

A person wearing a maroon t-shirt and grey pants is using a shovel to dig up a large, dense clump of knotweed plants. The plants have thick, woody stems and some green leaves. The ground is covered with dry leaves and soil.

Knotweed Biology and Control

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www.kingcounty.gov/weeds

Objectives

- Understand how knotweed biology/lifecycle affects control choices
- Familiarity with common treatment methods
- Recognize steps to implement larger scale projects
- Practice using stem injector

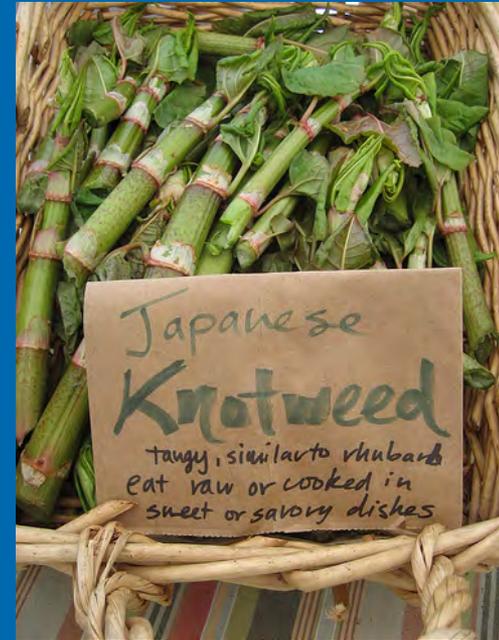


Agenda

- What is knotweed and why is it a problem?
- Status of knotweed in King County
- Knotweed identification and growth
- Knotweed control methods
- Project planning considerations
- King County knotweed projects and partnerships
- Stem-injection demonstration and training

What is Knotweed?

- A group of tall, robust plants from Asia in the buckwheat family
 - Japanese knotweed
 - giant knotweed
 - Bohemian knotweed
 - Himalayan knotweed
- Other common names:
 - elephant ear bamboo
 - false bamboo
 - Mexican bamboo
 - fleeceflower
 - Fallopia 'variegata'
- Introduced as a landscaping plant, used like bamboo
- Has spread throughout Europe and North America



Invasive Knotweed (*Polygonum bohemicum* et al)



Knotweed in King County

- Widespread, urban to rural and coastal to foothills
 - Introduced as ornamental in the early 1900's
 - Established and naturalized by the 1960's
 - Heaviest concentrations found along riparian corridors and road rights-of-way
 - Also in residential gardens, commercial lots, vacant properties, wetlands, and many other areas
- Legal Status: Non-Regulated Class B Noxious Weed
 - Control is not required in King County
 - Except on the upper and middle Green River and its tributaries
 - And on the Cedar River upstream of City of Renton
 - Too widespread and difficult to control to be a regulated weed
 - High priority for grant-funded projects and for providing technical assistance to landowners

Why Worry About Knotweed?

- Considered among the worst invasive plants in Europe and North America
- Causes expensive problems
 - Damages pavement
 - Limits visibility along roads
 - Impacts drainage and septic systems
 - Invades turf and landscapes
- Harms fish and wildlife habitat and water quality on rivers
 - We have miles of valuable riparian and wetland habitat that are vulnerable to knotweed invasion
- **One of the most difficult plants to eradicate growing in some of the most sensitive habitats**



