



Environment and Natural Resources Trust Fund (ENRTF) M.L. 2013 Minnesota Aquatic Invasive Species Research Center Sub-Project Work Plan

Date of Report: June 3, 2017

Date of Next Status Update Report: July 31, 2017

Date of Work Plan Approval:

Sub-Project Completion Date: June 30, 2019

Project Completion Date: June 30, 2019

Does this submission include an amendment request? No

SUB-PROJECT TITLE: MAISRC Sub-Project #17: Building scientific and management capacity to respond to invasive *Phragmites* in Minnesota

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Location: Statewide

Total ENRTF Sub-Project Budget:	Sub-Project Budget:	\$ 246,800
	Amount Spent:	\$ 0
	Balance:	\$ 246,800

Legal Citation: M.L. 2013, Chp. 52, Sec. 2, Subd. 06a

Appropriation Language:

\$4,350,000 the first year and \$4,350,000 the second year are from the trust fund to the Board of Regents of the University of Minnesota to develop and support an aquatic invasive species (AIS) research center at the University of Minnesota that will develop new techniques to control aquatic invasive species including Asian carp, zebra mussels, and plant species. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

I. SUB-PROJECT TITLE: MAISRC Sub-Project #17: Building scientific and management capacity to respond to invasive *Phragmites* in Minnesota

II. SUB-PROJECT STATEMENT:

European strains of common reed (*Phragmites australis*), a highly invasive wetland grass, have been introduced to multiple locations in Minnesota and appear to be spreading. Invasive populations of *Phragmites* can have strong negative impacts on biological diversity, wildlife, habitat quality, and recreation. Thus far, there have been no systematic attempts in Minnesota to map and monitor spread of invasive *Phragmites* and develop coordinated control efforts. **The aims of this project are to: 1) Map the current distribution of invasive *Phragmites* in Minnesota, 2) Determine its capacity for further spread in Minnesota, and 3) Formulate and disseminate model management protocols for this species.** The products of this work will support a comprehensive statewide response to this aquatic invasive species (AIS).

Like many AIS, *Phragmites* does not quickly spread immediately after introduction. The initial barrier to rapid spread is overcome when *Phragmites* can produce viable seed—in addition to its ability to spread vegetatively. This occurs when there is enough genetically diverse *Phragmites* on the landscape to support sexual reproduction. In Minnesota, seed production may also be limited by climate because of our relatively short growing season. Once viable seeds start spreading by wind and water, eradication is no longer feasible and control is much more difficult and expensive. Compared to other Midwestern states, we have relatively little invasive *Phragmites*, but this is changing. The window of opportunity to limit invasion in Minnesota is now. For this reason, it is crucial to map the current distribution of invasive *Phragmites* in Minnesota, assess its potential for further spread, and promote coordinated control and spread prevention efforts.

The distribution of invasive, European *Phragmites* in Minnesota is unknown because it is not easy for non-experts to distinguish it from native *Phragmites*. *Phragmites* is a “cryptic” invader in the U.S. because there are both native and non-native lineages here. Native *Phragmites* is an important component of wetlands that can be displaced by invasive *Phragmites* and harmed by indiscriminate control efforts that do not distinguish invasive from native forms. Resource managers need support in distinguishing and targeting the invasive.

An efficient statewide response to *Phragmites* requires effective management techniques for different invasion scenarios found in Minnesota. For example, treating a large infestation in a high-quality wetland presents different challenges than a new infestation along a roadside. We will develop management protocols that identify and communicate optimal responses to different scenarios. These protocols will consider different factors, such as: How large is the population? Is it producing seed? Is the invaded site connected to other water bodies? Is the population a threat to resources of special concern such as wild rice waters?

The proposed project will generate critical data on statewide distribution and reproduction of invasive *Phragmites*. We will collaborate with external partners to use findings to respond to *Phragmites* invasion. We will also leverage a separately funded workshop for managing *Phragmites* in Minnesota. This workshop will engage resource managers from state, federal, and other agencies and will inform the proposed project by helping us identify invasion scenarios in the state and key areas of uncertainty. Project partners will also help us focus capacity-building efforts on solutions that are feasible within the context of their agencies’ broader missions. Management protocols will be developed for different *Phragmites* invasion scenarios and disseminated to partner agencies and other stakeholders through in-person meetings, webinars, and online resources. While this project is focused on invasive *Phragmites*, this approach to research-management collaboration will serve as a model that could be applied to other invasive species issues. In particular, use of a collaborative network (“crowdsourcing”) for sampling statewide distribution and development of custom response protocols for different invasion scenarios will be applicable to other invasive species.

