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# Wild Rice Adaptation to Climate Change

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## **Title: Wild Rice Adaptation to Climate Change**

### **Abstract**

Climate change is predicted to significantly warm ambient and water temperatures in the Great Lakes wild rice region, increase invasive species, increase decomposition rates which will release phosphorus and toxins from the sediment, and alter the conditions that presently exist. These changes will likely negatively affect wild rice (*Zizania spp.*) populations, which in turn, will affect the long-held traditions of wild rice harvesting by Tribal communities. The Lac Vieux Desert Band of Lake Superior Chippewa (LVD) has harvested wild rice for centuries from Lac Vieux Desert and surrounding lakes and rivers. It is a staple of their diet, an important component of their spiritual practices, and is the foundation of the traditional practice of wild rice harvesting. In partnership with the Tribe, we propose an adaptation strategy to ensure that rice beds and ricing culture are preserved for future generations. This strategy entails a coupled ecological and cultural approach to address climate variability and climate change. This approach can be implemented through a collaborative endeavor with the LVD community and key stakeholders, and can buildup resiliency and adaptation capacity through research, ecological assessment, education and training, development of networks, and the documentation of traditional knowledge.

## **Introduction**

Wild Rice (*Zizania spp.*, ‘Manoomin’ or good berry in the Ojibwe language) is a culturally important plant to the Anishinaabe people of the Great Lakes region and is harvested and enjoyed throughout the Upper Great Lakes Region by people of varied cultural backgrounds. It has been a central component of the culture of indigenous people in this region for thousands of years and continues to be of great importance to the Anishinaabe community and specifically to the Lac Vieux Desert Band of Lake Superior Chippewa (LVD). Wild Rice’s spiritual significance is evidence of the fulfilling of the prophecies of the Anishinaabek migration story; its cultural significance is the fact it is one of the staple foods of the community and is also used in ceremonies and feasts. The traditional and social importance comes from the rice camps where Wild Rice is harvested, processed, and reseeded, and is the time when Elders pass on the knowledge to the next generation. Wild Rice is also an important component of recent Tribal programs that encourage a healthy diet and lifestyle. Ecologically, this grain provides the base of the food chain for Indian Country’s wetland, lake and riparian habitats, especially during the later summer and autumn. Wild Rice is a key element of Great Lakes coastal and interior wetlands that provides food, cover, and spawning habitat for a variety of wildlife species.

## **Proposed Project**

Based on ecological and cultural characteristics of Manoomin and at the appropriate scale to address critical issues, we performed the following; 1) engaged the stakeholders and relevant public/private agencies in setting clear, measurable goals for the assessment of the health of Manoomin ecosystems and economies, 2) gathered information about the condition of wild rice habitat and resources and the local economy that depends on them, 3) used this information to propose adaptation strategy in light of climate change, and 4) coordinated with the stakeholders across communities in identifying and implementing strategies to achieve multiple goals. We employed the following broad outline in our efforts:

- Goal 1. Identify potential impacts of climate change on Manoomin habitats*
  - a. review scientific literature*
  - b. interview Traditional Knowledge keepers*
- Goal 2. Identify how these changes will affect LVD community*
  - a. interview wild ricing community*
  - b. interview Tribal Elders*
- Goal 3. Identify adaptation needs*
  - a. develop an understanding of Manoomin livelihoods*
    - 1. review current management strategies*
    - 2. review status of wild ricing tradition within the community*
    - 3. develop an understanding of the goals and objectives of the community*
    - 4. develop an understanding of climate driven changes and effects on Manoomin communities*
    - 5. assess current Manoomin management strategies and modify as needed to address climate change threats*
- Goal 4. Identify and develop partnerships to assist with management strategy and implementation*
  - a. Build upon existing relationships with US Forest Service, MSU Extension, Michigan Technological University, Northern Michigan University, Keweenaw*

*Bay Indian Community, Hannahville, Indian Community, Great Lakes Fish and Wildlife Commission*

*b. develop new partnerships*

*Goal 5. Develop a coordinated adaptation-based Manoomin management strategy*

*a. assess, respond, and mitigate: social, climate, habitat, planting and harvest conditions*