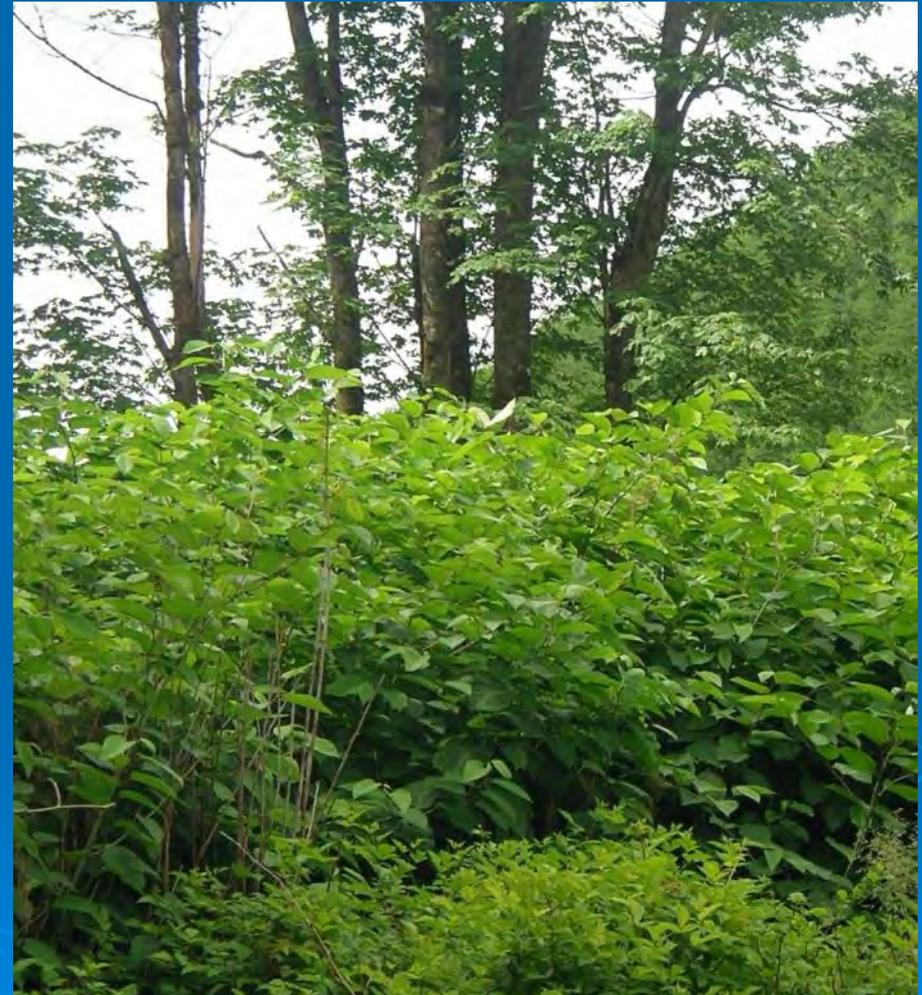
Knotweed Impacts on Rivers

- Forces out native and desirable plants
 - Thousands of stems per acre
 - Develops a monoculture
 - Dead canes decompose slowly
 - Rapidly invades riparian forests
- Increases erosion and turbidity
 - Rhizomes are brittle
 - Roots don't hold soil well
 - Dead stems in winter expose river banks to rain and flood waters
- Reduces habitat for fish and other wildlife
 - Reduces plant diversity
 - Food sources/ insects
 - Shade and microclimate
 - Large woody debris recruitment



How Knotweed Takes Over

- Colonizes flood-scoured shores and islands and other exposed areas
- Tough plant that out-grows others
- Emerges early in the season and quickly out-grows and shades out other plants
 - Inhibits even trees such as alder and willow
 - Understory of knotweed is usually bare of any other plants
- Few local natural controls on its growth





