July 2023

Reducing Canada Goose Herbivory Impacts to Wild Rice Restoration in the St. Louis River Estuary

Image Source: Wisconsin Department of Natural Resources

RECOMMENDED CITATION

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PROJECT SUMMARY

The overall goal of the Manoomin Restoration Team is to increase the abundance and distribution of self-sustaining wild rice (*Zizania palustris*) in the St. Louis River Estuary (SLRE; Figure 1; MN DNR 2014, Vogt 2022). Canada goose (*Branta canadensis*) herbivory has been identified as a major impediment to restoration progress because it inhibits natural seed development. Both lethal and non-lethal tactics were implemented to reduce goose herbivory on wild rice restoration sites in 2023. Personnel from Wisconsin Department of Natural Resources (WDNR), Minnesota Department of Natural Resources (MN DNR), Fond du Lac Band of Lake Superior Chippewa (FdL), Lake Superior National Estuarine Research Reserve (LSNERR), and 1854 Treaty Authority installed 49 non-lethal goose exclosures across 7 core restoration sites in May and June. Wildlife professionals from the WDNR and the USDA Animal and Plant Health Inspection Service (USDA Wildlife Services) implemented lethal goose removals in coordination with the Manoomin Restoration Team and resource management personnel from the cities of Superior, WI and Duluth, MN. A total of 549 geese were removed from strategic locations on the Wisconsin and Minnesota sides of the SLRE within, or adjacent to, wild rice restoration sites at the end of June.

