DRAFT REPORT

Lake Superior Manoomin Cultural and Ecosystem Characterization Study

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1. Introduction

Manoomin (wild rice) is integral to the culture, livelihood, and identity of the Anishinaabe, a group of indigenous peoples within Canada and the United States. Manoomin grows only in the clean waters of the Manidoo gitigan (The Great Spirits Garden). The arrival of the Anishinaabe to the Great Lakes Basin was in fulfillment of the prophecy that guided their migration from the Atlantic Northeast westward toward the Great Lakes to where "food grows on the water." In addition to the vital role of Manoomin in the lives of the Anishinaabe, it is also recognized as being ecologically important. Migrating and resident wildlife feed on Manoomin seeds in wild rice beds, which provide a nursery for many species of fish and serve as nesting and breeding habitats for many waterfowl and muskrat. Many species feed on the plant, including white-tailed deer. Wild rice plants can also help stabilize shorelines (Tribal Wild Rice Task Force, 2018; David et al., 2019).

In this project we aim to describe the importance of Manoomin to help foster community stewardship and education; and to inform Manoomin management, protection, and policy in the Lake Superior Basin and throughout the Great Lakes. Specifically, our objectives were to document and characterize (1) the importance of Manoomin habitat to cultural perspectives and identity, community connections, and cultural and spiritual practices of the Anishinaabe people; and (2) the ecological importance of Manoomin habitat as indicators of a high-quality, high-functioning, and biodiverse ecosystem around the Lake Superior Basin.

In this report we provide a brief background on the cultural and ecological importance of Manoomin, and describe current threats (Chapter 2). We then describe the methodology undertaken to characterize the importance of Manoomin in this study (Chapter 3); and provide the study's results, including cultural and ecological metrics developed to characterize cultural (Chapter 4) and ecological functionality of Manoomin and seven case studies (Chapter 5). Based on these results, we offer cross-case findings and lessons learned over the course of this study (Chapter 6), and provide conclusions and discuss potential next steps (Chapter 7).

Project Team members and audience

We, the Project Team members of this study, are a diverse group of Lake Superior Basin Anishinaabe communities, and federal and state agencies (Exhibit 1.1), supported by Abt Associates (Abt). We are self-identified participants in the study, which originated from Annual Lake Superior Manoomin Restoration Workshops. The workshops were held in April 2017 and 2018 to discuss the complexity of Manoomin management, its cultural significance, and the challenges and need for coastal wetland restoration where Manoomin is currently and historically harvested (NOAA, 2017, 2018). As an outcome of these workshops, the National Oceanic and Atmospheric Administration (NOAA) applied for and received a Great Lakes Restoration Initiative (GLRI) grant, which provided funding to support this current study. A larger group was involved in the initial 2017 and 2018 workshop discussions; the list in Exhibit 1.1 reflects the entities who continued to be

Exhibit 1.1. Project Team

The Project Team consists of the following entities:

- Fond du Lac Band of Lake Superior Chippewa
- Keweenaw Bay Indian Community
- Lac du Flambeau Band of Lake Superior Chippewa
- Lac Vieux Desert Band of Lake Superior Chippewa
- Grand Portage Band of Lake Superior Chippewa
- 1854 Treaty Authority
- Great Lakes Indian Fish and Wildlife Commission
- Lake Superior National Estuarine Research Reserve
- National Oceanic and Atmospheric Administration
- National Sea Grant College Program
- U.S. Bureau of Indian Affairs
- Wisconsin Department of Administration.

engaged in the GLRI-funded project implementation. As Project Team members, we decided upon the design and study methodology on a consensus basis, which Abt, our contractor providing technical support, then applied. We then reviewed and approved all reports and materials developed during this study.

The primary audiences for this report are indigenous communities, tribal and non-tribal governments, and organizations who are working to actively manage and restore Manoomin across the Great Lakes.

2. Importance of Manoomin

Manoomin is central to the Anishinaabe cultural identity, traditions, and livelihood. It is an important species to the ecology of waters within the Great Lakes region, proving food and habitat to endemic and migratory species. This chapter first provides a brief overview of the cultural and ecological importance of Manoomin, and then describes some of the threats to Manoomin and its associated habitat. For a more detailed understanding of the relationship Manoomin holds with other beings, see Barton (2018) and David et al. (2019).

Photo credit: Todd Marsee, Michigan Sea Grant

Cultural importance

Manoomin is a central part of the Anishinaabe migration story: the Anishinaabe people were told to head West to their chosen land by the third of seven prophets, and they would know they were home when they found "the food that grows out of the water." This food would sustain their families' bodies and souls for generations. As a result, Manoomin holds a critically important place in Anishinaabe culture. Manoomin is a sacred symbol – it represents the Anishinaabe people's journey, their relationship to the land, and their identity as a culture (Tribal Wild Rice Task Force, 2018). Within the Anishinaabe culture, Manoomin is a non-human being rather than an inanimate resource; it accompanies all ceremonies, celebrations, feasts, funerals, and initiations as a food source and a spiritual presence (David et al., 2019).

The Manoomin harvest is critical to Anishinaabe culture and is part of long-standing traditions. The harvest is a major community activity that strengthens bonds within the community and within families. Families and friends work together, and children and elders come together to harvest. This tradition is passed down through generations and links the past to the present, providing intergenerational connections and allowing young people to understand their heritage and history (Kjerland, 2015a). An essential part of harvesting, Manoomin is the renewal of ties to the land and spirits (Raster and Hill, 2017). Harvesting by hand reaffirms the nature of Manoomin as a gift from the Creator and that Manoomin should be treated with respect and gratitude (Tribal Wild Rice Task Force, 2018).

The migration story

Ongow Anishinaabeg ogii-piminizha'aawaan iniw miigisan. Mii iw gaa-izhi-dagoshinowaad eteg wiisiniwin imaa nibiikaang.

The Anishinaabe people were to follow the direction of the Miigis Shell and by doing so would find their final destination; a place identifiable because it was where "food grows on water" [The Migration Story: In Search of Wild Rice. *Ayanjigozing, Manoomin Nandawaabanjigaadeg*. As translated and transcribed by Gimiwan (Dustin Burnette)].

Source: David et al., 2019.

Wild rice harvesting

Mii izhichigewaad ingiw Anishinaabeg dibwaa bawa`amowaad akawe asemaakewag

biindaakoojigewag. Mii aw asemaa ayaabadizid biindaakoonind a`aw Manidoo. Geget apiitendaagozi asemaa. Mii akina ge izhichigeyangiban gegoo mamooyan imaa zayaaga`kiigin, gidaa-biindaakoojigemin.

The first thing Anishinaabe do is make an offering of tobacco before they harvest wild rice. Tobacco is used when making an offering to the spirit. Tobacco is highly valued. When we take from nature, we should make an offering of tobacco.

Source: GLIFWC, 2010.

Manoomin is a healthy, traditional food source for the Anishinaabe. It remains a dietary staple, nourishing the Anishinaabe and providing spiritual and cultural sustenance. Manoomin is highly nutritious, with a low-glycemic index, and provides benefits in preventing chronic diseases. It is a source of vitamins, minerals, fiber, and protein. Manoomin harvesting can also provide cardiovascular benefits from the physical activity associated with traditional food-gathering (Fond du Lac Band, 2018; David et al., 2019). It provides food sovereignty for the Anishinaabe as well, as it can be stored and consumed year-round (David et al., 2019).

Manoomin is so fundamental to the Anishinaabe identity and culture that Anishinaabe treaties with the U.S. government guarantee access to Manoomin. The Treaties of 1837, 1842, and 1854 reserve gathering rights for Manoomin (among other rights) in lands ceded to the United States. In the Treaty of 1837, Manoomin is the only more-than-human being (i.e., the only biological resource) specifically mentioned. The rights to rice waters explicitly reserved in these treaties have been fundamental to Anishinaabe life historically and currently; and ensure Manoomin's central place in Anishinaabe culture through religious, ceremonial, medicinal, subsistence, and economic uses (David et al., 2019).

Ecological importance


Photo credit: Todd Marsee, Michigan Sea Grant

Manoomin is an essential part of the Great Lakes ecosystem and environment. Natural Manoomin beds are part of complex aquatic ecosystems that support wildlife and waterfowl. Over 17 species of wildlife that use Manoomin habitat for reproduction or foraging are listed in the Minnesota Department of Natural Resources' Comprehensive Wildlife Conservation Strategy as "species of greatest conservation need" (Fond du Lac Band, 2018). Ducks, geese, swans, muskrat, deer, and moose all feed on wild rice. Additionally, insect larvae feed on Manoomin and, in turn, birds feed on these insects. Decaying Manoomin supports invertebrates that support birds, fish, and amphibians (Raster and Hill, 2017; Tribal Wild Rice Task Force, 2018). Manoomin beds provide breeding and resting grounds for migratory birds, rearing habitat for resident bird species (Raster and Hill, 2017), and nursery areas for young fish and amphibians (Fletcher and Christin, 2015).

