



Evaluation of Implementation of the
“Minnesota Management Plan for Invasive
Species”
2023 Summary Report

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Evaluation Background

This report summarizes the findings from the Minnesota Invasive Species Advisory Council's (MISAC) evaluation of statewide implementation of the "[Minnesota Management Plan for Invasive Species](#)" (hereafter, plan). The plan received a major revision in 2022, and the revised plan states that MISAC will evaluate implementation every four years. This is the first such evaluation, conducted in 2023.

The evaluation focused on the strategies and actions under each major plan "Element" and the plan's "Priorities for Action" (beginning on plan pages 74 and 95). MISAC formed Element Committees to rate implementation of the plan strategies and actions under each Element. Committee members rated implementation of the actions, then met to discuss and determine final ratings for each strategy under their respective Element. We also surveyed partner organizations statewide to allow them to rate how Minnesota organizations are doing in implementing the plan strategies and actions and identify those strategies and actions they are currently implementing. In addition, MISAC engaged content experts to draft brief summaries of progress in addressing the plan "Priorities for Action".

Evaluation Summary

MISAC Ratings: Implementation of Plan Elements and Strategies

MISAC rated progress in implementing the "Prevention" Element as "average". Research in understanding risks of invasive species is one area where implementation is "above average". However, there is a need for more research aimed specifically at supporting and improving invasive species prevention. MISAC assigned an "average" rating for implementation of strategies involving public awareness, coordination, state regulations, and funding related to invasive species. Strategies that received ratings of "needs improvement" related to regulations, enforcement, "managing for prevention", and evaluation of prevention efforts. Specific areas for improvement include increasing funding and staffing to support enforcement, education to sellers of live organisms regarding invasive species laws, and potentially development of local-level invasive species laws.

MISAC also rated implementation of the "Early Detection, Response and Containment" Element "average". The Aquatic Invasive Species (AIS) Detectors program and wide adoption of common online tools for detection led to an "above average" rating for the "Detection" Strategy. Areas that need improvement include enforcement, as with the "Prevention" Element, and evaluation of cost effectiveness. It was noted that there is a lack of the baseline information needed to conduct this type of evaluation. Other strategies received "average" ratings, such as invasive species databases; detection, response, and containment research; development and implementation of response plans; funding for detection; prioritizing containment; and monitoring spread. Alteration of funding structures to support more long-standing professional positions focused on invasive species would lead to improved follow-through on some projects.

Implementation of strategies under the "Management" Element "needs improvement." MISAC gave an "average" rating to the strategies involving prioritizing species and populations for control; developing, refining, and implementing integrated pest management plans; and management research and technologies. Specific strategies that were rated "needs improvement" included coordination and communication, funding, rehabilitation and restoration, and especially evaluation. MISAC members discussed the need for statewide management goals and management practices from which to evaluate progress, as well as funding to support evaluation. Regarding coordination and communication, more

entities can and should be included in the development, implementation, and evaluation of invasive species management. Most management is specific to projects or areas rather than state- or region-wide.

The “Leadership and Coordination” Element received a “needs improvement” rating from MISAC members. As a dedicated group, MISAC provides an effective forum for facilitating communication and coordination between entities working on invasive species in Minnesota. MISAC’s involvement in supporting the Upper Midwest Invasive Species Conference is a key example of this. Leadership and coordination at the local level was rated as “average”, with stronger local involvement and resources for aquatic compared to terrestrial invasive species (TIS). Areas that “need improvement” included coordination with other jurisdictions and supporting diversity, equity and inclusion (DEI). MISAC members discussed the need to survey its membership for understanding of regional, national, and international entities beyond Minnesota. While Minnesota is a leader in changing species naming conventions and MISAC annually reviews and invites new members, there is a need to improve understanding of and integrate indigenous knowledge. Partner organizations need dedicated leaders to support DEI.

Hundreds of individuals with a stake in invasive species prevention and management were invited to take the survey conducted as part of this evaluation process. MISAC invited the same individuals and organizations that were invited to weigh in on the 2022 plan revision. From March 20, 2023 to April 22, 2023, approximately 51 individuals took the survey, rating progress and identifying the actions they are implementing. At least 18 of these were MISAC members (not all survey takers identified themselves or their organizations). Respondents were affiliated with tribal, local, county, state, and national government agencies and non-profit, volunteer, private, and research entities. Based on the survey responses, all the plan’s strategies and nearly all of the actions are being implemented. No organizations said they were implementing action I.6.c. “Collaborate with foreign cooperators in offshore mitigation of pests” for aquatic invasive species (though the 2022 plan indicates that the U.S. Fish and Wildlife Service and the U.S. Department of Agriculture’s Animal and Plant Health Inspection Service may be leading this). Appendix A includes updated implementation tables indicating the groups implementing each action from the plan.

Progress related to Plan “Priorities for Action”

Many organizations are working to address the “Priorities for Action” laid out in the state plan. Examples of recent progress include:

- Efforts to support climate change-resilient ecosystems, such as replanting native species following invasive species removals.
- Implementation of various strategies to prevent the spread of high-priority species. For example:
 - Engaging diverse partners in an annual search for new starry stonewort populations.
 - An effort to detect and control invasive *Phragmites* statewide.
 - Proposed listing of jumping worms as prohibited invasive species.
 - The addition of nine new species to the Minnesota Noxious Weed List.
- Support and completion of many ground-breaking research projects on a wide range of species and issues. Just some of the notable research includes:
 - Development of new methods for:

- Detecting an invasive fungus which causes diseases in pine trees.
 - Using satellite imagery to detect oak wilt.
 - Using drones and machine learning to detect and map invasive *Phragmites*.
- Documentation of invasive *Phragmites* locations in Minnesota and initiation of a statewide coordinated control effort.
- Advancement of multiple soybean lines with resistance to soybean aphid.
- Investigation of novel methods for zebra mussel and invasive cattail control.
- Assessment of risks posed by trade pathways for invasive species, and development and distribution of new invasive species prevention guidance for businesses and customers in the pet, horticulture, food, and biological supply trades.
- Implementation of community-based social marketing strategies to promote best practices for AIS prevention.
- Increased efforts to educate and support participatory science reporting for non-native species, resulting in improved density and distribution data for many species, and in some cases supporting regulatory decisions.

