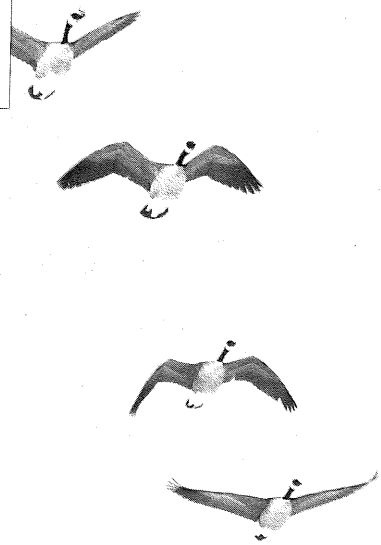

THIEF LAKE WILDLIFE MANAGEMENT AREA MASTER PLAN, 1980-1989

Minnesota Department of Natural Resources

THIEF LAKE WILDLIFE MANAGEMENT AREA
MASTER PLAN 1980-1989

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Minnesota Department of Natural Resources
Division of Fish and Wildlife
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Approved:

Director
Division of Fish and Wildlife

Commissioner of
Natural Resources

PREFACE

Concurrent with our population growth, our natural resources have been increasingly exploited through demands for raw materials and outdoor recreational opportunities. Recognizing Minnesota's existing and potential recreation and natural resource use problems, the 1969 legislature requested a "Study of the Total Environment" called Project 80. The study, to guide the legislature in reviewing appropriation requests for the acquisition, development, and maintenance of state-owned lands used for outdoor recreation, was conducted by the State Planning Agency and the Department of Natural Resources.

Project 80 recommendations led to the Outdoor Recreation Act of 1975. The act established an outdoor recreation system to preserve and properly use Minnesota's natural, cultural, and historical resources. The system is composed of 11 different classes of state-owned lands administered by the Department of Natural Resources, the Minnesota Historical Society, and the Department of Transportation (Appendix A). Each class within the system has an unique purpose and use. In this way, the system provides a variety of recreational opportunities with minimal use conflicts.

The Department of Natural Resources is preparing comprehensive management plans for the nine wildlife management areas in the state having resident managers. The plans include present and projected regional perspectives, resource inventories, and demand and use analyses, as well as acquisition and development plans, cost estimates, and resource management programs. These are 10-year management plans, and will be revised as new management practices develop, new resource philosophies evolve, and new problems are encountered.

Under a cooperative agreement with the State Planning Agency, the Department of Natural Resources completed plans for the Whitewater, Carlos Avery, Mille Lacs, Talcot Lake, and Lac qui Parle Wildlife Management Areas during the 1976-77 biennium. Plans for the Roseau River, Red Lake, Hubbel Pond, and Thief Lake Wildlife Management Areas will be completed during the 1980-81 biennium.

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INTRODUCTION

Minnesota has an abundance of natural resources. To many people, Minnesota's wildlife management areas and their associated wildlife and plant communities are among the state's most precious resources. In accord with the Outdoor Recreation Act of 1975, this master plan outlines the management of the Thief Lake Wildlife Management Area (WMA) through 1989. This plan was developed by defining area goals, examining existing conditions and resources, identifying management considerations, and then developing appropriate management programs.

DESCRIPTION

The 33,255-acre Thief Lake WMA is located in Marshall County in northwestern Minnesota (Figure 1). The nearest incorporated town is Middle River, 10 miles west of the unit on County Road 6. Thief River Falls (population 8,929), the largest city near the WMA is 38 miles southwest via County Road 6 and State Highway 32.

Agriculture is the dominant activity in the management area vicinity. The landscape consists of large agricultural fields interspersed with variable size stands of aspen forest or lowland brush.

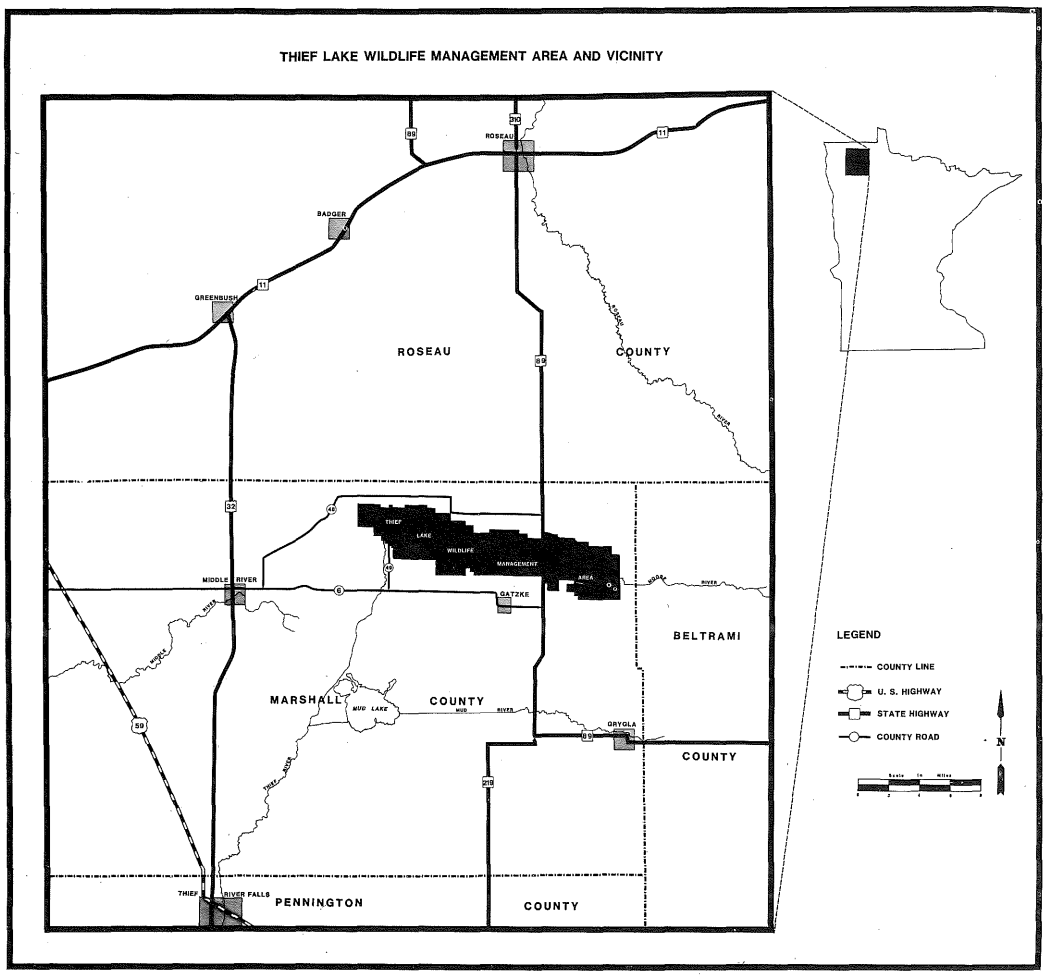


Figure 1

The management area includes the 7,140-acre Thief Lake and its adjacent marshes. The Moose River enters the lake from the east, and the Thief River flows southerly from the west end of the lake. The area is characterized by extensive areas of marsh and lowland brush plus large tracts of upland aspen forest and lowland coniferous bog. Waterfowl, deer, and grouse hunting are the dominant recreational uses. Other public uses include wildlife observation, environmental education, hiking, and photography.

LEGAL PURPOSE

Minnesota's wildlife management areas are lands and waters with a high potential for wildlife production. They are managed and developed by the Commissioner of the Minnesota Department of Natural Resources (DNR) to perpetuate and, if necessary, reestablish habitats for the maximum production of a variety of wildlife and to provide hunting, fishing, trapping, and other compatible outdoor recreational uses. Public use must be consistent with the units' resource limitations, and developments must minimize intrusion on the natural environment (Minnesota Statutes, Sec. 86A.05, Subd. 8, 1978).

Public lands have a limited potential for multiple recreational use. Minnesota has never actively encouraged the multiple recreational use of wildlife lands. The Commissioner of Natural Resources recognized those public uses associated with the observation, interpretation, and understanding of fish and wildlife populations and habitats as recreational uses compatible with Minnesota's wildlife management areas. Similarly, the U.S. Fish and Wildlife Service has recently realized that national wildlife refuge goals are endangered by conflicts between the demand for recreation and the ability of the resource to accommodate the use (Pulliam 1974).

Since the development, management, and administration of state wildlife lands are financed primarily through revenues derived from the sale of hunting, trapping, and fishing licenses, recreational uses of these lands are limited to activities directly oriented towards wildlife and fish. In addition, wildlife lands purchased with federal matching funds derived from the Pittman-Robertson Act were acquired with the understanding that they would be managed for the benefit of wildlife populations and/or for the public use and understanding of those resources.

The greatest contribution from our country's wildlife lands is the fostering of public uses directly associated with fish and wildlife and their habitats. To achieve these goals, the Minnesota DNR will continue to restrict public uses that are not related to fish and wildlife.

LONG-RANGE GOALS

The primary goal of the Thief Lake WMA is to maintain or restore a variety of grassland, wetland, forest, and agricultural habitats that will benefit diverse resident and migratory wildlife. Accomplishment of this goal will perpetuate native plant and animal communities in a region where agricultural pressures threaten the remaining natural areas.

A second management goal of the unit is to provide quality public hunting and trapping. Other forms of outdoor recreation will be accommodated only if compatible with wildlife management and use. People densities will be maintained at levels which will prevent excessive interference among users and will not endanger wildlife populations.

HISTORICAL AND ARCHAEOLOGICAL ASPECTS

Historical knowledge is valuable to natural resource management. Many of the land use problems and attitudes toward natural resource use arose with settlement of the region. An understanding of the historical use of an area's natural resources, the strong points and shortcomings of these practices, and the policies regarding natural resource use is necessary to develop a comprehensive management plan.

LOCAL HISTORY

The Sioux Indians were the earliest known inhabitants in northwestern Minnesota. By 1770, however, invading Chippewa Indians had driven the Sioux from most of the northern timbered region of Minnesota. The Chippewas were a migratory people, seasonally traveling to different camps. As late as 1890, Chippewas still followed a traditional migration pattern in Marshall County (Solum 1976). One band traveled up the Thief River each spring and camped on the shore of Thief Lake during the summer, where they trapped muskrats and fished for northerns, suckers, and bullheads. Another band had an encampment at the present location of the WMA headquarters (Solum 1976). The land in what is now Marshall County, along with much of northwestern Minnesota, was ceded to the United States by treaties with the Red Lake and Pembina bands of the Chippewas in 1863 and 1889 (Dana et al. 1960).

The first white men to enter the area were French explorers and trappers during the early 1800's. Fur traders soon moved in to trade with the Chippewas. The first settlers to the Marshall County area arrived in the early 1870's. Early immigrants, mostly Germans, Irish, and Scandinavians, homesteaded along the Red River and its tributaries (Solum 1976). Immigration ex-

panded with the completion of a railroad line through the area in 1878, and in less than 10 years nearly all of the accessible land was homesteaded (Minnesota Historical Records Survey Project 1939).

The first settlers in the Thief Lake area homesteaded on the Thief River about one-half mile south of Thief Lake in 1890 (Solum 1976). Within several years, most of the land south and west of Thief Lake had been homesteaded. Settlement east of the lake was discouraged by peat bogs and and wet, inferior soils.

WILDLIFE MANAGEMENT AREA HISTORY

Prior to 1915, Thief Lake was reported to be an excellent waterfowl area. Visitors described the lake as shallow, with an interspersion of reeds, rushes, and cattails which provided prime nesting habitat for diving ducks. In 1915, to drain the lake for agricultural purposes, a judicial ditch was constructed through the lake to the Thief River outlet. Drainage, however, was never fully successful and the area was frequently flooded. Few agricultural crops were grown and the lake bed was soon overgrown with emergent vegetation.

Efforts to restore Thief Lake, led by Dr. Paul Hagen of Crookston and local chapters of the Izaak Walton League, began in 1929. Many of the local landowners also expressed interest in reflooding the lake. Legislation passed in 1929 (Laws Minn. 1929, Ch. 319) gave the Commissioner of Conservation the authority to initiate proceedings to restore artificially drained lakes and to acquire title to lands affected by such proceedings. In 1930, the Department of Conservation (now the DNR) received approval to restore Thief Lake and establish it as a public hunting ground and game refuge. Condemnation proceedings began in 1930 and, by 1931, 14,388 acres of private land and 205 acres of Trust Fund and tax-forfeited land had been acquired. Further acquisition between 1932 and 1976 brought the total acreage controlled by the Division of Fish and Wildlife to 32,895 acres.

Construction of a dam on the Thief River outlet was initiated in 1930 under the Works Progress Administration. The dam was completed in 1931, but the lake remained dry for five years due to drought conditions. Heavy rains during 1937, however, restored the lake to its former level. The Haroldson dam, located two miles up the Moose River from Thief Lake, was constructed as a Civilian Conservation Corps (CCC) project in 1937, but has never been operational.

The federal government authorized extensive relief work projects in the area during the 1930's. A U.S. Biological Survey CCC camp operated on Thief Lake during the 1930's and constructed roads, firebreaks, bridges, dikes, telephone lines, buildings, and fences on the area. Additional CCC projects included food and cover plantings for wildlife, wildlife surveys, and the construction of waterfowl potholes (Minnesota Conservation Department 1933).

Refuges and sanctuaries have always been a part of the management area. In 1937, an order by the Minnesota Commissioner of Conservation established a 3,280-acre game refuge which included the northwest portion of Thief Lake. In 1962, 760 acres were added to the refuge. The refuge has been modified several times since 1962 and currently encompasses 5,500 acres.

CONSOLIDATED CONSERVATION AREA

A growing demand for agricultural lands in northwestern Minnesota during the early 1900's resulted in the development of extensive drainage projects to reclaim wetlands for farming. The early drainage projects, which were designed to drain some of the better land, were largely successful. Later projects, however, that attempted to drain the peatlands were generally not successful in creating farm land. As a result, many landowners were unwilling or unable to pay the taxes and ditch liens assessed against their land. By the late 1920's, several million acres of land in northwest Minnesota were forfeited for nonpayment of taxes (Dana et al. 1960.)

Beginning in 1929, a series of laws authorized the state to take title to tax-forfeited lands in Lake of the Woods, Beltrami, Koochiching, Roseau, Mahnomen, Aitkin, and Marshall Counties (Laws Minnesota 1929, Ch. 258; 1931, Ch. 404; 1933, Ch. 402). These lands, designated as Consolidated Conservation Area lands, were to be managed for wildlife, timber, and other resources and were placed under the jurisdiction of the Department of Conservation (DNR). Later legislation required that all Consolidated Conservation lands be classified as to their suitability for agriculture, forestry, and wildlife production, and that lands classified more suitable for agriculture be sold at public auctions upon approval of the Commissioner of Natural Resources. (Laws Minnesota 1935, Ch. 210; 1939, Ch. 320.) Since 1939, the state has obtained 147,470 acres of Consolidated Conservation lands in Marshall County. Of this, 79,629 acres (54 percent) have been classified and sold as agricultural lands.

ARCHAEOLOGICAL ASPECTS

No archaeological sites are recorded for the Thief Lake WMA (Johnson 1977). However, the area has not received an archaeological survey. A number of archaeological sites are located to the west of the WMA and include burial mounds on old beach ridges and small habitation sites on the Red River and its major tributaries. Early records report Indian encampments along the shores of Thief Lake, so it is probable that prehistoric habitation sites occur within the management area.

HISTORICAL SITES

The Marshall County Historical Society and the Minnesota State Historical Society were asked to identify historical sites on the Thief Lake WMA. There are no known historical sites in need of special management considerations.

RESOURCE INVENTORY

An inventory of the resources and conditions in the area is essential to developing comprehensive management programs. The resources can be divided into two classes: abiotic and biotic. While each category influences the other, the abiotic conditions generally determine the diversity, distribution, and density of the biotic resource. Examination of the existing resources in conjunction with the habitat requirements, population dynamics, and behavior of game and nongame wildlife is needed to develop programs for the sustained production and use of these populations.

ABIOTIC RESOURCES

Climate. The Thief Lake WMA vicinity has short, mild summers and long, cold winters. The average temperature for July is 66.9°F and for January 0.0°F (Table 1). Winter temperatures of -30°F are common. The average growing season is about 120 days. Killing frosts are expected from September 15 through May 28. Low-lying areas may experience frost throughout the summer.

Average yearly precipitation is 22.96 inches, ranging from 0.46 in February to 3.94 inches in June. About 15.9 inches, or 70 percent of the annual total occurs from May through September. Northwestern Minnesota is one of the drier regions in the state, and severe droughts occur every six to eight years. The last drought occurred in 1976-77. Average yearly snowfall is 35.5 inches, and snow cover is one inch or greater for about 110 days per year. Prevailing winds are northwest during winter, changing to the south and southwest during the spring and summer.

Geology. Precambrian bedrock underlies the management area. Granites, greenstones, slates, and older metavolcanic rocks predominate (Minnesota Conservation Department 1959). Cretaceous shale, sandstone, and sand deposits of varying thickness overlie the crystalline bedrock (Bidwell et al. 1970). The present soils and topographic features of the area are a result of three geological stages: (1) Pleistocene glaciation, (2) glacial Lake Agassiz and, (3) postglaciation. Glaciers covered the area several times during the Pleistocene epoch, but present landforms and surface deposits are the result of the most recent (Wisconsin) glaciation, approximately 50,000-10,000 years ago. From 200-300 feet of unconsolidated glacial drift consisting of silt, sand, clay, gravel, and boulders were deposited over the bedrock surface (Bidwell et al. 1970).

As the glacial ice sheets retreated late during the Wisconsin stage (approximately 12,000 years ago) meltwaters impounded behind a major drainage divide

Table 1. Temperature, precipitation, and snowfall for the Thief Lake WMA vicinity.

Month	Average Temperature (°F)[1]	Average Precipitation (inches)[2]	Average Snowfall (inches)[1]
January	0.0	0.77	7.8
February	7.0	0.46	4.4
March	20.0	0.90	5.8
April	39.1	1.89	3.0
May	52.2	2.59	0.4
June	62.4	3.94	0
July	66.9	3.70	0
August	65.2	3.00	0
September	54.5	2.74	0.
October	44.6	1.42	0.9
November	25.6	0.76	6.0
December	9.4	0.79	7.2
Total	37.2	22.96	35.5

[1] Data from weather reporting station at Roseau, Minnesota 1951-1974.
[2] Data from the Thief Lake WMA headquarters 1952-1977.

crossing northern South Dakota and south-central Minnesota, forming glacial Lake Agassiz (Elson 1967). During its maximum extent, Lake Agassiz covered over 200,000 square miles in parts of North Dakota, South Dakota, Minnesota, Saskatchewan, Manitoba, and Ontario (Arndt 1977). Calcareous, lacustrine clay, water-sorted sand and gravel, and lake-modified till were deposited over the area (Heinselman 1963). As new discharge outlets eroded and the ice margin alternately retreated and advanced, the lake level fluctuated. Ridges of sand and gravel, some with boulders, marked the former shorelines of the lake. Locally, one group of beach ridges extends from the northeastern corner of Marshall County, southwesterly past Thief Lake (Dohrman Ridge), to the southern county border (Allison 1932). Another remnant beach, the Randeen Ridge, lies along the northwestern boundary of the management area.

Final drainage of Lake Agassiz occurred around 7,300 years ago, leaving the area as a level, nearly featureless plain, interrupted by intermittant remnant beach ridges (Minnesota Conservation Department 1959). Remnants of Lake Agassiz within Minnesota include the Red Lakes in Beltrami County, Thief and Mud Lakes in Marshall County, and Rainy Lake and Lake of the Woods on the Canadian Border (Wright 1972).

Mineral potential for the area was assessed by the Minnesota DNR, Division of Minerals (David Meineke, personal communication). Based on a "fair" knowledge of local bedrock geology, the mineral potential for the management area was rated as "good." Iron, nickel, zinc, copper, lead, gold, and silver may occur on the unit, but not necessarily in deposits making commercial mining feasible or economical. The assessment did not, however, include the potential for non-metallic minerals or for peat. In 1973, the state issued five permits on the east half of the Thief Lake WMA for copper-nickel exploration and mining. A number of test drillings were made, but all leases have since been terminated by the leaseholder.

Mining companies have expressed interest in further leases for exploration and possible mining on the state lands in northwestern Minnesota. The Division of Fish and Wildlife will not oppose mineral leases on the Thief Lake WMA as long as the areas involved do not include sensitive wildlife areas such as sanctuaries, impoundments, and critical winter habitat. The division will require mitigation for the replacement of lands adversely altered by mining operations. The division will review leases on an individual basis for their potential impact on the natural resources of the proposed site and surrounding area. Proposals for mining operations are subject to state environmental impact statement requirements (Minnesota Statutes Section 116D.04, 1978), DNR water and mining permit procedures (Minnesota Statutes Chapter 105 and Section 93.481, 1978, respectively), and state reclamation policy (Minnesota Statutes, Section 93.44, 1978).

Requests for gravel recovery on the management area will be reviewed on a case by case basis. Permits may be issued provided that: 1) no alternative gravel sources are available within a reasonable distance, 2) an agreement for reclamation of the site is obtained, 3) the operation does not adversely impact sensitive wildlife areas, and 4) the gravel is not needed for wildlife management purposes.

Peat deposits in Marshall County have the potential for commercial development. Peat and peat products are in increasing demand for chemical and industrial uses, horticultural products, and alternative fuel sources. Thus far there have been no requests for peat leases in the vicinity of the WMA.

Soils. Soil development in the Thief Lake vicinity was influenced by parent materials, topography, climate, and vegetation. Underlying parent materials consist of unconsolidated lacustrine deposits of silts, clays, and sands plus lake-modified till.

The majority of the Thief Lake WMA is covered by organic soils belonging to the Cathro-Haug-Markey Association which formed in deposits of herbaceous materials on low-lying, relatively flat, and poorly drained areas (Figure 2). The surface layers vary from very dark brown to black mucky peats or mucky sandy loams from 4 to 51 inches thick underlain by loamy till, sandy loams, or fine sand (U.S. Department of Agriculture 1977). Most of these soils are not suited to agriculture.

Mineral soils on the management area occur on better drained sites (Figure 2) and belong to five major soil associations. The Lohnes-Syrene-Hangaard association occurs on or adjacent to remnant beach ridges and is found along the Randeen and Dohrman Ridges on the WMA. Surface layers are composed of black loams or sandy loams underlain by sands and coarse gravelly sands. The Roliss-Nereson and Mavie-Strandquist-Foxhome associations formed under prairie vegetation. These soils have black loam or sandy loam surface layers about 10-12 inches thick underlain by clay loams, loamy sands, or gravelly sandy loams. The Rockwell-Grimstad-Kratka association is characterized by black sandy clay loams or fine sandy loams over loamy sands or fine sands. The Enstrom-Grygla association formed under deciduous forests. These soils have dark brown to gray fine sands over yellowish-brown fine sands. Portions of all of these associations are in cropland, but low fertility, wind erosion, and wetness are limitations for agriculture (U.S. Department of Agriculture 1977). Even in the more productive soils, excess water may be a problem.

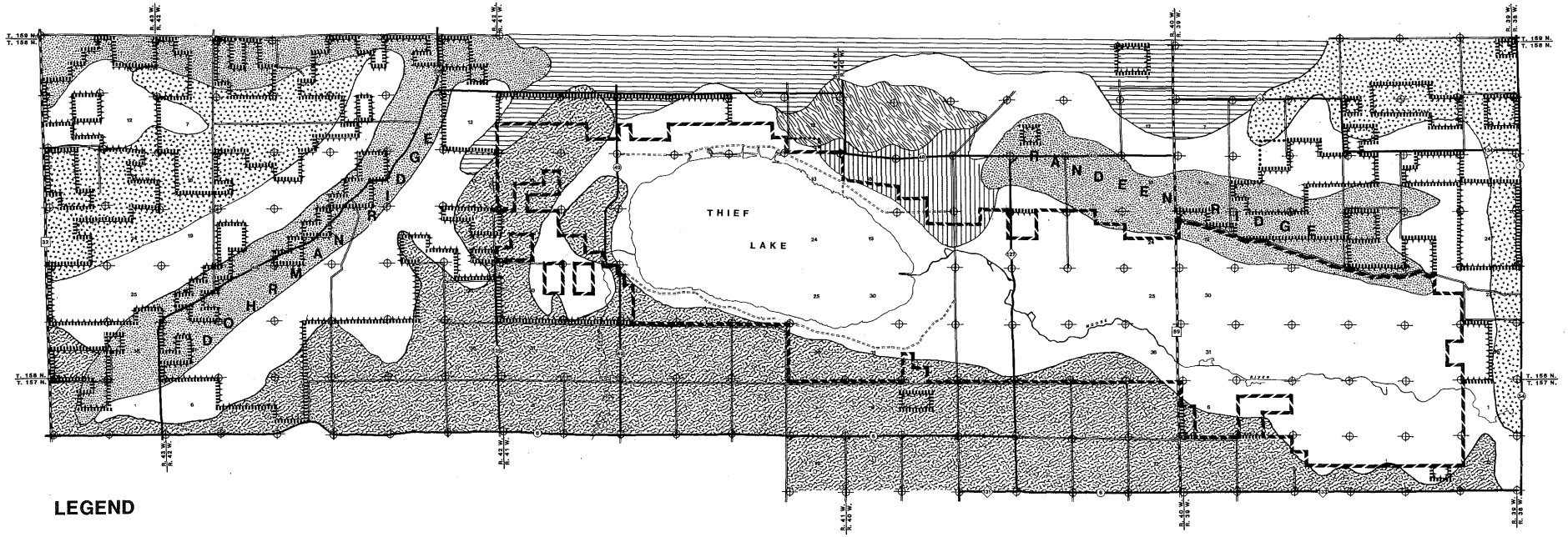
Underground Hydrology. Impermeable bedrock forms the base of the groundwater reservoir. The primary source of groundwater is from sand and gravel beach ridges and from aquifers in glacial deposits.

Local groundwater flow is from recharge areas in the permeable morainic deposits and beach ridges to discharge areas in adjacent lowlands, where it is dissipated by evapotranspiration or runoff. The regional water flow generally moves westward toward the Red River lowland (Bidwell et al. 1970).

Well depths and water-yielding capabilities vary, depending on the type, capacity, and depth of the groundwater source. In the WMA vicinity, water yields adequate for domestic and livestock uses can generally be obtained from wells less than 50 feet deep on most upland sites. Wells drilled in glacial till commonly yield less than 10 gallons per minute (gpm). Yields of more than 20 gpm can usually be obtained from wells located in larger beach ridge aquifers (Bidwell et al. 1970). In the bog areas, the water table generally remains at or near the surface.

Annual groundwater recharge is primarily from precipitation and snowmelt, and usually about equals losses. Approximately 88 percent (19.4 inches) of the

THIEF LAKE WILDLIFE MANAGEMENT AREA SOILS



LEGEND

- POORLY TO MODERATELY WELL DRAINED SANDY LOAMS TO CALCAREOUS SANDY CLAY LOAMS: MAVIE - STRANDQUIST - FOXHOME ASSOCIATION
- WET, VERY POORLY DRAINED ORGANIC DECOMPOSED MUCKS, AND MUCKY, SANDY LOAMS: CATHRO - HAUG - MARKEY ASSOCIATION
- POORLY TO MODERATELY WELL DRAINED CALCAREOUS SANDY LOAMS, AND SANDY CLAY LOAMS: ROCKWELL - GRIMSTAD - KRATKA ASSOCIATION
- MODERATELY WELL TO POORLY DRAINED FINE SANDS: ENSTROM - GRYGLA ASSOCIATION
- POORLY DRAINED LOAMY FINE SANDS: REDBY - CORMANT ASSOCIATION
- POORLY TO MODERATELY WELL DRAINED LOAMS , AND SANDY LOAMS: ROLISS - NERESON ASSOCIATION
- SOMEWHAT EXCESSIVELY TO POORLY DRAINED LOAMS TO SANDY LOAMS: LOHNES - SYRENE - HANGAARD ASSOCIATION
- W.M.A. BOUNDARY
- PROPOSED ADDITION BOUNDARY
- W.M.A. SUPPLEMENT BOUNDARY
- STATE HIGHWAY
- COUNTY STATE AID HIGHWAY
- COUNTY ROAD
- TOWNSHIP ROAD
- W.M.A. ROAD
- SECTION CORNER

N

scale in miles
0 1 2 3

Figure 2

annual precipitation is dissipated through evapotranspiration, mostly from lakes and lowland bog areas; 12 percent (2.6 inches) is lost through runoff (Bidwell et al. 1970). Areas underlain with lacustrine clay deposits are relatively impermeable, allowing only limited groundwater recharge (Minnesota Conservation Department 1959). As a result, the water table is normally high and peat bogs have formed on many of these areas.

Groundwater quality varies widely, depending on the distance of movement, physical and chemical characteristics of the water-bearing materials, and the contact time with these materials. In the WMA vicinity, most groundwater within the upper 50 feet of the surface is of the calcium magnesium bicarbonate type, high in total hardness. Sodium bicarbonate water occurs at depths generally greater than 100 feet and is associated with clayey Cretaceous sediments (Bidwell et al. 1970). Groundwater is suitable for domestic and livestock uses in most places. In the WMA vicinity, groundwater hardness is between 200 and 300 parts per million (ppm) and dissolved soilds content is about 200 ppm (Bidwell et al. 1970). Levels of iron and nitrate may exceed Minnesota Pollution Control Agency (1972) limits for domestic consumption (Table 2). Groundwater becomes increasingly mineralized in western Marshall County and levels of sulfate and total dissolved solids may exceed recommended consumption levels (Table 2).

Surface Hydrology. The Thief Lake WMA is located on the northwestern boundary of the 5,990 square mile Red Lake River watershed. The 1,823 square mile Middle River watershed and the 2,057 square mile Roseau River watershed adjoin the management area to the west and north. Drainage is generally towards the Moose River, Thief River, and Thief Lake.

The Moose River flows into the east side of Thief Lake and drains approximately 150 square miles, much of which is lowland peat bog. The lower portions have been dredged, widening and straightening the channel to an average 50 feet in width and eight feet in depth. The Thief River outlets from the west end of Thief Lake and flows southwesterly to Thief River Falls, where it joins the Red Lake River. The upper reaches of the river average 40 feet in width and six feet in depth (Minnesota Conservation Department 1959).

