research into current and past P. australis management plans (Cassie to do general, Shannon to do site)

Shannon – Site management
Site name – wesquage pond in bonnet shores
Site used to be owned by the Audubon Society of Rhode Island
2018 Vegetation observation of the Wesquage Pond refuge on April 18

- **DOES NOT INCLUDE PHRAGMITES AUSTRALIS AND MUTE SWAN** - although there are photos documenting the phragmites

Site:
History – formation from natural breach connecting to narragansett bay.
Land trust
"The proposed dredging of the Wesquage Pond sand delta forming in the southern area of the pond is only one step to help mitigate flooding of Bonnet Point Road, steps 2 thru 4 should also be implemented in an overall coordinated effort to reduce the roadway flooding."

- https://www.bonnetshoreslandtrust.org/wp-content/uploads/2024/01/ESM-pond-recommendation-11-2018-1.pdf

Sources:
About Wesquage Pond Wildlife Refuge | The Bonnet Shores Land Trust
Wesquage Pond Narragansett, Rhode Island
https://www.bonnetshoreslandtrust.org/wp-content/uploads/2014/12/02-2-phragmites.pdf

Notes:
General phragmites management strategies
Hazelton et al. (2014)

- Phragmites control requires multiple years of monitoring and adaptive management after initial treatment because populations can often bounce back from initial control measures, but most existing studies have not monitored for more than 2 years after treatment
- Herbicide is the most common management strategy, often in combination with other types of controls
- Main categories of control: mechanical, chemical, biological, and novel
- Mechanical control
    - Mowing- does little to control since rhizome system stays intact in the ground, actually may result in increased density of phragmites as it stimulates shoot production
    - Cutting- efficacy depends on timing (cutting in June has shown more impactful on biomass the following season versus cutting in July having no impact), cutting just before flooding season could improve control, cutting to just below

water line or cutting then putting plastic over shoots can improve effectiveness (plastic traps heat to stress remaining plant)
    - Cutting and mowing are not very effective alone and best practice may be combining with herbicide and plastic sheeting approach
    - Burning- variable results, may also stimulate growth, also best combined with herbicide and/or tidal flow enhancement
    - Excavation- removing all above and below ground biomass, very costly in time and resources
- Chemical control
    - Herbicides- two main ingredients used are glyphosate and imazapyr, there is a lack of data on long term effects of herbicides on phragmites and non-target species and on comparison of application techniques
        - Glyphosate- most common, EPA approved for aquatic environments, though non-selective and can kill non-target woody and herbaceous plants, not toxic to fauna itself while surfactant used may be; application is recommended at end of growing season though may be more effective on phragmites if early but that may increase non-target effects
        - Imazapyr- also approved for wetland habitat, non toxic to birds and mammals but surfactants may be to invertebrates, persists in soil
    - Multi-year application of herbicides are required to be effective controls
- Biological control
    - Revegetation of native plants where phragmites has been removed is important to do as soon as possible to increase competitive ability of native, diversity of native plants is helpful to resist colonization of phragmites
    - Herbivory- used more in Europe, goats can graze on phragmites though not guaranteed they will target it over other plants
    - Classical biocontrol- release of insect herbivores that would target phragmites, may have non-target consequences and introduce another invasive
- Novel methods
    - Hydrology restoration- introduced more sulfide through higher salinity tidal water which impedes phragmites growth and gives native tidal marsh plants an advantage, mature stands of phragmites may be more tolerant of sulfide so should be combined with cutting of mature plants
    - Control of nitrogen- hasn't been tested on phragmites yet

Kiviat (2013)

- Native phragmites (P. australis americanus) and invasive phragmites (P. australis australis)
- Phragmites produces colonies through vast underground rhizome and aerial shoots
- Human alteration of hydrology, water quality, soils, and vegetation facilitate phragmites spread

