Chapter 7

Terrestrial Wildlife Communities

Eaglets
Photograph by: Ron Eckstein, WI DNR

Lake Superior Lakewide Management Plan
2000

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Chapter 7
Terrestrial Wildlife Communities
Lake Superior Lakewide Management Plan

EXECUTIVE SUMMARY

The mission of the Terrestrial Wildlife Community Committee (TWCC) is to support a diverse, healthy, and sustainable native wildlife community in the Lake Superior basin. The work of the TWCC is guided by the following principles:

- Encourage disturbances that are within natural variation.
- Manage land and wildlife populations using practices that mimic natural variation.
- Understand the relationship between wildlife and disturbance.
- Keep wildlife species free of contamination.
- Encourage the use of native species in all remedial projects.
- Prevent and control the spread of undesirable exotic species.
- Educate the public to integrate the values of wildlife in economic development.
- Meet the restoration needs of wildlife communities.

The goals of the TWCC will be met when:

- There is a diverse, healthy, and sustainable native wildlife community in the Lake Superior basin.
- There is a wildlife community-based program to monitor the health of ecosystems in the Lake Superior basin.
- Species at risk/concern (federally threatened and endangered) are recovered.

The current status and health of terrestrial wildlife communities is a reflection of the landscape, its habitat and environmental quality, and human-imposed regulations and actions.

Mammalian populations in the Lake Superior basin have seen greater fluctuations and changes than any other group of terrestrial vertebrates. Many mammalian species, because they have been harvested for food and fur, have seen dramatic changes in community structure and abundance. Some species have become so abundant in certain areas that they are negatively impacting their surrounding environment. Differences in abundance and diversity of species from south to north has led to different management and recovery efforts between Canada and the United States. One of the biggest challenges concerning management of mammals is understanding what mammalian community structure represents a "healthy, sustainable terrestrial wildlife community."

Birds constitute 71 percent of the vertebrate species found in national forests in the lake states. Because the Lake Superior basin is heavily wooded, the composition, size, and structure of forests strongly affects songbird species diversity, abundance, and productivity. Lake Superior forests provide important habitat for migratory songbird populations, some of which may serve

as source populations for other areas. With concerns expressed nationwide over the decline of neotropical migrants, the Lake Superior basin should be a critical region for migratory songbird conservation.

Until 10 to 15 years ago, **amphibians and reptiles** were seldom considered in management and conservation efforts. As a result, historical population data is mostly incidental. Species ranges are often created from museum collections and records. Since scientists worldwide began focusing on declining amphibian populations in the early 1990s, new efforts to monitor populations and to study the effects of anthropogenic influences have given us an increased awareness and concern for amphibian and reptile communities.

About 90 percent of the nearly one million species of animals in the world are terrestrial or aquatic **invertebrates**. Insects are the most diverse group of invertebrates and globally may have the largest collective biomass of all terrestrial animals. Yet, within the Lake Superior basin, little information is available on the status and trends of the insect or terrestrial invertebrate populations.

Green plants form the base for all animal life, but protection of plants has seldom been associated with the protection of terrestrial wildlife. The term 'wildlife' has traditionally been used to refer to animals only. It is evident from the long list of rare and endangered plants in the Lake Superior basin that for every threatened animal there are two or more endangered plants. The importance of plants to the survival and well being of animals must be recognized and factored into the equation of wildlife conservation.

The role of **soil invertebrates, fungi, and microorganisms** in the ecosystem needs to be better understood. Interdependencies of every part of the biotic community, including the decomposers, must be taken into account. Very little information is currently available, and new research must be initiated in this area.

Habitat changes have a significant impact on terrestrial wildlife. Nearly eighty-five percent of the land in the Lake Superior basin is forested. Current forest management practices have resulted in a mosaic of many small stands of widely different age classes. Temporary edges are abundant, and large blocks of unbroken mature mesic forest are rare. Fire as a natural process is rare and is not currently used as a management tool in most areas. Degradation and loss of wetland habitat caused by eutrophication, pollution, scouring, addition of non-native fish, and loss of surrounding upland habitat affects species dependent on wetland habitats. Habitat fragmentation and destruction, compounded by pollution of some of the otherwise suitable habitat, as well as loss of the corridors between suitable areas and loss of plant diversity due to invasion of exotic species, all may have a devastating impact on the viability of wildlife communities.

Environmental quality also plays a significant role in the health of wildlife communities. Environmental contaminants from toxic chemicals that humans introduced into the environment in the mid-1900s nearly eliminated top carnivores such as bald eagles and cormorants. Populations of some of the affected species have recovered well, but these chemicals cause

health problems that include reduced hatching success, eggshell thinning, abnormal adult behavior, deformed embryos and hatched young, biochemical changes, endocrine disruption, and suppressed immune function.

Direct human interference, including harvest and management of selected species, has caused dramatic changes in wildlife communities over the past 150 years. Many mammalian species have been stressed by overharvest. For the species that are of interest to hunters and trappers, management programs have traditionally focused on providing populations for harvest and not on the overall ecosystem. But ecosystem management is now being tested and used by agencies and organizations throughout the basin. This has begun to create a focus on all wildlife species.

To achieve a healthy ecosystem that includes a healthy terrestrial wildlife community, human-caused stresses must be managed. To achieve such management, people who live in and use the Lake Superior basin must understand and value healthy wildlife communities.

National, state, county, and local public land units currently plan management strategies independently, but development of ecologically sound, cost-effective techniques that encourage natural processes on the forest landscape will require partnerships with the forest landowners, including the forest industry.

Actions

The following **strategies** are recommended in order to meet the mission and goals for terrestrial wildlife in the Lake Superior basin:

A. Develop action-oriented regional and watershed-scale management plans. Support the implementation of protection and restoration actions recommended in these plans.

B. Encourage land use planning efforts that are targeted at protecting and restoring wildlife while also maintaining economic viability of local communities.

C. Foster an understanding of the relationship between individual (personal, organizational, and government agency) land use decisions and cumulative effects on ecosystem integrity. Compile Best Management Practices that are conducive to sustainable terrestrial wildlife.

D. Implement actions that consider all ecosystem components in planning and implementation. Demonstrate positive results of basinwide, landscape-scale, intergovernmental planning and collaboration.

E. Support contaminant load reduction efforts, track contaminants within “best bet” wildlife species, and encourage the development of biological indicators for air quality monitoring.

F. Inventory all levels of the biotic community, assess wildlife needs and develop actions for protection, maintenance, and restoration, with priority attention to groups for which little is known (gaps).

G. Inventory extent of exotic, invasive terrestrial wildlife species and implement actions to prevent, remove, or control them in the Lake Superior basin.

H. Develop, test, and implement monitoring protocols, sampling procedures, and data handling for identified high priority "best bet" indicators. Network this monitoring and compile the information long-term and basinwide.

I. Beyond "best bet" indicators, develop an integrated, community-based wildlife program to monitor ecosystem health.

J. Conduct assessments and implement conservation strategies for important terrestrial wildlife species and communities.

K. Evaluate restoration projects and restoration ecology research that addresses terrestrial wildlife in order to link successes to specific restoration features and future needs.

L. Protect, enhance, and restore species of concern such as caribou, moose, colonial waterbirds, boreal owl, northern goshawk, white pine, and hemlock.

M. Encourage the use of native species for all projects requiring vegetation restoration.

N. Identify population issues and implement recovery actions for threatened and endangered species.

The **priority projects** listed in Figure 7-1 were selected to provide a range of opportunity with an emphasis on an ecosystem approach. The projects identified focus on collaborative efforts, non-traditional species, and species for which little is known. Many of these needs have not been well-funded historically, yet they make up significant components of our Lake Superior basin ecosystems.

Figure 7 -1. Action Summary

Project	Lead Agency/Funding Source	Funded	Needs Funding
Watershed Analysis and Restoration	Lake Superior NF's, with partners including MN DNR, MI DNR, WI DNR, GLIFWC, Tribes, etc.		X
Bayfield Peninsula Binational Program Demonstration Project	USFWS, DU, USFS, NPS, GLIFWC, Red Cliff Band of LSC, local governments, private landowners, The Nature Conservancy (TNC), others		X
Upper Peninsula of Michigan Coastal Wetland Project	USFWS, DU, MI DNR, KBIC, BMIC, GLIFWC, TNC, WPBO, Village of L'Anse, Ottawa NF, NRCS, Private Landowners, UPRCD	X	X
Superior Coastal Wetland Initiative	USFWS, Bad River Band of LSC, Red Cliff Band of LSC, WI DNR, TNC, DU, TU, Douglas, Bayfield, Ashland, Iron counties Land Conservation District, NRCS, landowners, GLIFWC, Chequamegon Chapter of the Audubon Society	X	X
Determine the Status and Levels of Toxic Chemicals in Colonial Birds within the Lake Superior basin	NPS, USGS-BRD, MN DNR, WI DNR, MI DNR, USFWS, Pukaskwa National Park, OMNR, CWS, Parks Ontario, EC		X
Determine the Status and Trends of Amphibians within the Lake Superior basin	NPS, USGS-BRD, USFWS, WI DNR, MN DNR, MI DNR, Milwaukee Public Museum, NRRI, OMNR, CWS, USFS		X
Determine the Status and Trends of Breeding Birds within the Lake Superior basin	NPS, USFS, USGS-BRD, USFWS, NRRI, OMNR, CWS		X
Non-vascular Plants, Invertebrates, Fungi, and Micro-organisms Inventory/Analysis	Lake Superior NF's, MN DNR, MI DNR, WI DNR, GLIFWC, Tribes, etc.		X

Figure 7 -1. Action Summary

Project	Lead Agency/Funding Source	Funded	Needs Funding
Invasive Plant Species Inventory and Eradication	Ottawa NF, Northwoods Weed Council (Ottawa NF, Chequamegon Nicolet NF, Hiawatha NF, Apostle Islands NL, TNC, GLIFWC, LCO Tribe, WI DNR)		X
Implement High Priority "Best Bet" Monitoring	All federal, state, and provincial agencies, GLIFWC, Tribes, and First Nations within the LSB.		X
Survey for Ecosystem Approaches to Wildlife Community Monitoring	TWCC, GLIFIWC, USFS, NPS, USGS BRD, NRCS,		X
Conservation Assessments, Strategies, and Implementation for Wildlife Species	Lake Superior NF's, MN DNR, MI DNR, WI DNR, GLIFWC, Tribes		X
White Pine Regeneration	USFS, Gunflint RD, FSL Rhinelander, WI DNR, MN DNR, WPS		X
Native Plant Restoration - Nursery Production	J.W. Toumey Nursery, Ottawa NF, MI DNR, GLIFWC, Tribes		X
Kirtland's Warbler Recovery	USFWS, MI DNR, others	X	

7.0 ABOUT THIS CHAPTER

The Terrestrial Wildlife Communities chapter of the Lake Superior LaMP 2000 consists of several elements. The mission, principles, and goals of the Binational Program for terrestrial wildlife communities are presented in Sections 7.1, 7.2, and 7.3. Section 7.4 describes healthy terrestrial wildlife communities. Section 7.5 summarizes characteristics of the Lake Superior basin as they relate to terrestrial wildlife communities. Section 7.6 provides the status and trends of terrestrial wildlife communities. Sections 7.7, 7.8, and 7.9 describe the most significant needs facing the terrestrial wildlife communities, strategies for meeting the mission and goals for terrestrial wildlife communities, and the next steps toward implementing these strategies.

7.1 MISSION

The mission of the Binational Program for Terrestrial Wildlife Communities is to support a diverse, healthy, and sustainable native wildlife community in the Lake Superior basin. Terrestrial wildlife includes plants, animals, and associated microorganisms.

7.2 PRINCIPLES

Several principles were developed by the Terrestrial Wildlife Community Committee to guide the work of the Binational Program. They are:

- Encourage disturbances that are within natural variation.
- Manage land and wildlife populations using practices that mimic natural variation.
- Understand the relationship between wildlife and disturbance (both anthropogenic and natural).
- Keep wildlife species free of contamination.
- Encourage the use of native species in all remedial projects.
- Prevent and control the spread of undesirable exotic species.
- Educate the public to integrate the values of wildlife in economic development.
- Meet restoration needs of wildlife communities.

7.3 GOALS

The Binational Program for Terrestrial Wildlife Communities is working toward the following goals:

- There is a diverse, healthy, and sustainable native wildlife community in the Lake Superior basin.
- There is a wildlife community-based program to monitor the health of ecosystems in the Lake Superior basin.
- Species at risk/concern (federally threatened and endangered) are recovered.

7.4 HEALTHY TERRESTRIAL WILDLIFE COMMUNITIES

7.4.1 Natural Processes of a Healthy Ecosystem

For an ecosystem to be considered healthy, the following natural processes must function well:

- Natural disturbances are taking place (such as flooding of riparian zones, openings created by wind or fire).
- Native wildlife are producing young and remaining genetically viable.
- Energy is flowing to all trophic levels historically found in the habitat.
- Plant and animal communities have good diversity of native species.
- Populations of plants and animals are fluctuating in natural cycles relative to one another.

7.4.2 Human-Induced Processes

Certain human-caused stresses must be managed to recreate a healthy ecosystem.

- Contaminant levels in plants and animals are sufficiently low, so they do not negatively affect the life cycles of species, nor do they negatively affect human health.
- Exotic species of plants and animals, especially those that are harmful or invasive, are either eliminated, or are reduced to the point that biodiversity of the native community is not impaired. (Non-native species are considered exotic species; invasive species are those that are introduced into an area, and become either the most or one of the most abundant species within a short period of time.)
- Species of concern, especially threatened and endangered species, are recovered and are no longer in jeopardy.
- Human uses of our natural resources, including timber harvest, agriculture, recreation, mineral extraction, fish and wildlife harvest, energy generation and use, and construction of new dwellings, are done in an ecologically sustainable manner.
- Land management practices mimic natural disturbance.
- Forest habitats represent all age classes in blocks of various sizes, including large blocks of mature forest.

7.4.3 Definition of a Healthy Terrestrial Wildlife Community

The Terrestrial Wildlife Community Committee is focusing on one piece of the Lake Superior ecosystem, working concurrently with the other committees of the Lake Superior Binational Program. Together, implementation of each committee's recommendations will improve the health of the ecosystem.

The Terrestrial Wildlife Community Committee recognizes that its piece of the ecosystem (terrestrial wildlife) has processes that must function well to be considered a "diverse, healthy, and sustainable native wildlife community in the Lake Superior basin." These processes include:

- Genetic diversity is maintained at the population and individual level

- All indigenous species are present, or if not present, the habitat exists to rehabilitate or restore extirpated species
- Predator and prey interactions are intact and in balance over the long-term
- Populations fluctuate in natural cycles relative to one another
- Energy flows naturally from one trophic level to another
- No populations are so high (such as white-tailed deer) that they impact other populations in a negative, long-term manner
- Enough healthy young are produced to result in sustainable populations

As with ecosystems, human-caused stresses must be managed to recreate a healthy terrestrial wildlife community. The Terrestrial Wildlife Community Committee also believes that in order for this healthy ecosystem and terrestrial wildlife community to become a reality, people living in and using the Lake Superior basin must understand the value of healthy wildlife communities.

Figure 7-2. Lake Superior Basin

7.5 LAKE SUPERIOR BASIN

7.5.1 Historical

Native American Influence. Native Americans influenced terrestrial wildlife communities through habitat manipulations and harvests. Harvest of beaver and large ungulates could have indirectly affected the forest community through reduction in browsing and lowland flooding (Stearns 1995). The effects, however, were likely localized and minor and have never been quantified (Stearns 1995).

Fur Trade. The first white explorers and settlers were attracted to the Lake Superior basin by the abundance of furbearing animals. A series of forts and settlements were established along the Great Lakes to protect the fur trade (The Nature Conservancy [TNC]1994). Many populations of furbearing mammals were depleted as a result of unregulated fur harvest. Once the stocks were depleted, the fur trade moved west to more productive areas.

Logging. On the U.S. side of the basin, the forests were almost entirely cut-over between the mid-1800s and early 1900s. Early logging concentrated on white pine; individual trees could reach 200 feet in height and produce 6000 board-feet of lumber (TNC 1994). Red pine were harvested to a lesser extent. Early logging practices greatly reduced the seed source for many of the conifer species. In addition, burning of the slash from timber harvest further eliminated reproduction. Hemlock was removed during a later wave of logging when the bark was used for the tanning industry (WI DNR 1995).

After railroads and logging roads were built, hardwoods were harvested by both clearcutting and high-grading (cutting only the most valuable trees). Many hardwood species regenerated, especially sugar maple, beech, basswood, yellow birch, and ash.

Clearing of presettlement forests not only eliminated the forest ecosystem locally and regionally, but it also created other massive problems when cut logs were floated down the closest stream for transport to Lake Superior or other locations. Riparian vegetation was removed, stream banks were trampled, and stream bottoms were scoured or disrupted. The loss of vegetation created erosion of soils and sheet run-off into streams. Water quality was degraded, and fish habitat was often lost (TNC 1994).

In the Canadian boreal forest, logging began later than in the U.S. portion of the Lake Superior basin, mostly because the forest contained fewer timber-quality trees. The trees were harvested mostly for pulpwood (National Wildlife Federation [NWF] 1993).

In a 1993 report, the National Wildlife Federation predicted that the forest product industry is the most likely sector to grow and have an impact on biodiversity and ecosystem health in the Lake Superior basin.

Settlement. After the presettlement forests were cut-over, some of the land was completely cleared and leveled for agriculture. However, most of the forest lands were unsuitable for

farming and were later abandoned (Stearns 1995). Abandoned farm fields have grown back to trees, were planted to trees, or have become dominated by brush. Areas with productive soils remain in agricultural production today, dominating the landscape in localized areas (such as old lake plains). However, agriculture only dominates about one percent of the landscape in the Lake Superior basin. Agricultural practices have contributed to the loss of wetlands by draining or filling to level fields. Some of the most toxic and persistent chemicals used in the mid-1900s were agricultural-based.

Most human habitation and urban structure is focused on or near the shoreline of Lake Superior. The largest communities in the basin— Duluth, Superior, Marquette, Thunder Bay, and Sault St. Marie—are located directly on Lake Superior. Shoreline development continues today, but the focus has changed from industry toward housing and recreational development. This development creates more roads and infrastructure, hardens shorelines, and causes a loss of vegetation.

Since the mid-1800s, mining has had a major impact on the economics and natural resources of the basin. During the 1870s, the Silver Islet mine east of Thunder Bay was the world's most productive silver mine. It closed in the early 1880s. The Keweenaw Peninsula in the Upper Peninsula of Michigan was the world's leading producer of copper during the early 1800s. One of the largest Superfund sites in the country is a result of this copper mining (NWF 1993). Iron ore mining in Minnesota began in 1884 on the Vermilion Range and in 1892 on the Mesabi Range. The eastern portion of the Mesabi Range is within the Lake Superior basin. Mining of taconite, a lower-grade iron ore, continues on the Mesabi Range, and Minnesota remains the largest producer of iron ore and taconite in the United States. In Wisconsin, brownstone was quarried in the late 1800s to early 1900s. Approximately 12 quarries were mined, and the brownstone was exported to large cities in the United States, including Chicago, St. Louis, and Minneapolis/St. Paul. Brownstone buildings remain in the basin in Wisconsin, but brownstone is no longer quarried. Old, unreclaimed quarries dot the landscape.

One of the unique characteristics about the Lake Superior basin is that much of the land is in public ownership. In Ontario, about 95 percent of the basin is in public ownership, consisting of federal and provincial parks and crown (provincial) land. In the United States, about 25 percent of the basin is in public ownership under the jurisdiction of federal, state, and county governments (NWF 1993).

Transportation. By the early 1830s, the Great Lakes were opened to international shipping with the completion of several canals that connected all the Great Lakes to the St. Lawrence Seaway. This allowed commodities harvested from the Lake Superior basin to be exported to growing cities farther east. Many cities on Lake Superior had burgeoning shipping industries in the late 1890s and early 1900s, but only a few major shipping docks now remain, including those at Duluth-Superior in the United States, and at Thunder Bay, Marathon, and Sault Ste. Marie in Ontario.

Railways created additional accessibility and were important for transport of harvested hardwood timber, which was not readily transported by water. Numerous railroad companies and railroad

spurs were prevalent in the late 1800s and early 1900s, providing transportation to and from the region.

Recreation. The forests, streams, and lakes of the Lake Superior basin have attracted outdoor recreation enthusiasts throughout the 20th century. Since the mid-19th century, resorts and lodges have housed visitors from metropolitan areas who come for hunting, fishing, boating, camping, and other outdoor pursuits. Outdoor recreation interest remains high today and is increasing in popularity, especially in areas within driving distance of metropolitan centers, such as Minneapolis/St. Paul. Recreation pursuits have expanded to include skiing, snowmobiling, all-terrain vehicle riding, hiking, bicycling, wildlife watching, sailing, and others. Facilities for these activities have been developed in response to the interest and need.

7.5.2 Habitat

The habitat chapter (Chapter 6) of this LaMP provides detailed information about habitat status and trends in the basin. Land use/land cover in the Lake Superior basin is shown in Table 7-1. A significant majority of the land is in forest cover (84.4 percent). The remainder of land cover is developed, bare ground (which includes mines), grassland, and agriculture.

Table 7-1 1998 Land Use/Land Cover in the Lake Superior Basin (including Canada and U.S.)

Land Use/Land Cover	Percent of Basin
Developed	0.3
Agriculture	1.2
Grass/brush	4.4
Bare ground	0.5
Conifer	35.2
Conifer/Hardwood	22.8
Hardwood	25.2
Hardwood, early seral	1.2
Water	7.3

Source: Natural Resources Research Institute, University of Minnesota, Duluth, 1998.
Note: The data were compiled from satellite imagery and do not add to 100 due to cloud cover and missing data.

