

Workshop Summary: Habitat Management in the St. Louis River Estuary



University of Minnesota
Sea Grant College Program

HABITAT MANAGEMENT IN THE ST. LOUIS RIVER ESTUARY: IDENTIFYING EXISTING DATA, PARTNERSHIPS, AND EMERGING RESEARCH NEEDS

A SUMMARY OF THE 14 APRIL 2022 WORKSHOP

Hosted by the University of Minnesota Sea Grant College Program

Prepared by Kelsey Prihoda, Alexander Frie, Amy Schrank, and Donald Schreiner

©2022 Regents of the University of Minnesota. All rights reserved.

Produced by the University of Minnesota Sea Grant College Program (Duluth, Minnesota).

Cover design: Kelsey Prihoda (using CanvaPro template)

Reviewers: Nick Bogyo, Gini Breidenbach, John Downing, Deanna Erickson, Titus Seilheimer, Jeff Stollenwerk, and Marie Thoms

Contact: Kelsey Prihoda, Great Lakes Transportation Extension Educator, University of Minnesota Sea Grant College Program, priho011@d.umn.edu

University of Minnesota Sea Grant College Program

31 West College Street, Room 132

Duluth, MN 55812

Email: seagr@d.umn.edu

Phone: (218) 726-8106

<https://seagrant.umn.edu/>

Suggested Citation:

Prihoda, K.R., Frie, A., Schrank, A., & Schreiner, D.R. (2022). *Workshop Summary: Habitat Management in the St. Louis River Estuary*. University of Minnesota Sea Grant College Program.

<https://seagrant.umn.edu/programs/healthy-coastal-ecosystems-program/habitat-management-st-louis-river-workshop>

November 14, 2022

TABLE OF CONTENTS

List of Figures	3
List of Tables	4
Acknowledgements	4
Executive Summary	5
Forward – Workshop Framing	8
Workshop Objective 1 – Identify Research Needs for Birds, Wild Rice, and Fishes	10
Workshop Objective 2 – Develop New Tools for Data Visualization in the SLRE	17
Workshop Objective 3 – Define and Prioritize Future Project(s) to Address Research Needs	20
Conclusions	23
References	24
Appendix 1 – Summary of Workshop Keynote Presentations	26
Appendix 2 – List of Workshop Participants	31
Appendix 3 – Workshop Resources Document	32
Appendix 4 – Workshop Agenda	37
Appendix 5 - Post-Workshop Evaluation Summary	38

LIST OF FIGURES

Figure 1. Map showing the St. Louis River AOC boundary as of October 2020. Credit: St. Louis River AOC coordinators and leaders.	8
Figure 2. Results of survey conducted by participants in the bird breakout session.	12
Figure 3. Survey results showing the breakout session participants' rating of the status of wild rice long-term monitoring.	14
Figure 4. Survey results from the breakout session on fishes indicating the status of long-term monitoring in the SLRE.	17
Figure 5. Diagram Outlining the MNSG Funded Research Process. Credit: Alex Frie.	26
Figure 6. Map Showing the St. Louis River AOC Boundary as of October 2020. Credit: St. Louis River AOC Coordinators and Leaders.	28
Figure 7. Meso-Scale Geographic Zones and their Contributing Watersheds Utilized by the Lake Superior Headwaters Sustainability Partnership. Credit: Lake Superior Headwaters Sustainability Partnership, 2021.	29

LIST OF TABLES

Table 1. Priority research needs identified for the SLRE by workshop participants. Needs are categorized into six topics. The complete list of project ideas proposed by attendees are detailed in Workshop Objective 3 – Define and Prioritize Future Project(s) to Address Research Needs.	6
Table 2. Existing data summarization/visualization tools that workshop participants use, what they like about those tools, and ways the tools could be improved.	18
Table 3. Characteristics of a useful tool for data visualization in the SLRE. Potential users of this tool include researchers, natural resource managers, city planners, and science communicators.	19
Table 4. Project ideas, or suggested research questions to address, resulting from workshop breakout sessions under six categories (birds, wild rice, fishes, and the cross-cutting categories of estuary landscape, aquatic invasive species, and science communication and outreach).	20

ACKNOWLEDGEMENTS

Funding for this workshop and summary was provided by award NA20NOS4190088 from the Coastal Zone Management Act of 1972, as amended, administered by the Office for Coastal Management, National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce provided to the Minnesota Department of Natural Resources (DNR) for Minnesota’s Lake Superior Coastal Program.

In addition, Kelsey Prihoda, Alexander Frie, Amy Schrank, and Donald Schreiner prepared this report, with editorial assistance from Marie Thoms using federal funds under award NA18OAR4170101 from Minnesota Sea Grant (MNSG), National Sea Grant College Program, NOAA, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the authors and do not necessarily reflect the views of NOAA, MNSG, the National Sea Grant College Program, or the U.S. Department of Commerce.

Thank you to the leadership board who helped to plan this workshop: Nick Bogyo (1854 Treaty Authority), Jeramy Pinkerton (Minnesota Department of Natural Resources and Chair of the St. Louis River Habitat Workgroup), Jeff Stollenwerk (Duluth Seaway Port Authority), Gini Breidenbach (Minnesota Land Trust), and Jennifer Hauxwell and Titus Seilheimer (University of Wisconsin Sea Grant). MNSG is grateful to all the presenters and participants who contributed to the success of the workshop.

We thank the workshop facilitators from MNSG: Alexander Frie, Ellen Munshower, Kelsey Prihoda, Jesse Schomberg, Amy Schrank, and Donald Schreiner. Thanks to Chad Maniekee for providing technical support to the workshop participants. An incredibly special thanks to the University of Minnesota’s Office of Information Technology Video Event Support team who kept the workshop flowing smoothly.

On April 14, 2022, the University of Minnesota Sea Grant College Program (MNSG) hosted a one-day, virtual workshop to generate ideas and partnerships to support targeted, impactful research funding for the St. Louis River Estuary (SLRE) and expand the body of knowledge available for natural resource planning and regulatory decisions. The workshop was composed of keynote presentations ([Appendix 1](#)) and breakout sessions where thirty-one participants from state and tribal natural resource management agencies, research organizations, non-governmental organizations, economic development agencies, and transportation agencies and others ([Appendix 2](#)), contributed to focused discussions on the three major objectives described below.

OBJECTIVE 1 – IDENTIFY RESEARCH NEEDS FOR BIRDS, WILD RICE, AND FISHES

Participants in each of three morning breakout sessions that focused on birds, wild rice, fishes, and their habitats identified research needs that could be addressed in the next five years and would provide data useful for natural resource management decision making. Research needs that were noted by participants in the [bird breakout session](#) focused on monitoring and mapping and included: better understanding of potential bird habitats in the SLRE, the potential for increasing available bird habitat, and more comprehensive monitoring metrics that would provide data on the effects of contaminants on bird communities. Participants in the [wild rice breakout session](#) focused on increasing resiliency, citing research needs such as development of a robust seed bank, better understanding of water level impacts on wild rice establishment and survival, and determining the density at which wild rice can recover from goose herbivory. Research needs noted by participants in the [fishes breakout session](#) focused on spatial and temporal habitat use by fishes in the SLRE. For example, determining areas within the St. Louis River watershed where fish passage is impeded by structures such as culverts and dams.

OBJECTIVE 2 – DEVELOP NEW TOOLS FOR DATA VISUALIZATION IN THE SLRE

The perception articulated among workshop participants was that community interest in the status of the SLRE and the St. Louis River Area of Concern (AOC) is growing. The *Great Lakes Water Quality Agreement* (Annex 1 of the 2012 Protocol) defines AOCs as geographic areas designed by the United States and Canada ... “where significant impairment of beneficial uses has occurred as a result of human activities at the local level.” Within the Great Lakes, there are a total of 43 AOCs, 26 being in the United States, 12 in Canada, with five shared by the two countries. The St. Louis River AOC is one of the 31 AOCs listed in the United States (including the five binational AOCs).

One need identified by workshop participants was to tell the story of the restoration projects that AOC coordinators and partners have completed or are currently underway and articulate why those projects are important. Workshop participants said they had received questions about the estuary from a variety of stakeholders, including technical working groups, economic development organizations, anglers, friends, and family. Stakeholders told workshop participants they are interested in information beyond the St. Louis River AOC and SLRE habitat remediation and restoration, and have asked questions about the estuary ecosystem, maintenance dredging, community health, and fisheries management.

To address these stakeholder questions, workshop participants identified a public-facing tool for viewing and manipulating data on an estuary-wide scale an important outcome of this workshop. Features of such a tool would include the use of Findable, Accessible, Interoperable, and Reusable (FAIR) data principles (Wilkinson et al., 2016); inclusion of biological, social, economic, and human health and wellbeing data; calculated metrics and indices; and community science. Workshop participants suggested that users should have input into the design of the tool. People should use the tool’s output(s) to help tell the story of the estuary, provide data that demonstrates successes in restoration, and highlight the economic benefits of the restoration.

ArcGIS databases with story-mapping capability and the map-based tool [Great Lakes Aquatic Habitat Framework Explorer](#) are examples of tool formats that participants currently use.

OBJECTIVE 3 – DEFINE AND PRIORITIZE FUTURE PROJECT(S) TO ADDRESS RESEARCH NEEDS

Workshop participants brainstormed about SLRE research needs and questions. The result is a comprehensive list of project ideas (detailed in [Workshop Objective 3 – Define and Prioritize Future Project\(s\) to Address Research Needs](#)) with priorities listed in Table 1. These ideas could be used by all organizations conducting and funding research in the SLRE and this summary could be cited as a reference to help justify funding the needed research.

Table 1. Priority research needs identified for the SLRE by workshop participants. Needs are categorized into six topics. The complete list of project ideas proposed by attendees are detailed in [Workshop Objective 3 – Define and Prioritize Future Project\(s\) to Address Research Needs](#).

<p>Birds</p> <ul style="list-style-type: none"> ● Investigate why the Common Tern recovery objective to establish a minimum nesting population of 1,000 pairs at a total of seven or more colony sites by the year 2000 in the <i>Wisconsin Common Tern Recovery Plan</i> (Matteson, 1988) has not been met.
<p>Wild rice</p> <ul style="list-style-type: none"> ● Understand the human health risks from consumption of estuary-grown wild rice.
<p>Fishes</p> <ul style="list-style-type: none"> ● Understand the reasons for the reduced abundance in Lake Sturgeon juveniles observed during routine monitoring.
<p>Estuary landscape</p> <ul style="list-style-type: none"> ● Compare habitat maps from before Duluth’s historic June 2012 flood to habitat maps from 2022 to determine the impact of flooding, high water levels, and high turbidity on aquatic vegetation communities. ● Update the <i>Lower St. Louis River Habitat Plan</i> (St. Louis River Citizens Action Committee, 2002) and the associated habitat maps (aquatic vegetation, fish, invertebrates).

- Determine the concentrations of microcystin toxins in surface water within the SLRE.
- Plan and implement a long-term monitoring strategy for the SLRE, including AOC restoration sites.

Aquatic invasive species

- Examine Emerald Ash Borer management actions, successes, and recommendations in Black Ash forests, including hydrology data, transpiration, and groundwater.

Data summary, outreach, and science communication

- Quantify and communicate the improvement of ecosystem services and economic impacts to local communities because of St. Louis River AOC remediation and restoration efforts.
- Complete a secondary analysis of existing data from SLRE research studies to develop “state of the estuary” metrics and measurements.
- Summarize what have we learned from past beneficial uses of dredge material.

