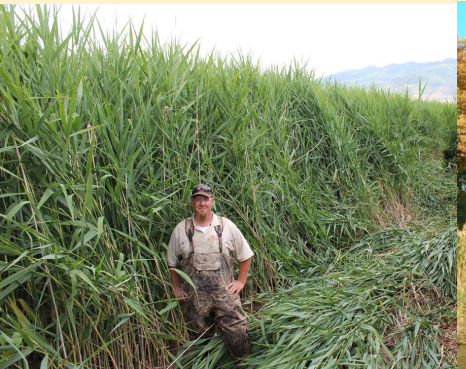
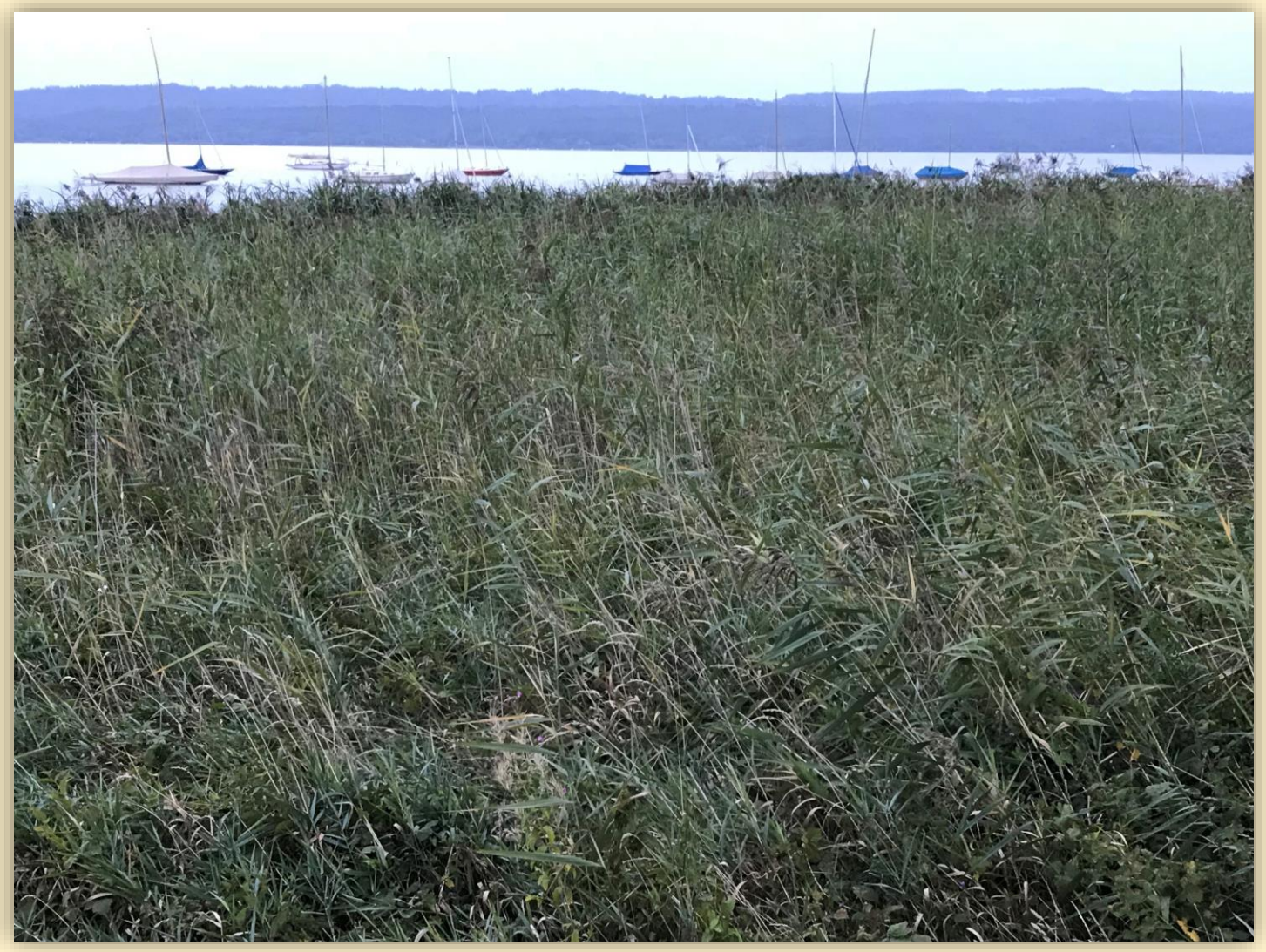
Phragmites ecology and management

Karin M. Kettenring

Collaborators: Christine Rohal, Chad Cranney, Keith Hambrecht



Why am I talking about *Phragmites*?