Thief Lake (7,140 acres) is entirely within the management area boundary and is approximately five miles long and three miles wide with a regular shoreline. It has a maximum and average depth of 4.5 and 3.2 feet, respectively (Minnesota Conservation Department 1964). Approximately 45 percent of the water area is covered by standing emergent vegetation in large clumps or islands. The lake bottom is mostly firm clay often covered by a layer of muck (Minnesota Conservation Department 1964). The entire lake is navigable by motorboat or canoe. A number of ditches drain into the lake. Frequent flooding of surrounding lowland areas occurs following spring snowmelt.

The lake level is controlled by a 60 foot, 10-bay, concrete dam located one-third of a mile west of the lake on the Thief River. The dam was constructed in 1931 with a crest elevation of 1,160 feet above sea level. Additional control to 1,163 feet was provided by the use of stop-logs. Renovation of the dam in 1938 lowered the crest by 18 inches to 1,158.5 feet, providing more water control. In 1951, the stop-logs were removed and water levels were lowered to improve waterfowl habitat. In 1968, sliding gates with a sill elevation of 1,155.5 feet were installed in the two, 10½ foot bays.

The resident manager monitors lake levels from a guage at the dam. Since 1941, high water levels have ranged from 1,158.9 feet in 1977 to 1,164.5 feet in 1948. The average high water level from 1960 to 1978 was 1,160.5 feet. At lake levels between 1,157 and 1,163 feet, flood storage capacity is about 50,000 acre-feet. The lake level is gradually drawn down in the fall and winter to an elevation of 1,157 feet by April 1.

Other than Thief Lake, permanent water bodies on the management area include marshes on the west

Table 2. Chemical analysis of water from selected wells in Marshall County.

Parameters[1]	Western Marshall County[2]	Town of Middle River	Consumption Limits[3]
Sample depth (feet)	14.0	178.0	
Iron	nd[4]	10.6	0.3
Aluminum	nd	2.2	
Calcium	290.4	38.0	
Magnesium	297.2	51.0	
Sodium	334.4 (combined Sodium	44.0	
Potassium	and Potassium value)	20.0	
Silica	nd	8.0	
Carbonate	12.0	7.2	
Sulfate	292.8	59.0	250
Chloride	216.9	7.1	250
Nitrate	nd	1.2	10
Total dissolved solids	1,842.6	484.0	500
Total hardness	nd	304.1	

[1] Measurements except sample depth in parts per million.
[2] Average analyses of water from 28 wells (less than 45 feet deep) in western Marshall County.
[3] Recommended domestic consumption limits (Minnesota Pollution Control Agency 1972).
[4] nd=not determined.
Source: Allison 1932.

and north sides of the lake, beaver impoundments, and scattered, natural and man-made potholes. Open water acreages fluctuate annually, depending on precipitation levels and beaver numbers and activity.

Water samples taken in July and October of 1978 from two locations on the Moose River and one location on the Thief River were analyzed at the Section of Ecological Services' laboratory at the Carlos Avery WMA (Table 3). Total Kjeldahl nitrogen (1.11 to 1.97 ppm) and phosphorus (0.05 to 0.114 ppm) concentrations were high, suggesting high fertility. Water in all samples was hard, which often indicates high productivity. Sulphate levels were high enough (5 to 67 ppm) to favor the replacement of submerged aquatics common to carbonate lakes by sulphate-tolerant forms such as Sago pondweed. Chloride concentrations were within the normal range for Minnesota lakes and streams (Howe and Carlson 1969).

BIOTIC RESOURCES

Vegetation. Vegetation is continuously changing with short-term disturbances such as fires or storms, and long-term events, such as climatic changes or soil development. Even without disturbance, plant communities change in response to changes on a site, with one species dying out and being replaced by another. The orderly changes in plant communities are called succession.

Marschner (1930) used original land surveyors' field notes to map the distribution of the dominant plant associations in Minnesota prior to settlement. Presettlement vegetation of the Thief Lake WMA and vicinity was transitional between the prairies to the west and the deciduous and coniferous forests to the east. Lowland areas around Thief Lake and along the Moose River were largely tamarack, black spruce, and white cedar swamps and open bogs. Expanses of willow/alder, cattail, sedge, and grass occupied the nonforested lowland areas. Higher ground supported a mixture of prairie, brush, and forested types. Forests dominated by aspen and paper birch, with red pine, white pine, balsam fir, and spruce, occupied remnant beach ridges to the north and west of Thief Lake. Prairie, brush-prairie, and oak savanna types occurred south of the lake. These types required recurrent fires to maintain their structure and composition. The brush-prairie type consisted of an interspersion of shrub thickets, patches of small trees, and prairie grasses. Marschner (1930) described the upland prairies in this area as tall grass prairies, with big bluestem, little bluestem, and Indian grass as the dominant plant species. The oak savanna type was transitional between the brush-prairie and other forest types. It consisted of prairie grasses and widely spaced oak trees.

Settlement altered the original vegetation of the area. Larger trees, especially red and white pine, were harvested for sawtimber. Land was cleared and cultivated. As fire prevention and suppression increased, fire-maintained plant communities, such as the prairies and oak savanna types, were gradually replaced by less fire-tolerant forest types.

Present vegetation on the Thief Lake WMA was mapped from two sets of aerial photographs, black and white from 1966 and color infrared slides taken in 1978 (Figure 3). Vegetation types were classified according to the dominant species. Stands of vegetation as small as 10 acres were mapped. Species composition and dominance in the various communities were determined from previous vegetation studies and by groundchecking. Wetlands were classified using criteria modified from Steward and Kantrud (1971) and Cowardin and Johnson (1973). Additional information on wetland plant species composition was obtained from Minnesota DNR Game Lake Surveys. A brief description of the vegetation types including dominant species and successional trends is given in sufficient detail for typical management operations. Descriptions of succession generally follow Curtis (1959). Names of plants follow Gleason and Cronquist (1963). A complete list of plant species mentioned in the text is found in Appendix B. Acreage of each vegetation type is listed in Appendix C.

ASPEN. This type has more than 50 percent of the canopy in aspen. Aspen stands occupy a wide range of soils and forest sites. Stand distribution generally

Table 3. Chemistry of surface water samples from the Thief Lake WMA, 1978.

	Thief River Below Dam		Moose River County Road 131 Bridge		Moose River County Road 1 Bridge	
Parameters[1]	July	October	July	October	July	October
Sulfate	27.0	67.0	5.0	60.0	5.0	40.0
Total Phosphorous	< 0.050	0.108	< 0.050	0.114	< 0.050	0.108
Soluble Phosphorus	< 0.010	< 0.010	0.015	0.020	0.041	0.010
Chloride	3.9	5.4	3.0	5.2	3.1	5.2
Nitrogen						
Ammonia	0.025	< 0.025	0.026	0.026	0.027	< 0.025
Nitrite	< 0.001	< 0.001	< 0.001	0.002	0.004	0.001
Nitrate	< 0.050	0.067	< 0.050	0.067	0.061	0.187
Total Kjeldahl	1.67	1.60	1.97	1.40	1.93	1.11
Total Alkalinity[2]	88.0	155.0	215.0	230.0	258.0	245.0
pH	9.10	8.20	8.05	7.80	8.00	7.90
Conductivity[3]	235.0	310.0	388.0	420.0	458.0	430.0

[1] Measurements in parts per million (ppm) except pH and conductivity.
[2] Expressed as ppm of calcium carbonate ($CaCO_3$).
[3] In micro-mohs.

THIEF LAKE WILDLIFE MANAGEMENT AREA
VEGETATION

N

SCALE IN MILES
0 1/2 1

LEGEND

- DECIDUOUS FOREST
  - A ASPEN
  - O OAK
  - Ub UPLAND BRUSH
  - BH BOTTOMLAND HARDWOODS
  - DZ DOZED
- M - MIXED DECIDUOUS-CONIFEROUS
- PP - PINE PLANTATION
- OF - OLD FIELD
- AF - AGRICULTURAL FIELD
- Lb - LOWLAND BRUSH
- LOWLAND CONIFER
  - S BLACK SPRUCE
  - T TAMARACK
  - C WHITE CEDAR
- WETLANDS
  - II TEMPORARY
  - III SEASONAL
  - IV SEMI-PERMANENT
  - XIII SHRUB BOG
- GP - GRAVEL PIT
- W.M.A. BOUNDARY
- W.M.A. SUPPLEMENT BOUNDARY
- STATE HIGHWAY
- COUNTY STATE AID HIGHWAY
- COUNTY ROAD
- TOWNSHIP ROAD
- W.M.A. ROAD
- HEADQUARTERS
- SECTION CORNER

T. 159 N.
T. 158 N.
T. 158 N.
T. 157 N.
R. 43 W.
R. 42 W.
R. 42 W.
R. 41 W.

THIEF LAKE

RIVER

THIEF

MATCH LINE

FIGURE 3A. VEGETATION

THIEF LAKE WILDLIFE MANAGEMENT AREA
VEGETATION

LEGEND

- DECIDUOUS FOREST
  - A ASPEN
  - O OAK
  - Ub UPLAND BRUSH
  - BH BOTTOMLAND HARDWOODS
  - DZ DOZED
- M - MIXED DECIDUOUS-CONIFEROUS
- PP - PINE PLANTATION
- OF - OLD FIELD
- AF - AGRICULTURAL FIELD
- Lb - LOWLAND BRUSH
- LOWLAND CONIFER
  - S BLACK SPRUCE
  - T TAMARACK
  - C WHITE CEDAR
  - SB BLACK SPRUCE-BALSAM FIR
- WETLANDS
  - II TEMPORARY
  - III SEASONAL
  - IV SEMI-PERMANENT
  - XIII SHRUB BOG
- GP - GRAVEL PIT
- W.M.A. BOUNDARY
- W.M.A. SUPPLEMENT BOUNDARY
- STATE HIGHWAY
- COUNTY STATE AID HIGHWAY
- COUNTY ROAD
- TOWNSHIP ROAD
- W.M.A. ROAD
- SECTION CORNER

SCALE IN MILES 0 1/2 1

N

THIEF LAKE

MOOSE RIVER

MATCH LINE

R. 41 W. R. 40 W. R. 39 W. R. 38 W.

T. 159 N. T. 158 N. T. 158 N. T. 157 N.

FIGURE 3B.

reflects past disturbances such as fire, logging, or wind damage (Hanson et al. 1974). Trembling aspen is the primary aspen species, but balsam poplar also occurs, especially on stream margins, ditch spoil banks, and other wet areas. Paper birch, green and black ash, balsam fir, and white spruce are common associates. Prominent understory species include American and beaked hazel, juneberry, round-leafed and red-osier dogwood, chokecherry, and mountain maple. Bracken fern, wild sarsaparilla, meadow rue, dogbane, hog-peanut, poison ivy, and baneberry are common groundlayer species.

Aspen is a short-lived, pioneer species which reproduces vigorously by root suckering following disturbances. Aspen, however, cannot reproduce successfully under shade, and, if undisturbed, aspen stands will begin to deteriorate after 60 to 80 years on the best sites. On drier sites, aspen is followed by oaks or red maple. On moist, fertile soils, aspen is succeeded by balsam fir or white spruce, and on wetter sites by balsam fir, black spruce, or white cedar (Ohmann et al. 1978). Many of the aspen stands along the Randeen Ridge on the WMA are over-mature and are being replaced by white spruce and balsam fir.

BUR OAK/UPLAND BRUSH. This type presently occurs on well-drained, sandy soils on remnant beach ridges. These areas were originally oak savanna. Bur oak was the dominant tree species, although white oak and black oak were also present. The oak savanna was maintained by recurrent wildfires. The exclusion of fires after settlement favored an increase in woody species. Present stands include a higher number of oak and aspen trees and have a well developed shrub understory which includes American and beaked hazel, chokecherry, juneberry, and arrow-wood.

In the absence of disturbance, an oak forest will develop (Curtis 1959). Bur oak, which does not reproduce well in shade, will eventually be replaced by shade-tolerant trees. Periodic fires would reduce the shrub understory and favor grasses and the fire-resistant bur oaks.

MIXED DECIDUOUS/CONIFEROUS. This upland type is a mixture of trembling aspen, balsam poplar, paper birch, black ash, white spruce, and balsam fir. Aspen is generally the most abundant overstory species, but in certain stands the frequency of spruce and balsam fir may approach or exceed aspen. Understory shrub and ground cover species composition is similar to the aspen type.

Without disturbance, succession will favor the replacement of the shade-intolerant, short-lived species such as aspen and birch by shade-tolerant species such as white spruce and balsam fir. On wetter sites, black ash and black spruce will eventually dominate.

BOTTOMLAND HARDWOOD. The bottomland hardwood type occurs on poorly drained and periodically flooded mineral soils. This type is found along portions of the Thief and Moose Rivers as well as adjacent to wetlands. American elm, black and green ash, boxelder, balsam poplar, and willow are the dominant tree species. Common understory vegetation includes red-osier dogwood, willow, and raspberry. Ground cover is dominated by species such as stinging nettle, dodder, and wild cucumber.

The major dominants of this type are capable of self-regeneration and form a relatively stable community (Curtis 1959). Changes resulting in drier soil conditions would favor the invasion of more mesic species such as oaks, aspen, and paper birch.

CLEARED/ASPEN-BRUSH. This type includes areas cleared with a bulldozer to provide felled browse for deer during winter and to promote the regeneration of browse species. Clearing occurred mostly in mature aspen stands. Aspen is generally the dominant regenerating species, but willow may be common on wetter sites. If undisturbed, these areas will develop into aspen stands.

WHITE SPRUCE/BALSAM FIR. This type occurs as small stands on upland sites. White spruce and balsam fir are the dominant tree species, but aspen and paper birch are common associates. Understory shrub and ground cover species composition is similar to the aspen and mixed deciduous/coniferous types.

The spruce-fir forest is considered the climax forest type over much of the region occupied by aspen and birch (Ohmann et al. 1978). White spruce and balsam fir are shade-tolerant and are capable of self-regeneration. Both species are susceptible to fire, high winds, and spruce budworm infestations. Openings created by disturbances may be replaced directly by spruce-fir or may have an intermediate and short-lived stage of aspen and birch (Curtis 1959). Many mature aspen stands on the management area have developed a spruce-fir understory, which will eventually dominate the stand as the aspen dies off.

PINE PLANTATION. Pine plantations occur on cutover upland sites and old fields. Red pine and white spruce are the most commonly planted species. On older sites, the dense overstory canopy limits understory growth.

OLD FIELD. Old fields include cropland and hay fields which have not been used for several years. Vegetation on these sites varies with the soil moisture conditions and the length of time since cultivation. Drier sites are dominated by species such as brome grass, quack grass, goldenrod, and ragweed. On wetter areas, common plants include bluejoint, reed canary grass, sedges, and others similar to the lowland brush type.

These sites will eventually be invaded by woody species unless they are periodically mowed, burned, or cultivated. Drier sites will become aspen, while wetter areas will develop into lowland brush.

AGRICULTURAL FIELDS. This type includes fields activity farmed for oats, wheat, flax, barley, and hay and areas used for pasture and summer fallow. In 1979, 535 acres of cropland and 239 acres of pasture and summer fallow were leased to local farmers. In addition, 450 acres were farmed by WMA personnel.

BLACK SPRUCE/TAMARACK. These lowland conifers are found on poorly drained peat soils. Species composition varies from pure stands to mixed associations. Common understory species include willow, red-osier and round-leafed dogwood, raspberry, bog birch, and alder. Ground cover consists of sphagnum moss or a combination of sedges and grasses. Ericaceous shrubs such as labrador tea, bog-rosemary, and leatherleaf are also common.

If undisturbed, this community can be long-lived. However, white cedar may eventually replace these conifers on some sites. Black spruce is highly susceptible to dwarf mistletoe infestations. Spruce-tamarack stands are also vulnerable to fire and high winds. Repeated severe fires will convert this type to sedge meadow. Openings created by smaller disturbances will allow brush growth, and eventually spruce-tamarack regeneration.

Vegetation on the Thief Lake WMA consists of a mixture of forests, cropland, old fields, and wetlands.

WHITE CEDAR. Stands dominated by white cedar are generally found along peatland margins, downslope from mineral soils. This type often merges with mixed coniferous-deciduous forests on adjacent mineral soils and black spruce and tamarack stands on peat soils (Heinselman 1970). Understory shrub and ground cover species composition is similar to the black spruce-tamarack type. The closed canopy, however, limits understory growth.

White cedar's shade-tolerance and vegetative reproduction tend to maintain stands for extremely long periods. Fires or flooding retard succession temporarily. Changes leading to drier conditions will allow the invasion of deciduous trees, such as black ash and aspen (Curtis 1959). Intensive browsing by wintering deer may destroy all vegetative reproduction, interfering with stand maintenance.

LOWLAND BRUSH. The lowland brush type occurs on waterlogged peat having standing water during part of the growing season. Alders and willows are the dominant shrub species, forming a dense thicket from 6 to 15 feet high. Bog birch and red-osier dogwood may also be present. Ground cover includes several kinds of sedges, reed canary grass, water-horehound, and water hemlock.

In the absence of major disturbances, this type may persist for long periods. Black spruce and tamarack invade these sites very slowly because of the dense shrub canopy. Repeated, severe fires could cause the reversion to a grass and sedge community.

SHRUB BOG (TYPE XIII). This type occurs on saturated peat soils peripheral to spruce-tamarack stands. Low-growing ericaceous shrubs including labrador tea, blueberry, cranberry, bog-rosemary, and bog-laurel are the major plants. Ground cover consists of an almost continuous blanket of sphagnum moss.

Periodic fires will perpetuate the shrub bog type. If protected from fire, this community will eventually be replaced by lowland brush or black spruce-tamarack types.

TEMPORARY WETLAND (TYPE II). Temporary wetlands occur on sites where shallow water stands for only a few weeks during the spring and following summer floods. Soils are saturated with water to within a few inches of the surface throughout all but the driest growing seasons. Cattails and common reed occur in the wetter areas. Species found in somewhat drier areas include sedges, reed canary grass, water hemlock, swamp milkweed, water-horehound, and blue flag. Scattered willows, alders, and red-osier dogwood may be present.

In the absence of fire and other disturbances, alder, willow, and red-osier dogwood will invade these wetlands, creating a dense shrub thicket. Eventually, tamarack and black spruce may become established.

SEASONAL WETLAND (TYPE III). This wetland has water depths up to 30 inches in the spring, but the standing water disappears by mid to late summer in many years. Cattails predominate in many such wetlands, sometimes interspersed with common reed. Other emergents include hardstem and softstem bulrush, sedges, and willows. Submergents, including water milfoil, coontail, and bladderwort, are found in areas having deeper, more open water.

SEMI-PERMANENT WETLAND (TYPE IV). This type of marsh has water depths up to five feet and contains surface water throughout the entire growing season. Species composition is influenced by water depth, seasonal water level fluctuations, and water chemistry. Type IV wetlands include Thief Lake and the deeper potholes on the WMA.

Common emergents found in this type include cattail, common reed, hardstem bulrush, and, in shallower water, arrow-head, water-plantian, sedges, willows, and alders. Common submergents include water milfoil, musk grass, bladderwort, and several species of pondweed (Minnesota Conservation Department 1964).

Vegetation on wetland sites depends on the depth, permanence, and chemistry of the water; on soil types; and on the degree of disturbance, usually fires. If a semi-permanent wetland was undisturbed over long periods (thousands of years), it would succeed by sedimentation through the seasonal and temporary wetland phases to lowland brush and finally to a lowland forest of spruce, tamarack, or white cedar. Sufficiently increased water depth and permanence will set back succession.

Birds. The Thief Lake WMA's diverse vegetation attracts a large variety and number of birds. A list of bird species known to occur or probably occurring on or near the unit was compiled by comparing lists from Robert Janssen of the Minnesota Ornithologists' Union, the Agassiz National Wildlife Refuge, and DNR personnel with species lists and accounts available in the literature (Table 4). The estimates of abundance are related to both the number and visibility of each species. Many species, especially migrants, may be uncommon or rare because preferred habitat on the area may be lacking or because the unit lies near the normal limit of a species' range.

Most bird species found on the area probably occurred before settlement. However, man's activities have altered the relative abundance of some species and have caused the introduction, extirpation, or range expansion of other species. As settlement progressed, species able to utilize man-altered habitats increased; some birds requiring specialized habitats decreased.

Prior to 1890, greater sandhill cranes were common summer residents in Marshall County (Roberts 1936). A drastic decline in crane numbers, however, occurred as settlement progressed. During this period, large numbers of cranes were harvested and critical wetland habitat was drained for agriculture. A gradual recovery has occurred in Minnesota in recent years, and the species was removed from the U.S. Fish and Wildlife Service "Endangered List" in 1973 (U.S. Department of the Interior 1974). The largest concentration of breeding sandhill cranes in the state occurs in the northwest region, including Beltrami, Lake of the Woods, Marshall, Kittson, Pennington, Polk, and Roseau Counties (Henderson 1978). At least five pairs of cranes nest on the management area.

Prior to drainage, Thief Lake was a prime waterfowl area. After a visit in 1901, Roberts (1936) reported that "thousands of ducks and some Canada geese were nesting at that time in that paradise for waterfowl."

The woodcock, a popular game bird species, commonly nests on the management area.

Table 4. Bird species and their relative abundance in the Thief Lake WMA vicinity.

Common Name	Permanent Resident	Migrant	Summer Resident	Winter Resident
Common Loon		U	U	
Red-necked Grebe		C	C	
Horned Grebe		C	C	
Eared Grebe		U	U	
Western Grebe		C	C	
Pied-billed Grebe		A	A	
White Pelican		C		
Double-crested Cormorant		C	C	
Great Blue Heron		C	C	
Green Heron		U		
Cattle Egret		R		
Great Egret		U	U	
Black-crowned Night Heron		A	A	
Least Bittern		U	U	
American Bittern		C	C	
Whistling Swan[1]		C		
*Canada Goose		A	A	
*White-fronted Goose		U		
*Snow Goose		C		
*Mallard		A	A	
*Black Duck		U		
*Gadwall		A/C	A/C	
*Pintail		A/C	A/C	
*Green-winged Teal		C	C	
*Blue-winged Teal		A	A	
*American Wigeon		C	C	
*Northern Shoveler		C	C	
*Wood Duck		C	U	
*Redhead		C	C	
*Ring-necked Duck		A/C	A/C	
*Canvasback		C	C	
*Greater Scaup		R		
*Lesser Scaup		C	C	
*Common Goldeneye		C		
*Bufflehead		C		
*Oldsquaw		R		
*White-winged Scoter		U		
*Black Scoter		VR		
*Ruddy Duck		C	C	
*Hooded Merganser		C	C	
*Common Merganser		C	C	
*Red-breasted Merganser		U/R		
Turkey Vulture		U/R		
Goshawk		R		R
Sharp-shinned Hawk		U		
Cooper's Hawk		R		
Red-tailed Hawk		C	C	
Red-shouldered Hawk		VR		
Broad-winged Hawk		C/U	C/U	
Swainson's Hawk		R		
Rough-legged Hawk		C		C
Golden Eagle		U		U
Bald Eagle		U		
Marsh Hawk		U/C	U/C	
Osprey		U		
Peregrine Falcon		R		
Merlin		R		
American Kestrel		C/U	C/U	
*Ruffed Grouse	C			
*Sharp-tailed Grouse	C/U			
*Gray Partridge	C			
Sandhill Crane[1]		C	C	
King Rail		VR		
*Virginia Rail		U	U	
*Sora		C	C	
Common Gallinule		VR		
*American Coot		A	A	
Semipalmated Plover		U/C		
Killdeer		A/C	A/C	
American Golden Plover		U/C		
Black-bellied Plover		U		
Ruddy Turnstone		U		
*American Woodcock		U/C	U/C	
*Common Snipe		C	C	
Whimbrel		R		
Upland Sandpiper		U	U	
Spotted Sandpiper		U/C	U/C	
Solitary Sandpiper		U		
Greater Yellowlegs		U/C		
Lesser Yellowlegs		C/A		
Willet		R		
Red Knot		R		
Pectoral Sandpiper		C		
White-rumped Sandpiper		U/C		
Baird's Sandpiper		U		
Least Sandpiper		C		
Dunlin		U		
Semipalmated Sandpiper		C		
Western Sandpiper		U/R		
Sanderling		U		

Common Name	Permanent Resident	Migrant	Summer Resident	Winter Resident
Short-billed Dowitcher		U		
Long-billed Dowitcher		U		
Stilt Sandpiper		U		
Buff-breasted Sandpiper		R		
Marbled Godwit		U/C	U/C	
Hudsonian Godwit		U		
American Avocet		U/R		
Wilson's Phalarope		U	U	
Northern Phalarope		U		
Herring Gull		C/U		
Ring-billed Gull		C		
Franklin's Gull		A/C	A/C	
Bonaparte's Gull		U		
Forster's Tern		C	C	
Common Tern		U/R		
Caspian Tern		U		
Black Tern		A/C	A/C	
Rock Dove	A			
Mourning Dove		A/C	A/C	
Yellow-billed Cuckoo		R	R	
Black-billed Cuckoo		U	U	
Screech Owl		R		
Great Horned Owl	C			
Snowy Owl		U		U
Hawk Owl		R		R
Barred Owl	U			
Great Gray Owl		R		R
Long-eared Owl		R		
Short-eared Owl		U		
Boreal Owl		VR		
Saw-whet Owl		R		
Whip-poor-will		U	U	
Common Nighthawk		C	C	
Chimney Swift		C	C	
Ruby-throated Hummingbird		C/U	C/U	
Belted Kingfisher		C/U	C/U	
Common Flicker		A/C	A/C	
Pileated Woodpecker	U/R			
Red-headed Woodpecker		U	U	
Yellow-bellied Sapsucker		U/C	U/C	
Hairy Woodpecker	C/U			
Downy Woodpecker	C			
Black-backed 3-toed Woodpecker	R			
Eastern Kingbird		C	C	
Western Kingbird		U	U	
Great Crested Flycatcher		U	U	
Eastern Phoebe		U	U	
Yellow-bellied Flycather		U/R		
Acadian Flycatcher		U		
Alder Flycatcher		U	U	
Least Flycatcher		C	C	
Eastern Wood Pewee		C	C	
Olive-sided Flycatcher		U/R	U/R	
Horned Lark		C	C	
Tree Swallow		A/C	A/C	
Bank Swallow		C	C	
Rough-winged Swallow		U/R	U/R	
Barn Swallow		A/C	A/C	
Cliff Swallow		A	A	
Purple Martin		C/U	C/U	
Gray Jay		U		U
Blue Jay	C			
Black-billed Magpie		U/C		U/C
Common Raven		C		C
Common Crow		A/C	A/C	
Black-capped Chickadee	C			
Boreal Chickadee		R		R
White-breasted Nuthatch	U			
Red-breasted Nuthatch		U		
Brown Creeper		U		
House Wren		C	C	
Winter Wren		U/R	C	
Long-billed Marsh Wren		C	C	
Short-billed Marsh Wren		C	C	
Mockingbird		R		
Gray Catbird		C	C	
Brown Thrasher		C/U	C/U	
American Robin		A/C	A/C	
Wood Thrush		R	R	
Hermit Thrush		U	U	
Swainson's Thrush		U	U	
Gray-cheeked Thrush		U		
Veery		C	C	
Eastern Bluebird		U	U	
Golden-crowned Kinglet		C/U	C/U	
Ruby-crowned Kinglet		C/U	C/U	
Water Pipit		C/U		
Bohemian Waxwing		R		
Cedar Waxwing		C	C	

Table 4 (continued)

Common Name	Permanent Resident	Migrant	Summer Resident	Winter Resident
Northern Shrike		U/C	U/C	
Loggerhead Shrike		VR		
Starling	A			
Yellow-throated Vireo		U		U
Solitary Vireo		U	U	
Red-eyed Vireo		C/U	C/U	
Philadelphia Vireo		U		
Warbling Vireo		U/C	U/C	
Black-and-white Warbler		U	U	
Prothonotary Warbler		VR		
Golden-winged Warbler		VR		
Tennessee Warbler		C	C	
Orange-crowned Warbler		U		
Nashville Warbler		C	C	
Northern Parula		R		
Yellow Warbler		C	C	
Magnolia Warbler		U	U	
Cape May Warbler		U	U	
Yellow-rumped Warbler		C/A	C/A	
Black-throated Green Warbler		U	U	
Blackburnian Warbler		U/R	U/R	
Chestnut-sided Warbler		C/U	C/U	
Bay-breasted Warbler		U	U	
Blackpoll Warbler		U/C		
Pine Warbler		R	R	
Palm Warbler		C/U	C/U	
Ovenbird		C/U	C/U	
Northern Waterthrush		U		
Connecticut Warbler		U/R	U/R	
Mourning Warbler		U	U/C	
Common Yellowthroat		C	C	
Wilson's Warbler		U		
Canada Warbler		U	U	
American Redstart		U	U	
House Sparrow	A			
Boblink		C	C	
Eastern Meadowlark		U	U	
Western Meadowlark		A/C	A/C	
Yellowheaded Blackbird		A/C	A/C	
Red-winged Blackbird		A/C	A/C	
Orchard Oriole		R		
Northern Oriole		C	C	
Rusty Blackbird		C		
Brewer's Blackbird		C	C	
Common Grackle		A	A	
Brown-headed Cowbird		A/C	A/C	
Scarlet Tanager		U/R	U/R	
Rose-breasted Grosbeak		C	C	
Indigo Bunting		C/U	C/U	
Evening Grosbeak				V
Purple Finch		C/U	C/U	C/U
Pine Grosbeak		V		V
Hoary Redpoll		U		U
Common Redpoll		A/C		A/C
Pine Siskin		C/U		
American Goldfinch		C	C	
Red Crossbill				V
White-winged Crossbill				V
Rufous-sided Towhee		U/R	U/R	
Savannah Sparrow		A/C	A/C	
Grasshopper Sparrow		U/R	U/R	
Le Conte's Sparrow		U	U	
Sharp-tailed Sparrow		U	U	
Vesper Sparrow		C/U	C/U	
Dark-eyed Junco		A/C		
Tree Sparrow		A/C		A/C
Chipping Sparrow		C/U	C/U	
Clay-colored Sparrow		C	C	
Field Sparrow		VR		
Harris' Sparrow		C/U		
White-crowned Sparrow		C/U		
White-throated Sparrow		C	C	
Fox Sparrow		C		
Lincoln's Sparrow		U		
Swamp Sparrow		C	C	
Song Sparrow		A/C	A/C	
Lapland Longspur		C/U		
Snow Bunting		A/C		A/C

* Species with Minnesota hunting seasons.

