2 copies

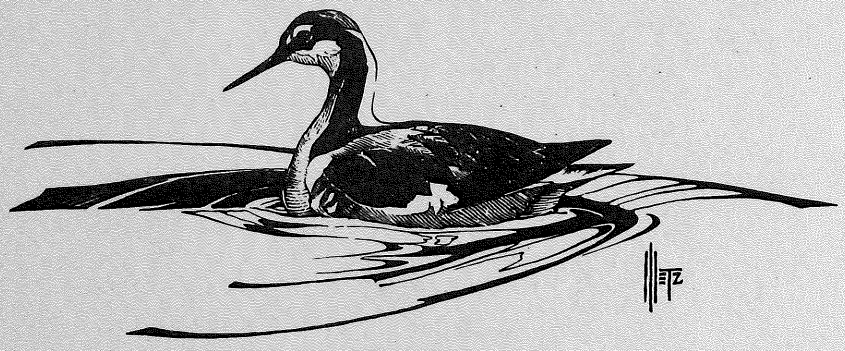
PLAN FOR THE MANAGEMENT OF NONGAME WILDLIFE IN MINNESOTA

PREAMBLE

VOLUME 2 - RESOURCE ASSESSMENT

(review draft)

DRAFT



DATE:9/15/83

Nongame Wildlife Program

Staff and Planning Team

Joan Galli - Planner, Regional Nongame Wildlife Specialist

Carrol Henderson - Program Supervisor

Katie Hirsch - Regional Nongame Wildlife Specialist

Jack Mooty - Regional Nongame Wildlife Specialist

Lee Pfannmuller - Nongame Wildlife Zoologist

John Schladweiler - Regional Nongame Wildlife Specialist

Pam Skoog - Regional Nongame Wildlife Specialist

Plan Volumes

Vol. 1 - The Planning Concept - draft issued 12/82, final 2/82

Vol. 2 - Resource Analysis - draft 9/83

Vol. 3 - Problem Analysis

Vol. 4 - Goals and Strategies

Vol. 5 - The Operational Plan

For additional information on the Nongame Wildlife Program contact:

Department of Natural Resources
Div. of Fish & Wildlife
Nongame Wildlife Program
Box 7
Centennial Office Building
658 Cedar St.
St. Paul, Mn 55112
(612) 296-3344

PREAMBLE

"Why Bother with Nongame Wildlife?"

The Commissioner of the Minnesota Department of Natural Resources (DNR) is entrusted with the responsibility for the conservation of all wildlife in Minnesota. For more than 40 years, the Section of Wildlife within the DNR's Division of Fish and Wildlife has conducted wildlife conservation programs involving habitat preservation, management, acquisition, research, census and species restoration. The primary goal was to enhance the status and harvestable supply of approximately 110 game species. Funds were traditionally not spent for wildlife other than game species. However, many nongame species benefited from the Division's actions to preserve habitat and promote the values of wildlife.

The creation, in 1977, of the Nongame Wildlife Program[1] within the Section of Wildlife was predicated on the need of the Department of Natural Resources to actively assume its full responsibilities for the entire wildlife resource which includes over 600 vertebrate species and their habitats. It is the specific responsibility of the Nongame Wildlife Program to preserve the diversity and abundance of the 400+ nongame species for our benefit and for future generations of Minnesota citizens.

---

1 The term "nongame wildlife" includes all vertebrate fauna not traditionally hunted, fished or trapped; species designated endangered or threatened under Minnesota statute (except the timber wolf); and crustaceans, mollusks, and butterflies.

Most species of nongame wildlife in Minnesota have maintained healthy population levels and are not in need of immediate actions. Populations of some species are declining, some have become endangered, and some no longer exist in Minnesota. It is a goal of the Nongame Wildlife Program not only to restore populations of endangered and threatened species, but to prevent future additional population declines.

It is also the intent of the Nongame Wildlife Program to complement existing natural resource conservation work - not to replace it. Nongame management is neither a new concept (Leopold, 1939), nor is it intended to replace game management. It has nothing to do with anti-hunting. Rather, it should build upon the existing foundationn of game management knowledge and complement current conservation efforts. The aim of the Nongame Wildlife Program should be a comprehensive program of wildlife management that objectively balances the conservation needs of all wildlife species.

Since the Nongame Wildlife Program's creation, people have asked, "Why bother with nongame wildlife?" and "Who cares?" The response to the first question constitutes the philosophical basis for the Program's existence.

Increasingly, the American public is expressing their belief that wildlife, including nongame species, has value and importance because:

Reason #1: Wildlife species add beauty and diversity to our environment and thereby enrich our lives. By their presence and the opportunity to experience them, these animals add an important aesthetic dimension to human existence. Our appreciation finds

expression in the widespread practices of feeding, viewing, photographing, painting, and studying wildlife.

Reason #2: Wildlife species are indicators of environmental quality. If wildlife populations are disappearing and their ecosystems have degenerated due to environmental contamination or habitat degradation, we have to ask what this destruction is doing to us and our life support system.

Reason #3: Wildlife species are a reservoir of genetic diversity. Genetic diversity refers to the multitude of unique gene combinations of various living organisms that have developed over time and allow a species to survive. Modern man has made use of these genes in medicine, horticulture, animal husbandry, etc. For no other reason than their possible further usefulness to man, viable populations of all wildlife species should be preserved. Allowing the extinction of a species is, in effect, throwing away a part of the ecosystem. The ecosystem may still function, but its efficiency will be reduced.

Reason #4: Wildlife is part of the cultural and natural heritage of America. Historically, it has played an important role as a source of food, clothing, shelter, religious inspiration, and personal enjoyment for native people. Presently, there is a strong desire and concern for the preservation of this national cultural heritage, including the preservation of wildlife.

Reason #5: In recent time, a strong legal basis for nongame wildlife protection and management has been developed. Through the Migratory Bird Treaty Act, Bald Eagle Protection Act, Endangered Species Act, and the Comprehensive Fish and Widlife Management Act of 1980, the American public is saying that they want and value all wildlife. They expect

their government to provide it for them. Further, they are insisting through the environmental review process of the National Environmental Policy Act and through the National Forest Resouces Management Act, that wildlife is an important natural resource deserving of equal consideration with timber, minerals, fossil fuels, soils, and water in multiple-use planning and natural resource utilization.

Reason #6: We have a responsibility to future generations to maintain wildlife for their enjoyment. It has been argued that no generation has the right to cause the extinction of a species so that none may ever enjoy it again. It is a sign of an enlightened society that will husband its resources and see that they are available for generations yet to come.

Reason #7: There is a developing economic justification for the maintenance of wildlife diversity and variety. The direct economic value of the wildlife resource may be calculated in part from the money spent to feed, view, photograph, and learn about these species. Figures on the amount spent in these ways are only now being assessed (George, et al., 1982). The indirect contribution of wildlife to the economics of art, literature, medicine, and science may never be documented, but should be acknowledged.

All the reasons cited so far are rooted in a view which values all things in relation to the benefits they provide to man. There is one final reason for caring about the continued existence of a species or community.

Reason #8: Wildlife species should be conserved because they exist and have done so for a long time. Wildlife species are important in their own right - without reference to how mankind perceives them or uses

them. Long-standing existence in nature is considered by some people to carry with it the unalterable perogative to continued existence (Ehrenfeld, 1976).

For all these reasons it is our belief that all wild animals are deserving of a place in the world. In the broadest terms, then, it is the mission of the Nongame Wildlife Program to assure such a place for the nongame portion of natural ecosystyems so that genetic diversity, variety and richness of the natural world is maintained.

The answer to the second question, "Who cares about nongame wildlife?" constitutes a user analysis. A detailed discussion of information available to answer the question and quantify the number of wildlife enthusiasts in Minnesota will be presented in The Demand portion of Volume 2 - The Resource Assessment.

It appears that a great many Minnesotans are interested and concerned for wildlife. One of the strongest statements of this concern is the willingness of Minnesotans to voluntarily contribute to the Nongame Wildlife Fund ("chickadee checkoff"). In 1982, approximately 199,000 Minnesota families contributed money as an expression of their concern for the continued existence of all wildlife in Minnesota. Other citizens have contributed as volunteers, reporting loon nests and other information. The contributions of these Minnesotans have made the Nongame Wildlife Program a reality and a success.

Plan for the Management of Nongame Wildlife in Minnesota

Volume 2 - The Resource Assessment

Date: 9/83

Minnesota Department of Natural Resources
Division of Fish and Wildlife
Nongame Wildlife Program
St. Paul, Minnesota

Funded by: Minnesota citizens through their donations to the Nongame Wildlife Fund.

Table of Contents

Page

LIST OF TABLES

LIST OF FIGURES

I INTRODUCTION to Volume 2

Purpose 1

Premises 1

Contents 1

II STATE OVERVIEW of factors important to an understanding of the present condition of nongame wildlife in Minnesota

Abiotic Parameters 4

Climate 4

Geology 5

Topography 7

Soil 10

Water 12

Discussion 14

Vegetation 14

Prairie Biome 15

Deciduous Forest 15

Northern Forest Biome 17

Discussion 18

Land Use History 18

Agricultural Zone 20

Land uses 21

Projected changes in land use 23

Consequences for wildlife 24

Unique aspects 27

Page

Management considerations 30

Transition Zone 32

Land uses 32

Projected changes in land use 34

Consequence for wildlife 36

Unique aspects 41

Management considerations 43

Forest Zone 44

Land uses 44

Projected changes in land use 54

Consequences for wildlife 56

Unique aspects 60

Management considerations 61

Discussion 62

Present Land Ownership 63

Public land 63

Private land 67

Discussion 67

SUMMARY STATEMENT 69

III THE NONGAME WILDLIFE RESOURCE

The Supply 72

Definition and Scope 72

Mammals 76

Species diversity 76

Species composition and status 76

Habitat affiliations and distribution 77

Special interest species 78

Page

Utilization 79

Birds 80

Species diversity 80

Species status and composition 81

Habitat affiliations and distribution 81

Special interest species 83

Utilization 83

Reptiles and Amphibians 87

Species diversity 87

Species status and composition 87

Habitat affiliations and distribution 87

Special interest species 88

Utilization 89

Fish 90

Species diversity 90

Species status and composition 90

Habitat affiliations and distribution 91

Special interest species 92

Utilization 93

Invertebrates of Concern 93

Endangered and Threatened Species 95

The Demand 97

Activities 98

Wildlife Observation including Feeding 107

Wildlife Photography and Wildlife Art 108

Maintaining Natural Areas for Wildlife 108

Wildlife Interpretation and Education 112

Bird Banding, Scientific Collecting, and other Wildlife Possession Activities 114

Page

Discussion 116

IV APPENDICES

I - Nongame Wildlife Species of Minnesota 117

II - Endangered and Threatened Fauna 135

III - Summary of Nongame Legislation 138

V LITERATURE CITED 142

LIST OF TABLES

Table number	Table Title	Page
1.	Projected land use change, 1975-1990	62
2.	Number of nongame species by vertebrate class and status	73
3.	Number of nomgame species by vertebrate class and region	74
4.	Characteristic nongame mammals of the three major biomes	78
5.	Characteristic nongame birds of the three major biomes	82
6.	Habitat affiliation of nongame fishes	92
7.	Projections of birdwatching/nature study occasions in Minnesota by region from 1980-1995	102
8.	Wildlife observation on the major wildlife management areas	106
9.	Number of permits for wildlife possession 1982-1983	114

LIST OF FIGURES

Figure Number	Figure Title	Page
1.	Mineral resources of Minnesota	6
2.	Peat resources of Minnesota	8
3.	Landforms of Minnesota	10
4.	Major lakes and streams of Minnesota	13
5.	Pre-settlement vegetation of Minnesota	16
6.	Minnesota land use zones - 1969	19
7.	Extirpated, endangered and threatened nongame species of the agricultural zone	25
8.	Publicly owned wildlife lands in Minnesota	29
9.	Generalized map of high urban land demand, 1975-1990	35
10.	Extirpated, endangered and threatened nongame species of the transition zone	40
11.	Public land ownership - 1976	45
12.	Minnesota counties containing lakes sensitive to acid precipitation	53
13.	Extirpated, endangered and threatened nongame species of the forest zone	57
14.	Minnesota's resource zone - the 80's	71
.15.	Resource management regions	75

INTRODUCTION

Purpose

The Resource Assessment is the second volume of the Plan for the Management of Nongame Wildlife in Minnesota. The purpose of the volume is to present a summary of the present condition of the nongame wildlife resource in Minnesota. This will be accomplished through a review of the factors which have created this present condition. It is the intent of such an approach to create a common ground of understanding as a basis for action to assure the future availability of nongame wildlife in Minnesota.

Premises

Two premises guided the development of this assessment. The first is that wildlife is a product of the land. The second premise is that Americans have a continuing and abiding interest in wildlife.

Overview of Contents

To understand the present occurrence, abundance, and distribution of wildlife species, we must understand the factors which have shaped the land and the resultant mantle of vegetation with which wildlife is associated.

The STATE OVERVIEW creates this perspective through a review of various factors which have shaped the landscape. The section begins with a discussion of important Abiotic Parameters such as climate and topography. A description of the vegetation which constituted the pre-settlement condition of wildlife habitats in Minnesota is then presented. This is followed by a discussion of Land Use History and Land Ownership which describe how man's past use of land and other natural resources, when superimposed on the pre-settlement condition of

the vegetation, has resulted in the present availability of wildlife. Also included will be some predictions of future trends in land use and implications of such activities for nongame wildlife.

The present condition of the nongame wildlife resource is summarized in NONGAME WILDLIFE. This section defines nongame wildlife in an operational sense. It serves as an inventory of Minnesota's nongame species (Appendix I) and includes a qualitative discussion of The Supply of this resource including endangered and threatened species (Appendix II).

The second premise that guided the development of Volume 2 is that Americans have always been interested in wildlife. Originally, this interest was for food and clothing. Now, increasingly, Americans are interested in wildlife in an appreciative sense, for recreation and refreshment (Nash, 1967; Matthiessen, 1959; Borland, 1975).

Only recently have attempts been made to describe this interest and characterize the participants (Kellert, 1979). The extent of these attempts to quantify interest in nongame wildlife on the part of Minnesota citizens is summarized in The Demand. This portion of the Assessment will list the activities that have been defined as constituting "a demand" for nongame wildlife. Following this listing is an analysis of the data which quantifies Minnesotans' interest in nongame wildlife.

It is not the purpose of the Resource Assessment to serve as a definitive treatise on all the nongame wildlife species in Minnesota. This would be an impossible task. Beyond a preliminary understanding of basic biology and distribution (Hazard, 1982; Green and Jannsen, 1975) much remains to be learned about the biology and ecology of

Minnesota's diverse nongame wildlife resource.

It is a purpose of this volume to serve as a reference for information on nongame wildlife in Minnesota. Consequently, Appendix III - Legislation, is included. It summarizes the laws, orders, and regulations related to nongame wildlife.

Portions of the text which follows have been extracted or adopted from a number of reference documents including: Borchert (1980), Minnesota State Planning Agency (1978), MN. DNR, Office of Planning, Research and Policy (1979), and National Research Council (1982). The availability of the information contained therein is appreciated and gratefully acknowledged.

STATE OVERVIEW

Wildlife is a product of the land. To understand wildlife as we see it today in Minnesota, we need to understand the contribution of a number of factors in creating the present landscape and the resultant abundance and distribution of wildlife.

The STATE OVERVIEW is a review of relevant information on each of the important factors which have shaped the landscape and consequently the present condition of our wildlife resources. The first of these factors to be considered is the Abiotic Parameters - climate, geology, topography, soil and water.

ABIOTIC PARAMETERS

The importance of these parameters relative to wildlife is derived from their statewide variation. This variation is highlighted in the following discussions.

Climate

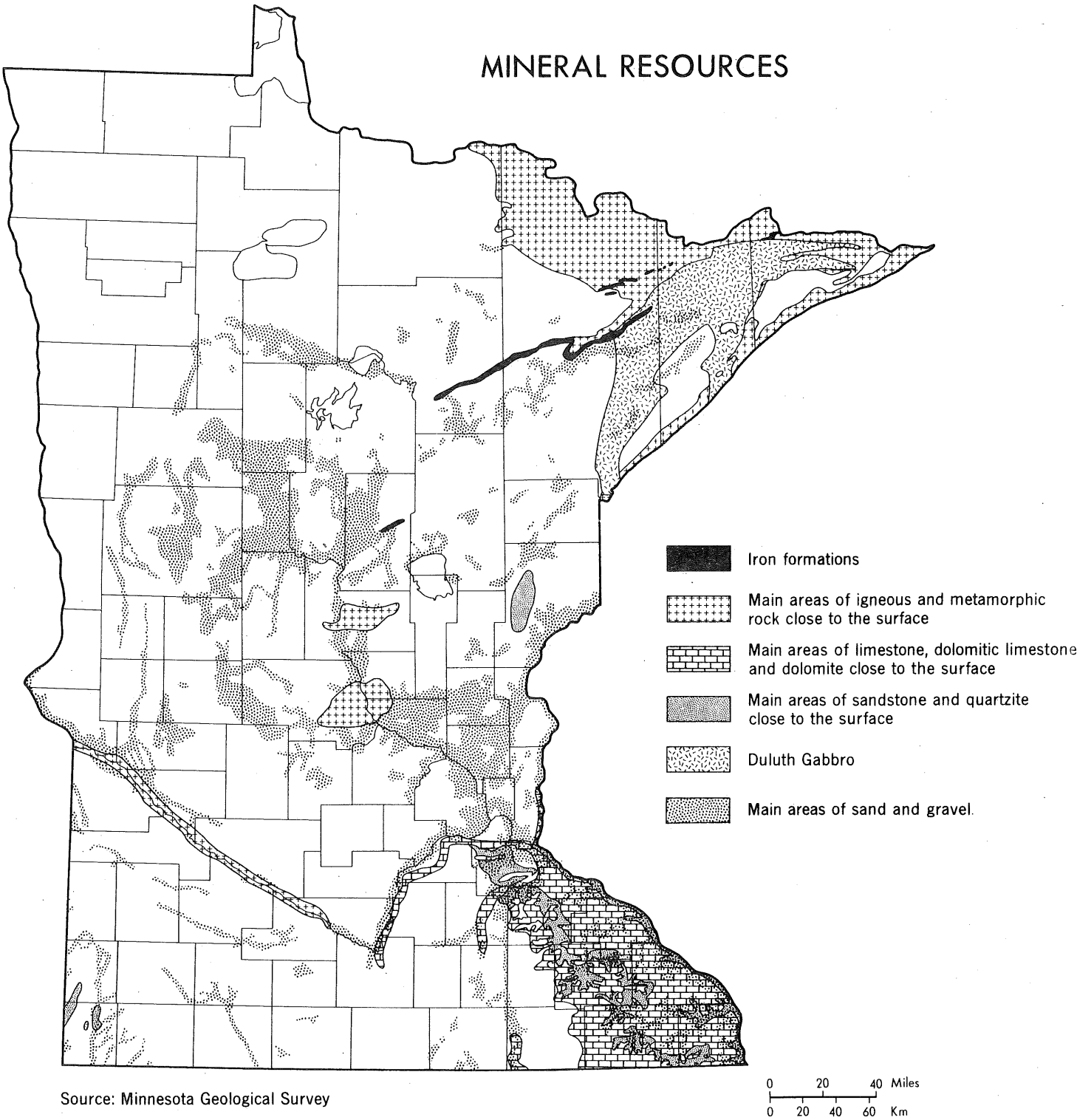
Minnesota has a "continental" climate with extremes in seasonal temperatures, and less precipitation than coastal areas. Winters are long and cold with significant amounts of snowfall throughout the state. Mean winter temperatures range from 6° F in the north to 20° F in the south. Summers are cool to warm. The growing season averages 139 days and increases from 90-120 days in the north to 130-160 days in the south. The extreme northeast lacks an adequate growing season for most commercial crops. Average summer temperatures range from 72° F in the south to 58° F along Lake Superior. The warmer southcentral counties lie within the richest part of the cornbelt. The cool northeast has the greatest surplus of rainfall over evaporation, and the southwest has the most frequent moisture deficit problem.

Geology

The bedrock formations in Minnesota are quite variable (Fig. 1). The more recently formed shale and sandstone deposits extend along the western edge of the state. The bedrock layers of southeastern Minnesota and extreme northwestern Minnesota are composed of paleozoic marine sediments which formed dolomitic limestone, sandstones and shale. About 1.1 billion years ago, a period of major volcanic activity created the Lake Superior basin, the basalt and rhyolite rocks above Lake Superior, and the copper and nickel-bearing gabbro and the granite rocks of northeastern Minnesota.

Older precambrian sedimentary rocks deposited approximately 1.4 to 2.0 billion years ago include quartzite, silt stone, the iron formations of the Cayana, Mesabi and Gunflint ranges, and graywacke. During the same time frame, the granite deposits in the St. Cloud area were formed by volcanic rock intruded into the sedimentary basin of central Minnesota. The ores of the Soudan Iron Formation formed between 2.6 to 2.7 billion years ago. The sedimentary rocks of north central and northwestern Minnesota were intruded by granite rocks about 2.6 billion years ago. These granites are quarried at their southern extent in the Minnesota River Valley.

Throughout the state, these bedrock formations are covered with a mantle of sand, gravel, boulders and clay of varying thickness. This mantle is generally less than 5 feet thick in northeastern Minnesota where glaciers swept the area down to the bedrock. In the southeast and portions of southwestern Minnesota, a shallow mantle has resulted where the surface materials had been washed away by water. This mantle reaches its greatest thickness in the terminal moraines of west-central



Source: Minnesota Geological Survey

Figure 1. Mineral resources of Minnesota.

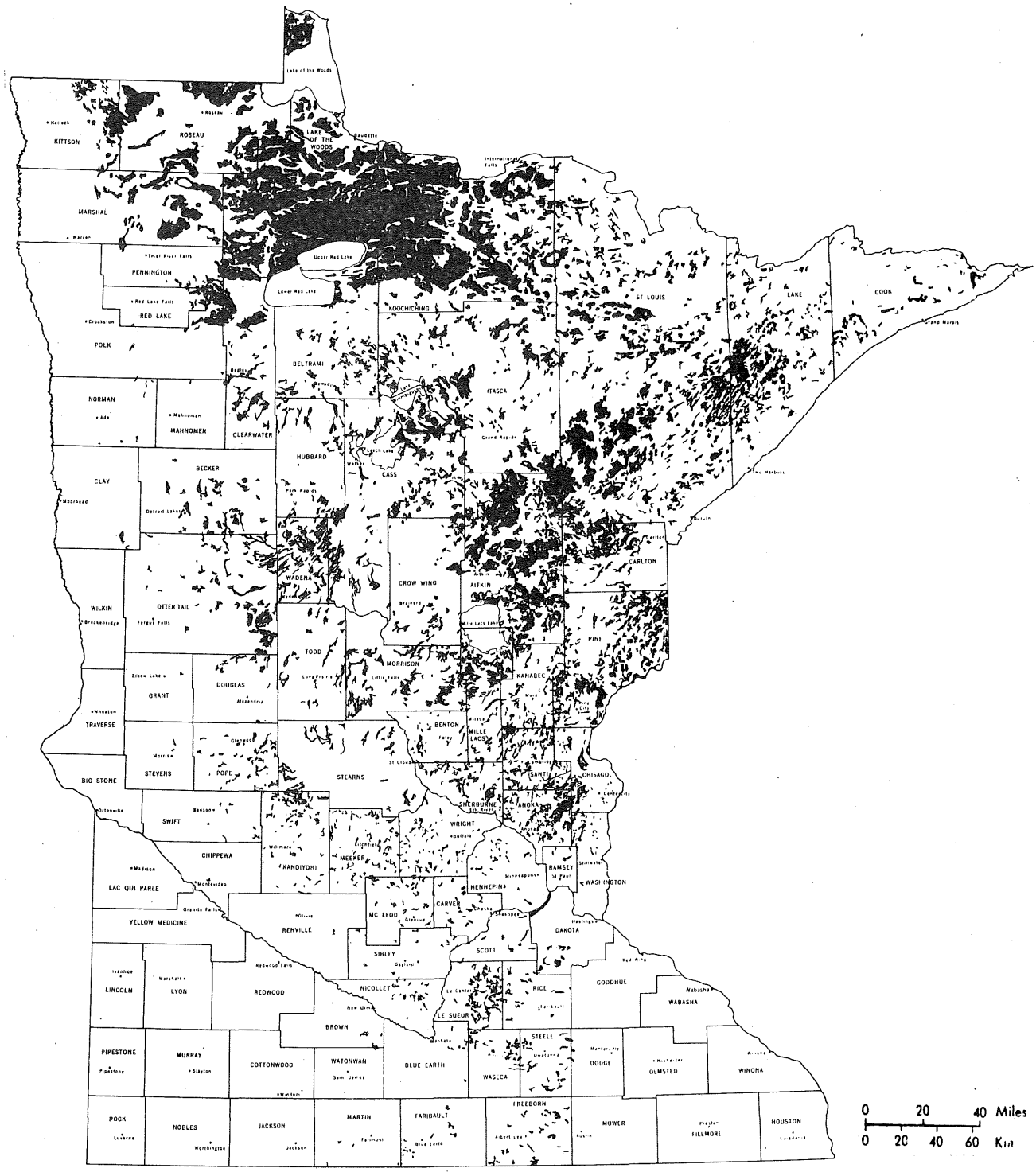
and south-central Minnesota, and in the Prairie Coteau of the southeast corner of the state.

Commercially exploitable ore deposits contained in the bedrock include the iron ore formations. Minnesota's iron ore deposits were among the richest in the world. The copper-nickel and titanium vanadium deposits in the Duluth gabbro are currently being studied to determine their commercial potential. Uranium exploration has been conducted in the sedimentary deposits of Pine and Carlton counties.

Minnesota has more than seven million acres of peat deposits (Fig. 2). Large deposits are located in the "Big Bog" area in Beltrami, Lake of the Woods, and Koochiching counties. Peat is also found in substantial quantities in St. Louis and Aitkin counties and in smaller scattered locations. In their natural state, peat bogs are important for their abiity to retain water and as habitat for wildlife. Many of Minnesota's northern peat bogs support commercially harvestable stands of black spruce. Peats may also be an important fuel source for the future. When dry, peat can be burned to produce electricity, or when gasified it can replace natural gas. The environmental and economic implications of the commercialization of peat as a fuel source are receiving considerable study in Minnesota.

Topography

Minnesota straddles three continental divides with water flowing in three directions in three great river systems - the Mississippi River to the Gulf of Mexico, Great Lakes through the St. Lawrence River to the Atlantic Ocean, and through the Red, Rainy and Nelson rivers to the Hudson's Bay. Elevations range from a high of 2,301 ft. at Eagle Mountain (Cook Co.) to a low of 602 ft. on the shore of Lake Superior.



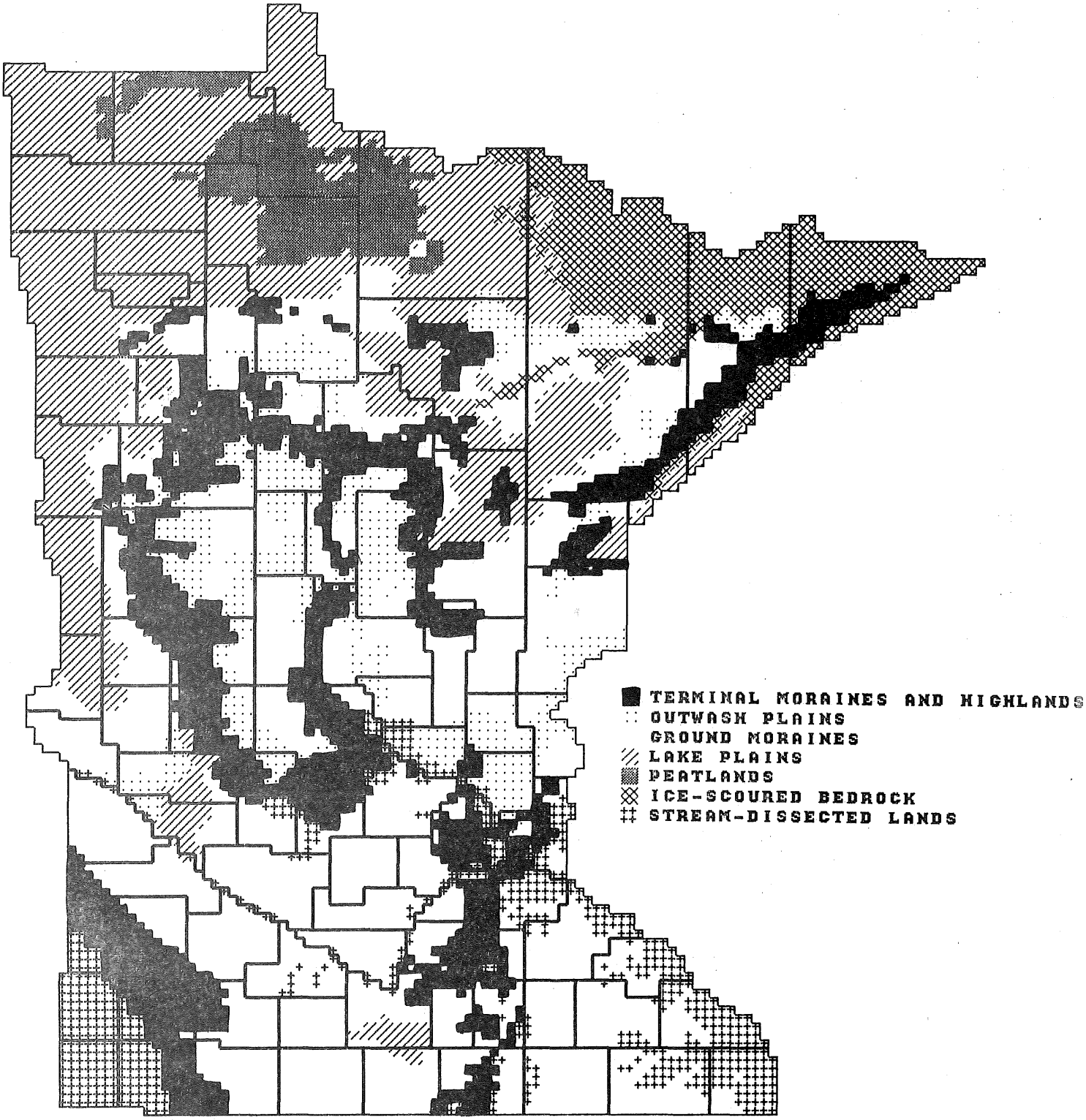
Source: Minnesota Department of Natural Resources

Figure 2. Peat resources of Minnesota.

Ice Age activity has given the local terrain great variety. Till plains, moraines, outwash plains, and lake plains are distinctive features on the surface of glacial drift (sand, gravel, boulders, and clay) left when the ice melted (Fig. 3). The melting glaciers also released large quantities of water which filled low basins and formed temporary glacial lakes, such as Lake Agassiz which once covered the entire northwestern portion of Minnesota. When the lake drained, the present flat surface of northwestern Minnesota remained and with it such residual bodies of water as the Red Lakes and Lake of the Woods. The western portion of this plain, stretching from Traverse County to the Canadian border, is the rich, gently westward-sloping Red River Valley. A northeastern extension of this lake plain, covering the area north of Red Lake, is the very flat, poorly drained Big Bog area.

Till plains are the dominant landform of Minnesota's southern agricultural areas. These plains are gently rolling and consist mainly of clay, silt, and loam soils. They comprise the rich farm lands of the cornbelt of southern Minnesota. Much of this area contained extensive wetlands at the time of white settlement.

Four areas of the state lack glacial deposits. Along the North Shore of Lake Superior, in the Border Lakes, and on the Mesabi Range glaciers removed much of the surface material to expose bare rock. These are areas of varied topography; Sawtooth Range, Lake Superior Cliffs (600-900 ft.) and deep, clear, boulder-filled lakes. The southeastern corner of the state also lacks glacial deposits. As a result, the topography of deep, stream-carved valleys and high, narrow, intervening ridges, with no natural lakes (except the anomaly of Lake Pepin), characterizes the area today. The steep valley walls, with



Source: Minnesota Geological Survey

Figure 3. Landforms of Minnesota.

many rocky bluffs, rise from the floodplains 100 to 500 feet upward to the ridge tops.

Soils

Soil is a most important natural resource, the base upon which the state's agricultural and forest products economies are built. Soils are the products of the original rock materials, climatic conditions that have eroded them and plants that have grown and decayed, adding organic matter. Consequently, soils vary widely in texture and chemical composition.

