KNOTWEED – CONTROL STRATEGIES AND ECONOMIC IMPACTS

IVMA CONFERENCE
NOVEMBER 9, 2016
Bob Drinkwater, P.Ag.
Drinkwater Environmental Services Ltd.

TOPICS

1. Taxonomy, biology & knotweeds in BC
2. Impacts and damage
3. Strategies
4. Control Techniques
5. Example

1. Taxo
Kno

Key to Identification of Invasive Knotweeds in British Columbia

Linda M. Wilson

March 2007

BRITISH COLUMBIA

Ministry of Forests and Range
Forest Practices Branch
Invasive Alien Plant Program

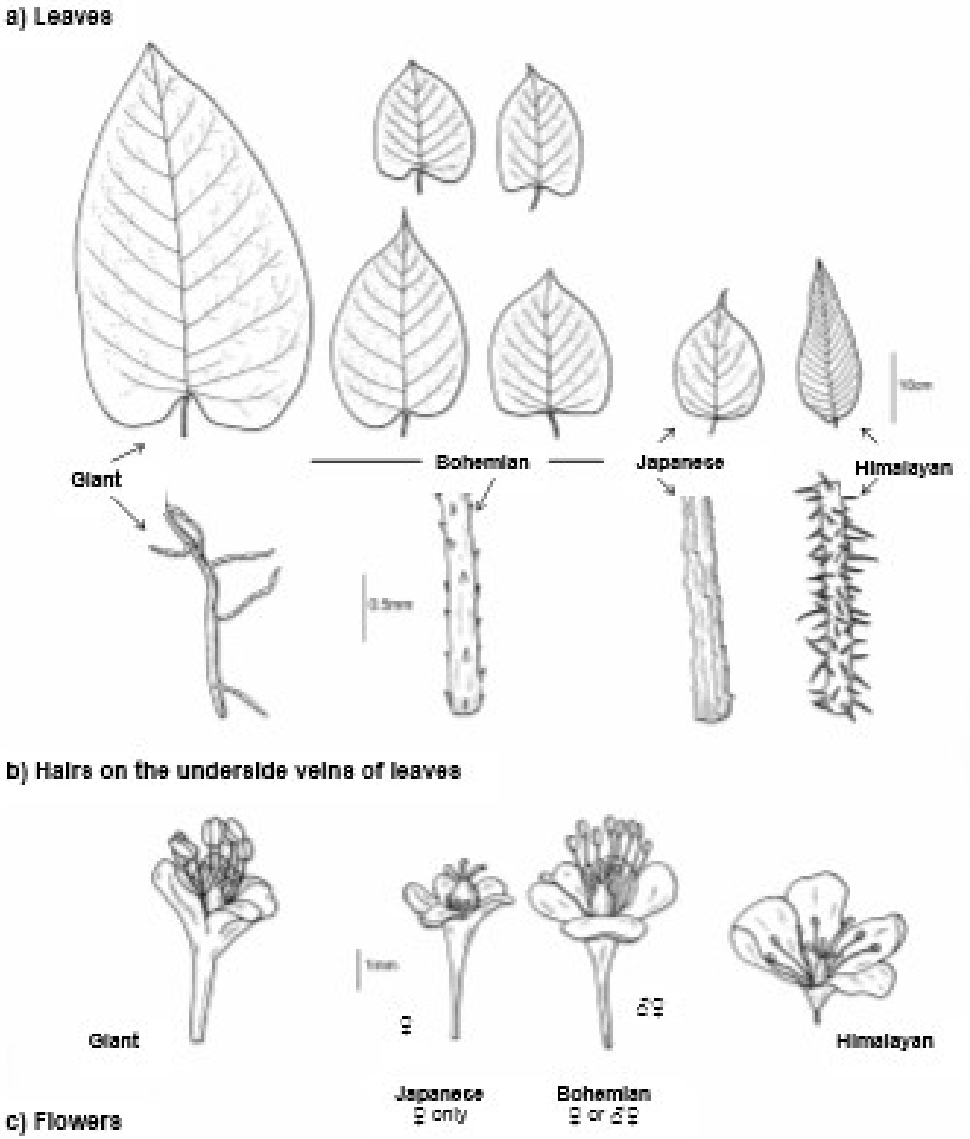

Figure 1. Invasive knotweeds in British Columbia. Line drawings by C. Roché.

DESCRIPTION and LIFE HISTORY

Knotweeds are tall, herbaceous, creeping, perennial weeds. Large overwintering roots produce new shoots in March and April. Plants grow rapidly, reaching their full height by late June. Knotweed typically grows in large clumps of stout, bamboo-like stems 1.5 to 6m tall. Though hollow, the jointed stems have solid nodes, each surrounded by a papery sheath (stipule). Stems are unbranched to profusely branched, and all bear alternate leaves on a long stalk (petiole) arising from the stem. Japanese knotweed leaves tend to be very straight (truncate) across the base and taper sharply at the tip. Giant knotweeds leaves can reach 40cm in length and have a distinctly heart-shaped (cordate)

1. Knotweed in BC

Agriculture and Agri-Food Canada

Canada

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→ Distribution and Potential Spread of Japanese Knotweed (Polygonum cuspidatum) in Canada Relative to Climatic Thresholds.

Science and Innovation

- Research Centres
- Scientific Staff and Expertise
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- Science Publications and Resources
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- International Engagement

Distribution and Potential Spread of Japanese Knotweed (Polygonum cuspidatum) in Canada Relative to Climatic Thresholds.

