Phalaris arundinacea Control and Riparian Restoration Within Agricultural Watercourses in King County, Washington

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Project Description

Main goals of the project:

Investigate ways to avoid or minimize agricultural maintenance related impacts on salmonid habitat.

Determine the effects of agricultural watercourse maintenance projects on riparian vegetation, in-stream erosion, fish habitat, and water quality.
Individual research projects included:

- Water Quality (DO and temperature differences between vegetation types)
- Sediment/Erosion Control (first flush, erosion control techniques)
- LWD (can LWD create hydraulic diversity in these systems?)
- **Riparian Vegetation (RCG control techniques)**
- Fish Biology (utilization of these watercourses, stomach contents)
- Macroinvertebrate communities (differences between vegetation types?)
Phalaris arundinacea (reed canarygrass) History

- Description – clonal C3 grass, long-lived perennial, up to 2.2m tall, highly rhizomatous.
- Distributed throughout northern temperate regions
- Hybrid of a native genotype and an introduced cultivar.
- Why was it introduced?
  - Agronomy, hay and pasture crop, especially on boggy land
  - Reclaim marshes and wetlands for cattle
  - Erosion control along drainage canals
  - Controlling weeds!
Problems caused by reed canarygrass

- Produces dense monocultures, altering habitat diversity and structure
- Out-competes native species, reducing biodiversity
- Excessive above and below ground biomass
- Alters hydrology, impacting fish utilization and invertebrate assemblages
Methods of control

- Card board, black plastic and other weed fabrics
- Mulch, alone or on top of fabrics
- Shading
- Mowing, tilling and grazing
- Burning
- Herbicide
- Flooding
- Micro and macronutrient manipulation
- Competition by natives or other non-indigenous species
Dredging and hydroseeding

2 years later
Weed fabric with planted willow, red osier dogwood and oceanspray

2 years later
Mowing, cardboard and mulch

After just one season

Mowing and willow stakes

After one year
Why these methods have generally not been successful...

Reed canarygrass (RCG) possesses:

- Substantial carbohydrate storage within the rhizomes, gives new culms the ability to push up lighter weight weed fabrics
- Ability to return very early in season
- Competitive pattern of above ground and below ground parts
- Excessive above and below ground biomass
- Bred to be drought tolerant, therefore, not only blankets riparian areas, but moves into nearby fields, etc.
- Tolerates inundation
- Clonal species, transfer photosynthates to portions of clone under shaded conditions
- Morphology plasticity
- Prolific seed producer, seed viability rate determined to be ~98%
Objectives

The objectives of the riparian vegetation enhancement section of this project include:

a) finding a BMP protocol for the effective control of reed canary grass, and
b) determining a method for providing native ground cover and woody riparian vegetation that is vigorous, shade producing and provides habitat for insects that constitute prey for salmonids.
King County Agricultural Production Districts (APD’s)

3 sites located within 2 APD’s

- Agriculture site
- Livestock site
- Natural site
Sammamish APD
Woodinville, Washington

Agriculture Site

Pilot project
Sammamish APD
Woodinville/Redmond, Washington

Livestock Site
Snoqualmie APD
Duvall, Washington

Natural Site
Field project methodology and treatment design

Mowed RCG

- RCG Barrier
  - 25 meters
  - Photograph of RCG Barrier

- Hogfuel/willow
  - 25 meters
  - Photograph of Hogfuel/willow

- Hogfuel/RCG Barrier
  - 1.5 meters
  - Photograph of Hogfuel/RCG Barrier

- Control
  - Photograph of Control
What the “RCG barrier” and hogfuel treatments will provide:

- Heavy, dense material on top of mowed reed canarygrass
- Allow for a 3 canopy layer planting scheme for shading of seeds and rhizomes
- Hogfuel is very dense and heavy, potentially allelopathic, and reduces nitrogen
Questions

1) Will the following treatments negatively affect the re-growth of reed canarygrass?
   - RCG barrier densely planted with native species
   - Hog fuel densely planted with *Salix sitchensis*
   - Hog fuel placed on top of RCG and below the RCG barrier

2) Is *Scirpus microcarpus* an effective competitor with reed canarygrass?