The St. Louis River watershed encompasses approximately 3,634 square miles and spans Minnesota and Wisconsin. The estuary, which is the portion of the St. Louis River that meets Lake Superior, is an important gateway to the Great Lakes and, at 12,000 acres, is the largest freshwater estuary in North America. The St. Louis River Estuary (SLRE) is home to the Port of Duluth-Superior, which is the largest freshwater port in the world (United States Army Corps of Engineers, 2020). According to the *Lower St. Louis River Habitat Plan* (St. Louis River Citizens Action Committee, 2002), “... the estuary and its tributaries are unusual in having such a variety of habitat types supporting a large and diverse assemblage of native fish species ... The freshwater estuary and baymouth bar systems are virtually absent elsewhere in the interior of North America.”

A portion of the St. Louis River watershed (Figure 1) was designated an Area of Concern (AOC) under the United States-Canada Great Lakes Water Quality Agreement in 1987, but it was not until the launch of the [U.S. Environmental Protection Agency’s Great Lakes Restoration Initiative](#) in 2010 that funding became readily available for AOC delisting efforts. Annex 1 of the *Great Lakes Water Quality Agreement* (2012 Protocol) states that beneficial uses that have become impaired due to local conditions at AOCs should be restored through development and implementation of Remedial Action Plans (RAP). Efforts to delist the St. Louis River AOC are outlined in the *St. Louis River Area of Concern Remedial Action Plan* (St. Louis River Area of Concern Coordinators and Leaders, 2020).

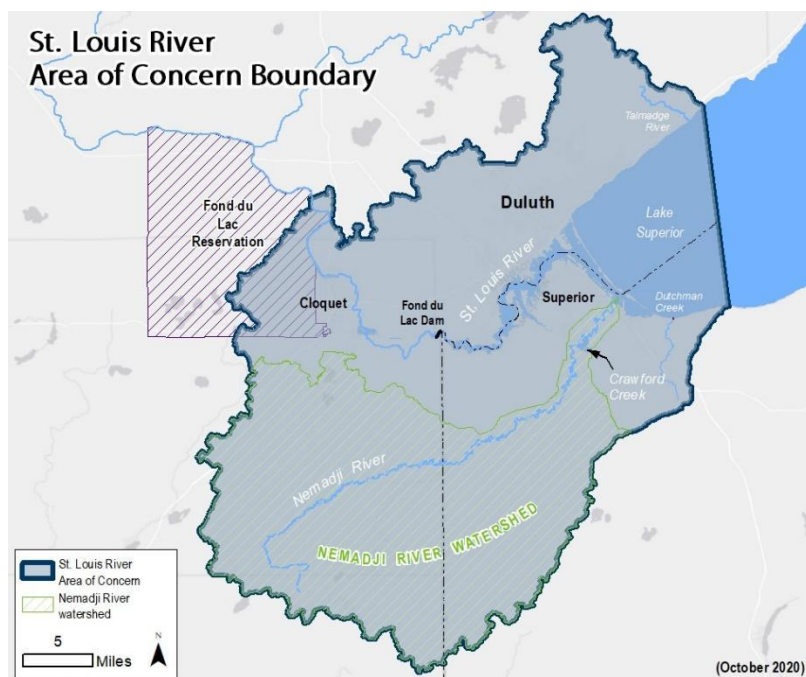


Figure 1. Map showing the St. Louis River AOC boundary as of October 2020. Credit: St. Louis River AOC coordinators and leaders.

To lay the foundation for the workshop and identify what information people want to know about the SLRE, facilitators in the three morning breakout sessions (i.e., birds, wild rice, fishes) led a discussion to

determine: (1) the most common SLRE-related questions workshop participants were asked, (2) who was asking these questions, and (3) what data participants were commonly asked to provide. According to workshop participants, questions and requests for data related to the SLRE fall into five categories:

- SLRE and its habitat remediation and restoration projects
 - What SLRE restoration projects are currently underway, why were they undertaken, and what is their status?
 - What locations in the SLRE need additional restoration?
 - What locations in the SLRE need protection?
 - Is habitat restoration benefitting wild rice populations?
 - What methods could be used for a more holistic approach to research within the SLRE?
 - What opportunities for funding restoration projects exist?
 - How will water-level fluctuations and more frequent, intense storm events impact completed habitat restoration projects in the future?
- SLRE ecosystem
 - Which aquatic invasive species have been detected in the estuary and how they can be controlled?
 - What contaminants are present in the estuary, where they are present, and how long they last?
 - What are the impacts of contamination on wild rice establishment and survival?
- Operation and maintenance dredging for commercial navigation
 - When is the best time of year to conduct dredging?
 - When and where should dredging work be avoided?
 - How dredge material can be used beneficially?
 - Is the dredge material used in habitat restoration projects contaminated?
- Community health
 - When will the fish consumption advisories be lifted?
 - How do contaminants present in food fish impact human and ecosystem health?
 - Is wild rice present in the SLRE? Where is the wild rice located?
 - Where and when can wild rice be harvested?
- Fisheries management
 - Where are the good Walleye fishing spots?
 - Why can only one large Walleye be harvested?
 - Is there a correlation between perceived declines in the Walleye fishery and the loss of submerged vegetation in the littoral zone?

According to workshop participants, questions and requests for data related to the SLRE come from a wide range of interested parties, including the St. Louis River Habitat Workgroup, members of the Harbor Technical Advisory Committee, friends, family, community members, and representatives from sport fishing organizations.

With this collective understanding of what SLRE-related information and data were most frequently being sought and by whom, the workshop facilitators and participants were better able to address the three workshop objectives. The following sections summarize what the University of Minnesota Sea Grant College Program (MNSG) learned from the workshop participants.

WORKSHOP OBJECTIVE 1 – IDENTIFY RESEARCH NEEDS FOR BIRDS, WILD RICE, AND FISHES

This section addresses current data, data gaps, and participant perceptions of long-term monitoring status for the breakout session topics of birds, wild rice, and fishes. Information presented in this section summarizes the comments from workshop participants, many of whom are considered local experts in their field. Where we were able to identify organizations that housed referenced data or were responsible for developing the information discussed, we did so. Given that this was a workshop based on discussion groups, not all information presented in in this report can be referenced and readers should be aware that some information may be considered anecdotal and reflects the opinions of the various experts engaged in the discussion. Due to the free-flowing nature of the discussion, it was not possible to attribute individual names to comments made during the breakout sessions.

BIRDS

CURRENT DATA

Participants were asked the following question: “When you consider the body of knowledge on birds in the SLRE, what do scientists have a good understanding of (issues, topics) based on the data?”

Participants in the breakout session on birds said that there is good scientific understanding of the following:

- Overall avian diversity and the importance of the SLRE for many species of breeding birds (Bracey et al., 2018; Grand et al., 2020).
- [Water quality in the SLRE has improved](#) (Bellinger et al., 2016), and bird populations have increased (Liljenquist et al., 2019)
- Nuisance locations for gulls and Canada Geese are well known, and the city of Duluth has an approved [goose control management plan](#). The city of Superior, Wisconsin, and the Wisconsin Department of Natural Resources have a [control plan in place for Canada Geese](#).

DATA GAPS

Participants were asked “What would be useful to know for natural resource management decisions that will be made in the next five years?” and “What are the gaps in our current body of knowledge that could be addressed in the next five years?”

Participants described the following knowledge gaps:

- A better understanding and maps of potential bird habitats (e.g., forest bird habitat) for a variety of avian species.

- Methods for increasing available habitat for breeding birds in the SLRE:
 - Determine whether nesting platforms for Black Terns would be a possibility within the estuary (specifically within [Allouez Bay](#)) given their successful use in other parts of the United States.
 - Determine if building additional islands upriver from the SLRE increase Common Tern habitat and whether there would be negative consequences (i.e., predation) on the now single colony inhabiting multiple locations.
- Absence and presence data are being collected and are needed to better determine habitat use in the SLRE.
 - Data are needed to assess whether past and current bird habitat restoration efforts are working at individual sites, throughout the estuary, and if those efforts are making a difference for bird populations overall.
- There is a need to assess the status of Great Blue Heron rookeries in the estuary.
 - Great Blue Heron populations are in decline in Minnesota and the presence of this species in the SLRE was listed as a conservation target for removal of the Degraded Fish and Wildlife Populations Beneficial Use Impairment (St. Louis River Area of Concern Coordinators and Leaders, October 2020).
 - There may be potential to reestablish a rookery in the [Superior Municipal Forest](#) located in the city of Superior, Wisconsin adjacent to Pokegama Bay.
- How might SLRE habitats change due to a changing climate and invasive species?
 - According to the [University of Minnesota Duluth Natural Resources Research Institute](#), invasive emerald ash borer threatens to irreversibly alter the structure and functioning of black ash-dominated wetlands throughout northeastern North America.
 - There is a knowledge gap about the use of Black Ash habitat by bird populations and it would be useful to know if the loss of Black Ash forests can be compensated for by providing habitat for migratory birds like Rusty Blackbirds.
- A better understanding of the effects of contaminants on bird communities is needed.
 - Bird presence and absence data is not sufficient to determine whether survival and reproduction is being impacted and targeted studies are needed to look at these potential population-level effects of contaminants.
 - In addition, as habitat restoration projects are completed within the SLRE, long-term water quality and sediment monitoring are needed to determine if there are reductions in contaminants in the environment and consequently the food chain for bird species such as the Common Tern.

MONITORING

Monitoring bird migration was discussed as a major challenge. Participants were asked to rate the overall status of long-term monitoring of birds in the SLRE: two participants indicated they had no knowledge of the status, two rated the status of long-term monitoring as poor, and the remaining three participants indicated that the status of bird monitoring in the SLRE is good (Figure 2). Participants agreed that

understanding how birds use the estuary during migration is needed. Although there is some knowledge of critical bird breeding habitat, understanding locations and temporal patterns of bird use throughout the estuary is needed. Currently, only Common Tern and gulls are routinely monitored and there is currently no monitoring of migratory and resident waterfowl. Challenges for long-term monitoring of birds include the reactionary or project-specific nature of the monitoring conducted to date and the lack of available funding for long-term monitoring.

How would you rate the overall status of long-term monitoring of birds in the SLRE
7 responses

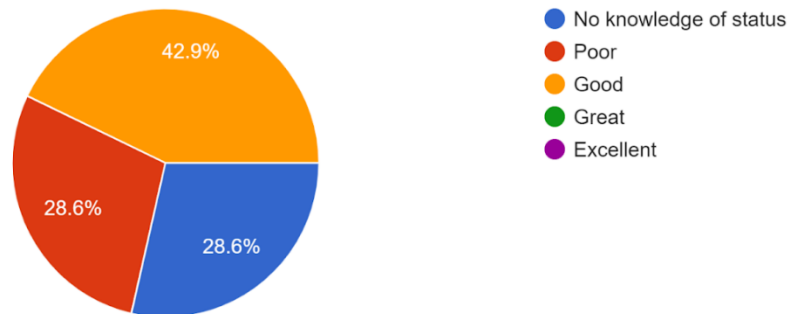


Figure 2. Results of survey conducted by participants in the bird breakout session.

An example of a current monitoring program is the established raptor migration monitoring program at [Hawk Ridge Bird Observatory](#) in Duluth, Minnesota. There are also data on migration density such as [eBird](#) and other community science efforts. However, access to the SLRE by researchers and community scientists is difficult because of ice cover and the large size and geomorphic complexity of the estuary. Full-scale monitoring could be improved through camera monitoring and/or acoustic recording, however, the data analysis for these tools is challenging. Participants suggested there may be value in collaborating or partnering with other large estuaries in the U.S. to see what they are doing in terms of long-term migratory bird monitoring.