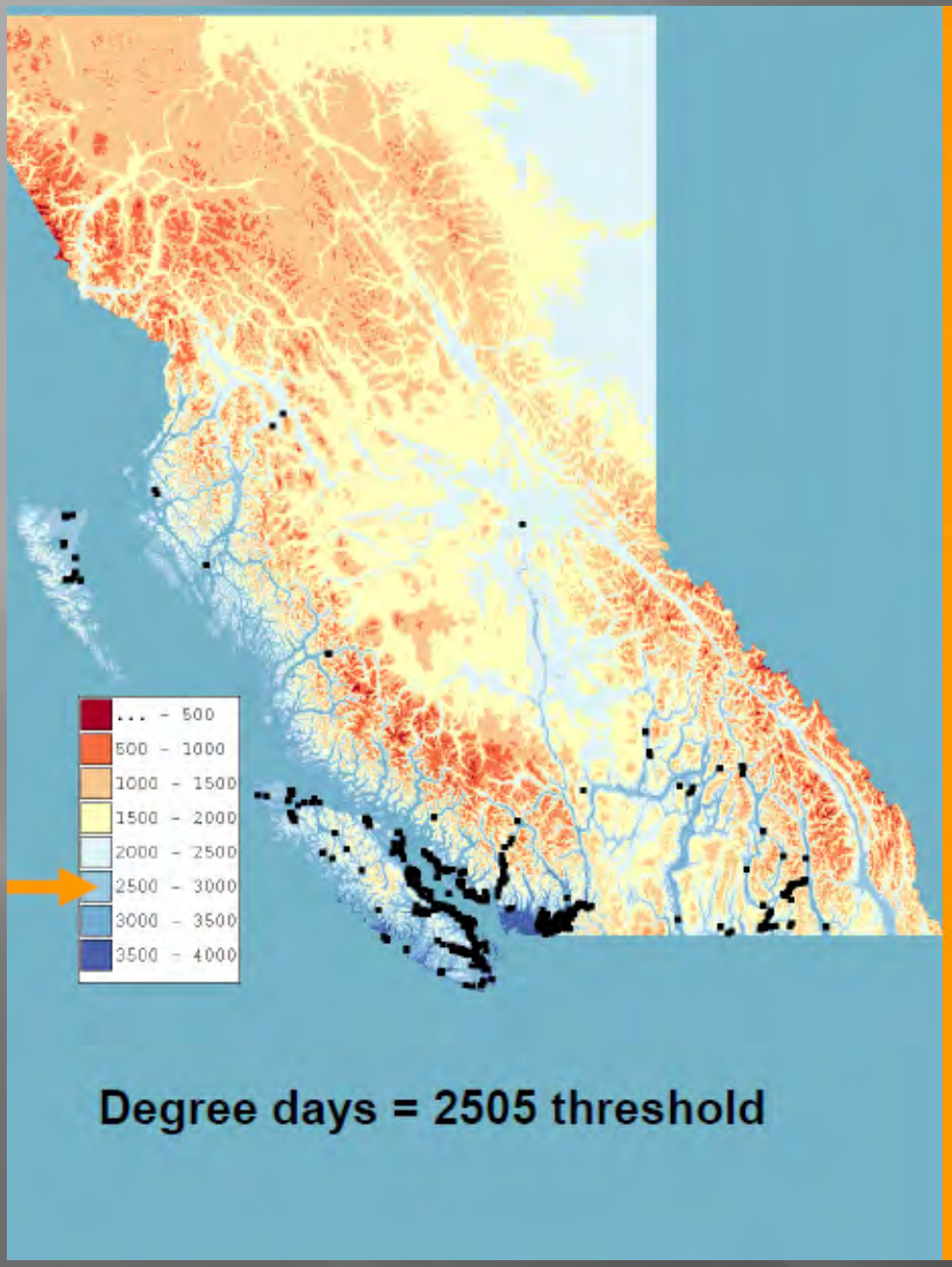
Bourchier, R.S. and Van Hezewijk, B.H. (2010). "Distribution and Potential Spread of Japanese Knotweed (Polygonum cuspidatum) in Canada Relative to Climatic Thresholds.", *Invasive Plant Science and Management, 3*(1), pp. 32-39. doi : 10.1614/IPSM-09-007.1 Access to full text