The conservation and management of forests in the Lake Superior basin will have a significant impact on terrestrial wildlife. The Wisconsin Department of Natural Resources (WI DNR) (1995) projected the following trends for northern forest management in Wisconsin:

- The total forested area will probably remain the same or increase slightly.
- Aspen-birch type forest will gradually decrease as forest succession progresses. The area in aspen has declined 1.8 million acres since 1936.
- Portions of current aspen-birch forests will be replaced by various mixtures of white pine, red maple, and locally, red oak. A significant proportion will succeed to mixed stands of mesic hardwoods, with sugar maple playing the largest role.
- All forests currently dominated by mesic hardwoods will remain so, but species composition will vary greatly depending on geographic location, site type, and management practices. Sugar maple will become more dominant on many mesic sites.
- Red pine plantations are likely to dominate local areas, particularly on forest industry lands. Jack pine acreage is decreasing, while acreage of red pine plantations is increasing.
- Because of great disparity between economic and biological maturity of most tree species, an increase in old-growth forests, in a biological sense, is unlikely. Increased utilization prevents development of old-growth characteristics in managed mature forests.
- Clearcuts and plantations will continue to fragment large, uniform blocks of mature mesic hardwoods. Temporary edges caused by forest cutting will continue to dominate the northern landscape.
- Small, permanent grassy openings will continue to decline to less than 1 percent of public and forest industry lands. Wildlife that are dependent on grassy, open areas will decline.
- Balsam fir and tag alder will continue to dominate the former white cedar forests. White cedar and Canada yew reproduction will be restricted to scattered, local areas.
- The scattered relict stands containing hemlock and yellow birch will continue to decline. Reproduction of these species will be restricted to scattered, local areas.
- Fire will not play a significant role as an ecological agent in the northern forest.
- Road networks will continue to be improved and expanded.

The demand will continue to increase for forest products such as pulpwood and sawlogs, game species such as white-tailed deer and ruffed grouse, and aesthetic characteristics such as wild country and solitude.

The WI DNR also made the following observations. Under current management practices, only selected economic tree species, a few forest game species, and selected endangered or threatened species receive funding and management attention. The result is a mosaic of many small stands of different forest age classes. Temporary edges are abundant. Large blocks of unbroken mature mesic forest are rare. Fire as a natural process is rare and is not currently used as a management tool in most areas. National, state, county, and local public land units currently plan management strategies independently, but development of ecologically sound, cost-effective techniques that encourage natural processes on the forest landscape will require partnerships with the forest landowners, including the forest industry. Public pressure to pay more attention to maintaining complete and functional forest ecosystems will surely continue.

7.5.3 Sociological

Specific population and sociological trends are provided in the sustainability chapter (Chapter 9) of this LaMP.

Pursuit of wildlife-related recreation is important for residents of the basin. In 1996, Michigan had the highest number of hunters of all states in the United States, with 934,000 (U.S. Dept. of Interior and U.S. Dept. of Commerce 1998). This was an increase from 1991, when 826,000 people hunted in Michigan (U.S. Dept. of Interior and U.S. Dept. of Commerce 1993). In 1996, Wisconsin was fourth in the United States with 665,000 hunters, which was a decrease from 747,000 in 1991 (U.S. Dept. of Interior and U.S. Dept. of Commerce 1998, U.S. Dept. of Interior and U.S. Dept. of Commerce 1993). The total number of days that Ontario residents spent on non-consumptive wildlife-related recreation increased from 1981 to 1991, but the total number of days spent hunting decreased (Filion and others 1993).

Wildlife watching is important to both residents and nonresidents of the basin. In 1991, more than 7 million Ontario residents aged 15 years and over (91.9 percent of the population) participated in one or more wildlife-related activity (Filion and others 1993). In 1996, almost $1.6 billion was spent in Wisconsin for wildlife watching, the fifth-highest in the United States. Michigan supported slightly more than 16 million days of nonresident wildlife watching, which was second in the nation (U.S. Dept. of Interior and U.S. Dept. of Commerce 1998).

Economic conditions play a large role in recreational use of the Lake Superior basin in the United States. As young, active people are employed, they gain disposable income but lose time for outdoor recreation pursuits. This often creates a demand for recreational opportunities that are closer to home and provide immediate gratification. Also, continued population growth in Chicago and the Minneapolis/St. Paul metropolitan areas will further contribute to the demand for outdoor recreation in the northern regions of Michigan, Wisconsin, and Minnesota (WI DNR 1999).

Access to quality outdoor activities has influenced land and home acquisition. The trend of private owners buying land and/or second homes/cabins is increasing, especially near Lake Superior and on inland lakes. In the United States, this trend is greatest along the North Shore of Lake Superior in Minnesota and the Bayfield Peninsula in Wisconsin, largely because they are within a half-day drive from large metropolitan areas. For example, Bayfield County in Wisconsin, which has more than half its land base in the Lake Superior basin, has seen significant land price increases in the last few years. Equalized property values increased 21.64 percent from 1998 to 1999, which was the second highest increase in Wisconsin (Wisconsin Department of Revenue 1999). This trend is slower in the Upper Peninsula of Michigan. In Ontario, this trend is greatest along the shorelines east and west of Thunder Bay and north of Sault Ste. Marie. Development is not yet as extensive as along the North Shore of Lake Superior in Minnesota.

This increased demand for land, especially along rivers and lakeshores, creates further stress on the landscape. An increase in habitat fragmentation is often the result. Shoreline habitats, both

upland and aquatic, lose much of their biodiversity value as they become developed (Gillum and others 1998).

7.5.4 Land Use and Economics

The sustainability chapter (Chapter 9) of this document provides detailed economic information about the Lake Superior basin. General information that directly relates to terrestrial wildlife is included here.

In general, family and household incomes in Lake Superior counties in the United States are well below the national and state medians (1979 and 1989 data). In 1990, average monthly mortgage payments within the watershed were considerably below those in the U.S. and the respective states, indicating slow or little economic growth.

The three principal industries in the Lake Superior basin are forestry/forest products, mining, and tourism (NWF 1993).

Land cover on the Canadian portion of the basin is 98.7 percent forests, and most of this is in public ownership (National Wildlife Federation 1993). It is mostly boreal forest of black spruce, white spruce, balsam fir, jack pine, aspen, and birch. Maple is found in the eastern portion of the watershed. Administration of natural resources in Ontario (including forestry, fish and wildlife, and public lands) is the responsibility of the OMNR. Portions of two OMNR Regions and five OMNR Districts are found within the basin. District offices coordinate the local field delivery of OMNR programs including forest management planning and fish and wildlife inventories and allocation. Forest management occurs on a number of forest management units under Sustainable Forest Licenses across the commercially harvested Crown forests of Ontario. Individual Forest Management Plans are prepared by the forest management companies, in conjunction with OMNR staff, every 5 years. The 2-year planning process involves a great deal of public and stakeholder consultation and is aimed at ensuring that sustainable forest management occurs. Planning and management follows an ecosystem approach in which timber harvesting attempts to follow natural disturbance patterns (e.g. fire) and retain important wildlife habitat features such as snags and winter habitat.

Eighty seven percent of the land in the U.S. portion of the basin is forested (National Wildlife Federation 1993). Ownership patterns of forest land in the U.S. portion of the basin are shown in Table 7-2.

Table 7-2 Forest Land Ownership Patterns for Lake Superior Basin in the United States

Landowner	Percentage
National Forest	18
Other Public Owners	29
Forest Industry	15
Private and Other Owners	38

Source: National Wildlife Federation 1993

Forty-seven percent of the timberland is in public ownership, which includes lands managed by the federal government (U.S. Forest Service), states (Departments of Natural Resources), and counties. The remainder is owned by the forest industry and private landowners. The U.S. Forest Service has a multiple-use mandate and follows a planning process that directly involves the public. State Natural Resources Departments and County Forestry Departments are beginning to encourage public involvement in their forestry planning. All lands, however, are open to recreation. Coordinated regional planning is seldom, if ever, done; however, the Wisconsin and Minnesota Departments of Natural Resources recently initiated a land use planning effort for the northwest sands region (locally referred to as the pine barrens), which is located on the edge of the Lake Superior basin. They are involving as many stakeholders as are interested, including towns, counties, landowners, the forest industry, and non-profit organizations.

Mining is currently one of the other major land uses. Interest in mining and manufacturing is increasing in the basin. In 1984, one of the world's largest gold deposits was found near Marathon, Ontario. Currently, there are four active gold mines in that area. Two smaller gold mines are located near Wawa. A platinum-palladium mine is located approximately 100 km north of Thunder Bay, and zinc/copper mines are located in Manitouwadge and Schreiber. The Schreiber mine is slated for closure.

Approximately three-fourths of United States iron ore is produced in Minnesota, totaling about 40 million tons per year (NWF 1993). Most of the ore is shipped to Great Lakes steel mills. One active iron ore mine is located near Ishpeming, Michigan. A large copper mine and smelting operation in Ontonogon in the Upper Peninsula was recently closed. On the Canadian side, the major iron ore-producing mine was located in Wawa. This mine produced ore from 1960 until its closure in May 1998, supplying material to the Algoma Steel mill in Sault Ste. Marie, which is still in operation.

There are currently five large and two medium-sized pulp and paper operations and four large, two medium, and four small sawmill operations located within the basin on the Ontario side. In addition, there are two veneer mills and two oriented strandboard/particle core board mills within the basin in Ontario. Four pulp and paper mills are found on the U.S. side of the basin, two in Minnesota and two in Michigan. Several mills located outside of the basin draw pulpwood from the basin's forests. A paper mill in Ashland, Wisconsin, closed in 1998.

Tourism in the Lake Superior basin is related to outdoor recreation opportunities. A significant draw is the large percentage of public lands and trails available for public use. Public lands that are set aside as parks include national parks such as Apostle Islands National Lakeshore in Wisconsin and Pictured Rocks National Lakeshore in Michigan, provincial parks such as Pukaskwa National Park in Ontario, and state parks and natural areas such as Split Rock Lighthouse State Park in Minnesota. These areas not only provide outdoor recreation opportunities, but they also protect important habitats for wildlife and provide opportunities for natural resource management that are not commodity-based. Local communities that serve as gateways to these protected areas and trails gain economic development opportunities by serving tourists and residents.

7.6 STATUS AND TRENDS OF TERRESTRIAL WILDLIFE

7.6.1 General

Habitat changes on the landscape, as well as harvest and management of select species, have created some dramatic changes in wildlife communities over the past 150 years. Table 7-3 provides an example of how some species and bird communities have changed since European settlement. Populations have fluctuated from common to rare or from rare to common, and community structures have shifted as a result of large-scale logging in the late 1800s and early 1900s. Species such as the gray squirrel, porcupine, and beaver were rare in the early 1900s, but populations increased as the forest began to mature. Other species, such as raccoon, eastern cottontail, and striped skunk became more abundant as young forests, forest edges, resorts, small towns, and agriculture provided favorable habitat. Birds such as ruffed grouse and woodcock increased as young forests became available. However, forest bird species, such as the pine warbler, barred owl, and scarlet tanager, decreased in numbers as forests were converted to brushlands; current trends from young to mature forests are again providing habitat for these species (Wisconsin Department of Natural Resources 1995).

Table 7-3. Changes in the Relative Abundance and Distribution of Selected Wildlife in Wisconsin's Northern Forests: 1850-1994

	Relative Abundance and Distribution			
Species	**Mid-1800s**	**Early 1900s**	**Mid-1900s**	**1994**
White-tailed deer	Low Clumpy	Low Clumpy	Abundant Continuous	Common Continuous
Coyote	Low Clumpy	Common Clumpy	Abundant Continuous	Common Continuous
Bobcat	Low Clumpy	Low Clumpy	Common Continuous	Rare Continuous
Moose	Low Clumpy	Rare Isolated	Gone Gone	Rare Isolated
Snowshoe hare	Low Clumpy	Common Continuous	Abundant Continuous	Low Clumpy

Table 7-3. Changes in the Relative Abundance and Distribution of Selected Wildlife in Wisconsin's Northern Forests: 1850-1994

	Relative Abundance and Distribution			
Species	**Mid-1800s**	**Early 1900s**	**Mid-1900s**	**1994**
Timber wolf	Common Continuous	Common Continuous	Gone Gone	Rare Clumpy
Fisher	Common Continuous	Rare Isolated	Gone Gone	Common Continuous
American marten	Abundant Continuous	Rare Isolated	Gone Gone	Rare Isolated
Elk, wolverine	Low Clumpy	Gone Gone	Gone Gone	Gone Gone
Bald eagle, osprey	Common Common	Common Continuous	Low Clumpy	Common Continuous
Ruffed grouse	Low Clumpy	Common Continuous	Abundant Continuous	Common Continuous
Woodcock	Low Clumpy	Common Clumpy	Abundant Continuous	Common Clumpy
Sharp-tailed grouse	Low Clumpy	Abundant Continuous	Common Clumpy	Rare Isolated
Beaver	Common Continuous	Rare Isolated	Low Clumpy	Abundant Continuous
Grassland birds	Rare Isolated	Common Continuous	Common Clumpy	Rare Isolated
Young-forest birds	Rare Isolated	Common Clumpy	Common Continuous	Common Continuous

Source: Wisconsin Department of Natural Resources 1995
In order of abundance, from least to most abundant: gone, rare, low, common, abundant.
In order of distribution, from extirpated to widely distributed: gone, isolated, clumpy, common, continuous.

Direct human interference and harvest also dramatically affects species abundance. Species that rely on large blocks of wild land with little human presence, such as timber wolf, Canada lynx, wolverine, and spruce grouse, were extirpated from a portion of their range (WI DNR 1995). Some of these species can be recovered with careful management and reintroduction. Many species were harvested or exploited until they nearly disappeared from the basin. For example, herring gull populations in the early 1900s were almost extirpated from the entire Great Lakes basin as a result of persecution at nesting sites and demand for bird feathers for the millinery trade during the late 1800s. The Migratory Bird Convention of 1916 provided protection, and herring gull populations began to increase in the 1940s (Ryckman and others 1997).

Environmental quality also plays a significant role in wildlife communities. Environmental contaminants from toxic chemicals that humans introduced into the environment in the mid-

1900s nearly eliminated top carnivores such as bald eagles and cormorants. The effect of chemical pollutants on amphibian populations has also been noted. Species such as bald eagle, herring gull, and river otter are indicators of the quality of the environment, and some monitoring is taking place in the basin to determine contaminant levels and their effects.

The landscape, its environmental quality, and human-imposed regulations and actions are reflected in the current status and health of terrestrial wildlife communities. Tough decisions are being made and will need to be made in the future regarding restoration and management of terrestrial wildlife. As a society, we have begun to understand what needs to happen in the Lake Superior basin to provide a native, healthy, sustainable wildlife community. But there is also much we don't know. Adaptive management and strategic decision-making may aid in moving toward our goals.

The following summaries are provided for groups of species: mammals, birds, amphibians and reptiles, invertebrates, and plants. We generally provide a broad overview of changes that have taken place in these communities and their current status. Some larger groups are broken down into smaller groups of species, depending on our knowledge. Information on federally threatened and endangered species is also provided, but the reader will be referred to the habitat section for more detailed information. Information on species that are considered rare to the Lake Superior basin is also provided in the habitat section of this LaMP.

The status and trend information helps to define the overall problems and opportunities for terrestrial wildlife communities in the Lake Superior basin and to define broad strategies for the Binational Program and its partners.

This work is not a detailed account of status and trends of all wildlife in the Lake Superior basin. There are two reasons for this. First, the time frame given to the working committees was very tight and did not allow for complete compilation of existing data or knowledge. Second, the Binational Program is not a wildlife management entity; rather it is a partnership of agencies from two countries trying to improve the integrity and health of the Lake Superior basin. The work is focused at the strategic level to identify broad goals and strategies. Individuals and organizations may investigate the details at the specific level as they develop and implement programs to meet the Binational Program's broad strategies.

Because this work was completed in a very tight time frame, gaps may exist in the information presented here. We welcome and encourage feedback concerning those gaps so we can continue to adjust our goals and strategies in an adaptive management mode.

7.6.2 Mammals

7.6.2.1 Status and Trends of Mammals

Mammalian populations have seen greater fluctuations and changes than any other group of terrestrial vertebrates. Furbearers were exploited during the fur trading years, which caused dramatic decreases of most species and nearly wiped out some. Ungulates were hunted for food and hides; carnivores, such as wolves, were feared and harvested to near oblivion in the lower portion of the basin. As regulations were enacted to control the harvesting of such animals, however, many populations rebounded. Wildlife management agencies have successfully reintroduced certain species, such as American marten, to their historic range. Other species, such as white-tailed deer, have become so abundant in certain areas that they may be negatively impacting their environment.

Some species, however, remain in peril. The woodland caribou has been nearly pushed out of the basin. Canada lynx is nearly gone from the southern part of the basin. There is very little we know about the trends of many small mammals, such as voles, mice, and bats, mostly because they are not harvested by humans for game or food.

There are differences in abundance and diversity of species from south to north. Many of the species that were lost in the U.S. portion of the basin in the early 1900s persisted in the Canadian portion. Species such as white-tailed deer moved into the Canadian portion of the basin in the late 1800s. Because of these differences, habitat and population management and recovery efforts are different between Canada and the United States. For example, Ontario is managing habitat to protect woodland caribou and needs to understand and monitor the effect that deer, moose, and wolf have on caribou. The states have and continue to actively reintroduce some mammalian species, such as moose, which was not necessary in Ontario. It is unlikely that any work to protect and manage mammalian species has focused on the Lake Superior basin specifically. Most work has been limited by political boundaries. Therefore, no information has been specifically compiled for the basin. This report can provide a starting point.

Ungulates

Within the Lake Superior basin and surrounding area, the ranges occupied by large ungulates (woodland caribou, moose, white-tailed deer, and elk) have been substantially altered from presettlement patterns. Harvesting, human disturbance, and habitat changes have nearly eliminated species such as woodland caribou and elk. Elk have been reintroduced into northern Wisconsin, but they are found nowhere else in the basin. Conversely, white-tailed deer populations in the southern part of the basin are high, largely due to favorable habitat conditions, mild winters, hunting regulations, and decline of natural predators, such as wolf. The white-tailed deer brought with it the parasitic brain worm, which is fatal to both caribou and moose. Minnesota's moose population has remained relatively stable since the early 1990s (Mark Lenarz, MN DNR, personal communication). Ontario has seen stable to increasing populations of moose since 1992 (Timmermann and Buss 1997). Michigan successfully reintroduced moose into the Upper Peninsula in 1985 and continues to manage the population to increase its range.

Caribou

Woodland caribou historically ranged throughout most of the Lake Superior basin, but they currently can be found only in the northern edge of the basin in Ontario and in remnant populations on islands and in parks (Figure 7-3). Reasons for the decline include hunting, fire, land clearing, logging, increased predation, disease, and human disturbance (Darby and others 1989). In Ontario, timber harvest following European settlement provided a proliferation of woody browse, which allowed moose and deer to thrive. The increased population of moose allowed timber wolf numbers to increase. Although wolves are a natural predator, as wolf populations increased, caribou populations were further stressed. Currently, caribou in northwestern Ontario are found only in areas with major limitations for supporting moose (and wolves) in high densities, unless they can find islands or other forms of refuge where they can exist in a predator-free environment (Godwin 1990). This creates a management scenario where populations of caribou and moose and/or white-tailed deer are not compatible on the same land base because of associated wolf predation and parasitic disease. Addendum 7-A describes efforts to manage and recover this species in Ontario under an ecosystem management approach.

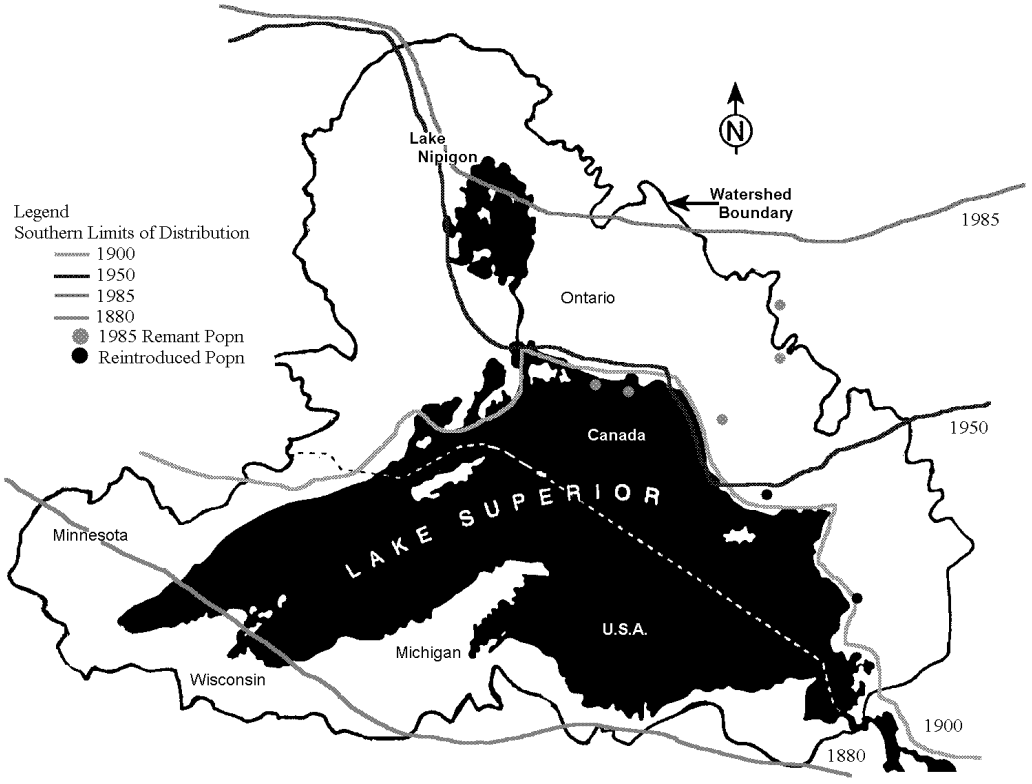

Figure 7-3. Decline of Woodland Caribou Range, 1880 to 1985
Source: Cummings and Beange 1993

White-Tailed Deer

Current deer numbers in the Upper Peninsula of Michigan are estimated to be approximately double the presettlement numbers, based on a habitat suitability model (Doepker and others 1996). Deer moved northward into northwestern Ontario in the late 1890s (Snyder 1938). McCaffery (1995) estimated presettlement populations of deer in northwestern Wisconsin to be approximately 19.5 deer per square mile and peak populations in the 1940s to be 40 to 50 deer per square mile. The 1995 population in northern Wisconsin was about 26.7 deer per square mile, largely due to mild winters and opposition to liberal harvests (McCaffery 1995). Minnesota's deer population increased steadily from 1980 to 1995, but severe winters in 1995-96 and 1996-97 caused the population to decline more than 40 percent. Their numbers have increased in the last few years, however, due to mild winters since 1997 (Mark Lenarz, MN DNR, personal communication). Three primary factors that affect deer numbers in northern Minnesota, in order, are: 1) winter weather, 2) human harvest, and 3) wolf predation (Mark Lenarz, MN DNR, personal communication). A discussion on the ecosystem effects of and approach to deer management is provided as Addendum 7-B.

