Strategic Plan 2020-2025

Preface

The Great Lakes *Phragmites* Collaborative (GLPC) developed an adaptive management program known as the *Phragmites* Adaptive Management Framework (PAMF). PAMF is designed improve *Phragmites* management throughout the Great Lakes basin by reducing uncertainties in management strategies and identifying approaches that maximize effectiveness and efficiency.

Non-native *Phragmites australis* (hereafter *Phragmites*) is an aggressive plant species invading North America[1,2]. It is well-established in the Great Lakes basin, along the Atlantic, Pacific, and Gulf Coasts, and in wetlands across the interior of the continent.[3,4] *Phragmites* is managed using a suite of conventional resource-intensive methods, including herbicides, cutting/crushing, flooding, and burning[5]. These methods differ in effectiveness, likely due to the variability in site conditions and approaches to implementation. Moreover, managers often disagree on what outcomes can be expected from *Phragmites* control efforts[6] and face local regulatory constraints that limit certain actions. Managers also lack a coordinated network through which to learn from different approaches implemented across a large landscape. These challenges limit managers' ability to have a lasting impact on *Phragmites* at the landscape scale.

PAMF is the first basin-wide application of adaptive management to address invasive *Phragmites*. In short, adaptive management is systematic learning from management outcomes. More specifically, adaptive management involves planning, implementing, evaluating, and adjusting management activities as a repeating cycle. It includes predictions about how an ecological indicator is expected to change in response to management efforts and compares observed outcomes to those predictions. Adaptive management is a useful approach when the need to make repeated management decisions over time presents an ongoing opportunity to learn from the results and improve future management outcomes.
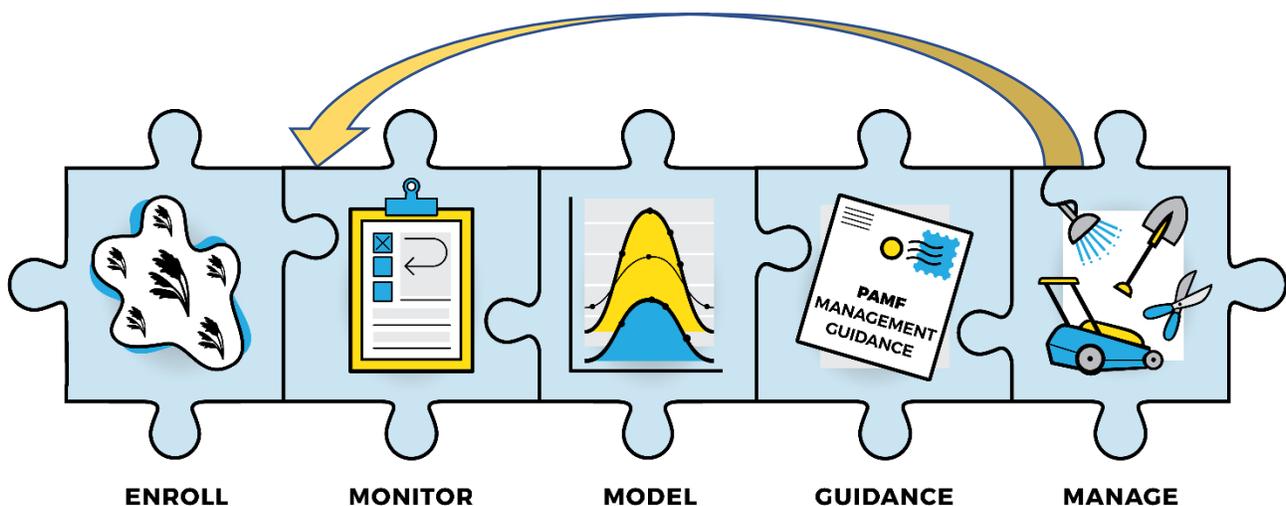

Figure 1. This figure represents the participant process of the Phragmites *Adaptive Management Framework: registering a* Phragmites *patch, monitoring the patch, submitting data for modelling, receiving data-based guidance, and managing the patch based on guidance received. Participants work through these steps, which repeat on an iterative cycle.*

With the assistance of a predictive model, PAMF learns about *Phragmites'* response to different management approaches. Managers input data about their *Phragmites* infestations and management approaches to PAMF. These data are used to by the model to produce future management guidance. The order and timing of management actions used by managers may change due to the status of *Phragmites* invasion (e.g., different management combinations may be more effective and efficient at controlling *Phragmites* depending on invasion status) and/or management constraints. This large-scale effort benefits from many management activities taking place around the Great Lakes basin to accelerate the learning process. This leads to continuously improving management guidance – the model's output – for more effective and efficient efforts.