[1] Protected in Minnesota but hunted in other states.

A = abundant, C = common, U = uncommon, R = rare, VR = very rare, V = variable, may be locally common in some years and absent in others.

Canvasbacks and redheads were reported to be common breeding birds on Thief and Mud Lakes. Reports of market hunters shooting a "wagonload" of ducks in one day were not uncommon (Solum 1976). Drainage of the lake in 1916 virtually destroyed the area for waterfowl. Waterfowl returned to Thief Lake after its restoration in the 1930's, but never in the numbers that occurred prior to drainage.

Of the 257 species that may occur on the management area (Table 4), 151 are permanent or summer residents and commonly nest on the area. Fall and spring migrants account for 87 species and 19 occur as winter residents.

Thirty-four bird species, protected under Minnesota Statutes, Sec. 100.27 (1978), may be taken only during authorized hunting seasons. All other species, except house sparrows, starlings, and rock doves, are protected by state or federal laws and have no open season in Minnesota. Among the game birds found on the management area are 26 species of waterfowl; 16 of these commonly nest on the area. Other resident birds associated with wetlands include the American coot, sora, Virginia rail, and the common snipe.

Four species of upland game birds occur on the management area. Ruffed grouse, sharp-tailed grouse, and gray or Hungarian partridge are permanent residents, while the woodcock is a summer resident. Woodcock and ruffed grouse are found mainly in the forested areas, while sharp-tailed grouse and gray partridge occur in more open areas such as grasslands, brushy areas, and croplands. Each spring, ruffed grouse drumming is recorded along established routes to provide an index to population levels (Table 5). Grouse numbers on the management area have generally been below the averages for northwestern and northcentral Minnesota. Surveys to estimate woodcock, sharp-tailed grouse, and gray partridge population levels are not conducted on the unit. However, two to three sharp-tailed grouse dancing grounds are located on the management area, four to six on the west supplement, and two to three on the northeast supplement.

Thief Lake is an important stopping place for waterfowl in migration. The mallard is the most abundant migrant species. Counts of peak mallard populations on the area ranged from 4,000 to 13,000 between 1975 and 1978. Duck species most commonly taken by hunters from 1968 to 1979 were: mallard, lesser scaup, ring-necked duck, redhead, blue-winged teal, wigeon, and gadwall.

Waterfowl production on the WMA is determined by aerial and roadside counts of breeding pairs. Breeding pair counts conducted by DNR personnel from 1950 to 1979 indicate that mallards, blue-winged teal, and ring-necked ducks were the most abundant breeding ducks. The estimated breeding population on the management area is between 1,000 and 3,000 pairs.

Beginning in 1959, giant Canada geese were transferred to Thief Lake from the Carlos Avery Game Farm to reestablish a resident flock and to attract migrating geese. From 1959 to 1961, a total of 192 goslings were wing-clipped and released in an enclosure constructed near the WMA headquarters. The birds were held until after their first breeding season

Table 5. Average number of ruffed grouse drums per stop for the Thief Lake WMA, northwestern Minnesota, and northcentral Minnesota, 1968 - 1979.

Year	Thief Lake WMA	Northwestern Minnesota[1]	Northcentral Minnesota
1968	0.40	—	2.60
1969	2.40	—	2.80
1970	1.30	—	3.10
1971	0.70	—	3.30
1972	1.90	—	3.40
1973	0.10	1.30	1.30
1974	0.30	0.80	1.10
1975	0.90	1.30	1.40
1976	0.60	0.80	1.50
1977	0.40	1.00	1.60
1978	0.80	1.90	2.40
1979	2.60	1.68	2.24

1 Includes the Thief Lake WMA.
Source: Minnesota DNR, Section of Wildlife.

and then were allowed to fly free along with their progeny. Currently, a resident flock of about 30 pairs produces about 75 fledged young per year, and the fall population is approximately 150 geese (Table 6).

The number of fall migrating geese using the management area peaked in 1969 at 20,000 birds. The peak population in 1979 was 9,000 birds (Table 6). The first geese usually arrive in early to mid-September, with numbers building to a peak in late September or early October. Total Canada goose use-day estimates fluctuated from 97,200 in 1974 to 432,600 in 1972 (Table 6). One goose use-day is one goose present for one day. It is estimated that between 160 and 2,200 Canada geese have been harvested annually between 1970 and 1979.

The Canada geese that use the WMA during migration are mostly from the Eastern Prairie Population, which nests near the southwestern shore of Hudson Bay and winters in Missouri (Bellrose 1976). The Canada geese at Thief Lake are primarily of three subspecies. In 1979, subspecies were harvested in approximately the following proportions: 84 percent medium-sized Canada geese ("Todd's" or "interior"), 7 percent giant Canada geese ("maxima"), and 9 percent small Canada geese ("Richardson's").

Snow geese also stop at the area during spring and fall migrations. Peak numbers in spring are usually less than 100 and fall peaks in recent years have ranged from 400 in 1977 to 4,000 in 1979.

The management area is also important for a variety of nongame birds. Migrating and resident shorebirds are commonly observed in the wetlands. White

Table 6. Estimated Canada goose numbers, production, use, and harvest at the Thief Lake WMA, 1969-1979.

Year	Resident Spring Population	Breeding Pairs	Production (Goslings)	Peak Fall Migrant Population	Goose Use-days[1]	Harvest
1969	—	—	100	20,000	—	—
1970	—	—	125	12,000	—	341
1971	—	—	200	—	—	160
1972	—	75	100	12,000	432,200	910
1973	220	60	75-100	10,000	256,611	1,400
1974	220	50	100	10,000	97,200	1,230
1975	—	40	75	16,000	361,126	2,187
1976	200	30	50	6,700	136,306	207
1977	200	25	35	13,000	260,200	1,230
1978	150	30	75	10,000	213,750	1,250
1979	—	20	50	9,000	162,750	1,520

1 One goose use-day is the presence of one goose for one day.

pelicans are observed on Thief Lake during spring and fall migrations. Abandoned cropland and agricultural fields provide habitat for such species as the mourning dove, rock dove, horned lark, western meadowlark, bobolink, and savannah sparrow. Wood warblers, flycatchers, vireos, woodpeckers, and thrushes occur in the forests. Twenty-five species of migrant and resident raptors may occur on the area. The red-tailed hawk, broad-winged hawk, American kestrel, and great horned owl are the most common resident raptors. Bald and golden eagles are commonly observed during spring and fall, but probably do not nest in the area. Nongame birds are most abundant during the fall and spring migrations.

Mammals. Most mammals found in the vicinity today were present during presettlement times. As settlement progressed, habitat destruction and uncontrolled hunting and trapping resulted in the decimation and, in some cases, the elimination of several larger mammals from the area. The historical distribution of small, inconspicuous species is unknown. Even today the occurrence of some species has not been verified on or near the management area.

Elk originally occupied much of the prairie and open woodland in Minnesota. As settlement expanded during the late nineteenth century, the elk population declined drastically, and, by 1900, elk has disappeared from the state. Reintroduction efforts begin in 1913, when 56 animals were obtained from Wyoming and released into a 700-acre enclosure in Itasca State Park. Between 1914 and 1934, surplus animals were released in various state parks and the Superior National Forest. In 1934, the remaining 27 animals were released in the Beltrami Island area, north of Upper Red Lake (Gunderson and Beer 1953). By 1940, the herd had expanded to about 100 animals and ranged in portions of Lake of the Woods, Beltrami, and Roseau Counties. Only about 20 elk currently remain, primarily in a 4-township area in eastern Marshall and western Beltrami Counties which includes a portion of the Thief Lake WMA.

Woodland caribou were once found over much of northern Minnesota but by the 1930's had been reduced to a small remnant herd in the Red Lake bog, north of Upper Red Lake. In 1938, 10 caribou from Canada were released in the bog in an attempt to replenish the herd. This effort failed and there have been no reports of caribou in the area since 1943 (Gunderson and Beer 1953).

Moose were probably common in this region during presettlement times. Settlement resulted in drainage, land clearing, and unregulated hunting, which by the 1920's had nearly eliminated the moose. Much of this farmland was abandoned during the 1930's and reverted back to brushland and forests. In addition, moose were protected between 1922 and 1970. As a result, the moose population has expanded during the past 40 years (Phillips et al. 1973). A regulated harvest has been in effect in alternate years since 1971. Recently, however, land clearing has intensified, resulting in a reduction of habitat and a gradual decline in moose numbers.

White-tailed deer were probably uncommon in the prairie-forest transition zone at settlement. Deer numbers increased somewhat after settlement, then increased even more with greater protection after the 1930's. Deer are near the northern limit of their range here, and populations may be severely reduced by hard winters. Declining habitat has also recently caused a gradual population decline.

Mammal species present on the management area were determined from information supplied by Bemidji State University and Minnesota DNR, Section of Wildlife records and personnel (Table 7). Forty-three mammal species occur on or near the management area. An additional 13 species possibly occur, but no positive evidence is available. Mule deer have been recorded in Marshall County but only as rare or transient visitors.

Eighteen of these 57 mammal species are protected under Minnesota Statutes, Sec. 100.27 (1978) and may be taken only during authorized hunting or trapping seasons. The gray wolf (eastern timber wolf) and elk are afforded special protection by state or federal laws and have no open season in Minnesota. The remaining species are unprotected by Minnesota laws. Two of these, the coyote and striped skunk, are trapped for their fur. On wildlife management areas, however, unprotected wild animals may be taken only from September 1 through the last day of February.

The gray wolf in Minnesota is classified by the U.S. Fish and Wildlife Service as a threatened species. A

Table 7. Mammals occurring in the Thief Lake WMA vicinity.[1]

Masked shrew	*Muskrat
Water shrew	Southern bog lemming[2]
Arctic shrew	Northern bog lemming[2]
Pygmy shrew	Norway rat
Short-tailed shrew	House mouse
Star-nosed mole	*Meadow jumping mouse
Little brown myotis	Woodland jumping mouse
Silver-haired bat[2]	Porcupine
Big brown bat	Coyote
Red bat	Gray wolf[2] (eastern timber wolf)
Hoary bat	*Red fox
*Eastern cottontail[2]	*Black bear
*Snowshoe hare	*Raccoon
*White-tailed jack rabbit	*Fisher
Eastern chipmunk	Ermine (short-tailed weasel)
Least chipmunk[2]	Least weasel
Woodchuck	Long-tailed weasel
Thirteen-lined ground squirrel	*Mink
Franklin's ground squirrel	*Badger
*Gray squirrel	Striped skunk
*Fox squirrel[2]	*River otter
Red squirrel	*Lynx
Northern flying squirrel	*Bobcat
Northern pocket gopher[2]	Elk[2]
Plains pocket gopher[2]	Mule deer[2]
*Beaver	*White-tailed deer
Deer mouse	*Moose
White-footed mouse	
Southern red-backed vole	
Meadow vole	

* Game species — may be taken only under DNR regulations.
[1] Names and sequence of mammal species follow Jones et al. 1975.
[2] Possible occurrence.
[3] Special protection under state or federal laws.
[4] Rare or transient occurrence.

White-tailed deer are the most common large mammal on the unit.

few lone or paired wolves occur on the management area and vicinity at times, but are probably only transitory and do not establish permanent territories.

White-tailed deer are the most common large mammal on the area. Winter aerial surveys were conducted in 1975-77 and 1979 to estimate deer population levels on a 178 square mile area, including the Thief Lake WMA. The number of observed deer ranged from 90 to 314 animals. When corrected for deer unobserved because of tree cover, density estimates ranged from 8 to 28 deer per square mile (Table 8). Based on spring pellet-group counts, density estimates in Lake of the Woods and northern Beltrami Counties showed a similar trend (Table 8).

Moose are also common on the management area. Winter aerial moose surveys have been conducted annually by the Division of Fish and Wildlife since 1962. Moose numbers have fluctuated but have generally remained stable in northwestern Minnesota since 1974-75 (Table 9). No density estimates are available for the management area.

Muskrat, beaver, mink, snowshoe hare, raccoon, and red fox are common on the area. Fisher and bobcat are occasionally found in the forested areas, and river otter may inhabit Thief Lake and its tributaries. Lynx are rare, but are occassionally found on the area, especially in years of high populations when individuals may immigrate from Canada.

Although generally inconspicuous, small mammals representative of deciduous forest, coniferous forest, bog, wetland, and grassland communities occur on the management area. Several species of voles, mice, shrews, bats, and squirrels are common.

Table 8. Estimates of deer per square mile for the Thief Lake WMA and vicinity and Lake of the Woods and northern Beltrami Counties, 1975-80.

Year	Thief Lake WMA and Vicinity[1]	Lake of the Woods and northern Beltrami Counties[2]
1975	8	11.1 ± 3.0[3]
1976	14	10.9 ± 3.3
1977	28	17.2 ± 4.5
1978	ND[4]	7.4 ± 5.3
1979	12.5	12.5 ± 3.6
1980	ND	10.9 ± 3.7

[1] Based on winter aerial surveys
[2] Based on spring pellet-group surveys.
[3] Mean number of deer per square mile ± 2 standard errors.
[4] ND = no data, survey not conducted.

Fish. Water bodies on the area are managed primarily for waterfowl and other wetland wildlife and not for fish production. Thief Lake, Moose River, and Thief River do not support a large or diverse fish population because of frequent low water levels, oxygen depletions, and winter freeze outs.

Although intensive fish surveys have not been con-

Table 9. Moose population estimates for northwestern Minnesota based on winter aerial surveys, 1962-1980.

Census Period	Estimated Population
1962-63	1,450 ± 350[1]
1963-64	1,450 ± 350
1964-65	ND[2]
1965-66	1,840 ± 290
1966-67	1,900 ± 400
1967-68	1,835 ± 260
1968-69	1,620 ± 220
1969-70	ND
1970-71	2,040 ± 430
1971-72 [3]	2,350[4]
1972-73	3,144 ± 572
1973-74	2,686 ± 544
1974-75	3,539 ± 1,070
1975-76[3,5]	2,416 ± 522
1976-77	3,562 ± 1,331
1977-78[3]	2,518 ± 713
1978-79	2,156 ± 473
1979-80	2,800 ± 600

1. Mean number ± 2 standard errors.
2. No data.
3. Posthunt census.
4. No standard error reported.
5. Area restratified for sampling.

Source: Minnesota DNR, Section of Wildlife.

ducted, 14 nongame fish and one game fish species are known to occur in the Thief and Moose Rivers (Table 10). Species common to the Moose River probably occur in Thief Lake. An additional 10 game fish and 35 nongame fish species have been found in lakes and streams within the Red Lake River watershed (Table 10).

Table 10. Fish species occurring in the Red Lake River watershed.[1]

Chestnut lamprey	Fathead minnow[2,3]
*Lake sturgeon	*Channel catfish
Bowfin	Brown bullhead
*Brown Trout	Black bullhead
Lake white fish	Tadpole madtom
Carpsucker spp.[2]	Stonecat
Golden redhorse	Central mudminnow[2,3]
Silver redhorse	*Northern pike[2]
Shorthead redhorse	Banded killifish
White sucker[2,3]	Burbot
Carp	Trout-perch
Creek chub[3]	*Large-mouth bass
Golden shiner	*Green sunfish
Emerald shiner	*Pumpkinseed
Rosy face shiner	*Bluegill
Common shiner[2]	*Rock bass
Weed shiner	*Black crappie
Blackchin shiner	*Walleye
Spottail shinner	Yellow perch
Bigmouth shiner[2]	Blackside darter[2]
Blacknose shiner	River darter
Mimic shiner	Johnny darter[2]
Northern redbelly dace[2,3]	Iowa darter[2,3]
Fine scale dace[2,3]	Freshwater drum
Hornyhead chub	Slimmy sculpin
Silver chub	Mottled sculpin
Blacknose dace	Brook stickleback[2,3]
Longnose dace	
Brassy minnow	
Bluntnose minnow	

[1] Names and sequence of fish follow American Fisheries Society (1970).
[2] Occurs in the Thief River.
[3] Occurs in the Moose River.
* Game species — may be taken only according to Minnesota DNR regulations.

OPERATIONS

The operation of the Thief Lake WMA depends on capital improvements, staff, equipment, and funding. The relationship of the area to other Minnesota DNR functions in Region I is important to the understanding of administrative and funding procedures and problems. Knowledge of the present operation is necessary to formulate a comprehensive plan that will utilize existing development and equipment and can be implemented under anticipated budgetary and administrative constraints.

ADMINISTRATION AND FISCAL

The Thief Lake WMA is one of 925 state wildlife management areas and is administered through the DNR Region I office in Bemidji. Region I consists of 21 counties and includes 323 wildlife management areas with approximately 644,000 managed acres. Ten area wildlife managers manage 319 of the wildlife areas, while four resident managers direct four additional units. The regional wildlife manager supervises wildlife management in Region I.

Wildlife and fish administration and management in Minnesota is financed primarily through appropriations from the Game and Fish Fund. Receipts from hunting, trapping, and fishing license sales, cash receipts from wildlife management areas, and federal-aid matching funds are deposited into the Game and Fish Fund. These monies are dedicated for state-wide fish and wildlife management and are appropriated to the Minnesota DNR.

Federal matching funds are derived from the Federal Aid in Wildlife Restoration Act (Pittman-Robertson Act) and the Federal Aid in Sport Fish Restoration Act (Dingell-Johnson Act). These acts impose excise taxes on sporting arms, archery equipment, and fishing equipment. Funds from these taxes are used to match state funds on a 3:1 ratio for federally approved wildlife and fish projects.

Expenditures for salaries, taxes, equipment, and other operating expenses on the Thief Lake WMA, estimated from the regional wildlife manager's records, totaled approximately $138,452 in fiscal year 1977 (July 1, 1977 to June 30, 1978) and $137,249 in fiscal year 1979 (Table 11). Salaries and benefits for permanent employees were over 45 percent of the expenses. Expenditures for seasonal laborers were about 20 percent of the total; however, spending in this category varies greatly in response to total regional funding, special needs on the unit, or special appropriations. On agricultural leases on the management area, the state receives a share of the cooperator's crop instead of cash rent.

Equipment, major equipment and building repairs, real estate taxes, and some capital improvements are budgeted through the DNR Field Services Bureau. These expenses vary yearly depending on equipment and management needs. Equipment needs and major capital improvements, such as buildings, dikes, and control structures, are funded on a region-wide priority basis. Supplemental legislative appropriations such as Wildlife Management Area Betterment, and the Waterfowl Habitat Improvement Program provide funding for some improvement projects.

Payments in lieu of taxes are made to counties for all state lands purchased for public hunting grounds and game refuges, except state Trust Fund lands. Payments are disbursed from the Game and Fish Fund at a rate of $0.50 per acre or 35 percent of the gross receipts, whichever is greater (Minnesota Statutes, Sec. 97.49, Subd. 3, 1978). A third alternative method of determining in lieu of tax payments will become effective July 1, 1981 (Minnesota Laws, Ch. 301, 1979). This method will tax qualifying lands at the rate of 3/4 of 1 percent of the appraised market value if this value is greater than $0.50 per acre or 35 percent of the gross receipts. Payments of $0.50 per acre total $9,578 per year for the Thief Lake unit.

Effective July 1, 1979, additional in lieu of tax payments are made to counties in which certain natural resource lands are located. Payments are disbursed from general funds at the rate of: (1) $3 per acre for state natural resource lands which were previously privately-owned and were acquired by purchase, condemnation, or gift, (2) 75 cents per acre for state tax-forfeited lands administered by the county, and (3) 37.5 cents per acre for other state lands administered by the DNR, including tax-forfeited, Trust Fund, and Consolidated Conservation Area lands (Minnesota Laws, Ch. 303, 1979). Any payments to the counties during the preceding year from the DNR under Minnesota Statutes 84A.51, 89.036, and 97.49 are deducted from the amounts levied under this provision. Annual payments to Marshall County for the Thief Lake WMA under this provision total about $60,000.

In addition, Minnesota Statutes, Sec. 272.011 (1978) requires the state to pay real estate taxes to counties for all state-owned residences occupied by state employees. These taxes are paid from the Minnesota DNR Field Services budget, 27 percent of which is derived from the Game and Fish Fund. In 1979, $802 in real estate taxes were paid to Marshall County for the state-owned residences at the Thief Lake WMA headquarters.

CAPITAL IMPROVEMENTS

Seventeen buildings are located at the area headquarters (Table 12). Eleven of these were constructed by the Civilian Conservation Corps between 1930 and 1937 and, except for the manager's and assistant manager's residences and a pump house, are in poor condition. An office building; portable shed; utility building housing an office, garage, and maintenance facilities; and three grain bins were constructed by the state between 1953 and 1969 and are in fair or good condition. A cabin was relocated near the headquarters and converted into a hunter registration station in 1974.

Capital improvements used by visitors are limited to roads, bridges, trails, parking areas, and water access sites. Sixteen miles of improved roads, three bridges,

Table 11. Expenditures on the Thief Lake WMA, fiscal years 1978 and 1979.

	1978	1979
Regional expenditures		
Permanent salaries and benefits	$ 62,709	$ 72,078
Seasonal and hourly salaries and benefits	31,483	29,856
Retail purchases and contract services	33,880	24,935
Equipment purchases	0	0
Land Bureau and Administrative Service Expenditures		
Payment in Lieu of Taxes	9,578	9,578
Real Estate Taxes	802	802
Total Expenditures	$138,452	$137,249

Table 12. Buildings maintained on the Thief Lake WMA.

Building	Dimensions (Feet)	Construction Date	Inventory Number	Condition
Utility Building (wood, 2 stories, 6 rooms)	28' x 55'	1968	1626-1262	Good
Residence (stone, wood, 1 story, 8 rooms)	27' x 41'	1937	1626-1263	Good
Residence (wood, 2 stories, 8 rooms)	25' x 34'	1932	1626-1264	Good
Cabin-check station (goose hunt registration center)	16' x 20'	1930	1626-1265	Poor
Garage (wood, 1 story, 1 room)	12' x 20'	1935	1626-1266	Poor
Machine Shed	32' x 108'	1935	1626-1267	Poor
Grain Bin	14' diam.	1961	1626-1268	Good
Grain Bin	14' diam.	1964	1626-1269	Good
Grain Bin	18' diam.	1969	1626-1270	Good
Granary	12' x 20'	1935	1626-1271	Poor
Granary	14' x 16'	1935	1626-1272	Poor
Garage & Stockroom (wood, 1½ story, 3 rooms)	32' x 42'	1935	1626-1273	Poor
Storage Shed	12' x 16'	1935	1626-1274	Poor
Wood Shed	16' x 18'	1930	1626-1275	Poor
Office Building (wood, 1 story, 3 rooms)	24' x 32'	1953	1626-1276	Good
Pump House	10' x 17'	1935	1626-1277	Good
Portable Building (wood, 2 story, 1 room)	6' x 8'	1964	1626-1278	Fair

and four improved water access sites are maintained by the Division of Fish and Wildlife (Figure 4). Besides parking provided at the access sites and the registration station, various sized lots are located along roads around the lake.

Two concrete dams have been constructed on the management area. Water levels on the lake are regulated by the Thief River dam, a 60 foot, 10-bay structure with removable stoplogs and two sliding gates. The Haroldson dam, a 4-bay dam on the Moose River, was constructed in 1937 but has never been operational.

EQUIPMENT

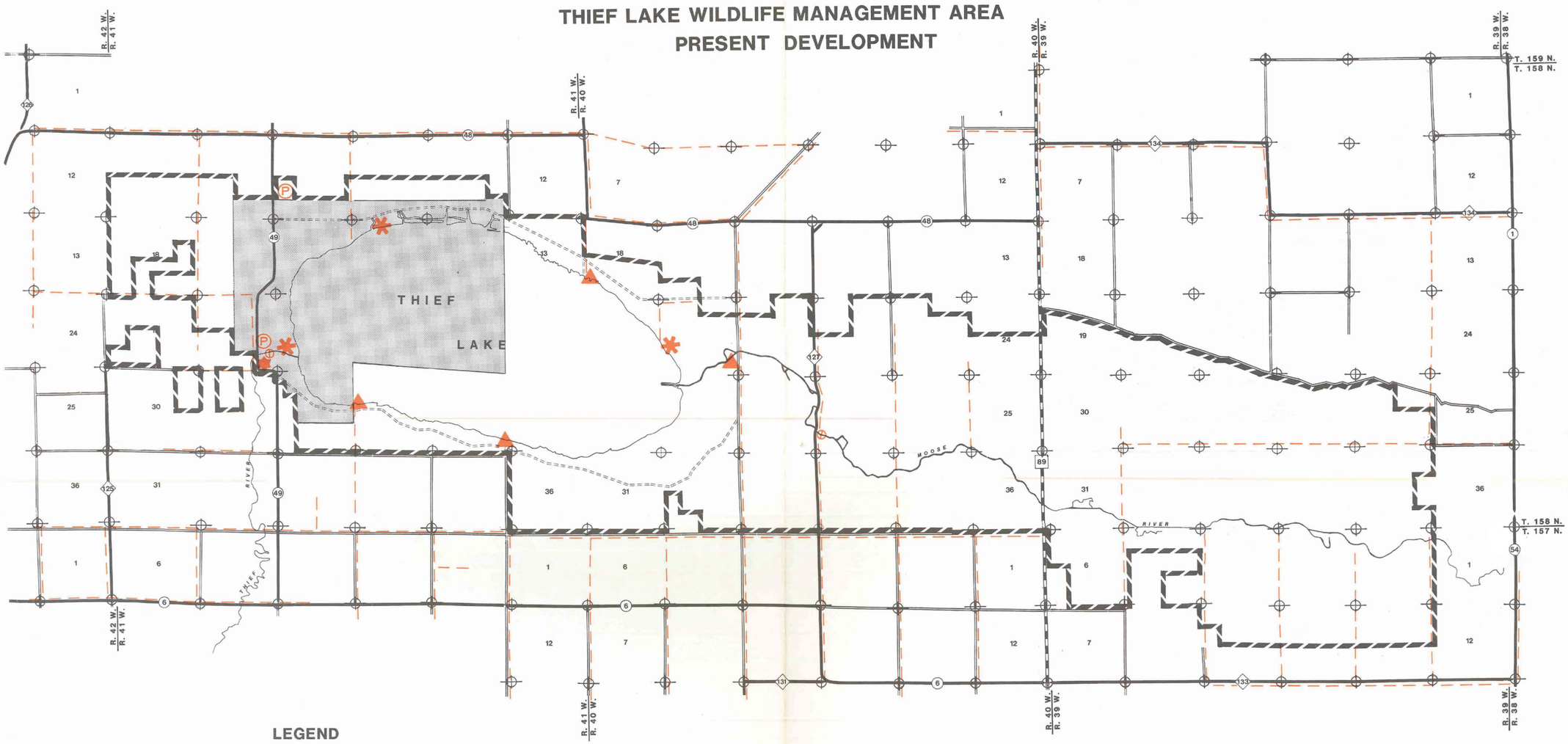
Thirty-two pieces of major equipment are maintained on the area (Table 13). The equipment is used mostly on the Thief Lake WMA but may be utilized at times on other Region I wildlife projects. Light and heavy duty trucks are used to transport personnel, equipment, and material. Tractors and farm implements are used for agricultural operations and vegetation management. Heavy equipment is used for construction and maintenance of roads, parking lots, and ditches, and for vegetation clearing.

STAFF

The Thief Lake WMA employs four full-time and two seasonal personnel. The manager, assistant manager, one general repair worker, and one laborer are full-time; two laborers work April through December. The general repair worker and laborer are on intermittant heavy equipment operation status. Temporary hourly laborers may be employed as needed if funds are available. Additional personnel have been employed in the past through federal and state programs for youth and the unemployed.

FIGURE 4. PRESENT DEVELOPMENT

THIEF LAKE WILDLIFE MANAGEMENT AREA
PRESENT DEVELOPMENT



LEGEND

- WILDLIFE SANCTUARY NO TRESPASSING
- W.M.A. BOUNDARY
- DRAINAGE DITCH
- WATERFOWL FEEDING SITE
- WATER ACCESS SITE/PARKING AREA
- PARKING
- DAM
- HEADQUARTERS
- W.M.A. ROAD
- TOWNSHIP ROAD
- COUNTY ROAD
- COUNTY STATE AID HIGHWAY
- STATE HIGHWAY
- SECTION CORNER

N

scale in miles

0 1 2

Table 13. Equipment based on the Thief Lake WMA

Equipment	Make/Model	Model year	Inventory Number	Condition
Truck, pickup	Dodge/D100, ½ton	1972	1246-117786	Good
Truck, pickup	Dodge/D100, ½ton	1972	1246-117787	Good
Truck, van, 6x6	GMC/2½ ton	1956	1246-269690	Fair
Truck, dump	International/1800	1975	1246-173094	Excellent
Truck, pickup, 4x4	Military	Unk.[1]	1246-265578	Poor
Truck, 6x6	Military cargo	Unk.	1246-146403	Fair
Truck, pickup, 4x4	Dodge/½ ton	1973	1246-174404	Fair
Truck, tractor	Ford/F950	1960	1246-001724	Fair
Tractor, farm	Minneapolis Moline	Unk.	938-296575	Fair
Tractor, farm	John Deere/4230	1975	938-198940	Good
Tractor, farm	Ford/3000	1973	938-129187	Good
Tractor, farm	International/656	1968	938-638	Fair
Tractor, towing	Massey Ferguson/M35	Unk.	938-146401	Fair
Tractor, loader, backhole	International	Unk.	938-202417	Fair
Dozer	International/TD24	Unk.	938-257156	Fair[3]
Crane	Truck-mounted	Unk.	1246-211532	Good[3]
Dragline	Byers	Unk.	1574-146615	Fair
Road grader[2]	Gallon/503A	1972	760-119196	Good
All-terrain-vehicle	Ranger/V	1966	3350-805	Fair
All-terrain-vehicle	Thiokol/601	1963	938-146421	Good
Mower, lawn	Toro/800	1969	739-1575	Fair
Mower, tractor, 7'	International/200	1970	739-1652	Good
Outboard motor	Johnson/5hp.	1953	1513-623	Fair
Outboard motor	Johnson/3hp.	1955	1513-684	Fair
Boat, aluminum	AlumaCraft/14'	1954	842-746	Good
Trailer	2 wheel	Unk.	1191-600	Poor
Trailer, tractor	Dorsey/lowboy	Unk.	1191-967	Fair
Elevator, portable auger	Centurl/6"x72'	1963	1311-19	Fair
Plow, 4-bottom	International/14" shares	1968	728-258	Fair
Plow, chisel	John Deere	Unk.	738-260119	Excellent
Plow, chisel	John Deere	Unk.	738-260119	Excellent
Disc	John Deere	Unk.	789-170369	Good
Cultivator	McCormick/#9	1964	789-326	Good
Harrow, coil spring	International/320	1968	789-350	Fair
Harrow, disc	Ford	Unk.	787-277011	Good
Grain drill, double disc	McCormick/#10, 12'	1963	848-55	Good
Seeder	Cyclone	Unk.	856-198297	Good
Corn planter	John Deere/2 row	Unk.	774-69	Fair
Weed sprayer, field — boom type w/tank	Fast-o-Matic/P-30-T	1962	881-244	Good

[1] Unk. = Unknown.
[2] Region IV equipment on loan.
[3] In need of repair.

