Using Phenological Events of Flowering Rush to Improve Chemical Control Strategies

Kurt Getsinger

US Army Engineer Research & Development Center
Environmental Laboratory
Vicksburg, MS

John Madsen

USDA – Agricultural Research Service
University of California
Davis, CA

Research Objectives

Link: Flowering Rush phenological data with chemical control strategies – against submersed and emergent growth forms

- Grow plants under mesocosm conditions to determine weak points in life cycle – e.g. distribution of biomass, partitioning of carbohydrate reserves, etc.
- Verify mesocosm results in field populations
- Utilize results for improved herbicide efficacy in field

Flowering Rush (*Butomus umbellatus* L.)

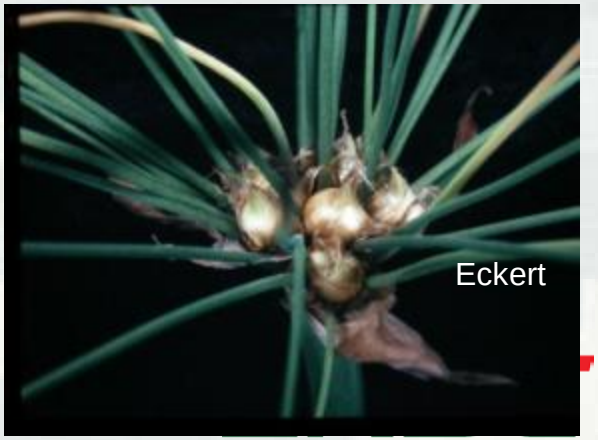
- Aggressive exotic in littoral zone habitats
- Grows from shoreline to 3 meters deep
- Reproduction - seeds, rhizomes, buds, bulbils
- Thrives in quiescent and high-flow environments
- Water-level fluctuations facilitate colonization

Flowering Rush Taxonomy

- *Butomus umbellatus* L.
- Flowering rush
- Member of it's own family, the Butomaceae
- Order Alismatales, or the same order as the arrowhead family

Flowering Rush

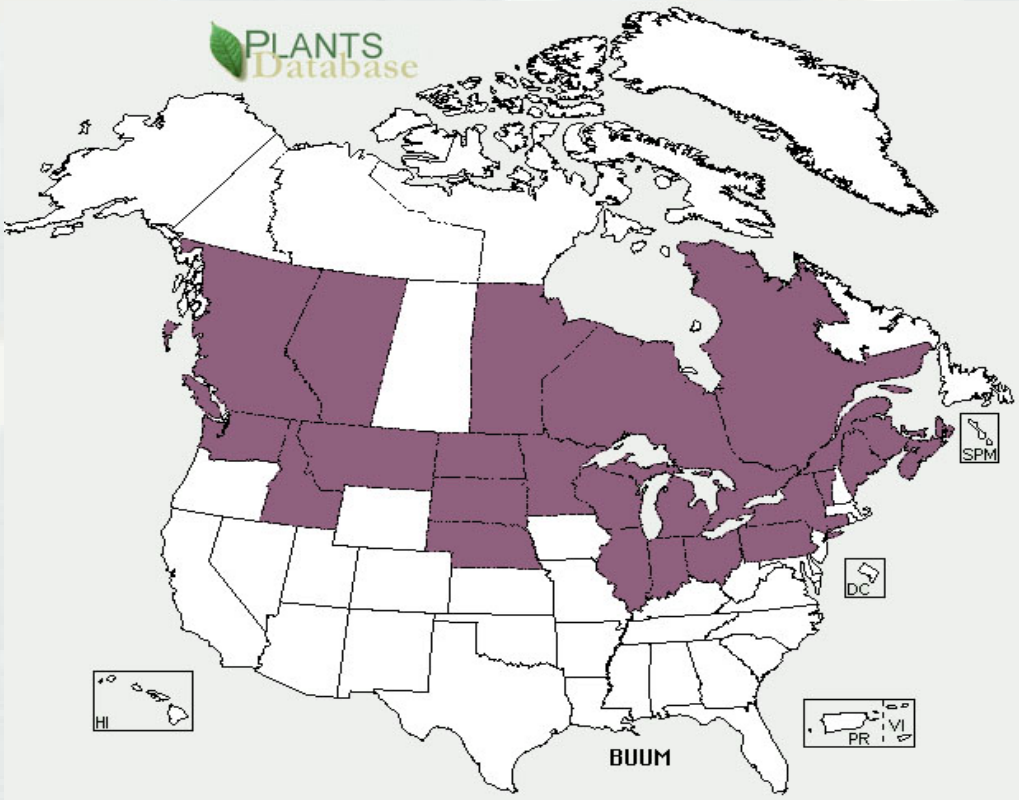
- Introduced from Europe and Asia
- Both a diploid and triploid biotypes
- Diploid biotype undergoes sexual reproduction an produces > 20,000 seeds per plant
- Diploid biotype also produces > 100 of vegetative bulbils per plant
- Triploid biotype produces few seeds and relies on vegetative growth for spread



Distribution of Flowering Rush

- **Spreading in reservoirs and river systems**

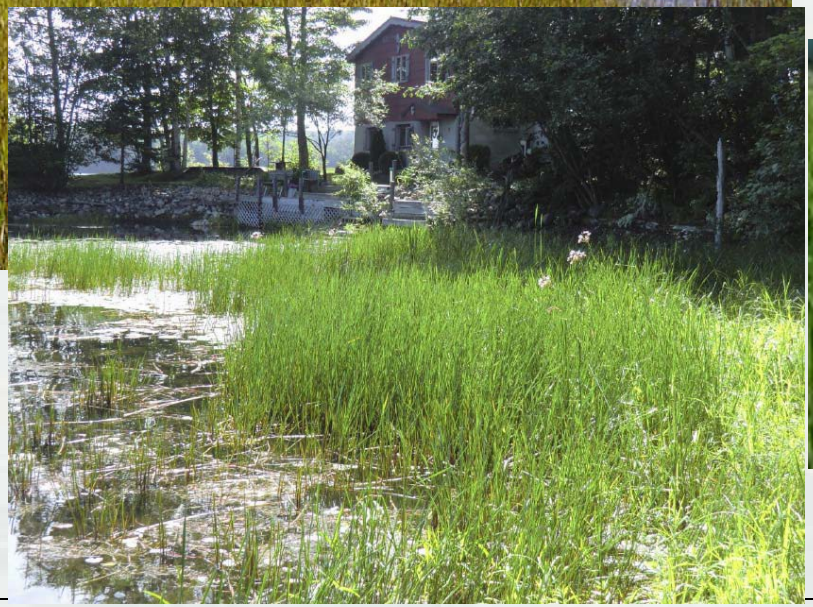
Diploid – eastern Great Lakes, ID (??); Triploid – MN, MT, ID, WA



