., Niagara Mohawk, National Grid and the Village of Pulaski for their cooperation. Thank you to The Nature Conservancy staff whom supported many aspects of this project; including grant administration, field operations, data management & analysis, human resources and especially our seasonal employees who set afoot day in and day out.

About SLELO – PRISM

The **St. Lawrence Eastern Lake Ontario Partnership for Regional Invasive Species Management** is one of eight partnerships in New York State, encompassing St. Lawrence, Jefferson, Oneida, Lewis and Oswego counties outside of the Adirondack Park.

Our mission is to protect native habitats, biodiversity, natural areas, parks and refuges, freshwater resources and open space by using a collaborative and integrated approach to invasive species management. The emphasis of these activities is on prevention, early detection, rapid response and education.

The SLELO PRISM is hosted by The Nature Conservancy, Central and Western New York Chapter



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Executive Summary:

Today, the Salmon River corridor appears much different than it did three years ago. As you walk sections of the river banks there is noticeably much less knotweed. Visibility is greater and the area seems more open. Japanese knotweed populations can be effectively be suppressed but requires multiple treatments. Sites where knotweed occurs in predominately shady areas can be eradicated. Sites that occur in predominately sunny areas can only be suppressed with limited to moderate efficacy. Treated sites can be restored to more native plant communities but are generally site specific. Again in shady sites one can expect moderate to excellent restoration whereas in sunny sites results can be mixed.

The overall goal of this project was to improve the native plant characteristics of the Salmon River riparian areas. To achieve this, the following objectives were identified:

Objective No. 1 – Suppress populations of Japanese Knotweed within the estuary portion and the upstream portions of the river.

Objective No. 2 – Restore treated areas by allowing for native regrowth and by intentionally planting native species of riparian plants.

Objective No. 3 – Implement an education & outreach effort to a targeted audience to garnish informed consent and to prevent future introductions and the spread of knotweed and other invasive species.

During the three years of project implementation we have treated 8.68 acres of knotweed with moderate to excellent suppression at most sites treated and limited suppression at several sites. We have restored several sites by reseeding 51,500 square feet with native grass seed and by implementing a live stake procedure with resident plant materials achieving a 20% live stake survival rate. We have reached dozens of individuals including conservationists and anglers through the implementation of diverse educational and outreach strategies. Based on these data it is reasonable to conclude that we have met our objectives.

Salmon River Landscape:

The Salmon River and the Salmon River Estuary are important both ecologically and economically. The Salmon River Estuary is a highly productive freshwater habitat located along the eastern shore of Lake Ontario. The estuary spans an area of approximately 270 acres which includes 130 acres of emergent marshes, 110 acres of riverine wetlands, and 30 acres of shrub swamps. In the spring and summer the Salmon River Estuary houses a variety of aquatic and terrestrial organisms, including state protected birds such as the pied-billed grebes (*Podilymbus podiceps*) and least bitterns (*Ixobrychus exilis*). The estuary not only provides nesting habitat for migratory birds, but provides habitat for their food sources; aquatic insects, small fishes, and crustaceans. During the fall months the estuary acts as a staging area for the migration of Chinook salmon (*Oncorhynchus tshawytscha*), Coho salmon (*O. kisutch*), Atlantic salmon (*Salmo salar*), steelhead (*O. mykiss*), and brown trout (*S. trutta*), (Chapman, Williams, & McHale, 2012).

The Salmon River is a high-quality tributary with a gravelly bed that not only provides substrate for salmonid egg incubation and protection, but a habitat for crustaceans and aquatic insects which maturing fish will consume. The river has an abundance of high quality riparian and ravine habitats that contribute to the diversity of fishes. Water that flows through the Salmon River originates in the Tug Hill plateau, one of the cleanest and most heavily-forested watersheds in New York State. In this report, the upper Salmon River is defined as the area between the upper limit of the Salmon River Estuary and the Lighthouse Hill Reservoir dam, spanning approximately 17 miles. The water flow in the upper Salmon River is impacted by the discharge from the Lighthouse Hill Reservoir dam and several tributaries (Chapman, Williams, & McHale, 2012).

The local economy benefits from the Salmon River, as it attracts anglers from all over the world in the fall during the salmon migration. An estimated 68% of all fishing within tributaries in Lake Ontario occurs within the Salmon River alone. Millions in local revenue occurs annually as a result of anglers utilizing the Salmon River. The Pine Grove Boat Launch within the Salmon River Estuary is popular during the summer months for anglers, boaters, kayakers, and canoers. Most shoreline fishing traffic within the estuary is concentrated around the New York State Department of Environmental Conservation (NYSDEC) public fishing access along the Route 3 Bridge (Chapman, Williams, & McHale, 2012).