Loam is a soil of mixed sand, clay, and organic material that exhibits great differences in its suitability for agriculture. Loam soils range from the deep, dark colored topsoils formed under the prairie grasslands of southwestern Minnesota, rich in organic matter and high in soluble mineral plant food, to the thin, light colored, low fertility soils that developed beneath the coniferous forests of central and northeastern Minnesota. Sandy soils and clay soils are directly related to the location of outwash plains and lake plains, respectively.

Rock outcrops predominate in the ice-scoured areas of northeastern Minnesota and in areas where soils have been eroded away leaving the underlying bedrocks exposed, as in southeastern Minnesota. Other surface materials in Minnesota include alluvium, spread across the flat floodplains of present-day streams; loess (windblown soil), found in southwestern Minnesota and parts of southeastern Minnesota; and the growing mass of mine tailings generated on the iron ranges. The peat type soils have already been discussed.

Water

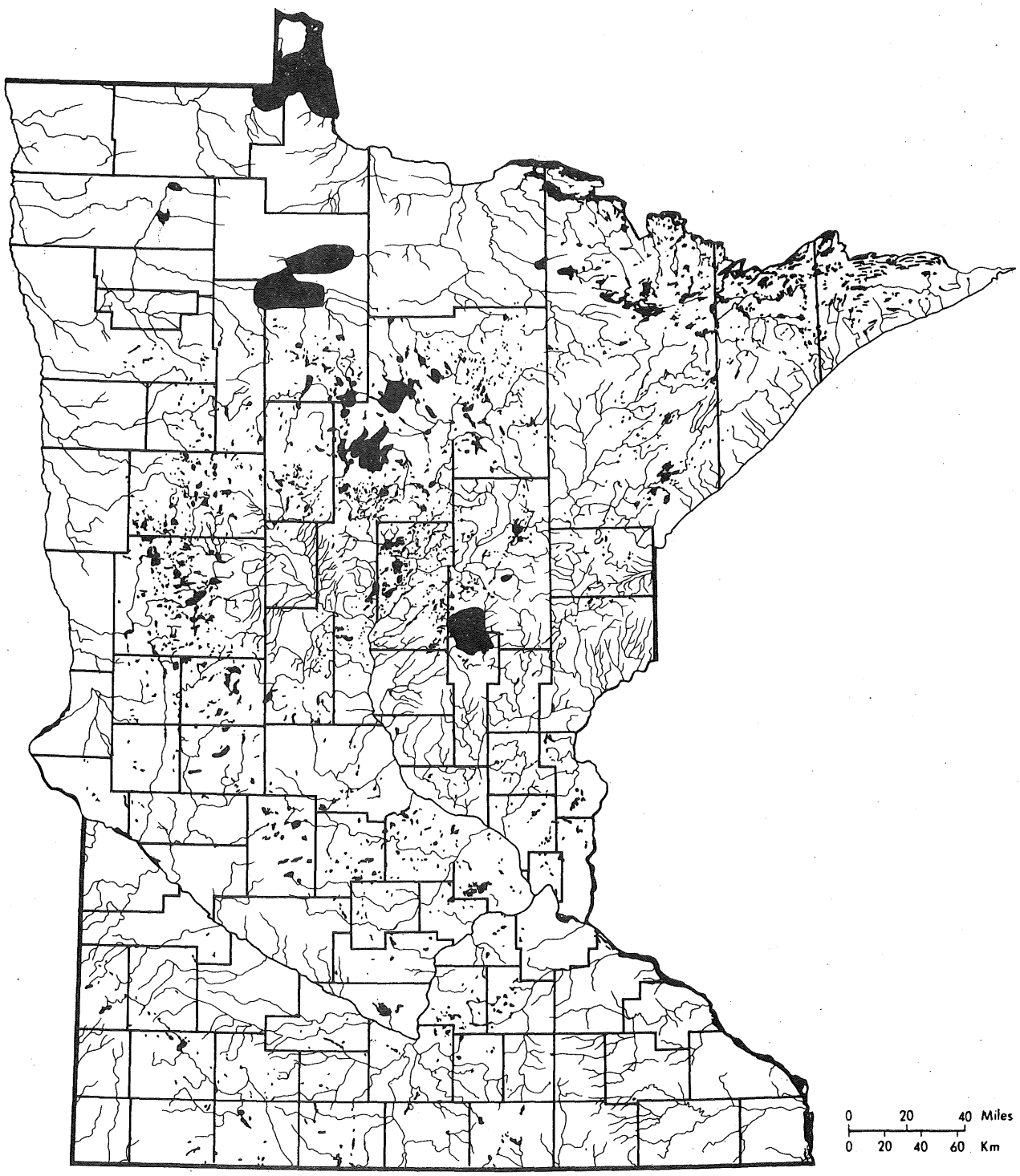
Minnesota has an abundance of water resources - lakes, rivers, marshes, bogs, and swamps (Fig. 4). The abundance, variety, and still relatively undeveloped condition of some of these areas contributes to an abundance of native plant and animal species which depend on these aquatic ecosystems.

Annual water runoff is the excess of average annual precipitation over evapo-transpiration. Runoff is Minnesota's basic water supply. It is the water available to replenish the state's 4.8 million acres of lakes and 25,000 miles of rivers and streams. The rate of water flow through these systems is dependent on the amount of annual runoff, which ranges from more than 10 inches in the northeast to less than one inch near the South Dakota border.

Concentration of rivers and streams occur along the North Shore of Lake Superior, in southeastern Minnesota, and along the edge of the Prairie Coteau in southwestern Minnesota.

The distribution of lakes in Minnesota was determined largely by the surface-shaping forces of glacial activity. The greatest concentration of lake basins is found in the terminal moraine belt of central Minnesota and the ice-scoured northeast. In these regions, lake basins cover at least 10 percent of the total surface area.

Minnesota's lakes are characterized by different fish communities, primary producers, chemistry, shape and depth of lake basins, and shoreline vegetation. In general, lake trout lakes occur in the northeast, walleye lakes in the north and north central, panfish lakes in the central and north central, and waterfowl lakes in the south and southwest. At least one-fifth of Minnesota's more than 15,000 lake basins of 10 or more acres have become dry as a result of



Source: Minnesota Department of Natural Resources

Figure 4. Major lakes and streams of Minnesota.

the natural processes of filling and vegetative growth and, more importantly, drainage projects to expand cropland. Extensive installation of drainage ditches and tiles is found on the gently rolling glacial till plains of southern and southwestern Minnesota. Drainage ditches, generally without tributary tile systems, are extensive in the moisture-retentive clay soils of the Red River Valley and in the marshland and bog areas of northwestern Minnesota and St. Louis County.

While drainage is a common activity in Minnesota, irrigation also has potential as a water management action. The great potential for supplemental irrigation is on the sandy outwash soils of central and east-central Minnesota and the sandy alluvial deposits along stream bottomlands. Of Minnesota's 8 million acres of predominantly sandy soil, as much as 1 million acres may be potentially irrigable.

Discussion

As a consequence of these varying abiotic parameters, the northeast region of Minnesota may be characterized as a cool zone with heavy snows and a relatively short frost free period. The ground is rocky and rough, with shallow, infertile, acid soils. The region has abundant mineral resources, a dependable water supply and many scenic amenities including numerous lakes.

In contrast, the southwestern region may be characterized as flat, dry and hot. The soils, however, are deep and fertile, and the growing season is longer. Evaporation exceeds rainfall. As a consequence, the region is drought-prone.

Between the two extremes is a zone of intermediate character. In general, these three contrasting zones cross the state from

northwest to southeast, and may be further characterized by the variation in vegetation reflecting the differering abiotic conditions in each zone.

VEGETATION

Vegetation constitutes a major component of wildlife habitat as it provides both food and cover for wildlife. It is the second factor of importance to our understanding of the present condition of wildlife in Minnesota.

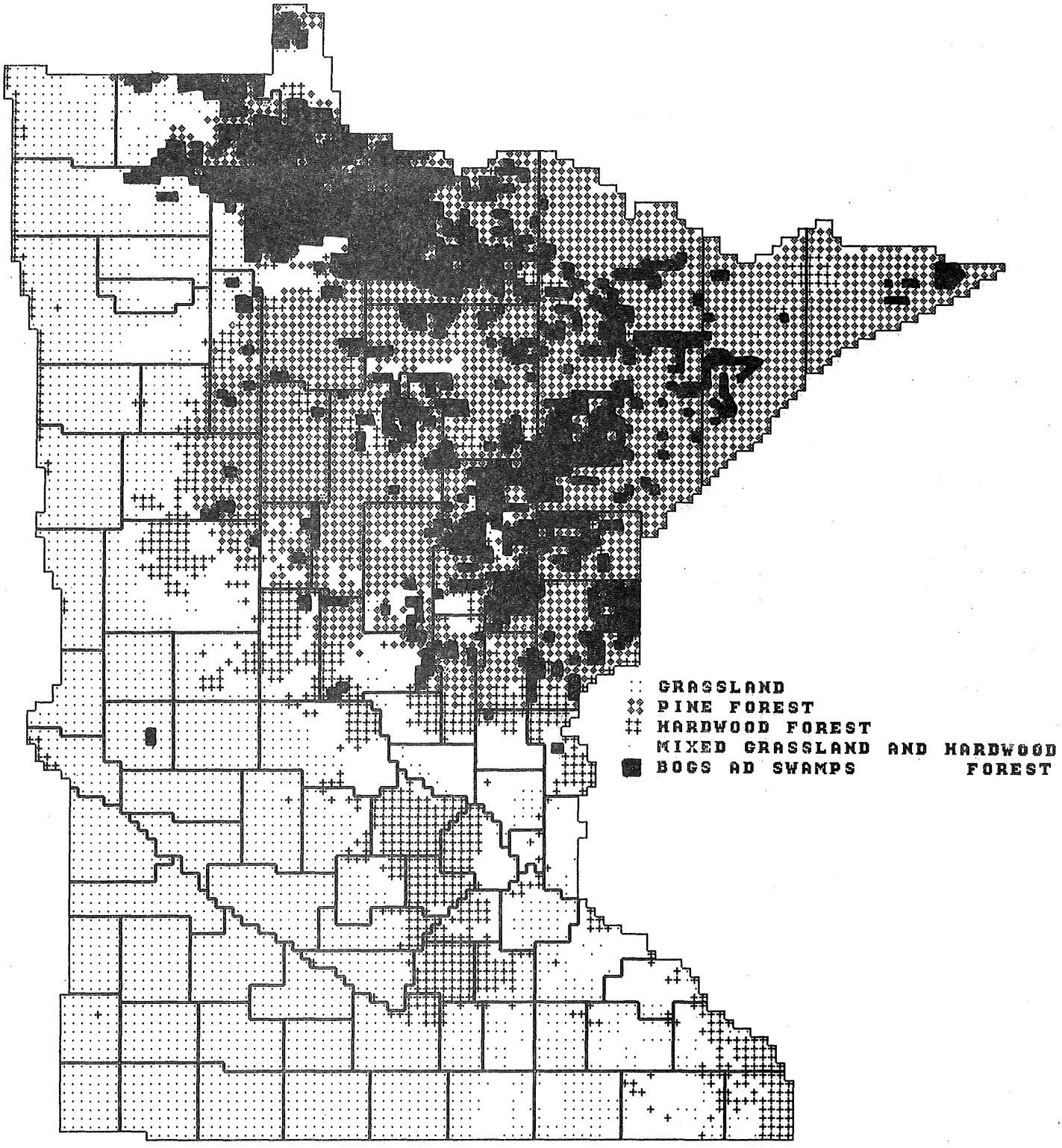
The following description of the original vegetation of the state is based on the work of Francis J. Marschner (1930) as presented in Borchert and Gustafson (1980). The pre-settlement vegetation of Minnesota comprised three major biomes - the prairie, the deciduous forest and the northern forest (Fig. 5). The general patterns of vegetation were relatively stable but the details of the mosaic were continually shifting as a result of climatic changes, fires, windstorms, insect infestation, plant disease outbreaks, and the gradual modification of lakes and wetlands by bog and swamp forming processes.

Prairie Biome

The tall grass prairie dominated southern and western Minnesota. Among the more common species were big bluestem, little bluestem, Indian grass, prairie clover, goldenrod, pasque flower, and shrubs such as roses and wolfberry. Prairie marshes included blue jointgrass, sedges, reeds, cattails, bullrushes, and wild rice.

Deciduous Forest Biome

The deciduous forest biome had two aspects. The mixed grassland and hardwood area represents the prairie-forest transition zone,



Source: F. J. Marschner

Figure 5. Pre-settlement vegetation of Minnesota.

consisting of grassland, with trees or brush scattered or in small clusters. Oak, wth some elm, ash, and basswood dominated in the southeast and east-central areas of the state. Aspen was an associate species toward the central and northern parts of this area. Burr oak, scattered and in groves, was typical of the Anoka Sand Plain. The oak gradually gave way to jack pine toward the sandy outwash plains of north-central Minnesota.

The hardwood forest or Big Woods extended from southeastern Minnesota to east-central Minnesota and included red, white, and burr oak as the dominant species. Secondary species varied from black walnut, butternut, hickory, and wild cherry in the southeast, to maple and basswood in central Minnesota, and elm, ash, and cottonwood along the river lowlands. Oak dominance gradually gave way to aspen and birch in the north.

Northern Forest Biome

The northern forest biome also exhibited two aspects. The pine forest included some nearly pure stands of white and Norway pine, the basis for Minnesota's early lumber industry. But mixtures of pine with balsam fir, white and black spruce, and northern white cedar were more typical. Also in this category are the transition areas between the conifers and mixed hardwoods, where, for example, post-fire aspen and birch dominance was being gradually overtaken by understories of white and norway pine, balsam fir, and spruce.

In areas of the state classified as bogs and swamps, the vegetation developed over peat and acid groundwater and included black spruce, tamarack, heaths, and sphagnum mosses. The less acidic areas included, in addition, balsam fir, northern white cedar, and birch.

This category includes, as well, the nearly treeless muskeg or floating bog areas north of Red Lake and in parts of St. Louis and Roseau counties. These bog areas have been dominated by sedges, reeds, grasses, bog birch, mosses, and stunted tamarack.

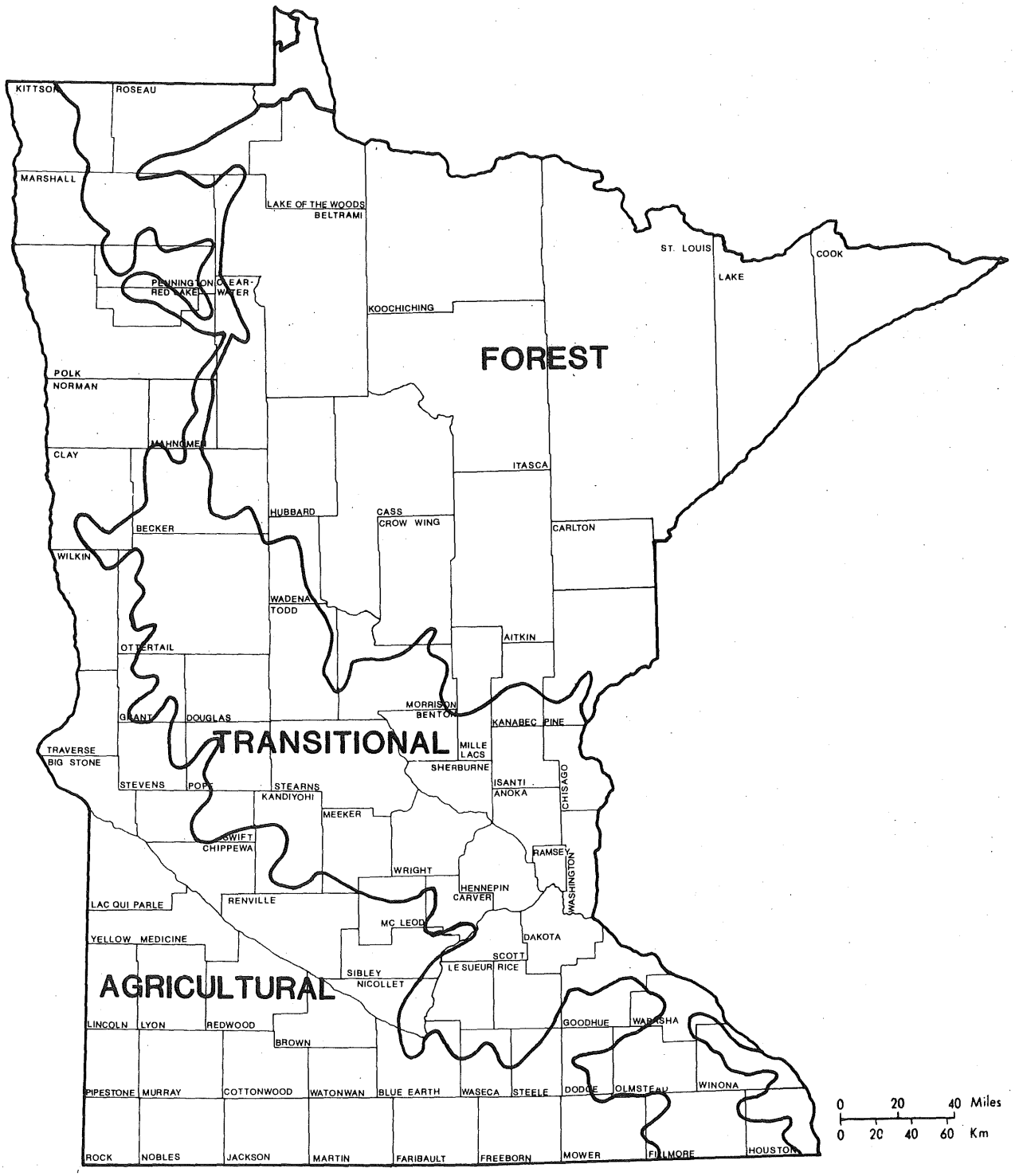
Discussion

More than any other natural element, the vegetation of Minnesota has been altered by human activities. The most dramatic impacts have been the nearly total elimination of prairies and the substantial reduction of wetland and forest acreage. The explanation for these vegetative changes since pre-settlement times may be found in a review of the land use in Minnesota, a summary of which is presented in the following section on Land Use History.

LAND USE HISTORY

The current pattern of land use in Minnesota has developed over the past 125 years. From its beginning in the southeastern corner of the state, settlement gradually pushed westward where farming dominated and northward where wood and wildlife were the attractions. Today, Minnesota is characterized by three major land use areas - the agricultural, transition and forest zones - which coincide with the three major vegetation biomes of the state (Fig. 6).

The relative impact of man's activities on the natural vegetation has been different in the land use areas. The prairie biome is now largely an agricultural zone where cultivated croplands and various associated domesticated forbs and grasses, as well as exotic weed species predominate over 99% of the original prairie area. This is the biome where the most dramatic change has taken place. Extremely small remnants of native prairie, woodland, and wetland vegetation



Source: State Planning Agency

Figure 6. Minnesota land use zones - 1969.

remain to support native wildlife species.

The deciduous forest has been altered to an intermediate degree. While logging, land clearing, and farming have introduced a significant amount of vegetation change in this transition zone, there are still many remnants of original vegetation in its woodlands and marshes.

The northern forest has been altered the least in terms of conversion to domestic crops. While the species composition of many areas has been dramatically affected by timber harvesting, native vegetation still covers much of the forest zone.

Agricultural Zone

During the early settlement period (1860-1880), the agricultural zone had an abundance of prairie habitat as well as shallow lakes and potholes, riverbottom hardwood forests of elm, ash and cottonwood and scattered stands of upland hardwoods and brush. Such waters and vegetation provided excellent habitat for native waterfowl, grassland birds and mammals. However, intensive agricultural management since that time has substantially changed the face of the landscape.

Today, the agricultural zone comprises south central and southwestern Minnesota and a narrow band of land along the Red River Valley. This zone consists of 15.7 million acres or 28% of the state. The highest proportion of land area in farms is on the rich prairie soils of the southern area and the lacustrine soils of the Red River Valley. The major crops are corn, soybeans, wheat, hay, oats and sugar beets.

The greatest proportion of pasture land is located in the hilly deciduous woodland areas of southeastern and west central Minnesota. In addition to dairy cows, major livestock raised include beef cattle,

horses, sheep and hogs.

Land uses - Changes in the landscape associated with this agricultural development have been dramatic. Loss of habitat is the most obvious. Almost all the virgin prairies with their rich soils, were converted to cropland before the turn of the century. Today, less than 1/3 of 1% of the original grassland remains unaltered in Minnesota. The scattered remnant tracts which remain along the beach ridges of glacial Lake Agassiz and other places are mostly on public lands or lands owned by the Nature Conservancy.

Drainage through ditching, tiling and stream channelization soon followed, altering both terrestrial and aquatic habitats. Most of the shallow marshes and seasonal wet areas have long since been drained and converted to cropland. Except for some of the steeper slopes of the river valleys, much of what was wooded has been logged or cleared for crops or pasture land. Such activities continue today, despite excess production and low economic return from lands already in production.

Early in the century, agricultural production sometimes resulted in increased wildlife diversity. Prairie chickens, for instance, initially expanded their range in Minnesota and thrived as a result of agriculture. However, the cumulative effect of recent agricultural intensification has been a continuing loss of habitat and a dramatic decline in species diversity. The trend in agriculture towards bigger equipment has led to a situation where many small, odd-shaped corners of habitat have been eliminated because they interfere with equipment operation. Wetland drainage and stream channelization are also the result of a desire for more cropland. This trend, along with rising land prices have been incentives to convert many marginal pieces of

grassland, woods, steeply sloping, rocky and erosion-prone land into cropland or pasture. Because of the common practice of fall plowing, much of this land has no protective cover of either crop foliage or residue for two-thirds of the year. This not only means no wildlife habitat in most cases but also excessive wind and water erosion.

Changes in the number of cropland acres have also resulted due to changes in farm programs which have been brought about by differing farm policies of various administrations. The full production policy of the Nixon-Ford administrations caused a large increase in the amount of acres in production. In contrast, large numbers of cropland acres were idle during the soil-bank years of the late 50's and early 60's. Even while one agency of the federal government was paying to take land out of production, another was subsidizing drainage of wetlands to create more cropland. Seemingly contrary policies such as this, though not as flagrant as before, still exist. Tax deductions are still given for wetland drainage under the guise of "conservation improvements" while payments are being made for acres taken out of production. Recently cleared or drained land can be farmed for a year or two and then put in the set-aside program.

In addition, many conservation practices such as shelterbelts or windrows which were installed previously on farms with public assistance have been destroyed. Public monies have consequently been wasted on measures which provided only short term conservation and wildlife habitat benefits.

Environmental contamination is also a serious consequence of modern agricultural practices. Fertilizers, herbicides and pesticides are used extensively in Minnesota agriculture. Heaviest use occurs in

the south central counties where the soils are most productive and corn and soybeans are the major crop. This area is also the Minnesota River drainage basin, with its relatively low level of runoff. These factors contribute to a high level of chemical nutrients and toxicants that contaminate the river, its tributaries, and associated wildlife.

Projected land use change[1] - Overall, little change is projected for future land use in the agricultural zone[1]. It is likely that there will be continued agricultural intensification. The degree of this intensification will depend upon markets and federal set-aside programs. During previous years, a federal policy of full agricultural production heightened the conflict with the desire to preserve wetlands and uplands for wildlife, and prevent soil erosion. However, we are now entering a period of reduced production because of the accumulation of large crop surpluses and low prices. This may temporarily ease the agriculture-wildlife conflict.

The potential exists for adding substantial acreage to the state's cropland base. One notable trend is toward increased irrigation. Recent University of Minnesota projections indicate that the state has at least 2 million acres that are potentially irriable. While estimates of the growth in irrigation are speculative, they do indicate the extent of potential land use changes. Urban growth is not expected to be a widespread problem in the agricultural zone. Only 5% of the state's urban land needs

---

[1] Much of the discussion on land use change is excerpted from Notebook on Land Use Projections (MN State Planning Agency, 1978)

are projected to occur in this zone. Cropland losses that do occur are likely to be located around existing population centers.

Consequences for wildlife - Wetland drainage, conversion of prairie and woodland to pasture and croplands, waterway degradation through channelization, siltation, nutrient loading from fertilizer, and pesticide contamination are all consequences of modern agricultural practices. These landscape changes have been extremely destructive to wildlife habitat. Of the 14 wildlife species proposed for listing as extirpated or endangered in Minnesota, 12 inhabit native grasslands (Div. Fish and Wildlife, 1983) (Fig. 7). All 12 were once more abundant and wide ranging throughout the agricultural zone. Their current status is a consequence of the destruction of the prairie grasslands and shallow wetlands.

Future expectation is that wildlife habitats in the agricultural zone will continue to be reduced by a number of agricultural trends including continued land drainage and removal of fence rows and woodlots in order to increase field size or for irrigation. Tree cover in the form of farmstead shelterbelts and field windbreaks are extremely important to many nongame species. They not only serve as important nesting areas for about two dozen bird (Berner - pers. comm.) species but they seem to serve as important daytime stopover areas for many nocturnal migrating woodland birds. These trees and shrubs are also important as habitat for reptiles, amphibians and small mammals.

Forest management (or the lack of it) is also of serious concern as a resource impact. As noted previously, very little of the agricultural zone remains in tree cover except in the riparian zones. However, these few places are still under constant pressure to be

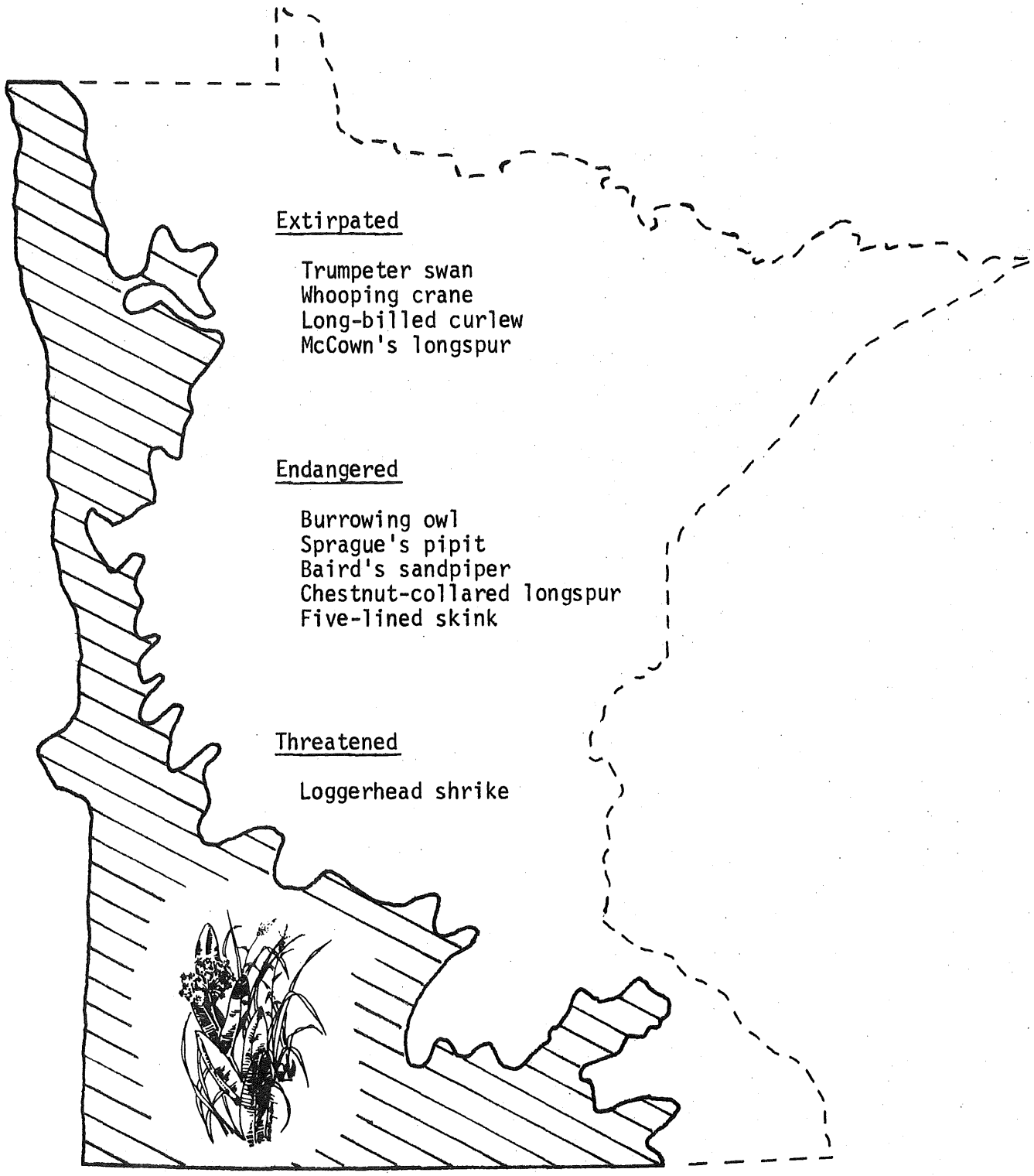


Figure 7. Extirpated, endangered and threatened nongame species of the agricultural zone.

cleared for agriculture. Other problems associated with timber management are overgrazing and cutting for firewood. Improper harvest of sawlogs has also caused serious habitat destruction in some cases. Because nearly all of the remaining tree cover in the region is in private ownership, it will only be through education, cooperation and fiscal incentive programs that proper habitat through forest management will be obtained.

Coupled with this reduction in habitats will be increased pesticide use. However, some benefits may accrue to wildlife habitat through the use of minimum tillage or no-till farming and a reduction in fall plowing. The Division is pursuing an expanded program to manage roadsides in grassy cover for pheasants (MN DNR, Div. Wildlife, 1982). Nongame passerines and small mammals will also benefit from the preservation of the natural cover.

Overall, the current and projected agricultural trends point to additional hardships for wildlife. As long as land use decisions are dictated mainly by economic considerations, there will be continued decreases in wildlife habitats throughout areas devoted to croplands and pasture. The major impediment to the inclusion of wildlife and habitat values in land use decisions is that these values provide little or no economic return and are difficult to measure. Without an accepted unit of value these resources cannot be expressed in dollars for comparison with other land use values. Additionally, there is little information available concerning integration of wildlife habitat management with modern agricultural practices, particularly from a cost-benefit standpoint. Unless this information can be developed, disseminated, and put into practice, the quantity and diversity of

wildlife throughout the agricultural zone will continue to decrease, particularly since the farmer's attitude toward wildlife is strictly utilitarian.

A recent study described farmers as expressing relatively limited interest in wildlife, the outdoors or animals in general (Kellert, 1980). In the summarization of the relationships between occupation and basic attitudes toward animals in American society, the report states that

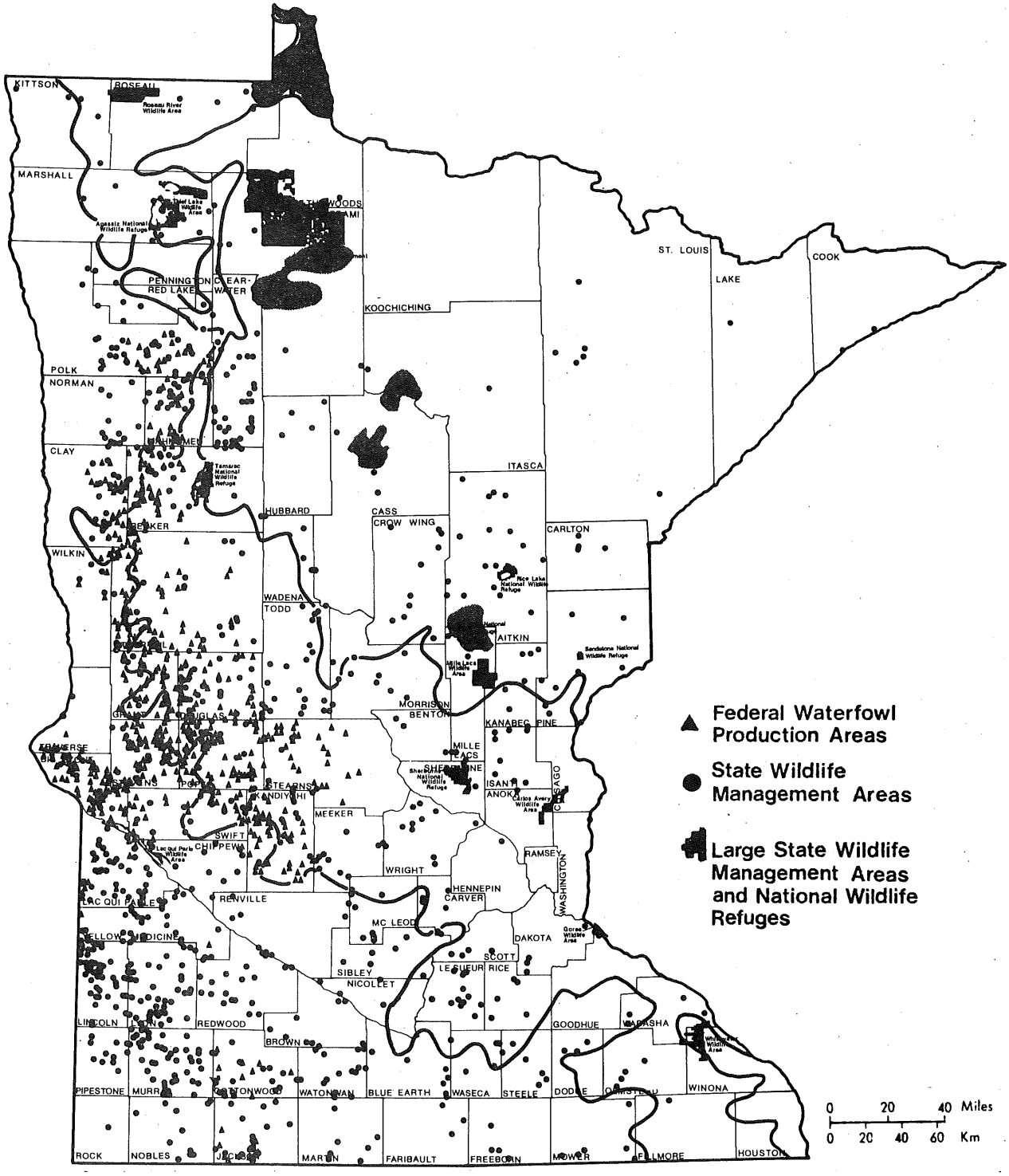
> "the limited interest and concern among farmers for animals is perhaps indicative of major difficulties that would be encountered in trying to promote effective wildlife management on one of our country's most important private lands. At a time of increasing pressure for monocultural farming and agricultural conversion or marginal habitat, new incentives and methods may have to be developed to enhance greater appreciation and a more protectionist ethic toward wildlife among farmers."

