

TOMAH MAYFLY MANAGEMENT SYSTEM
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INTRODUCTION

This document describes the process used by the Maine Department of Inland Fisheries and Wildlife (MDIFW) to implement management, research, and outreach programs for recovering the Tomah mayfly (*Siphonisca aerodromia*). Listed as threatened under Maine's Endangered Species Act (12 MRSA, Section 7753) in 1997, this mayfly is currently known to be extant at only 17 sites worldwide – 16 in Maine and one in northern New York. With nearly the entire global population contained within its borders, Maine holds the primary responsibility for conserving this rare species and its habitat for the future.

To begin this process, MDIFW completed a species assessment for the Tomah mayfly in February 2001 (Gibbs et al. 2001). The assessment summarizes all currently known information about the mayfly and includes reviews of past, present, and future habitat condition, population status, research, and management. In March 2001, a public working group established goals and objectives for Tomah mayfly management over the next 15 years. The Commissioner's Advisory Council approved these goals and objectives in October 2001.

The following Management System outlines MDIFW's strategy for achieving the goals and objectives established for managing and recovering the Tomah mayfly.

Management actions are enumerated, and a decision-making process is outlined,

based on the assumption that adequate funding will be available to accomplish these objectives within the current 15-year management cycle. It is also assumed that suitable, willing partners exist locally and sufficient MDIFW staff and resources will be allocated to Tomah mayfly management, research, and outreach. Currently, however, adequate funding and resources are **not** available to MDIFW and, unless they are secured, most objectives cannot be met within the expected deadlines.

Management actions for the Tomah mayfly are prioritized in Appendix 1. Potential partners, estimated costs, and realistic time frames for accomplishing these actions are also suggested. This information should serve as a guide to MDIFW for meeting the goals and objectives established by the public working group.

MANAGEMENT GOALS AND OBJECTIVES

The strategic planning process employed by MDIFW solicits public input in the development of goals and objectives for species management. The following were developed for the Tomah mayfly:

GOAL: Ensure the long-term viability of the Tomah mayfly and its habitat in Maine, and determine the criteria necessary for recovery of the species.

Population Objective 1: By 2002, develop and implement a monitoring plan to determine a statewide population index (e.g. presence/absence and relative abundance) for the Tomah mayfly in Maine.

Assumptions

- Existing methodologies for inventorying mayfly (or similar invertebrate) populations can be applied to develop reliable measures of assessing and monitoring presence/absence, relative abundance, and population trends over time.
- All populations of Tomah mayfly in Maine can be identified.
- Landowner/land manager permission for implementing a monitoring program can be obtained at all sites.
- The monitoring plan and implementation schedule will include considerations for natural fluctuations in population size and distribution.

Population Objective 2: By 2007, complete a statewide survey to identify all Tomah mayfly populations in Maine.

Assumptions

- Because floodplain sedge meadows are abundant in Maine and range in size from small pocket wetlands to expansive systems, comprehensive surveys of all potentially suitable sites may not be possible and, therefore, some Tomah mayfly occurrences may be missed.
- MDIFW ecoregional surveys are adequate to accomplish a comprehensive statewide survey for Tomah mayfly (based on an average of 30-35 potentially suitable sedge meadow wetlands identified per ecoregion).
- By selecting for habitat characteristics comparable to known occurrences, potentially suitable sedge meadow habitats can be identified from existing wetland characterization data.
- When more specific habitat requirements of the Tomah mayfly are identified, the survey site selection process will be re-evaluated, and potential gaps in previously surveyed ecoregions will be addressed.
- Some potentially suitable habitats currently unoccupied by Tomah mayfly could become occupied or re-occupied in the future, particularly in the vicinity of existing populations.

Population Objective 3: Through 2016, maintain existing populations at all sites occupied by the Tomah mayfly.

Assumptions

- Occupied sites include all sites where the Tomah mayfly has been documented in Maine since 1978.
- Population indices developed in Population Objective #1 will be adequate to determine if existing populations at each site are being maintained (*i.e.* stable or increasing).
- Habitat at occupied sites is adequate to continue supporting existing Tomah mayfly populations as long as the natural productivity and ecological integrity of the wetland system is protected from alteration or degradation.
- Life history details, specific habitat requirements, limiting factors, and other critical factors potentially affecting Tomah mayfly populations on a site or statewide basis can be identified.

Habitat Objective 1: By 2007, assess the amount and quality of suitable habitat at priority sites (occupied and unoccupied) as identified by Population Objective #2.

Assumptions

- Priority sites include all sites where the Tomah mayfly has been documented to occur in Maine since 1978, and all unoccupied sites determined to have a high

potential to support Tomah mayfly populations (e.g. based on presence and abundance of key prey species, proximity to occupied sites, extent and quality of available habitat compared to known site characteristics, likelihood of long-term persistence, and management and conservation potential).

- Additional factors determining which seasonally-flooded sedge meadows have a high potential to provide habitat for Tomah mayfly can be identified and incorporated into the selection process for priority sites.
- The Tomah mayfly has been found at only a small percentage (~10%) of the seasonally-flooded sedge meadows surveyed to date (~160 sites), therefore the total number of priority sites is likely to be limited.
- Habitat for Tomah mayfly at each site includes both the suitable wetland and a forested upland buffer.
- The amount of habitat at each site can be adequately derived from existing wetland data (e.g. vegetation type, hydrology, and other habitat parameters).
- Factors determining the quality of potential habitat can be identified.
- The amount and quality of potential habitat for Tomah mayfly can be increased or decreased as a result of both natural and human-influenced events.

Habitat Objective 2: By 2016, protect and manage all habitats supporting the Tomah mayfly in Maine.

