

# Biological control of flowering rush



## **Project scientists:**

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Agriculture

Washington State Department of  
Ecology

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Lands and Natural Resource Operations

## **Counterparts:**

Jennifer Andreas, Greg Haubrich, Peter  
Rice

# Prospects for biological control of flowering rush

Only species in genus, only genus in family  
Butomaceae

- No closely related native NA congeners
- Should increase chances to find a host specific biocontrol agent
- Will reduce the number of plants that need to be tested

# Literature survey

22 species recorded to develop on *Butomus*:

- 8 Coleoptera (3 Curculionidae, 5 Chrysomelidae)
- 5 Lepidoptera (3 Tortricidae, 1 Crambidae, 1 Cochylidae)
- 4 Diptera (1 Agromycidae, 1 Ephydriidae, 2 Chironomidae)
- 1 Hemiptera (Aphidae)
- 4 fungal pathogens

# Literature survey

6 species recorded as monophagous on *Butomus*:

- *Bagous nodulosus* (Col.: Curculionidae)
- *Bagous validus* (Col.: Curculionidae)
- *Donacia tomentosa* (Col.: Chrysomelidae)
- *Phytoliriomyza ornata* (Dipt.: Agromyzidae)
- *Hydrellia concolor* (Dipt.: Ephydriidae)
- *Glyptotendipes viridis* (Dipt.: Chironomidae)

# Flowering rush cytotypes

Diploids produce thousands of viable seeds and also reproduce by clonal bulbils formed on rhizomes and inflorescences

Triploids are sterile, hardly produce bulbils and mainly propagate by rhizome fragmentation

Diploids more common in eastern US;  
triploids more common in western US

Currently targeting mostly the triploids;  
rhizome feeders would be best

# Field survey - challenges

- Flowering rush is relatively rare in Europe and grows in sensitive, often protected habitats
  - Three of the potential agents are redlisted or regarded as endangered
- necessitates permission in most cases to visit habitats and survey plant

# Field surveys



# Field surveys

Field sites visited in 2013:

- Eissel (Germany)
- Kasseteich (fish ponds near Kiel, Germany)
- Niedervieland (Nature reserve near Bremen, Germany)
- Oparany (Czech Republic)
- Kolence (Czech Republic)
- Hlohovec (Czech Republic)
- Lanzhot (Czech Republic)
- L'uba (Slovak Republic)
- Nána (Slovak Republic)



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Sites with *Bagous nodulosus*











# Herbivores found

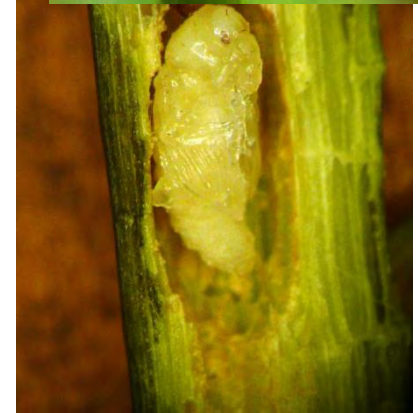
ID of some insects still needs confirmation

<i>Bagous nodulosus</i>	weevil	monophagous
<i>Donacia tomentosa</i>	leaf beetle	monophagous
<i>Phytoliriomyza ornata</i>	agromyzid fly	monophagous
<i>Hydrellia concolor?</i>	ephydrid fly	monophagous
<i>Glyptotendipes viridis?</i>	Chironomid fly	monophagous
<i>Plusia festucae</i>	noctuid moth	polyphagous
Unknown moth		



# *Bagous nodulosus*

- Typical adult feeding damage facilitates confirming presence at field sites
- Found at 5 field sites; collected 48 adults
- Established rearing with successful development from egg to adult
- Testing different setups for overwintering of adults



# *Bagous nodulosus*

- Oviposition in May (?) - July
- Larval development in leaves and rhizomes between June and August
- Pupation in July/August
- Damage both through larval and adult feeding
- Overwintering as adult



# *Phytoliriomyza ornata*

- Found at nearly all sites
- Larvae mine in leaves and flowering stems
- Pupation in July/August
- Less damaging than *Bagous nodulosus*



# *Hydrellia concolor?*

- Found at nearly all sites
- ID not confirmed yet
- Larval development mainly in leaves
- Damage not very obvious