Unique aspects - In spite of these monumental landscape alterations there are a number of unique habitats that remain in this zone. Heron Lake in Jackson County and Swan Lake in Nicollect County historically have been "hot spots" for unusual waterbird breeding records. While they are both still excellent habitat areas, the number of species using these areas has declined. Swan Lake and Middle Lake, just east of Swan, serves as the eastern boundary of the breeding range of a number of marsh species such as the western grebe and eared grebe. Other excellent marsh areas occur on both the Lac Qui Parle and Talcot Lake Wildlife Management Areas and the Big Stone National Wildlife Refuge. Marsh Lake, which is within the Lac Qui Parle WMA, is one of the two nesting sites in the state for the American white pelican. During years in which large numbers of geese remain throughout the winter at Lac Qui Parle WMA, large numbers of bald eagles are attracted and will winter there as well. Both these areas, because of their

size, are oases of wildlife habitat in a black desert of cultivated soil.

Adjacent to the Lac Qui Parle WMA, the Nature Conservancy owns a large tract of native grassland - the Chippewa Prairie. Unique grassland species such as marbled godwit and upland sandpiper utilize this tract. Other remnant prairie areas are scattered throughout Big Stone County. Because of the rocky soils, greater topographic relief and surviving wetlands there are many tracts of high quality prairie remaining in this county. No other county in the state has so many prairie potholes surrounded by mudflats, marshes and grasslands. Further north, remnants of virgin prairie with their associated fauna, are still present along the beach ridges of glacial Lake Agassiz at such places as Felton Prairie and Buffalo River State Park in Clay County and at Rothsay Wildlife Management Area in Wilkin County. The Felton prairie area is the only remaining nesting location known in Minnesota for three proposed state endangered species; the Sprague's pipit, Baird's sparrow and Chestnut-collared longspur.

Most of the remaining unaltered wetland areas which are scattered throughout the agricultural zone have been maintained through public ownership and designation as federal waterfowl production areas or state wildlife management areas (Fig. 8). Salt Lake is a highly alkaline prairie wetland which straddles the Minnesota-South Dakota border in Lac Qui Parle County. The high alkalinity provides luxurient beds of sago pondweed but prevents the growth of most emergent vegetation. Because of this, the shoreline, with little or very low growing vegetation, provides excellent habitat for shorebirds. It is one of the premier shorebird observation areas in the state.



Source: Minnesota Department of Natural Resources

Figure 8. Publicly owned wildlife lands in Minnesota.

Other important habitats include the Minnesota River Valley and its major tributary rivers. The riparian woodlands associated with this river system provide the necessary habitat for most passerines and other woodland species of nongame animals. There are many outcrops of bedrock exposed in the Minnesota River Valley which are important to reptiles species such as the five-lined skink.

Extremely important woodlands are associated with all of the state parks in this region, except perhaps Blue Mounds State Park. This park provides a unique outcropping of rock which is the location of many unusual bird sightings including blue grosbeak, lark bunting and rock wren. It is the only place in Minnesota where the lined snake has been collected. The Pipestone National Monument in Pinestone County provides a unique situation of rock outcropping and woodland habitat.

The largest heronry in the state is located on an island in Long Lake north of Willmar. In 1982, this rookery included about 1750 nests of great blue heron, great egret, black-crowned night heron and double-crested cormorant.

The only important hibernacula known in the region are certain caves which historically contained bats. They are located along the Minnesota River Valley near St. Peter in Nicollet County. The current status of these caves is unknown.

The fields around Borup, Minnesota are also noteworthy as a staging area for sandhill cranes. However, the northwest corner has a depaupered herptofauna, relative to other areas of the state.

Management considerations - Options for counteracting the conversion of wildlife habitat are few. There appears to be a limited potential to

reverse the effects of habitat loss and restore some grassland species of small mammals and reptiles in areas of the agricultural zone where they no longer exist. It may be appropriate to expand the population of five-lined skinks to other suitable outcroppings in the Minnesota River Valley. It appears that some species of birds may also be restored to public lands where the habitat quality has improved under public ownership.

While habitat management on public lands has potential for enhancing some nongame wildlife resources, work on private lands may have the most impact. As mentioned previously, the farm program and how it is administered has the potential for affecting a greater number of acres than work on public lands (85% of the region is under cultivation vs. 2% public ownership in the region).

The Section of Wildlife has long recognized the importance of maintaining habitat on private lands. As a consequence, the Division of Fish and Wildlife administered a cost-sharing incentive program to encourage maintenance of wildlife habitat on farm lands througout the state (see page 110 for further discussion of the Wildlife Habitat Improvement Program).

Land acquisition as a management technique, will probably not be an item of high priority in the agricultural zone except as it affects endangered or threatened species. High costs of land in this intensive agricultural region will probably preclude fee title acquisition for most situations. However, in certain situations, such as the five-lined skink habitat, fee title acquisition may be the alternative for maintaining the wildlife resource.

Transition Zone

The transition zone cuts across the state diagonally from the northwest to the southeast, and corresponds roughly with the deciduous forest biome and associated oak savanna ecotone. The pre-settlement vegetation of the transition zone also included prairie and the "Big Woods" hardwood forest. This zone encompasses 16.9 million acres or 32 percent of the state's land area, including a large portion of the state's lakes. Today, a mixture of woodlots and farmland is the major land use. Nearly half of the transition zone is cultivated. Agriculture predominates on the southern and western edges of the zone.

Twenty percent of the zone is in open space and pasture and 16 percent is forested. In some portions of the zone only remnants of the original forest cover can be found.

Land uses - Urbanization is a dominant feature of this zone. Approximately 70 percent of the state's urban development is located in this area. This development forms concentric zones of decreasing intensity of residential development, industrialization and second homes outward from the center of the Twin Cities.

In previous years, Hennepin and Ramsey counties were forerunners in the percentage of population increase. Now, however, rapid growth areas include scenic, high amenity counties, especially those surrounding the metropolitan area. Detroit Lakes, Fergus Falls, Alexandria and Brainerd are also experiencing seasonal home development of lakeshores and rural lands and an associahted increase in tourism, recreational activity and their consequent impacts. Also associated with urbanization is a loss of wetlands and aquatic habitat either through water quality degradation or direct destruction by filling. Contamination of the water sources due to fertilizer runoff is a

serious problem in the Minnesota River drainage. It is compounded in the Mississippi River south of the Twin Cities by locks and dams which have altered stream flow and necessitate dredging; by waterfront development, and the addition to the waters of heavy metals, PCBs and other toxic substances. The thermal discharge of the fossil fuel or nuclear generating stations at St. Paul, Red Wing, Stillwater and Rochester have further altered the wildlife utilization of the rivers in their vicinity by generating open water throughout the winter.

As in the agricultural zone, many of the water bodies of the area have been drained for agricultural purposes. However, a few wetlands and potholes of the former prairie lands have been maintained through public acquisition or legislative mandate as protected wetlands. The larger, deeper lakes are primarily the waterbodies that have survived this problem. Lakeshore development, aquatic vegetation control, and disturbance by fishermen and recreational boaters are the primary conflicts with the nongame resource on these waters.

Land clearing, logging, farming and fire prevention activities associated with agriculture and urbanization have changed the original vegetation types. Once again, significant habitat loss occurred in the transition zone, as prairie grasslands were converted to farms.

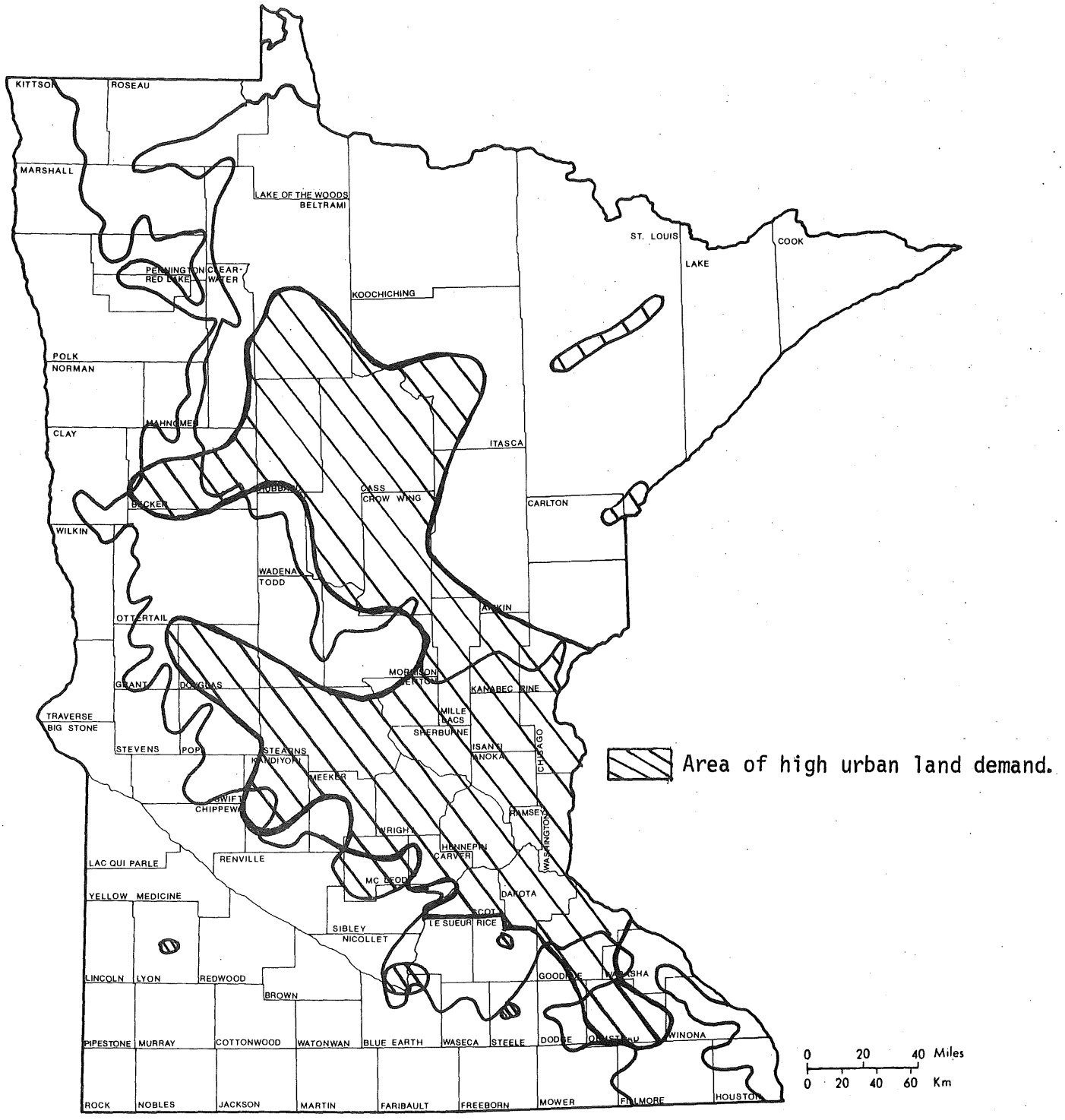
The loss of savanna and jack pine barrens through fire suppression is also an important consequence of human land use actions in this zone. In its original situation, the savanna community was perpetuated by fires which destroyed the young oak, maintaining an open canopy, grassy prairie understory and distinct wildlife community. Now that this type is protected from fire it has been invaded by trees and shrubs, "closed up" and has been replaced by oak forest.

Hardwood forests have also been cleared for agriculture and most of the Big Woods eliminated. The consequent forest fragmentation has resulted in discontinuous tracts of original forest cover interspersed among fields and pasture particularly along streams or on the steeper slopes in the southeastern portion of the zone. These remnant forests are now a minor cover type. Many of these remaining woodlands are grazed. The ability of these upland or riparian woodlands to provide wildlife habitat is consequently greatly reduced because of the loss of understory vegetation and mast (Ryder, 1980).

Development on the bluffs of the Minnesota River Valley west of the Twin Cities is of particular concern as alteration of the slopes' forest cover may seriously disrupt the valley's suitability as a protected migratory corridor for waterfowl and songbirds. To forestall such detrimental impact, the Minnesota Valley National Wildlife Refuge was authorized to protect the floodplain forests.

Projected land use change - Important projected changes in land use in the transition zone include increases in urban lands, irrigation and forest fragmentation. Projections indicate that major areas of increased urbanization will be south of the Twin Cities through Goodhue and Olmsted counties, north along Interstate 94 and 35E, and through the high amenity resort region of central Minnesota (Fig. 9). Increased urban development is also projected for Kanabec, Mille Lacs, Benton, Stearns, and southern Pine counties. This urban development will be in constant competition and conflict with rural land uses and with wildlife.

There is potential to increase crop production by irrigation on as much as 1 million acres of sandy soil in central and east-central



Source: State Planning Agency

Figure 9. Generalized map of high urban land demand, 1975-1990.

Minnesota (Mn State Planning, 1978). Much of this land is in the transition zone. More irrigation would probably stimulate more clearing of wooded areas and stream bottoms. Increased irrigation may also affect surface water through depletion of underground aquifers.

Continuing agricultural expansion is also projected in the northwestern counties of the transition zone. Such agricultural expansion has already resulted in conflicts with wildlife management goals. Conversion of these forested lands to agricultural use would also hasten the reduction of the state's commercial forest land base.

The extensive areas of sandy outwash river valleys and plains suitable for irrigation also serve as major transportation corridors. Since these areas are highly accessible, they will attract residential and commercial development which potentially would conflict with agricultural development.

A growing population, expanding industrial base and increasing irrigation will also generate greater demands for electrical energy. Additional commitments of both land and water resources will be required to meet this production. The full impact of these developmental needs will result in a direct withdrawal of land from both agricultural and forestry uses.

In total, shifts in land use will take place between forestry, agriculture, recreation, wildlife management, energy facilities and urban land needs. Over the next decade, land use fluctuation and change will be more evident in this zone than in the other two zones.

Consequences for wildlife - Urban expansion and agricultural development will continue to consume open space and wildlife habitat in the transition zone. Remnant examples of pre-settlement communities

will be lost unless a continuing effort is maintained to identify and protect the remaining areas of prairie, Big Woods, sand dunes, essential riparian woodlands and the variety of associated wildlife species.

The wildlife species of the transition zone are a mixture of those from the agricultural and forest zones - tiger salamanders and wood frogs, harriers and bald eagles, prairie voles and arctic shrews. It is not surprising, therefore, that consequences to wildlife of man's land use activities in the transition zone are similar, in part, to those in the agricultural zone. Prairie dependent species have declined in abundance as a result of habitat conversion from grassland to cropland. Their distribution has been restricted to disjunct patches of habitat, some of which may be too small to support viable populations of such species as marbled godwit and upland sandpiper needing large expanses of habitat. Proper management of the remaining prairie tracts is essential to retain the associated wildlife species of particular concern. One factor impacting wildlife in the transition zone and related to proper prairie management is fire. The past policy of fire suppressionn has disrupted the natural sequence of events. Only recently has there been a growing acceptance of prescribed fire as an important tool for wildlife habitat management on the prairies and in the oak savannas and jack pine barrens of the transition zone.

The elimination of much of the forest cover in this zone has potential for considerable impact on wildlife. This is evidenced, in part, by elimination or retreat from this area of some of the more conspicuous forest dwelling species such as the elk, wolf, bald eagle, and osprey. Timber harvest and conversion of lowland woods to pastures

has converted the more extensive woodlands needed by red-shouldered hawks to woodlots suitable for red-tailed hawks.

Additionally, many wildlife species utilize stream bottoms for winter cover or as migration and travel corridors. Therefore, flood control or other projects which eliminate or degrade riparian forest cover are adversely impacting essential wildlife habitat. This is especially true for the southeastern corner of the region where there are many aquatic and terrestrial species of restricted distribution associated with the river valleys of the Mississippi, St. Croix and lower Minnesota rivers.

Beyond these more obvious impacts, it was previously assumed that many smaller wildlife species could persist in the remnant woodlots and riparian woodlands. However, recent studies in the eastern and north central forest regions of the United States are documenting the dependence of many species on contiguous and extensive forest systems (Robbins, 1979; Burgess et al., 1981). Bond (1957) studying bird populations in woodlots of southern Wisconsin was one of the first to report that many songbird species adapted to living in forest interiors need large tracts of forest during the nesting season. More than two dozen species of forest dwelling birds, including wood warblers, vireos, flycatchers, the broadwinged hawk and the ruby-throated hummingbird have been identified as area sensitive species. According to Robbins (1979) these birds have already disappeared from suburban and agricultural lands in study areas along the East Coast. Their retreat is a consequence of forest fragmentation by such impacts as suburban sprawl, super highways, transmission lines, reservoirs and surface mining. The implications of such findings are

substantial, if only in regard to the management recommendation that 1,000 contiguous hectares (2500 acres) of forest canopy may be a minimum area needed to preserve habitat for most of the avian species (Robbins, 1979).

Overall, the impacts of man's land use on the wildlife resource in the transition zone have not yet been as destructive as in the agricultural zone. Adequate habitat may still exist for all four wildlife species previously occurring in the transition zone but now listed as extirpated or endangered (Fig. 10). The disappearance of the trumpeter swan and whooping crane is attributed to disturbance; that of the swallow-tailed kite to shooting; and the peregrine falcon to pesticide contamination, rather than habitat destruction. However, with continuing expansion of agricultural activities and urbanization, the potential for the same devastating consequences of habitat loss is very real.

A number of more southerly occurring vertebrate species have ranges extending into southeastern Minnesota. Their occurrences in the state are a consequence of the extension of their primary range north through the Mississippi River Valley or west in conjunction with the eastern deciduous forest biome. As a result, the variety of reptiles, amphibians, and fishes in the southern portion of the transition zone is great compared to other regions of the state (see Appendix I).

Thirty-nine of the 45 reptiles and amphibians in Minnesota occur in the transition zone, with seven essentially limited to the region. Thirteen are proposed for state listed "threatened" or "special concern" status due to their declining number, limited range or specialized habitat requirements (Mn DNR, 1983). Of immediate concern

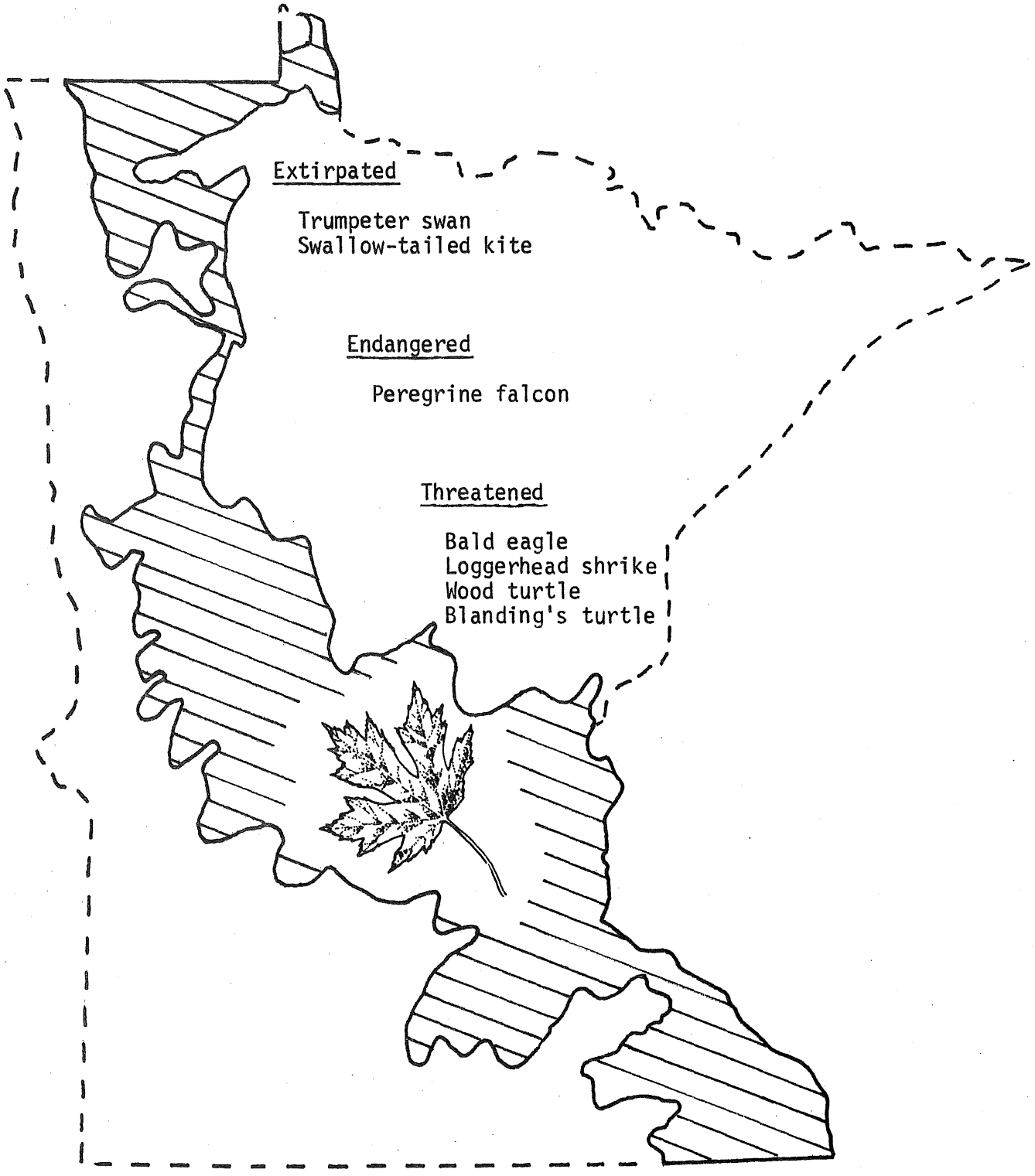


Figure 10. Extirpated, endangered and threatened nongame species of the transition zone.

are the wood turtle, Blanding's turtle and Minnesota's two venomous reptiles, the massasauga and timber rattlesnake. All four species occur primarily in the transition zone.

The variety of reptiles and amphibians in the southeastern corner of Minnesota is particularly noteworthy, considering the comparative absence of extensive marshes, lakes or ponds in the area. North and west of the area, reptile and amphibian diversity decreases due to cold or dry conditions. As a consequence, proper management of the remaining riparian lands in the transition zone will be particularly important for assuring the continued variety of reptiles and amphibians in Minnesota.

Of the fifteen species of fish proposed for special concern status in Minnesota, nine occur exclusively in the transition zone (Appendix I), as do all the mussels of particular interest to the Nongame Wildlife Program (Mn DNR, 1983).

Unique aspects - The river valleys of the Mississippi, Minnesota and St. Croix dominate the landscape of the transition zone. Many of the unique natural history attributes of the area are associated with these forested river valleys - including spring warbler migration at Frontenac, fall concentrations of waterfowl in the Weaver Bottoms, wintering eagles at Reed's Landing, and the uniquely diverse assemblage of reptiles, amphibians and fish. Particularly noteworthy areas include wood turtle habitat on the Cannon River, the Mississippi River floodplains from Goodhue through Houston counties, and the marsh and river bottom woodlands around LaCrescent which are excellent for breeding birds.

The importance of these river valleys to wildlife has been

recognized at the federal level through creation of two national wildlife refuges, the Minnesota Valley National Wildlife Refuge and the Upper Mississippi River National Wildlife Refuge. Designation of the St. Croix River as a National Wild and Scenic River acknowledges the river's "outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural and other similar values," (National Wild and Scenic River Act, [P.L. 90:542]).

The upland portions of the transition zone also encompass a number of unique communities of particular value to the nongame wildife resource. Unfortunately, many of these areas are now outstanding because they are the last remnants of once more extensive plant communities. Included in this group are the remnant examples of undisturbed old growth stands of maple-basswood forest. Of the remaining stands, Nerstrand Woods State Park in Rice County is a fine example of the "Big Woods" community type noteworthy as a migratory stopping place for spring warblers and a breeding area for the cerulean warbler, blue-gray gnatcatcher and other avian species characteristic of the southeastern deciduous woodlands. The remaining stands of this cover type occur as small isolated woodland "islands" separated by cultivated farms and residential lands. The effects that such isolation and discontinuity of forest remnants may have on the flora and fauna has recently become the subject of intense study (Burgess & Sharpe, 1981).

Prairies, which once covered a considerable portion of the transition zone, have since been converted to croplands. Once again, only remnants totaling less than a fraction of a percent of the original acreage remain and have been protected through public

ownership. Three prairie community types: the black soil (tall grass) prairie, the hill (goat) prairie on the steep south to west facing Mississippi River bluffs, and the sand prairies on the outwash plains of Anoka County and the Kellogg-Weaver Dunes area of Wabasha County are of interest. The particular value for nongame wildlife of these prairie areas relates to the number of species of particular concern associated with these habitats (i.e., Blanding's turtle, blue racer, prairie vole, tiger beetles and butterflies).

The rocky blufflands of the Mississippi River Valley serve as habitat for rattlesnakes and peregrine falcons. The caves of the area are important as hibernacula for wintering bats.

Management considerations - Restoration programs for two species, the trumpeter swan and peregrine falcon, have already been initiated in the transition zone. However, except for areas proposed by the Natural Heritage Program, specific information on areas of essential nongame habitat in the transition zone is lacking. Consequently, no substantial acquisition needs specifically for nongame species have yet been delineated. Any such acquisition proposal should be complementary to the acquisition plans already prepared by the Section of Wildlife (MN DNR, 1975). Much of the acquisition proposed under the Section's plan would be located in counties along the southern and western edge of the transition zone (MN State Planning Agency, 1978).

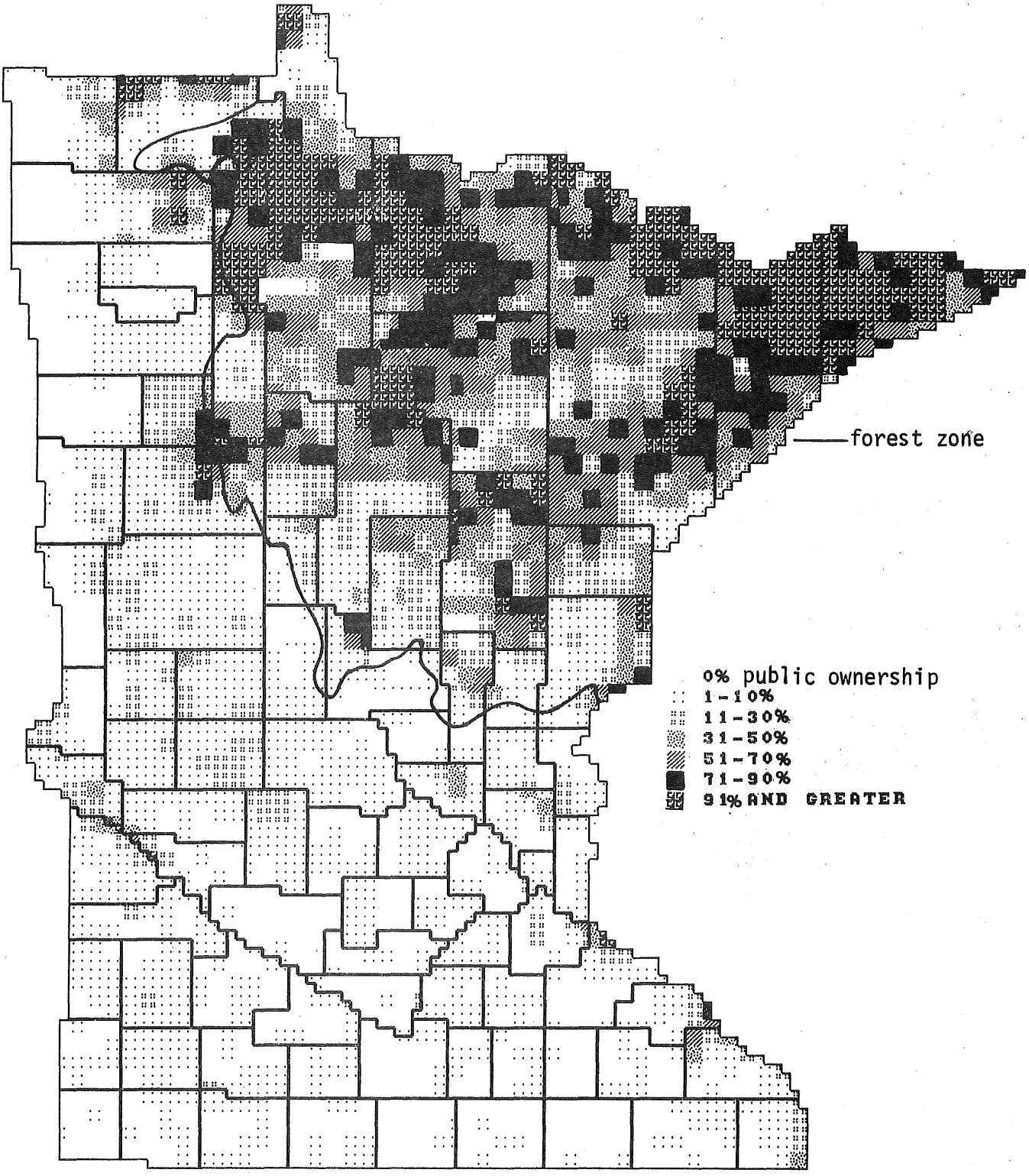
Lang et al. (1982) has recently made a strong statement on the need for increased protection of the state's herpetofauna by regulation of collection and rescinding of bounties. These recommendations are particularly relevant to the transition zone as bounty is still paid in Houston, Winona, Wabasha and Fillmore counties on rattlesnakes. Both

the massasauga and timber rattlesnake are currently proposed for "special concern" designation specifically because of their willful destruction by humans in these counties. Additionally, increased protection of bats and their winter hibernation caves is a resource management consideration for the transition zone. A specific need for a survey of the distribution of the herpetofauna in the southeast region has been identified. Research on the effects of current forestry and game management practices on nongame species and on the consequences to wildlife of habitat fragmentation are also priority considerations.

Forest Zone

The forested zone, comprising 18.4 million acres, dominates the northeastern one-third of the state. A heavy forest canopy covers 72 percent of the zone, interrupted only by numerous lakes and isolated areas of open land. The landscape is diverse, typified by extensive areas of moraine, a considerable amount of ice-scoured land in the northeast and a large bog in the northwest. The zone is a prime area for many forest uses including timber production, seasonal homes, recreation, wildlife management, and open space preservation. This zone contains nearly all of the state's large-scale mining activity and about 60 percent of the state's inland surface water resources. Sixty-one percent of the zone is in public ownership (Fig. 11).