Infestation of a riparian forest on North Fork Stillaguamish River





M. Walker

Knotweed infesting a remote area on the upper Skykomish River



Despite knotweed's large rhizome mass, it provides poor erosion control



Early season giant knotweed emerging through asphalt

Knotweed Up Close



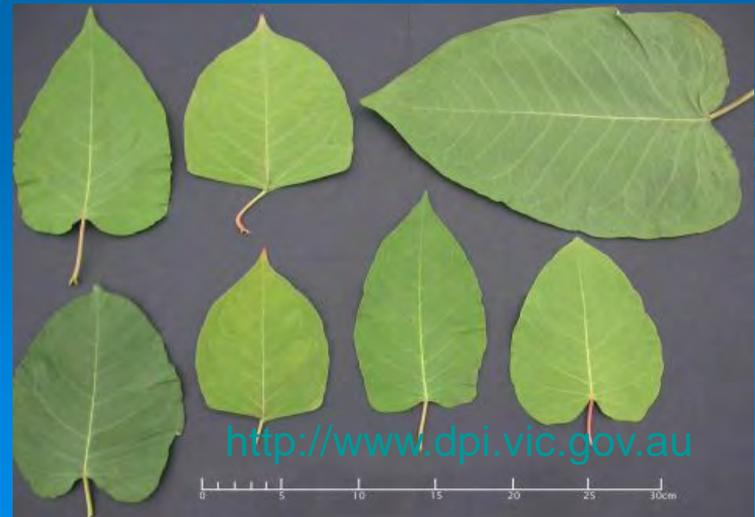
General Knotweed

Characteristics:

- Small flowers in dense clusters from leaf joints, July to August
- Large, untoothed leaves, growing alternate on stems
- Stems tend to zig zag
- Forms dense clones similar to bamboo



Flower clusters on stem; leaves broad





Hollow, upright, bamboo like stems often reddish or red-speckled





Japanese Knotweed (*Polygonum cuspidatum*)

Giant Knotweed (*Polygonum sachalinense*)

Bohemian Knotweed (*Polygonum bohemicum*)

- Hybrid species between Japanese & Giant, has intermediate features to parents

Himalayan Knotweed (*Polygonum polystachyum*)

Giant Knotweed

(*Polygonum sachalinense*)

- Tallest species, up to 15 feet
- Leaves very large all with heart shaped bases
- Also called elephant ear bamboo
- Flower clusters shorter
- Most clones in US are female



Giant Knotweed (*Polygonum sachalinense*)



Large heart-shaped leaves



Fine hairs visible
on back of leaf



Giant knotweed in early spring with last year's dead stems

Japanese Knotweed (*Polygonum cuspidatum*)

- ◉ Smaller than the others (6 feet usually)
- ◉ Leaf bases are flat, not heart-shaped
- ◉ Leaves are thicker
- ◉ Most clones in US are female (will have seeds later in season)
- ◉ Flower clusters are longer and more ornamental



Japanese Knotweed (*Polygonum cuspidatum*)



© 2004, Ben Legler



© 2004, Ben Legler



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Leaves broader, thicker, flat at base

No hairs on back of leaf (just low bumps)

Bohemian Knotweed

(*Polygonum X Bohemicum*)

- Most common type of knotweed in PNW
- Often called Japanese knotweed
- Naturally occurring hybrid
 - 8 to 12 feet tall
 - Mixed leaf shapes (vary between flat and heart-shaped at leaf base)
 - Leaves thinner than Japanese knotweed, smaller than giant knotweed
- Most clones are male (flower clusters stay stiffly upright, no seeds)
 - Introduced as an ornamental separately
 - Some females have been showing up with viable seeds (oh no!)





Typical stand of Bohemian knotweed with stiffly upright male flower clusters



Hybrid knotweed with seeds (result of back-crossing)

Himalayan Knotweed (*Polygonum polystachyum*)



Photos courtesy of Glenn Miller, Oregon
Department of Agriculture

Identifying Himalayan Knotweed

- Flowers are perfect (both male and female on same flower, all plants produce seeds and pollen)
 - Flowers are white to pink in loose, branched clusters
- Leaves are longer and narrower
 - Oblong, lance-shaped leaves are 4 to 8 inches long
- Leaf sheaths are very noticeable
 - Brown, persistent sheaths at the bases of the leaf stalks
- Stems are not hollow
- Grows in tighter clumps or mounds and is generally under 4 to 5 feet tall (up to 6 feet at most)
- Less widespread, seems to be less invasive or at least slower to spread



Knotweed Growth and Spread



How Knotweed Grows

- Starts growth in April, later in colder areas
- Grows extremely fast during the spring, uses root reserves
 - Giant knotweed can reach 15 feet by late June
 - Bohemian knotweed reaches “only” 12 feet or so
- Stems from deeply buried roots may emerge in late summer
- Roots can spread 20 feet from the parent plant and go 7 feet down into the soil