III. SUB-PROJECT STATUS UPDATES:

Sub-Project Status as of January 31, 2018:

Sub-Project Status as of July 31, 2018:

Sub-Project Status as of January 31, 2019:

Overall Sub-Project Outcomes and Results:

IV. SUB-PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Map distribution of non-native *Phragmites* in Minnesota

Description: We will work with statewide wetland managers to locate patches of suspected invasive *Phragmites* statewide and gather information and samples using a common protocol. Participants will be recruited through our professional networks, direct communications with agencies, relevant groups and list-servs, and a webinar. We will ensure that data collection is geographically comprehensive by working with agency partners to target all major portions of the state. We will also re-sample previously reported occurrences of non-native *Phragmites* compiled by the Minnesota Department of Natural Resources and other agencies to confirm their genetic status and survey in the vicinity of these early records to detect local spread. The project coordinator and other project staff will fill critical sampling gaps, where wetland managers are unavailable to do so.

For each occurrence, participants will enter information into a web-based platform; this will include geographic location, habitat type, approximate size of the population, connections to other wetlands and resources, and whether the population appears to be spreading along corridors or across waterbodies. We will use the EDDMapS platform (Early Detection & Distribution Mapping System, University of Georgia) for reporting *Phragmites* occurrences. EDDMapS is the most widely used national reporting system for invasive species occurrences. We will use a regional portal within EDDMapS (GLEDN: Great Lakes Early Detection Network), which has been adopted by Minnesota state agencies and U of M Extension. Reporters will also upload digital images of the population, select from indicators that they used to identify the population as suspected non-native *Phragmites*, and indicate their confidence (or lack thereof) in that determination.

Participants will then ship plant samples to us for processing, morphological identification, and submission to the Chicago Botanic Garden (CBG) for genetic analyses. Received materials will be classified by our project team as native or non-native based on morphological features. All indicators used for identification will be recorded. Leaf tissue from each population will be shipped to CBG, where plant geneticist Dr. Jeremie Fant will oversee genetic identifications as native or non-native.

We will compare the identifications made by participants with our morphological determinations and the genetic “gold standard.” This QA/QC process will be used to identify which morphological characters are the most reliable in Minnesota populations. We will use this information to refine protocols for future sampling efforts and to inform invasive *Phragmites* search efforts that lack funding or capacity for genetic testing. A project website will be developed, through which we will publish a map delineating sample locations and occurrences of invasive populations. This map will be updated throughout the duration of the project as new infestations are discovered or existing ones are treated. All non-native *Phragmites* occurrences associated with our project will also be linked to and viewable from GLEDN/EDDMapS.

Activity 1 will be the focus for an intensive initial phase during the first six months of our project as these data will inform all subsequent activities.

Summary Budget Information for Activity 1:

ENRTF Budget: \$ 106,755
Amount Spent: \$ 0
Balance: \$ 106,755

Activity Completion Date:

Outcome	Completion Date
1. Adapt GLEDN (EDDMapS) portal and develop submission system	August 15, 2017

2. Morphological identification and genetic fingerprinting	December 15, 2018
3. QA/QC crowdsourcing/identification approach	May 1, 2018
4. Publish/update distribution map for non-native <i>Phragmites</i>	November 15, 2018

Activity Status as of January 31, 2018:

Activity Status as of July 31, 2018:

Activity Status as of January 31, 2019:

ACTIVITY 2: Evaluate reproductive potential of non-native *Phragmites* in Minnesota

Description: The risk that *Phragmites* will spread rapidly and be difficult to control in Minnesota likely depends on two factors: 1) whether multiple genetic strains are present, overcoming the barrier to seed production, and 2) whether seed has the opportunity to ripen given the length of the growing season. These factors are likely to differ across the state based on differences in invasion history and climate. To evaluate these risk factors, we will delineate nine areas of the state (three longitudinal bands crossed with three latitudinal bands) and sample 4–9 occurrences within each of these regions. Within a geographic area, we will use a stratified random approach to select occurrences. The categories used to stratify occurrences will correspond to different invasion/management scenarios and be based on parameters such as infestation age, size, connections to other water sources, and proximity to sensitive wetland/aquatic resources. The criteria for categories will be determined based on variation observed in the occurrence data set (from Activity 1). We plan to create 2–3 categories for each region and randomly select 2–3 localities from all records within each category. For example, a geographic area might have two categories if occurrence data indicate populations are either 1) isolated and small, or 2) large, and often associated with highways, as has been reported anecdotally.

To assess production of viable seed, we will remove seed heads of 20–50 plants at each site and estimate seed viability of filled seeds. We will collect seed heads when no further ripening is possible but prior to detachment, approximately December 1 2017–January 15 2018. The number of seed heads collected will be based on population size and density and condition of seed heads. We will collect a greater number of seed heads for large, dispersed populations and if seed heads do not appear to contain many seeds. Specific locations of seed head sampling will be recorded with a GPS and added to the occurrence record in GLEDN. Seed heads for each site will be stored together in a breathable paper bag at room temperature and humidity.

