# Beltrami Island Land Utilization Project
# Comprehensive Conservation Management Plan

Final 2013

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# Land Utilization Project

## Comprehensive Conservation Management Plan

Final, 2013

Minnesota Department of Natural Resources
U.S. Fish and Wildlife Service

Acknowledgements

This plan is a product of the Minnesota Department of Natural Resources and U.S. Fish and Wildlife Service. Some sections of this plan, particularly where it references other plans, borrows language directly from those plans, including other Minnesota DNR documents, U.S. Fish and Wildlife Service Comprehensive Conservation Plans, the Red Lake Band of Chippewa Indian's Wolf Management Plan, and various watershed district and watershed basin plans. Much of the material presented in Chapter 3 on soils, peatlands, and vegetation communities was written and contributed by Scott Zager, Wildlands Inc. (i.e., from Zager 2011). The section on insect resources was provided by Kyle Johnson, University of Wisconsin-Madison.

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"*We and our families have enjoyed the Beltrami Forest area for many years. It's become an important part of our lives. My grandparents took us hunting, fishing, trapping, berry picking all our lives, and it continues for our grandchildren and great grandchildren.* ***It's not just land – it's a way of life.***"

Leon Wilson (age 102)
and Grace Sonstegard,
February 2011

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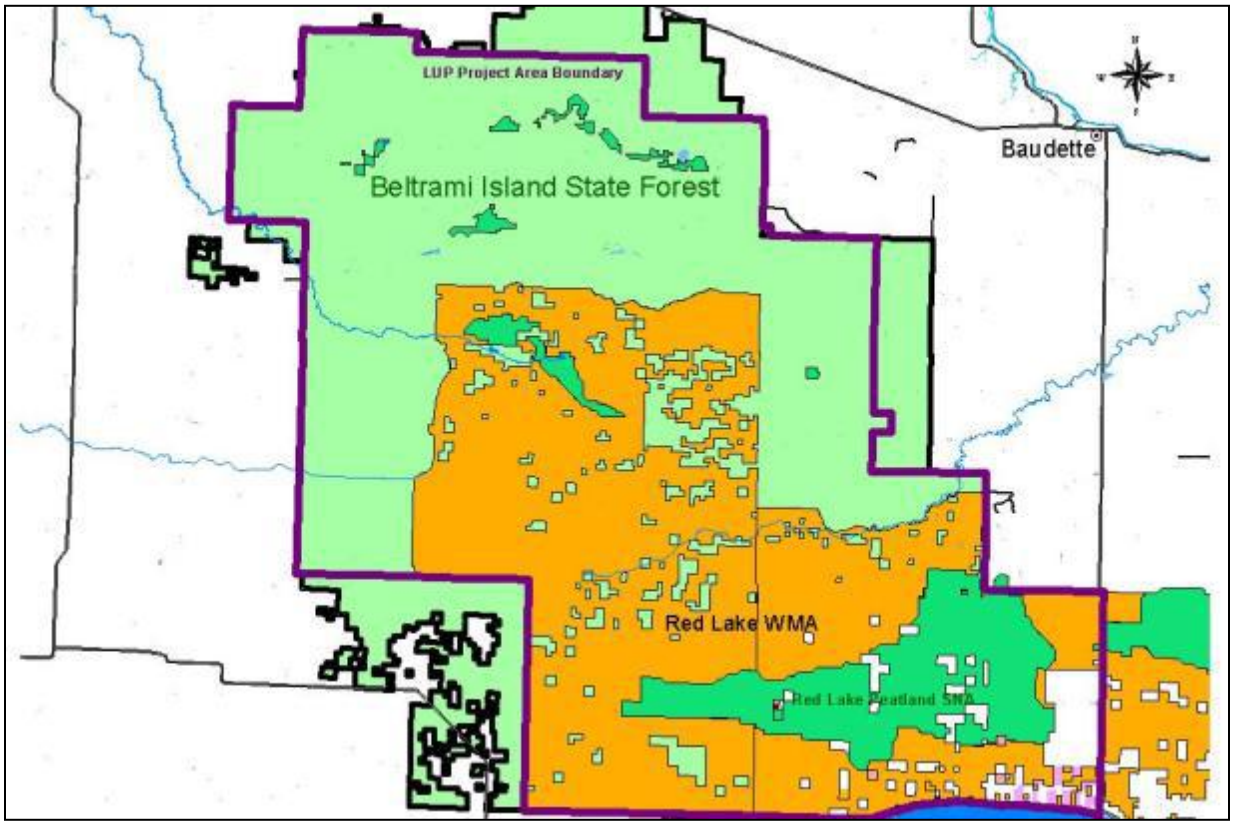
# Executive Summary

We propose to manage the 86,000 acres that comprise the Beltrami Island Land Utilization Project (LUP) under a landscape perspective. This Comprehensive Conservation Management Plan (CCMP) identifies and describes a series of goals, objectives, and strategies devised for managing wildlife, wildlife habitat, the human environment, and land assets and is intended to guide the management of LUP lands for at least the next 15 years. We developed three alternatives to accomplish the goals, objectives, and strategies: Alternative A: Current Management Direction (No Change/No Action), Alternative B: Manage the Landscape, and Alternative C: Manage by Species. **Alternative B (Manage the Landscape) is the Proposed Alternative.** The alternatives were fully described in the Environmental Assessment in the Draft CCMP.

The Beltrami Island Land Utilization Project CCMP does not include any proposed changes to existing public access (including motorized access) or hunting, fishing and trapping opportunities. Artificial water storage would be allowed on LUP lands if storage also provides mutual wildlife benefits.

The primary focus of the CCMP is managing habitat to provide a diverse array of habitats for wildlife species. A landscape approach that considers the quality, quantity and interspersion of habitat throughout the entire project area – essentially the statutory boundaries of the Beltrami Island State Forest (see inset) – is deemed the most effective mechanism for assuring the habitat needs of all native wildlife species are met, and that wildlife populations may be maintained within their natural range of variability. An assessment of the habitat needs of key game and nongame species revealed three groups of particular management interest: nongame species and furbearers that require mature forests; openland species that require early successional graminoid-dominated wetlands; and game species that thrive in early successional forest habitats. LUP lands were identified as being particularly important in providing habitat for species requiring mature forests. Therefore, the CCMP envisions managing LUP lands in part to provide more conifers and older forests on the landscape. This vision is complementary with the Agassiz Lowlands Subsection Forest Resource Management Plan (SFRMP). A landscape approach allows management decisions for a particular LUP parcel to be made in a holistic manner with the condition of surrounding state, tribal, or private lands taken into consideration.

The CCMP establishes a vision for the desired future condition of LUP lands while still honoring existing management plans. A few strategic land exchanges within the LUP project area are proposed that would benefit both the State and the purpose for which LUP lands were designated by President Franklin Roosevelt by Executive Order in 1942. These include exchanging LUP lands out of Hayes Lake State Park, exchanging some red pine plantations and some gravel pits with the State for ecologically sensitive areas, and consolidating LUP ownership of yellow birch stands on the north shore of Upper Red Lake. An area containing 4,477 acres of LUP lands in the Spina area within the Red Lake Wildlife Management Area (WMA) has been identified as containing wilderness values and characteristics. Under the CCMP we will manage the area to retain these wilderness values and characteristics.




Inset: LUP planning area, outlined in purple, based on original Resettlement Administration project boundaries.

# Chapter 1: Introduction and Background

## Introduction

This document is a Comprehensive Conservation Management Plan (CCMP) for approximately 86,000 acres of state-leased federal lands known as the Beltrami Island Land Utilization Project (LUP). These lands, also referred to as the Beltrami Wildlife Management Area (WMA), are located in Roseau, Lake of the Woods, and Beltrami counties in northern Minnesota.

The Beltrami Wildlife Management Area was established by Executive Order 9091 by President Franklin Delano Roosevelt on March 6, 1942, and "reserved as a refuge and breeding ground for native birds and other wildlife and for research relating to wildlife and associated forest resources, under such conditions of use and administration as will best carry out the purposes of the land conservation and land utilization program for which such lands have been, or are being acquired …" Executive Order 9091 made the Beltrami WMA "available to the State of Minnesota for use and management by its Department of Conservation" but still "under the custody of the Fish and Wildlife Service of the Department of the Interior …" Thus, these lands are collectively leased to the State of Minnesota, but remain part of the National Wildlife Refuge System as "coordination lands." Interestingly, the lands were leased to the State prior to the Executive Order, beginning on June 20, 1940.

The LUP lands are widely scattered and embedded within seven different DNR land conservation units occupying a total of some 848,000 acres (1325 $mi^2$): Red Lake WMA, Beltrami Island State Forest, Hayes Lake State Park, Winter Road Lake Peatland Scientific and Natural Area (SNA), Mulligan Lake Peatland SNA, Red Lake Peatland SNA, and Gustafson's Camp SNA. The Lease directs primary management duties to the DNR's Section of Wildlife. The purpose of the Beltrami WMA corresponds closely to the purposes of many of these State conservation land units; thus they can be managed uniformly. In the Beltrami Island State Forest, however, the LUP lands are afforded a different level of protection than adjoining state lands for some resource issues. However, the scattered nature of the lands, the fact that none of them are posted and few have modern day surveys, and the inability of the public to differentiate between federal and state lands, increases the complexity of the management of these lands.

### Overview of the Ecological Landscape

The LUP lands are situated in the Agassiz Lowlands subsection of the Laurentian Mixed Forest biome (Figure 1.1). The Agassiz Lowlands subsection (Figure 1.2) is a large, very flat, poorly drained area named after Glacial Lake Agassiz. The water holding capacity of the soils ranks among the highest in the world (NRCS 1998). The subsection is primarily a mix of some of the most significant peatlands in the world interspersed with remnant upland sand islands dominated by conifers and aspen. Peat soils cover

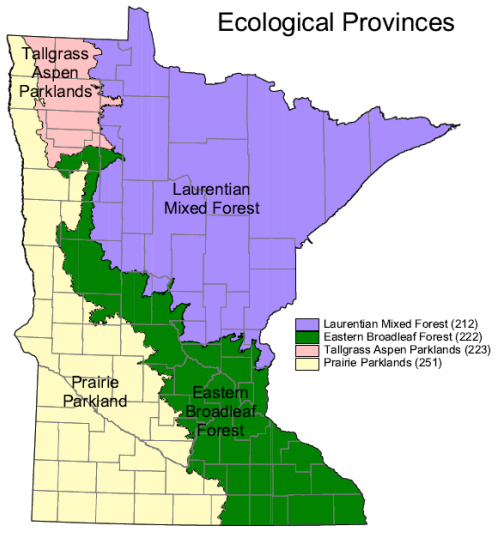



Figure 1.1. Ecological provinces in Minnesota.

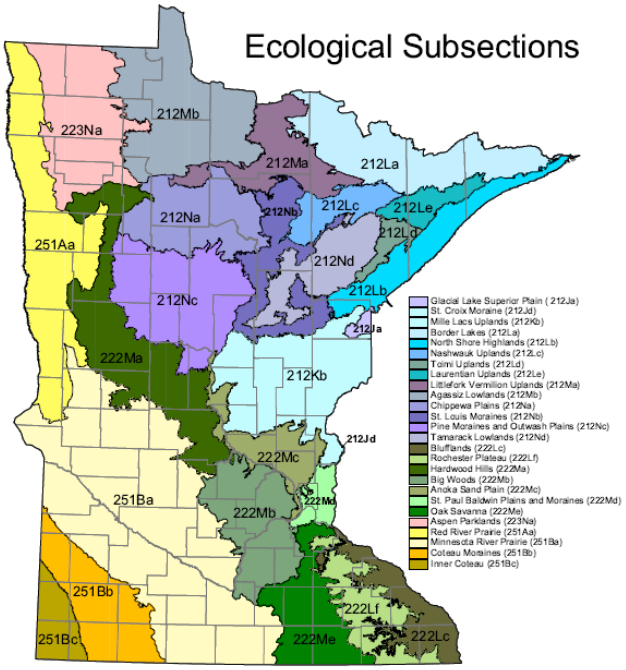



Figure 1.2. Ecological subsections in Minnesota.

60% of the Beltrami Island area. The peatlands are a mix of black spruce and tamarack forests, sedge meadows, and brushlands. Lowland white cedar stands are common. Heinselman (1963) states "the peatlands stand as a barrier of predominantly boreal vegetation between the outliers of the mesophytic hardwood forest [to the south], the prairies [to the west], and the true boreal region [to the north and northeast]." Glaser et al. (1997) state "The physical, chemical, and biotic properties of these bogs have no apparent relationship to the westward climatic gradient indicating a high degree of buffering from changes in moisture stress. Most bogs are located where groundwater discharge moderates moisture losses to the atmosphere and may decouple bogs from a direct climatic control."

The subsection also includes three large lakes: Upper Red, Lower Red, and Lake of the Woods, but these occur to the north and south of the Beltrami Island area. The LUP planning area is the headwaters area for six major watersheds. The Rapid River watershed is the healthiest watershed in the state, according to the Minnesota DNR's Watershed Assessment Tool. The tool assumes that a healthy watershed has a high level of intact natural vegetation, among other measures. The Upper/Lower Red Lake, Roseau River, and Rainy River-Baudette watersheds are also in the top six healthiest in the state.

Important wildlife species are defined as rare, uniquely abundant to the area, recreationally or commercially important, or critical to the functioning of the ecosystem in the Beltrami Island area include moose, white-tailed deer, black bear, pine marten, fisher, lynx, bobcat, ruffed grouse, sharp-tailed grouse, spruce grouse, sandhill crane, yellow rail, Wilson's (common) snipe, American woodcock, short-eared owl, whip-poor-will, Nelson's (sharp-tailed) sparrow, and golden-winged warbler. The populations of sandhill crane, golden-winged warbler, and gray wolf in Minnesota are significant at the national level (North 2001).

Other highly-sought watchable wildlife species that occur at various seasons include great gray and northern hawk owls, black-backed and three-toed woodpeckers, boreal chickadees, Connecticut warblers, pine grosbeaks, and red and white-winged crossbills.

Other keystone species, although often unrecognized in that role, include snowshoe hare, red squirrel, beaver, great horned and barred owls, least flycatchers, common ravens, gray jays, black-billed magpies, red-eyed vireos, black-capped chickadees, white-breasted and red-breasted nuthatches, ovenbirds, and several species of woodpeckers.

## Requirement for the Plan

In 1997, the U.S. Congress passed the National Wildlife Refuge System Improvement Act, which directed the U.S. Fish and Wildlife Service to prepare a Comprehensive Conservation Plan (CCP) for each unit of the National Wildlife Refuge System by 2013. Originally, Service policy indicated this Act did not include "coordination lands." However, the 2009 amended Lease between the State and the U.S. Fish and Wildlife Service contained a stipulation that a plan analogous to a CCP would be prepared by February 2014. This plan is prepared as a result of that amendment.

## Mission of the U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (Service) is the primary federal agency responsible for conserving, protecting, and enhancing the nation's fish and wildlife populations and their habitats. The Service oversees the enforcement of federal wildlife laws, management and protection of migratory bird populations, restoration of nationally significant fisheries, administration of the Endangered Species Act, and the restoration of wildlife habitat such as wetlands. **The mission of the Service is working with others to conserve, protect and enhance fish, wildlife, and plants for the continuing benefit of the American people**. The Service also manages the National Wildlife Refuge System. **The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.**

The following goals for the National Wildlife Refuge System were adopted on July 26, 2006:

- Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered.
- Develop and maintain a network of habitats for migratory birds, anadromous and interjurisdictional fish, and marine mammal populations that is strategically distributed and carefully managed to meet important life history needs of these species across their ranges.
- Conserve those ecosystems, plant communities, wetlands of national or international significance, and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts.
- Provide and enhance opportunities to participate in compatible wildlife-dependent recreation (hunting, fishing, wildlife observation and photography, and environmental education and interpretation).
- Foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats.

## Mission of the Minnesota Department of Natural Resources

**The mission of the Minnesota Department of Natural Resources is to work with citizens to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life (**Minnesota DNR 2009). Within the DNR there are six divisions, each with a different emphasis on the overall mission. Four of these divisions manage conservation units that contain LUP lands: Forestry, Fish and Wildlife, Parks and Trails, and Ecological and Water Resources; the other two divisions (Lands and Minerals, Enforcement) assist with administration of land transactions and enforce natural resource

laws and rules, respectively, on LUP lands. Overall State direction of LUP land management is by the DNR's Section of Wildlife according to the 2009 LUP Lease Amendment.
The DNR Conservation Units that contain LUP lands are:

- 59,945 acres in Beltrami Island State Forest. The primary purpose of the BISF is to provide an ecologically sustainable and diverse timber supply to support a logging industry by using sound forest management practices.
- 21,493 acres in Red Lake WMA. The WMA was originally established in a failed effort to protect the last woodland caribou in the Lower 48 states. Today the WMA covers 321,149 acres and is focused on managing for deer, grouse, woodcock, bear, moose, furbearers and native nongame species. It is the largest WMA in the state.
- 3,154 acres adjacent to the Red Lake WMA on the north shore of Upper Red Lake. This area was formerly part of the WMA and is referred to as the Red Lake WMA Supplement.
- 598 acres in Hayes Lake State Park. Hayes Lake SP is a 2957 acre park on the west side of the Beltrami Island SF and serves as a gateway to the vast semi-wilderness area to the east. Its purpose is to provide recreational hiking, biking, boating, swimming, fishing, camping, skiing, snowmobiling, and picnicking. It contains a 187-acre impoundment on the Roseau River and 13 miles of trails used for hiking, cross-country skiing, and snowmobiling. The park averages 30,000-35,000 visitors/year. Seventy-nine percent of the park is considered a native plant community.
- 186 acres in Gustafson's Camp Scientific and Natural Area (SNA). This SNA is located entirely on LUP lands and contains old-growth white and red pine stands.
- 397 acres in Winter Road Lake Peatland SNA.
- 39 acres in Mulligan Lake Peatland SNA.
- 190 acres in Red Lake Peatland SNA.

**The mission of the SNA program is to "preserve and perpetuate the ecological diversity of Minnesota's natural heritage, including landforms, fossil remains, plant and animal communities, rare and endangered species, or other biotic features and geological formations, for scientific study and public edification as components of a healthy environment."** As such, SNA's have significant restrictions on the uses that can occur on them. The three Peatland SNA's listed above were established by the Minnesota State Legislature in 1991 as part of the Wetland Conservation Act (M.S. 84.036). In addition, two other Peatland SNA's (Luxemberg Peatland SNA and Norris Camp Peatland SNA) occur in the project area but contain no LUP lands. The long range goal of the SNA program is to protect at least 1) five locations of plant communities known to occur in each landscape region, and 2) three locations per region of each rare species, plant or animal, and geologic feature. A concept plan for creating a Bemis Swamp SNA exists (Minnesota DNR 2010), which could include 680-1120 acres of LUP land.

# History of LUP Lands

Until 1889, the Beltrami Island area was reserved for the Red Lake and Pembina Bands of Ojibwe under the "Old Crossing" Treaty of 1863, and not available for white settlement (Figures 1.3 and 1.4). In 1889, the lands north of the current main Reservation boundary were ceded and opened to development. However, the region was remote, land surveys were not conducted until the period of 1895-1907, and the Beltrami Island area had no official population as of 1900, although logging was occurring and a post office was established at Wannaska in February 1894. The earliest known plat maps of the area date to 1913 and 1916 and show a few settlements and logging interests. In 1908, Minnesota passed the

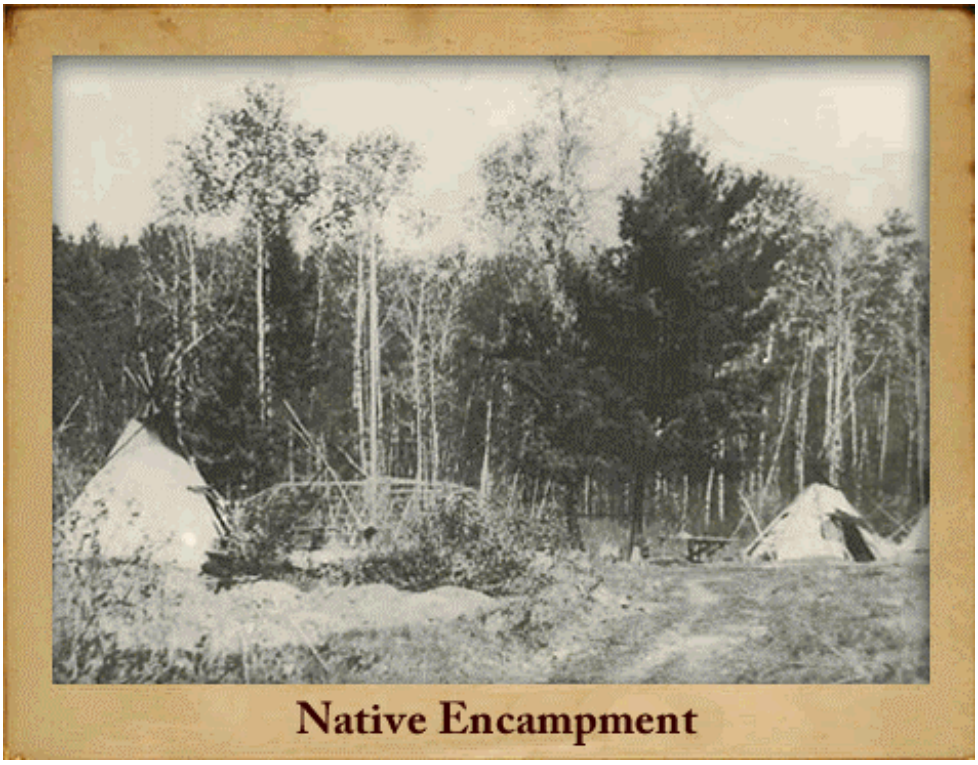



Figure 1.3. Native encampment, courtesy Lake of the Woods Historical Society.

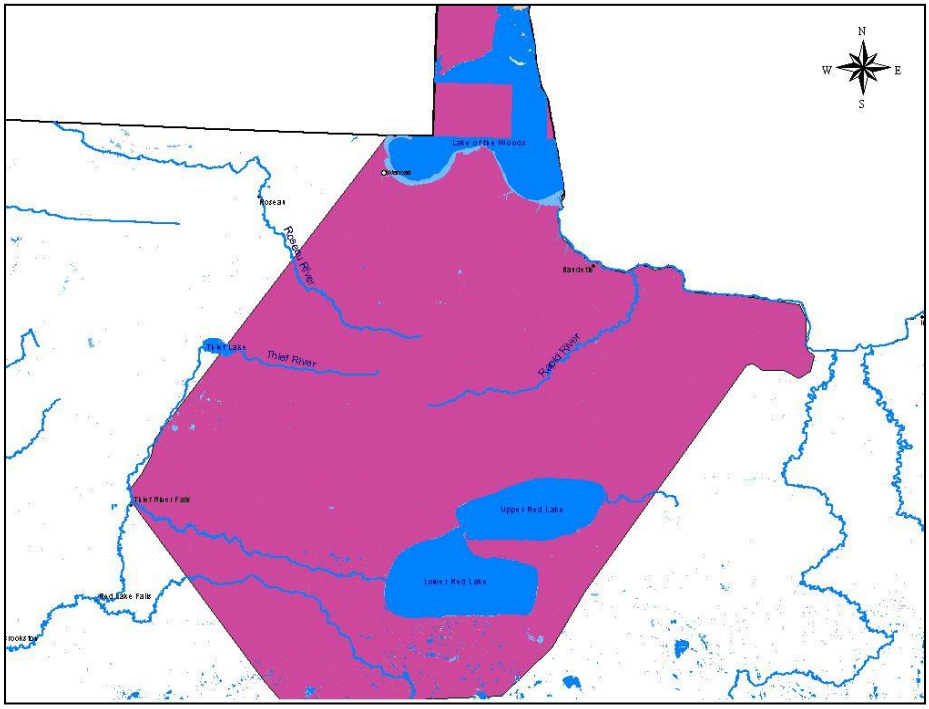



Figure 1.4. Old Crossing Treaty area.

Volstead Act aimed at draining public swamplands, and by 1910 local counties used this law to embark on ambitious ditch building and drainage plans in hopes of attracting settlers into the region to attempt farming (Figures 1.5-1.7).[1]

However, during the 1920s logging declined as areas were cut over and left unrestored, and a general economic downturn after World War I left agricultural economies depressed (Magner and Emerson, 2008). By the end of the decade, as settlers defaulted on assessments, rates of tax forfeiture increased and the population of northern Minnesota declined by as much as a third in some areas (e.g., the Beltrami Island area). Some northern counties faced bankruptcy. In 1929, in order to bail out the counties, the Minnesota legislature authorized the state to take title to 1.3 million acres of tax-delinquent lands in Beltrami, Lake of the Woods and Koochiching counties and pay off the drainage bonds. **These lands became what are referred to today as the Consolidated Conservation (Con-Con) lands.** These lands were originally designated the Red Lake Game Preserve and were to be managed as a state wildlife preserve and hunting grounds for the propagation, preservation, and use of wildlife, timber and other resources (Magner and Emerson 2008). From 1931-1933, the Red Lake Game Preserve was reconfigured into the Beltrami Island State Forest and the Red Lake Game Refuge, the latter for the purpose of protecting the last population of woodland caribou south of Canada.

Figure 1.5. Ditch digging on the Joseph Dostal farm in Beltrami County, circa 1915.
Photo courtesy of the Minnesota Historical Society.

[1] Some 2900 km (1790 miles) of ditches were dug, and in the 1930s there were 1600 farmers present (Fritts and Mech 1981).

Figure 1.6. Remnants of historic ditches are still evident on satellite imagery. Dick's Parkway, West Moose River Forest Road, and the Moose River dike system are visible on the left half of the photo.

Figure 1.7. Bill Rulien family and friends at his homestead near the Rapid River near Carp and Rako.

Not all of the farms in the area were abandoned or went into tax forfeiture. Some of the farms on the higher, better parcels of ground remained in private ownership. However, the remaining farms were isolated. Travel was long-distance to goods and services on unmaintained ditch-bank roads, and as farm abandonment reached 50% in the early 1930s, many township schools closed. Recognizing the unsustainability of the scattered remnant farms, the federal government (with the cooperation of the State), under the Resettlement Administration, initiated the Beltrami Island Project in 1936 to buy out and relocate remaining willing sellers.[2] **Those lands became the LUP lands that are the subject of this plan.** A few parcels to this day are still privately owned, and are being purchased from willing sellers.

During this same time period, the Red Lake Band of Ojibwe retained ownership of parcels of their ceded lands where homestead entry was not made or where would-be homesteaders failed to fulfill the terms of the legislation to receive title. This accounts for the contemporary dispersal of reservation inholdings throughout the Beltrami Island area and the Northwest Angle.[3] There is a set of LUP lands that are in dispute as to legal ownership. These are lands that the Red Lake Band claims were sold but never improved upon as required, and because they were never improved upon, the Band believes they should have legally reverted back to the Band. This plan will not take any position on the legality of these claims, but will establish an overarching goal that the lands will be managed to be in a healthy, productive condition at the time of jurisdictional transfer, should it be legally deemed that they be transferred to the Red Lake Band of Ojibwe.

# LUP Vision Statement

The vision for LUP lands is to "Preserve the headwaters area for the Roseau River, Rapid River, Warroad River, Winter Road River, and Red Lake River in a predominately natural condition where hydrologic conditions at the top of the watersheds function naturally, where quality timber is produced, and where ecologically healthy native plant and animal communities provide opportunities for recreation and human sustenance."

# Guiding Documents

There are several existing federal, state, and local plans that dovetail into this plan. This plan does not intend to replace other plans or make them obsolete. Instead, our intent is to incorporate other plans into our plan, for a plan that does not respect previous plans does not itself deserve to be respected by future planning efforts. That said, some of the existing plans are envisioned to be updated periodically. Our plan may influence those updates. Some of the plans discussed in this section were described in greater detail in the Draft CCMP, and are abbreviated here.

The primary guiding documents for this plan are the Executive Order that established the Beltrami Wildlife Management Area, and the 2009 Lease Amendment. Guidance in the Executive Order was discussed earlier.

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[2] The Act under which the Beltrami WMA lands were acquired was the Bankhead-Jones Farm Tenant Act, "in connection with the Beltrami Island Land Utilization Project or the Minnesota Isolated Settlers Project, under the authority of Title II of the National Industrial Recovery Act, the Emergency Relief Appropriation Act of 1935, and Title III of the Bankhead-Jones Farm Tenant Act" (Federal Register Document 48-6290, July 15, 1948, page 4015).

[3] See page 254, *The Patterned Peatlands of Minnesota*.

## 2009 Lease

The 2009 Lease Amendment has several provisions that guide the plan, including in part:

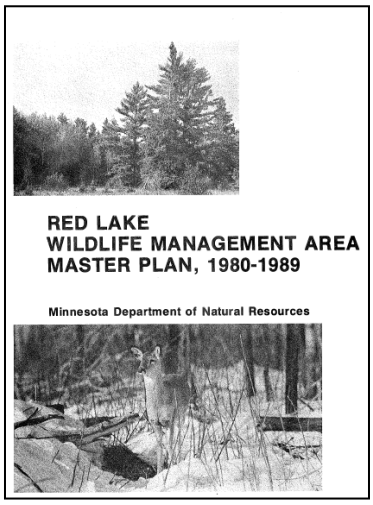
"WILDLIFE: The primary management mission for the LUP lands is to protect and manage the wildlife, native plants, and their communities for the intrinsic values and long term benefits to the people of Minnesota and the United States. Wildlife management practices on said property shall be of such character as to maintain the ecosystem in a productive condition for wildlife. Specific wildlife management plans and practices may be implemented for selected species and appropriate habitat management may be accomplished on said property to complement program objectives on adjacent or nearby lands."

"SCIENTIFIC AND NATURAL AREA AND HERITAGE ELEMENTS: All said property located in a state Scientific and Natural Area established by Commissioner's Order under Minnesota Statutes 84.033; and all said property located within Peatland Scientific and Natural Areas established by Minnesota Statute 84.035 and 84.036 (1991) and their associated Watershed Protection Areas delineated in the report: 'Recommendations for the Protection of Ecologically Significant Peatlands in Minnesota, MNDNR, November 1984' shall be managed in accordance with Minnesota Statutes 86A.05, Subd. 5 (1975); 84.033 (1975); and 84.035 (1991) to protect the significant features associated with these areas. The State shall maintain a current list of known heritage elements occurring on said property which shall also be made a part of the Rare Feature's Database within the State's Natural Heritage Program. All land management activities shall be conducted in such a manner as to avoid adverse impact to said heritage elements."

"RECREATION: The State shall operate, maintain and administer the existing and subsequently developed recreational facilities for the use and benefit of the general public. … Any recreational facilities and programs that may be subsequently developed shall be consistent with the primary use of the land. … On March 12, 2007 the MNDNR completed the 'Beltrami Island State Forest Motor Vehicle Use Classification Forest Road and Trail Designation Plan.' This plan took into consideration the scattered parcels of LUP, Tribal, State Wildlife Management Areas, County and Private inholdings within the Beltrami Island State Forest. Based on this plan, in the future, there will be no new permanent minimum maintenance roads or new snowmobile trails developed on LUP lands. Exceptions may be considered when alternate routes would cause greater environmental damage than routes through LUP lands, if mutually agreed to by the State and the United States. Trails for exclusive ATV/OHV use on LUP lands are prohibited."

"FORESTRY: Forestry practices shall comply with the overall intent of Executive Order 9091. Management actions will comply with the Endangered Species Act, environmental review, and historic preservation considerations. Ecological Classification System (ECS)-based forest stand prescriptions will be employed to benefit appropriate wildlife species, consistent with maintaining ecological integrity, range of natural variability, and forest ecosystem health concepts. Tree planting and timber harvesting should be done where it can be demonstrated to provide particular wildlife benefits. Forest management plans shall consider potential adverse impacts to federally-listed threatened and endangered species due to factors such as vehicle access. The State shall provide adequate infrastructure for forest fire protection, including a system of forest roads, access trails, and fire suppression equipment as afforded to other state administered lands in cooperation with the Federal Government."

## Red Lake Wildlife Management Area Master Plan, 1980-1989




The 2009 Lease refers to "specific wildlife management plans and practices may be implemented for selected species and appropriate habitat management …" The only comprehensive wildlife plan[4] for the area is the Red Lake WMA plan, which is not specific to LUP lands, is 20 years beyond its anticipated scope, and contains many habitat and species management prescriptions that are out of date. Nonetheless, this plan still provides the general basis for management of LUP lands, although obsolete prescriptions have been abandoned.

One aspect of this plan was to evaluate the boundaries of the WMA and dispose of surplus lands. One surplus area identified was 146,000 acres of sphagnum peatlands in the area that is now the Red Lake Peatland SNA and Big Bog State Recreation Area, and a campground in the Waskish area. Part of the impetus for this move was to allow for peat mining and mineral development. This area was removed from the WMA, but much of it was subsequently added back in through passage of the Wetland Conservation Act and as part of the Con-Con land issue settlement agreement.

This plan contains detailed descriptions of the vegetation communities and forest stands, and a summary of known wildlife resources. This plan identified an emphasis on forest habitat management for wildlife, but also recognized wetland management, non-forested upland management, and public use management as high priorities. The goal or vision for the Red Lake WMA in the plan is to "insure the sustained production and use of a variety of wildlife and fish and the protection of unique scientific, historic, and aesthetic resources." Management of peatlands was given a low priority since they provided poor habitat for game species and are difficult to hunt and trap in.

Wetland management focused on diking and excavation to create openwater habitat and wetland complexes for Canada goose management at Brown's Lake. Since Canada goose populations have fully recovered, and these wetland manipulation methods are generally contrary to the guiding principles of the Wetland Conservation Act, the wetland management prescriptions in this plan have long since been abandoned.

Forests are managed cooperatively between the Divisions of Fish and Wildlife, and Forestry for wildlife and forest products. Forest management for wildlife is mostly concerned with game species such as white-tailed deer, moose and grouse, but a variety of nongame species also benefit. Forest management prescriptions in the plan focused on creating an optimal dispersion of habitat types for deer in 4-mile$^2$ blocks, however, this is no longer the focus as wildlife agencies no longer focus on single species management but have shifted to holistic management. Still, priority is given to regenerating over-mature aspen stands.

The Red Lake WMA plan called for maintaining non-forested uplands including forest openings, croplands, and upland nesting cover areas. Many of the openings were associated with former

[4] There are existing and proposed single-species management plans for moose, wolf, ruffed grouse, American woodcock, and sandhill cranes.

homestead sites. Maintenance of former openings was considered more important for maintaining edge and providing habitat diversity when the plan was written than it is today, because there was less logging to create openings then. Today there is less emphasis on maintaining openings and food plots. Still, prescribed burning and shearing are tools used to maintain openings in desired locations.

The Red Lake WMA plan called for managing the WMA to "provide quality hunting, trapping, fishing, and other compatible fish and wildlife-related recreation. Dispersed, unstructured recreation with a minimum of developed facilities will be provided as part of the outdoor recreation system in northwestern Minnesota" which, when combined with more structured recreational opportunities on other state land in the area, provides for diverse recreational opportunities.

An objective of wildlife management on the WMA is an effectively balanced program for all native wildlife species. Nongame wildlife is considered in managing the forest, wetlands, non-forested openings, and other habitats. Projects designed to benefit specific wildlife species may be detrimental to other animals, plants, soils, or water. The plan recognized that all projects should be examined for their impact on non-target resources. Therefore it encourages research and surveys to evaluate present management programs and to develop new techniques.

The Red Lake WMA plan also contained a vision for the LUP lands: "Beltrami Island lease lands, including those outside the Red Lake WMA, will be managed cooperatively by the Divisions of Fish and Wildlife and Forestry for wildlife and forest resources. The DNR will seek to acquire LUP lands from the federal government." This vision has also been abandoned, since a cooperative approach between the DNR and the U.S. Fish and Wildlife Service has been found to be the best way to meet the requirements of Executive Order 9091.

## Agassiz Lowlands Subsection Forest Resource Management Plan (SFRMP) (2008)

The 2009 Lease refers to managing forest stands on Ecological Classification System-based prescriptions. The outline for this is the Agassiz Lowlands Subsection Forest Resource Management Plan, or SFRMP, which strives to balance the management of forest resources holistically across all DNR conservation units (i.e., forests, Parks, WMA's, SNA's). This is a highly-technical, complex plan, but one that is key to evaluating alternative management scenarios for LUP lands. The SFRMP identifies nine issues and several Desired Future Forest Conditions (DFFC's) for each issue, with a visioning timeline out to the year 2050. The nine issue statements are:

1. Increase quality and quantity of timber, and manage non-timber products for sustainable supply for both humans and wildlife
2. Convert 13,000 acres of aspen to other forest cover types
3. Seek a balanced age-class distribution among stands, including designating a percentage as extended rotation forest, and 3000 acres of old-growth forest
4. Maintain forest structure and increase/maintain plant diversity
5. Manage size and distribution of forest patches and encourage diverse, critical and riparian habitat
6. Tree health
7. Rare species and critical habitat
8. Visual quality
9. Cultural resource protection

See Table 1.1 for a list of the DFFC's associated with each issue statement. The issues and desired future forest conditions form a theoretical basis for compartmentalizing the forest into ecosystem service units or "ecosystem service districts"[5] in which LUP lands could provide different ecosystem services than surrounding state forest or WMA lands. For example, for SFRMP Issue 1, red pine plantations on LUP lands could be managed for earlier timber quantity (via heavier thinning early on) and then timber quality later in the life of the stand (via extended rotation forestry) while state forest lands could be managed for timber quantity and quality via the more traditional methods of less intense but more frequent thinning and final harvest at normal rotation age. For SFRMP Issue 2, LUP lands are currently managed towards meeting the goals expressed by DFFC 5, 6, 7, 10, 11, 13, and 14. For SFRMP Issue 3, deer and grouse can be managed through meeting DFFC 1. Under an ecosystem services district concept, LUP and WMA lands could be managed differently, one focusing on providing game habitat, the other nongame habitat. Current management of LUP lands implements all strategies under Issues 4 and 7; and it implements appropriate strategies under Issues 5, 6, and 8. SFRMP Issue 9 is irrelevant to LUP lands; instead we are proposing to implement the 2008 cultural resources plan drafted specifically for LUP lands.

The SFRMP is part of the basis for receiving Forest Stewardship Council forest certification for state and federal LUP lands in the Beltrami Island State Forest and Red Lake WMA. Dual forest certification for LUP lands was achieved on December 31, 2010. Appendix K of the SFRMP recognizes that LUP lands have contractual and management policies that differ from Forestry-administered lands, and that their vegetation management objective will likely be different from the Agassiz Lowlands Subsection as a whole. The Agassiz Lowlands SFRMP is scheduled for revisions beginning in 2013.

## U.S. Fish and Wildlife Service Letter Dated May 7, 2004

Certification of LUP lands required consent of the U.S. Fish and Wildlife Service. Consent was given in a letter dated May 7, 2004 from Charles M. Wooley, Acting Regional Director, USFWS, to Tim Bremicker, Chief, Section of Wildlife, Minnesota DNR.

Consent was based on eight management principles contained in the letter:

1. Continue forest wildlife opening maintenance (brush mowing, burning, and seeding after herbicide application for exotic species control).
2. Continue prescribed burning in lowland brush, grass/sedge, wetland, red pine stands, and jack pine harvest sites.
3. Continue shearing/hydro-axing lowland brush communities.
4. Continue walking trail creation and maintenance.
5. Deviate from Voluntary Site-level Forest Management Guidelines [VSFMG] by increasing the number of leave/seed trees and/or clumps of trees.
6. Deviate from VSFMG by allowing natural succession to understory species without harvest where there is a paucity of older age classes and/or there is an identified goal of converting to another habitat type.

[5] *Ecosystem services* are products or services that a piece of land provides to society at low cost or no cost. *Ecosystem services* include providing natural foods and medicines, clean water, a timber supply, recreational and tourism opportunities, carbon sequestration, oxygen, pollinators, nature viewing opportunities, water storage, groundwater recharge, birds to control insects, etc. An "*ecosystem service district*" could simply be a unit or units of land that are managed differently to provide an *ecosystem service* that is not being provided by adjoining lands.

Table 1.1. Elements of the Agassiz Lowlands Subsection Forest Resource Management Plan (2008).

| Issue Statement | Desired Future Forest Conditions (DFFC) |
|---|---|
| Issue 1.<br>Forest Products | DFFC 1. Increase the quantity and quality of wood available for harvest.<br>DFFC 2. Manage non-timber forest products (e.g., balsam boughs, berries, acorns, browse) to sustain a supply for humans and wildlife. |
| Issue 2.<br>Forest Composition and Wildlife (Convert 13,000 Acres of Aspen to Other Communities) | DFFC 1. Increase jack pine cover by 5000 acres.<br>DFFC 2. Increase red pine by 2000 acres.<br>DFFC 3. Increase white pine by 1000 acres.<br>DFFC 4. Increase spruce-fir by 3000 acres.<br>DFFC 5. Increase upland white cedar by 1500 acres.<br>DFFC 6. Increase upland tamarack by 600 acres.<br>DFFC 7. Manage 600 acres of northern hardwoods and mixed hardwood-conifer forest.<br>DFFC 8. Retain or increase oak as a stand component and perpetuate oak stands, cover types, and communities.<br>DFFC 9. Maintain mosaic of brushlands and peatlands at current level.<br>DFFC 10. Provide habitat for early succession wildlife species on state land.<br>DFFC 11. Provide sufficient amounts of soft and hard mast to meet wildlife needs.<br>DFFC 12. Work with utility companies to improve management of rights of way for wildlife.<br>DFFC 13. Provide habitat for late succession wildlife species on state land.<br>DFFC 14. Maintain present acreage of lowland white cedar. |
| Issue 3.<br>Age-Class Distribution | DFFC 1. Manage even-age cover types to achieve a balanced age-class distribution.<br>DFFC 2. Designate a portion of state timber lands for extended rotation forest (ERF) management to address species that need older forest.<br>DFFC 3. Manage approximately 3000 acres of forest lands for old-growth. |
| Issue 4.<br>Within-Stand Composition | DFFC 1. Manage forest stands to provide a diversity of plant species and forest structure. |
| Issue 5.<br>Patches | DFFC 1. Patches will be distributed in a range of ages and sizes characteristic of the landscape. |
| Issue 6.<br>Tree Health | DFFC 1. Manage insects, disease and wildlife so that damage will be at acceptable levels and desired native species or communities are not adversely affected. |
| Issue 7.<br>Rare Species and Critical Habitat | DFFC 1. Maintain habitats for rare plants and animals at known locations.<br>DFFC 2. Identify and conserve critical habitats.<br>DFFC 3. Protect riparian habitats. |
| Issue 8.<br>Visual Quality | DFFC 1. Minimize negative visual impacts of forest management.<br>DFFC 2. Maintain or improve visual quality along roads, waterbodies, and other visually sensitive areas. |
| Issue 9.<br>Cultural Resources | DFFC 1. Protect cultural resources on state administered lands. |

7. Under-planting, variable retention thinning, and understory burning are also used to increase species and structural diversity (i.e., may require deviation from VSFMG).
8. Riparian buffer strips left on LUP lands will often be wider than what is recommended in the guidelines to allow for effective wildlife travel corridors.

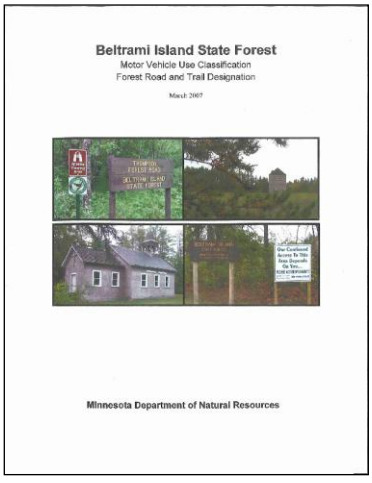
## Agassiz National Wildlife Refuge Comprehensive Conservation Plan (2005): LUP Lands Not Covered

Although state management of the Beltrami Island LUP lands is overseen by Agassiz NWR, the Comprehensive Conservation Plan (CCP) for the Refuge only provides brief mention of the LUP lands. On page 9, the Refuge CCP states, "Beltrami Island Land Utilization Project Lands consist of 81,695.5 acres owned by the federal government in scattered parcels throughout the Beltrami Island State Forest and Red Lake Wildlife Management Area in Lake of the Woods, Roseau, and Beltrami counties. The purpose of the Land Utilization Project lands as stated in Executive Order 9091, is that: 'such lands be reserved as a refuge and breeding ground for native birds and other wildlife.' The U.S. Fish and Wildlife Service administers these lands, which have been managed by the Minnesota Department of Natural Resources Division of Wildlife under a lease agreement since 1940. Agassiz NWR is the first point of contact for all Land Utilization Project management issues." And on page 10, the CCP states, "The draft CCP articulates the management direction for Agassiz NWR and its Management District for the next 15 years. It does not address Land Utilization Project lands."

## Forest Certification; Sustaining Minnesota Forest Resources: Voluntary Site-level Forest Management Guidelines

The State of Minnesota has expended considerable effort in getting state-administered timber lands certified as sustainable. Minnesota timber lands in the Beltrami Island State Forest and Red Lake WMA, including 81,673 acres of LUP land, are certified by both the Sustainable Forestry Initiative (SFI) and the Forest Stewardship Council (FSC). The CCMP allows the State to continue to meet the certification requirements of these two programs. Key elements of the State's certification are having the Subsection Forest Resource Management Plans (SFRMP) in place, and implementing the *Voluntary Site-level Forest Management Guidelines*. Therefore we consider the certification requirements and site-level guidelines as guiding documents.

## Beltrami Island State Forest Motor Vehicle Use Classification Forest Road and Trail Designation Plan (2007)




This plan, directly referred to in the 2009 Lease conditions, designated the Beltrami Island State Forest as a "managed" forest with respect to motor vehicle use. This means that ATV's and other off-highway vehicles (OHV's) may travel on existing roads and trails unless the trails are posted "closed." This plan also designated four Areas of Limitations, which are closed to OHV use: The Bemis East Area (4921 acres, including 846 acres of LUP land), the Bemis West Area (1980 acres, including 20 acres of LUP lands), the Hansen Creek

Area (2957 acres, of which the majority, 2493 acres, is LUP land), and the Manweiler Dam Area (1242 acres, of which a third, 405 acres, is LUP land).

The OHV plan addressed LUP lands but did not come to full closure on the issue within the plan; it states "LUP lands are not a separate management unit but instead exist within State Forests, State Wildlife Management Areas, State Parks, and Scientific and Natural Areas. Motor vehicle management on LUP lands is governed by **both**[6] the conditions of the lease agreement and the policies for the surrounding management area. A dialog has been initiated with the US Fish and Wildlife Service on management of motor vehicle use in a manner that will meet the conditions of the lease agreement and the rules for the management unit in which they are located." The outcome of the dialog referred to is reflected in the 2009 Lease. Thus, this CCMP will not propose to close existing open trails nor propose to open new trails per se, however, the outcome of land exchanges may allow for the opening of new trails on lands that become State, or expand on closed areas that become Federal, which should result in a theoretical no-net-loss or no-net-gain of motorized and non-motorized areas.

## Winter Road Lake Peatland Scientific and Natural Area Management Plan (2010)

The 2009 Lease refers to Watershed Protection Areas. This Peatland SNA plan identifies a 12,435-acre Watershed Protection Area (WPA) around the Winter Road Lake Peatland SNA. The WPA is comprised primarily of State Forest lands (ca. 11,053 acres), but also some LUP lands (1329 acres), Tribal lands (3547 acres), and private lands (145 acres). The WPA contains mostly lowland brush (6417 acres), marsh (2379 acres), muskeg (1892 acres), and lowland coniferous forest (909 acres), with less than 650 acres of upland forest.

Highlights of the plan call for managing part of the WPA as a High Conservation Value Forest, reserving all Ecologically Important Lowland Conifer as old-growth forest until formal evaluation is complete. Many wildlife habitat specialist "species of greatest conservation need" are found in the lowland conifer and wetland areas identified as "key habitats" in Minnesota's Comprehensive Wildlife Conservation Strategy, *Tomorrow's Habitat for the Wild and Rare.*

The Watershed Protection Area concept stems out of the following recommendation from *Recommendations for the Protection of Ecologically Signifcant Peatlands in Minnesota* (Minnesota DNR 1984): "Because of the intimate interdependence between peatland features and the surrounding hydrological regime, the task force also recommended a two-level management approach. The processes that perpetuate the peatland ecosystem, as well as plant communities and rare species, are extremely sensitive to changes in water levels and water chemistry. Accordingly, adequate protection of significant peatland features requires two types of protection. First, the peatland features must be protected directly from onsite physical disturbance. Second, the hydrology of the surrounding peatland area must be sufficiently protected in order to maintain the ecological integrity of the features under special protection."

Recommendations also include no prescribed fire in the SNA or WPA, conducting timber harvest in the WPA only in winter, and avoiding creation of any new corridors of disturbance in the WPA.

A management approach considered (but not specifically adopted) for LUP lands under this plan was to concentrate LUP lands, via land exchanges, in the ecologically important wetland areas that have been defined as Peatland SNA Watershed Protection Areas.

[6] Emphasis added to highlight a management issue.

## DNR Natural Resources Plan, Northwest Region (1995)

Another plan that lent itself to an *ecosystem services* approach is the Natural Resources Plan for the DNR's northwest region. That plan identified desired future conditions (DFC's) out to the year 2090 for four landscapes, one of which is the Agassiz Peatlands and Woodlands landscape that is roughly analogous to the Agassiz Lowlands subsection. In simplest terms, the Plan identified six DFC's that envision maintaining the current character of the landscape. The six DFC's were described in detail in the draft CCMP. Although not incorporated into this CCMP, the Natural Resources Plan will be consulted when considering land exchanges.

## A Management Plan for Hayes Lake State Park (1979)

This plan, implemented in 1979, established Hayes Lakes State Park as a "recreational" state park with the goal "to provide water and forest oriented recreation for large numbers of people and to provide a recreational gateway to Beltrami Island State Forest." The main focus of the park is Hayes Lake, which was created by damming the Roseau River and establishing an impoundment partially on LUP land. The project was conceived of and approved at the state level immediately prior to the passage of the federal National Environmental Policy Act. The park plan established zones within the park that guided subsequent development of the park. Among key provisions of the plan, it restricted motorized boats from the Hayes Lake impoundment, guided the development of snowmobile and other skiing and hiking trails on LUP lands in the park, and set a vision for vegetation management of LUP land in the park.

Overall, park management will be directed towards maintaining the ecological community and wildlife diversity consistent with existing habitats, and openings will be created and maintained to increase the visibility of wildlife for park visitors. Timber removal will be used to promote wildlife diversity, controlled burns will be used in cut-over areas to encourage jack pine regeneration, and pine plantations will be thinned to improve growth.

The LUP parcel lying under and south of Hayes Lake impoundment was identified as pioneering hardwoods that became established following a severe fire in 1910, with an expected longevity of about 100 years before succeeding to alder and willow if no management occurred.[7] A deer wintering area was identified in this parcel. No Indian burial mounds were known prior to the construction of the snowmobile and walking trail, but a potential one was discovered as it was being destroyed during trail construction in the 1970s. LUP lands along the River Forest Road and west of the park entrance road were identified as containing a mix of pioneering hardwood, sensitive marshes, jack pine, and alder-willow habitats.

The Park has an updated 2010 draft natural and cultural resources management plan[8] for 2010-2015 that describes existing and desired future vegetation conditions. Essentially, the plan calls for no changes in vegetation communities on LUP land except for some very minor restorations of jack pine woodland on slivers of land along the border of LUP lands at three locations.[9]

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[7] A site visit in 2011 indicated succession was not yet leading in the direction of alder and willows, but rather it is still a mixed forest dominated by aspen and other deciduous species.

[8] Hayes Lake State Park Unit Plan for Natural & Cultural Resource Management 2010-2015.

[9] See Appendix C in draft CCMP.

## Tomorrow's Habitat for the Wild and Rare: An Action Plan for Minnesota Wildlife (Minnesota Comprehensive Wildlife Conservation Strategy, 2006)

Minnesota's Comprehensive Wildlife Conservation Strategy establishes a broad vision of a better future for wildlife and provides a simple but challenging pathway to success: First, conserve key habitats used by Minnesota's "species in greatest conservation need" in order to conserve the majority of Minnesota's wildlife. Second, for species that fall through the first coarse filter, identify individual species-level actions necessary for their conservation.

The Agassiz Lowlands ecological subsection contains 88 species that have been deemed "species in greatest conservation need" (see Chapter 3). Four key habitats have been identified for this subsection: lowland coniferous forest, non-forested wetlands, shorelines (specifically Lake of the Woods shoreline), and rivers. LUP lands contain roughly 19,000 acres of lowland coniferous forests and 21,000 acres of non-forested wetlands, which will be conserved.

## A Strategic Conservation Agenda, 2009-2013

The Strategic Conservation Agenda is a two-part document outlining the Department's goals for a five-year period towards reaching the ultimate goal of "healthy natural lands and waters" which are considered "key to Minnesota's prosperity."[10] The Plan is designed to provide internal management direction by defining agency-level performance goals critical to mission success, and to demonstrate accountability to citizens and stakeholders by communicating the DNR's work in terms of measureable results. The goals cover all Divisions' programs, and are statewide in scope, but some of the goals and performance indicators are directly pertinent to the LUP planning area. See the Draft CCMP for a list of goals, visions, and performance indicators in the Strategic Conservation Agenda that are pertinent to the LUP planning area.

## Wolf Management Plan, Red Lake Band of Chippewa Indians (2010)

A main goal of this plan is to outline management options that help ensure long-term survival of wolves on Red Lake lands and protect them from adverse effects that could lead to population declines. The wolf represents a minor Clan of the Red Lake Band of Chippewa and the importance of wolves in Chippewa culture is highlighted in legends and oral history. Tribal spiritual leaders and elders speak of the parallel fates of wolves and native people. Many believe that if wolves prosper, the people of Red Lake will prosper, and if wolf populations suffer, so will the Red Lake Nation. A public opinion survey of 56 Red Lake residents showed 80% would not support a harvest of wolves. Thus the Red Lake Band's Wolf Management Plan includes the following policies: 1) hunting and trapping of wolves on tribal lands is strictly prohibited; 2) without further action by the Red Lake Tribal Council, Red Lake lands shall be a sanctuary for wolves; and 3) all efforts will be made to preserve wolves and the habitats that support them.

In terms of habitat management on Tribal lands, extensive harvest of hardwoods during the past 20 years has promoted early-stage successional vegetation communities on many upland sites that favor several key prey species, particularly white-tailed deer. On the Diminished Reservation, approximately 38% of the forested acreage is classified as young aspen**.** Timber harvest in many areas has slowed, but

[10] In this vision, a healthy environment enables a viable economy which leads to vibrant communities.

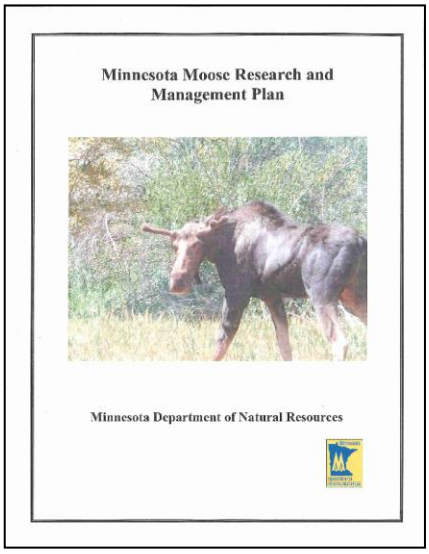
will continue to be a major factor affecting Red Lake's forested areas. Although logging activities may have short-term impacts on pack and/or individual wolf use of an area, these effects should be absorbed by the long term benefits of increased forage and cover that will promote increased prey abundance. A major pine restoration effort is underway on Red Lake's Diminished Reservation. Many upland sites that are currently dominated by hardwood communities will be cleared and replaced by coniferous forest cover types. The restoration effort involves re-establishing 50,000 acres of pine by the year 2057. Although conversion to pine communities might reduce local prey availability (within plantations), overall landscape effects to the prey base should be minimal. Establishment has been occurring at a rate of about 300 acres per year. The size of individual plantations will range from approximately five to 300 acres and they will be placed in suitable sites across Red Lake's Diminished Reservation and restored ceded lands. It is expected that 70% of the plantations will be red pine, 15% white pine, and 15% jack pine.

## DNR Wolf Management Plan (2001)

This plan was prepared in anticipation of an imminent federal de-listing of gray wolves from the protections of the Endangered Species Act. The plan reaffirmed a position statement adopted by the DNR in 1998: "The Minnesota Department of Natural Resources is committed to ensuring the long-term survival of the wolf in Minnesota, and also to resolving conflicts between wolves and humans."

The plan establishes two wolf management zones; Zone A with a minimum population of 1600 wolves, and Zone B with no minimum goal set. The LUP planning area is within Zone A. The zones also differ in the extent to which landowners who shoot wolves to protect livestock and pets must document the level of threat actually posed by the wolf that was taken**.** In Zone A, the "killing of depredating wolves is limited to situations of immediate threat, and immediately following verified losses of livestock, domestic animals, or pets." Also, "A person who destroys a wolf under these circumstances must protect all evidence and report the taking to a conservation officer as soon as practicable, but no later than 48 hours after the wolf is destroyed."

## DNR Moose Plan (2011)




The DNR plan for preserving and recovering moose populations is focused heavily on northeastern Minnesota where the moose population is currently around 4,900 animals. Highlights of the moose plan focus on more research to understand causes of mortality and to identify critical habitats during periods of summer heat. It also sets guidelines for when to close and reopen moose hunting, and sets a spring pre-fawn goal of <10 deer/mi$^2$ in moose range.[11]

The plan notes important habitat differences between the northwestern and northeastern moose populations. The northwest population occupied a mixture of public and private lands dominated by brushlands, mesic hardwood forests, aspen parklands, peatlands, agriculture and prairie; the northeast

[11] Deer are implicated in spreading diseases to moose, and a threshold of 13 deer/mi$^2$ has been suggested as the density at which transmissions readily occur.

population ranges over boreal forest dominated by large blocks of public land containing large numbers of lakes and rivers. The plan notes the DNR expended significant effort at regenerating brushlands to improve browse in the northwest, but those efforts did not prevent the significant decline of moose there. Otherwise, most moose habitat management in Minnesota is accomplished through commercial timber harvest management. Some key timber harvesting guidelines to benefit moose include conifer retention, protecting aquatic resources, legacy patches, and riparian guidelines as found in the *Sustaining Minnesota Forest Resources: Voluntary Site-Level forest management Guidelines*.

Some other habitat management recommendations include:

- Increase stand complexity
- Promote regeneration of mixed-species stands
- Protect desirable browse vegetation while reducing competition with conifer seedlings
- Promote more use of prescribed fire and take appropriate advantage of wild fire
- Maintain upland brush communities
- Increase rotation age of aspen to increase understory browse while retaining summer thermal cover

The use of prescribed fire, timber harvest, and mechanical treatment to create early successional habitats, and managing for patches of mature aspen are both elements of the Agassiz Lowlands SFRMP. The moose plan identifies using the SFRMP update process as an avenue for giving moose habitat needs more consideration on state lands in moose range.

## DNR Ruffed Grouse Plan (2011)

This plan establishes a long-range vision for ruffed grouse, which includes sufficient quantity, quality and spatial distribution of habitat to support robust populations throughout the species range in the state, along with a fairly stable number of hunters enjoying a range of quality hunting experiences and having adequate access to public lands. A guiding principal of this plan is that management strategies implemented for ruffed grouse will contribute to the overall health of Minnesota's forested landscapes.

The plan identifies 1) quality hunting issues and quality hunting strategies, and 2) quality habitat issues and quality habitat strategies. Highlights of the former topic (hunting) include:

- DNR will enhance the quality of hunting opportunities by providing more hunter access to grouse habitat and offering a balanced mix of hunting opportunities.
- Establish new Hunter Walking Trails (HWT's), maintain HWT's by mowing, and expand efforts to inform the public of HWT's. HWT's are trails through mixed forest types where motorized vehicles are not permitted.
- Promote Ruffed Grouse Management Areas (RGMAs). RGMA's are areas of forest land, often several sections in size, where management is prescribed to benefit ruffed grouse. RMGA's will be established through the SFRMP process.

Highlights of the latter topic (habitat) include:

- Convert a percentage of aspen stands to mixed conifer-hardwood stands.

- Where appropriate, apply silvicultural practices (winter harvest, clumped residual leave trees) that create high stem densities during early growth stages.
- Implement more habitat projects on WMA's.
- Emphasize ruffed grouse management in landscape-level management plans (e.g., SFRMP plans).
- Develop and communicate best management practices (BMP's) for ruffed grouse.
- Identify additional RGMA's.

## American Woodcock Conservation Plan (2008)

The overall goal of this joint-partnership plan written by Kelley et al. (2008) is to halt the decline of woodcock populations and return them to densities (not populations) that occurred in the 1970s. Specific objectives include halting population declines by 2012, halting the decline of early successional forests by 2012, and seeing an increase in early successional forests by 2022. It is widely believed that the loss of early successional forest habitat is responsible for declines in woodcock populations (Kelley et al. 2008), but it may be that ground nesting species overall are more susceptible to changes in predator populations (G. Niemi, pers. commun., during presentation of paper by Hanowski et al. 2000). Thus woodcock may not respond to increases in habitats as projected. In the Minnesota portion of the Boreal Hardwood Transition zone, woodcock populations have declined about 1%/year since 1968, but elsewhere in the Boreal Hardwood Transition zone the declines have been 1.9%/year (Dessecker 2008).

The woodcock plan recognizes the Beltrami Island area as a "coarse priority area"[12] and calls for using a landscape-level approach involving using management units of 500-1000 acres which would support approximately 500 woodcock, with several units located within 1-2 miles of each other. Management treatments should be centered on broad-leaved deciduous or on deciduous shrub-scrub wetlands where moist soils are found. Even-aged forest management treatments of $\geq$5 acres would stimulate sprouting of shade-intolerant species such as aspen to create ideal woodcock habitat, short rotation cutting cycles of about 20 years would ensure the forest not become too mature for woodcock use, and cuttings should cross riparian areas to assure the full moisture gradient is represented in the regenerating stand (Kelley et al. 2008). More specifically, in the Boreal Hardwood Transition zone, the prescription is to create 3.5 million more acres of early successional forest and sustaining aspen/birch communities through traditional clearcut regeneration (Dessecker 2008). However, the plan recognizes that these prescriptions run contrary to current public agency trends against managing clearcuts for regenerating aspen monocultures and for greater riparian area protections in the Boreal Harwood Transition zone. Furthermore, agencies are trending away from single-species management.

