



Oh death where is thy  
sting?  
On knotweed thy sweet  
sound does ring!

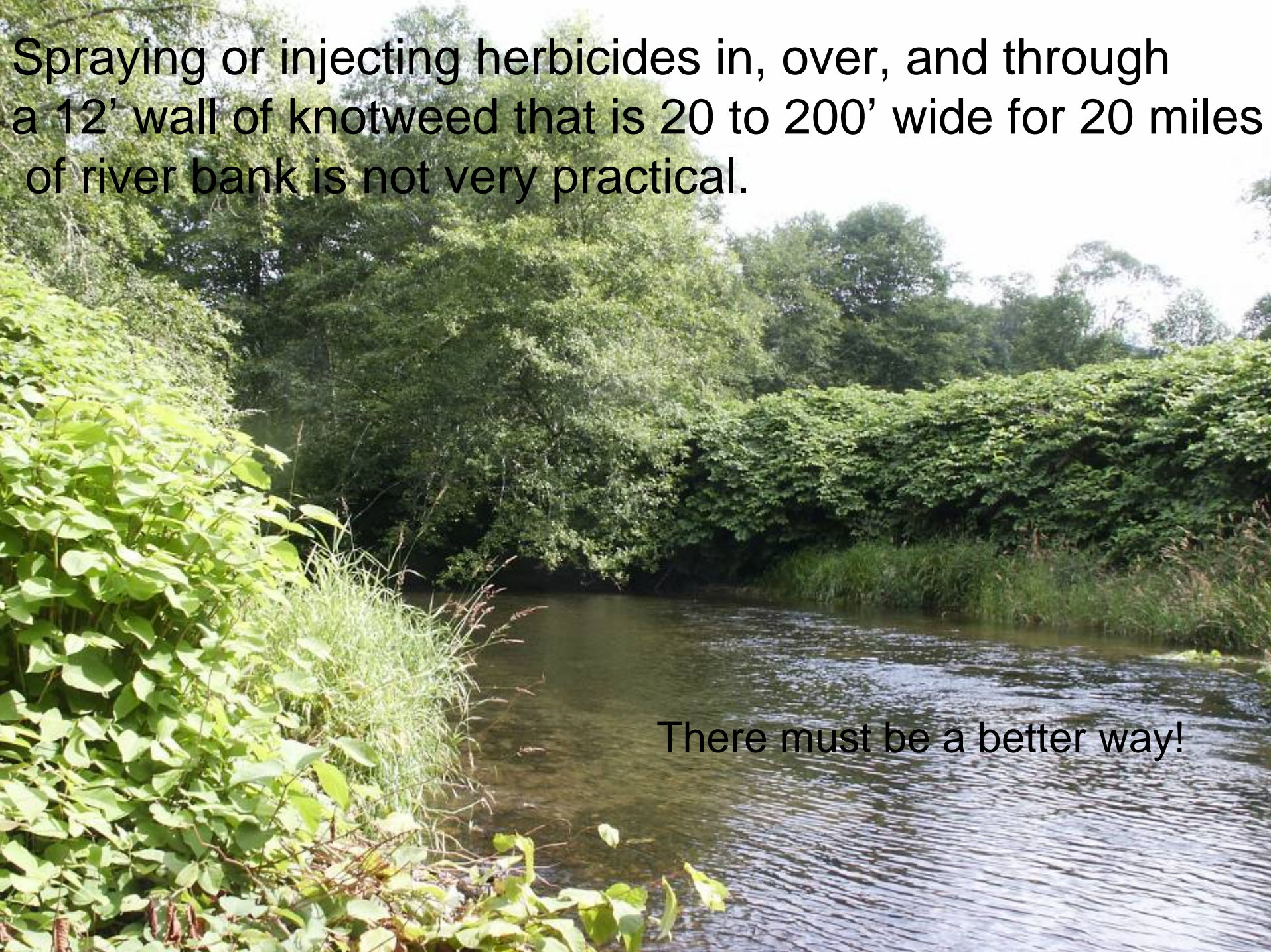
**Herbicide trials for Bohemian Knotweed Control**  
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**Numerous species of knotweed have completely infested the PNW riparian zone.**



Spraying or injecting herbicides in, over, and through a 12' wall of knotweed that is 20 to 200' wide for 20 miles of river bank is not very practical.

