Japanese Knotweed (*Fallopia japonica*) in Nova Scotia: Ecological Impacts and Management.

Todd Larsen
Sept 2010-Sept 2012
Master of Science Program, Nova Scotia Agricultural College, Truro, Nova Scotia, Canada
Supervisor: Dr. Nathan Boyd
Committee: Dr. Vilis Nams & Dr. Gordon Brewster

Introduction

There is a growing need to seek management options for various invasive weeds as they become established in their introduced habitats. Preventative measures are rarely enacted, so land managers must evaluate various control methods once there is a need to contain or eradicate a nuisance species. In eastern and western North America, Japanese Knotweed (*Fallopia japonica)* has proven to be a particularly difficult species to control. Although its presence has been documented in Nova Scotia for about 100 years, it does not attract as much attention as an agricultural weed because it occurs in riparian areas, roadways, and dump sites. However, knotweed is a very effective invader due to its rapid growth, vegetative and sexual reproduction, and ability to form persistent and extensive mono-specific stands that exclude native vegetation. Due to its ability to out-compete other species, native plant abundance and diversity is reduced. This in turn also affects other components of the ecosystem that rely on the native plant communities. Furthermore, this plant is stupendously difficult to eradicate.

Knotweed management options must be evaluated in terms of cost, labour, environmental impact, and overall efficacy. A variety of physical, chemical, biological, and alternative methods have been evaluated. Overall, an integrated management approach is recommended for knotweed with multiple methods employed depending on the specific knotweed invasion.

My intentions with this research project are: (1) identify and describe the specific knotweed species at the research sites; (2) map knotweed distribution and evaluate its effects on plant and small mammal biodiversity; and (3) determine an effective herbicide application timing regime.

Objectives

Knotweed Species Identification

Describe the species present at the research site in Nova Scotia, using floral keys and personal observations of plant morphology.

Ecological Effects

1. Map the current location and size of knotweed patches using GPS data, GIS computer software, and aerial photography, and monitor population spread over three years.

2. Evaluate differences in riparian plant communities (dominated by: knotweed; grass; shrub): comparing species abundance, stem count (density), diversity indices, and percent cover.
3. Assess small mammal (mice and vole) population abundance and diversity in knotweed stands compared to native plant community habitats (grass; shrub).

Chemical Control

Analyze the effects of herbicide on knotweed growth at various times of application, and determine the most significant time or combination of times for effective chemical control.

Site Description

This study will be conducted at a location in Antigonish, Nova Scotia for several reasons. Funding for the project is from Nova Scotia Transportation & Infrastructure Renewal (NSTIR), and this site was chosen as a Wetland Compensation Program to offset destruction of wetlands from highway construction and expansion. In order to restore this former wetland, invasive species must be controlled so they do not affect the natural plant community dynamics. There is a large, well-established population of knotweed stands running along both sides of the Rights River, most likely introduced about 25 years ago by dumping of garden waste, then consequently spread by water movement (ice scouring in the winter, and flooding in the spring). A second site will be located near the Salmon River in Bible Hill, Nova Scotia. It also has a large knotweed population, which is slowly encroaching on the surrounding riparian plant communities.

Methods

Knotweed Species Identification

I will identify which species are present at the research sites by floral keys as well as genetic analysis. I will record all personal observations of plant characteristics and compare them with floral keys.

I have sent some knotweed samples from the Antigonish site to Dr. Robert Bourchier, a Biological Control Research Scientist at the Agriculture Research Centre in Lethbridge Alberta. He will use a chromosome count to identify the species and provide me with his conclusions.

Ecological Effects

In order to map the current knotweed distribution in Antigonish, I will use a handheld GPS unit (Trimble GeoExplorer 2005 Series) and walk around the perimeter of each knotweed patch while holding the device. These data observations will then be uploaded to an ArcView GIS program, and overlaid on an aerial photograph from 2007. This map will provide an accurate representation of knotweed patch size and distribution over the site.

Patch spread will be documented in order to determine the rate of advancement from established knotweed colonies. In the early spring, plastic stakes will be placed every 50 cm along the outer edge of five random patches, as determined by the outermost stalk from the previous fall. In the following two growing seasons, new growth outside of the stakes will be measured and used to estimate rate of spread.