## Partners in Flight Tri-National Vision for Landbird Conservation (2004)

This landbird conservation plan[13] spearheaded by the U.S. Fish and Wildlife Service builds upon the priorities identified for the U.S. and Canada in the 2004 Partners In Flight Landbird Conservation Plan, with a decidedly tropical focus. However, among the species identified as "Species of Tri-National Concern" are a few that occur in the Beltrami Island area (olive-sided flycatcher, wood thrush, golden-winged warbler, and Canada warbler), and a few grassland species typical of the Dakotas that could utilize the area in the future if habitats become more savannah-like (greater prairie chicken, Sprague's

[12] See Figure 1.9 in Draft CCMP, page 29.
[13] Written by Berlanga et al. (2010).

pipit, Baird's sparrow, Henslow's sparrow, and chestnut-colored longspur). Among the most steeply declining species in temperate forests are species dependent on disturbed early successional forests (ruffed grouse, whip-poor-will, golden-winged warbler). The plan also lists 42 common species that have seen dramatic declines (>50%) based on data from Breeding Bird Surveys, amounting to a cumulative total of 800 million birds of these species that have disappeared from the landscape. This list includes species such as ruffed grouse, short-eared owl, belted kingfisher, northern flicker, and Connecticut warbler which occur in the LUP planning area. The plan identifies six actions for conserving Species of Tri-National Concern (that will also benefit common species): 1) protect and recover species at greatest risk (aimed primarily at Mexico), 2) conserve habitats and ecosystem functions, 3) reduce bird mortality, 4) expand our knowledge base for conservation, 5) engage people in conservation action, and 6) increase the power of international partnerships.

## Old-Growth Forests Guideline (1994) and Old-Growth Forests Guideline Amendment #5 (2002)

The old-growth forest guidelines establish goals for designating and preserving old-growth stands for a variety of species. In the Agassiz Lowlands subsection, the plan established goals for identifying and preserving six stands and 425 acres of old-growth black ash, ten stands and 1230 acres of lowland hardwoods, one stand and 55 acres of northern hardwoods, two stands and 40 acres of oak, seven stands and 360 acres of red pine, five stands and 230 acres of white pine, six stands and 130 acres of white spruce, and eight stands and 335 acres of upland white cedar.[14]

The original plan also established "special management zones" (SMZ's) around candidate and future old-growth stands. SMZ's are to be a minimum of 330 feet around candidate and future old-growth stands in order to minimize the potential damage to old-growth from catastrophic windstorms, and the SMZ's are to be managed under extended rotation forestry guidelines. SMZ's also buffer old-growth from the effects of adjacent vegetation management and recreational impacts.

In 2002, Amendment #5 added the concept of designating "old forest management complexes" (OFMC's) that took in old-growth stands and SMZ's, and expanded the application of extended rotation forestry practices to additional adjacent stands where practical to create connectivity, maintain soil and water quality, for recreational and aesthetic values, etc. One benefit of designating OFMC's was to "ensure that Special Management Zone boundaries are determined."

## Wetland Conservation Act (1991)

The Minnesota Wetland Conservation Act of 1991 is more than an Act codifying wetland protection measures. It also established 18 peatland Scientific and Natural Areas, gave special protections to calcareous fens, and it established a state policy towards wetlands. The State policy is to "A) achieve no net loss in the quantity, quality, and biological diversity of Minnesota's existing wetlands; B) increase the quantity, quality, and biological diversity of Minnesota's wetlands by restoring or enhancing diminished or drained wetlands; C) avoid direct or indirect activities that destroy or diminish the quantity, quality, and biological diversity of wetlands; and D) replace wetland values where avoidance of activity is not

[14] Actual acres designated were 938 acres of black ash, 399 acres of upland white cedar, 1093 acres of lowland hardwoods, 0 acres of northern hardwoods, 55 acres of oak, 539 acres of red pine, 316 acres of white pine, and 153 acres of white spruce, for a total of 3493 acres (DNR's Old-growth Forests Guideline Implementation Results 2002).

feasible and prudent."[15] The added protections provided to calcareous fens are: "Calcareous fens may not be drained or filled or otherwise altered or degraded except as provided for in a management plan approved by the [DNR] commissioner."[16] A calcareous fen exists in the Bemis swamp area.[17]

The Wetland Conservation Act also provides extra protections to endangered and threatened species, rare natural communities, and special fish and wildlife resources by requiring denial of permit applications that do not adequately mitigate adverse impacts.[18]

In addition, DNR has an Executive Order Policy imposing a higher mitigation standard for DNR projects: any project that impacts more than 0.10 acres of wetlands that would otherwise be exempt under WCA, except for incidental wetlands, shall be replaced at a minimum 1:1 ratio.

Although the Wetland Conservation Act does not apply to federal LUP lands, it does apply to adjoining state lands that are jointly managed, and state employees would not advocate extending lesser protections to LUP lands in their management practices.

## Executive Order 11990, Protection of Wetlands (1977)

Federal Executive Order 11990 for the protection of wetlands was signed by President Jimmy Carter on May 24, l977. In essence, the E.O. directed each federal agency to provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities. In carrying out the activities described in Section I of this Order, each agency shall consider factors relevant to a proposal's effect on the survival and quality of the wetlands. Among these factors are: (a) public health, safety, and welfare, including water supply, quality, recharge and discharge; pollution; flood and storm hazards; and sediment and erosion; (b) maintenance of natural systems, including conservation and long term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utility, fish, wildlife, timber, and food and fiber resources; and (c) other uses of wetlands in the public interest, including recreational, scientific, and cultural uses. All LUP lands would be subject to E.O. 11990.

## Red River Basin Commission Long Term Flood Solutions Plan (2011)

In response to the 2009 record flooding, state legislators in North Dakota and Minnesota asked the Red River Basin Commission (RRBC), as an international Basinwide organization, to spearhead the effort to develop a comprehensive, proactive plan that responds to and mitigates flooding throughout the watershed. The RRBC was uniquely positioned for this endeavor given its ongoing organized effort to further commitment to shared land and water stewardship goals through their Red River Basin Natural Resource Framework plan, including the goal of flood damage reduction.

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[15] Minnesota Rules Chapter 8420.
[16] Minnesota Rules Chapter 7050.0180.
[17] Calcareous fens are the rarest wetland types in Minnesota if not all of North America (Leete 1996). They typically occur at the foot of a slope above a watercourse, where groundwater is discharged from a recharge zone higher up on the landscape. In the Bemis Hill area the recharge zone is the greater area of higher elevations to the southeast of the calcareous fens. Calcareous fens are also listed as Outstanding Resource Value Waters by the Pollution Control Agency in Minnesota Rules Chapter 7050.
[18] Minnesota Rules Chapter 8420.0548.

The resultant report was called the Red River Basin Long Term Flood Solution Plan (LTFS). The LTFS was completed in September 2011. This report contains a number of recommendations related to necessary flood water retention. These goals are centered around providing a minimum of 20% reduction in peak flow on the Red River mainstem. The minimum goal for peak flow reduction on the Red River mainstem at the international boundary for a 100-year flood equates to around 1.5 million acre feet of storage upstream accounting for timing of flow.

The Red River Basin Commission's plan identifies a goal of a 20% reduction in peak flows on the Red River mainstem south of Emerson, Manitoba. Key points from the plan include:

- Achieving the 20% flow reduction would require about 1.5 million acre-feet of appropriately placed storage in the subbasins.
- Upstream impoundments are identified as the first or second most likely options for protection for almost 70% of mainstem and tributary cities.
- When ease of implementation is added to the criteria, off-channel storage is rated as high or medium at almost 90% of basin cities, surpassing all other structural or nonstructural options considered.
- The MIKE 11 Hydraulic Modeling Tool found that floodwater peak reduction can be achieved by a wide variety of flood water retention measures and projects, including on-channel or off-channel impoundments, culvert sizing or waffle storage, wetland restoration, or land-use change.
- That individual watershed districts should determine the best approach for their area.

Two local watershed districts have identified flood damage reduction projects that involve LUP lands, as described later. Project plans, however, have to be approved under the auspices of a 1998 Mediation Agreement between various federal, state, and local units of government.

## 1998 Mediation Agreement

The 1998 Mediation Agreement was the product of eight months of consensus-based, mediated negotiations by the Red River Basin Flood Damage Reduction Work Group. It responds to a mandate from the Minnesota Legislature to resolve gridlock over state permitting of flood damage reduction projects in the Red River Basin. The agreement is intended as the framework for a new, collaborative approach to implementing both flood damage reduction and natural resource protection and enhancement in the Red River Basin

The Mediation Agreement contains eight broad goals for flood damage reduction in the Basin. It also includes 11 flood damage reduction principles, including: 1) water resource problems should not be passed along to others; a solution for a watershed should not create a problem upstream or downstream; 2) water should be stored/managed as close to where it falls as is feasible and practical; and 3) the responsibility for mitigation of negative environmental and cultural impacts rests with the project proponent. The Warroad River Watershed is not in the Red River Valley and is not a part of the Mediation Agreement; the Roseau River Watershed is in the Red River Valley and the District does abide by the Mediation Agreement process.

The Mediation Agreement establishes a comprehensive Project Review and Permitting Process, which includes the formation of a Project Team to "work with the project from formation to the conclusion of

either build or end." The Project Team participants "will include the watershed districts, state, federal and tribal agency personnel, local government officials, affected landowners and interested citizens and interest group representatives." State agency personnel will be assigned participation as part of their position description. The Project Team "meets to evaluate alternatives identified in Step 1, formulate new alternatives as necessary, and identifies their preferred alternative(s), using an evaluation process that is consistent with the eleven flood damage reduction principles identified in Part II." The Project Team "identifies data and information needs for the environmental review associated with the review and permitting process. The use of '*Information Required to Evaluate Most Impoundment Projects*' and other sources or checklists will be used where appropriate and available."[19] The Project Team "collaborates with the Responsible Government Unit (RGU) to help prepare an environmental assessment worksheet (EAW) for the preferred alternative. The RGU publishes an EAW for the proposed project which includes the preferred alternative, other alternatives considered, proposed mitigation for any adverse effects, and operating plans, if the project involves on-going operation."

## Red River Basin Commission Natural Resources Framework Plan (2005)

The Red River Basin Commission also has a Natural Resources Framework Plan that includes the following goals and objectives: 1) manage natural resources by watershed boundaries rather than political boundaries; 2) integrate natural resource management; 3) increase applied research and data management to support decision-making; 4) improve stakeholder participation and awareness of land and water issues; 5) maintain state-of-the-art flood forecasting tools for the Red River Basin; 6) reduce risk of flood damages for people, property and the environment in the mainstem floodplain and in tributary waters; 7) ensure that flood (natural disaster) response and recovery programs meet the needs of all Basin residents; 8) manage urban and agricultural drainage systems to enhance productivity, while minimizing impacts to others; 9) maintain, protect and restore surface and ground water quality in the Red River Basin; 10) ensure the appropriate use and sustainability of the Basin's surface and groundwater: 11) increase soil conservation efforts within the basin; 12) conserve, manage and restore diversity and viability of native fish and wildlife populations; and 13) enhance and develop recreational infrastructure and access to the Basin's natural resources. Relative to item 12, objectives include a) maintain, enhance and protect aquatic and terrestrial populations, b) enhance, protect or restore natural systems, and c) identify and protect rare and unique species, habitat types and plant communities.

## Roseau River Watershed Plan (2004)

The Roseau River Watershed District plan (RRWD 2004) identifies goals, objectives and strategies for projects aimed at comprehensive 1) flood damage reduction and 2) natural resource enhancement. Major initiatives include protecting the City of Roseau from severe flooding, and restoring at least some water to drained Roseau Lakebed. Other watershed restoration opportunities identified included restoring drained Whitney Lakebed and drained Mud Lakebed, and evaluating how much water is diverted into this watershed by ditches draining from other watersheds (e.g., County Ditch 6/9 and Judicial Ditch 61 that move water from the Warroad River watershed to the Roseau River watershed).

Goals, objectives, and strategies for flood damage reduction and for natural resource enhancements are listed in the Draft CCMP.

[19] The referenced checklist was replaced with *On-Channel Storage Site Natural Resource Assessment Worksheet* included in the TSAC Technical Paper No. 13.

The Roseau River watershed plan incorporates the County Comprehensive Local Water Plan (JOR Engineering 2002) which identifies a goal of storing 30,000-40,000 acre-feet of water and identifies 15 potential impoundment sites. Specific opportunities for impounding water in the Beltrami Island State Forest include reconstruction and evaluation of potential enhancements to the five dam structures that were previously damaged by flooding on the Roseau River and Hanson Creek. These five dams would have a combined pool area of about 3712 acres (5.8 $mi^2$). Also, the Roseau Flowage impoundment is proposed to be augmented to have a pool area of 3776 acres (5.9 $mi^2$). The first five sites would have a total of 10,105 acre-feet of gated storage and 13,616.6 acre-feet of total storage; and the Roseau Flowage would have 10,229.4 acre-feet of gated storage and 13,938.3 acre-feet of total storage (JOR Engineering 2002). Most of the impounded areas would be on LUP lands, but some would be on private land and some on State land. Another proposed project at Beaver Township would impound 580 acres, of which 15 acres is LUP land. However, flexibility is built into the plan. The goal of storing 30,000-40,000 acre feet of water could be accomplished by construction of 60 to 70% of the 15 sites, or other comparable sites.

Forest species composition and age affect runoff into watersheds (Verry 1976, Ohmann et al. 1978, Stednick 1996, National Research Council 2008). Our CCMP supports this approach by managing vegetation (e.g., more conifers and extended forest rotations on the landscape) and using natural stream management to help mitigate flood events. Our plan also allows for the consideration of water storage structures that have mutual wildlife benefits.

The RRWD recommends that HEC-HMS modeling that is currently being updated by the U.S. Army Corps of Engineers should be used to evaluate future project benefits**.**

## Warroad River Watershed Plan (2007)

The Warroad River Watershed District's (WRWD) mission is to "take a proactive role in managing resources by providing leadership for water management and working in partnership with local, state, and federal partners to focus water flow management, address issues related to surface water run-off, educate the public, and model good stewardship of the environment" (WRWD 2007). The intent of the WRWD is to partner to focus water flow management to meet a goal of a 20-30% reduction in peak runoff by water detention and other best management practices within the BISF (WRWD, personal communication).

The WRWD identified one specific issue that we believe is pertinent to LUP lands: road washouts at Clausner Creek intersection with Tangnes Trail, with a possible long term solution being to retain water in Beltrami Island State Forest.

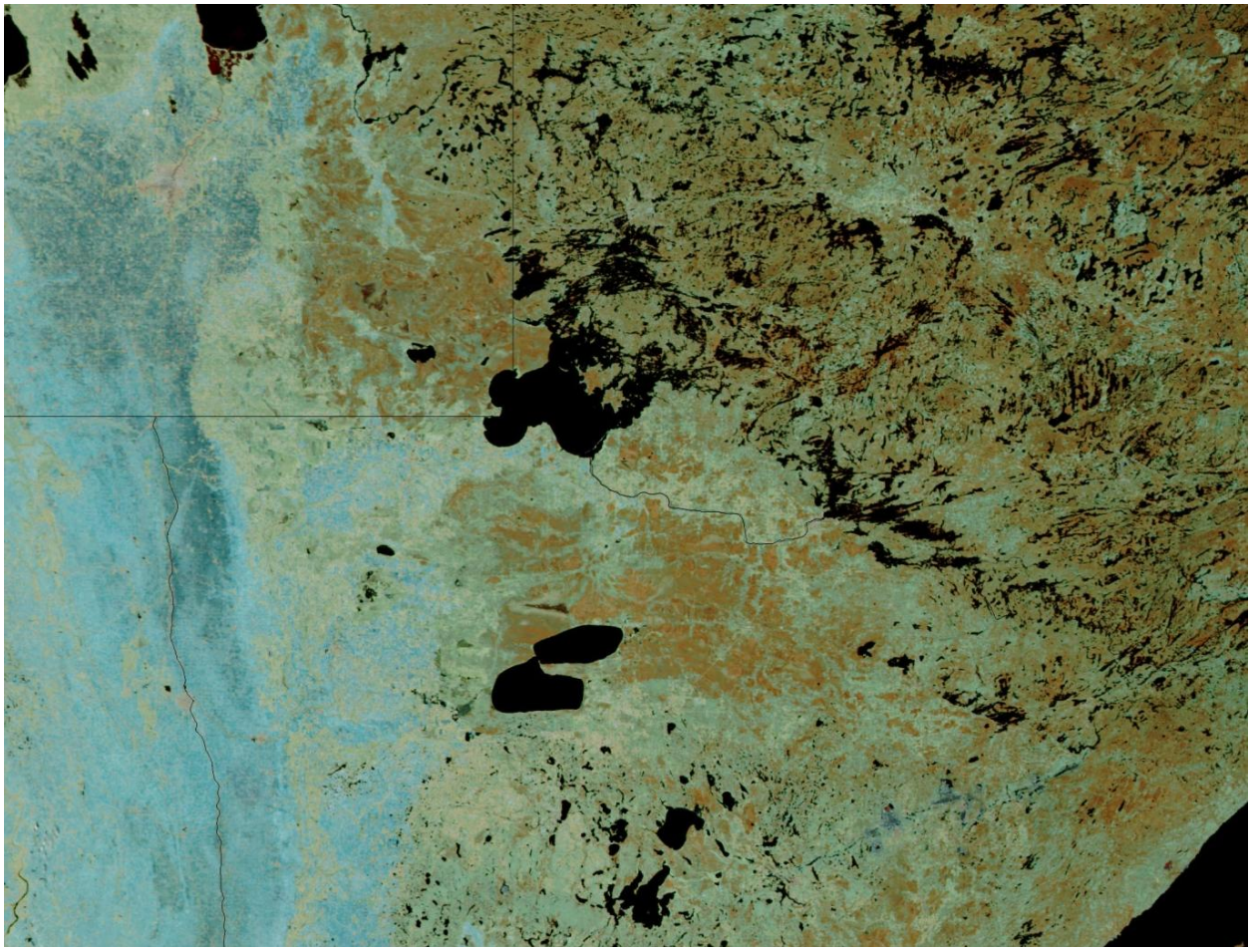
The WRWD has also adopted the following goal and strategies that may be pertinent to LUP lands:

> Goal: Focus on water flow management and water quality.
>
> Strategies: 1) a culvert inventory will be done over the entire watershed; 2) adopt and implement a beaver control program; because beaver dams impede the flow in various ditches and other waterways, it is necessary to remove and control beavers to aid in drainage and flood control and to improve water quality and reduce erosion by restoring original stream channels; and 3) inventory log jams and blockages on rivers and creeks, then begin a clearing and snagging program.

We note, however, that the last two strategies, if implemented in the BISF, could be at cross purposes to retaining more water in the BISF.

## Rainy River Basin Plan (2004)

This collaborative plan was developed by the Minnesota Pollution Control Agency (MPCA) under Sections 209 and 303(e) of the Clean Water Act. It set a basin-wide goal to "maintain or improve the existing condition of streams, rivers, lakes and groundwater in the Rainy River Basin." Three rivers that flow out of the LUP planning area form watersheds within the Rainy River Basin: Rapid River, Winter Road River (called the Rainy River/Baudette watershed), and Warroad River (called the Lake of the Woods watershed). Basin-wide goals and objectives, and local committee concerns, are listed in the Draft CCMP.



Inset: The Beltrami Island area as seen from space, showing unique bogs and water track features.

# Chapter 2: The Planning Process

## Meetings and Public Involvement Opportunities

The planning process for this CCMP began formally on January 11, 2011, with formal notices announcing Scoping appearing in the *EQB Monitor* on January 10, 2011 and the *State Register* on January 11, 2011.

Informally, preparation for the plan began much earlier. A cultural resources management plan[20] was prepared jointly by the DNR and Minnesota Historical Society (Magner and Emerson 2008). Although a stand-alone document, because the cultural resources management plan has not gone through a public review process, we are accepting comments on it as part of the draft CCMP public environmental review process. Also in 2008, Scott Zager of Wildlands Ecological Services was contracted to prepare background information on the natural resources of the project area; that material is incorporated in this draft CCMP and is part of the current public environmental review process.

In September 2010 a Project Consultant was hired to complete the writing of the CCMP and to manage the public review process. A Leadership Team was also assembled (Appendix B), which oversaw the development of communication plans, public outreach plans, information materials, the development of a project website, and the development of a questionnaire/alternative comment form prior to the start of Scoping. This included a meeting with project staff and the U.S. Fish and Wildlife Service's Midwest Region staff on December 15, 2010, and consultation with a statistician (Dr. David Fulton) of the U.S. Geological Survey's Cooperative Wildlife Unit at the University of Minnesota on November 1, 2010. An Alternative Public Scoping/Questionnaire Comment Form[21] was developed to assist the public in providing useful input. The form contained four parts: public use, public knowledge of LUP lands, public preferences for LUP land management, and scoping questions recommended by the U.S. Fish and Wildlife Service.

A website (www.beltramiisland.info) was developed. The website included a Powerpoint presentation that contained the same information displayed at public open houses, a downloadable questionnaire/ alternative scoping comment form, information on open house dates and locations, and pdf files of existing pertinent plans and what we perceived to be some key scientific literature.

In addition, information on the LUP planning and public comment processes was included in the October 2010 and January 2011 issues of Norris Camp News, a periodic newsletter of the Red Lake WMA; a letter was sent to the Red Lake Tribal Council on December 30, 2010; a DNR news release was sent out to statewide media on January 12, 2011 announcing the planning process and website; a notice was sent to the Warroad Chamber of Commerce for their community calendar website to fulfill a request they made to receive it; and on January 7, 2011, individual letters were sent to 61 entities (state, national, and local elected officials, watershed organizations, user group umbrella organizations, non-profit environmental groups, industrial trade groups, professional wildlife and ecological societies, local commerce and tourism chambers, and other interested individuals).

[20] See Appendix D in draft CCMP.

[21] Public notices and materials on display at the public open houses also encouraged traditional forms of comment (i.e., letters and email).

The news release was picked up by media outlets including Outdoor News, ABC Newspapers, Minnesota Outdoorsmen, Minnesota on the Web, Outdoors Weekly, Lakeshore Dreams, Fishing Buddy, Implu Corporation, and Northern Light.

Three public open houses were held:

January 26, 2011, 6-8 pm, in Baudette at the Lake-of-the-Woods County Board Room;

January 27, 2011, 6-8 pm, in Warroad at the Warroad Community Center; and

February 2, 2011, 4-8 pm, in Bloomington at the REI store.

The open houses contained informative displays, and questionnaires were distributed for visitors to fill out and return that night, or mail in later. DNR and Fish and Wildlife Service staff on the Leadership Team were present to answer questions. No formal program or question-and-answer session was offered.

In addition, the Leadership Team met with the Red Lake Band's Department of Natural Resources staff on January 25, 2011 to present the materials for the open houses, to distribute questionnaires, and to inquire about the need for an additional public meeting to gather tribal concerns. No additional public open houses were deemed necessary, and the Red Lake Band created a link on their website to our project website.

Scoping closed on March 2, 2011.

# Public Response

Data indicate that the website was visited 1,645 times. Once visited, the questionnaire was downloaded 1,006 times, the key science documents were viewed 421-450 times, and various existing related plans were viewed 142-196 times.

A total of 109 people attended the three open houses, and 113 questionnaires were distributed at them. Twenty people attended the open house in Baudette, and 75 people attended the open house in Warroad, including some who attended the open house earlier in Baudette. No one at the Baudette open house turned in a questionnaire that evening. However, 14 questionnaires were turned in at the Warroad open house, including three that had been picked up at the Baudette meeting and seven that had been downloaded from the website. Fourteen people attended the open house in Bloomington, of which 12 owned property or had worked in the Beltrami Island area; four questionnaires and one letter were submitted at that open house.

In total, 70[22] scoping comments were received. Some of the comments were specific to LUP lands, but the majority of comments were deemed to be directed to the greater Beltrami Island State Forest (and Red Lake WMA) area in general. Comments came in the form of letters (6), email messages (20), phone messages (1), and questionnaires (43). Of the questionnaires received, 18 were picked up at open houses, 22 were downloaded from the project webpage, two were phoned in, and one person emailed in only the answers to the questions (i.e., not the form).

[22] Five of these were received/postmarked after March 2, 2011. After consultation with the U.S. Fish and Wildlife Service, we decided to accept these since "scoping" is an ongoing process throughout environmental review, and focus groups had yet to meet.

# Public Use and Knowledge About the Area

The questionnaire revealed that the greater Beltrami Island Area received use year-around by 72% of the respondents, with the greatest amount of use in the fall (100%, 43 of 43 respondents), and the lowest use in the spring (74.4%, 32 of 43 respondents). The Beltrami Island State Forest was the most visited unit by respondents (97.7%, 42 of 43 respondents), followed by Hayes Lake State Park (83.7%), Red Lake WMA (76.7%), Winter Lake Road Peatland SNA (55.8%), Gustafson's Camp SNA (39.5%), Mulligan Lake Peatland SNA (37.2%), and Red Lake Peatland SNA (34.9%). One respondent volunteered that they only visit the SNA's in winter, and we believe this is probably true for most of the SNA's which are most easily accessed by snowmobiles.

The most participated in recreational activities by 43 users of the area were:

| | | | |
|---|---|---|---|
| Hunting | 41 (4)[23] | Gathering natural medicines | 1 |
| Berry picking | 33 (4) | Exposing grandchildren to the outdoors | 1 |
| Nature drive | 33 (1) | Teaching children how to treat the land, keep it clean for future generations | 1 |
| Camping | 29 (2) | | |
| Hiking | 29 (1) | Stargazing (without interference from lights) | 1 |
| ATV/ORV riding | 25 (1) | Target practice | 1 |
| Snowmobiling | 25 (1) | Sighting in rifle | 1 |
| Bird watching | 19 (1) | Quality family time | 1 |
| Mushroom hunting | 19 | Relaxation | 1 |
| Photography | 17 | Gathering diamond willow | 1 |
| Fishing | 17 (1) | Botanizing | 1 |
| Nature observation | 11 (3) | Seed collecting | 1 |
| Skiing | 9 (1) | Canoeing | 1 |
| Gathering natural foods | 8 | Motorcycling | 1 |
| Biking | 6 | Running | 1 |
| Trapping | 5 | Having a cabin lease on state land | 1 |
| Horseback riding | 4 (1) | Cutting firewood on own property | 1 |
| Snowshoeing | 3 (1) | Picnicking | 0 (1) |

Inset: Ruffed grouse hunting. Photo by Lloyd McKissick.

[23] Number in parentheses indicates number of letter writers or e-mail writers who indicated they participated in these activities.

However, when asked which of these activities were most important to them, the results shifted somewhat:

| | | | |
|---|---|---|---|
| Hunting (general) | 17[24] | Berry picking | 3 |
| Ruffed grouse hunting | 2 | Bird watching | 2 |
| Deer hunting | 1 | Fishing | 2 |
| Bear hunting | 1 | Nature drive | 1 |
| Bobcat hunting | 1 | Family time | 1 |
| ATV/ORV riding | 15 | Teaching the next generation | 1 |
| Snowmobiling | 9 | Rare plant life list | 1 |
| "All" | 6 | Running | 1 |
| Camping | 5 | Biking | 1 |
| Hiking | 5 | Snowshoeing | 1 |
| Skiing | 3 | Natural resource management and research | 1 |

The most popular hunted species indicated by 43 questionnaire respondents were:

| | | | |
|---|---|---|---|
| Ruffed grouse | 39 | Ducks and geese | 10 |
| Deer | 34 | Bear | 6 |
| Woodcock | 17 | Squirrel | 5 |
| Rabbit/hare | 16 | Moose | 1[25] |
| Spruce grouse | 15 | Mourning dove | 1 |
| Sharp-tailed grouse | 11 | Bobcat | 1 |

Berry pickers targeted the following species:

| | | | |
|---|---|---|---|
| Blueberry | 31 | Chokecherry | 8 |
| Cranberry | 14 | Strawberry | 8 |
| Highbush (5) | | "All" | 2 |
| Lowbush (1) | | Rose hips | 1 |
| Unspecified (8) | | Wild grapes | 1 |
| Raspberry | 11 | Pin cherry | 1 |
| Juneberry | 8 | | |

Inset: Cranberry harvest. Photo by Lyle Lauber.

[24] Total would be 22 if the specific types of hunting that followed were included in the general category.
[25] One additional person applied for but did not receive a moose permit.

When asked if they utilized the LUP lands for work-related activities, 43 questionnaire respondents answered:

| | | | | | |
|---|---|---|---|---|---|
| Yes | 12 | Logging | 9 | Fisher | 4 |
| No | 29 | Driving a vehicle | 4 | Marten | 2 |
| Not currently | 1 | Natural resource management | 4 | Bobcat | 2 |
| No answer | 1 | Trapping (furs) | 4 | Muskrat | 2 |
| | | Minnow/leech trapping | 1 | Beaver | 1 |
| | | Planting trees | 1 | Mink | 1 |
| | | | | Weasel | 1 |
| | | | | Rabbit | 1 |
| | | | | Fox | 0 |
| | | | | Otter | 0 |
| | | | | Raccoon | 0 |

When asked a series of questions about their familiarity with LUP lands and the different management philosophies and policies between different state conservation units, the questionnaire respondents indicated a level of some familiarity. More specifically, when asked if they were familiar with the different land management goals and regulations of the DNR's Red Lake WMA, Beltrami Island State Forest, Hayes Lake State Park, and Scientific and Natural Areas, the majority of respondents indicated they were "somewhat familiar" (53.5%, 23 of 43), followed by "not familiar at all" (21%), "vaguely familiar" (16%), and "very familiar" (9%).

The next question asked respondents if they were aware of the existence of Land Utilization Project lands embedded within the Beltrami Island State Forest, Red Lake WMA, and other DNR conservation units; 29 (76.3%) of 38 respondents indicated they were familiar with the existence of LUP lands. When asked how familiar they were with the different allowed public uses and legal restrictions between federal LUP lands and the state lands they adjoin, we got a similar response to the earlier question: the majority of respondents indicated they were "somewhat familiar" (39.5%, 17 of 43), followed by "not familiar at all" (23%), "vaguely familiar" (21%), and "very familiar" (16%). However, one person who indicated they were "very familiar" with the differences added a note that there was "no difference."

The next question asked respondents how familiar they were with the different forest and land management practices between federal LUP lands and the state lands they adjoin, and again we got a similar response to the earlier questions: the majority of respondents indicated they were "somewhat familiar" (42%, 18 of 43), followed by "not familiar at all" (28%), "vaguely familiar" (19%), and "very familiar" (12%).

The last question in the first part of the questionnaire/alternative scoping comment form was designed to ask whether respondents could recognize if they were on LUP land (whether by map, GPS unit, or other means) while visiting the Red Lake WMA, Beltrami Island State Forest, Hayes Lake State Park, or a Scientific and Natural Area. Twenty-two (58%) of 38 said "yes", but three of those earlier indicated they were not even aware of the existence of LUP lands; 14 (37%) said "no"; one respondents offered "sometimes", and one respondent offered "yes, usually, but most people have no idea."

An additional 15 questions were asked that required respondents to write out answers. These questions and the responses we received were included in Appendix F of the draft CCMP.

# Focus Groups

Two "focus group" meetings were hosted at Norris Camp on April 30 and May 7, 2011, from 10 am to about 3 pm each day. The first focus group addressed forest management and wildlife management (i.e., technical) topics, and the second focus group addressed public use and overall land management (i.e., policy) topics. Invitations were extended to all individuals and organizations that during Scoping expressed an interest in participating, as well as individuals and organizations that we considered affected stakeholders (e.g., The Ruffed Grouse Society, Minnesota Deer Hunters Association, Red Lake Band of Ojibwe, logging contractors, local historical societies).

The first focus group meeting was attended by 19 interested individuals and 6 project team staff. Main outcomes included:

- a desire to see sites managed using best technical data, best science
- a skeptical challenge to explain how gravel extraction benefits wildlife
- a desire to identify habitat that holds specialty species (e.g., Connecticut warbler)
- maintain access; maintain beauty of forest roads by not logging right up to roads
- loggers lose timber volume by letting aspen and white spruce get overmature and fall down
- post-harvest "leave trees" die from sunscald (birches) and windthrow (where soils are sandy)
- if converting aspen to jack pine on sandy soils, consider May or June harvest instead of July in order to put stress on root system
- unique ecological values on LUP lands should have priority
- not enough being done for deer; shorten season, keep homestead openings open, need more hunters, deer browse getting too high because not enough deer to keep it clipped short
- watershed district wants more water retention in BISF
- impoundments serve as low-flow augmentation for fish
- need more prescribed burning
- a desire to see more hunter walking trails with loops (no dead ends)
- a desire to see some areas to remain hard to access; not all of area should be young forest

The second focus group meeting was also attended by 19 interested individuals and 6 project team staff. Main outcomes included:

- a desire to see the wildness of the area maintained
- a desire to see public access maintained, but a divergence of viewpoints on whether there should be more or less access
- a desire to see relatively uniform or seamless public use regulations between the federal lands and the state lands they adjoin
- a lack of support for any large-scale land exchange alternatives
- a desire for water to be retained in the upper regions of the watersheds emanating from the Beltrami Island project area

# Additional Public Involvement Meetings

On November 22, 2011, DNR and FWS staff attended a meeting at the invitation of the Roseau River Watershed District to share an outline of some of the goals, objectives, and strategies that pertain to Watershed District interests and to get Watershed District feedback. On December 15 the Watershed

District offered opposition to the plan because at that point it did not contain provisions for water storage.

On March 15, 2012, DNR and FWS staff attended another meeting at the invitation of the Roseau River Watershed District to address the lack of a water storage component in the plan. An agreement was reached to include the possibility of water storage provided that mutual wildlife benefits were included with proposed projects. However, the parties came away from the meeting with different perceptions as to how project reviews would proceed.

On July 24, 2012, DNR and FWS staff attended a meeting at the invitation of the Roseau River Watershed District. The meeting focused on how the review process would move forward after close of comments, on the practicability of having local input on the planning process and plan approvals, and on the need for water storage components in the plan.

# Review of Draft CCMP

The formal comment period on the Draft CCMP began June 11, 2012 with the issuance of public notices that day in the *EQB Monitor* and *State Register*. Printed copies were distributed to public libraries in Warroad, Baudette, Roseau, Thief River Falls, Crookston, Bemidji, International Falls, and East Grand Forks, MN. Compact discs and/or pdf files were mailed or emailed to approximately 120 individuals, elected officials, organizations, and government agencies who participated in the process during scoping, were deemed interested stakeholders, or who are mandated to receive environmental review documents. A press release was distributed statewide to media on the DNR's distribution list announcing the availability of the plan. The plan was also posted on the project website and the DNR website.

A public meeting was held on June 27, 2012, from 4-8 pm at the DNR Area Forestry Office in Warroad. A total of 21 members of the public, including elected officials, attended the public meeting.

The public comment period closed on July 26, 2012. We received a total of 20 comments, representing 14 unique comments from 15 entities. Leadership team members met several times from August through October to review and respond to public comments. Our response to public comments will be published in a separate document and posted on the DNR website.

# Chapter 3: The Natural and Human Environment

## Area Description

### Ecological Context

The LUP planning area[26] is situated entirely in the Agassiz Lowlands subsection of the Laurentian Mixed Forest biome. However, elements of the Aspen Parklands ecosystem[27] come right up to the LUP planning area on the west and southwest. The Agassiz Lowlands is a large, gradually sloping, poorly drained area named after Glacial Lake Agassiz. Upper and Lower Red Lake and Lake of the Woods are remnants of Glacial Lake Agassiz. Much of the area is peatland, including forested peatland dominated by black spruce and tamarack, and non-forested sedge meadows (or sedge fens). Aspen, birch and jack pine dominate uplands that were sand islands left behind by the receding glacial lake. Although the area is often perceived as and described as "very flat", there is in fact considerable topographic relief. USGS topographic data show a maximum elevation of approximately 1,316 feet located a little west of Norris Camp, and the Hogsback Forest Road (FR) generally follows a topographic divide. To the north of Hogsback FR the land drops off towards Lake of the Woods, which has an elevation of 1,063 feet. To the south the land gently slopes towards Upper Red Lake, which has an elevation of 1,175 feet. To the west, the North Branch of the Roseau River exits Hayes Lake State Park at an elevation of 1,158 feet, and at the City of Roseau the elevation of the river is 1,041 feet.[28] To the east, the North and South Branches of the Rapid River exit the Beltrami Island State Forest at elevations of 1,159 and 1,158 feet respectively, and from there the Rapid River enters the Rainy River at an elevation of 1,068 feet.[29]

### Socioeconomic Context

The LUP planning area lies in three different counties in northern Minnesota: Beltrami, Lake of the Woods, and Roseau. Generally, the area is sparsely populated. Lake of the Woods County had a population of 4,045 in 2010, down 11.5% from 4,522 people in 2000. This makes it the second least populous county in the state. The majority of residents live along the Minnesota TH11 corridor in the northern half of the county, with a quarter of the population residing in Baudette. The main economic generators are agriculture, forestry, and tourism. In 1999 the median household income of Lake of the Woods County was $32,861.

Roseau County had a population of 15,629 in 2010, down 4.5% from 16,338 people in 2000. A quarter of the population resides in the Cities of Roseau and Warroad. The main economic generators are

[26] The LUP planning area is an ambiguous area roughly defined as the lands within the boundaries of the Beltrami Island State Forest, Red Lake WMA, and Hayes Lake State Park, including SNA's, Tribal, and private lands within these areas. However, it arbitrarily excludes areas east of TH 72, west of TH 89 and Moose River Dike FR, and areas north of TH 11. It contains about 848,000 acres, or an area of 1325 square miles.

[27] In some versions of the ecological classification system, the Tallgrass Aspen Parkland is considered a subsection of the Eastern Broadleaf Forest, in others it is considered a stand-alone biome.

[28] Upstream of Roseau, the river has a gradient of 2.8 ft/mile (NGH 2001); downstream of Roseau the river has a gradient of 0.2 ft/mile (RRWD 2004).

[29] Elevation data from National Geographic's Seamless USGS Topographic Maps on CD-ROM, Minnesota (NGH 2001).

manufacturing, agriculture, forestry, and tourism. In 1999 the median household income of Roseau County was $39,852. Major employers are Marvin Windows in Warroad, and Polaris in Roseau. Wheat, canola and hay are the major agricultural crops.

Beltrami County had a population of 44,442 people in 2010, up 12% from 39,650 people in 2000. However, the majority of the population lives in the far southern part of the county, with a third to a quarter of the population residing in and around Bemidji. The northern part of Beltrami County is sparsely populated, with the residents in the northwestern part of the county isolated from direct road connections to the rest of the county by Upper and Lower Red Lake and the extensive peatlands north of Upper Red Lake. The predominant economic activity in the northwestern part of Beltrami County is agriculture. In 1999 the median household income for all of Beltrami County was $33,392.

LUP lands are an important source of timber and revenue for the local economy. From 2000-2010, LUP lands provided an average of 14,520 cords (range 5,579-21,279) of wood worth an average of $433,833 (range $116,237-$718,239) from an average of 734 acres (range 351-1,151) of timber sold per year. Wood from the Beltrami Island area, including the LUP lands, feeds paper mills and sawmills in Baudette, Warroad, Wannaska, International Falls, Duluth, Big Falls, Kelliher, Cohasset, Solway, Bemidji, Grand Rapids, Cloquet, Deer River, and Sartell, Minnesota; Barron, Wisconsin; and Barwick and Fort Francis, Ontario. Tamaracks that are killed by beetles and salvaged are also sold as wood chips for industrial heating in Warroad. Within the greater Roseau River Watershed District, about 90% of timber harvested is sold as pulpwood to widely dispersed mills, and 10% is sold as dimensional lumber at local mills, with aspen and jack pine comprising 65% and 25% of the harvest, respectively.

The forestry industry is interested in issues involving both timber quantity and quality. The concept of “quality timber” is dynamic; its definition changes with market conditions, the intended use of the wood, and innovations in technology. Quality can variously relate to lack of heart rot (i.e., solid all the way through), diameter (i.e., not too large or too small), straightness of trunk, strength (minimal knots, width of rings), susceptibility to warpage, and compression failures. For example, rapidly grown pine has wider annual rings, which are more brittle and prone to warping than narrower growth rings, therefore they can be inferior for dimensional lumber, or pattern or cabinetry work (Shirley 1964). Conversely, rapidly grown ash and maple are harder than slowly grown wood of the same species and are used where strength and shock resistance are important (e.g., for baseball bats, axe handles, garden tool handles; Shirley 1964). Also, excessive bending of trees from wind, snow or handling methods during harvest can produce compression stresses along the grain (U.S. Forest Service 1987). Silvicultural methods employed on LUP lands can affect timber quality, primarily through intensity, frequency and selectivity of trees during thinning treatments in red pine plantations. Growth rates in red pine stands increase with increasing amounts of thinning (i.e., decreasing basal area; Benzie 1977). Quality can also be improved by minimizing exposure to wind stress. In this plan, timber quality is addressed through red pine plantation management on LUP land selected for eventual trade for state land within the LUP project area, and through management of timber for wildlife species dependent on young forests.

The tree species that are most utilized for commercial forest products within the LUP area are aspen and jack pine. The wood fiber from these species is utilized for dimensional lumber, oriented strand board and paper. For these products, quality in the harvested wood products can be defined as material with a minimal amount of defect due to internal defects and rot. While aspen trees generally have higher growth rates in the Lake States than in western United States, they also generally begin deterioration and decay earlier (DeByle and Winokur 1985). The mean annual growth of aspen stands in northern Minnesota on average sites culminates by about 50 years, which indicates a pathological rotation of

from 40 to 50 years for economic production of mass products (Schmitz and Jackson 1927). Pathological rotation age can be defined as that age when volume lost to decay equals volume added by growth. To minimize losses to insect and diseases, recommended rotations generally can range from about 30 years on the poorest sites to between 50-60 years on the best sites (Brinkman and Roe 1975). In aspen used for paper, additional bleaching chemicals are needed for wood beyond the pathological rotation age due to the increased staining of the wood fiber due to internal decay. This plan impacts timber quality for these species by influencing the amount of the forest cover type acreages that are managed by harvesting at the standard rotation age and the amount that are managed as older forests on LUP versus state land. As the percentage of older forests increases, less useable wood fiber is produced per acre of land. However, the amount of older forest on the landscape is ultimately determined through the SFRMP plan, not the LUP plan.

## Historical Context

American Indians have lived in the Beltrami Island area for more than 10,000 years. Artifacts, including finely crafted spear points, arrowheads and fragments of pottery have been found along the region's rivers and lakeshores. French explorers arrived in the 1730s and stayed to engage the indigenous peoples in trade, and adopted many of their lifestyles and customs. French influence gradually waned after 1760 as British influence through the Hudson Bay Company increased. American control of the Beltrami Island area did not occur until 1818. Much of northwestern Minnesota was reserved for the Ojibwe under the "Old Crossing" Treaty of 1863. The area north of Upper Red Lake was ceded to the U.S. government in 1889, but the Red Lake Band retains many parcels in the forest.

A land boom in the early 1900s attracted farmers to the area. Extensive ditches were constructed in a failed attempt to drain the peatlands for agriculture, but the sandy soils and extensive wetlands proved unsuitable for farming. By 1940 most of the settlers had left, either allowing their land to go tax forfeit,[30] or with the assistance of the federal Resettlement Act buyout.[31] In the 1930s public works programs, such as the Civilian Conservation Corps, were initiated that lead to the construction of roads and impoundments, Norris Camp, and the establishment of many of the pine plantations that still exist today. Red pines were planted primarily on abandoned farm fields.

## Land Management Context

LUP lands are embedded within seven DNR conservation units: Red Lake WMA, Beltrami Island State Forest (BISF), Hayes Lake State Park, and four peatland Scientific and Natural Areas.[32]

To the east, the BISF grades into the Lake of the Woods State Forest which in turn grades into Carp Swamp WMA, and the Red Lake WMA and Red Lake Peatland SNA grade into the Big Bog State Recreation Area. All of these DNR conservation units are west of Highway 72 and south of Highway 11. To the west, the BISF grades into the Moose River WMA[33] and Wapiti WMA, which in turn grade into 17 or more WMA's carved out of Con-Con lands.[34] We believe that a large segment of the general public does not differentiate between these units in their minds.

[30] These lands became state-owned Consolidated Conservation (Con-Con) lands.
[31] These lands became LUP lands.
[32] Red Lake Peatland, Mulligan Lake Peatland, Gustafson Camp, and Winter Road Lake Peatland.
[33] The Moose River WMA is actually within the boundaries of the Beltrami Island State Forest.
[34] This number could vary depending on where one draws a boundary of scope of effects of this planning effort on a map.

# Climate

The climate of the Beltrami Island area is characterized as humid-continental with short, mild summers and long, cold winters. Winter temperatures of -40°F were characteristically common in the past, but less frequent lately. The average growing season is approximately 100 days, with the first killing frosts typically occurring in mid-September and the last frost around Memorial Day. However, low-lying bog areas may experience frost anytime during the summer. See tables 3.1-3.3.

Data from the two 30-year periods for Baudette shows warming temperatures for 10 out of 12 months, with an increase in average annual temperature of 1.2°F. The two months with decreasing temperatures were October and November. The data shows slight decreases in total annual precipitation and snowfall, with decreases in springtime and early growing season precipitation and increases in precipitation in early fall (October, November). Likewise, late winter snowfall has decreased, while early and mid-winter snowfall has increased.

Table 3.1. Average temperatures (°F) in the Beltrami Island area.

| | Baudette | Baudette | Roseau | Warroad | Wannaska |
|---|---|---|---|---|---|
| | 1941-1970[35] | 1971-2000[36] | 1971-2000 | 1971-2000 | 1971-1988 |
| January | 2.7 | 3.9 | 0.6 | 1.9 | 0.9 |
| February | 7.6 | 11.9 | 8.8 | 9.7 | 9.9 |
| March | 20.9 | 24.3 | 22.3 | 22.6 | 22.7 |
| April | 39.5 | 41.0 | 39.2 | 38.3 | 41.0 |
| May | 51.9 | 55.2 | 53.3 | 53.4 | 54.1 |
| June | 61.9 | 63.4 | 61.0 | 62.8 | 62.0 |
| July | 67.3 | 67.8 | 65.5 | 67.3 | 67.3 |
| August | 65.1 | 65.8 | 64.2 | 65.3 | 64.5 |
| September | 55.1 | 55.8 | 53.9 | 54.7 | 54.1 |
| October | 45.5 | 44.1 | 42.1 | 42.5 | 42.9 |
| November | 26.9 | 26.2 | 23.5 | 24.6 | 25.0 |
| December | 10.1 | 10.4 | 7.4 | 8.5 | 8.6 |
| Annual Average | 38.0 | 39.2 | 36.8 | 37.6 | 37.8 |

Comparing recent data from the different reporting stations shows a general decreasing trend in temperature and precipitation from east to west across the Beltrami Island area. Historically, precipitation decreased from southeast to northwest, total snowfall decreased from east to west, and snow persistence decreased from northeast to southwest across the region (University of Minnesota 1980).

[35] From Red Lake WMA Master Plan, 1980.

[36] Recent TAPS (Temperature and Precipitation) data for Baudette, Roseau, Warroad, and Wannaska from U.S.D.A.'s Natural Resources and Conservation Service (NRCS) online at www.wcc.nrcs.usda.gov/ftpref/support/climate/taps/mn

Table 3.2. Average precipitation (inches) in the Beltrami Island area.

| | Baudette | Baudette | Roseau[37] | Warroad | Wannaska |
|---|---|---|---|---|---|
| Month | 1941-1970[38] | 1971-2000[39] | 1971-2000 | 1971-2000 | 1971-1988 |
| January | 0.59 | 0.58 | 0.70 | 0.63 | 0.49 |
| February | 0.46 | 0.43 | 0.52 | 0.59 | 0.46 |
| March | 0.79 | 0.65 | 0.56 | 0.71 | 0.90 |
| April | 1.42 | 1.20 | 1.24 | 1.17 | 1.22 |
| May | 2.43 | 2.63 | 2.15 | 2.42 | 2.13 |
| June | 4.07 | 3.70 | 3.86 | 3.84 | 3.75 |
| July | 3.49 | 3.37 | 3.26 | 3.67 | 3.14 |
| August | 3.39 | 3.30 | 3.18 | 2.95 | 2.65 |
| September | 2.84 | 2.70 | 2.38 | 2.57 | 2.81 |
| October | 1.50 | 2.16 | 1.56 | 1.81 | 1.87 |
| November | 0.91 | 1.13 | 0.75 | 1.19 | 1.04 |
| December | 0.66 | 0.55 | 0.69 | 0.62 | 0.54 |
| Annual Total | 22.55 | 22.39 | 20.86 | 22.16 | 21.00 |

Table 3.3. Average snowfall (inches) in the Beltrami Island area.

| | Baudette | Baudette | Roseau | Warroad | Wannaska |
|---|---|---|---|---|---|
| Month | 1941-1970[40] | 1971-2000[41] | 1971-2000 | 1971-2000 | 1971-1988 |
| January | 8.4 | 9.2 | 9.8 | 7.7 | 6.5 |
| February | 5.5 | 6.1 | 5.6 | 4.8 | 5.4 |
| March | 6.8 | 5.2 | 3.6 | 5.1 | 6.8 |
| April | 5.8 | 2.5 | 2.7 | 1.9 | 1.0 |
| May | trace | 0 | 0 | 0 | 0 |
| June | 0 | 0 | 0 | 0 | 0 |
| July | 0 | 0 | 0 | 0 | 0 |
| August | 0 | 0 | 0 | 0 | 0 |
| September | 0 | 0.1 | 0 | 0 | 0.2 |
| October | 0.6 | 1.2 | 0.7 | 0.6 | 1.5 |
| November | 8.8 | 9.7 | 6.4 | 7.6 | 4.6 |
| December | 7.7 | 9.2 | 8.7 | 7.6 | 6.0 |
| Annual Total | 43.6 | 43.1 | 37.6 | 35.2 | 32.0 |

[37] A record 48-hour rainfall event of 14.55 inches was recorded just south of Roseau on June 9-10, 2002, causing major flooding in the city.
[38] From Red Lake WMA Master Plan, 1980.
[39] Recent TAPS (Temperature and Precipitation) data for Baudette, Roseau, Warroad, and Wannaska from U.S.D.A.'s Natural Resources and Conservation Service (NRCS) online at www.wcc.nrcs.usda.gov/ftpref/support/climate/taps/mn
[40] From Red Lake WMA Master Plan, 1980.
[41] Recent TAPS (Temperature and Precipitation) data for Baudette, Roseau, Warroad, and Wannaska from U.S.D.A.'s Natural Resources and Conservation Service (NRCS) online at www.wcc.nrcs.usda.gov/ftpref/support/climate/taps/mn

# Geology and Soils

The Beltrami Island area lies on the western edge of the Canadian Shield, or Laurentian Plateau, where bedrock forms the oldest crustal plate on the North American continent (Ojakangas and Matsch 1982). The Canadian Shield covers most of Greenland and stretches through the eastern half of Canada from the Arctic Ocean to the Great Lakes, and extends southward through the northeastern United States to the Adirondack Mountains. The bedrock is the base of a former mountain range that has been repeatedly uplifted and eroded. The various strata are comprised of Late-Archean igneous, metamorphic and volcanic-sedimentary rocks that formed during the Precambrian Era, between 4.5 billion and 540 million years before present.

Despite the fact that most of the underlying bedrock is buried beneath glacial sediments and lake deposits, there are two known areas of exposed bedrock within the Beltrami Island area along the South Branch of the Rapid River. The outcrop known as "Moose Mountain," near Oak's Corner, has been described by Lockner (2008) as a "long ridge of bedrock oriented from northwest to southeast, and about 1000 feet long."

The surficial physiognomy of the Beltrami Island area is presently one of deep glacial drift overlying bedrock. This arrangement was caused by repeated episodes of glaciation during the last ice age, which covered most of the Canadian Shield. As the glaciers retreated, northwest Minnesota was inundated beneath meltwaters of a vast glacial lake. The modern result is a geologically young, nearly level landscape with vast areas of poorly drained fens and bogs. Characteristic of recently glaciated till-plains are the numerous streams and rivers that meander widely within their shallowly eroded valleys. Yet, the predominant perception of Beltrami Island area as a flat landscape cloaks the striking regional prominence that the area's bedrock expresses. Data derived from well drilling cores reveals that the highest elevation of bedrock within the vicinity of Norris Camp is about 100 feet or more higher than the bedrock in the surrounding region. Essentially, the bedrock forms a monadnock, an isolated hill standing above the general level of the surrounding peneplain. On a broad regional scale within the Agassiz Lowlands, the monadnock rises above the expansive plain of the ancient bed of Glacial Lake Agassiz, giving the impression of an island – which at one time it was – hence the geomorphic name, "Beltrami Island." From this high point, streams flow in every direction away from this central point within the Beltrami Island area.[42]

During the Wisconsin Glaciation, from 75,000 to 13,000 years ago, the Laurentide Ice Sheet covered much of North America, from which several large ice lobes advanced and retreated many times. Sediments deposited by these lobes and their aftermath predominantly influence the modern landscape of the Beltrami Island area. As glacial ice advanced, debris was scraped, lifted, carried and deposited some distance from its origin. This debris, which is called glacial till, is an unsorted mix of clay, silt, sand, pebbles and rocks. Till from each lobe forms a distinct stratum or parent soil, depending upon the origin of the debris (Lusardi 1997). Stratigraphically, the debris of earlier advances of ice is covered by debris of later ice lobes.

Northwestern Minnesota is covered by three general types of glacial drift originating from separate ice lobes emanating from the Wisconsin Glacier at different times (Ojakangas and Matsch 1982). These drifts are comprised of debris originating from the bedrock type over which the glaciers passed. The

[42] Beltrami Island includes the headwaters of numerous rivers and streams flowing outward to Lake of the Woods (Warroad River, Rapid River, Winter Road River), Red Lake (Big Deer River, Little Deer River), and the Red River (Roseau River).

source material and the mode of deposition of the drift contributes to important differences in soil texture and nutrients that ultimately affect vegetative growth (McAndrews 1966). Drift from the Wadena and Des Moines Lobes are derived from regions underlain by Paleozoic limestone and dolomite. Soils derived from these drifts are calcareous. In addition, drift from some regions of the Des Moines Lobe is derived in part from Cretaceous shale, which adds silt and clay to the resulting soils.

The Wadena Lobe was comprised of several phases, the latest phase of the Wadena Lobe readvanced to a new terminus forming the prominent Itasca Moraine (including Itasca State Park). The Wadena Lobe advanced across the Winnipeg lowlands in southern Manitoba, where it incorporated limestone rocks and deposited loamy materials rich in carbonates (Wright 1962).

The Des Moines Lobe scoured the Red River Valley before expanding southward to its maximum extent in Iowa, about 14,000 years ago. The St. Louis Sublobe separated from the main lobe in northwest Minnesota and expanded southeast across the Beltrami Island area and the surrounding region. The Des Moines Lobe carried debris eroded from the limestone and dolomite of the Winnipeg Lowlands. It formed the moraine immediately south of Lower Red Lake, and later the long peninsula between Upper and Lower Red Lakes (Wright 1992). Deposits from the Des Moines lobe are generally buff-colored to yellow-brown. Till from the Des Moines has a loam or clay loam texture created from a fine-textured glacial till rich in limestone and granite with limited amounts of shale. The Des Moines lobe contains a higher percentage of shale fragments with few boulders and is thought to have originated from a more northwesterly source area than were deposits from the Wadena Lobe.

As glacial ice retreated northward, meltwater became impounded between the ice margins and moraines and/or other topographic barriers recently exposed from the wasting ice. Glacial Lake Agassiz began to form about 11,700 years ago when the Des Moines Lobe of the Wisconsin Glacier melted and retreated northward into the Red River Valley away from the topographic divide at Browns Valley, Minnesota, which separates the drainageways of the Red River from the Minnesota River (Fisher 2004). For the next 4,000 years, Lake Agassiz fluctuated widely in area and volume, sometimes merging with other glacial lakes to form super lakes because drainageways for glacial meltwater were constantly shifting. Drops in lake level between stages represent enormous volumes of discharge. By 10,000 years ago, the glaciers had melted completely away from Minnesota leaving meltwater lakes that persisted for 1,000 years afterwards. By 9,000 years ago, the final stage of Glacial Lake Agassiz drained away from Minnesota for the last time. Afterwards in Canada, Glacial Lake Agassiz experienced several more distinct stages before the last ice dam was breached about 7,700 years ago. Remnants of Glacial Lake Agassiz exist as modern Lake of the Woods, and Upper and Lower Red Lake.

Across Beltrami Island, several beach ridges mark the various stages of Lake Agassiz where it temporarily stalled as its waters receded (Eng 1979). The best examples of these beach ridges are marked by roads within the Red Lake WMA and the surrounding Beltrami Island State Forest, including the Faunce-Butterfield Forest Road, Hogsback-O'Brien Trail, Stony Corners Trail, Spina Trail and the Thompson Forest Road on the Bemis Ridge.

There appear to be some unexplained discrepancies between the elevations reported in the Minnesota literature for prominent beach ridges for Lake Agassiz and elevations for Beltrami Island.[43] The differences in elevations are most likely related to isostatic rebound of the Earth's crust since the Wisconsin Glaciation (Upham 1896, Bluemle 2008). When glacial ice covered the Lake Agassiz Plain, the weight was so great that it depressed the crust of the earth approximately one foot for every three feet of overlying ice. The greatest rates of postglacial rebound in North America occur in the southeastern portion of Hudson Bay, presumably where the ice was thickest. Here there has been at least 935 feet of rebound and the area continues to rise at 4.3 feet/100 years. Along the southern shore of Glacial Lake Agassiz, the ice was less thick; hence, the same beach ridge will rebound less on its southern shoreline than its northern shoreline. For example, the Herman Beach Ridge in North Dakota has rebounded 179 feet higher at its Canadian border than where the Herman Ridge crosses the South Dakota border (Brevik 1994). This difference in elevations of the Herman Beach probably represents, at a minimum, only three-fourths of the total rebound that is yet to occur (Bluemle 2008). Likewise, there was a comparable rebound of 206 feet between the Lower Campbell Beach at Lake Winnipeg in Manitoba, relative to the southern outlet of Glacial River Warren in Minnesota (Brooks et al 2005). From these consistent examples, one can conclude that prior to isostatic rebound from glacial depression, the 1,276 foot peak of Beltrami Island was indeed lower in elevation than the 1,060 foot surface waters of Glacial Lake Agassiz as it is presently delineated by the southern portion of the Herman Beach Ridge. Consistent with the data, it would appear that Beltrami Island has rebounded some 216 feet (66 m) since Glacial Lake Agassiz first appeared.

Lake Agassiz initially covered the entire Beltrami Island area. Later stages may have perhaps only covered part of Beltrami Island. As lake levels lowered, Beltrami Island literally became surrounded by water due to its high bedrock elevations, which formed a monadnock above the plains. During this brief time, Beltrami Island was constantly subjected to wave action where sorted glacial till formed beach ridges or strandlines. Once formed, these beach ridges were interspersed with shallow marshes occupying swales resembling lagoons whose connection to the larger water body of Lake Agassiz was interrupted by the beach ridges.

The Beltrami Island area includes 106 different soil map units and complexes delineated as soil polygons by the Natural Resources Conservation Service (NRCS). While conducting vegetation surveys within LUP lands, soil characteristics were observed in the field and compared with NRCS soil map units.[44] Later, after native plant community (NPC) map polygons were delineated, each NPC map unit (class or type) was analyzed spatially to determine what soil units occurred beneath the vegetation categories. No exclusive relationships were perceived between any one NRCS soil map unit and any particular NPC class or type observed on LUP lands. Therefore, it was concluded that NRCS map units do not represent distinct ecological units useful for distinguishing and mapping vegetation. However, the soil properties that define higher levels of soil taxonomy do explain plant patterns observed on the landscape.

Based upon direct observations in the field, it was determined that the most important soil characteristics influencing plant occurrence and their respected NPC distributions across the landscape were the organic content in the rooting zone, presence of an "E" horizon, drainage, soil texture and the

[43] Herman Beach, elevation 1,060 ft, represents the highest stage of the glacial lake; followed by Norcross Beach, elevation 1,040 ft and Upper Campbell Ridge, elevation 980 ft (Upham 1896, Fisher 2004). (The modern water level for Lake of the Woods – a remnant of Glacial Lake Agassiz – is maintained at about 1,060 feet [Gustafson 1997]). But there is in fact a crescent rim of beach ridges around the crest of Beltrami Island with an elevation of 1,275 feet (Lively et al 2006; Eng 1982).

[44] Field work and analysis by Scott C. Zager, Wildlands Ecological Services.

soil moisture regime.[45] By combining 106 separate soil units into ten categories based upon soil moisture regime, we make a complex, obtusely-abstract relationship more discernable between soil types and native plant types. Arranging plant communities (ordination) along a soil moisture gradation (continuum) is a fundamental principle of plant ecology (Curtis 1959). Nonetheless, while species associations are recognizable on the landscape, each species of the guild has an individualistic pattern of distribution that varies slightly differently than its associate species across the continuum. Consequently, key species useful for distinguishing between plant communities may overlap, causing boundaries between plant communities to be indistinct. Similarly, plants are distributed across the landscape according to preferred properties of the soils. Yet these properties, while distinct in the middle of a soil unit, tend to blend together at the margins. By combining soil units into larger groups with similar properties, we are able to accentuate those soil characteristics most responsible for observed plant distributions.

The mineral soil throughout the Beltrami Island area is calcareous; however, soil properties vary in moisture retention, soil drainage (porosity) and texture. Based upon their soil properties, S. Zager (unpublished manuscript) classified ARCGIS polygons of soil map units according to ten ecological categories describing soil moisture regimes. Zager found that by combining NRCS soil map units into these nine categories, a generalized map of soil moisture regimes and soil texture could be made. This soil moisture map illustrates NRCS soil polygons in a manner more useful for recognizing and delineating boundaries of native plant communities. These moisture regime categories include: 1 = Dry Sand, 2 = Dry-Mesic Sand, 3 = Mesic Sand, 4 = Mesic Loam or Silt, 5 = Wet-Mesic Sand, 6 = Wet-Mesic Loam or Silt, 7 = Wet Sand, 8 = Wet Loam or Silt, 9 = Peat.

Wet soils have saturated root zones throughout the year. Wet-mesic soils have a high water table in spring, sometimes with shallow surface water, but the water table drops below the upper root zone later in summer. Mesic soils are often part of a complex landscape with a wide range of moisture regimes, but usually they are moderately drained to somewhat poorly drained. In general, mesic soils remain moist throughout the year either due to high-seasonal water tables near the rooting zone and/or with a high content of fine soil particles (silt) that tend to retain moisture. Dry-mesic soils are moderately to well drained, being moist in spring but tending to dry later in summer (such soils tend to be droughty at least 2 of 5 years). Dry soils are excessively well-drained or well-drained and experience water stress seasonally; these soils are usually found on the crests of the highest beach ridges.

The following general descriptions (Gustafson 1997) characterize the most representative soils of the soil moisture categories shown in Figure 3.1.

**Dry Sand**

Dry sandy soils (Alfisols) are found on nearly level to moderately steep sandy or gravelly sediments. The excessively drained soils are on nearly level to moderately steep areas on the tops of ridges and side slopes on the highest beach ridges (e.g., Bemis Ridge). Typically the surface layer is very dark gray loamy sand. The subsurface layer is light brownish gray sand. These soils comprise only 0.46% of the greater Beltrami Island area.

[45] The Natural Resources Conservation Service has variously mapped the soil moisture regime as Udic (NRCS 1999) and Aquic (NRCS 2003). The 1999 map shows the Udic soil moisture regime transitioning to the drier Ustic soil moisture regime just to the west of the planning area.