LAND OWNERSHIP

Land ownership and policies bear strongly on natural resource management. The management goals and acquisition status are affected by the project acquisition history, present land ownership patterns, and the sources of acquisition funds.

ACQUISITION OF WILDLIFE LANDS

The Commissioner of Natural Resources is authorized to acquire lands for wildlife management purposes (Minnesota Statutes, Secs. 97.48 and 97.481, 1978). However, before acquisition begins, the Section of Wildlife prepares project proposals which identify areas desirable for wildlife land acquisition. The Director of the Division of Fish and Wildlife has the authority to approve project proposals for the Commissioner of Natural Resources. After approval of the project proposal, the Division of Fish and Wildlife may attempt to acquire lands within the project boundary from willing sellers. The division must also obtain approval from the appropriate county board before any purchase may be completed.

Acquisition of wildlife lands has been financed primarily through appropriations from the Game and Fish Fund and with federal matching funds derived from the Federal Aid in Wildlife Restoration Act (Pittman-Robertson Act). Pittman-Robertson funds are used to match state funds on a 3:1 ratio for federally approved acquisition projects. Since the mid-1960's, significant appropriations for wildlife land acquisition have also been made from general revenue funds by the Minnesota Legislature through the Legislative Commission on Minnesota Resources.

Federal law requires federal aid project lands to be managed for approved project purposes only. Other uses of these lands could be considered a diversion of funds (Code of Federal Regulations, Title 50, Chap. 1, Sec. 80.5) and could cause the federal government to suspend all federal aid to fish and wildlife projects in the state, which totals about $3,000,000 per year. A diversion of funds created by non-approved activities can be rectified by: a) replacing the affected property with a property of equal current market value with commensurate values to fish and wildlife; or b) ceasing the uses which interfere with the accomplishment of approved project goals. Generally, the approved project activities for the Thief Lake WMA are the operation of a game refuge and public hunting grounds and the improvement of wildlife habitats.

The Commissioner of Natural Resources may dedicate Consolidated Conservation lands to wildlife management areas and transfer administrative control of these lands to the Division of Fish and Wildlife (Minnesota Statutes, Sec. 97.481, 1978). Dedicated Consolidated Conservation lands are protected from sale.

ACQUISITION OF THE PRESENT WMA

Land acquisition for the Thief Lake WMA began in 1931 when 14,593 acres of private, Trust Fund, and tax-forfeited lands were condemned and purchased by the state for the restoration of Thief Lake. About 3,571 acres of private and four acres of federal land were added between 1932 and 1970. In 1960, 12,528 acres of Consolidated Conservation lands were formally dedicated to the management area by the Commissioner of Natural Resources; an additional 400 acres have been dedicated since 1962. In 1966, 1,800 acres of Trust Fund lands were purchased. To date, 32,895 acres have been acquired by the Division of Fish and Wildlife (Table 14, Figure 5).

Table 14. Previous land ownership and method of acquisition of Division of Fish and Wildlife lands in the Thief Lake WMA.

Previous Ownership	Acres	Method of Acquisition
Private	3,570.7	Fee purchase
	14,388.11	Fee purchase by condemnation
Federal	3.85	Acquired federal patent
State		
Consolidated Conservation	12,927.74	Dedicated by the Commissioner of Natural Resources
Tax-forfeited	120.0	Purchase
Trust Fund	1,884.6	Purchase by condemnation
Total	32,895.0	

FIGURE 5. LAND OWNERSHIP AND ACQUISITION PRIORITIES

THIEF LAKE WILDLIFE MANAGEMENT AREA
LAND OWNERSHIP AND ACQUISITION PRIORITIES

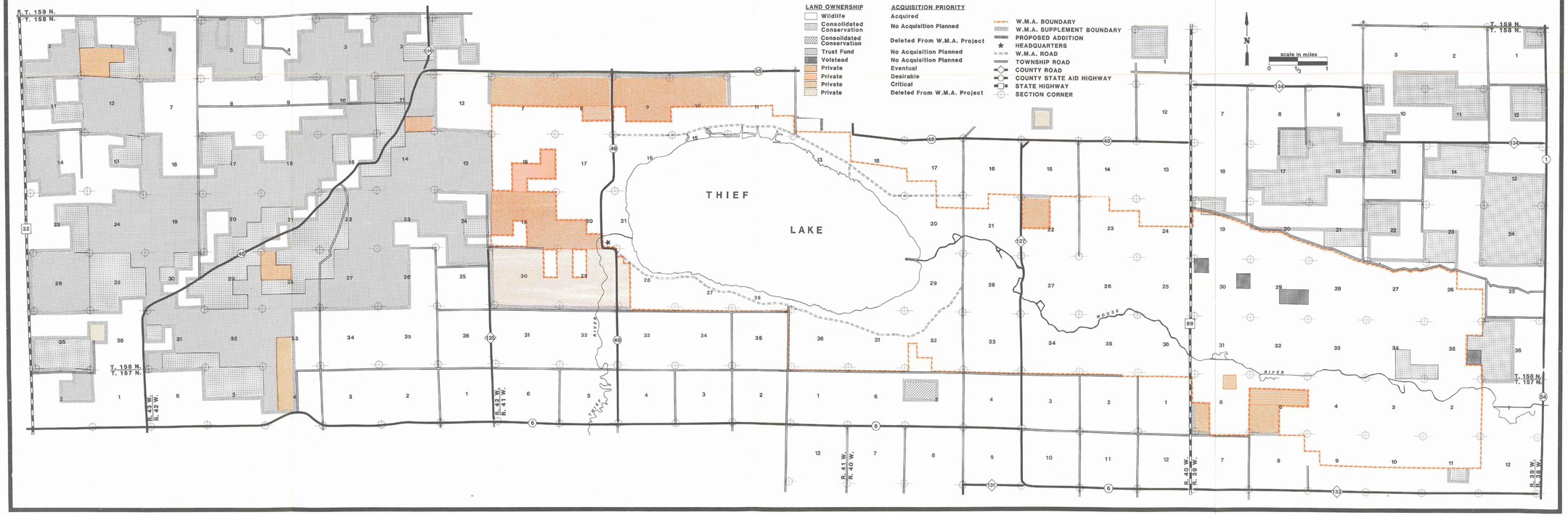


Table 15. Sources of funds and acreage purchased by the Division of Fish and Wildlife in the Thief Lake WMA.

Acquisition Method	Sources and Amounts of Funds: Federal Aid in Wildlife Restoration[1]	Sources and Amounts of Funds: Minnesota Game and Fish Fund	Acres
Section of Wildlife Project	$ 0	$106,797	15,001
Federal Aid Project	42,949	14,316	4,962
Consolidated Conservation Area Dedication (no funds involved)	0	0	12,928
Federal patent transfer	0	0	4
Totals	$42,949	$121,113	32,895

[1] Pittman-Robertson Act.

Over $164,000 has been spent on land acquisition in the Thief Lake WMA by the Division of Fish and Wildlife (Table 15). Fifteen percent of the land was purchased through Pittman-Robertson projects. Approximately 46 percent of the land was purchased solely with Game and Fish Fund monies. The remainder of the land consists of Consolidated Conservation lands dedicated at no cost to the DNR.

WMA SUPPLEMENT

Project proposals approved by the Division of Fish and Wildlife in 1959, 1967, and 1975 established a 27,032-acre supplement to the Thief Lake WMA (Figure 5). Eighty-one percent (21,966 acres) of the supplement is state-owned and administered by the Division of Forestry (Table 16). The remaining 5,066 acres are privately owned. Land acquisition is discussed further in the management section on "Thief Lake WMA Supplement — Management, Administration, and Acquisition."

Table 16. Ownership and acreage of unacquired land within the Thief Lake WMA approved project.

Present Ownership Classification	Administrator	Acres	Percent of total
State			
Consolidated Conservation	DNR-Division of Forestry	9,292	34.3
Trust Fund	DNR-Division of Forestry	12,478	46.3
Volstead	DNR-Division of Forestry	196	0.7
Private		5,066	18.7
TOTAL		27,032	100.0

LOCAL PERSPECTIVE

Fish and wildlife management is influenced by factors in the management area vicinity. Land use and ownership, demographic characteristics, and economic conditions must be examined before formulating a comprehensive plan. Development or the potential for development adjacent to the management area may affect future management decisions. In addition, the availability of public lands for outdoor recreation in the vicinity will influence the demand for recreation on the Thief Lake WMA.

GENERAL

The management area is located in one of the least populated regions of the state. Roseau and Marshall Counties rank 80th and 81st among Minnesota's 87 counties in population density, with 7.8 and 7.3 persons per square mile (Minnesota State Planning Agency 1980). A 12 percent population increase is expected in Roseau County by 1990, while population levels in Marshall County should increase by 4.5 percent (Minnesota State Planning Agency 1979). Thief River Falls (population 8,929) and Roseau (population 2,552), the largest cities in the local area, are 40 and 20 highway miles from the Thief Lake WMA. Grand Forks, North Dakota (population 61,000) is about 70 miles southwest of the unit, and the Twin Cities lie about 320 miles to the southeast.

The two counties are primarily agricultural. Fifty-five percent of Marshall and Roseau Counties is cultivated and 15 percent is pasture or open land (Table 17) (Minnesota State Planning Agency 1975). In 1974, about 39 percent of the two counties' population resided on farms (Minnesota Department of Agricultural 1975). The average farm is 452 acres, 71 percent larger than the state average. Although the number of people living on farms has decreased, the acres of land in production has increased by 18 percent since 1967 (Minnesota Department of Agriculture 1967, 1978). Cash crops provided about 80 percent of the two counties' farm income in 1979 (Minnesota Department of Agriculture 1979). Wheat is the principal crop, followed by barley, oats, hay, and flax. Sunflowers have been an increasingly important crop in northwestern Minnesota in recent years. Total acreage in sunflowers in Marshall and Roseau Counties has increased from 3,300 acres in 1971 to 79,000 acres in 1978. Livestock include beef and dairy cattle, hogs, and sheep.

Forests occupy 20 percent of the counties' land, but over 70 percent of the forest is in Roseau County (Table 17). Much of the timber is low quality aspen, but some merchantable softwoods are available. Timber harvest is of little importance to the economies of the two counties. Markets for spruce and pine in the area are good, while aspen demand is low. The DNR, Division of Forestry, however, expects the demand for aspen to increase as new wood-products plants are developed in northcentral Minnesota.

Wetlands occur on 9 percent of the land in the two

Table 17. General land use in Marshall and Roseau Counties.

	Marshall		Roseau	
	Acres	Percent	Acres	Percent
Forested	127,684	11	313,618	29
Cultivated	766,102	66	465,019	43
Pasture and open	185,722	16	151,402	14
Marsh	58,038	5	140,587	13
Residential	4,080	T[1]	3,680	T
Water	11,608	1	10,814	1

[1] Trace
Source: Minnesota State Planning Agency 1975.

counties (Table 17). Few lakes exist and only about 1 percent of the area is open water.

Land use patterns in northwest Minnesota are clearly visible on an infrared photo taken in late August, 1978 by a LANDSAT satellite from an altitude of 570 miles (Figure 6). The regular patchwork pattern is composed of agricultural fields. Intensive agriculture occurs immediately north and south of the Thief Lake WMA. The open areas without fields are primarily extensive wetlands or coarse-soiled beach ridges. The vast undeveloped area to the east is the Red Lake peatland. The Agassiz National Wildlife Refuge is located to the south of the WMA.

Although the economy of the area is primarily agricultural, other activities employ the majority of the wage-earners. Retail and wholesale trade and services employ over half of the workers. Manufacturing, led by snowmobiles and related equipment and lumber and millwork products, employs over 20 percent of the salaried workers. Tourist-travel related business, such as that generated by the WMA, accounts for less than 5 percent of the total sales in Roseau County and less than 1 percent in Marshall County (Minnesota Department of Economic Development 1975).

Outdoor recreation in the 2-county area is provided for with much public land but few developed facilities (Table 18). In addition to the Thief Lake WMA, there are 2,987 acres in two state parks, 94,618 acres in 13 additional wildlife management areas, 76,404 acres of the Beltrami Island State Forest, and 61,487 acres in the Agassiz National Wildlife Refuge (Figure 7). Other recreational facilities include eight campgrounds with 110 campsites, 16 picnic areas, and over 60 miles of recreational trails. Water-based facilities include five water accesses, two swimming beaches, and one marina.

Other recreational facilities outside the 2-county area may influence the demand for recreation on the Thief Lake WMA. The Twin Lakes WMA (7,930 acres) in Kittson County and the Red Lake WMA (284,106 acres) and portions of the Beltrami Island State Forest (430,364 acres) in Beltrami and Lake of the Woods Counties are within 50 miles of the unit (Figure 7).

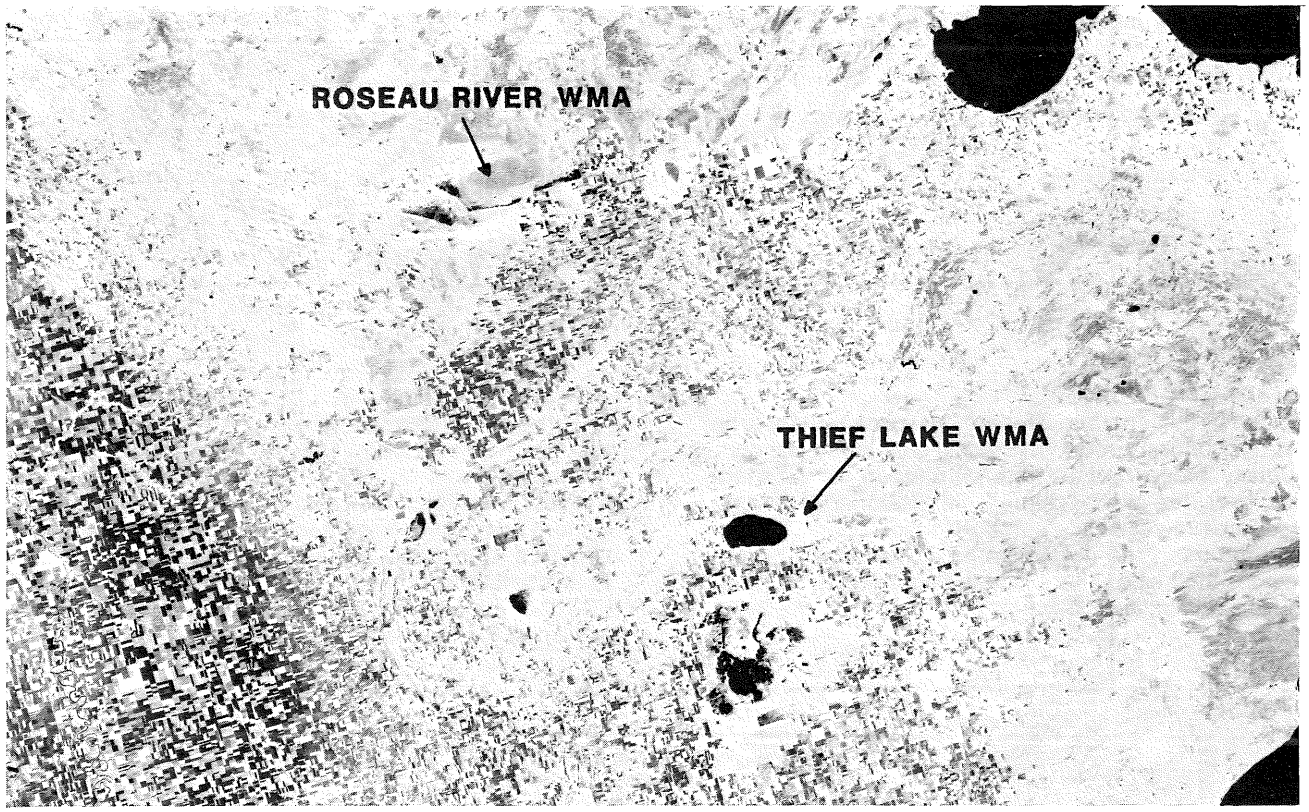


Figure 6

Table 18. Selected public use facilities in Marshall and Roseau Counties.

Area	Name	Marshall	Roseau
State Parks (acres)	Old Mill	287	
	Hayes Lake		2,700
Wildlife Management Areas (acres)	Agder	240	
	East Park	9,033	
	Eckvoll	6,600	
	Elm Lake	15,253	
	Espelie	160	
	Florian	1,005	
	Grygla	320	
	Mudlac	240	
	Whiteford	80	
	Roseau River		61,333
	Border		266
	Grimstad		8
	R.C. 3		80
National Wildlife Refuge	Agassiz		61,487
State Forest (acres)	Beltrami Island		76,404
Water Accesses	Sites	0	5
	Acres	0	29
Trails (miles)	Snowmobile	5	3
	Hiking	7	8
	Cross-country skiing	2	5
Camping Areas	Areas	3	5
	Campsites	64	44
Picnic Areas	Areas	8	8
	Tables	152	31
Water Facilities	Swimming beaches	2	0
	Marinas	0	1

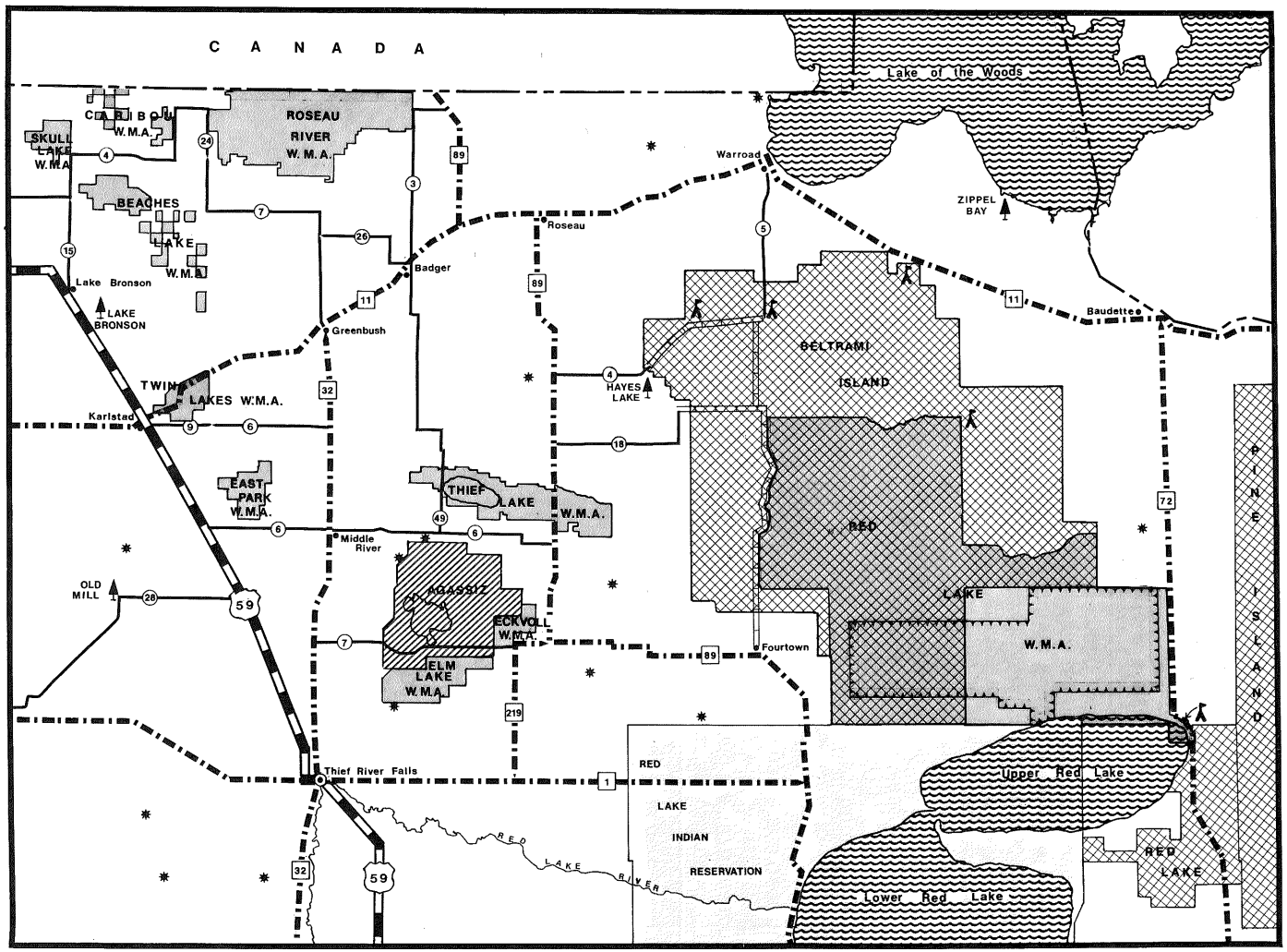
ADJACENT DEVELOPMENT

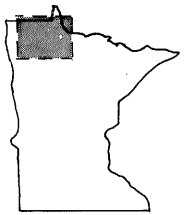
Much of the land surrounding the management area is in agricultural production. Additional lands are continuously being drained and/or cleared for farming. Local pressure exists for the Commissioner of Natural Resources to reclassify certain Consolidated Conservation lands in the northwest as agricultural lands to allow for their sale. There is little commercial, residential, and associated development near the management area.

AGASSIZ NATIONAL WILDLIFE REFUGE

This 61,487-acre refuge is located five miles south of the Thief Lake WMA. The refuge has 18 impoundments and a total of 37,000 acres of wetlands. A network of roads, trails, and dikes provides access for visitors and for management purposes. The refuge includes a 4,000-acre wilderness area, a 4-mile public auto drive, and a ¼-mile nature trail. No camping or off-road vehicles are allowed. Portions of the refuge are open for deer and moose hunting.

SELECTED STATE AND FEDERAL AREAS IN NORTHWESTERN MINNESOTA





LEGEND

- LARGE WILDLIFE MANAGEMENT AREA
- SMALL WILDLIFE MANAGEMENT AREA
- STATE FOREST
- STATE PARK
- STATE FOREST CAMPGROUND
- PEATLAND NATIONAL LANDMARK BOUNDARY
- NATIONAL WILDLIFE REFUGE
- INDIAN RESERVATION
- INTERNATIONAL BOUNDARY
- U. S. HIGHWAY
- STATE HIGHWAY
- COUNTY ROAD
- STATE FOREST ROAD

Scale in Miles
0 5 10 20

N

Figure 7

PUBLIC USE

Minnesota wildlife management areas are used for public hunting, trapping, fishing, and other activities compatible with wildlife and fish management. Outdoor recreation has always accounted for the largest share of public use on the Thief Lake WMA, but the area is also used for nonrecreational activities such as environmental education and farming. Knowledge of the present use levels is necessary to predict the future demand for outdoor recreation and to prepare management programs.

Public use figures for the Thief Lake WMA were obtained from estimates by WMA personnel and from a public use survey conducted for this plan from June to December, 1978. Questionnaires were placed on cars parked on the WMA on randomly selected days. Responses to the questionnaires were used to estimate public use types and levels and to determine the attitudes and demographic characteristics of area users. Although survey results do not represent absolute use figures, they provide reasonable estimates of use types and levels.

The units of public use in this section are use-days and visitor-days. A use-day is one person using the area for one activity on one day. A visitor-day is one person using the area on one day. One person may account for as many use-days as activities participated in on one day, but the person only accounts for one visitor-day. A description of survey techniques, data analysis, and additional results is presented in Appendix D.

A total of 446 questionnaires were distributed to area users; 162 (36 percent) were returned. Total visitor-days during this period were estimated at 7,310 (Table 19). Less than 1 percent of the total use occurred during the summer period (June 15 - September 15) and over 99 percent during the fall/winter period (September 16 — December 31). Only two parties were encountered during 15 summer survey routes.

HUNTING

Hunting has been the dominant recreational use of the Thief Lake WMA. In 1979, 98 percent of the parties surveyed hunted on the management area (Table 20). Based on survey results, an estimated 7,164 hunter use-days were spent during the 1978 season. Most use was by waterfowl hunters, with an estimated 5,811 use-days, followed by upland game and deer hunters with 1,645 and 1,133 use-days, respectively (Table 20). Forty-six percent of the waterfowlers hunted both ducks and geese, 35 percent hunted geese only, and 19 percent hunted ducks only.

WMA personnel monitor waterfowl hunting pressure by counts of cars parked on the unit, hunter bag-checks, and goose hunter registration. In 1978, total waterfowl hunting pressure was estimated at 10,600 use-days, compared to 5,811 estimated from the questionnaire survey. A total of 8,300 hunter use-days occurred during the 1979 waterfowl season. Use estimates by WMA personnel may provide the better estimate, as sampling was more intensive. The estimated average daily use of Thief Lake during the 1978 and 1979 waterfowl seasons was 117 and 89 hunters, respectively. A total of 2,267 and 2,151 hunters participated in the 1978 and 1979 controlled goose hunt.

Table 19. Distribution and percentage contribution of visitor use by season and type of day on the Thief Lake WMA, June 16 — December 31, 1978.

Type of Day/Season	Visitor-days	Percent total
Summer (June 16 — Sept. 15)		
Weekend	19	0.3
Weekday	0	0
Subtotal	19	0.3
Fall/Winter (Sept. 16 — Dec. 31)		
Weekend	4,787	65.5
Weekday	2,504	34.2
Subtotal	7,291	99.7
TOTAL	7,310	100.0

Table 20. Percent of parties participating in and estimated number of use-days for each of 13 major recreational activities on the Thief Lake WMA, June — December, 1978.

Activity	Percent of Parties	Use-days
Hunting	98	7,164
Waterfowl	80	5,811
Deer	16	1,133
Upland small game[1]	14	1,045
Camping	28	2,047
Observing nature	12	863
Bird watching	7	541
Boating/canoeing	6	453
Photography	5	366
Firewood gathering	4	314
Hiking	5	366
Picnicking	4	314
Trapping	1	73
Berry picking	2	146

[1] Includes ruffed and sharp-tailed grouse, gray partridge, and snowshoe hare hunting.

Most waterfowl hunting occurred during the first week of the season (Table 21). Hunting pressure was lower but comparable during the second and third weeks, but declined steadily after the third week.

Moose hunting seasons in Minnesota have been conducted in alternate years since 1971 on a permit-quota basis. Based on the number of moose killed on the WMA or on adjacent sections (61), the percent success for that zone (98.6), and the maximum party size (4), an estimated maximum of 248 moose hunters used the management area supplement and adjacent sections during the 1977 season.

Hunting pressure is not uniformly distributed over the management area because of habitat distribution, hunter preferences and habitats, and accessibility.

Table 21. Temporal distribution of waterfowl hunters on the Thief Lake WMA in 1978 and 1979.

Date	Percent Use 1978	1979
First week	33	38
Second week	23	26
Third week	23	21
Fourth week	12	12
Fifth week	5	3
Sixth week	4	T[1]

[1] T = trace.

Waterfowl hunting is the most popular recreational activity on the management area.

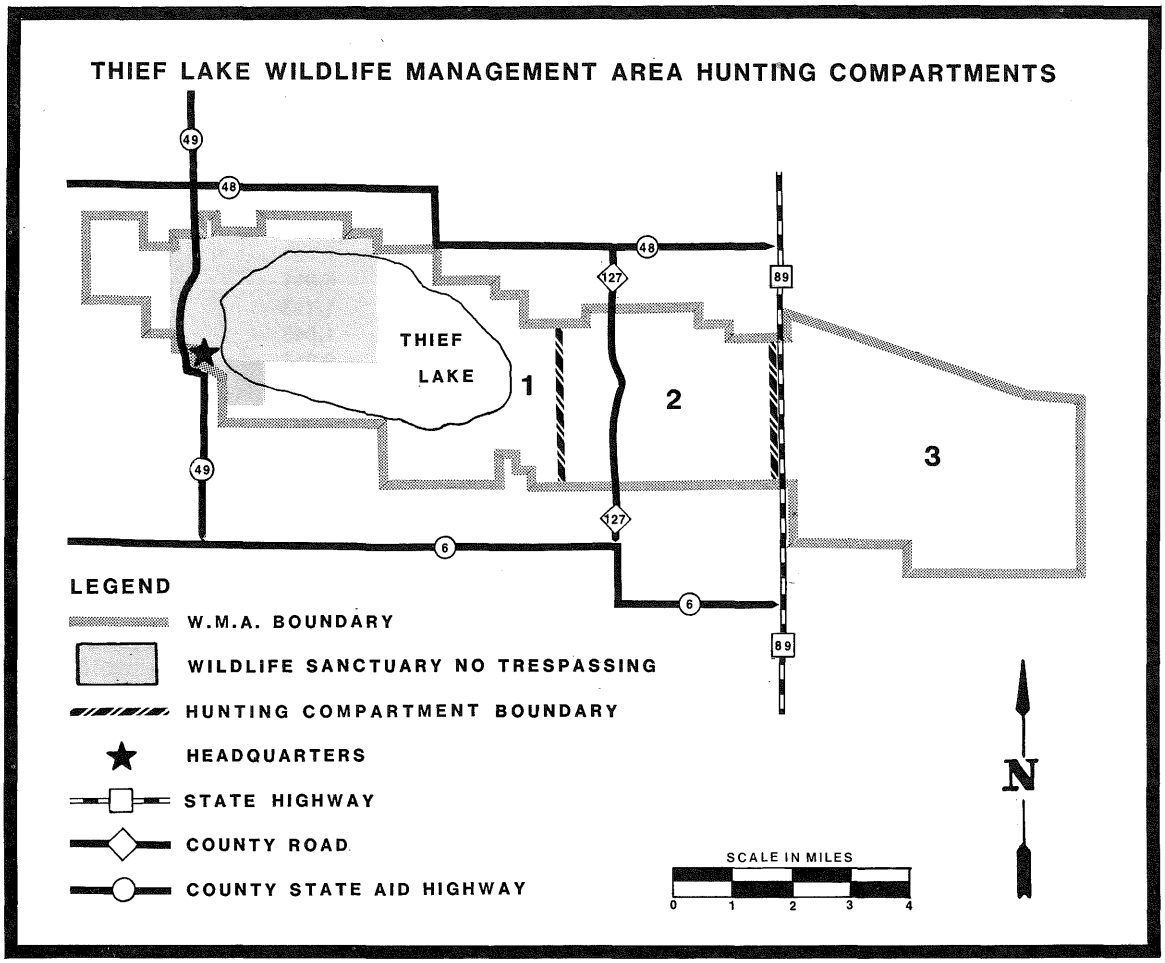


Figure 8

Visitors were asked to indicate on the survey questionnaires which of three hunting compartments (Figure 8) they used on the WMA. In the responding parties, 79 percent of the hunting occurred in Compartment 1, which includes the western one-third of the unit and Thief Lake (Table 22). Hunting pressure in Compartments 2 and 3 was similar but substantially lower. The majority of waterfowl and small game hunting occurred in Compartment 1, while deer hunting was relatively evenly distributed over all compartments. Most duck hunting is on Thief Lake from boats or canoes, but a few hunters walk to isolated potholes. Geese are also hunted on the lake, but most of the goose hunting is pass shooting from 58 blinds along the west and north sides of the Thief Lake wildlife sanctuary (Figure 9). The sanctuary includes the west end of Thief Lake and is closed to all entry.