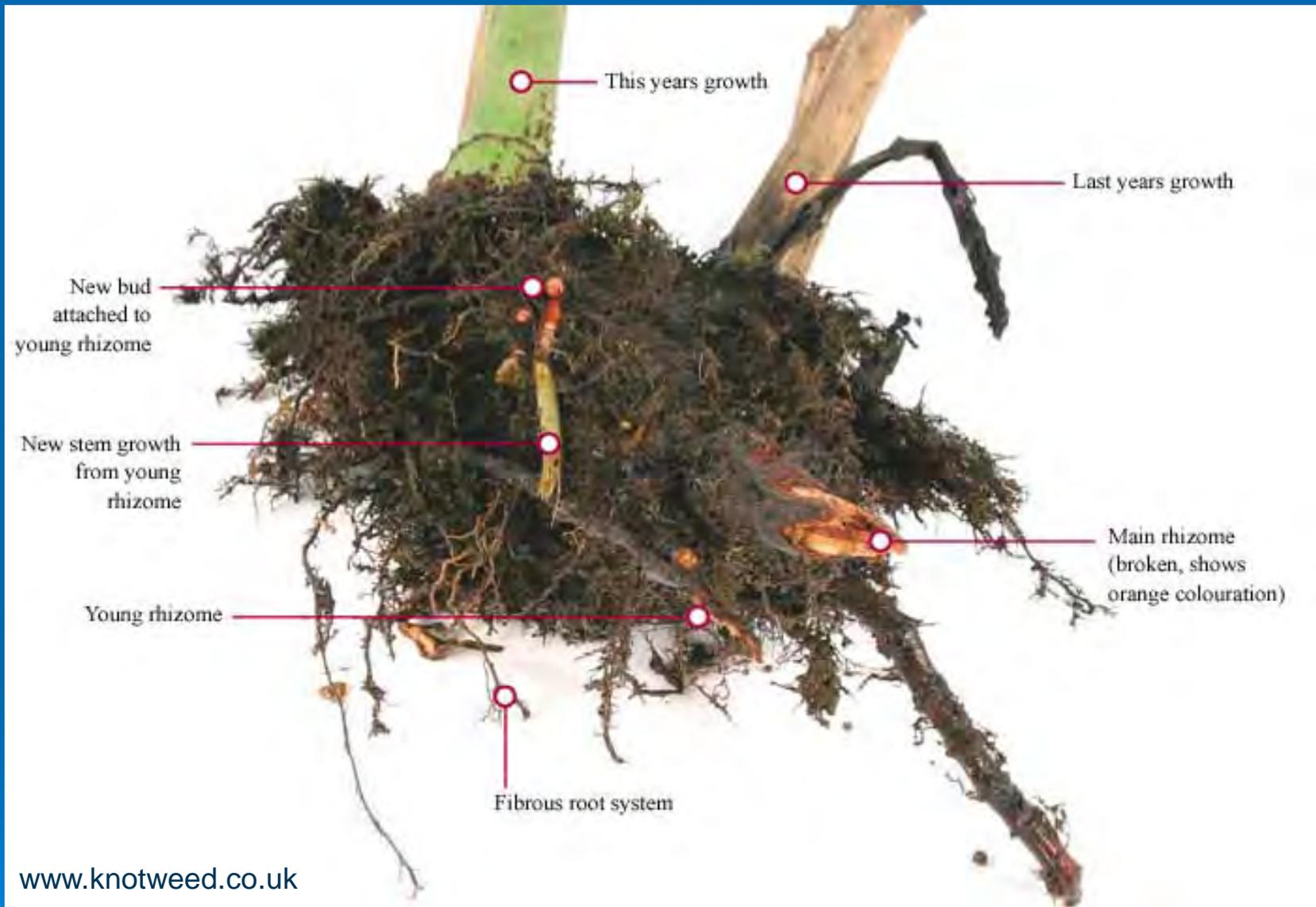
Young giant knotweed stems



Young shoots in early spring look similar to red asparagus



Japanese knotweed shoots emerge from rhizomes in April



When knotweed is cut or damaged, it vigorously and rapidly re-sprouts from latent buds on root crowns and rhizomes



How Knotweed Grows, cont.