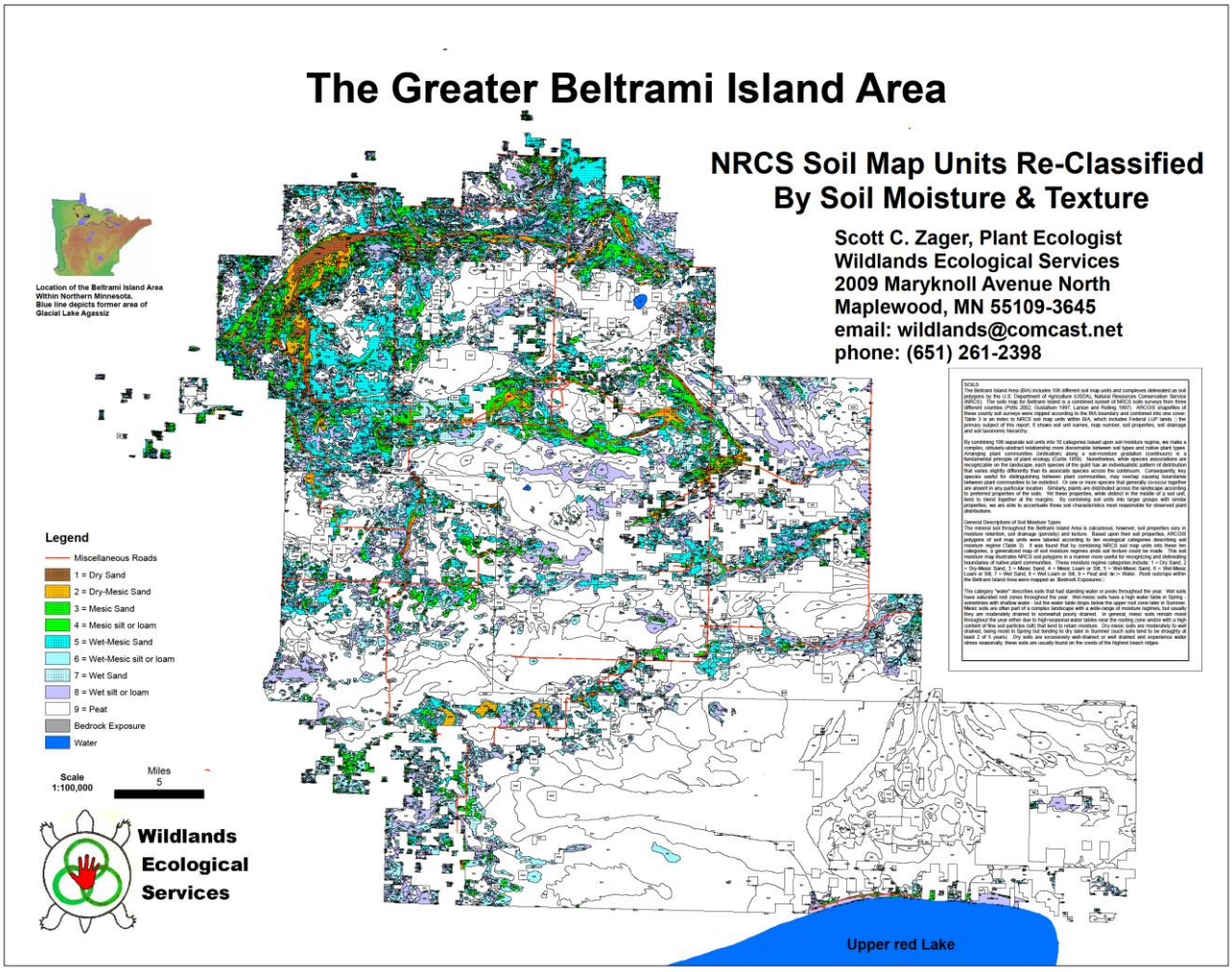



Figure 3.1. Soil map units identified by Scott C. Zager, based on soil moisture and texture. See Zager (2011).

**Dry-Mesic Sand**

Dry-mesic sandy soils (Alfisols, Entisols) are found on nearly level to moderately steep sandy or gravelly sediments, and are well drained to moderately well drained soils. These soils comprise only 1.50% of the greater Beltrami Island area.

The well drained soils are on nearly level or gently sloping areas adjacent to old glacial lake beach ridges. Typically, the surface layer is very dark grayish brown fine sand. The upper part of the subsurface layer is yellowish brown fine sand. The lower part is strong brown sand. The subsoil is yellowish brown sand and dark yellowish brown loamy coarse sand. The underlying material is light yellowish brown and very pale brown, calcareous stratified sand and gravelly sand.

The moderately well drained soils are on nearly level, slightly convex to slightly concave areas on glacial lake beaches. Typically, the surface layer is very dark grayish brown loamy sand. The subsurface layer is brown loamy sand. The subsoil is brown, mottled sandy loam. The underlying material is light brownish gray, mottled, calcareous, gravelly, coarse sand.

**Mesic Sand**

Mesic sandy soils (Alfisols, Entisols) are on nearly level and gently sloping sandy sediments formed on glacial lake beaches and glacial lake plains. They are moderately well drained soils. Typically the surface layer is very dark brown fine sand. The subsurface is light brownish gray fine sand. The upper part of the subsoil is yellowish brown, mottled fine sand. The middle subsoil is yellowish brown fine sand. The lower subsoil is light yellowish brown, mottled fine sand. The underlying material is light brownish gray and pale brown, mottled fine sand. These soils comprise 4.56% of the greater Beltrami Island area.

**Mesic Loam**

Mesic loamy soils (Alfisols, Mollisols) are on nearly level and gently sloping loamy till formed on glacial lake plains. They are moderately well drained soils. Typically, the surface layer is very dark grayish brown fine sandy loam. The subsurface layer is brown, mottled loamy fine sand. The subsoil is mottled clay loam. The upper part of the subsoil is dark brown and the lower part is dark yellowish brown. The underlying material is brown, mottled, calcareous fine sandy loam. These soils comprise only 0.34% of the greater Beltrami Island area.

**Wet-Mesic Sand**

Wet-mesic sandy soils (Alfisols, Entisols) are somewhat poorly to very poorly drained soils that formed on gently sloping sandy sediments on glacial lake beaches. Typically the surface layer is very dark grayish brown loamy fine sand. The subsurface layer is light brownish gray fine sand. The subsoil is yellowish brown, mottled fine sand. The underlying material is grayish brown, mottled fine sand. These soils comprise 8.53% of the greater Beltrami Island area.

**Wet-Mesic Loam or Silt**

Wet-mesic loamy and/or silty soils (Alfisols, Mollisols, Vertisols) are somewhat poorly drained to poorly drained soils that formed on nearly level and gently sloping loamy till on glacial lake plains and alluvial terraces along major streams. These soils comprise 2.74% of the greater Beltrami Island area.

The somewhat poorly drained soils are on alluvial sediments of floodplains. Typically, the surface layer is very dark grayish brown silt loam. The subsurface layer is dark grayish brown silt loam. The subsoil is brown silt loam over brown very fine sandy loam, which is mildly alkaline. The underlying layer is brown and grayish brown, stratified very fine sandy loam, loamy very fine sand, silt and silt loam; with fine distinct yellowish brown and dark brown mottles. The lower underlying layer is yellowish brown stratified silt and silt loam with fine distinct light brownish gray mottles.

The poorly drained soils are on nearly level areas. Typically, the surface layer is very dark gray fine sandy loam. The subsurface layer is grayish brown, mottled loamy fine sand. The subsoil is grayish brown, mottled loam. The underlying material is light brownish gray, mottled calcareous loam.

**Wet Sand**

Wet sandy soils (Entisols) are poorly drained and very poorly drained soils that formed on nearly level or slightly concave sandy sediments on glacial lake beaches and glacial lake plains. Typically, the surface layer is black loamy fine sand. The underlying material is light brownish gray and grayish brown, mottled fine sand and sand. These soils comprise 6.89% of the greater Beltrami Island area.

**Wet Loam or Silt**

Wet loam or silty soils (Entisols, Inceptisols, Mollisols, Vertisols) are poorly drained to very poorly drained soils that formed in nearly level, highly-decomposed organic material overlying mineral material on glacial lake plains. These soils comprise only 7.28% of the greater Beltrami Island area.

The poorly drained soils are on nearly level areas. They are calcareous throughout. Typically, the surface layer is black fine sandy loam. The subsoil is dark grayish brown and light brownish gray, mottled fine sandy loam. The underlying material is light brownish gray, mottled loam.

The very poorly drained soils are on small depressions and concave basins. Typically, the surface layer is black muck about 15 inches thick. Below this is a very dark gray, mottled, calcareous fine sandy loam. The underlying material is grayish brown and light brownish gray, mottled, calcareous fine sandy loam and sandy loam.

**Peat**

Various types of peat (Histisols) occur on nearly level, very poorly drained soils that formed in very decomposed muck (sapric peat), moderately decomposed organic material (hemic peat) on glacial lake plains, or well preserved organic material (fibric peat) on level to raised bogs. These soils comprise 59.47% of the greater Beltrami Island area.

Some of the very poorly drained peat is in drainageways, small depressions and on the outer margins of large bogs. Typically, the organic part of the surface layer is muck about 25 inches thick. The upper part of the surface layer is dark reddish brown, and the lower part is black. Below this is a mineral surface layer of silty clay loam. The upper part of underlying material is dark gray, mottled silty clay loam. The lower part of the underlying material is light brownish gray, mottled, calcareous silty clay loam. Some of the very poorly drained peats are in flowages or in large level areas on peatland basins. Typically, the surface layer is dark brown mucky peat. The next layer is very dark grayish brown mucky peat.

Some of the very poorly drained peats are in large, level or slightly concave bogs. Typically, the surface layer is very dark grayish brown mucky peat about 3 inches thick. Below this is a very dark brown muck.

Some of the very poorly drained peats are in large, level or slightly convex bogs. Typically the surface layer is grayish brown peat. Below this is a deep mucky peat. The upper part of this peat is dark brown, and the lower part is dark reddish brown.

Some of the very poorly drained peats are on raised areas in bogs. Typically, the surface layer is dark brown peat. Below this is a dark brown mucky peat.

**Other**

Open water occupies 973 acres, or only 0.11% of the greater Beltrami Island area. Exposed bedrock accounts for 35.5 acres, and gravel pits account for 132 acres. Red Lake Indian Reservation lands were not classified, and they account for 7.19% of the land base.

# Hydrology and Peat

Peatlands cover nearly 60% of the Beltrami Island area and are part of the largest peatland complex in the United States outside of Alaska. Peatlands in Minnesota cover up to 7.6 million acres (11,880 $mi^2$),

about 11 to 16 percent of Minnesota's total area (MN DNR 1982a). The Beltrami Island area is part of a larger peatland complex in the former plain of Glacial Lake Agassiz, covering about 2.5 million acres (1,265 $mi^2$; Griffin 1975). Within the defined LUP planning area boundaries, peatlands cover 510,642 acres (798 $mi^2$). The surface vegetation on Beltrami Island area peatlands varies from cedar swamps, raised bogs in ovoid islands and vast patterned fens studded with tear-shaped islands dominated by tamarack and black spruce. The edges of the peatland have been cut by drainage ditches dating from 1905-1920, but a large central area of peatlands within the Beltrami Island area remains unaffected (Bradof 1992).

North American peatlands did not develop for a long time after the glaciers and their meltwater lakes receded. Climate conditions were not compatible with peat formation until about 5,000 years after Lake Agassiz disappearred. Numerous ponds and shallow marshes must have remained within the Beltrami Island area immediately after the waters of Glacial Lake Agassiz drained away from Minnesota about 9,000 years ago. However, these shallow wetlands did not persist, because water tables were lowered substantially as the climate became colder and dryer – and later hotter and dryer – during a constantly changing paleoclimate regime lasting several thousand years. This trend continued until about 6,000 years ago, when regional climates shifted and the Upper Midwest became influenced by air masses bringing an increasingly cooler and wetter climate that produced higher local water tables and lowered evaporation and plant transpiration levels. Based upon peat cores collected across a broad region of Canada and the northern United States, including the Red Lake Peatlands, peat did not develop until the water table rose high enough to inhibit plant decomposition (Nichols 1969). This occurred about 4,500 to 3,500 years ago in the Red Lake Peatlands and across a broad region in North America (Janssens et al. 1992).

Heinselman (1963) concluded that most of the Lake Agassiz peatlands developed on gently sloping substrates through paludification, or the swamping of uplands, rather than from lake infilling. Waterlogging from high water tables removed oxygen in the uppermost soil horizons, thereby inhibiting plant decomposition. Peat accumulates when plant production exceeds organic losses from a site. This usually occurs in saturated areas where anaerobic conditions inhibit organic decomposition. The rate that peat accumulates depends on many factors, all of which vary with climate (Gorham et al 2003). In general, paludification occurs in climates with a positive moisture balance where precipitation exceeds evaporation and plant transpiration (evapotranspiration). These conditions prevail in cool-wet climatic regimes as opposed to cold-dry or warm-dry regimes.

Peatlands are separated into categories of bogs and fens on the basis of their 1) peat landforms, 2) indicator species, 3) water chemistry, and 4) inferred hydrology (Glaser 1992a). Both bogs and fens can be dominated by woody or herbaceous plants. The vegetation in peatlands is very sensitive to water chemistry, and different vegetation types correspond to different ranges in pH, potassium and calcium concentrations (Glaser et al 1990). Bogs are topographic domes that contain acidic surface waters (pH <4.2) with low concentrations of inorganic solutes (<2 mg/kg of calcium). Bog vegetation contains few species and generally develops into raised or elevated structures above the surrounding water table. Bogs are mostly dominated by *Sphagnum* peat moss. Fens are peat landforms with flat or gently sloping surfaces. Fen surface waters are circumneutral to alkaline, with higher pH (4.2 - 8) and greater solute concentrations (> 2 mg/kg calcium). Fens have a higher overall species diversity with a bryophyte flora comprised of feather mosses, brown aquatic mosses and green-colored *Sphagnum* moss (Glaser 1992a).

There are four basic types of peat within the Beltrami Island area: 1) hemic, which is mostly sedge peat, 2) fibric, which is mostly *Sphagnum* moss peat, 3) woody peat, and 4) sapric and/or muck. These form under different climatic and hydrologic conditions that favor certain vegetation over others, and

different rates of decomposition (or lack thereof). For example, white cedar is found only on woody peat, tamarack prefers peat derived from sedges and woody material, and black spruce occurs on all types of peat (Averill and McGrew 1929). Woody peat is created from the partial decay of trees and shrubs. Woody peat is prominent in 1) white cedar swamps found on the lower slopes of beach ridges where groundwater discharges, 2) tear-shaped islands dominated by tamarack and bog birch, and 3) spruce dominated bogs. Partially decayed plant parts are prominent in fibric, hemic and woody peat types because decomposition is hindered by oxygen-depleted conditions created by high water tables. Periodically low water levels promote aerobic decomposition of woody, fibric and hemic peat into silty or mucky peat with a consistency resembling potting soil. This highly decomposed peat, with no visible plant parts, is called sapric peat, which upon further decomposition develops into muck.

The vegetation patterns created by the various kinds of peat and the conditions under which they form are called peat landforms, because of their visual similarity to geomorphic landforms (Glaser 1992b). There are nine re-occurring types of peat landforms in the Beltrami Island area: 1) boreal swamps, 2) non-patterned fens in basins, 3) water track channels, 4) tear-shaped islands of forested fens, 5) patterned fens with strings and flarks, 6) spring fens, 7) raised bogs, 8) ovoid bog islands, and 9) featureless drains of *Sphagnum* lawns (Glaser 1992b, Griffin 1975, MN DNR 2003).

Boreal swamps are rich forested peatlands dominated by white cedar, black spruce and tamarack. Swamps are found on landscapes with high water tables, most often on lower slopes of beach ridges (often with broad zones of groundwater seepage), and within swales on broad uplands. Swamps develop when tangled masses of tree roots form suspended hummocks over the saturated substrate. Boreal swamps are an amalgamation of different kinds of peat, because the vegetation cover is a mosaic of moss carpets on the tree roots perched over groundwater springs or flowing surface water. Often there are muck lined pools or sedge-dominated patches interspersed throughout the swamp. In situations characteristic of white cedar swamps on lower slopes, the water table fluctuates and each of these peat types are in varying stages of decomposition to sapric and mucky peat.

Within the inter-beach basins and swales of various sizes, most of the hemic peat within the Beltrami Island area developed under wetland sedges and grasses that developed into non-patterned fens. They have no distinctive vegetation patterns and are often uniformly dominated by grasses and sedges. These graminoid-dominated fens vary in pH and alkalinity from poor fens with low acidity (pH 4-5.5) to circumneutral, or slightly alkaline, rich fens (pH 6.5-8).

Water tracks are usually surrounded by boreal swamps, which form at the margin of the inter-beach basins along the lower slopes and toes of beach ridges (Wright and Glaser 1983). Runoff from the beach ridges is channeled into sinuous flow lines that converge within the center of the water tracks. The water tracks originate as non-forested wet meadows and featureless rich fens that become progressively wetter and more intensely patterned downslope. Large water tracks develop as accumulating peat spreads to concentrate groundwater flow into channels or water tracks. The convergence of various channels causes the mixing of subsurface flows of groundwater with the underlying lake-modified tills to produce surface waters with concentrated solutions of dissolved minerals. This in turn, promotes mineral-loving (minerotrophic) plants that favor circumneutral to highly alkaline water characteristic of extremely rich fens. The most characteristic peat landforms in water tracks are forested teardrop islands and ribbed fens.

Tree-covered, tear-shaped islands occur among sedge-dominated channels within large water tracks. They are teardrop-shaped peat formations with a blunt, obtuse head at one end, covered with thick clusters of black spruce and/or tamarack. The other end is a trailing tail with bog birch. Many of the

teardrop islands originate from the expansion of the nonforested sinuous flow lines through swamp forest that progressively restrict trees to long tapering fingers and ultimately form the teardrop islands. These islands range in length from 30 to 800 m (Janssens and Glaser 1986).

Ribbed fens occur within the water tracks and are comprised of a parallel network of peat ridges and troughs, called strings and flarks (Glaser 1992b). Strings are parallel ridges within water tracks that form perpendicular to the direction of flow. The strings are about 15-30 cm high and are spaced 3-14 m apart (Griffin 1975). Between the strings are flarks, which are relatively low hollows with standing water supporting aquatic plants, such as bog bean and bladderwort. The simplest explanation for the development of ribbed fens is that the force of moving water causes the compression of peat in some places and tearing-apart in others. Or perhaps the strings develop by the coalescence of sedge hummocks in response to increased water flow through a narrowing channel. The sedge hummocks often support low shrubs, such as bog birch or leatherleaf.

Spring fens are another type of peatland landform, created by the up-welling discharge of groundwater. Spring fens have a braided network of non-forested channels among floating mats of herbaceous vegetation. This reticulating network of alkaline pools usually drains through boreal swamps.

True bogs are topographic domes of acidic peat with centrifugal drainage. Bogs developed within the Beltrami Island area when acid-producing *Sphagnum* peat mosses began to accumulate fibric peat on top of the hemic peat of former sedge meadows and fens; eventually creating elevated domes or linear ridges characteristic of bogs. As fibric peat moss accumulated above the surrounding water table, the crest of the bog developed radial drainage from a central point. The accumulation of peat and the subsequent drainage of water away from the bog, isolates vegetation from the mineral-rich groundwater. Accumulating peat creates the ombrotrophic conditions where the only nutrient source is mineral-poor precipitation. Such conditions reduce the ability of minerotrophic plants to persist while simultaneously promoting acid-loving species through the process of natural selection. With their increasing abundance, *Sphagnum* mosses rapidly accelerate the decreasing acidity of the surface waters because they release hydrogen ions into the surface waters in order to capture scarce cations of potassium and magnesium. As bogs further elevate and drainage patterns fully develop, stunted trees of black spruce are able to colonize and expand coverage into black spruce bog forests.

Within the Beltrami Island area, huge bog complexes have spread across the Red Lake Peatlands, where the peat surface is isolated from mineral soil by dense accumulations of peat across broad areas. The growth of these bogs first results in the formation of a domed or linear crest when fibric peat forms over hemic peat. Later, scattered clumps of black spruce trees develop, which are separated by non-forested drains that radiate down from the crest. These bog drains coalesce downslope into broad tongue-shaped *Sphagnum*/sedge lawns with a featureless surface. A bog drain may be established initially by concentrating water seepage among clumps of trees, where tree roots and buried wood provide an obstruction to flow while favoring the spread of *Sphagnum* mosses. The headward expansion of the bog drains results in the formation of 1) tongue-shaped *Sphagnum* lawns on which water flow is channeled into internal water tracks and 2) spruce-dominated ovoid bog islands created by the fragmentation of a larger black spruce forests whose margins are shaped by adjacent water flow. The *Sphagnum*-dominated drains expand into water tracks that grow in size around the clusters of bog forest, converting them into the ovoid islands, which are generally 1-2 km broad by 2-3 km long, with a rounded forward head and a point or a tail extending downslope (Wright and Glasser 1983).

**Groundwater**

In Minnesota, all the large water tracks of the patterned peatlands arise downslope from beach ridges, glacial outwash plains, or glacial moraines. Within the Beltrami Island area, the huge water track north of Upper Red Lake is fringed by beach ridges to the north and west (Glaser 1992c). Most groundwater within the Beltrami Island area is recharged from the upland beach ridges. However, the Red Lake Peatlands receive some subsurface flow from Upper Red Lake. Groundwater models have determined that within the Beltrami Island area, all groundwater discharges occur within a 10 km radius of local aquifers (Reeve et al. 2001). The larger surrounding region does not play a prominent role in the hydrology because the surrounding watersheds intercept groundwater flow before it reaches Beltrami Island area. For example, groundwater recharged on the Itasca Moraine is intercepted by the Red Lakes and/or their adjacent rivers.

# Plant Communities

There are several estimates for historical and recent compositions of plant communities in the Agassiz Lowlands today, and not all of the estimates are comparable due to different classification systems or level of detail in the classification systems. Some of the estimates are better used for management purposes, while others are better suited for planning purposes. See Tables 3.4-3.9.

Driving the road system can give a false image of the plant communities present in the area. Many of the roads (e.g., Hogsback-O'Brien FR, Rapid River FR, Bankton FR, Thompson FR) follow higher, dryer lands which support different plant communities that hide the vast extent of lowland plant communities from view (see Figure 3.1).

Minnesota's forests have undergone profound changes statewide since settlement began. For example, Friedman and Reich (2005) found that white pine co-dominated 45% of 253 100-$km^2$ blocks in northeastern Minnesota prior to settlement, but none in 1990; and although the same 11 species made up the presettlement forest that make up the forest today (i.e., 1990), their relative abundance and dominance has changed so profoundly that 85% of the 100-$km^2$ blocks now contain plant community types that did not dominated anywhere in the presettlement forest. Conversely, the seven most common presettlement community forest types are not represented in the modern forest at the 100-$km^2$ scale. The greatest beneficiary was aspen, which now dominates or co-dominates 82% of the forest zones and represents diminished regional landscape diversity; other species with increased proportional abundance include balsam fir, maple and ash. Reduced proportional abundance occurred for spruce, tamarack, paper birch, jack pine, red pine and white pine, with a minor decrease in northern white cedar. A driving factor of this vegetation shift was the substitution of logging for fire as the predominant form of disturbance, giving a competitive advantage to broad-leaved shade-intolerant species from shade-tolerant coniferous species. Table 3.4 provides historic and recent data specific for the Agassiz Lowlands subsection.

Table 3.4. *Tomorrow's Habitat for the Rare and Wild* includes the following breakdown for the entire Agassiz Lowlands subsection, and includes historic and recent data.

| Habitat | % area: 1890s | % area: 1990s |
|---|---|---|
| Lowland coniferous forest | 50.5 | 44.5 |
| Deciduous aspen forest | 19.4 | 13.7 |
| Non-forested wetland | 7.8 | 9.7 |
| Upland coniferous forest | 0.2 | 1.1 |
| Lowland deciduous forest | 0.5 | 0.8 |
| Deciduous hardwood forest | 0.3 | 0.8 |
| Shrub woodland (upland) | 3.9 | 0.6 |
| Prairie | 0.3 | 0.0 |
| Grassland | ? | 4.2 |
| Cropland | 0.0 | 8.0 |
| Other (e.g., lakes, rivers) | 16.1 | 16.6 |

Table 3.5. The Agassiz Lowlands SFRMP includes the following breakdown for state-owned lands, including LUP lands, for 2003 and for the desired future condition in 2050.

| Habitat | % area: 2003 | % area: 2050 |
|---|---|---|
| Ash, willow, lowland hardwoods | 1.7 | 1.7 |
| Aspen | 14.5 | 13.0 |
| Birch | 0.3 | 0.3 |
| White spruce, balsam fir | 1.7 | 1.9 |
| Northern hardwoods | <0.1 | <0.1 |
| White pine | <0.1 | 0.1 |
| Red pine | 0.7 | 0.8 |
| Jack pine | 2.1 | 2.4 |
| Lowland black spruce | 10.9 | 10.9 |
| Upland black spruce/tamarack | 0.1 | 0.2 |
| Lowland tamarack | 10.4 | 10.4 |
| Lowland white cedar | 2.9 | 2.9 |
| Upland white cedar | 0.2 | 0.3 |
| Brushlands | 20.0 | 20.0 |
| Stagnant lowland conifer | 22.7 | 22.7 |
| Non-forest | 11.9 | 11.9 |

Table 3.6. Current estimates of cover types on LUP lands, based on DNR Forest Inventory Modules.

| LUP Cover Type | Acres | % of Area |
|---|---|---|
| Aspen | 19542 | 25.5 |
| Lowland brush | 15962 | 20.8 |
| Jack pine | 9173 | 12.0 |
| Tamarack | 7225 | 9.4 |
| Black spruce | 5035 | 6.1 |
| Lowland white cedar | 4319 | 5.6 |
| Upland grass | 2516 | 3.3 |
| Lowland grass | 2497 | 3.3 |
| Balsam fir | 1970 | 2.6 |
| Stagnant lowland cedar | 1850 | 2.4 |
| Marsh | 1735 | 2.3 |
| Balsam poplar | 1704 | 2.2 |
| Red pine | 1518 | 2.0 |
| Ash | 1194 | 1.6 |
| White spruce | 1159 | 1.5 |
| Muskeg | 1003 | 1.3 |
| Upland brush | 638 | 0.8 |
| Stagnant lowland tamarack | 586 | 0.8 |
| Birch | 557 | 0.7 |
| Stagnant lowland black spruce | 509 | 0.7 |
| Water | 407 | 0.5 |
| Upland black spruce | 227 | 0.3 |
| White pine | 145 | 0.2 |
| Developed areas, roads | 74 | 0.1 |
| Oaks | 71 | 0.1 |
| Agricultural | 21 | 0.0 |
| Unclassified cut-over areas | 17 | 0.0 |

Table 3.7. Vegetation composition of State, LUP, Tribal and private lands within the boundary of the Red Lake WMA, from the 1980 Red Lake Wildlife Management Area Master Plan.

| Habitat | % total area | % State and LUP lands | % Tribal lands |
|---|---|---|---|
| Lowland coniferous forest | 34.1 | 34 | 34 |
| Deciduous aspen/birch forest | 9.2 | 9 | 10 |
| Bottomland hardwood | 0.7 | 1 | <1 |
| Upland coniferous forest | 2.3 | 2 | 4 |
| Lowland deciduous forest | 32.3 | 33 | 26 |
| Mixed deciduous/coniferous | 1.1 | 1 | 3 |
| Fen/bog | 18.5 | 18 | 18 |
| Experimental burn area | 0.2 | <1 | <1 |
| Old field | 0.3 | <1 | 1 |
| Cropland | 0.2 | <1 | 0 |
| Marsh, open water | 1.4 | 1 | 3 |

Table 3.8. Native plant community cover types within Hayes Lake State Park, 2010.

| Habitat/cover type | % area 2010 | Notes |
|---|---|---|
| Jack pine woodland | 25 | FD,[46] S2[47] |
| Jack pine-balsam fir woodland | 0.1 | FD, S2 |
| Aspen woodland | 13 | FD |
| Black ash-silver maple terrace forest | 10 | |
| White cedar swamp | 0.1 | |
| Alder swamp | 12.5 | |
| Tamarack-black spruce swamp | 0.4 | |
| Aspen-fir forest | 12 | |
| Wet aspen forest | 5.5 | |
| Sedge meadow | 0.4 | |
| Red pine plantation | 4 | |
| Old field | 6 | |
| Cropland | 1 | |
| Open water | 8 | |
| Developed areas | 2 | |

Inset: Hansen Creek. Photo by Dana Carlson.

[46] FD = fire-dependent communities.

[47] Plant communities are given a "security" ranking. S1 communities are critically imperiled, S2 communities are imperiled, S3 communities are rare or uncommon, S4 communities are widespread and apparently secure, and S5 communities are abundant and secure.

Table 3.9. Native plant community classes and native plant community types on LUP lands determined by Scott Zager based on the *Field Guide to the Native Plant Communities of Minnesota: The Laurentian Mixed Forest Province* (Minnesota DNR 2003).

| Native plant community type or land cover type | LUP acres | % of LUP | Notes |
|---|---|---|---|
| Northern dry-sand pine woodland/jack pine woodland | 2987 | 3.66 | FD, S2 |
| Northern dry-sand pine woodland/red pine woodland | 696 | 0.85 | FD, S2 |
| Northern poor dry-mesic woodland/jack pine-black spruce woodland | 2750 | 3.37 | FD, S2 |
| Northern dry-mesic mixed woodland/red pine-white pine woodland | 1272 | 1.56 | FD, S3 |
| Northern dry-mesic mixed woodland/aspen-birch woodland | 1024 | 1.25 | FD |
| Northern dry-mesic mixed woodland/black spruce woodland | 221 | 0.27 | FD, S2 |
| **Northern wet-mesic boreal hardwood-conifer forest/aspen-fir forest**[48] | 10662 | **13.07** | |
| Northern wet-mesic hardwood forest/aspen-ash forest | 339 | 0.42 | |
| Northern spruce bog/black spruce bog | 295 | 0.36 | |
| Northern poor conifer swamp/poor black spruce swamp | 96 | 0.12 | |
| Northern poor conifer swamp/poor tamarack-black spruce swamp | 7 | 0.01 | |
| Northern terrace forest/black ash-silver maple terrace forest | 187 | 0.23 | S3 |
| Northern floodplain forest/silver maple-(sensitive fern) floodplain forest | 42 | 0.05 | S3 |
| **Northern cedar swamp/white cedar swamp (northwest)** | 4595 | **5.63** | S3 |
| Northern rich spruce swamp(water track)/rich black spruce swamp (water track) | 1623 | 1.99 | S3 |
| Northern rich tamarack swamp(water track)/rich tamarack (sundew-pitcher plant) swamp | 2727 | 3.34 | |
| Northern rich tamarack swamp (western basin)/rich tamarack-(alder) swamp | 2382 | 2.92 | |
| Northern rich tamarack swamp (western basin)/extremely rich tamarack swamp | 2972 | 3.64 | |
| Northwestern rich conifer swamp/tamarack-black spruce swamp (aspen parkland) | 35 | 0.04 | S3 |
| Northern wet cedar forest/lowland white cedar forest (northern) | 3645 | 4.47 | S3 |
| Northern wet ash swamp/black ash-aspen-balsam poplar swamp (northeastern) | 2632 | 3.23 | |
| Northern very wet ash swamp/black ash-alder swamp (northern) | 291 | 0.36 | |
| Northwestern wet aspen forest/lowland black ash-aspen-balsam poplar forest | 3158 | 3.87 | |
| Northern open bog/low shrub bog | 58 | 0.07 | |
| Northern open bog/graminoid bog | 20 | 0.02 | S2-S4 |
| Northern poor fen/low shrub poor fen | 31 | 0.04 | |
| Northern poor fen/graminoid poor fen (basin) | 38 | 0.05 | S3 |
| Northern poor fen/graminoid poor fen (water track) | 85 | 0.10 | |
| Northern rich alder swamp/alder-(maple-loosestrife) swamp | 1338 | 1.64 | |
| Northern mixed cattail marsh/cattail-sedge marsh (northern) | 177 | 0.22 | S2 |
| Northern mixed cattail marsh/cattail marsh (northern) | 13 | 0.02 | S2 |
| Northern bulrush-spikerush marsh/bulrush marsh (northern) | 46 | 0.06 | S3 |

[48] Bold highlighting indicates communities comprising more than 5% of the total acreage.

| | | | |
|---|---|---|---|
| Northern bulrush-spikerush marsh/spikerush-burreed marsh (northern) | 33 | 0.04 | S2 |
| Northern rich fen/shrub rich fen (water track including strings) | 202 | 0.25 | |
| Northern rich fen (water track)/graminoid rich fen (water track) | 608 | 0.74 | S2-S3 |
| Northern rich fen (basin)/graminoid rich fen (basin) | 2053 | 2.52 | |
| Northern rich fen (basin)/graminoid-sphagnum rich fen (basin) | 387 | 0.47 | |
| Northern extremely rich fen/spring fen | 47 | 0.06 | S2 |
| Northern wet alder swamp/alder-(red currant-meadow-rue swamp) | 2120 | 2.60 | S3 |
| **Northern wet meadow carr/willow-dogwood shrub swamp** | 4859 | **5.95** | |
| **Northern wet meadow carr/sedge meadow** | 5644 | **6.92** | |
| Open water | 403 | 0.49 | |
| **Young forest (undetermined class)** | 7159 | **8.77** | |
| **Recent cuts and blowdowns (undetermined class)** | 5122 | **6.28** | |
| Planted trees (non-native plant community) | 2246 | 2.75 | |
| Open fields (non-native plant community) | 3754 | 4.60 | |
| Cropfields (food plots) | 184 | 0.22 | |
| Developed areas | 99 | 0.12 | |

In total, the first eight communities listed in Table 3.9 above are upland forest types, covering 19,951 acres, or 24.45% of LUP lands. Of these, the first six are fire-dependent communities totaling 8,450 acres, or 10.96% of the LUP lands. Four of those six communities are considered "imperiled," one is "rare or uncommon," and only one is "apparently secure." The "imperiled" S2 communities amount to 6,654 acres, or 8.15% of the LUP land base, and the "rare or uncommon" S3 community covers 1,272 acres, or 1.56% of the LUP land base.

The middle 15 communities are wetland forest types covering 24,687 acres, or 30.26% of LUP lands. Six of those communities are considered "rare or uncommon," amounting to 10,127 acres, or 12.41% of the LUP land base.

The last 18 native plant communities are non-forested wetland cover types covering 17,769 acres, or 21.77% of LUP lands. Of these, four communities are labeled "imperiled, amounting to 270 acres or 0.36% of the land base. The "graminoid rich fen (water track)" community amounts to 608 acres (0.74%), but ecologists are undecided if it warrants "imperiled" or "rare or uncommon" status. Three communities are considered "rare or uncommon," covering 2,204 acres (2.71%). Lastly, the "graminoid bog" community ranks somewhere between "imperiled" and "apparently secure," but there is only 20 acres of habitat classified as this community on LUP lands.

The last seven cover types listed (starting with open water) are non-native or undetermined native class cover types. Open water covers only 403 acres, or 0.49% of the LUP lands. The remaining six cover types amount to 18,564 acres or 22.7% of the LUP lands, and presumably are mostly, but not entirely, uplands.

In summary, in the tables above, the most direct comparisons can be made between the current data for state lands in the SFRMP plan (Table 3.5), versus estimates of cover types on LUP lands (Table 3.6), which are both more suited for planning purposes than Zager's more detailed analysis in Table 3.9 which is more suited for management purposes. These comparisons show:

- aspen, jack pine, ash/lowland hardwoods, white spruce/balsam fir, red pine, white pine (minimally) and lowland white cedar are more predominant on LUP lands than on state lands;
- lowland black spruce, lowland tamarack, stagnant lowland conifers, and non-forest habitats are more predominant on state lands than on LUP lands; and
- the amount of lowland/upland brushlands, birch, oak, and upland black spruce are roughly equivalent between LUP and state lands.

These results can then be compared with historic vegetation from *Tomorrow's Habitat* (Table 3.4) and put in additional context. They indicate that in the Agassiz Lowlands ecological subsection:

- deciduous aspen forest has declined from 19.4% coverage to 13.7% coverage; yet current aspen coverage on the LUP lands exceeds the subsection's historic coverage;
- lowland coniferous forest has declined from 50.5% coverage to 44.5% coverage; on LUP lands these cover types currently amount to about 24.9% cover; and
- shrub woodlands declined from 3.9% coverage to 0.6% coverage; on LUP lands upland brush cover types currently amount to about 0.8% cover.

The declines in native vegetation cover types above have generally been due to creating new acreages of grasslands and croplands. The ability to restore or create lowland coniferous forests is largely limited by specific hydrological requirements that are difficult to impossible for humans to adequately replicate, and the limited amount of upland brushlands on LUP lands are important for trending the amount of this cover type in the Agassiz Lowlands ecological subsection back towards historic levels. Aspen is the cover type most easy to work with in order to achieve desired future forest coverage. A management question is, "Do we retain the current level of aspen on LUP lands above historic levels in order to move the ecological subsection trend towards historic conditions, or do we decrease aspen coverage on LUP lands towards historic subsection coverage in order to move other plant community types toward historic ecological subsection conditions?"

**Vegetation at the Time of the Public Land Survey**

The Public Land Survey (PLS) is the best record of vegetation in the Beltrami Island area just prior to settlement by European-Americans. Survey records, notes and maps created during the original survey provide valuable information about trees and vegetation. These historical data predate widespread settlement by European-Americans and are especially valuable where the vegetation has been greatly altered since. The Bearing Tree Database contains computerized records of PLS bearing trees at standard section and quarter-section survey corners.[49] Bearing trees are a special kind of witness tree that the surveyors notched, blazed and scribed in a standard way to facilitate the relocation of the survey corner. In addition, the database includes codes for the type of vegetation at each stand survey corner as were determined or inferred from the surveyor's line summary notes. PLS data has been used to make maps of presettlement vegetation, ascertain tree species composition, and evaluate the importance and character of disturbance regimes (Heinselman 1974, Almendinger 1996).

Figure 3.2 shows the MN DNR version of PLS vegetation as mapped by Marschner (Heinselman 1974). The two main "vegetation units" described by Heinselman (1974) are "jack pine barrens and openings,"

[49] Minnesota's bearing tree database is maintained by the Natural Heritage Information System (NHIS) within the Minnesota Department of Natural Resources's Division of Ecological Resources.

which roughly corresponds to the beach ridges within the Beltrami Island area, and "conifer bogs and swamps," which occupy most of the inter-beach basins of Glacial Lake Agassiz. The estimated acreage and percent cover of PLS vegetation categories within the Beltrami Island area is 87,595 acres (or 9.54% of the area) for "jack pine barrens and openings," which roughly corresponds with the combined acreage of dry to mesic soil types mapped within the Beltrami Island area. The estimated acreage and percent cover of PLS category of "conifer bogs and swamps" (615,723 acres or 67% of the area) roughly corresponds with the acreage of peat soil types in the Beltrami Island area.

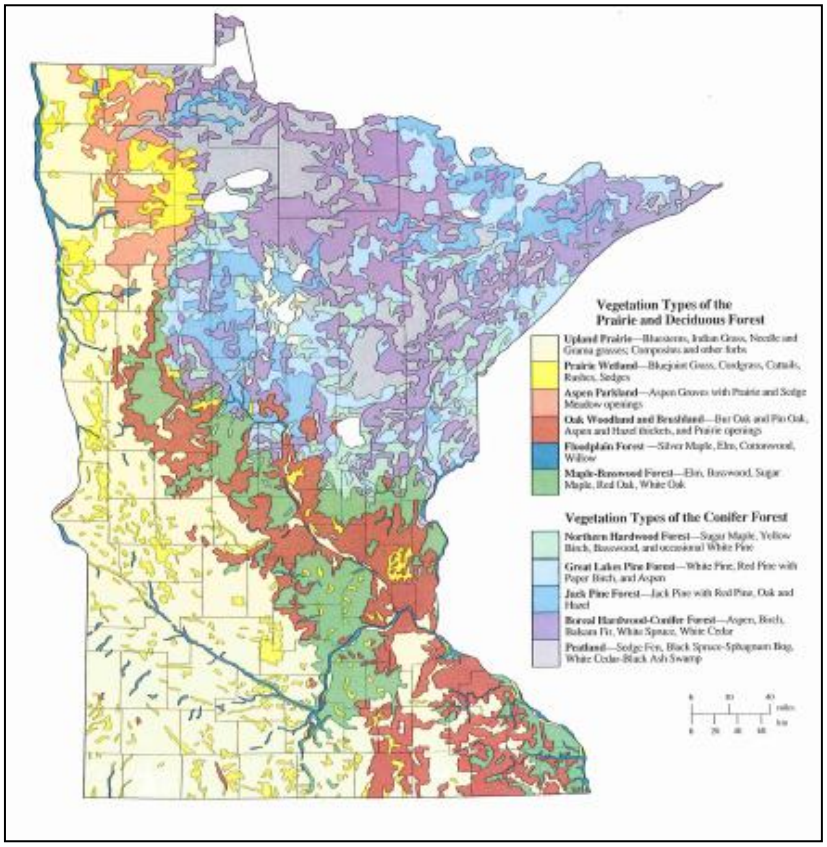



Figure 3.2. The natural vegetation of Minnesota at the time of the Public Land Survey: 1847-1907. Minnesota DNR Natural Heritage Program, 1988.

The vegetation "conifer bogs and swamps" is considered largely unaltered to date with the exception of woody encroachment in some areas due to ditching. However, the "jack pine barrens and openings" unit occurring on the upland beach ridges has been substantially altered since presettlement times. To ascertain the vegetation composition on the Beltrami Island area beach ridges at the time of the original survey, Zager clipped the PLS section and quarter-section points occurring within the area delineated as "jack pine barrens and openings." Percentages of PLS points with a particular vegetation designation can be interpreted as an estimate of the percent cover area for vegetation unit because it is assumed that the PLS points are distributed uniformly throughout the beach ridge. From this, Zager concluded 84% of the upland beach ridges were considered forest or timber (489 PLS points listed as "forest, timber"), and about 6% of the area was burned. There were 339 bearing trees of jack pine recorded on the beach ridges. Even though there were up to four bearing trees per PLS point , it can be roughly interpreted that jack pine covered approximately 58% of the area of beach ridges; red pine covered about 4% of the area; and upland aspen covered about 12% of the beach ridges at the time of the original survey. The most interesting conclusion drawn from this analysis is that while mature white pine trees were established within the Beltrami Island area, they represent a very low percentage of the beach ridges (0.5% cover). In fact, only eight white pines were recorded as bearing trees within the Beltrami Island area. No species of oak were recorded. Wet prairie was recorded at the western edge of the Beltrami Island area, but no prairie of any type was recorded on the beach ridges.

To summarize, at the time of the original public land survey, the upland beach ridges were dominated by jack pine with lesser amounts of red pine, paper birch and very rarely white pine. Aspen probably

occupied lower slopes bordering swamps and other moist areas, which were scattered about in small basins. Because fire was a commonly recorded occurrence, and because jack pine requires periodic fire for regeneration; pine trees formed open-canopied woodlands or pine savannas with an open understory (i.e., brush thickets were scarce). The pine openings were small meadows scattered throughout the barrens.

**Future Vegetation Communities**

There are several models that attempt to predict future climatic conditions based on different levels of carbon emissions, and built upon these models there are other models that attempt to predict future vegetation (and animal) communities. Some of the early efforts at predicting vegetation responses to climate change were carried out by Lee Frelich, Peter Reich, and Susan Galatowitsch. Frelich and Reich (2009) said, "The climate of the future will likely lead to higher mortality among mature trees, due to the greater frequency of droughts, fires, forest-leveling windstorms, and outbreaks of native and exotic insect pests and diseases. In addition, increasing populations of native deer and European earthworm invasions will inhibit the establishment of tree seedlings. The expected net impact of these factors will be a 'savannification' of the forest due to loss of adult trees at a rate faster than that at which they can be replaced. This will cause a greater magnitude and more rapid northeastward shift of the prairie-forest border, as compared with a shift solely attributable to the direct effects of temperature change."

Galatowitsch et al. (2009) outlined a scenario in which, in addition to "savannification", 1) boreal species such as black and white spruce, tamarack, balsam fir, and white birch are extirpated or become very rare in Minnesota; 2) red pine and jack pine are lost, or persist in a mixed forest with oaks and maples on nutrient poor sites; and 3) bur oak is likely to spread and become more abundant. Specifically for boreal peatlands, they predict "lower water table in peatlands; increase in peat fires; increased shrub growth in bogs; increased tree mortality from drought, disease, insects and disturbances."

However, Prased et al. (2007) predicted potential suitable habitat for trees in the year 2100, and found that little change is expected in the distribution for most species. The greatest changes are predicted for bur oak (more widespread, but not invading LUP lands), jack pine (a little less abundant, but greatest decreases in LUP planning area), red pine (a little less abundant), and tamarack and basswood (both with slight increases in abundance). These models are based only on habitat suitability and do not consider potential changes in impacts from herbivores, pests, and diseases.

The different predictions for forest direction seem to hinge on whether the future climate will be drier or wetter than the present climate. Galatowitsch et al. (2009) outline different strategies for dealing with climate change, whichever direction it goes.

**Forest Management/Forest Conversion Toolbox**

The Department has a variety of methods available for converting forest stands from one cover type to another. These fall under two main categories, active and passive. *Passive conversions* are accomplished by allowing stands to succeed naturally to their next seral stage through competition. It is most often employed where there is regeneration of desired species already occurring in the mid-canopy or understory. A prescribed burn may be included to help drive succession in the desired direction by controlling competing species or promoting (releasing) desired species.

*Active conversions* include 1) some form of harvest (clearcut, shelterwood, selective, thinning), 2) a season of harvest, 3) decisions about "leave" trees (species, amount, interspersion), and 4) decisions

about regeneration (seeding or planting and the site preparation and the possible use of herbicides that goes with them, versus natural regeneration; also prescribed burning, underplanting).

> *Clearcut* is the removal or all or most trees during harvest to permit the reestablishment of an even-aged forest of shade intolerant species such as aspen and/or jack pine.[50]
>
> *Shelterwood harvest* is a cutting in which trees are removed in a series of two or more cuttings to allow the establishment and early growth of new seedlings under partial shade and protection of older trees, resulting in an even-aged forest.
>
> *Selective harvest* is a management option used for shade-tolerant species in which single scattered trees or small groups of trees are removed at relatively short intervals, which results in continuous reproduction and an all-aged stand is maintained.
>
> *Thinning* is a treatment to reduce the density of trees in a forest stand to improve growth, enhance forest health, recover potential mortality, or encourage understory development. *Row thinning* is used in plantations to remove selected rows (usually during the first thinning) to provide room for equipment during later harvests. *Selective thinning* is where individual trees are marked for harvest based on their diameter, spacing or quality. Both row thinning and selective thinning are usually designed for improving timber for markets. *Variable density thinning* is used to create ecological heterogeneity in forest stands by creating an appearance of random, non-uniform thinning (Franklin et al. 2007). The extent of thinning (to a relatively higher or lower basal area) can affect both tree growth and understory plant development.

During harvest, the selection of "residual" trees can profoundly influence the direction in which a stand regenerates and how it ultimately appears. For example, species that might not regenerate well on a site might be retained to provide desired diversity. Or a prescribed quantity of "seed" trees might be retained in a uniform or random distribution to provide an adequate seed source for natural regeneration. Or a variety of "leave" trees may be retained in clumps or patches to create a future heterogeneous stand or provide for wildlife habitat and travel corridors.

If a site is to be planted, decisions need to be made about site bed preparation, whether to use seeds or seedlings, species composition and genetic parent material used, need for herbicide applications, and whether to include a prescribed burn.

Intermediate-stand treatments are used to redirect stand succession or create greater heterogeneity. *Single-tree selection* and *group selection* are forms of selective thinning that can be used to create uneven-aged stands by creating gaps that mimic natural disturbances (Franklin et al. 2007). *Heavy partial disturbances* are used in *two-cohort management systems* to create stands with two cohorts, providing a middle ground along the gradient from even-aged to uneven-aged management (Franklin et al. 2007). This is used in red pine and/or white pine forests to create standing and downed snags, patches of understory plants, and horizontal heterogeneity. This is analogous to a shelterwood harvest where 20-60% of the stand is retained. *Underplanting* is used to introduce shade-tolerant species into a stand where past management or disturbances have removed local seed sources (Franklin et al. 2007). An example is underplanting white pine in aspen stands. Prescribed fires can be used to control undesirable species and promote the regeneration of desirable understory species.

[50] Definitions are from the Agassiz Lowland SFRMP (Minnesota DNR 2008a) unless indicated otherwise.

# Peatlands

The greater Beltrami Island area contains five of the 18 peatland Scientific and Natural Areas that were formally designated as part of the Minnesota Wetland Conservation Act in 1991 (Table 3.10). Of these, the Red Lake Peatland is considered nationally and internationally significant, and is one of seven sites in Minnesota designated as a National Natural Landmark (Minnesota DNR 1984). It alone comprises over 50% of the acreage in peatland SNA's, and is the premier peatland in Minnesota. By comparison, the second ranked peatland in Minnesota, with 54 evaluation points, is the Myrtle Lake peatland, also designated a National Natural Landmark (i.e., the Lake Agassiz Peatlands Natural Area National Natural Landmark). Mulligan Lake peatland, Winter Road Lake peatland, and Luxemberg peatland were notable for scoring 10 out of 10 possible points for lack of physical disturbance to the peatlands, while Red Lake peatland scored 7 points and Norris Camp peatland scored only 1 point in that category (Minnesota DNR 1984).

**Development of Peatlands Starting 4,500 Years Ago**

Peat did not extensively accumulate on the former lake plains for about five thousand years after Glacial Lake Agassiz II drained away from Minnesota (Wright 1992). Beginning about 6000 to about 4000 years ago, the Red Lake Peatlands originated simultaneously with large tracts of peatland across Canada (Nichols 1969) when a cool, moist climate returned to the upper continent. An analysis of a 3.8 m deep core from the Red Lake Peatland estimated that peat accumulation began at this site about 3,500 years ago (Janssens 1983). Delay in peat development is attributed to an insuffciently wet and cool climate that did not maintain a continuously-high water table, which is necessary to inhibit decomposition of accumulated plant material. A second reason for the delay is attributed to the lag required for colonization from plant propagules migrating into new sites from existing peatlands (Gorham et al. 2007). Peat began to develop while the prairie-oak woodland was declining and before the mixed coniferous-deciduous forest became established. There is no evidence of extensive boreal swamps before peat development. Wood remains are common only after the initial sedge-meadow phase (Janssens et al. 1992). Because no significant lake deposits were found at the base of peat cores, Heinselman (1963) concluded that most of the Lake Agassiz peatlands developed by the process of paludification (swamping) over wet prairie-meadows rather than lake infilling.

Lake or marsh in-filling by peat did not occur in the Agassiz Lowlands because many shallow water wetlands had been filled with sediment deposits. Eventually, as the water table elevated, the vegetation began to develop a blanket of peat over the former plain of Glacial Lake Agassiz. The peat

Table 3.10. Peatland Scientific and Natural Areas within the Beltrami Island LUP planning area. Rank is based on the relative evaluation of the 18 Peatland SNA's designated in the Minnesota Wetland Conservation Act.

| Peatland Name | Core Area (acres) | Watershed Protection Area (acres) | Rank (1-18) | Evaluation Points (80 possible) | LUP Acres in Core Area |
|---|---|---|---|---|---|
| Red Lake Peatland | 87,580 | 145,928 | 1 | 70 | 190 |
| Mulligan Lake Peatland | 6,145 | 14,591 | 6 | 37 | 39 |
| Winter Road Lake Peatland | 4,300 | 14,684 | 10 | 27 | 397 |
| Luxemberg Peatland | 1,132 | 1,990 | 15 | 22 | 0 |
| Norris Camp Peatland | 1,656 | 4,866 | 18 | 9 | 0 |

blanket spread from east to west as the climate become progressively cooler and wetter across the continent. Janssens et al. (1992) describes the sequence of paludification as follows. Initially, as the water table lowered during the Hypsithermal, rooted aquatic plants became established and later kept pace with the rising water level. Following this, the lowlands became dominated by sedges . These were interspersed with cattail swales and small pools with emergent and submergent aquatic plants. Mosses were nearly absent at the time as indicated by low quantities of bryophyte fossils found in peat cores dated to this period. As the water table continued to rise, there was a major shift from sedge meadows to sedge and moss dominated rich fens (pH 6.5-8) associated with mineral rich groundwater. This is attributed to increased precipitation percolating through the soil and dissolving minerals from the lake-modified till before discharging into the large, inter-beach basins. This mineral-rich solution promoted minerotrophic, rich fens dominated by sedges, from which hemic sedge peat accumulated.

Eventually, species of *Sphagnum* peat mosses colonized and began to rapidly increase across some locations forming ombrotrophic mire (fibric peat). In areas eventually dominated by bogs and bog forests, some sedge meadows were replaced immediately by peat moss (*Sphagnum*) creating poor and intermediate fens with pH 4 - 5.5. Also, some rich fens were abruptly supplanted by poor fens dominated by wire sedge, and/or bog forest dominated by black spruce. Raised bogs formed as *Sphagnum* moss accumulated fibric peat over the hemic or sedge peat, eventually rising higher in elevation than the surrounding fen. As peat accumulated on the ever-rising bogs, surface drainage on the crest permitted black spruce to colonize and expand into bog forests.

Between 3,000 to 2,000 years ago, minerotrophic fen species declined in the areas where bogs and ovoid bog islands presently occur (Janssens et al. 1992). As drainage developed on the bog crests, spruce became established and expanded downslope. After about 2,000 years ago, these bog forests were replaced by featureless lawns of wet *Sphagnum*, which formed when surface flow became concentrated in drains over the compressed fibric and woody peat. Sphagnum lawns formed as the bog drains expanded and coalesced into broad blankets of peat moss covering the lower aprons surrounding the raised bogs. At about 2,100 years ago, at one site, the *Sphagnum* lawns and the developing ovoid islands became separated by internal water tracks. Afterward, ombrotrophic peat expanded over the minerotrophic peat, and thus lead to the enlargement of the ovoid bog islands.

The establishment and expansion of acid peatlands is attributed in part to the change on the upland beach ridges from oak savannah/prairie community to a mixed deciduous-pine forest. This transformation of plant dominants on the beach ridges yielded a corresponding change in nutrient cycles that caused the surface water to become more acidic with less dissolved minerals. Within the inter-beach basins, these changes in water chemistry are associated with the increasing dominance of acid-producing *Sphagnum* peat mosses, black spruce, tamarack, and ericaceous shrubs such as cranberry (Jacobson 1979; Janssen 1967, 1968; Janssens et al 1992). As acid peat accumulated over the basins, the thickening peat layer hindered the mixing of groundwater with the underlying lake-modified till. This further reduced the dissolved mineral content in waters nearest to the growing vegetation.

Over the course of time, ombrotrophic peat continued to grow on ovoid islands and raised bogs as *Sphagnum* moss expanded from their point of origin over minerotrophic fens (Janssens et al 1992). The water tracks observed today within the bog complex are not remnants of the original fen but developed later as water flow became channelized by the expansion of peat. The expanding peat gradually channeled flow into so-called water tracks with their present position and width; (i.e., the ombrotrophic peat restricted subsurface flow, thereby intensifying the water tracking through these ever-diminishing channels). High concentrations of minerals were present in these narrowed water-tracks resulting in extremely-rich fen communities with species characteristic of spring fens that are associated with the

nutrient-rich discharge of artesian groundwater. This is attributed to intensified hydraulic current in the narrowing water tracks, causing the groundwater to collect more dissolved minerals as it deeply penetrated into the underlying mineral till. During the last 500 years, there has been a decrease in dissolved mineral content in the water tracks of these rich fens. As the peat further developed, dense, semi-impermeable layers formed at the base of the peat. Water chemistry became increasingly muted due to this barrier imposed by the dense peat that restricted mixing of groundwater with the underlying calcareous substrate. This has gradually reduced the amount of soluble minerals in the peat, thereby lowering dissolved calcium content and pH and thus has promoted more ombrotrophic bogs at the expense of minerotrophic fens.

**Peatland Management Considerations During Climate Change**

By the late 1800s and early 1900s, logging and farming caused a precipitous drop in pine pollen types with a corresponding increase in ragweeds (Janssens et al 1992). Several hundred miles of drainage ditches were dug in the peatland area between 1900 and 1918 in preparation for agriculture (Bradof 1992). However, despite the failure of this homestead project, these ditches remain on the landscape today. Historic climate patterns reveal important considerations for the management of peatlands in the Beltrami Island area. Peat did not develop in northwestern Minnesota until about 5,000 years after Glacial Lake Agassiz receded from Minnestoa. Deglaciation was immediately followed by a gradual change from a cold-dry climate to a warm-dry climate maximum during the Late-Middle Holocene about 7,000 to 5,000 years ago. This warming period is known as the Hypsithermal. During this time, the moisture balance between precipitation and the moisture loss due to evapotranspiration was negative causing water tables and lake levels to drop across the Upper Midwest. This dry climate hindered the development of the Red Lake Peatlands until about 3,500 years ago.

It is predicted that in the next 100 years the climate will increase in temperature in a magnitude equal to or possibly greater than historical levels cited in this report. The peatlands within northwest Minnesota are on the edge of a favorable moisture balance for peat development, where evapotranspiration losses just equal precipitation. This is evident by the prevalence of fire-scarred peat, which is common along the edge of the prairie-forest boundary. Peatlands at this boundary are extremely vulnerable to atmospheric changes that would tip the balance to a warmer-dryer climate. Historically this has been shown to lower local water tables and thereby increase the propensity of peat fires.

The margins of bogs are sensitive to the adjustment in height of the water table. These changes are best evident in areas altered by drainage ditches. Future management practices that impede waters from leaving the peatland and promote rainwater infiltration on the uplands will help maintain high water tables and lower the likelihood of peat fires.

# Birds

Due to the vastness of the Beltrami Island/Red Lake area and the diversity of native plant communities present on LUP lands alone, the area is extremely important not only as a breeding ground for native birds, but also for migrants and wintering species from the boreal forests and tundra areas of Canada. Ironically, at the time the *Red Lake Wildlife Management Area Master Plan, 1980-1989* was written, there had been no published accounts of the region's avifauna apart from a couple of grouse studies. The first bird list for the Red Lake WMA (i.e., the list in the Master Plan) was assembled from staff field notes, gleanings from Roberts (1932), and a then-recent report to the Legislature on peatland resources (Warner and Doehlert 1978).

Little has changed since then. In the early 1980s Gerald Niemi and JoAnn Hanowski conducted the most thorough assessment of the avifauna resources of the Red Lake peatland areas (see Niemi and Hanowski 1984, 1992), Christmas Bird Counts (CBC) have been conducted in the Spina area annually since 1985, and a Breeding Bird Survey (BBS) route has been run along the Rapid River since 1993.

The entire Big Bog area has been designated as an Important Bird Area (IBA) by the National Audubon Society. This designation covers the LUP lands in Lake of the Woods and Beltrami counties, and also extends east into mid-Koochiching County and to the south, nearly enveloping Upper Red Lake. The western parts of the LUP lands are also featured as part of the Pine-to-Prairie Birding Trail.

Bird lists for the Red Lake WMA/Beltrami Island State Forest area and for Hayes Lake State Park, and results of the CBC and BBS are presented in Appendix C. The bird lists are broken down by three categories: 1) breeding species, including permanent residents, 2) spring and fall migrants, and summer visitors, and 3) winter visitors. Focal bird species can be identified by considering various groupings: game species, rare listed species, highly sought-after species by bird watchers (i.e., those species that generate eco-tourism), and ecological keystone species.

In comparing between lists and surveys, the limitations of each must be considered. For example, the Red Lake WMA bird list provides data over a large geographic area, which will not be as accurate for a specific site; the Hayes Lake State Park list on the other hand provides more accurate information but for a smaller area. Likewise, the Breeding Bird Survey route and the Christmas Bird Count circle are more focused on upland forested habitats rather than the peatlands and wetland expanses that dominate the south end of the Red Lake WMA.

## Game Species

**Grouse**

The most significant avian game species in the Beltrami Island area are the grouse species (ruffed, spruce, and sharp-tailed). They are highly sought after by hunters, as evidenced by the results of the questionnaire distributed during scoping. They are also ecological keystone species, and the spruce grouse is a “species of greatest conservation need” as well as a boreal species sought out by bird watchers. The sharp-tailed grouse is also limited in distribution in Minnesota, and here it is tied to peatlands and brushlands. Of the 43 people who returned questionnaires during scoping, 91% hunted ruffed grouse (more than any other species, including deer), 35% hunted spruce grouse, and 26% hunted sharp-tailed grouse.

**Ruffed grouse** are associated with deciduous and mixed deciduous-coniferous forests (Table 3.11), reaching their highest densities in aspen forests. Ruffed grouse need a mix of young and old aspen stands in close proximity in order to find the right combination of food and cover, with a preference for younger aspen stands, although recent research (e.g., Kouffeld 2011, Gutierrez 2012) is suggesting a greater importance for conifers than the classic research of Gordon Gullion. Pole-sized and sapling aspen stands are needed for various life stages, and conifers can be important thermal cover in winter, especially if warmer winters result in less snowcover. Some coarse woody debris (i.e., fallen logs) typical of older forests is necessary in the forest in order for male ruffed grouse to have drumming logs. Black bear, white-tailed deer, snowshoe hare, beaver, American woodcock, and a variety of songbirds also benefit from early successional forests that are created by logging and preferred by ruffed grouse.

Table 3.11. Cover types with a mean ruffed grouse habitat score greater than or equal to 2 on a relative index scale from 0 to 4. Habitat types with a score 2 or greater are considered ruffed grouse habitat. Source: DNR Ruffed Grouse Management Plan, 2011.

| Cover Type (from MNGAP) | Score | Cover Type (from MNGAP) | Score |
|---|---|---|---|
| Aspen/white birch | 4.000 | Bur/white oak mix | 2.555 |
| Upland shrub | 3.333 | Red oak | 2.555 |
| Spruce/fir-deciduous mix | 3.111 | Red/white pine-deciduous mix | 2.333 |
| Jack pine-deciduous mix | 3.000 | Upland deciduous | 2.222 |
| White/red oak | 3.000 | Balsam fir mix | 2.111 |
| Upland coniferous/deciduous mix | 2.889 | Red cedar-deciduous mix | 2.000 |
| Northern pin oak | 2.778 | Lowland deciduous shrub | 2.000 |

Management recommendations for benefiting ruffed grouse in aspen forests (DNR Ruffed Grouse Management Plan, 2011) include:

- Maintain 3-4 age classes or growth stages of aspen in association, including young aspen 6-25 years old for nesting cover and summer and fall foods; mature aspen >25 years old with a hazel or ironwood understory for food in fall, winter, and spring; and dense sapling aspen 4-15 years old for brood-rearing cover.
- Harvest aspen in small patches (10 acres or less).
- Maintain clumps of shrubs, conifers or mature aspen in larger cutover areas, and retain mature aspen along wetland edges.
- Leave scattered snags for use by other wildlife and eventually for drumming logs for grouse.

Kouffeld (2011) and Guiterrez (2012) add the following recommendations:

- When managing for conifers, emphasize either mixed-species composition during replanting or conifer plantations interspersed with aspen or mixed aspen/hardwood-conifer patches to create a mosaic of more evenly distributed cover types.
- The configuration of landscape cover types should be considered in management plans. Landscape management that favors heterogeneity of cover types such as aspen interspersed with patches of balsam fir or mixed conifer/aspen stands may ameliorate the impacts of climate change.

DNR management recommendations also exist for oak forests, should oak forests invade the Beltrami Island area as a result of projected climate change.