Seeds will be stripped from heads and processed as a single lot per collection site. The entire lot will be inspected under 30X magnification to determine if filled seed is common or rare. If filled seed appears to be common, a haphazard subsample of approximately 100 seeds will be assayed for seed fill and viability. If filled seed is rare, we will estimate the total number of seeds in the lot (based on weight) and set aside all filled seed to be counted and assayed for viability. Seed viability will be determined from a tetrazolium (TZ) assay. Viability will be estimated as the proportion of all seeds that are viable. We will also estimate the proportion of all seeds that are filled and the proportion of filled seeds that are viable.

To evaluate genetic structure and diversity of each study site, we will collect leaf samples during the following growing season (July–August 2018). This timeline—seed head collection in winter 2017, leaf tissue collection in summer 2018—is based on how the different activities feed into each other. We need to complete initial activities under Activity 1 to determine where to collect seed and genetic samples. And seed heads are best collected in winter following seed ripening. In contrast, genetic tests work best on live, green tissue. Thus we will collect seed heads first and then return for leaf samples. We will haphazardly collect leaves from 30 stems distributed throughout each study population; we will analyze genetic diversity for 5 out of these 30 samples selected randomly. This will show the extent to which seed set is likely to be limited by self-incompatibility and allow us to differentiate expansion of patches by seed vs. clonal (vegetative) spread. These data will also enable us to identify possible native/invasive hybrids, which are rare but have been identified in

field settings and would be of concern because of the potential for hybrid vigor or genetic “pollution” of native populations.

Summary Budget Information for Activity 2:

ENRTF Budget: \$ 97,272
Amount Spent: \$ 0
Balance: \$ 97,272

Activity Completion Date:

Outcome	Completion Date
1. Microsatellite results to quantify genetic diversity of subset of statewide populations	December 15, 2018
2. Collection of seed heads from subset of populations	February 15, 2018
3. Evaluation of seed viability from subset of populations	June 15, 2018

Activity Status as of January 31, 2018:

Activity Status as of July 31, 2018:

Activity Status as of January 31, 2019:

ACTIVITY 3: Build response capacity

Description: The overarching goal of our project is to increase capacity to respond to *Phragmites* invasion in Minnesota in a systematic, scientifically sound manner. There is an opportunity to develop coordinated monitoring and management responses to minimize negative impacts of *Phragmites* invasion in Minnesota before it becomes more widespread. To facilitate this, we will integrate data gathered under Activities 1 and 2, existing knowledge about *Phragmites* invasion and management, and information from project partners to develop and disseminate response protocols for different *Phragmites* invasion scenarios occurring in the state.

The first step in this process will be to characterize the different invasion scenarios that Minnesota resource managers are confronted with: different combinations of patch size, seed production, and associated threats as described above. We will gather this information through the data collected in Activities 1 and 2 and by surveying project partners about *Phragmites* occurrences on their managed lands. Partners will include representatives from MnDNR and other state, federal, tribal, or non-governmental organizations.

To gather more in-depth information from project partners for developing management protocols, we will host key partners from these agencies in a structured decision making (SDM) workshop funded by University of Minnesota’s Institute on the Environment in late 2017. SDM facilitates groups evaluating possible solutions to complex problems involving uncertainties. It provides a systematic way to support collaborative problem solving and is increasingly being used in natural resources management. Workshop participants will be key players in their respective agencies, able to represent their organizations’ needs and disseminate project findings and tools back to colleagues for implementation.

In preparation for the SDM workshop, we will review and synthesize lessons learned from elsewhere in North America where *Phragmites* has been managed, including scientific literature on costs and effectiveness of different interventions. During the workshop, we will present our initial findings from Activity 1 on the distribution of invasive *Phragmites* in Minnesota and information on management options implemented elsewhere and what we know of their efficacy. We will then gather information from Minnesota participants about invasion scenarios occurring on lands they manage, their main objectives for *Phragmites* management, and the feasibility of their agencies implementing different management strategies. We will also identify key areas of uncertainty related to management, for example, information gaps regarding the effectiveness of different management actions in different invasion contexts. Products of the SDM workshop will be incorporated into preparing model response protocols.

To develop these protocols, we will evaluate and prioritize potential management strategies under different invasion scenarios. Given a limited budget for *Phragmites* management, we must determine how to best allocate funds across different management options to achieve the desired outcomes. We will evaluate these management strategies for multiple objectives based on the reported goals of partners, such as native species conservation, habitat quality for wildlife, and protecting key resources like wild rice. Candidate management actions that have been used to reduce *Phragmites* and assist habitat recovery include use of herbicide, cutting/mowing, prescribed fire, flooding, and seeding.

