IDENTIFYING AND INTERPRETING
CONTEMPORARY WILD RICE HABITAT
IN CEDED CHIPPEWA LANDS OF
NORTHERN MINNESOTA

by
Martha L. Henderson, Ph.D
Associate Professor of Geography
University of Minnesota, Duluth

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A Report for the 1854 Authority, Fond du Lac
Band of Chippewa, and the Center for
Community and Regional Studies
University of Minnesota, Duluth

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Acknowledgements

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Finally, I would like to thank the students who worked endless hours on the bibliography and the GIS processing. These individuals are David Grinstead, Jason Holinday, Deb Pomroy-Petry, and Anna Werta. Without their effort this project would not have been successful.

Dr. Robert Powless deserves recognition for suggesting that wild rice would be an appropriate topic for study.
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Introduction

1. Introductory Information

Wild rice was a traditional food of indigenous populations of northern Minnesota. Today, this aquatic species is valued by modern Chippewa, also known as Ojibway, primarily for ties to pre-European traditional life, and secondarily, as a source of subsistence. Recent legal avenues allow modern Chippewa to pursue enforcement of off-reservation treaty rights including habitat maintenance in ceded territories. With expanding Chippewa populations and a gradual decline in wild rice production, the availability of wild rice for traditional and modern uses is in jeopardy. Wild rice production must increase if modern Chippewa are to continue traditional practices such as wild rice harvesting which reinforce Chippewa culture and constructs of nature in northeastern Minnesota (see Fig. 1).

In March of 1994, the 1854 Authority (a federal agency with jurisdiction over non-reservation treaty-rights in northeastern Minnesota), the Fond du Lac Band of Chippewa, and the Center for Urban and Regional Studies at the University of Minnesota, Duluth (UMD) provided funds to the UMD Department of Geography to assess the areal extent of historic and contemporary wild rice in the upper St. Louis and Vermilion Rivers watersheds. This analysis of areal extent fit into a three year project to first, identify the location of historic and current wild rice, second, define the difference, if any, of extent, and third, to suggest possible reasons for the difference in area. The three phase project was developed between the three agencies with Martha Henderson, Associate Professor of Geography, as the
Fig. 1 1854 ceded Chippewa territory and modern reservations.
principle investigator. Geographical analysis with the use of ARC/INFO, a geographical information system, was possible in the Department of Geography Geographical Information Systems Laboratory.

The goal for Year One, 1994, was to identify the location of historic and contemporary wild rice area as well as produce a bibliography of sources and potential sources of information on wild rice in northern Minnesota. During Year Two, the difference in area would be assessed, and during Year Three, potential reasons for the assumed loss of area would be identified. With all the hopes of achieving these logical goals, the project was re-defined after Year One. Year Two, 1995, was spent in identifying potential wild rice habitat with the use of ARC/INFO. This report includes a description of the work accomplished in 1994 and 1995 and discusses the opportunity for the 1854 Authority and the Fond du Lac Band to monitor and predict areas of potential wild rice habitat in the future.

2. Purpose of Study

The purpose of the three year, three phase research project was to 1) identify historic areas of wild rice and contemporary areal extent of the species in the Vermillion and upper St. Louis Rivers watersheds; 2) determine the differences in areal extent; and 3) identify potential causes for the believed discrepancy between historic and contemporary areal extent of wild rice in the watersheds. These two foci of study are significant in establishing the methods for evaluating the extent of specific species within the landscape ecology of a relatively large area. The specific species in question, wild rice, is valued for its traditional
uses by the Chippewa and its role in maintaining traditional practices among Chippewa peoples today. The record of wild rice production sites is a much a statement of physical attributes of an area as it is the role of humans in constructing nature. A broader approach to landscape ecology must include the human construction of each ecological region.

The purpose of this report is to document the findings and discuss the theoretical and technical aspects of identifying the geographic area of existing wild rice and potential wild rice habitat in the 1854 ceded territories of northeastern Minnesota and resource management areas of interest to the Fond du Lac Band. Stewardship of wild rice habitat requires an inventory of current resources and analysis of potential habitat areas using technologies that fit within theoretical assumptions about resource management goals.


This project is based on the assumption that once the differences in areal extent of wild rice are determined, the cause of loss of wild rice habitat can be identified. Knowing the cause of loss of habitat would then make it possible to pin-point action in specific locations to increase the amount of wild rice being produced allowing traditional practices by the Chippewa to continue.

In addition, a secondary assumption for Year Two states that GIS analysis of geographically referenced data representing habitat characteristics will indicate relationships between habitat components that can provide potential wild rice habitat. Existing lists of lakes supporting wild rice can be built upon by adding areas of potential wild rice habitat.
4. Definition of Terms

Wild rice, *zizania aquatica*, is described by William Dore as an annual plant, upright, killed by frost in autumn; staminate and pistillate florets borne on stalks completely smooth at their summit; hull of grain thin, papery, dull, and minutely roughened on the surface (Dore, p. 16).

The species is often divided into two classes; one found in riverine and the other found in lacustrine locations. For the purposes of this study, both classes of *zizania aquatica* are studied as one plant growing in similar habitats.

Wild rice habitat was identified in this study with the use the geographic information system software ARC/INFO. This software is a vector based system for the analysis of geographically referenced data, that is, data that are fixed within a standard coordinate system that represents exact location on the earth’s surface. The data are registered or, digitized, as points, lines, and polygons. Each entity is described with an attached attribute table. ARC/INFO allows for data recordation, analysis, and management possibilities. These possibilities are known as build-out scenarios and provide a mechanism for observing alternative conditions when topologies, the relationships between datasets, are altered. Layers of data can be created by the software and then overlaid for analysis and measurement of correspondence. These measurements provide an assessment of relationships between species and habitat data.

5. Limitations of Study

This study is limited by several conditions, primarily the lack of geographically referenced data. Historic and contemporary data on the location of wild rice are non-
existent. Several datasets describing habitat characteristics of wild rice are not geographically referenced. Without the geographically referenced data, the use of ARC/INFO becomes problematic. These conditions were met in a variety of ways and are explained in the following chapters.

6. Sources of Information on Wild Rice

There are many books, governmental reports, professional papers, and other sources on wild rice. A search for all sources was conducted in the spring of 1994. The results of that search is included in Appendix A at the end of this report. The majority of these works document the growing conditions of wild rice in northern Minnesota and Wisconsin, and in Ontario, Canada.

Equally prevalent are sources describing the traditional uses of wild rice by the Chippewa. Anthropologists and other social scientists have documented the significance of wild rice in Chippewa culture both as an artifact in ritual and an important food source. Descriptions of wild rice gathering and utilizing are common in the literature.