A plant community survey will be conducted to identify and describe three types of plant communities: (i) areas invaded by knotweed, (ii) areas with open grassland vegetation, and (iii) areas dominated by shrubs. Each plant community or habitat will be described by the types of species present, stem count (density), and percent cover. According to a map provided by environmental engineer company CBCL, the three vegetation types are well represented along the Rights River. I will locate at least 15 plots of each type of at least 15 m^2 in size to represent the desired vegetation type. Near the centre of each plant community type, a stake will mark the middle with a 2 m string radiating out to encircle a plot of 12.5 m^2. Within each plot all plant species will be identified, using identification keys. Also, a 1 m x 1 m square quadrat will be randomly placed in each plot and stem density will be counted. These observations can be multiplied to estimate stem density in the whole plot. Percent cover will be calculated using the Daubenmire Cover Scale to estimate the percentage of ground surface covered by vegetation material in the plot. Key plant species such as knotweed, goldenrod, and reed canary grass may be measured separately to better describe the plots. Diversity will be analyzed using the Shannon Index for species richness and evenness, and Simpson's Index for species dominance.

To conduct a population survey of the resident small mammals, a well-documented and effective method has been chosen: tracking tubes. Tracking tubes are 35 cm long, 3.75 cm diameter PVC tubes with an inkpad in the center of the tube, and a strip of white paper for recording the tracks. Mice have a tendency to enter these tubes when placed in their vicinity.

The knotweed patches occur in random patches along both sides of the Rights River for about 1.2 km and extend inland to varying distances up to 100 m. Tracking tubes will be placed along the whole extent of knotweed infestation and 150 m on either end, for a length of 1.5 km on each riverbank, or 3.0 km in all. Sixty numbered tracking tubes will be placed on the ground in each plant community for a total of 180 tubes. They will be located in undisturbed areas of the plots to reduce manmade pathways. The tubes will be left for one week in the spring (June), and one week in the summer (August), then collected and the tracks will be identified according to a mammal tracking chart.

In order to cross-reference the tracks, and to get a better picture of the present species, I will also set some live traps in the research site. I will place three live traps (with food, water, and nesting material) in each plant community type for a total of nine traps, in areas where animals are known to reside according to the tracking tubes. The traps will be placed for one week in the summer (August), and one week in the fall (September) and checked every 24 hours. Prior to release, mammals will be identified and a track sample will be taken. Small mammal diversity will also be analyzed using Shannon and Simpson's Indices.

Chemical Control

Herbicide will be applied to knotweed patches according to various phenological stages in order for the chemical to reach the desired target. The exact combination of phenological stage and herbicide treatment is not known so we will test a variety of recommended combinations. The various times and reasons for their inclusion are:

i. Pre-emergence of shoots (April-May): reduce vigour and density of spring growth.
ii. End of shoot growth (August): translocate herbicide from leaves to storage in rhizome.
iii. Mid-flower (September): disrupt seed production
iv. Senescence (October): disrupt mass movement of nutrients from shoots to rhizome

Aminopyralid (Milestone) will be sprayed at a rate of 0.5 L/ha (Litre per hectare), or 120 g a.i./ha in 100 L/ha of water on the pre-emergent shoots. Imazapyr (Arsenal) will be sprayed at a rate of 3 L a.i./ha in 100 L/ha of water on the three other treatments (full growth, flower, and senescence). Both herbicides will be applied using backpack sprayers in accordance with necessary regulations.

By testing all possible combinations there will be 16 test plots and herbicide will either be applied at one stage (yes), or not (no) (4^2 = 2x2x2x2 = 16). The four treatments for the factorial design are: pre-emergence; full growth; mid-flower; and senescence. The plots will be set up in a randomized complete block design (RCBD), each plot being 2 m x 2 m with a 2 m buffer in between each plot. This experiment will be reproduced so there are three blocks at the site; the locations will depend upon appropriate size of knotweed patches. This experiment will be duplicated at the Bible Hill site.

To analyze the efficacy of the respective herbicides and date of treatment, various methods will be employed to determine the effect on the knotweed plant:

i. Stem count (density) in a random 0.3 m x 0.3 m quadrat within each plot
ii. Stem height in a random 0.3 m x 0.3 m quadrat within each plot will be measured
iii. Ratings scale (Pest Management Regulatory Agency) of the plants in the plot to analyze herbicide effect on plant growth
iv. Biomass in the second year to determine full year efficacy. Emergent shoots will be cut down in the spring (May 2012), dried, and weighed.

These data will be collected 2, 4, and 8 weeks after treatment (WAT), and in spring 2012 to determine effects on biomass of new growth.

Conclusion

Through this research, we will have a better understanding of Japanese knotweed and similar invasive weeds in North America. Equipped with this knowledge, we can provide land managers with more insight towards effective management of Japanese knotweed. Furthermore, with an increased awareness of the ecological impacts of invasive weeds, we can move towards conserving our natural areas, preventing further invasions, and protecting the flora and fauna of Nova Scotia and beyond.