Implementation of Plan Elements

Element 1: Prevention

Overall rating by MISAC: Average

Overall Element Rating from Survey: Needs improvement (mean = 1.87, variance = 0.70)¹

1. Understand Risks

Final rating: Above average

Discussion: Minnesota has two funded research centers for invasive species, the Minnesota Aquatic Invasive Species Research Center (MAISRC) and the Minnesota Invasive Terrestrial Plants and Pests Center (MITPPC), which gives us an advantage over other states in conducting research to better understand risks.

2. Coordination

Final rating: Average

Discussion: Minnesota has above average coordination for weeds, with regular coordination between invasive plant staff across the Minnesota Department of Agriculture (MDA), the Minnesota Department of Natural Resources (DNR), the University of Minnesota Extension, the U.S. Forest Service, etc.

3. State Regulations

Final rating: Average

Discussion: There is room for improvement in this strategy. Minnesota generally has reasonable regulations, but we lack adequate mechanisms for enforcement.

4. Tribal, State and Local Regulations

Final rating: Needs improvement

¹ In the survey of partner organizations, participants were asked to rate each action in the plan as: 1 – Needs Improvement, 2 – Average, 3 – Above Average, or 4 – Excellent. Overall Element ratings from the survey were assigned according to the mean of all the action ratings under each Element as “Needs improvement” (1-1.99), “Average” (2-2.99), “Above Average” (3-3.99) or “Excellent” (4).

Discussion: Regulations have not been implemented at the local level. Especially outside of the Twin Cities Metro region, few cities or counties have regulations related to invasive species prevention. This is likely due at least in part to a lack of staff capacity and knowledge at the local level.

5. Federal Regulations

Final rating: Needs improvement

Discussion: The strength of federal regulations differs across taxa. For example, plant regulations are weaker at the federal level than for the state of Minnesota, while insect regulations are stronger at the federal level (e.g., quarantines) than at the state level. AIS has some comprehensive federal regulations, including those related to ballast water. There also appears to be a lack of organization and leadership on invasive species regulation at the federal level via the invasive species advisory council.

6. Federal and State Inspections and Enforcement

Final rating: Needs improvement

Discussion: As referenced in the discussion about strategy 3, more enforcement of existing regulations is needed all around. Some of the barriers to this include funding and staff capacity. Agricultural inspectors are tasked with enforcing the Noxious Weed Law for invasive plants, but they are not funded positions. There is also a lack of knowledge at nurseries and plant sales regarding which species are or are not regulated – there are so many species listed that it is hard to keep track of, so perhaps more education is needed.

7. Local Enforcement

Final rating: Needs improvement

Discussion: Turnover at the local/county level is high, among staff in general and agricultural inspectors. County sheriffs are supposed to enforce AIS regulations, but this is not a priority for them (many counties have to pay dedicated overtime for this purpose). For some sheriffs, this is not an area of their expertise, so they are hesitant to write a ticket if they themselves don't feel knowledgeable on this issue. Perhaps enforcement of invasive species prevention should be more of a state role via increasing the number of conservation officers who have more training on invasive species.

8. Prevention Research and Technology

Final rating: Above average

Discussion: Survey respondents rated this Needs Improvement, while MISAC members and our discussion group rated it Above Average. While we have the invasive species research centers who engage in this research, but there may be a gap in communication – there's a big body of research, but the perception is that because of lack of enforcement, our technology and approaches are viewed as insufficient. In actuality, there are lots of new technology and tools. The discussion group noted that there is a related question under the Management Element, and that was rated by the general survey respondents as Average, so maybe there is a lack of *prevention* research; "needs improvement" could mean "needs more."

9. Public Awareness

Final rating: Average

Discussion: No discussion; survey and MISAC members were in agreement.

10. Regional Approaches

Final rating: Average

Discussion: Different methods work in different regions of the state, and especially, what works in the Metro area does not necessarily work in outstate Minnesota. People do a lot of things differently in different places, and it works for them locally.

11. Manage for Prevention

Final rating: Needs improvement

Discussion: There are strides being made here, including some newer work on replanting in aquatic systems as well as ongoing research part of the Cover it up! buckthorn project. There are still knowledge gaps – we do not know how to do this well or effectively in different systems. There is also a lack of funding – groups can get funding for invasive species removal but it is harder to secure funding for replanting. Minnesota is probably similar to other states, but no one is doing enough.

12. Funding

Final rating: Average

Discussion: There are major discrepancies between AIS and TIS funding levels. However, compared to other states Minnesota is average. There are big differences in the type and extent of outreach campaigns between AIS, insects, and plants.

13. Evaluation

Final rating: Needs improvement

Discussion: It is very difficult to evaluate prevention because you cannot prove a negative. Evaluation can be done through surveillance (which we do not think there is enough of in Minnesota) or by measuring intent (which has been done some regarding AIS prevention). For example, there is a lot of data on failure rates on boat inspections, but less data collection is done when inspectors are not there (failure rate would likely be higher if people did not know they were being watched).

Element II: Early Detection, Response and Containment

Overall Element Rating by MISAC: Average

Overall Element Rating from Survey: Average (mean = 2.04, variance = 0.68)

1. Detection

Final Rating: Above Average

Discussion: One example of invasive species detection in Minnesota is the AIS detector program. The frequent and common use of online tools such as EDDMapS and iNaturalist also contribute to the “above average” rating since these tools help both professionals and the public easily report incidents of both AIS and TIS. Overall, Minnesota is doing very well with invasive species detection.

2. Database

Final Rating: Above Average

Discussion: One way Minnesota is doing well in the Database category is by using EDDMapS. Minnesota utilizes EDDMapS as its main reporting database for invasive species. EDDMapS makes reporting easy and accessible to all, and therefore can be used by professionals and the public alike.

3. Prioritize Detection

Final Rating: Average

Discussion: Most invasive species that are present in Minnesota make it a necessity to prioritize invasive species detection. Examples of the prioritization of detection include volunteer event days centered around invasive species identification.

4. Detection Research and Technology

Final Rating: Average

Discussion: One example of Minnesota's invasive species detection research and technology is the University of Minnesota's invasive species research centers, MAISRC and MITPPC. This research includes eDNA, early detection of zebra mussels with multibeam sonar, etc. However, the University's research with invasive species is more than just detection based, which is ultimately why this category was rated "average". Additionally, there are always opportunities to increase research with TIS, such as using AI to detect weed seeds in seed mixes.