Assumptions

- Habitats supporting Tomah mayfly populations include all sites where the Tomah mayfly has been documented in Maine since 1978.
- Habitat protection can be achieved using a variety and combination of land protection tools specific to the needs of each site.
- Landowners/land managers, user groups, municipalities, and the public will support protection and management initiatives.
- Protection and management of Tomah mayfly habitat will be a high priority for conservation organizations and agencies with ownership or management authority on sites supporting the mayfly.
- Habitat protection initiatives will ensure each site can support a viable population of Tomah mayfly over the long-term.
- Habitat protection includes providing adequate upland buffers around wetlands.
- Adequate upland buffer distances can be determined.
- Habitat protection includes monitoring for and mitigating events (natural or human-influenced) occurring in the watershed that might negatively affect the Tomah mayfly or its habitat (e.g. beaver impoundments, irrigation drawdowns, etc).
- Habitat protection includes maintaining the integrity of the existing aquatic invertebrate (*i.e.* prey populations) and native fish (*i.e.* predator/prey dynamics) communities.

- Maintaining habitat may require only monitoring, and little or no management actions.
- Limiting factors affecting the Tomah mayfly can be identified and incorporated into effective management strategies.
- Best management practices for maintaining seasonally-flooded sedge meadows can be identified and incorporated into effective management strategies.
- Factors defining the quality and significance of an individual site to the Tomah mayfly can be identified and incorporated into effective habitat protection and management strategies.

Research Objective: By 2002, identify strategies to determine prey population dynamics, habitat requirements, long-term population dynamics, historic habitat and hydrological changes at each site, and global distribution.

Assumptions

- Existing strategies for similar species and wetland systems can be used as templates to develop methods for researching the Tomah mayfly.
- Local expertise will be available outside of MDIFW to help identify these strategies and pursue research objectives.

Outreach Objective: By 2002, and in conjunction with partners, develop and implement an outreach plan to increase awareness and understanding of the Tomah

mayfly and its habitat requirements in Maine. Outreach should be targeted at towns, landowners/land managers, and the general public.

Assumptions

- Increasing awareness and understanding of the Tomah mayfly and its habitat requirements is essential to the species' recovery.
- Support from both the local and statewide public is necessary.
- Within the Tomah mayfly's limited distribution, key partners and audiences for outreach can be identified and will be receptive to an outreach plan.

MANAGEMENT DECISION-MAKING PROCESS

The following four-part management system provides the framework for managing populations and habitats of the Tomah mayfly in Maine. Further, it identifies a system for determining research strategies to fill key knowledge gaps about the Tomah mayfly, and for improving public understanding and appreciation of this threatened insect.

POPULATION MANAGEMENT SYSTEM

Decision Criteria

The following criteria determine the sequence of procedures used to conserve Tomah mayfly populations in Maine and establish recovery objectives (Figure 1).

Criterion A: *Has a monitoring plan to determine a statewide population index been developed and implemented?*

This criterion addresses the need for reliable indices of population status, size, distribution, and trends statewide, and at each site supporting Tomah mayfly populations. These indices are essential to determining meaningful population objectives and recovery goals, and to monitoring status, future trends, responses to management actions, and progress towards recovery. Information about population size and status is also critical to understanding the relative importance of each site to species recovery, and to developing long-term, site-specific habitat management plans.

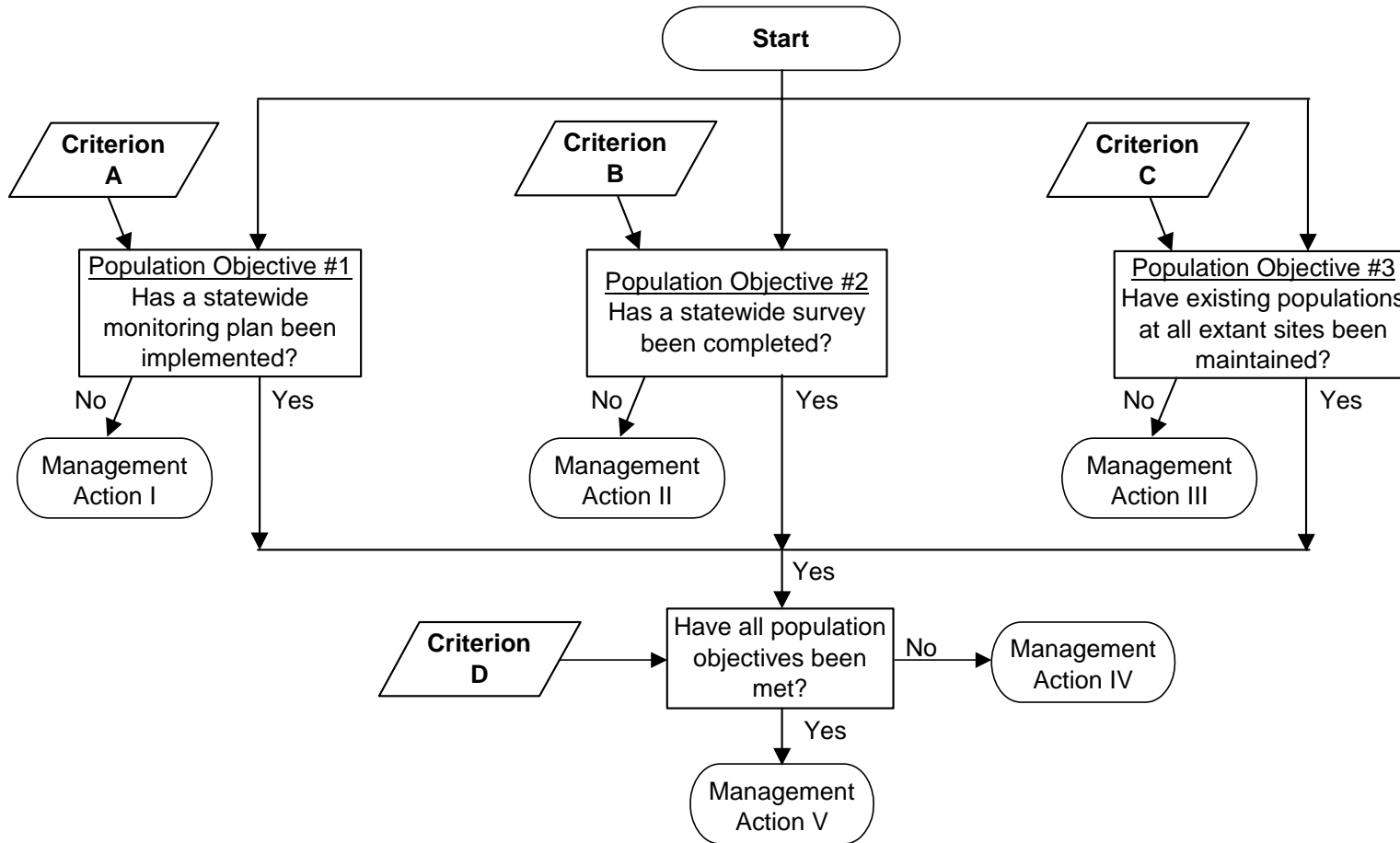


Figure 1. Flow diagram depicting decision criteria for Population Management System for Tomah mayfly in Maine.