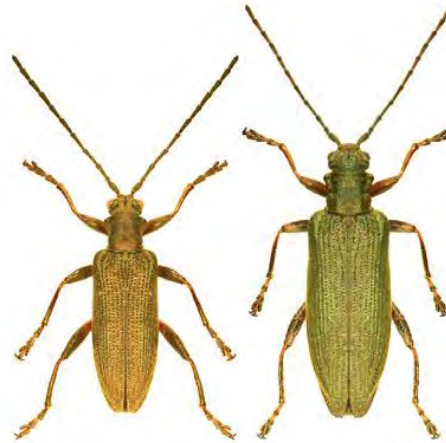
# Chironomid flies

- Found at all sites
- Larval development mainly in submerged leaves
- Feeding damage limited; could get substantial at high densities



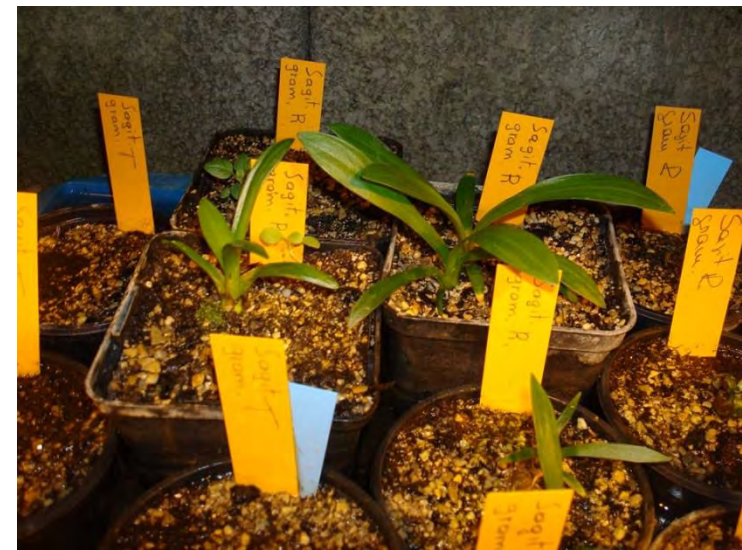
# *Donacia tomentosa*

- Rare and endangered species
- Larvae develop on roots; damage ??
- Adults feed on leaves
- Larval development of many *Donacia* species takes 2-3 years