Abstract

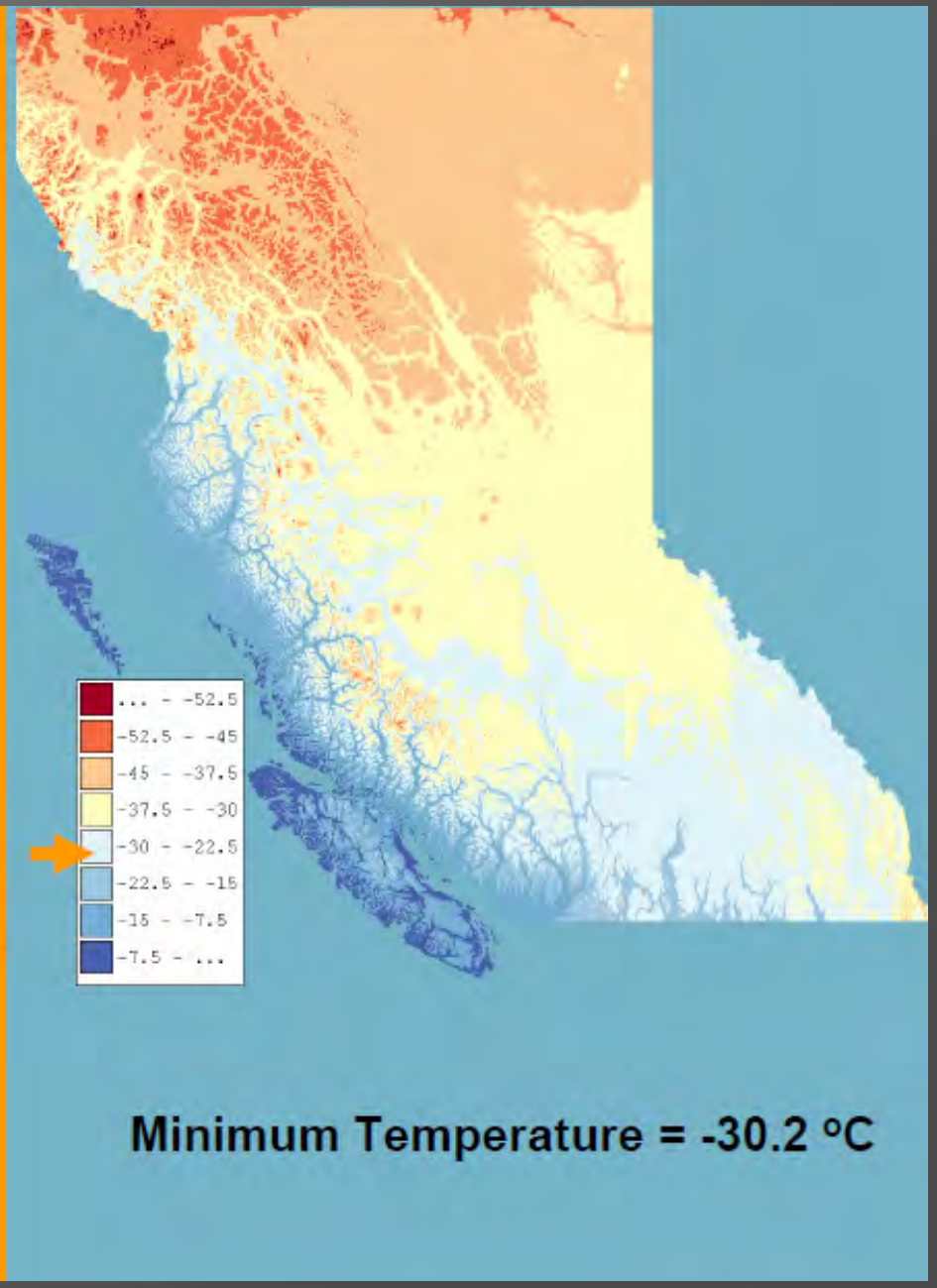
Japanese knotweed (JK) is one of the most aggressive invasive plants known in the U.K., where its biology has been well-studied. It was introduced into Canada around 1900, but only recently has it become a serious concern in the province of British Columbia (BC). Climatic conditions, including annual degree days and mean-annual minimum temperatures at knotweed sites in British Columbia were modeled in BioSIM, using weather normals and long-term daily weather data, and compared to published thresholds (degree day = 2,505 DD, minimum temperature = -30.2 °C, base temperature 0 °C). The degree-day threshold was more limiting to JK in British Columbia than mean-minimum temperature (12.3% of province habitat was suitable for JK based on degree days compared with 26% for mean-minimum temperature). A new annual-precipitation threshold of 735 mm/year based on 95% of known knotweed sites in BC was identified. The best-fit logistic regression model included degree days and annual precipitation and predicted knotweed presence/absence with over 97% efficiency. Existing knotweed sites occupy just over half of the suitable habitat in BC, indicating there are still significant areas to be invaded. The limiting threshold for knotweed was reversed in Southern Ontario with between 35 to 53% of the habitat suitable based on minimum temperatures, whereas degree-day accumulations and annual precipitation were not limiting. Warmer temperatures from 2000 to 2008 resulted in an increase to 53% of the habitat in Southern Ontario being suitable for knotweed, compared to 35% when 1971 to 2000 weather normals were used. Different climatic thresholds among provinces might result in selection for different invasive knotweed genotypes. This could influence the success of biological control agents because of differential host suitability of knotweed genotypes. Habitat suitability maps generated will enable better targeting of knotweed surveys based on the risk of knotweed establishment.

Date modified: 2010-10-15

- Introduction around 1900 or earlier
- Existing knotweed sites occupy just over half of the suitable habitat in BC, indicating there are still significant areas to be invaded.
- Drinkwater – a very small portion of the susceptible habits where knotweeds are currently located are infested.