Why am I talking about *Phragmites*?


Image by Gary Crandall

Poor habitat for wildlife

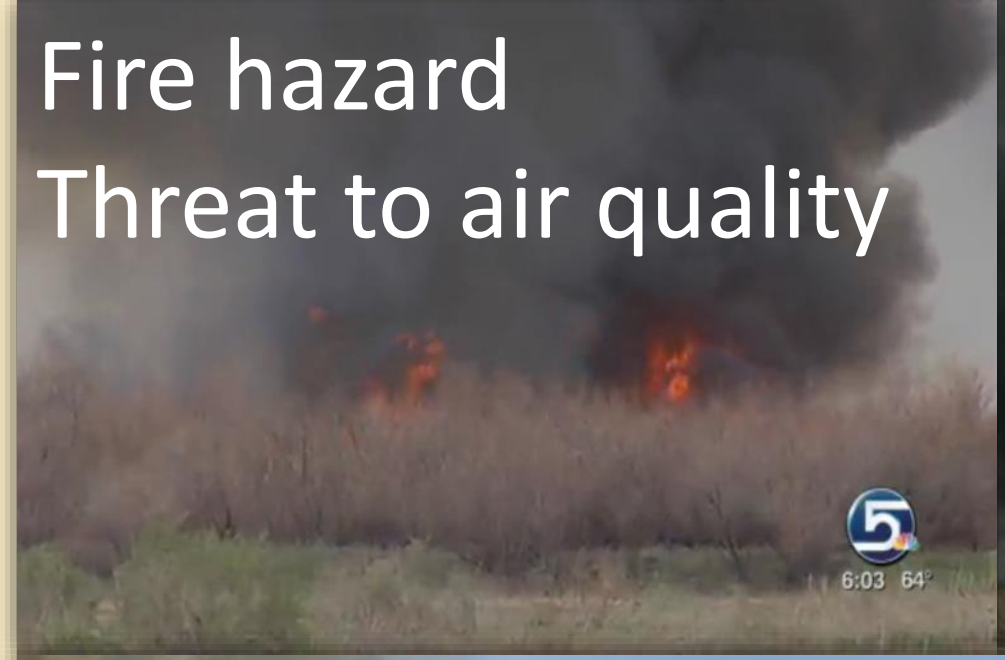
Crowds out other plant species

Impossible to move through

Poor food source for wildlife

Impedes recreation, views, site access

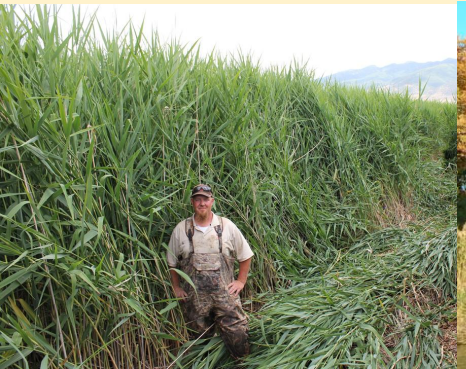
Fire hazard
Threat to air quality



Outline of talk

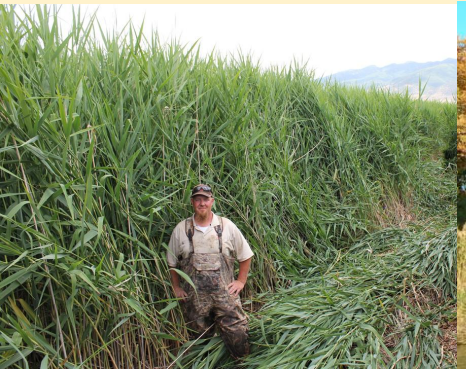
1. Key aspects of *Phragmites* ecology that affects management
2. Management options
3. Revegetation within invasive species management
4. Collective effort and landscape management

- *Building on our research in the Chesapeake Bay since 2006 and the Great Salt Lake since 2008*
- *Supported by our published research and others (see citations)*