3) How long will the reed canarygrass rhizomes need to be covered with a weed block fabric to deplete the rhizome carbohydrate reserves?
Planting Scheme for RCG barrier

Scirpus microcarpus  
(Small-fruited bulrush)

Rubus spectabilis  
(Salmonberry)

Lonicera involucrata  
(Black twinberry)

Ribes bracteosum  
(Stink currant)

Symphoricarpos albus  
(Common snowberry)

Rubus parviflorus  
(Thimbleberry)

Cornus stolonifera  
(Red-osier dogwood)

Salix sitchensis  
(Sitka willow)
Agricultural Site - Year 2005

Two way ANOVA over all sites

Treatment * Site interaction  p=0.043
Livestock Site - Year 2005

Stem Count Results

Two way ANOVA over all sites

Treatment * Site interaction  p=043
Stem Count Results

Natural Site - Year 2005

Two way ANOVA over all sites: Treatment * Site interaction, p=0.043
Agriculture Site Vegetation
Percent Cover

- Salix sitchensis
- Rubus spectabilis
- Scirpus microcarpus
- Lonicera involucrata
- Ribes bracteosum
- Symphoricarpus albus
- Rubus parviflorus
- Cornus stolonifera
- Phalaris arundinacea
- Bare ground

Hogfuel/RCG
Barrier treatment
Average of 3 replicates / 6 quadrats closest to the watercourse
Livestock Site Vegetation
Percent Cover

- Salix sitchensis
- Rubus spectabilis
- Scirpus microcarpus
- Lonicera involucrata
- Ribes bracteosum
- Symphoricarpus albus
- Rubus parviflorus
- Cornus stolonifera
- Phalaris arundinacea
- Bare ground

Hogfuel/RCG Barrier treatment
Average of 3 replicates / 6 quadrats closest to the watercourse
Natural Site Vegetation
Percent Cover

- Salix sitchensis
- Rubus spectabilis
- Scirpus microcarpus
- Lonicera involucrata
- Ribes bracteosum
- Symphoricarpos albus
- Rubus parviflorus
- Cornus stolonifera
- Phalaris arundinacea
- Bare ground

Hogfuel/RCG Barrier treatment Average of 3 replicates
RCG and SFB at 22 Weeks
Three way ANOVA

- Moisture *
- Nitrogen interaction  \( p=0.002 \)

\( R = \text{RCG vs. RCG} \)
\( S = \text{RCG vs. SFB} \)

\( \text{LSM} = \text{Low Soil Moisture} \)
\( \text{HSM} = \text{High Soil Moisture} \)
\( \text{LN} = \text{Low Nitrogen} \)
\( \text{HN} = \text{High Nitrogen} \)
Allocation of Resources

RCG Dry Weight

Treatment

grams

R/LSM LN
R/LSM HN
R/HSM LN
R/HSM HN
S/LSM LN
S/LSM HN
S/HSM LN
S/HSM HN

LSM = Low Soil Moisture
HSM = High Soil Moisture
LN = Low Nitrogen
HN = High Nitrogen
Scirpus microcarpus dry weight

Allocation of Resources

LSM = Low Soil Moisture
HSM = High Soil Moisture
LN = Low Nitrogen
HN = High Nitrogen
Conclusions / Recommendations

- Multiple canopy layers
- Recommended species – *Scirpus microcarpus, Rubus spectabilis, Lonicera involucrata, Salix sitchensis, Cornus stolonifera, Rubus parviflorus*
- If using willow stakes alone, try additional species, not just willow sp. (willow borer)
- Thicker fabric in place of burlap (jute)
- Place hogfuel when possible
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Methods

- Randomized block design, with 3 treatments (plus control) within 3 blocks (or replicates) chosen randomly at each of the 3 sites.

- Reed canarygrass mowed, rhizome barrier placed around 1.5x2.5 meter plots.

- Three treatments applied at each site.

- The stems of any returning RCG counted and recorded biweekly during the growing season.

- Data Analysis conducted utilizing a one way ANOVA.

- Percent cover of vegetation recorded at the end of the second growing season to determine survival and competitive efficacy of planted native species with RCG.
Competition study

- Bare-root RCG and small fruited bulrush (SFB) of similar size # of nodes will be collected. Above ground biomass clipped at 10cm, and weighed.

- 12 RCG and 4 SFB randomly chosen, planted in 2 gallon pots and placed in the greenhouse at UWBG for 22 weeks.

- Treatments - competition (RCG vs. SFB), high and low soil moisture, high and low nitrogen

- Watered and fertilized (NH4 NO3) weekly

- RCG and SFB harvested, washed, determined dry weight of above & below biomass of RCG and sample of SFB

- Analyzed utilizing a 3 way ANOVA.