WILD RICE

CURRENT DATA

Participants were asked the following question: When you consider the body of knowledge on wild rice in the SLRE, what do scientists have a good understanding of (issues, topics) based on the data?

Participants in the wild rice breakout session said the outcomes of recent, highly cooperative research efforts have led to good scientific understanding of the following:

- How the SLRE’s hydrologic characteristics affect vegetation (Vogt, 2021).

- Impact of goose herbivory on wild rice growth and the wild rice seed bank (Haramis & Kearns, 2007; Jobe et al., 2022).
- Impact of sulfate on wild rice (Pastor et al., 2017; Wang & Zhang, 2019).
- The current (2020) density and biomass of wild rice in areas of the SLRE that have been restored (Vogt, 2021).
- [Bathymetric data exist](#), and maps exist that indicate point locations where wild rice is growing (Vogt, 2021), but no maps exist outside the restoration areas.
 - The *Lower St. Louis River Habitat Plan* (St. Louis River Citizens Action Committee, 2002) was noted as a particularly useful resource with respect to wild rice.
- Traditional ecological knowledge is important but is not reflected in the current data.

DATA GAPS

Participants were asked “What would be useful to know for natural resource management decisions that will be made in the next five years?” and “What are the gaps in our current body of knowledge that could be addressed in the next five years?”

Participants described the following data gaps:

- Development of a robust wild rice seed bank.
 - Annual variations in seed production exist and multiyear storage may be a solution to poor seed production in a given year.
 - Determine the multiyear viability of seeds in sediment.
 - Understand how to manage brown spot fungal disease.
 - Identify the barriers to seed access by organizations conducting restoration work, and (given growing demand) ensuring scientists that need to acquire seed can do so.
- A better understanding of the features within the SLRE that attract Canada Geese.
 - Goose management techniques, apart from exclosures, need to be investigated to determine what can be done to deter and control geese effectively on an estuary-wide scale.
 - Determine the effectiveness of goose removals in order to more effectively target the estuary locations where these removals should take place.
 - The wild rice density at which it becomes resilient to goose herbivory was also noted as a knowledge gap.
- Determine the impact of climate change on wild rice within the SLRE to mitigate these impacts and increase the resiliency of wild rice.
- Continuous monitoring of SLRE water levels is needed, water levels are highly variable, and a better understanding of how changing water levels affect wild rice production could more effectively guide future wild rice restoration efforts.
 - The impact of upstream water releases on wild rice habitat is not well understood.
 - Determine whether water releases could be managed to expand and/or maintain wild rice habitat.

- Identify methods for enhancing and sustaining a community engagement effort for estuary-grown wild rice that include recruitment of people to harvest wild rice and the development of commercial capacity to process wild rice that is harvested recreationally.
 - Assess the toxicity of SLRE-grown wild rice and determine whether the rice is safe for human consumption.

MONITORING

Nearly 65% of the participants in the wild rice breakout session indicated that the overall status of long-term monitoring of wild rice in the SLRE was “good”, “great”, or “excellent” (Figure 3). Within the estuary, restoration and long-term monitoring programs exist and wild rice density and biomass data exist. The two locations not currently being monitored: Allouez Bay and upstream stands in the St. Louis River. Participants said that the most useful metrics to include in a long-term monitoring strategy were (1) wild rice-specific water-quality parameters, (2) an index of biotic integrity that includes biological communities associated with wild rice (e.g., cattails, fishes, microbes), (3) geese and carp density (carp can be an issue in some areas within the SLRE), (4) remote sensing, (5) seed bank monitoring, and (6) culturally significant monitoring metrics (e.g., community education, wild rice restoration as an educational tool, wild rice as a cultural indicator).

How would you rate the overall status of long-term monitoring of wild rice in the SLRE

8 responses

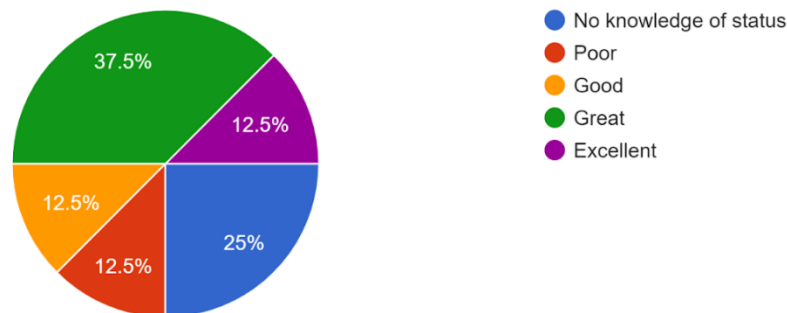


Figure 3. Survey results showing the breakout session participants' rating of the status of wild rice long-term monitoring.

FISHES

CURRENT DATA

Participants were asked the following question: “When you consider the body of knowledge on fish in the SLRE, what do scientists have a good understanding of (issues, topics) based on the data?”

Participants in the breakout session on fishes said that there is good scientific understanding of the following:

- The 1854 Treaty Authority, Fond du Lac Band of Lake Superior Chippewa, Minnesota and Wisconsin Department of Natural Resources, and U.S. Fish and Wildlife Service monitor fish populations annually. As a result, adult game fish density, diversity, habitat use, habitat types, and [benthic macroinvertebrate](#) (i.e., fish food) density and diversity within the estuary are well understood. Results from population assessments can be found in agency files and internal reports.
- Importance of sheltered bays that have aquatic vegetation for feeding, and nursery areas is well understood (St. Louis River Citizens Action Committee, 2002).
- [Aquatic vegetation communities](#) within the estuary and maps of community types are available (Reschke & Hill, 2020).
- Natural reproduction of [Lake Sturgeon](#) has been documented by natural resource management agencies working in the SLRE since 2011, although reproduction is variable from year to year and recruitment to adult appears to be limited (Anselmo et al., 2022; Bogyo, 2022; Estep, 2019; Welsh et al., 2019).
- Lake Sturgeon spawning locations and movement behavior (Anselmo et al., 2022; Estep, 2019; Schram et al., 1999; Welsh et al., 2019).
- Creel or angler surveys conducted by the Minnesota and Wisconsin Department of Natural Resources provide information on anglers' preferences and what species they are targeting.
- Fish consumption guidelines ([Minnesota Department of Public Health](#), [Wisconsin Department of Natural Resources](#)) and associated monitoring efforts provide information about contaminants present in some game fishes (Janssen et al., 2021).
- Population density information for Eurasian Ruffe and Round Goby population density is known, and populations of these invasive fishes have stabilized within the estuary (Bogyo, 2022).
- Monitoring efforts for Rusty Crayfish by the [U.S. Geological Survey](#) have revealed that the population of this invasive species has diminished in the estuary and individuals are not typically observed during routine monitoring.

DATA GAPS

Participants were asked “What would be useful to know for natural resource management decisions that will be made in the next five years?” and “What are the gaps in our current body of knowledge that could be addressed in the next five years?”

Participants described the following data gaps:

- Community science efforts with recreational anglers is an area where more work is needed.
- Determination of the specific areas where fish passage is impeded by infrastructure like culverts and dams.
 - Better utilization by managers of [Fishwerks](#), a GIS-based tool that targets candidate fish passage barriers to maximize habitat restoration/improvement projects.
- Vegetation and turbidity
 - Understand the extent of submerged vegetation loss along Minnesota Point bayside, and how it might be reestablished.

- A better understanding of the historic 2012 flood impacts on the SLRE aquatic vegetation community and how restoration has proceeded.
- Continued effects of high turbidity and run-off in the SLRE on aquatic vegetation.
- The impact of operation and maintenance dredging within the Port of Duluth-Superior's federal navigational channel on surface water turbidity.
- Impact of both short-term and long-term water level fluctuations on fishes and water quality in the SLRE.
- Analysis and results of Minnesota Pollution Control Agency monitoring of benthic macroinvertebrate and aquatic vegetation pre-restoration (2010 – 2015) and post-restoration (2018 – 2027). These data could shed light on the impacts of prolonged, elevated surface water levels on fishes and water quality.
- Fish habitat and habitat use
 - A better understanding of spatial and temporal fish habitat uses in the SLRE. This would inform future maintenance and in-water work (e.g., dredging, construction, habitat restoration).
 - Identification of fish habitat types in the estuary that are required for various life stage development and the times of year in which those locations become critical for resident fish species.
- Lake Sturgeon
 - Quantification of predation on egg and larval stages of Lake Sturgeon
 - Information on Lake Sturgeon vessel strikes in the federal navigation channel.

MONITORING

Most breakout session participants (six out of seven or 86%) rated the overall status of long-term monitoring for fishes in the SLRE as good (Figure 4). Participants listed the following fish-related metrics currently being monitored in the SLRE:

- Fish density, reproduction, and growth is measured by the Minnesota and Wisconsin Departments of Natural Resources during gill netting assessment at 21 monitoring locations.
- Fish tissue contaminant analysis for fish consumption advisories are conducted by the [Minnesota Department of Public Health](#) and [Wisconsin Department of Natural Resources](#).
 - This includes sampling and analysis of [Lake Superior Rainbow Smelt](#) in Wisconsin for per- and polyfluoroalkyl substances (PFAS) in 2019.
- Using macroinvertebrate monitoring data from the [U.S. Environmental Protection Agency's Great Lakes Coastal Wetland Monitoring Program](#) (sites sampled once every five years), an Index of Biological Integrity (IBI) is being generated by the Minnesota Pollution Control Agency for the Minnesota portion of the SLRE.

Participants said one potential area for improvement in current long-term fish monitoring efforts is an analysis of the benthic macroinvertebrate IBI at reference sites within the estuary compared to the IBI at sites that have been restored. In addition, participants noted that fish presence above the

Minnesota Highway 23 area (upstream of Chambers Grove) should be included as a location for long-term fish monitoring plans because it is a critical location for reproduction of Lake Sturgeon and survival of newly hatched larvae. The bayside of Minnesota Point is also an area that is not being monitored due to challenges in sampling in the Port of Duluth-Superior’s federal navigation channel. However, participants noted that this and other similarly difficult areas could be sampled systematically.

How would you rate the overall status of long-term monitoring of in the SLRE
7 responses

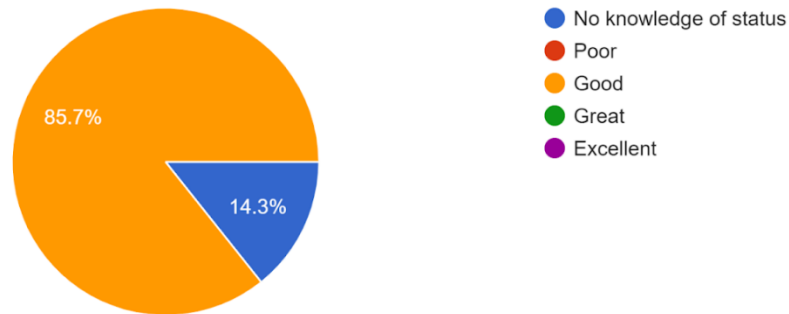


Figure 4. Survey results from the breakout session on fishes indicating the status of long-term monitoring in the SLRE.

WORKSHOP OBJECTIVE 2 – DEVELOP NEW TOOLS FOR DATA VISUALIZATION IN THE SLRE

The aim for Objective 2 was to develop ideas for a public-facing tool that will allow natural resource managers, researchers, and others to view estuary-wide data. A breakout session was held with all participants to discuss both existing data management and visualization tools and desires for future data tools.

EXISTING TOOLS

Participants were asked “What data summarization/visualization tool(s) do you currently use to analyze and summarize your data?” and as a follow-up, “What do you like about that tool?” and “How could the tool be improved?”