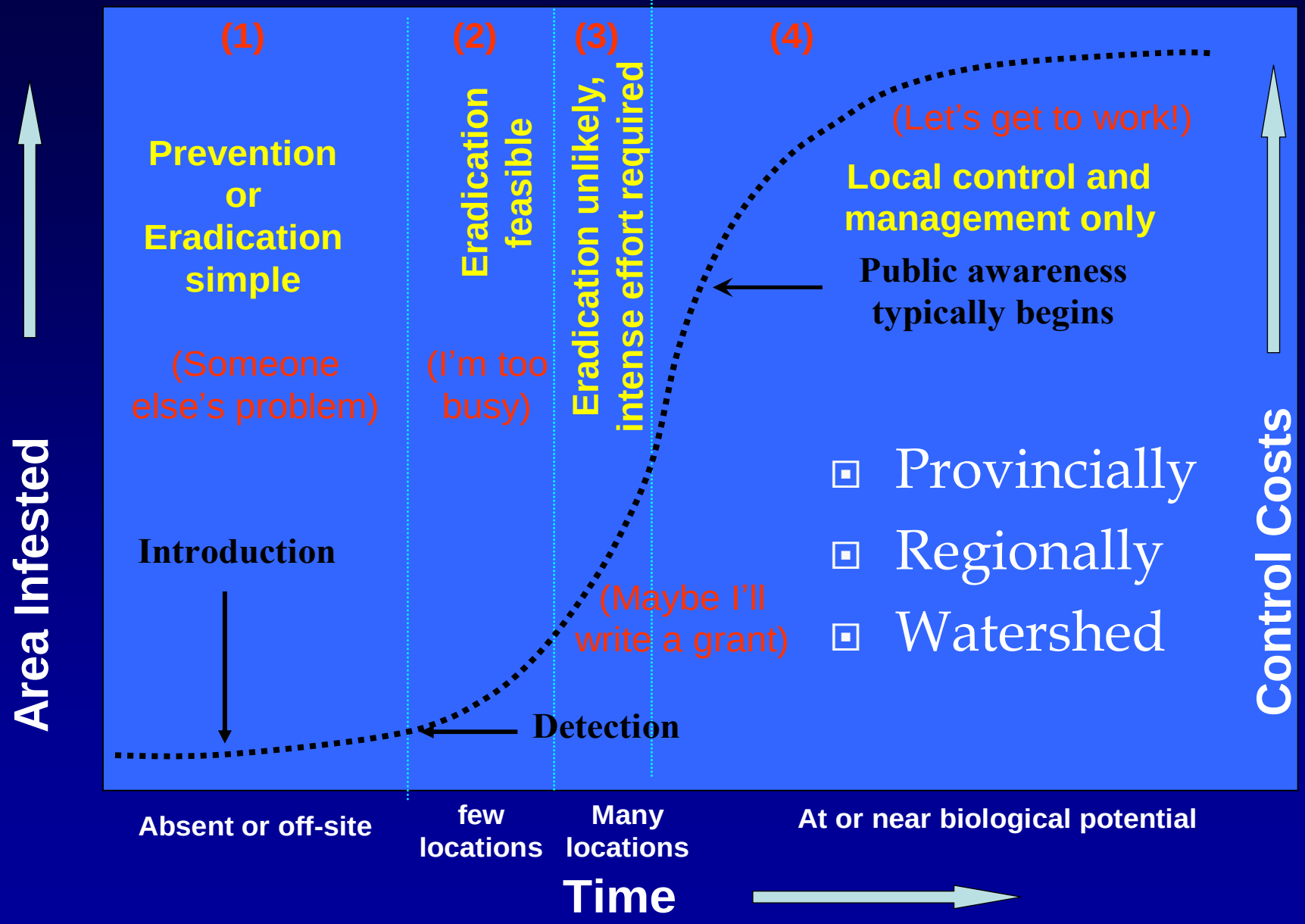


Degree days = 2505 threshold



Minimum Temperature = -30.2 °C

Weed Increase Over Time and Control Potential

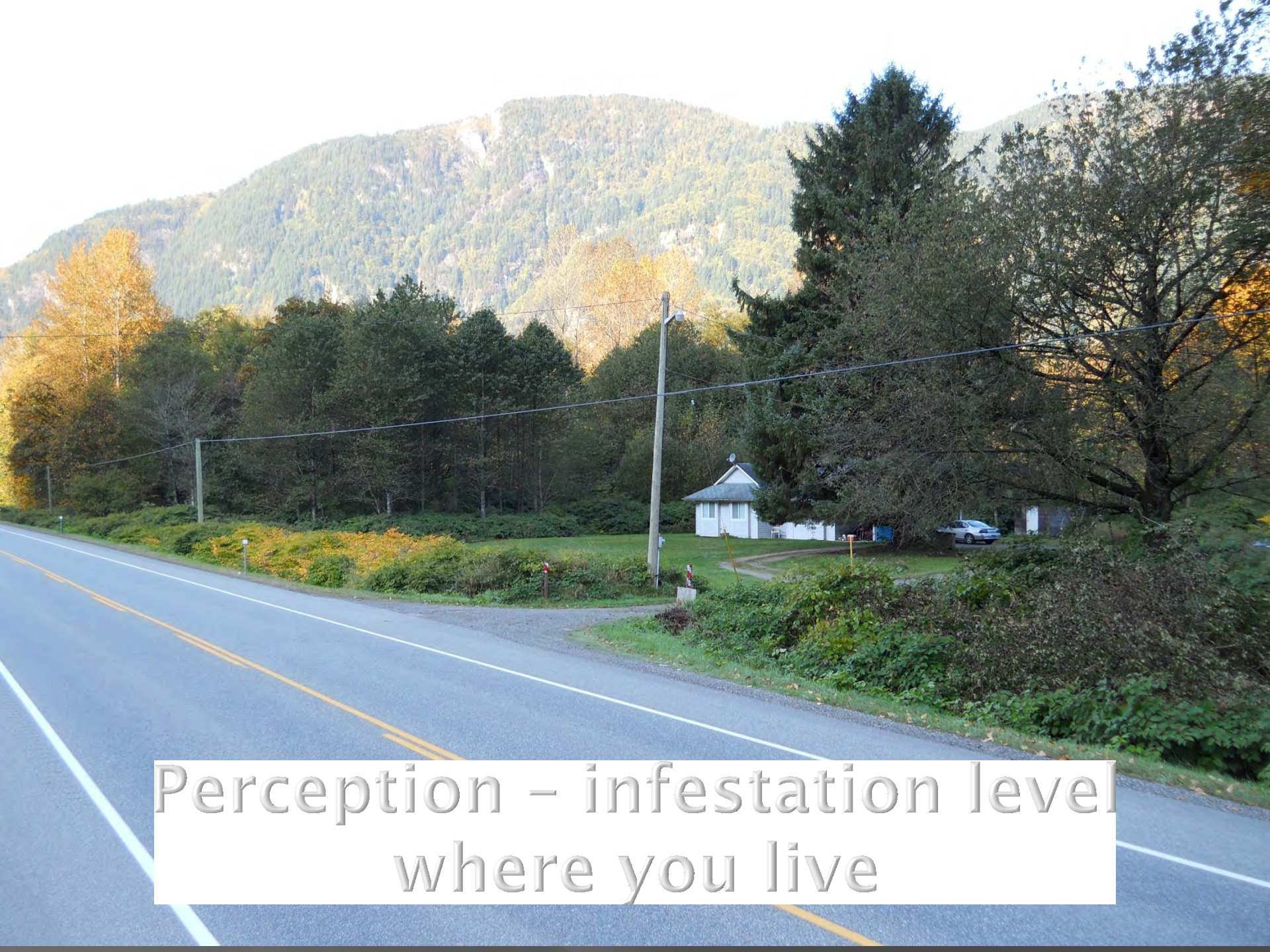


Modified from Hobbs & Humphries 1995 from Mandy Tu, TNC

Haida Qwaii 2006


Kitimat 2011


Hwy 7 - Chawathil 2011


Perception – infestation level
where you live

2. Impacts and Damage

PMP Consultations and 'The best paper'