There are four Ruffed Grouse Management Areas in and near the Beltrami Island LUP area: 1) an area of slightly <1 $mi^2$ in T.158N, R.36W just north of Gate's Corner that contains no LUP land but is adjacent to 160 acres of LUP land; 2) about 1120 acres in T.159N, R.36W by 7-Mile Corner of which about 920 acres is LUP land; 3) about 360 acres in T.157N, R.34W by the *Canis lupis* Walking Trail, containing no LUP land, and 4) an area of about 5 $mi^2$ just west of Carp Swamp WMA in the Lake of the Woods State Forest also containing no LUP land.

**Sharp-tailed grouse** occur in open landscapes such as grasslands, sedge meadows, brushlands, savannahs, and boreal peatlands that are kept open through disturbances, such as fires or brush shearing. In Minnesota there is a population in the northwestern counties that includes all of the Beltrami Island area, and another population centered in Aitkin, Pine, Carlton and St. Louis counties. The mating system of sharp-tailed grouse involves a lek, or dancing ground, where males congregate to display or "dance" and females visit to select a mate. Dancing grounds occur in open landscapes where predators can be detected. As the amount of brush cover increases within about 1 km of a dancing ground, the suitability of an area decreases as a dancing ground (Hanowski et al. 2000, Bailey and Larson undated). However, brush cover away from dancing grounds is an important component of sharp-tailed grouse habitat for nesting, hiding, and brood-rearing (Bailey and Larson undated). A study in Canada found that leks are abandoned when aspen cover exceeds 56% in a 1 km radius and when grass and sedge covers decreases to below 15% cover (Berger and Baydack 1992). Other species that benefit from sharp-tailed grouse habitat management (i.e., shearing, mowing, and prescribed fire) include sandhill cranes, yellow rails, short-eared owls, northern harriers, bobolinks, and Nelson's sharp-tailed sparrows.

The DNR has been going through an informal process to identify priority open landscapes, primarily through the SFRMP process. This process has identified 44 land type associations (LTA's) for designation as priority open landscapes (Figure 3.3). Sharp-tailed grouse habitat needs were an integral part of the designation process, but the designated LTA's were not limited to sharp-tailed grouse range. The majority of the LUP planning area has been designated a priority open land-scape. Management for sharp-tailed grouse must be done at a landscape level (Hanowski et al. 2000).

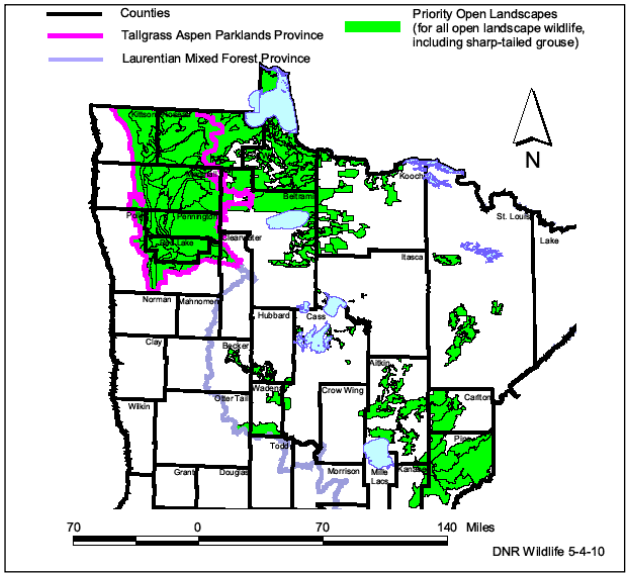



Figure 3.3. Priority open landscapes in Minnesota.

**Spruce grouse** inhabit both lowland coniferous forests and upland coniferous forest, particularly black spruce and jack pine. Broods sometimes use the edge of clearcuts if lowland coniferous forest is nearby. Spruce grouse eat spruce needles and buds. In winter they roost in the snow pack. In a study of radioed spruce grouse in Hubbard County, Pietz and Tester (1979)[51] found their radioed birds exclusively in jack pine during winter. Adult males established display territories in black spruce-tamarack bogs in late March and remained there through summer and fall, although some alder fringe habitat was used. Females showed strong selection for black spruce-tamarack bogs during the month before incubation began. In two cases, nesting and brood-rearing occurred exclusively in jack pine stands. During summer and early fall both jack pine and black spruce-tamarack bogs were used, but by late fall all radioed spruce grouse were back in jack pine. Essential habitat components appear to be dense (2500-3500 stems/acre), early successional conifer stands 7-14 m in height, with branches that touch or nearly touch the ground; preferred jack pine stands are typically <12 m tall and have not yet reached the self-pruning stage (Gregg et al. 2004). A habitat use study is currently underway in the Beltrami Island area.

[51] See also Tester and Pietz (1978).

**Waterfowl**

Waterfowl are not a particularly significant component of the avian community on LUP lands. This is due primarily to the lack of open water habitats (400 acres) and marshes (270 acres) on LUP lands. BBS data shows that the most abundant breeding species, mallard, was detected on only 38% of the annual routes, and at a density of 0.44/year. This assessment was confirmed during 232 hours of surveys of 23 nine-$mi^2$ priority blocks during Breeding Bird Atlas Project surveys: Canada geese were found in only four priority blocks, mallards in six priority blocks, and trumpeter swans, American wigeon, ring-necked ducks, and hooded mergansers in one priority block each. Despite this, breeding species that are listed as common to abundant on the Red Lake WMA bird checklist include Canada geese, wood ducks, mallards, blue-winged teal, green-winged teal, ring-necked ducks, common goldeneyes, and hooded mergansers. Although an uncommon breeder, American wigeons were also considered an abundant spring and fall migrant, and gadwalls, lesser scaup, and buffleheads were common migrants.

Canada geese, mallards, teal, and ring-necked ducks are marsh birds which have limited habitat in the Beltrami Island area. However, this habitat is neither at risk of degradation or loss in the project area. It also cannot be readily enhanced or expanded. The waterfowl that do breed in the area primarily use riparian habitats. Therefore, these species would not respond significantly to focused management. Wood ducks, common goldeneyes, buffleheads, hooded mergansers, and common mergansers, however, are cavity-nesting species and their populations could be affected by timber management plans. However, none of these species are prevalent in the LUP planning area, primarily due to a lack of brood-rearing habitat. Although bufflehead breeding range is closely tied to the distribution of aspen and northern flickers, they have not been documented as breeding in the Beltrami Island area. They have been documented breeding near Agassiz NWR and their population could expand into the Beltrami Island area in the future. It may be that there is unsuitable brood-rearing habitat for buffleheads in the LUP planning area. Habitat needs of these cavity-nesting ducks are shown in Table 3.12. Ten of 43 people (23%) who returned questionnaires during Scoping indicated they hunted waterfowl in the LUP planning area.

**Other Hunted Species, including Sandhill Cranes and American Woodcock**

Other hunted bird species include Wilson's (common) snipe, American woodcock, Virginia rail, sora, American coot, sandhill crane, and mourning dove. The Red Lake WMA bird list indicates American coots are abundant; sandhill cranes, Wilson's snipe, American woodcock, and mourning doves are common; soras are uncommon, and Virginia rails are rare. The Breeding Bird Survey (BBS) data, however, paints a different image: an average of 7.88 Wilson's snipe are detected per survey (n=16), but only 0.81 sandhill cranes/survey, 0.19 mourning doves/survey, 0.12 soras/survey, and 0.06 American woodcock/survey; and no Virginia rails or American coots have been detected yet. Results from the Breeding Bird Atlas Project (through 2011) also followed the general trend of the BBS: Wilson's snipe found in 18 blocks, sandhill cranes found in 9 blocks, mourning doves found in 12 blocks; soras, American woodcock and Virginia rails found in 1 block each; and American coots were not found. Of these species, sandhill cranes and American woodcock would most readily respond to management of their habitats. The other species are either marsh or wetland species with secure stable habitats, or common generalist species (e.g., mourning doves) that can adapt to a wide variety of habitat conditions.

Table 3.12. Nest site and brood-rearing habitat requirements of cavity-nesting waterfowl. Data from various species accounts in *Birds of North America* (Poole et al., eds, 1992-1999).

| Species | Nest site habitat needs | Brood-rearing habitat needs |
|---|---|---|
| Wood duck | Mature forests; mostly natural cavities caused by limb breaks and subsequent heart-rot, or infrequently old pileated woodpecker nest cavities, average 7.3 m up; in trees with dbh >30 cm, but usually about 60 cm dbh | Swampy marshes, rivers, creeks, floodplains and beaver ponds where interspersion of flooded shrubs, water-tolerant trees and small areas of open water creates 50-75% cover; stable water levels important; waterways provide travel corridors for broods |
| Common goldeneye | Natural cavities or old pileated woodpecker nest cavities, 1-13 m up | Lakes bordered by mature forests, with complex shorelines, high abundance of invertebrates and low abundance of fish that feed on invertebrates |
| Bufflehead | Primarily aspen, but also fir; primarily use old northern flicker cavities which are too small for goldeneyes to use, but sometimes cavities excavated by pileated woodpeckers | Prefers small ponds or lakes with no outlets or only seasonal outflow, with limited to no emergent or submergent vegetation, but with abundant food, pH 6.5-10 |
| Hooded merganser | No preference for type of cavity, except nest tree must be near water | Use wide variety of waterbodies of neutral pH, but generally 1) shallow, small, fishless ponds (in Ontario), or 2) shallow, swift flowing forest-lined rivers (in Wisconsin) |
| Common merganser | Natural cavities or cavities formed by pileated woodpeckers in live or dead trees, sometimes >0.5 km from water | Prefers large waterbodies surrounded by mature coniferous or mixed forests, with moderate to high pH and plentiful fish; may travel >8 km by waterways or drainageways from nest to ultimate brood-rearing territory |

Sandhill cranes in northwestern Minnesota belong to the “greater” subspecies, but migrate westward with the midcontinent population rather than southeast with the rest of Minnesota’s greater sandhill cranes. A coarse Habitat Suitability Index (HSI) model has been developed for greater sandhill cranes that recognizes four key habitat variables (Armbruster 1987). The first habitat variable is wetland classification. Emergent wetlands are recognized as providing maximum value; scrub-shrub wetlands and forested wetlands provide 50% and 25% value respectively, and aquatic beds have no value. The second habitat variable is wetland water regime. Semipermantly flooded and seasonally flooded wetlands were given 100% and 80% value respectively. Other saturated or variable flooded/exposed wetland types had 10-50% value, and permanently flooded wetlands were assigned no value. The third habitat variable is percent of area that is wetland, which recognizes that an upland habitat component is important to cranes. In this variable, areas where wetlands occupied 40-60% of the area were assigned full value. Areas containing less than 40% wetland decreased linearly and sharply in value as the proportion of wetlands decreased. Areas containing greater than 60% wetland decreased linearly but gradually in value as the percentage of wetlands increased. The last habitat variable is size of disturbance-free area. Areas of 200 ha or more were given full value; the value of smaller areas decreased linearly to no value for areas less than 20 ha. Maintenance of essential habitats is the primary need for all populations of sandhill cranes (Tacha et al. 1994).

American woodcock need a variety of habitats for their life cycle needs. Male woodcock perform their courtship displays in a variety of openings, including timber harvest areas, natural openings, roads and grasslands. Openings usually are within 100 m of diurnal cover, which include areas of early

successional growth, shrub lands, or dense understory in forests (Kelley et al. 2008). Woodcock nest in young, second-growth hardwood stands where stem density varies from 6500-20,000 stems/acre. Brood habitat is characterized by dense hardwood cover on good soils that provide an abundance of earthworms (Kelley et al. 2008). Earthworm abundance is a critical determinant of woodcock use of a site during the breeding season.

## Rare Listed Species[52]

A number of rare listed species have been documented in and around the Beltrami Island area. Some of these are known from LUP lands, others are known from nearby lands which indicates they are likely to regularly or occasionally occur on LUP lands, and others are simply known to occur in the general area but are unlikely to occur on LUP lands. In general, however, the total number of records for these species is small relative to the expanse of the area. This is due in part to the remoteness of the area and the inability to effectively monitor it.

**Horned Grebe (*Podiceps auritus*)[53]**

The horned grebe is a state-listed threatened species that inhabits marshes and lakes in the Tallgrass Aspen Parkland ecosystem west of the Beltrami Island area. It is considered an uncommon spring and fall visitor to Hayes Lake State Park. The Beltrami Island area is therefore not considered habitat for this species other than for occasional use.

**Trumpeter Swan (*Cygnus buccinators*)**

Trumpeter swans historically nested in western and southern Minnesota, however they were extirpated from Minnesota as a breeding species about 1885, and the full extent of their original range is unknown. The species was re-introduced with birds from Alaska starting in 1969. They were subsequently state-listed as a threatened species, but are now proposed for delisting due to the great success in re-establishing them. There are several nesting pairs in the Beltrami Island area, including a pair that had a nest with 8 eggs in the Brown's Lake area in 2010 and a pair that nests on the Roseau Flowage impoundment. The current state population exceeds 5,000 birds.[54]

**Northern Goshawk (*Accipiter gentilis*)**

The northern goshawk is on the U.S. Forest Service's sensitive species list, is a species of greatest conservation need, is proposed for listing as a state species of special concern when the list is revised, and is tracked in the Natural Heritage Database. The statewide population is estimated at 1500 birds based on Breeding Bird Survey data (RMBO 2008), although a statewide survey in 2010 found only 124 territories. There are an additional 12 records in the Natural Heritage Database and species in greatest conservation need database, for a total of 136 unique breeding season records. It is listed as an uncommon resident and breeding species on the Red Lake WMA, and as "occasional" at Hayes Lake State Park. There are no records within 1 mile of LUP lands, and although there are no known specific

[52] All of the bird species listed in this section are also listed as Species in Greatest Conservation Need.
[53] A note on use of scientific names: although giving scientific names is a standard practice in ecological literature, we have elected to limit use to rare species and to taxonomic groups (e.g., insects, some plants) where common names may not exist or are not agreed upon. This will shorten the plan by many pages.
[54] Carroll Henderson, personal communication.

nest locations within the LUP planning area, they have been observed in the planning area during the breeding season and on 38.5% of the Christmas Bird Counts. Goshawks are top predators, preying primarily on grouse and other large birds, and individuals have foraging territories that range up to 12,000 acres in size. However, the cumulative territory of a pair of breeding goshawks may range from 12,400 to 19,400 acres (Minnesota DNR 2003). The DNR has developed considerations[55] or guidelines for goshawk breeding territories (GBT), goshawk nest areas (GNA), and goshawk post-fledging areas (GPA) that can be applied in "landscapes in which there may be no known goshawk nests, but in which conditions are likely to support goshawks in the present or near future" (Minnesota DNR 2003).

**Bald Eagle (*Haliaeetus leucocephalus*)**

Bald eagles are a state-listed species of special concern although they are currently proposed to be removed from the state list. Information about this species is given on pages 100-101 under Species of Special Concern.

**Short-eared Owl (*Asio flammeus*)**

Short-eared owls are state-listed as a species of special concern. Information about this species is given on page 101 under Species of Special Concern.

**Yellow Rail (*Coturnicops noveboracensis*)**

The yellow rail is a secretive marsh bird that is state-listed as a species of special concern. Information about this species is given on page 101 under Species of Special Concern.

**Marbled Godwit (*Limosa fedoa*)**

The marbled godwit is a large shorebird that is state-listed as a species of special concern. The Beltrami Island area is not considered habitat for marbled godwits other than for occasional use. Although its range is primarily west of the Beltrami Island area in the Tallgrass Aspen Parkland ecological section, it is included on the bird species list for Hayes Lake State Park as uncommon during spring and summer. It has also been documented as a probable breeder at three sites along Roseau CSAH 2, one mile north of the BISF boundary.[56] It generally prefers short grass prairie habitat with temporary wetlands, although it will use recently burned or hayed areas for foraging. Niemi and Hanowski (1992) did not include it as a bird of peatland habitats.

**Wilson's Phalarope (*Phalaropus tricolor*)**

Wilson's phalarope is a state-listed threatened shorebird that has an affinity for wetlands with some open surface water. Phalaropes differ from other shorebirds in that the males incubate the eggs and are less colorful than females, they forage by spinning in shallow water and creating a vortex that causes food to rise to the surface, and they winter on the open ocean. Prior to 2012, the only two breeding season records for Wilson's phalarope in the project area were a record from the Red Lake peatlands north of Upper Red Lake (T.155N., R.33W., Sec. 3), and a pair observed in the Mulligan Lake Peatland

[55] "Considerations for Goshawk Breeding Territory Management" in Northern Goshawk Management Considerations (Minnesota DNR 2003).
[56] Beth Siverhus, personal communication.

SNA in June, 1984. They had also been recorded at Hayes Lake State Park. In 2012, several individuals were observed at Brown's Lake acting territorial and acting defensive of broods. The habitat for this species is considered secure in the project area; the only threat would be from altering water levels through inundation or drainage.

**Loggerhead Shrike (*Lanius ludovicianus*)**

The loggerhead shrike is a state-listed threatened species. It is on the Hayes Lake State Park bird list as an occasional visitor in spring, summer, and fall. There are no supportive records in the Natural Heritage Database, nor other records from the Beltrami Island area.

**Nelson's Sharp-tailed Sparrow (*Ammodramus nelsoni*)**

This secretive sparrow is both rare and rarely detected; it is rarely detected because it sings at night and inhabits marshy areas and peatlands that have a few inches of permanent standing water. It is state-listed as a species of special concern. Although its range is primarily west of the Beltrami Island area in the Tallgrass Aspen Parkland ecological section, it has been detected during marsh bird surveys at the junction along Dick's Parkway at the Roseau River (Sidie 2010), and it is included on the Red Lake WMA bird list although the historical basis for including it is not clear. Niemi and Hanowski (1992) included it as a resident of sedge fens.

**Common Loon (*Gavia immer*)**

The common loon is a DNR recognized species in greatest conservation need. The only known nesting pair in the project area is a pair on Hayes Lake with a nest in 2011. The nest was in a bay south of the southwest end of the dike, on state land, although the pair's brood-rearing territory would certainly encompass LUP land. Nesting on bog lakes in Mulligan Lake Peatland SNA and at Brown's Lake potentially occurs but is not known, although a pair was discovered on Mulligan Lake in 2011 as part of the Breeding Bird Atlas survey project. Thus the common loon would not be considered a significant breeding species in the planning area.

**Spruce Grouse (*Falcipennis canadensis*)**

Inset: Spruce grouse, by Wes Bailey.

The spruce grouse is a DNR recognized species in greatest conservation need, and a species of concern to the U.S. Forest Service (Gregg et al. 2004). Also, the Association of Fish and Wildlife Agencies commissioned a continental conservation plan (Williamson et al. 2008) for the species, in part because, due to it being a non-migratory gallinaceous species, it does not fall under the auspices of the federal Migratory Bird Treaty and the U.S. Fish and Wildlife Service, and therefore had not been given consideration from a continental perspective. It is a boreal species that is tied to lowland and upland coniferous habitat, especially black spruce and jack pine. It was nearly extirpated following the logging of the virgin forests after 1880, but made a comeback in the 1930s as the forests recovered (Gregg et al. 2004). Its current range in Minnesota includes Cook, Lake, St. Louis, Itasca, Koochiching, Beltrami, Lake of the Woods, and Roseau counties. It historically nested in northern Hubbard County in the Lake Alice area as late as the 1970s,

but has not been found there during Breeding Bird Atlas surveys from 2009-2012. Because the coniferous forest that it is associated with is at risk of retreating from Minnesota due to climate change,[57] the spruce grouse is recognized as a species that could easily be extirpated from the state. Boag and Scoeder (1992) also note that fire suppression along the southern edge of their range leads to extermination or confinement to remnants of suitable habitat. Their main predators are great horned owls, northern goshawks, martens, fishers, and foxes.

Red Lake WMA initiated a pilot project in 2010 to determine habitat use in the Beltrami Island area, but only 15 female grouse were located in 2010; 65 spruce grouse were observed in 2011.

**Connecticut Warbler (*Geothlypis agilis*)**

The Connecticut warbler is a DNR recognized species in greatest conservation need, and a federally recognized species of high tri-national concern. Its population has decreased 70% since the 1960s (Berlanga et al. 2010). It is associated with lowland coniferous forests. Other birds associated with lowland coniferous forests that have been declining in the western Great Lakes forest region are yellow-bellied flycatcher (declining significantly), Swainson's thrush, and yellow-rumped warbler (Niemi 2012).

**Golden-winged Warbler (*Vermivora chrysoptera*)**

The golden-winged warbler is a DNR recognized species in greatest conservation need. It has also been petitioned for listing under the federal Endangered Species Act (Will 2012). Information about this species is given on page 102 under Species of Special Concern.

**Black-throated Blue Warbler (*Setophaga caerulescens*)**

The black-throated blue warbler is a DNR recognized species in greatest conservation need. It inhabits coniferous forests primarily in Lake and Cook counties, however, it has been recorded as a rare visitor in spring, summer, and fall on the Red Lake WMA. Unless breeding is eventually confirmed, it is not a species we would manage for on LUP lands.

**Other Species of Greatest Conservation Need (SGCN's)**

Other species of greatest conservation need that occur in the Beltrami Island area include red-necked grebe, American white pelican, American bittern, Virginia rail, northern harrier, black tern, Forster's tern, boreal owl, whip-poor-will, black-billed cuckoo, least flycatcher, eastern wood pewee, marsh wren, sedge wren, veery, rose-breasted grosbeak, Le Conte's sparrow, swamp sparrow, white-throated sparrow, and bobolink.[58] The Beltrami Island area appears to be a center of abundance for whip-poor-wills in Minnesota, based on preliminary results of the Minnesota Breeding Birds Atlas Project. A common characteristic with other areas of whip-poor-will concentrations in Minnesota appears to be sandy soils. Whip-poor-wills nest on the ground in forests near open areas. Boreal owls are associated with mature, mixed upland forests for nesting, but show a strong preference for thick, homogenous lowland conifers for roosting (Lane et al. 1997).

[57] Published peer-reviewed papers by Frelich and Reich (2009a,b) and Galatowitschet al. (2009) predict this trend.
[58] See Winter Road Lake SNA WPA Plan (DNR 2010).

Although not SGCN's, great gray owls, northern hawk-owls, gray jays, evening grosbeaks, white-winged crossbills, and red crossbills have been identified by Section of Wildlife staff as species of local concern due to low or declining populations and/or narrow habitat needs. There have been few studies of great gray owls, and those are primarily from the mountainous areas in the western U.S. (Hayward 1994). Great gray owls breed in a variety of coniferous and northern forest types, but seem to prefer lowland conifers in Saskatchewan and Manitoba (Duncan and Hayward 1994). Their home ranges include open areas such as meadows and muskeg for foraging. Nests are in large trees in natural cavities or in nests made by other large birds (e.g., goshawks). Northern hawk-owls also prefer open coniferous or mixed forests. They nest in old woodpecker cavities or natural cavities in snags >19 cm dbh (James 1984), and seem to prefer foraging in open brushlands and peatlands. There have been even fewer studies of northern hawk-owls than of great gray owls. Optimal gray jay habitat appears to be lowland coniferous forests (Axelson 2011, Strickland et al. 2011). Some gray jay populations have declined by as much as 50% since 1977, especially among pairs that used deciduous habitats versus lowland conifer habitats. Gray jays have a unique habit of caching animal and fruit food items that are susceptible to spoilage and decay. One theory to explain the decline is that delayed onset of winter (due to climate change) is causing gray jay food items to spoil before freeze-up (Waite and Strickland 2006, Axelson 2011, Strickland et al. 2011).

**Colonial Waterbirds**

Waterbird colonies are considered ecologically sensitive sites even if the species itself may be quite common. There is a record from 1998 of a great blue heron colony about 3 miles south-southwest of Winter Road Lake. The colony is either on state forest and/or tribal land, not on LUP land.

## Sought-After Species by Bird Watchers

There is no official list of highly sought-after birds by birdwatchers, as any such list would be highly regional. However, the American Birding Association (ABA) does rank species that have occurred in the North American birding area by difficulty or likelihood of detection. These rankings factor in species abundance, frequency of occurrence in North America, and extent and geographic isolation of the species' range. Those species that occur in the Beltrami Island area that are harder to detect (i.e., given a score higher than "1" by ABA, which implies that they are desired sightings by birdwatchers) are spruce grouse, sharp-tailed grouse, yellow rail, piping plover, snowy owl, northern hawk-owl, great gray owl, long-eared owl, boreal owl, northern saw-whet owl, American three-toed woodpecker, black-backed woodpecker, bohemian waxwing, golden-winged warbler, Connecticut warbler, white-winged crossbill, and hoary redpoll.

Inset: American three-toed woodpecker.
Photo by Carl Greiner.

Among Minnesota birders, this list could be accentuated by the addition of short-eared owl, Wilson's phalarope, boreal chickadee, black-throated blue warbler, bay-breasted warbler, red crossbill, evening grosbeak, and pine grosbeak.

## Ecological Keystone Species

Ecological keystone species are those species that are critical to the functioning of local ecosystems. There are numerous ways to identify keystone species. One method would be to examine abundance based on density or percent occurrence rates. Other methods would be to look at biomass or locations on the food chain, or to employ an empirical approach (i.e., identifying a critical ecosystem function performed by a species). Despite these approaches, because ecosystems are complex, actual keystone species could be overlooked.

We identified avian ecological keystone species (Table 3.13) by employing a hierarchical step-down process based on reviewing Breeding Bird Survey route data. First we listed all species that were detected on ≥15 of 16 surveys, and calculated their average number of detections (range 3.50-66.31/survey) as a measure of abundance. Then we calculated the average number of detections for the remaining species to determine if any had an average detection rate above 3.50/survey.[59] Only one species (Connecticut warbler) fit into this category, with a detection rate of 14 of 16 surveys and an abundance of 6.12 birds/survey.[60] Thus, all species with a detection rate >3.50/survey, including Connecticut warbler, were considered keystone species. One bias to this approach is that large keystone species that require larger home ranges (such as northern harrier, great horned and barred owl, pileated woodpecker, northern flicker, yellow-bellied sapsucker, gray jay and common raven) would be unlikely to be detected at the frequency or abundance thresholds set. However, some of these species (e.g., sandhill crane, ruffed grouse) have been determined to be significant species for management for other reasons. One advantage to this approach is that the importance of small, obscure species are not overlooked.

### Woodpeckers as Keystone Species

Woodpeckers, as a guild, merit consideration as ecological keystone species for two reasons. First, they are cavity nesting birds that excavate their own nesting cavities. These cavities are then used by other species for breeding in subsequent years, such as common goldeneyes, buffleheads, mergansers, wood ducks, saw-whet owls, great crested flycatchers, tree swallows, chickadees, nuthatches, eastern bluebirds, house wrens, squirrels, pine martens and fishers. Some interspecific associations are rather specialized; for example, buffleheads specialize in used flicker nests, common goldeneyes use old pileated woodpecker nests, and saw-whet owls tend to use old flicker and pileated woodpecker nests. Other associations are more generalized: chickadees and nuthatches use cavities of smaller woodpeckers (e.g., downy and hairy); and great crested flycatchers use cavities of larger

Inset: Black-backed woodpecker (*Picoides arcticus*).
Photo by Ben Wieland, courtesy Deep Portage Learning Center.

[59] See Appendix G in the draft CCMP for greater detail.
[60] The Connecticut warbler was missed on the first two BBS surveys, and may have not been detected due to observer unfamiliarity with it. Its average rate of encounter for the next 14 surveys it was found on was 7.00/survey.

Table 3.13. Avian keystone species identified based on abundance and frequency of occurrence on Breeding Bird Survey route data.

| Species | Abundance (No./survey) | Frequency (Percent surveys detected on; n=16) |
|---|---|---|
| Red-eyed vireo | 66.31 | 100% |
| White-throated sparrow | 48.25 | 100% |
| Nashville warbler | 45.00 | 100% |
| Common yellowthroat | 36.88 | 100% |
| Ovenbird | 35.62 | 100% |
| Veery | 22.62 | 100% |
| Chestnut-sided warbler | 22.44 | 100% |
| Least flycatcher | 17.81 | 100% |
| Hermit thrush | 17.06 | 100% |
| Black-and-white warbler | 15.06 | 100% |
| Swamp sparrow | 14.19 | 100% |
| American robin | 12.56 | 100% |
| Alder flycatcher | 11.56 | 100% |
| Rose-breasted grosbeak | 10.12 | 100% |
| Song sparrow | 9.88 | 94% |
| Blue jay | 9.44 | 100% |
| Mourning warbler | 9.38 | 100% |
| Winter wren | 8.31 | 100% |
| Wilson's snipe | 7.88 | 94% |
| Chipping sparrow | 6.56 | 94% |
| American redstart | 6.12 | 94% |
| Connecticut warbler | 6.12 | 88% |
| Cedar waxwing | 6.00 | 94% |
| Yellow-rumped warbler | 5.38 | 94% |
| Eastern wood pewee | 4.81 | 100% |
| Black-capped chickadee | 4.62 | 94% |
| Great crested flycatcher | 4.19 | 94% |
| Black-throated green warbler | 3.50 | 94% |

woodpecker species.[61] Used cavities also provide roosting and wintering sites for several of these same species. Second, woodpeckers consume vast quantities of insects that damage or destroy trees, keeping these pest species in check and/or controlling outbreaks. Woodpeckers seem to have an uncanny ability to detect burned areas and areas with insect infestations, and to congregate there (e.g., Schroeder 1983a, Sousa 1987). Yellow-bellied sapsuckers and ruby-throated hummingbirds also have a symbiotic relationship, where feeding holes drilled by sapsuckers provide a source of sap important to hummingbirds upon their arrival in spring, prior to widespread flowering by nectar-producing plants.

Woodpeckers generally prefer to nest in aspen trees, although a variety of tree species are used for nesting. They also tend to prefer dead trees, and density of snags is the main determining factor of woodpecker and other cavity-nesting species' abundance. Managed forests typically have fewer snags and fewer cavity-nesting species than do unmanaged forests (Raphael and White 1984, Zlonias 2012).

[61] Data from individual species accounts in *Birds of North America* (Poole et al. 1992-1999).

Woodpecker species have differing requirements for tree diameters where they excavate their cavities (Table 3.14), so assuring a full suite of forest tree species composition and age diversity is important for maintaining woodpecker populations. Many tree species do not reach suitable diameters until past the age of normal rotation forestry (Table 3.15; see also Raphael and White 1984).

Although the data in Table 3.15 could be interpreted to suggest that woodpeckers need trees grown under extended rotation forestry (ERF) practices in order for trees to attain suitable size to support nests, this could also be accomplished with best management practices that leave suitable "leave" trees or patches under normal rotation harvest age. Nesting is also only one aspect of woodpecker life-cycle habitat requirements. Downy woodpeckers, for example, frequent younger forests and cutover areas with slash accumulations for feeding (Schroeder 1983a). Nonetheless, Conner (1980 in Schroeder 1983a) recommended a harvest rotation of 60-80 years in Virginia to provide foraging habitat for downy woodpeckers.[62] Older mature trees are also needed by other cavity nesting species. For example, the minimum dbh for barred owl nest trees is 51 cm, and it has been suggested that stand harvest (tree species not specified) prior to 80 years of age may not allow for suitable nest sites (Allen 1987).

Table 3.14. Nest site characteristics of woodpeckers.[63]

| Species | Preferred Trees | Notes | Diameter at Cavity | Tree DBH[64] | Cavity Height | Tree Height |
|---|---|---|---|---|---|---|
| Pileated woodpecker | Wide variety | Prefers older/ mature trees, dead trees | 45-60 cm | 54 cm | | |
| Downy woodpecker | Aspen | Prefers dead deciduous wood | 18-21 cm | 25-32 cm | 5 m | 8-10 m |
| Hairy woodpecker | Wide variety | Prefers living trees | 22.4 cm | 25.2 cm | 8.8 m | 13 m |
| Yellow-bellied sapsucker | Aspen | Also uses birch | 22.8 cm | 33.6 cm | 8.6 m | 19.4 m |
| Northern flicker | Wide variety | Prefers dead or diseased trees, often in cutover areas/openings | 34.5 cm | 47 cm | 5.7 m | |
| Red-bellied woodpecker | Wide variety | Prefers dead trees | | | | |
| Red-headed woodpecker | Oaks, other hardwoods | Prefers no understory | | | | |
| Three-toed woodpecker | Conifers, aspen, birch | Prefers snags | | 27.9 cm | 5.6-7.7 m | 23 m |
| Black-backed woodpecker | Wide variety of boreal species | Uses aspen, birch, lowland conifers | | 37-40 cm | 11 m | 28 m |

[62] In Virginia, Connor and Adkisson (1976) found pileated woodpecker nest trees averaged 143.5 years of age, northern flicker nest trees averaged 92.7 years of age, hairy woodpecker nest trees averaged 91.2 years of age, and downy woodpecker nest trees averaged 63.6 years of age.

[63] Data from individual species accounts in *Birds of North America* (Poole et al. 1992-1999) and HSI models (e.g., Sousa 1987).

[64] Diameter of tree at breast height. Minimum dbh for pileated woodpeckers is 38 cm (Schroeder 1983b); average dbh for downy and pileated woodpeckers from Schroeder (1983a, 1983b).

Table 3.15. Age characteristics of trees at suitable diameter to support nesting woodpeckers.

| Species | Tree DBH[65] | Aspen, high site index[66] | Aspen, low site index | Paper birch[67] | Eastern white pine[68] |
|---|---|---|---|---|---|
| Pileated woodpecker | 54 cm | >>>70 yrs | | | 108 yrs |
| Downy woodpecker | 25-32 cm | 60-70 yrs | >70 yrs | ≥50 yrs | 50-60 yrs |
| Hairy woodpecker | 25.2 cm | 60-65 yrs | >70 yrs | ≥50 yrs | 51 yrs |
| Yellow-bellied sapsucker | 33.6 cm | >70 yrs | >>70 yrs | ≥50 yrs | 67 yrs |
| Northern flicker | 47 cm | >>>70 yrs | | | 94 yrs |
| Three-toed woodpecker | 27.9 cm | 70 yrs | >70 yrs | ≥50 yrs | 56 yrs |
| Black-backed woodpecker | 37-40 cm | >>70 yrs | >>>70 yrs | | 74-80 yrs |

# Mammals

Although not as diverse as birds, mammals are a significant component of the natural environment of the Beltrami Island LUP planning area for hunting and trapping, as watchable wildlife, and as ecological keystone species. A list of the species known to occur in the Red Lake WMA/Beltrami Island State Forest area is included in Appendix D.

**Faunal Changes: Past and Future**

Woodland caribou and wolverine historically occurred in the area. Caribou disappeared from most of Minnesota by about 1900, with the exception of a small population that found refuge in the Big Bog country. That population eventually disappeared also, in the 1940s, despite an attempt to supplement the herd with the release of nine individuals from Saskatchewan in 1938. Wolverines ranged widely across the northern half of Minnesota, but also disappeared circa 1900 (Swanson 1940) due to unregulated harvest and extensive land clearing (Berg 1992). These species are unlikely to return to Minnesota, except for an occasional wanderer from Canada. Elk were once fairly common across much of Minnesota, but the last record of a native elk was from the Northwest Angle in 1932 (Fashingbauer 1965). In 1914, some elk from Yellowstone National park were re-introduced into northwestern Minnesota, first at Itasca State Park and then in 1935 twenty-seven elk were moved from Itasca to Red Lake. At one point recently, their numbers were reduced to 15 animals in a single herd near Grygla. The Grygla herd has since grown to about 40 animals and occupies about a 45 $mi^2$ area. In addition, there is a herd in northern Kittson County that expanded into the area from Canada. Elk are currently listed as a species of special concern by the State of Minnesota.

Moose populations are in severe decline in Minnesota. The northwestern population has been reduced from a peak of about 4000 in 1985 to <100 in 2007. The northeastern population has declined recently from about 8000 moose in 2006 to about 5000 in 2011, and to about 2760 in 2013. Both populations could potentially disappear from the state. Causes of the decline are not certain, but reproductive rates

[65] DBH from Table 3.14.
[66] Based on tables in Perala (1977). Normal rotation (harvest) age is 50 years where site index is high, and 45 years where site index is low; "established ERF rotation" (harvest) age is 70 years where site index is high, and 65 years where site index is low (Agassiz Lowlands SFRMP).
[67] Based on trees in mature stands average 25-30 cm in dbh (Tubbs 1977). Normal rotation harvest age is 50 years; "established ERF rotation" (harvest) age is 60 years (Agassiz Lowlands SFRMP).
[68] Based on average growth rate of 0.5 cm/year (Wendel and Smith 1990).

(both calving rates and calf survival) are too low to sustain a population, and mortality rates are above normal. Causes of reduced survival may relate to parasites (some of which are linked to white-tailed deer) or nutritional deficiencies related to climate change. Human hunting and wolf predation are not thought to be contributing factors to the decline. During the winters of 1977-78 and 1978-79, a 675 $mi^2$ area that included the northern part of the Red Lake WMA supported an estimated population of 0.10 and 0.13 moose/$mi^2$, respectively. Fritts and Mech (1981) reported a moose density in the early 1970s of 0.78/$mi^2$, mostly in the western part of the LUP planning area.

Fisher, pine marten, and gray wolf are three species that had seen steep population declines due to extensive habitat change and hunting and trapping (e.g., Coffin and Pfannmuller 1988), but have since recovered.[69] Fishers and gray wolf in particular have seen their populations grow and their ranges in Minnesota expand. The recovery of the pine marten has been slower, but steady. Wolves were rare or absent in the area at the time of settlement, but started returning following settler relocation. During the 1950s, an average of 15 wolves/year were harvested. The wolf population in particular began to recover towards carrying capacity in the LUP planning area as soon as federal protection was afforded it in August 1974 (Fritts and Mech 1981). With the return and increase in wolves, coyote populations decreased sharply after 1974; in the 1960s the ratio of coyotes to wolves in paid bounties was 20:1 (Fritts and Mech 1981). Another species couplet that has reversed abundance ratios in Minnesota, including in the Beltrami Island area, are lynx and bobcat; in 1870 the lynx:bobcat ratio in one fur market was 53:1; in 1945 the ratio in the state fur harvest was 1:55 (Breckenridge 1949).

White-tailed deer populations have increased in the region since pre-settlement times, probably as a result of an increase in the amount of early-successional forests created by logging and fires. Early in the last century, moose populations may have also benefitted from the increase in early successional forests (MNDNR 1980). In the early 1970s, the deer density in the LUP planning area was 10.4-15.6/$mi^2$ (Fritts and Mech 1981), at a time in which the population had been declining for 3-4 decades. From 1975-1980, Lake of the Woods and northern Beltrami counties had springtime densities of 7.4-17.2 deer/$mi.^2$

With a warming environment, several species that occur just to the south of the project area may expand their range northward, and someday be a component of the local fauna. The first record of a gray fox in the project area occurred only recently. Other species that may expand into the area include eastern cottontail, fox squirrel,[70] and opossum.

## Game Species

The following mammals that occur on LUP lands are considered game species, and thus are highly valued by the public: white-tailed deer, moose, black bear, gray squirrel, and snowshoe hare. The northwestern population of moose, however, has been closed to hunting since 1997 due to steep population declines.

Of the 41 people who hunted who returned questionnaires during scoping, 83% hunted white-tailed deer, 39% hunted snowshoe hares, 15% hunted black bear, and 12% hunted squirrels. One person also reported hunting bobcat.

[69] In the case of wolves, Mech (2009) includes poisoning and aerial hunting as factors in their decline.
[70] Fritts and Mech (1981) reported fox squirrel remains in wolf scat from the LUP planning area in the 1970s.

**White-tailed Deer (*Odocoileus virginianus*)**

White-tailed deer range widely across North America, occupying a wide range of habitats from boreal and deciduous forests to grasslands, urban areas and tropical rainforests. They are habitat generalists, although they prefer forest edges and open woodlands in proximity to brushland. Timber harvesting helps create the edges and openings and shrub habitats that they prefer. In areas where winter snows accumulate, they move to sheltered habitats called "deer yards", often lowland conifer stands, where they congregate to conserve energy and avoid predation. Deer are browsers, feeding on leaves, twigs and shoots of herbaceous vegetation and small trees and shrubs, acorns, berries, mushrooms, ornamental plants, and agricultural row crops.[71] Deer and elk feeding is prohibited by law in the LUP planning area as well as areas farther west in order to prevent the spread of bovine tuberculosis (TB).

Historically humans and wolves were the primary predators of deer in Minnesota, with bobcat, bear and coyote being incidental predators. Today, non-hunting mortality (across their range) is due to vehicle collisions (44%), starvation (43%), predation (5%), parasites and diseases (4%), and fence entanglement (3%). Causes of mortality in the LUP planning area are not quantified, but probably differ considerably than those listed above.

Although white-tailed deer were historically present in the LUP planning area, it is believed that white-tailed deer populations increased as a result of early successional forest habitat brought about by the original logging and subsequent frequent fires (MNDNR 1980) at the turn of the last century. The desired spring density in the LUP planning area is 6.6 deer per square mile, which falls in line with long-term trends.[72] From 1995-2009, the deer harvest in management unit 111 has ranged from a low of about 500 to a high of about 2500, and has been trending downward since the peak in 2003. The deer population in management unit 111 is currently below goal as a result of efforts to eliminate bovine (TB) from deer through an aggressive deer population reduction program. The population will be allowed to rebuild once we are confident that bovine TB has been eliminated.

**Black Bear (*Ursus americana*)**

Inset: Bear hunt. Photo by Brian and Dan Lambie.

Black bears are habitat generalists, being found in deciduous and coniferous forests, forested swamps, and even urban areas.[73] They primarily eat mast (acorns and other nuts, and berries and other fruit), other vegetation, insects, and some carrion and meat. Food abundance dictates bear social patterns, i.e., whether they are dispersed or concentrated. Males have an average home range of 81 $km^2$, which is large enough to overlap with smaller territories of 7-15 females. Males reach maturity at 3-4 years of age but continue to grow until 10-12 years old, attaining a typical weight around 400-500 pounds (maximum weight about 900 pounds). Females continue growing until about 6 years old, attaining a typical weight around 250-300 pounds (maximum weight 520 pounds). Females in northern Minnesota reach maturity at 4-6 years of age, compared to 3-4 years of age in central Minnesota, and

[71] This information is from Wilson and Ruff (1999).

[72] Deer zone 111; in 1978 there were 7.4 deer/$mi^2$, in 1979 there were 12.5 deer/$mi^2$, and in 2005 there were 7 deer/$mi^2$ during spring based on pellet counts.

[73] In fact, a housing development in Pennsylvania with >1000 people/$mi^2$ has a denser black bear population than any national forest or national park (Wilson and Ruff 1999).

their average first litter size is smaller in the north also (Noyce and Garshelis 2012). Mating occurs before nuts and berries ripen, so that mating does not interfere with fat accumulation for overwinter survival. Average lifespan is about 10 years, and mortality is primarily due to encounters with humans.[74]

In Minnesota, lowland coniferous forests are among the poorest producers of black bear foods; the primary exception being blueberries and raspberries found in black spruce communities, and red-osier dogwood, currant and swamp buckthorn[75] in lowland forests in general (Berg 1992). These forests are, however, important winter denning areas. In one study, 17% of females and 40% of males denned in lowland coniferous forests, with males travelling up to 150 miles from their summer range to their den sites (Berg 1992). Another study found that the abundance of fruit–producing species was highest in young aspen stands (5-15 years old), followed by older aspen stands (>30 years old) and birch forests, and red pine stands. However, the greatest amount of food produced (300 kg/ha) was in red pine plantations with interspersed openings or thinnings, followed by birch forests and young aspen stands (>100-<150 kg/ha; see Noyce and Coy 1990). The value of pine plantations varied with amount of herbicide applied to control hazel (a major bear food resource), and the study did not give added weight to more-preferred foods; instead it concluded that a diverse forest provides a diverse food base for bears. Likewise, a study in New York found that bears used burned areas, managed (harvested) areas, and unmanaged (mature forests) selectively during different seasons, and also concluded that a diverse forest provides a diverse food base for bears (Costello and Sage 1994).

**Moose (*Alces alces*)**

Moose inhabit boreal forests, tundra, and alpine areas typically north of 45°N latitude. They can range over large areas and use wetlands, forests, bogs and open areas. Moose are primarily limited in their distribution by their need to avoid hot climates,[76] and by parasites that are transmitted by white-tailed deer (e.g., liver flukes, winter ticks, and a brainworm that causes “moose disease”). Boreal lakes and ponds are important habitat features both for cooling off and as a food source. Moose consume up to 20 kg of food/day, in the form of leaves and aquatic plants in summer to woody twigs of deciduous and coniferous plants in winter. Aspen and willow are particularly nutritious to moose. Optimum forage is often produced after fire or timber harvest. A moose typically occupies a home range of 5-10 $km^2$ (2-4 $mi^2$). Primary predators of moose are humans, wolves and bears (including black bears), with up to 50% of the calves being taken. Older adults become more vulnerable to predation due to tooth wear after age 8 that affects their nutrition.[77]

As with white-tailed deer, moose were historically present in the LUP planning area, particularly in the western part of the area (Fritts and Mech 1981), and it is believed that moose populations increased as a result of early successional forest habitat brought about by the original logging and subsequent frequent fires (MNDNR 1980) at the turn of the twentieth century. Unfortunately, moose populations in northwestern Minnesota have declined sharply from about 4,000 in 1985 to <250 in 2003 to <100 in 2007. The decline is attributed to “climatic changes combined with increases in deer numbers and parasite transmission rates [that] may have rendered northwest Minnesota inhospitable to moose” (Ballard, undated).[78] The implication of this is that there are limited management tools for restoring

[74] This information is from Wilson and Ruff (1999).
[75] A native species, also known as alder buckthorn or alderleaf buckthorn.
[76] Because they have large bodies, large stomachs that produce heat through fermentation, and an inability to perspire, moose are limited to regions where temperatures do not exceed 27°C (76°F) for long periods (Wilson and Ruff 1999).
[77] This paragraph based on Wilson and Ruff (1999).
[78] See also Murray et al. (2006), which is a related article from this research project.

moose to the LUP planning area. Some elements of the Agassiz Lowlands SFRMP dovetail with moose habitat management recommendations made by the Moose Advisory Committee for northwest Minnesota, which are 1) use prescribed fire, timber harvest and mechanical treatment to create early successional habitats, and 2) manage for patches of mature aspen.

**Snowshoe Hare (*Lepus americanus*)**

The snowshoe hare is a boreal species of mixed and coniferous forests, alder swamps, and aspen forests. In some locations it uses upland jack pine extensively in summer and lowland habitats in winter. Where it does use lowland habitats, hares frequently move to uplands from March through May (Pietz and Tester 1979), perhaps as a result of maximum wetness in lowlands at that time of year. In the Red Lake peatlands, hares use white cedar and mature tamarack bog extensively, at least seasonally (Pietz and Tester 1979). Although it will utilize forest openings, it never strays far from thick cover (e.g., downed logs, vines, dense shrubs). It feeds on a variety succulent herbs and woody shrubs, and its foraging can alter plant composition in its habitats (Carreker 1985). It is a significant prey species for lynx, bobcat, wolves, martens, fishers and great horned owls. The species has well-studied 10-year population cycles that influence predator populations.

**Squirrels**

Red squirrels and flying squirrels are the most abundant squirrels in the LUP planning area. Gray and fox squirrels are present in surrounding rural and urban habitats. Gray squirrels inhabit deciduous and mixed deciduous-coniferous forests. Forests containing larger-sized trees are considered optimum habitat because of the greater amount of nesting cavities and food supply available (Wilson and Ruff 1999). Together with fox squirrels, gray squirrels are keystone species in oak forests, where they harvest and bury acorns that sprout to regenerate the forest. Oaks, however, are not a significant species in the LUP planning area at this time except along the Rapid River, and gray squirrels are virtually absent from the project planning area. Red squirrel habitat is primarily coniferous forest, and they are hunted for food in this area.

## Furbearer Species

Trapping can be an important supplemental source of income for some families and also for youth. Five (12%) of 43 questionnaire respondents reported doing some trapping, with the following species targeted: fisher (4 trappers), marten, bobcat and muskrat (2 each), and beaver, mink, weasels, and hares (1 each). Nobody reported trapping otter, fox or raccoon, although these are taken by trappers in the area. Trapping records from the Red Lake WMA (a subset of the project planning area) from the 10-year period of 2001-2011 show the following species harvested: beaver 861, muskrat 130, mink 114, raccoon 76, fisher 71, marten 60, river otter 33, weasels 14, bobcat 4, red fox 2, and striped skunk 2. Trapping activity in the project area beyond the WMA is probably similar, although more upland species such as red fox and bobcat may be taken there.

**Fishers (*Martes pennant*)**

Fishers were once nearly extirpated from Minnesota, due in large part to extensive logging and loss of mature forests at the turn of the 20$^{th}$ century. The trapping season on fishers was closed from 1928 until 1977. As once-logged-over forests matured, fisher populations began to rebound, and today they

have repopulated the forested landscape. Fishers prey on snowshoe hares, mice, voles, and porcupines, and in turn are preyed upon by bobcats. They rest and den in hollow logs, natural or manmade slash piles, standing dead and live snags with cavities (collectively referred to as coarse woody debris), and wood duck nest boxes. Large diameter aspen (typically 20-25 inch dbh), oak and sugar maple have been identified in Minnesota as important maternal and resting den sites (Erb 2012, Axelson 2012).

**Marten (*Martes americana*)**

Marten, or pine marten, like the fisher, were also once nearly extirpated from Minnesota, due in large part to extensive logging and loss of mature forests at the turn of the 20th century. The trapping season on marten was closed from 1928 until 1985. Unlike fishers, marten are still recovering from their population crash, and are still largely limited to extreme northern Minnesota. Martens prey extensively on red squirrels, mice and voles, and in turn are preyed upon by bobcats, fishers and red fox (Erb 2012). Martens also frequently rest and den in coarse woody debris and snags, but in winter they also move into underground and under-snow tunnels in lowland conifers. Maternal den sites occur in trees with an average dbh of 18.4 inches in Minnesota (Erb 2012).

**Bobcat (*Lynx rufus*)**

Although primarily thought of as an upland species, bobcat in northern Minnesota use white cedar stands extensively, particularly in winter, where prey densities (especially snowshoe hares) are relatively high, there is a more favorable microclimate, and snow depth is reduced relative to open areas. Other lowland conifer stands are also important bobcat habitat, including during summer (Berg 1992).

## Rare Listed Species[79]

A number of rare listed species have been documented in and around the Beltrami Island area. Some of these are known from LUP lands, others are known from nearby lands which indicates they are likely to regularly or occasionally occur on LUP lands, and others are simply known to occur in the general area but are unlikely to occur on LUP lands. In general, however, the total number of records for these species is small relative to the expanse of the area. This is due in part to the remoteness of the area and the inability to effectively monitor it.

**Canada Lynx (*Lynx canadensis*)**

The Canada lynx is a federally-listed threatened species. It historically occurred in the Beltrami Island/Red Lake area (Breckenridge 1949, Errington 1963, Berg 1992), however, the U.S. Fish and Wildlife Service does not recognize this region as critical habitat for the species.[80] Lynx likely still occur in this area and have been documented just to the north by cameras at the Minnesota-Manitoba border and to the south on the

[79] All of these species, along with elk, are also listed as species in greatest conservation need.

[80] Critical habitat is a legal term under the Endangered Species Act. It contains geographic areas that contain features that contribute to the conservation of a threatened or endangered species and may require special management or protection. In Minnesota, all of the state east of Highway 53 from International Falls to Duluth is designated critical habitat for lynx (Federal Register 73:10860-10896; Feb. 28, 2008).

Red Lake Indian Reservation, where one was killed and turned in to the DNR there in 2003 (see photo). Lynx populations are highly cyclic and linked to snowshoe hare populations. When snowshoe hares are plentiful, they constitute the bulk of the lynx diet; when hares are scarce, lynx prey on a variety of smaller mammals (Berg 1992).

**Mountain Lion (*Felis concolor*)**

Mountain lions are a state-listed species of special concern. Although the number of sightings in Minnesota has increased in recent years, there is a lot of ambiguity about the origin of most of the individuals sighted. Some have been documented to have escaped from captivity, and some have been dispersing animals from the Black Hills of South Dakota. A young male radio-collared in the Black Hills was tracked to the Roseau River WMA in 2007 before it moved on into Canada. There is no evidence of a breeding population in the state.

**Northern Bog Lemming (*Synaptomys borealis*)**

Northern bog lemmings are also a state-listed species of special concern. There are less than ten records of this small rodent in Minnesota since it was discovered here in 1932, and all or most are restricted to patterned peatlands where they are found in open bog and shrub carr (wet, open conditions with *Sphagnum* moss and a dense layer of ericaceous plants; Nordquist 1992). The species is patchily distributed, occurs in low numbers, and likely experiences little-to-no gene flow between populations. The current distribution of northern bog lemmings may comprise isolated, relic populations that are now trapped in remnant post-glacial habitats (Foresman 2001, in Minnesota Rare Species Guide). Too little is known about this species in Minnesota to formulate a management plan around it.

Three additional mammals that have been identified as species in greatest conservation need that have been included on the species list for Winter Lake Road Peatland SNA are least weasel, American badger, and Franklin's ground squirrel. The extent of their range in the Beltrami Island area is unknown.

## Ecological Keystone Species

**White-tailed Deer (*Odocoileus virginianus*)**

Keystone species are those species that are critical to the functioning of local ecosystems. White-tailed deer are an ecological keystone species due to their herbivory and ability to fundamentally restructure the herbaceous layers of forests as well as inhibit regeneration of certain tree species. Deer can affect plant growth rates, morphology (shape and appearance), survival, seed production, seed survival and germination (in the case of acorns and oaks), and they can affect the species composition of plant communities (Augustine and McNaughton 1988, Russell et al. 2001, White 2012). In Minnesota, deer selectively browse on white pine and white cedar seedlings, inhibiting regeneration; on acorns, preventing sprouting; and on a wide array of herbaceous layer and understory layer species, affecting plant community composition.

**Beaver (*Castor canadensis*)**

Beaver are an ecological keystone species because of the profound influence they have on wetland creation in northern landscapes, and the other species that respond to the wetlands they create. They

also affect hydrology, nutrient cycling patterns, the composition of fish and aquatic invertebrate communities, and they can increase species richness on the landscape (Wright et al. 2002). In the western U.S. beavers are being reintroduced to control stream erosion and regenerate riparian habitats. Beavers feed on inner bark and leaves of deciduous trees (preferring aspen and willow), aquatic and terrestrial herbaceous vegetation, and roots and tubers of aquatic plants. Intermediate-sized trees seem to be preferred food sources, due to a higher rate of return of energy or nutrients than that obtained from larger or smaller trees, especially as the distance beavers have to travel from water to trees increases. Beavers can also detect toxicity concentrations in trees and select those with lower levels of toxins. Wolves and humans (trappers) are the only major predators on beavers.[81] The network of drainage ditches and the aspen, willow, and balsam popular that have become established on the spoil banks have become favorable habitat for beavers (MNDNR 1980). In the early 1970s there was an estimated one beaver colony for every 1.9 miles of ditch (Fritts and Mech 1981), and with approximately 1,790 miles of ditches, the LUP planning area would have supported about 950 beaver colonies. Modifying riparian margins from aspen-dominated to spruce-fir-domination can result in reducing beaver populations.

Beavers have profound impacts on water storage on the landscape (Naiman et al. 1986, 1988, Woo and Waddington 1990, Verry 2007, Hood and Bayley 2008, and Host and Meysembourg 2010). Woo and Waddington (1990) looked at beaver dams in various states of repair and decay. They found that active beaver dams have less water storage available than some abandoned dams, and no storage at all if the dam is already experiencing *overflow* or *gapflow* discharge; thus, if a storm event is substantial enough, it will quickly fill the basin and overflow. A dam at the latter stages of disrepair has *throughflow* discharge, and has virtually no influence on discharge or retention. An abandoned dam in the early or middle stages of disrepair experiences *underflow* discharge, thus it has the greatest amount of storage potential and more slowly meters out runoff. In other words, it functions like a down-sized culvert or a beaver dam with a Clemson leveler. However, Woo and Waddington also found that dammed basins capture more runoff than they release downstream, whereas undammed basins do not. This is largely due to beaver dams creating surfaces where evapo-transpiration results in a net water loss, and in their study evapotranspiration in one beaver pond exceeded that in a control basin by 39%.

Inset: Beaver pond. Photo by Gretchen Mehmel.

**Red Squirrel (*Tamiasciuris hudsonicus*) and Northern Flying Squirrel (*Glaucomys sabrinus*)**

The pugnacious red squirrel is closely tied to boreal forests. Its primary food source is conifer cones and seeds, where in some locations red squirrels can consume two-thirds of the cone crop, but they also eat insects, mushrooms, bird eggs and small vertebrates. Red squirrels are more abundant in older forests, where cones are more abundant (Erb 2012). Red squirrels can influence forest composition negatively by inhibiting the natural regeneration of some conifers, but they are also beneficial by spreading the spores of fungi which are symbiotic with different conifers and provide valuable minerals to the trees.

[81] This section based on Wilson and Ruff (1999).

In addition, they are a primary prey species for some predators, such as martens.[82] Northern flying squirrels are considered a keystone species in the Pacific Northwest because they play a crucial role in spreading spores of symbiotic fungi, and they are a primary prey species for many predators, such as owls and martens.[83] They may play a similar role in northern Minnesota. Northern flying squirrels nest and den in natural and woodpecker-created cavities in deciduous and coniferous forests.

**Gray Wolf (*Canis lupus*)**

The gray wolf is a keystone ecological species because its absence or abundance can set off trophic cascades affecting 1) abundance, age structure, and distribution patterns of prey species (usually herbivores), 2) structure and composition of vegetation communities through the regulation of herbivores, and 3) abundance and behavior of competing carnivores, with cascading effects on their prey and the vegetation supporting their prey. These beneficial relationships have been documented in Yellowstone National Park (Chadwick 2010). Wolves affected elk movements and distribution, which in turn affected aspen growth and riparian vegetation survival, beaver presence/absence, stream stabilization and erosion, songbird abundance, insect abundance, and fish populations. It has also been suggested that wolves can aid in the recovery of lynx populations by controlling coyotes, which depress populations of snowshoe hares, the main prey item for lynx (Ripple et al. 2011).[84]

In Minnesota, wolves help structure the deer, beaver, and snowshoe hare populations, which in turn regulate aspen, white pine, and white cedar stands. Wolves also tend to displace coyotes, which in turn would displace red foxes, and thus the prey populations of these lower level predators are affected in complex ways. The primary prey species for wolves is deer in terms of both biomass and numbers killed, followed by moose (in biomass) and hares (in numbers; see Table 3.17). Fritts and Mech (1981) also found "the age structure of the 42 deer killed by wolves … was significantly different from a sample killed by hunters from the same general areas during those years." For example, humans harvested few deer older than 5 years and none over 12 years, whereas about 37% of the deer taken by wolves were over 5 years and some were 12-16 years old.

Table 3.17. Diet of gray wolves in LUP planning area, 1972-1976 (from Fritts and Mech 1981).

| Prey species | % Biomass, Winter | % Biomass, Summer | % Total Biomass | Ratio[85] |
|---|---|---|---|---|
| Deer | 75.3 | 56.8 | 67.0 | 1.00 |
| Moose | 20.7 | 33.8 | 26.6 | 0.06 |
| Snowshoe hare | 0.5 | 1.0 | 0.7 | 0.32 |
| Beaver | 0 | 1.4 | 0.6 | 0.03 |
| Small rodents | <0.1 | 0.2 | 0.1 | 0.06 |
| Livestock[86] | 2.8 | 6.2 | 4.3 | 0.01 |
| Other | 0.7 | 0.6 | 0.7 | 0.07 |

[82] Ibid.
[83] Ibid.
[84] We believe this would apply in unfragmented habitats. In fragmented habitats, wolf populations may benefit bobcat populations which also prey heavily on snowshoe hares.
[85] Ratio of numbers taken relative to every deer taken.
[86] Majority of livestock eaten were suspected of being scavenged, not killed (Fritts and Mech 1981).

# Other Fauna

## Fish

As a generality, LUP lands do not provide significant fish habitat except where they contain or border rivers and streams. There are few open water wetlands, lakes or ponds in the project area, and those that do exist are typically too shallow to support fish over the winter. This does not mean that they do not have considerable value for fish, however, as they do filter water, store water on the landscape and release it slowly into the river systems. Much of the bottom of the Hayes Lake reservoir lies on LUP lands, and this reservoir provides an important local recreational fishery. Also, the LUP lands on the north shore of Upper Red Lake certainly buffer one of the most significant fisheries in Minnesota. A list of fish species associated with the project area is provided in Appendix E.

A species presence or absence can be indicative of habitat quality. This is the basis for the concept of the Index of Biological Integrity. For example, the following species present in the BISF/Red Lake WMA are insectivores, which inhabit healthy streams which support aquatic insect communities: common shiner, pearl dace, bigmouth shiner, blacknose shiner, finescale dace, longnose dace, shorthead redhorse, brown bullhead, central mudminnow, brook stickleback, pumpkinseed, Iowa darter, Johnny darter, logperch, and blackside darter (Schmidt 1999). Top carnivores such as largemouth bass and northern pike are at the top of the food chain and can only thrive in high quality and species rich streams (Schmidt 1999). Lithophilic spawners require clean gravel or cobble for egg survival and do poorly in streams or stream reaches experiencing sedimentation or siltation (Schmidt 1999); these include common shiner, blacknose dace, longnose dace, white sucker, shorthead redhorse, logperch and blackside darter. Also, headwater fishes indicate stable flow conditions, permanent (stable) habitat, low environmental stress and higher biological integrity (Schmidt 1999); these include pearl dace, northern redbelly dace, finescale dace, blacknose dace, and brook stickleback.

Surveys focused on streams in the BISF and Red Lake WMA in 1997 (Schmidt 1999) found the three most abundant species sampled were indicative of good habitat quality, based on Schmidt's (1999) criteria (brook stickleback, a "headwaters" species and insectivore; northern redbelly dace, a "headwaters" species; and central mudminnow, an insectivore). Together these three species comprised 58.5% of the fish sampled. Top carnivores like largemouth bass and northern pike occurred in very small numbers at only two of twenty sampling stations. Three "intolerant"[87] species (blacknose shiner, longnose dace, and Iowa darter) accounted for 2.0% of the total catch.

**Hayes Lake**

Hayes Lake is a scenic 180-acre impoundment on the south branch of the Roseau River, located within Hayes Lake State Park. The lake has a maximum depth of 28 feet, and stratifies during warm summer months. The undeveloped shoreline of Hayes Lake presents many shore fishing opportunities in small bays and off numerous points that are accessible from trails around the beach and campground areas. There is also a handicap-accessible public fishing pier near the boat ramp on the northwest portion of the lake. The boat ramp is a single lane concrete access. Canoe access to the lake is available as a carry-

[87] "Intolerant" species are species that are intolerant of habitat degradation (e.g., due to siltation, vegetation loss, or changes in water chemistry, temperature, or oxygen supply). Thus they are the most likely to disappear from a degraded aquatic system. Conversely, their presence is accepted as an indicator of good water quality and habitat conditions.

in access located near the main campground. Outboard motors are prohibited on Hayes Lake, so boaters must utilize a paddle or electric trolling motor while on the lake. Hayes Lake is a popular place to canoe and kayak; canoe rental is available through the state park office. As of 2009, a fishing license is no longer needed to fish on Hayes Lake during the open water season. However, during the ice fishing season a license is needed. All other statewide fishing regulations apply for inland waters.

