Great Lakes PHRAGMITES COLLABORATIVE

WELCOME!

Phragmites Management in the US: 40 years of Methods and Outcomes

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Ecology Center, Department of Watershed Science

September 30, 2014

The webinar is listen only. You can listen by phone or through your computer's speakers.

We will begin shortly!

Phragmites Management in the United States: 40 years of methods and outcomes

Webinar presented to the Great Lakes Phragmites Collaborative September 2014.

Eric Hazelton (USU, Smithsonian)
Karin Kettenring (USU)
Dennis Whigham (Smithsonian)
Thomas Mozdzer (Bryn Mawr)

Thanks!

- Kettenring Lab
- Whigham Lab
- GLPC
- Amanda Sweetman

Part 1. Review of Phragmites management in the US

Part 2. How might land use impact management outcomes

Part 3. Some insights into simplified monitoring

Origins

- Prague Symposium organized by Dennis and others.
- Compared EU to US
- Resulted in numerous reviews
- Represents state of knowledge in both native and introduced range.

AoB Plants Special Issue

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Invited Review

SPECIAL ISSUE: *Phragmites australis* in North America and Europe

Ecosystem services of *Phragmites* in North America with emphasis on habitat functions

Erik Kiviat*

AoB PLANTS http://aobplants.oxfordjournals.org/

Open access – Review

THIS ARTICLE IS PART OF A SPECIAL ISSUE ENTITLED '*PHRAGMITES AUSTRALIS* IN NORTH AMERICA AND EUROPE'

Hybridization of common reed in North America? The answer is blowing in the wind

L. A. Meyerson[1,2]*, C. Lambertini[3], M. K. McCormick[4] and D. F. Whigham[4]

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Open access – Invited review

THIS ARTICLE IS PART OF A SPECIAL ISSUE ENTITLED '*PHRAGMITES AUSTRALIS* IN NORTH AMERICA AND EUROPE'

Moving from a regional to a continental perspective of *Phragmites australis* invasion in North America

Karin M. Kettenring[1]*, Sylvie de Blois[2] and Donald P. Hauber[3]

AoB PLANTS — The open-access journal for plant sciences

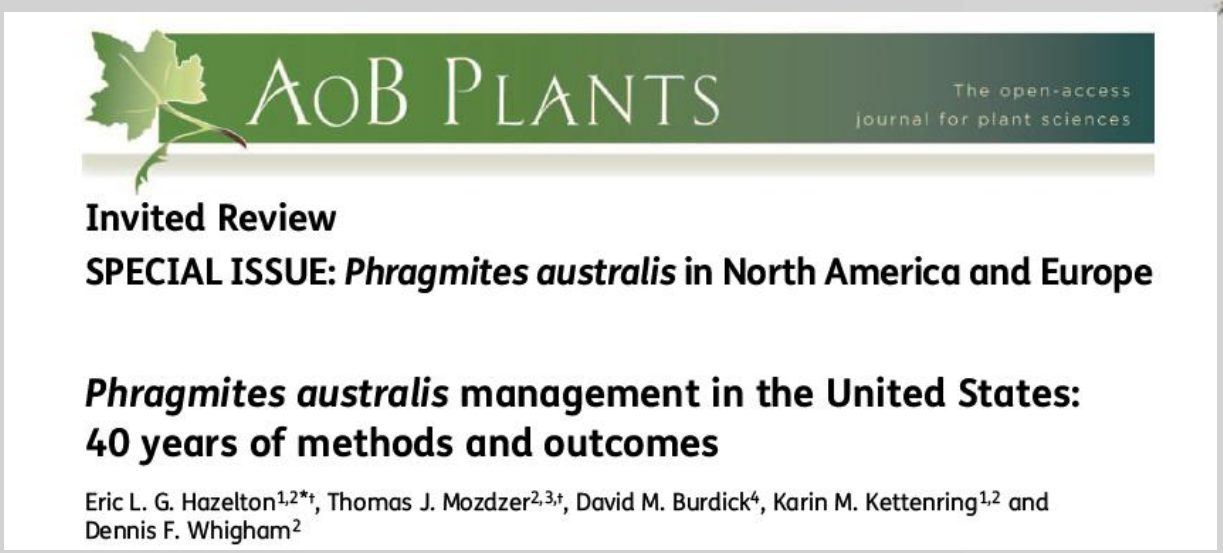
Invited Review

SPECIAL ISSUE: *Phragmites australis* in North America and Europe

Physiological ecology and functional traits of North American native and Eurasian introduced *Phragmites australis* lineages

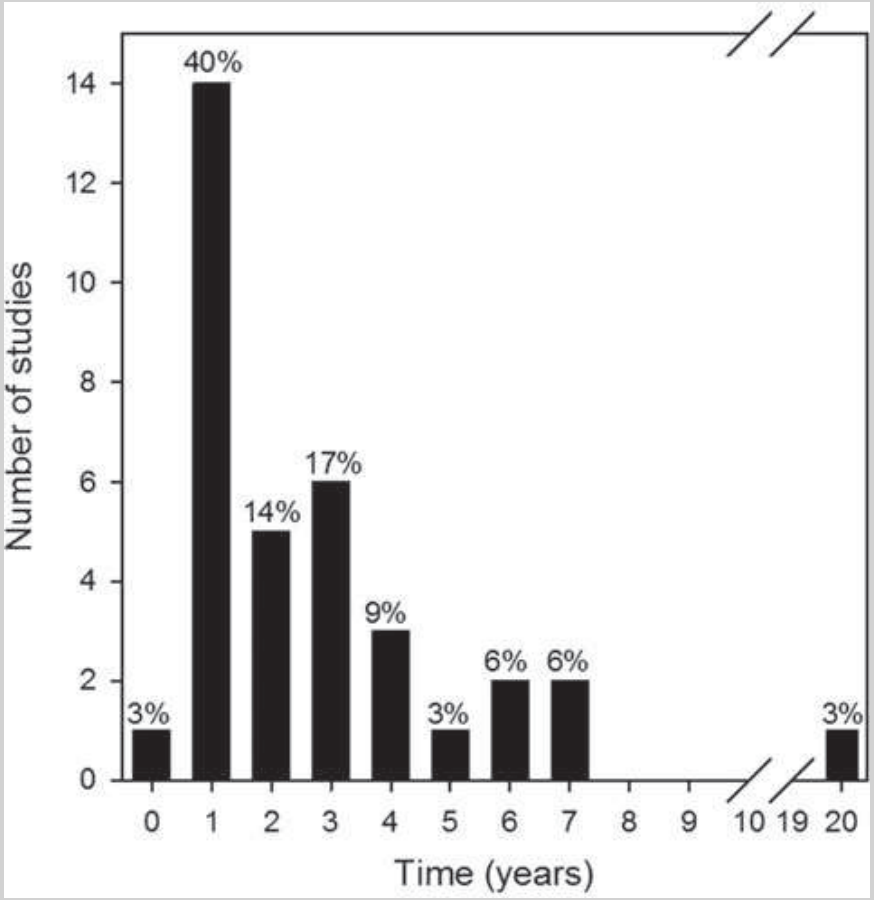
Thomas J. Mozdzer[1]*, Jacques Brisson[2] and Eric L. G. Hazelton[3,4]

Review methods



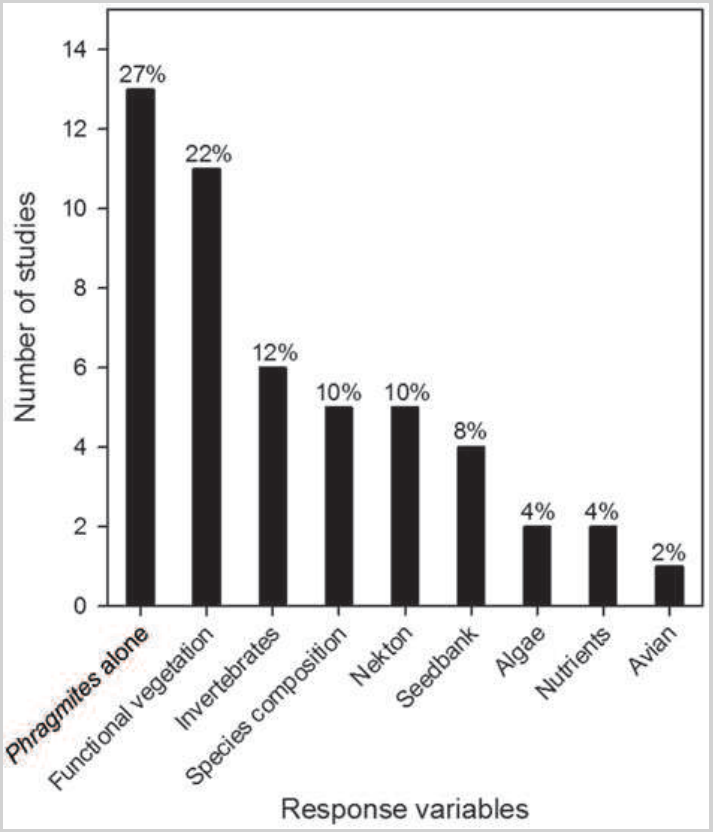
- Comprehensive review of Phragmites management in US
- 1960-2013
- Google Scholar and ISI Web of Science
- Keywords: “Phragmites management” and “Phragmites control”
- 41 Articles included

Duration of studies



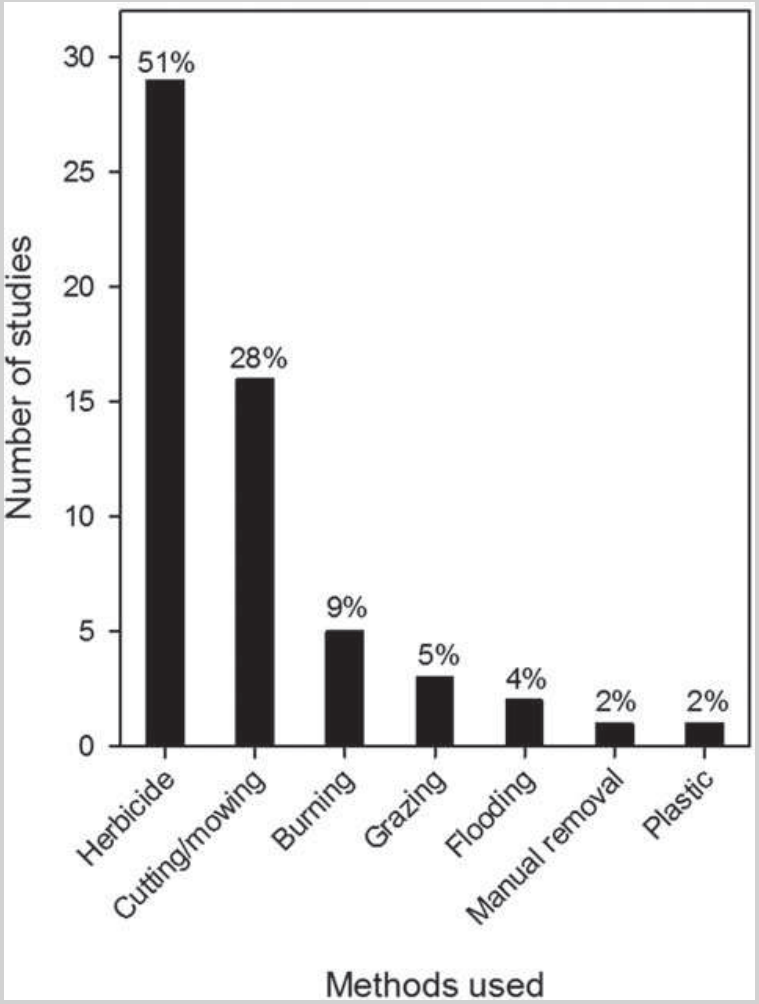
- More than 5 years: 5/41
- Majority only report ≤3 years of data post treatment.