Increasing numbers of deer have resulted in several impacts to the ecosystem within the basin and elsewhere. Waller and Alverson (1997) suggest that chronically high deer numbers are having substantial, deleterious ecological impacts across many regions. We do not know the overall extent of the problem in the basin, but several studies have shown negative impacts on certain plant species and plant communities in this region (Stoeckeler and others 1957; Frelich and Lorimer 1985; Mladenoff and Stearns 1993; Balgooyen and Waller 1995). Stoeckeler and others (1957) identified a direct negative impact on hemlock seedlings from deer browse in northeast Wisconsin, and Frelich and Lorimer (1985) identified negative effects in the western Upper Peninsula of Michigan. Mladenoff and Stearns (1993) point out that hemlock used to be a regional dominant, but now only occupies 0.5 percent of the landscape. Hemlock requires very specific microhabitat conditions for germination and seedling establishment, and the right conditions occur only in specialized locations. Mladenoff and Stearns agree that deer browsing has a negative effect, but it is only one of many current conditions that suppress regeneration. Climate, dominant forest type (which is now hardwood), and herbivory are all factors that affect hemlock. The ecosystem approach to conservation would require a look at more than deer numbers to reestablish healthy hemlock communities.

Herbaceous plants constitute the bulk of deer summer diets (McCaffery and others 1974), so certain sensitive plants can be negatively affected by deer browsing, especially the species that might be selected by deer as most palatable. In the Apostle Islands and northern Wisconsin, Balgooyen and Waller (1995) showed declines in several woody species, overall herbaceous species diversity, and specific declines in wild sarsaparilla (*Aralia nudicaulis*), Canada mayflower (*Maianthemum canadense*), and blue beadlily (*Clintonia borealis*). The impacts to herbaceous diversity had persisted for over 30 years, with blue beadlily apparently extirpated from Madeline Island.

Other studies have suggested that an overabundance of deer affects other animal species in the ecosystem. In Pennsylvania, for example, a study showed that intermediate canopy-nesting birds declined 37 percent in abundance and 27 percent in species diversity at higher deer densities. Five species completely dropped out at very high densities (38.2 deer/square mile), and two dropped out at highest deer densities (63.8 deer/square mile) (DeCalesta 1994). In New Hampshire, deer were browsing on lupine plants, which are host plants for the endangered Karner blue butterfly (*Lycaeides melissa samuelis*) (Miller and others 1992). This, in turn, decreased populations of the butterfly.

Human interaction with overabundant deer is also seen in increased vehicle collisions, loss of crops and landscape plants, and increased nuisance occurrences.

Furbearers, Including Mid-Sized Carnivores

Beaver, river otter, American marten, bobcat, fisher, mink, and other furbearers were intensively trapped in the mid- to late-1800s, some to the level that they were extirpated from significant portions of the basin. Fishers, for example, were extirpated from Wisconsin and Michigan due to overharvest and habitat destruction (Racey and Hessey 1989a).

Numbers of many furbearers were also severely reduced in Ontario, and species such as beaver, marten, and fisher were extirpated from portions of their historic range. Season closures and other regulations, along with the establishment of a number of Crown Game Preserves in the 1920s, helped reverse the declines and allowed populations to recover. Individual traplines were first established in the 1930s, and in 1950 it became a requirement for traplines to be registered. The registered trapline system, which licensed a trapper to a specific trapping area, stabilized a chaotic industry and allowed distribution of the harvest, eliminated competition between trappers, and encouraged trappers to manage their trapline areas on a long-term basis (Novak 1987). During the period of the 1940s through the 1950s, beaver, marten, and, to a limited extent, fisher, were transplanted from remaining populations to areas of their former occurrence. In 1950 both marten and fisher were generally absent or uncommon in most of the basin. They were common only in the eastern portion of the basin between Wawa and Chapleau (de Vos 1952). Since that time both fisher and marten numbers have increased, and they now reinhabit their former range. In the case of marten, current harvest levels are higher than at any time in over 100 years. Marten in Ontario were also used as source stock for an introduction into the Lower Peninsula of Michigan in 1985 and 1986 (Ludwig 1986).

In Minnesota, raccoon, fisher, American marten, red fox, and black bear populations have all recovered substantially over the past 20 or more years (Bill Berg, MN DNR, Grand Rapids, personal communication). Fisher and marten were closed to harvest in the late 1920s and reopened in 1977 and 1984. Both species have increased their ranges west and south in Minnesota (Bill Berg, MN DNR, Grand Rapids, personal communication). A long series of mild winters and general climate change have allowed many of these species to increase in abundance and range.

Populations of bobcats, fishers, martens and otters can be estimated using a population model developed by Bill Berg of the MN DNR. The model is used widely throughout the Midwest, including Minnesota, Wisconsin, and Michigan. The Wisconsin and Minnesota DNR used the model to estimate populations for their states, and this information is presented below. Unfortunately, little published information is available for population levels of Michigan furbearer species.

Harvest seasons have been established in all three states for otter, bobcat, and fisher. Marten harvest is permitted only in Minnesota. Martens, fishers, and otters have been expanding their ranges in all three states. Martens are designated as a sensitive species by the US Forest Service in the Chequamegon and Nicolet National Forest Land Management Plans.

Beaver

Beaver have increased in abundance and regained a continuous distribution since the trapping-induced population plunge of the early 1900s. The favorable habitat conditions resulting in the overabundance of white-tailed deer have also resulted in record high beaver populations. Beaver impact both the terrestrial and aquatic ecosystems of the basin. When they harvest trees and build dams, they change the aquatic community structure and open riparian canopies, which creates a positive impact to some species and a negative impact to others.

One of the negative impacts of beaver is to the cold water migratory fish communities. Beaver dams create a barrier to anadromous migratory fish that use tributary streams for spawning. In addition, cold water streams in Minnesota's portion of the basin exist and support trout by virtue of climate alone. Summer water temperatures of the surface water driven stream systems are often the limiting factor for healthy fish populations. Riparian forest cover is essential for moderating stream temperature conditions. The removal of riparian forest cover by abundant beaver populations and loss of stream shade results in thermally degraded aquatic trout habitat. Increased water temperatures are also found in ponds above beaver dams.

Bobcat

Bobcat populations in Minnesota are estimated at around 1,500 animals. This population level has been maintained for 20 years. The Wisconsin bobcat population is also estimated at 1,500 animals, which represents a 20 percent increase in population during the past 5 years. Bobcat harvests in all three states range from 100 - 300 animals. These harvests are regulated to provide for a size-stable population.

Fisher

The fisher population in Minnesota has been increasing for about 20 years since the lows of the mid- to late-1970s and is currently estimated to be 10,000 animals. The fisher population in Wisconsin peaked in 1992 at 9,500, declined to 7,500 in 1997, and is now estimated to be nearly 8,000 animals. Both Wisconsin and Minnesota are trying to stabilize the population growth of this species through harvests at about current levels.

Otter

Otter populations in Minnesota, currently estimated at 13,000 animals, have also been increasing for nearly 20 years. The Wisconsin otter population is estimated at 14,000 animals, which represents a decline from the peak population in 1992 of 15,500. Wisconsin harvest regulations were liberalized in 1992 to take advantage of high population levels.

American Marten

American marten are listed as a game species in Minnesota, and a trapping season has been in effect in that state for many years. The population is estimated at 12,000 animals. The marten population has been increasing steadily since 1980 with only small dips when trapping conditions are good and harvests unexpected large. Martens are classified as an endangered species by the State of Wisconsin. They were extirpated from the state in the early 1900s and were reintroduced in the 1970s and 1980s. The marten population continues to be small and isolated, centering around the two release sites. Reasons for the lack of expansion of this species are unknown.

Small Mammals

Small mammals include mice, voles, bats, cottontail rabbits, and snowshoe hares. Little population information is available for any of these species, except perhaps on a site-by-site basis. This group of mammals plays a very important role in providing a prey base for other mammals and birds and for preying on invertebrates.

Threatened and Endangered Mammals

The habitat section of the LaMP provides information about the status of the gray wolf and Canada lynx. Additional information about wolf recovery and status in Canada is provided below.

Gray Wolf

The gray wolf is listed as a federally endangered species in Michigan and Wisconsin, and as a threatened species in Minnesota. It has no special designation in Ontario or Canada.

Recovery programs have been initiated in all three states, and recovery goals are nearly met. The U.S. Fish and Wildlife Service is drafting a proposal to change the status to threatened in Wisconsin and Michigan. A state conservation plan is being developed in Minnesota; once approved by both the State of Minnesota and the U.S. Fish and Wildlife Service, it will allow federal delisting in Minnesota.

In Ontario there is no evidence to suggest that wolves are threatened or endangered on either a regional or provincial basis. Observations by field staff and trappers suggest that wolf numbers

are stable or increasing over nearly all of their historic range in the Province. The gray wolf population in Ontario is estimated at 8,000 to 9,000 animals (Buss and de Almeida 1997). Within the Ontario portion of the basin, wolf hunting and trapping is permitted year-round; however, wolves are essentially protected during the months of June through August, because the provincial small game-hunting license is not valid during this period. Hunting is prohibited in provincial and national parks, and trapping is prohibited, or minimal, in most provincial parks (Buss and de Almeida 1997). During the 1990s, the annual harvest of wolves has varied from 500 to 800 animals.

7.6.2.2 Unique Characteristics of Mammals

Many mammalian species, because they have been harvested for food and pelts, have seen dramatic changes in community structure and abundance. Also, because many mammals remain of interest to hunters and trappers, management programs focus on providing populations for harvest and not on the overall ecosystem. As a result, our society views these species primarily for their value to humans, not for their value as a functioning part of the ecosystem (see Addendum 7-B). Another consequence of single-species management is that impacts to the ecosystem, both positive and negative, were not historically considered. Single-species management is gradually being replaced with ecosystem management.

7.6.2.3 Stressors of Mammals

Overabundant Populations

The recovery of some species from near extirpation to overabundance has resulted in stresses to other species (see Addendum 7-A and 7-B). The management of overabundant deer, however, also provides opportunities to focus on ecosystem management principles and to manage wildlife communities as a whole.

Habitat

Habitat changes on the landscape have been a factor in the composition of mammalian communities (see Table 7-3). Habitat changes created by certain species, especially white-tailed deer, alter the composition of all mammalian communities.

Beaver also have a significant impact on the surrounding environment, especially riparian vegetation and adjacent aquatic communities. The long term management of beaver populations can be addressed through management of their riparian food source. The dominant aspen/alder riparian community we see today can be steered toward less palatable coniferous stands. The restoration of coniferous old-growth riparian forest will benefit both terrestrial and aquatic ecosystems.

Some species of particular concern have specific habitat requirements that must be met for their survival. For example, American marten and fisher require blocks of mature forest, and marten seem to prefer forests with a coniferous component. These requirements are an important

consideration in timber management (Racey and Hessey 1989b). Standing hollow trees must be present for den sites for both species, and coarse woody debris is critical for winter rest sites for marten (Gilbert and others 1997).

Contaminants

Mammals that are top predators accumulate toxic chemicals in their bodies. These chemicals might be affecting their individual health and reproductive capability. Most contaminant monitoring in the Lake Superior basin, however, has focused on birds and fish.

Concern has been expressed about cadmium levels in liver and kidney tissue of deer and moose that exceed recommended daily intake levels for humans. While negligible amounts of cadmium have been found in Ontario deer and moose muscle (Glooschenko and Burgess 1987), the OMNR recommends that people do not eat the liver and kidneys of moose and deer because of the concerns about cadmium levels in these internal organs. Kronberg and Glooschenko (1994) suggested that cadmium could serve as a proxy for other heavy metals of concern, such as lead and mercury, and that analyzing moose tissues on a regular basis could be useful for monitoring changes in environmental levels of these elements.

Studies begun on fisher (Gerstenberger and others 1996) found elevated levels of chlordane, but much work remains to be done. Mink and otter are good indicators of contaminant effects on mammals in the Great Lakes; they are carnivores, consume significant amounts of fish, and have been found to be very sensitive to PCBs and mercury (Ensor and others 1993). PCBs negatively affect mink reproduction (Heaton and others 1992; Kubiak and Best 1991). A study to develop baseline contaminant data in wildlife in Minnesota (Ensor and others 1993) found elevated levels of PCBs in mink collected along Lake Superior, and three of the highest levels of mercury were from mink collected along Lake Superior. They suspect that high mercury levels in combination with PCBs may be impacting mink populations.

Public Demands

Many mammalian species were historically stressed by overharvest, but many populations have recovered with the implementation of hunting laws and regulations. Recent demands from the public have resulted in agencies also managing wildlife populations for non-consumptive uses. Conflicts can arise with how an agency manages certain wildlife species or communities.

7.6.2.4 Management Efforts for Mammals

Management and recovery of mammalian populations is done by the state, provincial, tribal, or federal agency that has authority.

7.6.2.5 Current Monitoring Efforts for Mammals

Management agencies usually monitor mammal populations, either through population indexes or harvest surveys.

Ontario initiated a Wildlife Assessment Program to monitor representative wildlife species that may be affected by forestry activities. Eighty-two species were selected as a measure of sustainable forest management; 23 of these species are mammals.
National forests in the United States are monitoring some mammalian species, especially those that are indicators of the impacts of forest management activities.
A few programs are monitoring contaminant levels in top predators.

7.6.2.6 Gaps in Mammal Information

None of the monitoring information on any mammal species has been compiled for the Lake Superior basin.

Very little research is being conducted on contaminants in mammalian predators in the Lake Superior basin.

A significant amount of research needs to be conducted on the long-term effects of herbivory on plants and animals. We need to better understand whether population management programs can reverse some of the negative trends that are seen. This type of monitoring and research should be done in conjunction with adaptive management strategies.

7.6.2.7 Challenges for Mammals

One of the biggest challenges concerning management of mammals is understanding what mammalian community structure represents a "healthy, sustainable terrestrial wildlife community." As noted above, the current community profile of ungulates has changed drastically from what it was pre-European settlement. Do current conditions represent a healthy terrestrial wildlife community, or is the current community simply the one that will be most accepted by human society? Mammalian communities can have a substantial effect on habitat structure, which in turn affects other terrestrial wildlife and ecosystem functions.

The Binational Program is not, and should not be, in the position of defining a healthy, sustainable mammalian community at the population level. It can, however, help define healthy ecosystems in terms of habitat structure, landscape patterns, and disturbance regimes. The appropriate agencies, however, need to become more actively engaged on a landscape scale to address overlapping goals and objectives. If this is done, the Binational Program can advance those programs where goals overlap.

7.6.3 Birds

Birds receive substantial attention from many groups, including scientists, wildlife enthusiasts, anglers, and commercial fishermen. Birds constitute the greatest number of vertebrate species (~70) found in the Lake States national forests (Benyus and others 1992). Breeding songbirds are readily counted because they are both visually and aurally conspicuous. Their composition and abundance provide an indication of ecosystem health, and changes in their diversity and numbers

can provide an early warning system for biologists trying to understand the status of the ecosystem. They are enthusiastically watched at feeders, migration points, parks, and in the wild by novice and expert birdwatchers. Commercial fishermen keep an eye on fish-eating birds, fearing direct competition. Birds that are carnivores, such as bald eagles and herring gulls, give us a direct indication of the amount of contaminants in the system, by the thickness of their eggshells and the health of their young.

For all these reasons, there is a substantial amount of information on birds in the Lake Superior basin. But like most terrestrial wildlife information, very little is compiled on a basinwide basis. Highlights of much of the available information are provided below.

7.6.3.1 Status and Trends of Birds

Songbirds

Trends in songbird populations can be measured on the basis of individual species, communities, habitat guilds, or migratory status. Populations can be reviewed nationally, regionally, or locally, depending on the data set that is available. The North American Breeding Bird Survey allows us to look at continent-wide trends, as well as regional trends. Local trends are available only if individual studies or monitoring programs have been established. The Lake Superior basin has abundant information at all levels, but it has not been compiled on a basinwide basis. Therefore, we can only provide some relative trend information that is currently compiled at the national and regional level.

Portions of the Lake Superior basin have some of the highest species richness for breeding birds in North America, especially the southern and northwestern shores (Sauer and others 1997; Green 1995). Certain forest species appear to be more abundant, widespread, or productive in northern Wisconsin than in other regions. For these species, the Lake Superior basin could provide source populations. Some species include American woodcock, broad-winged hawk, black-billed cuckoo, winter wren, veery, blackburnian warbler, black-throated green warbler, and scarlet tanager (Howe and others 1992). The Minnesota portion of the basin also has some of the highest woodland species richness in North America (Sauer and others 1997).

Recent concerns have been raised about the decline of neotropical migrant bird populations (those birds that breed in North America and winter in Central or South America). Some neotropical migrants that are characteristic of Lake Superior forests have shown significant declines on a continent-wide basis, including eastern wood-pewee, wood thrush, veery, and indigo bunting (Peterjohn and Sauer 1994). The decline can be attributed to several factors, including habitat loss on their wintering range, changes in forest habitat in their breeding range, and migration obstacles. Concurrently, several species of neotropical migrants have shown an increase since 1966 on a continent-wide basis, including red-eyed vireo, solitary vireo, ovenbird, and pine warbler (Peterjohn and Sauer 1994). Many of the songbirds in the basin are neotropical migrants. For example, in Minnesota Green (1995) reported that 43 percent of the forest birds are neotropical migrants. Use of the basin by neotropical migrants is important for two reasons: 1) if the ecosystem is healthy, the basin should be an area where these migrants can produce young

and serve as source populations, and 2) factors outside the basin can have a significant effect on songbird populations.

Local surveys, especially those that are done in forest interior, show finer trends in woodland birds. For example, the Ontario Forest Bird Monitoring Program indicates that based on analysis of 69 species, 35 showed an increasing trend (11 significant) and 34 showed a decreasing trend (9 significant). In the Boreal Ecozone, significant declines were seen for brown creeper, golden-crowned kinglet, eastern wood-pewee, winter wren, and ovenbird. Significant increases were seen for yellow-bellied sapsucker, great-crested flycatcher, white-breasted nuthatch, northern waterthrush, red-eyed vireo, pine warbler, and chipping sparrow (Cadman and others 1998).

A regional analysis of BBS data was conducted for northeastern Minnesota, specifically the Great Lakes transition forest and the spruce hardwood forest regions (Niemi and others 1995). They compared data in these regions of Minnesota with statewide trends. Table 7-4 summarizes their findings.