*1. create metrics for wild rice distribution, density, harvest*

*2. annually repeat assessment, modify response and mitigation*

*Goal 6. Implement adaptation based Manoomin management strategy - requires flexibility to change with new conditions*

*a. based on current knowledge of Manoomin, expertise and assessment of social, economic and ecological implications - build resiliency and adapt to changes*

*b. ameliorate and reduce existing habitat and plant risk and vulnerability*

*c. expand capability (i.e. habitat expansion and recovery)*

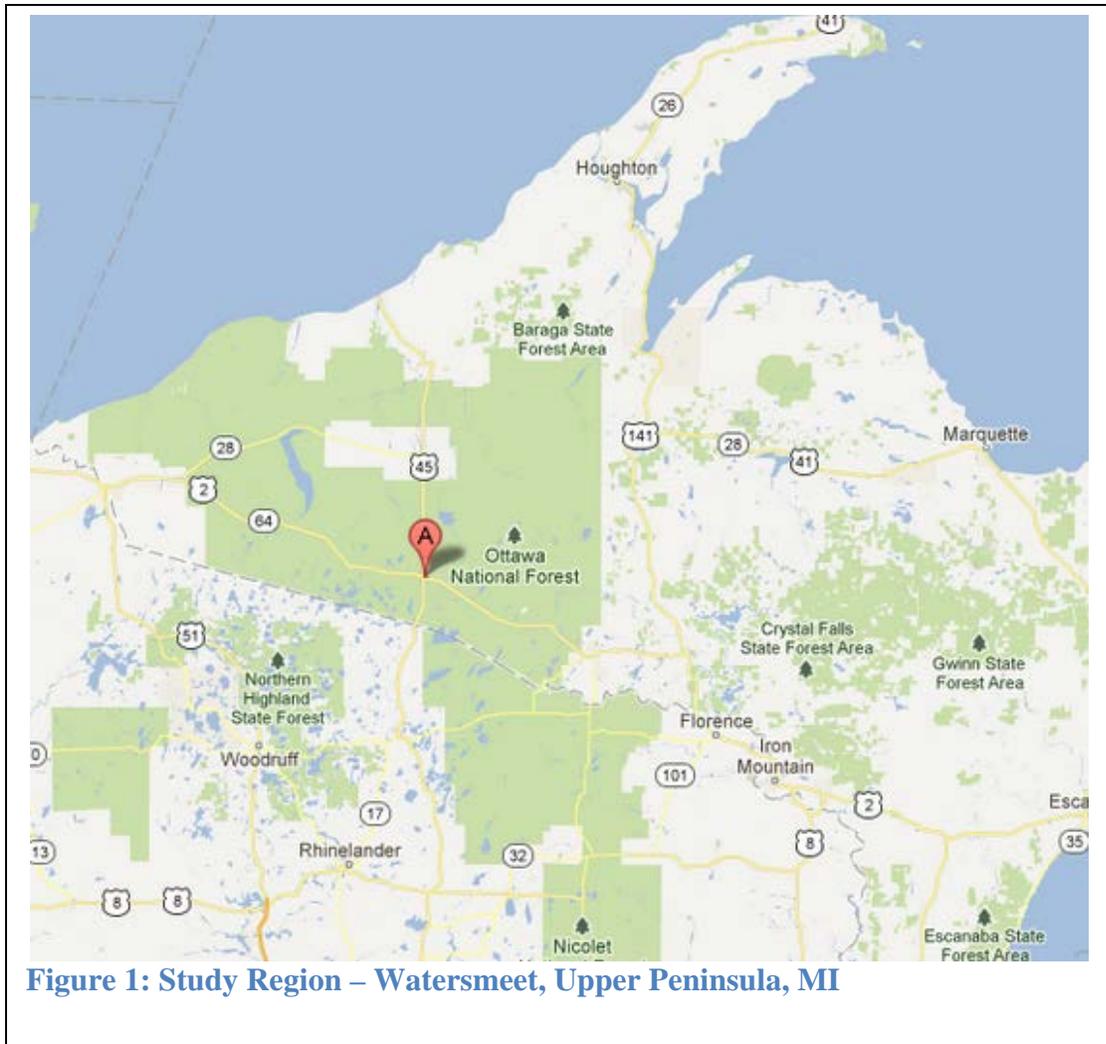
*Goal 7. Maintain sustainable wild rice beds in the LVD area*