5. Develop Response Plan

Final Rating: Average

Discussion: In Minnesota, it does appear that AIS have more structure than TIS when it comes to response plans. The Minnesota DNR has a response plan in place for the detection of AIS. The MDA also has TIS protocols such as notifying the public, creating EDDMapS reports, and archiving samples at the Bell Museum. Many folks in Minnesota have started to use ISMTrack as well, but more development is needed, as well as more awareness of the tool itself.

Ideas for Improvement: Develop an interagency response plan for TIS.

6. Implement Response Plans

Final Rating: Average

Discussion: See above.

7. Response Research and Technology

Final Rating: Average

Discussion: A rating of "average" was selected due to the fact that most of the research being done in the state is on management of already established invasive populations.

8. Enforcement

Final Rating: Needs Improvement

Discussion: There is a lack of funding and capacity to dedicate to the enforcement of both terrestrial (ex: County Ag Inspectors) and AIS. It is also very difficult to contain internet sales of invasive species (although this may be more of a prevention issue).

9. Funding

Final Rating: Average

Discussion: In the current period, there seems to be more federal funding available than there are people to apply for it. Ultimately, there is a need for funding structures to change to allow permanent employees the ability to submit proposals and oversee projects.

10. Prioritize Containment

Final Rating: Average

Discussion: An "average" rating was selected due to a lack of evidence to suggest otherwise. The AIS explorer tool is a good example of the action listed under this category.

11. Monitor Spread

Final Rating: Average

Discussion: It is difficult to monitor for terrestrial and aquatic invasive plants (and other taxa) because of the time it takes to follow up on populations.

Ideas for Improvement: Create a network of people to follow up on populations that are uploaded to EDDMapS to ensure all reports are up to date.

12. Evaluate Cost Effectiveness

Final Rating: Needs Improvement

Discussion: Not much is being done in the realm of evaluating cost effectiveness for invasive species early detection, response, and containment in Minnesota. The MDA has conducted past work with an economist on cost-benefit models for TIS in the state. However, there is a lot of work to be done in this strategy due to the need for baseline information for each species to be evaluated.

13. Risk Reduction

Final Rating: Average

Discussion: The use of boot brushes and boat cleaning stations in Minnesota contribute to risk reduction, as well as the large amount of outreach centered around prevention by cleaning off gear. The “average” rating is based on the fact that there is room for improvement when it comes to reducing the risk of spreading invasive species, especially on the terrestrial side. Additionally, reducing the risk of the spread of TIS through certain pathways (ex: utility ROWs, construction equipment, etc.) may involve regulation and enforcement that we don’t have the infrastructure for.

Ideas for Improvement: Increasing capacity to be able to enforce regulations that reduce the risk of spread of TIS in certain pathways.

14. Containment Research and Technology

Final Rating: Average

Discussion: Once again, Minnesota has two research centers in Minnesota that focus on aquatic (MAISRC) and terrestrial (MITPPC) invasive species research. Since the centers are fairly new, we are just beginning to see projects wrap up and having findings be implemented. It is important to note that MAISRC is older than MITPPC and therefore they have more developments on the AIS side. The “average” rating was given due to the fact that there is less research being done on TIS containment than AIS containment (ex: fish barriers, toxic bait, etc.).

Element III: Management

Overall Element Rating by MISAC: Needs Improvement

Overall Element Rating from Survey: Needs improvement (mean = 1.95, variance = 0.59)

1. Prioritize

Final Rating: Average

Discussion: MISAC created an overall threat rating for all species which is included in the Statewide Management Plan. Many agencies have individual priority lists of species based on varying criteria.

2. Develop and Refine Integrated Pest Management (IPM) Plans

Final Rating: Average

Discussion: Partnerships between state agencies, Universities, and private industry create IPM Plans and refine them as new research is conducted. MITPPC and MAISRC can conduct research to develop or refine IPM plans.

3. Implement IPM Plans

Final Rating: Average

Discussion: As species are detected in new locations the current IPM plans are provided to managers. Resource managers implement the IPM plans to the best of their ability. Funding, time, and staff influence how, when, and where IPM plans are implemented.

4. Coordination and Communication

Final Rating: Needs Improvement

Discussion: MISAC meetings encourage coordination and communication of management activities however, more needs to be done. There are more entities that can and should be included in the development, implementation, and evaluation of invasive species management. The MISAC calendar does communicate management activities for certain projects or species. Future MISAC meeting discussions could talk about if management is working well for all agencies, programs, and projects. The current MISAC member updates during meetings are too short to go in depth about how the work aligns with the Plan.

5. Management Research and Technology

Final Rating: Average

Discussion: Minnesota has funding allocated specifically for AIS and TIS research centers. These centers are able to conduct research on management activities and new technologies.

6. Evaluation

Final Rating: Needs Improvement

Discussion: This was identified as one of the top priorities in discussion among MISAC members. Do we have models for evaluation of best management practices, and can agencies allocate time and funding to this strategy? There is a need for statewide management goals to evaluate our progress against. Management goals are not specific enough to evaluate.

7. Funding

Final Rating: Needs Improvement

Discussion: There is an overall lack of funding for widespread invasive species management. Both AIS and TIS management are specific to projects or areas and not statewide.

8. Rehabilitation and Restoration

Final Rating: Needs Improvement

Discussion: Will it improve rehabilitation and restoration funding opportunities if we can evaluate and show management works?

Element IV: Leadership and Coordination

Overall Element Rating by MISAC: Needs improvement

Overall Element Rating from Survey: Average (mean = 2.02, variance = 0.69)

1. Facilitate Coordination

Final Rating: Above Average

Discussion: MISAC, as a dedicated and active group, keeps those in Minnesota working on invasive species working together. MISAC actively seeks and discusses advances in managing invasive species and the current status of invasive species of concern in Minnesota.

2. Communication

Final Rating: Average

Discussion: While implementation of a few actions in this strategy are lacking, others are strong. Tribal consultation and annual meetings with DNR related to invasive species are either not happening or not well publicized. While MISAC's website contains plentiful resources and partner sites, the educational components of the site are average when compared to other agency web pages. MISAC promotes interagency networking through our support of a regional conference on invasive species (i.e., the Upper Midwest Invasive Species Conference).

3. Local

Final Rating: Average

Discussion: The degree of local and community-based partnerships varies by taxa. AIS management is well-funded, and countless local connections support management. However, many stakeholders and organizations in Minnesota working on TIS management do not get the financial support needed (e.g., no county funding). The state also has very few CISMAs or opportunities to support terrestrial invasive management financially.