An affirmative response will require that a reliable, long-term monitoring plan has been initiated at each site currently known to support Tomah mayfly populations.

Criterion B: *Has a statewide survey been completed?*

This criterion addresses the need to identify all populations of Tomah mayfly in Maine, as well as all sites with the greatest potential to support Tomah mayfly populations. A complete, statewide understanding of the occurrence, distribution, and status of both the Tomah mayfly and its habitat is basic to the realization of all other population and habitat management objectives established for Tomah mayfly.

An affirmative response will be achieved when all seasonally-flooded sedge meadow habitats identified as potential survey sites in each of the 15 ecoregional units (Figure 2) have been surveyed to determine species presence or absence, and the amount and quality of suitable habitat at priority sites has been assessed. Survey gaps, resulting from either a refined site selection process or incomplete coverage of previously surveyed ecoregions, must also be addressed.

Criterion C: *Have existing populations at all occupied sites been maintained?*

This criterion recognizes the significance of each population, and addresses the need to protect all known populations of Tomah mayfly in Maine. Maintaining these populations will ensure recovery efforts for the Tomah mayfly are not jeopardized by a loss of, or significant decline at, any one of the few known occurrences. Both habitat protection and a better understanding of the species' life history requirements, limiting factors, and

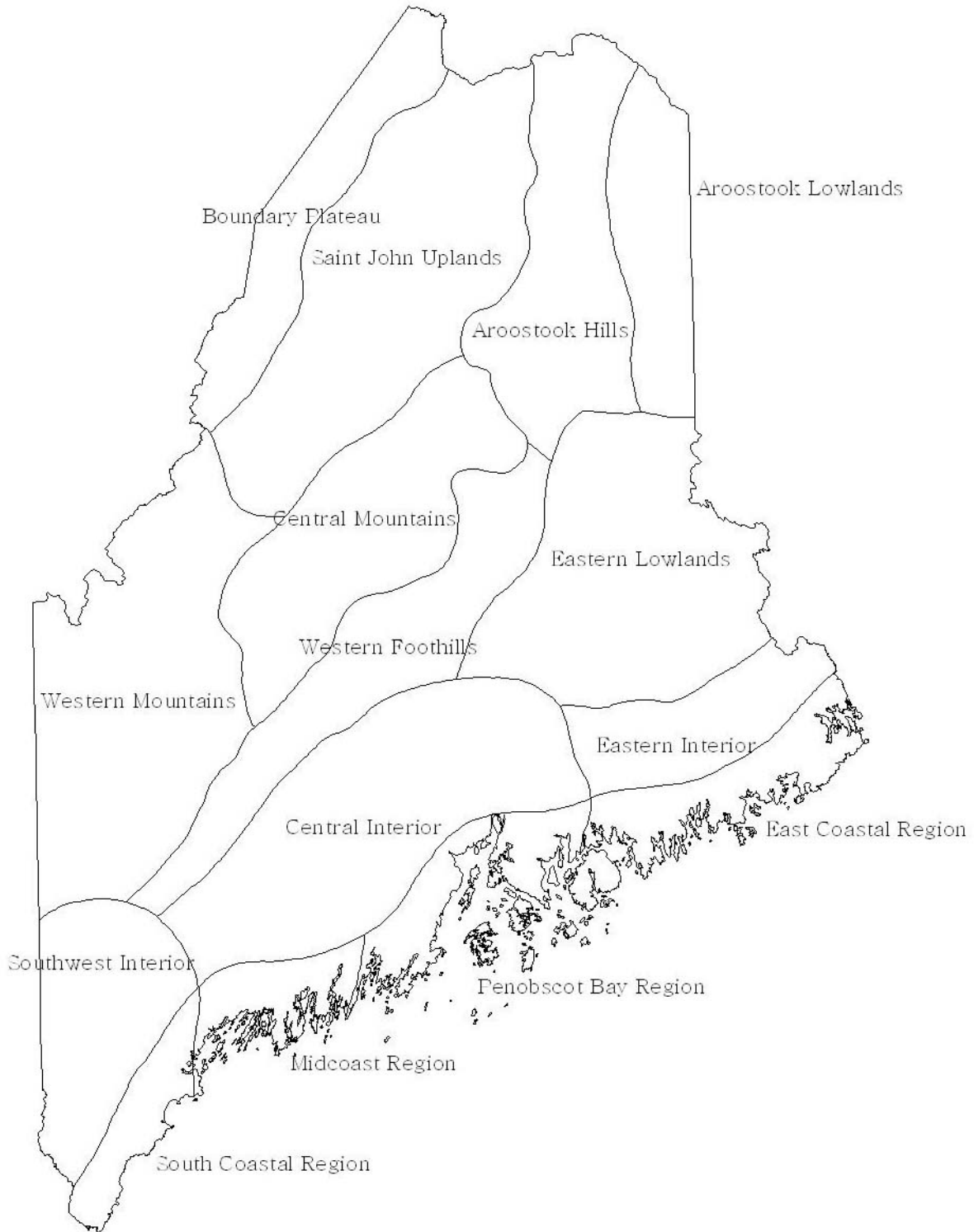


Figure 2. Ecoregional survey units of Maine. Boundaries are based on the biophysical regions of Maine identified by McMahon (1990).

management needs are likely critical to maintaining Tomah mayfly populations over the long-term.

An affirmative response will require that no populations have been lost or experienced significant declines in numbers or distribution, and that the amount and quality of habitat at each site has not been degraded.