All the tools discussed during this breakout session are listed with a brief description in the workshop resources document ([Appendix 3](#)). The information in Table 2 is focused on the tools that were utilized most by workshop participants.

Table 2. Existing data summarization/visualization tools that workshop participants use, what they like about those tools, and ways the tools could be improved.

Tool	Positive Features	Features Needing Improvement
------	-------------------	------------------------------

ArcGIS database/GIS story map	ArcGIS databases can both map and store data.	No comments received.
	Story maps tell the stories of the existing data and science.	
Lake Superior Headwaters Sustainability Partnership Decision Support Tool	Interoperable with other data sets making updating easier.	No comments received.
National Oceanic and Atmospheric Administration Data Integration, Visualization, Exploration, and Reporting (DIVER) Tool for the St. Louis River	Crosses jurisdictional boundaries, which is good for longevity.	Can be cumbersome or overwhelming to use because it has many components.
	Contains all sediment contaminant data.	Does not currently have the capacity for most biological data (e.g., fishes, vegetation, benthic macroinvertebrates, and birds).
	Data viewer is useful and contains legacy data.	It cannot accommodate all data types.
	Contains fish tissue contaminant data.	
Has a user group.		
Natural Resources Research Institute (University of Minnesota Duluth) Minnesota Natural Resource Atlas	Has some tribal data.	Tribal data are difficult to access.
		Would be helpful to extend the data to the Wisconsin portions of the estuary.

VISIONING FUTURE TOOLS

Following discussion of currently used data tools, participants were asked to envision a future idealized data visualization and summary tool.

Participants were asked the following questions:

- ***“What metrics would be most useful to include in any data summarization/visualization tool(s) for the SLRE?”***
- ***“Who could benefit from a publicly available and accessible tool for estuary data summary/visualization?”***
- ***“What are the partnerships that could help support (e.g., hosting, develop, maintenance) of this tool?”***

Feedback received during this discussion is summarized in Table 3 below. There were several important considerations noted by breakout session participants with respect to this idealized (hypothetical) future data tool.

- The metrics that are included in any tool depend heavily on the natural resource management question(s) being asked; anticipating metrics that may be useful in the future without knowing which questions will be asked is challenging.
- The public should be asked what metrics they would like to have included or what they would like to see in a tool. Community members should have input into what beneficial or aspirational uses they envision and would want to track for the SLRE.
- There are multiple uses of the term “beneficial uses,” which may mean different things to different individuals and organizations, so any future tool developers should be mindful of using that term.
- The metrics associated with measuring beneficial use impairments could be improved to provide a better sense of the health of the estuary.
- Data interpretation and context are important in any future tool, especially when considering public use of the data. Raw data require knowledge of applicability and may need scientific interpretation.

Table 3. Characteristics of a useful tool for data visualization in the SLRE. Potential users of this tool include researchers, natural resource managers, city planners, and science communicators.

<p>Features:</p> <ul style="list-style-type: none"> ● Interoperable; able to leverage data in existing tools ● Transparent ● Contains an index or directory to data listed and how to find it ● Includes successes in the estuary and resulting economic benefits ● Contains a public-facing dashboard with an internal technical component (for researchers and managers) ● Allows for storytelling by including more than just raw data, for example, photos with permissions that can be used by science communicators ● Includes data collected through community science efforts ● Uses Findable, Accessible, Interoperable, and Reusable (FAIR) data principles ● Includes analytics that provide data on who uses the tool, how the tool is used, and how effective it is
<p>Metrics and data:</p> <ul style="list-style-type: none"> ● Wildlife and bird data ● Calculated indices and metrics (e.g., biological, social, economic, and human wellbeing) ● Shallow water bathymetry (i.e., ≤ 0.5 m) ● “State of the Estuary” reporting including results from restoration projects, how many acres have been restored, how much funding has been invested, long-term monitoring results, etc. ● Large-scale synthesis of existing data from across the estuary ● Land use and development; both current and aspirational ● Ecosystem and cultural ecosystem services

- Metrics associated with social science research

Potential partners:

- Lake Superior National Estuarine Research Reserve (platform or repository)
- [Great Lakes Aquatic Habitat Framework](#)
- U.S. Environmental Protection Agency (there is current work on developing a repository for Cooperative Science and Monitoring Initiative (CSMI) data)
- Lake Superior Headwaters Sustainability Partnership
- Great Lakes Observing System, Smart Great Lakes Initiative

WORKSHOP OBJECTIVE 3 – DEFINE AND PRIORITIZE FUTURE PROJECT(S) TO ADDRESS RESEARCH NEEDS

The purpose of Objective 3 was to identify gaps in our current scientific understanding of the SLRE and collaboratively define and prioritize future research projects to address those knowledge gaps.

Participants were asked, “What are the research priorities within the SLRE for the next five years?”

Research needs and questions were recorded, and participants were then asked which needs MNSG should include in future requests for proposals (RFP) to fund two-year applied research projects. Results from this session are summarized in Table 4. An asterisk indicates research needs identified by workshop participants as priorities and are listed first in Table 4, the remaining research needs are listed in no particular order. Following the workshop, MNSG staff further categorized each research need (birds, wild rice, fishes, estuary landscape, aquatic invasive species, and science communication and outreach). Projects in Table 4 listed with a superscript “R” are research needs and questions that are most suitable for inclusion in a future MNSG RFP. Projects with a superscript “E” are most suitable for facilitation through MNSG extension programming. Projects with a superscript “O” are more suitable to be led or funded by other entities but could be supported by MNSG.

Table 4. Project ideas, or suggested research questions to address, resulting from workshop breakout sessions under six categories (birds, wild rice, fishes, and the cross-cutting categories of estuary landscape, aquatic invasive species, and science communication and outreach).

Birds:

- ^{*,*} Why is the Common Tern recovery objective (to establish a minimum nesting population of 1,000 pairs at a total of seven or more colony sites by the year 2000) in the *Wisconsin Common Tern Recovery Plan* (Matteson, 1988) not being met? Future projects should include sediment and water quality monitoring in Common Tern feeding areas.
- ^o Long-term monitoring of the St. Louis River AOC restoration sites is needed. Future projects should determine the success of restoration with respect to bird populations and include an emphasis on migratory and stopover sites and breeding sites.
- ^r Can mercury concentration in Common Terns be used as an indicator of the success of AOC remediation and restoration efforts?
- ^o How successful is bird breeding within the SLRE? Has this success changed over time?

- ° Analysis of bird habitat suitability including which habitat features are contributing to overall habitat value is needed.
- ° Establishment of appropriate restoration metrics for birds in the SLRE.

Wild Rice:

- *^R What is the human health risk from consumption of estuary-grown wild rice? Future projects should include wild rice contaminant monitoring over time.
- ^R How viable is the wild rice seed bank in the SLRE? How can this seed bank be expanded?
- ^R What is the contaminant uptake of wild rice?
- ^R What are the impacts of sulfate on wild rice, especially from upstream sources within the St. Louis River?
- ^R How effective are current goose control measures (e.g., exclosures)? Are there other effective control measures that could be used in the SLRE?

Fishes:

- *^R What is causing the decline in Lake Sturgeon juveniles observed during monitoring? Future projects should include a determination of predation on Lake Sturgeon eggs and larvae, and an analysis of the success of the current sampling methods (specifically, sampling gear).
- ° What impact does the hydrodynamics between Lake Superior and the SLRE have on fish movement?
- ^R How do fish use the federal navigation channel in the Port of Duluth-Superior?
- ° How are Walleye moving within and between the SLRE and Lake Superior? Future projects should include a focus on Lake Sturgeon movement via passive methods within the estuary.
- ° How do seiches and resulting water temperature changes impact fish spawning and fish movement?
- ^R How does in-water work (e.g., dredging, construction) impact fish populations and fish movement within the SLRE?
- ° What drives the migration of fish species from the St. Louis River to Lake Superior? What are they following and why do different genetic strains behave differently?
- ^E Education for recreational Walleye anglers is needed to combat the misconception that light-colored Walleye are “lake fish” and dark-colored Walleye are “river fish.” This misconception is being used by anglers to make decisions about which Walleye to keep and eat (lake fish) and which Walleye to release (river fish).
- ^R What habitat types within the SLRE are important for juvenile fish?
- ° What are the impacts to fish that overwinter in areas that experience anoxia (e.g., Pokegama Bay)?
- ° What types of contaminants (i.e., emerging and legacy) are present in sport fish and at what concentrations?

Estuary Landscape:

- *^o Comparison of habitat maps from before Duluth’s historic June 2012 flood to present habitat maps to determine the impact of flooding, high water, and/or high turbidity on aquatic vegetation communities.
- *^E Updating the *Lower St. Louis River Habitat Plan* and the associated habitat maps (aquatic vegetation, fishes, invertebrates) is needed. Future projects should result in habitat maps that are accessible and a mechanism for updating these maps regularly.
- *^R What are the concentrations of microcystin toxins in surface water within the SLRE?
- *^{E, o} Planning and implementing a long-term monitoring strategy for the SLRE, including AOC restoration sites is needed. Future projects should include a mechanism for effectively reporting on the results of monitoring efforts.
- ^R What is the effect of seiches on water quality, habitat use, and habitat suitability?
- ^R Can remote sensing data be used to track changes within the SLRE over time? Projects should include regular habitat surveys, data collection, development of habitat maps, and a comparison of current maps to pre-settlement maps.
- ^R What is the upstream water quality in the St. Louis River? How does upstream water quality impact the estuary?
- ^R How can stream bank erosion in upstream areas of the watersheds influence the SLRE?
- ^o What is the water quality in clay-influenced bays? Is the water quality in these areas impacting species abundance and diversity within the St. Louis River?
- ^o How do water level fluctuations impact aquatic plant communities? Future projects should include proactive planning for high water levels based on research outcomes.
- ^E Revisit the [Plectica](#) concept map resulting from the systems-thinking session at the St. Louis River Summit (~2017).
- ^o Examination of green infrastructure in northern climate applications is needed.
- ^o Refining the hydrodynamic model developed by [Jay Austin](#) to include shallow water areas (<0.5 m, requires accurate shallow bathymetry) and groundwater input is needed.
- ^o Examination of disparities in communities across the SLRE is needed. Future projects should include an examination of air quality (as measured by [PurpleAir](#) or other similar technology) and aesthetics.
- ^o Assessment of how the seiches in the SLRE are changing because of a warming climate and how those changes are impacting habitats and populations. Future projects should include an examination of plant species that are more tolerant of high-water levels and/or frequently fluctuating water levels, and strategic locations where additional energy-dampening tools (e.g., shoals constructed of dredge material) could be proactively employed.

Aquatic Invasive Species:

- *^R Examination of Emerald Ash Borer management actions, successes, and recommendations with respect to Black Ash forests, including hydrology data, transpiration, and groundwater.

- ^R Monitor invasive aquatic invertebrates (e.g., Bloody Red Shrimp) and their impact within the SLRE.
- ^R Determine ecosystem impacts from loss of wetland forest due to loss of Black Ash from Emerald Ash Borer. Future projects should include a determination of the best species to replace Black Ash in estuary wetland forest habitat.
- ^R How will climate change affect the establishment of aquatic invasive species in the SLRE?

Data Summary, Outreach, and Science Communication:

- ^{*,R} Quantify and communicate the improvement of ecosystem services and economic impacts to local communities because of St. Louis River AOC remediation and restoration efforts.
- ^{*,R} A secondary analysis of the “state of the estuary” data is needed, wherein existing data from research conducted in the SLRE is used to develop metrics and measurements.
- ^{*,R} What have we learned from past beneficial uses of dredge material? Future projects should include what has worked, what has not, and an assessment of future directions for habitat restoration and other beneficial uses.
- ^E Tell the story of fish migration from the St. Louis River to Lake Superior. Future projects could include interactive displays at the Great Lakes Aquarium and other locations, and story mapping to highlight the big picture/provide overview of the research results.
- ^O How to combat the loss of historical and institutional research knowledge within the SLRE because of data storage formats changing (e.g., floppy discs and CDs) and lack of capacity to maintain websites as historical archives?