United States Department of Agriculture
Forest Service

PNW
Pacific Northwest
Research Station

Science
FINDINGS

Issue one hundred sixty nine / January 20

"Science affects the way we think together."
Lewis Thomas

Knocking Out Knotweed: Research Pins Down a Rogue Invasive

Shannon Claeson

Bohemian knotweed, shown here along Wildcat Creek in the Chehalis River Basin, is among the most problematic invasive plants in the Pacific Northwest. The weed spreads quickly, grows fast, and damages native plant ecosystems along rivers and streams.

"If you know the enemy and know yourself, you need not fear the result of a hundred battles."
—Sun Tzu

Lush and verdant with heart-shaped leaves, *Polygonum × bohemicum* stirs in the breeze. To the uninitiated, it's just a sprawling and rather tall riverside shrub. But to anglers, farmers, and landowners in the Pacific Northwest and is notorious for spreading aggressively along riverbanks. It chokes streams and quickly edges out native plants that fish and wildlife depend on, eventually taking over and damaging the ecosystem it invades.

For the last nine years, government, nonprofit, and volunteer teams have battled infestations in Washington's Chehalis River Basin, a watershed rich with diverse plant and aquatic

IN SUMMARY

Bohemian knotweed spreads aggressively along rivers. This invasive wee chokes waterways, displaces native plants, erodes riverbanks, and keeps seedlings from growing. Communities the Pacific Northwest spend millions dollars to eradicate it on the assumpt that it harms fish habitats.

But knotweed is difficult to kill. It takes years of herbicide applications to destroy the weed, and a single frag ment can sprout and start new infesta tions. Also, control programs typicall don't evaluate whether native plants reestablish themselves after knotwee is cleared. Forest Service researcher wanted to understand whether eradic tion programs are achieving their go and how knotweed affects aquatic lif and fish habitat.

An analysis of leaf packs submerged Washington's Chehalis River revealed that fallen knotweed leaves are low i nitrogen and phosphorus, and high i cellulose, fiber, and lignin. This low- nutrient and hard-to-digest leaf litter limits the productivity of aquatic fung and macroinvertebrates—primary pr for juvenile salmon, trout, and other species. Researchers also found that although herbicide application clear river banks of knotweed and allowed colonization by native plants, it also pro- moted secondary exotic invaders. Suc- cessful reestablishment of native plants

An analysis of leaf packs submerged in Washington's Chehalis River revealed that fallen knotweed leaves are low in nitrogen and phosphorus, and high in cellulose, fiber, and lignin. This low-nutrient and hard-to-digest leaf litter limits the productivity of aquatic fungi and macroinvertebrates—primary prey for juvenile salmon, trout, and other fish species. Researchers also found that although herbicide application cleared river banks of knotweed and allowed colonization by native plants, it also promoted secondary exotic invaders. Successful reestablishment of native plants following knotweed removal may require active restoration, such as post-treatment plant surveys, controlling secondary invasions, and replanting native species.


Social impacts


NO
STOPPING
ANY TIME

Infrastructure and Ecomomic Imapcts parking lot Chilliwack 2015

Abbotsford 2014

SITE RECONCILIATION

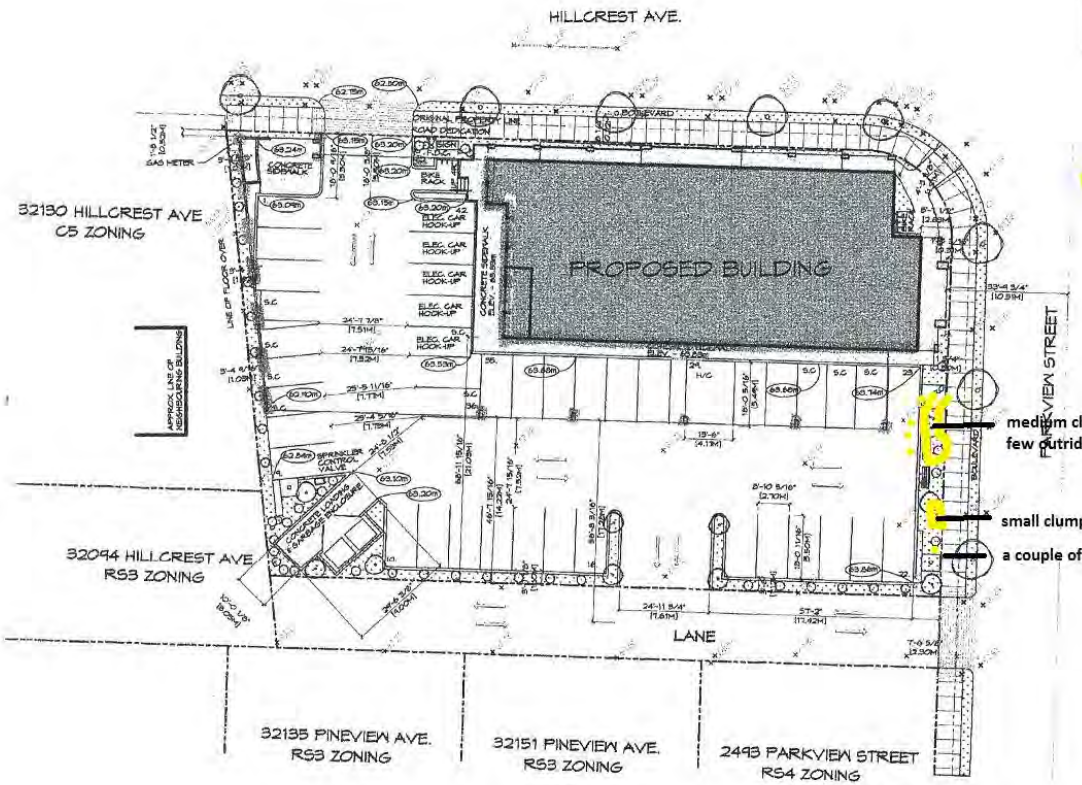
LEGAL DESCRIPTION - PARCEL 1, SECTION 20, TP 16, NWD PLAN 84301
CIVIC ADDRESS - 32156 HILLCREST AVE., ABBOTSFORD
ZONING - C5
LOT SIZE : 2,260 sq. m. OR 24,327 sq. ft.
LOT COVERAGE : 13,947 / 24,327 = 57.33% PROP.
DENSITY: 19,612/24,327 = .81 PROPOSED