There must be a better way!

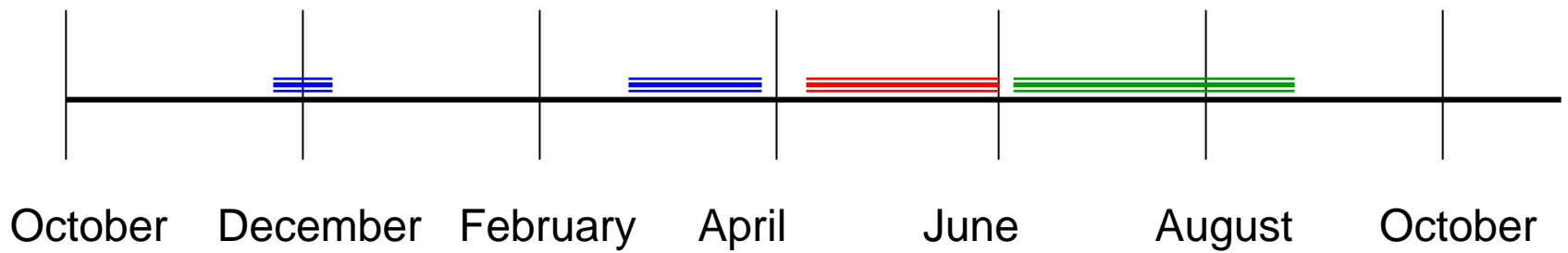


- Are there effective herbicide treatments when the canopy is not so tall or when the plants are dormant?
- What are the most efficacious herbicides?
- Do these herbicide treatments/residues affect riparian restoration effort?

Numerous studies were conducted to:

Evaluate efficacy of herbicides applied @

- Dormant basal buds
- Early growing season / 1' to 4' canopy
- Anthesis / full size canopy



Dormant Buds



Early growth



Mature Canopy



Early season target window



Traditional target window



# Herbicides

## Dormant basal buds - 2006

Aminopyralid - Milestone

Triclopyr - Renovate

## Early growing season - 2005/ 2006

Imazapyr - Habitat

Glyphosate - Aquamaster

Aminopyralid - Milestone

Triclopyr - Renovate

## Anthesis - 2005/2006

Imazapyr - Habitat

Glyphosate - Aquamaster

Imazamox – Clearcast

Aminopyralid - Milestone

Triclopyr - Renovate



# Dormant basal buds - 2006





# Dormant application of herbicides for Bohemian Knotweed control – Naselle River, 2006

Treatment	December application Stems/m <sup>2</sup> 5 MAT (May)	March application Stems/m <sup>2</sup> 3 MAT (June)
Renovate 10 % V/V @ 20 gpa (1.95 gal/ac)	14 a	23 ab
Renovate 20% V/V @ 20 gpa (3.9 gal/ac)	9 a	17 ab
Renovate 40% V/V @ 20 gpa (7.8 gal/ac)	11a	0 c
Renovate 10% V/V+ Agridex 10% V/V @ 200 gpa (5 gal/ac)	6 a	0 c
Milestone 7 FL OZ/A	2 a	6 bc
Milestone 14 FL OZ/A	3 a	7 bc
Control	15 a	40 a

Pre-treatment

1 MAT

3 MAT



## Dormant application of herbicides for Bohemian Knotweed control – Naselle R, 2006

Treatment	Stem/m <sup>2</sup> 5 MAT (September)
Renovate 10% V/V+ Agridex 10% V/V @ 200 gpa (5 gal/ac)	0 b
Milestone 14 FL OZ/A @ 20 gpa	2.7 b
Control	20 a