Modes of Spread

- Rhizomes and rhizome buds
- Seed (in diploid)
- Bulbils (in diploid)
- Boating
- Wave action / drift
- Waterfowl

Monoculture stands



Flowering Rush Impacts

- Dense stands exclude native plant species
- Reduces biodiversity in aquatic systems
- Degradation of fish and wildlife habitat
- Reduction of critical habitat for listed species
- Obstructs flow in irrigation ditches
- Interferes with navigation and recreation
- Obstructs use of waterfront
- Reduces the value of waterfront property

Flowering Rush Management Problem

- **Information gaps in life cycle events**

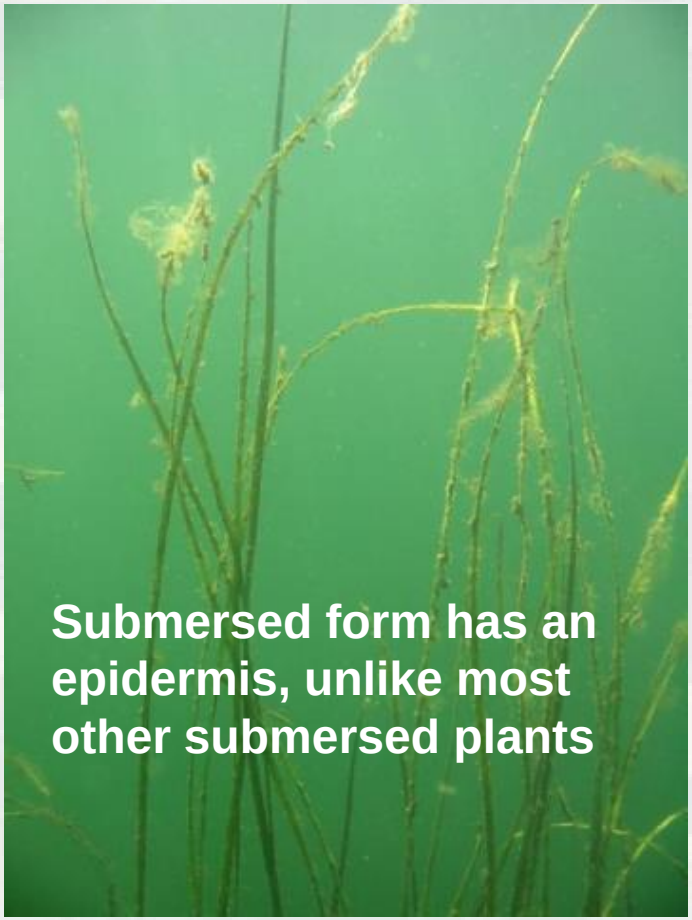
  Phenological** approach used to improve the management of other aquatic plants

  ** **phenology** - study of periodic life cycle events influenced by seasonal variations in climate

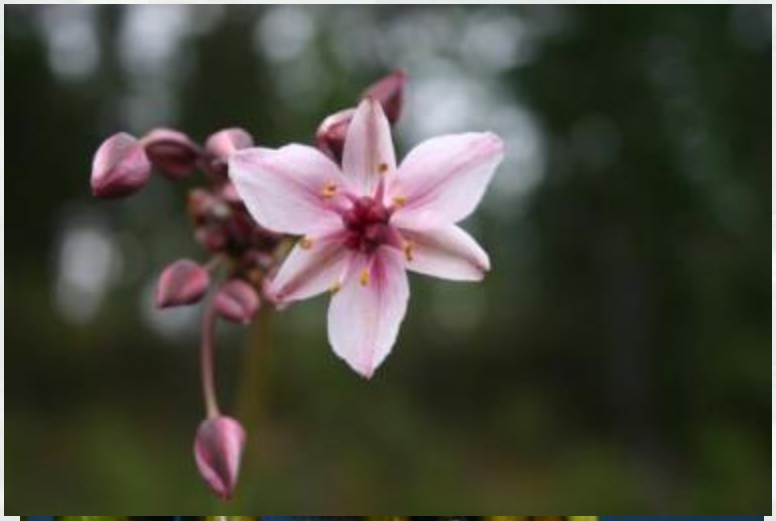
- **No reliable long-term control strategies**