Manoomin also plays an important role in maintaining ecosystem quality by sequestering nutrients, enriching soils, and countering nutrient loading and its negative impacts such as algal growth and turbidity amphibians (Tribal Wild Rice Task Force, 2018). Manoomin binds loose soils, which prevents erosion. Additionally, through binding loose soils and acting as a windbreak, Manoomin limits the mixing of soil nutrients into waters, thus improving water clarity and reducing algal blooms (Loew and Thannum, 2011; Fletcher and Christin, 2015; Tribal Wild Rice Task Force, 2018). Manoomin is also an indicator of overall water quality and ecosystem health because it is highly sensitive to changes in water quality (David et al., 2019).

Threats to Manoomin

Manoomin and its associated habitat face many threats, some of which are highlighted below; for a more comprehensive list of threats, see David et al. (2019).

Hydrologic changes. Manoomin depends on shallow waters and both natural and human-based causes can alter these wetlands to make them inhospitable to this plant. Manoomin also depends on occasional hydrological disturbances, as long-term stability allows perennial plants to outcompete Manoomin, which is an annual plant. Therefore, occasional high or low water years allow Manoomin to flourish in the long-term. Damming and releasing water can degrade Manoomin habitat. Dams, created by humans or through natural causes such as beavers or vegetation, can result in water-level regimes that are not conducive to Manoomin. Manmade dams on some reservoirs impose a large annual variability in water levels that do not allow Manoomin to flourish, while others that control water levels on lakes with lakefront property often impose highly consistent annual water levels that are also unsuitable for Manoomin growth. These managed water-level regimes can further allow other plant species to outcompete Manoomin for habitat. Other human activities that can lead to hydrologic changes that are detrimental to Manoomin include industrial resource extraction, such as mining. Mining water appropriations and discharges can change water levels in Manoomin waters, preventing Manoomin from growing (David et al., 2019).

Pollution. Manoomin is highly sensitive to changes in water quality and requires unpolluted water to flourish. Sulfate pollution is particularly notable for its harm to Manoomin. Research dating back to the first half of the 20th century demonstrated that wild rice growth is impaired by elevated sulfate in water, but the specific mechanisms were unknown (Plain, 2017). Several recently published studies provide insight into how sulfate in water impairs wild rice: sulfate, which is converted to sulfide by microorganisms in the soil, is directly toxic to wild rice (e.g., Myrbo et al., 2017a, 2017b; Pastor et al., 2017; Pollman et al., 2017). Field research has shown that waters with sulfate levels over 10 parts per million (ppm) are detrimental to Manoomin (Moyle, 1944; David et al., 2019; Vogt, 2020a). Sulfate is commonly discharged in wastewater from mining activities, both from tailings basin discharges and process wastewater from ore processing plants (David et al., 2019).

Invasive and native competitive species. Several aquatic invasive species have locally threatened the survival of Manoomin, including milfoil, pondweed, cattail, common reed, flowering rush, and common carp. Plant species such as milfoil and pondweed can indirectly reduce suitable habitat for Manoomin by competing with Manoomin for space and nutrients, whereas plants like cattail can directly compete with Manoomin for habitat. Common carp can significantly diminish Manoomin survival by feeding on rice seeds and by uprooting plants (David et al., 2019). Some native plants such as ginoozhegoons (or pickerelweed or moose ear) also directly compete with Manoomin for habitat (see Exhibit 2.1).

Exhibit 2.1. Native plant competition

Ginoozhegoons is a native species that occupies the same habitat as Manoomin. As a perennial species, ginoozhegoons continues to grow each year, whereas Manoomin, an annual species, grows from an individual seed each year (Howes, 2010). Although ginoozhegoons is often considered a competitor, in some instances it appears to protect Manoomin beds by absorbing wind and wave action (David et al., 2019).

Photo credit: www.freepik.com.

Land use impacts. Manoomin is sensitive to changes in land use patterns, such as residential development. Lakeside residential development is often associated with high boating activity, which can increase wave damage and chop up rice mats. Channel dredging is also more likely to occur in areas with high boating activity, which can lead to changes in hydrology that negatively impact Manoomin. Residential development is also associated with higher levels of ammonium in wetlands, which can limit Manoomin stands (Pillsbury and McGuire, 2009). Shoreline development can also lead to wide-scale vegetation removal, including Manoomin, from property owners desiring an open view (David et al., 2019).

Herbivory. Manoomin can be threatened by large populations of geese, especially resident geese and trumpeter swans. Geese feed on Manoomin, and can have large impacts on small or sparse stands. These populations have been increasing on treaty territories over the past two decades and can have pronounced impacts on smaller rice lakes (Nichols, 2014; David et al., 2019). Other species such as muskrat and red-winged blackbirds can also heavily feed on Manoomin, sometimes causing significant impact.

Climate change. Climate change has begun to negatively impact Manoomin and is projected to have future negative impacts on Manoomin in the future. It is expected to lead to more frequent heavy rainfall events, which will lead to flooding that uproots Manoomin beds. Warmer temperatures resulting from climate change will also negatively impact Manoomin abundancy by favoring outcompeting plants that are better adapted for warmer climates; and being conducive to brown spot disease, which destroys photosynthetic tissues, reduces seed production, and favors high temperature and humidity (Barton et al., 2013; Cozzetto et al., 2013; Grand Portage Band of Lake Superior Chippewa, 2016; David et al., 2019). Warmer temperatures can also change the range of Manoomin and reduce germination. Projections of future climate in the 1854 Ceded Territory indicate substantial warming over the historical baseline that could lead to a shifting of wild rice outside the Great Lakes region and the 1854 Ceded Territory due to the location of Manoomin at the southern edge of its range. These increased temperatures could also lead to decreased germination of Manoomin if the temperatures are too warm for the dormant hardening-off period that some wild rice require (Stults et al., 2016). In the climate change vulnerability assessment conducted by the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), Manoomin was found to be the most vulnerable to the impacts of climate change out of all the species assessed, both because of the numerous climate-related threats and because it is sensitive to different climate effects at all stages of its life cycle (GLIFWC, 2018).

3. Methodology selected to characterize the importance of Manoomin

We evaluated several methodologies for characterizing the cultural and ecological importance of Manoomin and its associated habitat, and ultimately selected an innovative combined Habitat Equivalency Analysis (HEA) approach. This chapter describes how we selected and then applied this combined HEA approach.

Selecting a method

As a team, we identified several methods to characterize the cultural and ecological importance of Manoomin and its associated habitat. We reviewed the cultural and ecological literature, and used our collective knowledge of cultural and ecological characterization methodologies to develop the following list of possible methods:

- **In-person interviews or listening sessions** with tribal community members to gather qualitative information about perspectives, cultural identify, and value systems.
- **A case study analysis** to conduct a systematic and in-depth examination of the cultural and ecological importance of Manoomin across the Lake Superior region.
- **Indigenous metrics** to evaluate indigenous priorities for cultural, social, and ecological aspects of the community that are understandable to both indigenous and non-indigenous ways of thinking (Donatuto et al., 2016), including themes developed by the community (Fond du Lac Band, 2018).
- **An ecosystem service conceptual model** to link changes caused by external stressors or interventions to Manoomin through the ecological system to socioeconomic and well-being outcomes (Olander et al., 2018).
- **A social-ecological keystone concept** to quantify biocultural elements of Manoomin as a keystone species (Winter et al., 2018).
- **An HEA** to determine the amount of restoration needed as a counter-balance for habitat that has cultural and ecological functionality (NOAA, 2000, 2019).
- **A combined HEA approach** to combine several methodologies that overcome individual shortcomings to develop a strong framework to characterize Manoomin and its associated habitat.

We developed and applied a set of criteria to evaluate possible methods for characterizing the cultural and ecological importance of Manoomin (Exhibit 3.1). Using these criteria, we narrowed the possible methodologies to three options – case study analysis, indigenous metrics, and HEA – and a fourth approach that combined these three methods. Ultimately, we selected the combined HEA approach by consensus.

Exhibit 3.1. Criteria for selecting a characterization method

Methods should be:

1. Non-monetary
2. Capable of combining ecological and cultural characterization into a single analysis
3. Implementable using mainly existing data and information (i.e., study should not involve extensive primary data collection efforts)
4. Based at least in part on indigenous methodologies, or research for and by indigenous people using techniques and methods drawn from their traditions and knowledge.

Applying the combined HEA approach

We applied the combined HEA approach to determine or "scale" the amount of restoration needed to counter-balance habitat with cultural and ecological functionality losses over time. We developed and applied a set of cultural and ecological metrics to characterize (1) the degree of lost functionality at a given location, and (2) the increased functionality provided by restoration actions at that location. We then "scaled" the restoration gains to the losses to quantify the equivalent amount of that same restoration that would be needed to balance the losses. The case studies provide specific locations with degraded Manoomin habitat with reduced cultural and ecological functionality, and actions undertaken in attempts to restore or improve the cultural and ecological functionality. We applied the combined HEA approach to these locations.

The combined HEA approach included (1) identifying case study sites as examples of degraded and restored Manoomin habitat, (2) refining and applying cultural and ecological metrics to characterize the degraded and restored Manoomin and its associated habitat at the case study sites, and (3) using HEA to quantify the amount of restoration need to counter-balance the lost Manoomin habitat functionality (Exhibit 3.2). We describe these steps in more detail below.