Criterion D: *Have all population objectives been met?*

An affirmative response will be achieved when all components of the population objectives have been realized.

Management Actions

The following management actions are the recommended procedures for accomplishing the population objectives. Specific management actions result from responses to decision criteria identified in Figure 1.

Management Action I

- 1) Identify and map each site in Maine known to support a population of the Tomah mayfly.
- 2) By consulting with experts and current literature, develop a monitoring scheme that will yield reliable indices for population status and size, both statewide and at each site. Survey methods should include considerations for natural fluctuations in abundance and distribution (both statewide and at individual sites), and should

accommodate the need for measuring trends, responses to management actions, and progress towards recovery over the long-term.

- 3) Obtain landowner/land manager permission to initiate a long-term monitoring program at each site.
- 4) Establish survey plots and/or transects at each site, and design a monitoring schedule.
- 5) Initiate monitoring program at each site.

Management Action II

- 6) On an ecoregional basis, identify and map all seasonally-flooded sedge meadow wetlands with the potential to support Tomah mayfly populations by:
 - a) screening for potentially suitable sites, based on comparable habitat characteristics at known occurrences, using GIS and existing wetland data layers (e.g. wetland type, soils, hydrology, vegetative cover types, etc)
 - b) compiling all documented occurrences from ME Natural Areas Program records and other reliable sources
 - c) querying field personnel and local sources for knowledge of potentially suitable sites
 - d) refining the site survey list based on additional factors potentially significant to habitat selection by the Tomah mayfly (e.g. proximity to existing sites, documented presence of prey species, wetland size, etc.).
- 7) By ecoregion, survey all potentially suitable sedge meadow wetlands to determine presence or absence and relative abundance of the Tomah mayfly.

- 8) Concurrently (when possible) identify priority sites (occupied and unoccupied) based on critical factors such as presence/absence of Tomah mayfly and/or its prey species, wetland integrity and size, similarity to known occurrences, and proximity to existing populations. Also consider management and conservation potential, likelihood of long-term persistence, etc.
- 9) Determine the amount and quality of potential habitat at each priority site in order to simultaneously accomplish Habitat Objective #1 (Habitat Management System, Criterion A, Management Action I).

Management Action III

- 10) Implement long-term population monitoring program at all occupied occurrences to watch population status and trends at each site (Population Management System, Criterion A, Management Action I).
- 11) Implement habitat protection and management actions (Habitat Management System, Criterion B1/B2, Management Action II) to ensure wetland integrity and habitat quality for the mayfly are maintained at each site.
- 12) Identify and incorporate critical factors of life history, habitat requirements, population dynamics, limiting factors, wetland management techniques, etc in to conservation and management considerations at each site (Research Management System).
- 13) Develop and implement recovery plans at sites where populations have been lost or are experiencing significant declines.

Management Action IV

14) Continue work to meet all objectives.

Management Action V

15) Convene a public working group to develop new population goals and objectives.

16) Develop a new Population Management System based on revised goals and objectives.

HABITAT MANAGEMENT SYSTEM

Decision Criteria

The following criteria determine the sequence of procedures used to conserve Tomah mayfly habitat in Maine (Figure 3).

Criterion A: *Have the amount and quality of suitable habitat at priority sites in Maine been determined?*

This criterion addresses the need to identify, quantify, and evaluate habitat at all sites supporting Tomah mayfly populations in Maine, and at all unoccupied sites determined to have a high potential to support the species. This baseline habitat data is essential to