Hayes Lake is managed primarily for largemouth bass. Secondary species for management include bluegill and black crappie. Hayes Lake historically experienced annual winterkills until January 1985 when a hypolimnetic discharge tube was installed. Since then, only one major winterkill has been reported, during the winter of 1989-1990. Since 1990, largemouth bass, bluegill, black crappie, and walleye have all been reintroduced by stocking. Since 1993, the fish community in Hayes Lake has maintained itself through natural reproduction and appears healthy. One exception is walleye. Due to a lack of spawning habitat for walleye within the reservoir, no walleye have been sampled in the reservoir since 1993, and no additional stocking has been done. While walleye cannot exist in the reservoir, a fishable population exists in the Roseau River directly downstream of the dam at Hayes Lake and fishing below the dam can be very productive for walleye in the spring months.

Largemouth bass have recovered well since 1990, and a healthy naturally-reproducing population exists today in Hayes Lake. Electrofishing samples from 2008 and a full netting survey in 2009 indicate that ten year-classes are present and fish older than 9 years are present in the lake. The average size caught in the samples was 15 inches, and ranged from 7- 20 inches (and weighed up to 5 pounds).

A quality bluegill population exists that provides a great fishing opportunity. The recent fish netting survey conducted during the summer of 2009 indicated that the average size of bluegill is 5 inches, and fish up to 9 inches were caught in the nets. Natural reproduction is occurring in the lake and adult bluegills are abundant. Pumpkinseed are also present, but their abundance is at the lower range of what is considered normal for this type of lake, and their mean weight (0.07 pounds), is below normal.

Black crappies were also collected in the 2009 survey and during electrofishing in 2008. Black crappies ranged in size from 6-12 inches with an average size between 7-8 inches. Black crappie abundance in Hayes Lake is currently low, but good size fish are still found and provide a fishable population. When conditions are suitable, one good year of natural reproduction should help to increase abundance of black crappie within the lake.

Yellow perch are also present. Yellow perch, as of 2009, were mostly represented by individuals in the 6-7 inch size range with some perch up to 10 inches. The yellow perch population is at a sustainable level and within the typical range when compared to similar lakes.

Northern pike are abundant. The average size of northern pike is between 22-23 inches, and the population contains northern pike approaching 40 inches. During the 2009 survey a 39-inch northern pike was caught and released. Fishing reports from Hayes Lake indicate that large northern pike are commonly caught and a 15-20 pound fish is not impossible to find in the reservoir. Overall, the northern pike population appears healthy and continues to provide a great fishing opportunity.

White suckers and brown and black bullheads also occur. Bullhead abundance is below normal, but their mean size exceeds the normal range for this type of lake. Sucker abundance is towards the high end of the normal range, and their average weight (2.65 pounds) exceeds the normal range.

Overall, Hayes Lake provides a unique fishing opportunity near the city of Roseau. A quality fish community, undisturbed scenery, and new fishing regulations that allow fishing in a state park without a license during open water may increase angling use. The Minnesota Department of Health has issued a fish consumption advisory for Hayes Lake for crappie, northern pike and white sucker, for mercury. Some shoreline erosion on LUP land is noticeable, which would contribute to turbidity and nutrient loading to the lake.

**Upper Red Lake**

Upper Red Lake is a 120,000 acre lake, 60% (72,000 acres) of which is under the jurisdiction of the Red Lake Band of Chippewa Indians. The remaining 40% (48,000 acres) falls under the jurisdiction of the State of Minnesota. LUP lands occupy approximately 4.375 miles of shoreline, or about 7.7% of the approximately 57 miles of shoreline on Upper Red Lake. On a heavily developed lake, this amount of undeveloped lakeshore would provide invaluable ecosystems services; on a largely undeveloped lake like Upper Red Lake, however, the value of ecosystems services provided is difficult to quantify.[88]

Upper Red Lake is famous for its walleye fishery. The walleye fishery fluctuates with year-class strength, which is based on a complex interaction with yellow perch, its primary prey, and yellow perch year-class strength. The walleye population declined significantly in the 1990s due to overfishing, but was restored by closing the walleye season and re-stocking fish over a period of years through a cooperative management effort between the DNR and Red Lake Band. Northern pike are also a significant fishery on Upper Red Lake, and their population has been stable over the past eight years, with a nice mixture of fish sizes in the gill net samples. A popular black crappie fishery developed in the mid 1990s due to the demise of walleye, but the population has seen a gradual decline from an all-time high recorded in 1996. Age analyses indicate that a single strong year class produced in 1995 dominated the black crappie population, but none of the younger age groups have been very abundant compared to the 1995 year class.

**Rapid River**

The Rapid River has two branches that originate in the Red Lake WMA, in a remote bog area east of the Mulligan Lake peatland or perhaps within the eastern fringe of the Mulligan Lake peatland. Almost 75% of the watershed is comprised of wetlands (NRCS undated), which contributes to making the Rapid River watershed the healthiest watershed in the state. The river joins the Rainy River east of Baudette near Clementson near the Koochiching County line, and exceeds 57 miles in length from its headwater of the south branch. U.S.G.S. topographic map data indicates the north and south branches originate at an elevation of about 1310 ft, both exit the forest boundary[89] at about 1150 ft, join together at 1108 ft, and enter the Rainy River at 1063 ft. Portions of the river have been extensively channelized in the past. The river supports 28 species (see Appendix E), including five species (18%) that are deemed "intolerant" of degradation. Intolerant species include smallmouth bass and rock bass. Lake sturgeon spawn at the rapids near the mouth of the river. Some portions of the river, especially near the mouth, are well suited for northern pike. A 2003 stream assessment found that stream channels are relatively stable and well vegetated, with good water quality and habitat, but generally lack gamefish, probably due to extensive beaver dams upstream from Lake of the Woods County Highway 1. A 1997 fish survey

[88] Deciduous forests that abut water (i.e., wetlands, lakes) are particularly valuable bird habitat; a study in the Chippewa NF found the greatest amount of avian diversity occurred in this type of habitat (Probst et al. 1983).
[89] These river branches exit the Beltrami Island State Forest only to enter Lake of the Woods State Forest.

(Schmidt 1999) that focused on nongame species found that two sites (one each on the north and south branches) had two of the three most diverse fish populations among 20 sampling sites, with 15 and 14 species respectively.

**Roseau River**

The Roseau River in Minnesota extends for over 95 miles, and ultimately connects to the Red River of the North in Manitoba. The north branch of the Roseau River originates in the Mulligan Lake Peatland at an elevation of about 1250 ft, and exits Hayes Lake State Park at an elevation of about 1130 ft. The Roseau River supports 40 species of fish, of which only three (8%: rock bass, stonecat, Iowa darter[90]) are considered intolerant of habitat and water quality degradation (Appendix E). Early surveys of the river below the confluence of the north and south branches in the 1970s indicated game fish such as walleye and northern pike were prominent in the river system, but that extreme seasonal water level fluctuations limited the size of the fishery and concentrated large fish into remnant deeper water areas.

Surveys of the upper reaches of the river had not been conducted prior to 1996. In 1996 a survey of the first 1000 ft below the Hayes Lake dam was conducted. There, 19 species were located including walleye, yellow perch, northern pike, largemouth bass, crappie, bluegill, sunfish, and pumpkinseed. In 1997 Schmidt (1999) conducted sampling at Dam #1 and Winner Dam on Hansen Creek, and at the Roseau Flowage outlet, all upstream of Hayes Lake. At those sites, 18 species were detected, including three game species (largemouth bass, pumpkin seed, and northern pike) and blacknose shiner (an "intolerant" species that had not been detected elsewhere in the Roseau River system). Hansen Creek at the Dam #1 site had the second highest catch rate (catch per unit effort or CPUE) of the 20 sampling sites, but ranked among the lowest in diversity (only five species). The Winner Dam outlet ranked fourth in CPUE and tied for first in diversity (15 species). The Roseau flowage outlet had the second lowest CPUE and nine species present.

**Warroad River**

The Warroad River has two main branches that originate in the Beltrami Island State Forest. The east branch essentially originates out of the Winter Road Lake Peatland at about 1209 ft elevation, exits the BISF at approximately 1150 ft, and flows about 20 miles before meeting the west branch. The west branch essentially originates out of the west end of the Winter Road Lake Peatland at about 1212 ft elevation, exits the BISF at approximately 1130 ft, and flows a total of about 19 miles before meeting the east branch. The river then flows another four miles to Warroad and enters Lake of the Woods at an elevation of 1063 ft. Limited fish surveys in 1995-1998 focused on walleye, yellow perch, and northern pike near the mouth of the river. Surveys in 1997, 1999 and 2005 extended further upstream, into the east and west branches. A total of 28 species were found, including only three species (11%: rock bass, blacknose shiner, Iowa darter) considered intolerant of habitat degradation. Schmidt's surveys in 1997 (Schmidt 1999) found only 14 species in the BISF, including two intolerant species (14%: blacknose shiner, Iowa darter).

[90] Stonecat and Iowa darter were represented by only one specimen each out of over 9500 fish examined from 10 surveys. The lone specimen of Iowa darter was found just below the Hayes Lake dam.

**Winter Road River**

The Winter Road River originates in Winter Road Lake at an elevation of 1217 ft MSL, exits the BISF at an elevation of about 1129 ft, and flows just over 28 miles to Baudette where it enters the Rainy River at an elevation of 1061 ft. Only three fish surveys have been conducted, from 1986-2005, but the surveys found 31 species present, including six species (19%) considered intolerant of habitat degradation that were represented in substantial numbers (Appendix E). The six intolerant species comprised 179 out of 2016 (8.9%) fish collected.

**Trout Streams**

There is one designated trout stream on LUP lands, and two others in the greater Beltrami Island planning area. All three streams are stocked by the DNR's Baudette Area Fisheries Office. None of these streams have a self-maintaining population of trout. In 1976 the Rapid River was evaluated for designation as a trout stream, but was found to lack adequate habitat. Trout streams need to have a source of cold water, sufficient shading to keep the water cold, and a sufficient riparian buffer to keep nutrients and sediments out of the water in order to support trout.

The Bemis Hill stream is actually an L-shaped ditch along an abandoned road. It is stocked with brook trout. The short leg of the "L" is 1 mile long, of which 3/4 mile on the south is LUP land and 1/4 mile on the north is LUP land. The long leg of the "L" is 2 miles of which the north 3/4 mile is LUP land on both sides and a 1/4 mile segment in the middle is LUP land on both sides. Two tributaries to the short leg of the "L" coming in from the south are designated "protected tributaries." The other two local trout streams are a 5-mile stretch of ditch along the Pitt Grade FR that is stocked with rainbow and brown trout, and a 2-mile segment of Tomato Creek midway between Williams and Roosevelt that is no longer stocked with brook trout but remains a trout stream.

**Summary**

Based on diversity, percent composition and abundance of "intolerant" species, and metrics of biological integrity, the reaches of the Rapid, Roseau, Warroad, and Winter Road rivers in the LUP planning area provide good quality habitat for nongame fishes, and the primary management focus should be on preservation of their watersheds and riparian corridors rather than restoration measures.

## Reptiles and Amphibians

The Agassiz Lowlands subsection has a low diversity of reptiles and amphibians relative to other parts of the state, and certainly relative to other states. This is because northern climates support fewer heterotherimic or ectotherimic (cold-blooded) reptiles and amphibians than more southern climates. Eighteen species have been documented as occurring in Beltrami, Lake of the Woods, and Roseau counties.[91] This list is comprised of eleven amphibians and seven reptiles. The amphibians are blue-spotted salamander, tiger salamander, American toad, Canadian toad, gray tree frog, Cope's gray tree frog, spring peeper, western chorus frog, green frog, northern leopard frog, mink frog, and wood frog. The reptiles are painted turtle, snapping turtle, prairie skink, smooth green snake, redbelly snake, plains

[91]There is no known species list for just the project area, thus the list includes species from southern Beltrami County as well as western Roseau County, which are in different ecological subsections. Lake of the Woods County, which is most representative of the project area, has the fewest species, with only eight.

garter snake, and common garter snake. Of these, only wood frog, leopard frog, American toad, redbelly snake[92] and common garter snake have been documented in all three counties. The snapping turtle and smooth green snake are designated species in greatest conservation need.

Because reptiles and amphibians are restricted to surface travel, they remain in relatively small territories, which make them highly vulnerable to habitat changes (Oldfield and Moriarty 1994). The vast peatlands and coniferous forests are also among the poorest habitats for reptiles and amphibians (Table 3.18). Wood frogs, mink frogs, American toads and blue-spotted salamanders are common bog inhabitants. Bog water is very acidic (pH <4.5) which inhibits reptile and amphibian use. Certain habitats within the LUP planning area, such as rivers and streams, non-forested wetlands, and deciduous forested wetlands are likely to be most important to reptiles and amphibians.

Table 3.18. Distribution of reptiles and amphibians by habitat type in Minnesota (from Oldfield and Moriarty 1994).

| Habitat Type | No. Species |
|---|---|
| Rivers and streams | 24 |
| Marshes and prairie wetlands | 23 |
| Lakes and ponds | 21 |
| Oak forests and “Big Woods” forests | 20 |
| Floodplain forests | 19 |
| Prairies | 18 |
| Coniferous forests | 11 |
| Peatlands | 8 |

Inset: Wood frog. Photo by Carol Hall.

## Aquatic Invertebrates

There are no species meriting special comment other than those listed in the section on Endangered, Threatened and Rare Species, below. Mussel populations in northern Minnesota streams are of low diversity relatively to southern Minnesota streams. Schmidt (1999) collected five species of mussels while sampling for fish at twenty sites in the BISF/Red Lake WMA. The Rapid River system contained all five species: cylindrical papershell, fatmucket, white heelsplitter, creek heelsplitter, and giant floater, with both heelsplitters found only in this watershed. The Baudette River system supported three species; the Warroad and Winter Road river watersheds supported two species; and Hansen Creek in the Roseau River watershed supported only fatmucket. Water quality and quantity in the Beltrami Island LUP planning area are more than sufficient for maintaining mussel populations. The main threat to mussels would be from dams that block upstream movements of their host fish species.[93] Because mussels are long-lived (from several decades to over a century), it can take a long time for threats to successful reproduction to be detected.

[92] From Red Lake WMA records.

[93] The mussel life cycle requires that glochidia (larvae that develop from eggs released by breeding females) spend that stage of the mussel lifecycle in the gills of host fish species. Most mussels require one or a few specific species of fish to serve as their host.

## Insects[94]

The insect fauna of the Agassiz Lowlands has been poorly studied historically. Recent surveys reveal a rich fauna of strong boreal affinity, combined with elements of the eastern deciduous woodland and aspen parkland biomes. Species richness within the Agassiz Lowlands of Beltrami, Lake of the Woods, and Roseau counties could approach 10,000 species.[95] The task of surveying, specimen curation, and identification is a daunting one however, and many decades of field work and collaboration with specialists is needed to unveil most of the diversity. Well over 10,000 specimens representing approximately 1,500-2,000 species have been collected in recent surveys, but outside of the Lepidoptera (moths and butterflies) most await identification.

Four orders comprise the bulk of insect diversity. Coleoptera (beetles) are the most diverse, with perhaps 3000-4500 species expected in the Agassiz Lowlands. Hymenoptera (bees, wasps, and ants), Diptera (flies), and Lepidoptera (moths and butterflies) are also extremely diverse with approximately 1000-2000 species (each) expected. The moths and butterflies are the best studied group, with 618 species recorded.[96]

Insects are the dominant animals of terrestrial ecosystems (Grimaldi and Engel 2005). Their species diversity, biomass, and overall ecological importance are unmatched, yet they are given little regard as wildlife. Lepidoptera (moths and butterflies) are the dominant herbivores in the ecosystem, as well as important pollinators and food for other animals. As caterpillars, they consume more plant matter than any other group (large vertebrates included). Their feeding typically goes unnoticed, but outbreaks of some species can denude large stands of vegetation. Those which cause notable damage in the Agassiz Lowlands include the forest tent moth, which can defoliate many deciduous trees (especially aspen), the jack pine budworm, and the spruce budworm which can severely damage balsam fir; it is also a critical food source for many birds (Crawford and Jennings 1989). Even the smallest of the moths can have a big impact. The aspen leaf blotch miner moth is smaller than a grain of rice, yet the caterpillars (which form characteristic blotches on aspen leaves) can turn an entire forest from bright green to dull olive in outbreak years.

Coleoptera (beetles) occupy a variety of niches, from mammal burrows to streams and ponds, but are perhaps most notable for exploiting various niches in trees (from bark to inside wood, both living and dead). They are a major food resource for other animals (e.g. their larvae are the targets of woodpecker drillings) and many are important decomposers, predators, and pollinators. The larch beetle is an example of a species that is destructive to timber.

Hymenoptera (bees, wasps, and ants) are among the most important pollinators, serve as natural biological control to keep other insects in check, and are food for other animals. Diptera (flies) are perhaps the mostly ecologically diverse group. Although some are notorious for spreading disease and sucking blood (e.g., mosquitos), most are beneficial as detritivores, decomposers, pollinators, natural biological control, and food for other animals. The remaining insect orders may lack the great diversity of the four largest orders, but nonetheless are ecologically important. For example, aquatic groups such

[94] Contributed by Kyle Johnson, University of Wisconsin, Madison.
[95] Estimates based on ratios of Lepidoptera biodiversity to other insect groups (based on Grimaldi and Engel [2005] and regional surveys by K. Johnson).
[96] See Appendix K in the Draft CCMP. Many unidentified and unlabeled specimens are yet unaccounted for, and habitats other than peatlands are weakly sampled, so numerous additions are expected.

as Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are a major part of aquatic food chains, and are important indicators of stream health (Hilsenhoff 1987).

**Species of Conservation Interest**

The overwhelming diversity of insects, and the lack of information for many groups, makes conservation by habitat (rather than by species) the most practical approach for their protection. Individual species, however, can be useful indicators for management practices or ecological changes.

The broad habitat classes of the Agassiz Lowlands lack types (e.g., prairies) which would support imperiled species. Despite this, the area is an important stronghold for many boreal species at their range extreme, as well as some more southerly species at their northern range extreme.

The boreal peatland Lepidoptera fauna is remarkable and includes large populations of many seldom-encountered species. The presence of such large and detectable populations at their southern and western range extremes make these particularly valuable for climate monitoring. Species apparently at their southern range limit within the Agassiz Lowlands include arctic fritillary (*Boloria chariclea*), *Carsia sororiata, Lasionycta secedens*, *Lasionycta taigata*, and *Xestia mixta*. Other peatland species near their southern range limit (but occur farther south than the Agassiz Lowlands) include Freija Fritillary (*Boloria freija*), Frigga fritillary (*Boloria frigga*), and red-disked alpine (*Erebia discoidalis*).

The jack pine woodlands also harbor many boreal species possibly at their southern range extreme within the Agassiz Lowlands. These include large marble (*Euchloe ausonides*), Macoun's arctic (*Oeneis macounii*), and *Lithophane georgii*.

Inset*: Lasionycta secedens*, a boreal moth associated with lingonberry bogs. Photo contributed by K. Johnson.

**Managing for Insects**

For insect conservation, the overwhelming diversity and the lack of information for many groups makes management by habitat (rather than by species) the most practical approach. Glaser's comment (Glaser 1992d) about plant conservation applies to insects, because they are so closely connected: "The exact requirements for a rare population must be known to manage it successfully, but seldom is such information available. In the absence of this knowledge, preservation of an entire ecosystem offers the hope that it contains the complete suite of reguired habitats." Still, individual insect species are useful indicators for assessing management practices.

Large expanses of native vegetation in a variety of successional stages should maintain a diverse native insect fauna. Management (fire or logging) which creates early succession habitats, however, can create local extirpations through direct mortality or habitat/resource change. Thus a good rule of thumb is to apply any treatment to only a small portion of a habitat at any given time, and leave the full range of successional states. Fortunately the planning area has vast habitat tracts where such concerns are minimal. In addition, management for other wildlife should create the diversity of habitats needed for most insects.

Peatland logging is a special concern for some boreal peatland insects, as well as the habitats themselves. The time needed to regenerate the original peatland forest (if such habitat can regenerate) is questionable; regenerated "mature" forest stands often have a notably different tree structure and ground flora compared to original stands, and preliminary field work has found some of these regenerated stands to be rather lifeless for peatland specialist Lepidoptera. Species potentially sensitive to extensive harvest (especially black spruce bog forest and poor conifer swamp stands) include arctic fritillary, *Lasionycta secedens, Lasionycta taigata,* and *Xestia mixta*. The taiga alpine (*Erebia mancinus*), a species of special concern, is essentially restricted to certain commercial grade black spruce peatlands. While it has not been found in the Agassiz Lowlands to date, it could occur locally within the project area. If present, it would probably be the most sensitive species to extensive lowland black spruce harvest.

The lowland conifer stands are sufficiently vast that there are no immediate conservation concerns for boreal peatland insects, and areas with limited logging still support a rich fauna. A combination of intensive lowland conifer harvest and climate warming, however, could significantly deplete or even extirpate populations of boreal peatland specialists.

# Endangered, Threatened and Rare Species

## Federally Listed Threatened and Endangered Species

**Canada Lynx (*Lynx canadensis*)**

Inset: Canada lynx. Source: U.S. Fish and Wildlife Service.

The Canada lynx was listed as a threatened species in the lower 48 United States, including Minnesota, on March 24, 2000. Lynx in Minnesota are at the southern margins of a widely-distributed population centered in Canada and Alaska. It is believed that lynx populations in Minnesota are sustained by cyclic influxes from populations in Canada. Lynx are specialized predators of snowshoe hares, and their populations fluctuate with hare populations, but with a lag time effect. Lynx and snowshoe hares inhabit boreal forests with cold winters and deep snow. In Minnesota, the boreal forest transitions into prairie and eastern deciduous forests, and these transitions are not abrupt, but rather they result in a patchy transition zone. The habitat in these patches changes over time through natural or human-induced succession (including climate change), becoming suitable or unsuitable lynx habitat. Lynx can disperse large distances to find suitable habitat and food resources, including dispersing back into and out of Canada.[97]

Berg (1992) essentially considered all but the southwestern part of Lake of the Woods County to be lynx range; he did not consider Roseau or Beltrami counties to be part of lynx range. Errington (1963), on the other hand, found lynx in the white cedar thickets on the shore of Red Lake in the early 1920s. On February 28, 2008, the U.S. Fish and Wildlife Service proposed listing critical habitat for lynx. In Minnesota, critical habitat designation was limited to northeastern Minnesota east of U.S. Highway 53. Therefore, the Beltrami Island LUP planning area is not considered critical habitat for lynx.

[97] This paragraph from U.S. Fish and Wildlife Service, Federal Register, July 3, 2003, pages 40076-40098.

**Whooping Crane (*Grus americana*)**

The whooping crane is a federally-listed endangered species that has been extirpated from Minnesota. It historically nested in the western prairie regions of the state as late as 1876, but it was never very common (Coffin and Pfannmuller 1988). Today it is limited to one naturally occurring population that breeds at Wood Buffalo National Park in Canada, migrates through the Dakotas and other Great Plains states, and winters at Aransas National Wildlife Refuge in Texas. At one point the population fell to as few as 15 individuals, but today numbers over 1,000. Introduced "experimental" migratory and non-migratory populations have been established in Wisconsin and Florida, respectively. Theoretically, the shrublands and peatlands of the Beltrami Island area could have been excellent breeding habitat for whooping cranes, but the area was never explored by ornithologists prior to their extirpation. The area was considered a potential release site for an experimental population, but it was deemed too close to the migration route of the remaining wild and natural population, and therefore rejected as a release site. Conceivably, the Wisconsin population could continue to grow and eventually expand naturally into the Beltrami Island area. A similar possible expansion was noted in the CCP for Crane Meadows NWR in Morrison County.

**Western Prairie Fringed Orchid (*Platanthera praeclara*)**

The western prairie fringed orchid is a state-listed endangered and federally-listed threatened species that occurs in Minnesota primarily in the Glacial Lake Agassiz beach ridge area of Polk and Norman counties. It does not occur in the Beltrami Island area. However, in anticipation of climate change and a northeastward shift of prairie ecosystem conditions, we should consider whether the Beltrami Island area could become suitable habitat for this rare species, perhaps via facilitation of its movement. The species seems to have a discrete habitat preference for calcareous or subsaline prairies and wet meadows, often located in sinuous swales where hydrology originates from groundwater seeps at the bases of beach ridges (Coffin and Pfannmuller 1988). Our assessment is that this specific habitat condition is unlikely to be found or created in the Beltrami Island area. The only possible exceptions are two designated calcareous fens[98] in the Bemis Swamp area (Fen 13668 in the E1/2NW1/4 Sec. 1, T. 160 N., R. 38 W. [Beaver Twp.]; Fen 13669 in the SE1/4 Sec. 29 carrying over into NW1/4NE1/4 Sec. 32, T. 161 N., R 37 W.). These are currently state-owned forestry lands that abut LUP lands, and would be a prime focus area for land exchanges. The western prairie fringed orchid also has specific insect pollinators (Phillips 2003), of which only about a dozen are known. Two of these, *Sphinx luscitiosa* and *Sphinx drupiferarum*, both hawkmoths, occur in the LUP planning area (K. Johnson, unpublished data).

## State Listed Threatened and Endangered Species

**Wilson's Phalarope (*Phalaropus tricolor*)**

Wilson's phalarope is a state-listed threatened shorebird that has an affinity for wetlands with some open surface water. Phalaropes differ from other shorebirds in that the males incubate the eggs and are less colorful than females, they forage by spinning in shallow water and creating a vortex that causes

[98] Calcareous fens are the rarest wetland types in Minnesota if not all of North America (Leete 1996). They typically occur at the foot of a slope above a watercourse, where groundwater is discharged from a recharge zone higher up on the landscape. In the Bemis area the recharge zone is the greater area of higher elevations to the southeast of the calcareous fens. Calcareous fens are also listed as Outstanding Resource Value Waters by the Pollution Control Agency in Minnesota Rules Chapter 7050.

food to rise to the surface, and they winter on the open ocean. The only breeding season records for Wilson's phalarope in the project area are a record from the Red Lake peatlands north of Upper Red Lake (T.155N., R.33W., Sec. 3), a pair observed in the Mulligan Lake Peatland SNA in 1984, and several males acting defensive of broods at Brown's Slough in 2012. They have also been recorded at Hayes Lake State Park. The habitat for this species is considered secure in the project area; the only threat would be from altering water levels in wetlands through inundation or drainage.

**Pale Moonwort (*Botrychium pallidum*)**

This tiny species in the fern family is currently state-listed as threatened, but research and surveys since the species was listed have resulted in the number of known populations increasing from 6 to 65, so the species is under consideration for re-listing as special concern. Nonetheless, it is often regarded as one of the rarest moonworts in North America. This unusual plant grows in a variety of habitats from open to shaded, and wet to dry, including disturbed areas. It always occurs in association with other moonworts of the same genus, *Botrychium*. It appears most often in early to mid-successional habitats, where competition for light seems minimal. Because of its unusual breadth of habitats, it is unclear how suitable habitat should be managed or maintained.

There are several records in the Beltrami Island area on or near LUP land. A single plant was found in N1/2SW1/4 Sec. 29, T. 161 N., R. 36 W. in a red pine stand comprised of large, widely spaced trees in needle duff in partial sun. The site is in or near the Clear River campground location, which includes some LUP land. Another location on LUP land is in Sec. 3, T. 161 N., R. 35 W., also in a red pine plantation, just east of Cecil's Landing. The species also occurs near LUP land just south of the airfield near Norris Camp.

**Sterile Sedge (*Carex sterilis*)**

This specialized species of calcareous fens is currently state-listed as threatened. Although most populations in Minnesota are found in rare calcareous fens, the occurrence of sterile sedge in a few spring fens of the northern forest regions is an even rarer event. Fens are often small groundwater discharge areas, or portals, often 2 ha in size or less, for groundwater recharge areas covering large areas in excess of thousands of hectares.[99] Fens can be destroyed by additions (i.e., flooding) or subtractions (e.g., groundwater appropriations, including gravel mining, nearby or even occurring several kilometers away) to their hydrology. Other threats include livestock grazing, herbicide application, and excavation of ponds. Lowering of water tables and fire suppression also allow woody shrubs and invasive species such as reed canary grass to invade fens.

Sterile sedge has been found at both of the calcareous fens in the Bemis Hills area. There is no data on how abundant the plant is.

**Ram's-head Lady's-slipper (*Cypripedium arietinum*)**

This state-listed threatened species is associated with a wide range of habitats in both lowland and upland coniferous forests. One common denominator is that the soils of these habitats are weakly acidic to circumneutral, but they may be poor to rich in mineral content. It is a long-lived perennial that is pollinated by a variety of small bees. It reproduces only by seeds that are only spread short distances

[99] One hectare equals 2.47 acres.

by wind, so it cannot migrate long distances. It also does not survive efforts to transplant it. Primary threats include agricultural forestry practices of planting pine plantations, discing and bed preparation, herbicide application, and heavy equipment use during the growing season.


Photo by Scott Zager.

There are 11 known sites where this species occurs in the Bemis Swamp complex, one site in the Mulligan Lake Peatland on Con-Con Forestry land, one site in Gustafson's Camp SNA on LUP land in the N1/2NE1/4 Sec. 9, T. 158 N., R. 33 W.; and one site on LUP in the NW1/4SE1/4 Sec. 6, T. 158 N., R. 33 W. The site in Gustafson's Camp SNA is described as a white cedar stand with pools of surface water. The other nearby site in this township is described as a coniferous forested peatland dominated by black spruce and white cedar with sphagnum hummocks. Another population occurs on LUP land in the SW1/4NW1/4 of Sec. 23, T. 160 N, R. 34 W.

**Small White Water-lily (*Nymphaea leibergii*)**

This aquatic species has a limited geographic range and is rare wherever it is found. It is a state-listed threatened plant species. The second known population in the state was discovered at Mulligan Lake in 1949. In 1984, an attempt was made to relocate the population in Mulligan Lake, which had not been revisited by botanists since 1949, and at which time there were only four known populations in the state. Although Mulligan Lake was never reached, other populations were found in rivers and streams during this search. The preferred habitat is slow-moving streams, especially those impounded by beavers.[100] The plants are rooted in soft sediments in 1-2 m of water where emergent vegetation transitions to floating-leaved vegetation. The main threat to the population is believed to be competition with exotic invasive aquatic plant species.

In the greater project planning area, this species has been found 1) in several stretches of the Roseau River in the Mulligan Lake Peatland, 2) at two locations in Hansen Creek, one in the impoundment above the dam and one below the impoundment, 3) in small numbers in the impoundment above the Manweiler Dam, 4) in larger numbers in the impoundment above the Bednar Dam, 5) at one location in the North Branch of the Rapid River in the Red Lake WMA, 6) in Meadow Creek, a tributary to the North Branch of the Rapid River, 7) south of the Faunce-Butterfield FR in the Mulligan Lake peatland in the Red Lake WMA in a ditch with water control structures, and 8) in Mud Lake in the Luxemberg Peatland.

## Species of Special Concern/ Species in Greatest Conservation Need: State, Federal, and Non-Governmental Organization Lists

**Bald Eagle (*Haliaeetus leucocephalus*)**

Bald eagles are a state-listed species of special concern although they are currently proposed to be removed from the state list. They were formerly federally-listed as a threatened species, but have since been delisted (in August 2007) due to recovery from population declines related to DDT poisoning. Bald

[100] The DNR Rare Species Guide account for this species states, "Although populations of *N. leibergii* have been found in ponds that resulted from dams constructed on portions of small streams, it would be a mistake to assume that building a dam downstream or upstream of an existing population would be beneficial for the species. It is likely that this species colonizes new habitat only after habitat conditions stabilize."

eagles remain protected under the federal Eagle Protection Act, however, thus they warrant mention here.

There are six recorded bald eagle nests/pairs in the project area, of which some pairs shift nest sites slightly from year to year. Five of these are along the north shore of Upper Red Lake. Of these five, three are in Birch Island Township along the Blanchard Forest Road, but location data is not specific enough to indicate if they are on state or federal lands. A fourth nest has typical been located in Waskish Township along Highway 72, but in 2011 it shifted a little farther west barely into Red Lake Township. The fifth nest near Upper Red Lake is just south of the town of Waskish near the town's airport. These last two nests are not on public lands. The sixth nest in the project area is in Roseau County in Sec. 11 or 12 of Reine Township. It is not known whether this nest is on public lands.

**Short-eared Owl (*Asio flammeus*)**

Short-eared owls are state-listed as a species of special concern. They are one of only three species that are considered to have a world-wide distribution, and in Minnesota they nest on the ground in native prairies, marshes, and open peatlands (Coffin and Pfannmuller 1988). In peatlands, they utilize high shrub, low shrub, sedge meadow and muskeg habitats (Niemi and Hanowski 1992). In the project area they have been found in the Winter Road Lake Peatland SNA and adjoining watershed protection area (Minnesota DNR 2010), Luxemberg Peatland on tribal land, in the Red Lake Peatland SNA and watershed protection area just east of Highway 72, in southern Lake of the Woods County just west of Highway 72 near the Ecel Energy transmission line corridor and Carp WMA, and near the vicinity of Brown's Lake. Their habitats in the project area are well protected from direct damage (as designated peatland SNA's and through the Wetland Conservation Act).

Photo by Carroll Henderson.

**Yellow Rail (*Coturnicops noveboracensis*)**

The yellow rail is a secretive marsh bird that is state-listed as a species of special concern. It is best detected by listening for its calls, which can sometimes be elicited by humans by tapping two stones together. Its preferred habitats are sedge meadows (dominated by wiregrass sedge) and grassy marshes (dominated by lake sedge or bluejoint grass), with water depths of 2-25 cm (DNR Rare Species Guides). The main threats to their habitat are encroachment by shrubs due to lack of burning or shearing, or manipulation of water levels that leave sites too dry or too wet. In the project area there are several breeding season records from the Luxemburg Peatland area (both the SNA and tribal lands), in the Winter Road Lake Peatland SNA, in the southern Dick's Parkway corridor/Fourtown area,[101] in southern Lake of the Woods County just west of Highway 72 near the Ecel Energy transmission line corridor, and in the Red Lake Peatland SNA and watershed protection area on either side of Highway 72. Yellow rails and short-eared owls overlap in habitat preferences, although short-eared owls appear to tolerate a greater degree of shrub invasion in their habitat. Ironically, Niemi and Hanowski (1984) found the highest densities of yellow rails in high shrub habitat away from the transmission line (0.8 pairs/10 ha), and the second highest density in high shrub habitats under the transmission line (0.3 pairs/ha).

[101] From the Minnesota Breeding Bird Atlas Project database, from USFWS Yellow Rail Surveys, 2010.

**Golden-winged Warbler (*Vermivora chrysoptera*)**

The golden-winged warbler is a DNR recognized species in greatest conservation need. A petition to list it as a federal threatened or endangered species has been found to be warranted.[102] The population in Minnesota is estimated at 90,000 which represents 42.2% of the estimated global population of 214,220 (RMBO 2008), which is one-fourth of the population of 40 years ago (Will 2009). At the southern part of its range, golden-winged warblers interbreed with blue-winged warblers, and pure golden-winged warblers are disappearing. The range of golden-winged warblers has also been shifting to the northwest over the last 80 years, and may continue to do so for awhile (Will 2009).

Inset: Golden-winged warbler. Photo by Larry Leonard.

Golden-winged warblers are associated with regenerating aspen stands, lowland conifers, and shrub swamps. Regenerating aspen stands provide suitable habitat for about ten years before they grow too much, but lowland conifers and shrub swamps provide suitable habitat for much longer periods (Hanowski 2002). Also, blue-winged warblers may be averse to using shrub swamp habitats (Will 2009), so shrub swamps may ultimately be the more important habitat to maintain for golden-winged warblers. Other early-successional habitats used by golden-winged warblers include powerline rights-of-way, reforesting abandoned farmland, and beaver pond openings (Will 2012). However, Streby et al. (2012) recently documented that golden-winged warblers also use mature forests for some aspects of their daily activity cycles.

Through its Comprehenisve Conservation Plan process, Tamarack NWR identified the golden-winged warbler as a focal species for conservation management. The U.S. Fish and Wildlife Service has also developed a Golden-winged Warbler Breeding Season Conservation Action Plan and a Golden-winged Warbler Conservation Initiative. The latter plan has targeted increasing the population in two major Minnesota landscapes by 50% over the next 40 years (Will 2012), including northern portions of the LUP planning area (Figure 3.4). Successful conservation of golden-winged warblers will require coordinated actions at landscape scales (Will 2012).

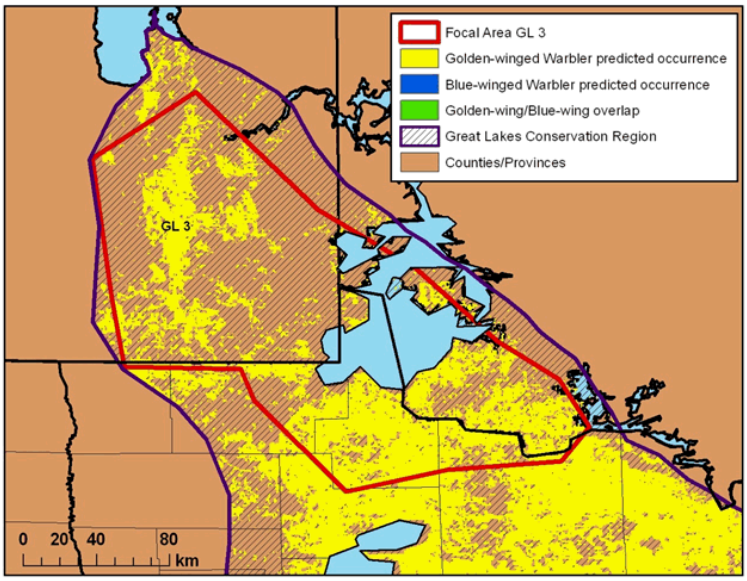



Figure 3.4. Golden-winged warbler conservation focus area, from *Golden-winged Warbler Conservation Initiative*.

[102] Federal Register vol. 76:31920-31926, June 2, 2011.

**Creek Heelsplitter (*Lasmigona compressa*)**

The creek heelsplitter is a state-listed special concern mussel species. It has been found in the Rapid River. The species, like most mussel species, was once more widespread and abundant than it currently is, and little reproduction has been noted in recent years. Mussels have specific host fish/parasite relationships, and dams and impoundments have been blamed for altering fish distributions in the state's river systems. Host species for creek heelsplitter glochidia (a stage in the mussel life cycle) are yellow perch, black crappie, slimy sculpin, and spotfin shiner; ironically, none of these hosts have been documented as occurring in the Rapid River.

**Leonard's Skipper (*Hesperia leonardis)***

The Leonard's skipper is a butterfly species that is tracked in the DNR Natural Heritage Database, but is not a protected species. It actually represents a complex of two forms and their various intergrades. In western Minnesota, the form is known as the Pawnee skipper, and is associated with dry prairies. The eastern form is associated with dry sandy habitats including prairies, savannahs, and forest openings. The single specimen from the project area is of the eastern form and was found in the Winter Road Lake Peatland. It was almost certainly a dispersing individual that probably originated from dry jack pine woodland/openings to the north. Because it has not been encountered in what is perceived to be appropriate habitat, this is not a species we would manage for unless additional individuals are found to indicate a viable population is present.

***Oxyetheria itascae*, a species of caddisfly**

This caddisfly species of special concern was discovered in 1993 and has never been found outside of northern Minnesota. Although larvae of other caddisflies of the genus *Oxytheria* have been found in both lakes and streams, larvae and adult females of this species have never been found. Adult males have never been found near lakes and seem to prefer meandering, silt-bottomed streams. In the project area, 17 males were collected in Hansen Creek in free-flowing reaches, 2 males were collected in the Roseau River in free-flowing reaches, 3 males were collected in Hayes Lake State Park (presumably in the Roseau River), all on 8 July 2000. One male was also collected in Miller Creek on 25 August 2000.

**Mingan Moonwort (*Botrychium minganense)***

Mingan moonwort is a small fern species listed as special concern. It occurs in a variety of plant communities and habitat conditions, including older disturbed areas. Not enough is known about its biology to identify critical habitat needs, or threats. There is a single record in the project area, from along the Bankton Trail in Sec. 23 of Meadowland Twp. The record is of two or three plants in a balsam fir stand near the second bridge from the east off the Pitt Grade Road. This description could place it on LUP or state land.

**Coastal Sedge (*Carex exilis*)**

Coastal sedge is one of eight[103] peatland species that Glaser (1992d) considered "rare vascular plants" meriting special attention. He classified it as a species of high density and high dominance. It is also

[103] Seven of these species occur in the greater LUP planning project area. The eighth, beaked spike-rush (*Eleocharis rostellata*) has been found southwest of Lower Red Lake and in Koochiching County, and could yet be found in the Red Lake Peatland

state-listed as special concern. It tolerates a range of pH from 4.9-7.6. Within the Red Lake Peatland (where it is at the western extent of its continental range) it is a dominant species at six locations where it occurs along the edges of water tracks. One of these locations is on state land adjacent to LUP land in Sec. 32, T. 156 N., R. 33 W.

**Twig-rush (*Cladium mariscoides)***

Twig-rush is one of eight peatland species that Glaser (1992d) considered "rare vascular plants" meriting special attention. He classified it as a species of high density and high dominance. It is also state-listed as special concern. It tolerates a range of pH from 5.7-7.2. It is characteristic of spring-fen channels where it typically has sparse cover and does not form large patches. However, in the Red Lake Peatland it forms large clones in at least three locations in a variety of hydrologic settings. One of these locations is on state land adjacent to LUP land in Sec. 32, T. 156 N., R. 33 W., and on private land in Sec. 5, T. 155 N., R. 33 W. adjacent to the same LUP parcel.

**Montane Yellow-eyed Grass (*Xyris Montana)***

Montane yellow-eyed grass is one of eight peatland species that Glaser (1992d) considered "rare vascular plants" meriting special attention. He classified it as a species of low density and low dominance. It is also state-listed as special concern. It is a small plant that usually forms small, highly-localized populations of less than 100 individuals. Glaser identified two populations in the Red Lake Peatland (neither on LUP land) in topographical locations where the water table fluctuates periodically and competition from more aggressive sedges is reduced. It requires a pH of 4.8-6.5.

**Bog Rush (*Juncus stygius)***

Bog rush is one of eight peatland species that Glaser (1992d) considered "rare vascular plants" meriting special attention. He classified it as a species of low density and low dominance. It is also state-listed as special concern. It is a small plant that usually occurs as a few isolated individuals. In the Red Lake Peatland, it occurs in one location (not on LUP land) in mud-bottomed pools in water tracks. It requires a pH of 5.2-5.4. Like *Xyris montana*, this species seems to occur in topographical locations where the water table fluctuates periodically, giving it a competitive advantage.

**Sooty-colored Beak-rush (*Rhynchospora fusca)***

Sooty-colored beak-rush is one of eight peatland species that Glaser (1992d) considered "rare vascular plants" meriting special attention. He classified it as a species of high density and high dominance. It is also state-listed as special concern. According to Glaser, this is one of the rarest species in Minnesota, but it is abundant in the few places it occurs. One of the occurrence locations is on state land adjacent to LUP land in Sec. 32, T. 156 N., R. 33 W. It occurs in at least six locations in the Red Lake Peatland (where it is at the western extent of its continental range), usually near the heads of water tracks. The water tables in these areas are usually above the peat surface, but not forming deep pools. It tolerates a range of pH from 4.8-6.3.

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(Glaser 1992d). Glaser concluded these eight species occur in habitats that seem vulnerable to invasion and establishment by new species, which would make them vulnerable to climate change.

**English Sundew (*Drosera anglica)***

English sundew is one of eight peatland species that Glaser (1992d) considered "rare vascular plants" meriting special attention. He classified it as a species of higher density but still low dominance. It is also state-listed as special concern. It has been found at six locations in the Red Lake Peatland, two locations in the Mulligan Lake Peatland, two locations in the Luxemburg Peatland, and two locations in the Bemis Swamp area. It occurs in the deeper water areas of flarks in pristine water tracks and spring-fen channels. According to Glaser, it may attain cover values of up to 20% in the deepest water areas, with percent cover decreasing as water levels drop. It tolerates a range of pH from 5.6-7.2.

One of the locations in the Red Lake Peatland is on state land adjacent to LUP land in Sec. 32, T. 156 N., R. 33 W., and on private land in Sec. 5, T. 155 N., R. 33 W. adjacent to the same LUP parcel. One location in Luxemburg Peatland SNA is in T. 160 N., R 37 W., Sec. 15, one-quarter to one-half mile east of LUP land; the other site is in Sec. 15 and 16, and could be on LUP land. One site in Mulligan Lake Peatland SNA is about one mile south-southwest of LUP land, and the other is near Lost Lake.

**Linear-leaved Sundew (*Drosera linearis)***

Linear-leaved sundew is one of eight peatland species that Glaser (1992d) considered "rare vascular plants" meriting special attention. He classified it as a species of higher density but still low dominance. It is also state-listed as special concern. It has been found at three locations in the Red Lake Peatland and two locations in the Mulligan Lake Peatland. It occurs in the deeper water areas of flarks in pristine water tracks and spring-fen channels. According to Glaser, it may attain cover values of up to 20% in the deepest water areas, with percent cover decreasing as water levels drop. It is more sensitive to disturbance than the English sundew, and never occurs in water tracks cut by drainage ditches. It also tolerates a narrower range of pH, from 5.6-6.1.

One of the locations in the Red Lake Peatland is on private land in Sec. 5, T. 155 N., R. 33 W. adjacent to a LUP parcel. One site in Mulligan Lake Peatland SNA is about one mile slouth-southwest of LUP land, and the other is near Lost Lake.

**Creeping Juniper (*Juniperus horizontalis)***

Creeping juniper is a ground-hugging juniper (red cedar) species that occurs in sand dunes and bedrock outcrops. It is state-listed as special concern. It is susceptible to fires, but paradoxically, its habitats are succeeding to other species in part due to fire suppression. In the project area there is one record of a 5-m diameter plant in Sec. 15, T. 159 N., R. 34 W. This record is within a thinned natural red pine stand on LUP land. This red pine stand was burned prior to thinning in June 2004 and the creeping juniper was protected from the fire, but the understory was burned all around it.

**White Adder's-mouth (*Malaxis monophyllos)***

White adder's-mouth is a small orchid of bogs and coniferous lowland communities of northern Minnesota. It is state-listed as special concern. The orchid is usually found under the canopy of white cedar, black spruce, balsam fir, tamarack, or black ash. There are four occurrence records of this species in the project area near LUP lands. Two records are in Norris Twp., just north and east of Norris Camp, in an area where 1/8$^{th}$ of the sections are LUP land. There is one occurrence record in Sec. 10 of Meadowland Twp. in which 7/8$^{th}$ of the section is LUP land. And there is one occurrence record in Sec.

17 of Victory Twp. in which only 1/16th of the section is LUP land. Most of the occurrence records are in lowland coniferous forests. Unmanaged timber harvesting, drainage, and road building would be the primary threats to this species

**Lapland Buttercup (*Ranunculus lapponicus)***

Lapland buttercup is a circumpolar species whose range extends south into Minnesota. It is state-listed as special concern. It is a species typically found under lowland white cedar and black spruce, but can also be found in alder swamps where white cedars are known to have once existed. Unmanaged timber harvesting, drainage, and road building would be the primary threats to this species

There are six occurrence records in the project area in the vicinity of LUP lands. Four of these records are in the Bemis Swamp area of Roseau County. There is one record in the Red Lake WMA south of the Spina Trail, in a section that is 11/16th LUP land. The last record is in a section one mile east of Norris Camp, where 1/8th of the land is LUP. The first five occurrences are in lowland white cedar forests, and the last occurrence record is in a blow-down area dominated by young balsam fir and paper birch.

**Curved-leaved Golden Moss (*Tomenthypnum falcifolium)***

This moss species is a state-listed species of special concern. However, because of discovery of more populations since its original listing, it is being considered for delisting. It is found in lowland coniferous forests and alder shrub swamps, which are relatively secure habitats. There is one record of this species near the project area, in a bog about 4.5 miles north of Waskish on the east side of Highway 72.

# Threats to Resources

## Climate Change

During the next 100 years average temperatures in Minnesota are projected to increase by 6 to 10°F in winter and 7 to 16°F in summer (Kling et al. 2003, Intergovernmental Panel on Climate Change [IPPC] 2007). Precipitation is projected to decline by 0 to 15% during summer but increase by 5 to 30% overall (Kling et al. 2003, IPPC 2007). The frequency of extreme precipitation events is projected to increase by 50 to 100% (Kling et al. 2003), which will result in greater surface runoff and less percolation into the soil. Increasing temperatures and declining soil moisture during summer will have dramatic effects on plant communities. Vegetation patterns are expected to adjust in response to climate change (MN DNR 2008). A shift in the boundary between grassland and deciduous forest biomes is likely.[104] Tree species composition in forests will change.[105] Climate change may affect forest disturbances by changing the frequency, duration, and severity of fires, droughts, tornados, outbreaks for insects and pathogens, and thunderstorms (Dale et al. 2001). Several climate change models predict warmer, drier conditions for existing deciduous forests. [106] Under this scenario, if managed with fire, deciduous forests will tend

[104] Frelich et al. (2012) document that minor changes in the ratio of precipitation to evapotranspiration can shift biomes from forests to grasslands.

[105] Galatowitsch et al. (2009) suggest that black spruce, white spruce, balsam fir, tamarack, and paper birch will be extirpated due to direct mortality; that deer herbivory will prevent white pine, white cedar, red oak, and yellow birch from germinating; that red pine and jack pine will persist on nutrient-poor sites; and that bur oak, white oak, red maple, American elm, red elm, hackberry, and basswood will become more prevalent.

[106] Other models predict warmer but wetter conditions, or a combination of wetter winters and drier summers.

toward savannah types (fire dependent hardwood systems) and the range of mesic (moist but well drained) hardwood forests will likely contract. If not managed with fire, these areas will likely become brushlands or become dominated by non-native woody invasive species (Hansen et al. 2001). Iverson and Prasad (2001) predict expansions of oak-hickory and oak-pine forests (fire dependent drier forest types) as well as reductions in aspen/birch forests (a mesic hardwood type).[107]

The U.S. Department of Interior issued Secretarial Order No. 3226 in January 2001 requiring all federal agencies within the Department to consider potential climate change impacts as part of long-range planning efforts. This Secretarial Order was amended in January 2009 to further expand and define agency climate change, carbon sequestration, and energy conservation responsibilities. The remaining text in quotes in this section on climate change is taken from U.S. Fish and Wildlife Service CCP's,[108] with modifications in brackets to make the text pertinent to LUP (coordination) lands.

"In its 2009 strategic plan, '*Rising to the Urgent Challenges of a Changing Climate*,' the [USFW] Service calls for bold, aggressive, and strategic action to address climate change on three broad fronts: adaptation, mitigation, and education. Despite considerable uncertainty regarding the magnitude, extent, and timing of changes, the Service vision includes measures to '…sustain diverse, distributed, and abundant populations of fish and wildlife by conserving healthy habitats in a network of interconnected, ecologically-functioning landscapes.' The plan also describes six principles deemed essential to achieving this vision: priority setting, partnership, best science, landscape conservation, technical capacity, and global approach."

**Land Management Impacts on Climate Change**

"There are two broad categories of responses to global climate change: mitigation and adaptation. Mitigation refers to actions taken 'before' climate change occurs – efforts to reduce climate change as we move forward from the present, and curb its effects before they increase in severity or reach critical thresholds. Adaptation measures can be applied both 'before' (anticipatory) and 'after' (reactive) climate changes have occurred, and are actions aimed at avoiding or coping with harmful impacts and taking advantage of new opportunities presented by new climatic and environmental conditions (Karl [et al.] 2009; FWS 2009). National wildlife refuge [system lands] help mitigate the onset of climate change by increasing ecological resiliency and reducing environmental stressors."

"The increase of carbon dioxide within the Earth's atmosphere has been linked to the gradual rise in surface temperature commonly referred to as global warming. In relation to comprehensive conservation planning for national wildlife refuges, carbon sequestration constitutes the primary climate-related impact that refuge [system lands] can affect in a small way."

"Vegetated land is a tremendous factor in carbon sequestration. Terrestrial biomes of all sorts … are effective both in preventing carbon emission and acting as a biological 'scrubber' of atmospheric carbon dioxide. The Department of Energy report's[109] conclusions noted that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere."

[107] Copied from DNR 2011 Ruffed Grouse Long-Range Management Plan.
[108] From CCP's for Seney NWR in Michigan and Crane Meadows NWR near Little Falls.
[109] "Carbon Sequestration Research and Development."

"Conserving natural habitat for wildlife is the heart of any long-range plan for national wildlife refuge [system lands]. The actions proposed in this CC[M]P would conserve or restore land and habitat, and would thus retain existing carbon sequestration on the [landscape]. This in turn contributes positively to efforts to mitigate human-induced global climate change."

"One [land management] activity in particular – prescribed burning – releases carbon dioxide directly to the atmosphere from the biomass consumed during combustion. However, there is actually no net loss of carbon, since new vegetation quickly germinates and sprouts to replace the burned-up biomass and sequesters or assimilates an approximately equal amount of carbon as was lost to the air (Dai et al. 2006). Overall, there should be little or no net change in the amount of carbon sequestered [on LUP lands] from any of the proposed management alternatives."

**Climate Change Impacts on Land Management**

"Climate change is rarely discussed in most management plans because its effects are often assumed to occur more slowly than even the federal planning process. However, for many taxa, recent shifts in phenology and distribution patterns have been strongly correlated with climate change, and for some species these changes have occurred over a relatively short time frame. … For most species, the influence of climate change is thought to be correlated to changes in habitat distribution and abundance."

"Several impacts of climate change have been identified that may need to be considered and addressed in the future:

- Habitat available for coldwater fish such as trout and salmon in lakes and streams could be reduced.
- Forests may change, with some species shifting their range northward or dying out, and other trees moving in to take their place.
- Ducks and other waterfowl could lose breeding habitat due to stronger and more frequent droughts."
- The timing of migration and nesting could put some birds out of sync with changes in the life cycles of their prey species.[110]
- "Herptofauna may have trouble meeting the moisture conditions required for reproduction, and even respiration in their local habitats, and difficulty dispersing through inhospitable environments.
- Animals and insect species, including invasive or pest species, shift their ranges north in latitude as winter climatic conditions become more moderate and the warm seasons lengthen."
- "Reduction in lake and river levels. Water levels, supply, quality, and water-based transportation and recreation are all climate sensitive issues affecting the region. … For smaller lakes and rivers, reduced flows are likely to cause water quality issues to become more acute. In addition, the projected increase in heavy precipitation events will likely lead to increased flash flooding and worsen agricultural and other non-point source pollution as more frequent heavy rains wash pollutants into rivers and lakes. … Shoreline damage due to high lake levels is likely to decrease 40 to 80 percent due to reduced water levels."
- Agricultural shifts. "With an increase in the length of the growing season …. the practice of planting a second crop after the first is harvested is likely to become more prevalent. The $CO_2$ fertilization effect is likely to enhance plant growth and contribute to generally higher yields.

[110] In this paragraph, we reversed the cause and effect relationship given in the CCP's.

The largest increases are projected to occur in the northern areas of the region, where crop yields are currently temperature limited."[111]

- "Lowland coniferous forests comprised of black spruce, tamarack, and balsam fir are most likely to be affected [as a] habitat type … since these boreal species … are near the southern edge of their distribution (Iverson et al. 1999)."

"The resiliency of natural systems is tied to biodiversity. The diversity of organisms may be one of the greatest weapons against climate change; each organism will react and respond differently (Scott et al. 2009). **Biological communities will not**[112] shift or **remain intact** because of the variability in each organism's sensitivity to climate change, size, mobility, lifespan, and the availability of food, shelter, and other resources it requires (Karl [et al.] 2009). In response, we must assess and provide for increased representation and redundancy across seasonal, geographic, and ecological thresholds. **Initial prioritization of action should be directed to those species for which climate change poses the greatest threat, namely those with limited distributions, highly specific ecological niches, and/or limited mobility**."

"Managers and resource specialists … need to be aware of the possibility of change due to global warming. When feasible, documenting long-term vegetation, species, and hydrologic changes should become a part of research and monitoring programs on [National Wildlife Refuge Systems lands]. Adjustments in [land] management direction may be necessary over the course of time to adapt to a changing climate."

## Invasive Species

The topic of invasive species is difficult to assess. There are numerous non-native invasive species that have apparently minor ecological impacts (e.g., ox-eye daisy, orange hawkweed, asian lady beetles, phragmites, sweet clovers and birdsfoot trefoil), there are species that pose great risk to the ecology of the area but are not currently present (e.g., emerald ash borer, gypsy moth), there are species already so pervasive it would be futile to attempt to eradicate them (e.g., reed canary grass, smooth brome grass), there are aquatic species that would be of greater concern elsewhere (e.g., zebra mussel, asian carp), there are those that are not even here yet but will find their way here through global commerce, and then there are those that pose a foreseeable risk with a foreseeable future presence or abundance. This later group includes common buckthorn, spotted knapweed, leafy spurge, gypsy moth, carregana, tansy, wild parsnip, purple loosestrife, and garlic mustard. It is beyond the scope of this plan to predict which additional invasive species will become a concern to the management of the planning area.

There are multiple avenues for controlling invasive species. These include hand pulling, spraying, burning, cutting, importing biological control agents (usually exotic insects), and of course quarantine and prevention. Hand pulling can be effective for eradicating new small populations of invasive plant species before they get out of control. Spraying and burning can be effective tools against larger infestations, but require more commitment of resources and may be too little too late to completely eradicate exotics. Biological controls are the best alternative for eradicating widespread, abundant infestations, but they can take a long time to be evaluated and approved.

[111] Increased crop yields on the landscape will likely benefit wildlife, including game species such as deer, elk, wild turkey, squirrels, rabbits, cranes, waterfowl, and mourning doves.
[112] Emphasis added to highlight key points.

Prevention is the best alternative for resisting incoming infestations. Seeds of some plants such as purple loosestrife and spotted knapweed can be carried in by machinery, vehicles, and off-highway vehicles; they can also be brought in with other seed mixes or erosion control mulch. Some species seem to invade where ground cover is sparse, such as spotted knapweed along roadways. Better initial revegetation efforts following construction projects could slow the spread of spotted knapweed. Wind, water, and wildlife can also transport exotic species, but these are more difficult, if not impossible, to prevent.

## Diseases, Parasites and Insect Infestations

**Plants**

Vegetation in the LUP planning area is susceptible to normal, periodic outbreaks of common diseases and insect infestations. Most concern focuses on outbreaks affecting trees. Common northern forest insects include the larch sawfly, redheaded pine sawfly, forest tent caterpillar, bark beetles, bole borers, bronze birch borer, birch leafminers, jack pine budworm, spruce budworm, white pine weevil, aphids, armyworms, spittlebugs, and cankerworms (Ascerno and Wawrzynski 1988). The invading emerald ash borer is also a concern for the future. Serious outbreaks of the redheaded pine sawfly were uncommon until the establishment of pine plantations in the 1930s (Wilson and Averill 1978). A healthy bird population is valuable for consuming vast quantities of forest insects. For example, Takekawa and Garton (1984) calculated that bird predation on spruce budworms in Washington state was worth $45,500/km$^2$ in appropriate habitat in 1984 dollars.[113] Marquis and Whelan (1994) showed that insect-eating birds reduced tree leaf loss by about 50% (and thus increase growth rates) in white oaks in Missouri. Various wasps and flies also prey on some of these insects (e.g., Batzer and Morris 1978, Wilson and Averill 1978).

Common deciduous tree diseases include *Septoria* leaf blight, aspen shoot blight, heart rot due to fungi, *Hypoxylon* cankers and other cankers, various root rots, needlecasts, white pine blister rust, various shoot and needle blights and rusts. These are usually caused by fungal infections. There are not effective treatments for many of these diseases, so many are simply tolerated. Recommendations for controlling *Hypoxylon* canker in aspen include harvesting the stand early if more than 15 percent of the trees are infected; if 15-25% are affected, post-harvest treatment includes measures to regenerate a good stand of aspen; if >25% are affected, post-harvest prescription is to convert the stand to other species (Anderson and Anderson, as revised by Schipper 1979).

Dwarf mistletoe is caused by a parasitic plant and attacks primarily black spruce, but also occasionally white spruce and tamarack. It spreads by explosively ejecting sticky seeds from a berry up to 50 feet, and the seeds also stick to birds and mammals which can transport them. The disease spreads faster in uneven-aged stands. Control of natural fire, which controlled mistletoe, has been cited as a cause for the spread of the disease (Ostry and Nicholls 1976).

**Animals**

Since 2005, bovine TB has been found in 27 wild deer in a small area (within a 10-mile radius of an infected cattle herd) that includes the western edge of the LUP planning area. One of the infected deer

[113] When parceled out among species, this calculated out to values of $1.80 and $6.80 per individual evening grosbeak at two sites, respectively. See also Bruns (1960) and Sterling (undated) for other examples.

was harvested on LUP land east of the junction of Morehouse FR and Stott's FR. Because of this find, the core bovine TB control area was expanded east and includes additional LUP land west of the Penturen townsite. The deer are being controlled by intensive harvest in an effort to eradicate the disease, and no deer have tested positive for the disease since 2009. The disease will be considered eradicated if no more infected deer are found for five consecutive years.

Bovine TB is an infectious disease caused by the bacterium *Mycobacterium bovis* that is transmitted by the exchange of respiratory secretions between infected and uninfected animals. Thus, transmission is a function of inter-deer-proximity which is a function of deer density. Transmission is also a function of interactions with domestic cattle, which are lacking within the LUP planning area. Although bovine TB transmission to humans is unlikely, in Michigan it has been transmitted to omnivores and carnivores such as black bear, raccoon, coyote, bobcat and red fox.[114] Even after bovine TB is eradicated locally, it is a disease that will probably be remembered in future management decisions.

West Nile Virus is a mosquito-borne virus that can kill some birds (particularly waterfowl, crows and jays) and mammals (including elk and moose). The disease was found in 71% of elk tested from 2004-2009, many of which were from the nearby Grygla herd.[115]

Eastern equine encephalitis is another mosquito-borne virus that can kill mammals, and is a greater mortality threat for most species than is West Nile Virus. It has been detected in 13.6% of elk tested from 2004-2009, many of which were from the nearby Grygla herd.[116]

*Mycobacterium* paratuberculosis is a disease of ungulates, including moose, that causes poor body condition and can lead to death. It is caused by the bacteria *Mycobacterium avium* ssp *paratuberculosis*. It was found in 29% of elk tested from 2004-2009, many of which were from the nearby Grygla herd.[117]

Mange, particularly sarcoptic mange, is a disease transmitted by mites, and affects mainly canids (wolves, foxes, coyotes), but also bears, raccoons, porcupines, and some rabbits and squirrels The mites are transferred from one individual to another through direct contact or transfer at den sites. The disease causes hair loss, and in some cases the exposed skin becomes encrusted or oozes fluids, often resulting in death. Red foxes are particularly susceptible to mange, and thousands can die during an outbreak. There was an outbreak of mange in the local wolf population in the mid-1990s, and some evidence of a recurrence in 2009-2010.[118] Infested animals can be treated by orally administering Ivermectin, which can be laced in food left for the animal to consume, although this is usually not very practical.