*a. create long-term wild rice management plan*

*b. identify funding needs*

*c. educate the LVD community on the importance of maintaining wild ricing tradition, threats related to climate change*

This project proposes a strategy for buildup of resilience and creation of adaptation capacity of Manoomin in LVD. The LVD is a traditional Manoomin harvesting Tribe located in the western Upper Peninsula of Michigan. The Tribe has been actively involved in restoration activities and Manoomin education in the form of traditional rice camps. The purpose of this project is to work with LVD to develop and implement effective strategies to adapt to the effects of climate change on, and reduce the vulnerability of, Manoomin beds. This will be accomplished by working collaboratively to identify how climate change may affect wild rice, developing habitat management recommendations and other strategies with the goal of maintaining sustainable harvesting opportunities.



**Figure 1: Study Region – Watersmeet, Upper Peninsula, MI**

This project is a collaborative effort between the Great Lakes Lifeways Institute, Michigan State University, and LVD. The advocacy component for this project is built in through the inclusion of the Tribe as a partner - by collaboratively working in partnership with the LVD community throughout project development and implementation, recommendations are assured to be adopted by the Tribe. Further, the collaboration with the LVD community aims to incorporate culturally relevant perspective in understanding climate change and their own adaptation capabilities and help to develop additional measures. In this way, the community becomes the primary decision maker and an advocate to implement the necessary changes. The work undertaken is presented as three interconnected pieces that expands our understanding of wild rice adaptation to climate change: 1) ecology, 2) climate change, and 3) culture.

Ecological Life History of Wild Rice: Wild rice is an annual grass that forms dense beds important to the biodiversity of the Great Lakes region. It provides food and cover for a variety of wildlife and fish species, and is an important stop over habitat for migratory waterfowl. It is a staple of their diet, an important component of their spiritual practices, and is the foundation of the traditional practice of wild rice harvesting. In order to understand the potential impacts of climate change on Wild Rice, we present a brief discussion of the life history and habitat requirements. Wild rice seeds lie in bottom sediments throughout the winter and must go through

a three to four month cold dormancy period of temperatures at or below 38° F in order to germinate. In spring, the submerged plant grows up from the sediments and enters into the “floating leaf stage”, the period when the plant is most vulnerable. At this stage, the roots are not yet fully developed and the rice plants are easily dislodged by fluctuating water levels, severe flood events, or bottom disturbance such as that caused by carp. Wild rice takes on an emergent form in mid-summer and flowers into August. Seeds form in late August through September and this is when wild rice harvesting takes place.

Wild rice prefers mucky or silt bottom sediments with waters having low turbidity. In lakes, flow is important and there is often an inflow and outflow with rice preferring depths of six inches to four feet. Wild rice grows best in rivers with slow currents and depths of two feet. Neither river nor lake rice competes well with floating leaved plants or *Typha* species.

Threats to Wild Rice include changes in hydrology, fluctuating water levels due to extreme flood events, boat traffic or water control structures, high turbidity, disturbance due to boat traffic, invasive species (carp, *Typha*, water milfoil, mute swans), pollution from activities such as mining, and overgrazing by native species such as Canadian geese and muskrats.

### **Potential Impacts of Climate Change on Wild Rice Habitats**

Ojibwe communities have traditionally respected and protected ricing. Many historic wild rice beds no longer exist and others are a shadow of their former productivity. Wild rice lakes and rivers are under threat from a number of factors: lake owners, water level fluctuations from dammed rivers, motorized boats damaging wild rice roots, invasive plant competition and displacement, and pollution from mining activities. Wild rice also plays an important role in food for birds and also aids in processing water quality.

Protection and enhancement efforts are limited (but see GLIFWC) and need to be expanded beyond the local scope. Wild rice habitats were historically regionally available and important. Protection and expansion of wild rice and habitats is part in parcel of sound habitat and watershed management.