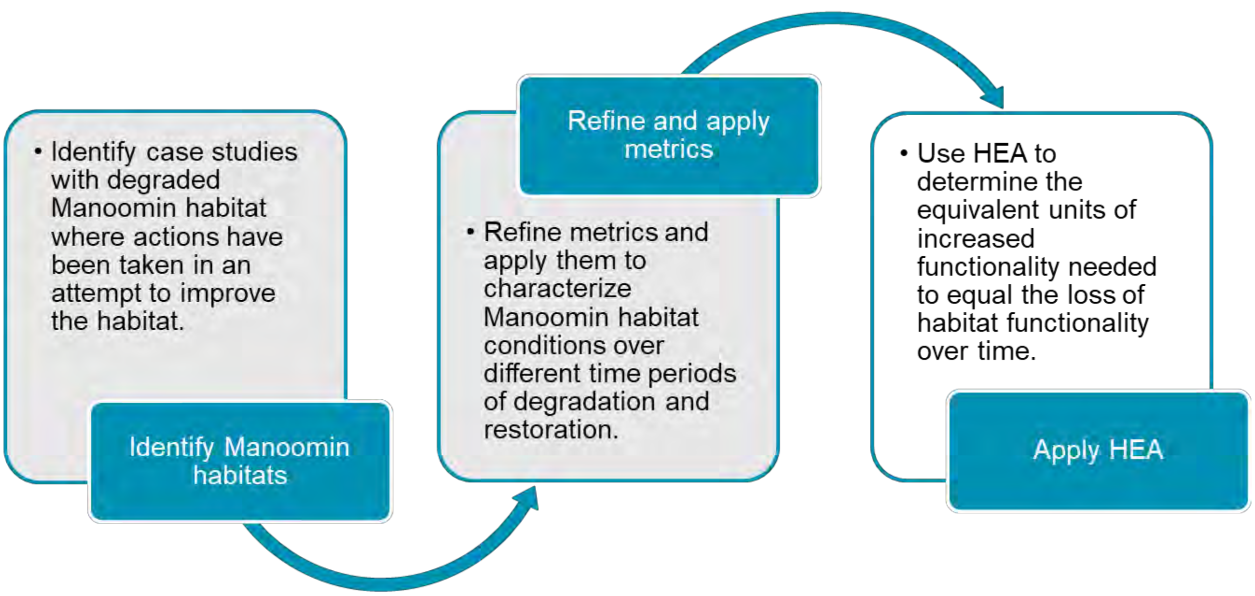


Exhibit 3.2. Steps in the combined HEA approach

Identify Manoomin habitats

We identified areas across the Lake Superior region with current or former Manoomin habitat. Our goal was to identify places that experienced a decline in Manoomin over time, and places where restoration actions have attempted to address the decline. At each site, we aimed to understand:

- The ecological conditions at the site, such as the hydrology, water quality and land use, and climatic conditions
- The cultural and ecological importance of Manoomin at the site, including Manoomin harvest and wildlife dependence on Manoomin
- The cause of Manoomin decline, such as hydrologic changes, invasive species, climate change events, or other threats
- The types of restoration actions undertaken, such as seeding efforts or management of invasive or competitive species
- The success or failure of those restoration actions, including cultural and ecological effects
- The timeline of degradation and restoration actions.

We first selected two pilot case studies to test and refine the approach: Big Rice Lake and Twin Lakes. Once we refined the cultural and ecological metrics and the combined HEA approach, as described below, we then selected five additional case studies. Each Band on our project team selected a case study, focusing on places of particular importance to their Band. Case studies could be on reservation lands, in ceded territory, or elsewhere. For each case study, we gathered information about the extent and timeframe of the degradation and restoration. This resulted in a range of types of Manoomin habitat degradation and restoration approaches represented in our case studies, dispersed over a broad geographical area. For each site (or case study), we formed a case study team that assessed the Manoomin habitat degradation and restoration, using cultural and ecological metrics (described below). The case study team included members of our Project Team and other tribal, federal, or state partners with experience managing Manoomin at each case study site.

Refine and apply cultural and ecological metrics

We developed a set of metrics to broadly measure all aspects of community health, with health defined as a coexistence with human beings, nature and natural resources, and spiritual beings (Donatuto et al., 2016). We started with Donatuto et al.'s (2016) indicators of indigenous health, as well as Fond Du Lac Band's (2018) health impact assessment themes and Winter et al.'s (2018) biocultural functional groups; and then adjusted and added to them, to develop a set of cultural and ecological metrics focused on Manoomin and the Great Lakes coastal wetlands.

We then refined the descriptive scales used by Donatuto et al. (2016) to rank the relative status of each metric at a specific time period. These rankings provided a baseline from which to compare future rankings of the same metric, and ultimately illustrated health trend data over time. We used the following five-point descriptive scale:

- We're doing great
- We're looking pretty good
- Things are not very good
- Things are very bad
- No use of Manoomin.

These descriptive scales, which are easy to understand and use, avoid asking natural and cultural resource managers to rank or assign numbers to cultural or spiritual values. We later added numeric scores to the descriptive scales as a scalar for our HEA; our numeric scores ranged from 0% (No use) to 100% (Doing great).

We applied draft metrics to our pilot case study during a workshop in August 2019. We subsequently refined the metrics to incorporate additional considerations, such as incorporating health into the *food sovereignty* metric because eating good foods relates to the mind, body, and spirit. Once we finalized the metrics and agreed to them on a consensus basis, we applied them to our case study sites.

Apply HEA to characterize Manoomin

The HEA tool was developed to determine or “scale” the amount of restoration needed as a counter-balance for habitat that has lost cultural and ecological functionality.

The case study team first worked to identify periods in time with distinct or changing Manoomin habitat conditions. This process relied on reviewing historical documents and records, as well as case study team member’s specific knowledge of the place. We then characterized each discrete time period, by ranking each metric according to the scale given above. Finally, we used our HEA model to calculate the amount of restoration needed to balance the reduced or lost functions. In other words, given that restoration is challenging and rarely achieves full functionality, and the degradation has often spanned prolonged periods of time, we use the HEA to quantify the additional amount of equivalent restoration that would be needed to counter-balance the lost functionality.

The HEA model includes:

- **Base year** for this economic analysis; we set the base year to the current year, 2020.
- **Intergenerational balancing factor** to account for time preference, where degradation and restoration are put in present value terms (NOAA, 1999). Because not all communities share this same time preference, we discussed the appropriate factor for this study and decided to apply a constant factor of 3% across all case studies, where things in the past are more valuable than they are today and things in the future are less valuable than they are today. A 3% factor is typical for ecological projects (OMB, 2003).
- **Acres** of Manoomin or its habitat characterized by the case study team. In some cases, acres included the full area of Manoomin waters and in other cases it was a portion of Manoomin waters.
- **Rankings** of Manoomin habitat over degraded and restored time periods using cultural and ecological metrics.

The amount of restoration in acres needed to counter-balance losses may be significantly larger than the acres of degraded habitat. This may be true because of practical limitations in our ability to produce fully functioning restored habitat. For example, if one acre of restored Manoomin wetland only reaches 50% functionality, then two acres of restored habitat are needed to counter-balance the one acre of lost Manoomin habitat. In addition, the amount of time that the habitat was degraded is counter-balanced with the time the restored habitat takes to reach its maximum functionality. Thus, we can account for habitat degraded for longer periods of time, and restoration actions that take longer to mature.

4. Cultural and ecological metrics

We developed 12 metrics that characterize the cultural and ecological functions of Manoomin and its associated habitat. These metrics describe how Manoomin contributes to maintaining connections with the Anishinaabe culture, how ecological functionality is supported and resilient to changing conditions, and how continued learning and sharing of Anishinaabe values are promoted.

Exhibit 4.1 displays the metrics graphically in the form of a dream catcher. Although many Tribes have adopted dream catchers over time, the Anishinaabe may have originated this tradition. There are many legends and stories behind the origins of dream catchers; in most legends, a dream catcher serves to filter out bad bawedjigewin (dreams) and allow only the good ones to enter (We R Native, 2020). Many indicate that dream catchers were also intended to teach natural wisdom (We R Native, 2020). In this graphical display of the metrics, we group cultural and ecological metrics inside the dream catcher hoop, with the Anishinaabe metric centered as it is critical for all other metrics. The three cultural and ecological education metrics are displayed below the dream catcher, as these educational metrics aim to generate and transmit the cultural and ecological knowledge between generations and communities.