Table 7-4 Summary of Breeding Bird Survey Analysis in Northeastern Minnesota, 1966-1993

Species that showed a decline statewide, as well as in both regions:	**Species that showed a decline statewide, but not in the two regions:**	**Species that showed a decline in the two regions, but not statewide:**
American Bittern	American Redstart	Blue-winged Teal
Ruffed Grouse	Red-headed Woodpecker	Brown Thrasher
Belted Kingfisher		Field Sparrow
Northern Flicker		Vesper Sparrow
Eastern Wood-pewee		Eastern Meadowlark
Least Flycatcher		
Ruby-crowned Kinglet		
Grasshopper Sparrow		
Western Meadowlark		
Brown-headed Cowbird		
Species that showed an increase in the state and in both regions:		**Species that showed an increase in the two regions, but not statewide:**
Common Loon	Red-breasted Nuthatch	Black-billed Cuckoo
Pied-billed Grebe	White-breasted Nuthatch	House Wren
Canada Goose	Sedge Wren	Marsh Wren
Wood Duck	Eastern Bluebird	Warbling Vireo
Mallard	Swainson's Thrush	
Red-tailed Hawk	Yellow-throated Vireo	
Common Snipe	Yellow-rumped Warbler	
Downy Woodpecker	Black-throated Green Warbler	
Hairy Woodpecker	Scarlet Tanager	
Pileated Woodpecker	Swamp Sparrow	
Eastern Phoebe	Northern Oriole	
Blue Jay	Evening Grosbeak	
Common Raven		
Black-capped Chickadee		

Source: Niemi and others 1995

Trends from this analysis indicate:

- Some bird species of mature forests are increasing (e.g. downy woodpecker, Swainson's thrush, pine warbler) and some are decreasing (e.g. least flycatcher, eastern wood-pewee).
- Species associated with fragmented forest landscapes are increasing (e.g. American kestrel, yellow-throated vireo, warbling vireo).
- Species associated with human habitation and human-dominated landscapes are increasing (Canada goose, wood duck, blue jay, black-capped chickadee, house wren, eastern bluebird). Some of these increases are a direct result of recovery programs for specific species, such as wood ducks.
- Four of the species that are increasing are highly associated with lakes and ponds (common loon, pied-billed grebe, double-crested cormorant, and great egret). These are fish- and aquatic-feeding species that were likely affected by chlorinated organic compounds in the 1950s and 1960s. Their increases parallel those of bald eagle and osprey.
- Several species of agricultural, rural landscapes have decreased (e.g. upland sandpiper, red-headed woodpecker, northern flicker, field sparrow, vesper sparrow, meadowlark). Possible reasons for decline include reduction and fragmentation of native grasslands, reductions in hayfields and pastures, and changes in agricultural practices.
- Several species associated with shrub/sedge wetlands are increasing (e.g. common snipe, sedge wren, LeConte's sparrow, and swamp sparrow). Wetlands in northern Minnesota remain in a relatively natural state when compared to other parts of Minnesota.[1]

Raptors

Bald Eagles

Populations of bald eagles declined sharply in the 1950s and 1960s as a result of contamination by toxic chemicals that accumulated in the food chain and affected reproductive success of eagles and other carnivores. Along the Lake Superior shoreline, bald eagles were nearly absent through the 1970s, but the population began to increase as the use of DDT was halted and DDE concentrations began to decrease. (DDE is a byproduct of DDT. It inhibits the action of the enzyme that is needed to transfer calcium carbonate to the eggshell.) Trend information for the three states and Ontario is provided in the habitat section of this LaMP.

Reproductive success of eagles that nest along the Lake Superior shoreline, and especially on islands, is lower than inland. This may be due to reduced availability of prey on Lake Superior and inclement weather. In Wisconsin, populations are increasing inland, but remain stable on the lake (Dykstra and others1998). Michael Hoff, (U.S. Geological Survey, personal communication) suggests that burbot population dynamics play an important role in food availability, as well as the role of commercial fishermen in casting off unused catch.

Migratory Raptors

1) It is important to note, however, that coastal wetlands are threatened and of concern in the entire Great Lakes region.

Migrating raptors seek thermals to make their flights more efficient. Because thermals rarely form over water, raptors prefer to migrate around Lake Superior. Several locations around the lake provide other physiographic features (such as ridges) that concentrate raptors during migration. These locations provide excellent sites for monitoring raptors and other birds during migration (Ryan Brady, Northern Great Lakes Visitor Center, Ashland, WI, personal communication). Hawk Ridge in Duluth, Minnesota, and Whitefish Point, Michigan, are two well-known hawk migration viewing areas on Lake Superior.

Colonial Waterbirds

Colonial waterbirds are good bioindicators of contaminant levels. Herring gulls and other long-lived fish-eating birds show the effects of prolonged exposure to toxic chemicals and help us understand wildlife health. Herring gull monitoring has occurred for more than 25 years in the Great Lakes. Two annual monitoring sites are located in Lake Superior (Mineau and others 1984; Pekarik and Weseloh 1988; Hebert and others1999).

Most colonial waterbirds had nearly disappeared in the early 1900s before the Migratory Bird Convention of 1916 provided some protection. Birds like herring gulls were valued for their feathers and were persecuted at nest sites. After they were protected through federal laws, their numbers began to increase in the 1940s. But by the early 1970s, herring gull populations had once again decreased. Contaminants were blamed, especially persistent chemicals such as DDE, PCBs, and dioxin, which affected eggshell thickness and embryonic growth and caused other problems (Gilbertson 1974; Mineau and others 1984). The mid-1970s saw the greatest concentrations of these toxic chemicals in herring gull eggs, but the levels have decreased since then (Bishop and others 1992a, 1992b; Pettit and others 1994a, 1994b; Pekarik and others 1988a, 1988b). Herring gull populations are recovering in the Great Lakes, but numbers in Lake Superior have shown declines (Table 7-5). Declines could be due to a smaller food base in Lake Superior (Weseloh and others 1999). Also, contaminants remain in the Lake Superior ecosystem and can continue to cause problems in certain areas (Ryckman and others 1997).

Table 7-5 Number of Herring Gull Nests (pairs) on Lake Superior in 1976-77, 1989-90, 1998 and 1999

	1976-78		1989-90		1999	
	pairs	colonies	pairs	colonies	pairs	colonies
Canada	6,410	149	12,181	299	1,115*	301*
% change from last survey			90.0%	100.7%	<-8.7%	<1.0 %
U.S.	7,106	90	13,263	187	7,715	134
% change from last survey			86.6%	107.8%	-41.8%	-28.3%

** Preliminary data, some sites missing; Compiled from: McKearnan, personal communication; C. Pekarik and C. Weseloh, personal communication; Cuthbert and McKearnan 1999.*

Double-crested cormorants have also seen unnatural fluctuations in their populations. It is believed that cormorants did not historically breed in Lake Superior and the Great Lakes. The

first suspected nesting occurred on the western end of Lake Superior in 1913 (Weseloh and Collier 1995). This was likely an eastward expansion of the Lake of the Woods population.

There was a continual expansion of cormorants into the Great Lakes, and by the late 1940s and 1950s the cormorant had become so common that control measures began, especially on the lower Great Lakes. People suspected that cormorants competed with commercial and sport fisheries. There were both sanctioned and unsanctioned control measures, including annual destruction of colonies by shooting adults and destroying eggs and young. Control measures largely ended by 1960.

Cormorant populations declined drastically throughout the 1960s and early 1970s. By 1973, breeding cormorants had completely disappeared from Lake Superior (Weseloh and Collier 1995). One of the leading reasons for the decline—if not the leading reason—was contamination by toxic chemicals. Cormorants, like many fish-eating birds, were producing thin eggshells because they had accumulated DDE in their system. They were breaking their eggs by lying on them. Deformities were also noted, probably caused by agents such as PCBs (Weseloh and others 1995).

In the mid-1970s, with decreased use of toxic chemicals, cormorants began a dramatic recovery. They increased by 300-fold between 1971 and 1995 in the entire Great Lakes region. Lake Superior saw a slower growth (Figure 7-4), mostly because it is less productive than the lower lakes, so it has a reduced food base. The rate of bill deformities also decreased (Weseloh and Collier 1995; Ryckman and others 1998).

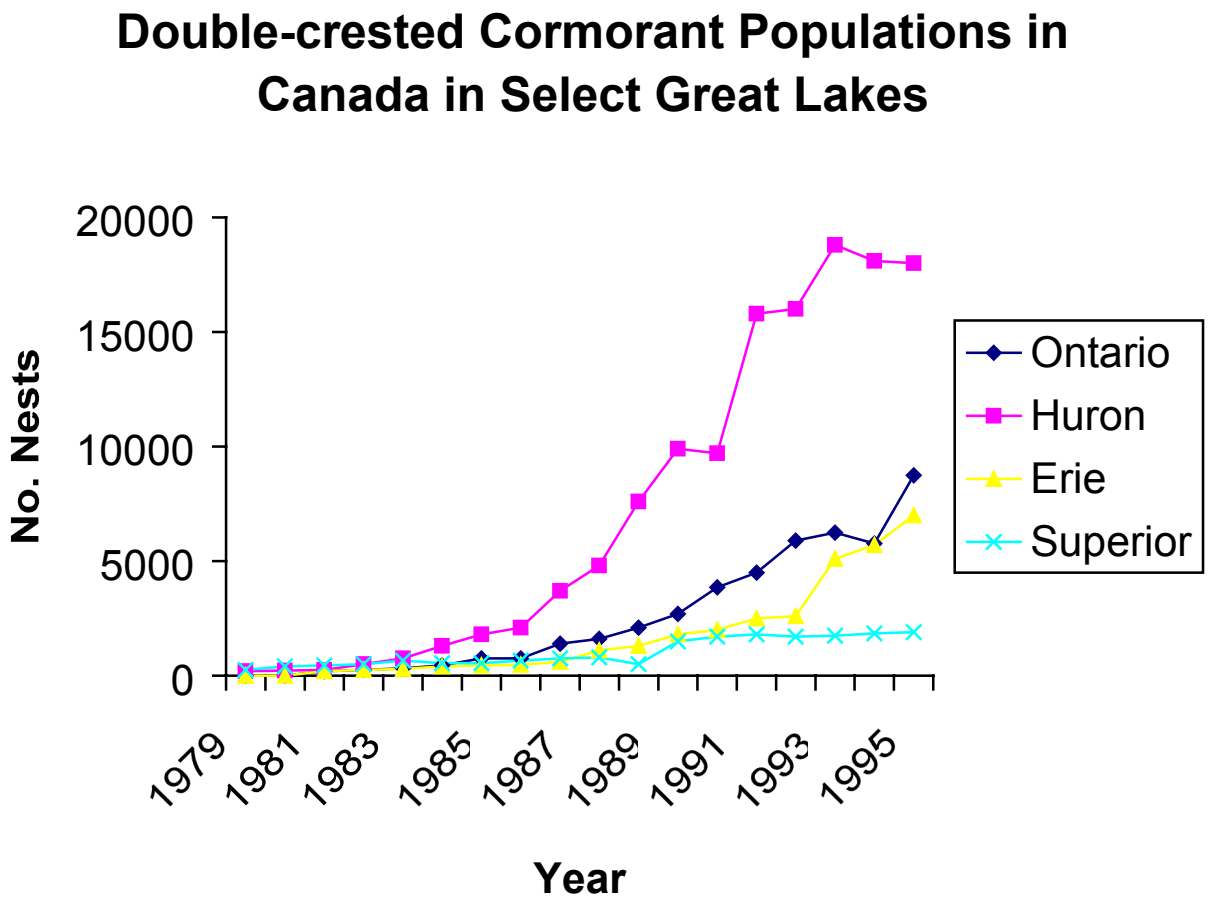

Figure 7-4. Double-Crested Cormorant Populations

Source: Weseloh and others 1999.

The American white pelican, generally considered a bird of the great plains/prairie regions of North America, has become established in the Lake Superior basin. Breeding colonies were discovered in the early 1990s on Lake Nipigon. These birds are believed to have come from breeding colonies on Lake of the Woods, which is located along the Manitoba/Ontario/Minnesota border (Bryan 1994 and Escott 1991).

Other Waterbirds

Shorebirds

Some information is available on the status of shorebirds east of the Rocky Mountains (Harrington 1995). Most information was gathered from migratory bird surveys and some from breeding bird surveys. Population trends were evaluated for 27 of 41 shorebird species. Of these,

12 showed no change, 1 increased, and 14 decreased. Some species that are of interest to the basin are: spotted sandpiper - no change; common snipe - significant decline; piping plover - endangered; American woodcock - significant decline.

Migration habitat is critical for many shorebirds. A high proportion of them migrate by visiting one or a small number of "staging sites," areas where the birds can accumulate fat. These staging sites are often productive areas with highly predictable but seasonally ephemeral "blooms" of invertebrates. The St. Louis River estuary at the Duluth-Superior Harbor is used by many species of shorebirds and could be a significant staging site for Lake Superior (Pat Collins, MN DNR, Two Harbors, personal communication). We are not aware of other heavily used sites on Lake Superior.

Common Loons

Most common loon pairs use inland lakes in the basin for breeding sites. Lake Superior is used by loons as a staging area, including Whitefish Point in Michigan. Isle Royale has a large loon population for its size, and some of these loons nest on Lake Superior (Michigan Loon Recovery Program 1992).

Loon reproductive success in Ontario decreased between 1981 and 1997. Loons breeding on acid lakes declined more rapidly than those on more alkaline lakes (Weeber 1999). In the upper Great Lakes, loons nesting on acid lakes were more susceptible to mercury contamination (Evers and others 1998).

Minnesota has the largest summer population of loons in the lower 48 states, and northeastern Minnesota is an important area (Strong and Baker 1991). Michigan had only about 300 pairs in 1988, and about 165 of these were in the Upper Peninsula (Michigan Loon Recovery Program 1992). Wisconsin saw an increase in its loon population from 1985 to 1995, probably due to good reproduction from 1986-1990, which was mostly weather-related (Daulton and others 1997).

Waterfowl

Lake Superior and the basin is not a hot spot for waterfowl production. The lake provides important habitat for migratory waterfowl, especially diving ducks. Coastal wetlands also provide important habitat for both breeding and migrating birds.

Information has not been compiled for the Lake Superior basin. Most waterfowl indices for North America are created from surveys done outside the basin. However, we can look at trend data for Minnesota, Wisconsin, and Michigan (Figure 7-5). Overall, waterfowl numbers are increasing, except for a few select species, such as the American black duck. The increase in numbers in North America is mostly due to ideal conditions in the prairie region and Alaska. Increase in abundance is also reflected in the data from Minnesota (U.S. Fish and Wildlife Service 1998). We don't know whether Lake Superior has contributed to waterfowl populations overall.

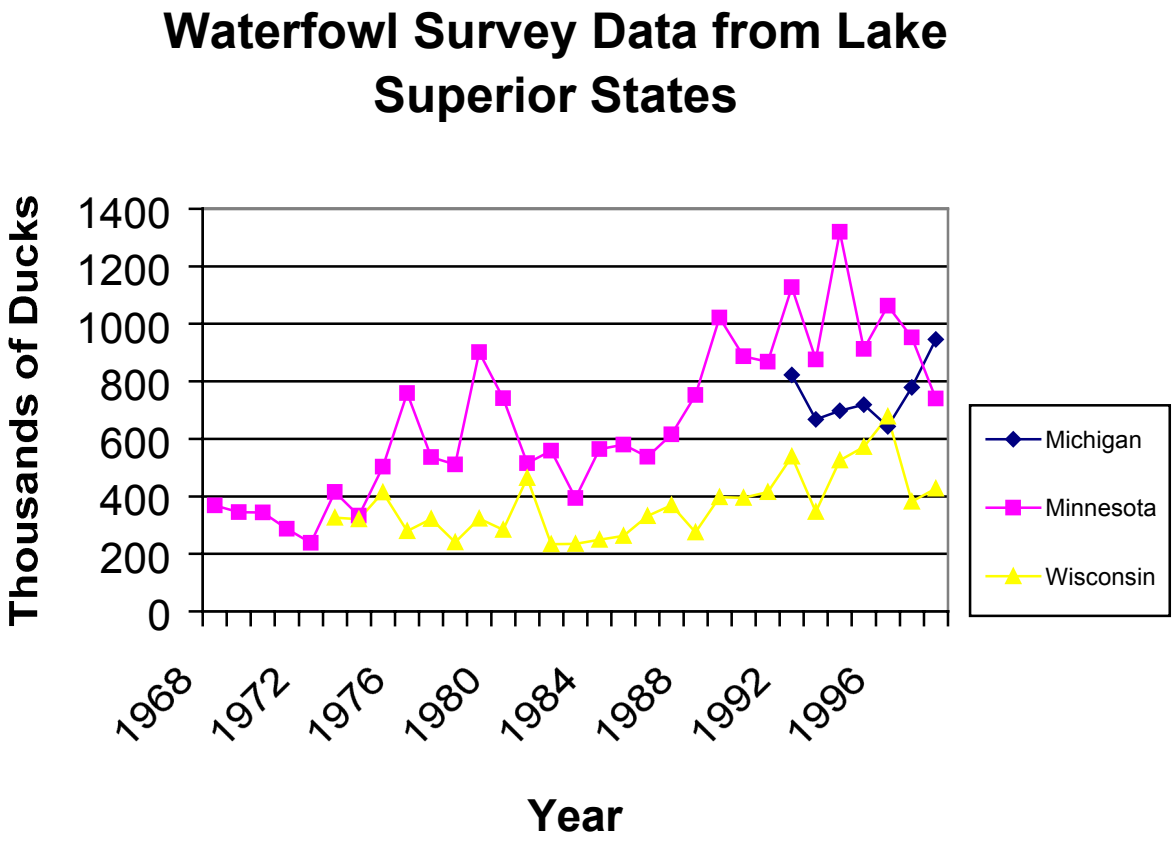

Figure 7-5. Waterfowl Survey Data
Source: U.S. Fish and Wildlife Service 1998.

Federally Threatened and Endangered Species

(Detailed information about these species is provided in the habitat chapter (Chapter 6) of the LaMP.)

Piping Plovers

The Great Lakes population of piping plovers remains precarious. The birds nest on sandy shorelines, which are often subject to human use. A recovery plan specifically for the Great Lakes is in draft form.

Bald Eagles

This species is soon to be delisted as a federally threatened species in the United States, but productivity of Lake Superior pairs remains uncertain. It is still listed as endangered in Ontario.

Kirtland's Warbler

The main population of Kirtland's warbler is found outside of the Lake Superior basin, but the population is expanding, and a few singing males have been counted in the Upper Peninsula of Michigan. It is possible that recovery efforts could involve habitat in the Lake Superior basin.

Peregrine Falcon

Successful recovery efforts allowed the peregrine falcon to be delisted in the United States in 1999. It was recently downlisted from endangered to threatened in 1999 in Canada; its status remains uncertain in the southern part of its range.

7.6.3.2 Unique Characteristics of Bird Habitat

Lake Superior is dotted with islands that provide important habitat for migratory birds, including colonial waterbirds, songbirds, and raptors (Blokpoel and Scharf 1999; Vigmostad 1999). Special considerations for these habitats include the fact that many of them are managed as national parks or protected in some way. They also provide an environment that is different from mainland habitat. They require special consideration in research, management, and protection.

7.6.3.3 Stressors of Birds

Chemical Contaminants

The presence of elevated levels of toxic chemicals coincides with poor health, reproductive impairments, and other physiological problems in herring gulls, as well as ring-billed gulls, double-crested cormorants, black-crowned night-herons, bald eagles, common terns, Caspian terns, and Forster's terns. This is related to reduced hatching success, eggshell thinning, abnormal adult behavior, deformed embryos, and hatched young, biochemical changes, endocrine disruption, and suppressed immune function (Fox and others 1998).

Currently, contaminants are being released or recycled by atmospheric deposition, agricultural land run-off, slow leaching of discarded stocks of pesticides and other chemicals from landfill sites and agricultural soils into the Great Lakes via groundwater and resuspension of contaminated lake/river sediments. On Lake Superior, up to 90 percent of toxic contaminants entering the lake comes from the atmosphere in the form of precipitation (Eisenreich and others 1981). Table 7-6 summarizes contaminant-related effects in fish-eating waterbirds.

Table 7-6 Summary of Some Contaminant-related Effects Observed in Herring Gulls and Other Fish-eating Waterbirds Inhabiting the Great Lakes.

Contaminant Effect	Evidence in the Great Lakes	Current Status
Eggshell Thinning - caused by high DDE levels in the 1950s, 1960s, and 1970s.	Resulted in widespread eggshell breakage, causing population declines of fish-eating waterbird species including double-crested cormorants, ospreys, bald eagles, black-crowned night-herons, and herring gulls.	Due to regulatory controls and banning of DDT, eggshell thinning is no longer a problem, resulting in improved reproductive success of affected species.
Reproductive Failure -causes include early embryonic death, embryo toxicity, and abnormal parental behavior during incubation.	Herring gulls, double-crested cormorants, and bald eagles were not reproducing during the late 1960s and 1970s when highest levels of organochlorines were present.	Due to significant declines in organochlorine levels, reproductive success has improved in most fish-eating waterbird species.
Biochemical Changes	Abnormal liver functions and low levels of Vitamin A may increase susceptibility to infectious diseases, possibly affecting the survival and development of young chicks.	Biochemical measures indicate that herring gulls are still chemically stressed. Full effect of biochemical changes on the reproduction or life span of waterbirds is not known at this time.
Suppressed Immune Function -several contaminants (e.g. PCBs and TCDDs) suppress important immune functions and can increase susceptibility to infectious diseases.	At highly contaminated sites, herring gulls and Caspian terns have suppressed T-lymphocyte function, atrophy of the thymus gland, and altered white blood cell counts.	Research is underway to determine the extent and significance of suppressed immune function in fish-eating waterbirds.
Congenital Deformities	Crossed bills, jaw defects, extra limbs, and malformed feet, joints, and eyes were found in herring gulls and at least eight other species of fish-eating waterbirds.	Waterbirds continue to display higher rates of deformities compared to clean sites outside of the basin. Studies continue on the links between contaminants and developmental problems in certain waterbird species.

Source: Ryckman and others 1997

Habitat

Habitat changes and landscape patterns have very strong effects on birds, especially migratory songbirds. Because the Lake Superior basin is primarily forested, the composition, size, and structure of forests strongly affects songbird species diversity, abundance, and productivity. For example, some songbirds prefer to nest in forest interiors (ovenbird), and others prefer disturbed, open habitats (indigo bunting). Some require dead, standing trees (pileated woodpecker), and some prefer dense shrubs under a canopy (black-throated blue warbler). Others prefer a mix of hardwood and conifer forests (black-throated green warbler). Therefore, habitat changes and forest management policies affect each species differently. However, the following habitat changes are known to be negative for forest birds in general and have caused stresses to populations:

- Even-aged stands of hardwoods with little understory decrease bird species diversity (Howe and Mossman 1995, Green 1995).
- Some bird species are dependent on conifers (Green 1995) or prefer conifers (Howe and Mossman 1995), and loss of conifers affects abundance of those species.
- Neotropical migrant birds often increase in diversity and abundance as woodland size in fragmented landscapes increases (Friesen and others 1995).
- Shape of woodlands also plays an important role. A woodland with minimal edge is likely to have greater bird production than one with maximum edge. Edge creates many problems, including increased predation, intrusion of invasive species, and human disturbance. Edges have the effect of increasing temperature and wind, and lowering humidity in the forest interior.
- Neotropical migrant birds consistently decrease in diversity and abundance as adjacent home development increases, regardless of forest size. This study was conducted in a heavy agriculture landscape in southwest Ontario with about 14 percent of the landscape wooded (Friesen and others 1995).
- Hard edges have a detrimental effect on most species of concern, even disturbance-dependent species such as indigo bunting (Suarez and others 1997). Soft edges and residual habitat in clearcuts are preferred (Merrill and others 1998, Suarez and others 1997).
- Large gaps without cover between woodlands are detrimental to some forest birds. The creation or preservation of woodland corridors for these species is important (Desrochers and Hannon 1997).