Land uses - The history of northeast Minnesota has been dominated by the exploitation of wildlife, iron ore, and forest products. The initial attraction was for fur. Iron ore was discovered in the mid-1800's and between 1884 and 1957 over 2.2 billion tons of ore were shipped from the Mesabi and Vermillion Ranges. The forest of Minnesota



Source: Minnesota Land Managment Information System

Figure 11. Public land ownership - 1976.

was also a potent factor in the state's economic development during the latter half of the 19th century. By 1920, logging of the great pineries was completed. This era was followed by a period of extensive forest fires which burned not only the logging debris and remaining forest, but also resulted in the loss of human life, homes and settlements.

The settlers had moved into northern Minnesota to farm and raise livestock. However, the shallow, acid, infertile soils of the area were better suited to timber than field crops. The poor soils and the drought and Great Depression of the 1930's caused settlers to abandon many of these farms. Pasture land and crop fields reverted to forest through natural succession and planting.

The major impacts on the wildlife resource in the forest zone are related to forestry, mining and tourism. A primary effect has been through habitat alteration. The wildlife and their habitats in Minnesota were dramatically affected by the white man's logging, fires, hunting, and scattered farming. What had been a mature "virgin" pine forest was reduced to slash, and then to ashes in 70 years (1856-1930). The new forest which regenerated was no longer of red and white pine, but was dominated by the pioneering species -- aspen, birch and jack pine. Accordingly, the wildlife species also changed. The caribou, elk, mountain lion, and wolverine were extirpated. Others like moose, white-tailed deer, fisher, pine marten and timber wolves were decimated and populations of these animals remained at low levels for many years. Today some 50 years later, our use of Minnesota forests for wood and wildlife are a direct result of the events of the early 1900's. Aspen in the mainstay of the wood-using industry, and the predominant game

species are those associated with the aspen community.

Forest management is the activity with the greatest continuing potential for affecting nongame wildlife habitat. Forestry practices determine the species, age, and stand size composition of a forest. These are important components for nongame wildlife habitat.

Over 56% of the state's commercial forest land is under public control. Recently, forest management activity on public lands has intensified, and much of the emphasis is on conifer management. Approximately 82,300 acres were disturbed in some way in 1982 by state, county, and federal forestry agencies. Of this disturbance, approximately 43,500 acres were for conifer management, i.e., direct seeding, planting, site preparation, stand release, and timber stand improvement.

Whenever hardwoods or natural conifer communities are converted to conifer plantations on a large scale, wildlife habitats are seriously reduced. Natural forests support a greater diversity and abundance of wildlife than do the structurally simplified plantation monocultures (Harris, 1979; Thomas et al., 1975).

Forest intensification is benefitted by practices that speed the establishment of new stands, accelerate tree growth (thereby compressing or bypassing early stages of vegetative succession) or shortening the rotation period and decreasing the amount of old growth trees. When implemented on a large scale, any one of these practices will decrease diversity unless conducted in such a manner that the timing, spacing, size, shape, tree species composition and overall pattern is planned to provide an interspersion of community types beneficial to many kinds of wildlife.

The increased harvesting of aspen is also a management concern in the forest zone. Past surpluses of aspen have resulted in much old growth aspen type. However, because of new wood-using mills, it is projected that the demand will equal the supply by the year 2000. As a result, much of the old growth aspen type will be cut. Therefore, consideration must be given to maintaining some stands for old growth-dependent wildlife species. Maintaining old growth spruce fir and white cedar in stands large enough to benefit wildlife will also become increasingly difficult as the demand for wood increases and landowners intensify operations and shorten rotation periods.

The elimination of standing dead timber and loss of tree snags for hole nesting species can also become a problem where intensive forestry or firewood cutting is practiced. The importance of maintenance of snags for the benefit of wildlife and the forest itself have been well documented by Evans and Conner (1970). Because of the pervasive influence of forest management practices in the forest zone, it is essential that wildlife habitat management be integrated into forest management on both public lands and private forest lands. It is, in fact, mandated on federal forest lands through the Forest Resources Management Act which required that wildlife be given equal consideration with timber and other values. The recognition of the appropriateness and importance of such cooperative interaction on the part of the state's forestry and wildlife management agencies is reflected in such documents of the Minnesota Forest Resources Plan (MN DNR, Div. For.,1982), the Wildlife/Forestry Coordination Policy, the Forest Resources Management Act of 1982 and the Forestry/Wildlife Guidelines to Habitat Management (MN DNR, 1982). The progressive

attitude of cooperation between the state forestry and wildlife agencies reflected in these documents, coupled with the expertise of federal Forest Service personnel, is encouraging for future natural resource management and protection in the forest zone.

One area of the forest zone with little public ownership is the Iron Range. This complex is the heart of Minnesota's iron ore country and extends 100 miles from Grand Rapids in southern Itasca County through Hibbing to Babbitt in central St. Louis County. The past impact of iron ore mining on wildlife was considerable, as large areas of habitat were stripped of vegetation, mined and the mining wastes accumulated, often with severe environmental consequences.

Today such destructive mining activity has been curtailed due to the national ecnomic slowdown and the requirements of Minesota's Mineland Reclamation Act of 1976 which is intended to minimize and control possible adverse environmental effects and preserve natural resources. As a consequence, further impacts will be limited by the extent of the remaining iron ore deposits and the requirements for reclamation.

The present emphasis in mining has shifted to focus on exploration for new minerals. In particular, copper-nickel exploration has been conducted along the north shore and in north-central Minnesota. Some uranium prospecting has also been undertaken in Carlton County. Hopefully, land use and reclamation regulations would be implemented prior to initiation of mining, in order to minimize environmental degradation or alteration.

The development of peatlands also looms on the horizon as an activity which could adversely affect nongame wildlife populations and

habitat. There are 7 million acres of peatland in Minnesota, approximately 90% of which is owned or administered by the state. However, only 452,480 acres of peatland in the entire state has been designated for wildlife management (MN DNR, Div. Min., 1981).

Because mining of peat would require vegetation removal and drainage it is reasonable to expect that native wildlife species will be affected. To minimize impacts, particularly crucial areas of peatland need to be identified so that their development can be avoided.

The recent study to evaluate the consequences of peatland develoment concluded the following with regard to wildlife:

> "The long-term effects of peat development on wildlife will depend on the ultimate condition of the peatland. In the case types of development requiring the excavation of peat, the long-term effects depend on the type of vegetation that invades the peatland following development... Reclamation of these areas could minimize the net impact on wildlife by encouraging the establishment of particular habitat types... However, artificial establishment of conditions for species having very specialized habitat requirements, as do many rare species, may not be practical or possible." (MN DNR, 1981)

These are two additional potential ramifications for wildlife of peatland development. The first of these is the possibility of vegetation alteration beyond the development site. Second, is the issue of mercury contamination or other water quality changes as the result of peat mining. The implications for wildlife are basically conjecture at this time.

At present, the pressure to develop peatlands is not great. This is fortunate as it allows time to gather additional information which may be needed to assess environmental impacts, suggest mitigation practices, or set aside peatland areas to maintain viable populations of certain species. The process of identifying and protecting

significant peatland areas has already been initiated.

While trapping for furbearers constituted Minnesota's first economic asset, trapping is of lesser economic importance today. However, the importance of wildlife as an economic asset has not diminished. Today, tourism is big business in Minnesota. This is particularly true in the forest zone where the North Woods wilderness image, enhanced by the presence of bald eagles, timber wolves, loons, moose, and a rich sport fisheries heritage, is especially in demand.

Many of the recreation facilities are located in St. Louis, Itasca and Lake counties. These facilities cluster around population centers and high quality recreation lakes. Three counties - Itasca, St. Louis and Aitkin - contain 75 percent of the region's resorts. Most of the other resorts occur along the North Shore (Lake County) and in the Brainerd-Crosby area of Crow Wing County.

Wildlife is an important attraction to both tourists and residents. The people - wildlife interactions can be positive as people enjoy seeing, hunting, feeding and photographing wildlife. However, some interactions are not pleasant for either man or beast.

Tourism's impact on the wildlife resource is associated with lake use and shoreline development (campgrounds, swimming beaches, seasonal homes, boat landings) which alter wildlife habitat and disrupt the area's solitude. These impacts are particularly obvious when aquatic vegetation is cleared or when wildlife is disturbed by recreationists during the breeding season. There are proposals to increase tourism in northeastern Minnesota to partially offset the economic losses due to the decline in the iron mining industry. More people in the region will mean more human-wildlife interaction and

greater potential for conflicts with bears in campgrounds, bats in residential structures and road-killed wildlife.

Pollution of the environment from the by-products of human activities is a problem even in the relatively undeveloped forest zone. The contaminant of particular concern in this zone is acid precipitation (acid rain).

Recently glaciated areas that are characterized by exposed granitic bedrock and noncalcareous soils are the most sensitive to acidic deposition. In Minnesota, areas of high to moderate sensitivity to this phenomena include the aquatic communities throughout the entire forest zone and portions of the transition zone (Fig. 12).

The potential effects of acid deposition that have implications for nongame resource management include:

- -Interference of the normal reproduction of fish, amphibians, and other aquatic organisms that occurs when unfavorable conditions such as high acidity coupled with high metals concentrations exist.
- -Temporary acidification of sensitive lakes and streams during snow melt which can also lead to reproductive failure in aquatic organisms.

Such effects have been documented. However, the implications to mammals and birds of the consequent disruption of the aquatic food web due to these decreases in aquatic invertebrates and amphibians is presently conjecture. Data reflecting the impact on birds and mammals is limited, although the suggestion has been made that a reduction in young fish, an important food source for aquatic birds, may lead to low reproductive success and local extirpation of some bird species. (MN PCA, 1982).

The most recent land use activity in the forest zone having

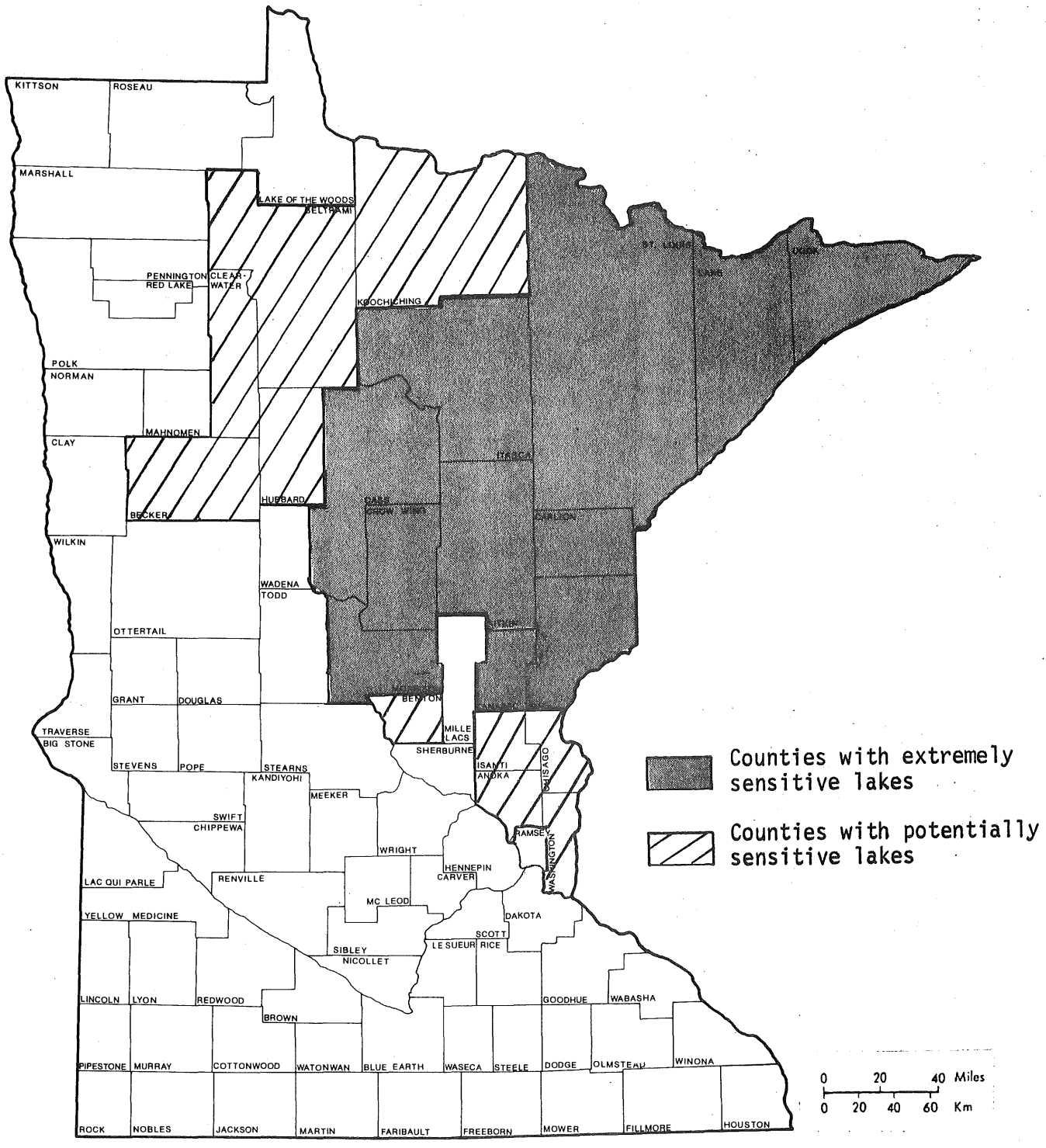


Figure 12. Minnesota counties containing lakes sensative to acid precipitation.

potential to adversely impact the nongame resource involves the state's desire to increase revenue from public lands. Current thinking in this regard has three aspects. First, the sale of Consolidated Conservation Area Lands in the six northwestern and northcentral counties for conversion to agricultural purposes is being promoted by various local interests. Secondly, the Department of Natural Resources' Land Suitability Task Force has been assigned the responsibility of identifying other public lands that could be sold and converted to private ownership.

Finally, the Land Bureau of the DNR recently commissioned a study to assess the economic feasibility and potential for wild rice paddy development on areas in northern Minnesota (Knopf, 1983). 485,000 acres of public lands, primarily under the jurisdiction of the Division of Forestry were identified in 9 counties in the forest and transition zones as potential areas for rice paddy development. Suitable cover types included marsh, pasture and cultivated lands in 40 acre parcels with road and water orientation. The appropriateness of such development on state lands should consider implications to wildlife in any future assessment of feasibility.

Projected land use change - While forest cover will remain dominant in this zone, competing uses are likely to steadily reduce the amount of commercial forest land. The projected major growth area is located along the southwestern edge of the zone in the high amenity lake resort region. The four counties of Crow Wing, Cass, Hubbard and Beltrami will account for about 75% or 26,000 acres of the zone's urban land needs. The increased conversion of land to residential, industrial, commercial, and agricultural uses may slowly convert the edge of the

forest zone into a transitional land use area (MN State Planning, 1978).

All of the state's large scale mining activities are located in the forest zone, and the second area of growth is likely to occur here. Extensive land areas are projected to be used for mine waste disposal if taconite mining recovers. Additional land commitments are possible for copper-nickel mining by 1990. Minnesota's growing energy demands might also facilitate development of peat resources.

Traditional land use conflicts between timber management, recreation, open space preservation, wildlife management, and watershed protection, will occur. Many of these conflicts center around the incompatibility of different forest uses. These conflicts wil continue until land use plans can better identify the type, timing and location of different forest activities.

Forested land cover will probably continue to diminish as the result of competing uses. More than 625,000 acres of land may be withdrawn due to urban development, electric energy facilities, mining activities and through land conversion to agricultural uses (MN State Planning, 1978). State acquisitions for park and recreational units will account for only 6% of the land withdrawn from forestry.

The losses of commercial forest land are not likely to be replaced very quickly by the market system. Timber management involves a long-term production cycle, as long as 120 years to grow mature trees. In terms of realizing a quick economic return, timber management is not as competitive as many other land uses. Few private land owners are willing to maintain the longterm investment. Minnesota's wood demands, on the other hand, will increase 20% each

decade from 1970 to 1990. If future demands are to be met, government may need to play a greater role. Emphasis should be placed on identifying highly productive forestry sites, encouraging intensive management where applicable and protecting these areas from unnecessary intrusions.

Consequences for wildlife - Despite the landscape-altering activities discussed above, nongame wildlife populations appear to be in good condition in the forest zone. This situation is attributable to the diversity and extent of forest cover types, relatively low human population and the large acreage of public lands. Only two species occurring in forest zone, the piping plover and peregrine falcon, are proposed for endangered status (Fig. 13). Currently, the peregrine is extirpated as a breeding species in the state. This situation is not, however, a consequence of habitat loss but pesticide contamination of the peregrines. Traditional cliff nesting sites along the North Shore are extant. A similar situation of environmental contamination also explains the designation of the bald eagle, a forest zone nester, as threatened.

The status of both the piping plover and the threatened common tern does reflect the loss of sandy "beach" habitat along the periphery of the large lakes (Superior and Lake of the Woods) in the forest zone.

More than any other vertebrate class, it is the mammals such as the wolf, moose, bobcat, and fisher that symbolize the North Woods wilderness character of the forest zone. While the larger game species are most familiar, it is the numerous species of small nongame mammals associated with the boreal forest; bog lemmings, shrews and voles that result in the diversity of mammals in the forest zone. Many of these

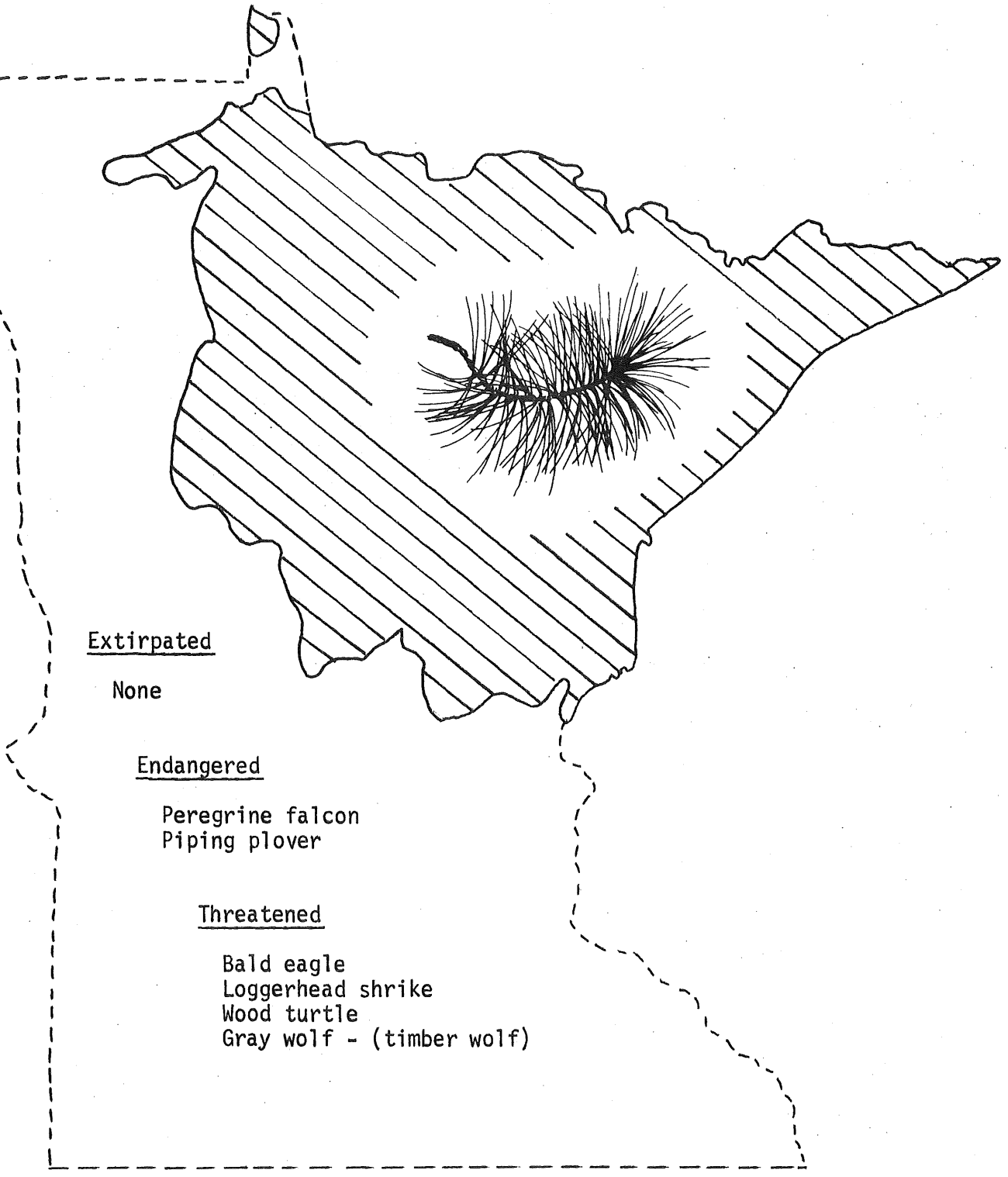


Figure 13. Extirpated, endangered, and threatened nongame species of the forest zone.

species appear to have restrictive habitat requirements and their occurrence in the state may be peripheral to their primary range. Our knowledge of the basic biology of these small mammals is limited, as the vastness of the forest zone makes them hard to know. It is not possible to make definitive statements about their status because these species have not been comprehensively inventoried or monitored.

This lack of information is reflected in the special concern status suggested for the rock vole, heather vole, and northern bog lemming. In particular, the impact of current timber management practices or of peat mining on these species and their habitats is unclear but needs to be assessed.

To date, much of the research to determine and evaluate the response of wildlife populations to forestry management practices has focused on birds (DeGraaf and Evans, 1979). The principle findings apply to all wildlife. The general thinking is that although periodic small-scale disturbance of woodlands is beneficial to maintaining a variety of habitats, the application of intensive forestry practices over large areas combined with the continued loss of forests to other uses (mining, seasonal home development) will gradually erode the utility of forests for wildlife.

However, technology is available for accenting the positive influences of forest management and mitigating adverse impacts. Methods for meeting both timber and wildlife needs are being tested, chiefly in the national forests, where management for multiple purposes is required by law. Progress has been slow, however, and additional commitments will be needed to implement the recommendations on public lands.

Some consideration of wildlife needs is being incorporated into industrial forestry activities, partly for the sake of public relations and in a few cases because of income from leasing land for hunting. It is difficult to include planned wildlife habitat management in private nonindustrial forests, however, since modifying the silvicultural or harvesting operations or retaining the special habitats needed by some wildlife species can be costly to landowners. It may be unrealistic to expect landowners to alter their forest management operations on a scale large enough to significantly benefit wildlife without financial incentives. Despite personal interest in wildlife, few landowners can afford to make the trade-offs required. Programs do exist to provide a framework for the application of technology to mitigate losses of habitat, and for incorporating financial incentives to landowners for saving or exchanging habitats on private land that otherwise would be lost or degraded.

During coming decades the importance of forests for wildlife habitats will increase because of more intensive use of nonforested land and also because of greater public concern about wildlife resources. The future of forest wildlife on federal lands will be governed by law and by the effectiveness of multiple-use management of the land. While regulation will play a role in safeguarding special areas for wildlife on private lands, strong economic incentives must be provided if the public desires to maintain and enhance suitable habitats. The increasing demand for forest products, new efforts to develop incentive programs for private landowners, and a strong public willingness to maintain wildlife habitats provide an excellent opportunity for adopting new approaches that integrate wildlife protection

with sound forest management (National Research Council, 1982).

Unique aspects - Even within the vast acreage of undeveloped forest lands, a number of areas are outstanding for their wildlife utilization, especially by birds, with wood warblers and raptors of particular interest. Both the Chippewa and Superior National Forests are noteworthy for their nesting populations of bald eagles and osprey as well as their progressive attitude toward multiple-use management. The National Forest Service also administers the Boundary Waters Canoe Area Wilderness which, with its prohibition on logging, may become increasingly important for wildlife species associated with old growth communities. Voyageurs National Park is also important as a vast undisturbed area with high quality aquatic habitat. Three of the state's parks - Itasca, Zipple Bay, and Jay Cook State Park - are also focal points for birdwatching activity in the forest zone. Itasca's prominence is as a location for migrating and breeding warblers. The proximity of Zipple Bay and Jay Cook State Parks to Lake of the Woods and Lake Superior, respectively, is responsible for their importance to birds. The shores of these large lakes form natural flyways for migrating warblers, passerines, waterfowl and shorebirds. The north shore of Lake Superior, in particular the Park Point, Hawk Ridge and entire harbor areas of Duluth, is noteworthy year round. The value lies in its utilization as nest sites for such rarities as piping plovers and common terns, or as a concentration point for migrating raptors and wintering waterbirds.

Finally, scattered throughout the forest zone are "islands" of coniferous bog habitat that harbor a distinct avifauna and some of the less common small mammals. These areas, too, should be recognized for

their wildlife values.

Management considerations - In general, very little is known about the abundance, distribution, and habitat requirements of many of the nongame species in the forest zone. Such informationn is essential for establishing priorities and cost-effective management programs. Therefore, the appropriate surveys should be conducted as a priority undertaking. When coupled with information from the ongoing forest vegetation inventory of state and county lands, such research and inventory data will provide a basis to evaluate nongame habitat types and conditions in the forest zone.

There is an abundance of public land in the forest zone. In most cases the habitat needs of nongame wildlife can probably be met by proper management of the lands now in public ownership. For this reason, it is not anticipated that the Nongame Wildlife Program will make substantial land purchases in the forest zone. However, limited acquisition that will benefit endangered, threatened, and special concern species should be considered.

Habitat management is the heart of a wildlife management program. By manipulating habitat we can determine the abundance and distribution of wild animals. The greatest impact on nongame wildlife habitat on public forest lands is through timber management. Therefore, guidelines for coordinated timber and nongame wildlife management are needed. These guidelines should be developed and incorporated into the Forestry/Wildlife Guidelines to Habitat Management Manual Some of the topics to be covered in these proposed guidelines are snags, old growth, openings, impoundments, lowland conifers, dead and down material, gravel pits, edges, riparian zones,

and endangered, threatened and special concern species.

Specific intensive habitat management projects in the forest zone should be limited to critical situations and species, such as the need for colonial waterbird nesting habitat in the Duluth Harbor, and management plans for eagle nesting territories which are outside of national forests.

Discussion

Land use patterns are not static. Land use changes occur in response to factors such as energy demands, technological advancements, economic conditions, etc. To some extent these changes may be anticipated from past experience and trends. The most recent analysis (MN. St. Planning Agency, 1978) projected 1,291,000 acres of land use change to take place in eight activities between 1975 and 1990 in Minnesota (Table 1).

Table 1. Projected land use change, 1975-1990.

LAND USE ACTIVITIES	ACRES	PERCENT
Wildlife land acquisition	832,000	64.4
Urban land	205,000	15.9
Mining	89,000	6.9
Transmission lines	59,000	4.6
Parks	36,700	2.8
Trails	28,000	2.2
Power plants	19,600	1.5
Airports	12,000	.9
Highways	10,000	.8
Total Projected Change	1,291,000	100 %

Source: MN State Planning Agency, 1978

The largest projected need is in wildlife land acquisition with an

additional 832,000 acres of combined federal and state fee title acquisition desired. Easements are desired on an additonal 457,000 acres. Achieving this goal would represent an 88% increase in managed acres and would bring the total area protected for wildlife to 2,744,000 acres by 1990.

Urban land development represents the second largest change - 16.1%. All other categories combined account for the remaining 18% of the projected change.

PRESENT LAND OWNERSHIP

The final factor which operates in conjunction with the abiotic factors, vegetation and land use history in affecting wildlife occurrence, abundance, and distribution in Minnesota is the pattern of land ownership.

Originally, territorial Minnesota was completely in the public domain, but federal government disposals to the state, individuals, and corporations in the 1800's involved 96% of the state's land area. Public land ownership today in Minnesota is mainly a product of past events and government policies. Much land was acquired by the state and counties as a result of forfeiture for unpaid taxes. This forfeiture began about 1900 and peaked during the depression of the 1930's. Additional state and federal ownership came about by governmental action to retain public lands not already in private ownership, and by direct purchase for forestry, wildlife and recreation.

Public Land

Of the approximately 12 million acres of public land, 11.2 million is located in 22 contiguous counties in the forest zone. The

remaining 800,000 acres of public land are state and federal wildlife lands in west central and southern Minnesota, hardwood forest lands in southeastern Minnesota, and the state parks.

Federal land ownership in Minnesota accounts for 3.7 million acres or 7.4% of the total land area of the state. It is heavily concentrated in northern Minnesota and includes the Superior National Forest, Boundary Waters Canoe Area Wilderness, Chippewa National Forest, and Voyageurs National Park. The U.S. Fish and Wildlife Service administers 300,000 acres which include Tamarac, Sherburne, Rice Lake, Agassiz, Minnesota Valley, Upper Mississippi River, and Big Stone National Wildlife Refuges and 530 waterfowl production areas. The waterfowl production areas furnish breeding and resting areas for migratory birds.

The National Park Service administers 219,000 acres of land and water along the Canadian border in Voyageurs National Park. There are also small park service holdings at Grand Portage National Monument in Cook County, and Pipestone National Monument in Pipestone County. They also administer the National Wild and Scienic Riverway on the St. Croix River.

County land in Minnesota consists largely of state-owned, tax-forfeited land that is administered by the counties, most of which is located in the northern part of the state. During the last forty years, northern counties have disposed of over half the tax forfeited land, a majority of which was returned to tax rolls through sale to private owners or transferred to the state for management. In recent years, however, counties have more often retained administration and management of tax forfeited lands.

Statewide, counties administer some 2.9 million acres of land (5.7%). Nearly half (1.3 million acres) of this land has been dedicated by the counties as memorial forest land to be managed in accordance with forestry principles.

State government is the largest landholder in Minnesota with 5.4 million acres or 10.6% of all land in the state.

During the latter half of the nineteenth century, the United States Congress granted the state of Minnesota several million acres of land, the income from which was to be used to support an educational system, the construction of railroads, public buildings, and other improvements. The original policy of the state was to sell these lands to generate income to stimulate the economic development of the state. Gradual modification of this policy resulted in permanent state ownership of certain lands, including mineral lands, water power sites, and lands adjoining public waters.

Tax forfeiture in certain northern Minnesota areas brought the state into the administration of additional lands. The state has also received several hundred thousand acres of county tax forfeited land over the past forty years. Purchase of land from private owners for state parks, fish and wildlife habitats, public access to lakes and rivers, and state forest parcels, is a relatively recent occurrence. Most state land holdings have been acquired from tax forfeited lands or earlier holdings.

The Department of Natural Resources - Division of Forestry administers 55 state forests totaling 3 million acres. These lands are managed under a multiple-use concept for wood, water, wildlife and recreation.

The Department of Natural Resources - Section of Wildlife - directly administers 480,000 acres in wildlife management areas, while another 435,000 acres are managed cooperatively with other DNR divisions. In all there are 900 state-owned wildlife management areas (Fig. 8). Wildlife management areas are maintained primarily for production of all wildlife species and for public hunting and trapping. Eighty percent of the areas are located in the western third of the state, reflecting the need to protect remnant wetland and prairie habitats. Additionally, the Section of Wildlife works with private landowners to provide wildlife habitat through tax incentives and various private land management programs.

The Section of Wildlife also administers the Scientific and Natural Areas (SNA) program. SNA's are a statewide system established to preserve and manage rare and/or endangered natural features on public lands, including landforms, fossil remains, plant and animal communities, and geological formations, for scientific study and public education. This program currently protects 27 areas. Numerous other areas are proposed for inclusion in the system. The Natural Heritage Program (NHP) is also administered by the Section of Wildlife. The NHP maintains the computer based information system on the location of unique geologic features, plant and animal communities in need of special attention. Together with the Nongame Wildlife Program, the SNA and NHP represent the Department of Natural Resources' commitment to protect those plants, animals or natural communities of particular uniqueness or concern. All three programs are cooperating in the development of an official state listing of endangered and threatened flora and fauna.

The State of Minnesota through the DNR's Division of Parks also administers some 160,000 acres in seventy-five state parks across the state. These provide recreational opportunities and preserve the state's scenic natural resources. Other state administered lands which have the potential to impact nongame wildlife resources are approximately 1,700 water access sites which provide entrance to public lakes and rivers. The DNR - Secion of Fisheries - also manages and protects streams and lakes that provide trout habitat. These trout streams are concentrated along Lake Superior and in southeastern Minnesota.