  – **<u>including use of herbicides</u>**

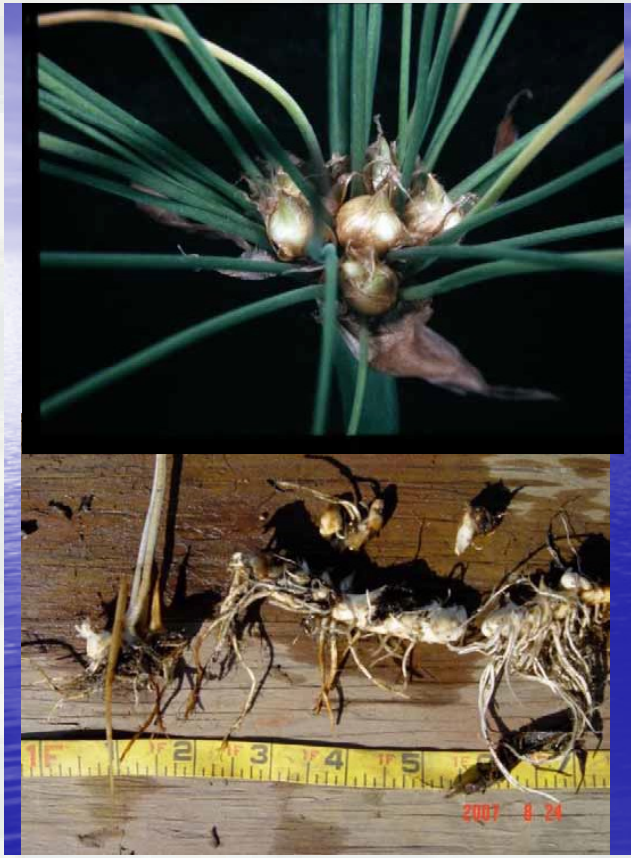
Growth Forms of Flowering Rush

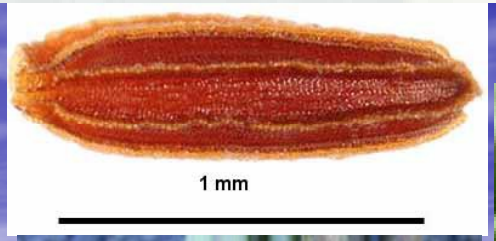


Production of Propagules



Reproduction

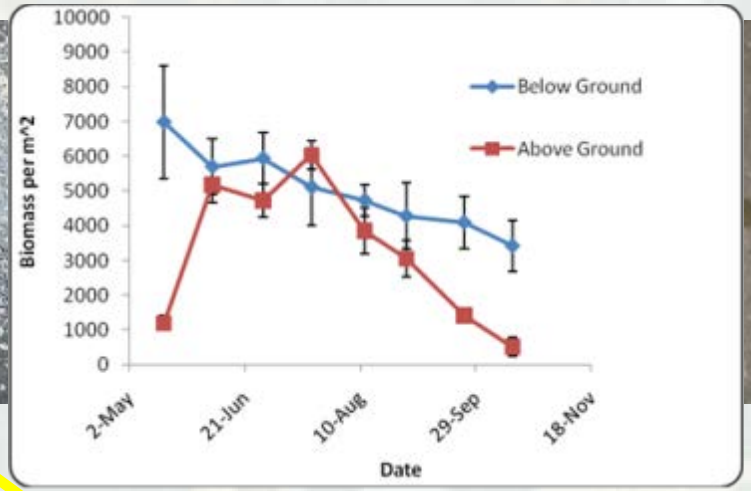




SUMMER

Leaves

FALL



SPRING

Rhizome Buds Increased

WINTER

Rhizome

Rhizome Buds

Management must be directed at population of rhizome buds:

- ✓Reducing number of rhizome buds
- ✓Preventing the production of new buds

✓Any technology (biological, chemical, mechanical, physical) must address rhizome buds

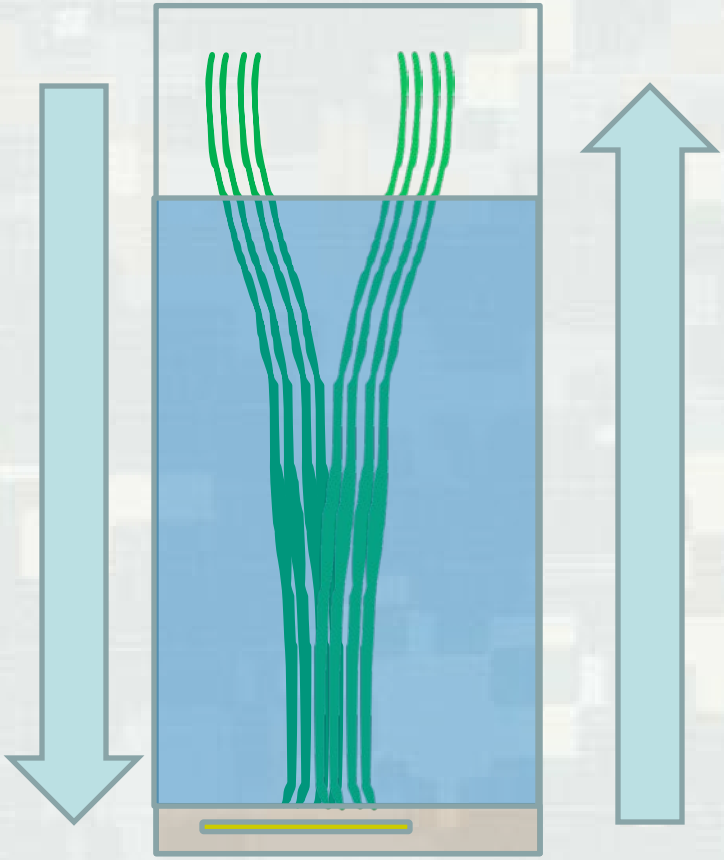
Figure 6A. The rhizome of flowering rush with two rhizome buds, indicated by the yellow arrows. Rhizome buds initiate new shoots and are the main form of vegetative propagation in flowering rush. Photo by J. Madsen, GRI.