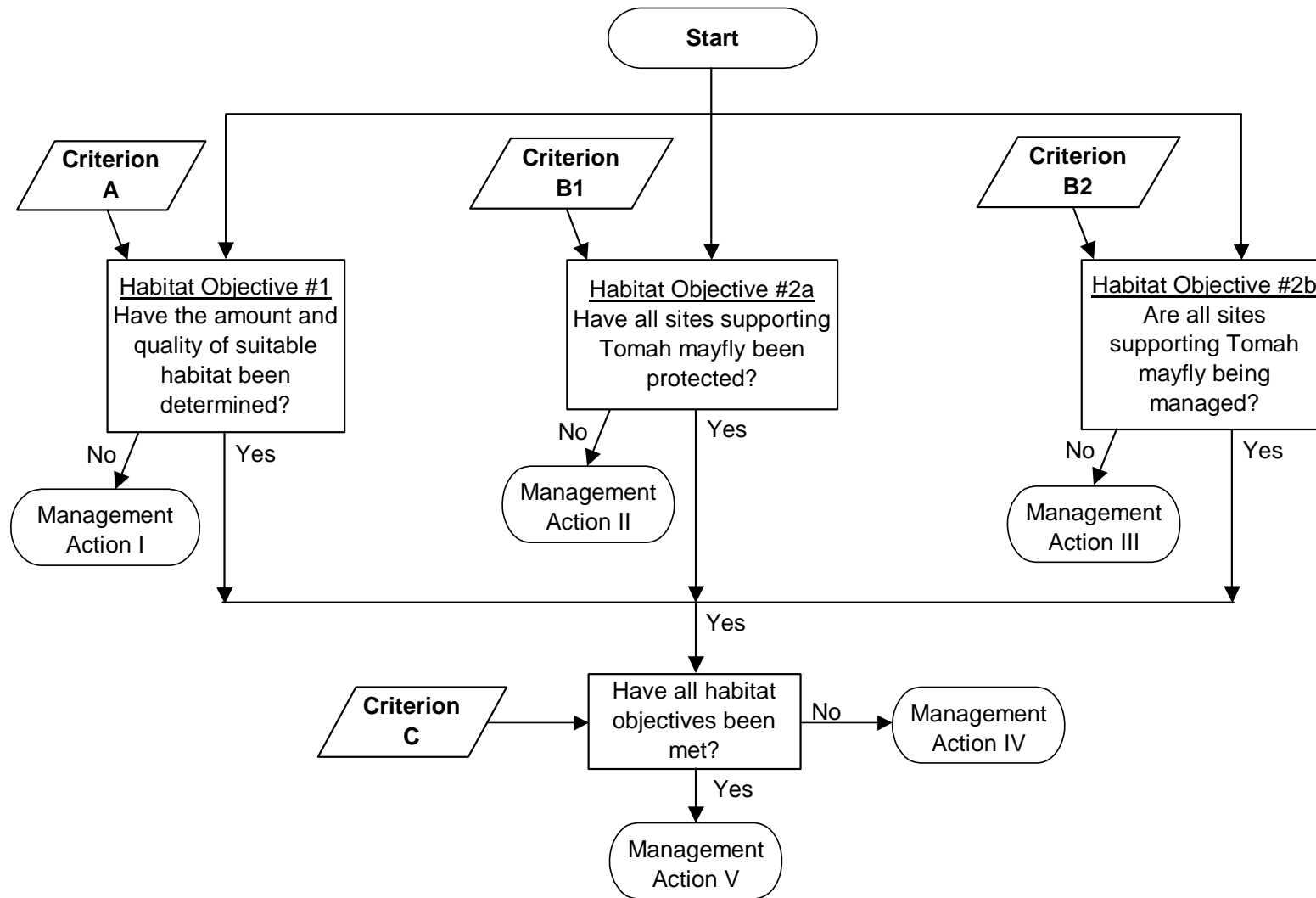


Figure 3. Flow diagram depicting decision criteria for Habitat Management System for Tomah mayfly in Maine.

understanding the mayfly's current status, habitat management needs, and recovery potential.

An affirmative response will be achieved when all potential habitats in the 15 ecoregional survey units of Maine have been identified and surveyed for the Tomah mayfly (Population Management System, Criterion B), and the amount and quality of habitat present at all priority sites has been assessed.

Criterion B1: *Have all sites supporting populations of Tomah mayfly in Maine been protected?*

This criterion recognizes the significance of each extant population to recovery, and addresses the need to protect all sites supporting Tomah mayfly populations to ensure long-term viability of this threatened insect and its habitat in Maine.

An affirmative response will be achieved when every site known to support Tomah mayfly populations in Maine is protected from habitat loss and degradation by an abiding habitat protection strategy (*i.e.* fee ownership, conservation easement, or long-term management agreement held by a conservation agency or organization); and is regulated as a no-spray zone by Maine Board of Pesticides Control and Maine Forest Service.

Criterion B2: *Are all sites supporting populations of Tomah mayfly being managed?*

This criterion addresses the need for site-specific habitat management plans, including habitat monitoring, to be implemented at each site supporting Tomah mayfly populations. It recognizes that habitat management may be critical to maintaining the long-term viability of some seasonally-flooded sedge meadow systems, and that management actions may also enhance existing habitat for Tomah mayfly.

An affirmative response will require that each site supporting populations of Tomah mayfly has been assessed for both short and long-term habitat management needs specific to the mayfly, and a comprehensive management plan for Tomah mayfly has been developed and implemented at each site.

Criterion C: *Have all habitat objectives been met?*

An affirmative response will be achieved when all components of the habitat objectives have been realized.

Management Actions

The following management actions are the recommended procedures for accomplishing the habitat objectives. Specific management actions result from responses to decision criteria identified in Figure 3.

Management Action I

- 17) Develop a system to evaluate the quality of seasonally-flooded sedge meadow wetland systems for the Tomah mayfly.
- 18) For all priority sites identified in the Population Management System (Criterion B, Management Action II), estimate the amount (acreage) and quality of potential habitat available to the Tomah mayfly. Whenever possible, these measurements should be made in conjunction with the statewide population survey objective.

Management Action II

- 19) Identify and notify landowners/land managers of all sites supporting Tomah mayfly populations. Include those whose properties provide upland buffers, or who hold land or water rights that could influence the quality or availability of habitat for Tomah mayfly.
- 20) Provide land owners/land managers with management recommendations for protecting and managing habitat for the Tomah mayfly.
- 21) In conjunction with the Maine Board of Pesticides Control and Maine Forest Service, develop and implement no-spray buffers around all sites supporting Tomah mayfly populations.
- 22) Assess current protection status of each site, based on ownership types and existing land management (e.g. management agreements) and protection measures, including regulatory oversight.

- 23) Prioritize sites based on current protection status, and considering element occurrence rank, vulnerability, threats, management needs, current and future land use demands, opportunities for protection, etc.
- 24) In conjunction with landowners/land managers, develop site protection plans for each site where long-term habitat protection for Tomah mayfly is not already secured. Protection plans should ensure habitat is protected from loss or degradation, and consider all appropriate land protection tools, including fee acquisition, acquisition of land and water rights, conservation easements, management authority, cooperative management agreements, designation of Essential and/or Significant Wildlife Habitat, and municipal and state zoning and permit review processes.
- 25) Implement site protection plans in order of prioritization (see Management Action #23).

Management Action III

- 26) Assess the short and long-term habitat management needs of each site supporting Tomah mayfly populations.
- 27) In conjunction with landowners/land managers, develop a site-specific, habitat management plan for Tomah mayfly at each site. Existing wetland management guidelines for maintaining seasonally-flooded sedge meadow systems should be consulted, and potential conflicts with other rare species management, as well as with existing and future land use objectives, should be considered .

- 28) Prioritize sites based on their element occurrence rank and any immediate need for habitat management to ensure long-term viability of the wetland system for the mayfly.
- 29) Obtain landowner/land manager permission to conduct habitat management activities.
- 30) Implement site-specific management plans in order of prioritization (see Management Action #28).

Management Action IV

- 31) Continue work to meet all objectives.

Management Action V

- 32) Develop a new Habitat Management System based on revised goals and objectives.

RESEARCH MANAGEMENT SYSTEM

Decision Criteria

The following criteria determine the sequence of procedures used to identify strategies to determine key factors affecting Tomah mayfly recovery in Maine (Figure 4).