Rabies is an acute infectious disease of the central nervous system caused by a virus that is transmitted in saliva through bites. Rabies is most common in raccoons, skunks, bats, and foxes, but can occur in any mammal. Once signs of the illness manifest themselves, rabies is 100% fatal; however, proper post-bite treatment is nearly 100% effective in preventing onset. As with mange, rabies outbreaks in the wild

[114] This paragraph based on Minnesota DNR webpage, *Managing bovine TB in wild deer*, and *Bovine Tuberculosis (TB) in Minnesota* fact sheet and Carstensen et al. (undated).
[115] Hildebrand et al. (undated).
[116] Ibid.
[117] Ibid.
[118] Norris Camp Newsletter, February 2010.

can be controlled by oral vaccinations in food items left out for consumption, but this is difficult and expensive.[119]

Waterfowl are susceptible to a number of infectious diseases that cause mortality including avain cholera, avian botulism, avian tuberculosis, avian salmonellosis, chlamydiosis, duck plague, aspergillosis, and avian influenza. A common denominator among outbreaks is a concentration of waterfowl, and often poor water quality. The LUP planning area does not have poor water quality issues nor do waterfowl concentrate there, thus outbreaks of the diseases are unlikely to originate there. Infected birds could, however, migrate into the area and spread the disease locally. Similarly, Newcastle disease virus kills colonial nesting waterbirds such as cormorants, pelicans, gulls, and terns.[120] As with waterfowl, these species do not congregate in the LUP planning area. Avian salmonellosis and aspergillosis also infect songbirds, but the source of these outbreaks is usually moldy, contaminated food at feeders, which also serve as the requisite concentration point. Concentrated winter bird feeding is not known to be a common practice in the LUP planning area.[121]

## Contaminants

We consider contaminants less of a risk to resources of this area than most everywhere else in Minnesota. The LUP planning area is at the top of six major watersheds,[122] and there are no commercial facilities located upstream of the planning area to discharge waterborne pollutants into the area. The atmospheric deposition of mercury is probably the single greatest risk for contaminants in the area, but the risk at this location is no greater than elsewhere in Minnesota, and the solution to the problem will have to be programmatic at a sub-continental level, not site-specific. Furthermore, peat has been shown to sequester minerals, heavy metals, and other industrial pollutants (Pakarinen et al. 1983, Grigal et al. 2000, Bartle 2009), and coniferous forests filter more mercury pollution than do deciduous forests (Kolka et al. 1999). However, if peatlands dry out due to climate change, they could become releasers (sources) of bound contaminants (Bartle 2009).

The deposition of lead into the terrestrial environment from hunting upland small game and fragments from rifle bullets is a well-documented concern, but the extent of the risk has not been assessed specific to LUP lands.[123] Although lead shot has been banned from waterfowl hunting, it remains in the mud at the bottom of marshes and could be consumed along with grit and food by trumpeter swans and other waterfowl, especially during periods of low water levels.

Bald eagles could ingest lead fragments from unrecovered deer carcasses, or from waterfowl that migrate into the area carrying lead shot in their digestive system. Data from The Raptor Center (Redig et al. 2009) show that an increase of eagles and other raptors arriving at the Center due to lead ingestion is strongly correlated to deer seasons throughout the Midwestern states. This increase has become predictable with deer seasons, and another increase occurs in spring as deer carcasses are exposed by snowmelt. Fragments from rifle bullets are as lethal, if not more lethal, than shotgun pellets (see Redig et al. 2009), and woodpeckers, ravens, magpies and gray jays may also be susceptible to ingesting lead.

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[119] Michigan Department of Natural Resources.
[120] The last major die-off of these species occurred in 2008, and included birds nesting on Lake of the Woods.
[121] This paragraph based on Friend et al. 1987.
[122] Upper and Lower Red Lake, Thief River, Roseau River, Rapid River, Rainy River (Baudette), and Lake of the Woods (Minnesota Rules Chapter 8420.0112(q)).
[123] We know of one instance of a trumpeter swan that died from lead poisoning in the LUP area, near Cecil's Landing, and of another swan showing symptoms of lead poisoning.

In Wisconsin, American woodcock have also been shown to accumulate lead in their systems from their breeding grounds (Strom et al. 2009). Lead sinkers and tackle could also pose a risk to common loons and waterfowl on Hayes Lake, where fishing occurs.

Scoping comments from the public also suggest that accidental leakage or intentional disposal of fluids from motorized vehicles (e.g., logging equipment) could be an issue.

## Human Economic Uses

**Extraction (forest products, sand and gravel, peat, water, game)**

Resource extraction has the greatest potential for altering the habitat and thus species abundance, composition and distribution in the LUP planning area. Various quantities of timber are harvested annually, usually during winter, however, the harvest follows sustainable forestry practices. The demand for sand and gravel is limited by the cost of transporting material out of the project area to where it is needed, and extraction from LUP lands is limited to local state management needs. During the 1970s, the potential for peat mining was given careful and extensive consideration, and ultimately resulted in the creation of the network of peatland Scientific and Natural Areas. The unlikely advent of peat mining offsite from LUP lands could adversely affect the hydrology of peatlands on LUP lands. A future demand for water is a more likely scenario, and there could be a sociopolitical effort to extract and export groundwater from the region. This could have severe impacts on the ecosystem, but any such initiative would have to go through environmental review. Game harvest is closely regulated, and the remoteness and wetness of much of the habitat prevents most of the landbase from being hunted.

**Recreation**

Recreational off-highway vehicle (OHV's) riding also has the potential for impacting the environment through modifying physical soil conditions, spreading exotic plants, and disturbing wildlife. The Beltrami Island State Forest is classified as a "managed" forest, meaning that OHV's can travel on trails unless they are posted "closed." The Red Lake WMA, Hayes Lake State park, and the peatland SNA's are all closed to OHV's by statute.

Hiking on walking trails can also disturb wildlife during critical periods, such as during avian territory establishment, pair bonding, and nest initiation. There is debate as to whether motorized vehicles (which cause a greater spatial disturbance) or walking trails (which have a longer temporal component to the disturbance factor) have a greater impact on wildlife.

Bird species which have historically been considered sensitive to human disturbance (e.g., bald eagles, colonial nesting waterbirds) are relatively uncommon to rare in the LUP planning area. However, Forman and Deblinger (2000) documented the extent to which common songbirds are disturbed by busy traffic corridors, with forest interior species exhibiting affects 650 m from a four-lane highway in Massachusetts, and grassland birds exhibiting affects out to 1 km. There has never been a comparative study examining the impacts of OHV's or hiking on breeding bird density along trails with differing levels of use in Minnesota.

**Renewable Energy**

There is potential demand for biofuel extraction and windfarm development in the area. Potential biofuels include slash left over after logging, and brush sheared from brushlands. A potential benefit from biofuel demand could be increasing the amount of brushlands that are sheared at non-state expense; a potential detriment would be the net export of nutrients and minerals that would not be returned to the soil.

A windfarm had been under preliminary consideration for the south shoreline of Lake of the Woods, but was abandoned by the developer from further consideration in 2010, possibly due to environmental considerations (e.g., piping plovers, migratory birds).

**Transmission Lines and Pipelines**

Xcel Energy owns and operates a major transmission line that cuts through the Beltrami Island State Forest, the Red Lake Peatland SNA (east unit), touches on the Red Lake WMA, and touches on four clusters of LUP land totaling 2400 acres. The impacts of clearing this powerline corridor on avian bird use was documented by Niemi and Hanowski (1984); species that preferred more open habitats benefitted at the expense of those that preferred more closed habitats. No new pipelines or transmission lines are likely to be allowed to be constructed through the area.

**Ditching, Draining, and Impoundments**

The LUP planning area was extensively ditched nearly 100 years ago, and several ditch plugs were constructed during the CCC-era (1930s). The ditches have become, or are becoming, non-functional, and they are unlikely to be maintained due to lack of benefited landowners to pay for maintenance costs. No new ditches are likely to be constructed. Impoundments are in various states of repair or disrepair. Cumulatively, the ditches, their spoil banks, and the impoundments altered the distribution and composition of vegetation in the LUP planning area. As early as 1929 it was recognized that the spoil banks affected the locations and extent of fires (Averill and McGrew 1929). This plan allows for some impoundments to be repaired by watershed districts (e.g., under the 1998 Mediation Agreement) if the project provides mutual wildlife benefits.

# Administrative Facilities and Visitor Services

Administrative and visitor facilities are limited in the project area. The Red Lake WMA headquarters is housed at Norris Camp, a Civilian Conservation Corps (CCC) camp that is on the National Register of Historic Places. Major facilities there include a combined office, shop and garage; a duplex that serves as a bunkhouse; another bunkhouse; a former CCC recreation hall that serves as a meeting place; the WMA manager's residence; and a handful of other buildings that house generators or fuels, are used for storage, or are unused.

Within two miles to the northeast of Norris Camp is located the WMA assistant manager's residence, a fire tower, a primitive campground, and a picnic shelter. A grass landing strip is located less than one mile south of Norris Camp. Near the junction of the Faunce and Butterfield roads, 10-11 miles east of Norris Camp, is another primitive campground and a fire tower. There is a primitive campground at the Clear River Staging Area 11 miles north-northwest of Norris Camp and another at Bemis Hill 14.5 miles

west-northwest of Norris Camp. There is a picnic shelter built by a local historical society at the Winner Silo 12 miles west of Norris Camp, and another group of pioneer descendants built a picnic shelter at Schilling Corners 17 miles south of Norris Camp. The only other visitor facilities in Red Lake WMA or Beltrami Island State Forest consist of informative signs, roads, walking trails, and parking areas.

Hayes Lake State Park contains several recreational amenities for visitors. The park has an entrance station, a campground with 35 sites (18 with electricity), and two isolated hike-in campsites on Hayes Lake. The main campground has bathrooms, showers, drinking water, and a dump station. The park also has a swimming beach with changing facilities, a playground, and a picnic shelter for up to 50 people. There is a boat access at Hayes Lake and canoes, kayaks, row boats and electric trolling motors can be rented. There are also various hiking and mountain bike trails, and a short boardwalk into a white cedar bog.

The distribution of visitor activities is largely determined by the limited road system and proximity to nearby towns. Visitor use/activity distribution was documented by designed surveys in 1978 (see MNDNR 1980) and has likely changed very little: the majority of visitor use occurred along the Highway 72 corridor, followed by the west central area centered around Norris Camp and Hayes Lake State Park; the least amount of visitor use occurred in the southern part of the area south of the Rapid River FR.

# Archaeological and Cultural Resources

There are numerous archaeological and cultural resources associated with the original development and drainage of the land during the early part of the last century. These resources are identified in the *Management Plan for Cultural Resources on the Land Utilization Project Parcels in the Red Lake Wildlife Management Area and Beltrami Island State Forest*, 2008. Additional cultural resources are identified in *Hayes Lake State Park Unit Plan for Natural and Cultural Resource Management 2010-2015*.

The only known Native American cultural resource is a reported burial mound in Hayes Lake State Park that is thought to be on LUP land that was damaged or destroyed by trail construction activities in the 1970s. The Minnesota Indian Affairs Council was contacted in writing during Scoping and following

Inset: Remnants of an abandoned homestead cabin on LUP land. Source: Red Lake WMA.

Scoping as a result of public comments we received, but it provided no comments on how to address this site during planning. A site visit on 24 May 2012 with the Red Lake Tribal Historic Preservation Officer and U.S. Fish and Wildlife Service Regional Historic Preservation Officer concluded that a burial mound likely did not exist and that current management activities would not impact it if does exist.

# Current Management

Current habitat management is focused on 1) forest timber management including harvest, thinning, natural succession, and stand diversification (including age of trees, species composition, and within stand structural diversity by leaving lots of residual trees and coarse woody debris post harvest), 2) maintaining openings, 3) brushland shearing and burning, and 4) some pineland prescribed burns.

Current wildlife management focus includes managing for deer, bear, moose, ruffed grouse and woodcock by providing habitat for early successional species through timber harvest, and by maintaining openings. Several nongame bird species that occupy shrublands benefit from the creation of early successional habitat, such as golden-winged warblers. Species that require mature and late successional forests (fishers, martens, owls, goshawks, pileated woodpeckers) benefit from retaining old growth forests, retaining other older forests to naturally succeed to the next seral stage without harvest, and implementation of more extended rotation forestry on LUP lands. Wetlands, waterfowl, and other aquatic species are primarily managed by maintaining natural hydrologic systems. Extensive effort is also invested in managing hunting (e.g., deer, bear) and trapping seasons.

Allowed public uses generally match those of the state lands in which the LUP parcels are embedded. With the exception of Hayes Lake State Park, visitor facilities on LUP lands are limited to primitive campgrounds, picnic shelters, parking areas, trails and signs. Cultural resources are managed under a plan developed in 2008.

Research is focused on ongoing surveys and monitoring for breeding birds (Breeding Bird Survey, owl surveys), wintering birds (Christmas Bird Count), frogs, and a weather monitoring station is maintained. Research on ruffed grouse, spruce grouse, moose, wolves, deer, insects, and vegetation response to burning and pine plantation thinning is supported. In 2011, as part of this planning effort, logistical support was provided towards completing 23 priority blocks for the Minnesota Breeding Bird Atlas Project. A research project on bird use of lowland conifer communities is being planned for 2013.

# Current Staffing Levels

The DNR does not have any staff dedicated only to managing LUP lands. The 2009 Lease Amendment identifies that primary management responsibility lies within the Section of Wildlife. Within the Section of Wildlife, two offices share responsibility for managing LUP lands. The Red Lake WMA currently has a wildlife area manager, two vacant assistant manager positions, a technician, a general repair worker, and a half-time office manager position. The Baudette Area Office has a manager, a vacant assistant manager position, a vacant general repair worker position, and a half-time office manager position. The vacant general repair worker position in Baudette may be replaced with a technician. Full staffing is envisioned once the State Game and Fish Fund is bolstered by a recently approved hunting and fishing license fee increase.

Three Area Forestry Offices have responsibilities within the LUP planning area: the Warroad, Baudette, and Blackduck area offices. Staff from these offices are assigned as needed by the respective Area Forest Supervisors to appraise, design, and administer timber sales on LUP lands and to maintain forest roads. Staffing levels at Hayes Lake State Park currently include a Park Manager stationed at Lake Bronson State Park and an assistant manager stationed at Hayes Lake 60% of the time. Fisheries resources are managed by the Baudette Area Fisheries Office, which is part of the Division of Fish and Wildlife. Their focus is primarily on managing Hayes Lake and the designated trout streams in the LUP planning area, along with periodic stream surveys. The Scientific and Natural Areas are managed by the Division of Ecological and Water Resources' office in Fergus Falls.

U.S. Fish and Wildlife Service oversight is provided out of Agassiz NWR, about 45 miles southwest of Norris Camp.

# Special Management Areas

All of the LUP lands are located within state lands that would constitute special management areas. However, the focus of this topical area is special management units that are located within LUP lands. Gustafson Camp SNA clearly fits in this category, as the SNA is entirely on federal LUP lands. Primary elements of the SNA are old growth white and red pine, but there are also populations of the state-threatened ramshead ladyslipper and a white cedar swamp. Access to the SNA is difficult and along an unmarked trail off the Stony Corners FR.

There are eight stands of old-growth forest on LUP lands, including just west of Gustafson Camp SNA, near the Norris Campground, by the Hogsback FR and Faunce-Butterfield FR intersection, south of Winner, along the shore of Upper Red Lake, south of the Rapid River Road, northeast of the Schuh Bridge, and northwest of the Spina Road. Some of these sites extend beyond the LUP property line. An old-growth pine forest stand near the Manweiler Dam site would be an excellent addition to LUP land.[124]

Areas of Limitations (AOL; areas with prohibitions on OHV use) could also be considered special management areas, however, all of the local AOL's extend beyond the LUP parcels. The closest one to a true special management area would be the Hansen Creek AOL, of which 84% (2493 out of 2957 acres) is on LUP land.

Inset: A prescribed pineland burn.
Source: Red Lake WMA.

[124] Other old-growth sites identified by Section of Wildlife staff for potential trade include red pine in T.159N., R.34W., Sec. 15 and 16; white spruce in T.159N., R.34W., Sec. 14; black ash in T.155N., R.35W., Sec. 28; and lowland hardwoods in T.157N. R.32W., Sec. 2, T157N., R.33W., Sec. 16, 17, and 21, and T.158N., R.32W, Sec. 35.

# Chapter 4: LUP Management Direction

Future management of LUP lands will focus on conserving and restoring the ecological integrity, particularly the structure, composition, and natural processes of native plant and animal communities and physical environments within the natural range of variability. At the landscape scale, management will conserve and restore nationally, regionally, or locally imperiled ecosystems and a diversity of habitat types and seral stages for wildlife species of national, state, or regional concern. At the landscape scale, management will strive to provide or maintain ecosystem services that are being provided by LUP lands but are not being fully provided by other lands nearby. At the patch scale, management will focus on conserving and restoring historic compositional and structural patterns to forests and other habitats for the benefit of native breeding bird species and other wildlife. Public use activities on LUP lands will largely be allowed to continue as they are under current management.

## Core Values and Guiding Principles

We have adapted the following core values and guiding principles from the Necedah NWR CCP:

| | |
|---|---|
| *An Ecosystem Approach* | The ecosystem approach is a vision of desired future conditions developed in collaboration with a diverse group of stakeholders that integrates ecological, economic, and social factors. It is applied within a geographic framework (usually a watershed) and founded primarily on ecological factors. |
| *Cornerstones of Biology* | We will conserve existing, relatively intact ecosystems first, for they are the cornerstones for providing biota and other natural materials needed for future restorations.[125] |
| *Ecological Integrity* | We will restore ecological integrity, particularly the structure, composition, and natural processes of native biotic communities and physical environments. |
| *Design for Self-Sustainability* | We will design for self-sustainability of natural systems. The best way to ensure long-term viability of habitat is to minimize the need for continuous maintenance. |
| *Within a Watershed Context* | We will focus within the watershed and/or broader landscape level context and seek to understand its biological potential. A watershed/landscape has the capacity to become only what its physical and biological setting will support. This includes climate, geology, hydrology, and biological characteristics. |
| *Addresses Degradation* | We will address ongoing causes of habitat degradation. Conservation, restoration, and management activities will fail if sources of degradation persist. |
| *Use Passive Restoration* | We will use passive restoration and management when appropriate. Where possible, we will simulate natural hydrologic processes using low input, low impact, and sustainable measures that capture the energies of the system to perpetuate the resources in question. |

[125] This concept applies to natural recovery processes as well as human-induced restorations, and it applies beyond the conceptual borders of the LUP planning area.

| | |
|---|---|
| *Use Reference Sites* | We will, whenever available, use reference sites when restoring habitat. Reference sites are areas that are comparable in structure and function to the proposed restoration before it was degraded.[126] |
| *Adaptive Management Processes* | An adaptive management approach features a structured, iterative process that recognizes that most information used in decision-making is incomplete. Adaptive management guides managers in efficiently collecting and using better information, thus enabling appropriate changes in management direction. |

## LUP Lands as Ecosystem Service Districts

*Ecosystem services* are products or services that a piece of land provides to society at low cost or no cost. Ecosystem services include providing natural foods and medicines, clean water, a timber supply, recreational and tourism opportunities, carbon sequestration, oxygen, pollinators, nature viewing opportunities, water storage, groundwater recharge, insectivorous birds and bats to control insects, and granivorous and frugivorous birds to spread seeds. Nationwide, the value of ecosystem services provided by natural habitats in the National Wildlife Refuge System is estimated to be $2900/acre, and the value of ecosystem services provided by all natural habitat in the lower 48 states is equivalent to more than 10% of the U.S. Gross Domestic Product (Southwick Associates 2011). In the strictest and original sense, an *Ecosystem Service District* is a governmental district with taxation, zoning, and decision making powers where ecosystem services are protected and provided (e.g., Heal et al. 2001, Lant et al. 2008). However, the concept does not need to imply taxation or zoning; an Ecosystem Service District could simply be a unit or units of land that are managed differently to provide an ecosystem service that is not being provided by adjoining lands. It is in this latter sense that we view LUP lands as Ecosystem Service Districts, capable of providing ecosystem services that other state, tribal, and private lands do not provide.

## Three Alternatives

The LUP planning Leadership Team developed goals and objectives for the future management direction of LUP lands and developed three alternatives to meet those goals and objectives as fully as possible. Alternative B (Manage the Landscape) was chosen as the basis for the final CCMP.

**Alternative A: Current Management Direction (No Change/No Action)**. Manage LUP lands "as a refuge and breeding ground for native birds and wildlife" based on existing state management plans (e.g., Red Lake Wildlife Management Area Master Plan, Agassiz Lowlands Subsection Forest Resource Management Plan, etc) and laws, with modifications based on advances in ecological science and changing governmental policies and laws.

**Alternative B: Manage the Landscape (Preferred Alternative)**. Manage wildlife, habitats, and (to a lesser extent) human activities within the context of time and place in the landscape (e.g., on a watershed basis). This is a more holistic or integrated approach, with less intensive (more passive) management of individual forest stands or patches and with a longer-term vision for the future than under Alternative C.

[126] LUP lands can also serve as reference sites for restoration projects beyond their boundaries.

**Alternative C: Manage by Species.** Manage individual habitat units "as a refuge and breeding ground for native birds and wildlife" based on current conditions. Wildlife populations will respond to more planned intensively (actively) managed changes in habitat conditions than under Alternative B. Human activities will be managed to avoid harming wildlife populations. This is a more compartmentalized or single-species management approach.

## Goals, Objectives and Strategies for LUP Parcels.

The Leadership Team also developed the following goals, objectives and strategies for LUP lands. The reach of some of the goals, objectives and strategies necessarily extend beyond the boundaries of the LUP lands in order for them to be attainable.

- Goals are broad statements of desired future conditions.
- Objectives are specific statements that describe management intent, provide detail, and may be supported by rationale statements.
- Strategies are specific actions, tools and techniques required to fulfill the objective. Strategies are intended to be adaptive and may be refined, amended, or changed as specific tasks are completed; as new issues, research findings or information arises; or as agency management policies evolve.

**Goal 1: Wildlife**

Protect, restore and maintain a natural diversity (i.e., species richness) and abundance of wildlife native to northwestern Minnesota with densities within their natural range of variability, with an emphasis on keystone, game, rare, and habitat specialist species.

Objective 1.1: Implement a robust research, inventory, and monitoring program.

*Rationale*: Adaptive forest and wildlife management requires updated information, especially as we face unknown consequences of global climate change. Data is also needed in order to determine whether the objectives that follow in this plan are being met. "Research" focuses on identifying species habitat needs for food, shelter, and successful reproduction through detailed studies and experiments. "Inventories" focus on collecting baseline information on species presence/absence and abundance. For many invertebrates, basic data on presence is lacking. For many higher vertebrates we lack baseline data on abundance. "Monitoring" focuses on identifying changes in abundance or distribution. Research on single species is not practical at a local level for the full suite of species present. Rather, research and monitoring that addresses a suite of species is more economical in terms of cost and time. Continuing to collect data for long-term data sets is as essential as starting new monitoring and research programs. The value of the LUP planning area for applied and empirical research in an intact ecosystem to address questions of interest of a regional or national scope was also recognized as early as 1980 (MNDNR 1980).

Current monitoring programs carried out in the LUP planning area include: 1) the Breeding Bird Survey (BBS), which monitors changes in bird abundance; 2) the Christmas Bird Count which provides an index of changes in abundance and distribution of

wintering bird populations; 3) DNR upland gamebird drumming/courtship counts that monitor populations of ruffed grouse, sharp-tailed grouse, and American woodcock; 4) owl surveys; 5) some limited marshbird surveys; 6) bear food surveys; and 7) frog and toad surveys. The Minnesota Breeding Bird Atlas project is a five-year inventory project (2009-2013) being conducted to document the distribution and abundance of breeding birds in Minnesota. A concerted effort to cover the LUP planning area was conducted by a volunteer in 2011 with WMA and Audubon Minnesota support. Insect inventories and collections are also ongoing in the project area through graduate research out of the University of Wisconsin.

Other breeding bird monitoring programs could be implemented in the area. The simplest of these are breeding bird point counts, which document the number of breeding birds seen or heard within a fixed radius of a permanent sampling point in a specific habitat. For example, if the BBS route does not adequately sample sedge meadows or lowland coniferous forests, additional point counts could be established in these habitats.[127] MAPS (Monitoring Avian Productivity and Survival) bird banding stations monitor local reproduction and survival by marking birds and recapturing them periodically throughout the breeding season, and they can also be extended into fall migration monitoring programs.[128] MAPS stations require an experienced bird bander and a few assistants or volunteers who are flexible enough to work early mornings when weather conditions are suitable for banding. MAPS stations also have a habitat monitoring element associated with them. A need for greater monitoring of boreal bird species and nocturnal bird species has been recognized (Partners in Flight Science Committee 2005).

*Strategies*:

Continue conducting Breeding Bird Survey, Christmas Bird Count, upland gamebird, owl, goshawk, bear food, predator scent post, winter track, and frog and toad surveys.

Continue spruce grouse research as necessary. Study spruce grouse habitat use to see how tamarack, white cedar and other conifers complement use of jack pine and black spruce.

Collect data as necessary to verify wildlife and habitat models, some of which are based on research from distant locations, are valid locally.

Continue contributing data to the Minnesota Breeding Bird Atlas on an ad hoc basis through 2013, and repeat the concerted priority block sampling effort if the Breeding Bird Atlas is repeated in the future. Look for opportunities to access remote priority blocks through 2013 that were not surveyed in 2011.

Assess habitat coverage of Breeding Bird Survey route, and establish and conduct breeding bird point counts and breeding marshbird surveys as necessary.

[127] The roads in the LUP planning area tend to follow higher, drier lands which support different plant communities than the vastly more abundant lowland areas. Thus the BBS does not proportionately sample the area's habitats.

[128] Prior spring migration monitoring is not recommended, due to the influence disturbance may have on subsequent bird breeding territory establishment.

Compile results of Breeding Bird Surveys, Breeding Bird Atlas, Christmas Bird Counts, and prior research into a report or publication.

Create a cooperative research program with universities for monitoring and research; encourage universities to utilize LUP lands as an outdoor laboratory/classroom.

Implement a lynx monitoring program (e.g., scratch posts, scent posts, winter track counts) to assess the frequency of occurrence on LUP lands and in the LUP planning area.

Study all aspects of three-toed woodpecker and black-backed woodpecker ecology when opportunities arise, including use of flooded areas created by beaver activity.

Participate in U.S. Nightjar Survey Network for whip-poor-wills and common nighthawks, or find a volunteer to participate.

Implement a Monitoring Avian Productivity and Survival (MAPS) bird banding station. Station should be established in a large block of contiguous LUP land.

Enlist volunteers to assist with surveys, monitoring, and bird banding. Have "Friends" group assume responsibility for monitoring and maintaining existing wood duck nest boxes.

Study impacts of motorized vehicles and pedestrians on breeding bird density near trails of varying levels of use.

Obtain a comprehensive list of insects collected from the project area at the conclusion of the study through the University of Wisconsin.

Maintain the bunkhouses at Norris Camp for contributors to ongoing and new research, inventory, and monitoring efforts.

Objective 1.2: Maintain or increase ruffed grouse population with a minimum 10-year running average index of 2.0 drums per stop in the LUP planning area.

*Rationale*: Ruffed grouse are associated with deciduous and mixed deciduous-coniferous forests (Table 3.11), reaching their highest densities in aspen forests. Ruffed grouse need a mix of young and old aspen stands in close proximity in order to find the right combination of food and cover, with a preference for younger aspen stands. Conifers can be important cover during winter if the snow pack is not deep enough or fluffy enough for roosting in. Some coarse woody debris (i.e., fallen logs) typical of older forests is necessary in order for male ruffed grouse to have drumming logs. It is not essential that all of these required habitat elements be provided on LUP lands if state lands are nearby, and vice versa.

Because ruffed grouse are a cyclic species, population objectives should be established as a running average over the course of several years in order to even out the highs and lows of the cycle. Three to six 10-stop routes have been surveyed for ruffed grouse in the LUP planning area since 1982. The number of drums per stop has typically ranged from 1.1-3.9, with outliers of 0.5 in 1983 and 6.5 in 2009. The 10-year running average has ranged from 2.0-2.8 drums/stop, and has averaged 2.46 drums/stop. One route is

almost exclusively on LUP land, and could be used to compare management of LUP lands with state lands. The Minnesota DNR has a ruffed grouse management plan with established strategies for reaching its goals. These goals cannot be attained by managing only LUP lands.

*Strategies*:

Ruffed grouse habitat management will be coordinated across LUP and state lands. Increase active management in non-aspen cover types primarily on state lands, unless it is assured that the state land will provide the requisite older forested habitat elements required by grouse. This would include 1) maintaining 3-4 age classes or growth stages of aspen in association, including young aspen 6-25 years old for nesting cover and summer and fall foods; mature aspen >25 years old with a hazel understory for food in fall, winter, and spring; and dense sapling aspen 4-15 years old for brood-rearing cover; 2) harvesting aspen in small patches (20 acres or less);[129] 3) maintaining clumps of shrubs, conifers or mature aspen in larger cutover areas, and retain a mature aspen component along wetland edges; and 4) leaving scattered snags for use by other wildlife and eventually for drumming logs for grouse. Older forests will likely tend to be on LUP lands.

A percentage of aspen stands will be converted to mixed conifer-hardwood stands on LUP lands and state lands. Specific amounts, locations, and timing will be determined through the SFRMP process.

When managing for conifers other than jack pine, emphasize either mixed-species composition during regeneration or conifer plantations interspersed with aspen or mixed aspen/hardwood-conifer patches to create a mosaic of more evenly distributed cover types.

Continue conducting the ruffed grouse drumming count survey in the LUP planning area in April and May of each year and monitor changes in the 10-year running drum index. Compare route that is almost exclusively on LUP land to others on mostly state land.

Develop and communicate ruffed grouse habitat BMP's. This is a Wildlife Section-wide effort not confined to the LUP planning area.

Identify Ruffed Grouse Management Area opportunities through the SFRMP process. An updated SFRMP is expected by 2013.

Objective 1.3: Maintain woodcock populations at a level that can be supported through ruffed grouse habitat management.

*Rationale*: The American Woodcock Conservation Plan calls for using a landscape-level approach involving management units of 500-1000 acres, which would support approximately 500 woodcock, with several units located within 1-2 miles of each other. Management treatments should be centered on broad-leaved deciduous or on

[129] Although the ruffed grouse management plan recommends harvesting in patches of 10 acres or less, we have raised this to 20 acres or less due to administrative inefficiencies in managing small cuts. Also, grouse densities were not different on 10-acre block cuts versus 20-acre block cuts at the Mille Lacs WMA (Gullion 1990 in McCaffery et al. 1996).

deciduous shrub-scrub wetlands where moist soils are found. Even-aged forest management treatments of ≥5 acres would stimulate sprouting of shade-intolerant species such as aspen to create ideal woodcock habitat, short rotation cutting cycles of about 20 years would ensure the forest does not become too mature for woodcock use, and cuttings should cross riparian areas to assure the full moisture gradient is represented in the regenerating stand (Kelley et al. 2008). More specifically, in the Boreal Hardwood Transition zone, the prescription is to create 3.5 million more acres of early successional forest and sustaining aspen/birch communities through traditional clearcut regeneration. However, the plan recognizes that these prescriptions run contrary to current public agency trends against managing clearcuts for regenerating aspen monocultures and for greater riparian area protections in the Boreal Harwood Transition zone. Furthermore, agencies are trending away from single-species management. However, woodcock and other early successional forest species do respond favorably to ruffed grouse habitat management.

*Strategies*:

Provide early successional habitat for ruffed grouse, which will also benefit American woodcock. Where feasible, and not contrary to other Best Management Practices, dovetail woodcock management recommendations with ruffed grouse management recommendations.

Shear or mow alder in patches on a 20-year cycle.

Locate timber landings and openings where they would provide woodcock courtship areas.

Objective 1.4: Maintain deer herd at a density of approximately 6.0-7.7 per square mile for human hunting opportunities and for a wolf prey base, provided that this does not result in overgrazing of vegetation.

*Rationale*: White-tailed deer are one of the top two most popular game species that utilize LUP lands. They are wide ranging, and a desired density has to be applied across a landscape-level management area. The desired density falls within the long-term historic range of pre-fawn densities in deer management zone 111. There are reasons to not increase the deer herd size. Bovine TB has shown up in the herd at the periphery of the project planning area, and spread of the disease is density-dependent. Deer also spread diseases to moose more readily if there is more density-dependent contact between the two species. An overabundant deer herd can also prevent forest regeneration (especially that of their desired browse species, white pine and northern white cedar). Our current estimate (as of 2011) is that the population is 16% below the upper limit of the target goal.

*Strategies*:

Monitor the size and population density of the deer herd through the deer model based on deer harvest.

Monitor for signs of habitat degradation such as browse lines, lack of regeneration in white pines and white cedar, and loss of forest forbs that would indicate carrying capacity has been surpassed.

Maintain adequate amount of openings and use timber harvest and prescribed burning techniques to create and maintain browse and cover.

Continue to utilize regulated hunting every fall as a means of controlling the deer herd at a level commensurate with the population density objective.

Objective 1.5: Maintain or increase current populations of rare species and habitat specialists by managing their habitat needs.

*Rationale*: Native plant communities have been decimated by conversion to agriculture, drainage, invasion by exotic species, fire suppression (i.e., altered successional patterns), fragmentation, etc. Rare species tend to be rare because they have specialized habitat requirements, rely on unique habitats, or have large home range sizes or limited reproductive capacity. Remnant native plant communities that support viable populations of rare species are largely confined to public lands. Maintenance of native plant communities and the species that rely on them periodically need human intervention, often in the form of eradicating exotic species or restoring fire to the environment. LUP lands contain 19,000 acres of lowland coniferous forests and 21,000 acres of non-forested wetlands that have been identified as key habitats for species in greatest conservation need in the Agassiz Lowlands.

Sedge meadows are a declining habitat type in Minnesota. Historically, many were lost to drainage and agriculture. Remaining sedge meadows that have been hydrologically compromised need periodic fire or shearing or mowing to control invading shrubs. Sedge meadows are important habitat for sandhill cranes, yellow rails, short-eared owls, Wilson's phalaropes, and sharp-tailed grouse. Many sedge meadows occur in the Peatland SNA's and many LUP lands occur in the SNA's designated watershed protection areas (WPA's). Protection of sedge meadows in the SNA's can be enhanced by managing adjoining LUP lands in accordance with the watershed protection plans (i.e., by minimizing mechanical entry into the WPA's).

The bobolink is a declining grassland species. It is one of three landbird species where greater than 10% of its worldwide breeding population occurs in Minnesota.[130] There is a population of bobolinks that occupy some grassland habitat (in abandoned rice paddies) on private land on the north shore of Upper Red Lake. LUP parcels dominated by lowland brush adjoin this area and could be managed to expand on lowland grass/sedge habitat the bobolinks are currently using.

Bald eagles and northern goshawk are two top predators that have large home ranges. Bald eagles and their nests are federally protected from disturbance, and the state and federal governments have recommended guidelines for activities near nests to prevent disturbance. Goshawk pairs have territories that occupy up to 18,000 acres cumulatively, though each adult in the pair may only occupy up to 12,000 acres

[130] PIF [Partners-in-Flight] Landbird Population Estimates Database (Rocky Mountain Bird Observatory 2007). The other two species are sedge wren and golden-winged warbler.

individually. No goshawk nests have been found in the LUP planning area, but territorial adults that respond to playback calls have been found. The DNR has developed some "considerations" for managing large blocks of breeding habitat near goshawk nests, should any nests actually be found.

Black-backed and three-toed woodpeckers are two closely related boreal forest species with specialized habitat needs. Three-toed woodpeckers are especially closely tied to spruce forests, whereas black-backed woodpeckers use spruce and other conifers. Three-toed woodpeckers have been rarely studied in North America due to their low population density, which makes them an ideal candidate for additional research focus; the same is true for black-backed woodpeckers, but to a lesser extent. Three-toed woodpeckers inhabit mature or old-growth coniferous forests (including lowland spruce) and recently burned areas with an abundance of insect-infested snags or dying trees; they tend to use denser forests than do black-backed woodpeckers. [131] The U.S. Forest Service advocates that management for both black-backed and three-toed woodpeckers requires a large-scale ecosystem perspective in which large tracts of habitat are managed through prescribed burning (Corace et al. 2001, Burdett and Niemi 2002).

Three-toed woodpeckers specialize in feeding on bark beetle larvae, whereas black-backed woodpeckers specialize in feeding on wood-boring beetle larvae. Three-toed woodpeckers can play a significant role in regulating timber-damaging beetles by consuming thousands of larvae per day. Fire suppression and salvage logging of trees damaged by fire or insects reduces the abundance of three-toed and black-backed woodpecker foods (Corace et al. 2001, Leonard 2001). The U.S. Forest Service also lists poor snag retention management, short-rotation logging, and logging of mature softwood stands as additional threats to three-toed woodpeckers, and they offer a series of management recommendations (Burdett and Niemi 2002). Black-backed woodpeckers show a strong affinity to recently (i.e., 0-4 years) burned-over coniferous forests. In particular the edges of stand-replacement fires represent a distinct (and more important) habitat feature from the interior of burn areas for black-backed woodpeckers, although this association seems to also depend on burn severity. Fire suppression and salvage logging have also been identified as being detrimental to black-backed woodpeckers (Dixon and Saab 2000, Corace et al. 2001). In the LUP planning area, these species also use areas impounded by beavers;[132] flooding undoubtedly acts like fires in killing trees.

Franklin et al. (2007) provide forest harvest and management techniques that provide for heterogeneous forest structure, including abundant snags and coarse woody debris that many specialist species require.

Because of the overwhelming diversity and the lack of information for many groups of insects, management by habitat (rather than by species) is the most practical approach for conserving insects. Large expanses of native vegetation in a variety of successional stages should maintain a diverse native insect fauna. Management (fire or logging) which creates early succession habitats, however, can create local extirpations through

[131] This and the next paragraph based on Murphy and Lehnhausen (1988), Dixon and Saab (2000), Leonard (2001) and Burdett and Niemi (2002).
[132] G. Mehmel and S. Laudenslager (pers. obs.). See also Burdett and Niemi (2002).

direct mortality or habitat/resource change. The precautionary principle is to apply any treatment to only a small portion of a habitat at any given time, and leave the full range of successional states. Fortunately, the planning area has vast habitat tracts where such concerns are minimal. In addition, management for other wildlife should create the diversity of habitats needed for most insects. Peatland logging is a special concern for some boreal peatland insects. The time needed to regenerate the original peatland forest is questionable; regenerated "mature" forest stands often have a notably different tree structure and ground flora compared to original stands, and preliminary field work has found some of these regenerated stands to be rather lifeless for peatland specialist Lepidoptera. Species potentially sensitive to extensive harvest (especially black spruce bog forest and poor conifer swamp stands) include arctic fritillary, *Lasionycta secedens, Lasionycta taigata,* and *Xestia mixta*. The taiga alpine (*Erebia mancinus*), a species of special concern, is essentially restricted to certain commercial grade black spruce peatlands. While it has not been found in the Agassiz Lowlands to date, it could occur locally within the project area. If present, it would probably be the most sensitive species to extensive lowland black spruce harvest. The lowland conifer stands are sufficiently vast that there are no immediate conservation concerns for boreal peatland insects, and areas with limited logging still support a rich fauna. A combination of intensive lowland conifer harvest and climate warming, however, could significantly deplete or even extirpate populations of boreal peatland specialists. Other particularly rare insects include Leonard's skipper, and a species of caddisfly (*Oxyetheria itascae*).

*Strategies*:

Maintain sedge meadows for sandhill cranes, yellow rails, short-eared owls, Wilson's phalaropes, and sharp-tailed grouse through restoring natural hydrology, and periodic brush removal through prescribed burning and/or shearing/mowing.

Limit timber harvest (i.e., mechanical entry) on LUP lands in Peatland SNA Watershed Protection Areas to situations where LUP land is near a road or adjacent to a planned harvest on state land, and there is a benefit to wildlife by allowing a harvest.

Consider northern goshawk, spruce grouse, great gray owl, northern hawk-owl, golden-winged warbler, and Connecticut warbler habitat needs when planning and reviewing proposed timber harvests. Provide for habitat needs in large blocks centered around goshawk nests (as feasible, considering the time lag between nest longevity and habitat response to management).

Restrict timber harvests and other human activities near northern goshawk and bald eagle nests. Implement "Considerations for Goshawk Breeding Territory Management" around northern goshawk nests and "Bald Eagle Management Guidelines" around bald eagle nests.

Implement Partners-in-Flight Tri-National Vision for Landbird Conservation by conserving habitats and ecosystem functions through sustainable forestry, and expanding the knowledge base through research and monitoring.

Manage vegetation types according to Ecological Classification System. Implement appropriate forest management recommendations provided by Franklin et al. (2007).

Maintain large expanses of native vegetation in a variety of successional stages to maintain a diverse native insect fauna.

Maintain a list of sharp-tailed grouse leks and continue coordination between Forestry and Wildlife on land management activities within a half-mile of leks.

Increase amount of prescribed burning on the landscape and limit amount of salvage logging in burned-over areas for 4 years following fires for benefit of three-toed and black-backed woodpeckers. Weigh benefits of controlling spread of insect outbreaks to other forest stands versus providing quality woodpecker prey base when deciding to salvage-log insect-infested stands.[133] Consider selective pretreatment thinning in interior areas to be burned or harvests to create firebreaks.

Design timber harvests to minimize the loss and fragmentation of late-successional spruce stands for the benefit of three-toed woodpeckers,[134] Connecticut warblers, and native insects. Continue to manage 40,000 acres of key habitat for benefit of species in greatest conservation need, with overlapping benefits for native insects.

Create and laminate identification cards for rare insects such as Leonard's skipper, taiga alpine, and *Oxytheria itascae* (a species of caddisfly), and distribute throughout work vehicles and to all field crews to monitor for. If taiga alpine is ever discovered in the area, survey individual black spruce stands for that species before planning a harvest. Evaluate presence or absence of *Oxyetheria itascae* in stretches of streams proposed for impoundments.

Study all aspects of three-toed woodpecker and black-backed woodpecker ecology when opportunities arise, including use of flooded areas created by beaver activity and areas of tamarack mortality due to eastern larch beetles.

When planning jack pine harvests, retain some larger-diameter trees (scattered, and in pockets) and implement prescribed burning, especially when they are located near large areas of permanent openland habitat for benefit of black-backed woodpeckers.[135]

Evaluate feasibility of creating a grassland management area on LUP lands north of Upper Red Lake. Bobolinks will be an indicator species for success, but other grassland species would benefit as well.

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[133] Steeger and Hitchcock (1998) recommend leaving dead trees in clusters rather than scattered across harvest areas to provide for needs of cavity nesting birds while reducing spread of insects and diseases, however their recommendations were from western North America where cuts tend to be larger. They also articulate this dilemma succinctly, "Overall, the challenge to forest managers is to develop silviculture systems with retention strategies that maintain tree diseases and parasitic insects without causing excessive tree mortality in the surrounding and regenerating forest" (JWM 62:1357). Burdett and Niemi (2002) also address this issue, "It is unclear what the ecological and economic tradeoffs are between management for the benefit of three-toed woodpeckers and other co-associated species and the economic benefits provided by the woodpecker species itself. It does not seem necessary to promote economically harmful insect populations to maintain these woodpecker species. Therefore, while it does require somewhat rare habitat whose maintenance may impact forestry operations, the ultimate economic benefit of healthy woodpecker populations may actually be positive for the forest products industry." Burdett and Niemi (2002) also recommended incorporating areas of more severe crown fires into prescribed burn plans.

[134] Recommendation by U.S. Forest Service (Burdett and Niemi 2002).

[135] Recommendation by U.S. Forest Service (Corace et al. 2001).

Objective 1.6: Conserve a suite of aspen, conifer and mixed forest age classes and diameter sizes to accommodate a full suite of nesting woodpeckers (primary cavity nesters), which provide nest sites for secondary cavity nesters (e.g., chickadees, nuthatches, bluebirds, wrens, great crested flycatchers, some ducks and owls, pine martens, fishers, and some squirrels and bats).

*Rationale*: Woodpeckers are ecological keystone species. They are considered primary cavity nesters because they excavate their own cavities. Their cavities are subsequently used in turn by a variety of secondary cavity nesters for nesting including buffleheads, common goldeneyes, owls, American kestrels, great crested flycatchers, tree swallows, chickadees, nuthatches, house wrens, and eastern bluebirds. Used woodpecker cavities are also occupied for nesting, roosting, and hibernating by squirrels, martens, fishers, bats and tree frogs. (Chickadees and nuthatches can be either secondary cavity nesters [i.e., they use old woodpecker cavities] or primary cavity nesters; as primary cavity nesters, chickadees frequently select old birch snags with rotting tops as nest sites.)[136]

The diameters of woodpecker nest trees are typically larger than attained at the age of normal rotation timber harvest, especially for aspen (see Tables 3.14 and 3.15). Woodpeckers prefer dead or dying trees, often with broken tops and almost always with heart rot, for nest sites. A large number of snags are needed to maintain maximum populations; for example, 200 snags/40 ha (88 acres) are needed to maintain a maximum density of 16 pairs of hairy woodpeckers/40 ha (Sousa 1987). Large woodpeckers, such as pileated woodpeckers, need large blocks of habitat; e.g., the HSI model for pileated woodpeckers is based on a minimum habitat area of 320 acres (Schroeder 1983b).

*Strategies*:

Manage an adequate amount of older, mature aspen, coniferous and mixed forests using extended rotation forestry[137] and natural regeneration practices in the LUP planning area to provide suitable nest sites for a full suite of woodpecker species. Implement extended rotation forestry practices on additional LUP acres if there is an inadequate amount on surrounding state parcels.[138]

Leave all dead and dying snags in harvested areas to serve as nest sites and feeding sites for woodpeckers. Leave occasional birch snags also for chickadee nest sites. Implement appropriate forest management recommendations provided by Franklin et al. (2007).

Maximize leave trees (in clumps, scattered trees, snags) on harvest sites.

Maintain wider riparian management zones.

Leave aspen in jack pine cutovers to serve as snags and discourage aspen regeneration.

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[136] M.R. North (personal observation), Steeger and Hitchcock (1998).

[137] The Agassiz Lowlands SFRMP defines *extended rotation forestry* (ERF) as "forest stands for which harvest age is extended beyond the normal or economic harvest age." The SFRMP goes on to identify "established ERF rotation ages" which identify when ERF stands would be targeted for harvest. In this plan, use of the term *extended rotation forestry* implies the generic definition from the SFRMP, not the "established ERF rotation ages."

[138] Current ERF targets are established in the Agassiz Lowlands SFRMP (2008).

Facilitate conversion of pure aspen to mixed stands.

Objective 1.7: Maintain a diverse food base for bears and abundant lowland conifer den sites for hibernating bears.

*Rationale*: Black bears are habitat generalists, being found in deciduous and coniferous forests, forested swamps, and even urban areas (Wilson and Ruff 1999). They primarily eat mast (acorns/other nuts, berries/other fruit), other vegetation, insects, and some carrion and meat. Food abundance dictates bear social patterns, i.e., whether they are dispersed or concentrated. Maintaining a diverse food base for bears will benefit many other wildlife species as well (e.g., deer, grouse, squirrels, raccoons).

In Minnesota, lowland coniferous forests are among the poorest producers of black bear foods; the primary exception being blueberries and raspberries found in black spruce communities, and red-osier dogwood and native buckthorn in lowland forests in (Berg 1992). These forests are, however, important winter denning areas. In one study, 17% of females and 40% of males denned in lowland coniferous forests, with males travelling up to 150 miles from their summer range to their den sites (Berg 1992). Another study found that the abundance of fruit-producing species was highest in young aspen stands (5-15 years old), followed by older aspen stands (>30 years old) and birch forests, and red pine stands. However, the greatest amount of food produced (300 kg/ha) was in red pine plantations with interspersed openings/thinning, followed by birch forests and young aspen stands (>100-<150 kg/ha; see Noyce and Coy 1990). The value of pine plantations varied inversely with amount of herbicide applied to control hazel (a major bear food resource), and the study did not give added weight to more-preferred foods; instead it concluded that a diverse forest provides a diverse food base for bears. A study in New York also found that bears utilized burned areas, managed (harvested) areas, and unmanaged (mature forests) selectively during different seasons, and also concluded that a diverse forest provides a diverse food base for bears (Costello and Sage 1994).

*Strategies:*

Maintain diverse forest cover and forest ages in the LUP planning area to provide a diverse food base for bears. If inadequate diversity is maintained on surrounding state forest lands, maintain or increase the diversity on LUP lands. Implement appropriate forest management recommendations provided by Franklin et al. (2007); retain conifers in hardwood stands.

Thin red pine plantations and create interspersed openings in red pine plantations to increase food production; allow hazel,[139] raspberry and blueberry to grow in plantation understory and openings.

Maintain lowland conifer forests for bear hibernation.

[139] Thinning hazel has been recommended as one approach to minimizing the impacts of climate change as soil moisture decreases. Trade-offs between retaining hazel as food versus thinning to conserve soil moisture may be necessary in the future.

Objective 1.8: Maintain or improve habitat for priority upland furbearer species (i.e., fisher, marten, and bobcat).

*Rationale*: Scoping questionnaires suggest that the priority upland furbearer species for trappers are fisher, marten, and bobcat. These are also the furbearer species that have seen the most significant historical population changes, and have the most specialized habitat needs. (Open water wetlands are limited in the area and, as is the case with waterfowl, have limited capacity for manipulation for aquatic furbearers such as beaver, muskrat, and river otter). Fisher populations declined sharply in the early 1900s but have since recovered. Marten populations also declined sharply in the early 1900s, but their population has been slower to recover. Bobcat were once vastly outnumbered by lynx by a 53:1 ratio, but the ratios have reversed and bobcat now vastly outnumber lynx (e.g., by a 55:1 ratio in the 1940s [Breckenridge 1949]).

Dense coniferous and mixed forests are the preferred habitat for fishers.[140] Mature to climax successional stages of coniferous forests provide the most suitable fisher habitat due to adequate cover and an abundance of potential den sites and windfalls, however, den sites are almost always in a hollow deciduous tree. Fishers avoid forested stands comprised of >75% deciduous trees. Habitat use studies suggest that uneven-aged, dense, mature forest stands in latter successional stages and/or old-growth forests are required to provide suitable winter habitat for fishers, and it is assumed that winter habitat is the limiting factor defining overall fisher habitat. More specifically, the Habitat Suitability Index (HSI) model for fishers (Allen 1983) indicates optimum habitat is considered a forest stand with overstory trees having an average diameter (dbh) of >38 cm (15 inches), a canopy closure $\geq$80%, where 50-90% of the overstory trees are conifers and where there are two or more subcanopy layers below the canopy. In optimum habitat, fishers occupy a home range of 5-10 $mi^2$ (range 1-15 $mi^2$), and it is assumed a minimum area of 100 $mi^2$ of suitable habitat is necessary to support a viable population.

Fishers and martens share similar habitats and compete for den sites and food resources, and because of this their populations may be inversely related. However, fishers are believed to be more adaptable to habitat alterations than are martens, and are more likely to use second growth forests and intermediate stages of forest succession; martens are more tied to older forests (Allen 1983). One aspect of marten habitat not identified as important to fishers are portals to foraging areas below the snow cover; such access is provided by abundant downfalls, snags, slash piles, and stumps (collectively called "coarse woody debris"; Allen 1982). In Minnesota, the average home range size is 6.0 $mi^2$ for males, and 1.7 $mi^2$ for females (Mech and Rogers 1977 in Allen 1982). The HSI model for this species was developed for boreal coniferous forests in the western U.S., and may not be entirely suitable for Minnesota. The HSI model (Allen 1982) assumes winter habitat is the limiting factor and identifies optimum marten winter habitat as mature to overmature coniferous forest comprised of 40-100% fir or spruce with 50-100% canopy closure and 20-50% ground cover of coarse woody

[140] This paragraph is based on the Habitat Suitability Index model by Allen (1983).

debris.[141] Research is currently being conducted in Minnesota which may refine the winter habitat needs for pine marten locally.

Bobcats are generally most abundant in early to mid-successional habitats and often concentrate their activities in human-modified areas (Boyle and Fendley 1987). In the past few decades they expanded their range into Canada (as well as northern Minnesota) as farming, logging and settlement invaded the boreal forests.[142] There is extensive habitat information for bobcats in the southern U.S., which allowed a HSI model to be developed specific to the south. In the north, stands of dense evergreen vegetation are used during winter. Deer and snowshoe hare are primary foods of bobcats in some northern areas. In the south, grass, forb and shrub cover types are highly productive of bobcat food items. In the south, habitat management for bobcat and timber management can be integrated. There, small mammal prey populations peak 1-3 years after timber harvest and decrease sharply afterwards as the canopy develops; canopy closure can be delayed with early and extensive thinning.[143]

Studies in Yellowstone National Park have shown that wolves play a role in structuring the ecosystem in complex ways, and these impacts have cascading effects at multiple trophic levels. In Minnesota, wolves help structure the deer, beaver, and snowshoe hare population, which in turn regulate aspen, white pine, and white cedar stands. Wolves also tend to displace coyotes, which in turn would displace red foxes, and thus the prey populations of these lower level predators are affected in complex ways.

*Strategies*:

Increase conifer[144] cover on LUP lands through the SFRMP process, unless adjacent state lands are better suited for this treatment.

Increase age of conifers and mixed forests through extended rotation forestry practices and the SFRMP process, unless adjacent state lands are better suited for this treatment.

Retain all snags and windfalls (coarse woody debris) in harvest areas (i.e., beyond minimum standards in the *Voluntary Site-level Forest Management Guideline*). Implement appropriate forest management recommendations provided by Franklin et al. (2007).

Before harvesting spruce or fir on LUP lands, assure that there are adequate stands for female marten wintering habitat (based on HSI models or local research results) within a 2 $mi^2$ area centered around the planned cut. For planning efficiency, ideally this should be accomplished during SFRMP revisions.

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[141] In the eastern half of the LUP planning area, the volume of course woody debris is very low (0-250 $ft^2$/acre), and in the western half it is low (250-500 $ft^2$/acre); some areas of the state exceed 1000 $ft^2$/acre (U.S. Forest Service 2007). The U.S. Forest Service (2007, p. 50) concluded that "because fuel loadings are not exceedingly high across Minnesota, possible fire dangers are outweighed by the wildlife habitat benefit provided by Minnesota's diverse down woody habitats."

[142] Milder winters may also factor into the bobcat's northward expansion (S. Laudenslager, pers. obs.).

[143] This paragraph based on Boyle and Fendley (1987).

[144] In this plan, the phrase "increase conifer" is intended to imply creating more mixed species stands (where stands are entirely deciduous) or increasing the conifer component in already mixed stands; it does not necessarily imply converting a mixed stand or deciduous stand to a pure conifer stand.

Red Lake and Baudette Area Wildlife Managers will remain updated on latest research results of marten and fisher habitat use studies.

Allow bobcat and lynx populations to respond naturally to increasingly older and more coniferous forests. The bobcat and lynx population responses are anticipated to be diametrically opposite; anticipate need to manage for benefit of lynx in the future.

Manage wolves in the LUP planning area according to the State Wolf Management Plan and incorporate models of wolf population dynamics under State management as management under State authority progresses. Maintain a wolf population within the "range of natural variation."

Continue winter wolf track count and scent post surveys.

Consider modeling ecosystem services (e.g., ecosystem structuring) provided by wolves in the LUP planning area.

Consult with the Red Lake Band of Chippewa Indians on wolf management.

Objective 1.9: Manage a population of spruce grouse in the face of boreal forest loss to climate change by assuring 14,000 acres of jack pine and black spruce are retained on LUP lands.

*Rationale:* Spruce grouse are considered a "trailing edge" boreal species in Minnesota, meaning that the southern extent of their range closely corresponds to the southern extent of boreal forests in Minnesota. In a study of radioed spruce grouse in Hubbard County, Pietz and Tester (1979) found their radioed birds exclusively in jack pine during winter. Adult males established display territories in black spruce-tamarack bogs in late March and remained there through summer and fall, although some alder fringe habitat was used. Females showed strong selection for black spruce-tamarack bogs during the month before incubation began. In two cases, nesting and brood-rearing occurred exclusively in jack pine stands. During summer and early fall both jack pine and black spruce-tamarack bogs were used, but by late fall all radioed spruce grouse were back in jack pine. A database of spruce grouse observations in the Beltrami Island State Forest documented 46 spruce grouse observations in the following cover types: jack pine (23), lowland black spruce (8), tamarack (4), white cedar (4), red pine (4), stagnant spruce (1), paper birch (1), and lowland brush (1). It has been suggested that isolated patches need to be >8 ha in size to support spruce grouse (Larson and Dick 2010). Wildlife biologists are concerned that their populations could be extirpated from Minnesota and elsewhere (Williamson et al. 2008) if climate change results in floristic northward shifts (see Galatowitsch et al. 2002). Boag and Schroeder (1992) indicate that fire suppression in fire-dependent native plant communities at the southern edge of their range also leads to extirpation or confinement to small areas of suitable habitat. Spruce grouse are a hunted game species, a species of greatest conservation need in Minnesota, and a sought-after species by birdwatchers. However, we do not have a mechanism for accurately monitoring their populations, nor do we have good baseline population data.

*Strategies*:

Develop methods for monitoring spruce grouse populations.

Study spruce grouse habitat use to see how tamarack, white cedar and other conifers complement use of jack pine and black spruce.

Encourage natural regeneration of jack pine following harvests.

Retain black spruce communities through establishment of legacy patches that are free of dwarf mistletoe infestations, and conduct harvests to allow natural reseeding. Employ an adaptive management approach to address new issues and use new techniques.

Implement prescribed burns in fire-dependent conifer communities as necessary.

Objective 1.10: Implement a moose restoration plan if future research indicates restoration is feasible; otherwise allow moose populations to fluctuate (or decline) as natural conditions dictate.

*Rationale:* The moose population has nearly reached the point of extirpation in northwestern Minnesota despite extensive effort to regenerate browse and implementation of closed hunting seasons since 1997. The decline is attributed to "climatic changes combined with increases in deer numbers and parasite transmission rates [that] may have rendered northwest Minnesota inhospitable to moose" (Ballard, undated). The implication of this is that there are limited management tools for restoring moose to the LUP planning area.

*Strategies*:

Monitor results of continuing moose research in northeastern Minnesota. If that research identifies causes of declines and management actions for recovery, implement those management actions in the greater LUP planning area. Allow hunting to resume when populations attain a sustainable, viable level.

Implement some elements of the Agassiz Lowlands SFRMP plan that dovetail with moose habitat management recommendations made by the Moose Advisory Committee for northwest Minnesota, which are 1) use prescribed fire, timber harvest and mechanical treatment to create early successional habitats; and 2) manage for patches of mature aspen.

Objective 1.11: Maintain existing natural waterfowl nesting and brood-rearing habitat on LUP lands.

*Rationale*: Suitable waterfowl brood-rearing habitat is highly limited on LUP lands specifically (e.g., about 2142 acres of marsh and openwater are present), and in the greater LUP planning area in general. The relative lack of waterfowl use of the Beltrami Island area is borne out by Breeding Bird Survey route data and by the Breeding Bird Atlas surveys conducted in 2011. Most of the significant open waterbodies in the LUP planning area are protected natural lakes located in peatland SNA's and are not suitable for management involving habitat manipulation. The primary open waterbodies specifically on LUP land are Hayes Lake and the Roseau Flowage. However, we believe a far greater amount of brood-rearing occurs on meandered streams rather than artificial impoundments. Because suitable brood-rearing habitat is naturally limited, there are

few opportunities on LUP lands to increase waterfowl productivity. Therefore, DNR efforts to increase waterfowl production are best spent in other ecological subsections in the landscape.

Several pairs of trumpeter swans nest in the LUP planning area. Nests are located on existing or constructed hummocks in water >0.5 m deep. During the breeding season, adults feed on submergent and floating-leaved aquatic plants in water <1 m deep, while cygnets feed on aquatic plants and insects (Mitchell 1994).

*Strategies*:

Assure adequate supply of large diameter aspen are retained during harvest for wood ducks, goldeneyes, and mergansers in proximity to suitable brood-rearing habitat. Implement wider riparian management zones on LUP lands.

Maintain at least two pairs of breeding trumpeter swans by managing Brown's Lake/Bog and Roseau Flowage for their habitat needs.

Avoid installing artificial nesting structures for waterfowl on LUP lands.

Encourage and protect beaver ponds.

Plug ditches (following the formal ditch abandonment process).

**Goal 2: Habitat**

Protect natural habitats and functioning watersheds and restore natural diversity and variability to altered habitats to ensure a sustainable functioning landscape that can support a full suite of native wildlife species and be resistant or resilient to future climate change.

Objective 2.1: Retain water on landscape through healthy forests.

*Rationale:* The LUP project planning area is at the top of six major watersheds. Some watersheds, such as the Roseau River and Warroad River watersheds, are experiencing downstream flooding issues. Past ditching and drainage increased the amount of runoff from the area, but most of those drainage improvements are now functionally ineffective. Despite this, the LUP project area contains most of the natural reaches of the watercourses draining the area. For example, in the Roseau River watershed there are about 350 miles of natural riparian areas located in subwatersheds that have not been highly modified, versus about 900 miles of drainage ditches or highly altered stream beds and about 210 miles of meandering stream in highly modified landscapes.[145] Some climate change models suggest that northern Minnesota will receive greater amounts of precipitation in the future than at present. Highly altered downstream reaches do not have the capacity to assimilate additional runoff.

Other climate models suggest that, although annual precipitation will likely increase in the future, summertime droughts may occur more frequently. Maintaining water on

[145] GIS data analysis by C. Scharenbroich, DNR. See Appendix J in draft CCMP. The RRWD disputes this number and places the miles of ditches at 430.

the landscape will help keep peatlands hydrated. Peatlands sequester vast amounts of carbon dioxide and methane. Hydrated peatlands retain carbon dioxidewhereas dry peatlands can release carbon dioxide (Gorham 1991, Minnesota DNR 2011b).

Forest composition and age affect hydrology (Verry 1976, Ohmann et al. 1978) in multiple ways. Aspen and other hardwoods contribute more water to streamflow and groundwater recharge than any other forest cover (Ohmann et al. 1978). Converting hardwood forests to pine forests can reduce streamflow by 94% in as little as 10 years (Verry 1976). Conifers both intercept more precipitation (thus allowing greater evaporation) and have higher rates of evapotranspiration than do hardwoods on an annual basis (Ohmann et al. 1978). Conifer cover also slows down snowmelt in the spring, moderating runoff hydrograph curves (Guertin et al. 1987). Trees also contain vast quantities of water, especially in their trunks (Cermak et al. 2007) but comparisons between deciduous trees and conifers are complex. In general, conifers contain a greater water content than do deciduous trees (75-100% vs. 35-60% dry weight;[146] Stewart 1967). Most water is stored in the sapwood of conifers, but aspen and oak can have as much or more water in the heartwood (Stewart 1967, Fromm et al. 2001). Moisture content tends to increase with height in many trees (Pollock 1896, Stewart 1967), however, younger trees transpire more water (Kravka et al. 1999) and have slightly more water content (2%; Pollock 1896). Therefore, after accounting for differences in basal area and volume, older forests retain more water than do younger forests because older mature trees are taller, have more volume in heartwood, and intercept more water for evaporation (i.e., less runoff). Moisture content also seems to reach its maximum in most species in late winter (Pollock 1896, Stewart 1967, Cermak et al. 2007). Therefore, manipulating forest composition by increasing the proportion of conifers on the landscape, extending the age of forests prior to harvesting, and increasing riparian management zone widths are measures that can retain water on the landscape longer. However, there is a lag time between when management actions occur and results are realized.