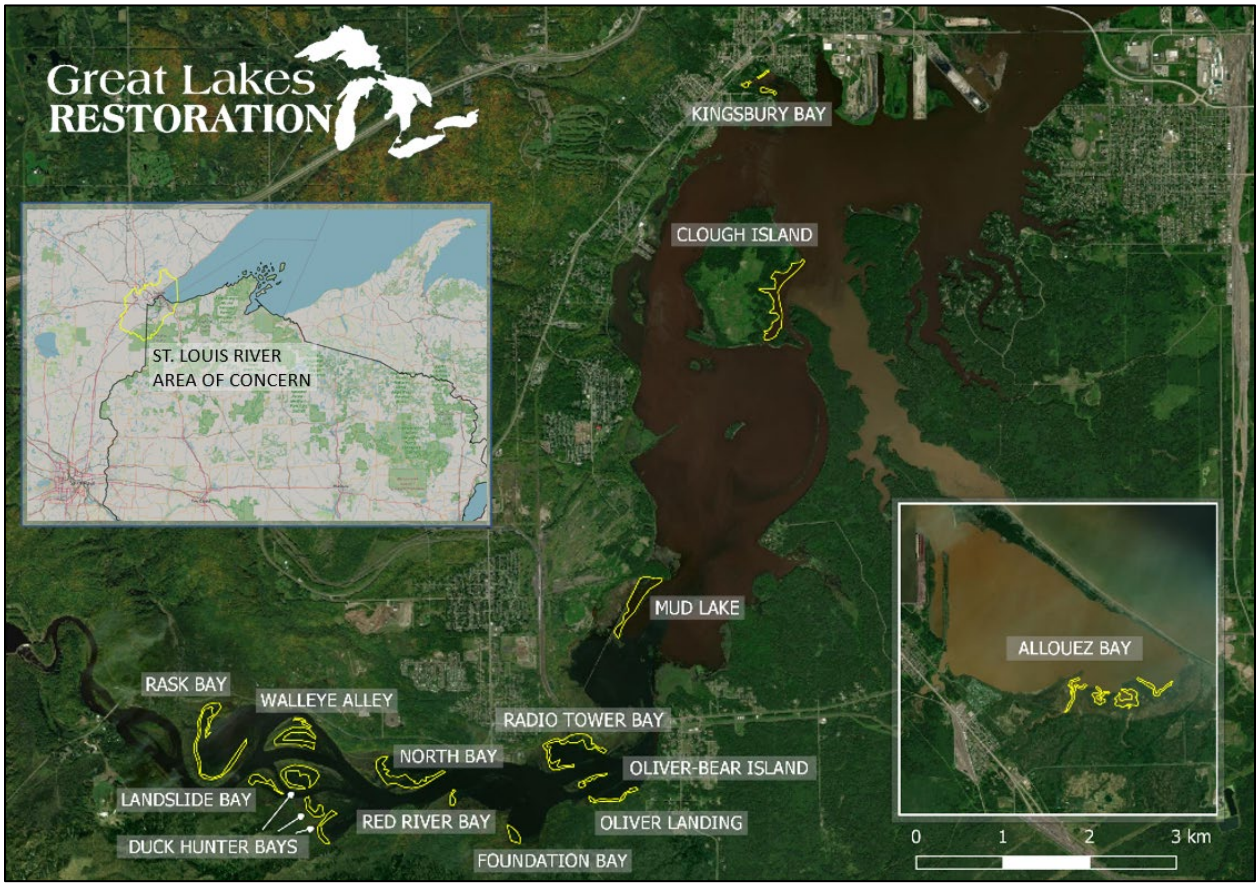

Figure 1. Wild rice restoration sites in the St. Louis River Estuary (Data Source: Wisconsin Department of Natural Resources).

PROJECT BACKGROUND

Wild rice (Ojibwemowin: Manoomin) restoration in the St. Louis River Estuary is guided by goals and objectives outlined in the Wild Rice Restoration Implementation Plan for the St. Louis River Estuary ("2014 Wild Rice Plan"; MN DNR 2014). Wild rice restoration is identified as a management action within the St. Louis River Area of Concern's (SLRAOC) Remedial action Plan with restoration work currently funded through the Great Lakes Restoration Initiative (GLRI) and administered by the US Environmental Protection Agency. Successful implementation of the 2014 Wild Rice Plan by the Manoomin Restoration Team will contribute to the eventual removal of Beneficial Use Impairment #9 – Loss of Fish and Wildlife Habitat for the SLRAOC. GLRI funding currently supports annual wild rice seeding, monitoring, herbivory management, and outreach (Vogt 2022).

Figure 2. Evidence of Canada goose herbivory on standing wild rice in the St. Louis River Estuary (Photo Credit: WDNR).

Wild rice restoration in the SLRE is hampered by Canada goose herbivory (Figure 2). Monitoring data, camera traps, and observations by natural resource personnel have documented substantial herbivory by Canada geese during late spring and early summer months when wild rice is transitioning from the floating leaf stage to the emergent stage of its life cycle (Schwartzkopf 1999, Burgstaler and Haines 2021, Vogt 2022). This vulnerable phase of the wild rice life cycle coincides with an abundance of molting non-breeding and resident nesting geese (and their offspring) that occupy wild rice sites in the Estuary. The long-term persistence of wild rice relies, in part, on plants maturing to produce seed which then serves as the seed source for the following season's crop. However, foraging by geese inhibits wild rice flowering and seed head production. In some locations, goose herbivory has been intense enough to completely remove unprotected rice. As a result, herbivory management is a crucial element of the SLRE Manoomin Restoration Model (Appendix A).

HERBIVORY MANAGEMENT

Herbivory Exclosures -- Protecting wild rice from goose herbivory is challenging due to the remote nature of restoration sites and their spatial distribution in the Estuary (Figure 1). Several non-lethal methods have been used to deter geese from browsing wild rice plantings within the SLRE, including egg oiling on the Wisconsin side of the river, hazing geese with kayaks and dogs, mylar tape deterrents, swan decoy placement, and fenced goose exclosures. Except for goose

exclosures, none of these techniques has resulted in a sufficient reduction in herbivory. The exclosures, which fence off a 20ft x 100ft rectangular patch of wild rice, protect wild rice by inhibiting access by foraging geese.

Table 1. Number of Canada goose exclosures installed in the St. Louis River Estuary (Data Source: WDNR).