This strategic plan will guide successful implementation of PAMF by setting program-specific goals, objectives, and measures for the next five years. The PAMF core science team that developed the plan includes representatives from the Great Lakes Commission, U.S. Geological Survey, and University of Georgia. The core science team will evaluate the status of PAMF annually against this strategic plan. Unless otherwise stated, the plan goals, objectives, and measures are designed to be achieved at the end of the five-year plan period, and overall progress will be measured at the end of the 2025/26 PAMF cycle. This plan should be reevaluated at the end of five years and an updated plan developed for subsequent years of program implementation.

Mission Statement
Our mission is to find the best strategies for managing invasive *Phragmites* in the Great Lakes region.

Vision Statement
We envision a program that transforms the way that invasive *Phragmites* management decisions are made throughout the Great Lakes region.

Focus Areas and Goals
1. ***Phragmites* Management**: PAMF management guidance is widely used to reduce the prevalence of invasive *Phragmites* in the Great Lakes region.

2. **Collective Learning**: PAMF uses its annual monitoring and data-driven modeling to understand how invasive *Phragmites* responds to management actions.

3. **Active Participation**: PAMF engages a diversity of active partners, and participation in PAMF is a standard practice for *Phragmites* managers.

4. **Program Sustainability**: PAMF is supported by a stable financial and programmatic knowledge base and reflects evolving management priorities and practices.

[1] Saltonstall, K. (2002). Cryptic invasion by a non-native genotype of the common reed, *Phragmites australis*, into North America. *Proceedings of the National Academy of Sciences*, 99(4), 2445-2449.

[2] Meyerson, L. A., Saltonstall, K., Chambers, R. M., Silliman, B. R., Bertness, M. D., & Strong, D. (2009). *Phragmites australis* in eastern North America: a historical and ecological perspective. Salt marshes under global siege. University of California Press.

[3] Chambers, R. M., Meyerson, L. A., & Saltonstall, K. (1999). Expansion of *Phragmites australis* into tidal wetlands of North America. *Aquatic Botany*, 64(3-4), 261-273.

[4] Saltonstall, K., Peterson, P. M., & Soreng, R. J. (2004). Recognition of *Phragmites australis* subsp. *americanus* (Poaceae: Arundinoideae) in North America: evidence from morphological and genetic analyses. *SIDA*, 21(2), 683-692.

[5] Hazelton, E. L., Mozdzer, T. J., Burdick, D. M., Kettenring, K. M., & Whigham, D. F. (2014). *Phragmites australis* management in the United States: 40 years of methods and outcomes. *AoB PLANTS*, 6, plu001.

[6] Dumoulin, C., Kowalski, K., & Moore, C. Unpublished data.

Objectives and Measures

1. *Phragmites* Management

Goal
PAMF management guidance is widely used to reduce the prevalence of invasive *Phragmites* in the Great Lakes region.

Objectives and Measures
1.1 PAMF management guidance is used to control *Phragmites* in management units.
    1.1.1   For each cycle, optimal or near-optimal PAMF management combination guidance is followed for at least 40% of management units.
    1.1.2   By the end of the 2025/26 cycle, at least 40% of participants receiving guidance will use either an optimal or near-optimal PAMF management combination for at least one MU in the subsequent cycle.

1.2 *Phragmites* infestations are reduced in actively managed units.
    1.2.1   For each cycle, at least 80% of management units that aren't in the lowest invasion state and that followed optimal or near-optimal guidance show a reduction in infestation level by at least one state.
    1.2.2   At least 65% of management units in which optimal or near-optimal guidance is followed for three consecutive cycles show a reduction in infestation levels to the least invaded state at the completion of that three-cycle period.

1.3 PAMF outputs and outcomes are documented for scientific and management audiences.
    1.3.1   By the end of the 2025/26 cycle, a PAMF-based *Phragmites* management best practices guide is created as part of the PAMF's double loop learning process and updated on an as-needed basis.
    1.3.2   By the end of the 2025/26 cycle, a PAMF-based *Phragmites* management best practices guide is available on the GLPC website and distributed through Great Lakes state and provincial natural resource management agencies in all 10 jurisdictions.
    1.3.3   By the end of the 2025/26 cycle, PAMF's design and lessons learned are reported on in four published papers, five national conferences, and ten regional meetings.
    1.3.4   By the end of the 2025/26 cycle, PAMF data are archived and publicly accessible.