Information on hunting success and harvest on the WMA is obtained from yearly spot checks of hunters. Waterfowl hunters have averaged between 1.32 and 1.42 ducks per hunt from 1972 to 1979. An estimated 3,720 ducks and 1,520 geese were harvested in 1979.

Table 22. Spatial distribution of hunters on the Thief Lake WMA in 1978 based on survey returns.

Compartment (See Figure 8)	Percent Use			
	Waterfowl	Firearms Deer[1]	Upland Small Game[2]	All hunting
1	92	32	81	79
2	7	35	15	13
3	1	32	4	7

[1] Nov. 4-19 bucks only, antlerless deer by permit Nov. 18-29, and special muzzleloader season Dec. 2-17.
[2] Includes ruffed grouse, sharp-tailed grouse, gray partridge, and snowshoe hare hunting.

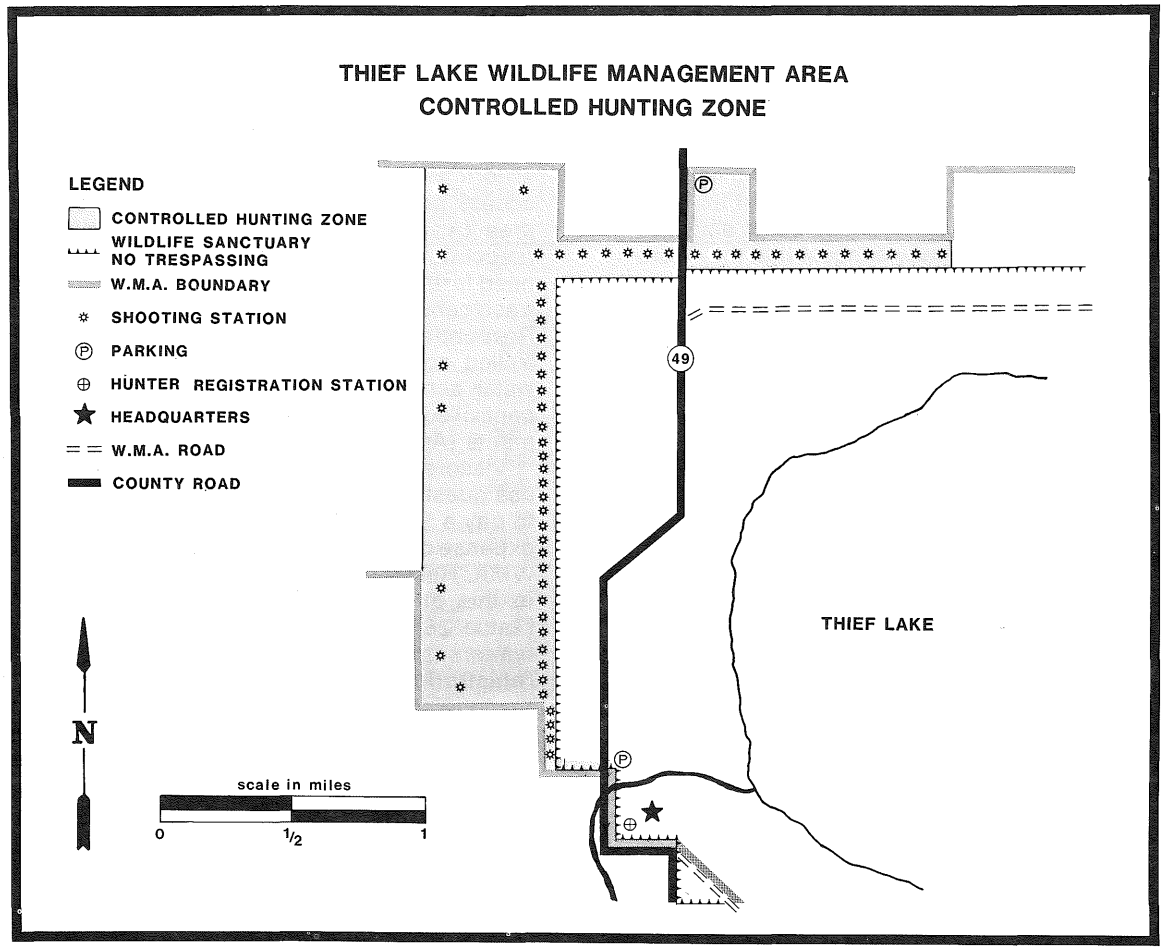


Figure 9

The moose kills for 1975 and 1977 on the unit and supplement were 49 and 61, respectively. No recent data are available for deer or grouse harvests.

TRAPPING

The resident manager issues general trapping permits and assigns each trapper to a specific area. Permits can be renewed annually. Vacancies and new permits are filled by a lottery system. Beaver permits for specific areas are issued separately. Between 8 and 17 general trapping permits and from one to six beaver permits have been issued yearly since 1972. The 1978 questionnaire survey estimated 73 trapping use-days (Table 23). Muskrat have been the most numerous species in the harvest. Mink, red fox, and raccoon are occasionally harvested. The estimated value of all pelts taken on the WMA from 1972 to 1978 averaged $4,541 per year, with a high of $10,336 in 1976 (Table 23).

Table 23. Fur harvest reported on the Thief Lake WMA, 1972 — 1978.

	Year						
	1972	1973	1974	1975	1976	1977	1978
Species							
Muskrat	537	927	824	1,097	2,422	2,125	465
Mink	3	9	4	11	3	6	7
Red fox	1	4	7	9	10	2	1
Raccoon	0	1	0	1	1	0	0
Lynx	1	0	0	0	0	0	0
Coyote	1	0	0	0	0	0	0
Number of Permits	8	9	16	15	17	13	11
Estimated value of fur	$1,357	$2,142	$2,266	$3,905	$10,336	$9,275	$2,507

OTHER RECREATIONAL ACTIVITIES

The management area is also used for other recreational activities. Of 161 parties responding to the 1978 questionnaire survey, 28 percent camped, 12 percent observed nature, 7 percent watched birds, 5 percent took photos, and 5 percent hiked on the area (Table 20). It is likely that most of these activities were incidental to hunting, since only 2 percent of the parties did not hunt. The fact that these other activities were mentioned, however, may suggest that they were of some importance to the participants. This survey was not designed to sample uses which did not involve parking a car on the unit. Such uses, including educational tours, snowmobiling, and miscellaneous sightseeing, occur on the unit, but no estimates of use-days are available.

VISITOR CHARACTERISTICS.

Visitors to the management area averaged 32 years of age. Over two-thirds, 70 percent, were younger than 40 years. Ninety-two percent were males. Only 4 percent of the respondents were out-of-state residents.

Most of the visitors (82 percent) traveled more than 50 miles to the management area (Table 24). Over 50 percent of the respondents had visited the unit at least once previously within the last year, averaging 2.6 trips. Most respondents came in groups of two to four individuals; average party size was 2.7 people. About one half, 53 percent, of the visitors to the area stayed longer than 24 hours. Visitors spent an average of $22 per visit per person locally (Table 25).

Sixty-five percent of the respondents rated their visit to the management area as good or very good. Only 15 percent of the visits were rated as poor or very poor. Respondents considered area appearance (wildness, scenic beauty); abundance of wildlife; hunting quality; waterfowl hunting; and parking, camping, and water access areas as the most important features of the area (Appendix D, Table 3). Seven percent of the respondents felt that the management area did not need further improvements. Most respondents felt that trash cans were needed at camping and access areas. Respondents also wanted to see changes in the controlled goose hunt; improved camping, parking, and water access areas; better posting of the refuge and controlled hunting zone; and wildlife habitat improvements (Appendix D, Table 4).

Visitors were also asked to indicate on the public use questionnaire whether or not they would be willing to pay a $3-5 or $5-10 fee per party to help cover the expense of the controlled goose hunt on the Thief Lake WMA. Nearly half, 45 percent, of the 133 respondents to this question stated that they would favor a fee (Table 26). Of the 133 respondents, 99 were goose hunters and about 45 percent of these favored a registration fee. Of the 34 non-goose hunters responding, 53 percent were against paying for a controlled unit. Thirty-seven percent of the hunters surveyed during the 1974 controlled goose hunt stated that they would be willing to pay a $4-5 registration fee per party.

Table 24. Traveling distance of visitors using the Thief Lake WMA.

Distance (miles)	Percent
0- 50	18.4
51-100	8.7
101-200	24.3
201-300[1]	16.1
> 300	2.5
Twin City Area[2]	26.3
Out-of-state	3.7

[1] Excluding the Twin City Area.
[2] Includes Ramsey, Hennepin, Washington, Dakota, Scott, Carver, and Anoka Counties.

Table 25. Average length of visit, party size, expenditures, and number of previous visits on the Thief Lake WMA.

Attribute	
Length of visit (hours)	44.6
Party size	2.7
Local expenditures/person/visit (dollars)	22.34
Number of previous visits/person in the past year	2.6

Table 26. Willingness of 133 respondents to pay a fee for the controlled goose hunt on the Thief Lake WMA.

	Number of Respondents	Willing to pay a fee (Percentage)		Amount (Percentage)	
		No	Yes	$3-5/party	$5-10/party
All respondents	133	54.9	45.1	75.0	25.0
Goose hunters	99	54.5	45.4	77.8	22.2
Non-goose hunters	34	52.9	47.1	75.0	25.0

AGRICULTURAL LEASES

Part of the cropland on the unit is leased to local farmers to provide fall and winter food for waterfowl, upland game, and deer; to provide small grain to reduce damage by waterfowl to crops on private lands; and to maintain open areas for some species of wildlife. In 1978 and 1979, cooperative farming agreements totaled 401 and 774 acres, respectively (Table 27). Leases were granted to three individuals in 1978 and seven in 1979. No cash income was received by the state, but cooperators were required to supply a share of their crop to the state (Table 27).

Table 27. Summary of agricultural lease agreements on the Thief Lake WMA, 1978 and 1979.

Crop	Acres		State Share: Unharvested (acres)		State Share: Harvested (acres)	
	1978	1979	1978	1979	1978	1979
Oats	70	161	0	0	5.8	40.25[4]
Winter Wheat	28	162	0	0	28	12.5
Flax	18	174	0	4	4.5	27.5[2]
Hay, tame	22	8	0	0	3.5	0
Pasture	80	80	0	0	0[1]	0[3]
Summer fallow	85	159	0	0	0	0
Timothy	55	0	0	0	0	0
Barley	0	30	0	0	0	0
Sweet Clover	43	0	0	0	10.8	0

[1] Plus 48 bushels of oats
[2] Plus 4 acres of baled flax.
[3] Plus 56 bushels of seed oats.
[4] Plus an amount of oats equal in value to 38 acres of wheat, 16 acres of flax, 7.5 acres of barley.

RECREATION DEMAND AND CAPACITY

Anticipating the demand for hunting, trapping, fishing and other compatible outdoor recreational uses is essential for the development of an effective management plan. By relating future demand to the recreational capacity of the area, programs can be designed to both utilize and protect the area's resources.

DEMAND

Predicting the wildlife and fish-oriented use of the Thief Lake WMA is difficult. Future hunting, trapping, and fishing demand can be estimated by examining state-wide population trends, license sales, game abundance and harvest, and availability of private and public lands for these activities. Demand for other types of compatible recreation can be projected from participation surveys if the survey limitations are recognized (Minnesota DNR 1974). This type of demand analysis must be general due to information limitation.

The Minnesota DNR presently administers over 925 wildlife management areas, totaling nearly 1 million acres. Because intensive agricultural practices, forest community succession, and increased posting of private lands has reduced the quality and quantity of land available for wildlife production and public hunting, wildlife management areas are increasingly important for both wildlife and sportsmen. Wildlife habitat improvement projects are also concentrated on wildlife management areas or other public lands and will attract an increasing number of hunters. Wildlife management areas are important for a growing number of urban hunters who have difficulty obtaining access to private land (Klessig 1970). As Minnesota's population increases, so will the number of hunters, especially the urban hunters who rely on wildlife management areas. Minnesota sportsmen and wildlife enthusiasts are mobile, so increased recreational pressure will be felt in relatively remote areas even though most of the demand will occur near population centers.

Deer hunting license sales have increased since 1940 at a rate greater than the overall population growth. Sales are expected to fluctuate near current levels of 250,000 to 350,000 with an upward trend through the next 10 years. Archery-deer license sales have followed a similar trend. However, the rate of increase from the low of 12,500 in 1970 to 1978 sales of 32,300 was over twice as great as the firearms license sales increase.

Small game license sales declined from a 1958 high of 379,667 to 221,154 in 1969, probably largely due to the pheasant decline in southern Minnesota. Small game license sales have stabilized at about 280,000 - 300,000 since 1970 and are expected to remain near this level in the near future.

Over one-half of total small game license holders are waterfowl hunters. Federal migratory waterfowl stamp sales, which closely parallel waterfowl hunter numbers, vary with bag limits, season limits, and the price of the stamp. Sales have fluctuated between 122,000 and 180,000 since 1969. The number of waterfowl hunters should remain a relatively constant proportion of the state's population if waterfowl populations and hunting regulations do not change significantly (Minnesota DNR 1974). Future restrictive regulations or increases in the price of the federal and state migratory bird stamps may depress the number of waterfowl hunters in Minnesota. Liberalization of regulations would probably increase waterfowl hunters.

The demand for trapping opportunities will probably be related to the availability of places to trap and fur prices. Since 1940 the number of trapping licenses sold in Minnesota has varied widely from a high of 53,899 in 1946 to a low of 5,903 in 1971. License sales stabilized at about 11,000 to 14,000 between 1973 and 1978. Due to increasing fur prices and furbearer populations, license sales increased to 18,121 in 1979 and over 30,000 in 1980. Trapper numbers are expected to remain near this level or decrease slightly in the near future.

Admittedly, the preceding discussions are only qualitative. These projections suggest that total hunting demand in Minnesota will not increase dramatically in the near future, but intensified use of private lands will increase the importance of management areas to Minnesota's wildlife and sportsmen. The same trend is developing for other wildlife-related recreation. The Thief Lake WMA will probably experience an increased demand for deer and small game hunting, and other wildlife-related recreation equal to the state average. However, if fuel shortages develop or if transportation costs rise too high, a decrease in use will probably occur since the unit is far from the population centers which generate over one-half of the present demand (Table 24).

CAPACITY

In order to insure quality public recreational use while protecting a wildlife management area's resources, the capacity of the area for hunting, trapping, fishing, and other compatible uses must be examined. The capacity of the Thief Lake WMA to ac-

commodate hunters, trappers, and fishermen is related to many factors such as fish and wildlife abundance, regulations, topography, vegetation, and access. Excessive user densities result in interference or conflicts between sportsmen. The U.S. Fish and Wildlife Service and U.S. Bureau of Outdoor Recreation (now the Heritage Conservation and Recreation Service) have developed hunter density guidelines for quality hunting which may be a useful guide for wildlife management areas (Table 28). Concentrations of sensitive wildlife populations may require the exclusion of hunting, trapping, fishing, or trespass at specific times from sanctuaries and refuges established within a wildlife management area.

Furthermore, quality experiences depend not only on user densities, fish and wildlife habitats, and fish and game abundance, but also on the sportsmanship and sense of responsibility of hunters and fishermen. Thus, the same set of user density standards cannot be applied uniformly to all wildlife management areas. The capacity of the Thief Lake WMA to accommodate hunters should be defined in terms of hunting experiences which are rewarding to hunters and acceptable to the non-hunting public.

The Division of Fish and Wildlife encourages the use of wildlife management areas for activities related to fish and wildlife or their habitats, such as nature observation, photography, hiking, or cross-country skiing. A management area's attractiveness for and capacity to support compatible outdoor recreation depend on factors such as access, the variety and sensitivity of the area's wildlife populations, plant communities, and topography.

The Thief Lake WMA has spectacular waterfowl concentrations and easily observed white-tailed deer, moose, sandhill cranes, and resident Canada geese. Some of these resources are sensitive to overuse. However, when used in a dispersed manner by low densities of people, the management area can accommodate many visitor-days of waterfowl and deer observation and photography, appreciation and study of wetlands, walking for pleasure, and other compatible activities.

Table 28. Hunter density guidelines proposed by the U.S. Fish and Wildlife Service and the U.S. Bureau of Outdoor Recreation.

Game Species	Standard	Length of Stay (hours)
Geese	1 blind per 200 yards per 2 hunters	4
Ducks	1 blind per 10 acres of marsh per 2 hunters or 1 blind per 200 yards	4
Upland game birds	13 hunters per square mile	2
Small game	13 hunters per square mile	4
Pheasants	64 hunters per square mile	3
Deer	13 hunters per square mile	8

Source: U.S. Department of the Interior 1967, 1972.

MANAGEMENT PROGRAMS

Plans for the Thief Lake WMA should insure the sustained production and use of a variety of wildlife and fish and the protection of unique scientific, historic, and aesthetic resources. To develop plans, management objectives were identified, factors influencing management programs were considered, past and present management programs were described, and future programs were then developed from research findings and management experience. Current emphasis on the Thief Lake WMA is on wetland management for waterfowl but forest and nonforested upland habitat management as well as public use management will receive high priority.

WETLAND MANAGEMENT

Objectives. Wetlands will be managed primarily for waterfowl production and migratory waterfowl use. At the same time, wetlands will provide areas for public hunting and trapping, furbearer production, and flood water storage.

Considerations. Thief Lake was restored for waterfowl through the efforts of local sportsmen and the Minnesota Conservation Department (DNR). It is managed primarily for waterfowl. Managed wetlands, however, also provide habitat for a variety of other wildlife species.

The ability to control water levels is desirable to properly manage wetlands like those on the WMA. The Minnesota DNR has no control over the amount of water that enters Thief Lake through the Moose River and the local drainage ditch system. A dam is located on the Moose River but has never been operational. Frequently, spring run-off exceeds the flow capacity of the Thief River channel, resulting in excessively high lake levels and local flooding. Flows during late summer and fall in some years are insufficient to maintain the desired lake level. Excessively high or fluctuating water levels during spring and early summer can destroy nests of waterfowl and nongame birds.

A periodic drying out, or drawdown, of wetlands may be used to manage vegetation, control unwanted fish or wildlife species, release stored nutrients, or retard the filling of the wetland with organic matter (Linde 1969). Reflooding of dry marshes in the fall creates excellent waterfowl feeding conditions. Without drawdowns there will be a decline in invertebrates that are an important food source for waterfowl and other wildlife (Voights 1976). However, water level manipulation capabilities for Thief Lake are restricted under the present system.

Spring flooding occurs regularly in the local area. Thief Lake can provide some relief by retaining spring runoff. A study by the Red Lake River Watershed District indicated that the Thief Lake WMA and Agassiz National Wildlife Refuge water storage facilities reduced peak flood stages at Crookston and East Grand Forks, Minnesota by 1.5 and 0.5 feet, respectively. Other wetlands, particularly those with natural vegetation, may help reduce flooding by holding water on the land for a longer time.

Emergent vegetation eliminates much of the open water in shallow wetlands. Excessive emergents restrict the growth of submerged waterfowl food plants and limit the movements of waterfowl. Creation of openings in extensive stands of vegetation is desirable. A wetland in which the area of open water and vegetation are about equal and well interspersed, generally has the maximum waterfowl species diversity and production (Weller and Spatcher 1965). An interspersion of water and vegetation is also desirable for waterfowl hunting. Control of emergent vegetation is currently not a problem on Thief Lake. Approximately 50 percent of the lake is open water with no emergent vegetation. The rest of the lake, primarily a wide band parallelling the shoreline, is well interspersed with emergent vegetation. Emergent food and cover plants may be encouraged by water level manipulations (Atlantic Waterfowl Council 1972, Linde 1969).

Muskrat and beaver are useful in creating and maintaining marsh openings. Muskrat houses provide nest sites and loafing areas for geese and ducks. Beaver, however, can cause problems by damming drainage ditches and plugging culverts. Fall or early winter drawdowns can result in complete freeze outs and dramatic declines in population levels of both species. If drawdowns are delayed until a good ice cover forms, muskrat and beaver survival is increased. The ice layer and air beneath prevent complete freeze outs, keeping the food supply available (Linde 1969). Lower population numbers would reduce the potential furbearer harvest and lessen the benefits to vegetation control.

Waterfowl breeding habitat can be created by constructing level ditches and dugouts, blasting potholes, or, in peat areas, by burning (Linde 1969). If natural waterfowl nesting sites are scarce, artificial nest structures and islands or large hay, straw, or flax bales in open water provide suitable nesting sites. When cavities in trees are lacking, wood duck nesting boxes provide nesting substitutes.

Woody vegetation may invade wetland edges or shallow areas. Late summer or early fall burns are effective in destroying invading brush. Water level manipulation and mechanical control can also be used (Linde 1969). There is some disagreement over whether or not all brush should be removed from impoundments. Some workers feel that acid stains from woody plants restrict the growth of desirable submergents, while others feel that brush adds valuable cover for waterfowl broods (Linde 1969).

For waterfowl production, marshes should be surrounded by grassy openings for nesting cover and goose grazing. Grain and/or green forage food plots for migratory waterfowl use should also be included. These developments increase the diversity of vegetation on the WMA and also provide important habitat for deer, furbearers, ground nesting birds, and small mammals. These areas also provide excellent sites for hunting, trapping, and wildlife observation and photography.

The Moose River, flowing westerly through Beltrami and Marshall Counties, has been designated Judicial Ditch 21. This drainage system includes the river and a number of lateral ditches draining into it. Portions of the river have been dredged and channelized. The Haroldson dam was constructed on the Moose River in 1937 but, because of local opposition and incomplete state land ownership within the project area, the dam has never been operational. All private lands in the project area have since been acquired by the Division of Fish and Wildlife. A preliminary survey of the proposed impoundment was conducted by the DNR, Bureau of Engineering in 1965. A detailed hydrological survey is scheduled for 1981. Another impoundment project, near the WMA six miles east of the Marshall County line, is proposed on the Moose River.

If completed, the Haroldson impoundment will provide an attractive area for resident and migratory waterfowl and public hunting. It is estimated that the project will increase spring flood water retention and would reduce peak overflow from Thief Lake down the Thief River by 20 to 25 percent. In addition, it will increase water manipulation capabilities on Thief Lake and reduce water level fluctuations during the waterfowl nesting season. Local landowners have opposed the Haroldson impoundment because they felt that the project would cause increased flooding by retarding runoff and would destroy valuable deer and moose habitat.

Construction of dams or other control works by any individual, corporation, or government agency, including the DNR, in any public drainage system to impound or divert waters requires a permit from the county board, if the drainage system lies wholly in one county, or the district court, in the case of a system affecting two or more counties (Minnesota Statutes, Sec. 105.81, 1978). A public hearing is also required as

This aerial photo of Thief Lake shows a good interspersion of emergent vegetation and open water.

provided under Minnesota Statutes, Sec. 106.101, 1978 before any permit can be issued. In addition, the rights-of-ways and flowage easements from all landowners affected by the proposed project must be obtained prior to construction.

Past and Present Programs. Water levels on Thief Lake are controlled by a 10-day concrete dam constructed in 1931 on the Thief River. Modifications of the dam in 1938, 1954, and 1968 resulted in lower water levels and improved waterfowl habitat. The current water management policy is for a gradual drawdown in late fall and winter to an elevation of 1,157 feet to increase spring flood storage capacity. Following spring runoff, water levels are regulated to provide optimum water depths for waterfowl and hunters alike.

Other wetland management projects include the construction and maintenance of open water areas for waterfowl brood habitat. Seventy small dugout ponds have been constructed in type II and III wetlands around Thief Lake and in shallow, upland basins. Approximately 3½ miles of level ditches connected with the lake have been constructed along the north shore. In addition, nesting islands constructed in 10 of the dugouts are periodically cleared of vegetation, and 23 goose nesting tubs are repaired and replenished with nesting material annually.

Additional waterfowl management projects are described in subsequent sections on Canada goose and non-forested upland management.

Future Programs. Most current wetland management and maintenance programs will continue. Before any significant changes in the water management program are made, the possible effects of any such changes on all species of animals and plants and on land and land uses will be investigated. Drawdowns for spring flood retention will begin as late in winter as possible to increase overwinter survival of muskrats. Within the capabilities of the water control system, water level fluctuations during the waterfowl nesting season will be minimized.

When funds are available and conditions permit, heavy equipment will be used to develop open-water habitat for waterfowl (Figure 10). Dugout ponds will be constructed in wetlands with bulldozers or draglines according to guidelines suggested by Linde (1969) and the Atlantic Waterfowl Council (1972). Level ditches will be constructed with bulldozers and draglines according to recommendations by Hammond and Lacy (1959) and Mathiak and Linde (1956). A raised earth nesting island will be constructed near the center of most dugouts. Additional nesting structures and islands will be constructed as labor and funding permit. Woody vegetation in the marshes will be controlled by brush discing and prescribed burning.

The Minnesota DNR will investigate renovating the Haroldson dam to impound about 1,500 acres of marsh averaging two to three feet deep. The engineering needs and effect of this project on the local drainage system will be studied to determine the feasibility of the project. Detailed information will be obtained regarding water levels and their effect on drainage capabilities of adjacent farm lands. Study results will be presented at a local meeting after which a final decision on rennovation of the dam will be made.

FOREST MANAGEMENT

Objectives. Forests will be managed to provide quality habitats for wildlife as well as forest products by maintaining and creating an interspersion of forest types and age classes. Habitat management will be most concerned with game species such as white-tailed deer, moose, and ruffed grouse, although a variety of nongame wildlife species will benefit as well.

Considerations. Current forest types and their distribution have an important effect on the species, density, and distribution of wildlife on the Thief Lake WMA. Plant communities, however, are not static. Through natural plant succession and human influences, the structure and composition of the plant communities

are continuously changing. Wildlife populations respond to these changes in the forest. To achieve the management objectives, forest manipulation will always be required.

Game species such as white-tailed deer, moose, and ruffed grouse are better adapted to plant communities of earlier successional stages, in a mixture of age classes and in different size stands. Studies in Minnesota and Wisconsin have shown that early successional forest types contain the greatest abundance of deer forage (McCaffery and Creed 1969, Rutske 1969, McCaffey et al. 1974, Kohn and Mooty 1971). As the forest matures, there is a reduction in the production of palatable deer forage due to increased shading (Wetzel et al. 1975). Optimum grouse habitat contains a mosaic of forest age classes within the restricted foraging range of grouse (Gullion and Svoboda 1972).

Fire prevention and suppression, forest succession, limited timber harvest, and conversions to less favorable plants all can reduce the capability of an area to produce forest game species. Forest succession can be set back to earlier stages by logging, prescribed burning, and mechanical methods. The removal of mature trees promotes resprouting of tree species as well as understory shrubs and herbaceous plants. The result is an increased yield of available woody browse and other food for wildlife and increased habitat diversity through establishment of a multiple age class forest.

Forests can be managed most efficiently by controlled commercial logging. Studies in Minnesota have demonstrated the effectiveness of commercial timber harvest as a wildlife management technique (Erickson et al. 1961, Rutske 1969, Stenlund 1971). Commercial timber harvest on the Thief Lake WMA has been limited. The demand for wood is expected to increase in the area, however, as new wood-products plants open in northcentral Minnesota.

The Division of Forestry, anticipating an increased demand for forest products and having experienced a decline in commercial forest acreage, wishes to manage any productive land in northwestern Minnesota for timber production. Since forest wildlife habitats can be most effectively managed by timber harvest, a DNR policy for coordination of wildlife and forestry management has been developed (Appendix E). The policy sets forth specific procedures for the implementation of integrated management and establishes administrative procedures to resolve disagreements. This policy will be used to implement cooperative management on the Thief Lake WMA.

Clear-cutting is an effective method for increasing habitat diversity and promoting desirable woody browse plus other wildlife foods. Smaller clear-cuts interspersed throughout the forest are more important to wildlife species, such as deer and ruffed grouse and other wildlife species adapted to more open habitats. Research has revealed that clear-cuts as small as one acre may be beneficial to ruffed grouse (Gullion 1976). Studies have also indicated that deer are more attracted to smaller cuts and use them more thoroughly than larger ones (Verme 1972, Drolet 1978). Cuttings larger than 40 acres will not be fully utilized by deer (Graham et al. 1963, Rutske 1969). Irregularly shaped or strip cuts are more beneficial to wildlife, as they increase the amount of vegetational variety and density between contrasting vegetative communities.

Removal of logging debris (slash) following timber harvest encourages greater ruffed grouse and deer utilization (Gullion 1976, Stormer and Bauer 1980) and improves hunter access. Slash also provides horizontal cover that furnishes more concealment for grouse predators than grouse (Dolgaard et al. 1976). Full-tree harvesting and limbing at central sites concentrates slash. Prescribed buring has been used to remove slash on other areas (Sando 1972) and is beneficial to nutrient cycling. Slash can be removed by mechanical means, but removal is expensive and tree stumps prevent the effective use of heavy equipment.