4. Regional Entities

Final Rating: Needs Improvement

Discussion: MISAC is surveying members to determine who participates in which regional groups and where Minnesota representatives are needed. While MISAC has continued to support UMISC, there are areas for improving this strategy. Response to invasive species at the border could be more collaborative and increase regional representation at MISAC and Minnesota representation in regional groups.

5. Neighboring States and Provinces

Final Rating: Needs Improvement

Discussion: MISAC has not developed a key of neighboring state and province contacts. While MISAC did host speakers (e.g., border agents and Wisconsin Sea Grant) at the quarterly meetings, relationships with North Dakota, South Dakota, and Iowa could be improved.

6. Support Diversity, Equity, and Inclusion

Final Rating: Needs Improvement

Discussion: While Minnesota is a leader in changing naming conventions, actions in this strategy and identifying leaders can be improved. MISAC routinely reviews membership and calls for suggested invitees to the council to improve the diversity of membership. MISAC and other organizations must improve their understanding of and integrate indigenous knowledge in invasive species management whenever possible. Actions under this strategy lacked identified terrestrial and aquatic leaders, and all partner organizations have some responsibility for these actions if the aim is to improve effective collaboration that considers and serves all communities.

7. National Entities

Final Rating: Needs Improvement

Discussion: MISAC is surveying membership for involvement in national entities to determine if national groups are missing Minnesota representatives.

8. International Entities

Final Rating: Needs Improvement

Discussion: MISAC is surveying membership for involvement in international entities to determine if international groups are missing Minnesota representatives.

Notes on the rating process

MISAC members made some important observations about the rating scheme that will be important to consider in the next evaluation. It may be beneficial to change the rating scale used or further define or calibrate participants' understanding of these categories. The rating categories were: Needs improvement, Average, Above Average, or Excellent. Some Element Committees interpreted the "Needs improvement" rating as serious (i.e., things are bad), whereas others interpreted it simply as below

average. Most groups also began to inform their ratings based on their understanding of other states' work. However, not all groups had a detailed understanding about other states' work, so the "average" category could be changed to "fair". Note "Excellent" was the highest possible rating, which none of the strategies received (i.e., improvements in implementation could be made in all areas).

Progress Towards Addressing Plan "Priorities for Action"

Integrate climate resiliency into all aspects of invasive species management

Invasive species that previously could not survive in Minnesota may be able to survive and thrive in the future under a changing climate. A key action currently employed by state regulatory agencies is to explicitly incorporate climate change when conducting risk assessments of both aquatic and terrestrial species being considered for regulation. For example, when assessing a non-native plant species for listing on the state Noxious Weed List, the Noxious Weed Advisory Committee considers whether the species has become established in areas with a climate and growing conditions similar to those in current and projected future climate conditions in Minnesota. The Classification Summary for Invasive Species used by the DNR to assess whether non-native aquatic species should be regulated also allows for consideration of future climate when determining whether a species is likely to survive and naturalize if introduced.

One aspect of climate resiliency is managing for healthy ecosystems to resist establishment and impacts of invasive species. Recent examples of this include replanting projects in aquatic systems after AIS removals as well as ongoing research as part of the Cover it Up! buckthorn project. However, more research is needed on how to effectively manage for resiliency in different systems. There are also funding limitations – groups may be able to apply for funding to remove invasive species but it is harder to secure funding for replanting following removals.

State leadership has provided direction and guidance on incorporating climate change in policy and practice. For example, the DNR's Division of Ecological and Water Resources strategic plan lists climate change as one of eight key strategic issues facing the division, which includes DNR's invasive species program. There is less clarity on how county or local jurisdictions may be incorporating climate change into invasive species policies and practices.

Some individual members of MISAC are members of Regional Invasive Species and Climate Change (RISCC) management networks, which gives them access to research, resources, and training about climate change and invasive species. Unfortunately, there is not currently a RISCC network for the Midwest region. While the issues tackled by some of the neighboring RISCC networks overlap with those relevant to the Midwest, a more focused Midwest RISCC may better target research and outreach to priority issues for the region.

Prevent the spread of high-priority species within the state, such as starry stonewort, zebra and quagga mussels, non-native *Phragmites*, jumping worms, emerald ash borer, and others (subsections 2b and 3b)

Both state and local governments implement watercraft inspections at public water accesses throughout the state, targeting waters infested with high priority AIS. In 2022, Level 1 and level 2 watercraft inspectors hired by the DNR, and 65 local units of government with delegated authority from

the DNR, inspected more than 400,000 watercraft, making Minnesota's watercraft inspection program one of the largest in the nation.

Starry stonewort: The University of Minnesota Extension, MAISRC, the DNR, and many counties and local partners implement an annual statewide search for new populations of starry stonewort, called "Starry Trek". In 2022 for example, 233 volunteers searched 248 Minnesota waterbodies. Starry Trek has successfully led to discoveries of starry stonewort where it was previously not known to be present. Watercraft inspectors prevented the introduction of starry stonewort in Lake Superior during a watercraft inspection in Two Harbors. Hand pulling efforts at the public water access in Grand Lake in Stearns County successfully reduced starry stonewort at the public water access. Hand pulling efforts were also conducted at five other water accesses in the northwest region of the state to help prevent spread in that area.

Non-native Phragmites: The University of Minnesota and the DNR are collaborating to lead a statewide project to manage non-native *Phragmites*. Key to this effort is identifying new small populations, controlling known populations, and monitoring the results of treatments. In 2022, 1,199 known sites were visited, both previously treated and newly identified. Of those sites, 897 were treated in 2022, while *Phragmites* was no longer detected at 302 sites. The University of Minnesota is researching alternative species to replace non-native *Phragmites* in wastewater treatment facilities that use reeds for biosolids.

Jumping worms: In October 2022, the DNR proposed listing jumping worms (*Amyntas* and *Metaphire* species) as prohibited invasive species under its official rulemaking process. There was a public open comment from October 31, 2022 to December 9, 2022. As of October 5, 2023, the proposal is under review by state leadership and the rule has not been finalized. University of Minnesota researchers continue to study jumping worm impacts and potential management options. The University of Minnesota Extension collected and shared input from homeowners on their changes to yard management and impacts to plants they were growing. University and agency staff continue to conduct outreach on jumping worm prevention to key groups, such as Master Gardeners.