Outline of talk

1. Key aspects of *Phragmites* ecology that affects management
   - Major forms of reproduction
   - Disturbance
   - Nutrient effects on growth and spread
2. Management options
3. Revegetation within invasive species management
4. Collective effort and landscape management




Major forms of reproduction

- Seeds important for long and short-distance dispersal

- Rhizomes / stolons more important for patch expansion

  (Kettenring and Mock 2012; McCormick et al. 2010)

Disturbance and invasion by seed

- *Phragmites* seeds require light to germinate

  (Kettenring et al. 2015)

- Disturbances (vegetation removal) facilitate germination

  (Silliman and Bertness; King et al. 2007; Chambers et al. 2008)

- *Phragmites* occurrence associated with disturbances overall
  - Agricultural and (sub)urban land-use
  - Shoreline development
    - Riprap, shoreline hardening, docks

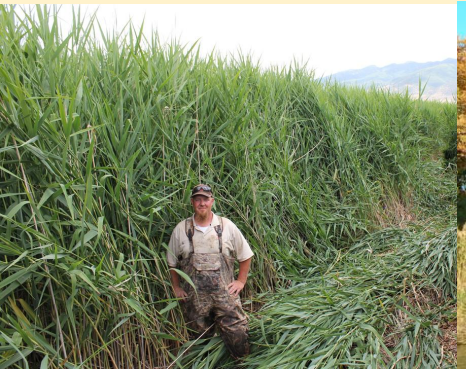
      (Sciance et al. 2017)

Nutrients and growth / spread

- *Phragmites* is a "high nutrient specialist" (Mozdzer and Zieman 2010)
- Occurs in areas associated with higher nutrient inputs (Long et al. 2017)
- ↑ nutrients result in:
  - ↑ inflorescence and floret production (Kettenring et al. 2011)
  - ↑ seedling size, growth rates, # of stems (Kettenring et al. 2018)
  - ↑ mature plant size (Minchinton and Bertness 2003)

Outline of talk

1. Key aspects of *Phragmites* ecology that affects management
2. Management options
   - Major approaches (herbicide, grazing, mowing, burning, etc.)
   - Synthesis of research findings and efficacy of different approaches
   - Environmental context driving effectiveness
   - Logistical challenges
   - Negative effects and unintended consequences
3. Revegetation within invasive species management
4. Collective effort and landscape management

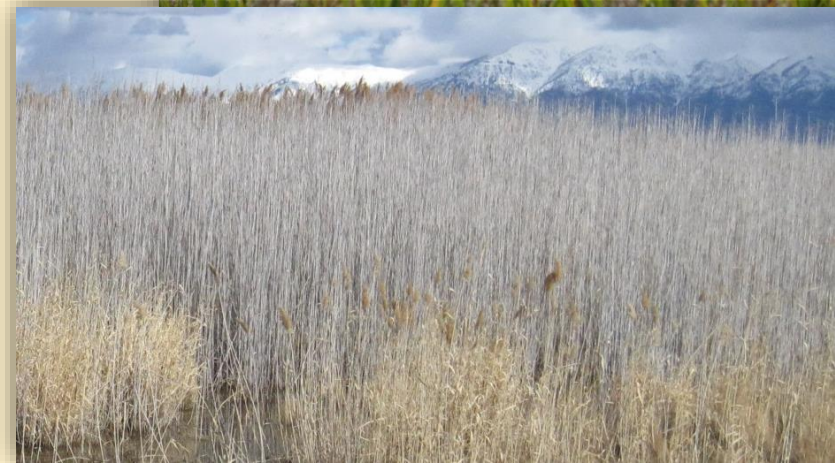



Management approaches overview

- Herbicide
  - 97% managers Utah (Rohal et al. 2018)
  - 95% (Martin & Blossey 2013)
  - Glyphosate
  - Imazapyr
- Biomass removal
  - Mowing
  - Burning
  - Grazing
- Mechanical removal without herbicide

Glyphosate

- Potential desirable outcomes
- How it is applied
  - Airplane/ helicopter, marsh-capable vehicle
  - Rate: 1-2% or 3 quarts per acre with surfactant
  - Follow-up treatments necessary (at least 3 years)
- Logistical challenges
  - Limitations of accessibility, especially for follow-up treatments
- Negative effects and unintended consequences
  - Non-target plant mortality
  - Marsh subsidence
  - Human health concerns