Year	# Exclosures	# Sites
2018	2	1
2019	0	0
2020	8	1
2021	18	3
2022	37	6
2023	49	7

Properly constructed goose exclosures can be highly effective in reducing herbivory and have been implemented at wild rice restoration sites since 2018 (Table 1; Vogt 2022). Exclosures are a reliable, non-lethal means of reducing herbivory (Figure 3). A significant expansion of herbivory exclosures has occurred since 2020. However, their application is limited in geographic scope, and it is not feasible to install exclosures throughout the Estuary where herbivory impacts are prevalent. Exclosures are labor and resource intensive to build, install, maintain, and remove. They must be regularly inspected to ensure barrier integrity. Nevertheless, exclosures are an important tool for protecting wild rice and a key tactic for reducing goose herbivory impacts in the Estuary.

Figure 3. Canada goose exclosure experiments have identified goose herbivory as the primary impediment to wild rice restoration in the St. Louis River Estuary (Photo Credit: WDNR).

The Manoomin Restoration Team expanded the use of goose exclosures at core restoration sites in 2023 with the intent of enhancing seed production and replenishing the seed bank for future growing seasons. Herbivory exclosures were installed for the first time in Rask Bay, bringing the number of core restoration sites to seven (Table 2). Three exclosure designs were utilized: woven

wire fencing in Allouez Bay, exclosure paneling in Rask Bay and Walley Alley, and snow fencing barriers elsewhere.

Table 2. 2023 herbivory exclosure locations in the St. Louis River Estuary (Data Source: WDNR).

Location	State	# Exclosures
Allouez Bay	WI	8
Duck Hunter Bay North	WI	10
Kingsbury Bay	MN	5
Landslide Bay	WI	5
North Bay	MN	5
Rask Bay	MN	8
Walleye Alley	WI	8

All three designs provided adequate protection, although periodic monitoring was needed to ensure exclosure integrity throughout the growing season. For example, wind and wave energy in Rask Bay resulted in fencing breaches due to fence posts breaking shortly after exclosure installation. Then, in late July, water levels dropped enough to allow for a small gap between the bottom of exclosure fencing and water surface in Rask Bay. There was one instance of a goose observed inside an exclosure in Kingsbury Bay where herbivory pressure remains high. Inspection of the Kingsbury exclosure failed to detect any broken posts or gaps in the fencing, suggesting that the bird flew into the exclosure. In most cases, exclosure breaches are quickly detected and repaired by restoration personnel.

Canada Goose Roundup -- Strategic Canada goose removals are another important tactic for reducing herbivory pressure and facilitating natural seed production. Referred to as "roundups", goose removals are conducted during the goose molting period (late June / early July) when most geese in the estuary are unable to fly. Prior to implementing a goose roundup, municipalities must develop a goose management plan. Federal and state permits must then be obtained. During the roundup event, personnel use watercraft to slowly herd geese to a predetermined capture location where the birds are surrounded by USDA Wildlife Services personnel, enclosed by portable net panel, and euthanized with CO_2 following methods for Canada goose euthanasia approved by the American Veterinary Medical Association.

Goose roundups in 2021 and 2022 removed 187 and 229 Canada geese from restoration sites and nearby waters on the Wisconsin side of the Estuary, respectively. Monitoring data from the 2021 and 2022 growing seasons suggests that removals were effective in reducing herbivory pressure and improving wild rice productivity. A comparison between Allouez Bay, where goose removals occurred in 2021, with Landslide Bay which was more distant from goose removal efforts in 2021, helps to quantify short-term roundup impacts to changes in wild rice density, plant height, and biomass between 2021 and 2022 (Table 3).

Table 3. Comparison of herbivory and plant productivity data from Allouez and Landslide bays during the 2021 and 2022 growing seasons in the St. Louis River Estuary. Goose removals occurred in Allouez Bay but not Landslide Bay (Data Source: WDNR). Positive values indicate increases and negative values indicate decreases.

Site	Change In Herbivory (%)	Change in Density (stalks/0.5 m^2)	Change in Plant Height (in)	Change in Biomass (g/m^2)
Allouez Bay	-34.4%	0.80	7.77	10.00
Landslide Bay	-16.8%	0.86	-15.15	-15.28

Although changes in wild rice density from 2021 to 2022 did not differ substantially between the two sites, herbivory pressure declined more in Allouez Bay than Landslide Bay (Table 3). Furthermore, plant height and biomass increased in Allouez Bay while decreasing in Landslide Bay. There may be other, unmeasured factors influencing these preliminary results, but these monitoring data provide some quantitative evidence that goose removal improved wild rice productivity in 2022.