Variables recorded

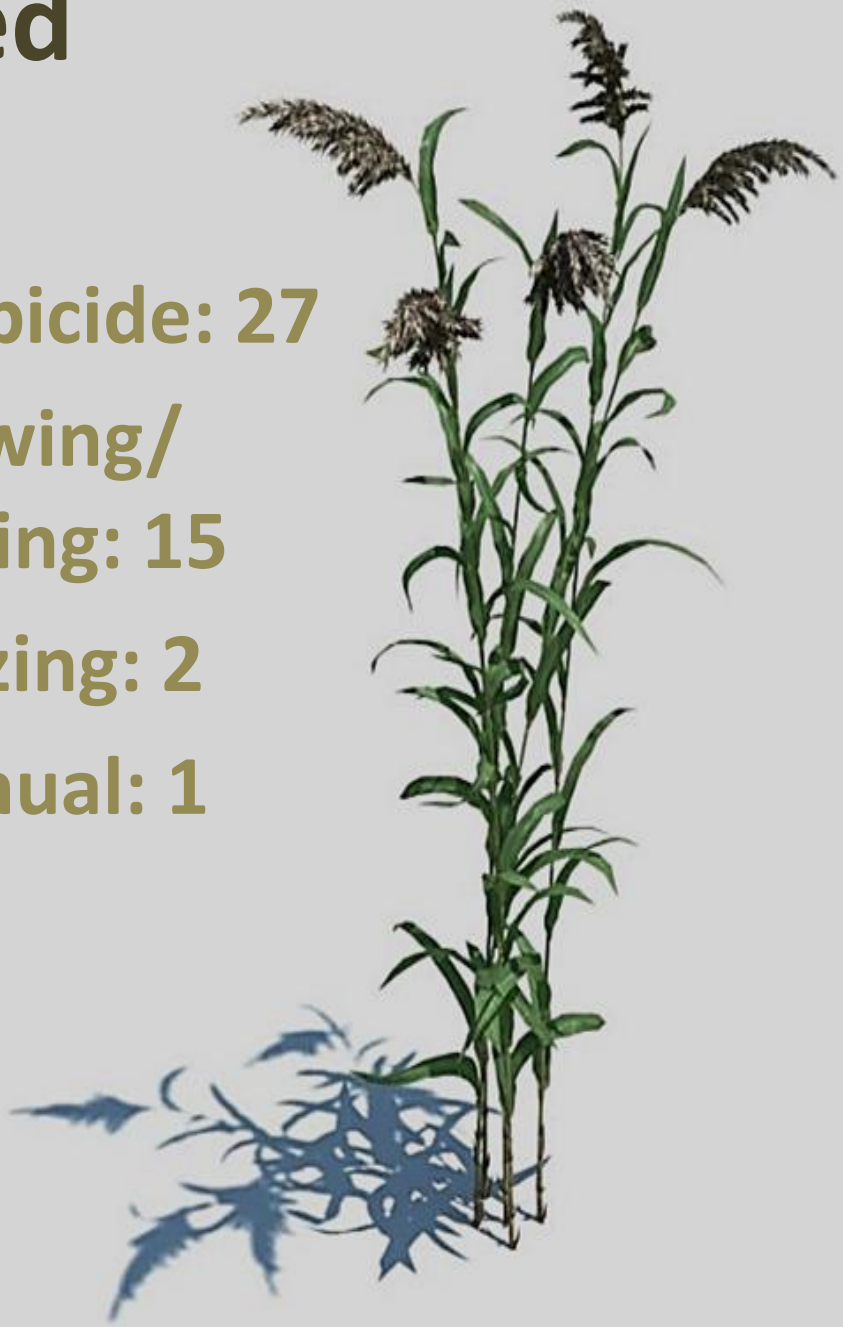


- *Phragmites* alone or functional vegetation: 21/41
- Species composition: 5/41
- Seedbank: 4/41
- Community statistics: 0/41

Methods tested



- Herbicide: 27
- Mowing/ cutting: 15
- Grazing: 2
- Manual: 1



Mechanical Methods

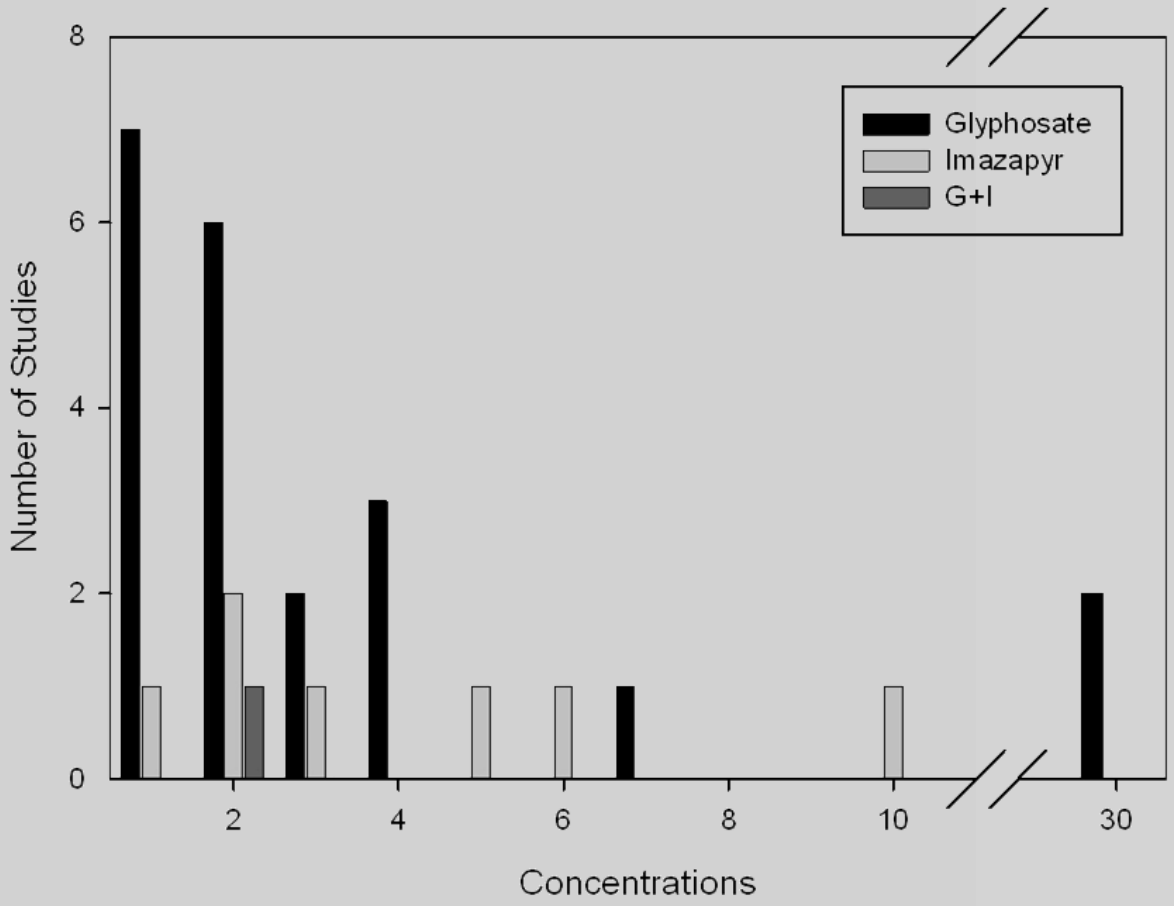
- Mowing most prevalent
- Often used in combination with herbicides
- Need to open canopy to stimulate recruitment
- Can act as a disturbance!

Biological Methods

Photo: A. Baldwin

- Grazing
  - Silliman *et al.* PeerJ
- "Traditional" biocontrols
- Planting diverse functional types!!
  - Makes site resistant to reinvasion (Byun *et al.*)

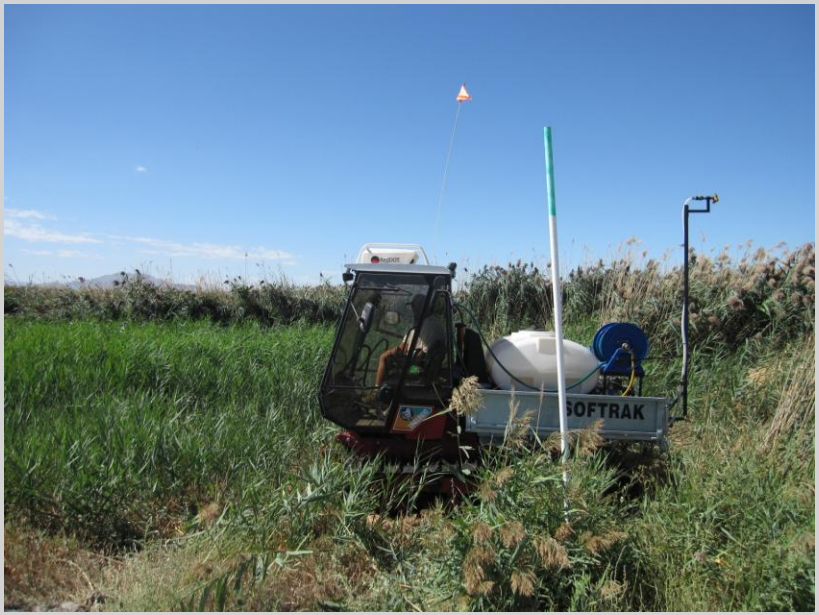
Herbicides tested

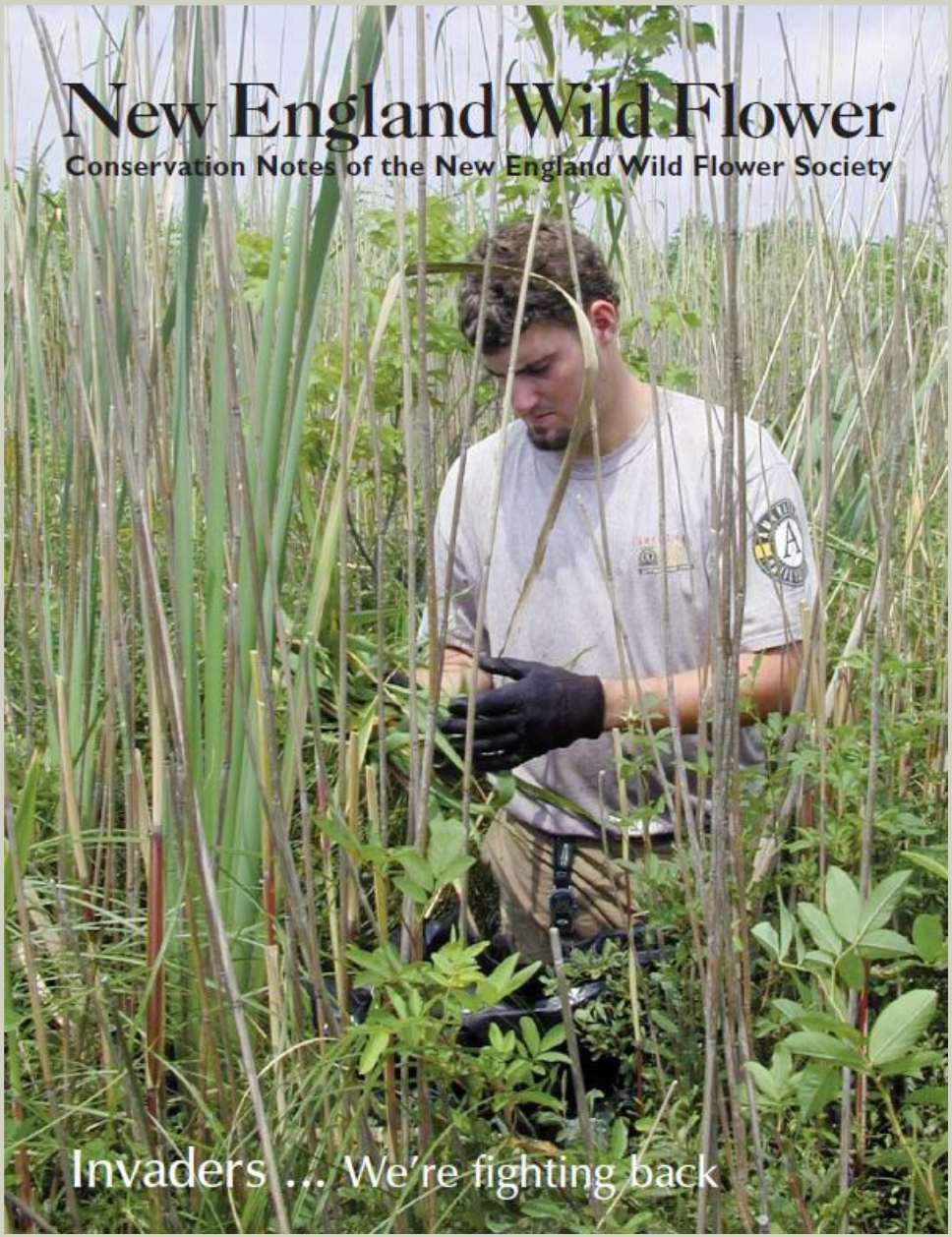


- Low concentrations effective
- Only 1 study compared combo
- Two studies went “off-label”

Herbicide Methods

- Most methods fairly successful
- Management typically 3 years to in perpetuity.
- Several studies report that mowing/grazing/burning is required for vegetation recovery