Private Land

Seventy-six percent of the land in Minnesota is in private ownership. The two most important private landowner groups are farmers and non-industrial forest landowners. Farmers own the most private land in Minnesota, including more commercial forest land than any other group (MN DNR, Div. For., 1982). The attitudes of these two owner groups toward wildlife on their lands has substantial implications for wildlife as has previously been discussed. One other private land ownership and management program of particular importance in Minnesota is that of The Nature Conservancy. Although its land holdings are small (15,607 acres) the properties are important for wildlife because they consist of rare or unique natural communities, particularly prairie remnants.

Discussion

Present day Minnesota is still relatively rich in wildlife fauna because it is rich in public lands. Public ownership of land and thriving wildlife populations usually go hand in hand. One need only

contrast the wildlife resources of states with substantial public lands vs. those with little public land to appreciate the significance of the habitat on public lands.

On private land, management is directed to maximizing production of crops that generate the greatest economic return. Competing resources are eliminated or minimized to become incidental products of the land. A good example is a corn field, where the object is to grow as much corn as possible. Competing vegetation is eliminated or reduced by using herbicides. Along with the competing vegetation goes the associated wildlife, so that such corn fields have little value for most wildlife. The same is true for extensive tree plantations where competing vegetation is controlled by herbicides. In both cases the productivity of the soil is being channeled into the target crops and little is left over for the production of wildlife. Only those wildlife species that are compatible with a landowner's management goals will exist on private land.

In contrast, on public lands in Minnesota, a multiple-use management approach attempts to optimize for a variety of resources. Thus, while no one resource is produced in the greatest quantity possible, neither are any eliminated. As much as possible, the naturalness and diversity of plant and animal communities are maintained.

The legal basis for multiple-use management on public land in Minnesota is found in laws such as the State Forest Resources Management Act of 1982, and the National Forest Management Act. These laws make it clear that wildlife is an important resource on public forest land and is to receive equal consideration with timber,

recreation, water, and soil resources. Further, these laws state that management will not necessarily produce the combination of uses that results in the greatest economic return, but assure the maintenance of a variety of natural resources.

SUMMARY STATEMENT

The pre-settlement appearance of the Minnesota landscape has been greatly altered in the past 125 years. Much of the change has been a result of man's activities. The most pervasive change has been conversion of natural communities to agricultural lands. The consequent destruction of wildlife habitat has been most severe in western and southern Minnesota in the agricultural zone. The future outlook for wildlife in this agricultural area is bleak and the situation most critical because of this inexorable and relentless destruction of wildlife habitat.

A number of natural resource agencies have struggled to counteract this trend by:

-Protecting wildlife habitat through public ownership of national widlife refuges, waterfowl production areas and wildlife management area.

-Legislative regulation of land use activities to protect natural resources and minimize adverse impacts.

-Tax incentives and cost sharing for habitat maintenance programs on private lands, and

-Educational programs and technical assistance to promote wildlife appreciation.

Despite these efforts, destruction continues at an accelerating pace. Unless there is a fundamental change in land use practices and

landowner attitudes brought about by public insistance and public initiative to alter federal agricultural policies, the trend will continue irreversibly and the situation will remain hopeless for wildlife in the agricultural zone.

Predictions for wildlife resources in the transition zone may not be much better. Agricultural expansion, coupled with urbanization and recreation activities, could convert open spaces and woodlands to rowcrops, campgrounds, resorts and residential subdivisions.

The remnant patches of natural habitat will shrink and retreat as a result of this civilization of the landscape. The adverse consequence for wildlife will accumulate in proportion to the intensity and magnitude of such developments. The transition zone may disappear, to be replaced by an encroaching agricultural zone and two new land use zones - an urban zone and a recreation zone (compare Figs. 6 and 14).

It is perhaps only in the forest zone that the future outlook for wildlife may be considered as hopeful. This attitude is tenuous. It is based on the presumption that landownership in this zone will remain primarily public and that the management of these public lands will continue to be guided by a strong multiple-use philosophy. A further expectation is that the progressive attitude of cooperation between forestry and wildlife interests will prevail. If so, a concerted effort to maintain wildlife habitat may be anticipated. Wildlife diversity and ecosystem structure and function should remain relatively unaltered, provided forest lands remain intact.

We shall see.

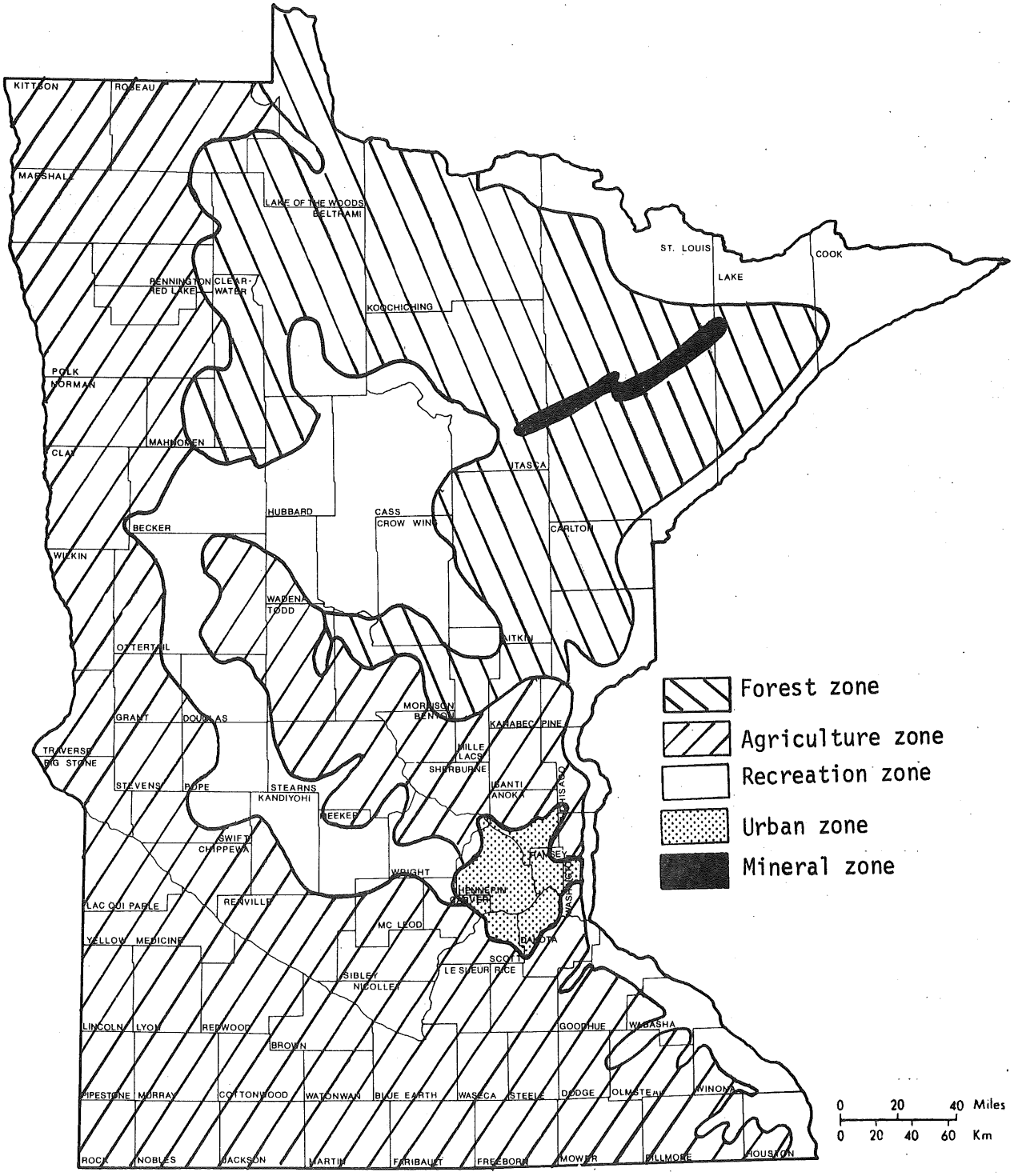


Figure 14. Minnesota resource zones - the '80s.

THE NONGAME WILDLIFE RESOURCE

The past gives us the present. As we have seen, nongame wildlife resources occurring today in Minnesota are a consequence of all that has gone before.

This section constitutes a summary of the current condition of the nongame wildlife resource in Minnesota. This section defines nongame wildlife in an operational sense. It also includes a qualitative discussion of the diversity and abundance of this resource, including endangered and threatened species.

THE SUPPLY

Definition and Scope

In practice, the term "nongame wildlife" has been applied to collectively describe those native wild animals which are not traditionally harvested for sport, food, fishing, bait or fur and which are not likely to be so harvested in the foreseeable future. In Minnesota, this term includes mammals, birds, fish, reptiles, amphibians, crustaceans, mollusks, and certain other invertebrates.

Nongame wildlife does not include furbearing animals which are currently protected year-round: pine marten, wolverine, cougar, and timber wolf. Also not included are unprotected furbearers which are traditionally harvested for their fur: striped skunk, spotted skunk, long-tailed weasel, short-tailed weasel, opossum, and coyote. The term does not include "big game" species which are currently protected: elk, caribou and pronghorn. It also does not include exotic pest species like the house mouse, Norway rat, English sparrow, European starling, common pigeon, monk parakeet, or mute swan. Upland game birds and webless migratory birds which have traditionally been hunted in

Minnesota but are now protected are not included: bobwhite quail, mourning dove, and prairie chicken.

While there have been suggestions about the hunting of sandhill cranes and tundra swans, these species have not been hunted in Minnesota since the Migratory Bird Treaty Act of 1918. There is little likelihood of a season being established on them in the future. They are considered nongame species.

Minnesota's nongame wildlife resource includes 455 out of 673 wild vertebrates. This is 67.6% of all wild vertebrates. Among the nongame species, 54 are either threatened, endangered, or of special concern. Table 2 is a tally of nongame species by vertebrate class and status.

Table 2. Number of nongame species by vertebrate class and status.

Endangered Class Nongame	Total Species	Nongame Species	Threatened, or Special Concern
Mammals	80	43	10
Birds	395	334	24
Reptiles and Amphibians	49	47	16
Fish	149	31	4
	673	455	54

Program responsibilities include mammals, birds, reptiles, amphibians, and fish. Selected invertebrates are also within the program's scope, including 4 molluscs and 15 butterflies which are threatened, endangered, or of special concern.

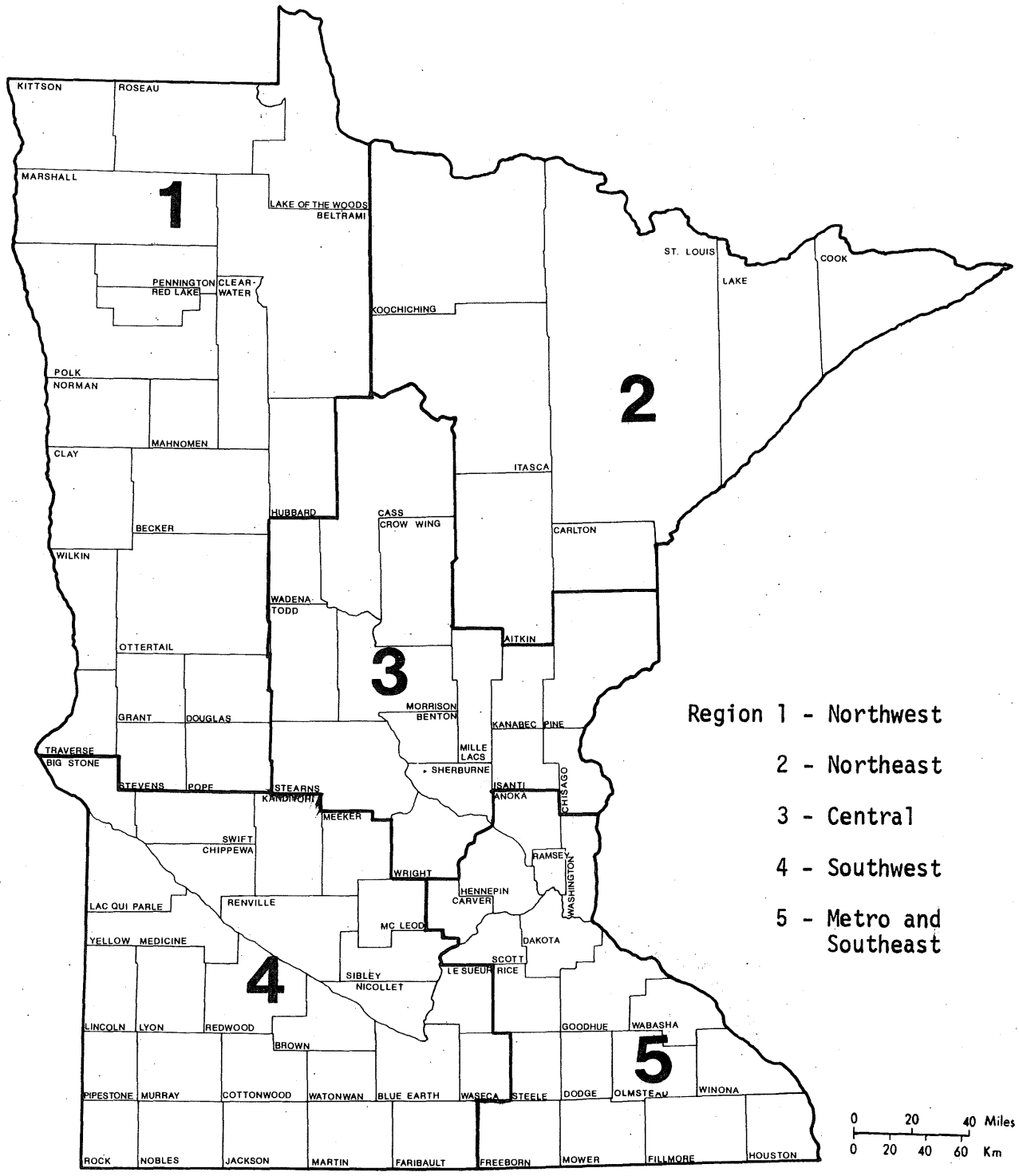
Table 3 is a tally of nongame species by vertebrate class and region (see Fig. 15 for map of DNR management regions). It shows how the species diversity varies across the state.

Table 3. Number of nongame species by vertebrate class and region.

	(Region 1) Northwest	(Region 2) Northeast	(Region 3) Central	(Region 4) Southwest	(Region 5) Southeast
Mammals	35	31	34	27	31
Birds	181	163	172	120	136
Reptiles & Amphibians	21	17	33	30	41
Fish	15	17	17	17	28
	252	228	256	194	236

The central region has the highest diversity, 256 species, followed closely by the northwest with 252 species. This is generally because these two regions represent a cumulative mix of species from all three major biomes in Minnesota - deciduous forest, northern forest, and prairie. The southwest has the lowest diversity, 194 species, and has a fauna mainly representative of the prairie biome. The metro and southeast region has an intermediate number of species, 236. It reflects a high number of more southerly forest species which have ranges peripheral in that region. The northeast also has an intermediate number of species, 228. That number primarily reflects a high number of northern coniferous bird species characteristic of that region.

Appendix I is a comprehensive listing of all nongame species. It includes the common name; scientific name; status of endangered, threatened or of special concern, and distribution by region. The bird



Source: Minnesota Department of Natural Resources

Figure 15. Resource management regions of Minnesota.

threatened or of special concern, and distribution by region. The bird list distinguishes breeding and nonbreeding species. It also identifies their status
as regular, casual, accidental, or extirpated.

This listing, combined with the discussion which follows on the five vertebrate classes and the invertebrates which are of concern to the Nongame Wildlife Program constitutes a qualitative assessment of the supply of nongame wildlife species in Minnesota.

More specific information on the biology of these nongame species and their general occurrence in Minnesota may be found in Birds of Minnesota (Roberts, 1932), Reptiles and Amphibians of Minnesota (Breckenridge, 1944), and the more recent Minnesota Birds, When, Where and How Many (Green and Jansen, 1975), The Mammals of Minnesota (Hazard, 1982) and Northern Fishes (Eddy and Underhill, 1974).

Mammals

Species diversity - Among Minnesota's 80 mammal species, 43 are nongame. This includes 6 shrews, 2 moles, 7 bats, 9 squirrels, 2 pocket gophers, 1 pocket mouse, 12 new world mice, 2 jumping mice, 1 porcupine, and 1 weasel. A list is given in Appendix I.

The species diversity varies from one region to another. The largest number, 35, is in northwest Minnesota (Region 1). There is a general increase in diversity as peripheral northern species are encountered. This is opposite from the situation with fish, reptiles and amphibians which have less diversity in the north and more diversity in southeast Minnesota as many peripheral species characteristic of southeastern deciduous forests are encountered.

Species composition and status - The Norway rat and house mouse are the

only exotic species of wild mammals which have become established in Minnesota. They are not included as nongame species. An exotic species is one which has been introduced from another country and is not native to Minnesota. None of the state's nongame mammals have become extinct in recent times. An extinct species is one which has completedly disappeared from the earth.

While 4 game species have become extirpated from Minnesota (grizzly bear, bison, woodland caribou, and wolverine), no nongame mammals have become extirpated. An extirpated species is one which has disappeared from a portion of its original range which is usually defined by political boundaries.
hies.

There are no endemic nongame mammals found in Minnesota. An endemic species is one whose distribution is limited only to one area or state. There are no "accidental" nongame mammals in Minnesota, either. An accidental species is one which occasionally shows up outside of its regular range. A hypothetical species is one predicted to occur in a state or region but for which verification is lacking. There are no hypothetical nongame mammals listed for Minnesota.

Habitat affiliations and distribution - Review of nongame mammals by habitat preference facilitates understanding their distribution and conservation needs. Since Minnesota is in a mid-continental location which contains the intersection of three major biomes, the ranges of species associated with those biomes also meet in Minnesota. Table 4 contains a list of these species of nongame mammals which characterize the three biomes.

Table 4. Characteristic nongame mammals of the three major biomes

Characteristic Species of Deciduous Forests

Least Shrew
Eastern Mole
Eastern Pipistrelle
Southern Flying Squirrel
Plains Pocket Gopher
Plains Pocket Mouse
Western Harvest Mouse
Pine Vole

Characteristic Species of the Prairie and Grasslands

Northern Pocket Gopher
Northern Grasshopper Mouse
Prairie Vole

Characteristic Species of the Northern Forests

Arctic Shrew
Northern Water Shrew
Pygmy Shrew
Star-Nosed Mole
Least Chipmunk
Northern Flying Squirrel
Heather Vole
Woodland Jumping Mouse
Porcupine

Mammals known only from one region are the northern pocket gopher, heather vole, rock vole, and pine vole.

The northwest, northeast, and metropolitan regions have been well surveyed by mammologists so few species remain to be verified. In other regions there are some species which still require more work to verify their presence or absence.

Special interest species - Bats are of particular interest among nongame mammals because of the specialized cave habitats which some require for survival. Two of our seven bat species are of special concern - Keen's myotis and the eastern pipistrelle. Most caves in Minnesota are in the southeast so the preservation and management of

cave habitats for bats will be a point of special emphasis in that area.

Other species of special concern include the least shrew. Only one specimen is known from Homer in southeastern Minnesota. The woodland vole is the only other small mammal of special concern in the southeast. Its habitat is primarily upland deciduous forest with a grassy understory.

Limited prairie habitats in Minnesota are occupied by the prairie vole. The uncommon northern grasshopper mouse and plains pocket mouse are also associated with prairie and grassland habitats.

Finally, there are several boreal species of new world mice which are found in limited habitats of northern Minnesota, including the heather vole, rock vole, and northern bog lemming. All are species of special concern.

Utilization - There is essentially no problem caused by commercialization or overutilization of our nongame mammals.

Some species have potential for creating either real or imagined problems. Few of these problems are of any economic significance. Eastern moles and plains pocket gophers can damage lawns, gardens and sod farms. Bats can create smelly, noisy and undesirable situations in attics and they may carry histoplasmosis or rabies. Thirteen-lined ground squirrels and woodchucks can create problems in pastures by excessive digging. Woodchucks can also create extensive burrows under foundations and damage gardens. Deer mice, white-footed mice, flying squirrels and eastern red squirrels can enter houses and outbuildings and make nests in them. Porcupines can damage trees which are of value for timber. Meadow voles and woodland voles can girdle fruit and shade

trees.

Some people perceive that they have a problem wherever bats are present. Bats are generally very beneficial mammals which prey heavily on insects. In these cases the problem lies not with the bats but with the human prejudice that is involved.

Some counties or townships or utility companies pay small "bounties" for pocket gophers and thirteen-lined ground squirrels. These bounties have essentially no impact on the pest populations involved and are not endorsed by the Nongame Wildlife Program.

There is very little use of nongame mammals as pets. Occasionally a flying squirrel, woodchuck, or chipmunk is kept as a pet but it is not recommended.

BIRDS

Species diversity - Minnesota's avifauna includes 395 species in 44 families of which 334 are nongame and 61 are game species. The species diversity ranges from 120 breeding species in the southwest (Region 4) to 181 breeding species in the northwest (Region 1). The combined southeast and metropolitan region has an intermediate number, 136, while the northeast and central regions are relatively high in species diversity, with 163 and 172 species, respectively.

This pattern of species diversity is opposite that observed for fish, reptiles and amphibians which are most diverse in the southeast. The general reason for this is that many of the more northern bird species are migratory and are adapted to relatively narrow niches in the northern coniferous forests. A large number of these species, including wood warblers, are insectivorous. They are able to take advantage of seasonably abundant insects during the short summer

nesting season and then migrate south.

Species and status composition - Minnesota's nongame birds include no exotic species. These are exluded by definition and include the house sparrow, European starling, and rock dove. The only species which has become extinct in recent times is the passenger pigeon. There are 6 extirpated nongame species - American swallow-tailed kite, peregrine falcon, whooping crane, eskimo curlew, long-billed curlew, and McCown's longspur. In addition, the state's avifauna includes 205 breeding nongame species and 123 nongame species which are regular, casual, or accidental nonbreeding species. There are no endemic birds.

Habitat affiliations and distribution - The regional distribution for resident breeding nongame species is given in Appendix 1. Species whose distribution appears limited to only one region include the: trumpeter swan (Metro), solitary sandpiper (NE),boreal owl (NE), acadian flycatcher (SE), black-billed magpie (NW), Sprague's pipit (NW), blue-winged warbler (SE), Wilsons's warbler (NE), blue grosbeak (SW), Baird's sparrow (NW), chestnut-collared longspur (NW), and rusty blackbird (NE).

Because Minnesota represents a juncture of three major biomes, it is characterized by nongame species of the northern coniferous forests (53 spp.), deciduous forests (16 spp.), and the prairie (20 spp). These species are listed in Green and Jansson (1975) and to a greater or lesser degree can be considered at the edges of their range in Minnesota. They are listed in Table 5.

Table 5. Characteristic nongame birds of the three major biomes.

Characteristic Species of the Deciduous Forest

Yellow-crowned Night-Heron	Blue-gray Gnatcatcher
Red-shouldered Hawk	Bell's Vireo
Red-bellied Woodpecker	Prothonotary Warbler
Acadian Flycatcher	Blue-winged Warbler
Tufted Titmouse	Cerulean Warbler
Bewick's Wren	Louisiana Waterthrush
Carolina Wren	Yellow-breasted Chat
Northern Mockingbird	Northern Cardinal

Characteristic Species of the Prairie

Eared Grebe	Forster's Tern
Western Grebe	Burrowing Owl
American White Pelican	Short-eared Owl
Swainson's Hawk	Western Kingbird
Upland Sandpiper	Sprague's Pipit
Willet	Orchard Oriole
Marbled Godwit	Lark Bunting
American Avocet	Baird's Sparrow
Wilson's Phalarope	Sharp-tailed Sparrow
Franklin's Gull	Chestnut-collared Longspur

Characteristic Special of the Northern Forests

Northern Goshawk	Orange-crowned Warbler
Bald Eagle	Nashville Warbler
Osprey	Northern Parula
Merlin	Magnolia Warbler
Solitary Sandpiper	Cape May Warbler
Herring Gull	Black-throated Blue Warbler
Common Tern	Yellow-rumped Warbler
Northern Hawk-Owl	Black-throated Green Warbler
Great Gray Owl	Blackburnian Warbler
Black-backed Woodpecker	Bay-breasted Warbler
Three-toed Woodpecker	Pine Warbler
Yellow-bellied Flycatcher	Palm Warbler
Alder Flycatcher	Northern Waterthrush
Olive-sided Flycatcher	Connecticut Warbler
Gray Jay	Mourning Warbler
Common Raven	Wilson's Warbler
Boreal Chickadee	Canada Warbler
Red-breasted Nuthatch	Rusty Blackbird
Winter Wren	Evening Grosbeak
Hermit Thrush	Purple Finch
Swainson's Thrush	Pine Siskin
Golden-crowned Kinglet	Red Crossbill
Ruby-crowned Kinglet	White-winged Crossbill
Solitary Vireo	Dark-eyed Junco
Philadelphia Vireo	White-throated Sparrow
Golden-winged Warbler	Lincoln's Sparrow
Tennessee Warbler	

Special interest species - Among species which are threatened, endangered, or of special concern are 1 grebe (horned grebe), 1 pelican (American white pelican), 1 heron ally (American bittern), 1 osprey (osprey), 2 eagles and hawks (bald eagle and red-shouldered hawk), 1 falcon (peregrine falcon), 2 rails (yellow rail and black rail), 1 crane (sandhill crane), 1 plover (piping plover), 2 sandpipers (upland sandpiper and marbled godwit), 1 phalarope (Wilson's phalarope), 2 terns (Forster's tern and common tern), 2 owls (burrowing owl and short-eared owl), 1 shrike (loggerhead shrike), 1 warbler (Louisiana waterthrush), and 4 sparrows (Baird's sparrow, Henslow's sparrow, sharp-tailed sparrow, and chestnut-collared longspur).

Of these, only the last 6 species are in the Order Passeriformes (perching birds). The McCown's longspur, which is extirpated, is also in that order. Among the 180 nongame passeriformes are only 7 listed species - 3.9%. Among the 154 nongame birds which are not passeriformes are 22 listed species - 14.3%. Most of the latter group are birds of prey, piscivorous waterbirds, or insectivorous birds of prairie grasslands or wetlands. These groups appear to have been much more significantly affected by environmental contamination and habitat loss than the perching birds.

Utilization - There is an extremely broad range of human experiences which can be derived from nongame birds - they range from the pure joy of watching newly hatched loons with their parents, the thrill of watching a peregrine falcon stoop on its prey, or the surprise of watching a great horned owl strike one of your duck decoys and ricochet into the water.

While most nongame birds are rather innocuous, some can cause

legitimate problems, and some cause perceived problems which are rooted in human misunderstanding and prejudice.

Some fish-eating birds can cause localized depredation problems at fish hatcheries, holding ponds for minnow dealers, and commercial fish ponds and trout farms. This includes the common loon, double-crested cormorant, great blue heron, and belted kingfisher.

The double-crested cormorant and American white pelican are occasionally blamed for "eating too many walleyes" in western Minnesota. Actually, these birds feed largely on rough fish and they are not a limiting factor for our game fish populations.

Some birds of prey can cause localized depredation problems for poultry raisers who do not keep their birds in confinement. This includes the bald eagle, northern harrier, Cooper's hawk, northern goshawk, red-tailed hawk, great horned owl, and snowy owl.

Perceived problems exist for these species and other birds of prey, especially falcons and accipiters. The dislike or hatred which some people have for birds of prey ("chicken hawks") is a bias that is difficult to overcome. Predation is a fact of life to be tolerated and understood.

Red-winged blackbirds as well as some yellow-headed blackbirds, common grackles, and brown-headed cowbirds probably cause the greatest economic damage by nongame birds in the state in late summer and early fall by feeding heavily on sunflower fields in western Minnesota. Concerted efforts are sometimes necessary by farmers to reduce such crop depredations.

Probably the second greatest economic damage by nongame birds in the state is that caused by hairy and downy woodpeckers on cedar siding

or cedar paneling of houses. Much of this damage occurs in the fall as the birds seek small grubs or insect larvae under the cedar boards or paneling. The paneling is especially prone to damage because of the manufacturing process which creates small grooves under the cedar veneer where small larvae can exist. These grooves could be eliminated in the manufacturing process, but the plywood industry has taken no steps to do so.

Barn swallows sometimes nest over light fixtures above doorways and swoop down at people as they enter the house. This is not a serious problem, but it can be disconcerting to someone who is not expecting it.

Robins can create a minor nuisance in the spring by repeatedly flying against the windows of a house where they see their reflections in the windows. This is a territorial defense against what appears to be another intruding robin in an occupied nesting territory.

The DNR discourages keeping any nongame birds as pets, as the possession of all bird species except the house sparrow and starling is prohibited by federal law. It is common practice for persons to temporarily care for injured or orphaned songbirds in the spring. It is technically illegal to do so without a permit, and conservation officers should be consulted whenever this situation occurs. About 25 persons in the state maintain rehabilitation permits so they can care for and release injured wildlife, primarily birds of prey. They also retain a few permanent cripples for educational purposes. Falconry is practiced by 56 licensed falconers in Minnesota.

Some bird species are so desirable that people either build houses or nesting platforms for them, feed and water them, or travel

great distances to view them.

Among species that nest in man-made houses or nesting platforms are the common loon, double-crested cormorant, great blue heron, osprey, American kestrel, Forster's tern, common barn owl, eastern screech-owl, great horned owl, burrowing owl, barred owl, great gray owl, boreal owl, northern saw-whet owl, northern flicker, great crested flycatcher, purple martin, tree swallow, cliff swallow, barn swallow, eastern phoebe, black-capped chickadee, white-breasted nuthatch, house wren, eastern bluebird, mountain bluebird, and American robin.

Species which are popular at backyard feeders and bird baths are the ruby-throated hummingbird, downy woodpecker, hairy woodpecker, pileated woodpecker, blue jay, black-capped chickadee, red-breasted nuthatch, white-breasted nuthatch, brown creeper, northern cardinal, American tree sparrow, dark-eyed junco, northern oriole, purple finch, red crossbill, common redpoll, hoary redpoll, pine siskin, American goldfinch, and evening grosbeak.

In addition to "casual and accidental" species which are generally of special interest to birders, people also travel especially to view and/or photograph migrating hawks and the following species: common loon, western grebe, trumpeter swan, bald eagle, peregrine falcon, yellow rail, sandhill crane, piping plover, eastern bluebird, American avocet, northern hawk-owl, burrowing owl, great gray owl, boreal owl, Sprague's pipit, blue grosbeak, Baird's sparrow, Henslow's sparrow, sharp-tailed sparrow, chestnut-collared longspur, upland sandpiper, and marbled godwit. Depending on individual preferences, there are also many other species which may generate trips by people who wish to view and enjoy them. Usually, however, birds are enjoyed

quite simply as part of a total outdoor experience or in proximity of one's own backyard.

REPTILES AND AMPHIBIANS

Species diversity - Minnesota's reptile and amphibian fauna includes 49 species, of which 47 are nongame. Only the snapping turtle and leopard frog are considered game species. The leopard frog is commercially used for fish bait. Minnesota's nongame reptile and amphibian fauna includes 47 species, including 8 turtles, 3 lizards, 17 snakes, 5 salamanders, and 14 frogs and toads. As shown in Appendix 1. the species diversity is greatest in the southeast (41 species) and lowest in the northeast (17 species). Many southern reptiles and amphibians reach the northern or northwestern limit of their range in the driftless (unglaciated) hardwood forest region of southeastern Minnesota.

Species status and composition - There are no exotic populations of reptiles or amphibians in Minnesota. No reptiles or amphibians have become extinct or extirpated in recent times. There are no endemic species. However, there is a disjunct (geographically isolated) populationn of five-lined skinks near Granite Falls in the southwest. The four-toes salamander is hypothetical. It is found in western Wisconsin, but not in adjacent areas of Minnesota. It may occur in Houston and/or Chisago Counties.

Habitat affiliations and distribution - An analysis of the distribution of the state's reptiles and amphibians reveals that Minnesota is at the northern or northwestern limit of the range for most species. A few western prairie biome species reach the eastern limit of their range in Minnesota -- the great plains toad, Canadian toad, prairie skink,

western hognose snake, and plains garter snake. Two species are generally associated with more northern forest environments -- the mink frog and wood frog.

Most of these species have life cycles associated with hardwood forests and wetland environments. Exceptions would be species associated with more open sandy prairie meadow or grassland habitats -- the prairie skink, five-lined skink, six-lined racerunner, western hognose snake, smooth green snake, and plains garter snake.

Special interest species - There are 2 turtles, 1 lizard, 10 snakes, and 3 frogs listed as endangered, threatened, or of special concern.

The wood turtle and Blanding's turtle are both threatened by habitat loss and land development.