Studies have shown the close relationship between aspen communities and deer and ruffed grouse populations and have emphasized the importance of proper management of this forest type on these wildlife species (Rutske 1969, McCaffery et al. 1974, Gullion and Svoboda 1972, Kubisiak 1978). Aspen and aspen-birch forest types, especially following disturbances, supply the greatest amounts of preferred deer forage (Stormer and Bauer 1980). Aspen alone in the proper age class diversity can supply all the basic habitat requirements of ruffed grouse. Flower buds of mature male aspen trees are the major winter food resource for ruffed grouse (Gullion 1969).

Low quality, poorly stocked aspen stands (off-site aspen), due to their open canopy, generally support an abundance of herbaceous and woody deer forage. Cutting of these stands results in dense suckering, which shades out ground flora and quickly grows out of reach. For some off-site aspen, therefore, it may be more beneficial not to regenerate the stand and allow it to perpetuate the desirable understory flora (Verme 1972).

Willow and willow-aspen types are extensively used by moose and sharp-tailed grouse. Phillips et al. (1973) found that moose on the Agassiz National Wildlife Refuge preferred an open willow type during summer and fall months, shifting to dense aspen-willow, tall willow, aspen, and mixed hardwoods during winter. Open willow communities accounted for 45 percent of the radio-locations of female sharp-tails during spring and summer in a study in northwestern Minnesota (Artmann and Beer 1970). In a similar study, Schiller (1971) reported that brushlands consisting of 25 to 30 percent willow shrubs were the most frequently selected habitat types by sharp-tails for nesting and incubation. Such habitat can be maintained by periodic burning of brushland and off-site aspen.

Mature conifer stands produce only sparse wildlife forage and are of little use to wildlife except for winter cover. Deer and moose in this region often use conifer stands for protection from severe winter weather and deep snow conditions. White cedar, balsam fir, and white spruce provide the most important cover. Spruce and balsam fir occasionally provide useful winter cover for ruffed grouse if the trees occur in small dense stands. Pines, up to 15 to 20 years of age, can provide valuable grouse cover until self-pruning begins (Gullion 1967).

Trails created with bulldozers in forested areas during deep snow conditions are beneficial to deer. In addition to making it easier for deer to travel, dozed trails make browse immediately available for deer, expose forest soils to allow for earlier spring green-up of forbs, and promote regeneration of browse plants.

Where oaks occur, it is recommended that some of them be saved for deer and other wildlife (Rutske 1969, Sander 1977, Hardin and Evans 1977). Oak mast is an important food resource for wildlife. Acorn production, however, is often highly variable from year to year. These trees also provide cavities used as nesting and den sites. On the management area, oaks generally occur as scattered trees associated with upland brush. This forest type provides an abundance of

THIEF LAKE WILDLIFE MANAGEMENT AREA

PROPOSED MANAGEMENT

LEGEND

- FOREST WILDLIFE MANAGEMENT AREA
- OLD FIELD MANAGEMENT AREA
- POTENTIAL WETLAND DEVELOPMENT AREA
- EXISTING WILDLIFE FOOD PLOT
- POTENTIAL WILDLIFE FOOD PLOT
- DELETED FROM W.M.A. PROJECT
- PROPOSED FIREBREAK
- MAJOR PRESCRIBED BURN UNIT
- VEGETATION MANAGEMENT BY CONTROLLED BURNING, DOZING, OR MOWING
- POTENTIAL CONTROLLED GOOSE HUNTING ZONE EXPANSION
- DRAINAGE DITCH

- W.M.A. BOUNDARY
- W.M.A. SUPPLEMENT BOUNDARY
- STATE HIGHWAY
- COUNTY STATE AID HIGHWAY
- COUNTY ROAD
- TOWNSHIP ROAD
- W.M.A. ROAD
- HEADQUARTERS
- SECTION CORNER

SCALE IN MILES
0 ½ 1

N

VEGETATION TYPES

DECIDUOUS FOREST
- A ASPEN
- O OAK
- Ub UPLAND BRUSH
- BH BOTTOMLAND HARDWOODS
- DZ DOZED

M - MIXED DECIDUOUS-CONIFEROUS

PP - PINE PLANTATION

OF - OLD FIELD

AF - AGRICULTURAL FIELD

Lb - LOWLAND BRUSH

LOWLAND CONIFER
- S BLACK SPRUCE
- T TAMARACK
- C WHITE CEDAR

WETLANDS
- II TEMPORARY
- III SEASONAL
- IV SEMI-PERMANENT
- XIII SHRUB BOG

GP - GRAVEL PIT

T. 159 N.
T. 158 N.
T. 158 N.
T. 157 N.
R. 43 W.
R. 42 W.
R. 42 W.
R. 41 W.
R. 43 W.
R. 42 W.
R. 42 W.
R. 41 W.
THIEF LAKE
THIEF RIVER
MATCH LINE
32
48
49
125
6

FIGURE 10A. PROPOSED MANAGEMENT

THIEF LAKE WILDLIFE MANAGEMENT AREA
PROPOSED MANAGEMENT

LEGEND

- FOREST WILDLIFE MANAGEMENT AREA
- OLD FIELD MANAGEMENT AREA
- POTENTIAL WETLAND DEVELOPMENT AREA
- EXISTING WILDLIFE FOOD PLOT
- POTENTIAL WILDLIFE FOOD PLOT
- DELETED FROM W.M.A. PROJECT
- PROPOSED FIREBREAKS
- MAJOR PRESCRIBED BURN UNITS
- VEGETATION MANAGEMENT BY CONTROLLED BURNING, DOZING, OR MOWING
- ELK MANAGEMENT AREA BOUNDARY
- DRAINAGE DITCH

SCALE IN MILES: 0 ½ 1

N

VEGETATION TYPES

DECIDUOUS FOREST
- A ASPEN
- O OAK
- Ub UPLAND BRUSH
- BH BOTTOMLAND HARDWOODS
- DZ DOZED

M - MIXED DECIDUOUS-CONIFEROUS

OF - OLD FIELD

AF - AGRICULTURAL FIELD

Lb - LOWLAND BRUSH

LOWLAND CONIFER
- S BLACK SPRUCE
- T TAMARACK
- C WHITE CEDAR
- SB BLACK SPRUCE–BALSAM FIR

WETLANDS
- II TEMPORARY
- III SEASONAL
- IV SEMI-PERMANENT
- XIII SHRUB BOG

GP - GRAVEL PIT

- W.M.A. BOUNDARY
- W.M.A. SUPPLEMENT BOUNDARY
- STATE HIGHWAY
- COUNTY STATE AID HIGHWAY
- COUNTY ROAD
- TOWNSHIP ROAD
- W.M.A. ROAD
- SECTION CORNER

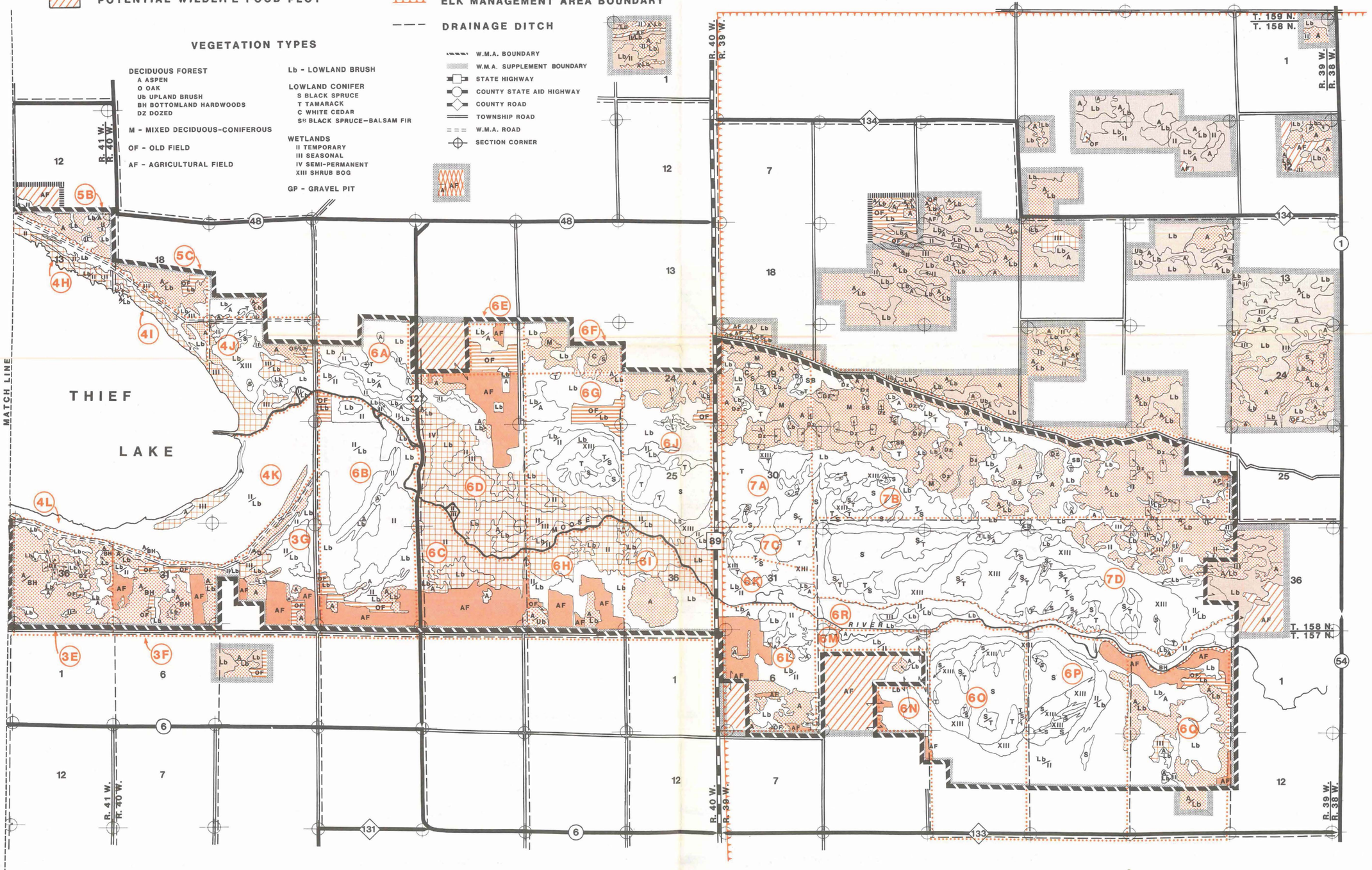


FIGURE 10B.

wildlife forage but the dense shrub growth restricts animal use. Periodic fires would suppress the shrub understory, promote grasses, and favor wildlife species associated with more open habitats, including sharp-tailed grouse, elk, and a variety of nongame animals.

Present Programs. Forest management on the unit consists of fuelwood and commercial logging, prescribed burning, and mechanical manipulation. Eleven fuelwood permits were issued in 1979 to cut dead and downed timber and off-site aspen. In addition, four commercial timber permits were issued to cut 21 acres of black spruce and aspen. WMA personnel used a bulldozer and shearing blade to fell aspen to promote regeneration. During severe winters, trails are dozed in forested areas for deer. In 1979, 10 acres of forest were dozed and 20 acres of brush were cut to promote regeneration.

Future Programs. The Division of Fish and Wildlife and Forestry will cooperatively manage the 21,966 acres of state-owned land administered by the Division of Forestry within the Thief Lake WMA Supplement. Field personnel of the two divisions will review and approve each other's management plans and attempt to develop an integrated management plan. The resident wildlife manager and area forester may agree to waive the review and approval process for certain types of projects. Disagreements not resolved at the wildlife and forestry area manager's level will be forwarded to the regional level for resolution. The division directors will attempt to resolve disagreements not settled at the regional level. If forestry and wildlife management disagreements on specific tracts of land still cannot be resolved at the division director's level, the Commissioner of Natural Resources, with the advice of the DNR Planning and Environmental Review Team, will decide the issue. The Commissioner will recommend the modification of management objectives or the transfer of administrative control of specific tracts of land between the Divisions of Fish and Wildlife and Forestry by lease, purchase, land exchange, or dedication. Cooperative agreements and land transfers between the divisions will be submitted to the State Planning Agency for review.

To improve habitat for deer, moose, and ruffed grouse and to increase diversity, emphasis will be placed on regenerating mature aspen stands (Figure 10). Aspen stands will be managed on a 30- to 40-year rotation. Stands will be clear-cut to favor sucker regeneration. Clear-cuts will be small, preferably less than 20 acres, and should be in irregular shapes or strips to produce more edge. Cutting and shearing will be planned for winter and early spring to make additional browse immediately available for deer.

The present practice of issuing fuelwood and commercial timber permits will continue. Because of increased fuelwood and pulp demands, it is anticipated that timber harvest objectives on the unit can be accomplished by private logging. WMA personnel may construct trails to provide access to areas where timber harvest is desirable. Priority will be given to harvesting over-mature aspen stands located along the Randeen Ridge on the northeastern boundary of the unit.

Conifer stands providing winter cover for deer will be maintained. Extensive plantings of conifers on the WMA are not planned.

Prescribed burning will be used to maintain willow/grass-sedge areas that provide habitat for sharp-tailed grouse, moose, and many nongame species. Oak/upland brush communities will be periodically burned to reduce understory shrubs and favor grasses.

An updated forest inventory describing the distribution, size class, and condition of timber types on the Thief Lake WMA and supplement will be done by the Division of Forestry. This inventory will provide a basis for developing integrated forestry-wildlife management plans.

NON-FORESTED UPLAND MANAGEMENT

Objectives. Non-forested uplands include forest openings, croplands, grasslands, and old fields. Forest openings will be managed to provide edge and to increase habitat diversity. Cropland will be managed to provide food for resident and migratory wildlife and to reduce wildlife crop depredations on private lands. Grasslands and old fields will be managed primarily for sharp-tailed grouse, nesting waterfowl, and nongame birds.

Considerations. As natural plant succession occurs, woody vegetation will encroach and eventually dominate forest openings, grasslands, and old fields on the WMA. Loss of such areas would result in a decrease in habitat diversity and a decrease in diversity of wildlife as well. Methods used to prevent encroachment of woody vegetation include prescribed burning and mechanical and chemical control.

Forest openings are an important component of forest wildlife habitat. Studies have documented the importance of openings to white-tailed deer (McCaffery and Creed 1969), ruffed grouse (Berner and Gysel 1969), and woodcock (Hale and Gregg 1976). Openings provide high quality deer forage in early spring and fall when the nutritional requirements of deer are greatest following winter stress and coinciding with rutting activities. Opening edges supply a variety of preferred ruffed grouse forage generally not found in the adjacent forest (McCaffery and Creed 1969).

Small, scattered openings are most valuable to forest wildlife. Openings less than five acres in size and narrower than 330 feet in width were used more intensively by deer in northern Wisconsin than larger openings (McCaffery and Creed 1969). Openings created by forest cuttings are more important to ruffed grouse than sodded openings (Moulton 1968).

Grasslands and old fields are commonly used by sharp-tailed grouse. This cover type accounted for 35 percent of the radio-locations of female sharp-tails during spring and summer in a study in northwestern Minnesota (Artmann and Beer 1970). Properly managed, these areas will provide nesting habitat for waterfowl and upland game birds as well as songbirds and shorebirds. Open areas are also used by deer (McCaffery and Creed 1969) and many nongame mammal species. These types may revert to prairie vegetation if they are periodically burned.

Farming for wildlife is a common practice on many state and federal wildlife areas. Agricultural crops can increase the capacity of an area to support both resident and migratory species. Resident wildlife such as white-tailed deer and sharp-tailed grouse use crops in the fall, winter, and early spring, while ducks and geese feed on them primarily during fall migration. Wintering songbirds may benefit from food plots, although breeding songbirds and small mammals may not be affected by the additional food source (Burt 1976). Small scattered food plots placed near heavy escape or winter cover are most beneficial to wildlife. Areas planted to legumes improve soil conditions and provide important "green-up" areas that are heavily used by deer in early spring and fall. An important reason for farming on many wildlife areas is to reduce

crop damage by wildlife on private land.

Small grains, including oats, wheat, and barley are the main crops grown in the Thief Lake WMA vicinity. Other crops grown in the area include sunflowers, flax, and hay.

Depredations on small grain crops on private land in northwestern Minnesota by waterfowl, especially mallards, have occurred for many years. The problem has become worse since the 1940's, when farmers began to abandon the practice of cutting and shocking grain for drying. Modern swathing and combining of grain leaves it spread out in the field for several days where it is extremely vulnerable to depredations. A decrease in available waterfowl habitat and an increase of large grain fields in the vicinity of state management areas and federal refuges have compounded the problem.

Depredations are not usually severe in a year with average or below average rainfall during the harvest period. When wet weather prevents the harvest of swathed grain, depredations may become a serious problem. Because of the flatness of the terrain and the low absorptive capacity of the soils in many areas, the soil dries slowly, prolonging the harvest season during years of excessive rainfall. A special study of duck depredation in Roseau and Marshall Counties, authorized by the Minnesota Legislature (Minnesota Outdoor Recreation Resources Commission 1967), included a survey of crop damage by waterfowl in the two-county area. Estimated damage in eastern Marshall County was about $120,400 in 1964 and $85,000 in 1965. Most damage in eastern Marshall County was reported within three miles of the Thief Lake WMA and the Agassiz National Wildlife Refuge.

Many different methods for reducing waterfowl damage to crops have been used or suggested (Minnesota Outdoor Recreation Resources Commission 1967). Mechanical methods include herding from the ground and from airplanes, and the use of firearms, exploders, firecrackers, flashers, and scarecrows. Environmental methods include providing protected habitat with adequate and equally acceptable food supplies, harvesting crops promptly, and delaying fall plowing of grain stubble containing waste grain. The development and use of crops which are less vulnerable to depredations because they mature early or are unpalatable to waterfowl can also help. Regulatory methods consist primarily of laws to permit the harvest of wildlife, reducing their numbers and also chasing large numbers from fields.

Past and Present Programs. Forest openings are created with bulldozers. In 1979, 10 openings, totaling 10 acres, were cleared and two openings, totaling 60 acres, were seeded to legumes. Brush mowing, dozing, and prescribed burning are used to prevent encroachment of woody vegetation on forest openings, grasslands, and old fields. About 120 acres of grass and marsh were burned in 1979 to improve nesting cover.

The total cropland on the WMA is about 1,220 acres, of which about 770 acres are managed by sharecrop leases to local farmers. On the leased lands, oats, barley, winter wheat, and flax are the crops most commonly grown (Table 27). Some of the state's one-quarter share of the small grain is left in the fields to provide fall and winter food for wildlife, and some is harvested for use at feeding stations to reduce damage by waterfowl to crops on private lands. To maintain nesting cover until after most duck and grouse broods have hatched, wild and tame hay may not be mowed until after July 15. Cropland that is farmed by WMA personnel is planted to crops such as winter wheat, flax, barley, corn, and sunflowers to provide food for wildlife, to reduce depredations, and to provide green browse for deer and geese.

Measures to reduce crop depredations on private lands are an important part of the WMA's cropland management program. Methods include the use of exploders, the planting of lure crops on state land, and the use of feeding stations on the WMA. Also, the DNR private lands program may cost-share the development of food plots on private land in depredation problem areas. Exploders are loaned to farmers having depredation problems, and state personnel demonstrate how to use them. The farmers are then responsible for maintaining the exploders. Some crops are left in the WMA fields to reduce depredations. Croplands on the WMA refuge provide areas where wildlife can feed undisturbed.

Feeding to reduce waterfowl depredation is done at two sites within the WMA sanctuary and one site on the northeast edge of Thief Lake (Figure 4). Grain has been fed every year since the early 1960's, even in dry years when an early harvest reduced depredations. Small grains, principally oats, are usually placed at feeding sites in early August, and feeding is continued until early or mid-September. According to federal regulations, all food must be removed from the sites at least 10 days before the waterfowl season opens. WMA personnel estimate that about 6,000 bushels of grain should be available to feed each year. A total of 5,540 and 4,920 bushels of grain were fed in 1978 and 1979, respectively. Grain for the feeding sites is obtained under the crop lease agreement and purchased from local farmers. Some grain was obtained free from the federal government through the Commodity Credit Corporation in the 1960's, but such grain has not been available in recent years.

Small, scattered openings are created in aspen stands to increase habitat diversity and provide quality forage for forest wildlife species such as white-tailed deer and ruffed grouse.

Depredation complaints most often concern field-feeding mallards, Canada geese, and sandhill cranes, but white-tailed deer, moose, and elk have also caused complaints. The latter three species are not influenced by the feeding stations, but lure crops and exploders have helped to reduce damage to crops on private lands.

Future Programs. The present management of non-forested uplands will continue. Prescribed burning and dozing will be used to maintain and improve existing openings, old fields, and grasslands. The treatment type and frequency will depend on the characteristic of each site and seasonal weather conditions for controlled burning as well as available funding. New openings will be developed as funding permits. The management objectives and schedule of a controlled burning program are described in the "Fire Management" Section.

The present system of agricultural leases and farming by WMA personnel will be continued. If funds for equipment and manpower are available, additional food plots will be developed in old fields or following timber harvest of upland forest sites (Figure 10). New food plots will be placed near heavy brush, marsh, or forest cover in relation to the distribution of deer, waterfowl, and other wildlife.

Methods currently used to reduce waterfowl depredations will continue. In some years when weather conditions permit an early harvest, it may be possible to cut back on the amount of grain fed, saving it for future use.

FIRE MANAGEMENT

Objectives. Prescribed burning will be used to create and maintain optimum wildlife habitat for nesting, feeding, and cover. A fire management program with a system of firebreaks will permit efficient and safe habitat manipulation while reducing the risk of uncontrolled wildfires.

Considerations. Recurrent fires were a natural part of the ecosystem and an important factor in creating and maintaining open plant communities such as prairies, brush prairies, oak savannas, and pine barrens (Curtis 1959). With the suppression of wildfires following settlement, these open, fire-maintained communities and their associated wildlife species were reduced. Over the years, wildlife managers have recognized the value of fire as a technique to manage wildlife habitat. Prescribed burning sets back succession to a stage more desirable for many wildlife species, including white-tailed deer, moose, waterfowl, and sharp-tailed grouse. Burning improves the density and height of cover, increases the production and nutrient content of regenerating forage, removes ground litter and matted vegetation, and under certain conditions reduces woody vegetation.

An increase in plant production frequently occurs after burning. Gordon (1974) showed a 350 percent increase in available woody browse for moose following a fire in Montana. Anderson (1972) found that biomass production on a Wisconsin prairie doubled following burning. Burns in marsh vegetation provide valuable feeding sites for waterfowl because desirable seeds from aquatic plants are exposed and readily available (Linde 1969). Burned areas also provide important "green-up" sites in early spring where deer and geese can feed on the tender new shoots. Late summer burns often provide new shoots for fall migrating geese.

Fire not only stimulates new growth but may also increase the forage quality. Fire speeds the rate of nutrient turnover, resulting in higher soil fertility and increased nutrient content of regenerating plants. Hendricks (1968) found that the nutrient value of browse per acre in California increased 240-fold following fire.

Prescribed burning has been used to manage the aspen type for wildlife. Perala (1974) reported that repeated spring burns on cutover aspen sites reduced aspen suckering. Repeated fall burns, however, stimulated aspen suckering as well as associated hardwood and shrub sprouting. Perala (1974) also noted a change in the species composition following repeated burning. Oaks, willow, and hazel increased, while mountain maple, a preferred deer and moose browse species, declined.

Dense undisturbed grasslands are beneficial to upland nesting waterfowl (Kirsch 1969), and certain species of shorebirds (Kirsch and Higgins 1976) and songbirds (Verner 1975). Prescribed burning on a rotational basis is an effective technique for creating and maintaining dense upland nesting cover. Fire improves the structure and density of the nesting cover by removing ground litter and matted vegetation and by stimulating new growth of stouter and denser plants. Such cover increases nesting success.

Periodic controlled burning of marsh vegetation creates a better interspersion of open water and cover and removes dense tangles of foliage on marsh edges which restrict travel and use by wildlife (Linde 1969). Fall burning of dense marsh vegetation, however, may reduce winter cover. During dry years, fires of sufficient heat and duration can create burn-outs in peat soils which provide desirable open water areas for waterfowl. Prescribed burns are also useful for controlling encroaching woody vegetation on upland nesting areas and surrounding wetlands.

Controlled burns to improve nesting cover and wetland vegetation are most effective during spring. Such burns will not only set back shrubs and cool season grasses, but will also promote the growth of desirable warm season grasses, which include late blooming, tall prairie species such as Indian grass, big blue stem, and little blue stem. Late summer burns more effectively control woody species but adversely affect warm season grasses. Fall burns will kill brush, promote cool season grasses, and, if the burn is late enough in fall, will not harm warm season grasses. Because of weather and fuel conditions, most prescribed burning in Minnesota occurs during the fall. On areas where brush is prevalent, a number of annual burns may be necessary to attain optimum nesting cover. A rotational burning system, with not more than one quarter of the cover burned in the same year will assure that adequate residual nesting cover is always available.

A prescribed burning program establishing a series of rotational burns and a system of firebreaks reduces fuel accumulation and lowers the risk of uncontrollable wildfires. In addition, burns improve access and visibility. Roads, trails, and mowed or plowed strips can be used as firebreaks. In northwestern Minnesota, drainage ditches provide effective firebreaks which require little maintenance.

Past and Present Programs. Controlled burns are conducted in cooperation with the area and district foresters according to a 1970 agreement between the Divisions of Fish and Wildlife and Forestry on prescribed burning for game habitat improvement. Burns on the management area have been limited by improper weather conditions, limited manpower and equipment, and a lack of firebreaks. Because of wet

conditions during spring, most burns are conducted during fall. In 1979, 20 miles of firebreaks were maintained and two sites, totaling 120 acres, were burned.

A fire management plan for the Thief Lake WMA was prepared in 1979 by WMA personnel in conjunction with the Division of Forestry. The plan divided the WMA into seven management compartments, which were further subdivided into burn units based on the current habitat types and the distribution of existing and proposed firebreaks (Figure 10). The management goals and burning schedules are specified for each unit.

Future Programs. Prescribed burning on the WMA will be conducted according to the fire management plan in cooperation with the area and district foresters. Between 1,000 and 2,000 acres per year are scheduled for burning, depending on weather conditions and funding. A system of firebreaks will be developed and maintained as shown in Figure 10. Wildfires may be allowed to burn if they meet with the objectives of the burn unit(s) involved and can be safely contained within the desired unit(s). The objectives and burning rotation schedule for each burn unit are described below.

COMPARTMENT 1

This compartment is divided into 10 burn units (1A-1J). Fire management will be directed towards creating and maintaining upland nesting cover and a better interspersion of emergent vegetation and open water on the marshes. Burning will be on a three to five year rotation, with a maximum burn unit size of about 340 acres.

COMPARTMENT 2

This area contains only one burn unit (2A) which includes an old goose pen and a field east of the pen. This unit will be burned to maintain nesting cover and to provide grazing areas for geese.

COMPARTMENT 3

This compartment consists of seven burn units (3A-3G). Burn units 3A and 3G will be burned on a three to five year rotation to maintain open grassland habitat for nesting waterfowl and sharp-tailed grouse. Portions of the remaining burn units will be burned on a 5 to 10 year rotation to regenerate aspen for deer and ruffed grouse.

COMPARTMENT 4

Located between the lake and the unit road around the lake, this compartment has 16 burn units. Areas of extensive brush will be burned annually to favor grasses and sedges for waterfowl nesting. These areas will then be burned on a two to three year rotation to maintain the habitat. Units 4A and 4P will be burned annually or on a two year rotation to provide early spring and fall grasses for migrant geese.

COMPARTMENT 5

This compartment is located north of the north unit road and consists of three burn units (5A-5C). These units will be burned as needed to prevent brush encroachment on the wetland areas and to promote aspen regeneration adjacent to the marshes.

COMPARTMENT 6

This area contains 18 burn units located east of Thief Lake and adjacent to the Moose River. Burns are currently planned for units 6L and 6Q. Prescribed burning may be used to manage portions of units 6O, 6P, and 6R for blueberries. Fire protection will be given to areas with merchantable timber.

COMPARTMENT 7

Compartment 7 consists of the Randeen Ridge and has four burn units (6A-7D). Burns on these units will be limited to small irregular burns or slash burns following logging operations.

CANADA GOOSE MANAGEMENT

Objectives. Canada goose management on the Thief Lake WMA will be directed toward both nesting and migrating geese. Efforts will be made to maintain a flock of nesting Canada geese on the area. Habitat, including food, water, and refuge, will be provided for migrant geese. Populations and harvest of Canada geese will be regulated to comply with Minnesota and Mississippi Flyway policies.

Considerations. Canada geese once nested throughout much of Minnesota, especially the southern and western parts of the state. The extensive marshes of Marshall and Roseau Counties were formerly one of the greatest Canada goose breeding grounds in Minnesota (Roberts 1936). Giant Canada geese had disappeared from many parts of their breeding range by the early 1900's, but flocks have since been reestablished in many areas (Hanson 1965). Reestablishment of nesting giant Canada geese on the Thief Lake WMA was undertaken to restore them to part of their former breeding range and to attract migrating Canada geese.

Resident flocks of Canada geese require adequate nesting and brood rearing habitat, as well as protection from overharvest. Nesting sites can be provided by muskrat lodges (Krummes 1941), artificial islands (Sherwood 1968), and nesting structures (Brakhage 1965, Rienecker 1971). Elevated nesting structures (Brakhage 1965) can help prevent nest loses due to flooding. During brood rearing, Canada geese prefer areas of short, succulent vegetation near water (Geis 1956, MacInnes et al. 1974). A local breeding flock may be limited or reduced by excessive harvest, especially in the local area (Sherwood 1968). The giant Canada geese that nest on the WMA are not particularly wary at times and may be more vulnerable to hunting.

The Thief Lake WMA lies within the migration path of the Eastern Prairie Population (EPP) of Canada geese (Bellrose 1976) which numbered about 190,000 in December of 1979. The EPP geese nest in northern Manitoba near Hudson Bay, and about 90 percent of them winter at the Swan Lake National Wildlife Refuge in Missouri. Most of the Canada geese that stop at the Thief Lake WMA are from this population.