Researchers, the Minnesota Department of Natural Resources, and the U.S. federal government do not record the exact area or location of wild rice. The largest gap in the literature is a discussion of the exact location of wild rice beds.

7. Organization of Study

This study was organized into three sections of work to be completed over a three year time frame. Because of limitations in data sources, Year Two’s work was redefined.
Year Three’s work must be delayed until data are gathered and geographically referenced. This report describes the work accomplished in Years One and Two and makes recommendations about work to be accomplished over the next five years before establishment of causes of loss in wild rice habitat can be identified.
Work and Accomplishments During Year One

1. Presentation of Data

Year One was dedicated to gathering information on wild rice use by Chippewa Indians in northern Minnesota with special attention paid to locations of wild rice beds or wild ricing activity. A search of archival, governmental, tribal, and natural resource management agency records provided information on the use of wild rice. Traditional uses of wild rice and conditions necessary for wild rice habitat generally are described in the following paragraphs including an historical analysis of wild rice use by the Chippewa.

By the early 1800s, Chippewa territory in the upper midwest was in high demand by the United States government as settlers began to move into the old Northwest. Treaty-making with the Chippewa progressed westward from Michigan and Wisconsin to northeastern Minnesota in 1854. In the 1854 Treaty of LaPoint, the Chippewa agreed to move to reservations along Lake Superior and other large lakes and rivers in northern Minnesota (Ebbott, p. 21). The federal government and the State of Minnesota acquired lands north of the Mille Lacs Reservation to the Canadian border and from the shores of Lake Superior to Nett Lake in the 1854 treaty. The Chippewa retained the rights to fish, hunt, and gather food resources beyond the reservation borders.

It was critical to the Chippewa that they maintain access to gathering areas especially for wild rice. Writing in this century, Ebbott records the voice of a Chippewa elder in the following statement:
Wild rice, called manomin meaning good berry in Ojibway, has been the stable food for Minnesota's Indians for centuries. Considered a sacred gift, wild rice is associated with happy reunions and festivals at harvest time. It is an important part of the Indian diet, served at every celebration, and an integral part of Indian culture. It is much more than a product to be used for economic benefit. One Ojibway Indian stated "There is a feeling you get out there that is hard to get other places, you are close to Mother Nature, seeing things grow and the results of the water and sun and winds.... We sort of touch our roots when we are among the rice plants."

(Ebbott, pp. 101-102)

With recent court interpretations of the 1854 and other Chippewa treaties including the 1994 Mille Lacs case, the ability of the Chippewa to harvest traditional food sources is to be protected. The Chippewa are anxious to protect the habitats of traditional foods primarily because harvesting wild rice maintains ties to traditional life.

Wild rice, zizania aquatica, is a native annual aquatic grass that produces a highly nutritious grain. The species grows in shallow water along streambanks or in shallow lake areas. Young plants begin growing in the spring following a winter dormancy period when seeds are buried in bottom muds. The grass grows during the summer months to a mature height between two to eight feet above water levels. Seeds, or kernels, ripen in the late summer and fall. Traditional harvesting occurred during this period.

The process of modern harvesting and preparation occurs in much the same way as traditional wild ricing. A canoe is pushed slowly through the ricebed by one person while another sits in the canoe, draws the stems of the rice over the edge of the canoe gunnel, and knocks the loose kernels into the boat. Once on shore, the rice is parched over an open birch fire until the kernels are black and hardened. Ricing is usually done in family groups in rice areas the family has utilized for generations. During rice harvesting entire families
and villages concentrate all their energies on the harvest thus maintaining a cultural tradition that dates prior to European settlement in the region.

Populations on Chippewa reservations continue to grow at a much faster rate than the general Minnesota population. Demand for wild ricing areas is expected to grow as Chippewa leaders take steps to protect and enhance activities that maintain Chippewa cultural traditions. Defining the past, current, and potential location of wild rice habitat becomes a necessity in resource management of habitats and species in northern Minnesota.

In northern Minnesota, lakes and streams containing wild rice are found in a mosaic of glacially scoured terrain and glacial deposition areas. Six generally accepted environmental parameters for wild rice growth are 1) water less than four feet in depth; 2) a substrata of organic material, or mud, on top of hard clay or sand; 3) some water movement by wind or flow; 4) water quality parameters generally low in sulfates and moderate in lime; 5) large drainages; and 6) periodic flooding to prevent establishment of other species.

2. Historical Documentation

The research design for the GIS analysis of historic wild rice area required the discovery of records documenting wild rice at approximately the time of the 1854 treaty. Actual research has revealed that very little data are available on the historic occurrence of wild rice. Literature and map searches have produced almost no information about the total extent of wild rice at the time of European settlement. It is generally agreed by
resource managers that wild rice was so plentiful at the time of settlement that government surveyors neglected to report it.

Wild rice was not seen as a potentially important commercial species like white and red pine, consequently American valued species were documented while Indian valued species were not. There are numerous written and verbal accounts of wild rice harvesting by the Chippewa but it is difficult to reference the accounts spatially with any accuracy. Even in this century, records are temporally and spatially spotty, and restricted to only the most productive harvest areas.

The most substantial areal study of wild rice in Minnesota was completed by Dr. John B. Moyle, Minnesota Department of Conservation in 1940-1941. Moyle identified 150 lakes and streams open for public harvest. His sources do not confirm that he interviewed or documented traditional Chippewa ricing areas. It is apparent that wild rice has been constant in the area but quantifying its historic occurrence in any serious way is not possible. Without a comprehensive survey of the harvested and known wild rice areas, the ability to overlay historic area with current habitat GIS analysis procedures is not possible.

2. Analysis of Historic and Contemporary Data

The area of current wild rice lakes and streams is also not comprehensively surveyed by any one source. Over the last year researchers have attempted to inventory the current locations of area by consulting the Minnesota Department of Natural Resource (DNR) and other resource management agencies. According to DNR aquatics, wildlife, and ecosystem management personnel no consistent records are available primarily for the same reasons
records were not kept in the 1800s. The DNR has maintained records of commercial permits in the state but this recordation does not include all known areas of rice or rice harvested for traditional purposes.

Field surveys and aerial surveys were conducted in the fall of 1994 in the upper St. Louis and Vermilion Rivers watersheds. This also proved to be conditional. Field checking is hampered by private ownership on most of Minnesota's lakes and streams or inaccessibility on public lands. Aerial surveys were more successful in identifying and locating wild rice beds, but costs prevented an aerial survey of the two watersheds.