Even non-native plant species negatively affect bird productivity. For example, buckthorn, which replaces native hawthorn, lacks sharp thorns that might deter predators. A study showed that productivity of robins and wood thrushes decreased for birds nesting in non-native shrubs (Schmidt and Whelan 1999).

Habitat changes created by shoreline development affect many species of birds and create dramatic changes in avian community guilds. A study by Gillum and others (1998) showed that ground-nesting birds decrease in numbers as development increases, probably due to vegetation alteration, increased predation, and nest disturbance. Insectivorous species are less common along developed shoreline. The proportion of omnivores, nectivores, frugivores, or seed eaters is

two times greater at developed lakes than at undeveloped lakes. Concerns are mostly related to species that are considered source/core species of northern Wisconsin, such as ovenbird, hermit thrush, black-and-white warbler, black-throated green warbler, and brown creeper, because they are displaced by development. Intensive shoreline development also eliminates habitat for certain water-dependent species such as herons and kingfishers (Gillum and others 1998).

Human Disturbance

Species such as loons can be negatively affected by direct human disturbance. Unsuspecting recreational users sometimes chase birds off their nest, leaving eggs or chicks susceptible to heat or cold. Loons also become entangled in commercial trap nets, fishing lines and hooks, and ingest lead fishing sinkers (Michigan Loon Recovery Program 1992).

Songbirds that nest on or near the ground are susceptible to predation by domestic cats and dogs.

Invasive and Nuisance Species

Cowbirds

Brown-headed cowbirds parasitize the nests of songbirds, laying their eggs in the nests of other species. The adult songbirds raise and feed the cowbirds to maturity, reducing their own nesting productivity. Cowbirds thrive in edge habitat, especially if the edge habitat is near to mowed grass or pasture, which is where they feed. In the Lake Superior basin, cowbirds are a problem where human habitation is the greatest and in agricultural landscapes, but they are not a major concern in the basin overall.

Non-Native Plants

Non-native plants can have a negative effect on habitat structure, resulting in decreased biodiversity. Schmidt and Whelan (1999) showed the effect of non-native shrubs on robin and wood thrush productivity. Predation of both species was higher in non-native shrubs than in native shrubs and trees, likely due to structural differences in non-native plants that provided easier access for predators.

7.6.3.4 Management Efforts for Birds

In general, states, tribes, and the Province of Ontario have regulatory authority and management responsibility for resident wildlife, which includes resident birds. Federal governments have regulatory authority and management responsibility for migratory birds. Federal agencies that manage federal lands have management responsibility for both resident and migratory birds. However, many responsibilities for migratory birds are shared between states and the federal government. Some examples are:

North American Waterfowl Management Plan - Recognizing the importance of waterfowl and wetlands to North Americans and the need for international cooperation to help in the recovery of

a shared resource, the Canadian and United States governments developed a strategy to restore waterfowl populations to 1970s levels through habitat protection, restoration, and enhancement. The strategy was documented in the North American Waterfowl Management Plan signed in 1986 by the Canadian Minister of the Environment and the United States Secretary of the Interior, the foundation partnership upon which hundreds of others are built. In 1994, the Mexico Secretario de Desarrollo Social signed the Plan, expanding the efforts to protect wetlands and improve waterfowl populations. The Lake Superior basin is included in the Great Lakes/Upper Mississippi Joint Venture.

U.S. Shorebird Conservation Plan - The U.S. Shorebird Conservation Plan is a collaborative effort among researchers, land managers, and education specialists from the United States who cooperate with colleagues from Canada and Mexico to advance effective conservation of North American shorebird species. The plan was initiated in 1997.

North American Colonial Waterbird Conservation Plan - This effort was initiated in 1998. The mission is to create a cohesive, multinational partnership for conserving and managing colonially-nesting waterbirds (seabirds, wading birds, terns, gulls) and their habitats throughout North America. A plan will be implemented to maintain healthy populations, distributions, and habitats of colonial-nesting waterbirds in North America, throughout their breeding, migratory, and wintering ranges.

North American Bird Conservation Initiative - NABCI was initiated in 1999 by representatives of federal, state, and provincial agencies, as well as nongovernmental organizations, to create a framework that would foster coordination among bird initiatives with the aim of conserving all of North America's bird resources.

Circle of Flight - This program provides funding and technical assistance to lake state tribes for wetlands protection, restoration, enhancement, and management projects. Many tribes have reseeded and now manage wild rice beds under this program. Thousands of acres of wetlands have been restored or enhanced since the program's inception in 1991. The program is administered by the U.S. Bureau of Indian Affairs and U.S. tribes. It involves many partners.

7.6.3.5 Current Monitoring Efforts for Birds

Songbirds

North American Breeding Bird Survey - Established in 1966, this program is a joint effort of Canada and the United States. Volunteers and natural resource agency employees complete selected roadside counts once a year. This program provides long-term trend data over a broad geographic area. The information is not currently compiled or analyzed for the basin.
Ontario Forest Bird Monitoring Program - This program began in 1987. Its goals are to: 1) compile a habitat-specific baseline inventory of forest songbirds, 2) describe changes over time in the numbers of forest songbirds in relation to habitat and landscape characteristics, and 3) contribute to an understanding of population trends for forest birds in Ontario. This information supplements breeding bird survey data (Cadman and others 1998).

Ontario Landbird Monitoring Strategy - This program encompasses all landbird monitoring, including breeding and migration monitoring. It is part of the Canadian Landbird Monitoring Strategy.

Marsh Monitoring Program - The Marsh Monitoring Program began in 1994 in order to monitor the condition of marshes in the Great Lakes basin, using marsh birds and amphibians as indicator species. Volunteers survey marsh birds, amphibians, or both. The Marsh Monitoring Program is a cooperative venture of Environment Canada and Bird Studies Canada. Migration monitoring is done at Thunder Cape, Ontario; Whitefish Point, Michigan; and Hawk Ridge, Duluth, Minnesota.

Songbird monitoring is conducted on many public lands to measure the effect of management on avian populations. Lands that are monitored in the basin include: U.S. national forests (Chequamegon Nicolet, Superior, Ottawa), U.S. national parks (Apostle Islands and Isle Royale), tribal lands (Red Cliff and Bad River), and national wildlife refuges (Whittlesey Creek).

Colonial Waterbirds

Herring gulls are monitored for contaminants, populations, and productivity. The herring gull is considered one of the major indicator species for environmental contamination in the Great Lakes. This program has been in place for more than 25 years and is one of the longest running wildlife monitoring programs for contaminants in the world. Two of the 15 monitoring sites are on Lake Superior: at Granite Island, east of Thunder Bay, and at Agawa Rocks, south of Wawa. Populations of cormorants, gulls, terns, and herons are monitored in the entire Great Lakes on both the Canadian and United States sides at varying intervals.

Waterfowl

Breeding pair and brood surveys are conducted in Minnesota, Michigan, Wisconsin, and Ontario, but a large area of the basin is not included in these surveys.

Loons

State and provincial agencies along with various loon watch programs monitor breeding pairs and productivity.

Work was recently initiated by the BioDiversity Research Institute to monitor contaminants in loons.

Bald Eagles

Nesting pairs are monitored along the Great Lakes and inland lakes in the basin by the states and Ontario. Productivity is monitored in select areas.

Habitat

Habitat changes at the landscape level are being monitored using computerized geographic information system (GIS) software. Satellite photographs, starting from the late 1980s, have been interpreted (at 200 x 200 meter resolution) and entered into GIS data layers

7.6.3.6 Gaps in Bird Information

Little information has been compiled specifically for the Lake Superior basin, but there is a lot of information available, especially for breeding birds, loons, bald eagles, and colonial waterbirds. Once the information is compiled for the basin, an analysis should be conducted to determine where the information gaps are.

Monitoring was initiated on contaminants in tree swallows, but work has slowed due to lack of funds.

The ongoing GIS data could be developed at a finer resolution (50 x 50 m) and interpreted every ten years to allow comparison over time. Linkages need to be made with landscape-scale habitat changes to songbird communities.

7.6.3.7 Challenges for Birds

Lake Superior forests provide very important habitat for migratory songbird populations, some of which probably serve as source populations for other areas. With concerns expressed nationwide over the decline of neotropical migrants, the Lake Superior basin should be considered a critical region for migratory songbird conservation. Significant work continues on population monitoring; some of this is being linked to habitat changes at the landscape scale. The Binational Program would be a logical organization to work toward compiling this information for the Lake Superior basin and providing it to project partners. The Binational Program should also provide recommendations for habitat conservation strategies to its project partners and to local units of government in the throes of land use planning.

Conservation of migratory songbirds remains uncertain because of the complex interactions between birds and their landscapes. However, Howe and others (1995) provide some recommendations that can be used to help guide conservation and management efforts. They include: 1) establish realistic conservation goals at several administrative levels, 2) select species that can be used as guidelines, 3) identify specific populations where priority species occur and implement appropriate management in these locations, 4) coordinate planning strategies among forest management units, and 5) design monitoring strategies to track populations and management actions.

Contaminant levels are being monitored in colonial waterbirds. This work needs to continue and should be coordinated closely with other contaminant studies being conducted in the basin. This is especially critical considering the goal of zero discharge for the Lake Superior basin.

7.6.4 Amphibians and Reptiles

7.6.4.1 Status and Trends of Amphibians and Reptiles

Little work has been done on amphibians and reptiles in comparison to other vertebrates. Until 10 to 15 years ago, few agencies and organizations even considered them in conservation efforts. Therefore, historical population data is mostly incidental. Species ranges are often derived from museum collections and records. Current efforts to monitor populations and to study the effects of anthropogenic influences have given us an increased awareness and concern for amphibian and reptile communities.

There are approximately 17 species of amphibians and 14 species of reptiles in the Lake Superior basin. Generally, the abundance and diversity of amphibians and reptiles is dependent on climatic conditions. The short growing season and cold, severe winters limit the number of species that can survive in the Lake Superior basin.

Species richness is more limited in the northern end of the basin. Eight reptile species may occur within the Ontario portion of the basin; however, at least half of these species have very limited ranges because they are at the extreme northern limit of their distribution. Fifteen amphibian species are found within the Ontario portion of the basin.

Populations of amphibians and reptiles are affected by many factors, and the overall trend for any species is not known. As with many vertebrates, the widespread changes in habitat cover across the landscape have had a dramatic effect on the community composition of amphibians and reptiles. For example, areas in the southern part of the basin that were historically mixed forest probably included species such as redback and blue-spotted salamander and species that are dependent on logs and downed branches, such as American toads, wood frogs, and redbelly snakes (Oldfield and Moriarty 1994). If those areas are logged and converted to agricultural lands, the amphibian species composition changes to those tolerant of human disturbance. Even then, the habitat must contain cover, a prey base, and water. Where these are present, American toads, garter snakes, and painted turtles might be present (Oldfield and Moriarty 1994).

Estimates of population trends for amphibian species in Wisconsin and Minnesota are available (Table 7-7). Local population declines of many amphibians are becoming a concern worldwide. Many possible reasons exist for these declines (see stressors section). Monitoring programs have been initiated to document trends.

Table 7-7 Status of Amphibian Species Found in the Lake Superior Basin in Minnesota and Wisconsin

Species	MN	WI
Wood frog	→	↑
Northern leopard frog	→↓	↓
Pickerel frog		↓
Mink frog	?	?
Green frog	→	→
Chorus frog	?	→
Northern spring peeper	→	↓↓
Eastern gray treefrog	→	→
Cope's gray treefrog	?	↓
Blanchard's cricket frog	SC	SE
American toad	→	→
Blue-spotted salamander	→	→
Eastern tiger salamander	↓?	
Spotted salamander		→
Four-toed salamander	?	SC
Redback salamander	→	
Mudpuppy	?	?

? – unknown, → - relatively stable, ↑ - increasing, ↓ - decreasing
SE - State Endangered, SC - Special Concern
Compiled from Casper 1998; Moriarty 1998; Mossman and others 1998

Some specific examples of species found in the basin and their estimated status are listed below.

Blue-Spotted Salamander

This is a relatively widespread species, which is tolerant of both cold temperatures and human habitat disturbance. They may be common in woodlands with the required breeding ponds. They are tolerant of selective logging and low-density residential development, as long as the critical parts of the habitat remain intact. Local populations are threatened by clear-cuts and roads that separate breeding ponds and terrestrial habitats (Harding 1997).

Northern Spring Peeper

Spring peepers are common in the Lake Superior basin. They require temporary and permanent ponds, marshes, or ditches for breeding. After breeding, they disperse to old fields, woodlands, and shrubby areas. They remain abundant, but their wetland habitats must be conserved to ensure they do not become a species of concern (Harding 1997).

Northern Leopard Frog

The leopard frog is probably one of the best known frogs, largely because it was often dissected in school biology labs. It is a widespread, ubiquitous species, but there have been significant declines in parts of its range, including Minnesota, Wisconsin, and Ontario (Mossman and others 1998; Casper 1998; Moriarty 1998; Seburn and Seburn 1997). Leopard frogs were completely absent from a large area of northern Ontario in 1997, indicating a major population decline there (Seburn and Seburn 1997). Collections by biological supply houses have been suggested as a potential problem, but there could be other reasons for the decline, such as disease, weather, and exposure to ultraviolet radiation (Seburn and Seburn 1997).

Snapping Turtle

The common snapping turtle is a large freshwater turtle that can live as long as 50 years. They are fairly common in the southern part of the basin, but they are at the edge of their range in Ontario. They are omnivorous, and because they eat a lot of animal matter, they may be exposed to higher concentrations of contamination than most other turtle species, which are mainly vegetarian. Their eggs, which are laid in sand next to water, are often eaten by skunks, foxes, and raccoons, and hatchlings are often eaten by avian predators. The adults are harvested for their meat. Snapping turtles are often thought of as common, but all the factors listed here make them vulnerable to population declines (Shirose and others 1996).

Wood Turtle

The wood turtle is found in the southern part of the basin and may occur in Ontario near Sault Ste. Marie. It is rare in the basin, and its numbers are thought to be declining. Like the snapping turtle, it is long-lived, but it does not reach maturity in northern latitudes until 14 to 18 years of age. A female lays one clutch of eggs, which are quickly taken by mammalian predators. It was collected by biological supply houses until recently, it is a target of people collecting turtles for the pet trade, and it is also harvested for food. Its home range can be very small (0.25 ha) to relatively large (100 ha) (K. Smith, personal communication), making it vulnerable to habitat loss and direct exploitation. (Harding 1997; Oldfield and Moriarty 1994).

It is important to understand how amphibians respond to changes in the ecosystem. Most amphibians are secretive, so it isn't readily obvious that they constitute a large percentage of the biomass of terrestrial ecosystems. Because amphibians and reptiles are often in the middle of the food chain, their presence or absence causes a shift in patterns of predation. (Stebbins and Cohen 1995).

It is also important to consider metapopulations (a metapopulation is a network of semi-isolated populations with some level of regular or intermittent migration and gene flow among them, in which individual populations may become extinct but may be recolonized by other populations). This is especially important in areas that are being quickly developed because amphibian populations are becoming isolated (Casper 1998). Even where they are not isolated, conservation efforts need to keep in mind that individuals of many reptiles and amphibian species travel

between sites, which increases genetic viability. This is also important where certain conditions (such as drought) might temporarily create population sinks.

7.6.4.2 Unique Characteristics of Amphibians and Reptiles

Blaustein and Wake (1995) did a good job of describing the special characteristics of amphibians:

"*Amphibians are valuable as gauges of the planet's health for a few reasons. First, they are in intimate contact with many components of their natural surroundings. For example, as larvae, frogs live in water, but as adults most find themselves at least partially on land. Their moist, delicate skins are thin enough to allow respiration, and their unshelled eggs are directly exposed to soil, water and sunlight. As larvae, they are herbivores and as adults, carnivores. Because amphibians sample many parts of the environment, their health reflects the combined effects of many separate influences in their ecosystems. Second, these animals are good monitors of local conditions because they are homebodies, remaining in fairly confined regions for their entire lives. What happens to frogs and their brethren is happening where humans live and might affect our species as well*."

A unique characteristic of turtles is their longevity. Certain turtle species, such as wood turtles, can live as long as 40 years. This is very important given the fact that their annual productivity is often low and they do not reach maturity until they are 12 to 20 years old (Harding 1997). They lay eggs in sandy beaches, and these are often completely destroyed by predators. When adult turtles are collected and harvested, the remaining adults cannot replace the population with enough young to keep it viable. Collection of turtles for contaminant analysis has been discontinued for this reason (Brooks and others 1987 and Galbraith and others 1987); tissue from their eggs provides sufficient information to analyze contaminant levels.

Concerns about amphibian abnormalities have been in the news for the past five years, since the highly publicized 1995 discovery of deformed leopard frogs by middle school students in Minnesota. Since then, reports of abnormalities have surged, and a North American database and reporting system was established through the U.S. Geological Survey. The North American Reporting Center for Amphibian Malformations is now a repository of data about amphibian deformities. A web site has also been established to make this information easily accessible.

Experts have been conducting studies to try to determine the causes of these deformities, looking mainly at parasites, chemical contaminants, ultraviolet light, temperature, and other environmental factors. According to a recent report by Jamie K. Reaser (U.S. Dept. of State) in FROGLOG (a newsletter published by the International Union for the Conservation of Nature [IUCN] Declining Amphibian Population Task Force), it is unlikely that any one particular factor can be singled out as the cause. Different factors, such as chemical contamination, UV light, and parasites, operate by similar mechanisms, impacting similar ecological and developmental pathways to cause abnormalities.

7.6.4.3 Stressors of Amphibians and Reptiles

Stressors to amphibian and reptile populations are not clearly defined for the Lake Superior basin, but we will assume that the problems noted for the Upper Midwest and Canada are reflected in the Lake Superior basin. Stressors can be related to global problems and to local problems. Global problems include the increase of ultraviolet radiation from depletion of the ozone, acid precipitation, and bioaccumulation and transport of toxic chemicals such as DDT. Local problems are related to habitat loss and fragmentation, direct impact from chemical applications such as pesticides and herbicides, infectious diseases, and invasive species.

Habitat

Degradation and loss of habitat is a concern for many species, especially those dependent on wetland habitats. Degradation of wetlands is caused by eutrophication, pollution, scouring, addition of non-native fish, and loss of surrounding upland habitat. Loss of plant diversity due to invasion of exotic, invasive species can affect invertebrate populations, which can in turn affect the health of amphibians and reptiles (Casper 1998). Changes in land use surrounding wetlands and aquatic habitats may increase sedimentation rates (Casper 1998; Lannoo 1998). Clear-cutting may affect amphibians by changing soil moisture and acidity (Blymyer and McGinnes 1977). Woodlands that are managed by removing mature trees before they fall would not be suitable habitat for species that require litter and downed logs. Habitat fragmentation also causes loss of migration corridors and loss of the mosaic of wetland types that are often critical for amphibian life cycles, especially during drought years. Some species move from a seasonal pond to a permanent pond during dry years (Lannoo 1998). Migration corridors for reptiles are often disrupted by roads and trails, which can directly cause mortality of turtles (Oldfield and Moriarty 1994).

Ultraviolet Radiation (UV-B)

Ambient UV-B radiation can directly or indirectly kill some amphibian eggs under both field and laboratory conditions (Blaustein and others 1994, 1995, 1997). The depletion of the ozone has increased the amount of UV-B radiation striking the earth, which might be one of the reasons why amphibian populations in relatively pristine habitats are declining. The increase in UV-B radiation might have a synergistic effect, by making amphibians more susceptible to diseases.

Invasive Species

Zebra mussels and rusty crayfish alter the native prey base of areas they invade. Zebra mussels are voracious consumers and can drastically reduce the zooplankton population, leaving other native invertebrates little to eat. This can result in a drop in native invertebrate populations and less food for amphibian larvae. Rusty crayfish can wipe out native plants, which are used by invertebrates for food and shelter. The result is similar to zebra mussels, with a lower invertebrate population and less food for amphibians and reptiles.

The non-native plant, purple loosestrife, invades and dominates wetlands. These wetlands lose many microhabitats that are needed by invertebrates, causing a decrease in invertebrate diversity, which can negatively affect amphibians and reptiles in their aquatic stage.

Contaminants

Many studies have been done on contaminants and their effects on amphibians and reptiles, but most were laboratory studies, so little information is available about direct and indirect effects. More research needs to be done to better understand the direct, indirect, and cumulative effects of contaminants on reptiles and amphibians. Agricultural chemicals could be a significant cause of toxic effects, but this needs to be better investigated. Habitat fragmentation and destruction, compounded by pollution of some of the remaining, otherwise suitable habitat, as well as loss of the corridors between suitable areas, may have a devastating impact on the viability of amphibian metapopulations (Diana and Beasley 1998).