Climate change is expected to critically affect wild rice beds in the Great Lakes region. This project seeks to identify these changes and work in partnership with the LVD to advocate adaptation measures to ensure the continuity of the ricing tradition by reducing the vulnerability and building adaptation capacity of wild rice beds to these changes. Adaptation measures require the understanding of climate change implications for the cultural, economic and ecological (habitat, plant) relevance of this resource. This information will provide the understanding for the build up and creation of adaptation measures that will be required for the continuity and longevity of this important staple.

A review of the scientific literature was conducted to determine how climate change will affect habitats and growing conditions for wild rice in Michigan. The following table presents predicted conditions within the next 50 to 100 years by season and includes the life stage of rice. Climate change data is from the Union of Concerned Scientists, effects on wild rice from Natural Wild Rice in Minnesota (2008) unless otherwise indicated.

**Table 1: Ecological Life Cycle**

Potential Change due to Climate	Winter <i>Dormant Seeds in Sediment</i>	Spring <i>Floating Leaf Stage</i>	Summer <i>Emergent/Flowering</i>	Late Summer/Fall <i>Seeds</i>
Ambient Temperature	Increase 5°-10° F <i>Can negatively impact germination by shrinking cold dormancy period</i>		Increase 7°-13° F <i>Hot, dry (drought) conditions negatively affect pollination. Increase and decrease wetland habitats, Saginaw Bay and other shallow bays threatened with habitat loss due to already shallow conditions</i>	<i>Hot, dry conditions reduces seed production</i>
Water Temperature	Less ice cover		Increased decomposition, lower dissolved oxygen levels, increased release of contaminants, phosphorous from sediments <i>Increase in carp, hydrilla, water hyacinth, other invasives detrimental to wild rice. Water/sediment quality unsuitable</i>	
Precipitation	Increased snowfall	Increased heavy rain storm events <i>Severe flooding events, changes in water levels, increased sedimentation</i>	Decreased precipitation <i>Low water levels, loss of suitable habitat, loss of stream flow, less stream habitat</i>	Decreased precipitation <i>Low water levels, loss of suitable habitat, loss of stream flow, less stream habitat</i>
Increased Dew Point	Warm humid conditions increase brown spot fungus			

	<i>(Bipolaris oryzae and B. sorokiniana), other pathogens</i> <i>Can ultimately affect seed production in fall</i>			
Changes in wind, waves, and extreme storm events	Unstable sediment may prevent seed dormancy	Possible removal of rooted plants	Destruction of rice beds	
Variation in weather among years	Loss of seeds from previous year			Lack of seeds to germinate for subsequent year
Changes in seasons and phenology	Delayed or no germination	Delay or early floating leaf stage		Delayed, early or nonexistent seeds
Species variation	Invasive outcompete wild rice			

## **Methods**

The project team focused their efforts on tasks aimed at assessing the relationship between wild ricing ecology, climate change and cultural knowledge in the LVD community. The tasks included background research and interviews of wild ricers at LVD. Two separate trips were undertaken to present background research, interview community members, and participate in ricing activities. During the initial interviews, we had a number of participants and responses, all of whom were members of families who previously or currently harvest rice at LVD. Over our visit, more reflections and stories were gathered from varied members, both young and old of the community.

The majority of cultural knowledge was gathered from Tribal Elders and knowledge keepers of the community through informal interviews and discussion circles (or spirit circles). Information about their memories and experiences with Manoomin and knowledge of climate change were elicited. The community members conveyed their recollections of the past, and the importance of ricing and the annual ricing weekend and the links of Manoomin to the cultural identity. We also had a few interactions with younger community members. They held considerable scientific understanding of climate change unlike the elders. Conversely the elders provided the historical perspective and narrated the heritage of wild ricing and past climate events. A cursory evaluation of the topics discussed suggests that the different age segments of LVD held very different knowledge about ricing and climate change.

The elders brought up four key themes; 1) recognition of history and legacy of wild rice, 2) sovereignty and rights (legal) of LVD to pursue ricing, 3) protection of rice habitats (lakes, wild rice beds), and 4) education of younger community members about climate change and wild ricing. Other key aspects of the interviews include; 1) ricing is important to their community identity and connection to the past, 2) community members riced in the past, often away from Tribal areas. 3) ricing is threatened since revitalization efforts are in their nascent stage, 4) ricing is threatened due to outside political and economic factors and LVD does not have control or influence over traditional harvesting activities, and 5) lack of younger practitioners and experts that will carry traditions of their ancestors.