CONCLUSIONS

Many restoration initiatives in the St. Louis River watershed have been initiated and successfully completed. Major progress and emphasis has occurred in restoration of habitats in the St. Louis River AOC (Figure 1). Progress toward delisting the AOC accelerated in 2010 when significant funding became available from the Great Lakes Restoration Initiative. A direct result of the targeted work on habitat in the St. Louis River AOC was the proposed removal of the Beneficial Use Impairment (BUI) for degraded fish and wildlife populations with a public meeting and open house held on April 14, 2022 (the same day at this workshop). Many agencies, organizations, researchers, and the public worked together to make this possible.

MNSG is one of many organizations that continue to assist in rehabilitation of the SLRE. MNSG has historically offered opportunities for scientists to apply for research funding to address data gaps within the SLRE. One outcome of this workshop was to address the need to turn existing data, some of which is included in [Appendix 3](#), into an easily accessible body of *knowledge* that would continually be updated. Two other important outcomes were to determine and *prioritize data gaps* yet to be addressed, while brainstorming how this body of knowledge could be used to *improve natural resource management* within the SLRE. The organizers and participants said the workshop provided a better understanding of what other people with an interest in the SLRE want to know, which questions scientists and natural

resource managers could likely answer, and which questions could only be answered with additional research.

MNSG will incorporate the information gathered during this workshop in developing future RFPs highlighting the needs identified in Objective 1 for birds, wild rice, and fishes along with the other cross-cutting topics participants identified. Developing new tools for data visualization in the SLRE as described under Objective 2 will also be a high priority when the next MNSG RFP is developed. The prioritization of research needs addressed in Objective 3 (Table 4) will help determine which of the topic areas identified by workshop participants will be highlighted in the next MNSG RFP scheduled for distribution early in 2023. It is our hope that other organizations conducting or funding research within the estuary will also use the prioritized topics identified in Objective 3 to inform their future research and activities in the SLRE.

REFERENCES

- Anselmo, T., Bogyo, N., & Borkholder, B. (2022). *Larval Sturgeon Drift Netting Summary on the St. Louis River, 2021* (Technical No. 22–09; p. 12). 1854 Treaty Authority and Fond du Lac Resource Management Division.
<https://www.1854treatyauthority.org/management/biological-resources/fisheries/reports.html?id=256&task=document.viewdoc>
- Bellinger, B. J., Hoffman, J. C., Angradi, T. R., Bolgrien, D. W., Starry, M., Elonen, C., Jicha, T. M., Lehto, L. P., Seifert-Monson, L. R., Pearson, M. S., Anderson, L., & Hill, B. H. (2016). Water quality in the St. Louis River Area of Concern, Lake Superior: Historical and current conditions and delisting implications. *Journal of Great Lakes Research*, 42(1), 28–38.
<https://doi.org/10.1016/j.jglr.2015.11.008>
- Bogyo, N. (2022). *2021 St. Louis River Estuary Bottom Trawling Survey Summary Report* (Technical No. 22–05; p. 27). 1854 Treaty Authority.
<https://www.1854treatyauthority.org/management/biological-resources/fisheries/reports.html?id=252&task=document.viewdoc>
- Bracey, A., Lisovski, S., Moore, D., McKellar, A., Craig, E., Matteson, S., Strand, F., Costa, J., Pekarik, C., Curtis, P., Niemi, G., & Cuthbert, F. (2018). Migratory routes and wintering locations of declining inland North American Common Terns. *The Auk*, 135(3), 385–399.
<https://doi.org/10.1642/AUK-17-210.1>
- Canada, U.S. 2012. The Great Lakes Water Quality Protocol 2012. Accessed online 6 December 2022, 1530 hrs, at:
<https://binational.net/agreement/full-text-the-2012-great-lakes-water-quality-agreement/>
- Estep, K. (2019). *Genetic Origins and Movement of Lake Sturgeon Acipenser fulvescens in the St. Louis River and Western Lake Superior* [University of Wisconsin Stevens Point].
<https://minds.wisconsin.edu/bitstream/handle/1793/80127/Estep.pdf?sequence=1&isAllowed=y>
- Grand, J., Saunders, S. P., Michel, N. L., Elliott, L., Beilke, S., Bracey, A., Gehring, T. M., Gnass Giese, E. E., Howe, R. W., Kasberg, B., Miller, N., Niemi, G. J., Norment, C. J., Tozer, D. C., Wu, J., & Wilsey, C. (2020). Prioritizing coastal wetlands for marsh bird conservation in the U.S. Great Lakes. *Biological Conservation*, 249, 108708. <https://doi.org/10.1016/j.biocon.2020.108708>
- Haramis, G. M., & Kearns, G. D. (2007). Herbivory by Resident Geese: The Loss and Recovery of Wild Rice along the Tidal Patuxent River. *The Journal of Wildlife Management*, 71(3), 788–794.
- Janssen, S. E., Hoffman, J. C., Lepak, R. F., Krabbenhoft, D. P., Walters, D., Eagles-Smith, C. A., Peterson, G., Ogorek, J. M., DeWild, J. F., Cotter, A., Pearson, M., Tate, M. T., Yearley Jr., R. B., & Mills, M. A. (2021). Examining historical mercury sources in the Saint Louis River estuary: How legacy contamination influences biological mercury levels in Great Lakes coastal regions. *Science of The Total Environment*, 779, 146284. <https://doi.org/10.1016/j.scitotenv.2021.146284>
- Jobe, J., Krafft, C., Milton, M., & Gedan, K. (2022). Herbivory by Geese Inhibits Tidal Freshwater Wetland Restoration Success. *Diversity*, 14(4), 278. <https://doi.org/10.3390/d14040278>
- Liljenquist, A., Bracey, A., & Grinde, A. (2019). *Avian Surveys for the St. Louis River Natural Areas Project: Submitted to Minnesota Land Trust* (Technical Summary Report NRRI/TSR-2019/09; p. 39). Natural Resources Research Institute, University of Minnesota Duluth.
<https://duluthmn.gov/media/6729/appx-c-bird-survey.pdf>
- Matteson, S.W., (1988). *Wisconsin Common Tern Recovery Plan*. Wisconsin Endangered Resources Report 41, Wisconsin Department of Natural Resources, Madison, WI.

- Pastor, J., Dewey, B., Johnson, N. W., Swain, E. B., Monson, P., Peters, E. B., & Myrbo, A. (2017). Effects of sulfate and sulfide on the life cycle of *Zizania palustris* in hydroponic and mesocosm experiments. *Ecological Applications*, 27(1), 321–336. <https://doi.org/10.1002/eap.1452>
- Reschke, C., & Hill, C. S. (2020). *Aquatic Habitat Mapping in the St. Louis River Estuary* (Technical NRR/IR-2020/19; p. 49). Natural Resources Research Institute, University of Minnesota Duluth.
- Schram, S. T., Lindgren, J., & Evrard, L. M. (1999). Reintroduction of Lake Sturgeon in the St. Louis River, Western Lake Superior. *North American Journal of Fisheries Management*, 19(3), 815–823. [https://doi.org/10.1577/1548-8675\(1999\)019<0815:ROLSIT>2.0.CO;2](https://doi.org/10.1577/1548-8675(1999)019<0815:ROLSIT>2.0.CO;2)
- St. Louis River Area of Concern Coordinators and Leaders. (2020). *St. Louis River Area of Concern 2021 Remedial Action Plan October 1, 2020—September 20, 2021* (p. 103) [Remedial Action Plan]. https://widnr.widen.net/view/pdf/styxzeasio/GW_SLR_RAP2021.pdf?t.download=true
- St. Louis River Citizens Action Committee. (2002). *Lower St. Louis River Habitat Plan* (p. 123) [Habitat Plan].
- The Lake Superior Partnership. (2016). *Lake Superior Lakewide Action and Management Plan 2015—2019* [Management Plan].
- United States Army Corps of Engineers. (2020). *The Great Lakes Navigation System*. Great Lakes Navigation, Detroit District. <https://www.lre.usace.army.mil/Portals/69/docs/Navigation/GrtLaksNavSysBro2020.pdf?ver=2020-02-03-150106-733>
- Vogt, D. J. (2021). *St. Louis River Estuary Wild Rice Restoration Monitoring (2015-2021)* (Technical Technical Report 21-09; p. 53). 1854 Treaty Authority.
- Wang, H., & Zhang, Q. (2019). Research Advances in Identifying Sulfate Contamination Sources of Water Environment by Using Stable Isotopes. *International Journal of Environmental Research and Public Health*, 16(11), 1914. <https://doi.org/10.3390/ijerph16111914>
- Welsh, A. B., Schumacher, L., & Quinlan, H. R. (2019). A reintroduced lake sturgeon population comes of age: A genetic evaluation of stocking success in the St. Louis River. *Journal of Applied Ichthyology*, 35(1), 149–159. <https://doi.org/10.1111/jai.13726>
- Wilkinson, M. D., Dumontier, M., Aalbersberg, I. J., Appleton, G., Axton, M., Baak, A., Blomberg, N., Boiten, J.-W., da Silva Santos, L. B., Bourne, P. E., Bouwman, J., Brookes, A. J., Clark, T., Crosas, M., Dillo, I., Dumon, O., Edmunds, S., Evelo, C. T., Finkers, R., ... Mons, B. (2016). The FAIR Guiding Principles for scientific data management and stewardship. *Scientific Data*, 3(1), 160018. <https://doi.org/10.1038/sdata.2016.18>

INTRODUCTION TO MINNESOTA SEA GRANT’S FUNDED RESEARCH PROGRAM — A SUMMARY OF REMARKS MADE BY ALEX FRIE

Alex Frie, MNSG’s Research and Fellowship Coordinator, helps MNSG set research priorities and facilitate research and fellowship programs. Alex introduced Sea Grant as a network of 34 state-based programs that support coastal and Great Lakes communities through research, extension, and education. Sea Grant is part of the National Oceanic and Atmospheric Administration (NOAA). Alex described the MNSG research process (Figure 5), which includes first identifying needs (i.e., as MNSG demonstrated during this workshop) via direct stakeholder engagement, MNSG Advisory Board recommendations, and MNSG Strategic Planning efforts.