Emerald ash borer: The MDA continues to regulate emerald ash borer using quarantines. A total of 44 counties are currently under quarantine for emerald ash borer. The MDA also conducts visual surveys in new municipalities, offers workshops on detection and management, and participates in delimit surveys. The MDA also releases parasitoid wasps to aid in the control of emerald ash borer. In total, 654,468 parasitoids have been released in Minnesota since 2010. The MDA also currently has 13 certified firewood dealers in the state with 17 certified kilns between them.

Brown marmorated stink bug: The MDA has been surveying for the invasive brown marmorated stink bug for over 10 years. Populations of this insect continue to grow and spread further out into the rural areas of the state. This insect is also becoming more prevalent in orchards and other agricultural settings. In 2022, the MDA began trapping for the samurai wasp, *Trissolcus japonicus*. This insect is very good at controlling brown marmorated stink bug populations in its native range but has been shown to also attack some native predatory stinkbugs. The MDA found the samurai wasp at two different residential sites in the Twin Cities metro area. Adventive populations of this wasp have shown up in many US states and some states have used these populations to start biological control programs. The University of Minnesota in collaboration with the MDA will be seeking funding from MITPPC to evaluate the risks and benefits of the samurai wasp in Minnesota.

There are nine new species regulated by the MDA, added to the Noxious Weed List in January 2023:

- Additions to the Prohibited Eradicate Noxious Weed list: Johnsongrass, *Sorghum halepense*; pale swallow-wort, *Cynanchum rossicum*; red hailstone/ goldencreeper, *Thladiantha dubia*. If Prohibited Eradicate species are found, the law requires that they must be eradicated.
- Additions to the Restricted Noxious Weed list to prevent additional introductions: Amur silvergrass, *Miscanthus sacchariflorus*; lesser celandine, *Ficaria verna*; saltcedar, *Tamarix ramoissima*. Restricted species may not be sold or transported.
- Additions to the Specially Regulated Plant List to reduce spread. Each has species-specific regulations. For Amur corktree (*Phellodendron amurense*) only sales of named male cultivars permitted. Sales of all other *Phellodendron amurense* are prohibited. All existing planted and escaped fruit producing trees must be controlled, by tree removal or other means, such that no seed is disseminated. Callery pear (*Pyrus calleryana*) begins a three-year production phase-out period, after which sale of this species will be prohibited and the species will be designated as Restricted in 2026. Sellers of Tatarian maple (*Acer tataricum*) must affix a label directly to the plant or container packaging that is being sold that advises buyers to only plant Tatarian maple and its cultivars in landscapes where the seedlings will be controlled by mowing or other means. Tatarian maple seed is wind dispersed and trees should be planted at least 100 yards from natural areas.

Preserve Minnesota’s leadership in invasive species research by supporting development of new detection and management technologies and funding for invasive species research

The Minnesota Invasive Terrestrial Plants and Pests Center (MITPPC) at the University of Minnesota leads research to protect Minnesota’s forests, prairies, wetlands, and agriculture from the harmful effects of TIS. MITPPC was established by the Minnesota Legislature in 2014 with the requirement that research investments be directed towards the greatest TIS threats to the state and research results be shared broadly. To date, MITPPC has received \$3.4 million from the General Fund and \$24.94 million from the Environment and Natural Resources Trust Fund. The funding has supported 52 research projects involving 96 researchers (faculty, staff, post-docs, and students) and 52 external partners. Up to 13 new research projects will be launched in January 2024. Results from previous projects appear in 91 peer reviewed publications and have been shared through numerous presentations, news outlets, electronic newsletters, social media, and MITPPC’s website. MITPPC has become a regional and national leader in invasive species research as it remains focused on TIS solutions that will benefit Minnesotans.

MITPPC has made significant progress in the development of new technologies and techniques for the detection and management of invasive species. Examples of progress from 2022-2023 include:

- Dr. Robert Blanchette and his colleagues developed a spore-trapping network and used it to detect the fungus that causes Heterobasidion root disease, considered one of the world’s worst diseases of pines in northern latitudes but generally thought not to occur in Minnesota. The team is working with the DNR to identify potential infection centers in the state and coordinate a rapid response.
- Dr. Jeannine Cavender-Bares and colleagues reported success with the analysis of satellite imagery to detect oak wilt, caused by a non-native, invasive fungus that continues to spread through the state. This new approach will allow for broader areas of the state to be monitored for the presence of the disease.

- Dr. Joseph Knight and his team advanced techniques to use drones and machine learning to detect and map invasive *Phragmites* in wetlands. This team shared their findings with the DNR and MAISRC, who are working collectively towards the targeted control of invasive *Phragmites*.
- Dr. Dean Malvick and his team made a major breakthrough with the development of a technique to artificially infect corn with the pathogen that causes corn tar spot. This new method creates major opportunities to screen corn varieties for resistance to the fungus, test fungicides for efficacy against the disease, and explore more precisely how this fungus affects the physiology of corn plants.
- Dr. Aaron Lorenz and his colleagues advanced multiple soybean lines with resistance to soybean aphid; two new lines are nearing commercial release.

The Minnesota Aquatic Invasive Species Research Center (MAISRC) at the University of Minnesota leads research to develop solutions that can reduce the impacts of AIS in Minnesota by preventing spread, controlling populations, and managing ecosystems. MAISRC was established by the Minnesota Legislature in 2012 to advance AIS research and the development of management techniques and technologies to address the AIS of greatest concern in the state. Over the last 10 years, MAISRC has received \$24 million from the Environment and Natural Resources Trust Fund and \$7.2 million in additional state funds. This funding has supported 85 research projects on high priority AIS like zebra mussels, invasive carp, Eurasian watermilfoil, spiny waterflea, and starry stonewort. Results from MAISRC supported projects have produced 123 peer reviewed publications and have been shared through numerous presentations, lab tours, news outlets, and MAISRC's website and online communications channels. MAISRC is a respected partner and national leader in the fight against AIS and plays a central role in addressing AIS in Minnesota.

MAISRC has made significant progress in the development of new technologies and techniques for the detection and management of invasive species. Examples of recent progress include:

- Developed a model that allows scientists to simulate invasion dynamics within lakes and across a network, and compare the influence of different management strategies under idealized circumstances.
- Mobilized volunteers and partners to survey and map invasive *Phragmites* across Minnesota. Identified 1,000+ populations and developed a management plan.
- Developing species-specific methods of RNA interference (RNAi) using genetic weak points in the zebra mussel genome, the first steps towards the application of targeted genetic biocontrol strategies.
- Effectively reduced the zebra mussel population density in a lake below levels where they cause ecological impacts using low doses of copper. Reduced the population density for about two years.
- Evaluating the effectiveness of mechanical harvesting as a management tool for hybrid cattail in Minnesota lakes in nearshore lake zones. Preliminary analyses show a significant decline in hybrid cattail across treatment areas one year following treatment.