An advertisement was placed in the local Fond du Lac newspaper requesting information about wild ricing locations with the hopes of contacting individuals who would be willing to answer questions and provide information about historic wild rice beds. There was no response to the ad. Ethnographic research opportunities were discussed with the Natural Resources manager with the idea that individuals probably know more about wild ricing in the past and present than any agency. Discussing wild rice, however, requires a lengthy period of familiarity between a researcher and informant and this condition is not possible within the conditions of the current contract.

One other attempt to locate wild rice areas was made by reviewing USGS place names data for the two watersheds. Place names often relate to features of a specific location at the time of contact. In this case, it was hoped that areas once producing wild rice could be identified based on given place names. These data were converted to ARC/INFO by Minnesota Land Management Information Center. Analysis of the place names data did not reveal any areas that were not already known to produce wild rice.
Without accurate records of current area, a new research design was proposed to the Chippewa agencies. Instead of defining existing wild rice areas, perhaps the Chippewa would support research to identify potential wild rice habitat. A research design based on the idea that since historical and current data were either unavailable or difficult to obtain, a predictive model indicating where wild rice habitat should occur could assist the Chippewa in identifying areas where wild rice production could occur.
Work and Accomplishments During Year Two

1. A New Research Design

Research during Year Two took a new direction based on the failure to identify historic or contemporary records of wild rice location. A new research design was proposed to the 1854 Authority for future definition and monitoring of wild rice habitat in northern Minnesota. The proposal was funded by the 1854 Authority with additional expert support for the Fond du Lac Band Natural Resources Program. Work began in the spring of 1995 on the newly proposed research.

The research design for Year Two is based on the concept of creating a predictive model for wild rice habitat in northern Minnesota. A spatial model was designed on the basis that environmental data could be overlaid with the use of ARC/INFO to produce a geographically referenced map of locations with the potential of producing wild rice given existing environmental conditions.

In addition to identifying areas of potential wild rice habitat, records of environmental information such as annual water depths, harvest amounts, and access can be recorded in the attribute table of each identified wild rice polygon with the use of ARC/INFO. The value of recorded and manageable data is that over time, a pattern of wild rice production by area and volume can be traced within a given set of habitat characteristics.

The work for Year Three, to identify the causes of more or less wild rice production in northern Minnesota, can be reached after a five to ten year period of record keeping. At that point the 1854 Authority and the Fond du Lac Band will possess defensible data for
requesting modification of existing habitat management or alterations in land use practices for wild rice production.

2. Construction of the Predictive Model

The possibility of creating a predictive model is simplified by the availability of a spatial database known as the National Wetlands Inventory (NWI). The National Wetlands Inventory is a geographically referenced digital database at 1:24,000 scale of wetlands including lakes and rivers in the United States. It is accessible in the GIS software ARC/INFO, the most commonly used GIS software by natural resource decision-makers. The database was constructed from U. S. Geologica Survey (USGS) 7.5’ topographic maps and only includes information found on USGS topographic maps. The NWI includes information about different types of wetlands in a hierarchical classification system. The classification system is best described as a pyramid with the broadest classification of a wetland at the top and a multitude of specific wetland types at the base. The broadest classification is a system followed by subsystem, class, subclass, and modifiers at the base of the pyramid (See Fig. 2).

Three types of wetlands are identified in riverine, lacustrine, and palustrine environments. For the purposes of this project, data contained in the riverine and lacustrine systems were utilized to identify the location of potential habitat. Riverine systems are identified as "contained in natural or artificial channels periodically or continuously containing flowing waters." Lacustrine systems are defined as "wetlands and deepwater habitats with all of the following characteristics: 1) situated in a topographic depression or
National Wetlands Inventory
Hierarchical System

Example polygon attribute code: L10WH

L = System: Lacustrine
1 = Subsystem: Litoral
OW = Subclass: Open water
H = Modifier: Permanently flooded

Source: U.S. Fish and Wildlife Service

Fig. 2. National Wetlands Inventory hierarchical system
a dammed river channel; 2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30 percent areal coverage; and 3) total area exceeds 8 hectares (20 acres). Basins or catchments less the 8 hectares in size are included if they have a least one of the following characteristics: 1) a wave formed or bedrock feature forms all or part of the shoreline boundary; or 2) have a low water a depth greater than 2 meters in the deepest part of the basin" (U.S. Fish and Wildlife, p. 25 - 26).

The NWI is the foundation of the predictive model. It identified lakes and streams in northeastern Minnesota. No additional work was done to gather or digitize information about wetland locations in the area. The NWI is appropriate as a database because it covers the 9,000 square mile area and identifies all wetlands. However, there are gaps in the NWI database with respect to wild rice occurrence. The most significant gaps are 1) the scale is not large enough to isolate one to two acre wild rice habitat areas, and 2) specific types of data are missing from the database. The NWI by itself is too coarse to successfully identify wild rice habitat.

Faced with these problems, additional data and resolution are necessary to establish potential wild rice habitat. Additional environmental parameters must be added to the NWI data by adding coverages for geology, soils, geomorphic regions, and water depth in ARC/INFO. These datasets must cover the entire 1854 ceded territory of northern Minnesota. A search for potential datasets to refine the NWI was initiated in 1995. Tribal, federal, state, and regional sources were consulted.

The availability of geographically references data for the entire 1854 ceded territory is extremely limited. While a variety of sources exist, it is difficult to identify any one
source for any habitat characteristic that is 1) complete for the entire 9,000 square mile area and/or 2) that is geographically referenced or digitized for use in ARC/INFO. Generally, federal and state datasets are designed to meet specific needs and do not consistently address the kinds of data required in this project. In addition, northeastern Minnesota is a complicated natural area and inventories such as soil data are not complete. The data sets were generally created before the precise accuracy of geographic information systems was defined, although the goal of the state and federal agencies is to be able to process all natural history data in the state in ARC/INFO or other GIS systems.

When possible, pre-existing geographically referenced datasets have been incorporated into the model. Datasets in usable formats are: 1) geomorphology maps produced in CAD software at 1:100,000 available from MN DNR (map production in progress in the Department of Geology at UMD). These maps contain some information on soil conditions at the same scale; 2) USGS paper topographic maps at 1:24,000 which must be digitized for water depth; and 3) MN DNR Ecological Services maps in paper format containing some information about water depths. There is no easily usable digital map data at a scale of 1:24,000 or less for water quality and soils. Resource management agencies are currently working on these types of datasets which should be available within five years. The lack of data is not only a lack of geographically referenced digital data, the fact is that soil characteristics have not been successfully mapped in northeastern Minnesota. There is some data available on water quality in the MN DNR Lakes Database but it does not cover the entire region. One list of lakes that are currently known to produce wild rice is
maintained by the MN DNR. This list is of existing production and should not be confused with potential wild rice habitat, the goal of the predictive model.