NORTH SETBACK : 0.71' (.22m) PROPOSED
EAST SETBACK : 45' (.30m) PROPOSED
SOUTH SETBACK : 46.06' (14.22m) PROPOSED
WEST SETBACK : 3.50' (1.01m) PROPOSED

PROP. BUILDING HEIGHT : 13.46m (42.93')

MAIN - 928.71 x .85 = 441.44/91 = 23.85
UPPER - 1,272.44 x .85 = 1,081.81/91 = 24.25
TOTAL PARKING REQUIRED : 93.68 STALLS

SMALL CAR PROVIDED : 9 STALLS
H-CAP PROVIDED : 1 STALL
REGULAR STALLS PROVIDED : 32 STALLS
TOTAL PARKING PROVIDED : 42 STALLS
VARIANCE IN PLACE FOR 42 STALLS



= 1 Hour FRR

= 1½ Hour FRR - F/S

Japanese knotweed on the lot

REQUIREMENT FOR THE DISABLED

SEE DETAIL SHEET ATTACHED

medium clump with a few outrider stems

small clump

a couple of stems

CITY OF ABBOTSFORD ACCEPTED BUILDING INSPECTION SERVICES

13-126662

TRIO Architectural Design Inc.
3242 BEVERLEY CR.
ABBOTSFORD, BC
V2S 4M5
P. 604.854.3740
F. 604.854.3125

COMMERCIAL BUILDING
32156 HILLCREST AVE, ABBOTSFORD

SITE PLAN

Date: AUGUST 2012
Scale: 1/16" - 1'-0"
Drawn: B.W.
Checked:
Project no. 212140
Sheet no. A-1.1

Catching it at the source


Surrey 2016


Dealing With Knotweed
at Fill Sites
Langley 2016

3. STRATEGIES

PROBLEMS

1. consistency
2. jurisdictions

Consistency

- It takes multiple treatments over several years to remove knotweed
  - There are maintenance requirements
  - Clearing ‘deficiencies’ in plans is often the requirement
  - Annual budgets for perennial problems
- Inappropriate advice

Jurisdictions

- Knotweeds infest and spread in watersheds across jurisdictions
- A watershed can be cleaned or have threats reduced to a manageable maintenance level (reg 77) if there is cooperation across jurisdictions

Strategic Components

- Communication and integration of planning, awareness programs and control activities
- Surveillance and inventory
  - Reporting
- Effective and efficient treatments
- Working entire watershed and ensuring upstream infestations are cleaned up

3. STRATEGIES

SOLUTIONS

- Communication
  - Recognize diversity and use it to advantage
  - Regional Invasive Species Councils
    - Shared Regional Plans – if possible PRDM
  - Document activities and talk about successes
- Consistent resources
  - People – Local Champions (verd, doug, grame, jill, Russ)
  - Funds

4. CONTROL

- Use science and technology and evaluate antidotal information
- Think about:
  - the plant
  - the people
  - the goals

Evaluate Antidotal Information

- Knotweeds are hard to kill and you need to have high concentrations of herbicides
- Herbicides are the tool of last resort in IPM
- Knotweeds spread fast and must be controlled quickly
- Roundup is the preferred or only herbicide to use on knotweed
- Knotweed seed is not viable

Information from Experience

Use the correct application rates – eg Roundup

- The literature indicates a range of application rates mostly between a dilution rate of .75 to 3%
- If your delivery rate is 400 liters per hectare then a 2% solution will give you an 8 L/ha application rate. Label rates for knotweed are at 8 to 9 litres/ha . With the size and stature of knotweed you need to be careful about your delivery rate.
- Look at the active ingredient content and the label recommendation.
- For spring treatments or treatments integrated with cutting when the plants are smaller dilution rates may be 2 or 3%. For late summer and fall treatments when there is a lot more foliage dilution rates may be 2% or possible 1%.
- A slow kill may mean more translocation to deeper roots
- Stem injection which may be back in the tool kit soon has a delivery rate, on the U.S. label, of 5 ml per stem which equates to 16.4 L / ha on 3200 stems /ha
- these rates will kill knotweed
- In my opinion - tolerance displays occur with both over and under dosage.