Upstream in the Salmon River fishing is concentrated along the shore, standing within the river, or with the occasional non-motorized drift boat. Of the 17 miles of the Salmon River, 12 miles are privately owned. Public Fishing Rights along these lands allow anglers to congregate and access the river. The Village of Pulaski owns and maintains land adjacent to the river as it passes through the village. Douglaston Salmon Run, which owns one of the largest private parcels along the Salmon River, allows anglers to pay a fee to fish on their land. During the off-season the NYSDEC, which owns the Salmon River Fish Hatchery, focuses on natural reproduction of Chinook, Coho and Atlantic salmon, Steelhead, and brown trout (Chapman, Williams, & McHale, 2012).

Japanese knotweed (*Fallopia japonica*), native to eastern Asia, was intentionally introduced as an ornamental plant in the U.S. during the later 19th century. It was a highly valued ornamental as a result of its hardy nature and large, showy flower clusters. In the early 20th century homeowners were warned to avoid purchasing and planting Japanese knotweed in their yards as it rapidly spreads and would overtake gardens. Instead, it was recommended that homeowners plant knotweed along out-of-

the-way areas, including stream-banks and pond edges. As a consequence of this recommendation, Japanese knotweed has been observed in the Salmon River region since the early 1980's (Chapman, Williams, & McHale, 2012).

Evidence Based Conservation:

The colonization of the Salmon River by Japanese knotweed has the potential to alter the native plant community composition. Japanese knotweed has colonized riparian areas along portions of the Salmon River creating monocultures which directly alter the ecosystem by shading out and dominating more beneficial native plant species, producing deep litter masses, and competing with native plants for nutrients and water. The decline in native plant diversity could also cause diminished wildlife value of riparian areas, as it alters the overall food web structure. Phytophagous (plant-feeding) and detritus feeding insects are may be impacted as a result of a loss of plant material to feed on. Japanese knotweed would not only impact the food web structure, but may impact the overall diversity and abundance of native species. The reduction or loss of riparian trees and shrubs may directly impact organisms that rely on the vegetative structure, like threatened nesting shorebirds. As the result of these growing concerns along the Salmon River, a Feasibility Study completed in 2012 recommended that knotweed populations (Figure 1, below) be suppressed and treated sites be intentionally restored to a native plant character (Chapman, Williams, & McHale, 2012).