2. Collective Learning

Goal
PAMF uses its annual monitoring and data-driven modeling to understand how invasive *Phragmites* responds to management actions.

Objectives and Measures
2.1 PAMF reduces uncertainty surrounding the efficacy of different *Phragmites* management combinations.
    2.1.1   There is no more than 3% variation annually for 70% of probability distributions describing the efficacy of management combinations implemented between 2023 and 2025.
    2.1.2   By the end of the 2025/26 cycle, uncertainty in management outcomes is reduced for at least 70% of the combinations that have been applied to management units in each invasion state.

2.2 High quality and quantity data are used and maintained within PAMF.
    2.2.1   At least 75% of management units have complete and valid data packages for a given cycle.
    2.2.2   PAMF data are quality controlled, well documented, and archived annually to facilitate reproducible analyses.

2.3 The PAMF model is documented, maintained, and improved.
    2.3.1   By the end of the 2025/26 cycle, the model interface is improved to ease end-user interaction and promote data integrity.
    2.3.2   By the end of the 2025/26 cycle, the model's data cleaning processes are standardized and semi-automated to maintain data integrity.
    2.3.3   By the end of the 2025/26 cycle, PAMF's software, documentation, and data management approaches make it possible to reconstruct the outputs of each model run.
    2.3.4   Annual model documentation is thorough and is sufficient to allow model maintenance and updating.

2.4 PAMF uses adaptive management techniques to evaluate its foundational structure.
    2.4.1   By the end of the 2025/26 cycle, PAMF has completed the double loop learning process for the first time.
    2.4.2   PAMF is evaluated annually using the strategic plan.

3. Active Participation

Goal
PAMF engages a diversity of active partners, and participation in PAMF is a standard practice for *Phragmites* managers.

Objectives and Measures
3.1 PAMF maintains engagement of existing partners.
    3.1.1   At least 90% of participants report on the annual feedback questionnaire that they are satisfied with the guidance they received.
    3.1.2   Each year, at least 75% of participants have one or more active management units.
    3.1.3   Each year, at least 20% of active participants enroll one or more new management units.
    3.1.4   Every participant is contacted by PAMF staff at least once per management phase.

3.2 PAMF recruits new participants and partners.
    3.2.1   Gaps in representative participation are identified annually and targeted for future recruitment.
    3.2.2   PAMF staff provide each participant with annual opportunities to engage at least one more PAMF participant because of the clear value received through program involvement.
    3.2.3   By the end of the 2025/26 cycle, 10 participants agree to serve as champions of the program and assist with actively recruiting new participants from diverse sectors.
    3.2.4   PAMF staff provide agencies and organizations with annual content to recommend participation in PAMF or mention PAMF in their communications.

3.3 Management units are representative of the Great Lakes region.
    3.3.1   By the end of the 2025/26 cycle, there is diversity in management unit site ecology and invasion state.
    3.3.2   By the end of the 2025/26 cycle, there is diversity in the organizations that participate in PAMF.

4. Program Sustainability

Goal
PAMF is supported by a stable financial and programmatic knowledge base and reflects evolving management priorities and practices.

Objectives and Measures
4.1 Multiple partners invest in maintaining PAMF.
  4.1.1   By the end of the 2025/26 cycle, a long-term funding model is developed based on identification and evaluation of different potential funding mechanisms.
  4.1.2   By the end of the 2025/26 cycle, funding for PAMF is provided through additional sources than the Great Lakes Restoration Initiative.
  4.1.3   By the end of the 2025/26 cycle, PAMF operations are documented and staff support is maintained through agency partnerships.

4.2 The PAMF program evolves over time based on model learning and participant feedback.
  4.2.1   By the end of the 2025/26 cycle, the PAMF program has been evaluated through the double loop learning processing and necessary updates have been made.
  4.2.2   Annual participant and partner feedback are collected and used to make appropriate program adjustments.

4.3   PAMF is integrated into relevant agency funding and management activities.
  4.3.1   By the end of the 2025/26 cycle, participation in PAMF is a requirement of receiving funding from federal, state, and provincial government agencies for *Phragmites* management in the Great Lakes region.
  4.3.2   By the end of the 2025/26 cycle, member agencies and organizations of the Great Lakes *Phragmites* Collaborative Advisory Committee support PAMF by working with their colleagues to make PAMF a funding requirement and enrolling management units.