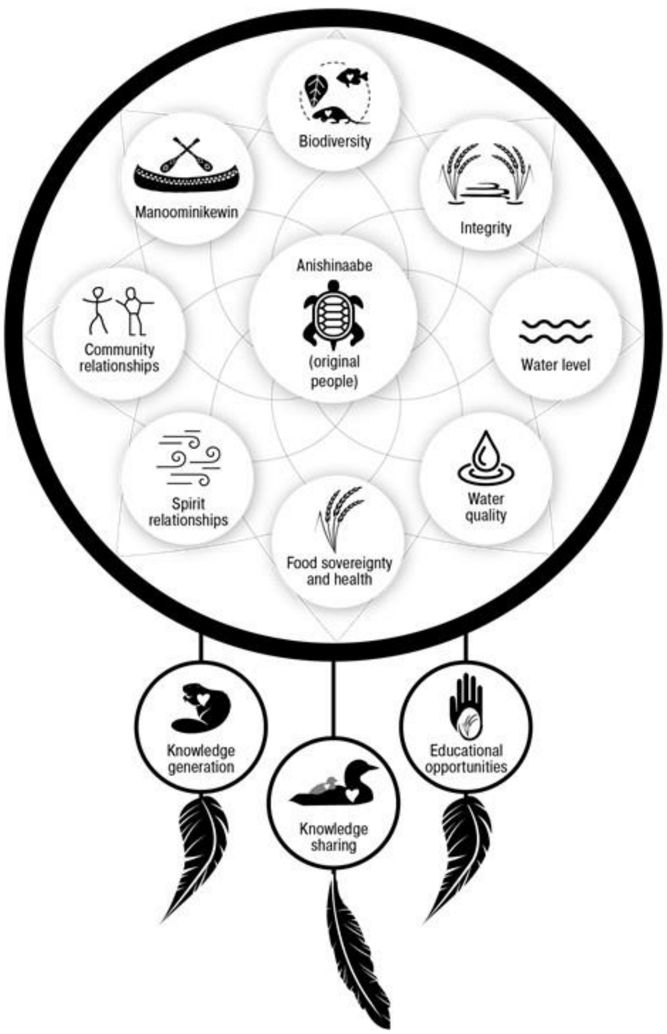


Exhibit 4.1. Dream catcher displaying the 12 metrics developed for this study

Below, we define the cultural, ecological, and cultural and ecological education metrics.

Cultural and ecological metrics

Cultural Metrics

Anishinaabe (original people) – The place provides manoomin, which is sacred to the Anishinaabe and central to the foundations of their culture, sovereignty, and treaty rights.

Community relationships – Manoomin at this place contributes to bonding, traditions, and strengthening family and community connections.

Spirit relationships – Manoomin at this place enables the Anishinaabe to maintain connections and balance with spirit beings (or relatives) from all other orders of creation (first order: rock, water, fire and wind; second order: other plant beings; third order: animal beings; fourth order: human beings).

Manoominikewin – This place allows for the Anishinaabe to harvest, prepare, and share (gifting, healing, and eating) manoomin in the ways practiced by their ancestors for centuries.

Food sovereignty and health – This place provides the capacity to provide for the sustenance, health, and independence of the Anishinaabe.

Ecological Metrics

Biodiversity – Healthy manoomin and appropriate habitat at this place supports diverse biological communities (e.g., free of invasive species) that indicate the capacity of the place to support abundant associated plant and animal species (e.g., other native aquatic vegetation, fish, waterfowl, muskrat), providing for spiritual and subsistence needs.

Integrity – Physical habitat and hydrology, water and sediment chemistry support stands of manoomin that exhibit natural annual variability; viable seed bank ensures that sustainable manoomin populations will persist even after occasional poor production years. Natural genetic diversity is maintained without impact from cultivated strains, or reduced gene flow from the loss of nearby manoomin populations.

Water quality – This place has clean water (e.g., sulfate levels below 10 ppm) and sediments that can support robust stand density and wildlife diversity; is free of contamination or impacts from industrial, agricultural, recreational, or residential influence; and is of sufficient areal extent to sustain a manoomin population.

Water level – This place has a natural or managed hydrologic regime that can maximize resilience under variable or extreme climatic conditions across the growing season (maintaining optimal depth range and flow).

Cultural and Ecological Education Metrics

Knowledge generation – This place allows for continued learning and generation of the Anishinaabe practices, values, beliefs, and language through experience.

Knowledge sharing – This place allows for the continued sharing and transmittal of the Anishinaabe practices, values, beliefs, and language among family members and community.

Educational opportunities – This place provides opportunities for language, land stewardship, and other educational programs, such as educational rice camps.

5. Cultural and ecological characterization case study results

The seven case studies, each of which profiles a story of changes in Manoomin cultural and ecological functionality over time, form the heart of this project. The case studies, grouped around the Lake Superior region, are located in the 1854 Ceded Territory and the 1842 Ceded Territory (Exhibit 5.1). Three of the seven case studies are located on reservation lands. As described in Chapter 3, these case studies are primarily located in places with current or former Manoomin habitat that have experienced a decline in Manoomin over time, and where restoration actions have been undertaken in an effort to restore Manoomin habitat over different time periods. In a few case studies, documentation of Manoomin presence is not available from historical records; however, their physical or hydrologic features make them conducive to growing Manoomin.

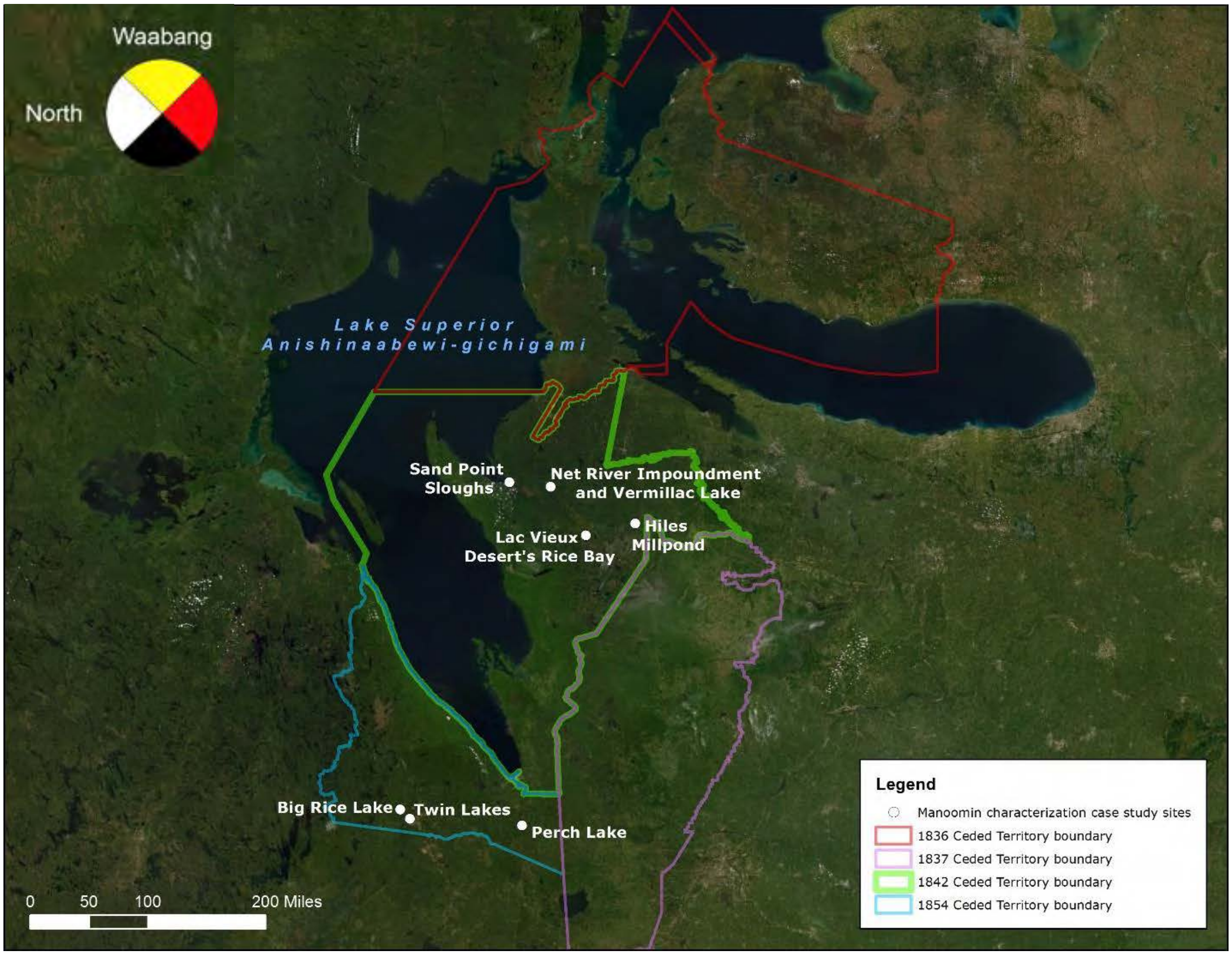


Exhibit 5.1. Map displaying the seven case study locations. The map is oriented to the Waabang (east), which is traditional for the Anishinaabe. The compass is in the form of a medicine wheel, an indigenous symbol used across the continent to denote the four directions. For additional information, see The Decolonial Atlas (2015).

Exhibit 5.2 provides a brief overview of the case studies, including the key threats to Manoomin at these places, some of the actions taken to improve Manoomin habitat, and, if available, the HEA results that indicate how many acres of similar Manoomin restoration habitat are needed to balance lost habitat functionality over time.