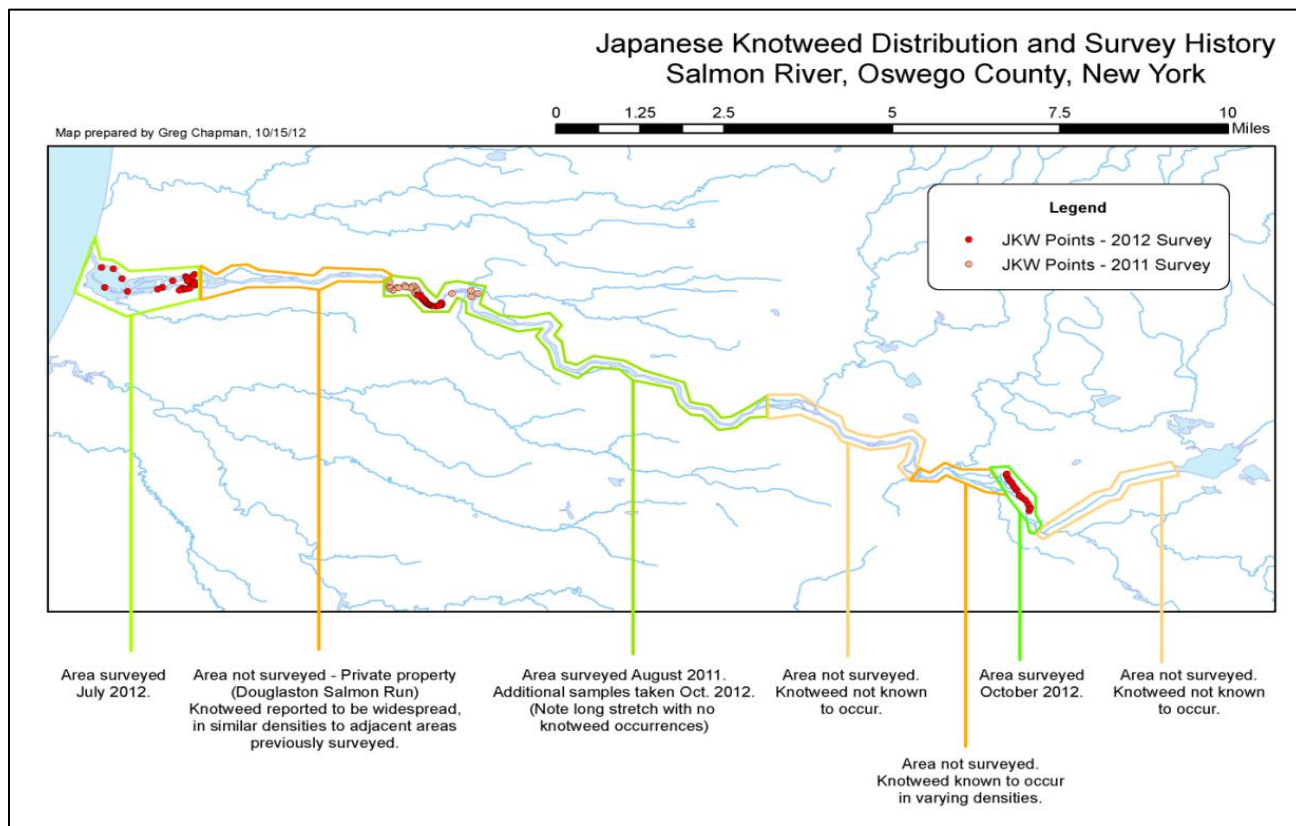


Figure 1: Japanese knotweed distribution and survey history along the Salmon River.

River Compartment	Number Of Patches	Avg. Patch Size (sq ft)	JKW Total Area (sq ft)	Compartment Total Area (acres)	Density (sq ft/acre)	Calculated Total JKW (sq ft)
Salmon River Freshwater Estuary	8	1097.29	8778.31			8778.31
Port Ontario Open Braided River	17	2496.83	42446.04	35.05	1211.01	42446.04
DSR Open Braided River				115.97		140441.29
DSR Linear River				56.06		47360.87
Pulaski Linear River	22	448.91	9876.00	11.69	844.82	9876.00
Pulaski Non-Area Samples	21					9427.11
Altmar (Non-Surveyed)				59.46		12808.73
Altmar (Surveyed)	16	407.81	6525.00	30.29	215.42	6525.00
					Estimated Total JKW	271138.35 ~6.37 Acres

Table 1: Data table used to estimate total Japanese knotweed area on the Salmon River. Calculated values with red backgrounds indicate that the infested area for that compartment was estimated.

Objectives of this Project:

Three objectives were outlined in the Salmon River Initiative Feasibility Study;

1. First was to suppress populations of Japanese knotweed within the estuary and upstream portions of the river.
2. The second objective focused on restoring treated areas by allowing native regrowth and/or intentionally planting native species of riparian plants.
3. The final objective involved implementing education and outreach efforts to targeted audiences to provide informed consent and to prevent future introductions of invasive species. This project component was aimed at anglers and those who use the estuary and river to avoid patches of knotweed and to help reduce its spread along the estuary (Chapman, Williams, & McHale, 2012).

Control Categories (Eradication, Containment, Suppression)

The successful control of invasive species relies on the synergistic use of the following strategies: prevention (i.e. the preclusion of new populations), early detection/ rapid response (i.e. the quick discovery and eradication of individuals in low abundance) and long-term management (i.e. the containment and suppression of well-established populations (Chornesky et al. 2005).

The Nature Conservancy, in conjunction with the aforementioned strategies, utilizes the following defined approaches to manage invasive species already known to be present in a region: eradication, containment and suppression. **Eradication** is often not feasible for both technical and financial reasons (Meyerson and Reaser 2002), for this control method requires the complete elimination of all individuals in an area, including those plausibly residing latently in the seed bank. An eradication effort is considered successful only after observing no invasive regrowth for three consecutive years, post-treatment (Rejmánek & Pitcairn 2002). **Containment** involves reducing or, if possible, completely preventing the dispersal of an already established population into new locations. This method is often used to prevent the spread of an invader into Priority Conservation Areas (PCA's) when stable populations are known to be nearby or adjacent. Lastly, **suppression** denotes the reduction of an ingrained population's density below a threshold to maintain native species or a desired ecological

process. Suppression is used frequently in conjunction with containment when infestations are widespread or otherwise beyond the scope of eradication and rapid-response.

Objective No. 1 - *Suppress populations of Japanese Knotweed within the estuary portion and upstream portions of the river.*

Target Level

Prior to its launch in 2013, a consent target of 80% of landowners needed to be met as requisite for the initiative's approval. After this target was reached, the Salmon River Initiative was free to proceed as initially outlined in the 2012 Feasibility Analysis (Chapman et. al 2012).