Summary Part 1

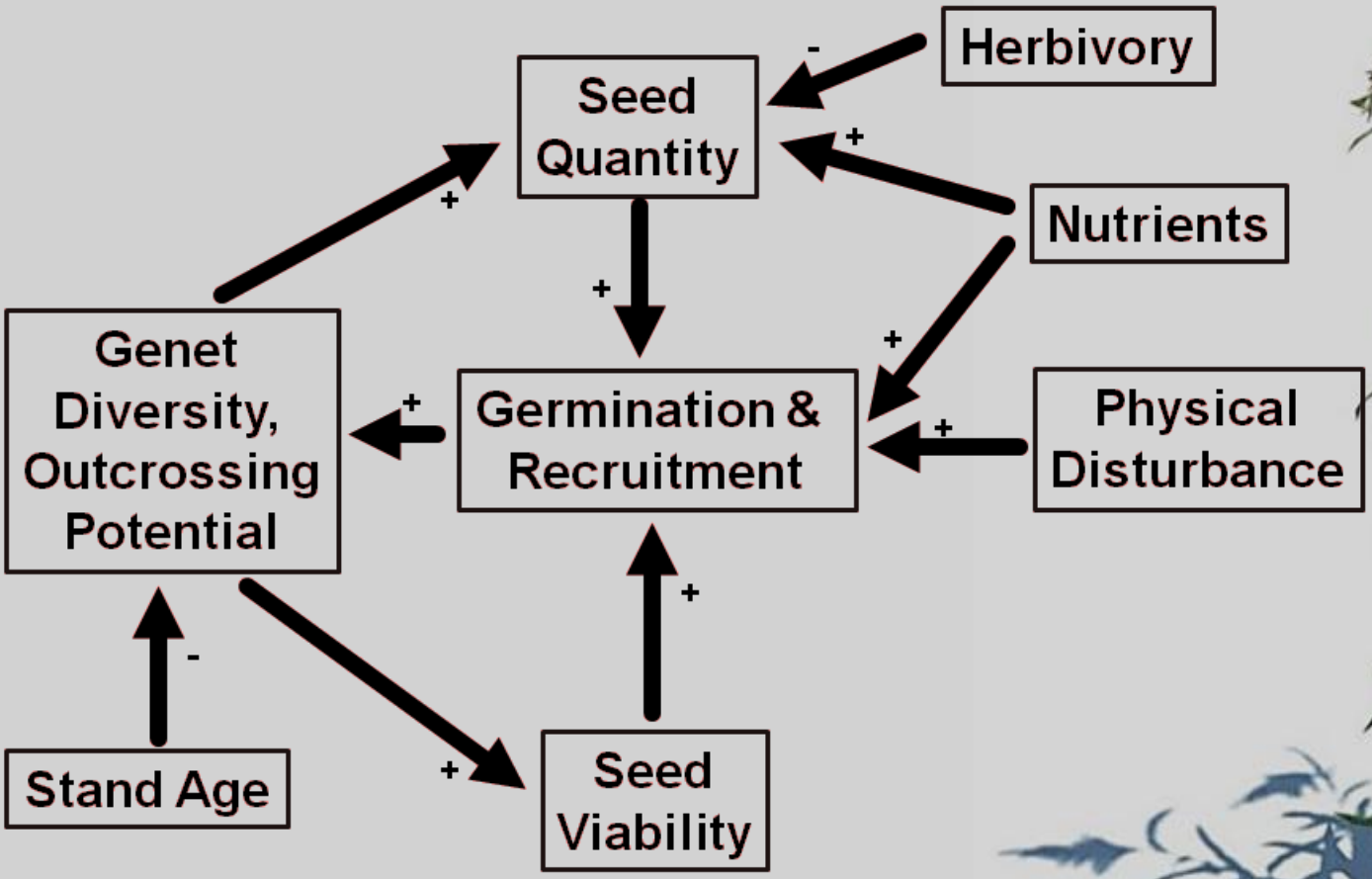
- Too much emphasis on herbicide
- Emphasis on herbicide reflected in surveys
  - Martin and Blossey
  - Kettenring *et al.*
- Studies are too short of duration
  - reinvasion
  - lag times
- Only measuring species of interest
- Variables recorded reflect bias toward habitat for fish and game
- Nearly zero knowledge on community recovery
- Need to incorporate reference areas

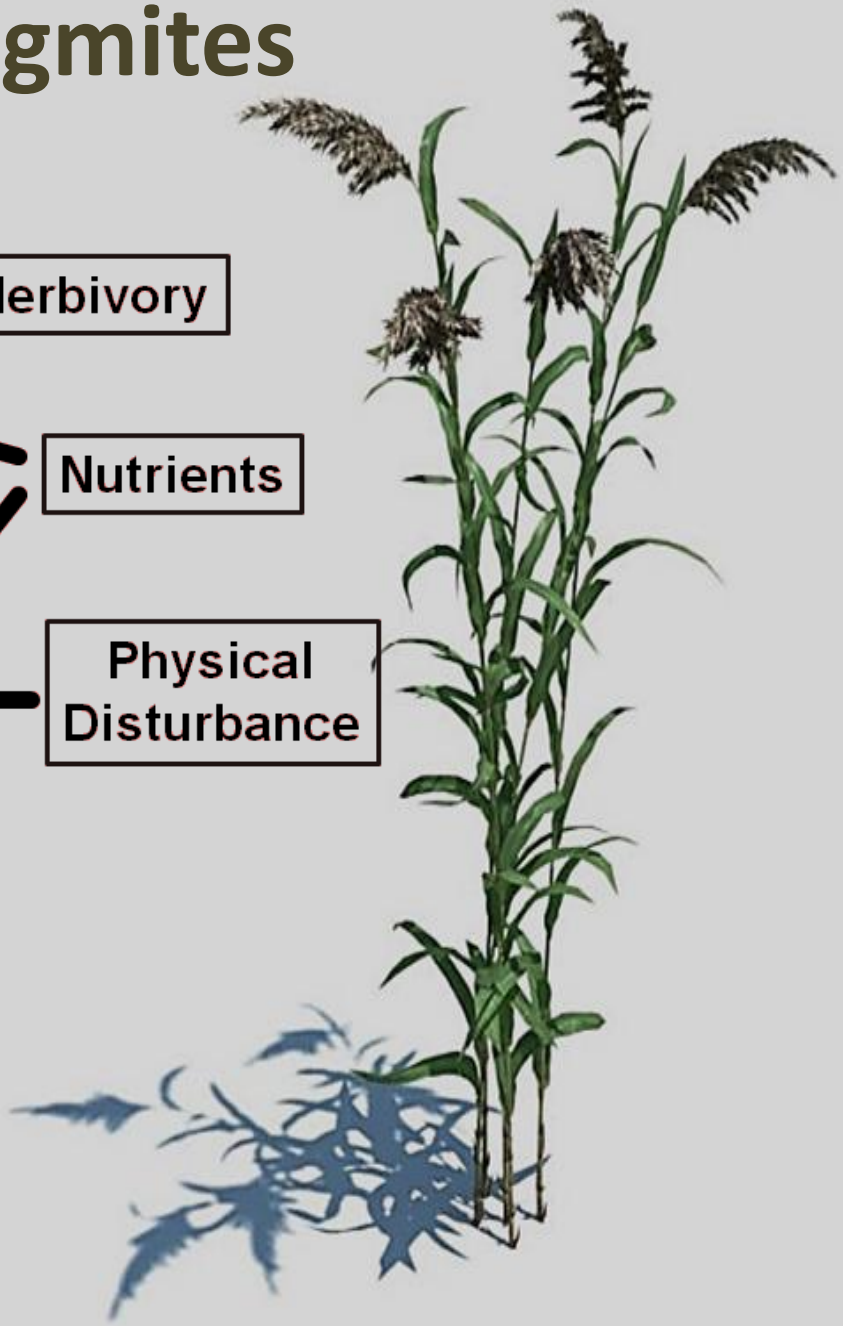
Part 1. Review of Phragmites management in the US