When datasets are not available strategies for acquiring data must be devised.

3. Synthesis of Data

Data are being analyzed in ARC/INFO in the UMD GIS Lab. The Minnesota Department of Natural Resources (MN DNR) readily provided copies of the NWI for the entire area. When possible, lakes data and water depth data were supplies by the DNR. Soil and geomorphic data were provided for specific areas by Howard Mooers in the UMD Department of Geology. Bathametic information is digitized from USGS maps when necessary. An additional source of water depth information is available on paper maps from MN DNR Ecological Services. Base maps showing political boundaries were digitized from tribal maps.

In theory, these data can be processed as coverages for the area with the use of ARC/INFO. The software allows researchers to identify polygons of potential habitat. Additional data per polygon can also be recorded in the attribute table which is tied to each polygon. For example, water depths recorded over a period of five years can be recorded in the attribute table for a specific polygon. In reality, the lack of complete data coverage of any resource over the entire region requires testing of available data on a specific site before the entire region can be processed.
4. Testing Procedures

In theory, wild rice habitat can be predicted based on a spatial analysis of known requirements for wild rice production. Success at creating a predictive model is being tested by acquiring and analyzing environmental parameter data for one specific area within the St. Louis watershed. The goal of this test project was to see if the accuracy of predicting wild rice habitat could be improved by adding additional data layers to the National Wetlands Inventory data. The NWI alone is unable to identify wetlands that support wild rice except in a general way. Additional data layers describing the environment and refining the predictability of wild rice was accomplished in the spring of 1995.

The first requirement was to identify a test site. The site had to have wetlands especially river and lake conditions, it had to be accessible for field testing, and it had to be in an area where digital data were available. Selecting a site that fit these conditions was difficult due to the lack of complete information about any one location. Ultimately the Seven Beaver area at the headwaters of the St. Louis River northeast of Duluth was selected as a test site (see Fig. 3). The area is found at the corners of four USGS 7.5' topographic sheets including Babbit SW, Babbit SE, Toimi, and Skibo (see Fig. 4). Wetlands are mapped in the NWI. Long Lake and Stone Lake are designated on the MN DNR list of known wild rice producing lakes. The rest of the St. Louis River is not designated as rice producing on the MN DNR list. Wild rice was observed on the river and on Seven Beaver by aerial observation in the August of 1994.

Data gathering followed selection of the site (see Fig. 5). Geologic and some soil data are obtained from the UMD Department of Geology, water depth data in manuscript
1854 Ceded Chippewa Territory
and Seven Beaver Study Area

Fig. 3 Seven Beaver Study Area
Fig. 4 Detail of Seven Beaver Study Area.
### Data Sources for Seven Beavers Analysis

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UMD Dept. of Geography  
GIS Lab 1995  

Fig. 6. Data Sources for Seven Beavers analysis.
form are provided by the MN DNR Ecological Services. No digital data on water quality exists. Data accessibility for the site are typical of the region. Geomorphology, some soils, and detailed water depth at five feet increments have been digitized and stored in ARC/VIEW. Labor for processing digital data for the four topographic maps is estimated to be four hours per topographic map. This work produces an output of area of potential wild rice habitat in statistical format. The area of potential wild rice habitat in the Seven Beaver study area is estimated to be 5.642 square kilometers based on water depth information. The location of the habitat exhibits a spatial distribution. The spatial output (map and screen image) indicates that habitat to be located on Seven Beaver, Round, Long, Pine, and Stone Lake, and the St. Louis River (see Fig. 6).

The accuracy of the computer model requires field checking.
### Data Sources for Seven Beavers Analysis

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Fig. 6 Data Sources for Seven Beavers analysis.
A GIS Predictive Model for Wild Rice

Geographic information systems provide the opportunity to describe and analyze natural resource information efficiently and accurately. By modelling a resource, including the variables that all for resource production or harvesting, relationships between environmental conditions required by the natural resource can be determined. Modifications to resource production can be envisioned by manipulating data within the software. One utility of a GIS system is that it has the capability to predict potential outcomes based on current conditions. This ability has been applied to the wild rice question.

The necessity to create a predictive model for potential wild rice habitat introduces several opportunities for research and practical application in natural resource management by the 1854 Authority and Minnesota Chippewa Bands. This project highlights types of data and software for data analysis which can be utilized for decision-making about the areal extent of wild rice. The same datasets, field work, and monitoring can be utilized for other natural resource issues, for example cranberry production. Databases in geographical information systems can be maintained and updated on a regular basis by the Chippewa, even to the point that the Chippewa will, in effect, have more reliable data for management of habitats in the ceded territories than other resource management agencies in the region.

The methods of data collection and analysis already described in this report are the basis for a natural resources management program. So far, the problem of wild rice habitat has been addressed primarily as an inventory process. The real value of the project,
however, is in the monitoring and decision-making applications. Analysis of data gathered during monitoring is possible with GIS.

Embedded in the GIS software are data storage and analysis units known as attribute tables where collected data can be recorded over time. Each polygon of identified lake or river has an attribute table attached to it. Attribute tables are forms in which quantitative or qualitative data for a geographically referenced point, line, or polygon can be stored. Each geographic object has attributes that describe it, and the attribute table can list an indefinite number of characteristics linked to the object. This ability of ARC/INFO to record attributes for a specific location allows for recordation of information over time.

The analysis commands in ARC/INFO can perform analysis functions with data stored in the attributes tables including statistical analysis, especially with the use of compatible statistical software, and spatial analysis. Outputs include spatial representations and quantitative records. With geographically referenced data new representations of data and analysis of topological relationships can be generated. These representations, primarily in paper map or screen form, can be reviewed by decision-makers. Decision-makers are now able to identify locations for specific management or identify the need for additional information at any given site (the attached polygon).

The predictive model for wild rice utilized both the inventory of objects and spatial and quantitative analysis of data with the use of ARC/INFO software. Inventories of existing wild rice beds and geographically referenced data describing habitat characteristics require the accumulation of datasets and spatial analysis. Analysis of inventoried data can provide representations of potential wild rice habitat. The exact reasons for the lack of wild rice in
all potential sites is not known at this time but the assumption in this report is that wild rice could be grown in all potential areas. Monitoring of objects, points, lines, or polygons, over time will assist in a better understanding of the ecology of wild rice and potential production of wild rice in identified areas.