## **Climate Change & Tribal Communities**

Historically, Tribal communities have shown resilience and the ability to survive changes in resource scarcity, but many may be less well equipped to cope with the impacts of climate change. LVD has a mixture of formal economies (Tribal services, gaming, fisheries, forestry, and tourism) and informal economies (e.g., harvesting of natural renewable resources, fishing, and hunting, plant foods gathering) (GLIFWC 2012). Harvesting of plants and animals contributes to community cohesion and self-esteem, and knowledge of wildlife and the environment strengthens social relationships (Warren *et al.*, 1995; Berkes, Kislalioglu *et al.* 1998). Ricing is an important harvesting activity of the community.

Ricing faces risks from a number of factors including climate variability and change, cultural loss of traditional knowledge, lack of legal protections of habitats, and lack of recognition of sovereign treaty rights. Additionally, this tradition is threatened due to decreasing number of ricers within the community.

Climate change affects temperate ecosystems of the Upper Peninsula in a number of ways, depending on the geography with changes in lake levels and snow and rainfall. These climatic changes results in plant and animal distributions, ranges, phenologies, symbioses and

community structures. LVD community depends on seasonal abundances of resources as part of their informal economy. They rely on predictable rainfall, snowpack to feed lakes, rivers that are critical habitat for wild rice and other resources.

As climate continues to change, there will be significant impacts on the availability of key subsistence aquatic and terrestrial species. Changes in population size, structure and migration are inevitable. This will entail local adjustments in harvest strategies as well as in allocations of labor and resources (e.g., boats, snowmobiles, weapons). As the climate a change, community involvement in decision-making has the potential to promote sustainable harvesting of renewable resources, thereby avoiding deterioration of common property. The management of resources will require not just a consultative, but a collaborative framework that is wide ranging and endeavor to integrate the culture and economy of LVD. However, factors that are beyond the control of the local community may frustrate this ideal. Historically, indigenous communities show considerable flexibility in coping with climate variability (Sabo, 1991; Odner 1992). Now, a number of factors (economic, political, land ownership) have reduced their options.

### **Management Recommendations**

Many Tribes, state and federal agencies, non-profit organizations, and general citizenry are involved in wild rice restoration in the Great Lakes region. Of great concern to Tribal communities is how climate change will affect culturally important natural resources. Recently the College of the Menominee Nation held a Changing Seasons Summit which was attended by Tribal leaders from all across North America. This project will provide management and adaptation recommendations which address adaptation to the predicted effects of climate change to Wild Rice. It can serve as a model for Tribes all across the Great Lakes region. This project can inform the development of policies and regulations of land use which will be required for the expansion and buildup of adaptation capabilities at a watershed scale. Our management recommendations will assist planners and resource managers in making informed, foresighted decisions to reduce the vulnerability of Wild Rice.

As a result of the limited study with the LVD community and our understanding of the current situation with regard to Wild Rice and climate change, we recommend a number of objectives that will need to be met in order for the community to adapt to climate change. Objectives include efforts to not only sustain but expand the focus on Wild Rice preservation and protection, and increase education to the broader community about the importance of ricing.

The study team recommends a multi pronged response to build wild rice resilience and adaptation capacity in the LVD community. Adaptation capacity can be best built by four future action areas;

- Basic and Applied Research
- Ecological services
- Regulatory protection
- Education and outreach
- Coalition building and collaborations.

### **Basic and Applied Research**

We recommend a long term research program between LVD, other Tribal communities and a network of scholars in climate change, plant and habitat ecology, and cultural studies. A considerable amount of scientific ecological knowledge regarding Wild Rice is already available.

But, this knowledge is incomplete and insufficient for developing adaptive capacity without depth of a traditional knowledge. Traditional understanding of ecology, economy and culture is important because adaptation is a human endeavor and not solely ecological. The program is aimed at building and supporting capabilities by leveraging the knowledge of Native communities and scholars by documenting and discussing climate change, responses and actions. Foremost, the cultural understanding of weather, climate, phenologies, and ecosystem changes in Wild Rice are critical to building adaptive capacity. Further, linked changes in Native livelihoods, health, welfare and culture needs to be better understood. This coupled knowledge will aid the effective adaptations, mitigations, and policies that are important to the success of Wild Rice.