Some turtle species are long-lived and consume animal matter, making them especially susceptible to contamination by toxic pollutants (Shirose and others 1996).

Infectious Diseases and Parasites

Outbreaks of infectious diseases may be an important indicator of stress and environmental mismanagement. The effects of a disease might not be as dramatic if the population were not already stressed. The protection of suitable habitat and maintenance of a diverse gene pool are of critical importance in limiting the ultimate impact of a range of infectious agents (Faeh and others 1998).

Other

Introduction of fish, crawfish, and bullfrogs into naturally fishless ponds and wetlands can cause several problems. Introduced species may provide direct competition for food, and they may prey on the larval or fledgling stages of native amphibians and reptiles.

7.6.4.4 Management Efforts for Amphibians and Reptiles

All states within the Great Lakes and Ontario have protective laws and regulations that affect amphibians and reptiles (Harding 1997).

In Ontario, the Fish and Wildlife Conservation Act (FWCA) of 1997 lists all reptile species, with the exception of the common snapping turtle, as specially protected reptiles. The snapping turtle may be harvested within specified seasons and bag limits under the authority of an angling license. Of the 15 amphibian species found within the Ontario portion of the basin, only the salamander species and the gray treefrog are listed as specially protected under the FWCA. The frog species are not offered special protection, and, with the exception of the bullfrog, there are no harvest seasons in place. Bullfrogs may be harvested only within specified areas, seasons, and bag limits in Ontario.

The MN DNR keeps track of turtle harvest (those harvested for food). Turtles and frogs are collected by biological supply houses, under license by the MN DNR, without restriction. Minnesota law protects wood turtles and Blanding's turtles. A bounty system for rattlesnakes was removed in 1989. Minnesota Herpetological Society and the Nongame Wildlife Program are attempting to raise the awareness of conservation needs, to conduct inventories, and to protect important habitats.

The WI DNR regulates the taking of amphibians and reptiles. They specify seasons for some species of frogs and turtles and regulate the method of capture. They also limit the size of some species, such as snapping turtles. State threatened or endangered species may not be collected except by special permit.

The MI DNR protects species that are listed as threatened or endangered. Reptiles and amphibians that are listed as special concern by the MI DNR require a permit for collection (Lori Sargent, personal communication).

The IUCN established a Declining Amphibian Population Task Force (DAPTF) in 1991. The DAPTF includes a network of over 3,000 scientists and conservationists belonging to national and regional working groups, which cover more than 90 countries around the world. Ultimately, the DAPTF hopes to understand why populations are declining and develop conservation programs to stabilize them. A Great Lakes working group was established, which covers Minnesota, Michigan, and Wisconsin. Canada has established a Canadian Amphibian and Reptile Conservation Network as part of DAPTF.

Partners in Amphibian and Reptile Conservation is a public-private network that was established in 1999 to facilitate greater conservation efforts for amphibians and reptiles in North America, encouraging the use of partnerships to facilitate successful work. Modeled after the successful Partners In Flight program, its focus is to protect amphibian and reptile populations and habitats to "keep common species common." A Midwest Working Group formed in September 1999 includes the Lake Superior basin.

7.6.4.5 Current Monitoring Efforts

North American Amphibian Monitoring Program - This program was established by the Declining Amphibian Populations Task Force. It encompasses Canada, the United States, and Mexico. The purpose of the program is to collect information to monitor populations on a global basis. It includes frog calling surveys and terrestrial salamander monitoring. Monitoring protocols along random routes are established and conducted mostly by volunteers. Surveys in the Great Lakes region are coordinated by state and provincial agencies. Routes are included in the Lake Superior basin, but the data has not been compiled for the basin.

Ontario has several surveys that monitor amphibian populations, mostly frogs and toads. These programs are: Backyard Survey, Road Call Count Survey, Marsh Monitoring, and Adopt-A-Pond/Frogwatch. Backyard Surveys are conducted by volunteers who record species and calling

intensity from their backyard or cottage on a daily basis. This program and the Road Call Count Survey is coordinated by the Canadian Wildlife Service. The Road Call Count Survey establishes routes that have stations from which observations are made. These surveys are also conducted by volunteers, who run the route three times during the spring and summer. The Marsh Monitoring Program's purpose is to monitor the health of wetland ecosystems in the Great Lakes basin, including 43 Areas of Concern around the Great Lakes. Marsh Monitoring includes an amphibian roadside survey, following the same protocols as the Road Call Count Survey mentioned above. Routes are also conducted outside of the Areas of Concern. This is coordinated by Bird Studies Canada.

Frogwatch USA is a new program established in February 1999. It is modeled after Frogwatch Ontario. Volunteers across the United States submit observations on their local amphibian populations by choosing and periodically monitoring a wetland site for calling frogs and toads. Adopt-A-Pond/Frogwatch in Ontario is coordinated by the Toronto Zoo and is similar to the Frogwatch USA program. This data is submitted to the Natural Heritage Information Centre of the OMNR. Both U.S. and Canadian programs allow citizens an opportunity to learn about the amphibian community in their area, as well as an opportunity to become involved in monitoring.

Some tribes and First Nation groups have initiated frog and toad surveys on native lands and project areas, including Bad River and Keweenaw Bay.

7.6.4.6 Gaps in Information about Amphibians and Reptiles

More routes and surveys are needed for all amphibian and reptile monitoring programs in the Lake Superior basin.

Monitoring protocols should be agreed to for amphibian and reptile surveys. Existing information for the Lake Superior basin should be compiled.

Few surveys are being conducted for reptiles, and those are usually very local or incidental. Monitoring programs should be established and followed.

Reasons for population changes for both amphibians and reptiles need to be identified.

7.6.4.7 Challenges for Amphibians and Reptiles

Most conservation and management actions have focused on vertebrate species that are either visible or harvested. Amphibians and reptiles can be highly observable at certain times of the year and are also harvested, yet they have been ignored in management plans in the past. An ecosystem approach to conservation should encompass habitat for all species, as well as all ecosystem functions. If the Binational Program is concerned with overall ecosystem health, then we need to pay closer attention to amphibians and reptiles in our inventories, planning work, actions, and monitoring efforts.

7.6.5 Invertebrates

7.6.5.1 Status and Trends of Invertebrates

About 90 percent of the nearly one million species of animals in the world are terrestrial or aquatic invertebrates (animals without backbones). In the Great Lakes region the larger, more easily seen invertebrates include insects and mollusks, such as snails and clams. Insects are the most diverse group and globally may have the largest collective biomass of all terrestrial animals. Yet, within the Lake Superior basin, we have little information on status and trends of the insect or terrestrial invertebrate populations. The groups are too large to encompass, and taxonomic problems have impeded the development of status and trend information.

Along with an appreciation of the interaction between plants and animals, the role of soil invertebrates, fungi, and microorganisms in ecosystem functioning must be understood. Interdependencies of every part of the biotic community, including the decomposers, must be taken into account. The complex spatial and temporal heterogeneity of habitats and species response to disturbance has to be understood. We have very little information on this, and new research must be initiated in this area.

7.6.6 Plants

7.6.6.1 Status and Trends of Plants

Green plants form the base for all animal life, and yet protection of plants in the ecosystem has not been associated with the protection of wild animals. The term wildlife has been traditionally used to refer to wild animals only. This gross misconception must be corrected. It is evident from the long list of rare and endangered plants in the Lake Superior basin (see habitat committee section) that the number of endangered plants far exceeds that of wild animals. For every threatened animal there are two or more endangered plants. This connection between wild plants and animals must be clarified and highlighted to the professionals and to the public. The importance of plants to the survival and well being of wild animals must be recognized and factored into the equation of wildlife conservation.

The habitat section of the LaMP includes status and trend information on plants and habitat, including threatened and endangered species. States and Ontario are interested in managing and protecting unique plant communities, representative plant communities, and also rare plants. Each state and Ontario has listed plant species that are rare or of special concern in their area. The federal agencies have also listed plants that are nationally threatened or endangered.

7.7 MOST SIGNIFICANT NEEDS

The following is a summary of the most significant needs (problems, challenges, and opportunities) facing terrestrial wildlife communities in the Lake Superior basin. The Binational Program will advocate and act as a catalyst to address these significant needs. Each need is tied to one or more strategies listed in Section 6. These needs have not been prioritized.

A. Habitat and land use changes have been very substantial in the basin, especially over the last 150 years. Terrestrial wildlife communities have shifted and changed in response, resulting in population increases for some species and population declines for others. The biggest challenges related to these changes are to 1) agree to the most feasible landscape mosaic that will support sustainable wildlife communities, and 2) work with partners to develop this landscape mosaic. This work must include an ecosystem approach to conservation and management.

Strategies that fit this problem/opportunity: A, B, C, D

B. Invasive species are causing major reductions in biodiversity where they dominate the landscape. Prevention and control is necessary to address this issue.
Strategies that fit this problem/opportunity: G, M

C. Little or no work has been done to compile existing information or to manage terrestrial wildlife communities on a basinwide basis.
Strategies that fit this problem/opportunity: H, I

D. Significant work has been done to recover some species in the basin; this work should continue and should be supported.
Strategies that fit this problem/opportunity: L

E. Forest management remains a critical activity that affects all wildlife communities, especially forest birds, amphibians, reptiles, and invertebrates. Forest structure, size of stands, and presence of large woody debris seem to be important characteristics for many wildlife communities. Planners and policy makers should work toward a landscape that encompasses all forest successional stages in various size parcels.
Strategies that fit this problem/opportunity: A, B, C, D

F. Terrestrial wildlife includes plants, animals and associated microorganisms. Many people think of wildlife in terms of individual species such as deer, grouse, ducks, and songbirds. Less often do they think of wildlife in terms of their functions in the ecosystem as a whole.
Strategies that fit this problem/opportunity: B, C

G. Additional work is needed to understand the role of invertebrates and microorganisms in terrestrial ecosystem health.
Strategies that fit this problem/opportunity: I, J

H. There is a great need to integrate the principles of wildlife community conservation into land use decisions at the federal, tribal/First Nations, provincial, state, local, and private planning level.
Strategies that fit this problem/opportunity: B, C, D

I. The effect of contaminants on many terrestrial wildlife species and populations remains unknown. Some species, such as bald eagles, are recovering as a result of decreasing contaminant levels, but many questions remain about the effect of contaminants on amphibians, reptiles, and mammals. Contaminants remain in the Lake Superior basin and are being transported from outside the basin.
Strategies that fit this problem/opportunity: E

K. Work should continue on understanding the long-term effects of herbivory on plants and animals.
Strategies that fit this problem/opportunity: J

L. GIS land cover classification is being initiated for the basin and should continue to be refined and updated at least every 10 years. This GIS land cover data needs to be linked to wildlife communities.
Strategies that fit this problem/opportunity: I, J

7.8 STRATEGIES

Meeting the mission and goals for terrestrial wildlife communities in the Lake Superior basin will require that a number of broad strategies be addressed. These strategies will be implemented not only through actions of participating agencies and organizations of the Lake Superior Binational Program (LSBP), but also through partnerships with many other individuals and organizations.

Projects that are committed to by LSBP members are identified in this chapter. Those projects in need of sponsorship and funding are also identified. Some projects could not be included at this time, and others are documented in the habitat chapter. The role of the LSBP will be to foster the implementation of those and other projects.

Many proposed projects are identified with inventory and monitoring strategies. This reflects the extent of the need for this work as identified by the partners of the Terrestrial Wildlife Community Committee. However, several strategies show no committed or proposed projects; these strategies will require action if we are to make progress.

STRATEGIES

A. Develop action-oriented regional and watershed-scale management plans. Support the implementation of protection and restoration actions recommended in these plans.

STRATEGY A COMMITTED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Whittlesey Creek National Wildlife Project	USFWS, DU, ALC, TU, others	Restore and protect habitat for anadromous trout and salmon of Lake Superior, protect habitat for waterfowl and other migratory birds, reintroduce coaster brook trout, and protect an important Lake Superior coastal wetland. About 40 acres of land were purchased in 1999; the plan is to eventually acquire 540 acres in fee title and several thousand acres in easement. The refuge is adjacent to the new Northern Great Lakes Visitors Center, a multi-agency regional visitor center.
STRATEGY A PROPOSED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Watershed Analysis and Restoration	Lake Superior NF's, with partners including MN DNR, MI DNR, WI DNR, GLIFWC, Tribes, etc.	Analyze watersheds and implement activities that will protect and maintain their health, and restore their composition, structure, and functions when impairments are found.
Ecology and Stability of Riparian-aquatic Interfaces of Boreal Forest Streams in NW Ontario	Lakehead University	Determine the structural and functional stability of the riparian buffer zone reserves along several boreal streams (approximately 500 sq. km.). A GIS-based model will be developed to predict the riparian zone structure and aquatic community characteristics from catchment-scale attributes.

B. Encourage land use planning efforts that are targeted at protecting and restoring wildlife while also maintaining economic viability of local communities.

STRATEGY B COMMITTED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Forest Management Planning	OMNR	For each Forest Management Unit in Ontario, a 5-year management plan must be prepared. The process includes extensive public consultation and detailed planning for timber extraction, road construction, protection and maintenance of wildlife habitat, tourism, and recreational opportunities.
Forest Management Planning	Bad River LSC, Red Cliff LSC, LSB National Parks, LSB National Forests, MN DNR, MI DNR, WI DNR	Prepare forest management plan. The process includes extensive public consultation and detailed planning for timber extraction, road construction, protection and maintenance of wildlife habitat, tourism, and recreational opportunities.

C. Foster an understanding of the relationship between individual (personal, organizational, and government agency) land use decisions and cumulative effects on ecosystem integrity. Compile Best Management Practices that are conducive to sustainable terrestrial wildlife communities.

STRATEGY C COMMITTED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Minnesota Loon Watcher Program	MN DNR	Lakeshore residents report on loon use of lakes, with notes on problems and concerns.
Lakescaping Workshops	MN DNR	Workshops are planned across the State of Minnesota. Two workshops to be held in St. Louis County. Workshops promote the need to protect shoreline and aquatic native vegetation around lakes in order to protect wildlife. Information is provided on native plant species and on landscaping with these species.

STRATEGY C COMMITTED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Wildlife Tourism Workshops	MN DNR	Workshops are planned across the State of Minnesota to promote awareness of alternative forms of tourism such as bird watching, nature photography, and wildlife watching. One workshop was held in Duluth in 1999. Two are planned for Ely and International Falls in year 2000. Workshops will be continued past 2000 pending funding. The objective of the workshops is to heighten the appreciation of natural and wild landscapes so these can be protected in spite of the increase in recreational development.
STRATEGY C PROPOSED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Post Logging Impact Study	Ottawa NF, MI DNR, GLIFWC, Tribes	Establish a post-logging study to assess the impact of timber harvesting on understory vegetation, based on the evaluation of historical studies to date.
Sharptail Grouse Habitat Video	WI DNR, UW Extension	Produce a public education video to increase awareness about the land management needs to provide suitable sharptail grouse habitat in the Douglas and Bayfield County barrens. In addition, build a demonstration site from current management near Solon Springs, WI.

D. Implement actions that consider all ecosystem components in planning and implementation. Demonstrate positive results of basinwide, landscape-scale, intergovernmental planning and collaboration.

STRATEGY D COMMITTED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Upper Peninsula of Michigan Coastal Wetland Project	USFWS, DU, MI DNR, KBIC, BMIC, GLIFWC, TNC, WPBO, Village of L'Anse, Ottawa NF, NRCS, Private Landowners, UPRCD	This multi-phase landscape-scale project will protect, restore, and manage coastal wetlands and associated uplands in the Lake Superior and St. Mary's River watershed in Michigan. Phase I, initiated in 1999, includes nine focus areas in the Lake Superior basin of the UP of Michigan. Specific project activities include acquisition of fee title or conservation easements by government agencies or conservation organizations. The project will preserve 1,237 acres of wetlands and 11,537 acres of associated uplands. Also 7,847 feet of Lake Superior shoreline will be protected from development, 3,347 feet of which are identified as "essential breeding habitat" in the draft Piping Plover Recovery Plan. The project will benefit migratory birds, rare species, and unique habitats.
Superior Coastal Wetland Initiative	USFWS, Bad River Band of LSC, Red Cliff Band of LSC, WI DNR, TNC, DU, TU, Douglas, Bayfield, Ashland, Iron Counties Land Conservation District, NRCS, landowners, GLIFWC, Chequamegon Chapter of the Audubon Society	A landscape-scale coastal wetland preservation and restoration initiative on the southern shore of Lake Superior in Wisconsin. The project emphasizes land stewardship combined with protection and restoration of 8,180 acres of wetlands and 6,359 acres of uplands in the Lake Superior basin. Because many of the coastal wetlands in this region are relatively intact, the project will protect these areas through fee title and easement acquisition. The project will reduce pollution into tributary streams that feed these wetlands by focusing on upland activities that reduce sedimentation.

STRATEGY D PROPOSED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Bayfield Peninsula Binational Program Demonstration Project	USFWS, DU, USFS, NPS, GLIFWC, Red Cliff Band of LSC, local governments, private landowners, TNC, others	Expand on the Wisconsin Lake Superior Coastal Wetland Initiative to develop a demonstration project for protecting watersheds under the Binational Program. This would include watershed plan development for select watersheds in Bayfield County, including Whittlesey Creek, Fish Creek, Sand River, Raspberry River, and others These plans would use tools developed for the Lake Superior watershed, including habitat GIS work, monitoring of best bet indicators, and following the ecosystem approach to conservation. It would also overlap with the county land use plan being developed by Bayfield County.

E. Support contaminant load reduction efforts, track contaminants within "best bet" wildlife species, and encourage the development of biological indicators for air quality monitoring.

STRATEGY E COMMITTED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Population Monitoring of Otter and Mink and their Roles as Biosentinels	Bad River Tribe, WI DNR	Thirty-two river otter and 30 mink will be live-trapped and implanted with transmitters to determine behaviors, movement patterns, home ranges, and territories in the Bad River Watershed. Contaminant profiles for standard pesticides, PCBs, and heavy metals will be determined from live-trapped animals with known territories, as well as from carcasses from trapped animals.
Upper Great Lakes Loon Biomonitoring Program	BRI and partners too numerous to list	Monitor population dynamics and reproductive success and conduct related studies (contaminant loading) using color-marked loons in the Upper Great Lakes region.
Mercury Levels in Wildlife within Sargent Lake Watershed, Isle Royale NP	NPS, USGS BRD, MTU, UW-Madison, Biodiversity Research, Inc	Determine Hg levels in loons, moose teeth, mice, fish/water/sediments of Sargent Lake watershed, and in human baby teeth in U.P. of Michigan

STRATEGY E COMMITTED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Assessing the Ecological Risk of Mercury to Wildlife in the north central U.S.	WI DNR, USGS BRD, UW-Madison	The common loon serves as an indicator species for several studies investigating the impact of mercury on wildlife in the Lake Superior and Upper Mississippi River watersheds. Project goals are to measure mercury exposure levels in common loons across the region, to determine mercury exposure levels associated with negative effects on common loon, and to develop a toxicokinetic model to predict loon mercury exposure as a function of prey-mercury concentrations.
STRATEGY E PROPOSED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Determine the Status and Levels of Toxic Chemicals in Colonial Birds within the Lake Superior basin	NPS, USGS-BRD, MN DNR, WI DNR, MI DNR, USFWS, Pukaskwa National Park, OMNR, CWS, Parks Ontario, EC	Utilize new and existing data to determine the status and trends of colonial birds within the Lake Superior basin and test herring gulls and double-crested cormorants for levels of toxic chemicals.
Great Lakes Bald Eagle Biosentinel Monitoring Program	WI DNR, USFWS, U.S. EPA, NPS, USGS BRD, EC, CWS, State and Provincial natural resource agencies	Conduct aerial surveys and sample bald eagle nestling blood and unhatched eggs at Great Lakes nest sites to quantify trends in contaminant exposure and identify nest sites where productivity is impaired by exposure. Early warning monitoring plan for future toxic threats. Methodologies developed will be used as the protocol for implementation developed by a multiagency workgroup.

F. Inventory all levels of the biotic community, assess wildlife needs, and develop actions for protection, maintenance, and restoration, with priority attention to groups for which little is known (gaps).

STRATEGY F COMMITTED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Furbearer Scent Post Survey	MN DNR	Annual survey. Results are used to set trapping limits for bobcat, otter, pine marten, and fisher. Model populations. Provide data on Otter and bobcat to CITES.
Woodcock Survey	MN DNR, USFWS	Annual survey to obtain an index of abundance of population to set harvest levels.
Ruffed Grouse Drumming Count	MN DNR	Obtain an index of abundance of ruffed grouse. This survey is important for public relations with hunters.
Ontario *Odonata* Summary	TEA	Annual summary of *Odonata* (dragonflies and damselflies) seen in the province each year.
Ontario *Lepidoptera* Summary	TEA	Annual summary of *Lepidoptera* (primarily butterflies) seen in the province each year.
Bear Food Production Survey	MN DNR	Annual questionnaire that is sent to various field biologists to estimate the abundance of plant species important in the diet of black bear. Data correlates well with number of bears that hunters observe in the field and with hunter success.
Black Bear Population Index	OMNR	Annual bait line surveys in a number of Wildlife Management Units.
Rare Plant/ Community Surveys	OMNR (NHIC)	Periodic surveys to determine the extent, status, and composition of various rare plant communities in Ontario. Has included surveys within the Lake Superior basin.
Canada Lynx and Pine Marten Monitoring and Habitat Improvement	Ottawa NF, MI DNR, MITA	Identify potential habitat for lynx and marten (separately) on the Ottawa NF. Inventory 40,000 acres of the mostly likely habitat and quantify the results using the previously developed habitat identified on GIS. Prepare a report on the results and develop management guidelines.