Seasonal Timing

- Growth stage
- Production of propagules
- Carbohydrate allocation

Carbohydrate Allocation

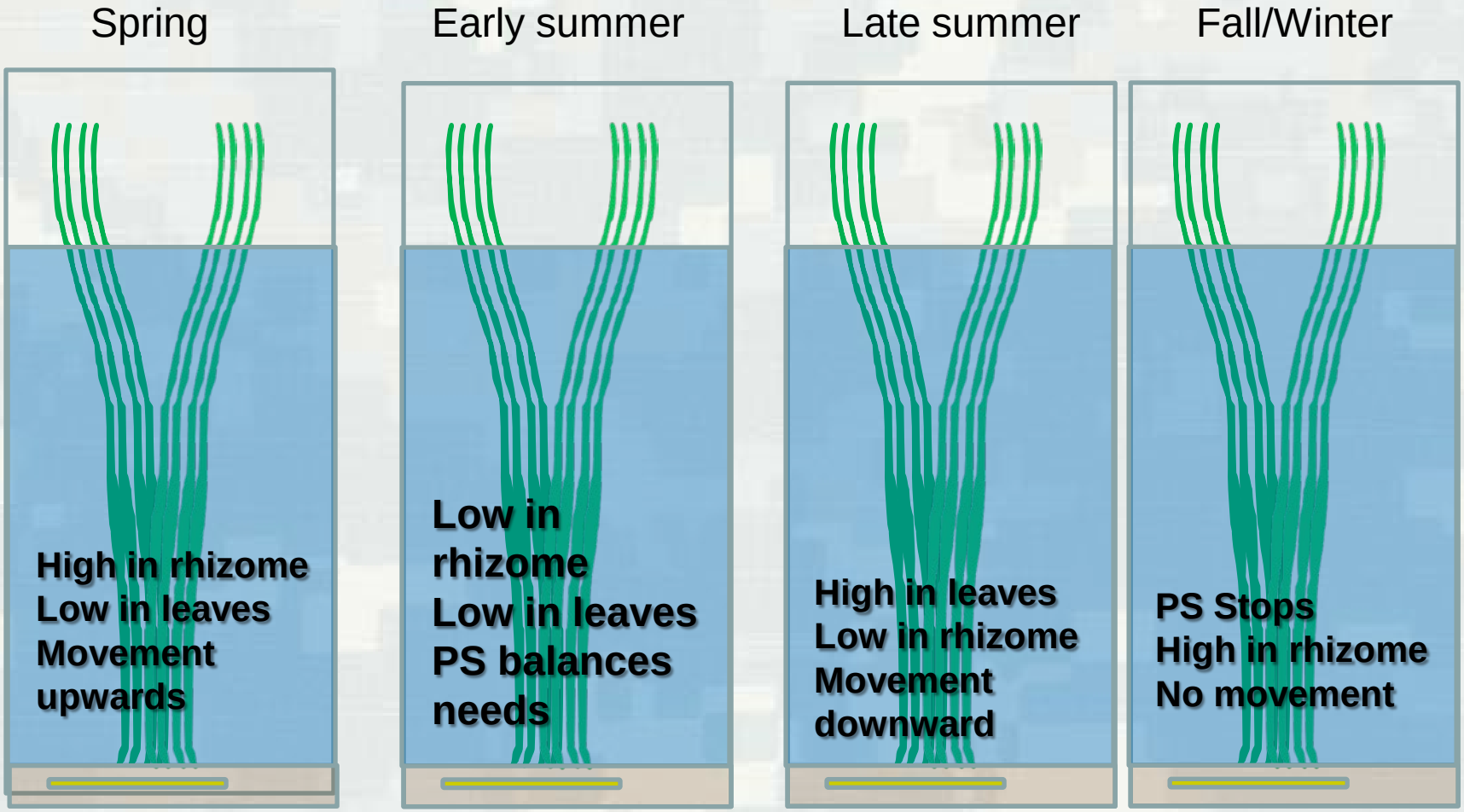
- Photosynthesis produces sugars
- Excess sugars are translocated to the rhizome
- In rhizome, sugars converted to starch for storage



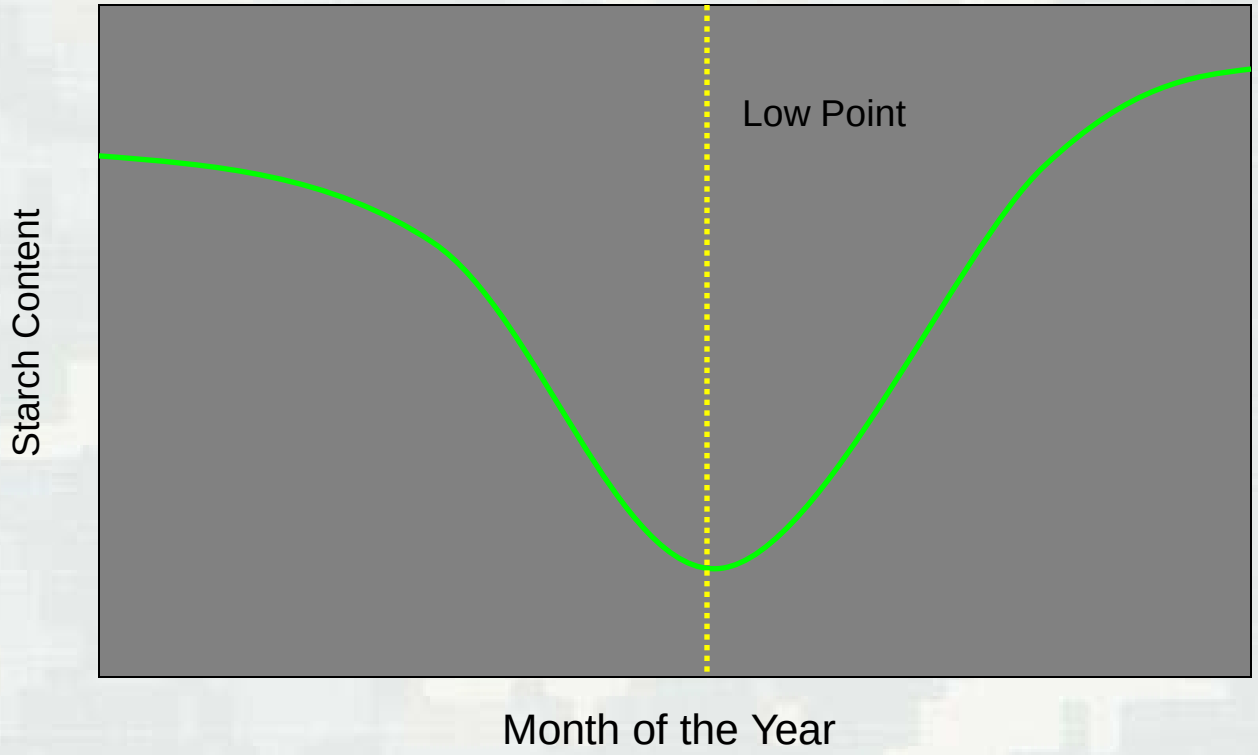
- In rhizome, starch is converted to sugar for movement
- Sugars are used in leaves to increase leaf length and build structures