Techniques/Methods

The primary categories of invasive plant control include: mechanical, chemical, biological and controlled burn. (Rejmánek & Pitcairn 2002). For this initiative chemical control was implemented using a combination of stem injection and foliar application of Glyphosate[®] and Activator 90[®] to suppress Japanese Knotweed populations along the Salmon River.

Stem injection was selected as the primary herbicide application technique after considering factors such as cost, reported efficacy, distribution, size and location of Japanese Knotweed patches along the river, and the desire to minimize non-target effects and spray drift within these riparian areas (Chapman et al. 2012). This method was conducted using a specially-designed injection gun which delivers a set amount of undiluted herbicide directly into the hollow cane of the target-plant (Chapman et al. 2012). Injections were made perpendicular to the stem, below the third aboveground internode (segment) of the target-plant. By applying the herbicide directly into the targeted individual above the root crown, the ability of the herbicide to translocate throughout the plant's root structure is greatly increased (JK Injection Systems 2013). Five milliliters of herbicide or less is recommended per injection by the product manufacturer (JK Injection Systems[®]) and each stem is marked upon injection, thereby preventing duplicate injections (Chapman et al. 2012). For larger populations away from the water's edge, foliar application was used.

All aboveground surfaces of plants are covered by a waxy cuticle, which helps prevent water loss and also provides protection against physical and microbial attacks (Wang & Liu 2007). Thereby, the cuticle also represents the greatest barrier to the penetration of herbicide uptake. The cut-stump and stem injection (Figure 2) methods avoid this barrier by physically cutting or piercing the stem, providing direct access to the xylem and phloem for herbicide translocation. Surfactants are the most common of herbicide adjuvants used to enhance the efficacy of foliar treatment. Surfactants have been known to affect the herbicidal uptake process, the deposition of herbicide solution onto the leaf's surface and the diffusion of solution (Wang & Liu 2007). Note, however, that the efficacy of surfactants depends on their type and varies greatly when used in combination with different herbicides and even when applied to different plant species. For this initiative, the non-ionic surfactant Activator 90 was used for foliar treatments.

Suppression Results:

The reduction of Japanese Knotweed populations in an effort to maintain native species or a desired ecological process has been generally favorable at both the estuary and upstream areas of the Salmon River.

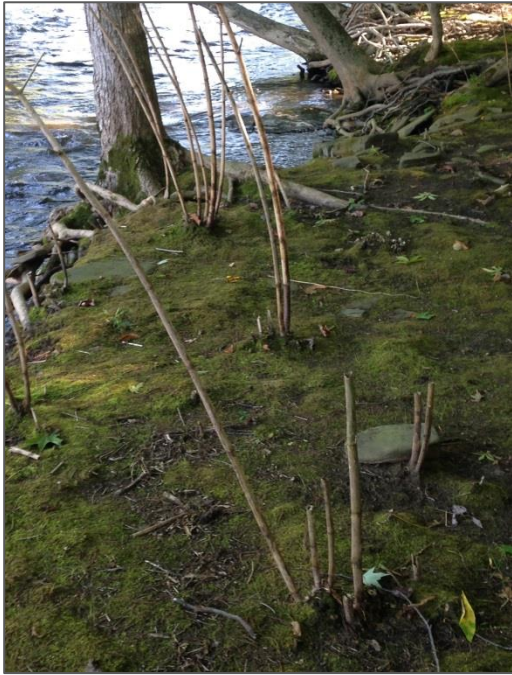


Figure 2 - Dead knotweed stems after single treatment using stem injection.

Suppression Results Summary:

- ✓ *8.68 total acres of knotweed treated a minimum of three times over a three year period.*
- ✓ *Moderate to excellent suppression at most sites.*
- ✓ *Eradication at only a few sites (no regrowth during the third year).*

Field Observations:

- *Plant mortality at predominately shade sites was noticeably greater than at sunny sites.*
- *Stem injection delivery resulted in a more rapid “initial” die-off, but long term there were no observed differences in mortality between injected sites and foliar treated sites.*
- *Soil type played no role as there was no observed difference in mortality between sites with rock soils verses silty-loam soils.*

“Having worked along the river for three seasons it was exciting to see the progress made with knotweed suppression. It’s encouraging to see the river begin to return to its original state which has attracted so many anglers for generations”.