Exhibit 5.2. Case study summaries

Case study	Threats to Manoomin	Restoration actions to improve Manoomin	Additional restoration needed
Lac Vieux Desert's Rice Bay *Characterization focuses on 243 restoration acres*	• **High water levels** caused by a concrete and steel dam at the outlet of the lake in the 1930s • **High water levels** caused by above-average precipitation in the 2010s	• Water level management • Manoomin seeding	**3,034 acres of similar Manoomin restoration** needed to balance the lost habitat functionality over time or **12 equivalent restoration efforts**.
Perch Lake *Characterization focused on 400 restoration acres*	• **High water levels** caused by agricultural ditching in the 1920s • **Competitive vegetation** caused by non-functional dam in the 1960s	• Water level management • Removal of competitive vegetation	**3,584 acres of similar Manoomin restoration** needed to balance the lost habitat functionality over time or **9 equivalent restoration efforts**.
Sand Point Sloughs *Characterization focused on 8 restoration acres*	• **Deposited mine tailings** from a copper ore processing plant that operated north of the sloughs in the 1920s • **High water levels** and **invasive species** after 2005	• Manoomin seeding • Remediation efforts to stabilize the tailings	**175 acres of similar Manoomin restoration** needed to balance the lost habitat functionality over time or **22 equivalent restoration efforts**.
Net River Impoundment and Vermillac Lake *Characterization focused on 97 restoration acres*	Unclear if Manoomin historically grew at site; if it was, land use change likely responsible for its depletion	• Manoomin seeding	**1,129 acres of similar Manoomin restoration** needed to balance the lost habitat functionality over time or nearly **12 equivalent restoration efforts**.
Hiles Millpond *Characterization focused on 300 restoration acres*	Unclear if Manoomin historically grew at site; if it was, high water levels caused by dam construction likely responsible for its depletion	• Water level management • Manoomin seeding	**864 acres of similar Manoomin restoration** needed to balance the lost habitat functionality over time or **3 equivalent restoration efforts**.
Big Rice Lake *Characterization focused on 1,870 restoration acres*	• Hydrological changes • Competing vegetation • Changes in precipitation patters	• Water level management • Removal of competitive vegetation	Varies depending on hypothetical improvement scenario.
Twin Lakes *Characterization focused on 210 acres*	• **Discharge of mine tailings** from an iron ore processing plant upstream of the lakes since the 1960s, which has ***increased sulfate levels*** and ***increased water volume***	• Seepage collection system to collect some of the mine tailings discharge • Manoomin seeding (limited) • Water level management (limited)	Varies depending on hypothetical improvement scenario.

These seven case studies are described in more detail below. For each case study, we briefly describe the cultural and ecological importance of the place, and provide an overview of the threats to Manoomin and the actions taken to improve the plant. We then summarize how each case study team characterized the place over time using ecological and cultural metrics; and describe the additional restoration needed, as calculated with the HEA tool.

Lac Vieux Desert’s Rice Bay

Lac Vieux Desert, located in Vilas County, Wisconsin, and Gogebic County, Michigan, is over 4,000 acres (Exhibit 5.3). Historically, Manoomin covered many parts of Lac Vieux Desert, including Rice Bay, Thunder Bay, Slaughters Bay, Misery Bay, and along the northwestern shore to the Wisconsin River and parts of the south shore.

Exhibit 5.3. Map of Lac Vieux Desert

Rice Bay is a 273-acre bay on the northeastern portion of Lac Vieux Desert, which historically contained a significant stand of Manoomin that was traditionally managed and harvested by the Lac Vieux Desert Band of Lake Superior Chippewa (LVD Band). West of Rice Bay is Ketegitigaaning, a ricing village used intermittently in the early 18th century by the LVD Band, followed by continuous habitation by 1900. In 2015, Rice Bay was registered as a Traditional Cultural Property on the National Register of Historic Places.

Threats to Manoomin at Rice Bay

Lac Vieux Desert was dammed around 1870 for logging operations. By 1907 the Wisconsin Valley Improvement Company (WVIC) began operating the lake as a storage reservoir and used the dam to create uniform stream flow down the Wisconsin River to reduce flooding events, facilitate hydroelectric power generation, and regulate effluent discharge downstream. In 1937, WVIC replaced the wooden dam with a reinforced concrete and steel structure. The high water levels caused by the dam initiated a decline in Manoomin (Labine, 2017). From 1938 to 1952, Manoomin declined steadily and community members stopped harvesting it during this period (Barton, 2018). During this time period, lakeside property owners became concerned about the erosion caused by rising lake levels.

More recently, heavy rainfall events have negatively affected Manoomin in Lac Vieux Desert (Roger Labine, LVD Band, personal communication, February 15, 2020). In the spring Manoomin is in the floating leaf stage, and can be uprooted by heavy rainfall that raises water levels and uproots Manoomin. In the summer, when Manoomin is in the flowering stage, heavy rainfall can knock Manoomin pollen down from the flower to the water’s surface, which prevents pollination and results in “ghost rice” or empty hulls that never fill. In addition, the combination of heavy rainfall events and higher air temperatures may also increase the amount of brown spot – a destructive wild rice fungal disease – in Manoomin beds.

Actions taken to improve the abundance of Manoomin at Rice Bay

In 1991, a coalition of tribal, state, and federal governments and governmental agencies determined the operating regime of the dam on Lac Vieux Desert had been detrimental to Manoomin and its associated habitat (Onterra, 2012). By 2001, following a decade of negotiation and litigation, WVIC lowered the maximum operating level by about nine inches and provided financial contribution toward a Manoomin seeding and monitoring program (Barton, 2018). From 2002 to 2005, Lac Vieux Desert was seeded with 14,000 pounds of Manoomin, most of which occurred in Rice Bay (Labine, 2017). From 2007 through 2012, as Manoomin became reestablished on Rice Bay, the LVD Band held traditional ricing camps and workshops, which included traditional practices and activities (Barton et al., 2013).

Exhibit 5.4. Photograph of Lac Vieux Desert Lake's Rice Bay in 2003 (above) and 2010 (below)

Credit: Peter David, Great Lakes Indian Fish & Wildlife Commission (GLIFWC).

From 2000 to 2010, the acreage of Manoomin on Rice Bay significantly increased. In 2000, Rice Bay had just 11 acres of Manoomin coverage (or 5% of Rice Bay). After the first year of seeding, Manoomin coverage increased to over 25 acres (or 10% of Rice Bay). With below-average rainfall conditions in 2010, the extent of Manoomin increased to over 92 acres (or 38% of Rice Bay; Exhibit 5.4). While the extent of Manoomin on Rice Bay was less than its historical coverage, it was considered an improvement over conditions caused by the operating regime of the concrete dam (Barton, 2018).

Since 2011, the acreage of Manoomin on Rice Bay has been declining, with 34 acres in 2019 (GLIFWC, 2019; Exhibit 5.5). Because Manoomin abundance on Rice Bay is generally greatest during low-water years, natural resource managers believe this may be due to above-average precipitation over the past seven years (Peter David, GLIFWC, personal communication, November 12, 2019).

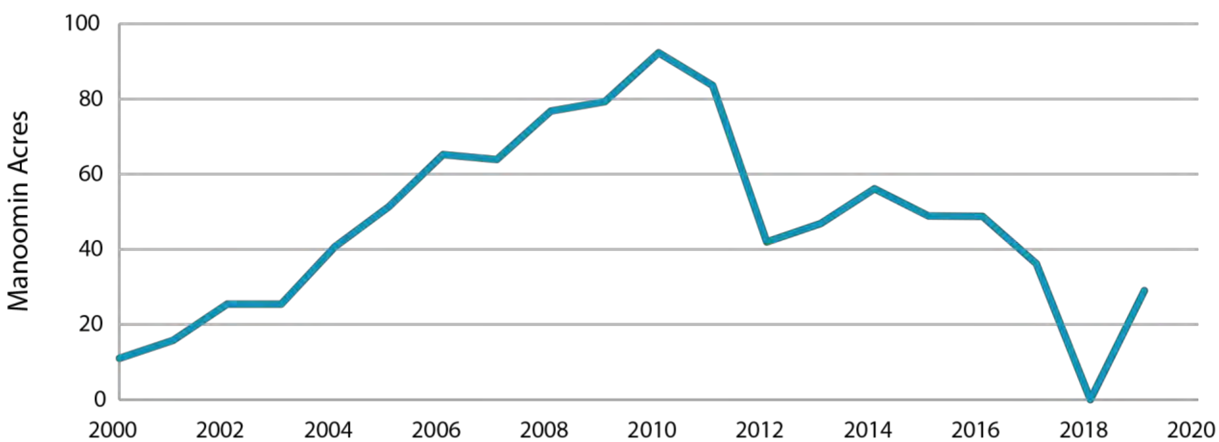


Exhibit 5.5. Manoomin acreage on Rice Bay, 2000 to 2019

Source: GLIFWC, 2019.

Cultural and ecological characterization at Rice Bay

Rice Bay's Manoomin and its associated habitat were characterized over four time periods.

1900 to 1936: With a wooden dam

Based on the combined ranking of cultural and ecological metrics, Rice Bay was characterized as "doing great" during this period. In the early 1900s, Ketegitigaaning was inhabited and the community harvested Manoomin in Rice Bay for gifting, healing, and consumption. The area also boasted a rich biodiversity; and hunting, trapping, fishing, and gathering local resources were common.

1937 to 1990: With a concrete and steel dam

After the replacement of the wooden dam with a concrete and steel structure, Manoomin declined steadily until the mid-1950s to the point that it was no longer harvestable by community members. During this time period, community members moved away from the lake and into surrounding towns, and stopped harvesting Manoomin in Rice Bay. The "disappearance of Manoomin started the deterioration of the Lac Vieux Desert community," where bonding, traditions, and community connections ceased (Roger Labine, LVD Band, personal communication, November 12, 2019). There was a steady decline in cultural and ecological functionality provided by Manoomin from 1937 to the mid-1950s, when Rice Bay was characterized as "very bad" based on the combined ranking of cultural and ecological metrics.