Movement in phloem is always from source to sink

Seasonal Dynamic



Carbohydrate Low Point

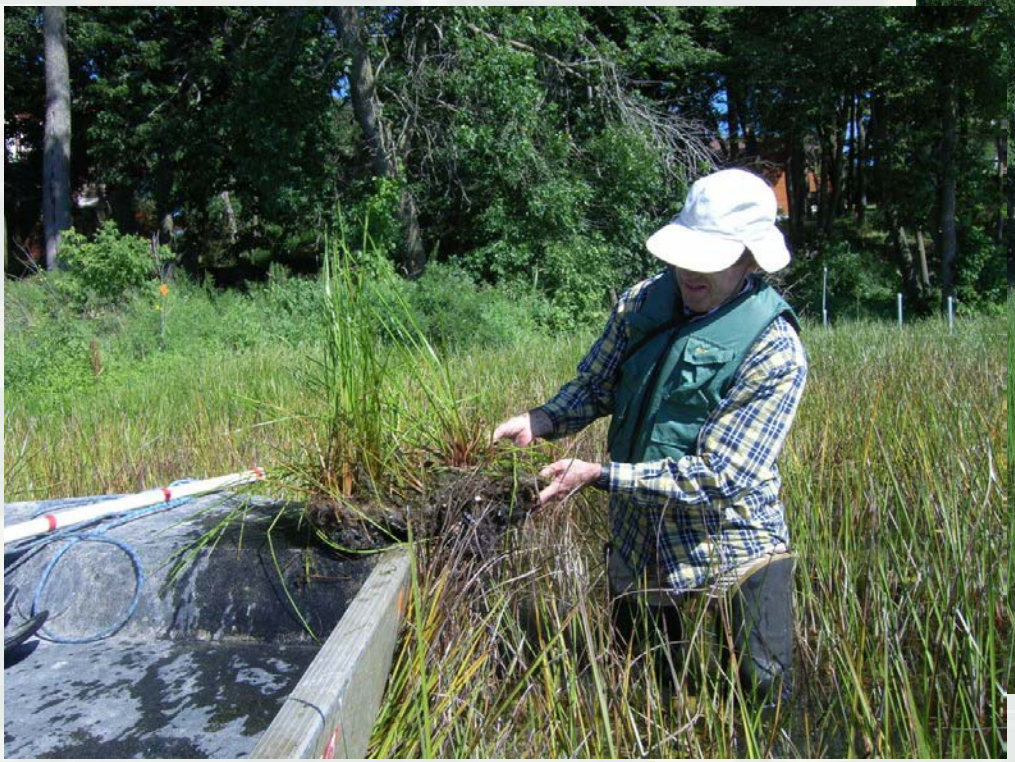


Flowering Rush Phenology

Mesocosm Evaluations

Flowering Rush Phenology

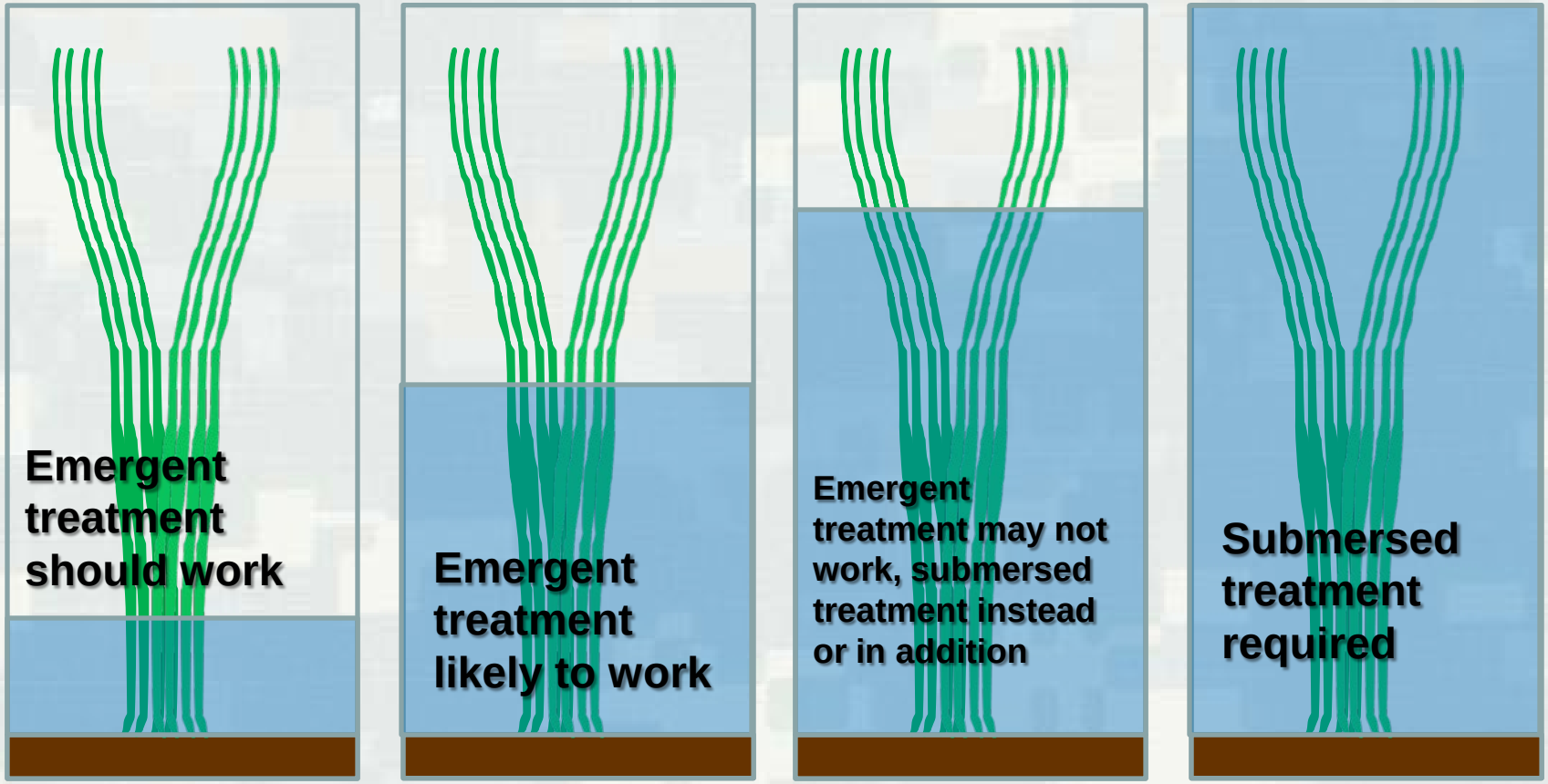
Field Verification

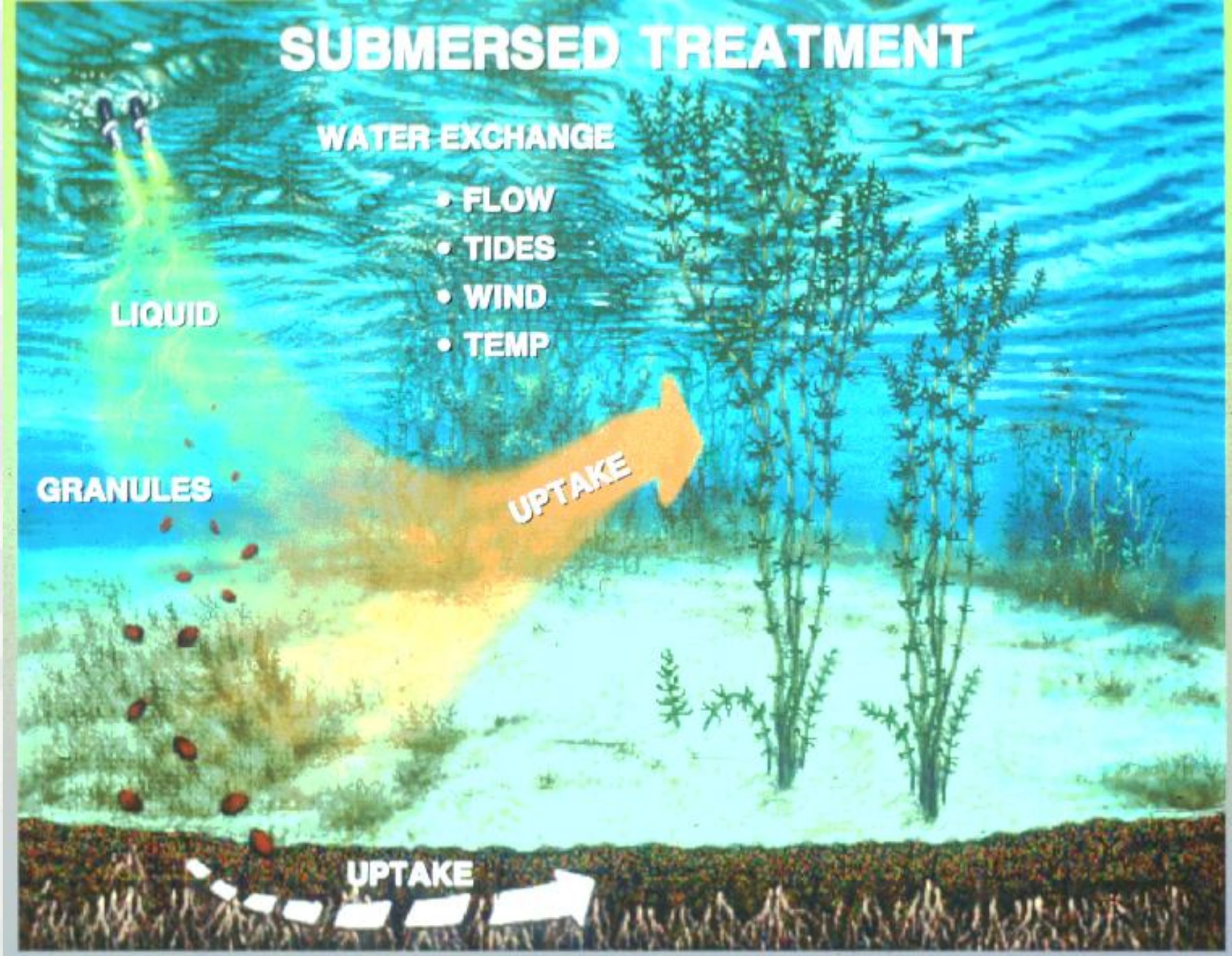


Management with Herbicides

- Depth of **inundation of shoots**
- Limited,short-term success with **submersed applications** using contact products – primarily diquat
- Water-exchange processes reduce success with longer acting systemic products in **submersed applications**
- Applications to plants in **de-watered littoral sites** show promise – quantification in progress