Tolerance

Information from Science and Experience

- Milestone, Garlon, Arsenal and other herbicides control knotweeds.
- There is a predominance of Roundup use because of IPMA reg 77
- The biology on knotweed requires some different approaches and application techniques

STOMATA PROPERTIES OF INVASIVE PLANT *Reynoutria japonica* Houtt. IN THE AREA OF TOPCIDER RIVER SIDES

Matilda Djukić, Danijela Djunisijević Bojović, Dragica Obratov Petković, Mihailo Grbić, Ivana Bjedov, Dragana Skočajić and Milica Milojević

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Abstract: *Reynoutria japonica* Houtt. (Poligonaceae) is one of the most invasive plants with a great spreading potential and it was ranked in a group of 100 the most invasive organisms by the International Union for Conservation of Nature (IUCN). It is very common and with luxury growth on the sunny, open and wet habitats. It can be found near the roads, railways, river banks and on degraded urban areas. In the paper

the more sunny sites in compare with plants in shade. Number of stomata was larger on the lower side than on the upper side of leaves in all populations and ecological conditions.

Stomata analysis can help in better understanding of physiological processes, water regime and photosynthesis. The damages of invasive plants are the great challenge in environment protection and for that reason it is important to have detailed information of their ecological and physiological properties, reproduction, spreading, taxonomy and other characteristics which can help to found the best measures how to control and destroy them.

PENNSTATE
Vegetation Management
Department of Horticulture
College of Agricultural Sciences
http://vm.cas.psu.edu

QuickSheet
Invasive Plant Species Management 1

Japanese knotweed (Polygonum cuspidatum)

Description

- Refer to the DCNR Invasive Exotic Plant Tutorial knotweed page (http://www.dcnr.state.pa.us/forestry/invasivetutorial/japanese_knotweed.htm), which describes Japanese knotweed and giant knotweed (*Polygonum sachalinense*).
- Herbaceous, rhizomatous, perennial dicot.
- Dioecious – male and female flowers on separate plants.
- Grows in tall (6 to 10-plus feet), dense stands that exclude almost all other vegetation.
- Native to East Asia, imported as an ornamental in the late-1800's.
- Grows almost anywhere, from acidic spoil in full sun to fertile, shaded alluvial soils along rivers and streams.

Management Keys

Japanese knotweed is difficult to control, but as long as you are willing to invest the effort and follow a few key guidelines, it can be successfully suppressed.

Target the Rhizomes

To eliminate knotweed, you have to injure the rhizomes. This is most effectively done with systemic herbicides, when the plant canopy is exporting sugars to the rhizomes for growth and storage.

Timing is Key

Systemic herbicides are most effective when applied later in the growing season (Figure 1). This is when the foliage is sending sugars produced through photosynthesis to the roots and rhizomes. Systemic herbicides are moved in the same direction through the plant as the sugars.

Applications made too early in the season or too soon after cutting do not translocate to the rhizomes, and only injure the shoots.

Cutting Helps

Cutting alone is not an effective suppression approach. However, cutting prior to an herbicide application can be very helpful. If you wait until about June 1 to cut, and wait 8 weeks to treat, you will find that the knotweed regrowth is much shorter than when it was cut. Typically, knotweed regrows 2 to 4 feet tall.

When knotweed is growing near water, cutting is useful because it is easier to treat the shorter regrowth without getting spray solution into the water.

If the knotweed is not near water, you have to decide if cutting the knotweed is a good use of your finite time and effort. Treating intact knotweed towering over your head is a lot like work, but cutting may be even more work.

Be Patient

Wait 8 weeks after cutting before applying herbicide. If you apply too soon after cutting, the herbicide will not be translocated to the rhizomes.

Recommended Herbicides

We recommend the herbicide *glyphosate*. *Glyphosate* is the active ingredient in the many 'Roundup' products that are available for agricultural, professional, and homeowner use. As of this writing, the *glyphosate* products available on the PA statewide herbicide contract are 'Aquaneat' and 'Glyphomate 41'.

Glyphosate has several advantages:

- it's effective
- it has low toxicity to non-target organisms
- it is available in aquatic-labeled formulations
- it has no soil activity
- it's relatively inexpensive

The herbicide *imazapyr* ('Arsenal Powerline', 'Habitat') is effective against knotweed, but has considerable soil activity and can injure nearby trees through root absorption.

The herbicide *triclopyr* ('Garlon 3A') is recommended in some accounts, but our research has shown that rates up to 4 quarts/acre had no visible effect on the following year's growth.

Be Persistent

There are two phases of knotweed management – control and maintenance. The control phase takes two seasons, and includes at least two operations in year-one (e.g. cut and treat, or treat twice) and at least one application in year-two.

After your control efforts have nearly eliminated the knotweed, you need to periodically monitor the sites and treat any signs of new growth to prevent re-infestation.

After the Knotweed

If you remove the knotweed early in its infestation, you probably will not need to establish replacement vegetation.

When a knotweed infestation is well established, you may need to suppress the vegetation that follows as well, and establish desirable plants in that space. If you are planning on replanting the area, BE PATIENT. If you plant desirable vegetation before the knotweed is completely suppressed, it will be much harder to manage the remnant knotweed without injuring the desirable plants.

This work was sponsored by the Pennsylvania Department of Conservation and Natural Resources, Bureau of State Parks (PA DCNR).
By Art Gover, Jon Johnson, Kirsty Lloyd, and Jim Sellmer, 2006. The contents of this work reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the PA DCNR or The Pennsylvania State University at the time of publication.
Where trade names appear, no discrimination is intended, and no endorsement by the Penn State College of Agricultural Sciences is implied.

Figure 1. The management calendar for Japanese knotweed emphasizes late-season applications of the herbicide glyphosate to maximize injury to the rhizomes.