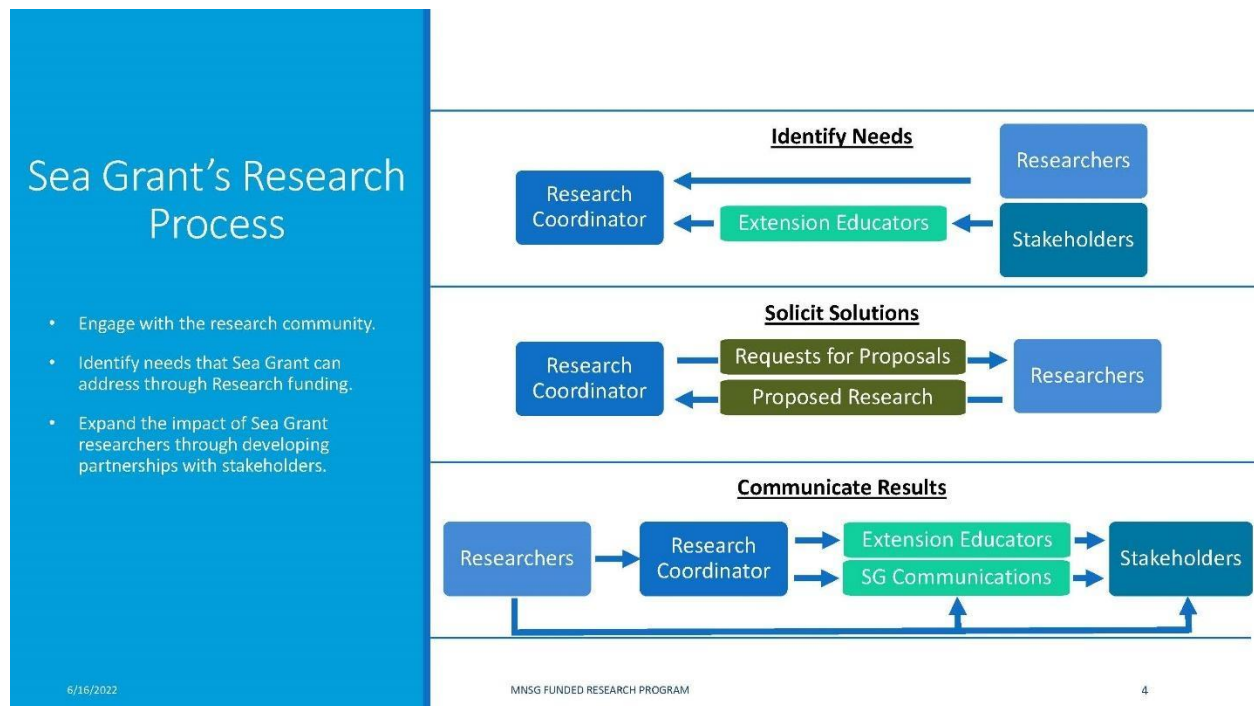


Figure 5. Diagram Outlining the MNSG Funded Research Process. Credit: Alex Frie.

The next step in the process is to ask for solutions to address those needs through a Request for Proposals (RFP), which can involve a joint proposal with another Sea Grant program. Submitted proposals undergo independent peer review, followed by external technical panel review, then MNSG Advisory Board review. The current RFP will be announced in November 2022 with proposals due in spring of 2023. Funding will start in spring of 2024 with a total of ~\$250,000 awarded per project, with two years of graduate student support included in this amount. The RFP is open to any researcher within the State of Minnesota, but there are no indirect costs for University of Minnesota researchers. The proposals require a 30% match of non-federal funds.

Alex described the variety of past funded projects that focused on the SLRE, including:

- *Tracking Muskellunge in the St. Louis River Estuary* (Miller)

- *Refining our Understanding of Methylmercury Production and Bioavailability in the S. Louis River Estuary* (Johnson)
- *Long-Term Aquatic Conditions to Inform Delisting Efforts on the St. Louis River* (Reavie)
- *Landscape Regulators of Biogeochemical Pattern and Process in the St. Louis River Estuary* (Finlay)
- *Gonadal Deformities in Smallmouth Bass as Indicators of Endocrine Disruption in the St. Louis River Estuary* (Olker)

However, there have been some needs that have been included in past solicitations but not yet addressed:

- (2020) Dredge material disposal and reuse issues: What are the spatiotemporal windows for minimizing dredging effects on fisheries? What are the sediment sources that cause harbor dredging? How can dredging in the harbor be reduced?
- (2022) Draw together all existing available data on fish habitat use, habitat, spawning, and movement to summarize the locations and times most critical to sustaining healthy fish stocks in the Duluth-Superior harbor and estuary. Identify knowledge gaps that need to be addressed to inform when and where dredging for shipping should occur to minimize damage to the fishery.

Finally, Alex outlined three important points for the workshop participants:

1. MNSG funds research in the SLRE,
2. MNSG has a particular interest in applied research, and
3. MNSG is interested in SLRE-specific research needs, project ideas, and identifying crucial partners/stakeholders.

LAKE SUPERIOR HEADWATERS SUSTAINABILITY PARTNERSHIP — A SUMMARY OF REMARKS MADE BY GINI BREIDENBACH

Gini Breidenbach is a Restoration Program Manager with Minnesota Land Trust. A significant focus of Gini's work for the past three years has been managing development of the Lake Superior Headwaters Sustainability Partnership (Headwaters Partnership), which is funded by the Fish and Wildlife Service through the U.S. Environmental Protection Agency's Great Lakes Restoration Initiative. Gini provided the workshop participants with an introduction and update on the work of the Headwaters Partnership, which is an intentional collaboration and information-sharing framework that was developed to answer the questions:

- What's next after the AOC work is over?
- What's our vision for the future?
- How do we work together to get there?

The landscape boundary of the Headwaters Partnership work is the same as the St. Louis River AOC boundary (Figure 6). The Headwaters Partnership planning approach divides the region into watersheds based on geographic zones established for the St. Louis River in the AOC process (Figure 7). There are three levels of analysis. Level 1 was completed through a series of workshops to gather information on

each objective for each geographic zone. Level 2 includes preparing a vision for natural resources restoration developed with community input. A prototype of this analysis is being completed for the Allouez Bay geographic zone (Figure 7). Finally, Level 3 is a site-level project design that partners within a geographic zone could use to develop their own project design consistent with the Level 2 vision. The sustainable landscape vision includes the intersection of natural resources management (the current focus), economic development, and community health. The partnership developed a [decision support tool](#) in the form of an online, map-based platform intended to be a place where workshop results (Level 1) and Level 2 vision designs are shared.

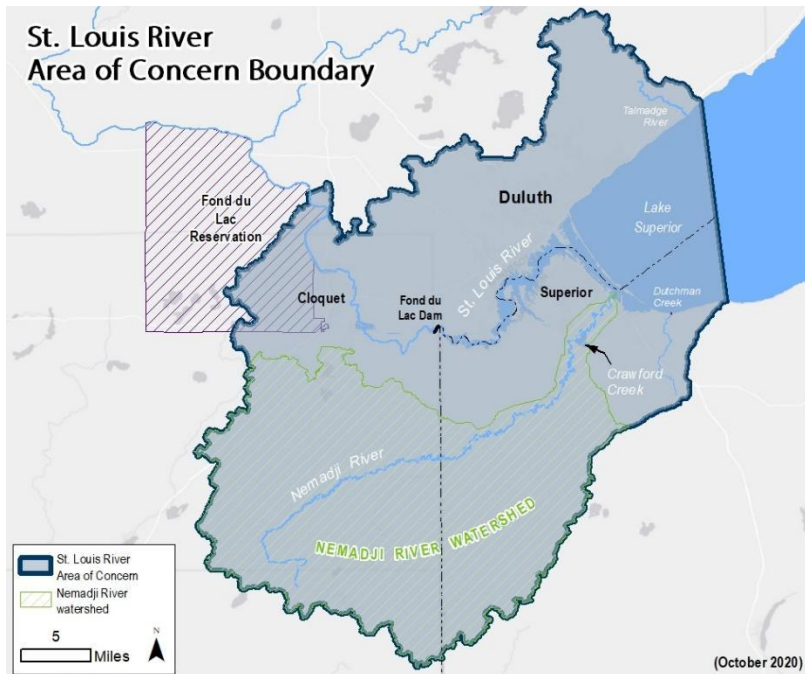


Figure 6. Map Showing the St. Louis River AOC Boundary as of October 2020.
Credit: St. Louis River AOC Coordinators and Leaders.

Gini described the status of the “landscape level rollup;” a direct result of the Level 1 analysis that includes a list of priority concerns within the St. Louis River landscape. The priority concerns are:

- Hydrologic integrity (physical characteristics and water quality)
- Fisheries – Tributaries (Brook Trout)
- Fisheries – St. Louis River (Lake Sturgeon)
- Birds (migratory and nesting)
- Coastal wetlands (includes all wet portions of the river and water quality)
- Wild rice
- Invasive species
- Terrestrial habitat connectivity and integrity
- Dredge material management
- Environmental justice and equity
- Community engagement



Figure 7. Meso-Scale Geographic Zones and their Contributing Watersheds Utilized by the Lake Superior Headwaters Sustainability Partnership. Credit: Lake Superior Headwaters Sustainability Partnership, 2021.

The Headwaters Partnership Advisory Group is working on a Memorandum of Understanding (MOU) for Tier 1 signatories; Tier 1 participants in the Headwaters Partnership include organizations with land and natural resource management decision-making roles (Fond du Lac Band of Lake Superior Chippewa, Minnesota Department of Natural Resources, Wisconsin Department of Natural Resources, City of Duluth, and City of Superior). Tier 2 and Tier 3 participation in the partnership includes federal agencies, the St. Louis River Habitat Workgroup, non-governmental organizations, universities, Duluth Seaway Port Authority, Harbor Technical Advisory Committee, Duluth Urban Watershed Advisory Committee, and other stakeholder groups. MOU signatories will agree to cooperate on the management of the Lake Superior Headwaters region and pursue issues of mutual concern.

Goals and objectives for each priority concern will be developed. This is an effort in which a group of partners per concern work together to draft goals and objectives based on Level 1 stakeholder input to date. Gini shared an example of a goal (future vision statement) and associated objectives that have been developed for the priority concern “Fisheries – Tributaries (Brook Trout),” the goal of which is “Self-sustaining, Brook Trout populations within watersheds that are resilient to the negative impacts of climate change.”

There were several questions from workshop participants following Gini’s presentation. One participant asked about the objectives from the “Fisheries – Tributaries (Brook Trout)” example and whether those objectives may conflict with one another. Gini responded that this is part of the intent of the Headwaters Partnership, to convene a variety of perspectives (natural resources management, economic, community) to develop goals and objectives using a systems-based approach. Another participant

expressed a concern about the multi-sector approach of the Headwaters Partnership, and whether conducting projects that support economic development may ultimately lead to degradation of natural resources. Gini responded to this concern to clarify that the goal of the Headwaters Partnership is to recognize that we live in an urban landscape (Duluth-Superior) and the goal is sustainability of this landscape; we must work together to achieve a balance between natural resources management, economic development, and community development. It is an intentional recognition that we have all three sectors to consider and that we need to make decisions holistically. We are learning from our historical mistakes of not making balanced decisions. The last question was about the mechanisms (e.g., funding sources, reporting, etc.) of the Headwaters Partnership and its partners that will be used to support the goals that are being developed. Gini explained that the purpose of the Headwaters Partnership is to achieve an organized, collective front to take to funding agencies and other project supporters. The other intent is to address some of the questions that have not been addressed within the framework of the AOC, and intentionally define these things so that work can move forward more effectively.

DEVELOPMENT OF A LONG-TERM WATER QUALITY MONITORING STRATEGY FOR THE ST. LOUIS RIVER ESTUARY — A SUMMARY OF REMARKS MADE BY DEANNA ERICKSON

Deanna Erickson, Director of the Lake Superior National Estuarine Research Reserve (NERR), which is led by NOAA and is part of a national system of reserves (30) around the country, introduced workshop participants to a future proposed project. One need that the NERR has perceived is long-term water quality monitoring within the SLRE, particularly at sites that have been restored. Deanna shared that the NERR is working with the Natural Resources Research Institute (NRRI, University of Minnesota Duluth) to conduct intensive water quality sampling in 2023 and 2024, including under ice and following storm events, to understand what is driving degraded conditions in some parts of the SLRE that they have deemed “hot spots” (e.g., where water quality or algal communities are degraded). This is a large and intensive sampling project funded through the [NERRS Science Collaborative](#), which will involve a NRRI graduate student, and the NERR staff will generate a synthesis of the data that will be accessible through an ArcGIS hub. A draft sampling site map that has been developed is end-user driven and may evolve as the project begins in Fall 2022. The partners on this project are NRRI, Fond du Lac Band of Lake Superior Ojibwe (Chippewa), Wisconsin Department of Natural Resources, City of Superior, and the Minnesota Pollution Control Agency. Following data collection, synthesis, and reporting, the project staff will develop recommendations for water quality monitoring to launch a facilitated process to determine where to monitor, when to monitor, and what instrumentation will be needed. Funding for future resources including staff and instrumentation is to be determined.