STRATEGY F **COMMITTED PROJECTS**		
Baseline Inventory of Amphibians and Evaluation of Catastrophic Deformities	NPS	Survey the major wetland areas within the basin for amphibians, determine their relative abundance, distribution, and the extent of deformities. Document important habitats and rare species. Develop protocols for long-term monitoring.
Survey *Lepidoptera* within the Apostle Islands NL Sandscape State Natural Area	NPS, Eastern National	*Lepidoptera* are increasingly being recognized as sensitive indicators of the integrity and continuity of native ecosystems and can provide a measure of successful habitat management. This project will survey lepidopterans (butterflies and moths) within the Apostle Islands NL Sandscape State Natural Area. Four high-quality sandscapes are included in the survey.
Migratory Bird Survey	NPS	The southern end of Outer Island and Long Island (Apostle Island NL) are important concentration points for migratory birds. Surveys are conducted approximately every five years.
Aerial Moose Inventory	OMNR	Aerial population survey of each Wildlife Management Unit (WMU), conducted on a three year rotation.
Winter Track Counts	MI DNR	Winter track count routes are established on trails throughout the northern 2/3 of Michigan. Identification and number of tracks are recorded for each wildlife species on the trail route. Counts are conducted once each year.
Bird Migration within the Lake Superior basin	MAS, LSSU, Hawk Ridge (Duluth), LPBO, TCBO	Volunteers record the species and number of migrating birds during spring and fall migration at various observation points.
Annual Trapper Questionnaire	OMNR, OFMF	Annual questionnaire to determine trapper estimates of wildlife population levels and population change.
Wildlife Observation Booklets	OMNR	Observation checklist program to supplement wildlife distribution range mapping.
Small Mammal Monitoring	OMNR	Fall live-trapping lines as index to small mammal population levels and population change.
Waterbird Count	WPBO	Conduct counts of waterbirds, including loons, migrating past Whitefish Point (eastern Lake Superior) during spring and fall.
Project Feeder Watch	OMNR, BSC	Bird feeder surveys to monitor winter resident birds.

STRATEGY F COMMITTED PROJECTS		
Loon Watch	SOEI, Northland College, MI LPA	Conduct educational programs about loons and lakeshore protection. Conduct annual and five-year surveys to monitor productivity and population size.
Rare Carnivore Inventory	Hiawatha NF, MI DNR, Pictured Rocks NL	Conduct a comprehensive inventory covering approximately 1,000,000 acres.
Avian Migration Monitoring	BSC, OMNR	Monitoring of migrant songbirds at Thunder Cape, Lake Superior, and Long Point, Lake Erie.
Ruffed Grouse Survey	MI DNR, WI DNR, MN DNR	Count the number of drums and the number of individual ruffed grouse drumming on survey routes throughout Michigan. Information obtained is used as an index to ruffed grouse numbers.
STRATEGY F PROPOSED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Determine the Status and Trends of Breeding Birds within the Lake Superior basin	NPS, USFS, USGS-BRD, USFWS, NRRI, OMNR, CWS	Use existing survey data from various agencies and entities to determine the status and trends of breeding birds within the Lake Superior basin. Gaps in survey data and recommendations for monitoring will be identified.
Study Fall Bird Migration within the Lake Superior basin	NPS, USFWS, National Audubon Society, OMNR, CWS, USGS-BRD, NRRI, USFS	Conduct fall migratory bird surveys at key locations within the Lake Superior basin, including Outer Island (in Apostle Islands NL). Determine the status and trends of migratory birds within the Lake Superior basin using new and existing data.
Determine the Status and Trends of Amphibians within the Lake Superior basin	NPS, USGS-BRD, USFWS, WI DNR, MN DNR, MI DNR, Milwaukee Public Museum, NRRI, OMNR, CWS, USFS	Assemble data from monitoring programs and studies to determine the status and trends of amphibians within the Lake Superior basin. Identify data gaps and provide recommendations for a Lake Superior basin wide monitoring program.
Ontario Breeding Bird Atlas	OMNR, CWS, BSC, FON, OFO and others	Second Ontario Breeding Bird Atlas planned for 2001-2005 to document ranges and relative abundance of breeding birds in Ontario and determine any changes from first atlassing project conducted in 1981-1985.
Breeding Bird Census	Ottawa NF, Educational Institution	The Ottawa Breeding Bird Census has been an ongoing project. The Forest is searching for additional partners, including an educational institution, to formalize the yearly event.

STRATEGY F **COMMITTED PROJECTS**		
Non-vascular Plants, Invertebrates, Fungi and Micro-organisms Inventory/Analysis	Lake Superior NF's, MN DNR, MI DNR, WI DNR, GLIFWC, Tribes, etc.	Conduct inventory and status/trends and problem analysis for selected non-vascular plants, invertebrates, fungi and micro-organisms.
Five-year Songbird and Herptile Survey of WI Wetlands	WI DNR	Collect baseline data.
Great Lakes National Parks Inventory and Monitoring Initiative	NPS, potentially numerous others	Proposed program to complete critical inventory needs for Great Lakes national parks for vascular plants, amphibians, birds, mammals, and fish.

G. Inventory extent of exotic, invasive, terrestrial wildlife species and implement actions to prevent, remove, or control them in the Lake Superior basin.

STRATEGY G COMMITTED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Control of Invasive Plants in Pictured Rocks National Lakeshore	Pictured Rocks NL	Use herbicide and mechanical controls to suppress invasive plant populations within park boundaries.
Public Education on Invasive Species	GLIFWC, NRCS	Educate the public about the consequences of invasive exotic species in the northern ecosystems. Displays, slide shows, pamphlets, and posters have been designed and distributed; presentations have been made to county fairs, 4-H groups, and civic organizations. Professional slide shows have been developed for use by others. Extensive use has been made of the Internet and its resources.
Exotic Plant Control Project	GLIFWC, U.S. EPA	Conduct an assessment of invasive exotic species that may be invading the ceded territories. This assessment will consist of literature search and expert interviews. Once the assessment is completed, a system of prioritization will be developed to identify high priority sites for control efforts.
Purple Loosestrife Control	GLIFWC, BIA, NRCS, TNC, Bad River Band of LSC	Develop and implement an integrated purple loosestrife control program in the Bad River Watershed. Loosestrife was surveyed in the watershed in 1994, followed by a 5-year control effort using herbicides. A repeat survey will be conducted in the summer of 2000.
Survey and Ranking of Nonindigenous Invasive Plants in Four National Lakeshores along the Upper Great Lakes	USGS-BRD, Pictured Rocks NL, Sleeping Bear Dunes NL, Indiana Dunes NL, Apostle Islands NL	Objectively quantify the abundance of exotic plants in four National Lakeshores.

STRATEGY G PROPOSED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Rusty Crayfish Reduction and Control	Ottawa NF, MI DNR, UNDERC	Reduce the numbers of rusty crayfish through policy and law changes. Promote commercial utilization of rusty crayfish as a means of reducing their numbers and their negative impacts on aquatic vegetation and native species.
Invasive Plant Species Inventory and Eradication	Ottawa NF, Northwoods Weed Council (Ottawa NF, Chequamegon Nicolet NF, Hiawatha NF, Apostle Islands NL, TNC, GLIFWC, LCO Tribe, WI DNR)	Field inventory to support non-native invasive plant control on the forest, particularly in sensitive and high visibility areas, including riparian zones. Project includes public education component. Project conducted on a cooperative basis across the subregion.

H. Develop, test, and implement monitoring protocols, sampling procedures, and data handling for identified high priority "best bet" indicators. Network this monitoring and compile the information long-term and basinwide.

STRATEGY H COMMITTED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Frog and Toad Monitoring	NPS, WI DNR	Frogs and toads are monitored within the Apostle Islands NL three times annually at ten survey sites (five on islands, five on the mainland). This survey is also part of the Wisconsin Annual Frog and Toad Survey.
Forest Bird Monitoring	OMNR, CWS	Point-count surveys to monitor forest bird populations.
Nocturnal Owl Surveys	OMNR, BSC	Roadside broadcast survey to monitor owl population trends.
Amphibian Road Call Counts	OMNR, CWS	Roadside survey to monitor frog and toad abundance levels.
Salamander Monitoring	OMNR	Artificial cover object surveys as an index to population levels and distribution.
Canadian Lakes Loon Survey	Bird Studies Canada	Volunteers conduct surveys of a lake or section of a lake to record number of adult loons, number of terrestrial pairs, and number and age of chicks.
Biological Monitoring Program, Isle Royale NP	NPS, SOEI, Biodiversity Research, Inc, volunteers	Annual surveys of forest songbirds (Breeding Bird Survey); common loons/productivity; frogs and toads; bald eagle and osprey productivity.

STRATEGY H COMMITTED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Breeding Bird Census	Ottawa NF, Volunteers	Annual surveys of breeding bird habitats and population counts.
Breeding Bird Survey	USGS, State DNR's, USFS, USFWS, Province of Ontario	Standardized roadside count of singing male birds along randomly selected routes in Michigan. Each route is 20 miles in length and has 20, 3-minute listening stops.
Trapper Booklet Program	OMNR, OFMF	Booklet to gather information on trapping effort (three trap set) and harvest for beaver, otter, marten, fisher, lynx, and wolf.
Breeding Bird Survey	Chequamegon Nicolet NF, Chippewa NF, Superior NF, NRRI, State of Minnesota	Thirteen hundred permanent points are established and will be sampled annually on the three national forests.
Frog and Toad Survey	MI DNR, WI DNR, OMNR	Identify calls of frog and toad species and record numbers heard, using a standardized methodology as an index to distribution and abundance. Surveys are conducted annually.
Develop Monitoring Protocols for Long-term Forest Vegetation Monitoring	NPS, USGS-BRD	Determine how forest communities in the lakeshore are changing through time, both old-growth and second-growth, and the extent of natural restoration of forest communities following logging. The project focuses on old-growth forest remnants within the Apostle Islands NL, including one area that was logged and not burned, and another area that was burned and logged.
Monitor Colonial Nesting Birds	NPS, WI DNR	Apostle Islands NL provides important habitat for colonially nesting herring gulls, double-crested cormorants, and great blue herons. The NL, in cooperation with the Wisconsin DNR, has been monitoring colonial birds in the islands since 1974. Twice every five years the two largest colonies in the lakeshore are monitored, and the entire lakeshore is monitored every five years.
Bald Eagle/Osprey Survey	MI DNR	Aerial survey flights are conducted twice each year. The first flight is conducted at the appropriate time to determine nests that are occupied by eagles. The second flight is timed to determine productivity. Secondarily, information on occupied nests is provided to eagle banders to expedite banding operations.

STRATEGY H PROPOSED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Implement High Priority "Best Bet" Monitoring	All federal, state and provincial agencies, GLIFWC, Tribes, and First Nations within the LSB	Develop and implement a coordinated monitoring effort for high priority "best bet" indicators as identified at the Lake Superior Monitoring Workshop (Oct. 1999).
Common Loons as Indicators of Recreational Use Impacts	NPS, Biodiversity Research, Inc, SOEI, USGS BRD-Ashland	Use common loons as an indicator of ecosystem health and impacts from human recreational use, possibly by tracking loon productivity.
Furbearer Monitoring Program	WI DNR	Obtain baseline data on furbearer populations and habitats.

I. Beyond "best bet" indicators, develop an integrated, community-based wildlife program to monitor ecosystem health.

STRATEGY I PROPOSED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Wilderness Monitoring and Rehabilitation	Ottawa NF, State DNR's, Other NF's and federal agencies, GLIFWC, Tribes	Look at opportunities to use wilderness as a baseline tying to species monitored by the states, federal, tribal, and other agencies. Concerns include the impact of recreation on nesting loons, eagles, and fishery resources. Develop monitoring plan and subsequent proposed action strategies as appropriate.
Survey for Ecosystem Approaches to Wildlife Community Monitoring	TWCC, GLIFIWC, USFS, NPS, USGS BRD, NRCS	One of the goals of the TWCC is to developed a community-based monitoring program to track proper ecosystem health and functioning rather than the more traditional single species monitoring protocols now in place. Other agencies and organizations across the U.S. and Canada are attempting to do the same thing. This project will conduct a survey of these agencies and organizations in an attempt to understand their progress. Information regarding monitoring objectives, protocols, and results will be solicited and summarized. TWCC will use this information to develop a similar monitoring program applicable to the Lake Superior basin.

J. Conduct assessments and implement conservation strategies for important terrestrial wildlife species and communities.

STRATEGY J COMMITTED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
White-tailed Deer Fawn Survival as Related to Winter Severity and Nutritional Condition of Does	MN DNR	Assess the impact of winter severity on the nutritional condition of female white-tailed deer and its relationship to subsequent fawn production and survival. This study will enhance our understanding of the functional relationship between winter weather and population performance of white-tailed deer in Minnesota and will provide a biological basis for deciding if and when the DNR should provide emergency feed to deer, as mandated by the Minnesota Legislature.
Isle Royale NP Moose Browsing Project	NPS, MTU	Effects of moose browsing on vegetation and the relationship to natural fire regime at Isle Royale.
White-tailed Deer Movement in the Upper Peninsula	MI DNR, UP Whitetails, Champion International, various sportsman's groups	White-tailed deer are captured during the winter when concentrated in deeryards. Deer are trapped in box traps and marked with ear-tags, which are uniquely colored for the yarding complex and numbered specific to the deer. Observations of marked deer are recorded at DNR offices and forwarded to a central location for compilation. Maps are generated to show tagging and observation locations.
White-tailed Deer Pellet Group Surveys	MI DNR	Information about deer pellet group density is useful as an index to the abundance of deer. A stratified random sample of pellet survey plots are established every 5 years.
Status of Vegetation and White-tailed Deer in Beaver basin, Pictured Rocks National Lakeshore	NMU, GLSC, Pictured Rocks NL	Assess the impact of deer herbivory on vegetation in the Beaver basin at Pictured Rocks NL.
Predator Interaction Study	GLIFWC, Chequamegon Nicolet NF, NCES, WI DNR, UWSP	Investigation into the spatial interaction among sympatric carnivores. Radio telemetry techniques employed to study movements, territoriality, and home range characteristics of bobcats, fishers, and American martens.

STRATEGY J PROPOSED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Colonial Nesting Bird Restoration	WI DNR	Restore colonial nesting birds and determine the negative impacts from the increase of herring gulls.
Deer Herbivary Impact Study	Ottawa NF, MI DNR, GLIFWC, Tribes, etc.	Establish a herbivary study to assess the impact of deer browsing on understory vegetation, based on the evaluation of historical studies to date.
Conservation Assessments, Strategies and Implementation for Wildlife Species	Lake Superior NF's, MN DNR, MI DNR, WI DNR, GLIFWC, Tribes	Complete conservation assessments and implement protection and/or restoration strategies for following species: dwarf bilberry, northern blue butterfly; *Botrychium* ferns; northern goshawk; red-shouldered hawk; ram's-head lady slipper; Canada lynx; butternut; American ginseng; boreal owl; lichens.

K. Evaluate restoration projects and restoration ecology research that addresses terrestrial wildlife in order to link successes to specific restoration features and future needs.

STRATEGY K PROPOSED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
American Marten Recolonization Across Landscapes	GLIFWC, USFS North Central Experimental Station, WI DNR	American martens were extirpated in Michigan and Wisconsin during the early 1900s. Reintroduction efforts have started new populations in these states. However, martens have not dispersed from release sites to recolonize new areas. This lack of dispersal is not understood but may be due to the lack of habitat and appropriate corridors. This study will attempt to document dispersal characteristics of American martens and to determine the type of corridors used for dispersal. This study will supplement information already gathered about home range and micro-habitat selection patterns.

L. Protect, enhance, and restore species of concern such as caribou, moose, colonial waterbirds, boreal owl, northern goshawk, white pine, and hemlock.

STRATEGY L COMMITTED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Woodland Caribou Study	OMNR, Laurentian University, Forest Industry	A multi-year study to look at the seasonal movements and habitat use (calving sites, wintering areas, summer habitat) of woodland caribou in northwestern Ontario.
Moose Population Assessment	MI DNR	Moose will be captured in the western UP using specially designed nets deployed from a helicopter. Moose are fitted with radio transmitters, and this marked population is followed to identify pregnancy and natality rates of female moose by age class. Radio-marked sample will be used to identify age- and sex-specific mortality, estimate dispersal rates and distances, and evaluate potential factors limiting moose population growth.
Northern Goshawk Monitoring	Hiawatha NF, Ottawa NF, NMU, Clemson University, MINGF, Seney NWR	Transmitters were placed on 6 northern goshawks for monitoring using radio telemetry during different times of the year.
Wild Rice Restoration	Ottawa NF, GLIFWC	Approximately 10 acres of wild rice were seeded at five sites.
Aerial Moose Survey	MN DNR	Survey to estimate numbers and recruitment of moose in northeastern Minnesota. The survey data is used to help set hunting seasons.
Determine Status, Distribution and Appropriate Trapping Levels of Fisher	NPS	Determine the distribution and abundance of fisher at Apostle Islands NL, determine whether existing state harvest models are appropriate; develop protocols for monitoring.
Update Regional Forester's Sensitive Species List, Eastern Region, USFS	USFS, with input and assistance of many interested parties	Update the regional forester's sensitive species list for the Eastern Region, including all Lake Superior National Forests.
Trumpeter Swan Reintroduction	Ottawa NF, KBIC, MSU, USCG, MI DNR, USFWS, UPPCO	Fifteen swans have been released on the Ottawa NF with another release planned for 2000. Released birds were radio-collared and are being monitored.

STRATEGY L PROPOSED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Wild Rice Restoration	Ottawa NF, GLIFWC, LVD Tribe	Restore wild rice at sites where it historically occurred and introduce it at new sites with suitable habitat.
Conservation Assessment and Strategy for Woodland *Botrychium* Species	Ottawa NF, Chequamegon Nicolet NF, Hiawatha NF, MI NFI	Develop a conservation assessment (status report) for rare *Botrychium* species through literature searches, consultation with experts, field surveys, and database queries.
Trumpeter Swan Reintroduction	Ottawa NF, KBIC, MSU, USCG, MI DNR, US FWS, UPPCO	Continue work to reintroduce trumpeter swans to the Ottawa NF. Obtain and radio collar up to 12 birds. Monitor their activity and range.
Moose Research	MN DNR, environmental education	A radio telemetry project to determine annual variability in moose survival and reproduction and develop educational opportunities for students in local community colleges.
White Pine Regeneration	USFS, Gunflint RD, FSL Rhinelander, WI DNR, MN DNR, WPS	Identify white pine locations within ECS Subsections 212LB on LTA's 01 and 02; make grafted collections; begin controlled breeding and out-planting of enclaves.

M. Encourage the use of native species for all projects requiring vegetation restoration.

STRATEGY M PROPOSED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Native Plant Restoration - Nursery Production	J.W. Toumey Nursery, Ottawa NF, MI DNR, GLIFWC, Tribes	Develop growing stocks of selected native plant species for soil and water protection, species recovery, and restoration of native stock to watersheds.

N. Identify population issues and implement recovery actions for threatened and endangered species.

STRATEGY N COMMITTED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Bald Eagle Monitoring	NPS, WI DNR	In cooperation with the Wisconsin DNR, an overflight is conducted in April to determine the number of occupied eagle nests. A second overflight is conducted in June to determine productivity. Eaglets are banded following the second overflight.
Gray Wolf Management in the Lake Superior Region: Voyageurs NP and Pictured Rocks NL	Voyageurs NP, Pictured Rocks NL, MTU	Assess the movements and habitat use of wolves in the two national parks. Determine impacts of visitors on wolf population dynamics, demographics, sustainability, and behavior.
Bald Eagle Monitoring	Chequamegon Nicolet NF, US Navy	Forty-two known eagle territories were monitored through aerial, fixed-wing surveys. 1998 results showed 31 active territories producing 35 young.
Kirtland's Warbler Survey	MI DNR, USFWS	Suitable habitat is visited each year, in early summer, to listen for singing male Kirtland's Warblers.
Piping Plover Survey	MI DNR	Areas of Great Lakes beaches known to have had nesting piping plovers are searched each year to confirm use. Suitable areas of Great Lakes beaches are also searched to identify potential new nesting areas.
Gray Wolf Monitoring	Chequamegon Nicolet NF, US Navy	Fourteen wolf packs were monitored throughout the year through trapping, radio-collaring, radio-tracking, track and howling surveys.
Piping Plover Monitoring	NPS, WI DNR, Bad River Tribe, USFWS	Apostle Islands NL provides nesting habitat for piping plover, a federally endangered species. After a hiatus of 15 years, piping plover began nesting in the Lakeshore in 1998. Monitoring is conducted in May to determine nesting status. If nesting occurs, protective actions are taken, such as erecting a nest exclosure. Intensive monitoring is done between egg laying and hatching.
Upper Peninsula Wolf Survey	MI DNR, USFWS	Winter track survey and capturing of wolves to attach radio collars. Goal is to have at least one member of each pack collared.