Monitoring must be done on identified wild rice production sites and in areas deemed desirable by the Chippewa to produce wild rice. For example, it may be desirable to enhance wild rice production in areas near reservation populations but not in the Boundary Waters Canoe Area (BWCA). It may be that wild rice habitat is possible inside the BWCA but accessibility and other complications may make this location undesirable. By monitoring identified sites over a period of time it will be possible to make decisions about resource management in those areas near the reservations.

Monitoring desirable sites for a period of five years should provide substantive information on the limitations of the site. All data about the site may indicate that soils, geomorphology, and water quality are adequate for wild rice production but wild rice is not recorded at the site. If consistently high water levels during early rice growth periods are recorded than it may be that wild rice is not growing due to water level conditions. Wild rice could grow if the water levels were maintained at a different level during the early growing stages of the plant’s life.

A number of possible resolutions to the question of differential water levels are possible. It is possible that water levels are being maintained by beaver or by local control structures such a small rock dams or transportation berms. These must be identified in the field and appropriate action taken. Or there is the possibility that water levels are being
maintained for other water users. In this case, the Chippewa may request support from the MN DNR or any other management agency to control water levels.

The key to monitoring is to select areas where intensive field work over a period of no less than five years can be conducted. Collected data must be entered into the attributes tables of the identified objects. Periodically, representations of the data and statistical analysis of data should be produced in order to pinpoint the potential cause of lack of wild rice production in identified potential habitat areas.

The predictive model has the advantage of utilizing inventoried data, establishing the need for additional inventory data, identifying potential wild rice habitat, monitoring existing wild rice areas, monitoring potential wild rice production sites in known potential habitat areas, and assisting resource managers in making decisions that will enhance total wild rice production in northeastern Minnesota.
Recommendations

On the basis of research and analysis over the last year, several recommendations are identified for the next five years of the wild rice project. Originally, it was proposed that Year Three be dedicated to determining the causes of loss of wild rice production in the ceded territories and on areas of the Fond du Lac Reservation. This work is not possible because there is no way to determined the areal extent of wild rice both in an historical and contemporary analysis. The following recommendations provide a mechanism to identify potential wild rice habitat and assist resource managers in identifying areas where the cause of a lack of wild rice production dominates a potential habitat area.

There are two sets of recommendations, one that highlights the application of this research and another that emphasizes the need for a more theoretical approach to the problem of wild rice habitat. In creating the research design for the predictive model, the true nature of the research problem comes to light. A re-definition of the research question leads to a renewed search for data, data management tools, and possibilities for resource managers.

Recommendations for work to proceed from this date on the practical question of potential wild rice habitat designation are identified as follows:

1) **Refinement of the GIS predictive model** including field testing and monitoring of the Seven Beavers test site. A GIS data manager should be hired to work with the model and maintain the system. Field testing should be done this year by the GIS manager and technical staff. From a technical perspective, it is essential that this type of project be
conducted with the use of a GIS system. The area, approximately 9,000 square miles, is extensive;

2) **Hire an ecologist** to continue working on the ecology of wild rice. While there are general studies on the growth of wild rice, the exact nature of wild rice production in the ceded territories is not clearly defined. Bibliographic sources do not indicate recent and/or sufficient information on wild rice production in wild areas or areas where water is controlled for purposes other than wild rice production. The ecologist should work closely with the GIS manager. Data gathering and analysis must be done as a team effort;

3) **Continue data collection and monitoring of datasets on habitat characteristics.** The dependence upon digital data is currently limiting the predictive model. Digital geologic and hydrological data for northern Minnesota are not easily accessible especially in large scale format. Federal and state agencies are slowly moving towards digital mapping however northeastern Minnesota, including the ceded territories, is consistently the last region of the state to be mapped. Potential reduction of funding in federal and state resource management agencies will also slow the rate of available data. Aerial observation with Dan Ross of the MN DNR in a seaplane is highly recommended;

4) **Select and monitor specific areas of desired wild rice production.** Selection of potential habitat areas for monitoring over the next five years is critical. It is in this stage that information about the controls on wild rice production can be identified. Once determined, these controls can be addressed by decision-makers;

5) **Analyze and output spatial and quantitative data representations.** Spatial characteristics of wild rice based on quantitative analysis of data can be produced in two
forms 1) as monitor or paper maps and 2) as graphs and charts of varies values. Computer software is currently available for these tasks;

6) **Include this GIS model in resource management decision-making.** The ability to identify specific wetland features for wild rice production should also provide clues to the general health of wetlands in the ceded territories. As new habitat requirements become desirable, the wild rice predictive model can easily be adapted for other resource management objectives; and

7) **Conduct ethnographic research.** Ethnographic research between qualified and trusted researchers and tribal elders and band members about resource locations, not only wild rice, should be conducted by the Chippewa Tribe. When and how this type of research is enacted is entirely within the purview of the tribe. The benefits would be a record of locations and spatial relationships discribing culturally valued resources. This type of information can be stored and analyzed in a GIS system. Methods of storing and analyzing non-public information are possible.

Implementation of these recommendations can be accomplished in two ways, either by contracting with a natural resource management group or by hiring knowledgeable scientists and technicians to work at local sites. There are many management groups who could perform these tasks. These groups could be asked to submit bids of cost to accomplish the tasks. They would most likely require local support and assistance for field work but would analyze and process data at remote sites. Bids for this type of work could run at a cost of approximately $200,000 for five years. The work performed would be that
work as identified in contracts. The Natural Resources Research Institute in Duluth could preform these tasks.

The other option is to hire individuals and identify a project manager who could work in conjunction with the 1854 Authority and the Natural Resources Program of the Fond du Lac Band. This option would allow for greater flexibility and the incorporation of a number of resource management issues into one larger program. Funding could be available from a variety of sources within a larger resource management framework. A budget and time estimates for work to be completed over the next five years can be found in Appendix C. This method of work would cost approximately $171,750 for five years of work. Much of the necessary computer software is already available either at the Natural Resources Program or has been purchased by the 1854 Authority and is maintained in the UMD GIS Lab. Lab fees have been calculated at the UMD GIS Lab rate. It is assumed that costs for maintaining a GIS at Fond du Lac would be similar. Individuals who have worked on this project over the last year are familiar with the predictive model and the needs of the project. A GIS manager, ecologist and a human ecologist could work together on this and other projects as a competent work team. Field checking and monitoring could also be done by natural resources technicians.