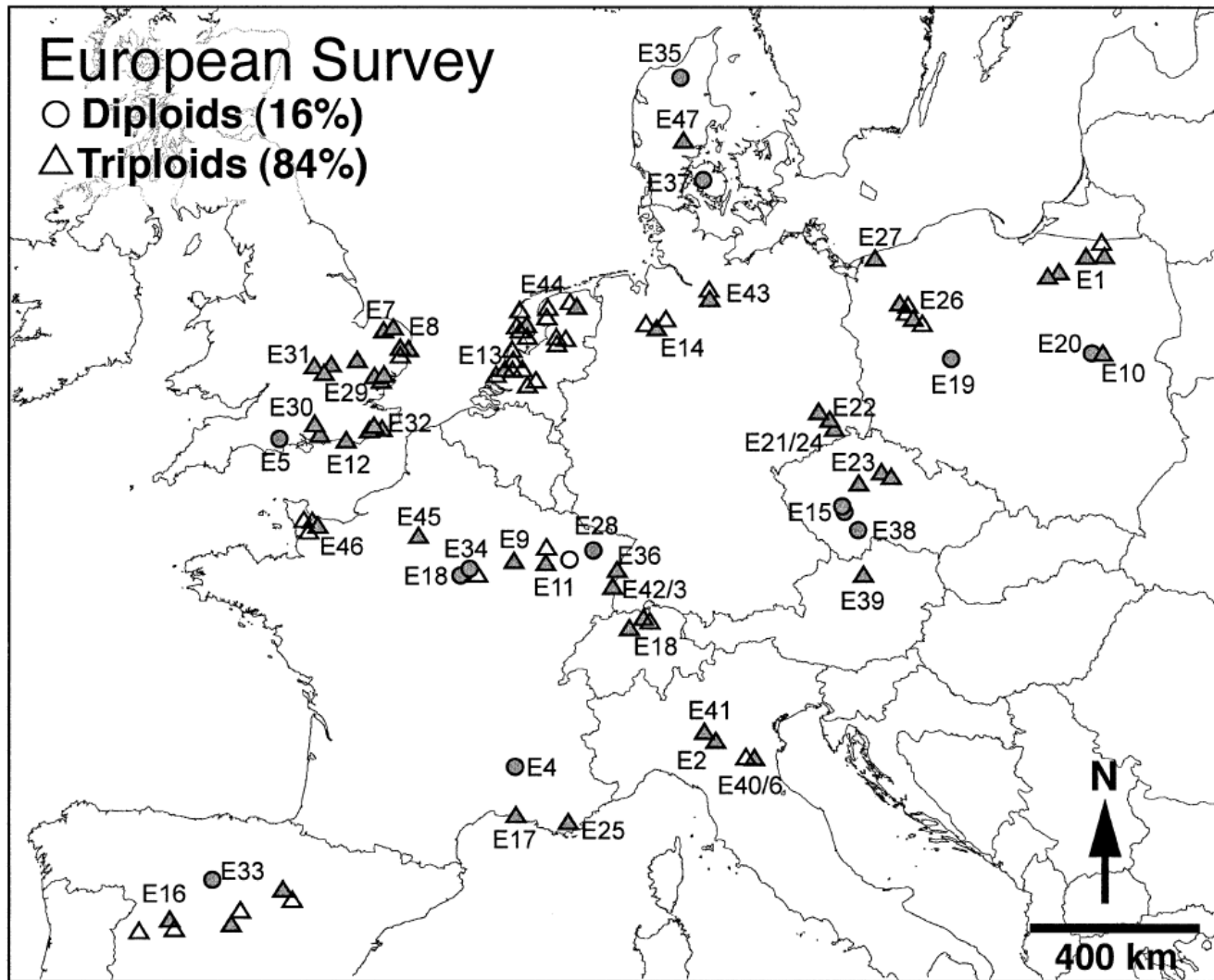


# Test plants

Species	Number received	Number growing
<i>Echinodorus cordifolius</i>	12	2
<i>Sagittaria graminea</i>	44	27
<i>Sagittaria latifolia</i>	43	3
<i>Sagittaria platyphylla</i>	40	11