The five-lined skink occupies a limited habitat niche on granite outcrops in the Minnesota River valley. That habitat is being encorached upon by eastern red cedar trees. More importantly, the outcrop areas utilized by the skinks are also being considered as sites for hazardous waste.

Most of the ten snakes of special concern are in jeopardy because of the potential for collecting and overharvest by people who intend to sell them in the pet trade. This is primarily a problem in southeastern Minesota where snake concentrations are highest. Loss of prairie habitat is also a problem for the western hognose snake in central and western Minnesota.

The pickerel frog and northern cricket frog are vulnerable to water pollution from pesticides and agricultural fertilizers. Bullfrogs may be overharvested becuase of demand for them as bait or food.

Utilization - Nongame reptiles and amphibians include a number of species which have high appeal and value as pets, including the painted turtle, Blanding's turtle, wood turtle, rat snake, fox snake, western hognose snake, eastern hognose snake, milk snake, gopher snake, and massasauga. Unrestricted collecting for commercial purposes can cause the decline of local populations.

There is some demand for the meat of softshell turtles, rattlesnakes, and bullfrogs for personal consumption and for sale in restaurants.

Many of these frogs, toads, snakes, and turtles are favorites among children who like to catch them, keep them for a few days, and then turn them loose again.

Some counties or townships still pay bounties on rattlesnakes in southeastern Minnesota. It is a long-standing tradition which does little to control rattlesnake populations, and, if anything, only perpetuates the myth that rattlesnakes are evil creatures that should be killed. The threat they pose to humans is negligible. They actually help control rodent populations.

There is a significant difference between the actual problems caused by nongame reptiles and amphibians (like being bitten by a rattlesnake) and perceived problems. Many people have a problem with the thought or presence of snakes simply because they do not like snakes. For this reason many beneficial snakes, primarily garter snakes, are killed every year because of this old prejudice which is passed on from generation to generation. The only solution to this problem is a long term educational program about snakes.

The keeping of reptiles or amphibians as pets can be an

educational experience and a rewarding hobby, but it needs to be done within a framework of regulations which prevent wild populations from being depleted. Such regulations still need to be promulgated in Minnesota.

FISH

Minnesota's fish fauna includes 149 species, of which 31 are nongame. The number of "nongame" fish species is actually higher, but Minnesota law defines all members of the family Cyprinidae (except carp and goldfish) and all members of the sucker family not over 12 inches in length as "minnows." Legally all "minnows" are considered as bait species used for commercial purposes even though many species in the family Cyprinidae are uncommon and unsuitable as bait. Six minnows and suckers are actually listed as species of special concern.

Minnesota's nongame fishes include 31 species in 9 families, including 3 lampreys, 1 mudminnow, 2 madtoms, 1 pirate perch, 1 trout perch, a killifish, 1 silverside, 2 sticklebacks, 15 darters, and 4 sculpins.

Special diversity - The species diversity ranges from 15 in the northwest (Region 1) to 28 in the southeast (Region 5). The high diversity of species in the southeast is directly related to the presence of the Mississippi River and its tributary streams which provide a variety of suitable habitats for these species. The pattern of species diversity generally resembles that found for reptiles and amphibians. That diversity also declines to the north and west. Regions 2, 3 and 4 all have 17 nongame species.

Species status and composition - None of the species listed have become extinct or extirpated in recent times. They do not iclude any

hypothetical species. There are no exotic or endemic species among the 31 nongame fishes. However, mosquitofish (Gambusia affinis) were unsuccessfully introduced in the metropolitan area for mosquito control purposes from 1958-1961.

Habitat affiliations and distribution - The American brook lamprey, slender madtrom, pirate perch, crystal darter, mud darter, bluntnose darter, and gilt darter are only found in east central and southeastern Minnesota in association with the St. Croix and/or Mississippi River.

The deepwater habitats of Lake Superior are habitat to the spoonhead sculpin and fourhorn sculpin. They are found nowhere else in the state. The ninespine-stickleback is primarily found in shallow waters along the shore of Lake Superior and in the Rainy River drainage.

A number of the nongame fishes are associated with relatively unpolluted, unsilted stream environments and several of the darters inhabit areas of swift current. These habitats are affected by a variety of human alterations -- impoundment of streams and rivers, enrichment of waters from agricultural fertilizers, chemical pollution, acid precipitation, stream channelization, and dredging of river bottoms. Since the habitat affiliations of the nongame fishes are quite varied, they are listed in Table 6.

Assessment of the status of these species can well serve as an indicator of water quality because of their varying tolerances for acidity and pollution.

Table 6. Habitat affiliations of nongame fishes.

Species	Habitat
Chestnut Lamprey	Smaller rivers and streams
Silver Lamprey	Large stream and lake habits
American Brook Lamprey	Small clear streams
Tadpole Madtom	Soft silt bottoms of lake margins
Slender Madtom	Riffles of small streams with swift currents
Pirate Perch	Oxbow lakes, sloughs, ponds with soft silt bottoms
Trout Perch	Deep water lakes
Banded Killifish	Sandy bottoms in shallow water of lakes
Brook Silverside	Clear unpolluted lakes and brooks
Brook Stickleback	Cool shallow waters, spring-fed brooks
Ninespine Stickleback	Cool shallow water habitats along Lake Superior and Rainy River
Crystal Darter	Shifting sand bottoms, swift stream current
Western Sand Darter	Shifted sand bottom, moderate to swift current
Mud Darter	Mud bottom river sloughs, over gravel in swift current
Rainbow Darter	Clear-rapid flowing streams, tolerant of fertilizer enrichment
Bluntnose Darter	Quiet waters, muddy bottoms, river, sloughs and backwater
Iowa Darter	Lakes, or streams near lakes
Fantail Darter	Coldest, swiftest streams
Least Darter	Vegetation in shallow waters of lakes and streams
Johnny Darter	Lakes and streams
Banded Darter	Restricted habitat at lower lip of stream pools entering rapids
Logperch	Rivers, streams and lakes
Gilt Darter	Clear water stream habitat
Blackside Darter	Streams and small rivers
Slenderhead Darter	Streams and rivers
River Darter	Rivers
Mottled Sculpin	Riffles over gravel or rock bottoms along shores
Slimy Sculpin	Spring-fed headwaters of brooks
Spoonhead Sculpin	Shallow water near shore of Lake Superior
Fourhorn Sculpin	Deep waters of Lake Superior

Special interest species - There are no state-listed threatened or endangered nongame fish species, but there are four of special concern -- the American brook lamprey, crystal darter, bluntnose darter, and the slender madtom. All are known only from southeastern Minnesota.

The American brook lamprey is restricted to the Zumbro and Root River systems in southeastern Minnesota. Formerly it occurred in the Credit River near Savage in the metropolitan area. It requires good water quality and minimal soil erosion along streams. The crystal darter is also known only from southeastern Minnesota in the Mississippi River and the Zumbro River. The bluntnose darter is found in Mississippi River backwaters south from Wabasha and in the Root River in Houston County. The slender madtom occurs as part of a disjunct population and is only known from three specimens collected in Otter Creek east of Lyle, Minnesota in 1954.

Utilization - Except for the Iowa darter which is hardy and makes an excellent aquarium fish, there is essentially no human utilization of the nongame fishes. Perhaps their greatest value is as environmental quality indicators.

The silver lamprey is parasitic on fish and affects northern pike, catfish and walleyes. However, the sores and scars caused by silver lampreys do not create damage comparable to that caused by sea lampreys on lake trout and whitefish.

Invertebrates of Concern

The extent of the Nongame Wildlife Program's interest and responsibility for wild animals is not limited exclusively to vertebrate species. It extends to invertebrates as well. This is a considerable extension of responsibility, as on a biomass or diversity basis, invertebrates are by far the largest animal group. Invertebrates should be included as they influence the ecology of vertebrate animals, including man, to a considerable degree.

Except for certain groups of arthropods and mollusks, most of Minnesota's invertebrates fauna has not even been identified or studied. The problem is further compounded by a lack of qualified specialists. As a result, most of the state's invertebrate fauna is unknown, and is likely to remain so for many years. However, a number of knowledgeable individuals do exist with expertise on the status and distribution of butterflies and skippers, tiger beetles, mollusks, and jumping spiders in Minnesota. These experts were called together to form the Invertebrate Animals Subcommittee of the Department's Endangered Species Techical Advisory Committee. The subcommittee was formed in consideration of the importance of invertebrates to the functioning of the ecosystem and their charge was to pool their knowledge and to propose species from within their areas of expertise which are endangered, threatened or of special concern status in Minnesota. Their species specific recommendations regarding butterflies and mollusks are included in the listing of endangered and threatned species in Appendix II. This listing represents a priority for action on behalf of Nongame Wildlife Program relative to invertebrates.

According to the final report submitted by the Invertebrate Animals Subcommittee, "The most critical requirement for any invertebrate species is the maintenance of appropriate habitat" (MN DNR Div. of Fish & Wildlife, 1983). Most invertebrate species do not have wide home ranges. A relatively small area of habitat will often suffice to maintain an invertebrate population if the habitat is protected and properly managed. The report concludes that "In the light of the necessity for habitat management, it should be noted that

the provisions of this bill (the Endangered Species Protection Act #97.488) are not adequate to protect most invertebrate species." as the bill does not provide protection for habitats, but only for individual animals.

Endangered and Threatened Species

Most species of nongame wildlife have maintained healthy populations in Minnesota. They range widely within the state and may be considered relatively abundant. Other species are considerably less abundant.

These less common species may be peripheral or otherwise occupy a very small range in the state because of specialized habitat requirements. Some species are characteristically rare or uncommon throughout their range.

Of particular note are those species which have experienced recent population declines. A few species have even declined to the point where they no longer exist in Minnesota. Except for the Breeding Birds Surveys (see Henderson, 1979) and a few species specific studies in limited portions of the state, there is little quantitative data which documents the changes in abundance and status of nongame wildlife species in Minnesota.

Despite the lack of quantitative data, declining populations of a number of wildlife species are very evident. As a consequence, in May, 1981, the state's endangered species protection law was amended to create an Endangered Species Advisory Committee to "... recommend criteria for determining the special concern, endangered or threatened status of species and those species appropriate for designation."

The committee submitted a list in January 1983, to the

Commissioner of the Department of Natural Resources of 250 species of plants and animals proposed for designation (Appendix II).

The list and proposed rule making (Minnesota DNR, 1983) are presently undergoing public review. The wildlife species proposed represent a priority for action on the part of the Nongame Wildlife Program. Beyond this listing, a great deal remains to be learned and accomplished on behalf of these species. Fact sheets prepared on each wildlife species by the Technical Advisory Committee include management recommendations in the form of activities to be conducted to benefit these species. In general, the recommendations encompass five categories of actions.

The first of these recommendations is for habitat protection and management. Figs. 7 and 10 highlight the fact that the majority of species proposed are associated either with the former prairie biome or native woodlands of the transition zone. These habitats have been reduced by agricultural development, particularly in the southern half and western third of Minnesota. The continued existance in Minnesota of a number of species is directly dependent on the identification, preservation, and management of these essential habitats.

For many species, however, the essential habitat has not yet been delineated as there is an absence of data on the species' present distribution, abundance and habitat requirements. Additionally, it is difficult to document impacts of habitat alteration on species where there is a paucity of historical data for comparison with present situations. Consequently, the need for research, census and survey data on both rare as well as abundant but little studied nongame species has repeatedly been identified as a management need.

The enabling legislation provides protection for endangered and threatened species through prohibition of possession. Except for birds, many of the nongame species of vertebrate fauna are unprotected species. The imposition of regulations on the collecting or harvesting of the state's entire herptofauna, not just those proposed for listing, has been recommended.

One of the most pressing needs relative to endangered species protection and management is the establishment of public education programs to promote knowledge and understanding regarding these species' precarious situations in Minnesota. The future direction of this aspect of program activities needs to be carefully delineated and will be the subject for considerable discussion in Volume 3.

The final type of action recommended involves the reestablishment of species in areas where they previously occurred in Minnesota. Two such programs are currently underway. The first is a cooperative effort among a number of agencies to reintroduce the peregrine falcon along the Mississippi River bluffs in southeastern Minnesota. The other program involves reintroduction of the trumpeter swan to Minnesota. The emphasis these projects should receive relative to other nongrame program responsibilities will be further considered in subsequent volumes of this plan.

The Demand

Only recently have efforts been made to determine "Who cares about wildlife?" A number of studies now describe Americans' interest in wildlife-associated activities and characterize the participants (Kellert, 1980; Witter, 1980). This research has begun to evaluate

such interest (termed "demand") through expenditure studies and participation rate studies (Payne and DeGraaf, 1975; U.S. Dept. Interior, et al., 1982). For the most part, these studies have been nationwide in scope.

Quantitative data on the demand in Minnesota, particularly for wildlife related activities other than hunting, fishing or trapping, is scarce. The information which is available has been compiled. It is presented here for two reasons. First, a review of such information will help answer the question "Who cares about nongame wildlife?" Second, the information has been compiled in anticipation of a future Nongame Wildlife Program need for a better understanding of Minnesotans' interest and expectations regarding nongame wildlife and the quality of life in Minnesota.

Activities

Activities constituting the demand for nongame wildlife have been classified generally as "nonconsumptive wildlife uses," frequently stereotyped as birdwatching. The term "nonconsumptive" is meant to denote activities not resulting in the death or attempted killing of the animal (More, 1979). Subsequent consideration has refined the term to include the following activities:

-Wildlife observation.

-Wildlife feeding.

-Wildlife photography.

-Maintaining natural areas or plantings primarily to benefit wildlife (U.S. Dept. of Interior, 1980).

For purposes of this present assessment, nonconsumptive wildlife-associated activities in Minnesota also include:

-Wildlife interpretation-educational programs.

-Bird banding.

-Collecting of wildlife for scientific study or education.

-Falconry.

-Wildlife rehabilitation.

-Wildlife pets.

Before presenting the available data on the amount of these activities, some qualifying considerations are necessary. First, the argument has been well made that the distinction between consumptive and nonconsumptive wildlife users is false, as every human, by existing, consumes or displaces wild things. Second, unless specified, the data should not be interpreted to indicate interest solely in nongame species. The national survey on nonconsumptive wildlife reports the information without distinguishing the type of wildlife "used." Birders may watch grouse and deer as readily as a deer hunter may pause to watch a red-tailed hawk. This emphasis on the broad category of "wildlife" is significant, as it reaffirms the fact that ultimately, our responsibiity to the citizens is for all the state's wild animals (MN 97.40 subd 5; 97.42) without distinction. It also examplifies the argument that there are only nongame and game values which can be assigned to a species and that categorizing wildlife species as game or nongame might cause problems (Brocke, 1979).

Quantifying the present or future demand for wildlife is difficult. Caution is urged in interpreting the statistics which follow because projections of demand for many outdoor recreation activities have proven inaccurate in the past, primarily due to changes in economic conditions. Other factors which tend to affect

recreational demand include income, education, mobility, the opportunity to participate and occupation. While trends may be anticipated, long term estimates as to the exact number of activity occasions may be chancy. The two most recent assessments of non-consumptive wildlife activities are the 1979 Minnesota State Comprehensive Outdoor Recreation Plan (SCORP) (MN DNR, 1979) and the 1980 National Survey of Fishing, Hunting and Wildlife - Associated Recreation (U.S. Dept. Interior, et al., 1982).

Findings of the national survey include the following national highlights:

1. A total of 93.2 million Americans 16 years of age and older participated in nonconsumptive activity in 1980 (55 percent of the population).

2. Participants in activites around the home numbered 79.7 million in 1980, or nearly one in two individuals 16 years of age and older. Of the nationwide population:
   a. 37 percent feed wild birds,
   b. 33 percent observed wildlife around the home,
   c. 12 percent fed wildlife other than birds,
   d. 7 percent photographed wildlife,
   e. 6 percent maintained natural areas for the benefit of wildlife.

3. Close to 28.8 million Americans (17%) representing one in every five adults, took at least one trip for the primary purpose of observing, photographing, or feeding wildlife. They spend, on the average, $11/day/traveler or $139 per year on wildlife trips (average of 10.7 trips/year/participant).

Additionally, a large proportion of the citizenry (57%) enjoyed wildlife incidental to their participation in other activities.

Focusing closer to home, the national survey also reported the following for the West North Central region of the country (Minnesota, the Dakotas, Iowa, Nebraska, Missouri, and Kansas).

1. 63.8 percent of the regional population 16 years and older were participants in nonconsumptive wildlife-associated

activities in 1980.

2. Slightly more than half of the regional population (53.1%) participated in wildlife activities around their home.
   a. 38.3 percent of the population observed wildlife and;
   b. an equal proportion (38%) feed birds in their yards on the average of little more than 5 months during the year. Half of the individuals maintained regular bird feeders.

3. Nearly one in four (23.5%) adults in the region took an average of 11.26 trips to observe, feed or photograph wildlife during the year. Most of these trips (93.3%) were within the participants' states of residence. They spent a reported $183.6 million for these activities.

The total nonconsumptive participants 6 years and older in Minnesota was reported as 3.2 million individuals. (U.S. Dept. Interior, et al., 1980).

Wildlife observation including feeding wildlife - Quantitative information on wildlife observation within Minnesota is contained in the SCORP report which categorizes this nonconsumptive wildlife activity as "birdwatching/nature study." The report predicts a 13.4 percent increase statewide in the number of birdwatching occasions in Minnesota between 1980-1995. This data, on a state and regional basis, is summarized in Table 7. The study projects steady growth in demand for birdwatching/nature study to over three million occasions statewide by 1995. About two-thirds of these occasions would originate in the metropolitan areas, representing a demand growth rate over each five-year interval of up to 8.5 percent.

Closer examination of the information reveals that almost half of all birdwatching/nature study occasions currently occurring in Minnesota are initiated in the Twin Cities metropolitan area. However,

Table 7. Projections of birdwatching/nature study occasions in Minnesota by region from 1980-1995.

Region	Originating in Region 1980	1995	% change
1	239,896	266,267	10.9
2	136.246	138.719	1.8
3	331.579	368.430	11.1
4	388.333	400.759	3.19
5	1,649,910	1,991,066	20.6 %
Total Statewide	2,745,964	3,165,241	+13.2 %

nearly half of these occasions (47%) which originate in the region occur elsewhere. In other words, metropolitan participants travel out of the Twin Cities to participate in these activities. It appears that these nature enthusiasts go north or northwest as far as Beltrami and Clearwater counties to participate in birdwatching/nature study. This movement is inferred from the data which shows an excess of birdwatching/nature study occasions occur as opposed to origination in management regions 1, 2 and 3. These regions may be considered to "import" birdwatching/nature study occasions.

Hirsch (pers. comm.) has postulated that the attraction of the Northwest, Region 1, includes opportunities to observe/photograph orchids and other wildflowers, prairie tracts and associated flora and fauna, peatland birds, and fauna of the extensive marshes on the wildlife management areas of the region. Itasca State Park and the

Chippewa National Forest have also be identified as major attractions.

The large number of birdwatching/nature study occasions originating in the metro area but occurring in the north is also probably a reflection of the locations to which metro residents travel for vacations or weekend recreation. Many metro residents maintain cabins in the lake district of central and north central Minnesota or vacation in the parks along the North Shore and the St. Croix River Valley. Hawk Ridge Nature Reserve and Minnnesota Point in Duluth, Duluth Harbor, Grand Marais Harbor, Gooseberry Falls State Park and the Superior National Forest have all been identified as significant birding areas in northeast Minnesota (Pettingill, 1980).

The Brainerd-Crosby lake area and Mille Lacs area are popular recreation spots attracting many tourists. Skoog (pers. comm.) in her assessment of the demand for nongame wildlife in Region 3, has identified an especially high interest in birds on the part of tourists, lakeshore property owners and retirement home owners. These home owner groups are a segment of the population that is rapidly increasing in the northern parts of Region 3. The SCORP report has also identified birdwatching/nature study as an activity of older participants (retirees). Keran (1977) reported that 61% of the private residences in Brainerd feed birds at some time during the year. Except for this study, there is no quantitative data for other areas of the state on the number of people involved in feeding birds. However, Hirsch (pers. comm.) has identified a perceived interest on the part of Region 1 residents for wildlife around their homes.

While not apparent from the SCORP information, it is known that

metropolitan birders also go south along the Mississippi River Valley in pursuit of birds, particularly waterfowl, eagles, and warblers (Pfannmuller, pers. comm.). That is not to say that there are not ample opportunities to participate in these activities in the metropolitan area. Pettingill (1980) identifies 12 locations in the Twin Cities noteworthy for birds.

The U.S. Department of Interior's study of recreation in the Minnesota River Valley service area (i.e. the seven county metro area) calculated a regional participation rate for wildlife observation as 908,000 activity occasions yearly by 1985 (USDI Refuge Tech. Report, 1982). For purposes of the technical report, birdwatching and nature study are synonymous with wildlife observation. Further calculations indicate that peak demand during one day would require 2119 acres of available wildlife observation lands.

A network of 43,000 acres of open space, parks and refuge lands dedicated by state, county and federal governments occur in the Twin Cities area. If we assume these lands are mostly available for wildlife observation, then supply is clearly sufficient to meet the demand for wildlife observation opportunities in the metropolitan area.

The acreages of public lands available in the various regions of the state are summarized in Table 2. As evident from this table, these public lands are extensive and numerous.

In Region 1, the state parks, national forest, and national wildlife refuges are in the forefront in providing wildlife observation opportunities (Hirsch, pers. comm.). This is also

probably true in Region 2, 3, 4, and 5. Additionally, the Minnesota Division of Fish and Wildlife administers 950 wildlife management areas throughout the state (500,000+ acres) much of which is open for viewing wildlife. Over 15,000 acres of lands administered by The Nature Conservancy are also available for wildlife observation (Searle & Heitlinger, 1980). There are also many millions of acres of private lands potentially available for viewing wildlife. Most people prefer, however, to view wildlife on wildlife lands and these are usually publicly owned.

In the metropolitan area, however, much of the opportunities for wildlife observation, and for the more formal wildlife educational and interpretive programs as discussed below, are provided primarily at county park reserves and nature center facilities, private nature centers, the local school districts or through the statewide programs of the Minnesota Environmental Education Board. Only recently has the federal wildlife agency created a wildlife refuge in the urban area. As an urban refuge, the Minnesota Valley National Wildlife Refuge and Recreation Area is unique within the federal refuge system. A number of state parks and wildlife management areas occur within the seven county area. Even when combined with the federal refuge, these public areas can't be expected to meet the demand without the opportunities provided at the county and private level (Saxton, 1979).

The growing interest or concern on the part of innercity and suburban residents for wildlife in proximity to their homes has fostered a relatively new area of wildlife professionalism - that of urban wildlife management. The appropriateness of an urban wildlife

specialist position to serve the needs of the Metro area citizens will be a consideration in the review of the Nongame Wildlife Program staffing requirements to be included in Volume 3 - Issues.

The most comprehensive listing of wildlife observation locations on all lands statewide is "A Birder's Guide to Minnesota" (Eckert, 1983). This publication identifies more than 150 locations throughout the state noteworthy for birds.

Beyond a consideration of the Minnesota Valley service area assessment, the SCORP report, and information presented in Table 8 on nonconsumptive user occasions on the 9 major wildlife management areas, data on demend for wildlife observation opportunities is limited. The SCORP report did not identify any substantial regional needs for additional birdwatching/nature study opportunities and the supply appears adequate to meet demand.

Table 8. Wildlife observation on the major wildlife management areas.[1]

	Activity		
WMA	Observing nature[2].	Photography	Birdwatching
Red Lake	4,356	1,138	-----
Thief Lake	863	366	541
Roseau River	1,477	903	574
Hubbel Pond	-----	-----	-----
Talcot Lake	5,000 (annual)	250 (including photography & birdwatching)	
Lac qui Parle	10,000 (annual)	250 (including photography & birdwatching)	
Mille Lacs	-----	-----	-----
Carlos Avery	-----	-----	-----
Whitewater	6,500	-----	2,000

[1]. Except where otherwise indicated - figures represent # use days/activity/6 month period.

[2]. From Minnesota Department Natural Resources 1977a thru 1980b - see Literature Cited.

2,000

1. Except where otherwise indicated - figures represent # use days/activity/6 month period.
2. From Minnesota Department Natural Resources 1977a thru 1980b - see Literature Cited.

Schladweiler (pers. comm.) has speculated that demand for birdwatching in Minnesota may most closely approach supply in Region 4 where intensive agriculture has eliminated a large portion of wildlife habitat. Seasonal, short term demand may also approach supply at Salt Lake (Lac qui Parle County), Hawk Ridge Nature Reserve (St. Louis County), and other avian migratory concentration areas which also concentrate large numbers of birdwatchers in a specific area over a short time frame (Mooty, Schladweiler pers. comm.).

Skoog (pers. comm.) has also identified some unsatisfied demand to view rare or secretive wildlife. Some species have virtually unlimited demand for viewing that may never be met because of the habits of the species. Other species have potential for management of some type that can increase their numbers or viewability. Examples of species that have a very high demand for viewing include rare birds of prey such as the peregrine falcon, great grey owl, goshawk, bald eagle and sandhill crane; songbirds such as the eastern bluebird, purple martin, scarlet tanager, and cardinal; and waterbirds such as the common egret, trumpeter swan, white pelican, and Wilson's phalarope. These are only some of the bird species for which demand exceeds visible supply. Mammal species are in less demand due to their habit of becoming a nuisance around human habitation. Reptile and amphibian species, especially snakes, also have a low demand, except from a small portion of the human population that appreciated the native herptofauna.

The extent to which the Nongame Wildlife Program should strive to enhance opportunities for wildlife observation through management, restoration or education programs must be carefully assessed as too much opportunity or access may be detrimental to the resource.

Wildlife photography and wildlife art - There is a demand for all types of wildlife for photography and art purposes. There are many artists that rely on the presence of wildlife in the state for their inspiration. The prosperity of these artisans is linked to the tourist trade. In turn, Minnesota's North Woods image, with its wildlife, is especially attractive and in demand with these tourists.

The popularity of such wildlife art among Minnesota residents and visitors alike is reflected in the large number of successful Minnesota artists, the popularity of the duck stamp competition, and attendence at the various wildlife art shows. While depictions of the traditional hunting and fishing activities and game species predominate, wildlife artists are increasingly representing nongame species including butterflies, songbirds, small mammals and raptors.

Maintaining natural areas or plantings primarily to benefit wildlife - An assessment of the rate of participation in habitat maintenance on private lands specifically for wildlife has only recently been included as a measure of nonconsumptive wildlife interest use. Such habitat maintenance activities are considered "primary residential activity" and by definition consists of maintaining natural areas of at least 1/4 acre or maintaining plantings (shrubs, agricultural crops, etc.) for which benefit to wildlife is an important concern (U.S.D.I. et al., 1982). In the West North Central states (including Minnesota) an estimated 8.3% and 9.9% of the population, respec-

tively, maintain areas or plantings for wildlife benefit.

In Minnesota, a more exact measure of this interest may be obtained through a review of the activities of the Section of Wildlife's Private Lands Program. Management of wildlife habitat on private lands, particularly intensively farmed lands, is the primary concern of this program. The Division recognizes that most habitat converted to other uses will never be regained as wildlife lands. Consequently, it is the aim of the Private Lands Program to encourage private landowners to retain the remaining unaltered acres of certain habitats in a natural condition. Additionally, the program has an interest in restoring some other selected acres. These efforts, concentrated in the agricultural and transition zone, have focused on three aspects of wildlife habitat protection or management.

First, the Division of Fish and Wildlife in association with the U.S. Fish and Wildlife Service has had a long standing commitment to the retention of wetlands unaltered by drainage or diversion. In the past ten years the Division has been aided in its efforts to promote retention of privately owned wetlands by a variety of legislatively mandated wetland preservation and enhancement programs including: the Wetlands (Property) Tax Exemption and Credit Program, the State Water Bank Program, and the Federal Water Bank Program. All these programs provide monetary advantages to landowners for retaining undisturbed wetland acres. In 1982, approximately 742,000 acres of privately owned wetland habitat were voluntarily included and thereby offered some protection under these programs. An additional 250,000 acres have received "protected wetlands" status. State Waterbank Program may compensate for drainage denial on these protected wetlands.

However, the state does not grant compensation to riparian landowners for restrictions against filling, drainage, construction, vegetation removal or other special uses within "protected waters" of which 879,000 acres have been identified.

In a more direct capacity, Division personnel have worked with private landowners to restore and manage wetlands for wildlife, primarily by providing technical assistance and cost-share funding through the Division's Wildlife Habitat Improvement Program (WHIP) funded by hunting license revenue. To date, approximately 4,000 acres of wetlands have been restored or improved, some with additional funds available from U.S. Department of Agriculture's Agriculture Conservation Program (ACP) and the Minnesota Waterfowl Association's financial assistance program for the creation of shallow water impoundments for wildlife.

The second aspect of habitat management undertaken by the Division and reflecting the majority of the Division's work on private lands involves restoration or supplementing upland habitat on intensively farmed lands. Once again, actions consist primarily of providing technical assistance and cost-sharing through WHIP for land management practices which provide the following:

1. Permanent nesting cover for waterfowl, upland game and other wildlife.
2. Wildlife food plots as a winter food source for resident wildlife.
3. Woody cover plantings as permanent blocks of woody cover for pheasants and other wildlife (i.e. farmyard shelterbelts and windbreaks)

In 1983, the Division appropriated $169,000 for WHIP (including wetland development). These monies funded cost sharing of 850 practices on approximately 2000 acres. Expanded funding ($500,000) for the Wildlife Habitat Improvement Program to finance private land cost-share habitat practices is anticipated in 1984 from revenues generated by the Pheasant Stamp Act (MN DNR, Div. Wild., 1982). This funding will triple private land habitat practices.

Additional funding ($1.4 million) through A.C.P. to establish permanent wildlife habitat, vegetative cover, and windbreaks in fields and farmsteads enhanced habitat for wildlife on an estimated 12,000 farmland acres and partially financed 1080 windbreaks in 1982 (T. Bremicker, pers. comm.)

The appropriateness of using these habitat improvement figures as a quantitative measure of nonconsumptive demand for nongame wildlife may at first seem questionable as all these efforts were initially implemented to improve habitat for waterfowl and upland game species. However, recent research has shown that nongame species may be a primary beneficiary of these habitat improvement practices (A. Berner, pers. comm.) voluntarily implemented by landowners interested in encouraging wildlife on their lands.

The third and most recent aspect of wildlife habitat management protection on private lands in Minnesota involves protection of native grasslands through the Native Prairie Exemption and Tax Credit Program. The division's involvement is through the Natural Heritage Program's administrative responsibility for this program the purpose of which is to retain native prairie as habitat for wildlife and native plants. In 1983 the Minnesota Native Prairie Tax Credit Program protected over

10,000 acres of high quality prairie owned by 250 private individuals. This acreage represents almost 15% of the 75,000 acres of remaining native prairie in the state (formerly 18 million acres of prairie covered one-third of the state).

The total acreage included in all these voluntary habitat management programs on private land is approximately 766,000 acres or 4.8% of the 15.7 million acres of agricultural land in Minnesota. It has been stated that, on the average, every farm in Minnesota includes at least one of these wildlife habitat conservation practices. This assessment represents Minnesota farmers as more concerned for wildlife than the national attitudes study (Kellert, 1979) might lead us to expect. However, wetland drainage and habitat conversion will continue on private land in the agricultural and transition zone despite these efforts until federal, state and private agricultural policies are changed to reflect consideration of wildlife values on farmland acres. The Division is working on this approach.

Wildlife interpretation and educational programs including extension services - the SCORP report does not distinguish between birdwatching/nature study and the demand for the more formal and non-formal opportunities for environmental education and interpretive activities. The only currently available estimates of demand for wildlife interpretation and environmental education facilities and programs in Minnesota are reports prepapred by Saxton (1979) and Wagner (1979) for the Minnesota Valley service area (the Twin Cities metropolitan area).

In summary, these reports calculated 508,500 student activity hours per year as the demand for grades K through 12 environmental

educational programs in the metro area. These environmental education programs are not exclusively widlife related. Further, an interview of 25 nature centers statewide found that the actual demand for interpretive programs was quite high, but is being masked by such factors as limited capacity and decreasing school budgets. Not a single metro area facility could be described as having decreasing attendance or being conerned about a lack of demand for these programs.

Four groups were identified as having unmet program needs: special populations, high school students, adults and "average citizens." Saxton (1979) reported an apparent paradox in the fact that most visitors to interpretive facilities are those who already have a high degree of interest in nature. Consequently, interpretive programs often merely reaffirm convictions instead of initiating them.