- Upward growth slows in July and is much reduced after August
- Begins to build up root reserves for next year's growth
 - Most of the growth is underground
 - Transfers sugars down
- Late season knotweed loses petals but flower stems persist





Knotweed Stems in Winter



©2003, Gary Fewless



Seattle Public Utilities

Plants die back to the ground after hard frost but woody, dry stems persist through the winter

How Knotweed Reproduces

- Seedlings occur but are uncommon
- Mostly reproduces by vegetative means
 - Root and stem fragments, as small as 1/2" can form new plant colonies
 - Cut or broken stems and roots will sprout if left on moist soil or put directly into water



How Knotweed Spreads

- Fragments are spread by floods or high water, beavers, earth moving equipment, and in contaminated fill material
- Seasonal floods sweep plants into rivers and creeks, then fragment and disperse knotweed plant parts throughout the floodplains and cobble bars
 - Roadside ditches, irrigation canals, and other water drainage systems can be colonized the same way



Knotweed Broken Loose on South Fork Snoqualmie River





Knotweed stems also move downstream – cut by people, animals, floods



Cut knotweed stems in the river



Beaver using knotweed on dam

Mowing spreads knotweed stem fragments along roadsides



Take Home Points

- Knotweed is not required for control in most of King County
- Knotweed uses root reserves and grows upward until June/July
- Don't worry too much about seed production
- Do worry about vegetative spread (i.e. don't mow roadside knotweed and don't move contaminated soil)



Knotweed Control



Controlling Knotweed

- Takes several years to achieve control
- Need multiple treatments
- Consistent follow up is key
- Work at landscape level if possible



Integrated Pest Management (IPM)

- **Control** is one part of cycle (monitor, identify, prevent, control, feedback)
- Weigh effectiveness against risk and choose best option
- Every control action has negative consequences
- Consider:
 - Extent
 - Timing
 - Site sensitivity (erosion, water, etc.)
 - Accessibility
 - Available follow up
 - Proximity to water
 - Permit requirements

When To Use Manual Methods

- Easy site access
- Patches are small (less than ~100 sq ft)
- You have enough time
- You don't intend to use stem injection method
- As follow up to one or more seasons of chemical control



Control Methods- Mowing or Cutting

- As soon as stems emerge, begin cutting as close to the ground as possible
- Repeat weekly until rapid growth stops (July/August), then repeat bi-weekly
- Try to keep canes less than 6" tall
- Pile or rake cut canes and allow to desiccate before composting
- Mowing has the potential to cause spread, use care
- Goal is to “starve” plants
- Expect to repeat for at least 7 growing seasons



1. Cut early
2. Cut often



Control Methods- Digging

- Cut down canes in August to get to root crown; dispose of canes carefully
- Dig under root crown and remove as much root as possible
- Sift through soil and remove as many fragments as possible, following roots out to ends
- Dispose of roots as garbage
- Monitor site and pull/cut/dig any regrowth
- Search up to 20 feet away from original canes
- Repeat over 5-7 growing seasons
- Creates lots of ground disturbance

1. Cut down canes, dry completely
2. Dig underneath root crown
3. Remove as much root as possible
4. Dispose of roots
5. Continue to monitor



Control Methods – Covering

- Not suitable for steep or flood prone sites
- Overlapping heavy geotextile fabric
- Weight or string installation in place, leaving fabric loose
- Monitor for damage (attracts wildlife)
- Crush down every 1-2 weeks during growing season
- Leave in place 5-7 years
- Monitor, replace if regrowth occurs





1. Cover area completely, overlapping material
2. Weight down or run strings
3. Leave room for growth
4. Check at least bi-weekly
5. Stomp down regrowth and repair as needed
6. Leave in place several growing seasons