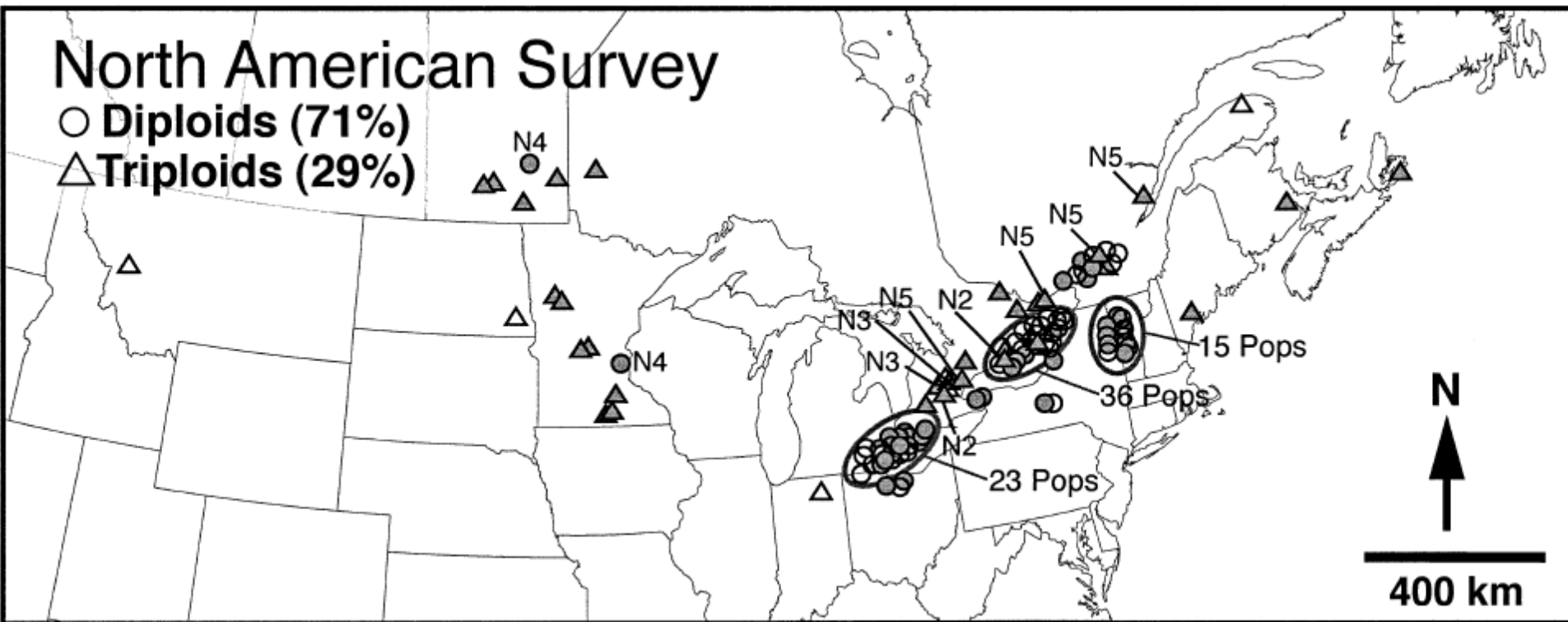


# Flowering rush cytotypes



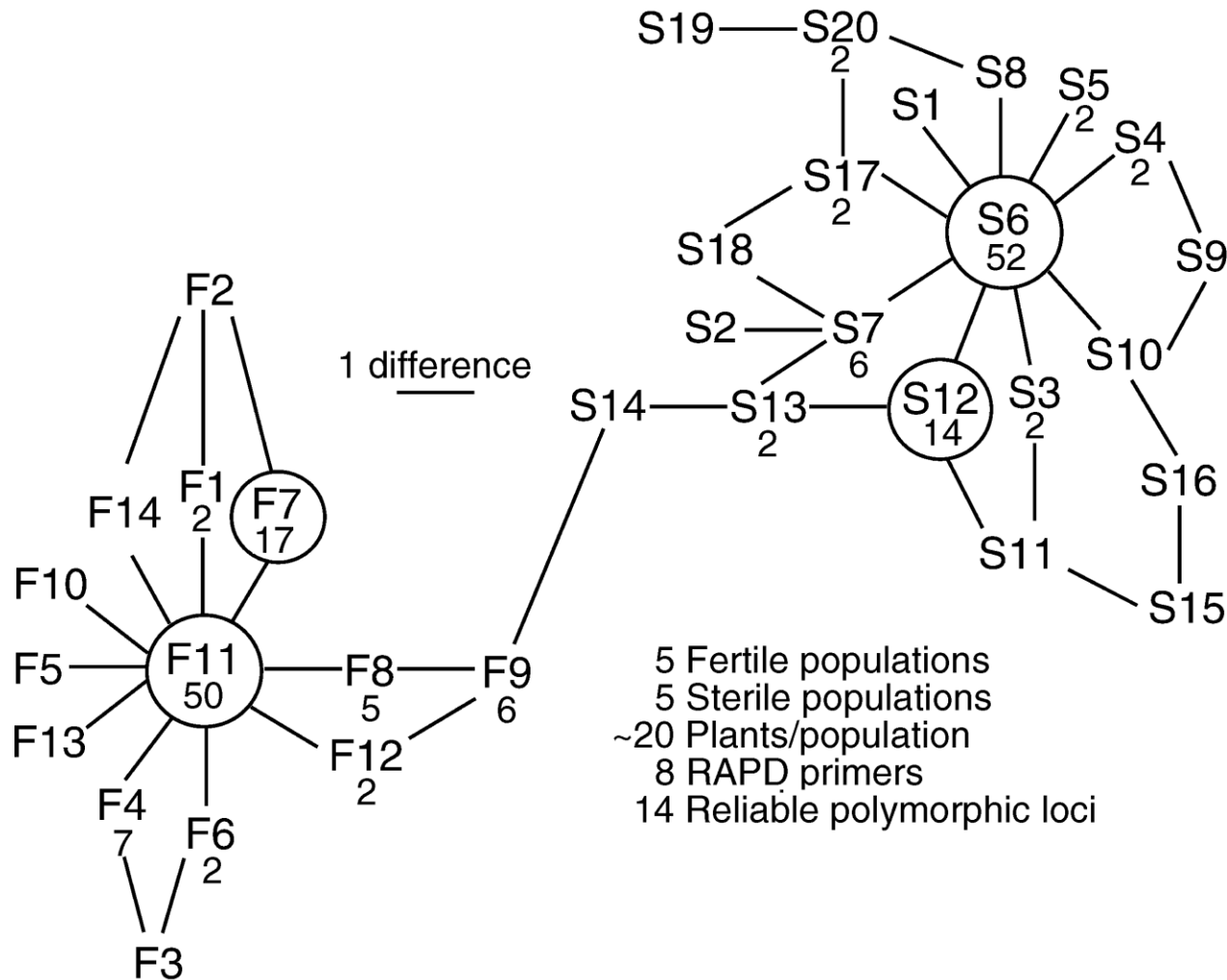
Kliber and Eckert (2005)

