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Great Lakes Science Center

Novel tools for controlling invasive *Phragmites australis*

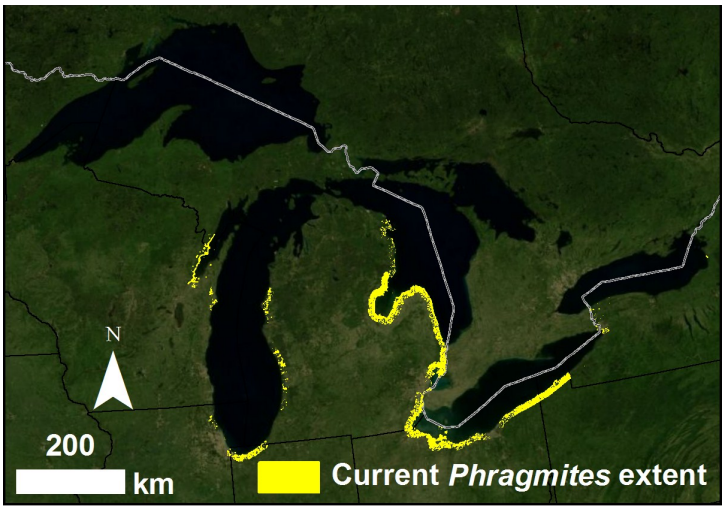
Phragmites (common reed) is a tall, invasive wetland plant that forms dense stands and impairs wetland functions, reduces biodiversity and property values, limits human uses of beaches and recreational areas, and is extremely difficult and costly to eradicate once established.

Phragmites invasion: a critical issue

Biology: A highly invasive, exotic strain of *Phragmites* is rapidly colonizing Great Lakes coastal wetlands. Colonization occurs via seed and the spread of rhizomes (roots). The invasive strain of *Phragmites* grows in incredibly dense stands that force out native species through changes in available light and nutrients and the production of biochemicals harmful to other plants. These stands are poor quality habitat for wetland fauna, decrease the aesthetic value of property, and increase the likelihood of fires.

Drivers of invasion: The degradation of many coastal wetlands via shoreline developments, high nutrient concentrations, and high sediment loads has increased invasion success by this aggressive species. In recent years, reduced lake levels promoted *Phragmites* invasion by exposing fertile lake bottom land. Further lowering of lake levels may occur in coming years as climate patterns shift, which could drastically increase the area of land vulnerable to invasion.

The invasion of Great Lakes coastal wetlands by *Phragmites* is of great concern given the limited extent of healthy coastal wetlands.



The need to develop novel approaches:

Current management techniques include the aerial application of herbicides, mowing, raking, and burning. These methods may provide short-term reductions in the density of *Phragmites*; however, they are costly, time-intensive, and have low long-term success rates (*i.e.,* require regular re-application). These techniques are not species specific and often impact native assemblages negatively. Scientists at the USGS Great Lakes Science Center are developing new techniques for more systemic controls on this nuisance species:

- Map the current extent of *Phragmites* and develop a model to predict areas that may be vulnerable to invasion.
- Develop species-specific controls:
  - Targeted controls on entophytic fungi that support *Phragmites* growth
  - Gene silencing technology to limit photosynthesis and reproduction

U.S. Department of the Interior
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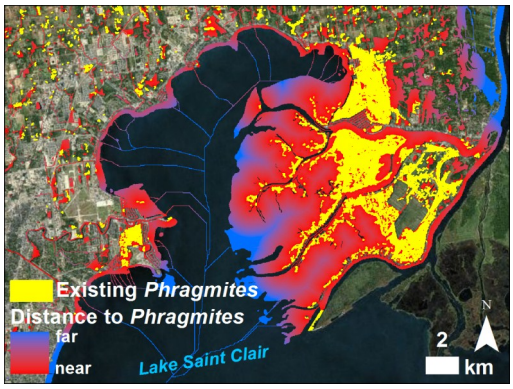
Innovative strategies

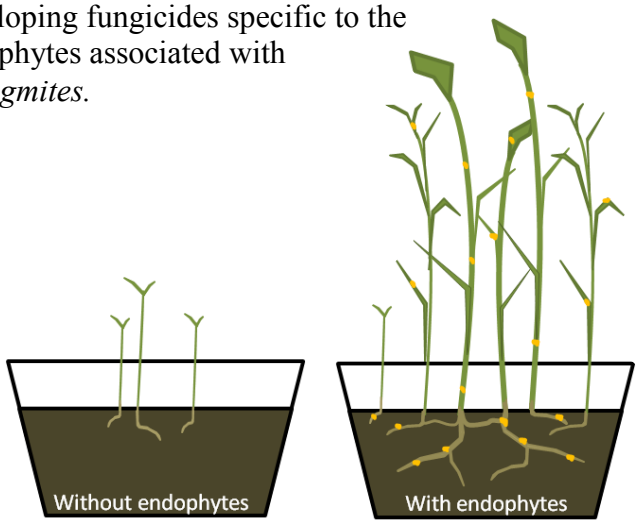
Mapping and Predictive Models: Scientists at the GLSC, in partnership with researchers from the Michigan Tech Research Institute (MTRI), have used remote sensing data and extensive field work to produce a high resolution map of the current extent of *Phragmites* throughout the U.S. portion of the Great Lakes (see map on reverse). GLSC researchers have taken information on factors such as land use and climate to develop a habitat suitability index. This index, when combined with the map of the current extent of *Phragmites,* was used to create a vulnerability index for the coastal regions of the Great Lakes. These data will allow for earlier response to *Phragmites* invasion and highlight opportunities for wetland restoration efforts.



Estimation of the vulnerability to invasion under a 1-m drop in lake level.

Species-Specific Controls:

***1. Microbial approach*:** Plants have symbiotic relationships with endophytic microbes (fungi that live within plants). The presence of these endophytes is important to the fitness of native and invasive plant species (see diagram below). Scientists at the GLSC and the University of Washington are working on developing fungicides specific to the endophytes associated with *Phragmites.*



The goal of this research is to find a simple and resource efficient method of controlling *Phragmites* in wetlands with minimal detrimental side effects of herbicide or mowing.

2. Gene-silencing approach: Genes are sections of an organism's DNA that act as the blueprint for the formation of proteins needed to perform tasks such as photosynthesis or reproduction. Researchers at Wayne State University have been able to silence (hide the blueprint) the expression of genes that control photosynthesis in spinach (see picture).

Researchers at the GLSC and Wayne State University are working on a project to reduce the competitive ability of *Phragmites* by silencing genes required for photosynthesis, vegetative reproduction, and floral reproductive development (flowers, seeds). Gene silencing is a promising approach to invasive species management because it is species specific and must be applied directly to each plant. This ensures that, unlike biological controls involving insect predators, there is negligible risk of non-targeted species being harmed by this technique.

Significance of research

These groundbreaking techniques, which are currently specific to *Phragmites*, will be readily transferable to other invasive species problems at the regional, national and global level.

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