Canada geese respond readily to management providing food, water, and protection from disturbance. In some cases, populations may build up far beyond expectations, increasing crop depredations and the risk of disease. Increased goose populations accelerate goose hunting pressure, resulting in hunter overcrowding, law enforcement problems, relatively large goose harvests near the area, and a decrease in hunting quality. Efforts to reduce large concentrations of geese may cause public relations problems because hunters and goose watchers become accustomed to the large numbers of geese. It is possible that larger numbers of Canada geese will use the Thief Lake WMA in the future, but the lack of a large corn crop for food and the early freezeup in this northern area will help to limit goose use.

Canada geese at the Thief Lake WMA have been beneficial to the local vicinity and the state. Large concentrations of geese afford excellent viewing and shooting opportunities which are popular with hunters, landowners who rent hunting sites, and others who enjoy seeing geese. Money spent by sportsmen and birdwatchers in the WMA vicinity benefits local businessmen.

Giant Canada geese, introduced to the management area between 1959 and 1961, return each spring to breed on Thief Lake and surrounding wetlands.

The goose harvest locally, within Minnesota, and in the Mississippi Flyway is a major consideration. The Canada goose harvest in Minnesota is managed to meet the following objectives: 1) to limit harvest associated with goose management areas to less than 50 percent of the state harvest (Minnesota Conservation Department 1968); 2) to limit Minnesota's total EPP harvest to avoid mandatory Mississippi Flyway quotas (Section of Wildlife Waterfowl Committee unpublished minutes June 1976); and 3) to apportion Minnesota's share of the EPP harvest equitably among the state's goose management areas. These objectives are being met now, but the addition of another large harvest area would change patterns in Minnesota and the Mississippi Flyway.

The Minnesota DNR has established policies for Canada goose management on managed units in the state (Minnesota Conservation Department 1968). The policies recommend that peak fall populations of Canada geese not exceed 20,000 for one area, reducing the need for controlled hunting and distributing the harvest more widely. This policy was amended in 1976 to allow for a monthly average goose population of 50,000 for the Lac qui Parle WMA. It was also recommended that the state attempt to limit the annual harvest of Canada geese from any one management area to no more than 2,000 birds. Fall population levels and harvest on the Thief Lake WMA have been well below the policy limits.

Goose use and management on the Thief Lake WMA and crop depredations on local private lands are affected by the Agassiz National Wildlife Refuge, located six miles south of the management area. This 61,487-acre refuge is closed to waterfowl hunting and attracts large numbers of migrating geese. Peak fall populations have varied between 10,000 and 21,000 since 1976. Starting in 1978, moist soil plant management took the place of artificial feeding of small grains to try to control waterfowl depredations. The Agassiz Refuge currently has two moist soil units, totaling 400 acres. Portions of these units are planted to winter wheat and Japanese millet. Unfortunately, plants in moist soil units do not mature early enough to control depredations during the height of the depredation season in most years. Over 200 acres of small grains are also planted as wildlife food crops.

Past and Present Programs. Giant Canada geese were transferred to the Thief Lake WMA from the Carlos Avery WMA between 1959 and 1961. Geese initially nested in the pens but were allowed to fly free after their first breeding season and began nesting elsewhere on the unit. A resident Canada goose flock has become established, and about 200 young were produced by 30 nesting pairs in 1978. The reduction in the resident flock may be due to high local hunting mortality.

From early September until freeze-up, state personnel make weekly estimates of goose numbers on the Thief Lake WMA based on ground and aerial counts. From 1970 to 1979, peak fall population levels have varied between 7,000 and 16,000 birds.

Refuge for resident and migrant geese is provided by a 5,500-acre waterfowl sanctuary and a limited access controlled hunting zone on the north and west boundaries of the refuge. Small grains and grazing areas provide food for geese in the refuge.

Estimates of the goose harvest on the WMA are obtained from car counts and bag checks. All geese shot

in the controlled hunting zone are checked and counted at the hunter registration station. The Canada goose kill has increased from an estimated 340 in 1970 and 160 in 1971 to 1,000 in 1978 and 1,320 in 1979. A survey was conducted in 1979 to estimate the Canada goose harvest on private lands bordering the WMA. An estimated 750 geese were harvested on the lands during the 1979 season. There have been no Canada goose harvest quotas set for the WMA and vicinity, although there have been quotas set elsewhere for the EPP.

Future Programs. Management of the resident Canada goose flock will continue. Goose nesting sites will be maintained, and more and possibly different sites will be added as necessary. If local hunting mortality becomes excessive, the movements of the flock will be investigated to identify areas where harvest is excessive, and management will be altered to reduce this kill. No additional releases of Canada geese are planned.

Most migratory goose management will continue. Cropland management on the area and the management of goose hunting on the unit and on surrounding private lands will be coordinated with changes in goose numbers and status on the area. Careful monitoring of numbers of Canada geese and possible problems associated with them, such as depredations and disease, will continue. Surveys to estimate the goose harvest outside the WMA will continue. WMA personnel will work with local landowners to ensure that cropping and hunting practices are responsive to goose management needs on the area. If the goose harvest on the WMA should increase substantially some time in the future, it may be necessary to limit the harvest by means of a quota system, by restricting shooting opportunities, or by a combination of methods.

PUBLIC USE MANAGEMENT

Objectives. The Thief Lake WMA will provide dispersed, unstructured recreation as part of the outdoor recreation system in northwestern Minnesota. Emphasis will be on providing quality public hunting, trapping, and other compatible recreation. Goose hunting opportunities on the WMA will be distributed as equitably as possible while still maintaining or improving hunting quality.

Considerations. State wildlife management areas, state parks, and state forests in northwestern Minnesota are public natural resource lands accommodating a variety of recreation. As components of the Minnesota outdoor recreation system, these units should be managed to maximize the types of recreational opportunities provided by the system, while avoiding unnecessary duplication. To best serve the widest range of Minnesota recreationists, opportunities should include organized activities, such as group camping and naturalist-directed interpretative programs; less structured or intensively developed activities, including the use of marked and developed trails and self-guiding interpretative programs; and unstructured activities with low participant densities, such as fishing, hunting, and self-directed hiking and skiing. This approach will provide a variety of opportunities and will fill the needs of most individuals.

Northwestern Minnesota state parks provide a variety of outdoor activities. Depending on the classification of each park, the park resources, and theme, state park-oriented recreation will include organized and directed programs as well as less intensively structured use with lower use densities. Because of their relatively small sizes, however, these parks cannot provide for some dispersed types of recreation nor all the trail systems to accommodate hikers, skiers, and snowmobilers.

State forests provide less structured recreation than state parks. These areas accommodate a variety of unstructured activities such as hunting, fishing, and primitive camping, as well as providing picnic and sanitary facilities and marked, improved trails. More intensively organized activities with higher participant densities, however, may conflict with sportsmen and recreationists seeking more solitude.

To round out this system, the Thief Lake WMA should provide for public hunting and trapping plus unstructured compatible forms of recreation such as nature observation, hiking, cross-country skiing, and photography at lower user densities. Management of the Thief Lake WMA for dispersed, unstructured recreation can provide alternative opportunities for northwestern Minnesota recreationists and will minimize use conflicts on all areas. Intensified agricultural practices, increased areas of cultivated land, increased posting of private lands, and more restrictive trespass laws will increase the importance of the state wildlife management areas to wildlife and sportsmen.

In addition to the state outdoor recreation system, the Agassiz National Wildlife Refuge provides a substantial area for unstructured forms of recreation such as deer and moose hunting, photography, and nature observation. The refuge also provides for more structured facilities, including a scenic auto drive and a marked nature trail.

The maintenance of quality public hunting on the Thief Lake WMA is a major concern. A quality hunting experience depends on many factors, one of the most important of which is the density of hunters. With few exceptions, crowded conditions have not been a problem for upland small game or moose hunters on the management area. The density of moose hunters is limited by the number of permits issued for the zone that includes the Thief Lake WMA. Hunting pressure during the grouse and deer seasons may be high enough in some areas to result in interference between hunters and reduce the quality of the hunt. However, there are usually harder to reach areas where hunters can go to avoid the crowd. With waterfowl hunters, however, crowding is often a major problem in maintaining quality huntino, particularly early in the season and on weekends. Crowded duck hunting conditions cause interference among hunting parties and destroy traditional values of the sport such as skill in the use of calls and decoys. Waterfowl hunters shooting at birds out of range can also decrease hunting quality for others by flaring approaching birds. A shell limit imposed on hunters on several managed goose hunting areas has discouraged such shooting and improved the quality of the hunt for many hunters, in addition to reducing crippling loss (Hunt 1968).

The concentration of Canada geese using the Thief Lake WMA during fall migration has attracted an increasing number of hunters. In earlier years, the relative ease and predictability of the firing line hunt around the wildlife sanctuary resulted in overcrowded hunting, competitive conditions with shooting at extreme ranges, and footraces for downed geese. These problems prompted the DNR to initiate a preregistered, controlled goose hunt on a portion of the management area. The controlled hunt has reduced hunter densities and conflicts over downed geese; however, problems still exist. Most stations are too conspicuously sited to permit the effective use of goose calls and decoys. A shell limit has reduced in-

discriminate shooting; however, WMA personnel continue to observe shooting at extremely highflying geese. Geese shot from blinds bordering the sanctuary occasionally fall into the sanctuary where they cannot be legally retrieved by hunters, and management personnel must be summoned to retrieve the birds. Thus, hunters are faced with the temptation to trespass in the sanctuary, and many wounded geese may escape and die unretrieved.

Hunters participating in the Thief Lake WMA controlled goose hunt were surveyed in 1974. Seventy-seven percent of the hunters surveyed who had hunted the refuge boundary prior to the controlled system, felt that the controlled hunt had improved the quality of their hunt. Eighty-nine percent of the hunters stated that the DNR should continue the controlled hunt. Over 60 percent of the respondents felt that the six shell limit was too low. However, 75 percent of the hunters believed that the shell limit did decrease the shooting at birds out of range (skybusting).

Excessive regulation and regimentation can, however, decrease hunting quality. The added regimentation of filling hunting spaces through pre-registration may decrease the quality of the hunt for some hunters and cause problems for some who do not know far in advance when they will be free to hunt. Other hunters may prefer such a system since it would assure them of a hunting space without competing with a large number of other hunters and without being tempted to violate regulations to pre-empt a hunting spot.

Few managed goose hunting areas outside of Minnesota are operated without a fee being charged, with the usual fee being $2 to $5 per hunter (Hunt 1968). Thus, goose hunters pay the added costs of administering controlled hunts. No fees are charged on any of the state controlled hunting areas in Minnesota, and the DNR lacks legal authority to do so. Approximately 45 percent of the hunters surveyed in 1978 at the Thief Lake WMA were in favor of a fee to operate the controlled goose hunt on the area (Table 26). Only 37 percent of the hunters participating in the 1974 Thief Lake controlled hunt favored a fee to cover the cost of such a hunt. In 1979, the cost of operating the Thief Lake controlled hunt totaled approximately $4,000 which would have amounted to about $2 per hunter per day.

Considerations should also be given to the effects of public use and especially certain types of vehicles on wildlife, vegetation, soils, and roads. Motorboats are inappropriate for use in the lake during spring and summer because they could disturb waterfowl during the nesting and broodrearing period. Vehicles driving on wet trails would compact the soil, make deep ruts, cause extensive erosion, and destroy vegetation. Snowmobiling may be detrimental to white-tailed deer (Kopischke 1974, Dorrance et al. 1975).

State highway 89 runs north and south through the center of the WMA. According to the Minnesota Department of Transportation, this highway is below current state standards and will need to be upgraded sometime in the near future.

Other activities such as hiking, sightseeing, bird watching, and photography are minor uses compared to hunting. However, such activities help to cultivate an appreciation of wildlife and of the wildlife management area and should be permitted and encouraged when facilities and manpower permit and when they do not conflict with the main objectives of the area. Since the WMA is far from major population centers, a visitors' center could not be justified. However, environmental education and hunter education could be done during guided tours of the area and through slide talks to local clubs and schools. Hunter orientation programs would be helpful in familiarizing hunters with the regulations, hunting opportunities, access, and other features of the management area.

In addition to providing an opportunity for people to visit and enjoy the area, the WMA plays a role in the local economy. Visitors responding to the 1978 user's survey reported spending an average of about $22 per person in Marshall County while visiting the WMA. During the waterfowl hunting period alone, October 1 through November 14, visitors to the WMA spent an estimated $120,000 in Marshall County.

Past and Present Programs. Public use of the Thief Lake WMA is regulated by the resident manager in accordance with Minnesota DNR Commissioner's Order No 1961, Regulations Relating to the Public Use of Wildlife Management Areas (Appendix F), in addition to the numerous other state laws and DNR regulations. Hunting is permitted under statewide regulations from September 1 to the end of February. The area contains a 5,500-acre no trespassing wildlife sanctuary (Figure 4). Camping is permitted in parking areas and water access sites during the hunting season. Motorboats with motors of 10 horsepower or less and snowmobiles may be operated on the management area.

Maps of the unit, showing the WMA boundary, refuge boundaries, roads, and public access and parking areas are available at the area headquarters. The maps do not show trails or all water areas and do not include area regulations. The resident manager or another staff member is usually at the headquarters area to assist visitors during high use periods.

In response to increased hunting pressure and problems with hunter behavior, the Thief Lake WMA initiated a controlled goose hunt in 1974. A controlled hunting zone (CHZ), extending 125 to 880 yards from the north and west boundaries of the refuge, was established (Figure 9). Goose hunting within the CHZ is confined to 58 fixed shooting stations, spaced about 100 yards apart. Use of these stations is controlled under a DNR Commissioner's Order.

Each day during the waterfowl season, hunters who have pre-registered by postcard lottery claim a station through a random drawing. Non-registered hunters then participate in a similar, standby drawing for unclaimed stations. Other non-registered hunters may report to the registration building and "refill" stations vacated by earlier parties. Both ducks and geese may be shot from the stations. After each completed hunt, hunters must report to the headquarters and register any geese or ducks bagged.

Hunting station use is restricted to the successful applicant and no more than two guests. Hunters are limited to one day in the stations either as a guest or a successful applicant during the first half of the waterfowl season. There is no limit on the use of stations by the "standby" or "refill" process. During the latter half of the season, stations are filled on a first come first serve basis with no restriction on the number of visits. Each hunter is limited to six shotgun shells per day. Hunters may not hunt farther than 10 feet from their station and may not retrieve birds from the sanctuary unless accompanied by authorized state personnel.

There are no special restrictions, except for the sanctuary area and the CHZ, on the number and spacing of duck and goose hunters on WMA or on any other type of users. Access to Thief Lake is provided by four improved access sites. The distribution of public use is regulated to some extent by the location of access points and parking areas.

A firing line still exists along the north refuge line

east of the CHZ, reducing hunting quality, increasing crippling losses, and increasing trespass in the refuge to retrieve birds. In 1979, crippling loss on the CHZ was 15 percent compared to 25 percent along the north refuge firing line.

The number of trappers using the WMA is limited by issuing only a certain number of trapping permits each year. Trappers are assigned to a specific trapping zone. Except for special beaver permits which cost $2.50 per season, trappers are not required to pay either a percentage of their catch or a permit fee. Usually two to six beaver permits and 12 to 18 general permits are issued.

Tours of the area for school groups and others are conducted by the resident manager. Visitors are permitted to drive the WMA road around the south end of the lake to view the area and the wildlife.

Enforcement of regulations on the area is done primarily by WMA personnel with assistance from DNR conservation officers.

Future Programs. Improved maps of the area, including trails, major vegetation types, water areas, access sites, and area regulations will be prepared and made available to visitors. An informational brochure describing the area will be prepared in conjunction with the map. The brochure will include descriptions of various wildlife species and plant communities and a summary of management and development.

The pre-registered controlled goose hunt will continue under the current set of regulations. The Minnesota DNR may seek legislation permitting a $1 to $3 registration fee to fund the administration of the controlled goose hunt. If hunting pressure and problems with hunter behavior increase along the north sanctuary firing line, the DNR will include this area in the CHZ to regulate hunter use (Figure 10). If included, a 100 yard strip will be cleared along the refuge line, and shooting stations will be constructed at approximately 125-yard intervals. Potentially, 26 additional stations could be sited. Law enforcement in the CHZ will be intensified if funds and manpower become available.

The current trapping system will be continued. As is done at present, trappers will be required to report their take to the resident manager at the end of the trapping season.

The present parking and primitive camping areas will be maintained, but no additional areas are planned.

An environmental education program, in the form of talks and guided or self-guided tours, will be developed, if possible. Hunter orientation classes for moose hunters and others may be conducted by WMA personnel sometime in the future. Activities such as sightseeing, bird watching, berry picking, and hiking will be encouraged when they do not interfere with major objectives of the WMA.

The DNR, Division of Fish and Wildlife will consult with the Department of Transportation to ensure that any plans to upgrade State Highway 89 will be consistent with the objectives of the WMA and will not adversely affect important wildlife habitat.

NONGAME MANAGEMENT

Objectives. An objective of wildlife management on the Thief Lake WMA is an effectively balanced program for all native wildlife species. Nongame wildlife will be considered in managing the wetlands, forests, croplands, and other habitats. Special consideration will be given to uncommon species.

Considerations. The Minnesota DNR has statutory responsibility for the protection, propagation, and wise use of the state's wildlife resources. State and federal wildlife management programs have, in the past, emphasized game species because of the popularity of hunting and because most of the funding for wildlife management came from hunters. Benefits or losses to nongame species were not considered in various management practices. However, most of the land acquisition and habitat management that has been done for game species has also been beneficial to nongame species. Even though management on the WMA will continue to emphasize game species, nongame species will not be neglected.

It is not possible to manage all portions of an area for all species at the same time. Some species are associated with climax plant communities, while others are adapted to early successional stages. A variety of habitats is needed to provide for a variety of wildlife species. In managing habitats for wildlife, especially mobile species such as most birds, a manager should consider which habitats are rare or becoming less common in the general vicinity.

Little is known about the requirements and responses to management of many species of mammals, birds, reptiles, amphibians, fish, and invertebrates. The nongame discussion emphasizes birds because there has been more public interest in this group than in any other and more research has been done on birds. Birds are also the most visible of the management area's nongame wildlife.

The marbled godwit is one of a variety of nongame species which benefits from habitat management on the unit.

Nongame bird management should consider three factors (Zeedyk and Evans 1975). First, maximum diversity of birdlife is found when the horizontal and vertical diversity of the vegetation are maximum. Second, bird species are adapted to nearly every habitat, so management benefiting some species can be detrimental to others. Finally, bird species differ in their ability to adapt to habitat variability since some species have specific requirements, while others are more general in their requirements.

The diversity of bird species often increases with forest maturity due to the greater vertical diversity of layers in mature forests (Odum 1971). Setting back forest succession by cutting or other means produces edges between contrasting vegetation types which increase horizontal diversity, resulting in a greater diversity and density of birds (Curtis and Ripley 1975). Species of birds that respond to cutting and increased edge include common flicker, catbird, brown thrasher, and yellow warbler. As the forest begins to regenerate, species closely associated with early successional stages, such as the mourning and chestnut-sided warblers, common yellow-throat, and white-throated sparrow, will benefit (Titterington et al. 1979). Access trails and forest openings also provide greater vegetative diversity for birds.

Species attracted to clear-cuts and edges usually have broad ranges of tolerance, high reproductive rates, and good powers of dispersal. Other species with more narrow ranges of tolerance can be adversely affected if management is directed entirely toward creating the maximum habitat diversity (Balda 1975). Species that require mature forests include the goshawk, oven-bird, barred owl, pileated woodpecker, red-headed woodpecker, and wood thrush. Extensive cutting of mature forest areas may be detrimental to these species.

Wetland management for game birds is generally good management for nongame birds as well. An interspersion of open water and structurally diverse emergent vegetation should be attractive to a wide variety of marsh birds (Weller and Spatcher 1965). Marsh management helps to maintain certain fish populations, which, in turn, provides food for birds such as pied-billed grebes, great blue herons, and great egrets.

Croplands on the WMA provide food for wintering songbirds (Burt 1977) as well as game birds. Grain fields and fallow fields are used by mourning doves and sandhill cranes which are presently nongame species in the state. Hay fields and grassy areas provide habitat for songbirds such as the western meadowlark, bobolink, and vesper sparrow, plus small rodents which are fed upon by hawks, owls, and mammalian predators. Small rodents may serve as buffer species, reducing predation on other species including waterfowl (Weller 1979).

The elk herd in eastern Marshall and western Beltrami Counties presents the best current opportunity for nongame management. As previously described (page 16), this free-ranging group of 20 to 30 animals is the result of a 1934 introduction, and is the only such herd in Minnesota. Free-roaming elk have, however, created problems for farmers in this area. Elk often graze and trample small grain crops, hay fields, and haybales. The elk's herding behavior causes the damage to be locally severe. The elk's behavior has led to illegal shooting of elk by farmers frustrated by crop depredations. The herding and unwary nature of these elk also makes them vulnerable to poaching. The task of elk management in this area is to preserve this unique species while reducing depredations to the lowest possible level.

The Thief Lake WMA lies within the peripheral range of the gray wolf (eastern timber wolf) in Minnesota (Bailey et al. 1978). Wolves occasionally occur in the management area and vicinity but only in very limited numbers. Although the U.S. Department of the Interior has reclassified the wolf in Minnesota from endangered to threatened, the Minnesota DNR does not consider the wolf to be in danger of elimination in the state in the foreseeable future. Since their protection in Minnesota, the wolf has expanded its range. The potential exists around the Thief Lake WMA for livestock depredations by wolves. At present, the DNR is negotiating with the U.S. Fish and Wildlife Service to develop a comprehensive, state-directed wolf management plan.

Up to the present, all funding for nongame management has come from hunting, fishing, and trapping license fees. In 1980, however, legislation was passed creating the Minnesota Nongame Wildlife Fund. This is a dedicated funding source for nongame management and research derived from voluntary checkoffs of state income tax refunds beginning in 1981. In addition, federal nongame funding legislation which would provide excise tax appropriations as matching funds for state nongame projects is under consideration. This legislation may provide substantial support for specific nongame management in the future.

Past and Present Programs. Current management on the WMA benefits nongame wildlife by promoting the maintenance of diverse habitats and preserving naturally occurring communities. Maintaining cover and food supplies and limiting human disturbance should help both game and nongame species. Nongame wildlife is considered in management plans, but thus far, lack of funds and information has limited management specifically for nongame species.

In recent years, Thief Lake WMA personnel have assumed responsibility for elk management. Managers have responded to requests for assistance in crop depredation situations by loaning "exploders" to affected farmers. These devices, fueled by propane and emitting periodic explosions sounding like gunfire, have not been completely effective. Often, depredation complaints have not been directed to Thief Lake personnel. Thief Lake WMA personnel also conduct yearly censuses of the elk.

An elk management plan was prepared by Thief Lake WMA managers and approved by the DNR Commissioner in 1976 (Minnesota DNR 1976). The plan calls for intensive habitat management in four townships (T.157N. and 158N., R.38W., and T.157N., and 158N., R.39W.) which includes the eastern portion of the Thief Lake WMA and the northeastern WMA supplement lands (Figure 10).

A nongame wildlife specialist employed by the Section of Wildlife beginning in 1977 has worked at evaluating the current status of many nongame species, especially uncommon ones, plus making suggestions for management. Breeding records and sightings of uncommon species are reported to and summarized by the nongame specialist.

Future Programs. Management programs on the Thief Lake WMA will continue to consider all wildlife species, especially uncommon and threatened species. As funds become available for nongame work, additional surveys and habitat management will be done. Suggestions of the nongame wildlife specialist will be incorporated into the management of the WMA whenever possible.

The elk herd will be maintained at present population levels with as little conflict with agriculture as possible. Management will include prescribed burning and food plot development on state lands,

cooperative, state-funded food plot development on private lands, and intensified depredation control. Elk management will be a primary management objective on WMA supplement lands to be managed in cooperation with the Division of Forestry in Township 158N, Range 39W. Depredation complaints will be referred to Thief Lake WMA personnel who will either: 1) provide scaring devices to landowners, 2) provide supplemental food for elk, or 3) shoot offending animals as a last resort.

RESEARCH AND SURVEYS

Objectives. Surveys will be conducted to monitor wildlife abundance and harvest, public use, and the effects of management on the unit's resources. Research to gather information on wildlife and their habitats will be encouraged. Research and survey results will be used to evaluate present management programs and to develop new management techniques.

Considerations. Information on wildlife abundance and distrubtion, hunting and trapping harvests, and public use is needed to guide the development and management of the WMA. Such information is collected regularly by surveys or informal observations by DNR personnel.

Wildlife abundance is difficult to assess. Aerial surveys of deer and waterfowl are used under certain conditions. In forested regions, deer pellet group surveys in spring provide an index to deer numbers. Annual surveys, such as ruffed grouse drumming counts and sharp-tailed grouse dancing ground counts on established routes, can be used as indexes to small game abundance. All of these techniques, however, require extensive labor and funding. Surveys of deer populations receive the highest priority, since their present management depends heavily on annual changes in harvest regulations based, in part, on these population estimates. Measuring changes in wildlife abundance in response to management on specific areas is complicated by changes in abundance in the surrounding area and by animal movements to and from the managed area.

Wildlife productivity is even more difficult to assess. Deer reproduction can be assessed by examining car-killed does in spring. Waterfowl productivity can be estimated using breeding pair counts, nest searches, or brood counts. Measurement of the reproductive response of waterfowl to habitat manipulation may be complicated by other factors such as weather, predation, the harvest in the preceding year, or the phenology of the nesting season.

Wildlife harvest statistics are used, in part, to estimate wildlife abundance and the success of management programs and regulations. Harvest data is determined by hunter bag checks, game registration, carcass collections, and mail surveys. Harvest records also supply information on physical conditions of the animals, population, sex and age structures, and, in some cases, food habits.

Public use is difficult to assess because of the limited staff and the numerous public entry points. Information on the number of users, temporal and spatial distribution of use, and other statistics on area visitors are used to document public use trends, problems, and needs. Input from individual users by interviews or questionnaires is useful in determining factors which increase or decrease the quality of a visit.

The effects of management on the resources of the area should be examined. Projects designed to benefit specific wildlife species may be detrimental to other animals, plants, soils, or waters. All projects should be examined for their impact on nontarget resources. Federal guidelines require these investigations when federal aid is involved.

Research information helps to develop effective management programs. The area has potential for research in many areas, including waterfowl production, depredations, mortality, and habitat management; deer populations; hunter behavior; and the effects of specific wildlife species management on nontarget wildlife. Information from such studies could lead to more effective management. The unit will become more important as a research area as natural areas in the state are fragmented or destroyed by development.

Past and Present Programs. Since the establishment of the Thief Lake WMA in 1931, there have been many types of surveys and research projects conducted on the area. Some of these are old projects that have been discontinued, others were begun years ago and are still being carried on, and some have just recently been completed (Table 29).

The present public use surveys concentrate on waterfowl hunters. Morning and evening car counts are conducted three days per week throughout the waterfowl season by WMA personnel. Car counts are not made at other times of the year on a regular basis. During 1979, mechanical car counters were placed along the WMA road south of the lake to estimate public use during the nonhunting season. The public use survey involving questionnaires in 1978 was conducted especially for this plan (Appendix D).

The number of ducks and geese killed by hunters is estimated by bag checks conducted after the morning and evening car counts. The number of deer and moose killed on the area is known because hunters are required to report their kill. Small game hunters are occasionally checked, but estimates of small game harvests cannot be made from bag checks because of small sample sizes. The furbearer harvest can be determined from mandatory reports.

The game lake and aquatic surveys that were done by the DNR provide information on the vegetation, physical characteristics, wildlife use, and water chemistry of Thief Lake. Vegetation transects and maps were completed, but work was not continued to document changes. A study to determine the availability and use of sago pondweed by ducks on Thief Lake was conducted by DNR biologists in 1960.

Several regular state or area-wide surveys are used to assess wildlife abundance (Table 29). Aerial transects are flown each year to estimate white-tailed deer and moose numbers and waterfowl populations during migration periods. Aerial and ground counts of breeding duck pairs during spring are used to estimate waterfowl production on the unit. Routes to census drumming ruffed grouse on the WMA are conducted every spring.

Future Programs. Car counts during the waterfowl season will be continued to monitor hunter use. Irregular car counts at other times of the year will be continued if other staff duties permit. Interviews with visitors or questionnaires placed on vehicles will occasionally be used to sample visitors' concerns and suggestions. This could be done during car counts and bag checks and would require little additional time.

Bag checks will continue as in past years to obtain data on the waterfowl harvest. Mandatory harvest reports by trappers will be continued.

Table 29. Research and surveys on the Thief Lake WMA and the dates and status of each.

Survey or Project	Dates	Status
Aquatic survey	1938, 1941, 1942, 1947	Not scheduled
Game lake survey	1949, 1955, 1957, 1964	Not scheduled
Waterfowl and muskrat habitat survey	1950	Not scheduled
Sago pondweed study	1960	Discontinued
Waterfowl breeding pair survey	1959 to present	Continuing
Waterfowl migration count	Unknown to present	Continuing
Hunter bag-check	1949 to present	Continuing
Trapping harvest summary	Unknown to present	Continuing
Big game census	1952 to present	Continuing
Ruffed grouse drumming count	1962 to present	Continuing
Public use survey	1978	Not scheduled
Resident Canada goose brood count	1961 to present	Continuing

The wildlife surveys presently being conducted on the WMA will be continued and improved as new techniques are developed. Management and research personnel of the DNR will cooperate in improving the collection of data on wildlife populations. If staff and support funds permit, additional wildlife surveys will be initiated. A survey to census sharp-tailed grouse will be given highest priority. In addition, surveys to monitor muskrat and beaver populations and to estimate sandhill crane use and production will also be considered.

Research by the Minnesota DNR and other competent researchers will be encouraged. Area personnel will cooperate and provide any assistance which their other duties permit.

New projects and maintenance will be evaluated by the area manager for their effects on non-target resources. Plans for major projects will be submitted to the Minnesota Historical Society for review in order to avoid destroying or altering important prehistoric or historic cultural resources.

THIEF LAKE WMA SUPPLEMENT — MANAGEMENT, ADMINISTRATION, AND ACQUISITION

Objectives. The long-range objective for the Thief Lake WMA Supplement is management of all lands within the approved project boundary for wildlife, outdoor recreation, and forest products. Wildlife management will be directed toward moose, white-tailed deer, ruffed and sharp-tailed grouse. Lands administered by the Division of Forestry will be managed cooperatively for wildlife and forest products. Private lands will be purchased from willing sellers by the Division of Fish and Wildlife, after county board approval.