Theoretical issues to be considered include questions of goal and management perspective. A series of new research questions have arisen as application of the predictive model have progressed over the last year. What are the goals of the organization for whom the project is being done? Are there other types of stewardship questions not addressed by the collected data? What types of data are available? Finally, whose management goals
will be implemented in managing wild rice habitat and other culturally specific species in
the ceded territory? Stewardship of wild rice habitat will require 1) a decision model to
define the needs and goals of the Chippewa and answer such questions as which areas of
the ceded territory should be enhanced for wild rice production; 2) an application system
framework that allows the central database to be applied to other resource management
issues in the territory once other culturally specific species are identified; and 3) production
of cartographic representation of simulation or build-out scenarios of resource management
alternatives.

It has been assumed throughout the last year that the Chippewa are interested in
identifying habitat so that wild rice beds can be developed to meet population growth. This
assumption, however, has never been confirmed most likely because the question of
actualizing the predictive model for resource management in ceded territories has not been
addressed by the Chippewa. In other words, how will the Chippewa negotiate with the
Minnesota Department of Natural Resources, affected federal agencies, and Minnesota
Power who controls water levels on many northern Minnesota water bodies, to increase the
actual production of wild rice? Interruption in water levels that are maintained for economic
needs rather than Chippewa cultural needs seems problematic.
Conclusion

The ability of northeastern Minnesota Chippewa to increase wild rice production for the purpose of maintaining traditional practices requires an investigation of current and potential wild rice habitat. More than a year ago this project began as a simple query with regard to historic and current wild rice areas in northern Minnesota. In attempting to compare two maps for a measurement of area presumably lost to wild rice production, a number of new research questions have arisen. A new research design for predicting wild rice habitat has brought to light a number of technical and theoretical questions concerning the ready availability of GIS generated products at this scale and the context of decision-making in contested areas.

Devising a method to predict potential wild rice habitat was the primary benefit of this project. Predictive modelling in landscape ecology is a relatively recent and has generally concentrated on the physical attributes of an ecosystem. This project recognizes the significance of physical attributes that promote wild rice production. In addition, it brings to light the need for an integrated approach to landscape ecology based on human constructions of nature, in this case, the preference for wild rice by Chippewa peoples for the purposes of maintaining traditional culture. The design of the predictive model emphasises the need for adequate and standardized data for use in a GIS, establishment of long-term monitoring programs, inclusion of the predictive model in decision-making, and identification of human values for specific species and land areas. This report indicates the
need for establishment of the monitoring system and an ethnographic study to historic riceing areas.

In addition to creating the predictive model and establishing the need for an integrated study, several other benefits have resulted from this work. The majority of the work was accomplished by graduate and undergraduate students at UMD including American Indian students providing them with geographical methods and research experience. The project strengthened ties between the University of Minnesota, Duluth and Chippewa populations in northern Minnesota. Finally, it has been possible to demonstrate the utility of GIS and the role of geography in natural resource management in several different settings including the classroom, professional meetings, and formal presentations.
Bibliography


Moyle, John B. 1942. "The 1941 Minnesota Wild Rice Crop," Fisheries Research Investigational Report No. 40, Bureau of Fisheries Research, Division of Game and Fish, Minnesota Department of Natural Resources, St. Paul, MN.


Appendix A

A Selected Bibliography on Wild Rice Production with Special Reference to Geographical Location
Wild Rice Bibliography

Agricultural Experiment Station, University of Minnesota. *Minnesota Wild Rice Research.* St. Paul MN: Agricultural Experiment Station, University of Minnesota.


Behr, Michael. *Indian Potential in the Wild Rice Industry.* (S.l.: s.n.) 1977.


Appendix B

Seven Beaver Data Base Guide
WILD RICE PROJECT
SEVEN BEAVER STUDY AREA
HABITAT ANALYSIS
DATABASE GUIDE

TABLE OF CONTENTS

DATA ATLAS

Reference Layers

Minnesota Bounds (MNTEMPLA)
Minnesota 7.5 Minute Quads (MNQUADS)
1854 Treaty Territory Bounds (MINN1854)
Reservation Bounds (RESERVAT)
1854 Treaty Territory Geographic Names (GNIS1854)
1854 Rice Names Query (RICENA54) [make 1854 clip file "block]]
St. Louis River Watershed Bounds (STLOSHED)

Seven Beaver Study Area Analysis Layers

Seven Beaver Study Area Bounds (SBBOUND) Major Analysis Layer
Lakes and River Segments (SEVBEAVE) Major Analysis Layer
Moyle Inventory (SBMOYLE) Major Testing Layer
MDNR Inventory (MDNRINVE) Major Testing Layer
Geomorphology (NEWGTCPLP) Major Analysis Layer
Wild Rice Depth (DEPTH5FT) Major Analysis Layer
Substrate From UMDG Geomorphology (GEOMSOIL) Major Analysis Layer
Substrate From NRCS Soils (NRCSSOIL) Major Analysis Layer
Air Inventory of Wild Rice (AIRINVEN) Major Testing Layer
Ground Inventory of Wild Rice (GROUNDIN) Major Testing Layer
Monitoring System (SMONITO)
Bottom Cover (SBBOTTOM)
Water Quality PH (SBPH)
Water Quality Oxygen (SBOXYGEN)
Water Quality ????
Roads (SBROADS)
Trails (SBTRAILS)
Railroads (SBRAILS)
Land Ownership (LANDOWNE)
Water Level Control (WATCONTR)
Windsize
Flow
Forest Type
Landuse
Pollen Cores
Archaeological Sites
Human Population

Titles in italics are under construction

Source Data Layers

National Wetlands Inventory (NWI####)
Geographic Names Information System (GNISS)
USGS Digital Line Graphs (DLG####)
MDNR Watershed Bounds (####SHED)
Minnesota Quadrangles (MNQUADS)
Minnesota Quadrangle Control Points (ARTICU)
TIGERLINE CENSUS FILES (#######)
DATA DICTIONARY

Reference Layers

Minnesota Bounds (MNTEMPLA)
Minnesota 7.5 Minute Quads (MNQUADS)
1854 Treaty Territory Bounds (MINN1854)
Reservation Bounds (RESERVAT)
1854 Treaty Territory Geographic Names (GNIS1854)
1854 Rice Names Query (RICENA54) [make 1854 clip file "block]]
St. Louis River Watershed Bounds (STLOSHED)

Seven Beaver Study Area Analysis Layers

Seven Beaver Study Area Bounds (SBBOUND) Major Analysis Layer
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Water Quality PH (SBPH)
Water Quality Oxygen (SBOXYGEN)
Water Quality ????
Roads (SBROADS)
Trails (SBTRAILS)
Railroads (SBRAILS)
Land Ownership (LANDOWNE)
Water Level Control (WATCONTR)
Windsize
Flow
Forest Type
Landuse
Pollen Cores
Archaeological Sites
Human Population
Source Data Layers

National Wetlands Inventory (NWIndianapolis****)
Geographic Names Information System (GNISS)
USGS Digital Line Graphs (DLG####)
MDNR Watershed Bounds (####Shed)
Minnesota Quadrangles (MNQUADS)
Minnesota Quadrangle Control Points (ARTICU)
TIGERLINE CENSUS FILES (####)
DATA ATLAS

The atlas sheets in this data atlas show graphically (in map form) the spatial extent of the specific layer as well as the values for the principle attribute of the principle entity type (point, line, or polygon) represented in the layer (in legend form). Only one attribute (or ArcViewII theme) is represented in the legend although other secondary attributes may exist in the attribute tables for the coverage.