Continue discussions between researchers and federal, tribal, state, and local entities to understand the potential risks and benefits of emerging invasive species control technologies (in particular, better understand public and particularly tribal opinions of and potential regulatory structure for implementing genetic biocontrol agents)

Coordination and conversation between researchers and federal, tribal, state, and local entities are critical during the development of genetic biocontrol technologies that have broad and diverse stakeholder groups. A particular emphasis recently among engaged parties is understanding attitudes, perceptions, and beliefs related to a variety of biocontrol technologies. MAISRC is working closely with regional and national partners to continue conversations about the potential use of biocontrol technology and possible regulatory pathways.

Assess risks posed by trade pathways for invasive species and increase prevention and enforcement as appropriate

The Great Lakes Restoration Initiative funded a position in the DNR invasive species program to focus on invasive species in trade from 2019-2022. The trade pathways specialist wrote an assessment of risks associated with different trade pathways in Minnesota, existing programs aimed at managing those pathways, and opportunities for future work to address those pathways. The DNR connected with over 3,500 business in the pet, horticulture, food, and biological supply trades in Minnesota to provide information about regulations, invite participation in a survey, and encourage sign-up for an email list to facilitate continued communication. New DNR web sites were created to better address the questions that business and their customers have about invasive species. The DNR also conducted surveys of hobbyists related to invasive species in trade and an assessment of the availability of invasive species in aquarium and seafood businesses. The DNR shared this work with enforcement professionals and invasive species professionals from groups at all levels, local to international. The DNR continues to engage with regional and national partners who are working to prevent and manage the risks of trade pathways for invasive species.

Evaluate the effectiveness of invasive species outreach strategies and promote strategies that result in positive invasive species prevention behaviors

Historically, Minnesota was the first state in the nation to develop and implement a comprehensive program to address invasive species with an emphasis on invasive species prevention behaviors. Campaigns and initiatives were launched including *Clean Boats*, *Clean Waters* (later replaced by *Stop Aquatic Hitchhikers!*TM in 2002), *Habitattitude*TM, *Clean Drain Dry Initiative*TM, *Play Clean Go*TM, and *Clean Drain Dispose* messaging – all of which are grounded in community-based social marketing. Based on lessons learned, these platforms evolved, and improved – aimed at supporting and strengthening sustainability of prevention behaviors among target audiences.

Evolution as a National Leader:

For nearly 30 years, Minnesota has been a national leader in evaluating effectiveness of invasive species outreach which has not only resulted in greater public awareness, but also behavior change among recreational water users, aquarists, and water gardeners. A model boater survey developed in 1994 has been adopted and adapted by dozens of other states and organizations. Results show that awareness and behavior change by recreational water users, as well as aquarists and water gardeners, is highest where more effort and variety of proven techniques are used. Results of several surveys showed that

Minnesota boaters were more knowledgeable about AIS issues and had already changed their behavior to a greater extent (to prevent the spread) than boaters any other state.

A Case Study:

Minnesota has a compelling story of prevention through effective public AIS outreach. According to a 1994 multi-state survey, 70 percent of Minnesota boaters reported willingness to take action at water accesses to prevent spread of AIS, more than Ohio and Wisconsin. In 2000, 90 percent were willing to take action, more than Vermont, Ohio, Kansas and California. As mentioned above, Minnesota discontinued the *Clean Boats, Clean Waters* campaign in 2002 in lieu of the national *Stop Aquatic Hitchhikers!* campaign, which offered a stronger and more robust platform for federal, state, tribe, academia, businesses and non-profits to partner and support as a call to action to all types of recreational water users. The first-ever assessment of this campaign was tied to an aggressive outreach strategy launched in 2005 and, revealed by 2007, 97% of Minnesota, Wisconsin, and Iowa boaters reported willingness to take preventative actions – for Minnesota, a 27 percent increase in twelve years.

Nationally, these results caught AIS managers' attention with the realization that strategic AIS public prevention can work if made a priority. Subsequent AIS outreach and assessments funded by the Great Lakes Restoration Initiative grants and other sources continue to show that positive behaviors among Minnesota boaters is greater than 95 percent. Is this working to prevent AIS spread? The DNR Watercraft Inspection Program reports that statewide compliance has been consistently over 95 percent since 2015. Many local AIS county programs report 99 percent compliance. Importantly, only eight percent of Minnesota's 11,842 lakes are infested with AIS. Given the ease for AIS spread, over 830,000 registered boaters, 1.4 million licensed anglers, 2,200 public water accesses and tens of thousands more private accesses – if prevention was not working – all of Minnesota lakes would now be infested.

Moving Forward:

Building on these lessons learned, the DNR's Invasive Species Program has supported adoption of invasive species prevention behaviors by providing trainings, guides, and tools to AIS managers.

By bridging the gap between awareness and action, efforts aim to build "community norms" – actions that everyone can take, adopt, and consistently practice. Research findings continue to broaden and strengthen behavior-based strategies by prioritizing pathways such as anglers, shoreline residents, and commercial trade pathways. To implement lessons learned, DNR has awarded prevention change grants to local governments designed to deliver behavior change intervention strategies to target audiences in local jurisdictions.

Bolster programs to support public reporting of suspected invasive species populations, including citizen and community science and education related to reporting processes, such as the use of EDDMapS

From 2019-2022, the University of Minnesota Extension (hereafter, Extension) has significantly increased efforts to educate and support participatory science reporting for non-native species that may become invasive. In 2008, the Extension Forest Pest First Detector program began doing targeted participatory science. Building from that collaborative effort with partners at the DNR and the MDA, program organizers began a new approach to participatory science and launched five unique programs

in the spring of 2020. In early 2023, that effort emerged into a major focus of Extension and was rebranded as [TIPS, Terrestrial Invasive Participatory Science](#).