Imazapyr

- Potential desirable outcomes
- How it is applied
  - Airplane, marsh-capable vehicle
  - Rate: 1-2% or 3 quarts per acre with surfactant
  - Follow-up treatments necessary (at least 3 years)
- Logistical challenges
  - Limitations of accessibility, especially for follow-up treatments
  - More expensive than glyphosate
- Negative effects and unintended consequences
  - Non-target plant mortality
  - Longer residence time in soil, possible implications for revegetation (esp. in drier soils)

Herbicide timing and type

(Rohal Ph.D. research; Cranney M.S. research)

- Fall application much better than summer over longer term
- Imazapyr not significantly superior to glyphosate
- Long-term application necessary
- *Phragmites* often reinvades when management ceases

Previous studies – shorter in duration and smaller in scale – found that summer treatments might be as effective as fall treatments, and imazapyr is as effective as glyphosate.

Derr 2008
Mozdzer et al. 2008
Ailstock et al. 2001

Mowing

- Potential desirable outcomes
  - Open up marsh surface
  - Accelerates litter decomposition when done in summer
  - Reduce seed production
- How / when it is applied
  - Possible year round, common in summer and winter
- Logistical challenges
  - Marsh mowers can get stuck in soggy conditions
- Negative effects and unintended consequences
  - Leaves deep litter layer that impedes quick native plant recovery
  - Concerns about soil compaction

Burning

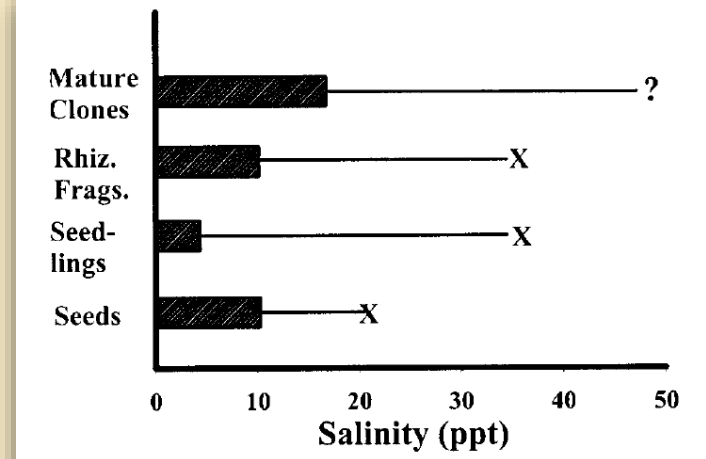
- Potential desirable outcomes
  - Removal of dead biomass
  - Opens up marsh surface
- How / when it is applied
  - Most common in spring
- Logistical challenges
  - Often need permits, controlled-burn training
  - Challenges near populated areas
- Negative effects and unintended consequences
  - Air quality concerns
  - Leaves sharp *Phragmites* stubble