Criterion A1: *Have strategies been identified to determine the relationship and significance of prey population dynamics to Tomah mayfly populations in Maine?*

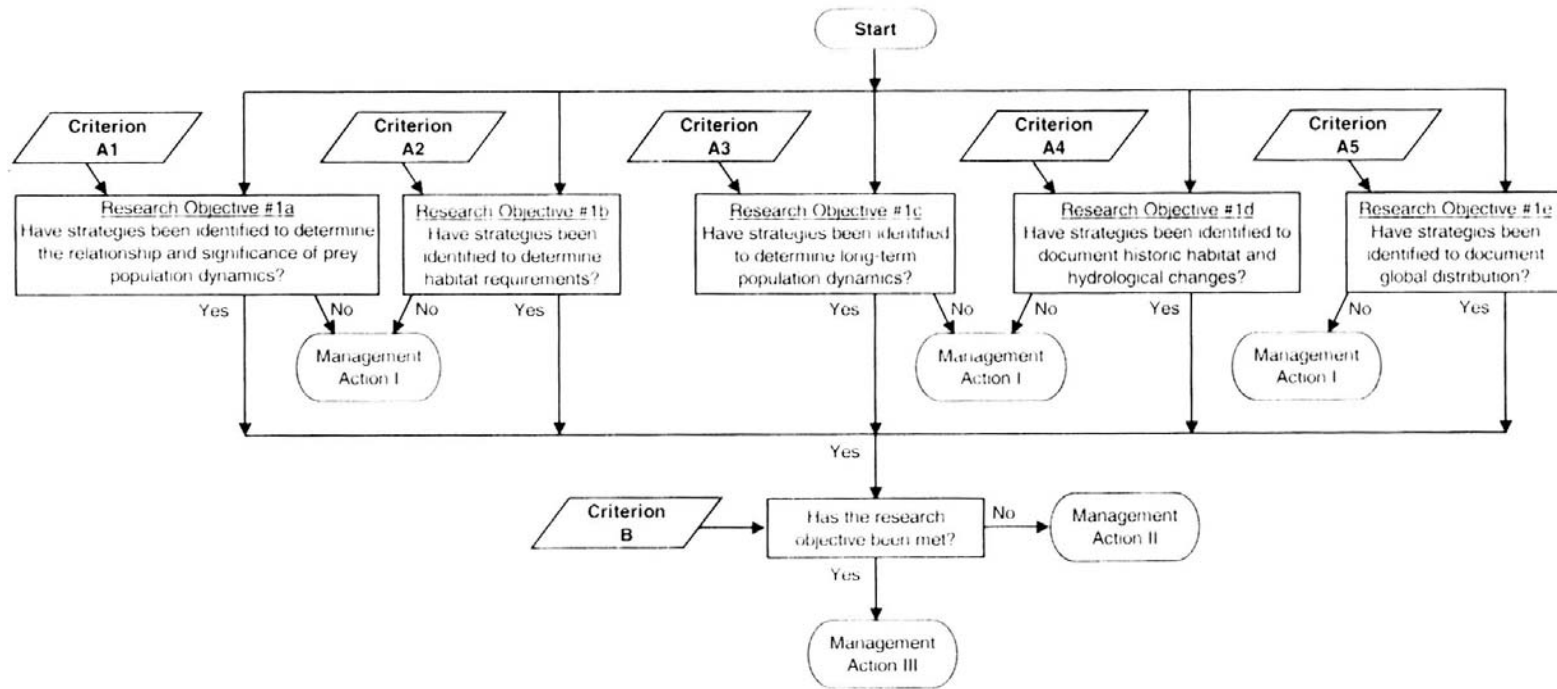


Figure 4. Flow diagram depicting criteria for Research Management System for Tomah mayfly in Maine.

This criterion addresses the need to better understand the role of co-existing mayfly species selected as prey in the occurrence, distribution, and population dynamics of Tomah mayfly in Maine. It recognizes that, while funding and opportunities for research are limited, progress towards filling the knowledge gap about the Tomah mayfly is essential to developing an effective recovery plan.

An affirmative response will require that research partners, when necessary, have been identified, appropriate research strategies have been developed, and adequate funding has been secured.

Criterion A2: *Have strategies been identified to determine the habitat requirements of the Tomah mayfly in Maine?*

This criterion addresses the need to determine the specific habitat requirements of the Tomah mayfly in Maine, and to identify the habitat parameter(s) influencing which sedge meadow wetlands provide suitable habitat for the species. It recognizes that, while funding and opportunities for research are limited, progress towards filling the knowledge gap about the Tomah mayfly is essential to developing an effective recovery plan.

An affirmative response will require that research partners, when necessary, have been identified, appropriate research strategies have been developed, and adequate funding has been secured.

Criterion A3: *Have strategies been identified to determine the long-term population dynamics of Tomah mayfly in Maine?*

This criterion addresses the need to document the dynamics within and between populations of Tomah mayfly in Maine, and determine their significance to recovery. It recognizes that, while funding and opportunities for research are limited, progress towards filling the knowledge gap about the Tomah mayfly is essential to developing an effective recovery plan.

An affirmative response will require that research partners, when necessary, have been identified, appropriate research strategies have been developed, and adequate funding has been secured.

Criterion A4: *Have strategies been identified to document historic habitat in Maine and the hydrological changes that may have occurred at each site?*

This criterion addresses the need to investigate the potential influence of historic events (e.g. dams, impoundments, rechannelization, draining, etc) on the current status and distribution of Tomah mayfly and its habitat in Maine. It recognizes that, while funding and opportunities for research are limited, progress towards filling the knowledge gap about the Tomah mayfly is essential to developing an effective recovery plan.

An affirmative response will require that research partners, when necessary, have been identified, appropriate research strategies have been developed, and adequate funding has been secured.

Criterion A5: *Have strategies been identified to document the global distribution of the Tomah mayfly?*

This criterion addresses the need to document both the historic and current distribution of the Tomah mayfly throughout its range in order to understand its global status, conservation needs, and recovery potential; and also acknowledges the significance of Maine's responsibility in the conservation of this species. It recognizes that, while funding and opportunities for research are limited, progress towards filling the knowledge gap about Tomah mayfly is essential to developing an effective recovery plan.

An affirmative response will require that research partners, when necessary, have been identified, appropriate research strategies have been developed, and adequate funding has been secured.

Criterion B: *Has the research objective been met?*

An affirmative response will be achieved when all components of the research objective have been realized.