To date, eight different projects have been completed and three more launched in 2023. Those projects have improved density and distribution data for: squill, *Scilla siberica*, oak wilt, *Ceratocystis fagacearum*, Amur corktree, *Phellodendron amurense*, Norway maple, *Acer platanoides*, Siberian peashrub, *Caragana arborescens*, Japanese tree lilac, *Syringa reticulata*, porcelain berry, *Ampelopsis glandulosa*, black alder, *Alnus glutinosa*, white mulberry, *Morus alba*, and jumping worms, *Amyntas* spp. The 2023 projects focusing on: garlic mustard aphid *Lipaphis alliariae*, mock strawberry, *Potentilla indica*, and spotted lanternfly, *Lycorma delicatula*, which also includes tree-of-heaven, *Ailanthus altissima*, and round leaf bittersweet, *Celastrus orbiculatus*.

Several of these projects have contributed to other important outcomes including: Amur corktree's addition to the Minnesota Noxious Weed List; a new genetic test for rare, native red mulberry (which is hybridizing with non-native white mulberry); increased efforts to breed and introduce butternut canker resistant threatened butternut trees; and furthering scientific understanding of possible jumping worm management and understanding, for the first time, the impact of jumping worms on people's emotions. These projects have engaged the community through all aspects of participatory science including formulating research questions, collecting data, and interpreting results.

In addition to these traditional participatory science activities, significant progress has been made in response to community feedback to improve some invasive and non-native species common names. To date, efforts led by the Extension Invasive Species Community of Practice have directly or indirectly improved the common names of 22 species.

Increase opportunities for communication, outreach, coordination and collaboration between organizations involved in invasive species management in Minnesota

Increasing collaboration and coordination between organizations in Minnesota is an ongoing effort. Each partner plays a critical role in the state's overall progress in preventing invasive species spread. State agencies such as the Minnesota DNR have led efforts in promoting best practices for AIS Prevention with community-based social marketing. Local governments have utilized grants and resources to enhance and guide AIS outreach and stakeholder communication. Local government, lake associations and conservation clubs support educational campaigns such as *PlayCleanGo*TM and *Stop Aquatic Hitchhikers!*TM. Extension's AIS Detectors and Forest Pest First Detectors host early detection and identification training workshops targeting high-priority forest and AIS for natural resource professionals and committed volunteers. Coordination between Extension, the MDA and the DNR resulted in participatory science projects on spotted lanternflies (including round leaf bittersweet and tree-of-heaven), mock strawberry, and garlic mustard aphid identification and reporting.

Address the gaps identified in subsection 3d. Gaps in Invasive Species Authorities, Funding and Program Implementation (plan page 69)

Harmonizing Noxious Weed and Seed Regulations

The importance of evaluating species for potential noxious weed seed listing is understood by Mike Merriman, the MDA seed program supervisor. He said the seed risk assessment and regulatory recommendation process will be overseen by the MDA's Seed Program Advisory Committee. The first step will be to formally form this committee with appointed members. After the committee is up and

running in 2024 - 2025, they will develop their evaluation process and determine who will write risk assessments. A set of seed risk assessment questions was drafted in 2020, so the committee already has a start on this. The MDA's Seed Program Advisory Committee will decide which species to prioritize for risk assessment. The MDA's Noxious Weed Advisory Committee is planning to develop a priority list of plant species for seed risk assessment in 2024 as a recommendation to the Seed Program Advisory Committee.

Emerging Invasive Species Control Technologies

Researchers with MAISRC and the U.S. Geological Survey Upper Midwest Environmental Sciences Center are working to provide decision-making support for the use of copper in lake management for controlling zebra mussel veligers with a copper-based molluscicide in select, high value habitats while minimizing non-target impacts. Copper-based products (e.g., EarthTec QZ) have been used in partial-lake treatments at the maximum allowable concentration to effectively control zebra mussels. Because copper can harm native species, managers are hesitant to use copper products without weighing the trade-offs. Much lower copper concentrations could control veligers with less risk to native species. Research results show that low-dose copper treatment can greatly reduce zebra mussel settlement at less cost and with less risk to native species compared to eradication treatments using maximum allowable copper concentration. This information will be used to guide decision making with stakeholders for invasive mussel management in Minnesota.

Researchers with MAISRC and the University of Minnesota are evaluating the antifouling performances of a novel, non-toxic technology using enzymes to disrupt microbial signaling, in order to reduce biofouling. This enzyme-based coating could help mitigate the spread of sessile invasive species and reduce the use of current antifouling solutions that are both partly effective and highly toxic to the environment.

Within participating partner organizations or across coalitions of partner organizations, develop SMART (specific, measurable, actionable, relevant, and time-bound) metrics to determine if respective efforts to implement aspects of this plan are achieving desired outcomes with respect to preventing or mitigating impacts from invasive species. In the survey responses, 26 individuals reported that they or their organization had developed SMART goals related to their invasive species work. Of these, 11 individuals from nine organizations identified themselves along with their survey responses. Organizations that were identified included DNR, MDA, MAISRC, 1854 Treaty Authority, Carver County, Meeker County, Ramsey County, the Little Boy-Cooper-Rice Lakes Association in Cass County, and Lake Restoration Inc. Six of these are MISAC member organizations. These six represent only a small proportion of MISAC member organizations. Note that these findings are based only on the survey responses, though other organizations may have also developed SMART metrics.

Priorities Specific to Aquatic Invasive Species Management

Maintain or increase funding for aquatic invasive species prevention, outreach, research, surveillance and management of existing populations

Over the last four years, MAISRC has been able to increase and diversify the funding that is allocated to AIS research and outreach at MAISRC. In 2023, MAISRC was able to secure additional, one-time “Lab to Lakes” funding for the implementation of research tools and recommendations in the field. The Lab to Lakes project will bring together MAISRC researchers, outreach staff, and natural resources managers to share research-based information on AIS prevention and control and implement new tools and techniques that have been developed by research teams. This work will occur from 2023-2027.

Continue to support invasive species management efforts in Minnesota border waters, such as sea lamprey control in Lake Superior and invasive carp prevention

Sea lamprey monitoring and control has been ongoing in the Great Lakes for over 60 years. The Great Lakes Fishery Commission, U.S. Fish and Wildlife Service, Fisheries and Oceans Canada, and the U.S. Army Corps of Engineers manage this invasive species using barriers and selective pesticides called lampricides. Treatments are applied in Minnesota tributaries to Lake Superior, as well as in Wisconsin, Michigan, and Ontario. New technologies including attractants and traps are currently being developed by the U.S. Geological Survey (Blaser 2021). Sea lamprey abundance has been reduced by an estimated 86% in Lake Superior, but abundance is still above target levels (Great Lakes Fishery Commission 2023). Continued management will be necessary to maintain healthy Great Lakes fisheries.