Part 2. How might land use impact management outcomes

Part 3. Some insights into simplified monitoring

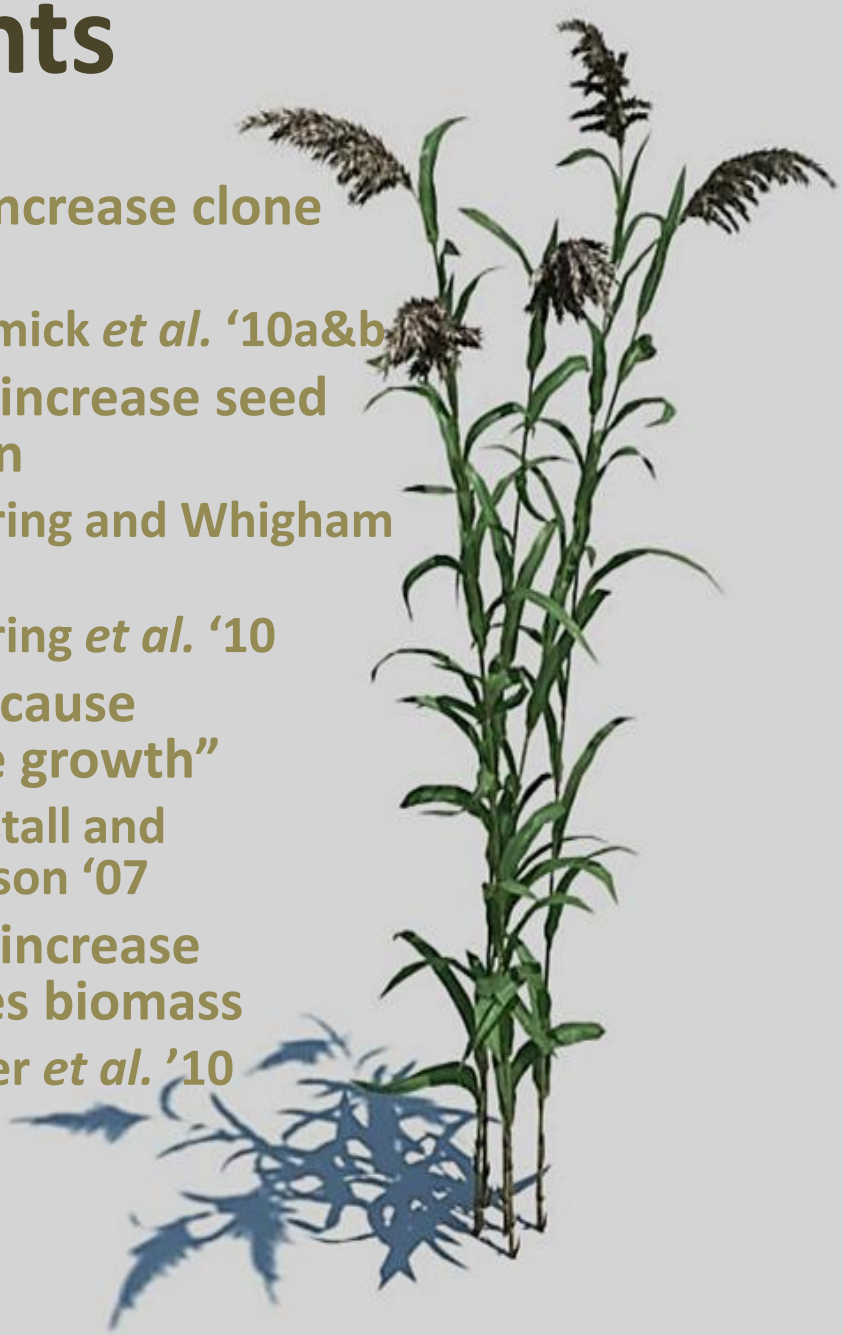
Components of Phragmites Invasion



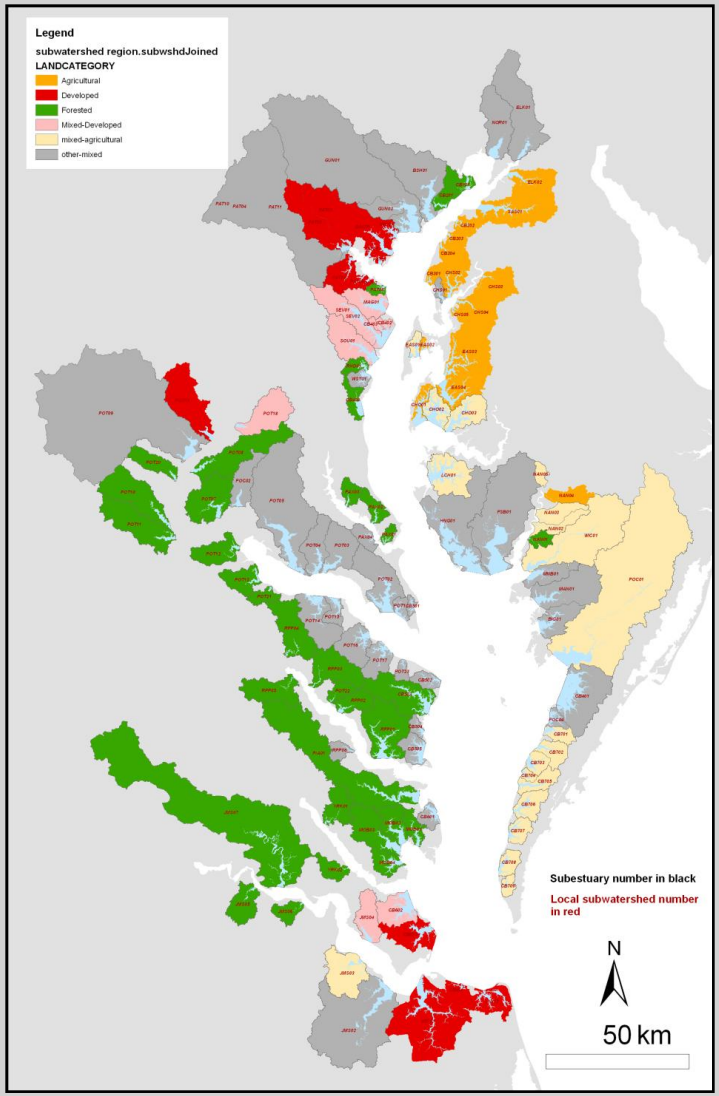


Nutrients

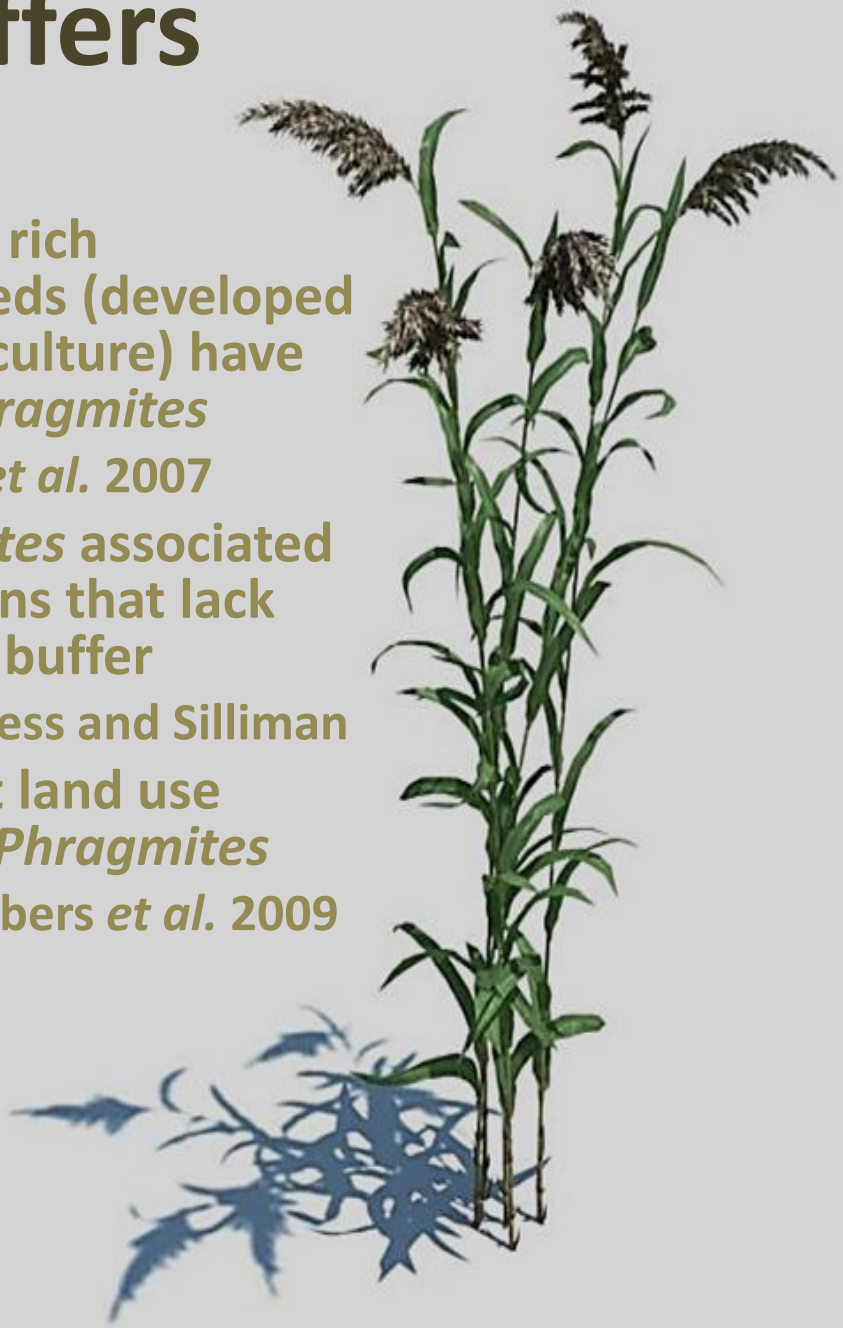
- Nutrient increase clone number
  - McCormick *et al.* ‘10a&b
- Nutrients increase seed production
  - Kettenring and Whigham ‘09
  - Kettenring *et al.* ‘10
- Nutrients cause “explosive growth”
  - Saltonstall and Stevenson ‘07
- Nutrients increase Phragmites biomass
  - Mozdzer *et al.* ’10



Land Use and Buffers



- Nutrient rich watersheds (developed and agriculture) have more *Phragmites*
  - King *et al.* 2007
- *Phragmites* associated with lawns that lack forested buffer
  - Bertness and Silliman
- Adjacent land use impacts *Phragmites*
  - Chambers *et al.* 2009

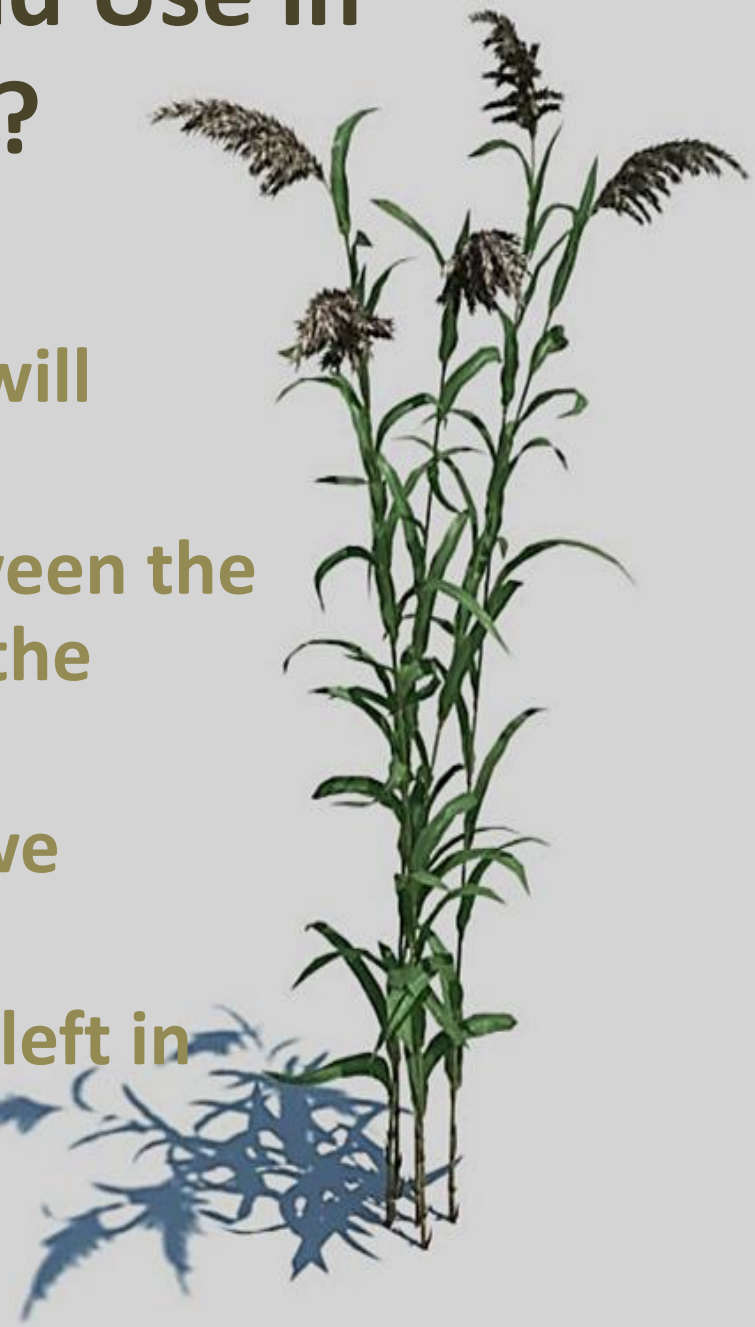


Disturbance

- Wrack
- Construction
- Seeds
- Rhizomes

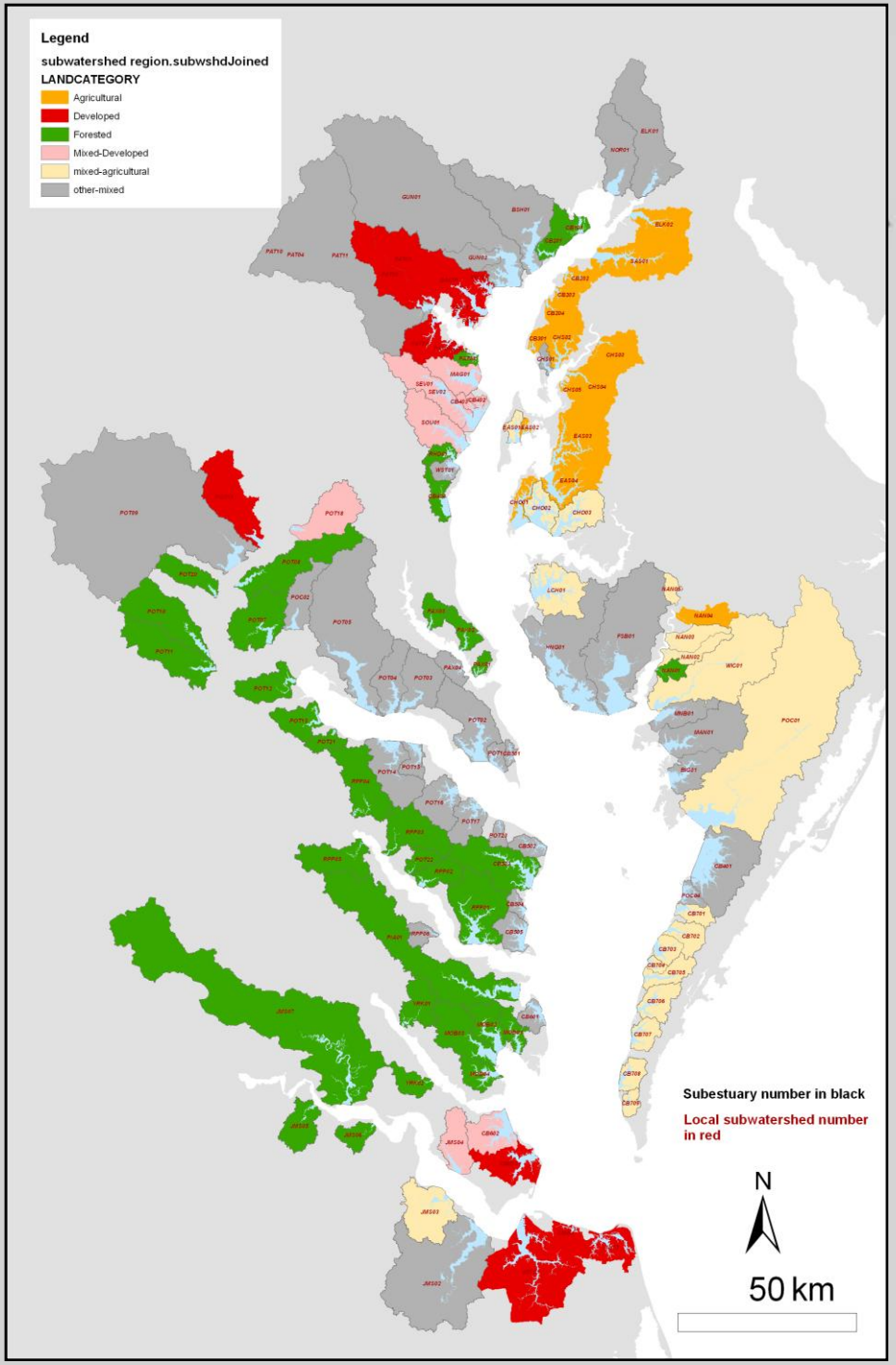
Can We Consider Land Use in Management?

- *Phragmites* is only a symptom.
- We do not know how land use will impact restoration outcomes.
- How do we bridge the gap between the science of invasive species and the management?
- Need to prioritize which areas we manage.
- Some areas are likely better off left in the alternative (invaded) state.



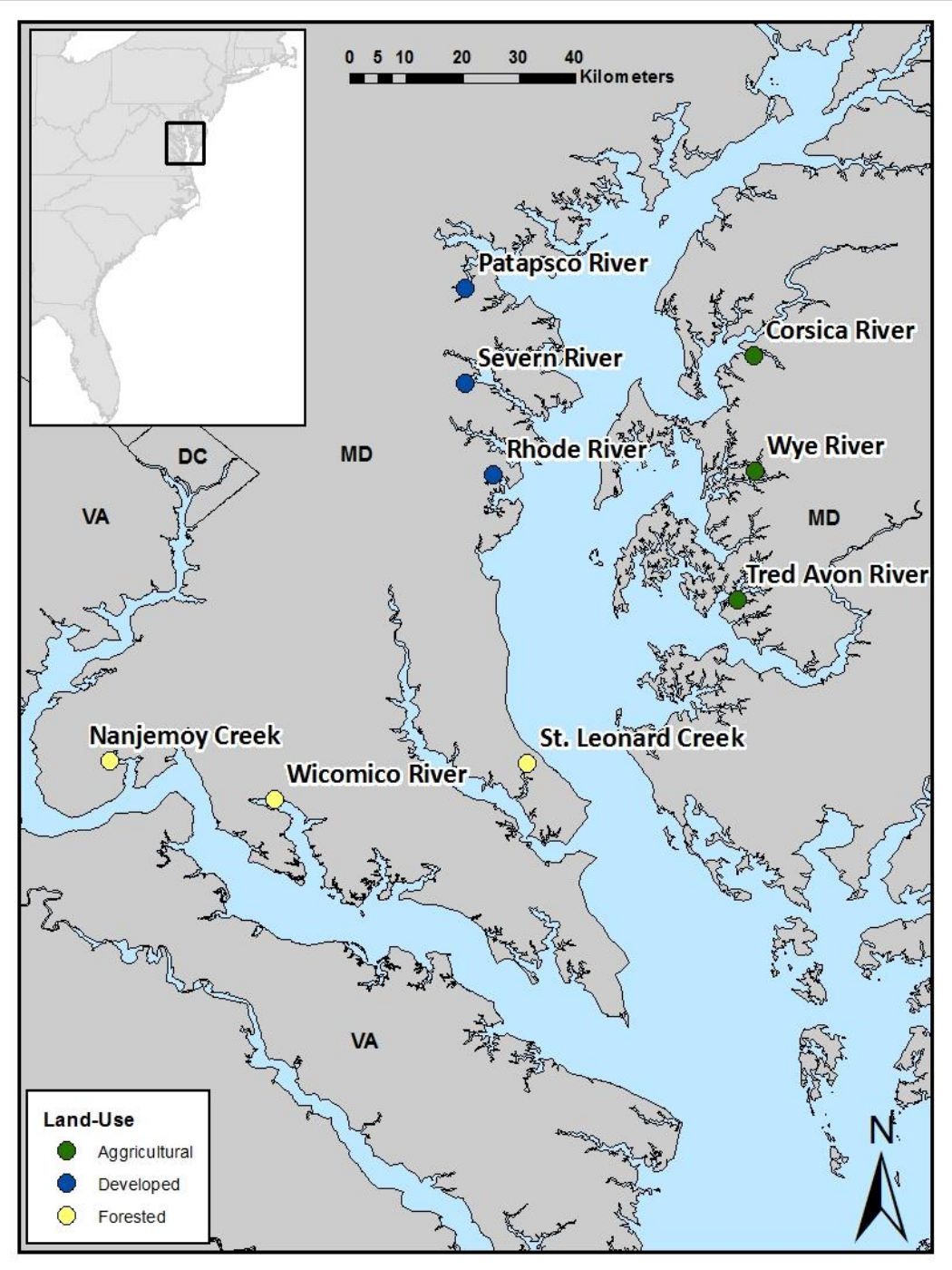
What are we doing?