Building on removal successes in 2021 and 2022, WDNR coordinated goose roundups in 2023 which included both Wisconsin and Minnesota capture sites. Previous removal efforts were limited in scope due to permitting challenges in Minnesota and a lack of suitable capture sites in the upper portion of the Estuary on the Wisconsin side of the river. In 2023, however, permitting was in place to expand the roundup effort to Minnesota capture sites. This expansion was critical for protecting wild rice at core restoration sites that had not previously benefitted from reductions in goose numbers.

A total of 549 geese were removed from strategic capture locations near core restoration sites in the SLRE during the 2023 roundup (Figure 4). A single post-roundup aerial survey and repeated

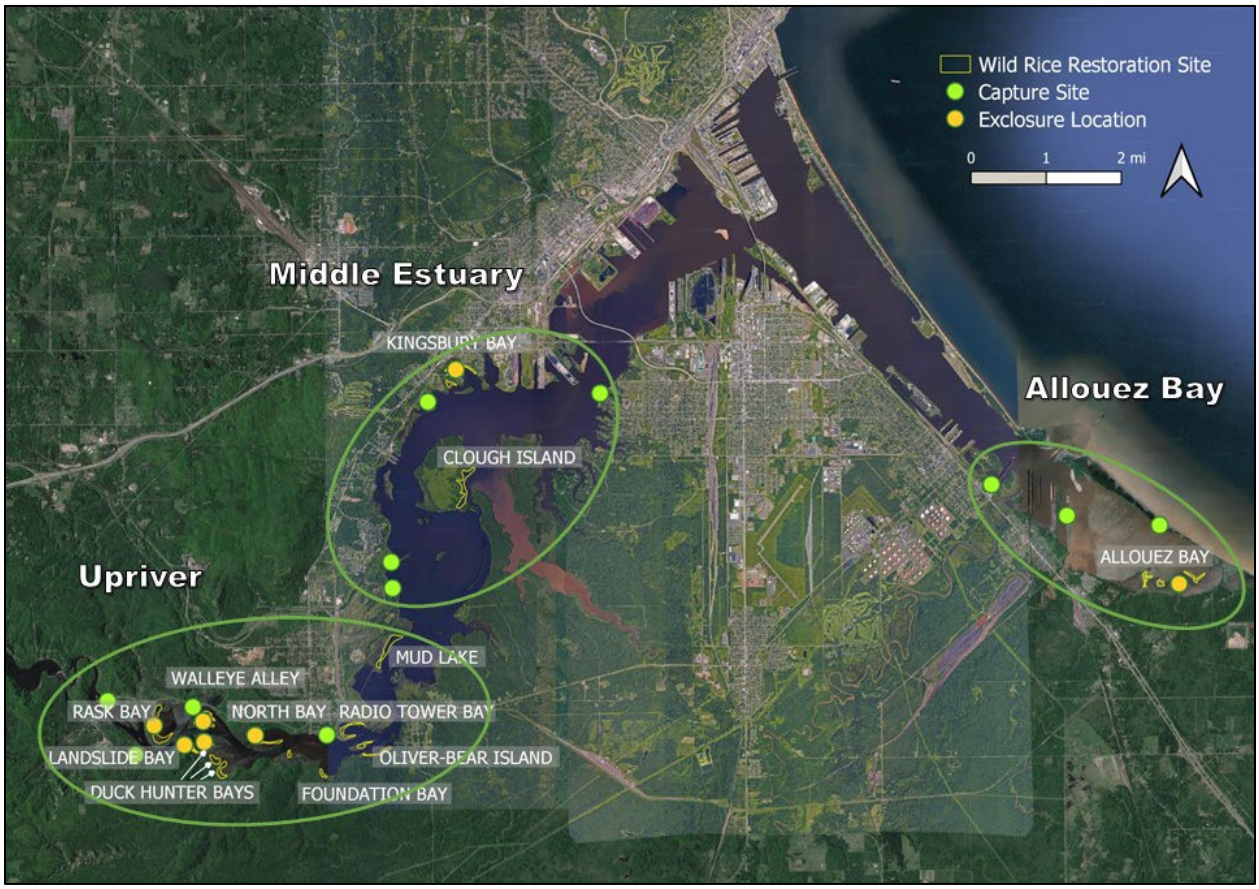

Figure 4. Herbivory exclosure and Canada goose capture locations in the St. Louis River Estuary (data source: WDNR). Forty-nine exclosures were installed across 7 core restoration sites. Geese were removed from upriver (n = 148), middle estuary (n = 199), and Allouez Bay (n = 202) geographic zones to protect wild rice restoration sites.

boat-based surveys suggests that this represents 60-80% of the goose population foraging in, and near, wild rice restoration sites during the 2023 molting period (note: a larger population of geese are present within the active harbor though these geese are unlikely to impact wild rice restoration and were not the focus of roundups in 2021, 2022, or 2023). Three hundred and sixteen geese were collected at Minnesota capture sites which exceeded the removal permit quota of 300 geese in Minnesota. As a result, 16 geese were released during the final Minnesota capture. An additional 249 geese were removed from Wisconsin capture sites. Geographically, a total of 148 geese were removed from the upriver portions of the Estuary from Chamber's Grove to Oliver Bridge, 199 geese in the middle Estuary between Oliver Bridge and Arrowhead Landing, and 202 geese from Allouez Bay (Figure 4).

In 2021, all 187 geese were donated to the Lake Superior Zoo in Duluth, MN for use in carnivore enrichment programming. Avian influenza concerns in 2022 and 2023 required that birds be disposed of at landfills. However, one hundred adult geese captured in 2023 were submitted to the Wisconsin State Lab of Hygiene for testing to determine if the meat was suitable for human consumption. Contaminant testing followed the established protocol for screening harvested geese for human consumption in Wisconsin (WDNR 2010). Tests will evaluate the presence of lead, mercury, and polychlorinated biphenyls (PCBs) and determine if the meat can be donated to local food pantries in Duluth and Superior. The results of these tests were not available at the time that this report was prepared.

CONCLUSIONS

Herbivory management in the SLRE has yielded measurable benefits for wild rice restoration progress. Wild rice density, a key indicator of restoration progress, has exhibited a steady increase since 2020 (Figure 5). These improvements have been particularly significant at core