The Minnesota DNR has been monitoring for and responding to invasive carp for over a decade. The border waters of the Upper Mississippi River and St. Croix River continue to be focal points for monitoring and management. The DNR’s invasive carp program monitors for all life stages of invasive carp, tags and tracks invasive carp to learn about movement patterns, contracts with commercial fishermen to remove invasive carp, and develops new approaches to capture invasive carp, such as adapting the Modified-Unified Method for our use. The DNR partners with U.S. Fish and Wildlife Service, U.S. Geological Survey, Wisconsin DNR, National Park Service, the University of Minnesota, and Wild Rivers Conservancy on monitoring and management actions.

Invasive carp remain at a relatively low density in Minnesota and border waters, and reproduction has not yet been detected in Minnesota. However, captures and sightings of invasive carp have increased since 2020. This is likely related to 2019 flooding that caused dams to open their gates, allowing both floodwaters and fish to pass. With these changes in mind, the DNR will update its Invasive Carp Action Plan in 2023. A structured decision-making process including experts and stakeholders will identify management objectives and assess management options to recommend actions for the plan.

Priorities Specific to Terrestrial Invasive Species Management

Increase funding for terrestrial invasive species prevention, surveillance and management of existing populations

Historically, AIS management has been funded better than TIS management. The DNR Natural Heritage Advisory Committee’s Terrestrial Invasive Species Funding Subcommittee plans to use AIS funding and county involvement as a model for TIS funding. The initial focus will be on invasive plants. The aim is to increase legislative support for the following existing funding efforts.

1. State funding for County Agricultural Inspector positions – There is no state funding currently. These funds would increase capacity at the local level to respond to invasive plant threats. This would be similar to the AIS funds counties receive, currently \$10,000,000 per year.
2. The MDA noxious and invasive weed program core funding – Expand capacity to address new and existing invasive plant threats. Potential examples include:
 - a. Increase prevention efforts such as stopping online sales of regulated plants.
 - b. Conduct early detection and rapid response to control target populations when they are small and manageable. This is much less expensive than allowing them to spread, then trying to control them.
 - c. Currently, there is insufficient capacity to apply for and fully utilize available federal funds. Additional staff are needed to propose and manage federally-funded projects.
3. Increase state funding for the MDA noxious weed grants to local governments for noxious and invasive plant management – There is an established grant program that provides grants to local governments and tribes for priority noxious weed management. Program funding has been insufficient to meet demands and fund sustained multi-year infestation management efforts. Infestations rebound in years when funding is not available. A request for \$800,000 for the biennium (FY24 and FY25, 07/01/23 – 06/30/25) was in the governor’s budget but \$300,000 was received.

Strengthen requirements for and coordination related to invasive species management on roadway, rail and utility rights-of-way

The Minnesota Department of Transportation (MnDOT) has worked toward addressing this priority. MnDOT:

- has a standard specification which requires certified weed free mulch to be used on construction projects. As other products become more available, requirements for weed free topsoil and gravel will also be required. This has been implemented in northeast Minnesota on a few projects to prevent establishment of new noxious weed infestations.
- is currently implementing an “integrated vegetation management approach” on MnDOT rights-of way. Goals are to strengthen native plant communities through a variety of management methods including biological control, prescribed fire, herbicide applications, selective mowing, and cultural control.
- is strengthening efforts detection and rapid response. MnDOT uses weed population data from EDDMapS to guide maintenance and projects. New data is submitted into EDDMapS where it is shared with other agencies. The Metro district has two dedicated staff who focus on early detection, rapid response during summer maintenance months. Greater Minnesota districts also provide time each summer to target high priority noxious weed infestations. MnDOT’s Roadside Vegetation Management Unit (RVMU) develops the state noxious weed book and provides copies to each district, along with annual herbicide meetings. Maintenance staff are trained in integrated vegetation management, safe herbicide application, and plant identification to find new noxious weed populations, or reduce spread of existing populations. Corridor management plans are also in development with sections focusing on noxious weed management in high priority management areas. These are intended as working documents shared between the Office of Environmental Stewardship, RVMU, and local district staff to support highly specialized and targeted management.

- coordinates with other agencies to provide consistent management across boundaries. MnDOT works with the MDA to strengthen language and requirements for independent utilities working on MnDOT ROW. NextGen utilities will be required to develop a noxious weed management plan. Data is be shared with state agencies and can be entered into EDDMapS. RVMU is currently updating standard specifications for vegetation management to include requirement for contractors to control weeds during construction projects. Noxious weed management is integrated into construction projects (e.g., avoid areas, management during construction, cleaning equipment before leaving site).

Assess the effectiveness of enforcement of terrestrial invasive species laws in the state
 The Noxious Weed Law is functional and effective. From 2016 to 2021, the MDA has collected data from County Agricultural Inspectors (CAI) on costs of weed control reported by townships, cities, and counties, and the number of weed law violations issued by counties. These jurisdictions reported spending \$10,000 to \$4,000,000 annually on noxious weed control. The number of weed law violations issued annually has trended downward over the past several years, indicating that landowners are more informed about and coming into compliance with the Noxious Weed Law after initial contact is made about the presence of a noxious weed on their land.

The Noxious Weed List is effective at bringing attention to nuisance plants. The risk assessment process for assessing and adding species to the list works well. The process involves input from CAIs, townships, cities, soil and water conservation districts, ag commodity groups, and other agriculture stakeholders across the state through the Noxious Weed Advisory Committee. Rigorous risk assessments capture issues and concerns from stakeholders, including available resources for mapping and treatment.

Though the CAIs effectively enforce the noxious weed law through the noxious weed list, CAI programs across the state are varied. Funding disparities around the state mean that the ability to give these issues proactive attention varies greatly between jurisdictions, leading to inconsistent weed management throughout the state. There are limited funding opportunities available to help standardize weed management through the noxious weed law.

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Appendix A. Updated Implementation Tables

Pages 76 through 94 of the “[Minnesota Management Plan for Invasive Species](#)” contain the plan’s strategies and actions. The survey conducted along with this evaluation asked partners to indicate which strategies and actions from the plan’s implementation tables they are involved in. The implementation tables have been updated accordingly in this appendix: [Appendix A: Updated Implementation Tables](#).