Treated 4/12/06, 2-6" organic stem/leaves litter over soil at site, shoots just emerging



## Early growing season herbicides

### 2005 (Mid May)

Imazapyr - Habitat

Glyphosate - Aquamaster

Triclopyr - Renovate

### 2006 (Mid April to Mid May)

Imazapyr – Habitat

Glyphosate - Aquamaster

Aminopyralid – Milestone

Triclopyr - Renovate

# Herbicide efficacy comparison – mid-spring application 2005\*

Treatment	% control 11 MAT
1% Habitat 5/23/05	100.0 a
0.5% Habitat 5/23/05	100.0 a
1% Habitat 8/3/05	100.0 a
0.5% Habitat + 2% Aqua-Master 5/23/05	100.0 a
2% Aqua-Master 5/23/05	95.0 a
2% Renovate 5/23/05	93.3 a



\* Plants 6' to 8' tall at application.

# 2006 early growth studies

- Site one - Applications made April 12 or May 1
  - Habitat 6 pt/a
  - Aquamaster 2 gal/a
  - Milestone 7 and 14 oz/a
  - Renovate 1 gal/a
- Site two - Applications made May 5 or May 18
  - Habitat 6 pt/a
  - Aquamaster 5 gal/a
  - Milestone 7 and 14 oz/a
  - Renovate 1 gal/a
- Site three - Application made May 18
  - Habitat 6 pt/a
  - Habitat 3 pt/a
  - Aquamaster 5 gal/a
  - Milestone 7 and 14 oz/a

Site One - April 12, 2006





**Site One**

**April 26, 2006 – 2 WAT**



**Site one- April 26, 2006 – 2 WAT**



**June 28, 2006 2 MAT**





**Site one- September 2006 – 4 MAT**

**Site two – September 26, 2006 – 5 WAT**



# Early season treatment September Efficacy 2006

Treatment	% control 5 MAT	
	Site 1	Site 2
Habitat - V. Early	95 a	85 abc
Habitat - Early	93 a	98 a
Rodeo - V. Early	72 ab	66 c
Rodeo - Early	79 ab	87 abc
Milestone 7 oz/a -V. Early	43 bc	68 bc
Milestone 7 oz/ac - Early	53 abc	80 abc
Milestone 14 oz/a - V. Early	62 abc	86 abc
Milestone 14 oz/a - Early	79 ab	94 ab
Renovate - V. Early	42 bc	55 c
Renovate - Early	26 cd	78 abc

Site 1 - V. Early April 12, Early May 1 – Plants @ 2-6' & 3-8' at application  
 Site 2 – V. Early May 15, Early May 30 - Plants @ 1-5' & 6-10' at application

# Early season treatment September Efficacy 2006

Treatment	% Shoots re-sprouting 5 MAT	
	Site 1	Site 2
Habitat - V. Early	14 e	9 c-f
Habitat - Early	7 e	2 def
Rodeo - V. Early	38 cde	38 b
Rodeo - Early	25 de	16 bcd
Milestone 7 oz/a -V. Early	72 a-d	23 bc
Milestone 7 oz/ac - Early	46 b-e	21 bcd
Milestone 14 oz/a - V. Early	62 a-d	12 cde
Milestone 14 oz/a - Early	31 cde	1 ef
Renovate - V. Early	87 ab	65 a
Renovate - Early	80 abc	30 bc

Site 1 - V. Early April 12, Early May 1 – Plants @ 2-6' & 3-8' at application  
 Site 2 – V. Early May 15, Early May 30 - Plants @ 1-5' & 6-10' at application

Site Three September 2006



# Early season treatment \*

## September 2006

Treatment	% control 4 MAT	% shoots re-sprouting 4 MAT
Habitat 6 pt/a	98 a	2 b
Habitat 3 pt/a	98 a	1 b
Aqua-Master 5 gal/a	98 a	8 ab
Milestone 7 oz/a	65 b	10 a

\*Applied May 18, 2006, Plants 8' to 12' tall at application.