~Marcus Roggie



Sites Without Permission:

The success of this initiative relied heavily upon access to private lands beside the Salmon River, without which, chemical treatment could not have been implemented. In areas where access was denied, however, a consistent effort was made to educate landowners about Japanese Knotweed as well as the ecological and economic importance of the Salmon River to the local community. These property-owners were then further encouraged to manage their own Japanese Knotweed patches.

Site Restoration:

To restore sites treated by herbicide application as a method to expedite native plant regrowth, two methods were selected for this project to include: 1) planting a fast germinating seed and 2) utilizing live staking of on-site tree and shrub stems.

Objective No. 2 - *Restore treated areas by allowing for native regrowth and by intentionally planting native species of riparian plants.*

Seeding of sites was achieved by using a cyclone hand spreader and at times broadcasting the seed by hand only. A mix of annual ryegrass, perennial ryegrass and little bluestem (*Schizachyrium scoparium*) at a 3:2:1 ratio was used. The seeding rate was approximately twenty five pounds per acre.

Live staking (Figure 3 and 4) involves the insertion of live, vegetative cuttings into the ground in a manner that allows the cutting (stake) to take root and grow (Darris 2002). The purpose of using live staking along the Salmon River was to expedite the regrowth of native riparian species at the treatment sites. Each cutting was approximately three feet in length with a single severed end (i.e. where the section was removed from the parent plant). The severed end of each cutting was planted into the ground. From the available native species, various species of dogwoods and willows were selected as cuttings for this initiative due to their well-known success as live stakes (Darris 2002).

To assess the restoration of treated sites along the river, three sites were chosen for active restoration and monitoring. Although additional sites were actively restored, these three sites were the focus of restoration efforts so that the results could be better documented.

Site DSR-1: This site was located within the upstream section of the river between the braided stream and the Village of Pulaski. The site was immediately adjacent to the river, consisted of rocky substrate and full sunlight.

DSR-2: This site was located just downstream of DSR-1, immediately adjacent to the stream and consisted of rocky substrate and shaded from direct sunlight

DOT-1: This site was located in the estuary just east of the Route 3 overpass along State Route 3 in Port Ontario. It is characterized by emergent marsh, full sunlight and silt-loam soils.

Site Restoration Results:

Site restoration ranges from moderate to good. Two monitored sites DOT-1 and DSR-2 show 0% knotweed regrowth and very good native plant and grass growth. This same observation is noticed at additional sites treated along the river.



Figure 3: Preparing a live stake in early spring along the Salmon River.



Figure 4: Shows successful live stake at Salmon River.

Site Restoration Results Summary:

- ✓ *51,500 sq. feet restored to native grass using annual ryegrass, perennial ryegrass and little bluestem mix at 21 locations.*
- ✓ *20% live stake survival using native on-site plant materials.*
- ✓ *Trees For Tribes® restoration being pursued as supplemental restoration.*

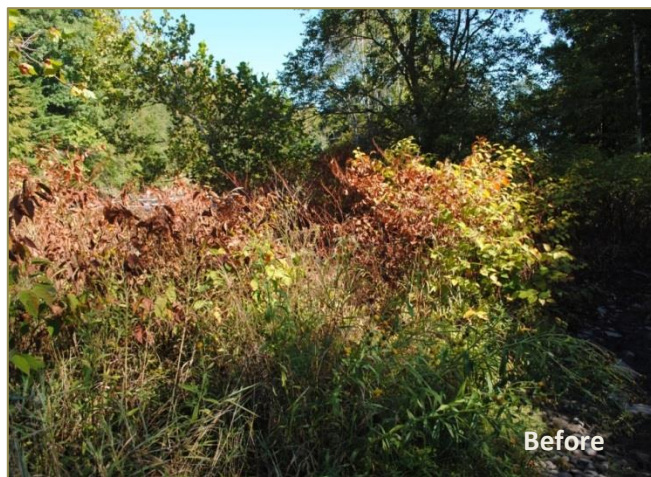
Field Observations:

- *Site restoration ranges from moderate to good. Two monitored sites DOT-1 and DSR-2 show little or no knotweed regrowth and very good native plant and grass growth. This same observation is noticed at additional sites treated along the river. Site DSR-1 shows good suppression, but some knotweed regrowth.*
- *First native plants to volunteer at upstream sites included; jewelweed, smartweed, ferns, grass and maple tree seedlings.*
- *In general, the Salmon River corridor appears much different than it did three years ago. As you walk sections of the river banks there is noticeably much less knotweed and the treated areas have much different plant communities.*

As with many of the shady sites treated along the river, Site DSR-2 (Figure 5 – below), demonstrates that knotweed can be eliminated from a given site and that the site can be effectively restored to a more native character by way of intentional planting of native species.