- Large-scale removal experiment
- Looking at how land-use impacts recovery from *Phragmites* invasion
- 9 marshes
  - 3 agricultural
  - 3 developed
  - 3 forested
- 3 treatments
  - *Phragmites* removed
  - *Phragmites* intact (control)
  - Native vegetation (reference)



Methods

- Glyphosate Spraying
  - Helicopter sprayed Oct ‘11
  - Hand sprayed Oct ‘12-’13
- Measuring
  - Plant community
  - Seedbank
  - Nutrients
  - Reproductive output
  - Germination rates
  - Herbivory
  - Clonal richness

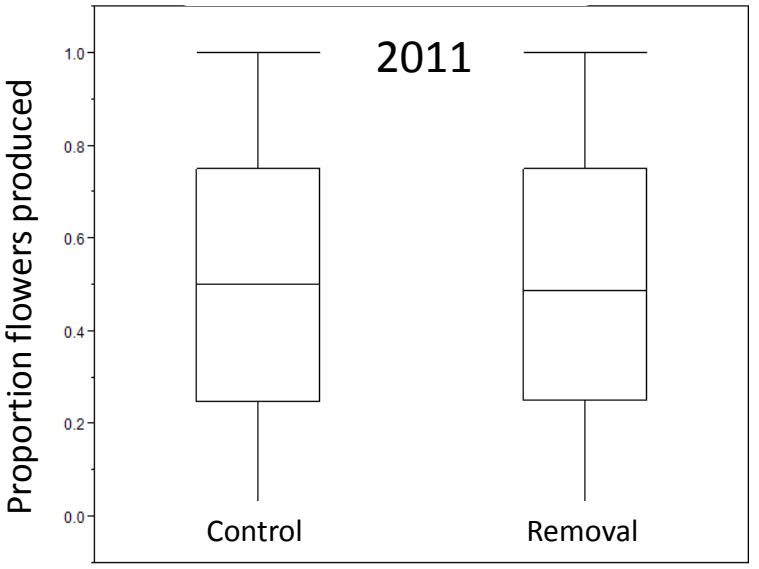


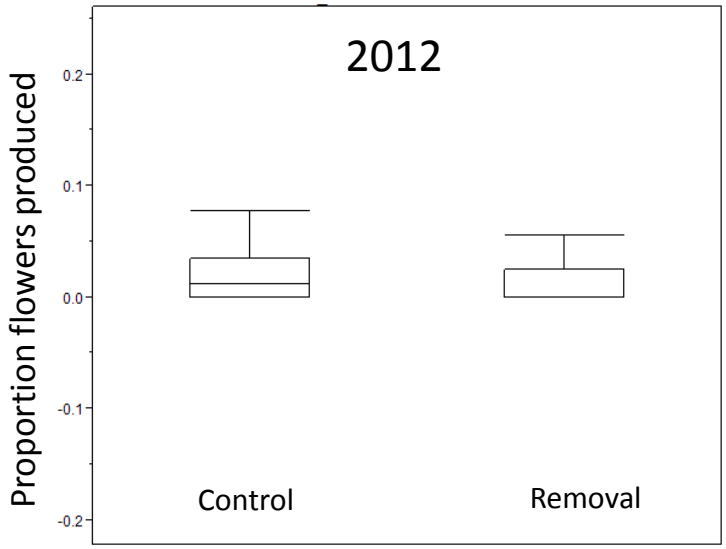
Phragmites Vigor

Flowering

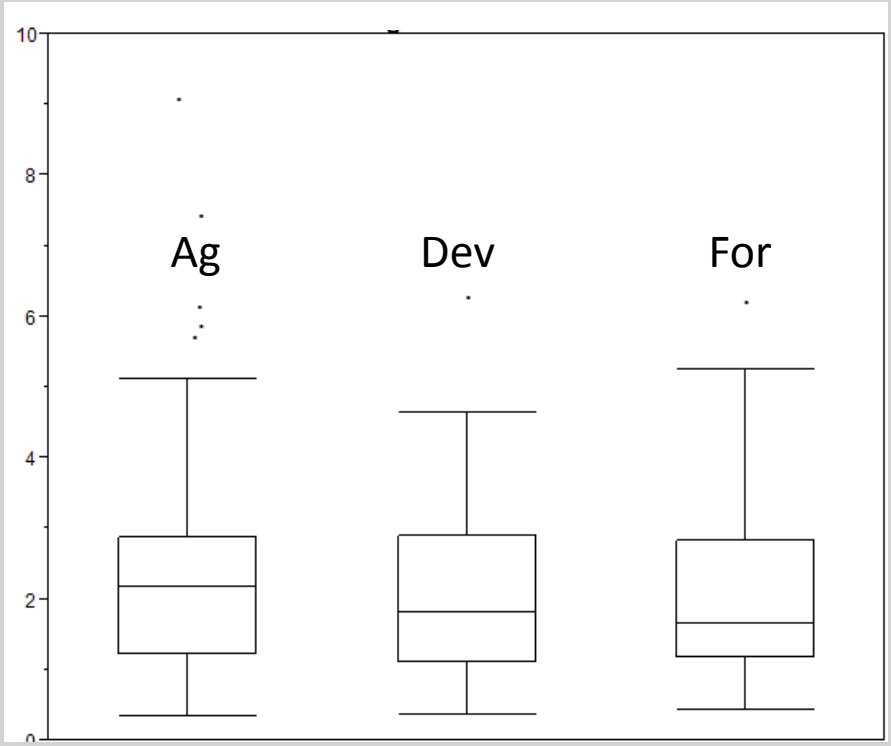
Flowering rates of non-attacked stems differed pre-treatment by land-use type but not post-treatment.

2011 Factor	F	P
Treatment	0.4	0.5
Land-use	5.9	0.04
Treatment * Land-use	4.6	0.01
2012 Factor		
Treatment	2.8	0.1
Land-use	1.5	0.3
Treatment * Land-use	0.03	1.0