In a confirmation of the finding of Saxton (1979), both Skoog and Hirsch (pers. comm.) have also identified school groups and the general public as user groups in particular need of educational efforts relative to nongame wildlife. Additionally, Hirsch has identified a need for more interpretive information on the wildlife management areas, and Schladweiler (pers. comm.) has identified a demand by private forest landowners and state foresters on behalf of these private owners, for nongame wildlife management information. This need on the part of foresters has also been identified in a nationwide study by Decker, et al. (1982).

In addition, wildlife professionals identify a need for more biological and behavioral information (include habitat preference studies) on many nongame species as a basis from which they can design effective species or community management programs. Currently, formal

training in the scientific study of wildlife is available at the University of Minnesota, community colleges statewide, the James Ford Bell Museum of Natural History, and incidentally at various technical schools, particularly Brainerd Area Vocational Technical Institute. There is still an unmet need for basic and applied research on nongame species and their management.

There is currently no quantitative assessment on the demand for extension information for nongame species relating to such topics as nuisance wildlife control, wildlife rehabilitation, natural history, identification or habitat management. All that can be said is that supplies of free written information on wildlife available from Division offices, the DNR's Information and Education Bureau, university extension services, and other agencies is continually being depleted. Consideration should be given to the possibility that a heavy reliance on printed matter is not keeping up with the audio/video needs of the media.

Bird banding, scientific collecting and other wildlife possession activities - Indications are that the interest in falconry, bird banding, wildlife rehabilitation, and collecting of living or dead protected wildlife species for scientific study or educational purposes is relatively small (Table 9).

Table 9. Number of permits for wildlife possession 1982-83.

	Activity			
	Bird Banding	Scientific Collecting	Falconry	Rehabilitation
# Permits	236	113 (including fish)	56	38

This may be a reflection of the careful and strict regulation of wildlife possession activities through federal and state permit requirements. The possession of wildlife as pets is discouraged by the NWP as discussed in the preceeding text on utilization for each vertebrate class.

One activity relating to the possession of wildlife which needs further careful consideration and evaluation by the Nongame Wildlife Program and the Division of Fish and Wildlife is wildlife rehabilitation. This relatively new and somewhat controversial activity involves private citizens' possession and care of individual animals which are orphaned, sick or injured in order to restore the animal to health and return it to the wild. Currently, there is a network of 38 citizens or organizations throughout the state authorized to conduct such activities. They receive animals for care from a larger number of Minnesota citizens.

There are a number of substantial financial, philosophical, legal, biological and medical concerns involved that must be considered before the Division finalizes a position or develops policy and guidelines relative to this activity. A Wildlife Rehabilitation Policy Committee has been formed within the Section of Wildlife to review this activity in Minnesota.

For the Minnesota citizens interested in wildlife conservation organization membership or environmental action, there are numerous national organizations with state or regional chapters, as well as private environmental groups (Fritschel, 1982) and sportsmen's clubs available to meet their needs.

Discussion

Nongame Wildlife Program personnel all agree, based on their experience in the last year, that future demand for wildlife experiences such as bird feeding, plantings for wildlife and viewing nature will be greater than is indicated by the projections. This anticipated increase is attributed to the growing environmental awareness on the part of the general public and an increasing appreciation for all living creatures.

Techniques to secure future supplies of the nongame wildlife resources and resource-related recreation opportunities are limited only by our imagination and financial resources. Traditional avenues have included habitat management and protection, census and survey, research, and educational and information programs.

There is ample opportunity for both public and private initiative in this regard. The alternative strategies available for the Nongame Wildlife Program to pursue in order to fulfill its responsibilities will be outlined in Volume 4 - Goals and Strategies.

Appendix I

Annotated Listing Nongame

Wildlife Species in Minnesota

A comprehensive listing of all nongame wildlife species in Minnesota

Key: DNR Regions

Region 1 = northwest

Region 2 = northeast

Region 3 = central

Region 4 = southwest

Regions 5 & 6 = southeast and metro

Status

SC = Special Concern

T = Threatened

E = Endangered

EX = Extirpated[1]

R = Regular[2]

C = Casual[3]

A = Accidental[4]

1. Extirpated - Species which formerly occurred regularly in the state, but disappeared and are not expected to recur.
2. Regular - Species for which there are records in at least nine (and in some cases eight) of the past ten years.
3. Casual - Species for which there are acceptable records in seven (and in some cases eight), six, five, or four (and in some cases three) of the past ten years.
4. Accidental - Species for which there are acceptable records in two (and in some cases three) or fewer of the past ten years. Accidental species fall into three categories:

A_a - species for which there is a recognizable and preserved specimen, photograph or tape recording taken in the state;

A_b - species for which there is no specimen, photograph or tape recording but for which there have been sight records substantiated by written documentation unanimously accepted by the Records Committee;

A_c - species for which there is a question as to the origin or wildness of the bird (does not include obviously escaped or released exotics).

FISH	Distribution by Region				
	1	2	3	4	5&6
LAMPREYS					
Chestnut Lamprey (*Ichthyomyzon castaneus*)	x		x		x
Silver Lamprey (*Ichthyomyzon unicuspis*)	x	x	x	x	x
SC- American Brook Lamprey (*Lampetra appendix*)					x
MUDMINNOWS					
Central Mudminnow (*Umbra limi*)	x	x	x	x	x
MADTOMS					
Tadpole Madtom (*Noturus gyrinus*)	x	x	x	x	x
SC- Slender Madtom (*Noturus exilis*)					x
PIRATE PERCHES					
Pirate Perch (*Aphredoderus sayanus*)					x

	Distribution				
	Region				
	1	2	3	4	5 & 6
TROUT PERCHES					
Trout Perch (Percopsis omiscomaycus)	x	x	x	x	x
KILLIFISHES					
Banded Killifish (Fundulus diaphanus)	x	x	x	x	x
SILVERSIDES					
Brook Silverside (Labidesthes sicculus)		x	x	x	x
STICKLEBACKS					
Brook Stickleback (Culaea inconstans)	x	x	x	x	x
Ninespine Stickleback (Pungitius pungitius)	x	x			
PERCHES					
SC- Crystal Darter (Ammocrypta asprella)					x
Western Sand Darter (Ammocrypta clara)				x	x
Mud Darter (Etheostoma asprigene)					x
Rainbow Darter (Etheostoma caeruleum)				x	x
SC- Bluntnose Darter (Etheostoma chlorosomum)					x
Iowa Darter (Etheostoma exile)	x	x	x	x	x
Fantail Darter (Etheostoma flabellare)				x	x
Least Darter (Etheostoma microperca)	x		x		x
Johnny Darter (Etheostoma nigrum)	x	x	x	x	x
Banded Darter (Etheostoma zonale)				x	x
Logperch (Percina caprodes)	x	x	x	x	x
Gilt Darter (Percina evides)			x		x
Blackside Darter (Percina maculata)	x	x	x	x	x
Slenderhead Darter (Percina phoxocephala)				x	x
River Darter (Percina shumardi)	x	x	x		x
SCULPINS					
Mottled Sculpin (Cottus bairdi)	x	x	x	x	x
Slimy Sculpin (Cottus cognatus)		x	x		x
Spoonhead Sculpin (Cottus ricei)		x			
Fourhorn Sculpin (Myoxocephalus thompsoni)		x			
Total Species	15	17	17	17	28

Reptiles and Amphibians

	Distribution by Region				
	1	2	3	4	5 & 6
TURTLES					
TH- Wood Turtle (*Clemmys insculpta*)		x	x		x
False Map Turtle (*Graptemys pseudogeographica*)				x	x
Map Turtle (*Graptemys geographica*)			x		x
Ouachita Map Turtle (*Graptemys ouachitensis*)					x
Painted Turtle (*Chrysemys picta*)	x	x	x	x	x
TH- Blanding's Turtle (*Emydoidea blandingii*)			x	x	x
Smooth Softshell (*Trionyx muticus*)				x	x
Spiny Softshell (*Trionyx spiniferus*)			x	x	x
LIZARDS					
Prairie Skink (*Eumeces septentrionalis*)	x		x	x	x
E - Five-lined Skink (*Eumeces fasciatus*)			x	x	
Six-lined Racerunner (*Cnemidophorus sexlineatus*)			x		x
SNAKES					
Redbellied Snake (*Storeria occipitomaculata*)	x	x	x	x	x
Brown Snake (*Storeria dekayi*)			x	x	x
Northern Water Snake (*Nerodia sipedon*)			x	x	x
Plains Garter Snake (*Thamnophis radix*)	x		x	x	x
Common Garter Snake (*Thamnophis sirtalis*)	x	x	x	x	x
SC- Western Hognose Snake (*Heterodon nasicus*)	x			x	x
SC- Eastern Hognose Snake (*Heterodon platyrhinos*)			x		x
Ringneck Snake (*Diadophis punctatus*)		x			x
SC- Racer (*Coluber constrictor*)					x
Smooth Green Snake (*Opheodrys vernalis*)	x		x	x	x
SC- Gopher Snake (*Pituophis melanoleucus*)	x		x	x	x
SC- Fox Snake (*Elaphe vulpina*)			x	x	x
SC- Rat Snake (*Elaphe obsoleta*)					x
SC- Milk Snake (*Lampropeltis triangulum*)			x	x	x
SC- Massasauga (*Sistrurus catenatus*)					x
SC- Timber Rattlesnake (*Crotalus horridus*)					x
SC- Lined Snake (*Tropidoclonion lineatum*)				x	
SALAMANDERS					
Mudpuppy (*Necturus maculosus*)	x		x	x	x
Eastern Newt (*Notophthalmus viridiscens*)	x	x	x		x
Blue-spotted Salamander (*Ambystoma laterale*)	x	x	x		x
Tiger Salamander (*Ambystoma tigrinum*)	x	x	x	x	x
Redback Salamander (*Plethedon cinereus*)		x	x	x	

TOADS & FROGS

		Distribution by Region				
		1	2	3	4	5 & 6
	Canadian Toad (*Bufo hemiophrys*)	x			x	
	American Toad (*Bufo americanus*)	x	x	x	x	x
	Great Plains Toad (*Bufo cognatus*)	x			x	
	Spring Peeper (*Hyla crucifer*)		x	x		x
	Cope's Gray Treefrog (*Hyla chrysoscelis*)	x		x	x	
	Gray Treefrog (*Hyla versicolor*)	x	x	x	x	x
SC-	Northern Cricket Frog (*Acris crepitans*)					x
	Striped Chorus Frog (*Pseudacris triseriata*)	x	x	x	x	x
SC-	Pickerel Frog (*Rana palustris*)					x
	Mink Frog (*Rana septentrionalis*)	x	x	x		x
	Northern Leopard Frog (Rana pipiens)	x	x	x	x	x
	Green Frog (*Rana clamitans*)		x	x		x
	Wood Frog (*Rana sylvatica*)	x	x	x	x	x
SC-	Bullfrog (*Rana catesbeiana*)			x	x	x
	Total Species	21	17	33	30	41

Mammals	Distribution Region 1	2	3	4	5 & 6
SHREWS					
Masked Shrew (*Sorex cinereus*)	x	x	x	x	x
Water Shrew (*Sorex palustris*)	x	x	x		
Arctic Shrew (*Sorex arcticus*)	x	x	x		x
Pygmy Shrew (*Microsorex hoyi*)	x	x	x		x
Short-tailed Shrew (*Blarina brevicauda*)	x	x	x	x	x
SC- Least Shrew (*Cryptotis parva*)					x
MOLES					
Eastern Mole (*Scalopus aquaticus*)			x	x	x
Star-nosed Mole (*Condylura cristata*)	x	x	x		x
BATS					
Little Brown Bat (*Myotis lucifugus*)	x	x	x	x	x
SC- Keen's Little Brown Bat (*Myotis keenii*)		x	x		x
Silver-haired Bat (*Lasionycteris noctivagans*)	x	x	x	x	x
SC- Eastern pipistrelle (*Pipistrellus subflavus*)	x			x	x
Big Brown Bat (*Eptesicus fuscus*)	x	x	x	x	x
Red Bat (*Lasiurus borealis*)	x	x	x	x	x
Hoary Bat (*Lasiurus cinereus*)	x	x	x	x	x
SQUIRRELS					
Eastern Chipmunk (*Tamias striatus*)	x	x	x	x	x
Least Chipmunk (*Eutamias minimus*)	x	x	x		
Woodchuck (*Marmota monax*)	x	x	x	x	x
Richardson's Ground Squirrel (*Spermophilus richardsonii*)	x			x	
Thirteen-lined Ground Squirrel (*Spermophilus tridecemlineatus*)	x	x	x	x	x
Franklin's Ground Squirrel (*Spermophilus franklinii*)	x	x	x	x	x
Red Squirrel (*Tamiasciurus hudsonicus*)	x	x	x	x	x
Southern Flying Squirrel (*Glaucomys volans*)			x	x	x
Northern Flying Squirrel (*Glaucomys sabrinus*)	x	x	x		
POCKET GOPHERS					
SC- Northern Pocket Gopher (*Thomomys talpoides*)	x				
Plains Pocket Gopher (*Geomys bursarius*)	x		x	x	x

	Distribution by Region				
	1	2	3	4	5 & 6
POCKET MICE					
Plains Pocket Mouse (Perognathus flavescens)	x		x	x	x
NEW WORLD MICE					
Western Harvest Mouse (Reithrodontomys megalotis)			x	x	x
Deer Mouse (Peromyscus maniculatus)	x	x	x	x	x
White-footed Mouse (Peromyscus leucopus)	x	x	x	x	x
Northern Grasshopper Mouse (Onychomys leucogaster)	x			x	
Gapper's red-backed Vole (Clethrionomys gapperi)	x	x	x	x	x
SC- Heather Vole (Phenacomys intermedius)		x			
Meadow Vole (Microtus pennsylvanicus)	x	x	x	x	x
SC- Rock Vole (Microtus chrotorrhinus)		x			
SC- Prairie Vole (Microtus ochrogaster)	x		x	x	x
Woodland Vole (Microtus pinetorum)					x
Southern Bog Lemming (Synaptomys cooperi)	x	x	x		
SC- Northern Bog Lemming (Synaptomys borealis)	x	x			
JUMPING MICE					
Meadow Jumping Mouse (Zapus hudsonius)	x	x	x	x	x
Woodland Jumping Mouse (Napaeozapus insignis)	x	x	x		
NEW WORLD PORCUPINES					
Porcupine (Erethizon dorsatum)	x	x	x		
WEASELS					
Least Weasel (Mustela nivalis)	x	x	x	x	x
Total Species	35	35	34	27	31

Birds (Apapted from MN. Ornithlogical Reoords Comm. 1983)

	Migrant or Accidental Nonbreeding Species	Resident Breeding Species DNR Region				
Order Gaviiformes		1	2	3	4	5 & 6
Family Gaviidae: Loons						
Red-throated Loon (Gavia stellata) R	X					
Arctic Loon (Gavia arctica) C	X					
Common Loon (Gavia immer) R		x	x	x	x	x
Yellow-billed Loon (Gavia adamsii) A a	X					
Order Podicipediformes						
Family Podicipedidae: Grebes						
Pied-billed Grebe (Podilymbus podiceps) R		x	x	x	x	x
SC- Horned Grebe (Podiceps auritus) R		x				
Red-necked Grebe (Podiceps grisegena) R		x	x	x	x	x
Eared Grebe (Podiceps nigricollis) R		x			x	x
Western Grebe (Aechmophorus occidentalis) R		x		x	x	x
Order Pelecaniformes						
Family Pelecanidae: Pelicans						
SC- American White Pelican (Pelecanus erythrorhynchos) R		x			x	
Family Phalacrocoracidae: Cormorants						
Double-crested Cormorant (Phalacrocorax auritus) R		x	x	x	x	x
Family Anhingidae: Anhingas						
Anhinga (Anhinga anhinga) A b	X					
Order Ciconiiformes						
Family Ardeidae: Herons, Egrets and Bitterns						
SC- American Bittern (Botaurus lentiginosus) R		x	x	x	x	x
Least Bittern (Ixobrychus exilis) R		x	x	x	x	x
Great Blue Heron (Ardea herodias) R		x	x	x	x	x
Great Egret (Casmerodius albus) R		x		x	x	x
Snowy Egret (Egretta thula) R					x	
Little Blue Heron (Egretta caerulea) R		x			x	
Tricolored Heron (Egretta tricolor) R	X					
Cattle Egret (Bubulcus ibis) R		x			x	
Green-backed Heron (Butorides striatus) R		x	x	x	x	x
Black-crowned Night-Heron (Nycticorax nycticorax) R		x	x	x	x	x
Yellow-crowned Night-Heron (Nycticorax violaceus) R		x	x	x	x	x

		1	2	3	4	5 & 6
Family Threskiornithidae: Ibises						
Glossy Ibis (Plegadis falcinellus) A_b	X					
White-faced Ibis (Plegadis chihi) C	X					
Order Anseriformes						
Family Anatidae: Whistling-Ducks, Swans, Geese and Ducks						
Subfamily Anserinae						
Tundra Swan (Cygnus columbianus) R	X					
Ex- Trumpeter Swan (Cygnus buccinator) A_c						x
Order Falconiformes						
Family Cathartidae: American Vultures						
Turkey Vulture (Cathartes aura) R		x	x	x		x
Family Accipitridae: Ospreys, Kites, Eagles, Harriers and Hawks						
Subfamily Pandioninae						
SC- Osprey (Pandion haliaetus) R		x	x	x		
Subfamily Accipitrinae						
American Swallow-tailed Kite (Elanoides forficatus) A_a	X					
Black-shouldered Kite (Elanus caeruleus) A_b	X					
Mississippi Kite (Ictinia mississippiensis) A_b	X					
Bald Eagle (Haliaeetus leucocephalus) R		x	x	x		x
Northern Harrier (Circus cyaneus) R		x	x	x	x	x
Sharp-shinned Hawk (Accipiter striatus) R		x	x	x	x	x
Cooper's Hawk (Accipiter cooperii) R		x	x	x	x	x
Northern Goshawk (Accipiter gentilis) R		x	x	x		
Common Black-Hawk (Buteogallus anthracinus) A_c	X					
SC- Red-shouldered Hawk (Buteo lineatus) R		x	x	x		x
Broad-winged Hawk (Buteo platypterus) R		x	x	x		x
Swainson's Hawk (Buteo swainsoni) R		x			x	x
Red-tailed Hawk (Buteo jamaicensis) R		x	x	x	x	x
Ferruginous Hawk (Buteo regalis) R	X					
Rough-legged Hawk (Buteo lagopus) R	X					
Golden Eagle (Aquila chrysaetos) R	X					
Family Falconidae: Falcons						
American Kestrel (Falco sparverius) R		x	x	x	x	x
Merlin (Falco columbarius) R		x	x			
EX&E Peregrine Falcon (Falco peregrinus) R	X					
Gyrfalcon (Falco rusticolus) R	X					
Prairie Falcon (Falco mexicanus) R	X					

		1	2	3	4	5&6
Order Gruiformes						
Family Rallidae: Rails, Gallinules and Coots						
SC- Yellow Rail (*Coturnicops noveboracensis*) R		x	x	x	x	
Black Rail (*Laterallus jamaicensis*) Aa				x		x
SC- King Rail (*Rallus elegans*) C		x		x	x	x
Family Gruidae: Cranes						
SC- Sandhill Crane (*Grus canadensis*) R		x	x	x		x
EX- Whooping Crane (*Grus americana*) Aa	EX					
Order Charadriiformes						
Family Charadriidae: Plovers						
Black-bellied Plover (*Pluvialis squatarola*) R	X					
Lesser Golden-Plover (*Pluvialis dominica*) R	X					
Snowy Plover (*Charadrius alexandrinus*) Aa	X					
Wilson's Plover (*Charadrius wilsonia*) Aa	X					
Semipalmated Plover (*Charadrius semipalmatus*) R	X					
Piping Plover (*Charadrius melodus*) R		x	x			
Killdeer (*Charadrius vociferus*) R		x	x	x	x	x
Family Recurvirostridae: Avocets						
American Avocet (*Recurvirostra americana*) R		x			x	x
Family Scolopacidae: Sandpipers, Curlews, Godwits, Turnstones, Snipe, Dowitchers, Woodcock and Phalaropes						
Subfamily Scolopacinae						
Greater Yellowlegs (*Tringa melanoleuca*) R	X					
Lesser Yellowlegs (*Tringa flavipes*) R	X					
Solitary Sandpiper (*Tringa solitaria*) R			x			
Willet (*Catoptrophorus semipalmatus*) R		x			x	
Spotted Sandpiper (*Actitis macularia*) R		x	x	x	x	x
SC- Upland Sandpiper (*Bartramia longicauda*) R		x	x	x	x	x
Eskimo Curlew (*Numenius borealis*) E	EX					
Whimbrel (*Numenius phaepous*) R	X					
Long-billed Curlew (*Numenius americanus*) C	EX					
Hudsonian Godwit (*Limosa haemastica*) R	X					
Marbled Godwit (*Limosa fedoa*) R		x		x	x	
Ruddy Turnstone (*Arenaria interpres*) R	X					
Red Knot (*Calidris canutus*) R	X					
Sanderling (*Calidris alba*) R	X					
Semipalmated Sandpiper (*Calidris pusilla*) R	X					
Western Sandpiper (*Calidris mauri*) R	X					
Least Sandpiper (*Calidris minutilla*) R	X					
White-rumped Sandpiper (*Calidris fuscicollis*) R	X					
Baird's Sandpiper (*Calidris bairdii*) R	X					
Pectoral Sandpiper (*Calidris melanotos*) R	X					
Purple Sandpiper (*Calidris maritima*) A_a	X					

		1	2	3	4	5&6
Dunlin (Calidris alpina) R	X					
Stilt Sandpiper (Calidris himantopus) R	X					
Buff-breasted Sandpiper (Tryngites subruficollis) R	X					
Ruff (Philomachus pugnax) C	X					
Short-billed Dowitcher (Limnodromus griseus) R	X					
Long-billed Dowitcher (Limnodromus scolopaceus) R	X					
Subfamily Phalaropodinae						
SC- Wilson's Phalarope (Phalaropus tricolor) R		x	x	x	x	x
Red-necked Phalarope (Phalaropus lobatus) R	X					
Red Phalarope (Phalaropus fulicaria) C	X					
Family Laridae: Jaegers, Gulls and Terns						
Subfamily Stercorariinae						
Pomarine Jaeger (Stercorarius pomarinus) C	X					
Parasitic Jaeger (Stercorarius parasiticus) R	X					
Long-tailed Jaeger (Stercorarius longicaudus) A a	X					
Subfamily Larinae						
Laughing Gull (Larus atricilla) C	X					
Franklin's Gull (Larus pipixcan) R		x			x	
Little Gull (Larus minutus) R	X					
Bonaparte's Gull (Larus philadelphia) R	X					
Mew Gull (Larus canus) A_b	X					
Ring-billed Gull (Larus delawarensis) R			x	x		
California Gull (Larus californicus) C	X					
Herring Gull (Larus argentatus) R		x	x	x		
Thayer's Gull (Larus thayeri) R	X					
Iceland Gull (Larus glaucoides) C	X					
Glaucous Gull (Larus hyperboreus) R	X					
Great Black-backed Gull (Larus marinus) A a	X					
Black-legged Kittiwake (Rissa tridactyla) C	X					
Sabine's Gull (Xema sabini) C	X					
Ivory Gull (Pagophila eburnea) Aa	X					
Subfamily Sterninae						
Caspian Tern (Sterna caspia) R				x		
SC- Common Tern (Sterna hirundo) R		x	x	x		
Arctic Tern (Sterna paradisaea) A a	X					
SC- Forster's Tern (Sterna forsteri) R		x			x	x
Least Tern (Sterna antillarum) C	X					
Black Tern (Chlidonias niger) R		x	x	x	x	x
Family Alcidae: Auks and Murres						
Dovekie (Alle alle) A_a	X					
Ancient Murrelet (Synthliboramphus antiquuas) A a	X					

		1	2	3	4	5 & 6
Order Columbiformes						
Family Columbidae: Pigeons and Doves						
Band-tailed Pigeon (Columba fasciata) A_a	X					
Order Cuculiformes						
Family Cuculidae: Cuckoos and Anis						
Subfamily Coccyzinae						
Black-billed Cuckoo (Coccyzus erythropthalmus) R		x	x	x	x	x
Yellow-billed Cuckoo (Coccyzus americanus) R		x	x	x	x	x
Subfamily Crotophaginae						
Groove-billed Ani (Crotophaga sulcirostris) A_a	X					
Order Strigiformes						
Family Tytonidae: Barn Owls						
Common Barn-Owl (Tyto alba) C		x	x		x	x
Family Strigidae: Typical Owls						
Eastern Screech-Owl (Otus asio) R		x	x	x	x	x
Great Horned Owl (Bubo virginianus) R		x	x	x	x	x
Snowy Owl (Nyctea scandiaca) R	X					
Northern Hawk-Owl (Surnia ulula) R		x	x			
E- Burrowing Owl (Athene cunicularia) R		x			x	
Barred Owl (Strix varia) R		x	x	x	x	x
Great Gray Owl (Strix nebulosa) R		x	x	x		
Long-eared Owl (Asio otus) R		x	x	x		x
SC- Short-eared Owl (Asio flammeus) R		x	x	x	x	
Boreal Owl (Aegolius funereus) R			x			
Northern Saw-whet Owl (Aegolius acadicus) R		x	x	x		x
Order Caprimulgiformes						
Family Caprimulgidae: Goatsuckers						
Subfamily Chordeilinae						
Common Nighthawk (Chordeiles minor) R		x	x	x	x	x
Subfamily Caprimulginae						
Common Poorwill (Phalaenoptilus nuttallii) A_a	X					
Chuck-will's-widow (Caprimulgus carolinensis) A_a	X					
Whip-poor-will (Caprimulgus vociferus) R		x	x	x		x
Order Apodiformes						
Family Apodidae: Swifts						
Chimney Swift (Chaetura pelagica) R		x	x	x	x	x

		1	2	3	4	5&6
Family Trochilidae: Hummingbirds						
Ruby-throated Hummingbird (*Archilochus colubris*) R		x	x	x	x	x
Rufous Hummingbird (*Selasphorus rufus*) C	x					
Order Coraciiformes						
Family Alcedinidae: Kingfishers						
Belted Kingfisher (*Ceryle alcyon*) R		x	x	x	x	x
Order Piciformes						
Family Picidae: Woodpeckers						
Lewis' Woodpecker (*Melanerpes lewis*) A a	x					
Red-headed Woodpecker (*Melanerpes erythrocephalus*) R		x	x	x	x	x
Red-bellied Woodpecker (*Melanerpes carolinus*) R				x		x
Yellow-bellied Sapsucker (*Sphyrapicus varius*) R		x	x	x	x	x
Williamson's Sapsucker (*Sphyrapicus thyroideus*) Ab	x					
Downy Woodpecker (*Picoides pubescens*) R		x	x	x	x	x
Hairy Woodpecker (*Picoides villosus*) R		x	x	x	x	x
Three-toed Woodpecker (*Picoides tridactylus*) R		x	x	x		
Black-backed Woodpecker (*Picoides arcticus*) R		x	x	x		
Northern Flicker (*Colaptes auratus*) R		x	x	x	x	x
Pileated Woodpecker (*Dryocopus pileatus*) R		x	x	x	x	x
Order Passeriformes						
Family Tyrannidae: Tyrant Flycatchers						
Subfamily Fluvicolinae						
Olive-sided Flycatcher (*Contopus borealis*) R		x	x	x		
Western Wood-Pewee (*Contopus sordidulus*) A a	x					
Eastern Wood-Pewee (*Contopus virens*) R		x	x	x	x	x
Yellow-bellied Flycatcher (*Empidonax flaviventris*) R		x	x	x		
Acadian Flycatcher (*Empidonax virescens*) R						x
Alder Flycatcher (*Empidonax alnorum*) R		x	x	x	x	x
Willow Flycatcher (*Empidonax traillii*) R		x	x	x	x	x
Least Flycatcher (*Empidonax minimus*) R		x	x	x	x	x
Black Phoebe (*Sayornis nigricans*) Ab	x					
Eastern Phoebe (*Sayornis phoebe*) R		x	x	x	x	x
Say's Phoebe (*Sayornis saya*) C	x					
Vermilion Flycatcher (*Pyrocephalus rubinus*) Aa	x					
Subfamily Tyranninae						
Great Crested Flycatcher (*Myiarchus crinitus*) R		x	x	x	x	x
Western Kingbird (*Tyrannus verticalis*) R		x		x	x	x
Eastern Kingbird (*Tyrannus tyrannus*) R		x	x	x	x	x
Scissor-tailed Flycatcher (*Tyrannus forficatus*) C	x					
Family Alaudidae: Larks						
Horned Lark (*Eremophila alpestris*) R		x	x	x	x	x

		1	2	3	4	5 & 6
Family Hirundinidae: Swallows						
Purple Martin (*Progne subis*) R		x	x	x	x	x
Tree Swallow (*Tachycineta bicolor*) R		x	x	x	x	x
Violet-green Swallow (*Tachycineta thalassina*) Ab	X					
Northern Rough-winged Swallow (*Stelgidopteryx serripennis*) R		x	x	x	x	x
Bank Swallow (*Riparia riparia*) R		x	x	x	x	x
Cliff Swallow (*Hirundo pyrrhonota*) R		x	x	x	x	x
Barn Swallow (*Hirundo rustica*) R		x	x	x	x	x
Family Corvidae: Jays, Nutcrackers, Magpies and Crows						
Gray Jay (*Perisoreus canadensis*) R		x	x	x		
Blue Jay (*Cyanocitta cristata*) R		x	x	x	x	x
Clark's Nutcracker (*Nucifraga columbiana*) Aa	X					
Black-billed Magpie (*Pica pica*) R		x				
Common Raven (*Corvus corax*) R		x	x	x		
Family Paridae: Chickadees and Titmice						
Black-capped Chickadee (*Parus atricapillus*) R		x	x	x	x	x
Boreal Chickadee (*Parus hudsonicus*) R		x	x	x		
Tufted Titmouse (*Parus bicolor*) R				x		x
Family Sittidae: Nuthatches						
Red-breasted Nuthatch (*Sitta canadensis*) R		x	x	x		x
White-breasted Nuthatch (*Sitta carolinensis*) R		x	x	x	x	x
Family Certhiidae: Creepers						
Brown Creeper (*Certhia americana*) R		x	x	x		x
Family Troglodytidae: Wrens						
Rock Wren (*Salpinctes obsoletus*) A a	X					
Carolina Wren (*Thryothorus ludovicianus*) C				x		x
Bewick's Wren (*Thryomanes bewickii*) C				x		x
House Wren (*Troglodytes aedon*) R		x	x	x	x	x
Winter Wren (*Troglodytes troglodytes*) R		x	x	x		
Sedge Wren (*Cistothorus platensis*) R		x	x	x	x	x
Marsh Wren (*Cistothorus palustris*) R		x	x	x	x	x
Family Cinclidae: Dippers						
American Dipper (*Cinclus mexicanus*) A a	X					
Family Muscicapidae: Kinglets, Gnatcatchers, Wheatears, Bluebirds, Solitaires and Thrushes						
Subfamily Sylviinae						
Golden-crowned Kinglet (*Regulus satrapa*) R		x	x	x		
Ruby-crowned Kinglet (*Regulus calendula*) R		x	x	x		
Blue-gray Gnatcatcher (*Polioptila caerulea*) R				x		x

		1	2	3	4	5&6
Subfamily Turdinae						
Northern Wheatear (Oenanthe oenanthe) Ab	X					
Eastern Bluebird (Sialia sialis) R		X	X	X	X	X
Mountain Bluebird (Sialia currucoides) R	X					
Townsend's Solitaire (Myadestes townsendi) R	X					
Veery (Catharus fuscescens) R		X	X	X	X	X
Gray-cheeked Thrush (Catharus minimus) R	X					
Swainson's Thrush (Catharus ustulatus) R		X	X	X		
Hermit Thrush (Catharus guttatus) R		X	X	X		
Wood Thrush (Hylocichla mustelina) R		X	X	X	X	X
American Robin (Turdus migratorius) R		X	X	X	X	X
Varied Thrush (Ixoreus naevius) R	X					
Family Mimidae: Catbirds, Mockingbirds and Thrashers						
Gray Catbird (Dumetella carolinensis) R		X	X	X	X	X
Northern Mockingbird (Mimus polyglottos) R			X	X		
Sage Thrasher (Oreoscoptes montanus) Aa	X					
Brown Thrasher (Toxostoma rufum) R		X	X	X	X	X
Curve-billed Thrasher (Toxostoma curvirostre) Ab	X					
Family Motacillidae: Pipits						
Water Pipit (Anthus spinoletta) R	X					
Sprague's Pipit(Anthus spragueii) R		X				
Family Bombycillidae: Waxwings						
Bohemian Waxwing (Bombycilla garrulus) R	X					
Cedar Waxwing (Bombycilla cedrorum) R		X	X	X	X	X
Family Laniidae: Shrikes						
Northern Shrike (Lanius excubitor) R	X					
Loggerhead Shrike (Lanius ludovicianus) R		X	X	X	X	X
Family Vireonidae: Vireos						
White-eyed Vireo (Vireo griseus) C	X					
Bell's Vireo (Vireo bellii) R				X	X	X
Solitary Vireo (Vireo solitarius) R		X	X	X		
Yellow-throated Vireo (Vireo flavifrons) R		X	X	X	X	X
Warbling Vireo (Vireo gilvus) R		X	X	X	X	X
Philadelphia Vireo (Vireo philadelphicus) R		X	X	X		
Red-eyed Vireo (Vireo olivaceus) R		X	X	X	X	X
Family Emberizidae: Wood Warblers, Tanagers, Grosbeaks, Buntings, Towhees, Sparrows, Longspurs, Blackbirds, Meadowlarks and Orioles		X	X	X	X	X
Subfamily Parulinae						
Blue-winged Warbler (Vermivora pinus) R						X
Golden-winged Warbler (Vermivora chrysoptera) R		X	X	X		X
Tennessee Warbler (Vermivora peregrina) R		X	X	X		
Orange-crowned Warbler (Vermivora celata) R	X					