Figure 5 above: Site DSR-2. Post restoration with 0% knotweed, 60% native grass cover including germinating live stakes (inset). Prior to project initiation this site was 100% knotweed.



Before



After

Figure 6 - Above, Site DSR-1, sunny site. Left after initial treatment. Right shows area after three annual treatments. About 20% knotweed remains.



Figure 7 - Above Site DOT-1. Left prior to treatment. Right, shows area after three annual treatments. Site (patch) went from 100% knotweed to less than 4% knotweed.

Additional Restored Sites (Figures 8 , 9):



Figure 8 - Left: Upstream Site SR-9. From 90% knotweed stems to 0% knotweed stems. Grass at 40% cover.

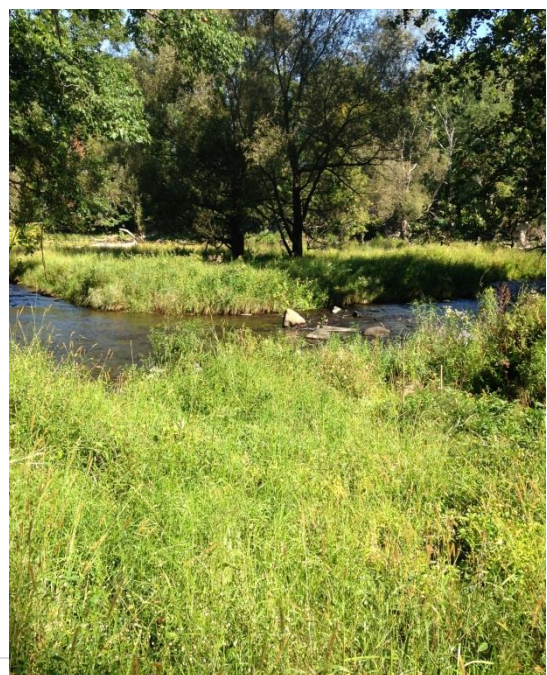


Figure 9 -Right: Site SR-6. Both the foreground and island had numerous knotweed patches. After three annual treatments both sites are dominated by grass and herbaceous plant material.



Site Monitoring:

In order to determine the relationship between knotweed suppression and the return of native flora as the result of intentionally restoring treated sites, the Multiple Species Inventory and Monitoring (MSIM) method of site monitoring was incorporated into the project¹. Three sites were chosen based on soil characteristics and proximity to the stream. Plant species composition surveys are conducted at each monitoring point at least three times per year to include early, mid and late season samples. The points are randomly selected at each site.

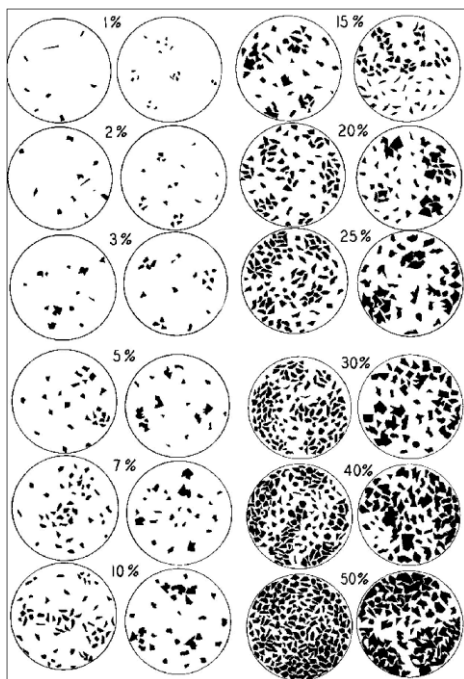


Figure 10 – Showing percent cover estimations. Groupings of plants (including the target species) are then grouped into five categories to include; target species, herbaceous, forbs, sedges and grasses. Reference plots used for cover estimation are based on the Forest Inventory and Analysis (FIA) composition charts.

Observations:

Monitoring results for a three year period are presented in (figures 11,12 and13). Sites DOT-1 and DSR-2, show moderate to excellent knotweed mortality. Site DSR-1 shows mortality however this site also demonstrates significant regrowth of knotweed. Intentional planting of grass did not occur until after the second year of treatment, but shows good growth at sites DOT-1 and DSR-2. Grass establishment at DSR-1 is occurring, but limited.

¹ Murphy and Wilcox, 1986.