Implementing these measures corresponds with SFRMP goals for the Agassiz Lowlands subsection, and implementing these measures on LUP lands can have added benefit for wildlife. However, SFRMP prescriptions could require offsets on state lands for changes made on LUP lands, and it would be uneconomical to convert cover type on an LUP parcel if the desired condition is provided on a state parcel nearby. Therefore, cover conditions on state parcels need to be considered when deciding whether to convert forest cover on LUP parcels to another type. LUP parcels that are not converted could be held in reserve for future conversions if conditions on nearby state lands change.

Paired watershed/catchment studies have been used to assess the effects of vegetation removal on streamflow responses, particularly annual water yield, due to different forest covers (Stednick 1996). Typically these studies involve pairing two catchment areas, then manipulating the vegetation in one to assess impacts of land cover on

[146] According to the Alabama Forestry Commission, water accounts for 54% of the “green” weight of softwoods and 47% of the “green” weight of hardwoods, and it assigns an average value of 50% water content by weight for all trees (www.forestry.state.al.us). The Minnesota Loggers Education Project also assumes 50% water content by weight in its “green” weight to dry weight calculations (www.mlep.org).

runoff. The North and South Branches of the Roseau River readily lend themselves to such a study. The two watersheds are 216 $mi^2$ and 217 $mi^2$ in area, respectively. The North Branch drains 152 $mi^2$ of forest and wetland, and 64 $mi^2$ of agricultural land. Conversely, the South Branch drains 40 $mi^2$ of forest and wetland, and 177 $mi^2$ of agricultural land (RRWD 2004).

*Strategies:*

Assess whether passive conversions that increase conifer cover on the landscape (per the SFRMP) can be targeted to LUP lands, especially in the Roseau River watershed, and move suitable stands in that direction. Focus on natural increase through leave tree selection, cone bearing trees, and legacy patches.

Assess whether encouraging natural succession to increase the amount of conifer cover and extending rotation age on LUP lands would have unintended consequences of increased timber harvest to cover types on state land.

Protect existing natural meandering streams and restore altered stretches where possible.

Implement wider riparian management zones on LUP lands as stipulated by U.S. Fish and Wildlife Service letter of May 7, 2004. Otherwise, implement *Voluntary Site-level Forest Management Guidelines* as minimum standards. Consider managing riparian areas as extended rotation forest patches.

Allow State to add strategic ditch plugs and to restore wetland conditions where ditches have effectively drained wetlands. DNR staff will not actively seek out wetland restoration opportunities (i.e., we will not formally delineate wetlands on the ground), but we will act upon any feasible opportunities we find or are brought to our attention. LIDAR (Light Detection and Ranging) aerial photography has the potential to identify restoration opportunities.

Encourage local partnerships to establish stream monitoring stations/gauges on the north and south branches of the Roseau River to comparatively monitor runoff from the two systems. Data collected can be used to assess effectiveness of vegetation management and help prioritize land and water conservation measures.

Objective 2.2: Maintain at least 2500 acres of sedge meadows for sandhill cranes, yellow rails, short-eared owls, Wilson's phalaropes, sharp-tailed grouse, Nelson's sharp-tailed sparrows, LeConte's sparrows, and sedge wrens through restoring natural hydrology, and periodic brush removal through prescribed burning and/or shearing/mowing.

*Rationale*: Sedge meadows once constituted more than 75% of Minnesota's original wetlands and are indispensible habitat for rare birds and plants. Many of the sedge meadows that were not drained or plowed have succeeded to brushlands primarily due to fire suppression (Hanowski et al. 1999). If climate change scenarios that suggest more growing season droughts will occur in the future come to fruition, than less-hydrated peatlands may succeed to brushlands at an accelerated rate (Weltzin et al. 2000, Galatowitsch et al. 2009). Sharp-tailed grouse leks (in Canada) are abandoned when aspen cover exceeds 56% in a 1 km radius and when grass and sedge cover

decreases to below 15% cover (Berger and Baydack 1992). Although brushlands are also valuable habitat for breeding birds (including American bitterns, golden-winged warblers, Nashville warblers and alder flycatchers [Hanowski et al. 1999]) and mammals, they are not as scarce as sedge meadows on LUP lands (16,000 acres versus 2,500 acres). Also, the quantity of brushlands exceeds our capability to convert them to sedge meadows, thus there will always be an adequate quantity of brushlands in the LUP planning area. Many acres of sedge meadow and brushlands are not readily accessible, and this fact will be considered when selecting areas for treatment, as well as periodicity of treatment. Burning produces quicker nutrient recycling than does shearing, but larger areas can be treated with shearing and it is not weather-dependent.

An oral comment was received during the Warroad open house to allow harvest of brush for biofuels. Selling rights to harvest brushlands in winter has merit for generating revenues and would allow a greater amount of sedge meadow habitat to be maintained. If a market for brushland biomass develops, harvesting should be focused near roads, where access is feasible and benefits for birdwatchers and hunters would be greatest.

*Strategies*:

Use DNR open lands roving burn crew, Minnesota Conservation Corps crews, and The Nature Conservancy burn crews to burn, shear, or mow an average of 200 acres of brush per year.

After five years evaluate whether additional resources are necessary to meet the goal, or whether existing resources allow additional brushlands to be converted to sedge meadow habitat. If existing resources allow additional brushlands to be converted to sedge meadow habitat, evaluate whether the expenditure of resources would be more effective on LUP lands or state lands (e.g., within Peatland SNA watershed protection areas or Red Lake WMA).

Allow State to restore wetland conditions where ditches have effectively drained former wetlands. DNR staff will not actively seek out (on the ground) wetland restoration opportunities via extensive formal wetland delineations, but we will act upon any feasible opportunities we find or are brought to our attention.

Consider selling rights to harvest brushlands for biofuel biomass if markets develop; limit harvest to winter (i.e., frozen conditions) and near road systems.

Assure proposals for artificial water control structures on LUP lands adequately replace impacted sedge meadows.

Objective 2.3: Increase conifer[147] coverage on LUP lands, especially in Roseau and Warroad River watersheds.

*Rationale*: The Agassiz Lowlands SFRMP calls for converting 13,000 acres of aspen to other cover types, primarily conifers. Aspen is the most abundant cover type on LUP

[147] The phrase "increase conifer" is intended to imply creating more mixed species stands (where stands are entirely deciduous) or increasing the conifer component in already mixed stands; it does not necessarily imply converting a mixed stand or deciduous stand to a pure conifer stand.

lands (19,500 acres, or 25.5% of the area), and exceeds the historic coverage ratio (19.4%) of the subsection. Conifers provide valuable cover, food sources, and nest sites for birds and other wildlife, including species such as deer and ruffed grouse that are generally thought of as preferring young aspen habitat. Conifers also help retain water on the landscape longer than deciduous trees do, by intercepting and evapotranspiring more precipitation, and by shading snowcover and slowing the melt in the spring.

However, SFRMP prescriptions could require offsets on state lands for changes made on LUP lands, and it would be uneconomical to convert cover on an LUP parcel if the desired condition is provided on a state parcel nearby. Therefore, cover conditions on state parcels need to be considered when deciding whether to convert forest cover on LUP parcels to another type. LUP parcels that are not converted could be held in reserve for future conversions if conditions on nearby state lands change.

*Strategies*:

Wildlife staff will participate in SFRMP annual stand exam reviews and annual plan revisions (i.e., harvest and salvage logging additions).

Assess whether passive conversions that increase conifer cover on the landscape (per the SFRMP) can be targeted to LUP lands, especially in the Roseau and Warroad River watersheds, and move suitable stands in that direction.

Assess whether passive conversions to increase the amount of conifer cover on LUP lands would have unintended consequences to cover types already existing on state land.

Increase amount of jack pine, white pine, spruce-fir, upland white cedar, and upland tamarack, and provide habitat for late successional species on LUP lands in the Roseau and Warroad River watersheds where appropriate.[148] Allow natural succession and natural regeneration on suitable sites, and protect advanced conifer regeneration.

Implement appropriate management techniques recommended by Franklin et al. (2007) and stipulated by U.S. Fish and Wildlife Service letter of May 7, 2004.

Objective 2.4: Retain coniferous and mixed forests longer (beyond normal harvest age) on the landscape on LUP lands, especially in the Roseau and Warroad River watersheds.

*Rationale*: Many wildlife species (e.g., marten, fisher, lynx, barred owls, black-backed and three-toed woodpeckers, pileated woodpeckers, northern goshawks, black-throated green warblers, Connecticut warblers) require older forests in order to find suitable habitat for some or all aspects of their annual life cycles. Some plants and lichens occur only in older forests. Woodpeckers tend to require trees of certain diameters that are often not attained by trees under normal rotation forestry, although this can be mitigated by retaining an appropriate amount of "leave" trees. Northern Minnesota forests with natural successional and disturbance regimes provide habitat for a higher density and richness of bird species (Zlonis 2012). Older forests contain more snags and downed coarse woody debris than younger forests. Thirty-two species of

[148] For SFRMP Issue 2, this meets Desired Future Forest Condition (DFFC) objectives 1, 3, 4, 5, 6, and 13.

birds and 26 species of mammals require tree cavities and snags for nesting, feeding, and roosting (U.S. Forest Service 2007).[149] Older forests also retain more water on the landscape than do younger forests, sequester carbon longer (Minnesota DNR 2011b), and older forests are often more aesthetically pleasing to humans. Older forests should be considered a long-term investment that cannot be replaced as readily as younger forests.

However, SFRMP prescriptions could require offsets on state lands for changes made on LUP lands, and it would not be beneficial to extend forest age on an LUP parcel if the desired condition can be better provided on a state parcel nearby. Therefore, cover conditions on state parcels, as well as stand genetics, need to be considered when deciding whether to extend forest age on LUP parcels. LUP parcels that are not managed as extended rotation forests could be held in reserve for future designation if conditions on nearby state lands change.

*Strategies*:

Wildlife staff will participate in SFRMP annual stand exam reviews and annual plan revisions (i.e., harvest and salvage logging additions).

Assess whether extending rotation age on LUP lands would have unintended consequences to cover types already existing on state land.

Extended forest rotation ages in coniferous and mixed forest stands on LUP lands in the Roseau and Warroad River watersheds (SFRMP Issue 3, DFFC 2) where appropriate, and where stand genetics allow.

Preserve ecologically important lowland conifer (EILC) black spruce, tamarack, and white cedar stands in the eastern part of the LUP planning area.

Implement appropriate management techniques recommended by Franklin et al. (2007) and stipulated by U.S. Fish and Wildlife Service letter of May 7, 2004.

Objective 2.5: Focus management of habitat for early successional species in central part of planning area and along some of the beach ridges in the eastern part of the planning area.[150]

*Rationale*: Aspen is the primary forest cover type that is managed for early successional species such as deer, ruffed grouse, golden-winged warblers, American woodcock, black bear, and moose. If the Roseau and Warroad River watersheds are to be managed for increased conifer coverage, then the central part of the forest and the eastern beach ridges become the logical location to focus early successional forest management. This does not restrict management for early successional species in the other watersheds, nor does it restrict management for coniferous forests in the central and eastern portions of the greater LUP planning area. To the contrary, most early successional forest species also require other habitats than just aspen at certain periods of their annual life cycles. Likewise, harvested areas are used by many mature-forest birds after

[149] The ratio of standing dead to live trees is slightly higher in national forests (0.15) than on state land (0.13) in Minnesota, perhaps due to different stand ages (average stand age is 57 years in national forests versus 55 years on state and local government lands; U.S. Forest Service 2007).

[150] This is in concordance with DFFC objectives 7 and 10 for SFRMP Issue 2, and DFFC objective 1 for SFRMP Issue 3.

nesting, primarily for the food resources (Streby 2012). This objective is simply a statement of where these efforts will be focused.

*Strategies*:

Identify aspen and mixed stands through the SFRMP interdisciplinary review process that can be harvested to provide early successional forests.

Consider Best Management Practices for ruffed grouse, American woodcock, deer and bear when designing harvest treatments. Consider opening up the adjoining forest understory (for ≥15 m) with mechanical treatment or burning to enhance whip-poor-will nesting habitat if whip-poor-wills are in the area.

Set aside an adequate amount of forest for extended rotation forestry and oldgrowth objectives, and harvest the remaining aspen and mixed stands at normal rotation age in approximately equal annual increments (as stand age composition across the landscape allows).

Implement appropriate management techniques recommended by Franklin et al. (2007) and stipulated by U.S. Fish and Wildlife Service letter of May 7, 2004.

Objective 2.6: Retain oak, manage brushlands, and maintain white cedar and peatlands wherever they are found.[151]

*Rationale*: Oak are rare in the landscape, being found mainly along the Rapid River, and peatlands and white cedar communities have specific habitat requirements that prevent them from being readily shifted around on the landscape. Some brushlands can be temporarily converted to sedge meadows, but will return to brushlands in the absence of fire, shearing, or mowing.

*Strategies*:

Retain oak, manage brushlands, and maintain lowland white cedar and peatlands wherever they are found on LUP lands through SFRMP annual plan reviews.

Create a database of brushland shearing, mowing, and burning activities.

Implement appropriate management techniques stipulated by U.S. Fish and Wildlife Service letter of May 7, 2004.

Objective 2.7: Manage yellow birch stands on north shore of Upper Red Lake for old-growth designation, and propagate yellow birch in adjacent stands if applicable.

*Rationale*: Yellow birch is the most valuable of the birch species, for both its timber value and wildlife value (Erdmann 1990). It is at its western continental extent in the LUP planning area. The species is easily susceptible to fire, and its occurrence on the north shore of Upper Red Lake is likely due to the lake acting as a natural fire break. It also has fairly strict requirements for regeneration (e.g., it is nearly obligate to germinating on highly-decayed coniferous nursery logs [Bolton and D'Amato 2011]) and

[151] This is in concordance with DFFC objectives 8, 9 and 14 for SFRMP Issue 2.

is not a great competitor at early stages of growth. The DNR does not have old-growth goals specific to yellow birch (rather they are tied into goals for northern hardwoods), and the stands on the north shore of Upper Red Lake merit designation as old-growth or future old-growth, and would be the only stands so designated in the state.

*Strategies*:

Update forest inventory information on forested LUP lands on the north shore of Upper Red Lake. Discuss inventory findings and management strategies to maintain and increase the yellow birch component during the 2012-2013 Agassiz Lowlands SFRMP update process.

Monitor the yellow birch component during the Agassiz Lowlands SFRMP 2013 update time span.

Implement or develop management strategies to maintain yellow birch and encourage regeneration in these stands and adjacent stands. Consider prescriptions in Tubbs (1977), Erdmann (1990), and Bolton and D'Amato (2011) for favoring yellow birch if harvesting in area. Add or retain existing or future coniferous coarse woody debris.

Consolidate LUP lands on the north shore of Upper Red Lake into a contiguous unit via land exchanges with the State.

Objective 2.8: Manage the Rapid River Headwaters Area to retain its existing wilderness characteristics and values. State lands are not proposed for wilderness designation.

*Rationale*: Wilderness Area reviews are a required element of National Environmental Policy Act reviews. There are no designated Wilderness Areas in the LUP planning area, but there is one roadless area that appears to meet the criteria for consideration for Wilderness designation. The Rapid River Headwaters Area consists of 4,475 acres of LUP land (Figure 4.1). This area 1) could be confined entirely to LUP lands, 2) could be enhanced by land exchanges with the State or Red Lake Band of Chippewa Indians, or 3) could be a combination of Federal and Tribal lands dually designated as one area. Another area, the Spring Fen Channels Area, also contains wilderness characteristics but contains only 80 acres of LUP land embedded in State-owned peatlands. Both of the potential areas are within the boundaries of the Red Lake WMA. Formal Wilderness Area reviews would need to be conducted by the U.S. Department of Interior, and this plan is not in a position to encumber other agencies' time. However, we can manage both areas to preserve their existing wilderness values and characteristics.

*Strategies*:

Avoid road construction in the Rapid River Headwaters Area (as shown in Figure 4.1). Timber harvest will be allowed only if it moves stands towards histgoric abundances and dominance structures as determined by the Ecological Classification System review, results in uneven-age stands (i.e., original diverse stand conditions), and utilizes least-obtrusive methods (e.g., selective harvest, variable density thinning).

Avoid timber harvest in the Spring Fen Channels Area and recommend this ecologically significant area be added to the Red Lake Peatland SNA.

Increase amount of LUP land in area via land exchanges. Focus primarily or initially on Rapid River Headwaters Area.

Develop cooperative management plan with Red Lake Band if they are willing partners.

Continue to manage the surrounding state and LUP lands using standard wildlife and forestry management techniques, with continued traditional non-motorized public access (consistent with WMA policy) of both the wilderness quality area and the surrounding public lands for hunting, trapping and other nature-related activities.

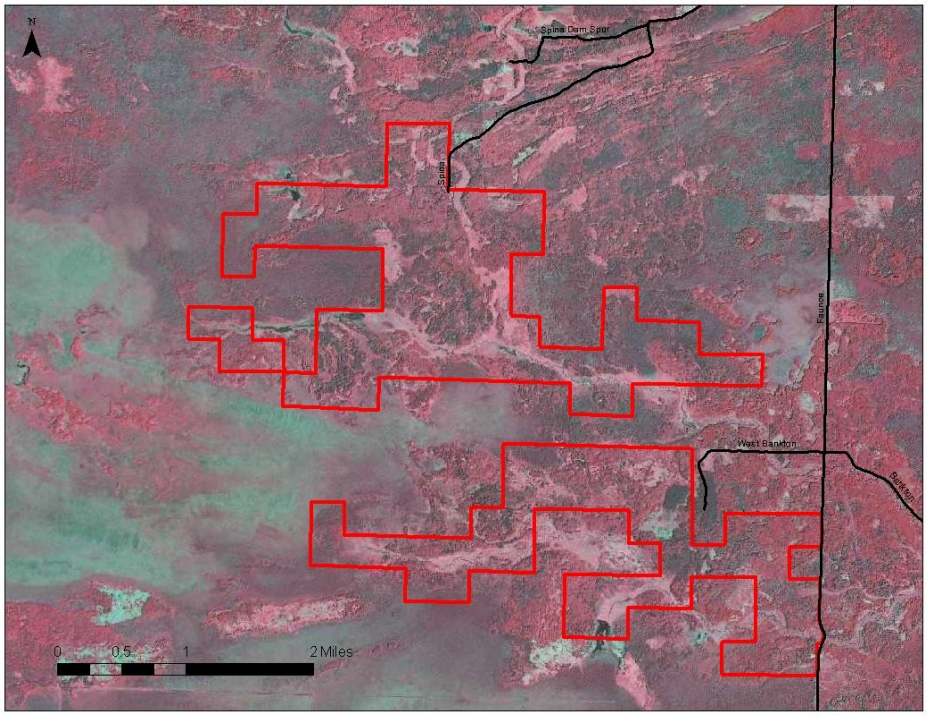


Figure 4.1. The 4,475-acre Rapid River Headwaters Area, as shown in infra-red satellite imagery. All lands within the solid red lines are LUP lands.

Objective 2.9: Support a pending proposal to create a Scientific and Natural Area in the Bemis Swamp area within the existing Bemis Area of Limitations to protect rare plants and plant communities. This proposal is outlined in *Land Asset Pilot Project in Roseau County*,[152] and could include 17 LUP parcels totaling up to 680 acres.

*Rationale*: Complex groundwater hydrology exists in the Bemis Swamp area on both the east and west sides of Bemis Hill Forest Road. The plant and wetland communities contain two calcareous fens and support populations of listed threatened (sterile sedge, ram's-head lady's-slipper) and special concern (Lapland buttercup) species. The area has already been designated an Area of Limitations, which closes it off to OHV use. The Division of Ecological and Waters Resource's long range plan for SNA's includes protecting at least three locations per landscape region for each rare plant species, which is supported by the Agassiz Lowlands SFRMP. This goal has been met for ram's-head lady's-slipper but not for sterile sedge in the Laurentian Mixed Forest region.

[152] *Land Asset Pilot Project in Roseau County* (Minnesota DNR 2010).

Designating the Bemis Swamp area an SNA would provide ultimate protection to this complex ecosystem. Although most SNA's are managed by the Division of Ecological and Waters Resources (EWR),[153] all lands in the area are either LUP or Forestry lands. Because there are no EWR lands to serve as a core for an SNA, LUP lands could serve that function. However, the Division of Forestry is reluctant to exchange any parcels with commercial timber or sand and gravel deposits, and they can designate management units to protect rare ecological resources. Also, calcareous fens already receive the highest level of protection afforded by the Wetland Conservation Act.

*Strategies*:

Create an internal DNR working group to identify ecological areas of concern that the Division of Forestry would be willing to exchange.

Consolidate all of the rare ecological features into a single management unit by:

A) increasing the amount of LUP land in area via land exchanges[154] in order to encompass all rare ecological features on LUP land and then designate a Scientific and Natural Area, and/or
B) designating an SNA that includes all state lands that contain rare ecological features, and then exchange LUP lands out of the SNA boundary.

Objective 2.10: Resist invasion by exotic species.

*Rationale*: Invasive species are uniquely adapted to responding to disturbances, and they are expected to benefit from a warming climate (Schlaepfer et al. 2011, Frelich et al. 2012). Invasive species can prevent the regeneration of desirable plants species, and they seldom have much value to wildlife. Exotic earthworms in particular benefit exotic plants. The primary desire is to prevent the spread of exotic species into the area in the first place. Small infestations can be easy to control, but they must be found quickly. Biological controls are ultimately the best control method for large infestations. Biological controls, however, can take several years to develop, test, and prove safe and effective.

*Strategies*:

Implement restrictions (e.g., on firewood, vehicles) as necessary to inhibit the spread of exotic plants and animals.

Eliminate new infestations while small, and prevent spread of larger infestations. Monitor all known infestations at least annually to assure treatment success and/or containment, as seeds may germinate over the course of several years. Examine exotic plant infestations for exotic earthworm activity to see if there is a correlation.[155]

Hire Conservation Corps Minnesota crews with Beltrami Island funds to work throughout the LUP planning area for mechanical and chemical control, monitoring and mapping.

[153] Gustafson Camp SNA is an example of an exception.
[154] We would target LUP lands in Hayes Lake State Park as part of the exchange.
[155] Loss et al. (2012) have developed a rapid assessment tool for recognizing earthworm invasions in hardwood forests.

Continue to control approximately 5 acres per year. Increase acres controlled as necessary and as resources allow.

Look for newly emerging biological control opportunities.

Fully implement DNR Operational Order 113 (Invasive Species). Check invasive species databases to determine if timber management sites are near known infestations, and report new infestations to the database.

Limit timber harvest (i.e., mechanical entry) on LUP lands in Peatland SNA Watershed Protection Areas to situations where LUP land is near a road or adjacent to a planned harvest on state land, and there is a benefit to wildlife by allowing a harvest.

Objective 2.11: Manage and restore gravel pits so that they provide some wildlife benefits.

*Rationale*: LUP lands were designated as the Beltrami Wildlife Management Area "as a refuge and breeding ground for native birds and other wildlife and for research relating to wildlife and associated forest resources, under such conditions of use and administration as will best carry out the purposes of the land conservation and land utilization program for which such lands have been, or are being acquired." Comments received during the focus group meetings raised questions as to how allowing gravel pits meets the purpose of LUP lands. Gravel from LUP lands is used to maintain forest roads, some of which traverse LUP lands,[156] and all of which provide access to LUP lands as well as state forest lands. Providing gravel only from state lands for use on only state lands, and only from federal lands for use on only federal lands, is inefficient and impracticable. Gravel pits do provide habitat for some species that would not normally find suitable habitat in a forested setting (e.g., killdeer, spotted sandpipers, belted kingfishers, bank swallows, and rough-winged swallows). There are, however, improvements that can be made in the operation and restoration of gravel pits to mitigate temporal impacts to wildlife and habitat. Some management issues associated with gravel pits include deposition of trash and lead shot, the spread of exotic invasive species, and destruction of desirable vegetation.

*Strategies*:

Restore old gravel pits based on current assessment of predicted vegetation responses to climate change. In the absence of predicted vegetation responses, gravel pits will be revegetated to complement or supplement adjacent forest patches.

Gate and close existing gravel pits to prevent spread of invasive species and contamination.

Monitor and control invasive species.

Use gravel from LUP land for roads in proportion to amount of road mileage on LUP land in local area.

Develop operational Best Management Practices.

[156] About 25% of road miles are on LUP land.

Limit new gravel pits only if no other practical alternatives exist as determined by a comprehensive interdisciplinary review process.

Consider trading some active gravel pits for state lands.

Objective 2.12. Thin and treat monotypic red pine plantations on LUP lands with prescribed burns, scallop the edges, and encourage other tree species to convert plantations to uneven-aged mixed forest stands. Consider exchanging some red pine plantations on LUP land for other State lands.

*Rationale*: Even-aged stands of red pine in plantations usually lack structural diversity as well as species diversity. Understory vegetation is often lacking on both the ground layer and in the form of a subcanopy. This is particularly the case on LUP lands, where red pine plantations were created on formerly cleared farm fields. This lack of diversity results in minimal wildlife use. Plantations also usually have one or more straight edges and trees are planted in rows, resulting in the lack of a natural appearance. Although treating pine plantations is not typical of a landscape management approach, neither is the retention of plantation monocultures. This activity will become obsolete as red pine plantations are restored to a more natural condition.

Thinning is used to capture timber volume that may be lost to mortality, or to improve product quality and value. Traditional thinning practices often perpetuate the homogenization of plantation stands. Franklin et al. (2007) recommend increasing heterogeneity by thinning to stimulate development of larger trees, employing variable-density thinning to stimulate development of horizontal heterogeneity, small gap creation to develop vertical and horizontal heterogeneity and opportunities for establishing and releasing regeneration and other understory components, creating standing snags and downed coarse woody debris by killing live trees, underplanting when the seedbank is lacking due to past management activities, and periodically using prescribed fires.

The Division of Forestry is interested in exchanging some state lands for some red pine plantations on LUP land. The Section of Wildlife is amenable to trading several of the red pine plantations, especially those that lack a diverse understory or subcanopy. Wildlife would like to retain those that have developed a diverse understory, and those that are remote from the road system. This plan proposes managing those stands that would be retained in LUP ownership for wildlife habitat benefits, and managing those that would be exchanged to the State for timber production benefits.

*Strategies*:

The U.S. Fish and Wildlife Service, DNR Section of Wildlife, and DNR Division of Forestry will develop a list of red pine plantations and State lands proposed for a land exchange, and prepare a detailed plan (including target dates) for accomplishing the exchanges.

Thin stands on retained LUP lands to 60 $ft^2$ basal area/acre. Use variable-density thinning whenever practical (based on stand size).

Thin stands proposed for exchange to 90 $ft^2$ basal area/acre or as otherwise prescribed by the Division of Forestry.

Implement prescribed burns on retained LUP lands before and after thinning if ongoing research suggests it could increase diversity.

Hand plant or inter-seed white pine and/or jack pine depending on the native plant community/ecological classificiation system on retained LUP lands if diverse natural regeneration is not occurring.

Implement other management techniques recommended by Franklin et al. (2007) and stipulated by U.S. Fish and Wildlife Service letter of May 7, 2004 on retained LUP lands.

Objective 2.13. Maintain natural diversity of all rare and highly-diverse native plant communities.

*Rationale*: Rare[157] and highly-diverse native plant communities include fire-dependent communities, old-growth forests and their buffers (or special management zones), old forest management complexes, high conservation value forests, and Peatland SNA's and their watershed protection areas. LUP lands support 8,450 acres of fire-dependent native plant communities (which burned on average once every 100 years[158]), of which 7926 acres are community types that are imperiled or rare statewide.

Gustafson Camp SNA is composed primarily of old growth white and red pine forest, and there are other old growth tracts dispersed on LUP lands (e.g., near Manweiler Dam, along Spina Road, near Norris Camp, and west of Faunce along the Faunce-Butterfield FR). Old growth forests are supposed to have delineated special management zones (buffers), but none have been mapped out yet; they do however exist by definition. Old forest management complexes have not yet been designated in the LUP planning area. High conservation value forests are in the process of being identified in Roseau County where the Minnesota County Biological Survey (MCBS) is complete, but they have not been identified in the other counties where the MCBS is not complete. Identification of high conservation value forests is a requirement of forest certification.

Ecologically important lowland conifers (EILC) include black spruce, tamarack, and northern white cedar communities. Black spruce is a component of nine ECS communities found in or adjacent to the LUP planning area, seven of which produce commercial timber products[159] and two that are stagnant communities.[160] Historically, black spruce was a major component of four or five of the pre-settlement ECS communities of commercial quality, but today under modern forestry practices it is a major component of all seven commercial quality ECS communities. Black spruce trees regenerate well under modern forestry practices , but black spruce communities with a

[157] Native plant communities are ranked from S1 to S5, with S1 and S2 communities being considered imperiled, to S5 communities being abundant and secure.
[158] Heinselman (1973, in Schulte and Niemi 1998) found an approximate average presettlement fire rotation period of 100 years. Replicating that frequency in fire-dependent communities on LUP lands would require burning an average of 84.5 acres/year. Earlier Heinselman (1970) reported a fire frequency of 50 years, which could be replicated by burning an average of 169 acres/year.
[159] FPn63, FPw63, FPn71, FPn81, FPn82, APn80, and Apn81.
[160] APn90 and APn91.

diverse understory can be more difficult to regenerate, and there is evidence that clearcutting may result in regenerating stands of stunted (stagnant) black spruce, perhaps due to the nutrient-poor conditions already present prior to harvest. In most pre-settlement ECS communities black spruce had fair to good regeneration only in mature stands (an exception is APn80 where peak regeneration was in the first 55 years). In the seven commercial quality ECS communities, under pre-settlement conditions, black spruce started out (usually) as minor components of communities (except APn80) and increased in dominance as the stand age reached maturity. Under modern forestry practices, black spruce starts out as a major component of all seven communities, but in three communities its dominance declines back to near the same dominance level as in pre-settlement conditions as stands reach maturity. Section of Wildlife staff are particularly concerned that harvested black spruce does not regenerate on "raised bogs." Conversely, black spruce is more abundant in APn81 sites now than it was historically, when it was subdominate to tamarack. Ecological data and assessments of presettlement vegetation from the Public Land Survey indicate this habitat type is normally dominated by tamarack after a stand-replacing disturbance, and black spruce slowly becomes more abundant since it is more shade-tolerant than tamarack. Tamarack is one of two species that has declined most significantly in dominance (Friedman and Reich 2005).

*Strategies:*

Use Geographic Information System (GIS) to map all S1, S2, and S3 native plant communities.

Increase amounts of prescribed burning in fire-dependent communities to a minimum average of 84.5 acres/year and a maximum average of 120 acres/year.

Implement some prescribed burns that cover larger blocks and a mosaic of habitat types.

Assess opportunities to develop fire management teams that utilize staff and expertise from other organizations (e.g., The Nature Conservancy, National Audubon Society, Red Lake Band of Chippewa Indians, and U.S. Forest Service) in order to accomplish larger or more frequent prescribed burns.

Delineate special management zones around old-growth stands on LUP lands by 2013.

Establish some old forest management complexes on LUP lands by 2013, focusing on connecting mature patches in and around old-growth stands, but not limited to proximity to old growth stands.

Designate some high conservation value forests as appropriate on LUP lands by 2016, using data from the Minnesota County Biological Survey that has identified plant communities of high and outstanding biological diversity.

Limit timber harvest (i.e., mechanical entry) on LUP lands in Peatland SNA Watershed Protection Areas to situations where LUP land is near a road or adjacent to a planned harvest on state land, and there is a benefit to wildlife by allowing a harvest.

Base black spruce harvest and regeneration prescriptions on the Ecological Classification System community type. Reserve black spruce stands occurring on "raised bogs" from harvest. For some black spruce and tamarack stands, use harvest methods other than clearcutting such as seed tree or shelterwood methods, and monitor results. In some black spruce harvests, leave tamarack seed trees. Allow some harvested sites to regenerate naturally, beginning with tamarack and succeeding slowly to black spruce.

Implement appropriate management techniques recommended by Franklin et al. (2007) and stipulated by U.S. Fish and Wildlife Service letter of May 7, 2004.

Objective 2.14. Within the life expectancy of this plan, begin to create a resilient forest to enable the landscape to evolve under changing climate conditions (anticipating a trend towards savannah or grassland conditions).

*Rationale*: A scientific awareness of the potential impacts of climate change on vegetation communities has been around since at least 1987 (see Joyce et al. 1990, Ledig and Kitzmiller 1992). Some climate change models suggest Minnesota will become warmer and drier,[161] others suggest Minnesota will become warmer and wetter.[162] Even those that suggest Minnesota will become wetter predict drier summers. While birds and other animals will have an easier time shifting their ranges in response to climate change, vegetation communities are slow to shift their ranges and may not be able to keep up with the pace of changes. "Savannification" is predicted to occur, in part, through decreases in summer soil moisture (Frelich and Reich 2009a, Galatowitsch et al. 2009). Soil moisture monitoring is a recommended component of adaptive management to climate change (Galatowitsch et al. 2009). Impacts of climate change are expected to be most pronounced on plant establishment phases (i.e., seed germination, seedling survival; Millar et al. 2007).

Galatowitsch et al. (2009) outlined three responses ecologists can take to deal with climate change: resistance, facilitation, and resilience.[163] ***Resistance*** is a reactive, labor-intensive approach. *Resistance* is a defensible approach to uncertainty, best applied in the short-term and to forests of high value (Millar et al. 2007). Resistance is ultimately considered fighting a losing battle, and it includes the concept of resisting invasive species. ***Facilitation*** is a proactive, labor-intensive approach. Facilitation reverses course from resistance and instead fosters the moving of species into new areas. The concept of facilitation suffers from a lack of sufficient ecological knowledge to predict the positive and negative outcomes of facilitative actions. Some elements of *facilitation* identified by Millar et al. (2007) – who termed it *response* – include assisting with species transplants, increasing redundancy and buffers, promoting connected

[161] Hamilton and Johnson (2002), Johnson and Polasky (2003), Galatowitsch et al. (2009), Frelich and Reich (2009b); see also Kling et al. (2003), The Wildlife Society (2004), and IPCC (2007). Drier conditions are expected due to less soil moisture during the summer growing season, not necessarily due to less annual precipitation.

[162] The Hadley model and Canadian Climate Center model in Matthews et al. (2004); Frelich and Reich (2009b).

[163] Earlier, Ledig and Kitzmiller (1992) identified and termed the three responses as *conservation*, *diversification*, and *deployment*. Millar et al. (2007) renamed these *resistance*, *resilience*, and *response*.

landscapes, and experimenting with refugia. ***Resilience*** is a proactive, but more passive approach. The concept behind *resilience* is assuring that the landscape contains all natural elements so that nature can select for those that will survive the changing conditions. *Resilience* can include measures from resistance and facilitation, such as increasing redundancy and buffers, promoting connected landscapes, and experimenting with refugia. *Resilience* is considered the most economical, the most fundamentally-grounded, and the most likely successful approach. All three approaches can be combined, with one approach phasing into another, or with different levels of emphasis on each approach. Swanston and Janowiak (in press) provide a useful outline of actions within each of the three response strategies (Appendix F).

Response strategies may also vary with expected stand longevity. For example, resistance might be appropriate for a white pine stand that might be expected to persist for 350 years, resilience might be appropriate for jack pine and white spruce stands expected to persist for 120 years under an extended rotation regime, and facilitation might be appropriate for stands to be harvested at an earlier age (example tree ages given from Ravenscroft et al. [2010]). Ledig and Kitzmiller (1992) state that maximizing diversity (i.e., resilience) and deploying seeds to new zones (i.e., facilitation) are not mutually exclusive; maintaining or maximizing diversity is essential because climate change will not stabilize for a long time.

Millar et al. (2007) note that some environments are more buffered against climate change and short-term disturbances than others, and suggest that if these can be identified they should be considered sites for long-term retention of plants for establishment of new forests. The peatlands and lowland conifer forests seem to meet this criterion. Galatowitsch et al. (2009) identified lower magnitudes of climate change for boreal peatland areas than other areas in Minnesota, and Glaser et al. (1997) noted bogs may be decoupled from a direct climatic control.

Hamrick (2004) suggests that longevity of trees is an important consideration since although seeds are usually produced in abundance at regular intervals, successful recruitment may be more episodic. He then poses the question, “How many successful recruitment events must occur in the lifetime of a tree to insure population survival?” It follows that extended rotation forestry practices might provide more opportunities for successful reproduction and recruitment of additional tree species than normal rotation forestry practices; this applies more to long-lived species that reproduce through periodic seed production, and not to short-lived species that regenerate through suckering or seeding after fire.

Forests stressed by climate change are expected to be more susceptible to diseases and insect pest outbreaks, particularly opportunistic pests. Integrated Pest Management (IPM) is a holistic approach to pest management. It consists of six steps: 1) pest identification, 2) population monitoring (of pest and its predators), 3) determination of thresholds of epidemic levels, 4) selection of an appropriate control strategy (managerial, biological, or chemical), 5) determine most effective timing of control, and 6) monitor and evaluate effectiveness of the control project. IPM also establishes prioritizations for pest control; e.g., 1) prevent new infestations, 2) early detection and treatment of new infestations, 3) treatment of sites with greatest potential for spreading, 4) protect known rare and sensitive plant and animals communities, 5)

protect special forest areas, and 6) contain and control established infestations.[164] A more fundamental step in IPM prioritization, however, should be "conservation of existing natural enemies."[165]

*Strategies*:

Implement a soil moisture monitoring regime[166] for guiding adaptive management decisions (per Galatowitsch et al. 2009), and maintain an awareness of ecological changes that are occurring in plant communities in the planning area, as well as south and west of the LUP planning area. Emphasize regenerating certain forest types if and when it appears they may be susceptible to loss due to climate change; this approach assures at least one more generation of the community type on the landscape. Also, judicious thinning of forests can reduce ecosystem demand for water and may create stands more resistant to drought (Galataowitsch et al. 2009).

Continue use of existing forest management strategies for old-growth and extended rotation age stands. Promote landscape connectivity and travel corridors for the movement of plant and animal species, now and in the future. Ensure diversity of age classes in all tree species. Maximize structural and height diversity in each stand. Increase stand resilience by encouraging additional tree species that build redundancy in life history strategies. That way, as a tree species begins to diminish due to climate change, another is there to fill the niche.

Work with DNR Forest Health Specialist to monitor old-growth and extended rotation age stands for outbreaks of diseases and injurious insects, and treat accordingly. Appropriate treatments might be prescribed burns to reduce cone pests, installing and subsequently removing trap logs for bark beetles or wood borers, using sticky traps for gypsy moths or emerald ash borers, or letting the disease or pest run its course. Pesticide application would be the option of last resort.

Monitor and retain forest stands on the landscape longer than under normal rotation forestry practices where stand conditions and tree genetics allow.

Protect understory and natural seedbank for native prairie grass and forb elements that persist under the forest canopy. This would primarily be through avoiding soil rutting and compaction, and avoiding bringing in exotic species (i.e., by implementing the *Voluntary Site-level Forest Management Guidelines* for these activities). This could also include prescribed burning to encourage native forbs and grasses to grow and set seed after stand harvests.

Monitor regenerating stands, and if regenerations is lacking for one or more components, considered need to actively manipulate vegetation or manage to passively favor those species that are regenerating. Develop thresholds for when active management (e.g., site preparation, seeding, planting) is necessary.

[164] Adapted from Hoosier National Forest, Pest and Non-native Invasive Species Management weblink.
[165] Adapted from University of Maine Cooperative Extension: Insect pests and plant diseases weblink.
[166] See Appendix M in draft CCMP.

**Goal 3: Human Use**

Provide the local community and visitors the opportunity to experience and enjoy protected natural habitats; and ensure a sustainable functioning landscape that can support recreation and food harvesting, timber harvesting, and retains natural hydrology at the head of six major watersheds.

Objective 3.1: Maintain a no-net-loss of motorized trails in the Beltrami Island State Forest while assuring a no-net-gain on LUP lands.

*Rationale*: OHV use, especially ATV riding, is one of the most popular activities in the greater LUP planning area; 25 of 43 (58%) people who filled out questionnaires during Scoping reported participating in this activity; 15 (35%) reported it as the activity most important to them, behind only hunting. OHV use within the Beltrami Island State Forest (BISF) is "managed", meaning users can operate motorized vehicles on trails that are not posted "closed," unless an area has been declared an Area of Limitations. There are three Areas of Limitations (AOL's) in the BISF intended to protect sensitive resources. OHV use in the other DNR conservation units[167] in the LUP planning area is not allowed by statute. OHV use is allowed on pre-existing minimum maintenance roads on LUP lands in the Beltrami Island State Forest, and under the hunting and trapping exemption outside of AOL's. The 2009 Lease Amendment prohibits new trails on LUP land unless alternatives are more damaging, and concurrence from the USFWS is required. Because LUP lands are not signed, the general public has difficulty knowing whether they are operating on State or LUP lands. Some public comments during Scoping recommended signs to explain why trails are closed; others commented that there are too many signs in the forest.

*Strategies*:

Bring any OHV trail issues to the DNR's OHV Monitoring and Enforcement Coordination Team for input and resolution. Attempt to reroute or relocate any trails that need to be closed if they become unsustainable or contribute to illegal activity, after consulting with USFWS and obtaining their concurrence.

For some high-profile trails, add information to signs to indicate why the trails are closed. Primary reasons trails are closed are wetland conditions, erodible soils, or rare plants or animals somewhere along the trail, or the trail leads to private or Tribal land, resulting in trespass issues. Users at trail heads usually do not understand why individual trails are closed. Additional information would clarify the reasons for closures.

During land exchanges, attempt to locate new LUP parcels in locations where OHV use is already non-existent (e.g., in Areas of Limitations), which are usually areas of sensitive resources. LUP lands in the BISF that are traded out would then likely become open for less restrictive ORV use.

[167] State Parks, Wildlife Management Areas, and Scientific and Natural Areas.

Objective 3.2: Maintain diverse quality hunting and trapping opportunities in the project planning area.

*Rationale*: Hunting appears to be the single most popular activity in the LUP planning area, based on Scoping comments received. At least six species of mammals and nine non-waterfowl species of birds are hunted. Potentially 21 species of ducks and geese could be harvested during the waterfowl hunting season. At least eight species of mammals are reported as trapped, with potentially at least four more species occasionally taken. Several public comments requested more food plots be established, however, this is not a landscape oriented management activity, and food plots are not in accordance with the U.S. Fish and Wildlife Service's Ecological Integrity Policy, which emphasizes native vegetation and natural processes.[168] Several public comments also expressed appreciation of the hunter walking trails and requested additional ones specifically in Roseau County and the northern part of the BISF.

*Strategies*:

Early successional habitat that supports deer, black bear, ruffed grouse and woodcock during parts of their annual life cycles will be maintained and created through periodic timber harvests. Diverse mixed-species and uneven-aged stands will be maintained to assure habitat is available for other annual life cycle needs; some of this additional habitat will be maintained through extended rotation forestry practices.

Forest roads will be maintained and existing minimum maintenance roads crossing LUP lands in the BISF will remain open for hunter access and big game retrieval.

Increase the number of hunter walking trail miles and create loops where possible instead of dead-end trails. Investigate feasibility of a new hunter walking trail on LUP land at the intersection of Dick's Parkway and the Moose River FR by 2015. Look for opportunities to create additional walking trails out of timber access routes during timber sale processes.

Publish hunter walking trail cover maps on the Norris Camp website.

Add a hunter satisfaction and flush rate mail-in survey at several hunter walking trailheads (rotated annually), so that grouse abundance can be correlated with habitat cover conditions along the trail.

Increase conifer cover composition along hunter walking trails that are primarily in aspen where ECS indicates conifers are appropriate, and/or where hunter surveys indicate a need for greater habitat diversity.

Maintain the handicapped accessible hunter walking tail (Schultz trail) and publicize its location on the Norris Camp website.

Maintain all large diameter ($\geq$12") snags and other coarse woody debris for fisher and marten habitat.

[168] See Agassiz NWR Comprehensive Conservation Plan.

Objective 3.3: Relocate the Norris campground out of a stand of future old-growth pines.

*Rationale*: The Norris campground has a long history of use, however, it is located in a mixed stand of pines that are targeted for management for future old-growth forest. The campground formerly had eight designated campsites, but has been reduced to four sites. A satellite campground intended to replace the Norris Campground has been started one-half mile to the west on the same forest road in an area that already has some development and is less ecologically sensitive. The satellite campground is already equipped with picnic tables, fireplace rings, and a seasonal porta-potty. The old campground has been reduced to four remaining sites.

*Strategies*:

Close down the existing Norris campground to trailer camping by 2017. Close road with gates. Allow walk-in tent camping at the old site but do not advertise it; and provide a small parking area at one or both of the existing entrances.

Provide seasonal porta-potties, a hand-pump well, fireplace rings, and picnic tables at the satellite campground by 2017.

Cease maintaining outhouses at the Norris campground immediately upon plan approval.

Inform users of the campground modifications through the Norris Camp Newsletter.

Convert the existing campground's road into an interpretative hiking trail. Install kiosk providing interpretative information about old-growth forests.

Complete a GPS inventory and map of pre-existing features at Norris campground for future reference.

Objective 3.4: Promote volunteering and a more organized Friends group.

*Rationale*: Volunteers perform valuable assistance in many program areas in natural areas, and their assistance is more valuable than ever in times of limited government funding. Volunteers can expand the array of services offered when paid staff time is committed to other projects. Volunteers are also excellent ambassadors for natural areas in the communities in which they live, and are often more trusted than government officials.

*Strategies*:

Promote participation in and growth of a Friends group via newsletters and the media.

Develop a list of activities that could be accomplished by volunteers and/or a Friends group. Some activities could include conducting wildlife surveys and monitoring activities, maintaining nest boxes, helping with bird banding and research, maintaining trails, serving as trail ambassadors, maintaining a station website, leading birdwatching tours/walks, helping assemble newsletters and mailings, digitizing paper files, and writing news articles.

Objective 3.5: Promote wildlife and nature observation, and environmental education and interpretation.

*Rationale*: "Nature drive" was the second most participated-in activity (behind hunting), reported by 33 (77%) people who filled out questionnaires during Scoping; bird watching and nature observation were reported by 19 (44%) and 11 (26%) people, respectively. However, very few people reported this as the most important activity to them. Hayes Lake State Park, Red Lake WMA, and Beltrami Island State Forest are promoted as birdwatching sites on the Pine-to-Prairie Birding Trail; Brown's Lake is posted as a Watchable Wildlife site; and Lake of the Woods County promotes a Wilderness Drive, a Bog Drive, a Blueberry Picker's Drive, a Fall Color Drive, and a Homesteader's Drive in the LUP planning area.

Currently, staff at Norris Camp host two to four environmental education programs at Norris Camp as part of their outreach programs to local schools and groups. Additional environmental education opportunities exist, but are limited by staff availability.

*Strategies*:

Increase activity of a Friends group that can take an active role in promoting, developing, and carrying out environmental education activities.

Invite public to participate in bird banding at a MAPS station.

Have Red Lake WMA staff or a Friends group maintain and highlight the Norris Camp webpage.

Have a Friends group post weekly bird observation sightings/opportunities online and at kiosks.

Continue to support the Pine-to-Prairie Birding Trail.

Have a Friends group develop an auto interpretative brochure that dovetails with Lake of the Woods County's promoted nature driving routes.

Consider aesthetic design for timber harvests along roads on LUP lands.

Objective 3.6: Continue to manage former homestead sites as wildlife openings, but take an adaptive approach and allow some sites (primarily remote sites) to grow over via succession.

*Rationale*: Many comments were received during Scoping attesting to the importance of early homestead openings for wildlife benefits, for hunting opportunities, and as part of family histories. However, other National Wildlife Refuge System units have taken the position that small openings have limited wildlife benefit and are reforesting them. Upland grasslands account for 2500 acres (3.3% of the LUP area), thus are not limited to only homestead sites. Accessible homesteads do provide hunting opportunities and are valued by descendents of pioneer families, and most will be maintained in an open condition. Accessible homestead sites are marked with signs erected by volunteer history enthusiasts.

*Strategies*:

Maintain most accessible homesteads in an open condition through periodic mowing and burning.

Allow non-invasive exotic landscape plants (e.g., lilacs, lilies, chives, grapes, roses, plums, horse radish) to remain as part of the historical connection.

Have a Friends group or local historical society develop an interpretive sign on homesteading for placement at Norris Camp.

Objective 3.7: Help reduce downstream flooding by not allowing further drainage of peatlands and wetlands, reducing unnaturally high runoff rates wherever feasible through strategic ditch plug placement and culvert downsizing, and allowing existing ditches in peatlands (and elsewhere) to disappear through natural sloughing, filling, bog expansion and beaver activity.

*Rationale*: The Roseau and Warroad River watersheds periodically experience major flooding of communities, agricultural fields, and roads. Human alteration of the natural landscape (or "land use") is cited by Anderson and Kean (2004) as one of four major causes of flooding in the Red River Basin; the other three are geology, topography, and weather, which we cannot control. The potential for flood damage is related to the amount, type, and location of human development in the watershed (Anderson and Kean 2004, p. 2). In both these watersheds, the most extensive alterations in the natural landscape, and the areas most affected by flooding, occur downstream of LUP lands. Nonetheless, failure to retain natural hydrology and runoff rates from the upper watershed can exacerbate problems downstream. Historic efforts to ditch and drain the vast peatlands in the LUP planning area are the main alterations to the natural hydrology in the headwaters of both watersheds. Although the ditches have not been maintained for several decades, and most are thought to be ineffective in draining the peatlands due to natural plugging, there could be some contributions to runoff from some ditches.

Anderson and Kean (2004) stress "the importance of using multiple types of FDR measures in a strategic manner to achieve local, watershed, and main stem flood damage reduction." They also state, "There are many alternative measures that can be implemented to reduce flood damages. These include structural measures such as levees, channel modifications, and various types of floodwater impoundments, as well as nonstructural measures such as limiting floodplain development, changing floodplain use, and changing upstream land use to reduce runoff volumes and rates," and, "A basin-wide coordinated approach may utilize a variety of FDR and related NRE measures that, collectively, comprise a basin-wide FDR framework. This variety of measures may include small, dispersed measures, such as wetland restorations, watershed-wide culvert sizing, increased perennial vegetation and agricultural best management practices, as well as local protection/avoidance, increased conyeyance capacity, and strategically located larger impoundments."

In addition to the State plugging drainage ditches (following the formal ditch abandonment process) to retain water in the upper watershed, the U.S. Fish and Wildlife Service will review on a case-by-case basis flood damage reduction projects proposed by watershed districts, and determine if each project has mutual benefits to

fish and wildlife habitat as well as flood damage reduction. If proposed flood damage reduction projects are found to have mutual benefits to fish and wildlife habitat, and these benefits outweigh the negative effects, the project will be allowed to move forward. The U.S. Fish and Wildlife Service and the Beltrami Island Fund will not assume any operation and maintenance costs for structures (i.e., dikes, water control structures, etc.) associated with these projects.

Culvert downsizing has the potential to temporarily store rainfall and reduce runoff to the magnitude of 20-50% depending on retention times, rainfall storm-event (intensity), drainage area considered, and soil texture (Solstad et al. 2007). Coarse textured soils have naturally lower runoff rates and so it would be of little consequence to control those flows more than what is indicated by the recommended culvert sizing methodology. Culvert sizing provides relatively short-term storage. It is most effective in reducing main stem flooding if implemented in middle and late contributing areas of the basin (Anderson and Kean 2004). There are two general approaches to implementation of culvert sizing, the subwatershed approach and the incremental approach. The subwatershed approach is to resize all bridges and culverts within a subwatershed at the same time; this has the least risk and therefore greatest potential benefit. The incremental approach is to resize culverts one at a time as they are in need of replacement; this can back water up at downstream culverts if upstream culverts have not already been replaced.

*Strategies*:

Offer to partner with watershed districts to assess runoff contributions of abandoned ditches in the Roseau River watershed upstream from Hayes Lake and in the Warroad River watershed.

Continue to allow existing ditches in peatlands (and elsewhere) to disappear through natural sloughing, filling, bog expansion and beaver activity.

Strategically plug contributing ditches after following the formal ditch abandonment process. DNR will reserve the right to claim wetland restoration mitigation credits on state lands where plugs on LUP land restore offsite wetland conditions.

Review flood damage reduction projects proposed by watershed districts. Proposals should initially be submitted to the U.S. Fish and Wildlife Service. The Service will then assemble an interagency team to review benefits to flood control objectives and the mutual benefits and impacts to fish and wildlife habitat. The Service, with input from the DNR, will approve or deny projects based on Service policies and National Environmental Policy Act processes. Those projects that receive initial Service approval will then proceed through the Project Review and Permitting Process contained in the Red River Basin Flood Damage Reduction Work Group's 1998 Mediation Agreement, including state and federal environmental review. Project proposals that meet that approval may then need to obtain a Letter of Intent or a Flowage Easement from the Service, or there may need to be a land exchange.

Review DNR culvert location database in WHEELS and implement a strategic culvert downsizing project in partnership with the Roseau and Warroad River Watershed Districts.

Assure that seasonally-appropriate searches are conducted for the caddisfly *Oxyetheria itascae* where impoundments are proposed.

Objective 3.8: Help reduce downstream flooding by increasing conifer cover and stand age, and increasing width of riparian management areas in the Warroad and Roseau River watersheds in order to retain hydrology longer within the LUP area.

*Rationale*: The Roseau and Warroad River watersheds periodically experience major flooding of communities, agricultural fields, and roads. In a review of all flood causes in the Roseau and Warroad River watersheds that we can influence with this plan, we identified forest management practices on LUP lands in the upper watershed that can help alleviate problems downstream. Specifically, it is known that 1) conifers help retain water on the landscape more effectively than do deciduous trees (Ohmann et al. 1978), 2) older forests help retain water on the landscape more effectively than do younger forests (Ohmann et al. 1978), 3) older trees store more water in both their trunks and canopies per unit mass than do younger trees (Saatchi and Moghaddam 2000), and 4) wider riparian buffer strips help retain water on the landscape more effectively than narrower riparian buffer strips. However, aspen contain more water per unit mass in their trunks (but not necessarily their canopies) than do jack pine or black spruce (Saatchi and Moghaddam 2000). Anderson and Kean (2004) acknowledge the benefits of changing upstream landuse to reduce runoff; they state that perennial grasslands reduce runoff by 50% over cropfields, and that forest cover reduces runoff rates by another 5%. Because conditions are relatively natural in the project area, there are far fewer options for reducing runoff than there are for developed portions of the watershed farther downstream. But it is clear from Anderson and Kean (2004) and Solstad (1998) that land use cover conversions and wetland restorations are among the most effective mechanisms for reducing runoff rates and retaining water close to where it falls. Because the planning area is essentially entirely vegetated, our options for modifying vegetative cover include altering the deciduous-coniferous composition and age class distribution on the landscape. We believe this best meets the flood damage reduction principle of the 1998 Mediation Agreement (i.e., “water should be stored/managed as close to where it falls as is feasible and practical”) by managing it exactly where it falls.

Strategies:

Increase conifer cover and stand age wherever possible on LUP lands, unless it is more practicable to retain or implement this condition on nearby State land (e.g., avoid the unintended consequence of having to balance out conditions on State land in order to meet SFRMP prescriptions due to changes on LUP lands).

Increase width of riparian management zones on LUP land.

Implement findings from the report of the Riparian Science Technical Committee to the Minnesota Forest Resources Council (2007) on the science behind riparian management issues.

Objective 3.9. Maintain Norris Camp historical buildings, assistant manager's residence, Winner Silo and Penturen Church; and provide protection to cemeteries, other burials, and a representative suite of homestead sites.

*Rationale*: Many of the buildings at Norris Camp date from the Civilian Conservation Corps era and are included as contributing elements for the listing of Norris Camp on the National Register of Historic Places. The 2009 Lease Amendment requires "The State … shall maintain said property … in good condition and repair, making all repairs and replacements necessitated by deterioration, damage, use, negligence or any other cause whatsoever, provided, however, that the State shall be obligated to make repairs and replacements caused by defects in the original design, material or construction, or caused by the violent forces of nature only to the extent of such income and revenue received from the use of said property as is available. Historic buildings shall be maintained in a manner to preserve the characteristics that make them significant and in accordance with the comprehensive cultural resources management plan… "

The Winner Silo and the Penturen Church are the only known remaining structures of the pioneer homesteading era prior to the establishment of the LUP program (Magner and Emerson 2008) other than ditches, depressions, and cemeteries. These two structures are maintained by the Beltrami Island Forest Historical Restoration Society with oversight from the DNR and U.S. Fish and Wildlife Service. The Red Lake WMA assistant manager's residence is a former Forestry station, and has qualifying features that make it eligible for listing on the National Register of Historic Places.

Magner and Emerson (2008) identified the potential for the entire LUP planning area to be designated a National Historic Landscape under the auspices of the National Register of Historic Places, however, they did not identify a clear mechanism for moving forward with such an evaluation or nomination other than initiating consultation with the State Historic Preservation Officer (SHPO) concerning the possibility that the area meets the definition of a historic landscape.

Identified threats to homestead sites and unknown artifacts include using homestead openings as timber landings, and utilizing old beach ridges as borrow sites (Magner and Emerson 2008).

*Strategies:*

Implement the 2008 *Management Plan for Cultural Resources on the Land Utilization Project Parcels …* (Magner and Emerson 2008).

Seek funds other than "Beltrami Island Project, LA-MN-3" funds to maintain the historic buildings at Norris Camp "in a manner to preserve the characteristics that make them significant."

Partner with and work with the Beltrami Island Forest Historical Restoration Society to maintain the Winner Silo and Penturen Church, and to interpret the history of these structures for the visiting public. Complete an inventory and assessment of the ownership of items in the Penturen Church.

Avoid allowing timber landings to be placed in homestead openings. Ensure that LUP parcels are appropriately flagged in FORIST (Forestry Information System) databases.

Consult with the Minnesota Historical Society's Outreach Conservator on how best to preserve CCC/Resettlement Administration-era artifacts housed at Norris Camp.

Consult with SHPO to evaluate the potential for designating the LUP planning area a Historical National Landmark, and if found eligible, encourage the nomination process move forward.

Objective 3.10. Increase public awareness of the existence of LUP lands, and how LUP lands differ from adjoining state lands. Establish a Citizen's Input Panel to share information and improve communications related to the implementation of the plan.

*Rationale*: During Scoping in 2011, 76.3% of questionnaire respondents indicated they were aware of the existence of LUP lands; 55.5% indicated they were "somewhat familiar" or "very familiar" with the different allowed public uses and legal restrictions between LUP and state lands; and 54% were "somewhat familiar" or "very familiar" with different forest and land management practices between LUP and state lands. We believe that in order for the public to appreciate, protect, and engage in the management of a resource, they have to be aware of the existence and value of that resource.

During review of the draft CCMP, several comments were received requesting greater citizen input into the administration of LUP lands. While the level of input some commentors requested would likely be a violation of the Federal Advisory Committee Act, the DNR, with U.S. Fish and Wildlife Service concurrence, agreed to establish an advisory Citizen's Input Panel which will meet periodically, e.g., once or twice a year. The purpose of the Citizen's Input Panel will be to "improve communication related to implementation of the plan" and it would consist of invited members of several diverse interest groups. Topics covered may include water retention issues, public use and access issues, broad vegetation management issues (goals), wildlife research projects, wildlife monitoring opportunities, volunteer opportunities, interpretive signs, public programs, historic preservation issues, and land exchange updates. Day to day wildlife and habitat management decisions, however, will not be delayed for the sake of receiving public input.

*Strategies*:

Publicize LUP management activities in newsletters and on a station website, and post interpretative signs at strategic locations while avoiding adding too many signs in the forest.

Remind Local Government Unit officials, general public and other stakeholders about the differences between federal LUP and state land management whenever possible.

Create a Citizen's Input Panel that will meet once or twice a year.

**Goal 4: Land Consolidation**

Protect pristine habitats that contain the rarest and most unique significant natural resources to ensure a sustainable functioning landscape for wildlife and humans through targeted land exchanges and acquisitions. Ensure that all land transactions (exchanges and acquisitions) comply with DNR Land Asset Management processes and do not result in a reduction of public recreational access or trail miles.

Objective 4.1: Exchange LUP lands in Hayes Lake State Park for state lands outside of the Park.

*Rationale*: Hayes Lake State Park is managed primarily for recreation, as well as natural resource protection. From the perspective of the U.S. Fish and Wildlife Service, this may not always be analogous to being managed "as a refuge and breeding ground for native birds and other wildlife and for research relating to wildlife and associated forest resources." One of the most problematic issues is the continued use of a snowmobile trail over a formally listed Native American burial ground. Also, Hayes Lake is an impoundment that serves primarily as a recreational fishery and swimming area, and is experiencing some shoreline erosion on LUP lands. An argument could be made that Hayes Lake supports perhaps the only pair of nesting common loons in Roseau County, and thus contributes to biodiversity, however, that benefit would remain if a land exchange with the State occurs. Most LUP lands in the Park are located in remote corners of the Park and managed as native plant communities. Red pine plantations in the park are being thinned to create plant diversity.

*Strategies*:

Discuss land exchange options with U.S. Fish and Wildlife Service, Division of Forestry, Division of Parks and Recreation, Division of Fish and Wildlife, and Division of Lands and Minerals. Consider utilizing this land exchange towards accomplishing the goal of creating the Bemis Swamp SNA as outlined in *Land Asset Pilot Project in Roseau County*. Also consider consolidating LUP land in unused natural area of the state park.

Assess value of LUP lands in Hayes Lake State Park.

Assess value of State lands in Bemis Swamp area.

Complete a federal Environmental Assessment if necessary.

If these trades do not occur by 2020, stabilize eroding shoreline of Hayes Lake and restrict visitor use of that shoreline until it is revegetated, and thin and restore pine plantations to a natural condition.

Objective 4.2: Consolidate LUP lands in ecologically sensitive areas (old growth forests, mature pine forests, peatlands, ecologically-important lowland conifers, orchid concentration areas, spring fens) via land exchanges with the State or Red Lake Band.

*Rationale*: Because old growth forests, peatlands, mature pine forests, orchid concentration areas, and spring fens are ecologically sensitive areas, their continued preservation best correlates with lands "reserved as a refuge and breeding ground for native birds and other wildlife and for research relating to wildlife and associated forest resources." In exchange for State forest lands that support these resources, LUP lands that are suitable as sustainable working forests could be traded to the State to enhance

seamless management and efficiency. It is important to note that neither the U.S. Fish and Wildlife Service nor the DNR desires that all ecologically sensitive resources be consolidated into a single ownership.

*Strategies*:

The Division of Fish and Wildlife and the Division of Forestry, by2015, will identify parcels that are suitable for land exchanges that meet the objective. Additional parcels can be identified later. Consult the Northwest Region's Natural Resources Plan (1995) for opportunities to attain compatible Desired Future Conditions.

Discussions will then be initiated with the U.S. Fish and Wildlife Service and the DNR Division of Lands and Minerals by 2016.

Assess values of LUP and State parcels being considered for exchange by 2020. Values of additional parcels can be assessed later.

Complete a federal Environmental Assessment if necessary.

Objective 4.3: Consolidate LUP lands on the north shore of Upper Red Lake into a contiguous unit via land exchanges with the State.