# Flowering rush cytotypes



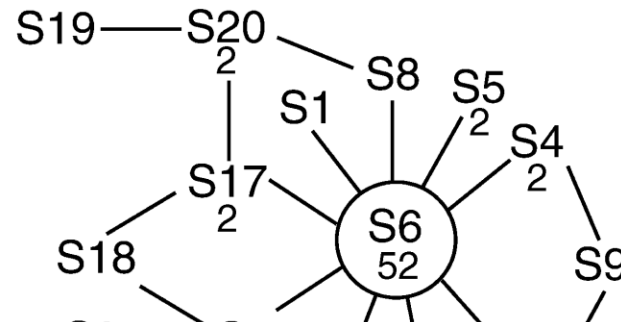
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# Flowering rush genotypes



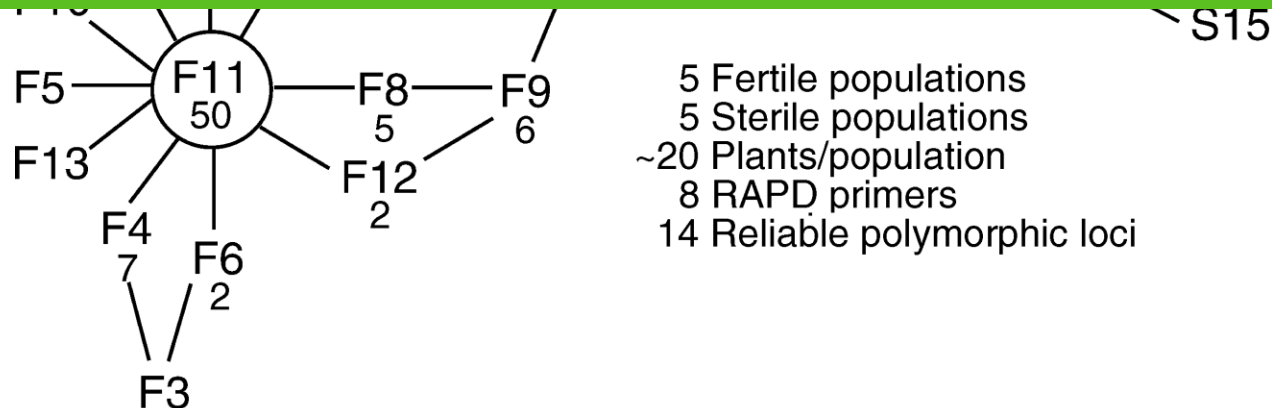
Eckert et al. (2003)

# Flowering rush genotypes



F2

But see Poovey et al. (2012) where all investigated populations belonged to the same genotype!



5 Fertile populations  
5 Sterile populations  
~20 Plants/population  
8 RAPD primers  
14 Reliable polymorphic loci

Eckert et al. (2003)

# Flowering rush genotypes

Test most common genotypes of each cytotype from North America

Eckert and his group not active anymore

John Gaskin (USDA, ARS, Sidney, Montana) volunteered to conduct molecular analyses on flowering rush samples

# Plans for 2014

- Return to sites visited in 2013 and collect more *B. nodulosus* adults
- Extend surveys to Hungary and Serbia
- Improve rearing of *B. nodulosus* and try to establish rearing of *B. validus*
- Continue collecting data on biology and phenology of *B. nodulosus*
- Conduct first host-specificity tests with *B. nodulosus*
- Obtain information on impact of the two fly species