1991 to 2012: With restoration actions

Once restoration actions began in the 1990s, cultural and ecological functionality provided by Manoomin improved. By 2008, the LVD Band opened Rice Bay for Manoomin harvest and began hosting rice camps in the area for the first time since 1940. Although the community began knowledge sharing and knowledge generation, and educational opportunities increased, it remained difficult to get many community members interested in Manoomin because of its absence over the last 50 years. Even so, restoration actions led to an increase in cultural and ecological functionality. By 2012, Rice Bay ranked as "pretty good" based on the combined ranking of cultural and ecological metrics.

2013 to 2019: With restoration actions and above-average precipitation

With heavy rainfall events negatively affecting Manoomin beds during the growing season, cultural and ecological functionality at Rice Bay have declined. Currently, Rice Bay is ranked as "not very good" based on the combined ranking of cultural and ecological metrics. The decrease in ecological and cultural functionality provided by Manoomin in recent years suggests the need for adaptive management of Manoomin. Actions taken that may have been successful in restoring Manoomin in the past may need to be adjusted to respond to additional threats, such as climate change, to be successful in the future.

Cultural and ecological functionality provided by Manoomin and its associated habitat at Rice Bay have changed over time, both in total and for individual metrics (Exhibit 5.6).

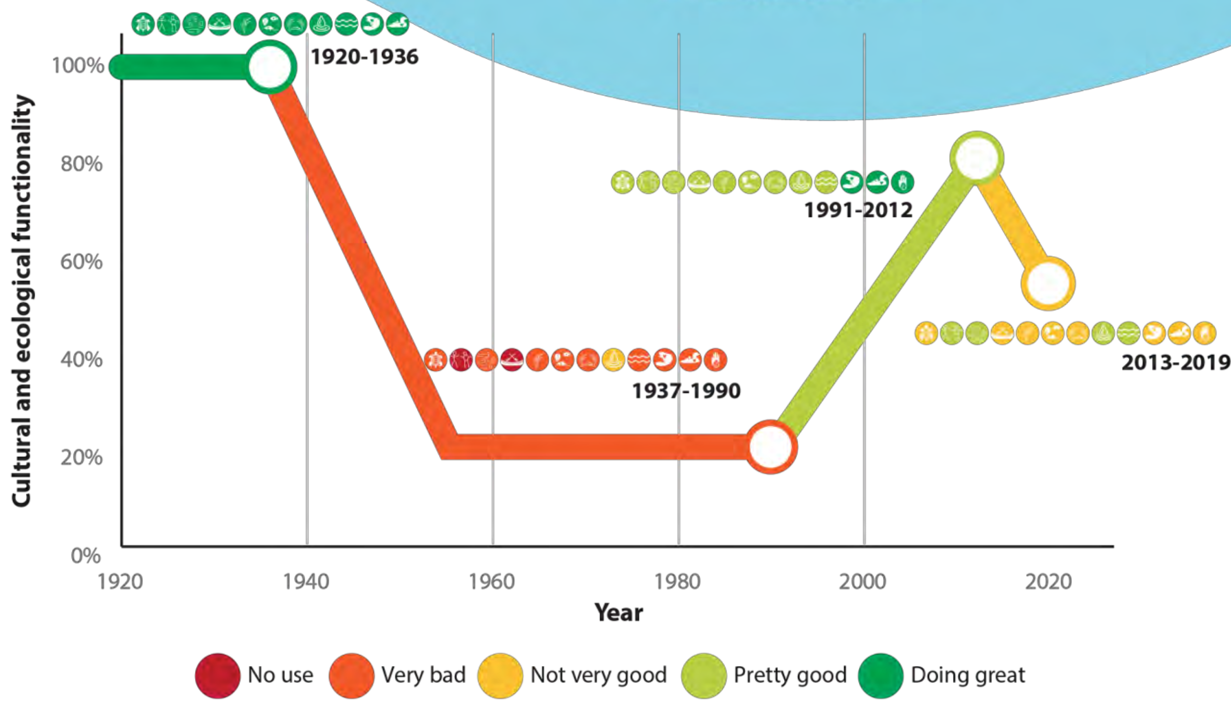


Exhibit 5.6. Characterization of cultural and ecological functionality provided by Manoomin and its associated habitat at Rice Bay

Additional restoration needed

Based on the characterization of the degree of cultural and ecological function over the four time periods, the HEA calculations demonstrate the additional equivalent units of restoration needed to counter-balance the severity and timespan of degradation. Given the success of restoration at the 243-acre Rice Bay, approximately 3,034 acres of similar Manoomin restoration is needed to counter-balance the lost habitat functionality that has occurred over time. In other words, 12 equivalent restoration efforts at Rice Bay (from 1991 to 2019) are needed to counter-balance the lost cultural and ecological habitat functionality (from 1900 to 1990).

Case study acknowledgments

The Project Team would like to acknowledge Roger Labine (LVD) and Peter David (GLIFWC) for their valuable input and feedback in the development of this case study, and for participating in the cultural and ecological characterization of Lac Vieux Desert's Rice Bay.

Sand Point Sloughs

Sand Point Sloughs are relatively shallow backwater sloughs connected to Lake Superior that are culturally important to the Keweenaw Bay Indian Community (KBIC). Native people used this area for hundreds of years, as indicated by the existence of ancient burial grounds and stories that have been passed on through oral tradition (KBIC, 2003). Manoomin is believed to have been present in Sand Point Sloughs prior to the 1900s (Ravindran et al., 2014). Today, the site contains the KBIC Pow Wow grounds, a traditional healing clinic, extensive wetlands, and Manoomin beds (Exhibit 5.7). A marina, campground, lighthouse, and recreational beaches signify the community's appreciation of this area. This area also holds ecological value as habitat. It provides for a number of species including medicinal plants, insects, fish, and other non-human relatives.

Exhibit 5.7. Map of Sand Point Sloughs

Threats to Manoomin at Sand Point Sloughs

Connected to Lake Superior, Sand Point Sloughs are part of a dynamic coastal system. In the early 20th century, a copper ore processing plant, Mass Mill, operated on the west side of Keweenaw Bay on the south shore of Lake Superior. During the copper ore processing, approximately six billion pounds of mine tailings, locally known as stamp sands, were disposed into Keweenaw Bay. Lake currents continue to carry these tailings southward and redeposit them onto Sand Point, located just four miles south of the Mass Mill. Sand Point, approximately 45 acres in size, has an extensive beach area with approximately 2.5 miles of lake front and is connected to the sloughs. These tailings contain high concentrations of heavy metals that have the potential to cause environmental harm to natural resources.

More recently, Sand Point Sloughs have been affected by regional hydrologic conditions – including higher water levels – that are occurring at a regional scale and are beyond local control. As a plant species sensitive to changes in water level, higher water levels have negatively affected the establishment and abundance of Manoomin in Sand Point Sloughs. The sloughs' connection to Lake Superior also opens the pathway to aquatic invasive species, such as carp and reed canary grass. Carp, for example, are bottom feeders that uproot Manoomin (Premo et al., 2014). Manoomin abundance may also be impeded by competing native vegetation, such as ginoozhegoons (pickerelweed); and by excessive browsing by wildlife on new stands, such as waterfowl.

Actions taken to improve the abundance of Manoomin at Sand Point Sloughs

Sand Point Sloughs are a KBIC Tribal Trust property, wholly owned by KBIC and located entirely within KBIC L'Anse Reservation boundaries. KBIC took over management of the sloughs in the early 1990s, and shortly after began efforts to reintroduce Manoomin. Between 1991 and 1997, KBIC seeded nearly 1,800 pounds of Manoomin across 8 acres of Sand Point Sloughs. By 1999, Manoomin density was sufficient for KBIC to engage in the tradition of ricing. Between 1999 and 2002, community members harvested an estimated 60 to 150 pounds per year (Ravindran et al., 2014). Since 2013, KBIC has seeded Manoomin annually at Sand Point Sloughs (Exhibit 5.8). KBIC continues to tend to this site in an effort to keep Manoomin teachings and traditions vital. However, since 2002, community members have not been able to harvest Manoomin at Sand Point Sloughs, due to decreased abundance of Manoomin related to regional hydrologic conditions.

In addition to seeding efforts, KBIC and partners have undertaken remediation along the Sand Point shoreline, which was listed as a brownfield site. Remediation efforts included capping stamp sands to stabilize the tailings; planting native plants, trees, and shrubs to increase habitat for birds and other wildlife; and installing mounds and boulders to provide relief in the topography, reduce erosion, and protect valuable coastal wetlands, including Manoomin beds (Ravindran et al., 2014).