Depth of Inundation

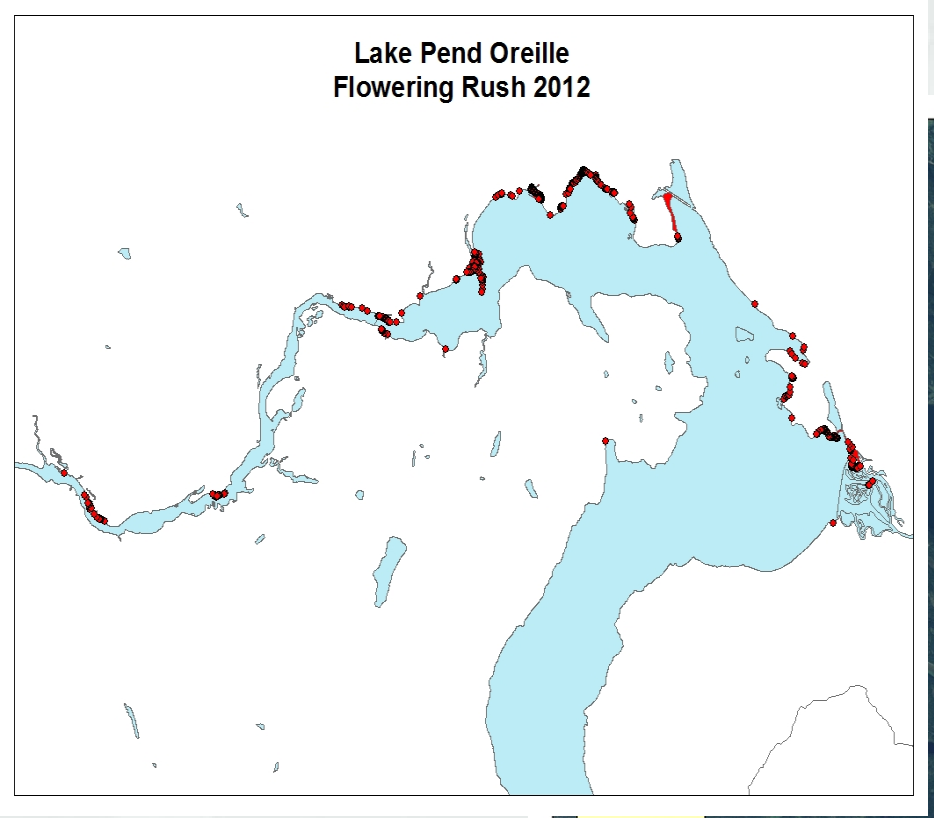


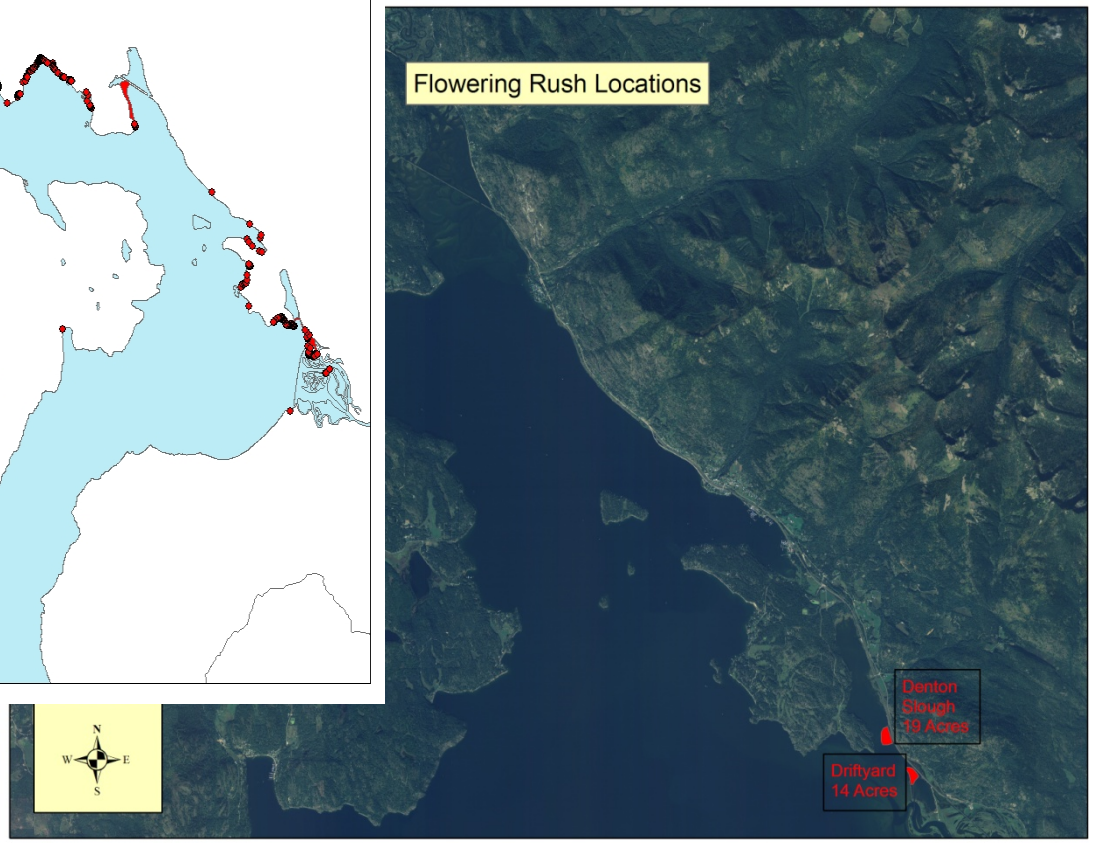

SUBMERSED TREATMENT
WATER EXCHANGE
• FLOW
• TIDES
• WIND
• TEMP
LIQUID
GRANULES
UPTAKE
UPTAKE

Research Approach

Field Evaluations – herbicides – build on results of other studies

Lake Pend Oreille, ID
Flowering Rush Sites





Lake Pend Oreille Dewatered Herbicide Trials -2015

Drift Yard Area

Lake Pend Oreille Dewatered Herbicide Trials

Five Treatments: 3 reps each, plots = 0.25 acre each

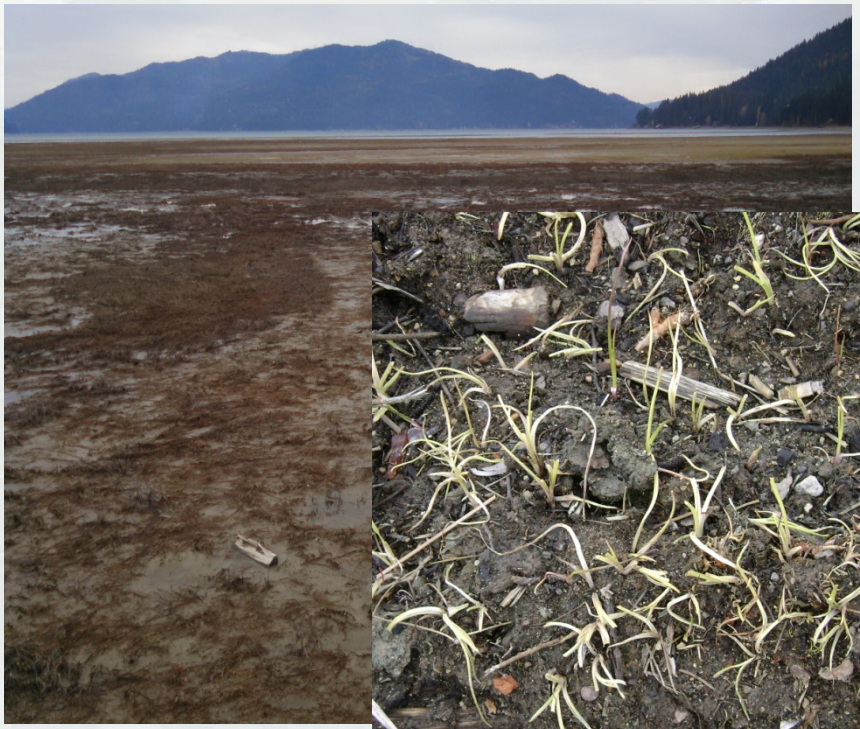
- Imazapyr, 3 qt/ac (Polaris, Nufarm)
- Imazamox, 2 qt/ac (Clearcast, SePRO)
- Imazapyr, 3 qt/ac + 2,4-D, 1 qt/ac (Weedar 64,Nufarm)
- Imazamox, 2 qt/ac + 2,4-D, 1 qt/ac
- untreated control (reference)
- all chemical treatments included surfactant, 1 qt/ac