The sheets were printed from PCArcInfo coverage files using ArcViewII software and CorelDraw drawing software.
DATA DICTIONARY

Each layer in this data dictionary is a separate PCArcInfo coverage with a primary object type (AVII Shape), a primary tabular descriptive attribute (ArcViewII theme), and associated tabular attribute values (AVII legend values). The data dictionary first summarizes the function of the layer and then outlines other important geographic information science parameters important in making the layer understandable and useful including:

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

REFERENCE LAYERS

These are the layers that are used as geographic reference or background information when viewing Seven Beaver Study Area layers. They are not restricted by the defined bounds of the study area. These layers are of a smaller scale and are not meant to be used for analysis with larger scale Seven Beaver Study Area data layers.
MINNESOTA BOUNDS (MNTEMPLA):

MNTEMPLA Summary of Function:

Mntempla is an arcinfo coverage layer with the function of referencing the boundaries of the state of Minnesota for study matrix orientation purposes. This layer was digitized from an analog 1:1,000,000 scale soil associations map produced by the United States Department of Agriculture Soil Conservation Service. Boundaries are very generalized and the coverage is not meant to be used for analysis. It contains only one attribute value "Minnesota" for the principle attribute of "state" which is the polygon object representing the entity Minnesota.

The following outlines the data origins, coverage area, digital size, projection, coordinate system, scale, resolution, attributes (ArcView II theme title), attribute values (ArcView II theme legend), and object type used in the MNTEMPLA layer.

MNTEMPLA Geographic Information Outline:

- Data Origins: USDA DCS soil associations map of Minnesota, 1982
- Coverage Area: approximately 43 to 49 degrees north latitude, and 91 to 97 degrees east longitude
- Digital Size: 11.473 Kb
- Projection:
- Coordinate System: UTM
- Scale: 1:1,000,000
- Resolution:
- Object type (AVII Shape): Polygon
- Attribute (AV theme): State
- Attribute Values (AV legend values): Minnesota
1854 TREATY TERRITORY (MINN1854):
Minn1854 is

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

MINNESOTA 7.5 MINUTE QUADS (MNQUADS):

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):

Attribute Values (AVII Legend Values):

RESERVATION BOUNDS (RESERVAT):

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

1854 TREATY TERRITORY GEOGRAPHIC NAMES (GNIS1854):

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
1854 RICE NAMES QUERY (RICENM54):

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

ST. LOUIS RIVER WATERSHED BOUNDS (STLOSHED):

Data Origin:
Coverage Area:
Digital Size:
Projection:

Coordinate System:

Scale:

Resolution:

Object Type (AVII Shape):

Attribute (AVII Theme):

Attribute Values (AVII Legend Values):
SEVEN BEAVER STUDY AREA LAYERS

MOYLE INVENTORY (SBMOYLE)

This coverage and layer has the function of identifying the lakes and rivers that were listed in a non-spatial analog database by John Moyle in 1942. The geographic locations of the entities described in Moyle's list are not specific areas of lakes or rivers, but the entire lake or river constrained spatially by only the area of the entire lake or river at the time of data collection. The numeric (quantitative use) attribute value of 1 was attached to National Wetlands Inventory lake and river segment polygons that were listed by by name and United States Public Land Survey location by Moyle as having harvestable wild rice in 1942. The scale remains 1:24,000 as digitized by the USFWS National Wetlands Survey.

Data Origin: Moyle, 1942 non-spatial analog database (list), and USFWS National Wetlands Inventory spatial database of lakes and river segments.

Coverage Area: An area bounded by 47 degrees 22 minutes 30 seconds, and 47 degrees 37 minutes 30 seconds north latitude, and 91 degrees 45 minutes and 92 degrees west longitude. Equal to four USGS 7.5 minute quadrangle sheets.

Digital Size: 36.369 Kb

Projection: Lambert Conformal Conic

Coordinate System: UTM

Scale: 1:24,000

Resolution: 15 meters Object Type (AVII Shape): Polygon

Attribute (AVII Theme): Moyles42

Attribute Values (AVII Legend Values):
1 = yes
2 = no
WILD RICE DEPTH (RICEDEPT)

RICEDEPT Summary of Function:

WILD RICE DEPTH (DEPTH5FT):

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

SEVEN BEAVER STUDY AREA BOUNDS (SBBOUND):

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

LAKES AND RIVER SEGMENTS (SEVBEAVE):

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

MDNR INVENTORY (MDNRINVE):

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

GEOMORPHOLOGY (NEWGTCLP):

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

SUBSTRATE FROM MDNR GEOMORPHOLOGY (GEOMSOIL):
SUBSTRATE FROM NRCS SOILS (NRCSSOIL):
AIR INVENTORY OF WILD RICE (AIRINVEN)  Major Testing Layer

Data Origin:

Coverage Area:

Digital Size:

Projection:

Coordinate System:

Scale:

Resolution:

Object Type (AVII Shape):

Attribute (AVII Theme):

Attribute Values (AVII Legend Values):

GROUND INVENTORY OF WILD RICE. (GROUNDIN)  Major Testing Layer

Data Origin:

Coverage Area:

Digital Size:

Projection:

Coordinate System:

Scale:

Resolution:

Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

**MONITORING SYSTEM (SBMONITO) Major Monitoring Layer**

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

**WATER QUALITY PH (SBPH):**

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:

Scale:

Resolution:

Object Type (AVII Shape):

Attribute (AVII Theme):

Attribute Values (AVII Legend Values):

ROADS (SBROADS):

Data Origin:

Coverage Area:

Digital Size:

Projection:

Coordinate System:

Scale:

Resolution:

Object Type (AVII Shape):

Attribute (AVII Theme):

Attribute Values (AVII Legend Values):