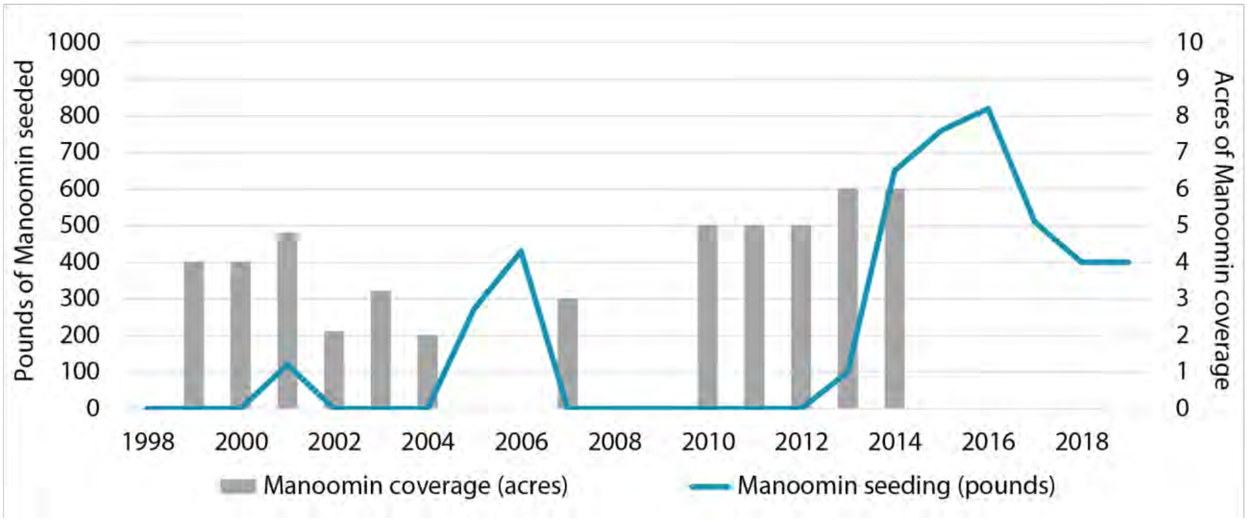


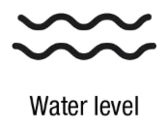
Exhibit 5.8. Manoomin seeding and acres of Manoomin coverage at the Sand Point Sloughs, 1999 to 2019 (Manoomin coverage data not recorded after 2014)

Source: Ravindran et al., 2014; Karena Schmidt, personal communication, October 31, 2019.

Cultural and ecological characterization at Sand Point Sloughs

Sand Point Sloughs' Manoomin and its associated habitat were characterized over four time periods. This characterization begins after the copper ore processing plant ceased operations around the 1920s.

1920 to 1990: Before KBIC ownership



For each of the four time periods, the water level metric was ranked as "not very good." Due to their location, the Sand Point Sloughs are influenced by regional factors such as Lake Superior water levels, which are beyond local control.

Based on the combined ranking of cultural and ecological metrics, Sand Point Sloughs was characterized as "not very good" during this period. This ranking reflects the absence of Manoomin from the sloughs and the deposition of mine tailings onto Sand Point. Although Manoomin was absent, the sloughs were still a place of cultural and ecological importance: waterfowl and other wildlife foraged at the sloughs; and community members fished, hunted, and gathered there and held Pow Wows on the grounds. Given the intrinsic cultural and ecological values of the sloughs, some cultural metrics – including spirit relationships, knowledge sharing, and food sovereignty – were characterized with a higher ranking.

1991 to 1998: With active management of Manoomin

Once KBIC took over management of Sand Point Sloughs in the early 1990s and began seeding activities, Manoomin grew modestly. Although community members could not yet harvest Manoomin, the presence of Manoomin significantly improved the ranking of most cultural and ecological metrics. During this period, Sand Point Sloughs ranked as "pretty good" based on the combined ranking of cultural and ecological metrics.

1999 to 2005: With active management and harvesting of Manoomin

Once Manoomin was adequately established at Sand Point Sloughs, KBIC was able to open Sand Point Sloughs to their community members for harvesting. Harvesting allowed the recovery and sharing of Anishinaabe practices, values, beliefs, and language at the sloughs in ways that had not been practiced for years. During this period, Sand Point Sloughs ranked as "doing great" based on the combined ranking of improved cultural and ecological metrics.

2006 to 2019: With higher water levels

Sand Point Sloughs is connected to Lake Superior, and affected by changes in the lake's water level and invasive and competitive species. Invasive species and competing vegetation that have been documented at Sand Point Sloughs may be impacting Manoomin abundance. Water levels have also fluctuated in Sand Point Sloughs, with lower water levels recorded in 2006 and 2007, and higher water levels in recent years (Ravindran et al., 2014). During this period, Sand Point Sloughs' functionality decreased to "pretty good" based on the combined ranking of cultural and ecological metrics. The decrease in ecological and cultural functionality provided by Manoomin in recent years suggests the need for adaptive management of Manoomin. Actions taken that may have been successful in restoring Manoomin in the past may need to be adjusted to respond to additional threats, such as climate change, to be successful in the future.

The cultural and ecological functionality provided by the Manoomin and its associated habitat at Sand Point Sloughs varied over time, both in aggregate and for individual metrics (Exhibit 5.9).

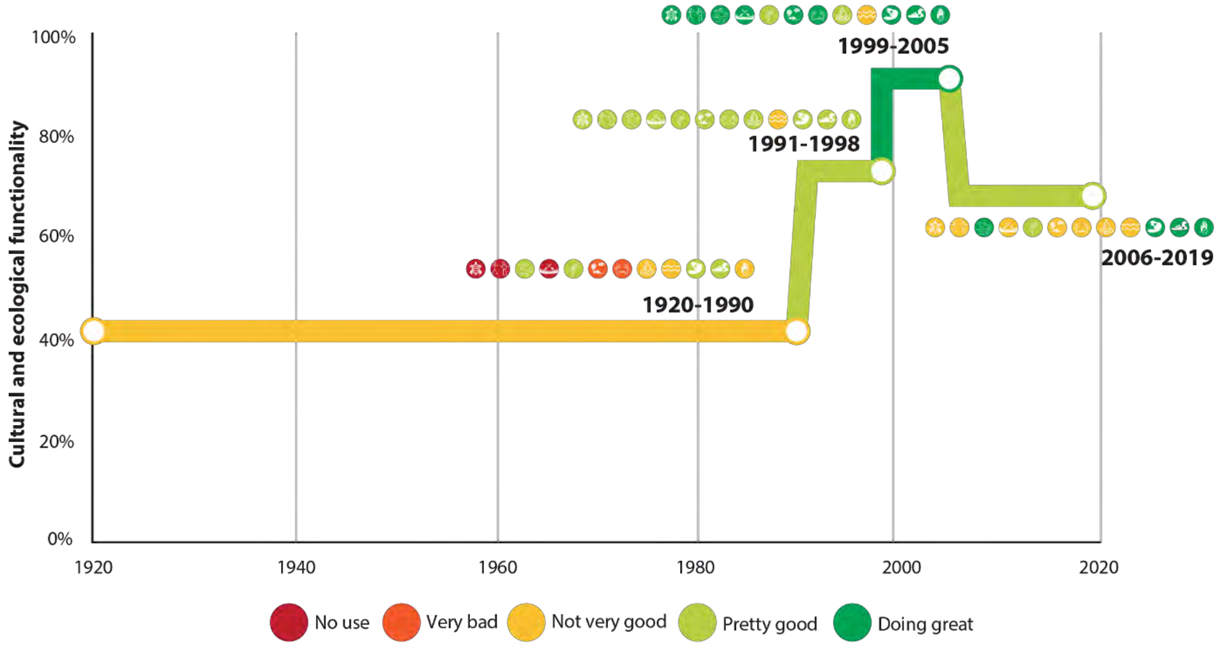


Exhibit 5.9. Characterization of cultural and ecological functionality provided by Manoomin and its associated habitat at Sand Point Sloughs

Additional restoration needed

Based on the characterization of the degree of cultural and ecological function over the four time periods, the HEA calculations demonstrate the additional equivalent units of restoration needed to counter-balance the severity and timespan of degradation. Given the success of restoration at the 8-acre Sand Point Sloughs, 175 acres of similar Manoomin restoration is needed to counter-balance the lost habitat functionality that has occurred over time. In other words, 22 equivalent restoration efforts at Sand Point Sloughs (from 1991 to 2019) are needed to counter-balance lost cultural and ecological habitat functionality (from 1920 to 1990).

Case study acknowledgments

The Project Team would like to acknowledge Evelyn Ravindran, Karena Schmidt, and Erin Johnston (KBIC) for their valuable input and feedback in the development of this case study, and for participating in the cultural and ecological characterization of KBIC's Sand Point Sloughs.

Net River Impoundment and Vermillac Lake

The Net River is nearly 15 miles long and flows from Baraga County to Iron County, Michigan. Impounded in 1990 as a wetland mitigation site to provide waterfowl benefits, the Net River Impoundment is now 35 acres in size. Vermillac (or Worm) Lake is a 423-acre lake in Baraga County. Both the Net River Impoundment and Vermillac Lake are located outside the L'Anse Indian Reservation, but within Ceded Territory (Exhibit 5.10).

Exhibit 5.10. Map of Net River Impoundment and Vermillac Lake

Threats to Manoomin at Net River Impoundment and Vermillac Lake

Both the Net River Impoundment and Vermillac Lake possibly had Manoomin beds in the past. Many believe that historical trails around the Net River Impoundment indicate traditional use of these places for cultural practices (Evelyn Ravindran, KBIC personal communication, August 20, 2019). Land use changes have altered the local landscape, which may have contributed to the presence or absence of Manoomin at these places.