To prioritize actions, we will consider several important factors for each action: (1) its ecological benefits, (2) its financial costs, (3) its feasibility, and (4) uncertainty regarding outcomes. These factors will be evaluated in the context of different scenarios of *Phragmites* invasion in the state. We will also identify the key information/data needed to build greater confidence in management recommendations. As this information becomes available, it can be incorporated into adaptive management.

Using prioritization results, we will develop model response protocols for different invasion scenarios. For example, the strategy recommended for an early-stage invasion in wild rice waters will differ from recommendations for a large infestation in a degraded wetland. Customized protocols will be developed for different contexts. We will then host an in-person workshop with project partners to present and invite feedback on protocols. Using this input, plans will be finalized, disseminated to agencies, and published on our project website. They will also be communicated through a webinar (presented live and recorded for archiving) and translated into outreach materials. This general approach and products from this activity will provide models that could be adapted to other invasive species.

Summary Budget Information for Activity 3:

ENRTF Budget: \$ 42,773
Amount Spent: \$ 0
Balance: \$ 42,773

Activity Completion Date:

Outcome	Completion Date
1. Project website	May 1, 2018
2. Project webinars	April 15, 2019
3. Decision making resources and meetings	June 30, 2019

Activity Status as of January 31, 2018:

Activity Status as of July 31, 2018:

Activity Status as of January 31, 2019:

Final Report Summary:

V. DISSEMINATION:

Description: We will publish peer-reviewed papers and present project findings on our website, through webinars, at an in-person workshop, and at professional meetings. Presentations will also be made to the public and other stakeholders through the annual MAISRC showcase, U OF M AIS Extension programming, and other forums.

Status as of January 31, 2018:

Status as of July 31, 2018:

Status as of January 31, 2019:

Final Report Summary:

VI. SUB-PROJECT BUDGET SUMMARY:

A. Preliminary ENRTF Budget Overview:

*This section represents an overview of the preliminary budget at the start of the project. It will be reconciled with actual expenditures at the time of the final report. See the Sub-Project Budget document for an up-to-date project budget, including any changes resulting from amendments.

Budget Category	\$ Amount	Explanation
Personnel:	\$ 207,895	1 assistant professor at 5.8% FTE each year for 2 years and 1 assistant professor at 5.8% each year for 1 year (\$26,977); 1 research fellow at 100% FTE for 2 years (\$149,744); 1 communications specialist at 8.3% FTE for 1 year (\$5,571); 1 graduate research assistant at 50% FTE for 1 semester (\$16,964); and 1 undergraduate research assistant at 17% FTE for 2 years (\$8,640).
Professional/Technical Services and Contracts:	\$ 15,120	Genetic analyses of <i>Phragmites</i> tissue samples (Chicago Botanic Garden)
Equipment/Tools/Supplies:	\$ 5,025	Miscellaneous laboratory and field supplies for sample collection; processing; and analysis, packaging, and shipping of samples.
Travel:	\$ 13,010	Personal vehicle mileage, car rental, food, lodging, and miscellaneous travel expenses for in-state travel for fieldwork, meetings, and conferences.
Other:	\$ 5,750	Costs for project website, webinars, and in-person workshop.
TOTAL ENRTF BUDGET:	\$ 246,800	

Explanation of Use of Classified Staff: N/A

Explanation of Capital Expenditures Greater Than \$5,000: N/A

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 1.395

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: 0

B. Other Funds:

Source of Funds	\$ Amount Proposed	\$ Amount Spent	Use of Other Funds
Non-state			

U of M Institute on the Environment (cash support)	\$ 3,000	\$ 0	Invasive <i>Phragmites</i> structured decision making workshop
State			
	\$	\$	
TOTAL OTHER FUNDS:	\$ 0	\$ 0	

VII. SUB-PROJECT STRATEGY:

A. Sub-Project Team/Partners:

Project Partners Receiving Funds:

- Chicago Botanic Garden: \$15,120 to perform genetic analyses on *Phragmites* samples.

B. Sub-Project Impact and Long-term Strategy:

C. Spending History:

Funding Source	M.L. 2008 or FY09	M.L. 2009 or FY10	M.L. 2010 or FY11	M.L. 2011 or FY12-13	M.L. 2013 or FY14

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VIII. ACQUISITION/RESTORATION LIST: N/A

IX. VISUAL ELEMENT or MAP(S): N/A

X. ACQUISITION/RESTORATION REQUIREMENTS WORKSHEET: N/A

XI. RESEARCH PROPOSAL: See attached Research Proposal

XII. REPORTING REQUIREMENTS:

Periodic work plan status update reports will be submitted no later than January 31 and July 31 each year (every six months). A final report and associated products will be submitted within two months of the anticipated sub-project completion of June 30, 2019.