Specifically, considerable ethnoecological (i.e., ecology from a Native perspective) work needs to be undertaken both in respect to climate change and Wild Rice. First, baseline data and monitoring of climate change and vegetation patterns that will be affected by climate change and also affect livelihoods. Second, ethnometeorology and ethnoclimatology efforts to understand climate from indigenous perspective is lacking. The ways, in which community classifies weather and climate, how they fit into cosmologies and activity schedules will provide a contrasting perspective than widely used western scientific notions. Next, community perceptions, effects, adaptations and mitigations of perceived changes will provide information regarding traditional ways that people cope and buffer existing and possibly future variability.

Take together; there is a desperate need for joint actions amongst native communities, scholars and other non Native stakeholders. A network of these stakeholders will need to be developed, who will aid in the creation of novel solutions using participatory and collaborative approaches. This research will aid in development of effective management and conservation of Wild Rice.

### **Ecological Services**

**Monitoring and conservation:** Plan, develop proposals, secure funding and implement projects that monitor, preserve, protect and disseminate knowledge about Wild Rice. These services will contribute to the understanding of changes in rice ecology, climate change, effects, and other factors that affect the success of Wild Rice.

**Resource services:** Wild Rice adaptation is linked to the capability of the plant to adjust to the changing environment. To facilitate this effort, actions aimed at the long term viability are required. For example, exchange and storage networks for seeds are needed to aid in the buildup of genetic diversity, and the avoidance of catastrophic failure. These activities can also aid scholars and communities by creating a repository of cultivars for study. Further, services that pool and disseminate information regarding ricing ecology, habitats and techniques (cultural and ecological) will also enhance adaptation capability.

### **Regulatory Protection**

Engage with efforts to understand and enforce the legal protection of Wild Rice. The efforts are inextricably tied to Native sovereignty and treaty rights. Using these existing legal frameworks, Tribes must preserve and protect wild rice habitats, their rights to harvest, and the patents of rice genetics. Further, habitat related issues must also be addressed; including the regulation of factors that influence water levels and limits of fluvial velocity that pose concern for wild rice. A first step can be to engage with Great Lakes Indian Fisheries and Wildlife Commission and respective state department of natural resources to discuss Tribal concerns

regarding Wild Rice and climate change. These interactions can possibly used to develop an intergovernmental strategy for climate change.

### **Education and Outreach**

Develop and implement an education plan directed at both Native communities and non Native stake holders about climate change, native perspective of wild ricing and adaptation. Topics should include ecological, economic and cultural information about Wild Rice, climate change, and ways to develop a climate resilient community. Additionally, education efforts in developing and implementing adaptation recommendations will aid in building resilient and adaptive community.

### **Coalition Building or Collaborations**

We propose the creation of diverse collaboration in order to create a network of stakeholders, agencies, institutions and special interests to develop a coordinated effort to implement this plan. This network can be leveraged to research, assess, monitor, therefore protect, preserve and expand Wild Rice to sustainable levels. Priority of collaboration with these agencies requires an equal place for native communities in planning and participation. A first step can be a creation of place (i.e., a web based resource center for stakeholders to interact, share resources, strategize and plan for future action).

### **Collaborative Agencies & Institutions**

- Great Lakes Fisheries and Wildlife Commission (<http://www.glifwc.org>)
- United States Fish and Wildlife Service (<http://www.fws.gov>)
- United States Forest Service (<http://www.usfs.gov>)
- Environmental Protection Agency (<http://www.epa.gov>)
- Department of Natural Resources ([http:// www.michigan.gov/dnr/](http://www.michigan.gov/dnr/))
- MSU – Native American Institute (<http://www.nai.msu.edu/>)
- Michigan Inter Tribal Council (<http://www.itcmi.org/>)
- Native Wild Rice Coalition (<http://www.nativewildricecoalition.com/>)
- United States Department of Agriculture (<http://www.usda.gov>)

### **Future Funding Sources**

EPA – Great Lakes Restoration Initiative (<http://greatlakesrestoration.us>)

NSF – National Science Foundation (<http://www.nsf.gov/>)

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