Lake Pend Oreille Dewatered Herbicide Trials

April 2015 Plot Lay-0ut

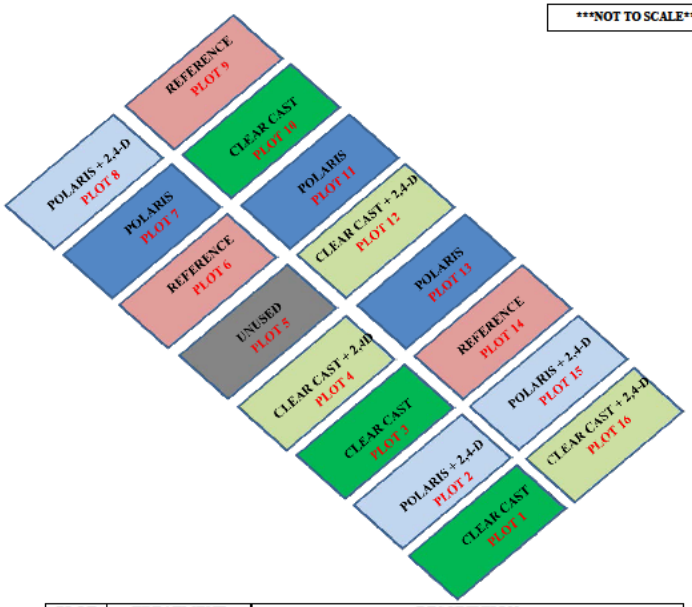
Lake Pend Oreille Dewatered Herbicide Trials

- Applied prior to re-flooding of littoral zone: 24-28 April 2015
- Used ATV and spray boom
- Plant shoots 1-2 inches above sediment surface



Lake Pend Oreille Dewatered Herbicide Trials

2015 Plots



PLOT	TREATMENT	DESCRIPTION
1	2	Imazamox (Clear Cast) + surfactant
2	3	Imazapyr (Polaris) + 2,4-D + surfactant
3	2	Imazamox (Clear Cast) + surfactant
4	4	Imazamox (Clear Cast) + 2,4-D + surfactant
5	\	Unused
6	5	Reference
7	1	Imazapyr (Polaris) + surfactant
8	3	Imazapyr (Polaris) + 2,4-D + surfactant
9	5	Reference
10	2	Imazamox (Clear Cast) + surfactant
11	1	Imazapyr (Polaris) + surfactant
12	4	Imazamox (Clear Cast) + 2,4-D + surfactant
13	1	Imazapyr (Polaris) + surfactant
14	5	Reference
15	3	Imazapyr (Polaris) + 2,4-D + surfactant
16	4	Imazamox (Clear Cast) + 2,4-D + surfactant

Lake Pend Oreille Dewatered Herbicide Trials

<u>Vegetation Assessments</u>: Pretreatment, 12 and 52 wks post

- 10 biomass samples each plot, each event

Lake Pend Oreille Dewatered Herbicide Trials

Preliminary Results – 12 weeks posttreat - July 2015

Lake Pend Oreille Dewatered Herbicide Trials

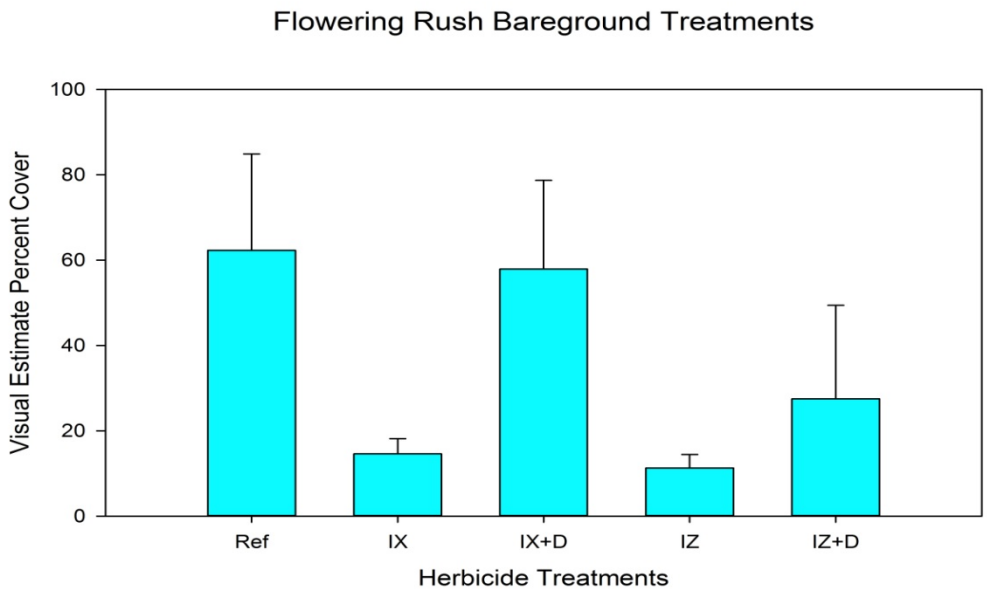
Preliminary Results – 16 weeks posttreat - Aug 2015

Lake Pend Oreille Dewatered Herbicide Trials

Biomass Sample – 12 weeks posttreatment

Lake Pend Oreille Dewatered Herbicide Trials

Mean (± SE) Estimated Cover – 12 weeks posttreatment



Lake Pend Oreille Dewatered Herbicide Trials

Preliminary Results: 12 wk post – Native Plants - July 2015

Benefits of Work

- **Phenological studies will benefit <u>all</u> flowering rush mangement techniques**

- <u>Chemical control</u> – application techniques, evaluation of products, timing of applications
- Cost-effectiveness -- linking weak points in FR life cycle to application parameters – less herbicides, consistent and prolonged control
- Restore native vegetation; improve fish and wildlife habitat, etc.

- **Provide guidance to resource managers for improving control of flowering rush**

Flowering Rush R&D Cooperators

- CE Aquatic Plant Control Program - ERDC
- CE Districts -- Seattle, Walla Walla, Portland, Omaha
- CE Albeni Falls Project – Lake Pend Oreille
- USDA-ARS – Davis, CA
- Idaho State Department of Agriculture
- Bonner Co, ID
- Washington State Department of Ecology
- Pend Oreille Co, WA
- Avista Utilities (WA, ID, MT)

- Others being sought …