- Many wetland managers consider phragmites a weed, while some have contrary view that it provides valuable ecosystem services
- Ecosystem services:
    - Stabilization of sediment, protection against sea level rise
        - At the same time, phragmites may reduce micro-relief which would be important for nekton habitat
    - Uptake of nutrients from water, especially used for wastewater
    - Uptake of heavy metals
    - Plant material has potential as a biofuel
    - High evapotranspiration and albedo can reduce climatic warming
    - Provides food for many insects
        - Many of those insects however are non-native themselves
    - Dead phragmites can provide food for detritivores and decomposers
    - Support for vine growth and stands for singing birds
    - Can shelter from wind, noise pollution, and flooding
- In studies, phragmites dominated landscapes often have less species richness than native habitats equivalents
- Phragmites reduces mummichog abundance
- May reduce nesting habitat for species of concern like saltmarsh sparrow, which selectively utilize Spartina patens
- More understanding of how phragmites affects other species at the population and fitness level is needed
- Kiviat recommends that phragmites management be very tailored to the specific site with assessment of both the ecosystem services it provides to the site as well how it affects certain species of concern that use the habitat, management plans should set specific goals with the long term sustainability of every action in mind
- Problems with methods like biological, chemical, and mechanical control include the high possibilities of affecting non-target species, unrealistic work required, and potential loss of services like sediment stabilization

Meyerson et al. (2009): "Phragmites australis in Eastern North America: A Historical and Ecological Perspective”

- Background on Phragmites invasion and ecology, where and how it is so successful, also includes costs and benefits
- Particularly successful in coastal marshes of the east coast US
- Introduced sometime in the 19th century from Europe, a native lineage of Phragmites australis existed in the US already and this was a different lineage introduced (P. australis australis)
- Phragmites is a perennial emergent grass, can spread by both seed and rhizome fragments, existing stands primarily spread clonally from the root system

https://nerrssciencecollaborative.org/resource/invasive-phragmites-provides-superior-wave-and-surge-damage-protection-relative-native#:~:text=Using%20a%20vegetation%2Dresolving%20three,would%20have%20increased%20by%2026%25.

- Found that phragmites was helpful in mitigating erosion, wave damage, and storm surge damage, but provided NEGLIGIBLE flood depth reduction effects!!

Wallace Major Paper:

Link: https://info.edc.uri.edu/mesm/Docs/MajorPapers/Wallace_M_2014.pdf

Things found useful in post-treatment monitoring reports:

- detailed photos of treatment area, including before and after.

- detailed descriptions of how transects were set up and how phragmites cover was measured.

- descriptions on how treatment has affected regrowth of native species (most CRMC issued permits did not do this.)

- graphs or tables showing percent change in phragmites cover from year to year.

- identifying time of year and how long after treatment monitoring efforts took place.

- Most common method for treating phragmites, as seen in CRMC issued permits, was a combination of herbicide application and cutting + mowing. "Treatment by tidal inundation and mowing and cutting were used only in a few circumstances."

- Generally believed that applying herbicides at the end of the growing season (late summer/ early fall) produces the most effective results.

Consultant recommendations for improved monitoring:

- clear and concise goals of treatment and an identified ultimate end result.

- monitoring should be done every year before and after follow-up treatment is performed.

- treatment should be done at end of growing season (august-November) [COULD CHANGE with climate change, yearly abnormal seasonal weather...]

- ensure access to the same site year after year.

- follow-up monitoring should be simple and streamlines (such as a checklist)

- money for monitoring should be set aside at the beginning/ proposal of a project.

- habitat maps, photo stations, and plant ID should be part of all monitoring efforts.

Best practices for phragmites management based on lit review:

- herbicide helps in short term but must be reapplied to ensure long-term effectiveness.

- combination strategies are best (herbicide + mowing, burning, flooding, cutting, etc.)

- Maximum effectiveness was hand cutting stems then dripping herbicide directly onto stems.(Time consuming and expensive.)

- Rodeo or aquamaster (glyphosate based) were most common herbicides.

-mowing during the growing season had the most significant impacts on limiting growth.

-herbicide treatment of phragmites negatively impacted marsh wren habitat, especially when aerial spraying was the application method. Primarily because phragmites stalks provide tall enough suitable area for these birds to build nest. so the herbicide effectiveness is what caused a negative effect on bird population.

Utah State article:

Link:https://extension.usu.edu/wetlands/research/phragmites-control-at-the-urban-rural-interface

As of 2014, no biological controls for phragmites existed or were still in development.