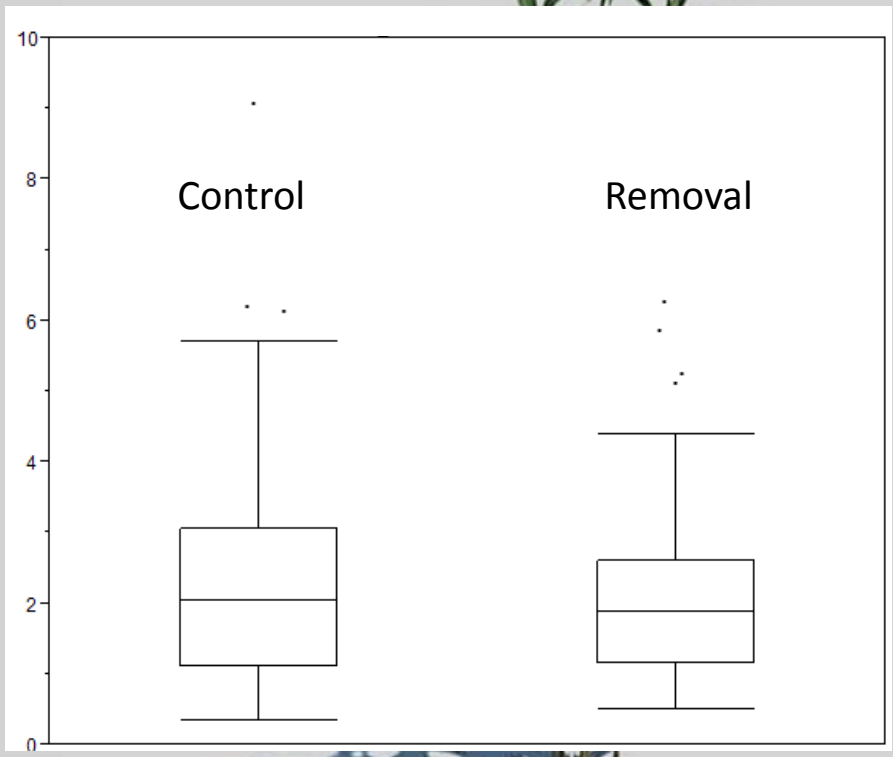




Inflorescence Size

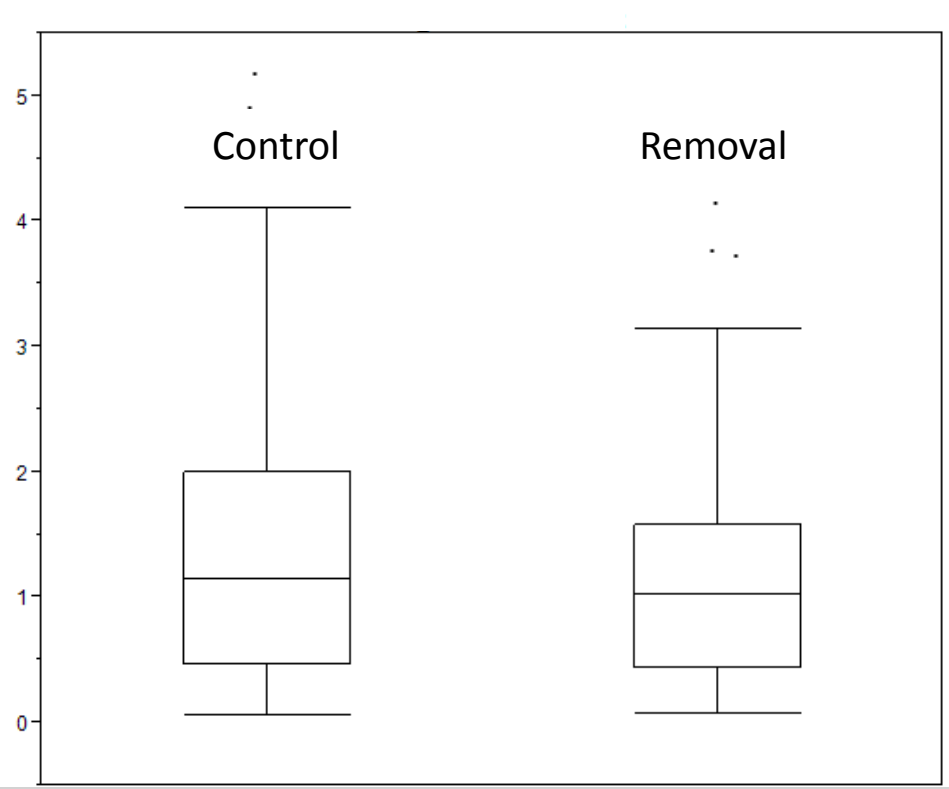


Factor	F	P
Treatment	3.1	0.08
Land-use	0.2	0.8
Land-use * Treatment	0.9	0.4

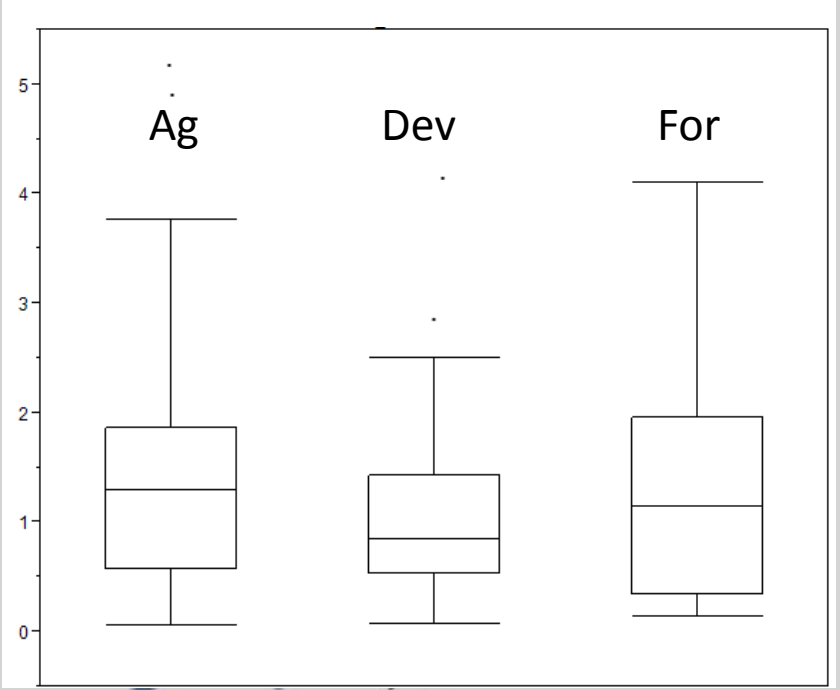


Inflorescences are larger in control treatment than in sprayed plots

Floret Production



Factor	F	P
Treatment	4.0	0.05
Land-use	0.2	0.8
Land-use * Treatment	0.5	0.6

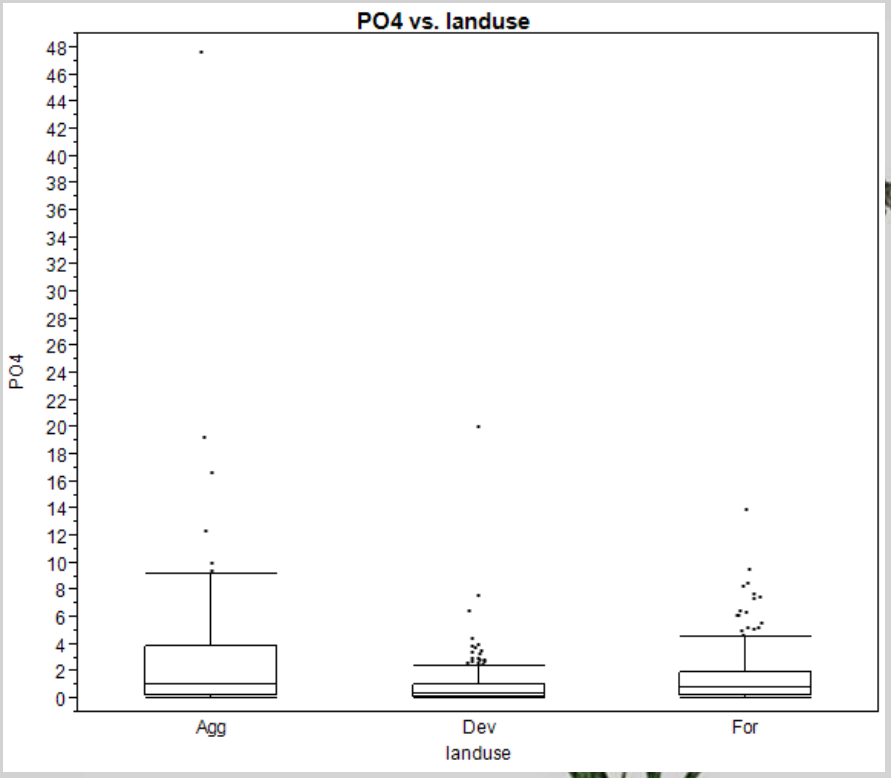


Plants in control plots produced more florets than sprayed plants

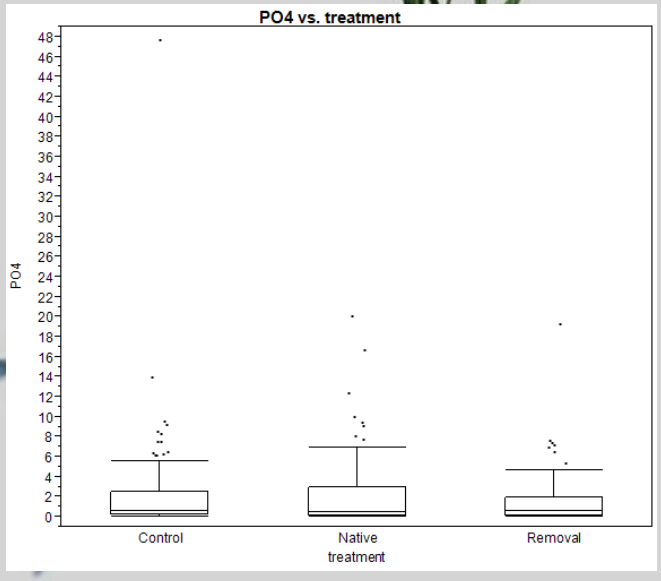
Nutrients

Nutrient Resin PO_4

PO_4 varies by land use, but not vegetation. This is likely the result of improve wastewater practices in developed regions.

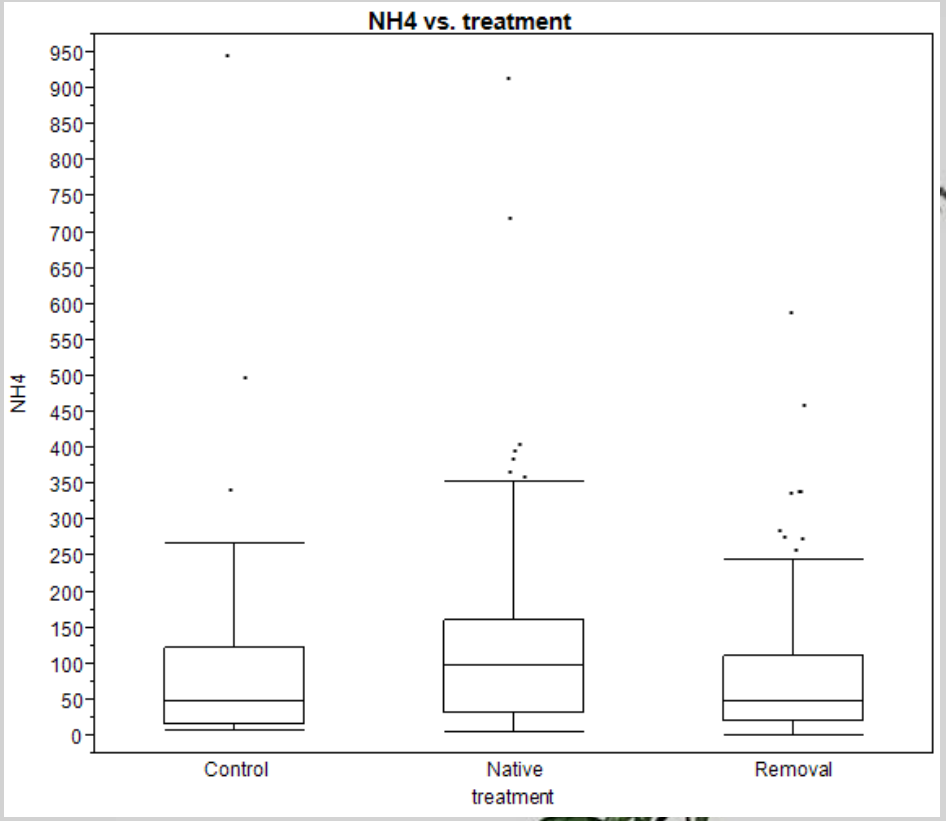


Factor 2011	F	P
Treatment	1.3	0.26
Land-use	4.0	0.004
Land-use * Treatment	6.2	0.03
Factor 2012		
Treatment	1.3	0.29
Land-use	3.3	0.12
Land-use * Treatment	2.0	0.09

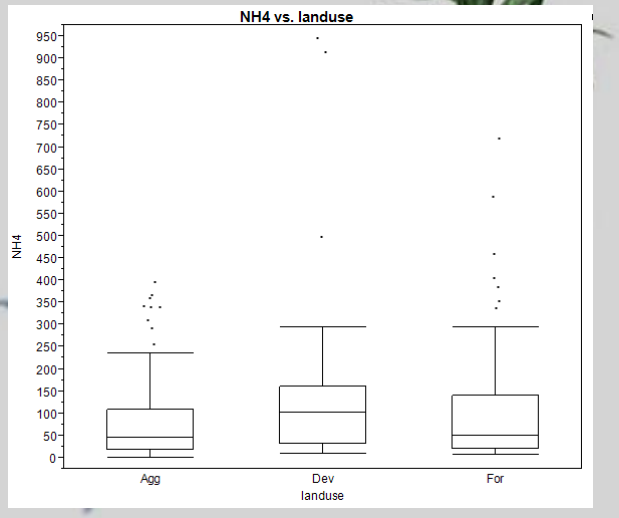


Nutrient Resin NH_4

NH_4 varies by landuse and by vegetation. There is less ammonium under *Phragmites* than native vegetation. There is higher ammonium in developed watersheds.

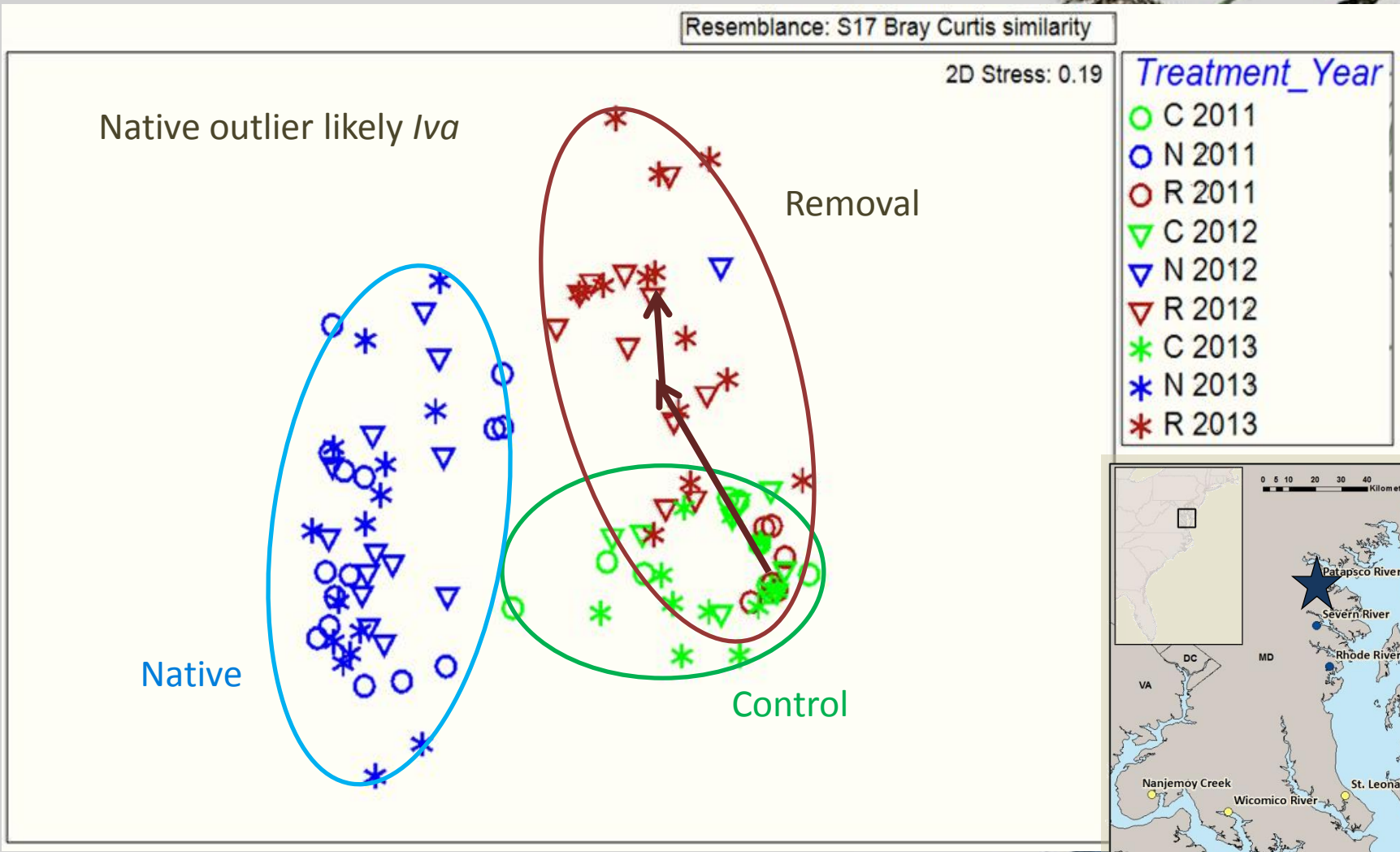


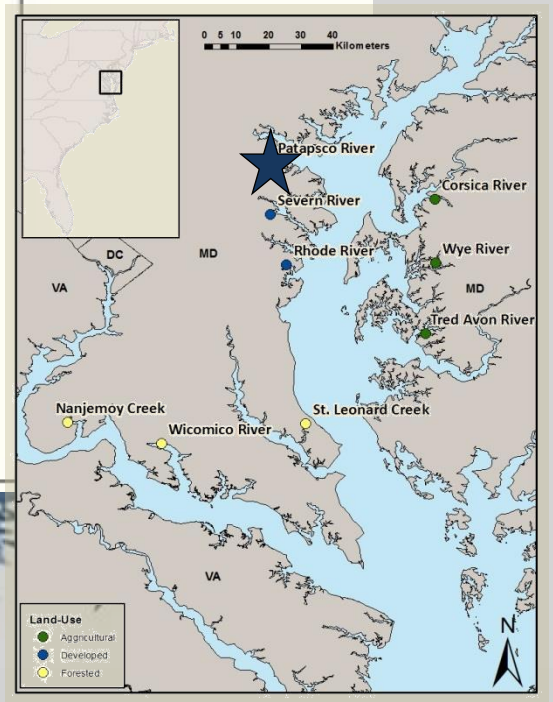
Factor 2011	F	P
Treatment	5.7	0.004
Land-use	6.4	0.03
Land-use * Treatment	4.0	0.004
Factor 2012		
Treatment	3.7	0.03
Land-use	0.1	0.9
Land-use * Treatment	1.5	0.2