*Rationale*: The LUP lands on the north shore of Upper Red Lake form a mini-cluster of parcels quite separated from the majority of LUP parcels. The individual parcels in this cluster are generally not contiguous, but interspersed with State lands, and even in this mini-cluster of LUP parcels two 40-acre parcels are quite separated from the rest. Consolidation of these parcels would provide for a contiguous unit of LUP lands, and allow for greater efficiency by managing State lands as a contiguous unit also. The LUP lands would encompass an area of old-growth yellow birch forest, and provide for uniform management of the forest.

*Strategies*:

Assess values of LUP lands in T.155N., R.31W. (Red Lake Twp.) north of Shoreline Drive; in T.155N., R.32W. (Birch Island Twp.), and in T.156N., R.33W.

Assess values of State lands in T.155N., R.31W. (Red Lake Twp.) south of Shoreline Drive.

Trade 160-acre LUP parcel in Sec. 32, T.156N., R.33W.; 40-acre LUP parcel in Sec. 25, T.155N., R.32W.; 40-acre LUP parcel in Sec. 27, T.155N., R.32W.; 49.25-acre LUP parcel in Sec. 32, T.155N., R.32W.; and a ca. 20-acre LUP parcel in Sec. 34, T.155N., R.32W. for State parcels south of Shoreline Drive in T.155N., R.31W (Red Lake Twp.).

Trade 160-acre LUP parcel in NE1/4 Sec. 19, 160-acre LUP parcel in NE1/4 Sec. 23, and 80-acre LUP parcel in NE1/4 Sec. 24, all in T.155N., R.31W (Red Lake Twp.) for State parcels south of Shoreline Drive in T.155N., R.31W (Red Lake Twp.).

Objective 4.4: Consolidate LUP lands in the headwaters of the Rapid River via land exchanges with the State or Red Lake Band, and manage area to retain its wilderness characteristics and values.

*Rationale*: There are two contiguous clusters of LUP parcels in the headwaters area of the Rapid River off of the Spina Road in the Red Lake WMA that appears to meet the criteria for wilderness designation. The size of this area could be augmented by 1) trading two 160-acre State parcels (one in SE1/4 Sec. 21 and one in SE1/4 of Sec. 23, both in T.158N, R.34W) for LUP lands elsewhere, which would provide a connection to the two clusters of LUP lands, and 2) trading LUP land along the Stony Corners Road for adjacent Red Lake Tribal lands.

*Strategies*:

Assess values of two State parcels in SE1/4 Sec. 21 and SE1/4 of Sec. 23, T.158N, R.34W.

Locate corresponding LUP parcels the State would like to acquire, and assess their value.

Begin discussions with the Red Lake Band of Chippewa Indians on possibility of land exchanges.

Follow DNR Land Asset Managaement processes on land exchanges.

Objective 4.5: Consider consolidating State ownership of SNA's through land exchanges of LUP land within peatland SNA's.

*Rationale*: LUP lands that are embedded within SNA's are managed as SNA's. Likewise, an entire LUP parcel can be designated an SNA, as in the case of the Gustafson Camp SNA. Consolidating State ownership within existing SNA's can allow for uniform management without sacrificing the level of land protection, while at the same time allowing for the beneficial expansion of LUP lands elsewhere. Conversely, LUP lands could be consolidated in key locations where they could serve as the core of a new SNA (e.g., Bemis Swamp), and once the SNA is established, the LUP lands could be traded out or retained. Or, funds generated from the sale of timber on LUP lands could be used to purchase private inholdings in existing SNA's (e.g., the Red Lake Peatland SNA) more expeditiously than State acquisition processes, and later traded to the State or retained.

*Strategies*:

Use funds generated from the sale of timber on LUP lands to purchase private inholdings in existing SNA's.

Consider trading LUP lands in Hayes Lake State Park for Forestry lands in the Bemis Swamp area to create the Bemis Swamp SNA as outlined in the *Land Asset Pilot Project in Roseau County* (Minnesota DNR 2010).

Consider exchanging LUP inholdings in existing SNA's (excluding Gustafson's Camp SNA), especially isolated inholdings or inholdings that block contiguous State ownership (e.g., the mid-section of Winter Road Lake Peatland SNA), for State lands elsewhere, if the benefits merit the effort and expense.

**Goal 5: Fiscal Management of LUP Lands**

Assure that there are sufficient funds in the Beltrami Island Fund to adequately manage LUP lands as well as provide the funds needed to inventory, monitor, and study resources necessary to carry out the other goals and objectives of this plan such as acquiring or exchanging priority lands and managing cultural resources.

Objective 5.1. Prioritize expenditures of revenue generated from timber sales and the sale of other products from the land as necessary to manage, inventory, study, and research natural and cultural resources, in order to carry out the objectives under Goals 1-4 of this plan.

*Rationale:* There is currently no federal appropriation of funds to manage LUP lands. LUP lands are managed with income from timber sales that are let for the purpose of wildlife habitat management, not for the purpose of timber sales unto themselves. The funds are in an account identified as "Beltrami Island Project, LA-MN-3" or commonly referred to as BELT funds or BELT account. Receipts of income are required to be identified by tract to the quarter-section, but there is no similar requirement to record debits to the same level. This CCMP identifies inventory, monitoring and research needs necessary for evaluating the effectiveness of the plan. In addition, there are legitimate costs to Forestry, Wildlife and other Divisions for managing LUP lands, including setting up and monitoring timber sales and carrying out other habitat management actions. Also, the 2009 Lease Amendment requires historical buildings and other cultural resources be maintained for their historical value and significance.

The DNR developed an Administrative Procedure[169] on January 3, 2012, to create and implement oversight procedures based on Minnesota Statutes 89.0385 which mandates the DNR to certify forest management costs on state-managed lands. DNR and FWS officials met on January 30, 2012 to review the Statute and Administrative Procedures. As a result, DNR and FWS agreed that part of the Statute did not apply, and funds are not automatically authorized to be transferred from the Beltrami Island fund, but a reimbursement for certified costs may be transferred to the Division of Forestry with annual revenues that remain in the BELT account after base operating costs of the Section of Wildlife are met.

*Strategies:*

The State of Minnesota and the U.S. Fish and Wildlife Service will convene an annual meeting to review 1) a proposed annual work plan (and budget) developed by the DNR for the upcoming state fiscal year, and 2) expenditures from the "Beltrami Island Project, LA-MN-3" account to assure that there are sufficient revenues to carry out the Goals and Objectives of this CCMP. The annual work plans are due to be approved by Division Directors by May 1. The meeting will be arranged by the Division of Fish and Wildlife via the Red Lake WMA Area Wildlife Supervisor and include representatives from the DNR Division of Forestry and U.S. Fish and Wildlife Service (Agassiz NWR). This meeting will be convened prior to the Commissioner certifying total costs incurred for forest management, forest improvement, and road improvement on state managed

[169] Forest Management Cost Certification on Non-Forestry Administered Land Units Procedure.

lands during the fiscal year. Proposed deviations from the budget will be submitted to the Agassiz NWR for concurrence.

Division of Forestry staff will track eligible costs incurred on LUP lands (eligible debits to the account) by tract to the quarter-section; and WMA and Agassiz NWR staff will advocate that this level of detail be required in the next Lease Amendment. Section of Wildlife will also keep detailed records of expenditures eligible to be debited from the account. Forestry will submit invoices quarterly to the Section of Wildlife and the U.S. Fish and Wildlife Service.

Annual operating expenses for the Red Lake WMA will be paid from the account first. These operating expenses include LUP land research and monitoring projects, utilities, supplies, repairs, communications, staff development, and staff salaries for time spent on work related to LUP land. Certified costs for the Division of Forestry to implement the approved annual work plan up to the annual timber revenue into the account will be paid second. Remaining balances in the fund will be available for costs associated with accomplishing LUP land exchanges, or for land acquisition by the U.S. Fish and Wildlife Service upon request (as third priority).

In the event timber sales do not generate enough revenue to carry out the Goals and Objectives of this CCMP), additional funds will be sought to supplement management of LUP lands until such time as sufficient revenues may be generated from timber sales. These additional funds could come from:

a) reducing other operating costs;
b) a federal appropriation of funds as requested by the U.S. Fish and Wildlife Service;
c) state funds from the Game and Fish Account, the Lessard-Sams Outdoor Heritage Fund, the general fund, or some other state funding source; or
d) other grant funding from a federal, state, or private source.

While Division of Forestry staff will administer timber sales, Wildlife staff will assist Forestry by marking out as many LUP timber sales as possible and will also monitor sales for compliance with sale regulations and communicate with the Forester administering the sale about any deviations observed.

The Section of Wildlife will consider selling rights to harvest some brushlands for biomass fuels for additional revenue. Wildlife staff will also consider seeking an LCCMR or similar grant to accomplish a timber management plan that accommodates a variable range of outcomes under an adaptive management scenario.

# Chapter 5: Plan Implementation

This draft CCMP outlines an ambitious course of action for the future management of LUP lands. Success of the plan relies on cooperation of several Divisions within the DNR with complementary, but sometimes competing, missions, and on prudent management of limited fiscal and human resources.

## Priority and Secondary Projects

The following provides a brief description of the highest priority projects for managing LUP lands.

1.1 Wildlife staff will coordinate with the Division of Forestry on: a) reviewing annual timber harvest and salvage logging plans across the entire LUP planning area (i.e., implementing the existing SFRMP); b) setting annual timber harvest objectives on LUP land; c) updating the existing SFRMP (scheduled for 2013), and d) to develop a method for completing marten habitat assessments near proposed timber sales. This task is critical for increasing the amount of conifers and older forests on the landscape and effectively distributing diverse habitat across the landscape, as well as for structuring the specific criteria of individual stand treatments for retention of coarse woody debris, snags, and leave trees on LUP land. It is also critical for balancing the competing habitat needs for early and late successional forest dependent wildlife and for creating a forest resilient to climate change. Leads on this for Wildlife will be the Area Managers at Red Lake WMA and Baudette, and designated support staff. Forestry will provide representatives from all three area offices.

1.2 Forestry staff will update the Forest Inventory Module (FIM) annually. Wildlife staff will review FIM data to monitor changes in forest cover on the landscape.

1.3 Forestry staff will initiate revisions to the Agassiz Lowlands SFRMP and include Section of Wildlife staff, among others, in the revision process. Desired future conditions of LUP lands, including retaining forest ages beyond normal rotation ages, will be considered in the decision making process for new or revised SFRMP goals and objectives.

1.4 Division of Forestry staff will administer timber sales, and Wildlife staff will assist Forestry by marking out as many LUP timber sales as possible and will also monitor sales for compliance with sale regulations and communicate with the Forester administering the sale about any deviations observed. Forestry staff will assist the Section of Wildlife in the technical design of non-harvest stand treatments when requested to do so, as staff availability permits.

1.5 Wildlife, Forestry, and Ecological and Water Resources staff will work cooperatively to identify Special Management Zones around old-growth forest stands, Old Forest Management Complexes, and High Conservation Value Forests on LUP land. Leads for Wildlife will be the Area Managers at Red Lake WMA and Baudette.

1.6 Wildlife staff will plan and implement prescribed burns for pinelands and wetlands, and shearing and mowing in brushlands and sedge meadows on LUP lands in order to maintain fire dependent communities and set back succession in rare or disappearing communities.

Wildlife staff will solicit assistance from other burn crews, including from the DNR, U.S. Fish and Wildlife Service, U.S. Forest Service, The Nature Conservancy and National Audubon Society to assist with larger and more frequent prescribed burns. Leads for Wildlife will be the Area Managers at Red Lake WMA and Baudette.

1.7 Wildlife staff will continue to conduct ongoing wildlife research, surveys and monitoring efforts, and will solicit projects from universities and colleges to carry out other research projects that will assist in managing wildlife and their habitats, and in creating a resilient forest capable of adapting to climate change. A ruffed grouse drumming count survey that occurs primarily on LUP lands will be evaluated annually for comparing and informing management activities on state and LUP lands. Leads for Wildlife will be the Area Managers at Red Lake WMA and Baudette. Wildlife staff will make the bunkhouses at Norris Camp available for visiting researchers and volunteer assistants.

1.8 DNR staff will work with the Roseau River Watershed District and other watershed districts to identify and implement wetland and riparian restoration opportunities, and to evaluate potential water retention projects on the ground. Lead for Wildlife will be the Area Wildlife Managers.

1.9 Wildlife staff will work to enhance volunteer opportunities for, and commitment from, a Friends of Norris Camp non-profit organization to enhance public use and awareness of LUP lands, to maintain and enhance the Norris Camp website, to develop and provide environmental education and interpretative programs, and to monitor and survey wildlife populations and habitat conditions. Wildlife staff will also advertise volunteer opportunities through established DNR volunteer-recruitment programs. Lead for Wildlife will be the Red Lake WMA Manager.

1.10 Wildlife staff will enhance hunter walking trails, post maps of hunter walking trails on the DNR and Norris Camp websites, and create user satisfaction/success surveys to help improve management of habitat for grouse where hunter walking trails exist. Lead for Wildlife will be the Red Lake WMA Manager and technician.

1.11 Wildlife staff will continue the transition of moving the Norris campground out of a future old-growth pine forest and into a satellite campground. Wildlife staff will GPS camp sites and outhouse locations and complete a sketch map of the existing Norris Campground before closing it, for historic reference. Lead for Wildlife will be the Red Lake WMA Manager and technician.

1.12 Wildlife staff will assemble fiscal data on annual revenue and expenditures, and host an annual oversight meeting with the U.S. Fish and Wildlife Service, prior to the Commissioner certifying debits to the Beltrami Island Project-LA-MN-3 account. Forestry staff will document expenditures against the Beltrami Island Project-LA-MN-3 account and identify the expenditures to specific 40-acre parcels on a quarterly basis. Lead for Wildlife will be the Red Lake WMA Manager.

1.13 The Northwest Regional Management Team will commission the Area Team or assemble a working group or groups to identify desireable parcels, including active gravel pits, for land exchanges, with U.S. Fish and Wildlife Service input on the team.

1.14 Wildlife, Forestry and U.S. Fish and Wildlife Service staff will develop a plan for exchanging red pine plantations on LUP lands for State lands. The plan will include a list of criteria for selecting red pine stands for trade, a list of LUP stands for exchange, a list of State lands for exchange, and target dates for accomplishing the exchanges. Lead for Wildlife will be the Red Lake WMA and Baudette Area Wildlife Managers. Oversight will be provided by the Northwest Regional Management Team. DNR and USFWS staff will jointly develop a method for determining how to equitably pay for costs associated with land exchanges that are mutually beneficial to multiple Divisions and agencies.

1.15 DNR will create an internal working group of Forestry, Wildlife, and SNA program staff to identify ecological areas of concern in the Bemis Swamp area that the Division of Forestry would be willing to exchange. Lead for Wildlife will be the Red Lake WMA and Baudette Area Wildlife Managers. Oversight will be provided by the Northwest Regional Management Team.

1.16 Wildlife staff will initiate conversations with Division of Parks and Trails, Forestry, Lands and Minerals, and Waters and Ecological Resources to exchange LUP lands in Hayes Lake State Park for state lands elsewhere, targeting first Forestry lands in the Bemis Swamp area. Lead for Wildlife will be the Red Lake WMA and Baudette Area Wildlife Managers, with oversight and assistance from the U.S. Fish and Wildlife Service and the Northwest Regional Management Team.

1.17 Wildlife staff will initiate conversations with Lands and Minerals and Forestry staff to consolidate LUP lands on the north shore of Upper Red Lake into a more-or-less contiguous unit for the management of an old-growth yellow birch community. Proposed land exchanges will be reviewed and approved by the DNR's Area Team and Regional Management Team, and the U.S. Fish and Wildlife Service. Wildlife staff will also evaluate the potential for creating a grassland management area in the vicinity, as this feasibility study will inform land exchange options. Lead for Wildlife will be the Baudette Area Wildlife and Red Lake WMA Managers, with oversight and assistance from the U.S. Fish and Wildlife Service and the Northwest Regional Management Team.

1.18 The U.S. Fish and Wildlife Service and the DNR Regional Management Team will initiate a three-way conversation with the Red Lake Band of Ojibwe regarding potential land exchanges in the Rapid River headwater area and Stoney Corners Forest Road.

1.19 Wildlife staff will consider modeling ecosystem services (e.g., ecosystem structuring) provided by wolves in the LUP planning area, or work with a university wildlife program to accomplish the objective.

1.20 Wildlife, Forestry, and Ecological and Waters Resources staff will work with local NRCS (Natural Resources Conservation Service), Minnesota Extension Services, Roseau River Watershed District, Minnesota Board of Water and Soil Resources, and/or Red Lake Band of

Ojibwe to identify local soil moisture monitoring projects that would be suitable to inform decision making on LUP lands, or develop and implement a soil moisture monitoring program on LUP lands such as installing an NRCS Soil Climate Analysis Network (SCAN) station. See Appendix M in draft CCMP.

1.21 Wildlife, Forestry, and Ecological and Waters Resources staff will identify thresholds for when to switch from passive forest management to active forest management when stands are failing to regenerate as desired.

1.22 The Charter for a Citizen's Input Panel will be developed by the Section of Wildlife and reviewed by the DNR Regional Management Team. This Charter will then be approved by the DNR Commissioner.

The following provides a brief description of secondary priority projects for managing LUP lands.

2.1 Wildlife and Forestry staff will cooperatively develop and implement Best Management Practices for operating, closing, and reclaiming gravel pits, including gating and posting entrances. Lead for Wildlife will be the Assistant Area Wildlife Managers.

2.2 Wildlife staff will coordinate with the Red Lake Band DNR to consider a cooperative wolf management zone if and when necessary, and a joint wilderness-value protection plan for the headwaters of the Rapid River watershed.

2.3 Wildlife staff will bring OHV trespass and trail condition issues on LUP land to the DNR's OHV Monitoring and Enforcement Coordination Team to identify appropriate responses, such as trail reroutes, temporary closures, or permanent closusres.

2.4 Wildlife staff will work with the Division of Parks and Trails and the DNR Sign Committee to modify or design information signs on why some trails on LUP land are closed to motorized vehicles, and modify signs accordingly at the trail heads.

2.5 Wildlife staff will compile material for Integrated Pest Management, and maintain a file on facilities that mass rear biological control agents, especially native biological control species, and sterile insects.

2.6 Wildlife staff will solicit volunteers to operate a MAPS (Monitoring Avian Productivity and Survival) bird banding station on LUP land, preferably in a location where LUP lands are clustered and predominate (e.g., Hansen Creek area, Bankton Road area).

2.7 Wildlife staff will compile avian data from a variety of sources (Breeding Bird Survey, Breeding Bird Atlas, Christmas Bird Count, prior studies) and synthesize it into a report or publication.

2.8 DNR Wildlife staff and U.S. Fish and Wildlife Service staff will continue to work together to identify and initiate actions on other land acquisition and exchange opportunities. DNR Wildlife staff will ensure that land exchanges comply with DNR Land Asset Management

processes. DNR Wildlife staff will assure that fee title acquisitions undergo internal DNR interdisciplinary and Regional Management Team review, but the overall transaction will follow U.S. Fish and Wildlife Service acquisition processes

2.9 Wildlife staff will initiate conversations with Parks and Trails and Section of Fisheries staff to address erosion issues on Hayes Lake if LUP lands have not been exchanged out of Hayes Lake State Park by 2020.

2.10 Wildlife staff will extend a request to the Minnesota Historical Society for a Conservator to visit the Norris Camp CCC buildings and original artifacts for advice on how to best preserve the artifacts. Willdife staff will apply for grants for restoring the exterior and cleaning up the interior of the CCC buildings and artifacts, and for displaying the items for occasional public tours of the camp.

# Partnership Opportunities

There are numerous potential partnering organization for conducting resource management and research on LUP lands. Potential partnering organizations for managing resources include, but are not limited to, the Red Lake Band of Ojibwe, The Nature Conservancy, Roseau River Watershed District, U.S. Forest Service, Friends of Norris Camp, and Beltrami Island Forest Historical Restoration Society.

Potential partnering organizations for researching, monitoring, and inventorying resources include, but are not limited to, the University of Minnesota - Crookston, University of Minnesota – Twin Cities campuses, Natural Resources Research Institute, Bemidji State University, Moorhead State University, Central Lakes College, University of Wisconsin, University of North Dakota, North Dakota State University, South Dakota State University, Friends of Norris Camp, and Audubon Minnesota.

# Step-Down Management Plans

The U.S. Fish and Wildlife Service utilizes step-down management plans on National Wildlife Refuge System lands they administer. The Minnesota DNR has not been in the habit of doing this per se, however, the DNR does prepare individual burn plans and we have prepared a cultural resources management plan for LUP lands. The Department will continue to prepare individual burn plans and we propose to develop best management practices for operating, closing, and restoring gravel pits. Typical hunting, fishing, trapping, and law enforcement management plans are developed at the state level and implemented regionally or locally. Wildlife research and inventory plans, specific habitat management plans, and visitor services plans have merit and will be considered if there is value and as staff time allows.

# Monitoring and Evaluation

The direction set forth in this CCMP and specifically identified goals, objectives, and strategies will be monitored annually at the fiscal oversight meeting.

# Plan Review and Revision

The CCMP for LUP lands is meant to provide guidance to LUP land managers for a minimum of the next 15 years,[170] yet establish a longer-range vision for at least the next 50 years. The CCMP is also a dynamic and adaptive document and several of the strategies contained in this plan are subject to influences of natural events, including climate change, advances in science, new threats, new technologies, and changing federal and state governmental laws and policies. Likewise, the ability to fully accomplish the goals and objectives of the plan are dependent upon adequate revenue and staffing. Because of all of these factors, the recommendations in the CCMP will be reviewed periodically and if necessary revised to meet new circumstances.

Members of the public may make recommendations for revisions to the Red Lake Area Wildlife Manager for consideration. Modifications that the Area Wildlife Manager deems reasonable will be submitted to the DNR's Northwest Region Management Team and to Agassiz NWR for concurrence, modification, or denial. If both the DNR's Northwest Region Management Team and Agassiz NWR agree to the proposed modifications, they will be written up and appended to the CCMP, interested parties will be notified, and the changes will be announced in the Norris Camp Newsletter and/or on the DNR website. Petitions to modify the plan based on generic opposition to elements of the plan are not appropriate reasons for plan revisions.

[170] It would be ideal to time the next revision of the LUP CCMP to run concurrent with revisions of other plans such as the SFRMP, Hayes Lake State Park management plan, Red Lake WMA management plan, and SNA management plans. There would be greater cross-discipline coordination and alignment of objectives, and potentially staff efficiencies, if these plans could be timed to be updated concurrently circa the year 2025.

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Inset: Male Wilson's phalarope defending brood, Brown's Slough, 2012. Photo by Beth Siverhus.

# Appendix A

## Finding of No Significant Impact Environmental Assessment and Comprehensive Conservation Management Plan (CCMP) for the Beltrami Island Land Utilization Project, Minnesota

An Environmental Assessment (EA) has been prepared to identify management strategies to meet the conservation goals of the Beltrami Island Land Utilization Project. The EA examined the environmental consequences that each management alternative could have on the quality of the physical, biological, and human environment, as required by the National Environmental Policy Act of 1969. The EA presented and evaluated three alternatives for managing fish, wildlife and plant habitats, and human services in the project area over the course of the next 15 or more years.

The EA identifies three possible alternatives primarily centered on wildlife and habitat management. The alternatives are A) Current Management Direction, B) Manage the Landscape, and C) Manage by Species. The main differences between the alternatives are that under Current Management Direction there are no unifying goals and objectives or timeframes for the different plans under which the lands are currently being managed; under Manage the Landscape there is a vision for integrating existing plans and accommodating natural resource voids in existing plans; and under Manage by Species greater effort would be placed on managing habitat on a parcel by parcel basis with less consideration for integrating management between parcels.

The alternative selected for implementation is Alternative B, Manage the Landscape. The strategies presented in the CCMP were developed in conjunction with the selection of this alternative. Because the CCMP incorporates and unifies existing management plans, and prioritizes and establishes timelines for completion of actions in these existing management plans, we believe it enhances management directions already underway. In addition, because the CCMP will not have an adverse impact on state or federal threatened or endangered species and will not alter current human use of the area, we have determined that the action of adopting Alternative B is not a major federal action which would significantly affect the quality of the human environment, within the meaning of Section 102(2)(c) of the National Envrionmental Policy Act of 1969.

/s/Thomas O. Melius_____ 3/29/2013
U.S. Fish and Wildlife Serivce Regional Director Date

/s/Lori Dowling-Hanson_____ 3/12/2013
Minnesota Department of Natural Resources Northwest Regional Director Date

# Appendix B
# Leadership Team and Staff

Assembled September 2010

Project Manager

Gretchen Mehmel, Area Wildlife Manger, Red Lake WMA, Minnesota DNR

Leadership Team

Lori Dowling, Regional Director, DNR Northwest Region, Bemidji

Gretchen Mehmel, Area Wildlife Manager, Red Lake WMA, Minnesota DNR

Margaret Anderson, Refuge Manager, Agassiz NWR, U.S. Fish and Wildlife Service (until retiring Dec. 2011)

Mike Carroll, as Regional Director, Northwest Region; later as Assistant Commissioner of Operations, Minnesota DNR

Paul Telander, Regional Wildlife Manager, Minnesota DNR, Bemidji

Dana Carlson, Area Forestry Supervisor, Minnesota DNR, Warroad

Peter Buesseler, Regional Waters and Ecological Resources Manager, Minnesota DNR, Bemidji

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# Appendix C

# Birds of the Beltrami Island Area

Table C-1. Breeding birds of the Beltrami Island Land Utilization Project area. Codes: A=abundant, C=common, U=uncommon, R=rare or occasional, X=present, T=present in treatment (human altered) habitat only, pr=permanent resident, br=breeder, pb=probable breeder, v=visitor. Species marked by an asterisk (*) are identified by the DNR as Species in Greatest Conservation Need. Species marked by (#) are USFWS Region 3 Conservation Priority Species.

| Species | Status: Red Lake WMA[171] | Status: Hayes Lake SP[172] | Status: Winter Rd SNA[173] | Birds/ha at Red Lake Peatland[174] | Singing males/ 100 acres[175] | Percent decline[176] |
|---|---|---|---|---|---|---|
| Common Loon*# | U v | R pb | | | | |
| Pied-billed Grebe | A br | C | | | | |
| American Bittern*# | C br | R | X | 0.20, hs[177] | | |
| Great Blue Heron | C br | C v | X | | | |
| Green Heron | | U pb | | | | |
| Trumpeter Swan*# | | | X | | | |
| Canada Goose | C br | C | X | | | |
| Wood Duck # | A br | C | | | | |
| Green-winged Teal | C br | | | | | |
| Mallard # | A br | C | | 0.12, os | | |
| Blue-winged Teal # | C br | C | | | | |
| Northern Shoveler | C br | | | | | |
| American Wigeon | U br | | | | | |
| Ring-necked Duck | A br | U | | | | |
| Lesser Scaup # | R br | | | | | |
| Common Goldeneye | C br | C | | | | |
| Hooded Merganser | C br | U | | | | |
| Turkey Vulture | U br | U | | | | |
| Bald Eagle*# | U br | U | | | | |
| Northern Harrier*# | C br | C | | 0.06, cs | | |
| Sharp-shinned Hawk | U br | U | | | | |
| Cooper's Hawk | R br | U | | | | |
| Northern Goshawk*# | U pr | R | | | | |
| Broad-winged Hawk | C br | C | | | | |

[171] From Red Lake WMA bird checklist, unless noted otherwise.
[172] From Hayes Lake State Park bird checklist.
[173] From Winter Road Lake Peatland Scientific and Natural Area Management Plan.
[174] Maximum density in control plot listed by Niemi and Hanowski (1984) derived by dividing their pairs/10 ha by 5.
[175] From Red Lake WMA Master Plan, 1980-1989; 1 singing male/100 acres = 0.05 birds/ha.
[176] Based on BBS survey route data, from Partners in Flight Tri-National Vision for Landbird Conservation (2004).
[177] Habitat: hs=high shrub, ls=low shrub, os=open spruce, cs=closed spruce, sf=sedge fen.

| Species | Status: Red Lake WMA | Status: Hayes Lake SP | Status: Winter Rd SNA | Birds/ha at Red Lake Peatland | Singing males/ 100 acres | Percent decline |
|---|---|---|---|---|---|---|
| Red-tailed Hawk | C br | C | | | | |
| American Kestrel | C br | C | | | | |
| Merlin | R br | U | | | | |
| Spruce Grouse* | C pr | U | | | 2.11, ss[178] | |
| Ruffed Grouse | A pr | C | | | | 72% |
| Sharp-tailed Grouse* | C pr | U | X | | 4.71, muskeg | |
| Yellow Rail*# | R pb | | X | 0.16, hs | | |
| Virginia Rail* | R pb | | | | | |
| Sora | U br | U | | | | |
| American Coot | A br | C | | | | |
| Sandhill Crane | C br | C | X | | | |
| Killdeer | C br | C | | | | |
| Spotted Sandpiper | U pb | C pb | | | | |
| Wilson's Phalarope[179]*# | R br | U v | | | | |
| Wilson's (Common) Snipe | C br | C | X | 0.16, hs | | |
| American Woodcock*# | C br | U | | | | |
| Black Tern*# | U br | U | | | | |
| Mourning Dove | C br | C | | | | |
| Black-billed Cuckoo*# | U br | U | | | | 53% |
| Eastern Screech Owl | R pr | R | | | | |
| Great Horned Owl | C pr | U | | | | |
| Northern Hawk Owl | R pr | | | | | |
| Barred Owl | C pr | U | | | | |
| Great Gray Owl | U pr | R | | | | |
| Long-eared Owl # | R pr | | | | | |
| Short-eared Owl *# | U pr | U | X | | | 71% |
| Boreal Owl* | R pr | | | | | |
| Northern Saw-whet Owl | C pr | U | | | | |
| Common Nighthawk* | C br | U | | | | 51% |
| Whip-poor-will*# | C br | U | | | | 58% |
| Chimney Swift | U br | | | | | 54% |
| Ruby-throat. Hummingbird | C br | C | | | | |
| Belted Kingfisher | C br | C | | | | 53% |
| Red-headed Woodpecker*# | R br | U | | | | 67% |
| Yellow-bellied Sapsucker* | C br | C | | | | |
| Red-bellied Woodpecker | R pr | | | | | |
| Downy Woodpecker | C pr | C | | | | |
| Hairy Woodpecker | C pr | C | | | | |
| Three-toed Woodpecker | R pr | R | | | | |
| Black-backed Woodpecker* | U pr | R | | | | |

[178] Habitat: ss=spruce swamp.

[179] Known only from Red Lake peatland area in WMA, Mulligan Lake Peatland SNA, and Brown's Slough. Sources: Natural Heritage Database, Minnesota Breeding Bird Atlas database.

| Species | Status: Red Lake WMA | Status: Hayes Lake SP | Status: Winter Rd SNA | Birds/ha at Red Lake Peatland | Singing males/ 100 acres | Percent decline |
|---|---|---|---|---|---|---|
| Northern Flicker # | C br | C | | | | 52% |
| Pileated Woodpecker | C pr | U | | | | |
| Olive-sided Flycatcher*# | U br | U | | | 0.28, ss | |
| Yellow-bellied Flycatcher | C br | U | | 0.30, cs | 4.34, ss | |
| Eastern Wood Pewee* | C br | C | | | | |
| Alder Flycatcher | A br | U | X | 0.52, hs | | |
| Least Flycatcher* | A br | C | | | | |
| Eastern Phoebe | U br | C | | | | |
| Great Crested Flycatcher | C br | C | | | | |
| Eastern Kingbird | C br | C | | 0.26, os | | |
| Horned Lark | | U pb[180] | | | | 56% |
| Purple Martin | | U pb | | | | |
| Bank Swallow | | C pb | | | | 56% |
| Rough-winged Swallow | | C pb | | | | |
| Tree Swallow | A br | C | | T | 0.86, muskeg | |
| Cliff Swallow | U br | C | | | | |
| Barn Swallow | C br | C | | | | |
| Yellow-throated Vireo | R[181] pb | U pb | | | | |
| Blue-headed Vireo | U br | U | | | 0.05, ss | |
| Red-eyed Vireo | A br | C | X | | | |
| Warbling Vireo | R pb | C pb | | | | |
| Gray Jay | C pr | U | | 0.12, cs | 3.17, ss | |
| Blue Jay | C pr | C | | 0.02, cs | 0.19, ss | |
| Black-billed Magpie | U pr | U | | | | |
| American Crow | C pr | C | | | | |
| Common Raven | U pr | U | | | 0.82, ss | |
| Black-capped Chickadee | A pr | C | | 0.06, hs | | |
| Boreal Chickadee* | C pr | | | 0.04, cs | | >50% |
| Red-breasted Nuthatch | C pr | C | | | | |
| White-breasted Nuthatch | C pr | C | | | | |
| Brown Creeper | U br | U | | | | |
| House Wren | U br | C | | | | |
| Winter Wren* | U br | U | | | | |
| Sedge Wren # | A br | C | X | 4.48, hs<br>3.92, ls<br>1.82, sf | | |
| Marsh Wren | C br | U | | | | |
| Golden-crowned Kinglet | C br | C | | .08, cs | | |
| Ruby-crowned Kinglet | U br | C | | | | |
| Eastern Bluebird | U br | C | | | | |
| Veery* | A br | C | X | T | | |

[180] Horned lark is also a very rare migrant in the Beltrami Island State Forest (M. North, pers. obs.).
[181] From Red Lake WMA Master Plan, 1980-1989.

| Species | Status: Red Lake WMA | Status: Hayes Lake SP | Status: Winter Rd SNA | Birds/ha at Red Lake Peatland | Singing males/ 100 acres | Percent decline |
|---|---|---|---|---|---|---|
| Swainson's Thrush | U br | | | | | |
| Hermit Thrush | C br | C | X | 0.32, cs | 2.06, ss | |
| Wood Thrush*# | R br | | | | | |
| American Robin | C br | C | | | 0.19, ss | |
| Gray Catbird | C br | C | | | | |
| Brown Thrasher* | C br | U | | | | |
| Cedar Waxwing | C br | C | X | | 0.58, ss | |
| European Starling | U br | U | | | | |
| Golden-winged Warbler*# | U br | R | | | | |
| Tennessee Warbler | R br | | | | | |
| Nashville Warbler | A br | C | | 0.96, cs | 4.96, ss | |
| Northern Parula | U br | R | | | | |
| Yellow Warbler | C br | C | X | 0.46, hs | | |
| Chestnut-sided Warbler | C br | C | | | | |
| Magnolia Warbler | U br | R | | | | |
| Cape May Warbler* | R br | | | | | |
| Yellow-rumped Warbler | C br | C | | 0.62, cs | 1.80, ss | |
| Black-throated Green Warbler | C br | | | | | |
| Blackburnian Warbler | C br | U | | | 0.38, ss | |
| Pine Warbler | R br | U | | | | |
| Palm Warbler | C br | | | 1.00, cs | 3.90, muskeg<br>3.33, ss | |
| Bay-breasted Warbler* | R br | R | | | | |
| Black-and-white Warbler | C br | C | | T | | |
| American Redstart | C br | C | | | | |
| Ovenbird* | A br | C | | | | |
| Northern Waterthrush | R br | | | | | |
| Connecticut Warbler*# | A br | U | | 0.84, cs | 1.44, ss | 70% |
| Mourning Warbler | U br | U | | | | |
| Common Yellowthroat | A br | C | X | 2.94, hs<br>1.54, ls | | |
| Canada Warbler # | C br | U | | | | |
| Scarlet Tanager | U br | U | | | | |
| Rose-breasted Grosbeak* | C br | C | X | T | | |
| Indigo Bunting | U br | U | | | | |
| Rufous-sided Towhee | U br | U | | | | |
| Chipping Sparrow | C br | C | | 0.12, cs | 4.91, ss | |
| Clay-colored Sparrow | A br | C | X | 0.94, ls<br>0.34, hs<br>0.26, os | | |
| Vesper Sparrow | | C | | | | |
| Savannah Sparrow | A br | C | | 2.20, os | 11.11, muskeg | |

| Species | Status: Red Lake WMA | Status: Hayes Lake SP | Status: Winter Rd SNA | Birds/ha at Red Lake Peatland | Singing males/ 100 acres | Percent decline |
|---|---|---|---|---|---|---|
| Grasshopper Sparrow | | U pb | | | | 78% |
| LeConte's Sparrow*# | U br | U | X | 4.04,sf<br>2.34, ls<br>1.80, hs | | |
| Nelson's Sharp-tailed Sparrow*# | R br | | | | | |
| Song Sparrow | C br | C | | T | | |
| Lincoln's Sparrow | C br | | | 1.00, os | 4.14, muskeg | |
| Swamp Sparrow* | C br | U | X | 3.00, hs<br>1.20, ls | | |
| White-throated Sparrow* | A br | C | X | 0.04, cs | | |
| Dark-eyed Junco | C pr | | | 0.26, cs | 6.27, ss | |
| Bobolink*# | C br | C | X | 1.06, sf<br>0.86, ls<br>0.74, hs | | 52% |
| Red-winged Blackbird | A br | C | X | | | |
| Western Meadowlark # | C br | C | | | | |
| Yellow-headed Blackbird | U br | U | | | | |
| Rusty Blackbird* | C br | | | | | 84% |
| Brewer's Blackbird | A br | U | | T | 0.19, muskeg | |
| Common Grackle | U br | C | | | | |
| Brown-headed Cowbird | C br | C | | 0.16, hs | 0.19, muskeg<br>0.14, ss | |
| Northern Oriole | U br | C | | | | |
| Purple Finch | C pr | U | | | | |
| Red Crossbill | U pr | | | | | |
| White-winged Crossbill | U pr | | | | | |
| Pine Siskin | C pr | U | | | | 71% |
| American Goldfinch | C pr | C | | | | |
| Evening Grosbeak | C pr | U | | | | |
| House Sparrow | U br | U | | | | |

Table C-2. Spring and fall migrant, and non-nesting summer visitor bird species occurring in the Beltrami Island Land Utilization Project area. Codes: A=abundant, C=common, U=uncommon, R=rare or occassional. Sources: Red Lake WMA and Hayes Lake State Park bird checklists.

| | Red Lake WMA | | | Hayes Lake State Park | | |
|---|---|---|---|---|---|---|
| Species | spring | summer | fall | spring | summer | fall |
| Eared Grebe | R | R | R | U | | U |
| Horned Grebe | | | | U | | U |
| Red-necked Grebe*[182] | | | | U | U | U |
| Western Grebe | R | R | R | | | |
| American White Pelican | U | C | U | R | R | R |
| Double-crested Cormorant | U | C | U | C | C | C |
| Great Egret | | | | U | R | R |
| Black-crowned Night-Heron | | | | U | U | U |
| Tundra Swan | R | | R | U | | U |
| Greater White-fronted Goose | R | | R | | | |
| Snow Goose | C | | C | U | | U |
| American Black Duck | R | R | R | U | U | U |
| Northern Pintail | U | U | U | | | |
| Gadwall | C | R | C | U | | U |
| Canvasback | U | | U | | | |
| Redhead | U | | U | U | | U |
| Greater Scaup | U | | U | | | |
| White-winged Scoter | R | | R | | | |
| Bufflehead | C | U | C | U | | U |
| Common Merganser* | U | R | | U | U | U |
| Red-breasted Merganser | | | | U | | |
| Ruddy Duck | R | | R | | | |
| Rough-legged Hawk | C | | C | | | |
| Golden Eagle | R | | R | R | | R |
| Osprey | U | | U | U | U | U |
| Peregrine Falcon | R | R | U | R | | R |
| Gray Partridge | R | R | R | | | |
| Black-bellied Plover | | | | U | | U |
| American Golden Plover | | | | U | | U |
| Greater Yellowlegs | | | | U | | U |
| Lesser Yellowlegs | | | | U | U | U |
| Solitary Sandpiper* | U | | U | U | U | U |
| Upland Sandpiper | R | R | R | | | |
| Marbled Godwit[183] | | | | U | U | |
| Ruddy Turnstone | | | | R | | R |
| Semipalmated Sandpiper | | | | U | | U |
| Least Sandpiper | | | | U | U | U |

[182] Species marked by an asterisk (*) potentially breed in the area.
[183] Breeds within 2 miles of BISF.

| | Red Lake WMA | | | Hayes Lake State Park | | |
|---|---|---|---|---|---|---|
| Species | spring | summer | fall | spring | summer | fall |
| Baird's Sandpiper | | | | R | | R |
| Pectoral Sandpiper | | | | U | U | U |
| Red-necked Phalarope | | | | R | | R |
| Ring-billed Gull | U | | U | C | C | C |
| Herring Gull | | | | U | | U |
| Franklin's Gull | R | | R | U | U | U |
| Common Tern | | | | R | | R |
| Forster's Tern | | | | R | R | |
| Northern Shrike | U | | U | | | |
| Loggerhead Shrike | | | | R | R | R |
| Philadelphia Vireo* | U | | U | U | | U |
| Gray-cheeked Thrush | U | | U | U | | U |
| Orange-crowned Warbler | R | | R | U | | U |
| Black-throated Blue Warbler* | R | R | R | | | |
| Blackpoll Warbler | R | | R | | | |
| Wilson's Warbler* | A | U | A | | | |
| American Tree Sparrow | C | R | C | C | | C |
| Vesper Sparrow* | U | | U | C | C | C |
| Grasshopper Sparrow* | U | U | U | U | U | |
| Fox Sparrow | C | | C | U | | U |
| White-crowned Sparrow | C | | C | U | | U |
| Harris's Sparrow | C | | C | U | | U |
| Lapland Longspur | U | | U | U | | U |
| Snow Bunting | C | | C | U | | C |
| Common Redpoll | C | | C | U | | C |

Table C-3. Winter resident bird species occurring in the Beltrami Island Land Utilization Project area, including results from 26 Christmas Bird Counts conducted in a 7.5 mile radius centered near Spina FR.

| Species | Status: Red Lake WMA | Red Lake Christmas Bird Counts[184] | | Status: Hayes Lake State Park |
|---|---|---|---|---|
| | | % Occurrence | Average Number | |
| Ruffed Grouse | C | 76.9 | 4.0 | C |
| Spruce Grouse | C | 46.2 | 2.2 | U |
| Sharp-tailed Grouse | C | 7.7 | 0.1 | U |
| Bald Eagle | U | 23.1 | 0.3 | |
| Northern Goshawk | R | 38.5 | 0.5 | R |
| Rough-legged Hawk | | 11.5 | 0.3 | R |
| Golden Eagle | | 3.8 | 0.04 | R |
| Eastern Screech Owl | R | | | R |
| Great Horned Owl | C | 3.8 | 0.04 | U |
| Snowy Owl | R | | | R |

[184] CBC data supplied by Martin Kehoe, circle compiler. Other data from Red Lake WMA and Hayes Lake State Park bird checklists.

| Species | Status: Red Lake WMA | Red Lake Christmas Bird Counts | | Status: Hayes Lake State Park |
|---|---|---|---|---|
| | | % Occurrence | Average Number | |
| Northern Hawk Owl | R | 26.9 | 0.3 | R |
| Barred Owl | C | 15.4 | 0.35 | U |
| Great Gray Owl | U | 19.2 | 0.5 | R |
| Long-eared Owl | R | | | |
| Short-eared Owl | R | | | |
| Boreal Owl | R | 3.8 | 0.04 | |
| Northern Saw-whet Owl | C | 11.5 | 0.3 | |
| Downy Woodpecker | C | 69.2 | 2.4 | C |
| Hairy Woodpecker | C | 96.2 | 5.3 | C |
| Three-toed Woodpecker | R | 34.6 | 0.6 | R |
| Black-backed Woodpecker | U | 73.1 | 1.85 | R |
| Pileated Woodpecker | C | 69.2 | 1.9 | U |
| Northern Shrike | U | 23.1 | 0.2 | U |
| Gray Jay | C | 84.6 | 11.8 | U |
| Blue Jay | C | 73.1 | 3.6 | C |
| Black-billed Magpie | C | 38.5 | 0.7 | C |
| American Crow | U | 7.7 | 0.3 | U |
| Common Raven | C | 100.0 | 37.4 | U |
| Horned Lark | | | | R |
| Black-capped Chickadee | A | 100.0 | 53.2 | C |
| Boreal Chickadee | C | 65.4 | 4.3 | |
| Red-breasted Nuthatch | C | 84.6 | 23.6 | C |
| White-breasted Nuthatch | C | 46.2 | 0.9 | C |
| Brown Creeper | | 30.8 | 0.65 | R |
| Golden-crowned Kinglet | | 3.8 | 0.1 | |
| Bohemian Waxwing | | | | R |
| Cedar Waxwing | | | | R |
| European Starling | U | | | U |
| American Tree Sparrow | | | | R |
| Harris's Sparrow | U | | | |
| Dark-eyed Junco | U | | | R |
| Lapland Longspur | | | | R |
| Snow Bunting | U | 11.5 | 0.2 | U |
| Pine Grosbeak | C | 88.5 | 29.0 | U |
| Purple Finch | C | 3.8 | 0.35 | R |
| Red Crossbill | U | 76.9 | 15.4 | R |
| White-winged Crossbill | U | 46.2 | 18.8 | R |
| Common Redpoll | C | 84.6 | 97.2 | U |
| Hoary Redpoll | U | 11.5 | 0.2 | |
| Pine Siskin | A | 30.8 | 13.0 | C |
| American Goldfinch | C | 15.4 | 1.1 | U |
| Evening Grosbeak | C | | | U |
| House Sparrow | | | | U |

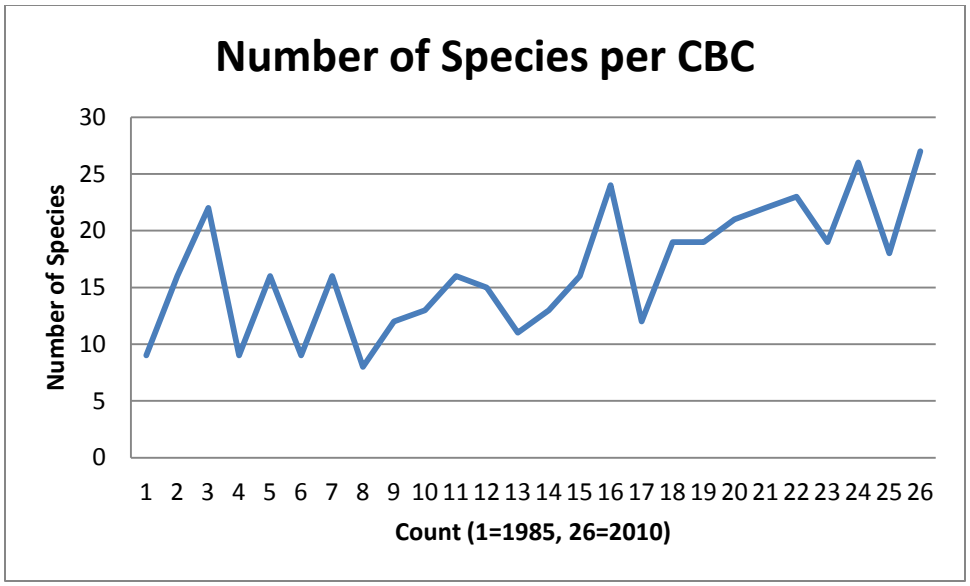


Figure C-1. Relationship over time for the number of species detected on Christmas Bird Counts held at the Red Lake WMA and Beltrami Island State Forest. Statistical data give a line estimate equation of y=15.37128+(0.468718)x, where 15.37128 is the y-intercept. What this indicates is that the number of species detected on the CBC is increasing at a rate of 0.47 species/year, or by about 1 species every two years. The correlation coefficient for the equation is .658783.

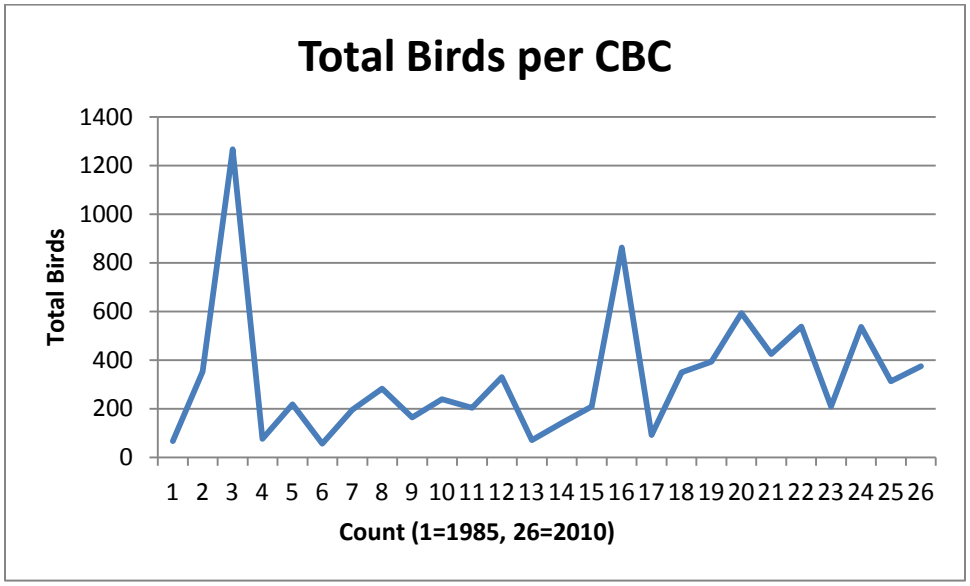


Figure C-2. Relationship over time for the total number of birds detected on Christmas Bird Counts held at the Red Lake WMA and Beltrami Island State Forest. Statistical data give a line estimate equation of y=259.7754+(5.122)x, where 259.7754 is the y-intercept. What this indicates is that the number of birds detected on the CBC is increasing at a rate of about 5 birds/year, even taking into account the fact that there was an invasion of a large number of common redpolls in 1987. The correlation coefficient for the equation is .145439.

Table C-4. Breeding Bird Survey route data for Red Lake WMA/Beltrami Island Area (BBS route 50-080, Red Lake), 1993-2010 (n=16 surveys).

| Species | % of surveys detected on (n=16) | Mean abundance per survey |
|---|---|---|
| Canada Goose | 6 | 0.06 |
| Mallard | 38 | 0.44 |
| Blue-winged Teal | 12 | 0.19 |
| Hooded Merganser | 6 | 0.06 |
| Common Merganser | 6 | 0.06 |
| Ruffed Grouse | 25 | 0.44 |
| American White Pelican | 6 | 0.19 |
| American Bittern | 6 | 0.06 |
| Great Blue Heron | 31 | 0.44 |
| Turkey Vulture | 12 | 0.19 |
| Northern Harrier | 6 | 0.06 |
| Cooper's Hawk | 6 | 0.19 |
| Accipiter sp. | 12 | 0.12 |
| Broad-winged Hawk | 31 | 0.50 |
| Sora | 12 | 0.12 |
| Sandhill Crane | 38 | 0.81 |
| Solitary Sandpiper | 6 | 0.12 |
| Wilson's (Common) Snipe | 94 | 7.88 |
| American Woodcock | 6 | 0.06 |
| Mourning Dove | 6 | 0.19 |
| Black-billed Cuckoo | 50 | 2.0 |
| Yellow-billed Cuckoo | 6 | 0.12 |
| Great Horned Owl | 6 | 0.06 |
| Barred Owl | 12 | 0.12 |
| Great Gray Owl | 6 | 0.06 |
| Long-eared Owl | 6 | 0.12 |
| Common Nighthawk | 6 | 0.06 |
| Whip-poor-will | 25 | 0.25 |
| Ruby-throated Hummingbird | 12 | 0.12 |
| Belted Kingfisher | 6 | 0.12 |
| Yellow-bellied Sapsucker | 81 | 2.56 |
| Downy Woodpecker | 31 | 0.44 |
| Hairy Woodpecker | 56 | 0.69 |
| Unidentified woodpecker | 44 | 1.88 |
| Northern Flicker | 81 | 2.06 |
| Pileated Woodpecker | 50 | 1.12 |
| Olive-sided Flycatcher | 75 | 2.12 |
| Eastern Wood Pewee | 100 | 4.81 |
| Yellow-bellied Flycatcher | 12 | 0.12 |
| Alder Flycatcher | 100 | 11.56 |
| Willow Flycatcher | 12 | 0.12 |
| Least Flycatcher | 100 | 17.81 |

| Species | % of surveys detected on (n=16) | Mean abundance per survey |
|---|---|---|
| Eastern Phoebe | 38 | 0.44 |
| Great Crested Flycatcher | 94 | 4.19 |
| Eastern Kingbird | 19 | 0.25 |
| Yellow-throated Vireo | 19 | 0.25 |
| Blue-headed Vireo | 56 | 0.69 |
| Warbling Vireo | 19 | 0.69 |
| Red-eyed Vireo | 100 | 66.31 |
| Gray Jay | 62 | 2.00 |
| Blue Jay | 100 | 9.44 |
| American Crow | 62 | 1.19 |
| Common Raven | 56 | 1.75 |
| Tree Swallow | 50 | 1.12 |
| Barn Swallow | 6 | 0.12 |
| Black-capped Chickadee | 94 | 4.62 |
| Boreal Chickadee | 6 | 0.06 |
| Red-breasted Nuthatch | 81 | 2.38 |
| White-breasted Nuthatch | 38 | 0.38 |
| Brown Creeper | 31 | 0.69 |
| House Wren | 44 | 0.62 |
| Winter Wren | 100 | 8.31 |
| Sedge Wren | 69 | 2.94 |
| Marsh Wren | 19 | 0.25 |
| Golden-crowned Kinglet | 69 | 2.69 |
| Ruby-crowned Kinglet | 81 | 1.19 |
| Eastern Bluebird | 6 | 0.06 |
| Veery | 100 | 22.62 |
| Swainson's Thrush | 19 | 0.38 |
| Hermit Thrush | 100 | 17.06 |
| Wood Thrush | 56 | 1.38 |
| American Robin | 100 | 12.56 |
| Gray Catbird | 56 | 0.94 |
| Cedar Waxwing | 94 | 6.00 |
| Golden-winged Warbler | 81 | 1.69 |
| Tennessee Warbler | 50 | 0.94 |
| Nashville Warbler | 100 | 45.00 |
| Northern Parula | 25 | 0.38 |
| Yellow Warbler | 75 | 3.19 |
| Chestnut-sided Warbler | 100 | 22.44 |
| Magnolia Warbler | 44 | 0.81 |
| Cape May Warbler | 25 | 0.44 |
| Yellow-rumped Warbler | 94 | 5.38 |
| Black-throated Green Warbler | 94 | 3.50 |
| Blackburnian Warbler | 69 | 1.12 |
| Pine Warbler | 6 | 0.12 |
| Palm Warbler | 38 | 0.50 |

| Species | % of surveys detected on (n=16) | Mean abundance per survey |
|---|---|---|
| Bay-breasted Warbler | 12 | 0.12 |
| Black-and-white Warbler | 100 | 15.06 |
| American Redstart | 94 | 6.12 |
| Ovenbird | 100 | 35.62 |
| Northern Waterthrush | 56 | 1.00 |
| Connecticut Warbler | 88 | 6.12 |
| Mourning Warbler | 100 | 9.38 |
| Common Yellowthroat | 100 | 36.88 |
| Wilson's Warbler | 38 | 0.56 |
| Canada Warbler | 12 | 0.12 |
| Scarlet Tanager | 88 | 2.25 |
| American Tree Sparrow | 6 | 0.06 |
| Chipping Sparrow | 94 | 6.56 |
| Clay-colored Sparrow | 12 | 0.12 |
| Grasshopper Sparrow | 6 | 0.06 |
| LeConte's Sparrow | 6 | 0.06 |
| Song Sparrow | 94 | 9.88 |
| Lincoln's Sparrow | 31 | 0.81 |
| Swamp Sparrow | 100 | 14.19 |
| White-throated Sparrow | 100 | 48.25 |
| Dark-eyed Junco | 31 | 1.06 |
| Rose-breasted Grosbeak | 100 | 10.12 |
| Indigo Bunting | 62 | 1.12 |
| Red-winged Blackbird | 56 | 1.19 |
| Brewer's Blackbird | 6 | 0.06 |
| Common Grackle | 19 | 0.31 |
| Brown-headed Cowbird | 62 | 1.38 |
| Northern Oriole | 38 | 0.38 |
| Pine Grosbeak | 6 | 0.31 |
| Purple Finch | 19 | 0.38 |
| White-winged Crossbill | 12 | 1.31 |
| Pine Siskin | 12 | 0.44 |
| American Goldfinch | 88 | 3.44 |
| Evening Grosbeak | 19 | 0.62 |
| House Sparrow | 6 | 0.06 |

# Appendix D.

## Mammals of the Beltrami Island Land Utilization Project Area

| | | |
|---|---|---|
| Masked Shrew | Beaver | Raccoon |
| Water Shrew | Muskrat | (Pine) Marten |
| Arctic Shrew | Deer Mouse | Fisher |
| Pygmy Shrew | White-footed Mouse | Ermine |
| Short-tailed Shrew | Southern Red-backed Vole | Least Weasel |
| Star-nosed Mole | Meadow Vole | Long-tailed Weasel |
| Little Brown Myotis (bat) | Southern Bog Lemming | Mink |
| Big Brown Bat | Northern Bog Lemming | American Badger |
| Red Bat | Meadow Jumping Mouse | Striped Skunk |
| Hoary Bat | Woodland Jumping Mouse | River Otter |
| Snowshoe Hare | House Mouse* | Wolverine** |
| Eastern Chipmunk | Norway Rat* | Lynx |
| Least Chipmunk | Porcupine | Bobcat |
| Woodchuck | Coyote | White-tailed Deer |
| Thirteen-lined Ground Squirrel | Gray Wolf | Moose |
| Franklin's Ground Squirrel | Red Fox | Caribou** |
| Gray Squirrel | Gray Fox | Elk*** |
| Red Squirrel | Mountain Lion | |
| Northern Flying Squirrel | Black Bear | |

*Introduced **Extirpated ***Extirpated and re-introduced

Inset: Red squirrel. Photo by Michael North.

# Appendix E

## Fishes of the Beltrami Island Land Utilization Project Area

| Species[185] | Upper Red Lake[186] | Hayes Lake[187] | Roseau River[188] | Warroad River | Rapid River | Winter Road Lake River |
|---|---|---|---|---|---|---|
| Mooneye | X | | | | | |
| Goldeye | X | | | | | |
| Northern pike | X | X | X**[189] | X | X | X |
| Quillback | X | | | | | X |
| **Lake whitefish** | X | | | | | |
| White sucker | X | X | X** | X | X | X |
| Silver redhorse | X | | X | | X | |
| Shorthead redhorse | X | | X | X | X | X |
| Golden redhorse | | | X | | X | |
| Carp | | | X | | | |
| Creek chub | X* | | X** | X | X | X |
| **Hornyhead chub** | | | | | X | X |
| Blacknose dace | X* | | X** | X | X | X |
| Northern redbelly dace | | | X** | X | X | X |
| Finescale dace | | | X** | X | X | X |
| **Longnose dace** | | | | | X | X |
| Pearl dace | | | X** | X | X | |
| Central mudminnow | | | X** | X | X | X |
| Common shiner | X* | | X** | X | X | X |
| Golden shiner | X | | | X | | |
| Emerald shiner | X | | | X | | |
| **Blackchin shiner** | X | | | | | |
| Spottail shiner | X | | | | | |
| **Mimic shiner** | X* | | | | | |
| **Blacknose shiner** | | | X** | X | | X |
| Bigmouth shiner | | | | | X | X |
| Sand shiner | | | | X | | |
| Spotfin shiner | | | X | | | |
| Brassy minnow | | | X** | X | X | |
| Fathead minnow | X | | X** | X | X | X |
| Black bullhead | X | X | X** | X | | |

[185] Species that are deemed "Intolerant" to aquatic degradation are indicated in bold. Their presence in a system indicates a healthy watercourse.

[186] From Eddy et al. (1972), Magnuson and Smith (1963), Smith and Krefting (1954), Smith and Pycha (1960), and Van Oosten and Deason (1957). X* means the species only occurs in tributaries to Upper and/or Lower Red Lake.

[187] DNR survey data, in Lake Finder report.

[188] Source for river data is Schmidt (1999) and DNR Area Fisheries Office, Baudette.

[189] X** indicates species found within 1000 feet downstream of Hayes Lake dam, or upstream of Hayes Lake.

| Species | Upper Red Lake | Hayes Lake | Roseau River | Warroad River | Rapid River | Winter Road Lake River |
|---|---|---|---|---|---|---|
| Brown bullhead | X | X | X** | | | X |
| Yellow bullhead | | | | | | X |
| **Stonecat** | | | X | | | |
| Tadpole madtom | | | X | X | | |
| Channel catfish | | | X | | | |
| Trout-perch | X | | X | | X | X |
| Log perch | | | | X | X | X |
| Burbot | X | | X | | | X |
| **Rock bass** | X | | X | X | X | X |
| Pumpkinseed | | X | X** | | | X |
| Bluegill | | X | X** | | | |
| Sunfish sp. | X* | | X** | | | |
| Largemouth bass | | X | X** | | | |
| **Smallmouth bass** | | | | | X | |
| Black crappie | X | X | X** | X | | X |
| Yellow perch | X | X | X** | X | | X |
| Walleye | X | failed introduction | X** | X | X | X |
| Sauger | | | X | | | |
| Johnny darter | X | | X** | X | X | X |
| Blackside darter | X* | | X | | X | X |
| **Iowa darter** | X | | X** | X | X | X |
| River darter | | | X | | | |
| Brook stickleback | X* | | X** | X | X | X |
| **Mottled sculpin** | | | | | | X |
| Freshwater drum | X | | X | | | |
| Silver lamprey | | | | X | X | X |
| Chestnut lamprey | | | X | | | |
| Northern brook lamprey | | | | X | | |
| Lake sturgeon | extirpated | | | | X | |
| Brown trout | introduced | | | | | |
| Rainbow trout | introduced | | | | | |
| Brook trout | introduced | | | | | |

# Appendix F

## Climate Change Adaptation Strategies Under Three Broad Adaptation Options[190]

| Strategy | Resistance | Resilience | Response[191] |
|---|---|---|---|
| Sustain fundamental ecological functions | X | X | X |
| Reduce impact of existing biological stressors | X | X | X |
| Protect forests from severe fire and wind disturbance | X | X | |
| Maintain or create refugia | X | + | + |
| Maintain and enhance species and structural diversity | X | X | |
| Increase ecosystem redundancy across the landscape | | X | X |
| Promote landscape connectivity | | X | X |
| Enhance genetic diversity | | X | X |
| Facilitate community adjustments through species transitions | | | X |
| Plan for and respond to disturbance | | | X |


Inset: Ruffed grouse. Photo by Steve Maxson.

[190] Strategies and headings from Table 2 in Swanston and Janowiak (in press). An "X" indicates strategies appropriate for adaptation options identified by Swanston and Janowiak. Ecologists do not seem unified in which strategies or actions fit under which adaptation options. For example, Millar et al. (2007) include surplus seed banking as a resilience strategy, whereas we would consider it a response or facilitation strategy. Millar et al. (2007) and Galatowitsch et al. (2009) also include refugia as a response or facilitation strategy (indicated by a "+" symbol), whereas we would also include it as a resilience strategy under a landscape perspective; similarly, Galatowitsch et al. (2009) include buffering and enlarging reserves (refugia) as resilience strategies.

[191] Same as *Facilitation*.