Control Methods – Biocontrol

- Research in UK and US
- Oregon State University may be able to release sap sucking psyllid in 2014 or 2015
- Possible initial release sites include the Snohomish County portion of the Skykomish
- Unclear how effective agent will be in wild
- May not be able to survive in flood prone areas
- Would take a minimum of 5 years to see results
- Will not eliminate populations, but may aid in other control efforts



C. Lucero



KCNWCP

1. Early stage species released onto site
2. Agent develops on plant
3. Cyclic population growth and reduction

Chemical Control



Chemical Methods- General Issues

- Use a systemic herbicide
- Read the label; follow the instructions
- Use a product labeled for the site
- Use the correct rate: more is not better
- Consider proximity to water
- Read the label again



Herbicide Types: Selective

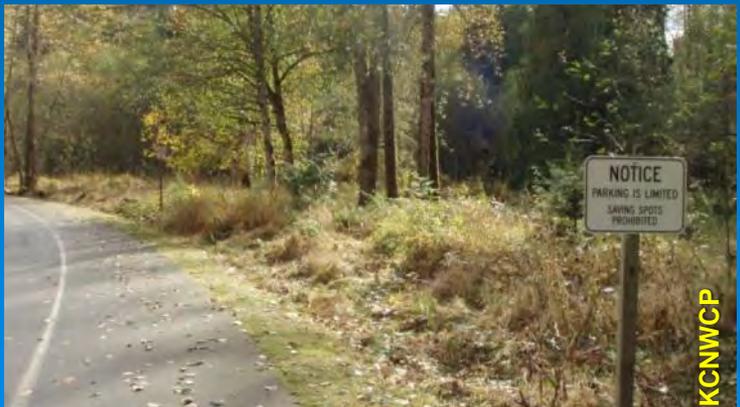
- **Triclopyr:** low control but lower rates may be better
 - Common formulations include Garlon 3A, Brush Be Gon, or Renovate
 - For grassy sites
 - Quick to show results
 - Least effective long term control; usually just one year of control
 - Unlikely to be the best option for knotweed control
- **Aminopyralid:** control dependant on follow-up application
 - Common formulations include Milestone
 - Very expensive, but low rates
 - Can be applied earlier in season (in May) to stunt growth
 - Must make second application with glyphosate or imazapyr in same season
 - Only recommended for specialized applications like ROW's with safety concerns



Herbicide Types: Non-Selective

- **Glyphosate:** 80-95% effective in first year
 - Common formulations include Roundup, Aquamaster, or AquaNeat
 - Inexpensive
 - Slow acting
 - No soil residual
 - Need concentrated product (at least 40% active ingredient)
 - The only herbicide used for stem injection
- **Imazapyr:** 90-95% effective in first year
 - Common formulations include Arsenal, Habitat, or Polaris AQ
 - Expensive
 - Used at low rates
 - Even more slow-acting
 - Has soil residual

Control Methods – Foliar Spray



- Application usually with a hand or backpack sprayer
- Use aquatic imazapyr (1%), glyphosate (4-5%) or a combination (.25% + 3%)
- Add a surfactant if needed
- Imazapyr is about 95% effective, glyphosate around 85%
- Bending or cutting first may reduce efficacy
- Requires annual retreatment for at least 3 years (8-10 for established riparian sites)



Control Methods- Wick Wipe

- Use sponge type applicator, or use cotton glove over chemical resistant glove and wipe concentrated herbicide on all parts of plant
- Apply glyphosate at 33%-50% concentration
- Time consuming
- Very targeted





Control Methods – Stem Injection

- Use special injectors
- Apply concentrated, aquatic glyphosate at 3mL per cane July-October
- Must inject every cane, but almost no drift
- About 95% effective
- Requires annual retreatment for at least 3 years (8-10 for established riparian sites)



Control Methods- Cut & Pour

- Similar idea as stem injection
- Cut canes to second or third node in July/August
- Immediately pour in 3 mL undiluted glyphosate
- Not very effective
- Need to remove cut stems away from water where they can dry out and not spread off site
- High risk of spilling