PARTICIPANT LIST (31)

- Aaron Gustafson, Regional Environmental Coordinator, Wisconsin Department of Transportation
- Andy Hinickle, Senior Manager - Wetland Conservation, Audubon Great Lakes
- Annie Bracey, Avian Ecologist, Natural Resources Research Institute at University of Minnesota Duluth
- Carol Reschke, Retired Plant Ecologist
- Dale Gentry, Conservation Manager, Audubon - Minnesota
- Dan Breneman, State Program Administrator, Minnesota Pollution Control Agency
- Dan Wilfond, Fisheries Specialist, Minnesota Department of Natural Resources
- Darren Vogt, Resource Management Director, 1854 Treaty Authority
- Dave Grandmaison, St. Louis River Wild Rice Restoration and Habitat Project Coordinator, Wisconsin Department of Natural Resources
- Deanna Erickson, Director, Lake Superior National Estuarine Research Reserve
- Gary Glass, Retired Research Chemist
- Gini Breidenbach, Restoration Program Manager, Minnesota Land Trust
- Jeff Stollenwerk, Director of Government and Environmental Affairs, Duluth Seaway Port Authority
- Jeramy Pinkerton, Project Manager, Minnesota Department of Natural Resources
- Jeremy Hartsock, Researcher, University of Wisconsin-Superior
- Jerry Henneck, Scientist, Natural Resources Research Institute at University of Minnesota Duluth
- Julie Macor, Director of Environmental Services, Western Lake Superior Sanitary District
- Kari Hedin, Watershed Specialist, Fond du Lac Band of Lake Superior Chippewa
- Kirsten Rhude, Stewardship Coordinator, Lake Superior National Estuarine Research Reserve
- Kris Liljeblad, Senior Transportation Planner, Arrowhead Regional Development Commission/Duluth-Superior Metropolitan Interstate Council
- Martha Minchak, Assistant Area Wildlife Manager, Wildlife Office - Minnesota Department of Natural Resources
- Nick Bogyo, Fisheries Biologist, 1854 Treaty Authority
- Pat Collins, Program Manager, Minnesota Land Trust
- Ryan Lepak, Research Limnologist, U.S. Environmental Protection Agency
- Terry Heatlie, Habitat Restoration Specialist, NOAA Fisheries
- Titus Seilheimer, Fisheries Specialist, Wisconsin Sea Grant
- Tom Hollenhorst, Landscape Ecologist, U.S. Environmental Protection Agency
- Tony Anselmo, Fish and Wildlife Specialist, 1854 Treaty Authority
- Valerie Brady, Research Associate, Natural Resources Research Institute at University of Minnesota Duluth
- Willis Mattison, Retired Ecologist, Avid Fisherman, Frequent Visitor to the Estuary
- Zach Stewart, Natural Resources Specialist/AIS Coordinator, Douglas County

One outcome of this workshop was to address the need to turn existing data into an easily accessible body of *knowledge* that would continually be updated. Although not an exhaustive list, this document is meant to be a publicly available repository that may be useful for anyone working in and around the SLRE. MNSG will work with the St. Louis River Habitat Workgroup members to update this list of resources on an annual basis. The workshop resources have been included on the [workshop project page on MNSG's website](#).

Some content listed below may not comply with accessibility standards set forth by the National Oceanic and Atmospheric Administration and/or the University of Minnesota. Contact the organization responsible for creating the resource to inquire about alternative formats. If you are an originating organization and have an accessible version of a resource listed below, please contact Kelsey Prihoda (priho011@d.umn.edu).

ESTUARY-WIDE

RESOURCES AND TOOLS

- Fond du Lac Band of Lake Superior Chippewa. 2018. [Integrated Resource Management Plan](#). Fond du Lac Resource Management Division.
- [Great Lakes Coastal Wetland Monitoring Program](#). Central Michigan University, Institute for Great Lakes Research, and collaborators.
 - [Site Mapping Tool](#)
 - Data may be requested from the Natural Resources Research Institute at University of Minnesota Duluth (contact: Valerie Brady, vbrady@d.umn.edu)
- Host, George and J. Silbernagel. 2010 - 2015. [St. Louis River Estuary the Stories and the Science](#). Wisconsin Sea Grant Institute, Minnesota Sea Grant College Program, Minnesota Pollution Control Agency, and Wisconsin Department of Natural Resources.
- Host, George and T. Hollenhorst. 2011. The Great St. Louis River Estuary Data Slam. [Proceedings of the St. Louis River Estuary 2011 Science Summit](#), Lake Superior National Estuarine Research Reserve, Superior, WI.
- Lake Superior Binational Program. February 2015. [A Bioconservation Strategy for Lake Superior](#).
 - [Background chapter for St. Louis and Cloquet Regional Biodiversity Conservation Plan](#), excerpt from *A Bioconservation Strategy for Lake Superior*.
 - [St. Louis and Cloquet Regional Biodiversity Conservation Plan](#), excerpt from *A Bioconservation Strategy for Lake Superior*.
- Minnesota Department of Natural Resources. October 2020. [Habitat Restoration and Protection St. Louis River Area of Concern](#). Minnesota.
- Minnesota Department of Natural Resources. [Watershed Health Assessment Framework](#).
 - [Online data map](#)
 - [Watershed health scores](#)
 - [Key concepts for watershed health](#)

- Minnesota Land Trust. December 2019. [Nomination of the St. Louis River Natural Area to the Duluth Natural Areas Program](#). City of Duluth Parks & Recreation Division, Duluth, Minnesota.
- Minnesota Pollution Control Agency. [St. Louis River Area of Concern Resources](#).
 - [Historical maps and photographs of the St. Louis River](#)
- National Oceanic and Atmospheric Administration. January 2016. [Implementation Plan for the St. Louis River Estuary Habitat Focus Area](#).
- National Oceanic and Atmospheric Administration Natural Resources Damage Assessment and Restoration [Data & Visualization Tools](#)
 - Data Integration, Visualization, Exploration, and Reporting ([DIVER Explorer](#)) for [St. Louis River](#)
- Staffen, Amy. 2012. [Lake Superior Estuaries Annotated Bibliography](#). Wisconsin Department of Natural Resources, Bureau of Endangered Resources.
- St. Louis River Area of Concern Partners. [Degraded Fish and Wildlife Populations Delisting Package](#).
- St. Louis River Citizens Action Committee. May 2002. [Lower St. Louis River Habitat Plan](#). St. Louis River Citizens Action Committee, Duluth, Minnesota.
- United States Environmental Protection Agency. [Lake Superior Lakewide Action and Management Plan and Associated Reports](#).
- Wisconsin Department of Natural Resources. 2005. [2015 - 2025 Wisconsin Wildlife Action Plan](#). Madison, WI.
- Wisconsin Department of Natural Resources. March 2015. [Habitat Restoration and Protection Projects in the St. Louis River Area of Concern, Wisconsin](#).
- Wisconsin Department of Natural Resources. [St. Louis River Area of Concern Resources](#).

ST. LOUIS RIVER HABITAT WORK GROUP

- [St. Louis River Estuary Habitat Work Group Google Site](#)
- [ArcGIS Map](#) of priority projects defined in the [Lower St. Louis River Habitat Plan](#) (St. Louis River Citizens Action Committee, May 2002)

LAKE SUPERIOR HEADWATERS SUSTAINABILITY PARTNERSHIP

- [Website and Decision Support Tools](#)
 - Supports partner collaboration on specific issues. Contains a mapping tool with habitat layers and a feature that will be made public in the future that is part of a metric dashboard to report out on the state of the estuary.

BIRD RESOURCES

- [Allouez Bay Marsh Bird Habitat Restoration](#)
- Hawk Ridge Fall and Spring [Bird Migration Counts](#)

- Matteson, S.W. June 1988. *Wisconsin Common Tern Recovery Plan*. Wisconsin Endangered Resources Report 41, Wisconsin Department of Natural Resources, Bureau of Endangered Resources, Madison, WI. 80 pp.
- [Minnesota eBird](#)
- Minnesota Land Trust and partners from Great Lakes Audubon, Wisconsin Department of Natural Resources, Minnesota Department of Natural Resources, and University of Minnesota-Duluth Natural Resources Research Institute are working on an estuary-wide bird conservation plan
 - For more information, contact [Gini Breidenbach](#) (Minnesota Land Trust)
- University of Minnesota-Duluth Natural Resources Research Institute [Avian Ecology Lab](#)
- [Wisconsin eBird](#)

WILD RICE RESOURCES

- [1854 Treaty Authority Wild Rice Resources](#).
- Kjerland, T. 2015. [Wild Rice Monitoring Field Guide](#). The University of Minnesota Sea Grant Program, Publication #SH15 (2nd ed.). ISBN 978-0-9965959-0-2.
- Kjerland, T. 2015. [Wild Rice Monitoring Handbook](#). The University of Minnesota Sea Grant Program, Publication #SH16.
- Minnesota Department of Natural Resources. 2014. [St. Louis River Estuary Wild Rice Restoration Implementation Plan](#). Division of Ecological and Water Resources, Duluth, Minnesota.
- [Manoomin Education and Outreach Toolkit](#). Wisconsin Sea Grant.
- [St. Louis River Alliance Wild Rice Project and Resources](#).
- Taplin, C. and Wenner, K. March 2018. [Potential Impacts of *Orconectes rusticus* \(Rusty Crayfish\) on Wild Rice in the 1854 Ceded Territory](#), Technical Report 18-09. 1854 Treaty Authority, Resource Management Division, Duluth, Minnesota.
- Vogt, Darren J. December 2021. [St. Louis River Estuary Wild Rice Restoration Monitoring \(2015 - 2021\)](#), Technical Report 21-09. 1854 Treaty Authority, Resource Management Division, Duluth, Minnesota.

FISH RESOURCES AND TOOLS

- 1854 Treaty Authority. Annual summary reports for [St. Louis River Estuary bottom trawling survey \(2011 - 2021\)](#) and [2021 Larval Sturgeon Drift Netting Summary](#).
- Goldsworthy, C.A.; Reeves, K.A.; Blankenheim, J.E.; and Peterson, N.R. July 2017. [2016 - 2025 Fisheries Management Plan for the Minnesota Waters of Lake Superior](#).
- Great Lakes Fishery Commission. [Lake Superior Committee Publications and Products](#).
- Minnesota Department of Natural Resources, Lake Superior Area Fisheries, Duluth, Minnesota.
- Piszczek, P.; Nelson, A.; and Wedge, M. 2015. [St. Louis River Lake Sturgeon Survey Summary](#). Wisconsin Department of Natural Resources, Minnesota Department of Natural Resources, and Fond du Lac Band of Lake Superior Chippewa.

- Wisconsin Department of Natural Resources. [2020 - 2029 Lake Superior Fisheries Management Plan](#), Administrative Report No. 93. Wisconsin Department of Natural Resources, Bureau of Fisheries Management, Lake Superior Fisheries Team.
- Wisconsin Institute for Discovery and University of Wisconsin Center for Limnology, University of Wisconsin-Madison. [Fishwerks](#).
 - Estimates restoration costs to optimize fish barrier removal. Web-based GIS platform tool that targets candidate fish passage barriers to maximize habitat improvement projects and coordinate restoration efforts.