-If water depth is greater than 12 inches the lateral spread of phragmites by rhizomes and stolons is inhibited and seedlings are killed. [Dredging, flooding?)

-"Simply tilling or disking soil will only serve to spread the weed." (Since rhizomes are so deep)

-Cutting stems 3-5 inches below water line enhance control efforts by drowning remaining rhizomes.

Great Lakes Phragmites article:

Link: https://www.greatlakesphragmites.net/phragbasics/life-cycle/

-Mechanical management should never be done when seed heads are set (they will likely spread.)

-Applying herbicides during the translocating phase is most effective as the plants is sending material down to the rhizomes from the aboveground stalks to prepare for winter.

-Cutting plants underwater starves them of oxygen, which is most needed during the growing season.

Great Lakes Phragmites, Phragmites Adaptive Management Framework (PAMF) Active Adaptive Management Program (AAMP):

Link: https://www.greatlakesphragmites.net/pamf/aamp-funding/

Research on Non-Native Phragmites Control (Great Lakes Phragmites):

Link:https://www.greatlakesphragmites.net/research/control-options/

Emerging treatment types in development:

-Biological: non-native phragmites host-specific moths from Europe that may be useful if released in the U.S. selectively, *Archanara geminipuncta* & *Archanara neurica*. (Shown to reduce 60% of stem biomass in field studies.) [Already in use in Canada by DU!]

Getting Rid of Phragmites without Dangerous Chemicals:

Link: https://www.friendsofbarnstableharbor.org/what-you-can-do/phragmites/

Integrated Vegetation Management webinar:

Link: https://www.youtube.com/watch?v=eBjg0c3X00g

"Biomass is Phragmites' superpower!"

-Removal of biomass is crucial, and must be followed-up year-after-year for at least 3 years. Studies in Utah showed a 1/2- 2/3 reduction in Phragmites when 3 year managemet practice was conducted.

-Stressed Phragmites in limiting environments may reduce herbicide effectiveness (ex: high salinity, etc.)

Issues that will be difficult to navigate (that we should give special attention to:)

- Rights of way
- roadway right next to Phragmites stands (greatly limits management options, increases spread by vehicles.)
- Management costs
- Delicacy of most-effective herbicide treatment (hand treating directly on shoots, leaves...)
- Total eradication may not be possible.

- Management project will NOT be a one-time thing (multiple years needed.)

Grant Opportunities:

- Great Lakes Phragmites Collaborative
- USDA National Invasive Species Information Center (https://www.invasivespeciesinfo.gov/subject/grants-and-funding)
- USFWS Invasive Species Eradication (https://www.fws.gov/story/2024-03/funding-available-tools-and-projects-eradicate-invasive-species)
- Dept. of Interior Invasive and Noxious Plant Management (BLM) Grant

Cost Estimates:

- https://www.greenshovels.ca/wp-content/uploads/2021/08/Ontario-Phragmites-Cost-Benefit-Analysis_DRAFT_Public-Review_WEB.pdf
- https://dem.ri.gov/sites/g/files/xkgbur861/files/2024-09/wat-wesquage-pond-watershed-mgnt-plan.pdf
- https://www.littletonma.org/DocumentCenter/View/7718/Open-Space_Cloverdale-Phragmites-Control

Drafts

General management:

Phragmites control includes chemical, mechanical, and biological methods, most often used in combination. Chemical control is the most common method, utilizing herbicides like glyphosate and imazapyr. Effectiveness is greatly increased with multi-year application during the growing season and potential harm to non-target species must be considered. Mechanical control includes mowing, cutting, burning, and excavating, many of which are practiced alongside herbicide treatment. Care must be taken not to spread phragmites further through transport of fragments when mowing. Biological control involves the introduction of species that consume phragmites, such as goats or herbivorous insects. This method….. as the consumers may not target phragmites and it risks introducing more non-native species to already vulnerable habitat. A novel method used in coastal wetlands is hydrologic restoration, which returns tidal flow and brings an influx of sulfur that phragmites cannot tolerate as well as native saltmarsh plants. All methods have their benefits alongside the costs, including monetary and time constraints as

well as potential harm to native species, so management is best tailored to individual sites based on the species present and the long term sustainability of each action.