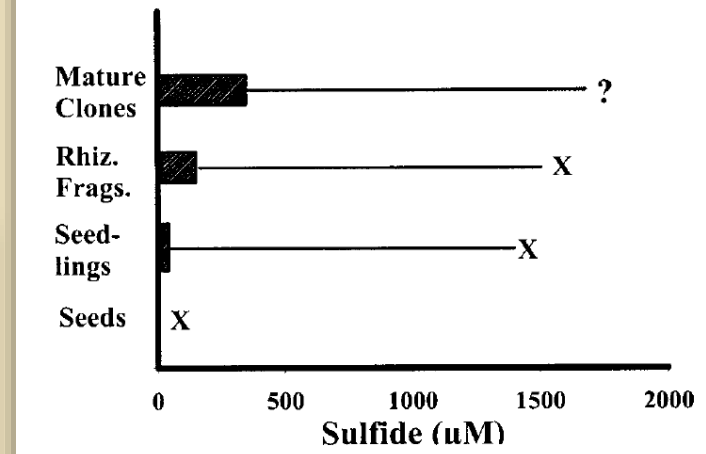
Grazing

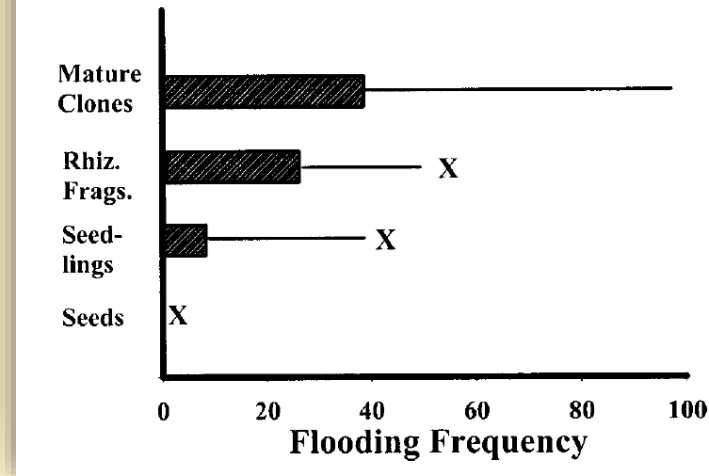
- Potential desirable outcomes
  - reduce *Phragmites* cover / biomass; trample litter
  - reduce seed production
- How / when it is applied
  - High intensity grazing often with paths / areas to congregate mowed to increase access
  - Only during growing season
- Logistical challenges
  - Widespread fencing, water accessibility for animals
  - Finding or training "marsh-capable" animals
- Negative effects and unintended consequences
  - Nutrient availability (but potentially not)
  - Compaction (but potentially not)

Other treatments

- Mowing and black plastic
- Mowing and flooding (drowning)
- Restoring hydrology — changing porewater sulfide and salinity concentrations; longer duration of flooding
  (Chambers et al. 2002)







Recommended options: removal, containment, prevention

- **Removal**
  - Mowing / intense grazing in summer, herbicide in fall
  - Herbicide in fall, burning or mowing in winter or spring
- **Containment**
  - Grazing, burning, or mowing during growing season can help contain the spread of *Phragmites* (reduces seed production and clonal expansion)
- **Prevention**
  - Limit factors that contribute to its broad expansion: nutrient enrichment, shoreline hardening, etc.
  - Shoreline buffers / hydrologic restoration

Research Report 224

How to restore

Phragmites-invaded wetlands

Christine Rohal, Keith Hambrecht, Chad Cranney, Karin Kettenring

WHY CONTROL *PHRAGMITES*?

Phragmites grows in tall, dense stands that shade out native plants. It spreads rapidly and overtakes important habitat for shorebirds and waterfowl, reducing the availability of nesting, loafing, and foraging areas. *Phragmites* makes large areas of wetlands inaccessible to wildlife and humans alike.

WHERE TO CONTROL *PHRAGMITES*

It is not always possible to effectively control all *Phragmites* on your property. Choose healthy, robust patches that you will be able to access for multiple years. Treating patches near established native plants will help protect important native habitat, and will promote passive native plant recruitment following control.

CONTROL TIMELINE

1. (optional) In year one, mow, cut, or intensively graze in June, at least 1 month before herbicide application, to prevent seed production.
2. Spray with glyphosate in August-September.
3. If patch was unmowed in summer, or grew back significantly, mow, cut, trample, or burn *Phragmites* in fall or winter (allowing 1 month for herbicide to take effect first).
4. Repeat for 3 consecutive years, spot treating the regrowth. Following year 3, monitor *Phragmites* in treated area, and continue spot treating as needed.

CRUCIAL TIPS

- The timing of herbicide application is very important. It should be applied just before the plant goes dormant, between tasseling and first frost. The best herbicide timing depends on location and is weather-dependent, but it usually occurs during August and September in Northern Utah.
- The plant must be healthy to thoroughly take up the herbicide. Avoid spraying *Phragmites* that is drought-stressed. Don't mow or graze *Phragmites* within 1 month of spraying, before or after.
- Avoid trampling recently sprayed *Phragmites* as much as possible. Crushed *Phragmites* is less likely to effectively transport herbicide to the roots which is needed for effective control.
- Disrupting bird nesting with *Phragmites* control could violate the Migratory Bird Treaty Act.
- Always calibrate your spray equipment to ensure the proper amount of herbicide is being applied. Too little, or too much, will result in less effective treatment.