Plant Community Recovery

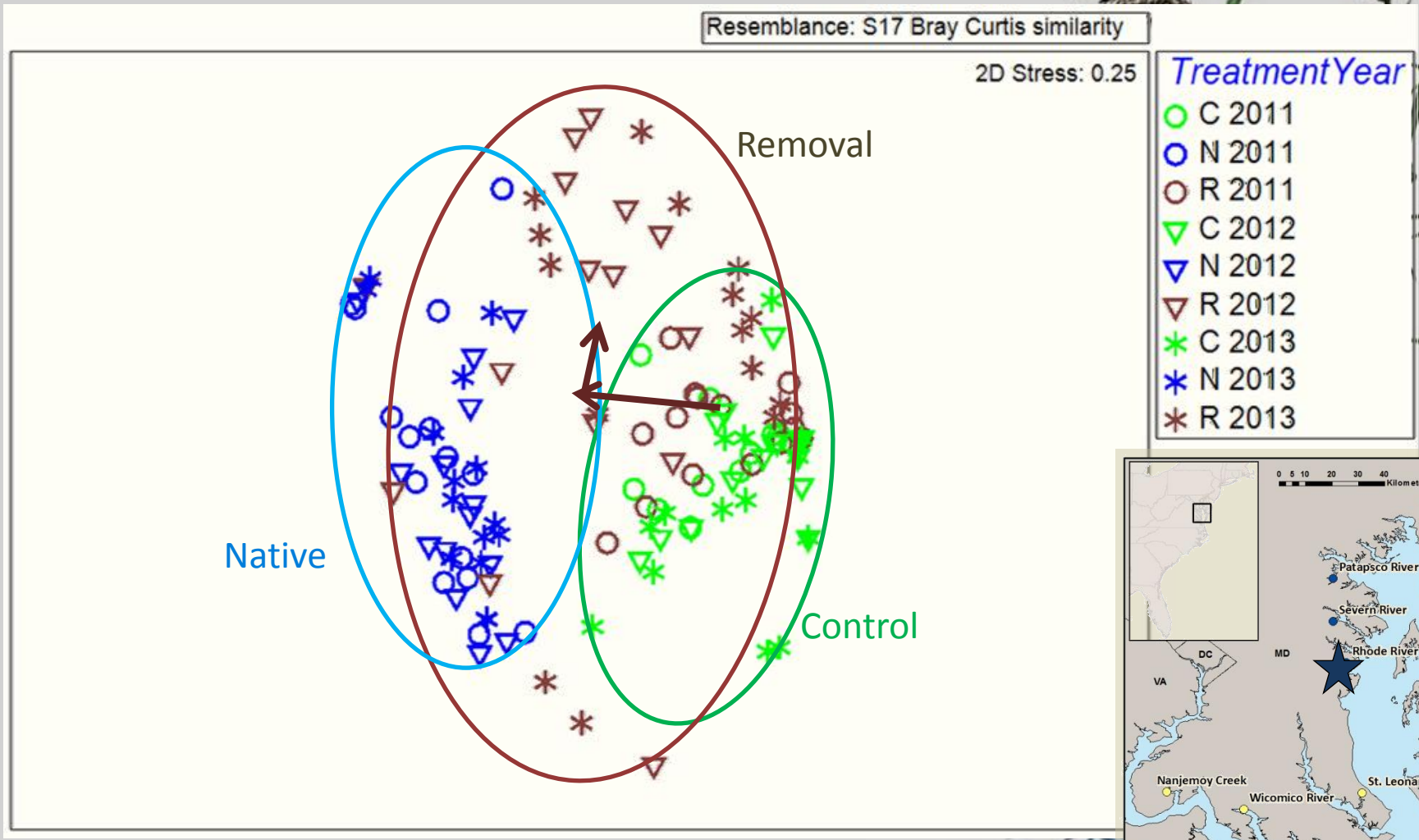
Patapsco River (Developed)

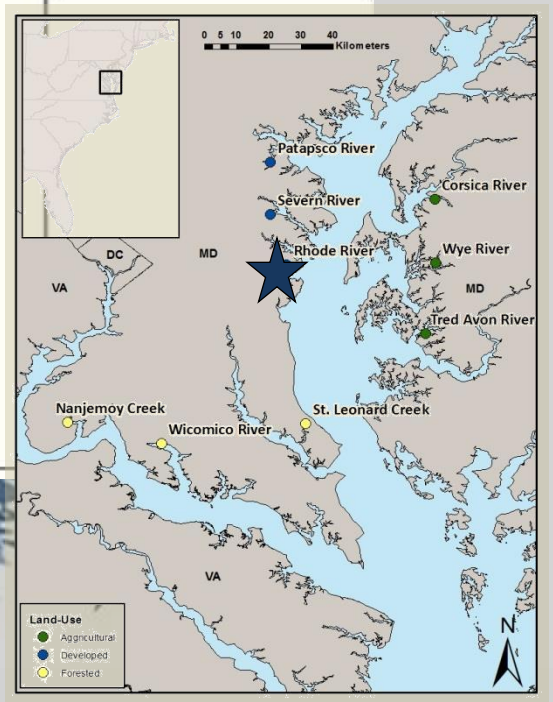




Vegetation is not returning to the uninvaded communities. Transition to a "novel state"

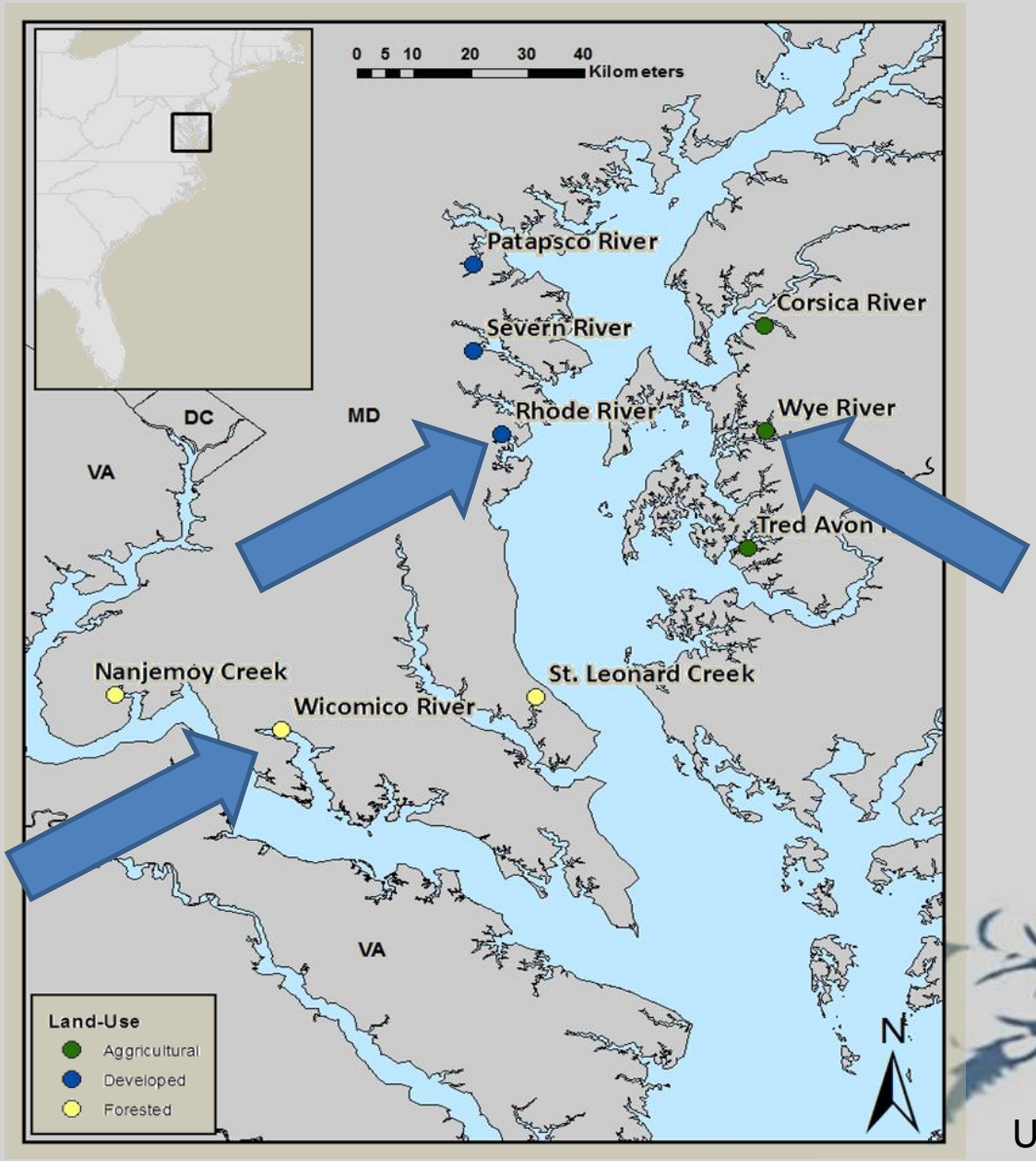
Rhode River (Mixed-Developed)





Vegetation is transitioning to the uninvaded communities.