## Herbicides Anthesis / mid summer - 2005/2006

Imazapyr - Habitat

Glyphosate - Aquamaster

Imazamox – Clearcast

Aminopyralid - Milestone

Triclopyr – Renovate

One study in 2005 – completed

Two studies in 2006 – data pending

**Summer treatment 2005 3 MAT**



# Herbicide efficacy comparison – mid-summer application 2005\*

Treatment	% control 10 MAT
Milestone 21 oz/ac	92 a
Clearcast 1 qt/ac	35 b
0.5% Habitat +2% Aqua-Master	97 a
5% Aqua-Master	97 a
2% Renovate	86 a
Control	0 c



Applied August 3, 2005, Plants 8-12', Anthesis

# Do these herbicide treatments/residues affect future riparian restoration effort?

- To assess for residual herbicide activity across plots with high rates of imazapyr and triclopyr
  - *In situ* seed germination bioassays were conducted post-treatment.
  - Willow whips were stuck in plots and assessed for grow-out

# Residual effects

- Seed germination bioassays post-treatment
- Willow whips assessed for grow-out

Seedling emergent – 3 to 12 MAT

Bioassays – Annual Rye Grass, Alfalfa, Radish



# Herbicide residual effects on seed germination

Herbicide	Time after treatment	% Germination		
		Annual blue grass	Alfalfa	Radish
Habitat 6 pt/ac May	12 MAT	55	13	2
Habitat 6 pt/ac August	10 MAT	100	68	53
Aquamaster 5 gal/ac May	12 MAT	59	18	53
Renovate 2 gal/ac May	12 MAT	96	36	8
Renovate 7.8 gal/ac March	3 MAT	82	16	2
Milestone 7 oz/ac March	3 MAT	86	25	43
Untreated Knotweed		65	13	5

No significant treatment effect on seed germination.  
Slugs were problematic at some sites

# Conclusions





# Dormant Basal Buds

- Triclopyr
  - Excellent activity of high rates in March (bud swell)
  - Not sure of minimal rate required for activity
  - Not sure of carrier effects
- Aminopyralid
  - Good activity at 7 and 14 oz/ac rate
  - Not sure of timing or rate

Data are very promising and  
an expanded research effort is planned

# Early spring growth

- Rapid and non-uniform growth makes exact timing problematic
- Early season timings are not as effective as mid season.
- For very early spring growth imazapyr most effective herbicide
- Knotweed grows out of other early treatments
- Small window for controlling early growth with aminopyralid ?
- Most herbicide are reasonable effective in spring as long as the canopy is full size.

Conclusion are tentative -12 MAT data are pending

# Anthesis/ Mid summer

- Habitat and Aquamaster - highly efficacious
- Renovate and Milestone - good efficacy, but not 100%
- Clearcast poor efficacy
- No Advantage of tank mixing Habitat and Aquamaster

Conclusion are tentative

12 MAT data are pending on several other studies

# Herbicide residual effects

- No evidence to suggest that this was an issue

# Management conclusions for Bohemian Knotweed

1. Relatively easy to control broadcast application of several herbicides to a fully developed canopy (Mid-May to September timing), but still have the problem of working with a massive canopy.
2. Early spring/ bud swell application of Milestone or Renovate has potential, but needs more research (rates, timings and carriers).
3. Application of Habitat during rapid growth period in the early spring results in reasonable control, but will require some follow-up treatment. Should wait until “all” clumps have gotten to 3-4’ tall, but by then some may be 8-10’ tall.
4. Possible alternative is to first use an early application of Renovate in when plants are 2-5’ tall to knockdown the canopy. The resulting regrowth would be uniform and reduced in height and could be more effectively treated with Habitat when the canopy is 3-6’ tall. This treatment scenario will need to be evaluated.
5. None of the herbicides evaluated showed any residual effects that would prevent succession by native species