WATER MANAGEMENT IMPROVES CONTROL OUTCOMES

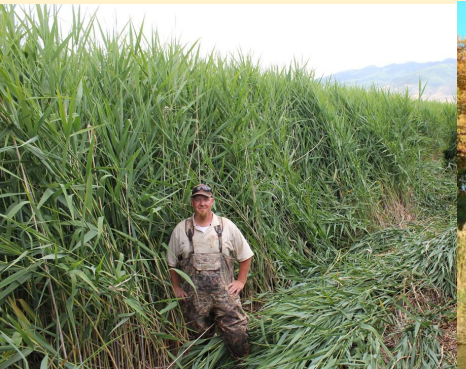
- Water control, if available, is a very useful tool. Water can be used to help grow the *Phragmites* and make it healthy before spraying, which improves herbicide effectiveness.
- After mowing or burning, flooding sites as deep as possible can help decompose the *Phragmites* litter.
- Once native vegetation is established, following a natural hydrologic cycle (lots of water in spring, phasing to little or no water in early summer i.e. mid-May/early June) will help the native plants establish and reduce *Phragmites* spread. Leaving shallow water on an area all summer and into the fall will promote *Phragmites* germination and growth.
- Following treatment years, drought stressing treated areas will help prevent the return of *Phragmites* and promote the establishment of drought-tolerant plants such as pickleweed and saltgrass. However, if the objective is to reestablish emergent plants such as bulrushes, deeper water will be required.

Environmental context drives effectiveness

- Stressed *Phragmites* limits herbicide effectiveness
  - Environmental: drought, high salinity and sulfide
  - Recently managed
- Broader context influences native recovery
  - *Phragmites* removal near intact native species increases success (more later)
  - Subsidence limited with quick native establishment

Outline of talk

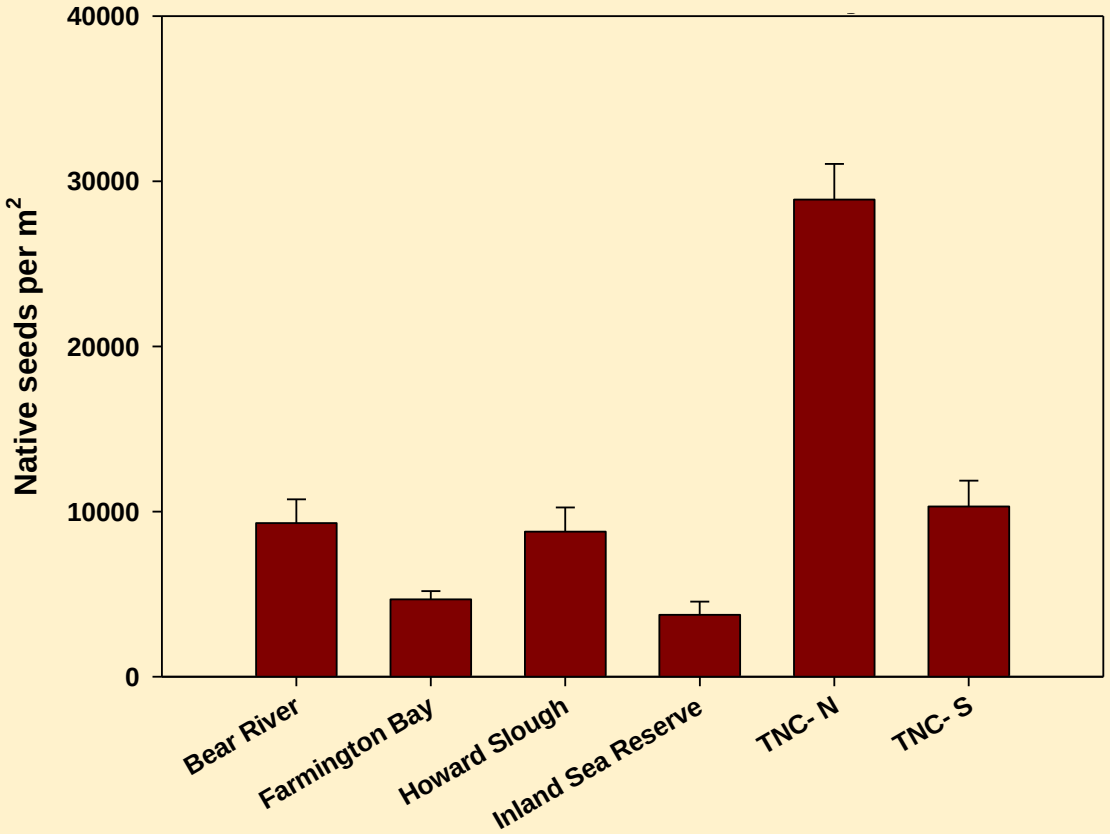
1. Key aspects of *Phragmites* ecology that affects management
2. Management options
3. Revegetation within invasive species management
   - Lack of native plant recovery
   - Seed bank potential
   - Remnant vegetation
   - Active revegetation – why and how?
   - Role of diversity at species *and* genetic levels
4. Collective effort and landscape management




Lack of native plant recovery common. Why?