Take Home Points

- Knotweed is difficult to control, success requires consistency
- Start from topmost infestation if possible
- Use care with manual/mechanical control methods to avoid further spread
- Chemical control is not effective until July at the earliest (later is better)
- Imazapyr and glyphosate are the most effective chemicals to use



Project Planning



The Plan- Reach Out

- ◉ Involve partners
- ◉ Landscape scale control is most effective for knotweed
- ◉ A project without key stakeholders may not be worth starting



The Plan- It Takes Time

- Projects involving the public will take a lot more time, budget extra
- If you need permission from landowners, have a backup plan in case you can't get it
- Be patient; some landowners take one or two seasons to decide that they are comfortable with your project
- Get feedback from landowners before starting, if possible



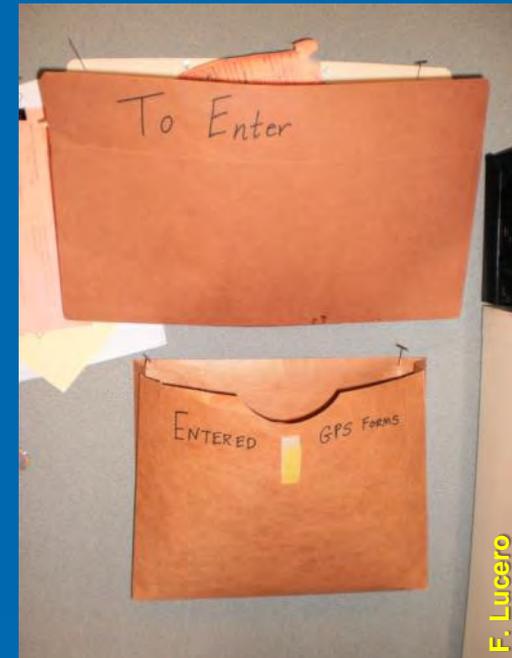
The Plan- Preliminary Survey

- Identify the uppermost infestation on a waterway
- Identify the outermost infestations in an upland area
- Roughly survey the remaining area to get an estimate of the scope, and learn access points



The Plan- Set and Measure Goals

- Consider what outcome you are looking for before beginning the project
- Set a reasonable control goal
- On many sites, eradication is not an option; be realistic
- Decide how you will track success (choose something with numbers)
- Track on an annual basis if possible
- Only collect the information that you need



The Plan- Be Consistent



- Visit every site every season to treat
- Continue retreating until plants have not been seen for several growing seasons
- Survey and treat entire area, not just where plants occurred in the past
- Have a policy for when to stop surveying a site

The Plan- Be Legal

If you use herbicide:

- Make sure you have the right type of license
- Make sure your contractors have the right type of license
- Use the right chemical
- Get permits (any herbicide in water requires an NPDES)
- Follow posting requirements for any permits AND for your agency

The Plan- Be Professional

- Make it look good
- Answer questions
- Conduct work carefully to minimize other damage
- Consider the impression you make



Take Home Points

- ⦿ Look at the big picture
- ⦿ Don't over-complicate initial planning and surveying, plants move
- ⦿ Track work with numbers
- ⦿ Commit to following up every season