Management Actions

The following management actions are the recommended procedures for accomplishing the research objective. Specific management actions result from responses to decision criteria identified in Figure 4.

Management Action I

- 33) Identify and engage research partners, either through university graduate positions or contracts.
- 34) In conjunction with partners, develop research proposals to determine objectives.
Combine objective components wherever feasible.
- 35) Secure adequate funding for research proposals.

Management Action II

- 36) Continue work to meet objective.

Management Action III

- 37) In conjunction with the public working group, develop a new Research Management System based on revised goals and objectives and considering updated information on the mayfly and its habitat.

OUTREACH MANAGEMENT SYSTEM

Decision Criteria

The following criteria determine the sequence of procedures used to increase awareness and understanding of the Tomah mayfly and its habitat requirements in Maine (Figure 5).

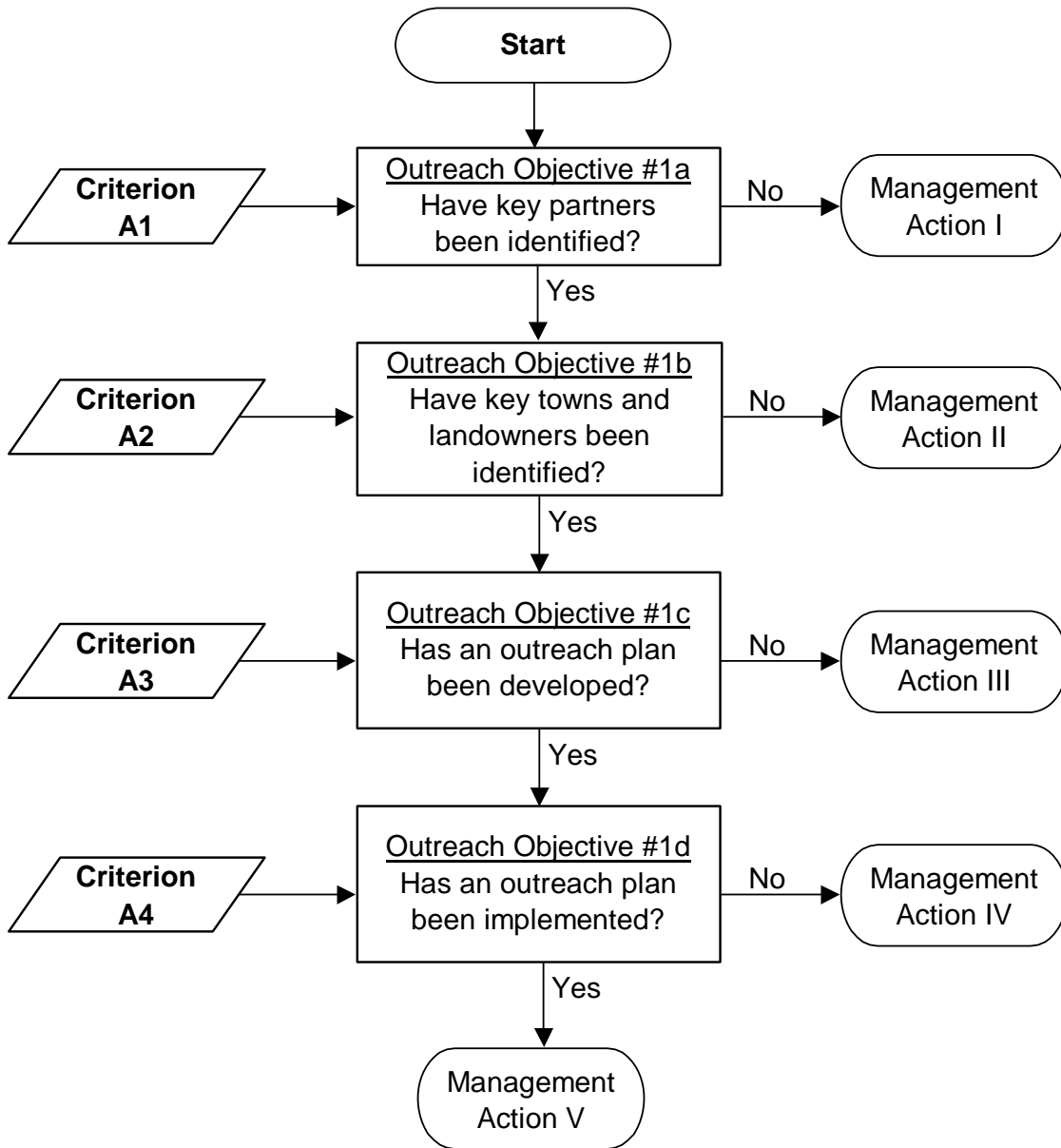


Figure 5. Flow diagram depicting decision criteria for Outreach Management System for Tomah mayfly in Maine.

Criterion A1: *Have key partners been identified?*

This criterion addresses whether key cooperators, at both a local and statewide scale, have been identified for the outreach initiative.

An affirmative response will be achieved when all appropriate partners have been identified and contacted to invite support for and participation in the development and implementation of an outreach plan for the Tomah mayfly.

Criterion A2: *Have key towns and landowners been identified?*

This criterion addresses whether municipalities and landowners/land managers having the greatest potential to affect recovery of the Tomah mayfly have been identified.

An affirmative response will be achieved when all municipalities with jurisdiction over sites supporting or potentially influencing Tomah mayfly populations, and all similarly related landowners/land managers, have been identified.

Criterion A3: *Has an outreach plan been developed?*

This criterion addresses whether a strategy for increasing awareness and appreciation of the Tomah mayfly and its habitat in Maine has been devised.

An affirmative response will require that a brief document outlining outreach objectives, proposed actions, informational materials to be developed, and an implementation schedule, has been produced.

Criterion A4: *Has an outreach plan been implemented?*

This criterion addresses whether a program for increasing awareness and appreciation of the Tomah mayfly and its habitat in Maine has been initiated.

An affirmative response will be achieved when outreach actions have been initiated and informational materials have been developed and distributed to all target audiences.