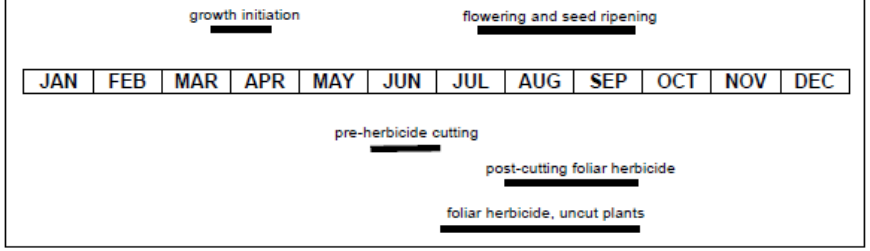

Table 1. Prescriptions for controlling Japanese and giant knotweed stress proper timing of operations to maximize injury to rhizomes. Improper timing (impatience) will result in treatments that provide 'topkill' (shoot injury) but little net effect.

timing	treatment	product rate	comments
June	cutting prior to foliar herbicide application	n/a	Cutting in June results in shortened regrowth and elimination of persistent stems from the previous season. This is a particular advantage in riparian settings, where knotweed will hang over the water. In this situation, it is impossible to treat without contacting the water with herbicide solution (therefore requiring a permit and an aquatic-certified applicator). Cutting will result in regrowth that is 2 to 4 ft. tall, which can be treated using a backpack sprayer (as opposed to a high volume application with a handgun), and without contacting the adjacent water.
anytime	cutting	n/a	Cutting does not eliminate knotweed, but it does slow its growth and lateral spread significantly. Where knotweed is adjacent to mowed areas, it should be included in mowing regimen. If you are going to treat the knotweed with a systemic herbicide, stop mowing 8 weeks prior to application.
At least 8 weeks after mowing	'Aquaneat' or 'Glyphomate 41'	4 qts/acre or 5.7 qts/acre	Use either of these *glyphosate* products to treat knotweed regrowth, waiting eight weeks after the June cutting to treat. The product rates differ because the glyphosate concentration differs. The application rates provide 4 lbs of *glyphosate*-acid per acre. Applications of 'Aquaneat' will require an additional surfactant (e.g. 'Timberland 90'). No additional surfactant is needed with 'Glyphomate 41'. Work at the early end of the operational windows so you can make a 'touch-up' application with the same treatment in September, before a killing frost.
July 1 to mid-September	'Aquaneat' or 'Glyphomate 41'	4 qts/acre or 5.7 qts/acre	Treatment to uncut knotweed should be delayed until after July 1. Unless the knotweed patches are small, this will need to be a high volume application. It is very difficult to get thorough coverage of dense vegetation that is over your head. Follow-up in September to treat misses and resprouts.


KG 7406
solo
solo
430-2G


Working large infestations over several seasons

(Treatment Oct Oct 2) monitor
Oct 18 – 2 green sprigs


Sweltzer Creek example
© 2014 Google
Image © 2014 IMTCAN
Cultus Lake
Google earth
Imagery Date: 2003/2004 49°05'04.62" N 121°58'17.46" W elev 73 m eye alt 6.04 km


Sweltzer Creek example
© 2014 Google
Image © 2014 IMTCAN
Google earth
Imagery Date: 20030/2004 49°04'41.49" N 121°58'43.71" W elev 47 m eye alt 389 m


Sweltzer Creek example

Sweltzer Creek example

- Area is infested with JK but Sweltzer Creek site was thought to be one of a few Bohemian knotweed sites in the Fraser Valley. For that reason it was put on a site list. It has now been determined that much of the JK is actually BO.

- Accessed PennState FactSheet and QuickSheet and other documents and talked to Linda Wilson and Laurel Baldwin
  - Review PennState FactSheet
  - How does the plant spread
  - What treatments work on the plant
  - When are those treatments most effective

- Accessed Reduced Instream Work Window
  - When are the least risk times to do the treatments

Sweltzer Creek example

- Began discussions, (with Jeanne's help):
  - Fish counting station
  - DFO Research Station
  - Cultus Lake Park Board
  - Cultus Lake Stewardship Group – CLASS (Cultus Lake Aquatic Stewardship Strategy) included area residents
  - Fraser Valley Watershed Coalition – restoration
  - Others
- Made it clear that the restoration process would take many years and would look not so nice through parts of the process

Sweltzer Creek example

- Began discussions on a watershed level strategy for managing JK
  - Contract included Vedder Mountain but was extended up to the US boarder in the Columbia Valley
- Developed a prescription for Sweltzer Creek site
- The entire site was within 10 meters of water therefore the only herbicide option is glyphosate

Sweltzer Creek example

- Site level treatment prescription for Sweltzer Creek
  - 0 to 1 meter from water - hand pulled trying to not let root fragments get into the water
  - 1 to 2 meters – stem inject isolated patches but mostly cut and inject so that tarps could be draped
  - 2 metes and beyond – foliar application behind draped tarps

Sweltzer Creek example

- Monitoring
  - Treatments and restoration will be ongoing
  - Cultus Lake Parks Board put resources in their budget to do maintenance work
  - Monitoring procedures identified in IAPP would be used but the ongoing nature of the work would mean more detailed monitoring and feed back
- The water shed level plan and work and restoration work would assist in preventing problems from reoccurring

Sweltzer Creek example

- Restoration Plan
  - Restore the site to a productive and resistant plant community
  - Work with Fraser Valley Watershed Coalition
  - Identify the resources necessary to maintain the site
  - Document and share the learning lessons and successes


Sweltzer Creek example

Sweltzer Creek example

Fall of 2012
leave stalks
until they are
good and dead

Fall 2013


Sweltzer Creek example

SAFE, EFFECTIVE & EFFICIENT – goals for knotweed management

- With this type of work people will see what you haven't done not necessarily what you have done
- Explain management approaches and be forthright with expectations, particularly with time required
- Though the focus often seems to be on efficient or inexpensive management that should not influence the effectiveness of management

THE KNOTWEED MUST BE NOTICABLY REDUCED AND IF POSSIBLE ELLIMATED OVER THE LONG TERM