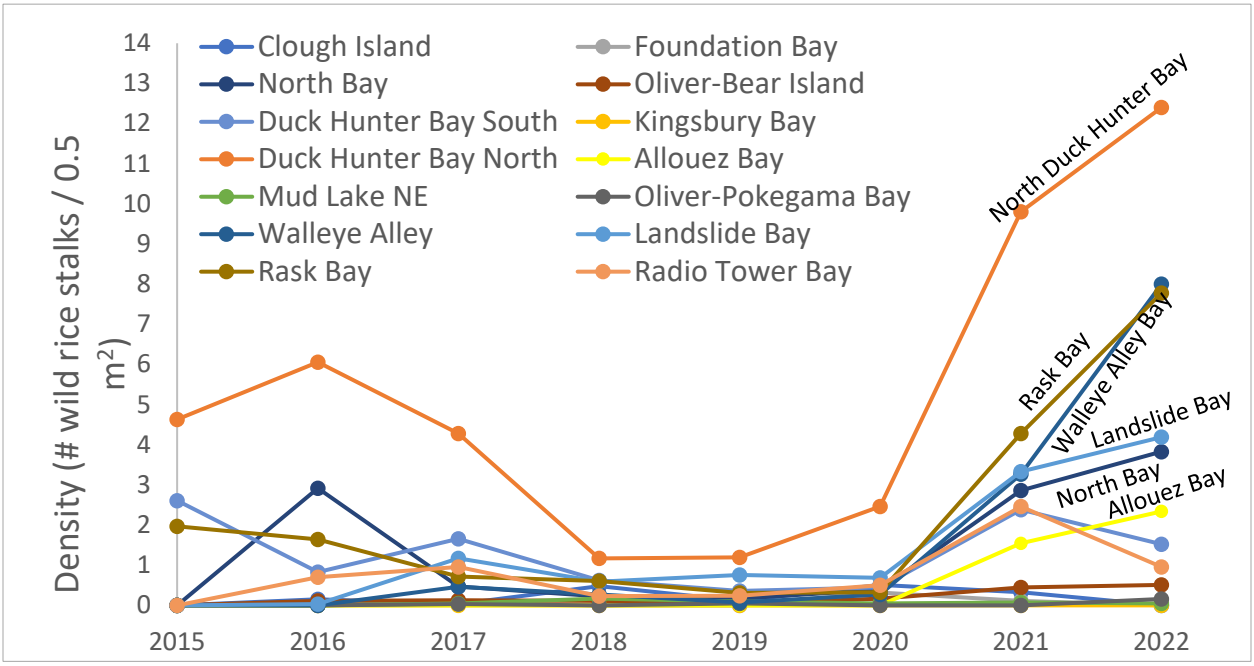

Figure 5. Wild Rice density estimates derived from long-term monitoring at restoration sites in the St. Louis River Estuary (data source: 1854 Treaty Authority).

restoration sites where herbivory management tactics are implemented (e.g., Duck Hunter Bay North, Rask Bay, Walleye Alley Bay, Landslide Bay, North Bay, and Allouez Bay). Unfortunately, Kingsbury Bay continues to suffer from high herbivory pressure with geese continuing to decimate unprotected wild rice.

Annual monitoring data will be used to quantify the prevalence of herbivory and wild rice density at core restoration sites. Density estimates from 2021 and 2022 indicate that the combination of non-lethal and lethal herbivory management tactics is yielding positive results for wild rice restoration in the SLRE. Utilizing capture sites on both the Wisconsin and Minnesota side of the river increased roundup efficiency and effectiveness.

RECOMMENDATIONS & NEXT STEPS

Continued Monitoring -- Continue annual wild rice monitoring in the SLRE, noting the prevalence of herbivory at each restoration site. Monitoring data are crucial for tracking the influence of herbivory management on wild rice density, plant height, and biomass. Although other factors such as seeding rates, water depth and weather patterns during the growing season can influence these metrics, herbivory is expected to decline across core restoration sites if herbivory management continues through the establishment phase. As core restoration sites become established, The Manoomin Restoration Team will use monitoring data to derive herbivory thresholds which identify when and where future herbivory management efforts are directed.

Kingsbury Bay -- Focus future goose removals in, and around, Kingsbury Bay. Kingsbury Bay continues to experience considerable herbivory pressure with post-roundup observations indicating that all the wild rice outside of herbivory exclosures was fully browsed in 2022 and 2023. Observations made during the 2023 roundup effort identified a considerable number of geese utilizing Stryker Bay and Slip 6 on the Minnesota shoreline in Duluth. Subsequent goose surveys and wild rice monitoring determined that all the wild rice in Kingsbury Bay, aside from plants growing inside herbivory exclosures, was completely browsed. Kingsbury Bay should be prioritized for the next round of goose removals.

Continued Management -- Support on-going herbivory management. Effective herbivory management that benefits wild rice restoration relies on cooperation among a diverse group of partners. Opportunities to increase public awareness regarding the cultural and ecological importance of wild rice should help expand support for herbivory management. Herbivory exclosures and goose roundups should be implemented in subsequent years until wild rice beds reach density thresholds which improve their resilience to goose herbivory. Continued monitoring will inform the effectiveness of these tools and the need for adding herbivory exclosures and/or conducting roundups at specific locations in the SLRE.

Exclosure Installation Guidelines -- Develop installation and maintenance guidelines for herbivory exclosures. Restoration personnel continue to identify opportunities for improving the effectiveness of herbivory exclosures and reduce the likelihood of exclosure failure with directed exclosure monitoring and maintenance. Knowledge gained in the SLRE should be shared with other wild rice restoration practitioners in the region.

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APPENDIX A. MANOOMIN RESTORATION MODEL