Seed bank potential

- Diverse native seed banks exist (UT, MD: tides)
- Lots of inter-site variability
- *Phragmites* density declines over time with herbicide



Remnant native vegetation

- Greater recovery when remnant native vegetation persists
- Contributes to inter-site variability in recovery

Active revegetation

- Why?
  - More quickly recover native species and habitat
  - Limit *Phragmites* invasion by seed
- How?
  - *Phragmites* litter removal
  - (Hydro)seeding – less expensive, cover broad areas
    - Tackifier to keep seeds in place
- Planting rhizomes and plugs – more costly, possibly higher establishment

M/R = mow and remove

R/C = roll and crush

Experimental hydroseeding in Utah

Bulrush seedling plug, North Fork Native Plants, Idaho

Role of diversity at species *and* genetic level

- Critical for plant establishment, persistence, and limiting invasion
- Species diverse mix (Peter and Burdick 2010; Byun et al. 2013)
- Genetically diverse mix
  - Source seeds from a range of sites

Outline of talk

1. Key aspects of *Phragmites* ecology that affects management
2. Management options
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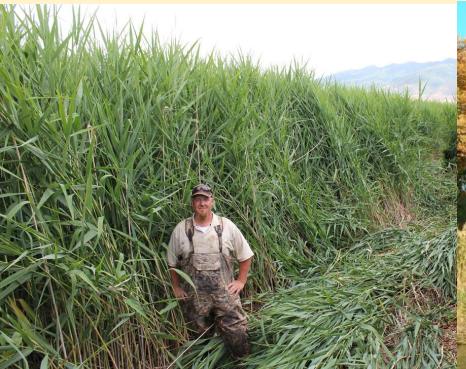
4. Collective effort and landscape management
   - Developing and fostering relationships
   - Coordinated and strategic landscape management




Developing and fostering relationships

- Scientific research as impetus for meetings – co-design of research
- Evaluate techniques feasible for managers to implement

Developing and fostering relationships

- Manager survey for collecting baseline data – "co-design" of research

IV. Invasive *Phragmites* control and management.

16. Have you or your organization managed invasive *Phragmites* on your property?
☐ Yes ☐ No (if no, skip to Section V)

16a. If yes, in what year did you **first** attempt invasive *Phragmites* control? _____

16b. If yes, in what year did you **last** attempt invasive *Phragmites* control? _____

17. What were your **broad goals** for invasive *Phragmites* control **over the last 5 years including 2012**? (check all that apply)
☐ Eradication of all *Phragmites* on our property.
☐ Stop the expansion of *Phragmites* to other areas on our property.
☐ Reduction of *Phragmites* to _____ acres or _____ % of our land.
☐ Other, please describe: _____.

17a. What are your **specific objectives** for invasive *Phragmites* control on an annual basis (**averaged over the last five years including 2012**)? (check all that apply)
☐ Treat _____ acres of *Phragmites*.
☐ Treat _____ % of our *Phragmites*.
☐ Treat _____ % of our wetlands.
☐ Other, please specify: _____.

18. What species, vegetation type, or habitat type would you like to see **replace** invasive *Phragmites* after your control efforts? (check all that apply)
☐ Alkali bulrush (*Schoenoplectus/Scirpus maritimus*)
☐ Hardstem bulrush (*Schoenoplectus/Scirpus acutus*)
☐ Common threesquare (*Schoenoplectus/Scirpus pungens*, *americanus*, or *olneyi*)
☐ Native broadleaf cattail (*Typha latifolia*)
☐ Non-native narrowleaf cattail (*Typha angustifolia*)
☐ Hybrid cattail (*Typha x glauca*)
☐ Rushes (*Juncus* spp.)
☐ Spikerushes (*Eleocharis* spp.)