STRATEGY N COMMITTED PROJECTS		
Kirtland's Warbler Nesting Habitat Improvement and Monitoring	Hiawatha NF, MI DNR, USFWS	Over 25 acres of jack pine were planted in newly regenerating stands. Seedlings were planted in dense pockets to simulate conditions after wildfire.
Kirtland's Warbler Recovery	USFWS, MI DNR, others	Recover Kirtland's Warbler populations to meet recovery team goals. 19 males were counted in the Upper Peninsula of Michigan in 1999. Work in the Lake Superior basin includes census of singing males and banding to determine site fidelity and survivorship. Habitat protection and management will follow once site fidelity is better known.
Piping Plover Habitat Protection	USFWS, private landowners, local governments, NGOs	A program has been developed and funded to advance recovery of Great Lakes piping plovers by protecting shoreline habitat through cooperation with private landowners and local governments.
STRATEGY N PROPOSED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Kirtland's Warbler Habitat Improvement	Ottawa NF, MI NFI, MI DNR	Complete Kirtland's Warbler surveys on 5,000 acres. Trap cowbirds at five locations. Inventory habitat on 8,000 acres. Complete management plans for all jack pine stands in the KW management area. Prescribed burn on 300 acres.
Lynx Analysis	Hiawatha and Ottawa National Forests, MI DNR and Michigan State University	Review land use/cover change over time to assess lynx habitat change/ corridor use, validate the lynx habitat suitability model, map temporal trends in lynx habitat quality, and assess how land use/cover changes and habitat quality may affect lynx movement, distribution, and metapopulation structure in the UP of MI.
Complete a Field Guide for Identification of All T&E Species	Ottawa NF, MI DNR, GLIFWC, Tribes	Complete a field guide for the identification of all T&E plants and animals in the Lake Superior basin. While some field guide development has occurred in Michigan for plants, a full field guide is needed for the Lake Superior basin. The intent is to have the field guide in the hands of field employees of agencies and organizations working in the basin.

STRATEGY N COMMITTED PROJECTS		
Determine Causes of Low Eagle Productivity along the Wisconsin Shoreline of Lake Superior	NPS, USGS-BRD, WI DNR	Determine if there are correlations between eagle productivity and productivity of major prey items.
Peregrine Falcon National Survey	OMNR, variety of naturalist groups	Survey of Ontario range to confirm nesting and successful breeding of reintroduced falcons. Part of a national survey that occurs every 5 years.
Upper Peninsula Timber Wolf Alliance (TWA) support	Ottawa NF, MI DNR, USFWS, SOEI	Support to TWA in the Upper Peninsula of Michigan in context of speakers bureau workshops, wolf boxes, school presentations, community organizations, hunter contacts, and other educational activities.

7.9 SIGNIFICANT ACCOMPLISHMENTS

Much work has been done and much work continues in support of the strategies to protect and restore the health of terrestrial wildlife communities in the Lake Superior basin. Much work has been done through habitat projects that are listed in the habitat chapter. Examples of other projects are listed below, but this list is not inclusive of all successful progress being made in the Lake Superior basin. Tracking our successes will be one important measure of progress toward the goals of the Terrestrial Wildlife Community Committee.

COMPLETED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Woodcock Nesting and Breeding Habitat	Ottawa NF, MI DNR, OIA, RGS, Trale UP, Sierra Club	Fourteen acres of new openings were created and trails improved in the Harris Creek Universal Access Area. A total of 219 acres of existing trail and opening maintenance, shrub planting, brush removal, and mowing were completed.
Great Lakes Bald Eagle Biosentinel Research Program	WI DNR, Apostle Island NL, UW-Madison, USFWS Green Bay, U of MN	Monitored and conducted research on reproductive success and contamination exposure of Lake Superior and Lake Michigan bald eagles. Findings published: Dykstra, C.R. and others 1998. J. Great Lakes Research 24:32-44.

COMPLETED PROJECTS		
Project Name	**Proponent(s), including partners**	**Brief Project Description**
Growth Response and Fruit Production of Blueberry (*Vaccinium* spp.) Following Forest Vegetation Management by Brush Cutting, Herbicide, and Prescribed Fire	Lakehead University	Study conducted in a young jack pine plantation showed that low-bush blueberry (*Vaccinium angustifolium*) is more sensitive than velvet-leaf blueberry (*V. myrtiloides*) to Roundup herbicide (glyphosate). The latter has higher morphological plasticity and more efficient vegetative regeneration strategy. Impacts of herbicides on berry-producing plants have direct implications on berry-eating wildlife in the Lake Superior basin.
Floristic Composition and Diversity of an Old Growth White Pine Forest in Greenwood Lake, NW Ontario	Lakehead University	Understory and overstory species diversity, habitat heterogeneity, and composition of this rare 300-year-old 162 ha. white pine forest was studied. The age class distribution of the tree species was determined. Research is also underway to study the natural regeneration of white pine in an adjacent area burned by a natural fire in 1992. It is very important to establish biodiversity and forest regeneration monitoring plots in this rare old-growth forest in the Lake Superior basin.
Puskaskwa Predator-Prey Study	Parks Canada	A multi-year study to look at the interactions among wolves, moose, and caribou in Pukaskwa NP.
Peregrine Falcon Reintroduction	OMNR, variety of naturalist groups	Hacking program to reintroduce peregrine falcons to a number of sites within their historical range.
Root-shoot Characteristics of Riparian Plants in a Flood Control Channel: Implications for Bank Stabilization	Lakehead University	This study, conducted in the Neebing-MacIntyre floodway channel in Thunder Bay, showed that native riparian plants selected on the basis of their root-shoot characteristics can be used in restoration projects. Another study conducted in the floodway examined plant colonization along the banks of the floodway ten years after construction.
Community-based Biodiversity Conservation in the Western Lake Superior basin	NAFEC, OMNR (NHIC), TNC	Identify key areas for conservation, share site conservation planning expertise with local community groups, and help these groups begin site conservation activities on their landscapes.

7.10 TERRESTRIAL WILDLIFE COMMUNITY COMMITTEE NEXT STEPS

The work of the Terrestrial Wildlife Community Committee between publication of the LaMP 2000 and the LaMP 2002 effort is identified below. The committee intends to be actively engaged in implementing the terrestrial wildlife strategies through support of priority projects, with the idea of reporting progress in the LaMP 2002 process.

A. Track and revise projects identified in the LaMP 2000.

B. Implement projects funded within the Terrestrial Wildlife Community Committee.

C. Maintain a priority list of projects for restoration/protection/rehabilitation of terrestrial wildlife in the Lake Superior basin.

D. Encourage, support, and develop projects that address strategies that are currently poorly represented.

E. Actively seek proponents, potential partners, and adequate funding for proposed terrestrial wildlife projects identified in the LaMP 2000.

F. Encourage development of monitoring protocols, sampling procedures, and data handling processes for selected "best bet" terrestrial wildlife indicators. Survey monitoring systems that are ecosystem-based for wildlife communities.

G. Work with the communications committee in LSBP to develop and implement a communications package, which would explain LSBP goals, objectives, and project needs to the practitioners of restoration/protection/rehabilitation in the basin. Offer technical and/or administrative assistance.

H. Produce quality articles about restoration/protection/rehabilitation activities in the basin. Distribute to publications of participating Terrestrial Wildlife Community Committee organizations, magazines, and other outlets.

I. Continue to work with the SWG of the LSBP to ensure delivery of the LaMP 2002 for Lake Superior.
   - Identify resource needs for the operation of the committee.
   - Update indicators and targets from LaMP 2000.
   - Identify existing programs and assess whether they are adequate to achieve committee goals.
   - Recommend new program requirements.
   - Complete and update the theme chapter for terrestrial wildlife based on public review and new information/need for revision.
   - Update and keep current the Terrestrial Wildlife section of LSBP web sites.

- Participate in and assist in the development and implementation of the overall LSBP communications strategy.
- Develop a scripted program with audio-visual aids for LSBP participants to take to stakeholder meetings.

J. Actively seek existing or proposed terrestrial wildlife projects for inclusion in the program.

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ADDENDUM 7-A
ECOSYSTEM CONSERVATION EXAMPLE - WOODLAND CARIBOU

Ecosystem Conservation Example - Woodland Caribou - Managing a Declining Keystone Species (OMNR 1999; Racey and Armstrong 1996)

The Ontario Ministry of Natural Resources (OMNR) initiated a strategy for woodland caribou conservation in the mid-1990s. The Ministry recognized that the caribou was a resource that was not considered or conserved by existing forest management practices and, as a result, its range was continually decreasing. Concurrently, the OMNR was shifting its policies toward sustainable development and an ecosystem management approach. Several policy principles were developed that speak to that philosophy:

- Human activity that affects one part of the natural world should never be considered in isolation from its effects on others.
- We must recognize the value of a diversified economy based on the preservation of the diversity of the natural world.
- Our understanding of the way the natural world works—and how our actions affect it—is often incomplete. This means that we exercise caution and special concern for natural values in the face of such uncertainty and respect the "precautionary principle" (Racey and Armstrong 1996).

The primary goal of the regional caribou strategy is to stop any further range recession and to maintain occupancy of current woodland caribou range (Ontario Ministry of Natural Resources 1999). The OMNR initiated their work by collecting baseline data on caribou distribution and biology. This information was synthesized and resulted in the recently drafted *Timber Management Guidelines for the Provision of Woodland Caribou Habitat*. These guidelines recommend maintaining a sustainable supply of winter habitat within large tracts of old forest, protecting calving areas, and minimizing human disturbance. Forestry practices were designed to mimic a landscape mosaic that would naturally occur with fire.

The woodland management strategies for caribou are different than they are for moose. They are designed to restore previous landscape structure and composition, whereas moose management strategies deliberately produce forest edge. The habitat management approach developed for caribou is an attempt to sustain a landscape pattern at a scale similar to that created by wildfire. It is believed that this approach will benefit caribou and possibly other forest species that evolved in such an environment. In this regard, caribou have become an indicator of a functioning fire dependent ecosystem.

Communication and consultation with interested parties was a critical part of strategy development. Information was provided to upgrade resource managers' knowledge and to increase the public's awareness of woodland caribou in Ontario. The concept of a caribou management strategy is difficult to understand, so public involvement remains critical. The public, including the forest industry, was consulted about the proposed strategy. The public's

response showed a strong dichotomy between environmental and utilitarian values among all the major stakeholder groups. The major issues identified include security of industrial wood supply, quality of the knowledge base, level of awareness of caribou, economic impacts on remote communities, concern about environmental impacts, and silvicultural know-how.

The planners involved in developing the strategy described the need to have an informed and involved public, especially since some of the public perceives that they will be hurt. The planners concluded that one of the biggest problems faced by natural resource managers is trying to trade off utilitarian and environmental concerns pertaining to resource allocation and conservation. It is one of the biggest challenges to "practice, implement, and refine ecosystem-based management in support of sustainable development" (Racey and Armstrong 1996).

Their management must follow a very adaptive process because the new timber management guidelines have not been used before. They are actively monitoring the effect of their habitat manipulations on caribou populations and will make changes as they learn more.

ADDENDUM 7-B
ECOSYSTEM CONSERVATION EXAMPLE - WHITE-TAILED DEER

Ecosystem Conservation Example - White-tailed Deer - Managing an Overabundant Keystone Species

Deer could be considered a "keystone" herbivore. Waller and Alverson (1997) define a keystone species as one that: 1) affects the distribution or abundance of many other species, 2) affects community structure by strongly modifying patterns of relative abundance among competing species, or 3) affects community structure by affecting the abundance of species at multiple trophic levels.

The overabundant deer problem highlights the complexity of the ecosystem's response to changes in the landscape and our attempts to manage those changes over the past 100 years. We recognize the need to manage wildlife communities as part of the ecosystem, not just as a single commodity that is desirable and valuable. If deer is a keystone species, then management programs should consider impacts to other ecosystem components, both plant and animal, and will attempt to improve the health of those components. This is being attempted in Wisconsin under the emerging "Deer Management for 2000 and Beyond" program.

The Wisconsin Department of Natural Resources has prided itself on managing the deer herd in Wisconsin. Hunters have traditionally been the cornerstone of management decisions, but the Natural Resource Board recently recognized there is a more diverse public that is affected by deer management. They set out to give all interests equal representation in developing future guidelines for managing deer. The "Deer Management for 2000 and Beyond" will use public forums to sort issues and actions into a long-range plan that managers will use to keep the herd, habitat, and surrounding communities healthy.

The goals of this planning process are:

- To produce a deer management framework that is flexible, realistic, and meets the needs of other natural resources as well as the desire of a wide range of stakeholders.
- To produce a management plan that will function within the limitations posed by institutional constraints, habitat, social desires, and public safety. Special emphasis will be paid to:

maintaining a healthy herd,
providing opportunities for a variety of diverse user groups,
simplifying and providing consistency in deer management goals and policies,
providing flexibility to adjust management goals when necessary.

A process has been designed for public involvement, from which emerged several issues: forest and ecological damage, private land access, baiting and feeding, sex and age structure of the herd, agricultural damage, herd size and capacity, and believability of population estimates. The planning will continue into the fall of 2000, when decisions will be made regarding implementation.

This program is a good example of sound ecosystem management for several reasons. First, it involves looking at the ecosystem as a whole, including human interaction with deer, as well as deer herd effects on other components of the ecosystem. Second, the public is involved in the planning process. The Department of Natural Resources understands the implications of its decisions on society and the limitations of its authority for deer management. Third, the Department recognizes that it must remain flexible in management actions and learn from its successes and failures (adaptive management). All these components are critical in managing wildlife within the ecosystem.

ADDENDUM 7-C
SCIENTIFIC NAMES OF SPECIES INCLUDED IN TEXT

Plants

Trees

-Ash…..*Fraxinus sp.*
-Aspen (trembling)…..*Populus tremuloides*
-Beech…..*Fagus grandifolia*
-Balsam fir…..*Abies balsamea*
-Basswood…..*Tilia americana*
-Birch…..*Betula sp.*
-Black spruce……*Picea mariana*
-Canada yew…..*Taxus canadensis*
-Hemlock…..*Tsuga canadensis*
-Jack pine…..*Pinus banksiana*
-Red oak…..*Quercus rubra*
-Red pine…..*Pinus resinosa*
-Sugar maple…..*Acer saccharum*
-Tag alder…..*Alnus rugosa*
-White cedar…..*Thuja occidentalis*
-White pine…..*Pinus strobus*
-White spruce…..*Picea glauca*
-Yellow birch…..*Betula alleghaniensis*

Other plants

-Blue beadlily…..*Clintonia borealis*
-Canada mayflower…..*Maianthemum canadense*
-Wild sarsaparilla…..*Aralia nudicaulis*
-Buckthorn…..*Rhamnus sp.*
-Hawthorn…..*Crataegus sp.*
-Purple loosestrife…..*Lythrum salicaria*

Mammals

Ungulates

-Elk…..*Cervus canadensis*
-Moose…..*Alces alces*
-White-tailed deer…..*Odocoileus virginianus*
-Woodland caribou…..*Rangifer tarandus*

Carnivores

-American marten…..*Martes americana*
-Black bear…..*Ursus americanus*
-Bobcat…..*Lynx rufus*
-Canada lynx…..*Lynx canadensis*
-Coyote…..*Canis latrans*
-Fisher…..*Martes pennanti*

-Gray wolf…..*Canis lupus*
-Mink…..*Mustela vison*
-Raccoon…..*Procyon lotor*
-River otter…..*Lutra canadensis*
-Striped skunk…..*Mephitis mephitis*
-Wolverine…..*Gulo gulo*

Hares and Cottontails
-Eastern cottontail…..*Sylvilagus floridanus*
-Snowshoe hare…..*Lepus americanus*

Rodents
-Beaver…..*Castor canadensis*
-Gray squirrel…..*Sciurus carolinensis*
-Porcupine…..*Erethizon dorsatum*
-Vole…..*Microtus sp. and Clethrionomys sp.*

Birds

Loons
-Common loon…..*Gavia immer*

Grebes
-Pied-billed grebe…..*Podilymbus podiceps*

Pelicans and Cormorants
-Double-crested cormorant…..*Phalacrocorax auritus*
-White pelican…..*Pelecanus erthrorhynchos*

Herons
-American bittern…..*Botaurus lentiginosus*
-Black-crowned night heron…..*Nycticorax nycticorax*
-Great egret…..*Ardea alba*

Waterfowl
-American black duck…..*Anas rubripes*
-Blue-winged teal…..*Anas discors*
-Canada goose…..*Branta canadensis*
-Mallard…..*Anas platyrhynchos*
-Wood duck…..*Aix sponsa*

Hawks and Eagles
-American kestrel…..*Falco sparverius*
-Bald eagle…..*Haliaeetus leucocephalus*
-Broad-winged hawk…..*Buteo platypterus*
-Osprey…..*Pandion haliaetus*
-Peregrine falcon…..*Falco peregrinus*
-Red-tailed hawk…..*Buteo jamaicensis*

Grouse
-Ruffed grouse…..*Bonasa umbellus*
-Sharp-tailed grouse…..*Tympanuchus phasianellus*
-Spruce grouse…..*Falcipennis canadensis*

Shorebirds

-American woodcock…..*Scolopax minor*
-Caspian tern…..*Sterna caspia*
-Common snipe…..*Gallinago gallinago*
-Common tern…..*Sterna hirundo*
-Forster's tern…..*Sterna forsteri*
-Herring gull…..*Larus argentatus*
-Piping plover…..*Charadrius melodus*
-Ring-billed gull…..*Larus delawarensis*
-Spotted sandpiper…..*Actitis macularia*
-Upland sandpiper…..*Bartramia longicauda*

Cuckoos

-Black-billed cuckoo…..*Coccyzus erythropthalmus*

Owls

-Barred owl…..*Strix varia*

Woodpeckers and Kingfishers

-Belted kingfisher…..*Ceryle alcyon*
-Downy woodpecker…..*Picoides pubescens*
-Hairy woodpecker…..*Picoides villosus*
-Northern flicker…..*Colaptes auratus*
-Pileated woodpecker…..*Dryocopus pileatus*
-Red-headed woodpecker…..*Melanerpes erythrocephalus*
-Yellow-bellied sapsucker…..*Sphyrapicus varius*

Perching Birds

-American redstart…..*Setophaga ruticilla*
-American robin…..*Turdus migratorius*
-Baltimore oriole…..*Icterus galbula*
-Black-and-white warbler…..*Mniotilta varia*
-Black-capped chickadee…..*Poecile atricapillus*
-Black-throated green warbler…..*Dendroica virens*
-Black-throated blue warbler…..*Dendroica caerulescens*
-Blackburnian warbler…..*Dendroica fusca*
-Blue jay…..*Cyanocitta cristata*
-Brown creeper…..*Certhia americana*
-Brown-headed cowbird…..*Molothrus ater*
-Brown thrasher…..*Toxostoma rufum*
-Chipping sparrow…..*Spizella passerina*
-Common raven…..*Corvus corax*
-Eastern bluebird…..*Sialia sialis*
-Eastern meadowlark…..*Sturnella magna*
-Eastern phoebe…..*Sayornis phoebe*
-Eastern wood-pewee…..*Contopus virens*
-Field sparrow…..*Spizella pusilla*
-Evening grosbeak…..*Coccothraustes vespertinus*
-Grasshopper sparrow…..*Ammodramus savannarum*

-Great crested flycatcher…..*Myiarchus crinitus*
-Hermit thrush…..*Catharus guttatus*
-House wren…..*Troglodytes aedon*
-Indigo bunting…..*Passerina cyanea*
-Kirtland's warbler…..*Dendroica kirtlandii*
-Least flycatcher…..*Empidonax minimus*
-Le Conte's sparrow…..*Ammodramus leconteii*
-Marsh wren…..*Cistothorus palustris*
-Northern waterthrush…..*Seiurus noveboracensis*
-Ovenbird…..*Seiurus aurocapillus*
-Pine warbler…..*Dendroica pinus*
-Red-breasted nuthatch…..*Sitta canadensis*
-Red-eyed vireo…..*Vireo olivaceus*
-Ruby-crowned kinglet…..*Regulus calendula*
-Sedge wren…..*Cistothorus platensis*
-Scarlet tanager…..*Piranga olivacea*
-Swainson's thrush…..*Catharus ustulatus*
-Swamp sparrow…..*Melospiza georgiana*
-Tree swallow…..*Tachycineta bicolor*
-Veery…..*Catharus fuscescens*
-Vesper sparrow…..*Pooecetes gramineus*
-Warbling vireo…..*Vireo gilvus*
-Western meadowlark…..*Sturnella neglecta*
-White-breasted nuthatch…..*Sitta carolinensis*
-Winter wren…..*Troglodytes troglodytes*
-Yellow-rumped warbler…..*Dendroica coronata*
-Yellow-throated vireo…..*Vireo flavifrons*

Amphibians and Reptiles

-American toad…..*Bufo americanus*
-Blanchard's cricket frog…..*Acris crepitans*
-Blue-spotted salamander…..*Ambystoma laterale*
-Bullfrog…..*Rana catesbeiana*
-Chorus frog…..*Pseudacris triseriata*
-Common garter snake…..*Thamnophis sirtalis*
-Cope's gray tree frog…..*Hyla chrysoscelis*
-Eastern gray tree frog…..*Hyla versicolor*
-Eastern tiger salamander…..*Ambystoma tigrinum tigrinum*
-Four-toed salamander…..*Hemidactylium scutatum*
-Green frog…..*Rana clamitans*
-Mink frog…..*Rana septentrionalis*
-Mudpuppy…..*Necturus maculosus*
-Northern leopard frog…..*Rana pipiens*
-Northern spring peeper…..*Pseudacris crucifer*

-Painted turtle…..*Chrysemys picta*
-Pickerel frog…..*Rana palustris*
-Redbacked salamander…..*Plethodon cinereus*
-Redbelly snake…..*Storeria occipitomaculata*
-Snapping turtle…..C*heldra serpentina*
-Spotted salamander…..*Ambystoma maculatum*
-Wood frog…..*Rana sylvatica*
-Wood turtle…..*Clemmys insculpta*

Invertebrates

-Deer tick…..*Ixodes dammini*
-Karner's blue butterfly…..*Lycaeides melissa samuelis*
-Rusty crayfish…..*Orconectes resticus*
-Zebra mussel…..*Dreisena polymorpha*