Sites with vegetation Overlap



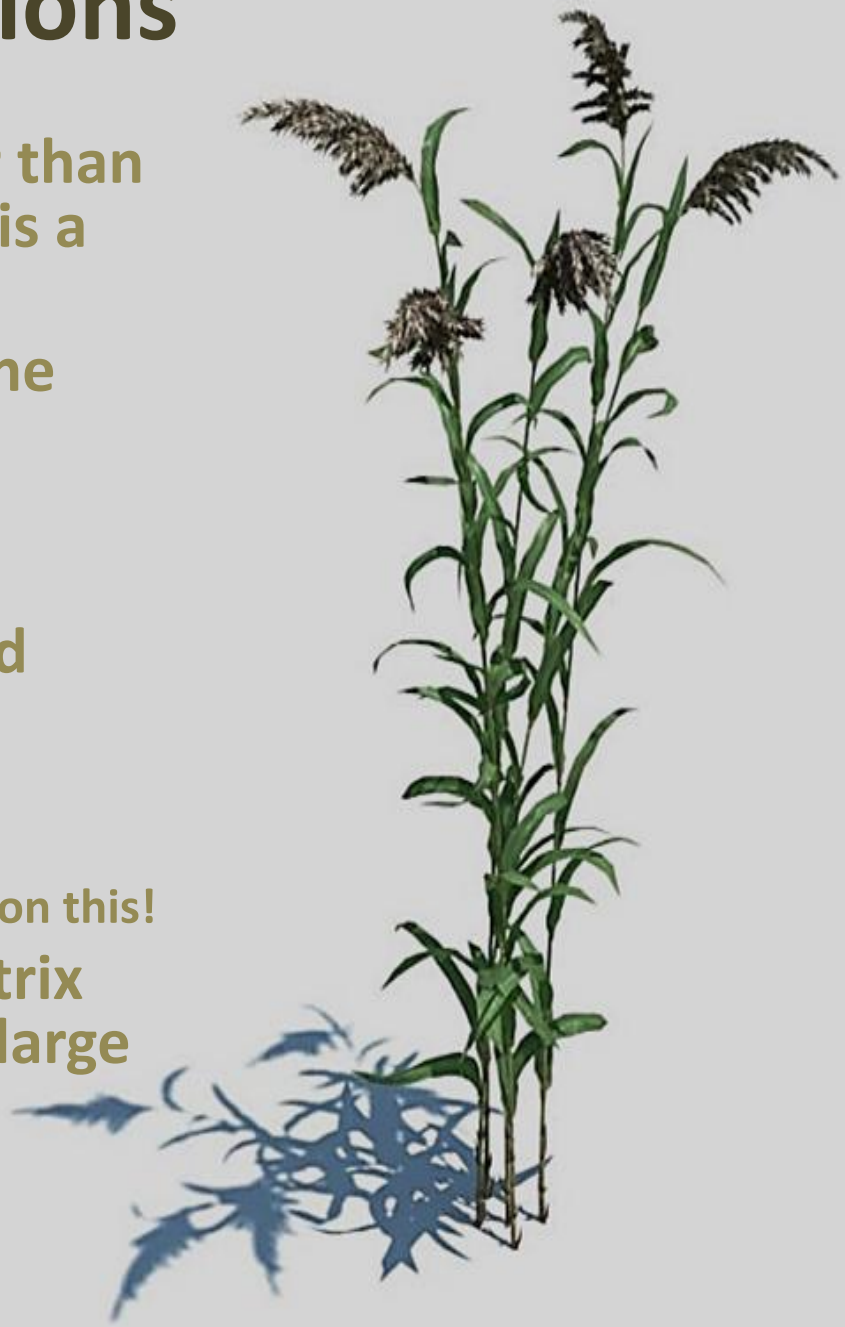
UC Davis Soilweb

Developed Sites

Sights with more intact native vegetation recover better after management

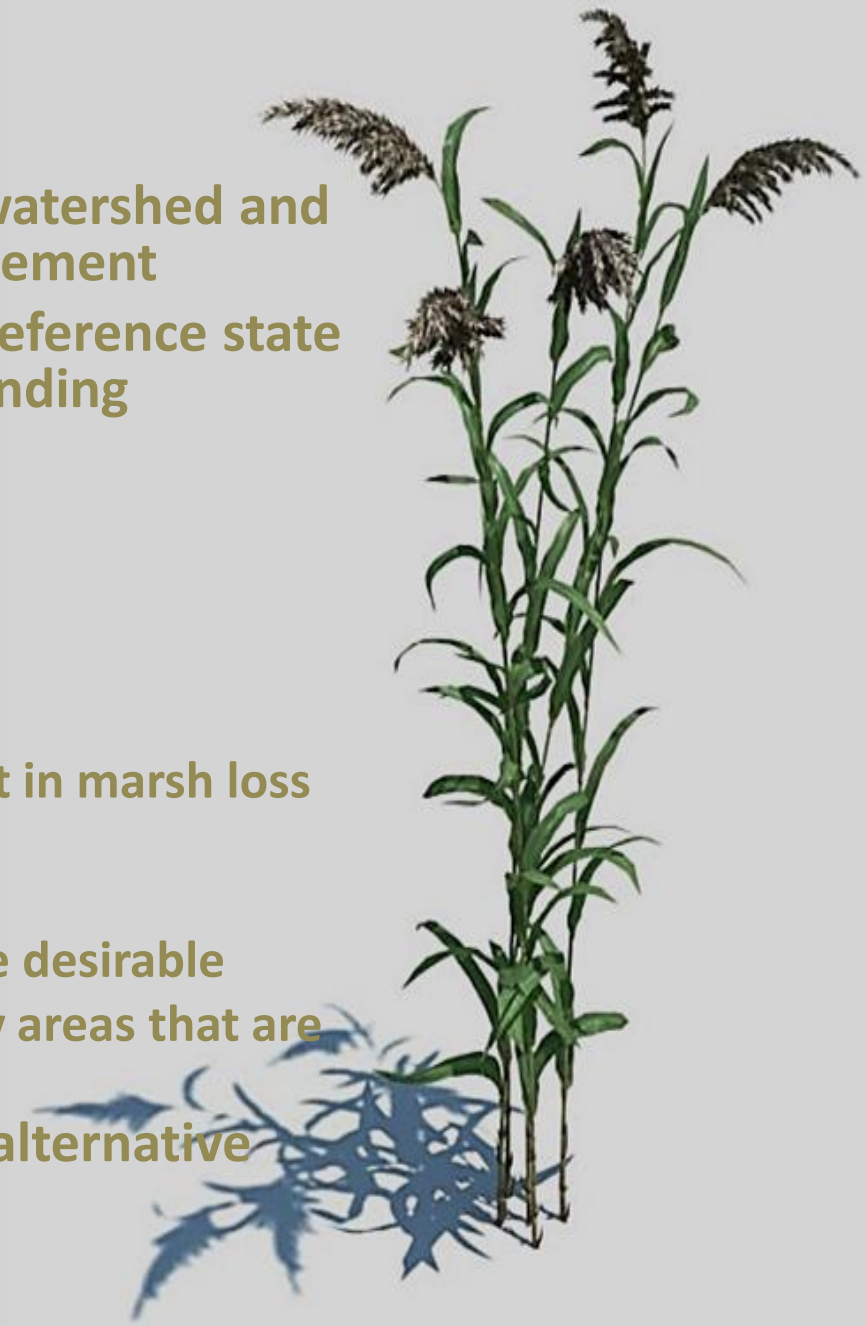
Management Implications

- Perennial plants may colonize later than annuals, but initially management is a disturbance
- Substrate is likely to impact outcome
  - Breakdown of peat (phrag rhizomes)
  - Sandy sites may recover better
- Fetch may help in clearing canopy.
- Consider potential for total wetland acre loss in some sites
  - Phrag → Pontederia!
  - Subsidence
  - We hope to draw further conclusions on this!
- Sites with native peat/rhizome matrix should retain integrity better than large monocultures.
  - Higher quality sites



Summary Part 2

- Nutrient and disturbance control (watershed and landscape scale) will benefit management
- Working Hypothesis: Transition to reference state requires intact native marsh surrounding Phragmites
- Two more years of data pending
- Site selection is likely critical
  - Early Detection, Rapid Response
  - Restore higher quality sites
  - Haphazard management may result in marsh loss (substrate breakdown)
  - Ecosystem services of invader
  - Management outcomes may not be desirable
  - Allocate resources to higher quality areas that are more likely to recover
- Some watersheds should be left in alternative stable state



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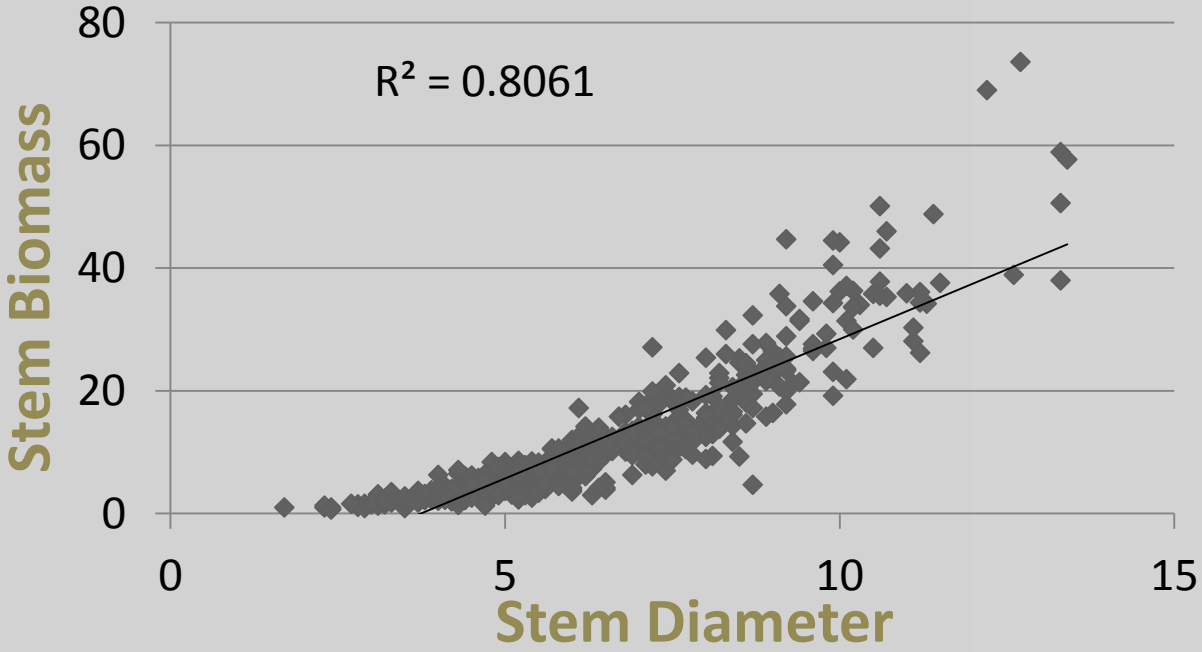
Part 3. Some insights into simplified monitoring

Simplified Monitoring Technique

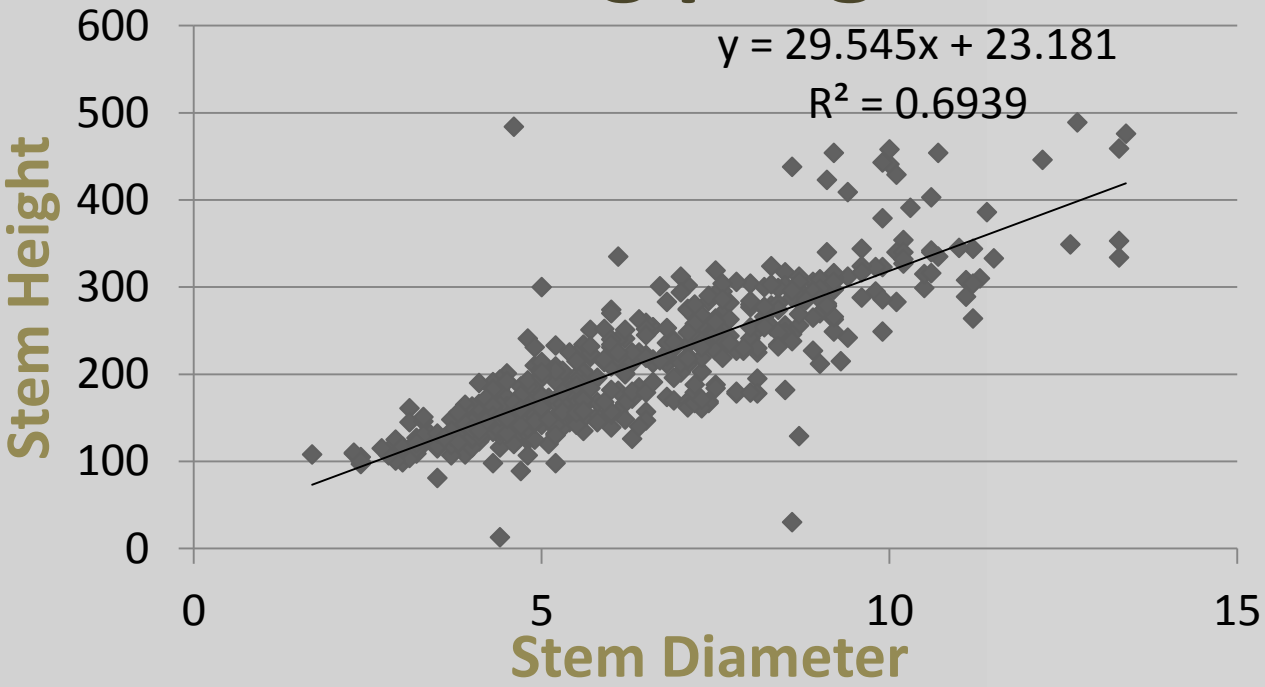
- Goal: rapidly determine plant health in response to management
- Grasses do not have “secondary thickening”
  - Basal diameter can predict biomass potential
- Insect damage changes stems
  - *Lipara* flies stunt stems
    - Attack rates up 90%
    - Abort inflorescences
  - *Giraudiela* Impact biomass production

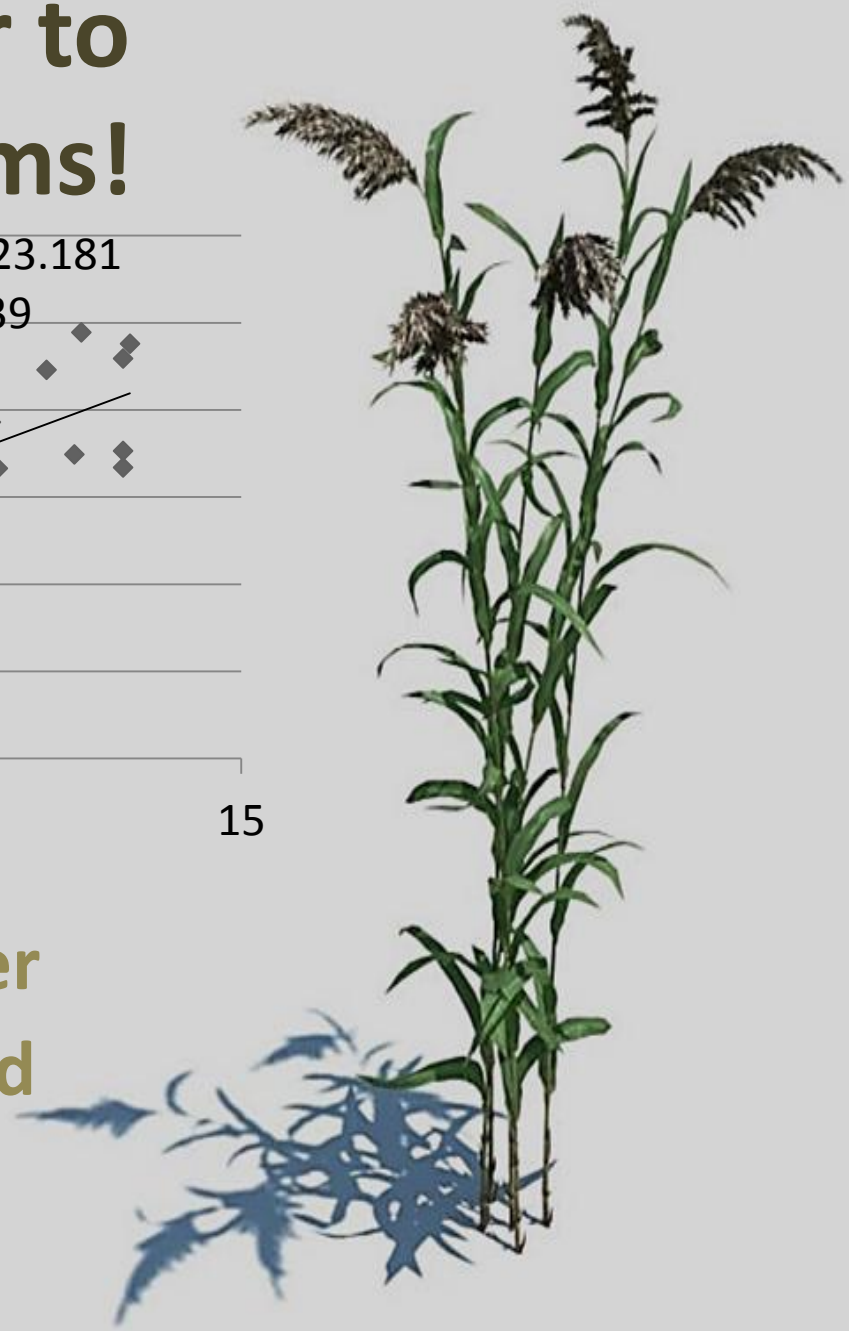
Simplified Monitoring Technique



- Stem Biomass vs Stem Diameter
- Only flowering stems included
- Preliminary data
- No attacked stems

Add stem diameter to monitoring programs!





- Stem Height vs Stem Diameter
- Only flowering stems included
- Preliminary data
- No attacked stems

Summary Part 3

- Add stem diameter to monitoring variables
- Faster and more accurate than height
  - Removes bias caused by herbivory
- Predictive of biomass
- Combine with stem counts (live) for broader estimates of management impacts

Conclusions 1

- Monitor
  - Use effective, sound science
  - Streamline methods for efficiency
  - Incorporate reference sites
  - Increase duration
  - I am not naïve, I know $$ is a problem
- Need more research on community response
  - Do wetlands recover to their native state?

Conclusions 2

- There is a knowledge gap in non-chemical *Phragmites* management
- Some watersheds should be left in alternative stable state
  - Ecosystem services of invader
  - Management outcomes may not be desirable
  - Allocate resources to higher quality areas that are more likely to recover

Questions?

Works Cited

- Hazelton, Eric LG, et al. "Phragmites australis management in the United States: 40 years of methods and outcomes." AoB plants 6 (2014): plu001.
- Mozdzer, Thomas J., Jacques Brisson, and Eric LG Hazelton. "Physiological ecology and functional traits of North American native and Eurasian introduced Phragmites australis lineages." AoB Plants 5 (2013): plt048.
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Q & A

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THANK YOU!

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