Contents lists available at ScienceDirect

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Research article

Surveying managers to inform a regionally relevant invasive *Phragmites australis* control research program

C.B. Rohal [a, *], K.M. Kettenring [a], K. Sims [b], E.L.G. Hazelton [a], Z. Ma [c]

Coordinated and strategic landscape management

- Cooperation among diverse landowners
- Requires shared goals, open lines of communication, commitment to action

Coordinated and strategic landscape management

- Where are you most likely to succeed?
  - Smaller, newer invasions
    - Some areas are so heavily invaded that not worth the effort
  - Less disturbed areas
  - Ease of site access
  - Water management capabilities
- Whole watershed approach
  - e.g., forested watersheds in the Chesapeake Bay = scale of entire subestuary

Invasive Plant Science and Management 2017 10:155–165

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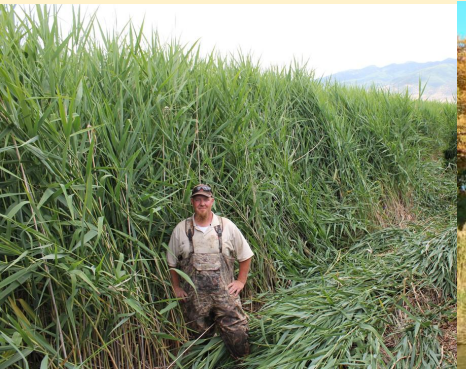
Prioritizing Management of the Invasive Grass Common Reed (*Phragmites australis*) in Great Salt Lake Wetlands

A. Lexine Long*, Karin M. Kettenring, and Richard Toth

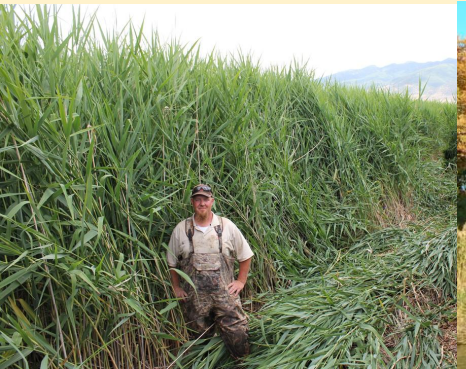
Summary

- Critical factors facilitating spread
  - Seeds, nutrients, disturbance




Summary

- Critical factors facilitating spread
  - Seeds, genetic diversity, nutrients, disturbance
- Best management practices
  - Fall glyphosate, but still address seed production in summer and litter layer

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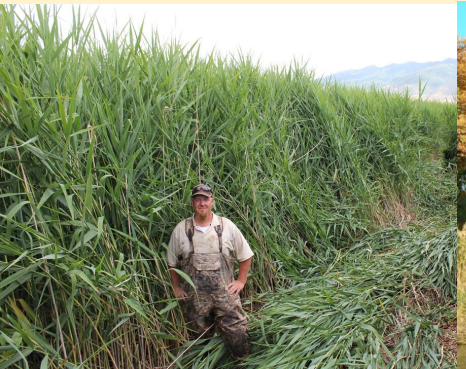


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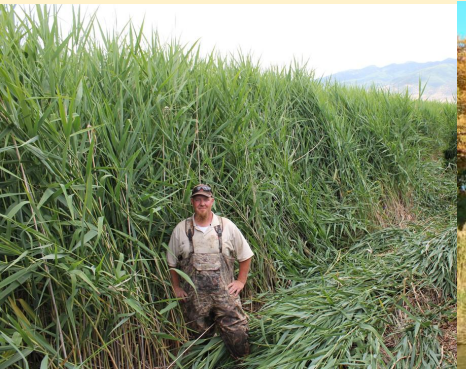


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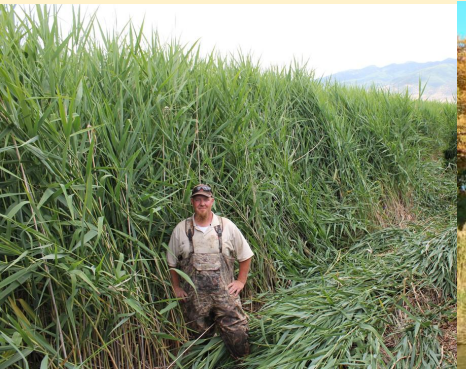
  - Scientist / manager partnerships; coordinated and strategic landscape management

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