Management Actions

The following management actions are the recommended procedures for accomplishing the outreach objective. Specific management actions result from responses to decision criteria identified in Figure 5.

Management Action I

38) Identify landowners/land managers, municipalities, conservation entities, and user groups who are potential partners in an outreach initiative for the Tomah mayfly.

Consider all parties, on both a local and statewide scale, whose support, interest, and expertise would benefit recovery goals and objectives.

39) Engage support and involvement from MDIFW's Public Information and Education Division.

Management Action II

- 40) Identify all municipalities and landowners/land managers with jurisdiction over sites supporting or potentially influencing Tomah mayfly populations. Include those whose properties provide upland buffers.

Management Action III

- 41) Produce a brief document which identifies cooperators, target audiences, and potential funding sources; and outlines the outreach objectives, proposed strategies and actions, participant roles, informational materials to be developed, methods and sites of delivery, and an implementation schedule.

Management Action IV

- 42) Develop and produce informational materials.
- 43) Distribute outreach materials and activate implementation plan.

Management Action V

- 44) Develop a new Outreach Management System based on revised goals and objectives.

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Gibbs, K.E., et al. February 21, 2001. Tomah mayfly assessment. Maine Department of Inland Fisheries and Wildlife, Wildlife Division, Resource Assessment Section, Endangered and Threatened Species Program, Bangor, ME.

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APPENDIX 1. PRIORITIZATION AND ESTIMATED COSTS OF MANAGEMENT ACTIONS

| ORDER WITHIN PRIORITY | PRIORITY | ACTION # | MANAGEMENT ACTION | POTENTIAL PARTNERS | TIME FRAME | ESTIMATED COSTS | COMMENTS |
|-----------------------|----------|----------|---|---|------------|-----------------|--|
| 1 | HIGH | 6 | Identify all sites with potential habitat. | private contractor(s); MNAP and USFWS/UMO COOP Unit assistance with identifying and estimating potential habitat; possibly contract with USFWS/UMO COOP Unit to develop habitat assessment scheme | 6 yrs | \$66,000 | costs include \$8000-\$10,000/yr to hire 2 seasonal (6-8 wks) contractors for up to 6 yrs (if surveys conducted via ecoregional surveys); \$6000 to hire 1 contractor for 6-8 wks to develop habitat assessment scheme |
| | HIGH | 17 | Develop system to evaluate quality of potential habitat. | | | | |
| | HIGH | 7 | Survey all sites with potential habitat. | | | | |
| | HIGH | 8 | Identify priority sites. | | | | |
| | HIGH | 9, 18 | Estimate amount and quality of potential habitat at priority sites. | | | | |
| 2 | HIGH | 19, 20 | Identify landowners at all sites supporting Tomah mayfly, and provide them with habitat management recommendations. | private contractor; MNAP assistance with identifying landowners; implementation may require partnerships with landtrusts, TNC, landowners, and/or state and municipal agencies | 1 yr | \$6000 | cost to hire one temporary contractor for 8-10 weeks |
| | HIGH | 21 | Work with MBPC and MFS to develop and implement no spray buffers around Tomah mayfly sites. | | | | |
| | HIGH | 22 | Assess current protection status of each site. | | | | |
| | HIGH | 23 | Prioritize sites for protection. | | | | |
| | HIGH | 24 | Develop site protection plans. | | | | |
| | HIGH | 11, 25 | Implement site protection plans. | | | ?? | implementation costs unknown |
| 3 | HIGH | 26 | Assess habitat management needs at each site. | private contractor, landowners, USFWS Partners for Wildlife, federal ET landowner incentives programs; MNAP assistance with landowner contacts | 1 yr | \$6000 | cost to hire one temporary contractor for 8-10 weeks; may depend on prior research results; could be combined with #19-23 for efficiency |
| | HIGH | 27 | Develop site-specific habitat management plans. | | | | |
| | HIGH | 28 | Prioritize sites for habitat management needs. | | | | |
| | HIGH | 29 | Obtain landowner permission to implement habitat management at each site. | | | | |
| | HIGH | 11, 30 | Implement habitat management plans. | | | ?? | implementation costs unknown |
| 4 | HIGH | 1 | Identify all sites supporting Tomah mayfly. | private contractor(s) or university graduate position(s); MNAP assistance with landowner contacts | current | \$0 | use current EOs tracked in BCD |
| | HIGH | 2 | Develop a statewide population monitoring plan. | | 2 yrs | \$15,000 | cost estimate for development and first year implementation of plan only; includes \$6000/yr for seasonal (~4-6 wks) contractor |
| | HIGH | 3 | Obtain landowner permission to implement population monitoring plan at each site. | | | | |
| | HIGH | 4 | Establish population survey plots and transects, and design monitoring schedule. | | | | |
| | HIGH | 5, 10 | Initiate population monitoring program at each site. | | | | |
| 5 | HIGH | 33 | Identify and engage research partners. | university and/or private contractor(s) | 4 yrs | \$200,000 | costs include funding to implement 3-4 graduate projects |
| | HIGH | 12, 34 | Develop research proposals. | | | | |
| | HIGH | 35 | Secure adequate funding for research proposals. | | | | |
| 6 | HIGH | 13 | Develop and implement recovery plans. | private contractor | <1 yr | \$6,000 | cost to hire one temporary contractor to develop recovery plan(s); implementation costs unknown |
| 1 | MEDIUM | 38 | Identify and engage outreach partners. | private contractor | 2 yrs | \$15,000 | costs include ~\$5000 to hire one temporary contractor (6-8 weeks) and ~\$10,000 to produce outreach materials and implement plan |
| | MEDIUM | 39 | Engage support and involvement of I&E. | | | | |
| | MEDIUM | 40 | Identify outreach targets. | | | | |
| | MEDIUM | 41 | Develop outreach plan. | | | | |
| | MEDIUM | 42 | Develop and produce outreach materials. | | | | |
| | MEDIUM | 43 | Implement outreach plan. | | | | |

MINIMUM TOTAL ESTIMATED COSTS = \$314,000
 (costs of MDIFW staff time, site protection, habitat management, and recovery plan implementation are not included)