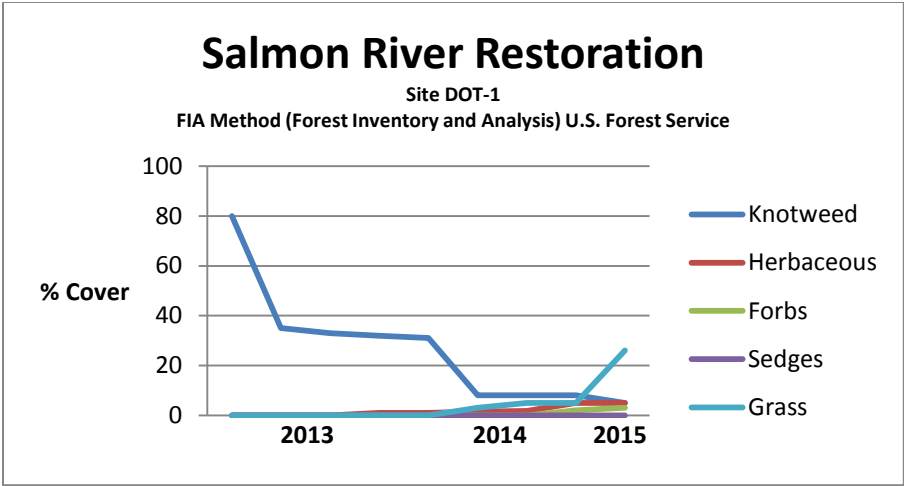


Figure 11, left:
Monitoring site DOT-1

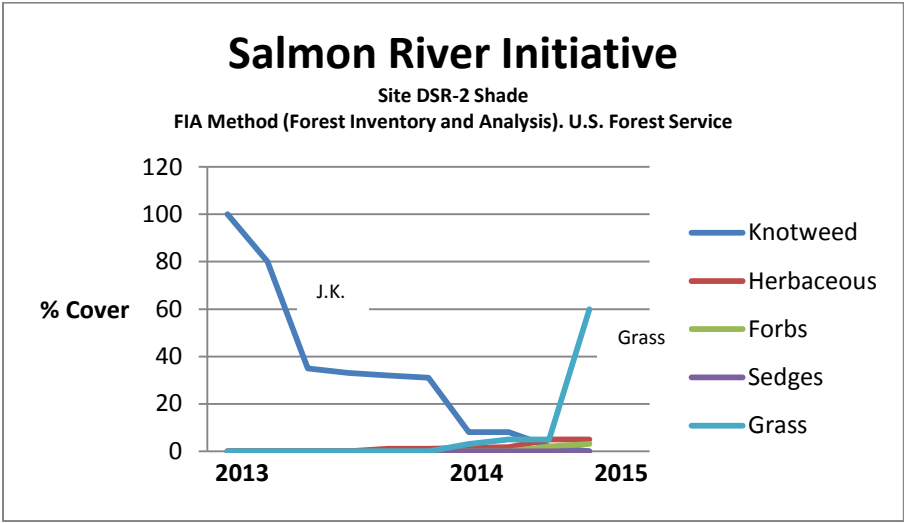


Figure 12, left:
Monitoring site DSR-2

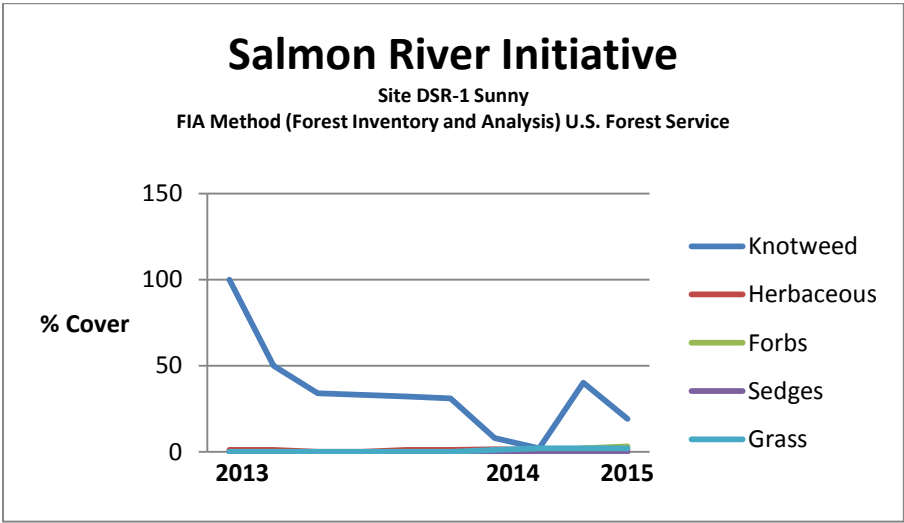


Figure 13, left:
Monitoring site DSR-1

Education and Outreach:

At the onset of this project people fishing the river were randomly asked if they knew about Japanese knotweed, most responded by saying no, but after showing them a knotweed plant they followed up by identifying the plant as bamboo. At the close of this project the majority of randomly selected anglers state that they are familiar with Japanese knotweed and could identify it.