Actions taken to improve Manoomin at Net River Impoundment and Vermillac Lake

KBIC is receiving more and more teachings from Manoomin and is working to understand which locations on the L'Anse Indian Reservation and within Ceded Territory have conditions that are conducive to grow and sustain Manoomin (BIA, 2019). KBIC is interested in having local sources of Manoomin as seed banks for future restoration activities; as well as places where community members can harvest, prepare, and gift Manoomin. KBIC is currently assessing suitable Manoomin habitat across their territory, and focusing restoration in lakes with the most favorable conditions for Manoomin.

In the early 2010s, KBIC worked with the Michigan Department of Natural Resources to identify additional areas for Manoomin restoration. The Net River Impoundment and Vermillac Lake were selected as lakes with potential for Manoomin beds, and KBIC seeded test plots at both lakes. Given their success, KBIC then seeded the Net River Impoundment and Vermillac Lake with nearly 2,000 pounds of Manoomin seed. Cultural teachings and practices related to Manoomin are beginning to occur at the Net River Impoundment. KBIC continues to seed 97 acres across both lakes with nearly 2,000 pounds of Manoomin each year.

The ultimate goal of seeding efforts is for the Net River Impoundment to produce a Manoomin seed source for Vermillac Lake and other KBIC restoration sites. In keeping with the principles of the honorable harvest, KBIC aims to achieve conditions that will allow the rice to reseed itself to feed wildlife and nourish the people.

Cultural and ecological characterization at Net River Impoundment and Vermillac Lake

Manoomin and its associated habitat at the Net River Impoundment and Vermillac Lake were characterized over two time periods. This characterization begins after the Net River was impounded as a wetland mitigation bank in 1990.

1990 to 2013: Before Manoomin seeding

Based on the combined ranking of cultural and ecological metrics, conditions at the Net River Impoundment and Vermillac Lake were characterized as “not very good” during this period. This ranking reflects the absence of Manoomin from the Net River Impoundment and Vermillac Lake before 2013. Although Manoomin was absent, these areas were culturally and ecological important. Community members used these sites for gathering, fishing, and hunting activities; during these activities, families passed down knowledge to their children or grandchildren about traditional practices and resources. Given the intrinsic cultural and ecological value of these places, some metrics – including spirit relationships, food sovereignty, knowledge generation and sharing, and water level and quality – ranked higher in cultural and ecological characterization.

2014 to 2019: After Manoomin seeding

Once KBIC began seeding the Net River Impoundment and Vermillac Lake, Manoomin grew at these places. Currently, Manoomin supports wildlife and other ecosystem functions. These places have the potential for Manoomin harvesting in the future, although they cannot yet support it. The presence of Manoomin significantly improved the ranking of most of the cultural and ecological metrics. During this period, conditions at the Net River Impoundment and Vermillac Lake ranked as “pretty good” based on cultural and ecological metrics. Although Manoomin provides many cultural and ecological functionality, additional management of water levels at the Net River Impoundment could continue to improve the abundance of Manoomin and the long-term sustainability of healthy Manoomin beds.

Cultural and ecological functionality provided by Manoomin and its associated habitat at the Net River Impoundment and Vermillac Lake have increased over time, both in aggregate and for the individual metrics (Exhibit 5.11).

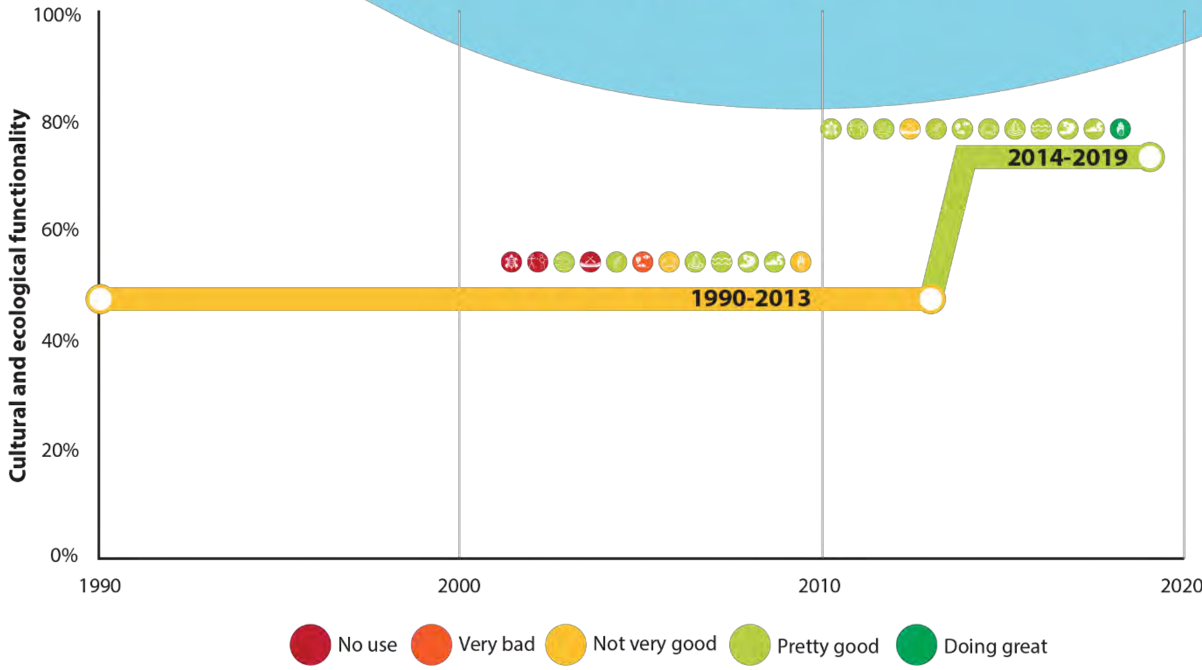


Exhibit 5.11. Characterization of cultural and ecological functionality provided by Manoomin and its associated habitat at Net River Impoundment and Vermillac Lake

Additional restoration needed

Based on the characterization of the degree of cultural and ecological function over the four time periods, the HEA calculations demonstrate the additional equivalent units of restoration needed to counter-balance the severity and timespan of degradation. With seeding, resource managers successfully established Manoomin across the Net River Impoundment and Vermillac Lake. However, given that the period of degradation is much larger (over 20 years) than the period of restoration (around 5 years), an additional 1,129 acres of similar Manoomin restoration is needed to counter-balance the lost habitat functionality that has occurred over time. In other words, nearly 12 equivalent restoration efforts at the Net River Impoundment and Vermillac Lake (from 2014 to 2019) are needed to counter-balance the lost cultural and ecological habitat functionality (from 1990 to 2013).

Case study acknowledgments

The Project Team would like to acknowledge Evelyn Ravindran, Karena Schmidt, and Erin Johnston (KBIC) for their valuable input and feedback in the development of this case study; and for participating in the cultural and ecological characterization of KBIC’s Net River Impoundment and Vermillac Lake.

Hiles Millpond

Hiles Millpond is an approximately 300-acre lake located in Forest County, Wisconsin, an 1842 Ceded Territory (Exhibit 5.12).

The millpond provides excellent wildlife habitat, especially for waterfowl, furbearers, eagles, and other wetland-dependent species. The lake also supports a northern pike and panfish fishery.

Threats to Manoomin at Hiles Millpond

Water ponded at Hiles Millpond in the late 1880s, when the Hiles Lumber Company built a dam for logging purposes. Although there is no record of the presence of Manoomin at Hiles Millpond, it may have been there at some point prior to dam construction, since Manoomin is in nearby waters. If Manoomin was present at Hiles Millpond historically, it could have been negatively affected by changes in water levels associated with construction of the dam.

Exhibit 5.12. Map of Hiles Millpond

The area and waters around the Town of Hiles were traditionally used by the Lac du Flambeau Band of Lake Superior Chippewa Indians (LDF Band), the Sokaogon Chippewa Community, and other Ojibwe Bands and their ancestors. However, use of the area by Bands for hunting, gathering, fishing, and trapping was limited during much of the last century up until the 1980s. Use of this area increased after this time when relations with the local community in the Town of Hiles improved.

Actions taken to improve the abundance of Manoomin at Hiles Millpond

In 1992, safety inspections found several problems with the dam structure at Hiles Millpond. To meet contemporary safety standards, the Town of Hiles needed to replace the dam structure. Since the town lacked adequate funds, federal, state, tribal, and nongovernmental organizations entered into a cooperative effort. A Memorandum of Understanding included a provision for the town to cooperate with the Forest Service to manage the millpond for productive wildlife and fish habitats, including possible manipulation of water levels, following completion of the project. The dam and water control structure were rebuilt in fall 1993.

Shortly after, biologists realized that the ecological benefits of Hiles Millpond could be significantly enhanced by establishing Manoomin on the millpond. Establishing Manoomin could also help to make up for the loss of Manoomin on other waters in the region, many of which were difficult or impossible to recover due to excessive development, conflicting uses, or other threats to Manoomin (Peter David, GLIFWC, personal communication, November 27, 2019).

In 1998, GLIFWC and the Forest Service cooperatively seeded the Hiles Millpond flowage with a relatively modest amount of Manoomin (329 pounds). Small patches of Manoomin then expanded modestly over the next several years. In 2011, Manoomin expanded significantly under natural drought