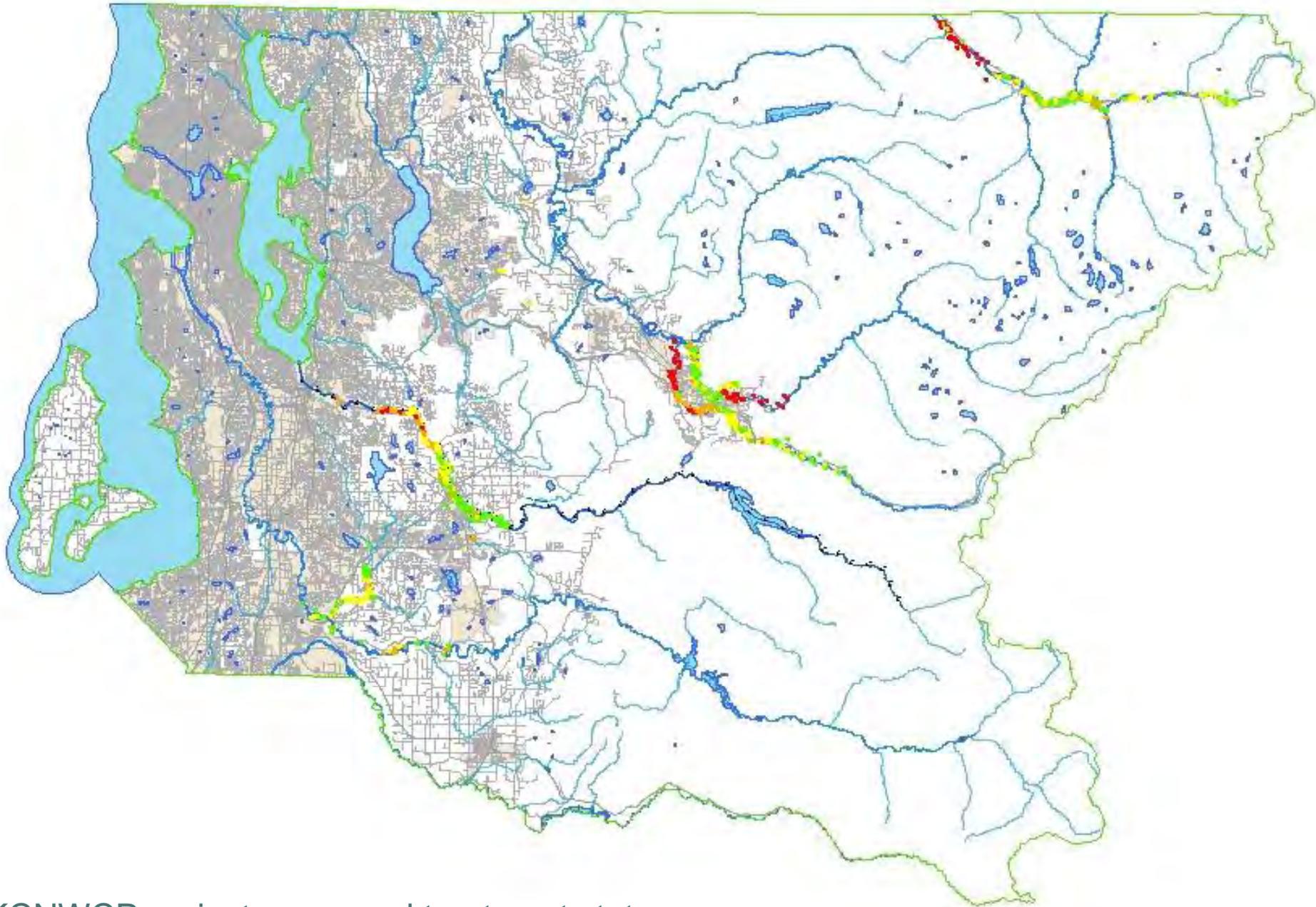
Objectives

- Understand how knotweed biology/lifecycle affects control choices
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King County Noxious Weed Program Knotweed Projects and Partnerships





KCNWCP project areas and treatment status

KCNWCP Knotweed Control Projects

- Focus on riparian systems
- Began in 2004
- All externally funded
- Cooperative and inclusive of all stakeholders
- Comprehensive and top-down
- Protect and restore fish and wildlife habitat
- In 2013:
 - Spent 90 crew days and ~82 staff days on control work
 - Worked with over 1350 landowners
 - Surveyed 1,642 acres along 80 rivermiles
 - Treated ~41 net acres of knotweed in ~164 gross acres



Knotweed site, Middle Fork Snoqualmie- Three Forks Island before treatment 2006



Knotweed site, Middle Fork Snoqualmie- Three Forks Island after injection 2006



Knotweed site, Middle Fork Snoqualmie- Three Forks Island, after treatment 2009



Skykomish, before treatment; 2005



Skykomish, after treatment; 2005



Skykomish, spring 2006



Skykomish, spring 2011



Skykomish, fall 2011



King County Noxious Weed Control Program

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