OTHER TOOLS

- Great Lakes Fishery Trust. [Great Lakes Aquatic Habitat Framework](#).
 - Can be used to track projects that have been completed in the St. Louis River Estuary. Comprehensive spatial framework, database, and classification for Great Lakes basin ecological data. Housed at the University of Michigan with maintenance supported by the Michigan Department of Natural Resources Institute for Fisheries Research.
- Great Lakes Observing System. [Seagull Platform](#).
 - Real-time access to Great Lakes buoy data.
- Minnesota Department of Natural Resources. [Watershed Health Assessment Framework](#).
 - Interactive map, ecological health scores, and other resources to help natural resource managers and citizens develop a common understanding of Minnesota's natural resource systems. Metrics look at overall health, stormwater, etc.
- National Geospatial Program, United States Geological Survey. [The National Map](#).
 - Products/services that provide access to base geospatial information to describe the landscape. Collaborative effort among USGS and federal, state, local partners to improve and deliver topographic information for the country and its territories.
- National Oceanic and Atmospheric Administration, Office for Coastal Management. [Digital Coast](#).
 - Website targeted to the coastal management community that provides coastal data, tools, training, and information. Content comes from many sources and is completely vetted by NOAA.
- Natural Resources Research Institute, University of Minnesota Duluth. [Minnesota Natural Resource Atlas](#).
 - Online mapping tools and data, including interactive map and data catalog. Has many data layers such as biota, political boundaries, and Minnesota biological survey data.
- State of Minnesota. [Minnesota Geospatial Commons](#).
 - Collaborative web space for users and publishers of Minnesota's geospatial resources, includes environmental resources, boundaries, and transportation.
- United States Environmental Protection Agency. [SteamCat Dataset](#).
 - Contains over 600 metrics, both natural and anthropogenic, for ~2.65 million stream segments and their associated catchments across the conterminous United States.
- United States Environmental Protection Agency. [EnviroAtlas](#).

- o Provides geospatial data and other resources related to ecosystem services, chemical and non-chemical stressors, and human health. Includes 50 specific communities, and there is work to bring the community of Duluth/Superior into this platform.
- United States Geological Survey. [NHDPlus HR](#).
 - o Has catchments with derived values for annual and summer flow, stream order, etc. Geospatial dataset that depicts the flow of water across the United States landscapes and through the stream network.
- Wisconsin Department of Natural Resources. [Surface Water Data Viewer](#).
 - o Many data layers and surface water layers; ties into the Surface Water Integrated Monitoring Systems (SWIMS). Interactive web mapping tools for chemistry (water, sediment), physical, and biological (macroinvertebrate, fish) data.

HABITAT MANAGEMENT IN THE ST. LOUIS RIVER ESTUARY

Identifying Existing Data, Partnerships, and Emerging Research Needs

Thursday, April 14
9:00 am to 3:00 pm CDT
Zoom Meeting

09:00 - Workshop Welcome and Opening Session

- Welcome and overview of workshop agenda, goal, and objectives (John Downing, Minnesota Sea Grant, MNSG)
- *Introduction to Minnesota Sea Grant's Funded Research Program* (Alex Frie, MNSG)
- *Lake Superior Headwaters Sustainability Partnership* (Gini Breidenbach, Minnesota Land Trust)
- *Development of a Long-Term Water Quality Monitoring Strategy for the St. Louis River Estuary* (Deanna Erickson, Lake Superior Reserve)
- Workshop framing and introduction of AM breakout session topic areas (Kelsey Prihoda, MNSG)

10:00 - AM Breakout Session

- **AM-1, Birds:** Discussion of estuary-wide decision-making needs for birds: key metrics, data compilation, current data, and data gaps
- **AM-2, Wild Rice:** Discussion of estuary-wide decision-making needs for wild rice: key metrics, data compilation, current data, and data gaps
- **AM-3, Fish:** Discussion of estuary-wide decision-making needs for fish: key metrics, data compilation, current data, and data gaps

11:00 - Come Together for AM Breakout Session Summary

11:30 - Break

12:45 - Workshop Welcome Back, Morning Summary, Introduce Afternoon Discussion (Don Schriener, MNSG)

13:00 - PM Breakout Session

- **PM-1, Data Tool:** Develop ideas for a public-facing tool to aid natural resource managers, researchers, and others to view data on an estuary-wide scale
- **PM-2, Future Projects:** Prioritize future research projects that could be funded through Minnesota Sea Grant's Request for Proposals process

14:15 - Come Together for PM Breakout Session Summary

14:45 - Closing (John Downing, MNSG)

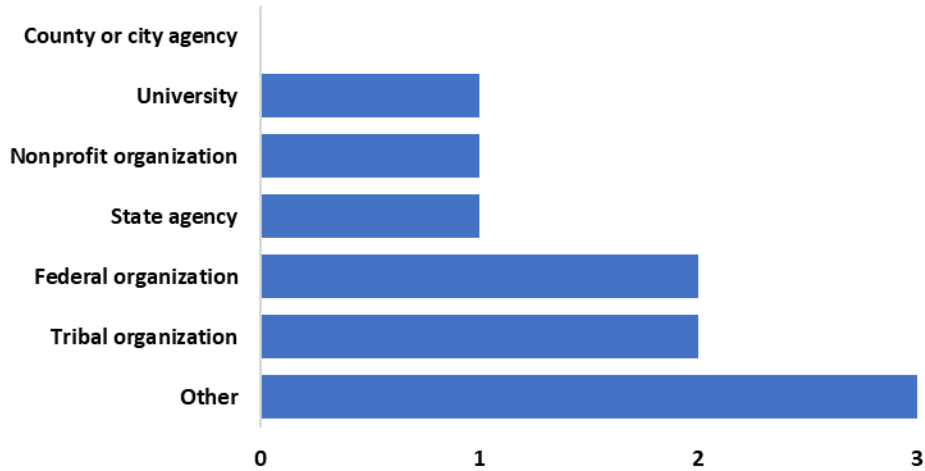
15:00 - Close Zoom



APPENDIX 5 - POST-WORKSHOP EVALUATION SUMMARY

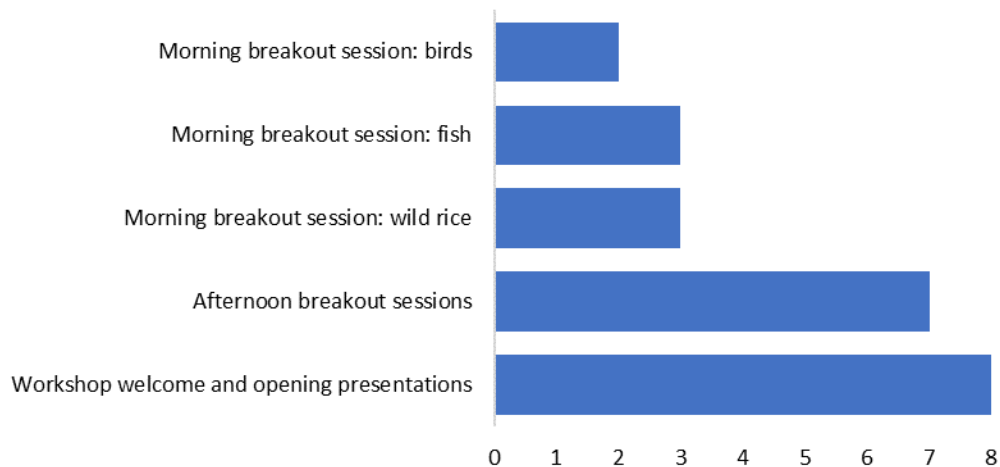
- Survey Open Date: Wednesday, April 20, 2022, at 9:18 am CDT
- Survey Close Date: Wednesday, May 4, 2022, at 5:00 pm CDT
- Survey sent to 45 people (individuals who registered for the workshop)
- Number of Respondents: 9 (20% response rate)

Those completing the survey were affiliated with:



Those answering “Other” were affiliated with the Metropolitan Interstate Council and Local Government – Special Subdivision of the State.

Survey respondents attended the following sessions:



Those completing the survey felt the workshop was **moderately to very effective** at meeting its objectives (0=Not Effective, 1=Slightly Effective, 2=Moderately Effective, 3=Very Effective, 4=Extremely Effective):

1. Develop ideas for a public-facing tool to aid natural resource managers, researchers, and others view data on an estuary-wide scale, including:
 - a. Identification of possible formats and mechanisms; and
 - b. Identification of key metrics for long-term monitoring of fish, birds, and wild rice that should be incorporated.

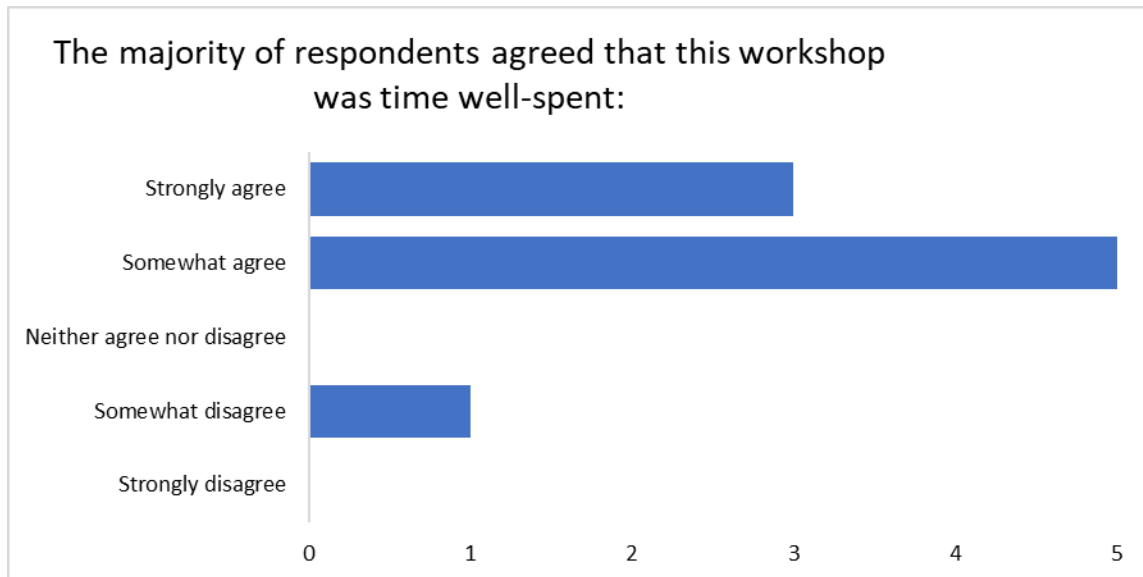
Average = 2.4, Minimum = 1.0, Maximum = 3.0

2. Prioritize gaps in current data that could be addressed through the University of Minnesota Sea Grant College Program’s grant-funded research.

Average = 2.5, Minimum = 1.0, Maximum = 4.0

3. Identify data-sharing partnerships that could increase the efficiency and impact of the estuary-wide, decision-making process.

Average = 2.4, Minimum = 1.0, Maximum = 3.0



When asked “What was the best part of the workshop?”, those completing the survey indicated that the **collaboration, communication, and camaraderie** was the best part. In addition, the technical aspects of discussion, such as **exploring data gaps that need to be addressed through research, applied metrics for long-term monitoring, and sulfate** were mentioned.

When asked “What was one aspect of the workshop you would change?”, the survey respondents indicated that **time was limited** and that the **workshop would have benefited from being broken up** into more than one workshop and **having longer break-out sessions/discussion time**.