Placing value and appreciation for the Salmon River as a natural resource while attempting to change behavior is an important component of this initiative. It was important throughout the course of this project to inhibiting the spread of knotweed along the river corridor by educating those who use this resource the most and to achieve informed consent.

Objective No. 3 - *Implement an education & outreach effort to a targeted audience to garnish informed consent and to prevent future introductions of knotweed and other invasive species.*

To achieve these objectives, SLELO partners implemented the following educational and outreach strategies:

Presentations to key stakeholders – Prior to and during the course of this project presentations were provided to key audiences including the New York State Department of Environmental Conservation, the SLELO PRISM Partnership and representatives of the Salmon River Fish Hatchery.

Pamphlet distribution – Four hundred informational pamphlets about Japanese knotweed were developed by the SLELO PRISM Educational Committee and disseminated at multiple distribution points surrounding the Salmon River to include: tackle shops, fish cleaning stations, stores, overnight accommodations and at the main entry gate at the Douglaston Salmon Run property. This occurred throughout the duration of this project.

Posting of flyers – Special flyers targeting conservationists and anglers were created by the SLELO PRISM Education Committee and were posted at all DEC kiosks at fishing access sites along the river. These were posted with permission from NYS DEC.

River steward efforts - The river steward component is a supplemental component of the Salmon River Initiative that involves person-to-person dialog along the river between the SLELO PRISM educator and anglers. The intent is to supplement past education and outreach efforts to targeted audiences (anglers and conservationists) to fulfill the goal of preventing the spread of Japanese knotweed. Efforts are focused on fishing hot spots located throughout the Salmon River to include the Douglaston Salmon Run, Port Ontario, Pine Grove Boat Launch. DEC fishing access sites include; the Black Hole, the Staircase, the Ballfield, Compactor Pool, Sportsman Pool North, Pineville, Trestle Pool North, Ellis Cove, Altmar North, Salmon River Visitors Center, and Sportsman Pool South. Sites have been visited a total of 3 times since the beginning of September and will continue to be visited throughout the salmon fishing season. The river steward component includes a short voluntary survey that will help to determine the overall knowledge that anglers have regarding Japanese knotweed, didymo and rusty crayfish. To date the river steward component has reached out to a total of 65 anglers.

Project Costs:

The cost of this project includes the preparation of a feasibility study, seasonal employee efforts, private contractors, education and outreach and projections of follow up site monitoring. Costs can be summarized as follows;

Invasive species inventory, mapping and preparation of feasibility study = \$7,280

Contractual herbicide services and seasonal applicators = \$62,280

Restoration (seed, plant materials) and monitoring = \$2,100

Total project costs = \$71,660

Was This Project Successful?

Based on the original project goal which was to suppress knotweed populations and given an estimated 35% regrowth of knotweed after three consecutive treatments at some locations, it is reasonable to conclude that we achieved a 65% suppression rate.

Site restoration ranges from moderate to good. Two monitored sites DOT-1 and DSR-2 show little or no knotweed regrowth and very good native plant and grass growth. This same observation is noticed at additional sites treated along the river. Site DSR-1 shows good suppression, but some knotweed regrowth.

In general, the Salmon River corridor appears much different than it did three years ago. As you walk sections of the river banks there is noticeably much less knotweed and people, especially the angling community seem to have greater awareness of Japanese knotweed.

Lessons Learned:

- Japanese knotweed is susceptible to systemic herbicide treatment but successive treatments must occur over multiple years.
- Knotweed growing in shady sites appears to be more susceptible to herbicides.
- Treated sites can be restored to their native community composition, but respond better to intentional restoration measures.
- Methods of estimating population size must be consistent. Our feasibility study used a cumulative patch size estimation whereas our treatment areas were based on the overall size of the area containing Japanese knotweed patches. Although when normalized, the latter would probably be reduced to better fit the feasibility estimation.

“Over time, the invasion of Japanese Knotweed has compromised the health of Salmon River corridor and its riparian ecosystem. After years of witnessing rampant spread, it is encouraging to see so much evidence of the species being suppressed and native vegetation returning. For DSR, the return of native vegetation is significant as it improves habitat for all species of fish, conserving the integrity of this great recreational resource for our community”

~Garrett Brancy



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