			1	2	3	4	5&6
Nashville Warbler (Vermivora ruficapilla) R			x	x	x		x
Northern Parula (Parula americana) R			x	x	x		
Yellow Warbler (Dendroica petechia) R			x	x	x	x	x
Chestnut-sided Warbler (Dendroica pensylvanica) R			x	x	x		x
Magnolia Warbler (Dendroica magnolia) R			x	x	x		
Cape May Warbler (Dendroica tigrina) R			x	x	x		
Black-throated Blue Warbler (Dendroica caerulescens) R			x	x	x		
Yellow-rumped Warbler (Dendroica coronata) R			x	x	x		
Black-throated Gray Warbler (Dendroica nigrescens) A_a		X					
Townsend's Warbler (Dendroica townsendi) A_b		X					
Hermit Warbler (Dendroica occidentalis) A_a		X					
Black-throated Green Warbler (Dendroica virens) R			x	x	x		
Blackburnian Warbler (Dendroica fusca) R			x	x	x		
Yellow-throated Warbler(Dendroica dominica) A_b		X					
Pine Warbler (Dendroica pinus) R			x	x	x		
Kirtland's Warbler (Dendroica kirtlandii) Aa		X					
Prairie Warbler (Dendroica discolor) A_b		X					
Palm Warbler (Dendroica palmarum) R			x	x	x		
Bay-breasted Warbler (Dendroica castanea) R			x	x			
Blackpoll Warbler (Dendroica striata) R		X					
Cerulean Warbler (Dendroica cerulea) R					x		x
Black-and-White Warbler (Mniotilta varia) R			x	x	x		x
American Redstart (Setophaga ruticilla) R			x	x	x	x	x
Prothonotary Warbler (Protonotaria citrea) R					x		x
Worm-eating Warbler (Helmitheros vermivorus) C		X					
Ovenbird (Seiurus aurocapillus) R			x	x	x	x	x
Northern Waterthrush (Seiurus noveboracensis) R			x	x	x		
SC- Louisiana Waterthrush (Seiurus motacilla) R					x		x
Kentucky Warbler (Oporornis formosus) R		X					
Connecticut Warbler (Oporornis agilis) R			x	x	x		
Mourning Warbler (Oporornis philadelphia) R			x	x	x		
MacGillivray's Warbler (Oporornis tolmiei) Aa		X					
Common Yellowthroat (Geothylpis trichas) R			x	x	x	x	x
Hooded Warbler (Wilsonia citrina) R		X					
Wilson's Warbler (Wilsonia pusilla) R				x			
Canada Warbler (Wilsonia canadensis) R			x	x	x		
Yellow-breasted Chat (Icteria virens) R						x	x
Subfamily Thraupinae							
Summer Tanager (Piranga rubra) R		X					
Scarlet Tanager (Piranga olivacea) R			x	x	x	x	x
Western Tanager (Piranga ludoviciana) C		X					
Subfamily Cardinalinae							
Northern Cardinal (Cardinalis cardinalis) R			x	x	x	x	x
Rose-breasted Grosbeak (Pheucticus ludovicianus) R			x	x	x	x	x
Black-headed Grosbeak (Pheucticus melanocephalus) Aa		X					
Blue Grosbeak (Guiraca caerulea) R						x	
Lazuli Bunting (Passerina amoena) Aa		X					
Indigo Bunting (Passerina cyanea) R			x	x	x	x	x
Painted Bunting (Passerina ciris) Aa		X					
Dickcissel (Spiza americana) R			x	x	x	x	x

		1	2	3	4	5&6
Subfamily Emberizinae						
Green-tailed Towhee (Pipilo chlorurus) A a	X					
Rufous-sided Towhee (Pipilo erythrophthalmus) R		X	X	X		X
American Tree Sparrow (Spizella arborea) R	X					
Chipping Sparrow (Spizella passerina) R		X	X	X	X	X
Clay-colored Sparrow (Spizella pallida) R		X	X	X	X	X
Brewer's Sparrow (Spizella breweri) A b	X					
Field Sparrow (Spizella pusilla) R		X	X	X	X	X
Vesper Sparrow (Pooecetes gramineus) R		X	X	X	X	X
Lark Sparrow (Chondestes grammacus) R		X		X	X	X
Black-throated Sparrow (Amphispiza bilineata) Aa	X					
Lark Bunting (Calamospiza melanocorys) R		X			X	
Savannah Sparrow (Passerculus sandwichensis) R		X	X	X	X	X
E- Baird's Sparrow (Ammodramus bairdii) C		X				
Grasshopper Sparrow (Ammodramus savannarum) R		X	X	X	X	X
SC- Henslow's Sparrow (Ammodramus henslowii) R		X		X	X	X
Le Conte's Sparrow (Ammodramus leconteii) R		X	X	X		
Sharp-tailed Sparrow (Ammodramus caudacutus) R		X	X			
Fox Sparrow (Passerella iliaca) R	X					
Song Sparrow (Melospiza melodia) R		X	X	X	X	X
Lincoln's Sparrow (Melospiza lincolnii) R		X	X	X		
Swamp Sparrow (Melospiza georgiana) R		X	X	X	X	X
White-throated Sparrow (Zonotrichia albicollis) R		X	X	X		X
White-crowned Sparrow (Zonotrichia leucophrys) R	X					
Harris' Sparrow (Zonotrichia querula) R	X					
Dark-eyed Junco (Junco hyemalis) R		X	X	X		
McCown's Longspur (Calcarius mccownii) A a	EX					
Lapland Longspur (Calcarius lapponicus) R	X					
Smith's Longspur (Calcarius pictus) R	X					
Chestnut-collared Longspur (Calcarius ornatus) R		X				
Snow Bunting (Plectrophenax nivalis) R	X					
Subfamily Icterinae						
Bobolink (Dolichonyx oryzivorus) R		X	X	X	X	X
Red-winged Blackbird (Agelaius phoeniceus) R		X	X	X	X	X
Eastern Meadowlark (Sturnella magna) R		X	X	X	X	X
Western Meadowlark (Sturnella neglecta) R		X	X	X	X	X
Yellow-headed Blackbird (Xanthocephalus xanthocephalus) R		X	X	X	X	X
Rusty Blackbird (Euphagus carolinus) R			X			
Brewer's Blackbird (Euphagus cyanocephalus) R		X	X	X	X	X
Great-tailed/Boat-tailed Grackle (Quiscalus mexicanus/major) Ab	X					
Common Grackle (Quiscalus quiscula) R		X	X	X	X	X
Brown-headed Cowbird (Molothrus ater) R		X	X	X	X	X
Orchard Oriole (Icterus spurius) R		X		X	X	X
Northern Oriole (Icterus galbula) R		X	X	X	X	X
Scott's Oriole (Icterus parisorum) Aa	X					
Family Fringillidae: Finches						
Subfamily Carduelinae						
Rosy Finch (Leucosticte arctoa) C	X					
Pine Grosbeak (Pinicola enucleator) R	X					

		1	2	3	4	5&6
Purple Finch (Carpodacus purpureus) R		x	x	x		
Red Crossbill (Loxia curvirostra) R		x	x	x		
White-winged Crossbill (Loxia leucoptera) R		x	x			
Common Redpoll (Carduelis flammea) R	X					
Hoary Redpoll (Carduelis hornemanni) R	X					
Pine Siskin (Carduelis pinus) R		x	x	x	x	x
American Goldfinch (Carduelis tristis) R		x	x	x	x	x
Evening Grosbeak (Coccothraustes vespertinus) R		x	x	x		
Total	123	181	163	172	120	136

APPENDIX II

Endangered and Threatened Fauna of Minnesota

	OCCURRENCE[1]		
EXTIRPATED	P	D	N
Cygnus buccinator; Trumpeter Swan	X	X	
Elanoides forficatus; American Swallow-tailed Kite		X	
Grus americans; Whooping Crane	X		
Numenius americanus; Long-billed Curlew	X		
Calcarius mccownii; McCown's Longspur	X		
Bison bison; Bison	X		
Cervus elaphus canadensis; American Elk (subspecies originally found in Minnesota)	X	X	
Ursus arctos; Brown Bear	X		
ENDANGERED			
Lampsilis higginsi (Lea); Higgins Eye		X	
Proptera (Potamilus) capax (Green); Fat Pocketbook		X	
Hesperia uncas W.H. Edwards; Uncas Skipper	X	X	
Hesperia assiniboia (Lyman); Assiniboia Skipper	X		
Oeneis uhleri varuna (W.H. Edwards); Uhler's Arctic	X		
Eumeces fasciatus; Five-lined Skink	X		
Falco peregrinus; Peregrine Falcon		X	X
Charadrius melodus; Piping Plover			X
Athene cunicularia; Burrowing Owl	X		
Anthus spragueii; Sprague's Pipit	X		
Ammodramus bairdii; Baird's Sparrow	X		
Calcarius ornatus; Chestnut-collared Longspur	X		
THREATENED			
Hesperia dacotae (Skinner); Dakota Skipper	X		
Hesperia ottoe W.H. Edwards; Ottoe Skipper	X		
Lycaeides samuelis; Nabokov Karner Blue	X		
Clemmys insculpta; Wood Turtle		X	X
Emydoidea blandingi; Blanding's Turtle		X	
Haliaeetus leucocephalus; Bald Eagle		X	X
Lanius ludovicianus; Loggerhead Shrike	X	X	X
Canis lupus; Gray Wolf		X	X

SPECIAL CONCERN

Elliptio crassidens (Lamarck); Elephant ear		X	
Fusconaia ebena (Lea); Ebony Shell		X	
Clossiana freija (Thunberg); Freija Fritillary			X
Clossiana frigga saga (Staudinger); Frigga Fritillary			X
Epidemia dorcas dorcas (W. Kirby); Dorcas Copper			X
Epidemia epixanthe michiganensis (Rawson); Bog Copper			X
Erebia disa mancinus (Doubleday & Hewitson); Disa Alpine			X
Erebia discoidalis discoidalis (W. Kirby); Red-disked Alpine			X
Oarisma poweshiek (Parker); Poweshiek Skipper	X		
Oeneis jutta ascerta (Masters & Sorensen); Jutta Arctic			X
Proclossiana eunomia dawsoni (Barnes & McDunnough); Bog Fritillary		X	
Acipenser fulvescens (Rafinesque); Lake Sturgeon		X	X
Ammocrypta asprella (Jordan); Crystal Darter		X	
Cycleptus elongatus (Le Sueur); Blue Sucker		X	X
Etheostoma chlorosomum (Hay); Bluntnose Darter		X	
Fundulus sciadicus (Cope); Plains Topminnow	X		
Hybopsis x-punctata (Hubbs and Crowe); Gravel Chub		X	
Ictalurus furcatus (Le Sueur); Blue Catfish		X	
Lampetra appendix (DeKay); American Brook Lamprey		X	
Morone mississippiensis (Jordan and Evermann); Yellow Bass		X	
Moxostoma duquesnei (Le Sueur); Black Redhorse		X	
Notropis amnis (Hubbs and Greene); Pallid Shiner		X	
Notropis emilae (Hay); Pugnose Minnow		X	
Noturus exilis (Nelson); Slender Madtom	X		
Notropis topeka (Gilbert); Topeka Shiner	X		
Polyodon spathula (Walbaum); Paddlefish		X	
Scaphirhynchus platorynchus (Rafinesque); Shovelnose Sturgeon	X	X	X
Chelydra serpentina; Snapping Turtle	X	X	X
Coluber constrictor; Racer (Blue Racer)		X	
Crotalus horridus; Timber Rattlesnake		X	
Elaphe obsoleta; Rat Snake (Black Rat Snake)		X	
Elaphe vulpina; Fox Snake	X	X	
Heterodon nasicus; Western Hognose Snake	X	X	
Heterodon platyrhinos; Eastern Hognose Snake		X	
Lampropeltis triangulum; Milk Snake	X	X	
Pituophis melanoleucus; Gopher Snake (Bull Snake)	X	X	
Sistrurus catenatus; Massasauga		X	
Tropidoclonion lineatum; Lined Snake	X		
Acris crepitans; Northern Cricket Frog (Blanchard's Cricket Frog)	X		
Rana catesbeiana; Bullfrog		X	
Rana palustris; Pickerel Frog		X	
Podiceps auritus; Horned Grebe	X		
Pelecanus erythrorhynchos; American White Pelican	X		
Botaurus lentiginosus; American Bittern	X	X	X
Buteo lineatus; Red-shouldered Hawk		X	
Pandion haliaetus; Osprey			X
Tympanuchus cupido; Greater Prairie Chicken	X		
Grus canadensis; Sandhill Crane	X	X	

Rallus elegans; King Rail	X	X	
Coturnicops noveboracensis; Yellow Rail	X	X	X
Gallinula chloropus; Common Moorhen	X	X	
Bartramia longicauda; Upland Sandpiper	X		
Limosa fedoa; Marbled Godwit	X		
Phalaropus tricolor; Wilsons's Phalarope	X		
Sterna forsteri; Forster's Tern	X	X	
Sterna hirundo; Common Tern			X
Asio flammeus; Short-eared Owl	X		
Seiurus motacilla; Louisiana Waterthrush		X	
Ammodramus henslowii; Henslow's Sparrow	X		
Ammospiza caudacutus; Sharp-tailed Sparrow	X		
Cervus elaphus nelsoni; American Elk (western subspecies introduced to Minnesota)	X	X	
Cryptotis parva; Least Shrew		X	
Felis concolor; Mountain Lion			X
Gulo gulo; Wolverine			X
Martes americana; Marten			X
Microtus chrotorrhinus; Rock Vole			X
Microtus ochrogaster; Prairie Vole	X		
Microtus pinetorum; Woodland Vole		X	
Myotis keenii; Keens' Myotis		X	X
Odocoileus hemionus; Mule Deer	X	X	
Phenacomys intermedius; Heather Vole			X
Pipistrellus subflavus; Eastern Pipistrelle		X	
Rangifer tarandus; Caribou			X
Spilogale putorius; Spotted Skunk	X	X	X
Synaptomys borealis; Northern Bog Lemming			X
Thomomys talpoides; Northern Pocket Gopher	X		

Number of Species			
Extirpated	6	3	1
Endangered	8	4	2
Threatened	4	5	4
Special Concern	32	42	24

APPENDIX III

State Legislative and other authority for nongame species management and protection in Minnesota

A. General authorizations

1. Minnesota Game and Fish Laws - Minnesota Statute, chapters 84 and 97-105.
The applicable Minnesota statutes do not distinguish between "game" and "nongame" species. The Commissioner of Natural Resources is given the authority, subject to certain limits, to do all things necessary to preserve, protect and enhance the state's wild animals. Minn. Stat. Secs. 84.027, Subd. 2, and 97.48, Subds. 1, 3 and 8. Wild animals are defined to include all wild mammals ,fish, amphibians, reptiles, crustaceans and mollusks. Minn. Stat. Sec. 97.40, Subd. 5.

2. Nongame wildlife checkoff - Minn. Stat. 290.431.
Effective with returns filed for taxable years beginning after December 31, 1979, every person who files an income tax return or property tax refund claim form may designate that $1 or more shall be added to the tax or deducted from the refund and paid into an account, The Nongame Wildlife Fund, established for the management of nongame wildlife.

3. Forest Resources Act of 1982 - Minn. Stat. Chapter 511
Provides the legal basis for management of all wildlife on state forest lands. In part, the Act states:

"Forest Resources" means those natural assets of forest lands, including timber and other forest crops, recreation, fish and wildlife habitat, wilderness, rare and distinctive flora and fauna, air, water, soil, and educational, aesthetic and historic values.

Multiple use means the principle of forest management by which forest resources are utilized in the combinations that will best meet the needs of the people of the state ...and not necessarily the combination of uses resulting in the greatest economic return or unit output."

4. Bounties and rewards - Minnesota Stat. Chapter 348
Provides authorization and guidelines for focal governmental agencies to bounty unprotected nongame species, specifically gophers, ground squirrels or rattlesnakes.

B. Species specific restrictions

1. Reptiles and amphibians - all lizards, snakes, salamanders, and toads are totally unprotected.
   a. Turtles - Minn. Stat. Chapter 98, Sec. 98.46. Subdivision 5, Paragraph (7) and Chapter 101,

Sect. 101.45 and Commissioner's Order 1943.
Any person permitted by law to take fish by angling may take, possess, buy, sell, and transport turtles. Turtles may not be taken by the use of explosives, drugs, poisons, lime or other deleterious substances or by the use of nets, other than landing nets.
The possession limit for snapping turtles is ten, and the dorsal surface of the carapace must be ten inches or more in length. A $25 commercial turtle license is necessary to take, transport, purchase, and possess for sale unprocessed turtles within the state.

b. Frogs - Minn. Stat. Chapter 101, Sect. 101.44 and 101.441; and in Commissioner's Orders 1381 and 1912.
Any person permitted by law to take fish by angling may take or possess frogs for bait purposes only. Frogs may not be taken from April 1 to May 15. Frogs may not be taken for bait if they exceed six inches from the tip of their nose to the tip of their hind legs when the hind legs are fully extended. Legal frogs can be possessed, bought, sold, and transported in any numbers. No more than 150 frogs over six inches in length may be possessed in or transported through the state if they originate in Minnesota.
The taking, possessing, purchasing, transporting, or selling of frogs for purposes other than as bait within the state is prohibited. Scientific or special permits may be issued to educational and scientific institutions within Minnesota.

2. Birds
All birds except the common pigeon, English starling and mute swan are protected by the Federal Migratory Bird Treaty Act (16 USC.703 et seq.) which superceeds state statute 100.26 subds. 2 on unprotected animals. Possession of such species is regulated through permits under 50 CFR sec 13, and 21. Federal regulations provide for the taking, without a permit, of blackbirds, cowbirds, grackles, common crows, and magpies, when committing certain acts of depredation; however, the regulations do not allow the possession or retention of birds so taken for taxidermy or display purposes.

3. Mammals - MN. Stat. 1976 Sec 100.26 1-3
All nongame mammals listed in Appendix I are unprotected species. Their unprotected status is designated in M.S. 1976, Section 100.26, Subdivisions 1 and 3. Unprotected mammals may be taken either in the daytime or at night, and in any manner, except with the aid of artificial lights. They may be possessed, bought, sold, or transported in any quantity. Poisons may not be used to take unprotected animals except in the manner authorized by Section 18.022. It is illegal to intentionally drive, chase, run over or kill with any motor propelled vehicle any unprotected animals.

4. Fish
Keeping of native fishes in an aquarium for pet or exhibition purposes in numbers greater than the legal possession limit or at times when they may not be legally taken and possessed and taking of them by other than legal methods requires a special permit. Rearing of native fishes for sale requires a private hatchery license.

5. Endangered species - MN. Stat. 97.488
Minnesota statute 97.488-generally prohibits the taking, import, transport, or sale of any endangered species of wild animals or plants except as provided.
The federal Endangered Species Act of 1973 (16 USC, 1531 et sec.) authorized the state and federal government to enter into cooperative agreement for the protection of state and/or federally listed endangered species including cooperative funding of approved projects.

C. Permits - Permits from the Minnesota Department of Natural Resources are required for taking, transporting, and possession of any protected animals for educational, scientific, or exhibition purposes by methods, in numbers or at times not permitted under the law. Such permits may be issued without fee to those qualified to have them. They are issued from the St. Paul Office of the Minnesota Department of Natural Resources, Division of Fish and Wildlife, Centennial Building, St. Paul, Minnesota 55155.

1. Damage Control - Permits to take animals doing damage are often issued by a Conservation Officer.

2. Salvage (of dead protected wild animals) Possession of protected wild animals found injured or dead, other than federally protected birds, may be obtained by having them confiscated by a Conservation Officer for a fee and at his descretion, but game birds are excepted during the regular season. Taking or salvage of dead or injured migratory birds, such as songbirds or hawks, at any time, or of waterfowl (except during the regular season or under a hunting license) requires both a federal and state permit. Protected migratory birds, including songbirds, found dead can be donated to museums, schools, or other public facilities authorized by permit to possess such. However, all salvaged eagles must be turned over to the U.S. Fish and Wildlife Service.

3. Scientific Collecting Permits - For collecting protected wild animals for scientific or educational purposes are issued only to representatives of educational and scientific institutions and not to private individuals. Special permits, for animals used on special projects, may be issued to private individuals.

4. Taxidermy - A federal permit for possession of protected migratory birds as taxidermic specimens is required even though the bird is found dead, but such federal permits are not issued to private persons, and a state permit is contingent upon a federal permit.
Protected animals, game birds, mammals and fish can be prepared as taxidermic specimens by anyone for his own use if he has taken them legally during designated seasons. No license is required if animals are prepared as taxidermic specimens for personal use and not for sale. A licensed taxidermist who is preparing specimens for others is required to have proof that such animals are legally in possession before he can prepare them as taxidermic specimens.

5. Falconry - A state special permit, for the possession of native raptors for the purposes of falconry may be issued in conjunction with federal authorization. See Commissioner's Order #1986.

D. Commissioner's Orders - Are administrative regulations issued pursuant to statutory authority by the Commissioner of the Department of Natural Resources having the full face and effect of law.

1. Order #1986 - Regulations for the taking, transportation transfer, possession and use of raptors for falconry purposes.

2. Order #2128 - Regulations for the taking of ducks, geese, coots, gallinules, and migratory game birds by falconry.

3. Order #1318 - Regulations for the propagation, importation, possession, transportation or sale of frogs for human consumption.

4. Order #1912 - Regulation of the taking, possession, purchase, transportation or sale of frogs for bait.

5. Order #1943 - Regulations for the taking and possession of turtles and tortoises in the inland waters of Minnesota.

LITERATURE CITED

Bond, Richard R. 1957. Ecological distribution of breeding birds in the upland forests of southern Wisconsin. Ecological Monographs 27:351-384.

Borchert, John R. and Neil C. Gustafson. 1980. Atlas of Minnesota resources and settlement. Center for Urban and Regional Affairs, University of Minnesota, Minneapolis, MN.

Borland, Hal. 1975. The history of wildlife in America. National Wildlife Federation, Washington, D.C.

Breckenridge, W.J. 1944. Reptiles and amphibians of Minnesota. The University of Minnesota Press, Minneapolis, MN.

Brocke, Rainer H. 1979. The name of nongame. Wild. Soc. Bull. 7(4):279-282.

Burgess, R.L. and David M. Sharpe, eds. 1981. Forest island dynamics in man - dominated landscapes. Spreng-Verlag, New York.

Decker, D.J., T.W. Seamans, J.W. Kelley and R.R. Roth. 1982. Wildlife interests and information needs of state service foresters and forest landowners: a situational analysis for extension education programming. National Resources Research and Extension Series No. 16. Cornell University, Ithaca, NY.

De Graaf, Richard M. and Keith E. Evans. 1979. Workshop proceedings - management of north central and northeastern forests for nongame birds. USDA Forest Ser. Gen. Tech. Rep. NC-51. Minneapolis, MN.

Eckert, Kim. 1983. A birder's guide to Minnesota revised second edition. The Pine Knot, Cloquet Newspapers, Cloquet, MN.

Eddy, Samuel and James C. Underhill. 1974. Northern fishes. University of Minnesota Press, Minneapolis, MN.

Ehrenfeld, David W. 1976. The conservation of non-resources. American Scientist 64:648-656.

Evans, Keith E. and Richard N. Conner. 1979. Snag management. pp 214-225 in: Workshop proceedings - management of north central and northeastern forests for nongame birds. USDA Forest Serv. Gen. Tech. Rep. NC-51.

Fritschel, Linda R. 1982. Minnesota environmental organizations: a directory. second ed. Environmental Conservation Library of Minnesota (ECOL), Minneapolis, MN.

George, John L., Arlene P. Snyder, and Gloria Hanley. 1982. An

initial survey of the value of the wild bird products industry. Penn. State U., College of Agriculture, Ag. Exp. Station, University Park, PA. UEd 82-813. 13 pp.

Green, Janet C. and Robert B. Jannsen. 1975. Minnesota birds - when, where and how many. University of Minnesota Press, Minneapolis, MN.

Harris, L.D., D.H. Hirth, W.R. Marion. 1979. Development of silvicultural systems for wildlife. Proc. Ann. La. St. Univ. For Symp. 28:65-81.

Hazard, Evan B. 1982. The mammals of Minnesota. U. of Minnesota Press, Minneapolis, MN.

Henderson, C. 1979. Breeding birds in Minnesota, 1975-1979: abundance, distribution and diversity. MN. Dept. Natural Resources, St. Paul, MN. 48 pp.

Kellert, Stephen R. 1979. Public attitudes toward critical wildlife and natural habitat issues, phase 1. U.S. Government Printing Office, Washington, D.C.

Kellert, Stephen R. 1980. Activities of the American public relating to animals, phase II, U.S. Government Printing Office, Washington, D.C.

Keran, Doug. 1977. Bird feeding survey in Brainerd, Minnesota. The Loon 49(3):180.

Knopf, Gregory. 1983. An evaluation of state agricultural and wild rice leasing in Minnesota with proposals for new directions. Submitted to MN. DNR, Land Bureau, St. Paul, MN. Unpublished report. 49 pp.

Lang, Jeffrey W., D. Karns, M. Nehl, M. Pappus, and D. Wells. 1982. Status report of Minnesota's amphibians and reptiles; a final report of the amphibian and reptile group committee submitted to the chairman, Endangered Species Advisory Committee, MN DNR, St. Paul, MN. Unpublished report.

Leopold, Aldo. 1939. Game management. Charles Scribner's Sons, New York.

Marschner, Francis J. 1930. The original vegetation of Minnesota (map).
U.S. Department of Agriculture, Office of Agricultural Economics. Washington, D.C. Reprinted with ecological notes by M. L. Heinselman, U.S.D.A. Forest Service, North Central Forest Experiment Station. St. Paul, Minnesota. 1974.

Matthiessen, Peter. 1959. Wildlife in America. Penguin Books, Middlesex, England.

Minnesota Department of Natural Resources. 1982. Forestry/wildlife guidelines to habitat management, Vol. 1. Northern Forests, St.

Paul, MN. 56 pp.

Minnesota Department of Natural Resources, Division of Fish and Wildlife. 1975. Wildlife Management Area Long-Range Acquisition Plan. Volumes A and B, St. Paul, MN.

Minnesota Department of Natural Resources, Division of Fish and Wildlife. 1977a. Lac Qui Parle Wildlife Management Area master plan, 1977-1986. St. Paul, MN.

Minnesota Department Natural Resources, Division Fish and Wildlife. 1977b. Talcot Lake Wildlife Management Area master plan, 1977-1986, St. Paul, MN.

Minnesota Department of Natural Resources, Division of Fish and Wildlife. 1977c. Whitewater Wildlife Management Area master plan, 1977-1986, St. Paul, MN.

Minnesota Department of Natural Resources, Division of Fish and Wildlife. 1980a. Roseau River Wildlife Management Area master plan, 1980-1989, St. Paul, MN.

Minnesota Department of Natural Resources, Division of Fish and Wildlife. 1980b. Thief Lake Wildlife Management Area master plan, 1980-1989, St. Paul, MN.

Minnesota Department of Natural Resources, Division of Fish and Wildlife. 1982. Minnesota's pheasant stamp proposal - a wildlife habitat improvement program, St. Paul, MN. Unpublished report. 13 pp.

Minnesota Department of Natural Resources, Division of Fish and Wildlife. 1983. Statement of need and reasonableness in the matter of the proposed adoption of rules of the Department of Natural Resources designating species of wild animals and plants as endangered, threatened and special concern. St. Paul, MN.

Minnesota Department of Natural Resources, Division of Forestry. 1982. Minnesota forest resources plan, Vol. 2. Issue Document; Vol. 3, Assessment; Vol. 4, Goals and Alternative Strategies (draft). St. Paul, MN.

Minnesota Department of Natural Resources, Division of Minerals. 1981. Minnesota peat program - final report, St. Paul, MN.

Minnesota Department of Natural Resources, Office of Planning, Research and Policy. 1979. Minnesota state comprehensive outdoor recreation plan (SCORP), St. Paul, MN.

Minnesota Ornithological Record Committee. 1983. Systematic checklist of Minnesota birds. James Ford Bell Museum of Natural History, Minneapolis, MN.

Minnesota Pollution Control Agency. 1982. Acid precipitation in Minnesota. St. Paul, MN.

Minnesota State Planning Agency, Environmental Planning Division. 1978. Notebook on land use projections. St. Paul, MN.

More, Thomas A. 1979. The demand for nonconsumptive wildlife uses: a review of the literature. USDA Forest Serv. Gen. Tech. Rep. NE-52. Northeast Forest Exp. Sta., Amherst, MA.

Nash, Roderick. 1967. Wilderness and the American mind. Yale University Press, New Haven, CT.

National Research Council. 1982. Impacts of emerging agricultural trends on fish and wildlife habitat. National Academy Press, Washington, D.C.

Payne, B. and R.M. DeGraaf. 1975. Economic value associated with human enjoyment of nongame birds. Proc. symposium on management of forest and range habitats for nongame birds. USDA For. Ser. Gen. Tech. Rep. W-1. pp6-10.

Pettingill, Olin S. 1980. A guide to bird finding east of the Mississippi. Oxford University Press, Boston, MA.

Robbins, Chandler S. 1979. Effects of forest fragmentation on bird populations. Pages 198-212 in: Workshop proceedings - management of north central and northeast area forests for nongame birds. U.S. For. Ser. North Central Exp. Sta. Gen. Tech. Rep. NC-57, St. Paul, MN. 268 pp.

Roberts, Thomas S. 1932. The birds of Minnesota. The University of Minnesota Press, Minneapolis, MN.

Ryder, R.A. 1980. Effects of grazing on bird habitats. Pages 51-56 in: Workshop proceedings: management of western forests and grasslands for nongame birds. U.S. For. Serv. Intermount. For. Range Exp. Sta. Gen. Tech. Rep. INT-86, Ogden, UT. 535 pp.

Saxton, Gary. 1979. An analysis of interpretive programming in Minnesota, with recommendations for program development of the Minnesota Valley Refuge. U.S. Fish and Wildlife Service Report, St. Paul, MN.

Searle, Newell and Mark E. Hietlinger. 1980. Prairies, woods and islands - a guide to the Minnesota preserves of the Nature Conservancy. The Nature Conservancy, Arlington, VA.

Thomas, J.W., G.L. Crouch, R.S. Bumstead, and L.D. Bryant. 1975. Silvicultural options and habitat values in coniferous forests. Pages 272-287 in Proceedings of symposium on management of forest and range habits for nongame birds. U.S. For. Serv. Gen. Tech. Rep. WO-1, Washington, D.C. 343 pp.

U.S. Department of Interior, Fish and Wildlife Service and Department of Commerce, Bureau of Census. 1982. 1980 national survey of fishing, hunting, and wildlife-associated recreation. U.S. Government Printing Office, Washington, D.C.

U.S. Department of Interior, Fish and Wildlife Service. 1982. Minnesota Valley National Wildlife Refuge. Refuge Tech. Rep. Twin Cities, MN.

Wagner, Donald. 1979. Environmental education telephone survey of metropolitan schools. Special report to the U.S. Fish and Wildlife Service. Minnesota Valley National Wildlife Refuge, St. Paul, MN.

Webster, Bayard. Are there too many birders? Citation unknown.

Witter, D.J., J.R. Wilson and G.T. Maupin. 1980. Eagles days in Missouri: characteristics and enjoyment rating of participants. Wildlife Society Bulletin 8(1):64-65.