SOURCE DATA LAYERS
NATIONAL WETLANDS INVENTORY (NWI#):

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

GEOGRAPHIC NAMES INFORMATION SYSTEM (GNISS):

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):

Attribute (AVII Theme):

Attribute Values (AVII Legend Values):

USGS DIGITAL LINE GRAPHS (DLG####):

Data Origin:

Coverage Area:

Digital Size:

Projection:

Coordinate System:

Scale:

Resolution:

Object Type (AVII Shape):

Attribute (AVII Theme):

Attribute Values (AVII Legend Values):

MDNR WATERSHED BOUNDS (####SHED):

Data Origin:

Coverage Area:

Digital Size:

Projection:

Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

MINNESOTA QUADRANGLES (MNQUADS):

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

MINNESOTA QUADRANGLE CONTROL POINTS (ARRTICU):

Data Origin:
Coverage Area:
Digital Size:
Projection:
Coordinate System:
Scale:
Resolution:
Object Type (AVII Shape):
Attribute (AVII Theme):
Attribute Values (AVII Legend Values):

TIGERLINE CENSUS FILES (#####):
Appendix C

Approximate Budget to for Work to be Preformed Over the Next 5 Years

GIS Manager*
Year 1 ($15.00 per hour for 100% time to implement system, field work, and process all data for 240 topographic sheets for the entire ceded territories) $30,000

Year 2 - 5 (25% time to maintain system and monitoring analysis) $ 7,500

Ecologist* ($50,000/yr)
Year 1 - 5 (25% time) $10,000 $40,000

Human Ecologist* ($25,000)
Year 1 (50% time) $25,000

GIS Lab fees ($3.75 per hour)
Year 1 $ 3,750
Year 2 - 5 $ 3,000

Other supplies
(film/paper/photocopying/maps/travel) $ 500 $ 2,000

YR 1 Total $69,250 YR 2 - 5 $52,500

Grand Total YR 1 and YRs 2 - 5 $121,750

It is assumed that working relations between the 1854 Authority and MN DNR will cover the cost of aerial observation and data acquisition.

*These figures are only for labor and direct costs. They do not include any estimates for overhead or benefits.
Appendix D

Draft Field Data Collection Form

Wild Rice Habitat Study

Date: ____________

Weather Conditions: ____________________________________________

Location:
  Legal __________________________________________________________
  GPS __________________________________________________________

Lake/River Name: ________________________________________________

Location of Work: ________________________________________________

Water Depth: ______________________________________________________

Observable Obstructions that maintain water depth:
  Human Made
    Type _________________________________________________________
    Location _____________________________________________________
    Observed Impact _____________________________________________

  Due to Wildlife
    Type _________________________________________________________
    Location _____________________________________________________
    Observed Impact _____________________________________________

Additional Comments: ____________________________________________
Appendix E

Year 2 Project Proposal

Proposed Work Plan and Budget

A Geographic Assessment of Potential Wild Rice Habitat in the Vermilion, St. Louis, Lower Rainy River and North Shore Watersheds

Introduction

Last year, research was conducted to identify historic and contemporary wild rice habitat in the St. Louis and Vermillion Rivers watersheds. The result of the research indicates that no data are available to measure historic wild rice habitat. Contemporary habitat fluctuates with yearly changes in water levels. With the use of a geographic information system (GIS), ARC/INFO, National Wetlands Inventory data are currently being analyzed for its ability to identify potential habitats or those areas where environmental conditions make wild rice possible when water levels are satisfactory.

Development of the GIS database will provide an opportunity to record data in the attributes portion of the system. The attribute records can be up-dated in future years by imputing data from yearly inventories of wild rice. Over time, records can be analyzed to indicate areal changes in wild rice production. Once changes are documented, interpreting why changes in wild rice production occurs will be possible. A final predictive habitat map will also be created with reference to the attribute records. These data will assist in making effective resource management decisions with regard to wild rice production.

While the National Wetlands Inventory indicates general environmental parameters
necessary for wild rice growth, the data set alone does not include specific information necessary to indicate habitat. Additional datasets must be layered into the GIS to accurately predict potential habitat areas. Areas identified by the GIS can be checked for accuracy with aerial surveys in the spring and late summer, and by remote sensed data analysis in the spring. This proposal is for funds to expand the project to include the Lower Rainy River and North Shore watersheds, improve the GIS prediction model by identifying the availability of additional datasets, and for aerial surveys during the early and late summer of 1995.

Work Plan

In order to expand the existing project to include the Lower Rainy River and North Shore watersheds, the watersheds will be identified and National Wetlands Inventory will be combined during the initial survey. An intensive effort to maximize the predictability of habitat will be undertaken by selecting a pilot study area. Additional datasets to be added to the GIS analysis include soils, geomorphic, geologic, and water data. These data will be combined with the National Wetlands Inventory to create a predictive model for wild rice habitat.

The pilot will be tested for accuracy with remoted sensed data of the test area and with aerial surveys during the summer of 1995.

An inventory of additional datasets must be completed to identify readily available and digitized spatial data with attribute information. Once existing datasets are identified
the need to digitize additional datasets can be assessed and the ability to successfully complete the predictive model and data management system will be identified.

Anticipated Results

It is expected that work during 1995 will result in a map and record of known attributes for each identified wild rice habitat area based on the National Wetlands Inventory. A list of additional data to be included in the attributes table including landforms, soil types, acerages, water quality, and water levels will be constructed. The availability of these additional datasets will be identified and a proposal for including these data into the database will be made.

A project proposal for monitoring wild rice habitat for the next five years including all known costs for survey and record keeping will be made.

Budget Request

$7250 from 1854 Authority

$7250 from Fond du Lac Natural Resources and Tribal Council

$14,500 Total (including 45% UMD overhead)
Budget Explanation

A Geographic Assessment of Potential Wild Rice Habitat
in the Vermilion, St. Louis, Lower Rainy River
and North Shore Watersheds

Salary
Research Assistant
@$8.61 for 250 hours ... .2152.50
@$8.61 for 250 hours ... .2152.50

Equipment
Computer Equipment and Software ... .1500.00

Data Acquisition ... .500.00
Aerial Survey ... .1000.00
GIS Lab Fee ... .500.00
Remote Sensing ... .1500.00
Supplies ... .50.00
Travel ... .645.00

Total $10,000
Overhead $4500
Grand Total $14,500
Funding of Tasks per granting Agency

**1854 Authority**

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Assistant</td>
<td>$2152.00</td>
</tr>
<tr>
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<tr>
<td><strong>Grand Total</strong></td>
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**Fond du Lac Natural Resources and Tribal Council**

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