Considerations. Historic patterns of state and private land ownership and agricultural practices in northwestern Minnesota produced an interspersion of cropland, brush, aspen forests, and wetlands which supported a diverse and productive association of wildlife. Relatively large tracts of state-owned land, generally in permanent forest, brush, and grass, were well dispersed throughout the region. Until recently, much of the private land was not in agricultural production due to poorly drained soils, fluctuations in rainfall, and low crop prices. Private lands were often cropped for several years, then abandoned to brush and grassland after a series of crop failures. Moose, white-tailed deer, sharp-tailed grouse, and ruffed grouse thrived in this mixture of wild lands and croplands.

In recent years, wild lands have been rapidly disappearing in northwestern Minnesota. Improved drainage techniques, favorable crop prices, and increased land values have encouraged private landowners to convert brush, forest, grass, and wetland habitats to cropland and pasture. U.S. Soil Conservation Service personnel estimate that in the past six years about 48,000 acres of wild lands have been converted to cropland in Marshall County and adjacent western Beltrami County. Wildlife managers in these counties estimate that up to 10 percent of the remaining privately-owned wildlife habitat is being eliminated each year.

State land ownership has declined dramatically in this region over the years. Of the 595,000 acres of Consolidated Conservation and Trust Fund lands in Roseau and Marshall Counties, about 40 percent (225,000 acres) has been sold to private parties. Most of this land has been converted to cropland.

Wildlife in these counties is becoming increasingly dependent on the remaining state-owned lands. In the 1979 moose season, about 80 percent of the harvest in northwestern Minnesota was on or adjacent to state lands.

Consolidated Conservation Area lands, administered by the Division of Forestry, comprise 34 percent of the Thief Lake WMA supplement. Minnesota Statutes, Sec. 84A.08, 84A.27, and 84A.37 (1978) specify that Consolidated Conservation Area lands be classified as to their suitability for agriculture, timber, and wildlife production and that lands classified more suitable for agriculture be subject to sale or rental by the state. Such lands may be reclassified from time to time. Conflicts between county boards and the DNR have arisen over the present land-use classification system in the northwest. Consolidated Conservation Area lands within the Thief Lake WMA supplement should be permanently classified for wildlife and forest management to allow

development and management with DNR wildlife and forestry funds.

Land purchases or leases by the state for wildlife purposes must be approved by the county board of commissioners (Minnesota Statutes, Sec. 97.481, 1978). The Marshall County Board has recently been reluctant to approve further land acquisition by the state until land classification procedures are agreed upon. Land classification negotiations between the DNR and Marshall County are in progress.

The DNR wishes to retain the current acreage of state-owned lands in Marshall County for natural resource conservation and management. However, the DNR negotiators have recently proposed a plan to redistribute state-owned lands in the county to reduce the impact of large state ownership in certain townships. The townships involved include Huntly (T.158N., R.43W.), Como (T.158N., R.42W.), and Linsell (T.156N., R.39W.) which contain proposed Thief Lake Supplement lands (Figure 5). The proposal calls for the sale of 8,000 acres of undedicated Trust Fund and Conservation Area land in five eastern Marshall County townships. The sales would be balanced by county-endorsed state acquisition of natural resource lands from willing sellers in areas of the county with limited state ownership and limited wildlife and forest lands or to consolidate state ownership in existing management units. The sales and acquisition would be phased over a ten-year period, and they would be contingent on the availability of adequate acquisition funds. Marshall County is currently evaluating this proposal.

State Trust Fund lands comprise about 46 percent (12,478 acres) of the Thief Lake WMA Supplement. Trust Fund lands are administered by the Division of Forestry. The Division of Fish and Wildlife may acquire Trust Fund lands by condemnation and payment of the current appraised market value of the condemned lands. Since much of this land is unsuited for agriculture or forestry, purchase of Trust Fund land for wildlife management would probably generate more income to the trust than potential commercial uses except mining.

Private lands comprise about 19 percent (5,066 acres) of the Thief Lake WMA Supplement. Acquisition of private lands would not only increase the value of the unit to wildlife but also would help to offset losses of wildlife habitat in the region due to land clearing. In addition, some private lands have been or may be developed for recreational residences or cropland which could be threatened by prescribed burning on the WMA.

Priority ratings have been established for wildlife land acquisition. Critical ratings apply to lands needed to protect or develop important wildlife habitat or solve serious management problems. Lands needed for future management, development, or habitat protection are designated as desirable. Eventual ratings include lands which will increase the value and manageability of the unit and protect wildlife habitat.

Much of the vegetation on the Thief Lake WMA Supplement including bur oak/upland brush, old fields, and lowland brush, could be best managed by controlled burning. Wildfires occur regularly in the area and require much time and expense to control. Periodic controlled burning facilitated by a network of firebreaks would prevent devastating wildlifes by reducing fuel buildup. The effects of fire on plant communities and its use as a technique to manage wildlife habitat are discussed in the "Fire Management" section.

Past and Present Programs. Little management has been done on the supplement lands. The Division of Forestry has controlled wildfires on the area and established conifer plantations on a number of old fields. Commercial timber harvest on the area has been limited. In 1979, the Division of Forestry leased approximately 600 acres in the supplement to private citizens for gravel, pasture, or cropland. WMA personnel have assisted local foresters in wildfire control. They have also dozed small clearings in aspen to encourage regeneration and provide deer browse.

As part of this plan, the Division of Fish and Wildlife has reassessed the Thief Lake WMA Supplement's project boundary and acquisition priorities. A total of 27,032 acres remain unacquired within the DNR-approved Thief Lake WMA project boundary.Three additions to this supplement, totaling 321 acres are proposed. Proposed deletions from the approved project include 1,401 acres of private land and 80 acres of Consolidated Conservation Area lands (Figure 5). The proposed net deletion from the supplement totals 1,160 acres (Table 30). All Consolidated Conservation, Trust Fund, and Volstead lands are designated as desirable. Private lands were assigned priorities by the resident manager (Table 31). Three tracts, totaling 280 acres, are rated as critical. Desirable lands include one tract, totaling 200 acres. The remaining 30 tracts, total-

Table 30. Ownership and acreage of proposed deletions and additions to the Thief Lake WMA approved project.

Present Ownership and Classification	Acres
DELETIONS	
Private	1,401
State Consolidated Conservation	80
Total	1,481
ADDITIONS	
Private	80
State	
Trust Fund	81
Consolidated Conservation	160
Total	321
NET DELETION	1,160

Table 31. Acreage, ownership, and acquisition priority of private land in the Thief Lake WMA Supplement.

Owner	Section	Township (North)	Range (West)	Description	Acreage	Priority[1]
R. Engevik	5	157	39	S½N½	160.	C
E. Peterson	5	157	39	SW¼	160	E
O. Dohrmann	6	157	39	NW¼NE¼	40	C
N. Morrisey	6	157	39	W½SW¼	70.45	E
I. Halvorson	10	158	40	NE¼SW¼	40	Proposed Deletion
P. Larson	22	158	40	NW¼	160	E
T. Berg	7	158	41	Lots 1 and 2, NE¼NW¼	145.17	E
E. Jensen	7	158	41	W½NE¼,SE¼NW¼	120	E
J. Novak	7	158	41	NE¼NE¼	40	E
F. Stannina	7	158	41	SE¼NE¼	40	E
F. Novak	8	158	41	NW¼,NW¼NE¼	200	E
J. Novak	8	158	41	NE¼NE¼	40	E
M. Novak	8	158	41	S½NE¼	80	E
M. Novak	8	158	41	N½SE¼	80	C
F. Novak	9	158	41	N½NW¼,NW¼NE¼	120	E
G. Kruta	9	158	41	S½NW¼,SW¼NE¼, NE¼SW¼,NW¼SE¼	200	E
T. Woyach	9	158	41	E½NE¼,NE¼SE¼	120	E
E. Lorenson	10	158	41	NW¼NW¼	40	E
G. Kruta	10	158	41	SW¼NW¼	40	E
R. Lorenson	10	158	41	NE¼NW¼,NW¼NE¼	80	E
W. Taus	10	158	41	SE¼NW¼,SW¼NE¼	80	E
R. Taus	10	158	41	E½NE¼	80	E
E. McAdams	18	158	41	SE¼NE¼,N½SE¼,E½SW¼	200	D
J. Cwikla	19	158	41	NW¼	190.3	E
E. McAdam	19	158	41	NW¼NE¼	40	E
W. Melby	19	158	41	S½NE¼,NE¼NE¼,SW¼SE¼	160	E
M. McAdam	19	158	41	NW¼SW¼	56.28	E
D. Danielson	19	158	41	E½SE¼,NW¼SE¼	120	E
E. Haugen	20	158	41	NW¼SE¼,SE¼SW¼	80	E
A. Haugen	20	158	41	SW¼SW¼,NE¼SW¼,SW¼SE¼	118.68	E
V. Thygeson	28	158	41	SW¼SW¼	40	Proposed Deletion
A. Haugen	28	158	41	SW¼NW¼,NW¼SW¼, SW¼NW¼NW¼	90	Proposed Deletion
A. Haugen	29	158	41	S½NE¼,W½NW¼	160	Proposed Deletion
E. Haugen	29	158	41	S½NE¼,N½SE¼,NW¼SW¼	200	Proposed Deletion
A. Cwikla	29	158	41	SE¼SW¼,SW¼SE¼	80	Proposed Deletion
V. Thygeson	20	158	41	SE¼SE¼	40	Proposed Deletion
E. Peterson	29	158	41	W½SW¼	80	Proposed Deletion
J. Swikla	30	158	41	W½NW½	115.2	Proposed Deletion
W. Melby	30	158	41	E½NW¼,W½NE¼	160	Proposed Deletion
S. Cwikla	30	158	41	SW¼,W½SE¼	276	Proposed Deletion
E Peterson	30	158	41	E½SE¼	80	Proposed Deletion
J. V. Super et al.	11	158	42	S½SE¼	80	E
O. Dohrman	28	158	42	W½NW¼,SE¼NW¼	120	E
H. Johnson	33	158	42	E½SW¼	80	E
A. Kolden	4	157	42	E½NW¼,NE¼SW¼	123.42	E
A. Craigmiles	1	158	43	SW¼,NW¼SE¼	200	E
E. Anderson	36	148	43	SW¼NW¼, less 8A.	32	Proposed Deletion
W. Nelson	36	158	43	8 A. in SW¼NW¼	8	Proposed Deletion

[1] C=critical, D=desirable, E=eventual

ing 3,184 acres, are rated for eventual acquisition. The two tracts of state-owned land in the proposed additions are rated as desirable, while the one private tract is rated as critical.

Future Programs. The Division of Fish and Wildlife and Forestry will cooperatively manage the 21,966 acres of state-owned land administered by the Division of Forestry within the Thief Lake WMA Supplement. Field personnel of the two divisions will review and approve each other's management plans and attempt to develop an integrated management plan by the process described in the "Forest Management" section of this plan. Division of Forestry-administered land will be acquired by the Division of Fish and Wildlife only upon mutual agreement between the divisions or upon recommendation of the Commissioner.

Acquisition of private land will follow the present proposal (Figure 5, Table 31). This plan will modify the project proposal to include the proposed deletions and additions to the supplement. Private land will be acquired only from willing sellers after county board approval. Priority will be given to those tracts of land rated as critical and desirable. Further land acquisition will depend on funding, availability of land, and county board approval. For these reasons, a definite acquisition schedule is not possible.

In summary, 25,872 acres outside the present Thief Lake WMA boundary are proposed to be managed by cooperative agreement with the Division of Forestry or acquired as part of the WMA. A land classification agreement with Marshall County will probably require modification of this proposal. As land classification, cooperative agreements, and acquisition are completed, the supplement will be posted with wildlife management area signs. Proposed cooperative agreements will be presented to the State Planning Agency for review.

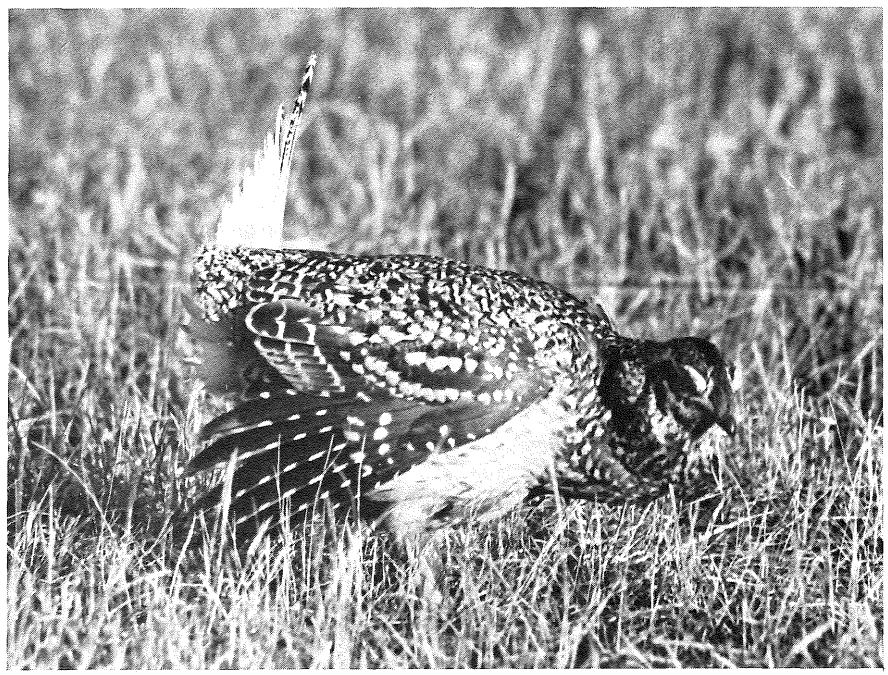
Wildlife management on the supplement will be primarily directed toward moose and sharp-tailed grouse. A fire management plan will be developed in cooperation with the district and area foresters. Prescribed burning will be used to prevent brush encroachment on grasslands and wetlands and to maintain brushy habitats in an open, easily-traveled stage at a height of five feet or less (Figure 10). A system of firebreaks will be maintained using roads and ditch grades where possible. The burning rotation will be 5 to 10 years.

Sites most desirable for forest management from the wildlife management viewpoint are identified in Figure 10. The Divisions of Fish and Wildlife and Forestry will evaluate these and other sites to identify blocks of land which can be effectively managed for commercial forestry. These blocks will be protected with firebreaks. The area and district foresters and the resident wildlife manager will cooperatively determine the forest management objectives for the area. To benefit ruffed grouse and white-tailed deer, aspen will be harvested in the smallest blocks and on the shortest rotation which are economical for commercial pulpwood operations. Harvest blocks of 20 acres or less and a rotation of about 40 years are preferred for wildlife management. Softwood regeneration sites and methods will be cooperatively identified to optimize the mix of wildlife habitat and timber production benefits.

As funding becomes available, impoundments and dugouts will be constructed on wetland areas to provide open water habitat for waterfowl. Impoundment construction will not obstruct water flow in public drainage ditches so as to effect drainage on private land. Wetland development and management will follow the guidelines specified in the "Wetland Management" section.

Food plots will be developed on existing agricultural fields, old fields, and clear-cut forest sites. All or part of this cropland will be leased to local farmers on a sharecrop basis.

Motor vehicle use will be permitted on existing roads, and small pulloff and parking areas will be developed as needed. All normal public uses of wildlife management areas will be permitted. Snowmobiles will also be allowed as provided for in Commissioner's Order No. 1961.



Sharp-tailed grouse will be one of the primary concerns of habitat management on the Thief Lake WMA Supplement.

SUMMARY OF MANAGEMENT PROGRAMS

WETLANDS.

Wetlands will be managed primarily for waterfowl and public hunting. Water levels in Thief Lake will be regulated to provide spring flood water storage and optimum water depths for waterfowl and hunters. Open water areas will be developed and maintained for waterfowl brood habitat. Small islands and artificial structures will be constructed and maintained to provide waterfowl nesting sites. A proposed 1500-acre impoundment, the "Haroldson dam," will be the subject of detailed hydrological studies and additional public input before the final decision is made.

FORESTS.

Forests will be managed to maintain or create an interspersion of forest types and age classes beneficial to wildlife. Timber will be harvested by commercial logging and fuelwood sales. Small (< 20 acre), dispersed clear-cuts will be the preferred harvest technique. Unmarketable timber will be periodically cut, sheared, or burned by WMA personnel to set back succession and maintain wildlife values. Priority will be given to regenerating over-mature aspen stands.

NON-FORESTED UPLANDS.

Non-forested uplands include forest openings, croplands, old fields, and grasslands. Forest openings will be created and maintained by burning, mowing, logging, and dozing to increase habitat needs for wildlife and to reduce wildlife damage to crops on private lands. A major portion of the cropland on the WMA will be managed by sharecrop leases with local farmers. Grain grown on the area will be used on feeding sites around Thief Lake to prevent waterfowl crop depredations on nearby private lands during late summer. Additional food plots will be developed in old fields or following timber harvest of upland forest sites. Grasslands and old fields will be managed by prescribed burning and mowing to provide nesting cover and open areas for wildlife.

PRESCRIBED BURNING.

Prescribed burning will be used to create and maintain quality wildlife habitat for nesting, feeding, and cover. Firebreaks will be developed to facilitate prescribed burns and to protect productive forest lands. Burning operations will be coordinated with Division of Forestry personnel. Between 1,000-2,000 acres per year are scheduled for burning.

CANADA GEESE.

Management for nesting Canada geese on the area will continue. Nest sites and possibly additional security from hunting pressure will be provided for the resident goose flock. Refuge and food will be provided to attract migrant geese. Local goose hunting pressure will be closely monitored and if the goose harvest should exceed DNR and/or federal guidelines, additional regulations may be imposed in the future to limit the harvest.

PUBLIC USE.

The area will provide quality public hunting, trapping, and other activities compatible with its legal purpose and management objectives. The pre-registered controlled goose hunt will continue under the current set of regulations. If necessary, the controlled goose hunting zone will be expanded and additional shooting stations will be provided. Registration fees will be considered if funding for the controlled hunt is insufficient. The current trapping permit system will continue. The present parking and primitive camping areas will be maintained, but no additional areas are planned. Other outdoor recreational activities such as cross-country skiing, hiking, wildlife observation, and snowmobiling will be permitted on the area, but no trails or special facilities will be developed for these activities.

NONGAME WILDLIFE.

Nongame wildlife will be considered in all management programs for game species. Special management considerations will be given to rare or unique species such as the greater sandhill crane, gray wolf, and elk. More specific programs for nongame species will be implemented as needs are identified and funds are provided through the state nongame wildlife program.

RESEARCH AND SURVEYS

Regular surveys of public use, including car counts, interviews, and hunter bag checks will be continued. Annual surveys of wildlife abundance, including aerial censuses of moose, deer, and waterfowl and ground counts of drumming ruffed grouse and breeding duck pairs will be conducted. Additional wildlife surveys, such as a sharp-tailed grouse dancing ground counts, may be initiated. The manager will cooperate with DNR and university research projects which will aid in statewide or unit management.

WMA SUPPLEMENT.

A total of 25,952 acres of land will be added to the Thief Lake WMA. The Divisions of Fish and Wildlife and Forestry will cooperatively manage 21,966 acres of state-owned land within this supplement. Private lands, totaling 3,664 acres, are proposed for acquisition from willing sellers after county board approval. When land classification and cooperative agreements are completed with Marshall County and the Division of Forestry, the supplement will be posted with wildlife management area signs. Wildlife management on the supplement will be primarily directed toward elk, moose, and sharp-tailed grouse. All normal public use of wildlife management areas will be permitted.

IMPLEMENTATION AND COST ESTIMATES

Specific programs to manage fish and wildlife and provide quality fish and wildlife-related recreation were developed based on present conditions and future expectations. Implementation of these programs depends on land ownership, land and management costs, and the amount and sources of funding.

LAND COSTS

Land acquisition costs are not estimated for the management area because of the extreme variation in land types and values. Acquisition costs will continue to increase as land values increase. Funds for land purchases are not part of the management area operating budget.

Land acquisition has been funded historically by a surcharge on small game hunting licenses. This $2 surcharge, which is authorized through 1984, currently generates about $600,000 annually for wildlife land acquisition. Throughout the years, special appropriations for wildlife and land acquisition have been made by the Legislative Commission on Minnesota Resources (LCMR). The LCMR's most recent appropriation was $350,000 in 1975. LCMR appropriations remain a possible future funding source. In recent years, surcharge and LCMR funds have been supplemented by general revenue funds under a program called Resource 2000. This 6-year program has provided $9.2 million for wildlife land acquisition since 1975. The amount of wildlife lands which can be acquired in future years will depend on the level of funding provided by these three sources.

MANAGEMENT PROGRAMS AND COSTS

The resident wildlife manager, under the supervision of the Region I Section of Wildlife Office in Bemidji, will implement the management proposals in this plan.

The resident manager must have the flexibility to decide how funds will be spent through the year and to modify programs to suit changing conditions. Proposed development and management programs depend on weather conditions, land acquisition, and equipment and labor availability. For example, proposed controlled burning might be impossible due to wet or dry weather.

The wildlife management programs were placed in three alternative spending levels (Table 32). All costs were estimated in 1980 dollars. Costs will increase if inflationary costs continue to rise. Included in the first spending level are those programs having the highest priority which can be implemented at the current spending level without management cutbacks. Present expenditures of about $130,000 to $140,000 per year represent current costs for salaries, routine equipment and facility maintenance and operation, and yearly habitat maintenance and development. Levels II and III require about 26 and 36 percent increases over present levels, respectively (Table 32).

All spending levels require additional funds for the purchase of equipment or the construction of capital improvements. Many of these capital investments are required to immediately implement all programs. Although spending levels are presented on an annual basis, the costs for capital expenditures listed in Table 32 will only occur once during the 10-year planning period. Expenditures for equipment and improvements for full implementation of management levels II and III are $371,500.

Equipment replacement needs are difficult to predict because of the uncertain demands on equipment. Also, major equipment replacement is dependent on funding, needs, and priorities within Region I. Because of these factors, the anticipated equipment replacement is scheduled in 5-year intervals (Table 33). Replacement costs were based on price estimates for new equipment. In many cases, however, used equipment, especially farm machinery, will be adequate and can be purchased at substantially lower costs.

The DNR, Division of Forestry programs can be conducted under current funding levels. Supplemental funds will be needed to complete an updated forest inventory of the area.

MANAGEMENT AREA FUNDING

Funding for completing acquisition within the Thief Lake project will be primarily from the surcharge fund and the Resource 2000 program described under land costs.

Funds for the development and operation of the management area are appropriated from the dedicated Game and Fish Fund. Receipts into this fund are primarily from the sale of hunting and fishing licenses and federal aid reimbursement through the Pittman-Robertson and Dingell-Johnson programs. Federal aid reimbursement is 75 percent reimbursement on approved projects. For the most part, the Division of Fish and Wildlife operates within a budget that can only be increased through an increase in license fees or license sales.

A $3 Minnesota migratory waterfowl stamp was initiated in 1977. The legislature appropriates an amount which approximates waterfowl stamp receipts. The appropriation is for the development of waterfowl habitat on public hunting grounds and designated lakes.

In addition, as part of the Resource 2000 program, the legislature appropriated $1,000,000 for the betterment of wildlife management areas.

Except for the recent increase in revenue provided by the migratory waterfowl stamp and possible future general fund appropriations, management funds will probably not increase significantly by 1989. Accordingly, most proposals are planned within the present budgetary constraints. Wildlife management finances in Region I are somewhat flexible, and funds can be shifted from item to item. To maintain the present wildlife programs throughout the region and to implement all of the planned management on the Thief Lake WMA, increased funding in Region I will be needed.

Table 32. Annual spending alternatives for the management of the Thief Lake WMA.

Level I. Management at current spending level.

Wetland management
1. Maintain dikes and water control structures
2. Maintain and develop artificial potholes or dugouts and level ditches
3. Maintain existing nesting islands
4. Manage lake and impoundment water levels

Forest management
1. Administer firewood and commercial timber sales
2. Cut browse and make trails for deer in severe winters

Non-forested upland management
1. Administer cooperative farming agreements
2. Maintain present acreage farmed by state personnel
3. Feed waterfowl to prevent depredations
4. Doze forest openings
5. Plant forest openings to a legume cover crop
6. Destroy noxious weeds

Canada goose management
1. Conduct present kill surveys and censuses
2. Maintain artificial nest structures, add new structures as needed
3. Administer the controlled goose hunt

Public use management
1. Maintain access roads, parking lots, and hunting blinds
2. Enforce game laws and special regulations
3. Maintain boundary and other regulatory signs
4. Conduct limited group tours of the unit
5. Manage public hunting and trapping

Research and surveys
1. Conduct present wildlife surveys
2. Cooperate with research projects

Fire management
1. Develop and maintain firebreaks
2. Burn woods, marsh, and grass following fire management plan

Annual spending	
1979 baseline	$137,000
Equipment replacement	37,200
Added labor and support	-0-
Annual Total	$174,200

Immediate needs for implementation	
Replacement	
Machine shed-50'x150'	$229,000
New	
Dozer/caterpillar D4	$ 70,000
Cultivator/20'	3,000
Front end loader/4x4	38,000
Interseeder	6,500
Total	$346,500

Table 32. (continued)

Level II. Additional management with increased spending.

Wetland management
1. Construct additional level ditches, dugouts, and nesting islands
2. Renovate Haroldson dam

Forest management
1. Develop forest management plan in cooperation with district foresters
2. Cut, shear, and burn unmarketable, over-aged aspen stands
3. Crush, mow, and burn lowland brush

Non-forested upland management
1. Develop more food plots on present cropland — more farming by state
2. Clear and maintain additional forest openings

Canada goose management
1. Survey resident goose reproduction and mortality
2. Expand controlled hunting zone and construct additional clearings and shooting stations

Public use management
1. Improve parking areas
2. Intensify enforcement of hunting regulations

Research and surveys
1. Improve public use surveys
2. Conduct annual spring sharp-tailed grouse survey

Nongame management
1. Implement elk management plan

Annual spending		Immediate capital needs for implementation	
Level I annual total	$174,200	Level I total	$346,500
Added labor and support		Repair	
(1, full-time natural resources wildlife technician)	$ 13,600	Haroldson dam	25,000
(2, 9-month laborers)	17,000	Total	$371,500
(support expenses)	15,000		
Annual Total	$219,800		

Level III. Additional management with increased funding.

Wetland management
1. Construct and manage new impoundments

Forest management
1. Intensify lowland brush crushing and burning
2. Experimental lowland conifer management

Non-forested upland management
1. Additional food plots, more farming by state

Public use management
1. Development and administer an environmental education program
2. Management and development of additional controlled hunting as needed

Annual spending		Immediate capital needs for implementation	
Level II annual total	$219,800	Level II total	$371,500
Added labor and support		Total	$371,500
(1, 9-month laborer)	8,500		
(Seasonal labor and support expenses)	8,500		
Annual total	$236,800		

Table 33. Equipment replacement schedule for the Thief Lake WMA.

Period	Item/Model	Estimated Cost
1980-1984	(2) Trucks, ½ ton pickup	$ 13,000
	(2) Trucks, ½ ton 4x4 pickup	13,600
	Tractor, loader and backhoe	18,000
	Trailer, 2 wheel	450
1985-1989	(2) Tractors, farm	41,300
	Dozer/Caterpillar D6	100,000
	Dragline	100,000
	Road grader	75,000
	All-terrain-vehicle	6,000
	Cultivator	4,800

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Appendix A. The Minnesota Outdoor Recreation System.

Classification	Purpose	Administration
Natural State Park	A natural state park shall be established to protect and perpetuate extensive areas of the state possessing those resources which illustrate and exemplify Minnesota's natural phenomena and to provide for the use, enjoyment, and understanding of such resources without impairment for the enjoyment and recreation of future generations.	Commissioner of Natural Resources
Recreational State Park	A recreational state park shall be established to provide a board selection of outdoor recreation opportunities in a natural setting which may be used by large numbers of people.	Commissioner of Natural Resources
State Trail	A state trail shall be established to provide a recreational travel route which connects units of the outdoor recreation system or the national trail system, provides access to or passage through other areas which have significant scenic, historic, scientific, or recreational qualities or reestablishes or permits travel along an historically prominent travel route or which provides commuter transportation.	Commissioners of Transportation and Natural Resources
State Scientific and Natural Area	A scientific and natural area shall be established to protect and perpetuate in an undisturbed natural state those natural features which possess exceptional scientific or educational value.	Commissioner of Natural Resources
State Wilderness Area	A state wilderness area shall be established to preserve, in a natural wild and undeveloped condition, areas which offer outstanding opportunities for solitude and primitive types of outdoor recreation.	Commissioner of Natural Resources
State Forests and State Forest Sub-Areas	A state forest, as established by Minnesota Statutes, Section 89.021, shall be administered to accomplish the purposes set forth in that section, and a state forest sub-area shall be established to permit development and management of specialized outdoor recreation at locations and in a manner consistent with the primary purpose of the forest.	Commissioner of Natural Resources
State Wildlife Management Area	A state wildlife management area shall be established to protect those lands and waters which have a high potential for wildlife production and to develop and manage these lands and waters for the production of wildlife, for public hunting, fishing, and trapping, and for other compatible outdoor recreational uses.	Commissioner of Natural Resources
State Water Access Site	A state water access site shall be established to provide public access to rivers and lakes which are suitable for outdoor water recreation and where the access is necessary to permit public use.	Commissioner of Natural Resources
State Wild, Scenic, and Recreational Rivers	State wild, scenic, and recreational rivers shall be established to protect and maintain the natural characteristics of all or a portion of a river or stream or its tributaries, or lake through which the river or streams flows which together with adjacent lands possesses outstanding scenic, scientific, historical, or recreational value, as provided by Sections 104.31 to 104.40.	Commissioner of Natural Resources
State Historic Site	A state historic site shall be established to preserve, restore, and interpret buildings and other structures, locales, sites, antiquities, and related lands which aptly illustrate significant events, personalities, and features of the history and archaeology of the state or nation.	Commissioner of Natural Resources, Minnesota Historical Society, Board of Regents of the University of Minnesota, Governmental subdivisions of the State and County Historical Societies.
State Rest Area	A state rest area shall be established to promote a safe, pleasurable, and informative travel experience along Minnesota highways by providing areas and facilities at reasonable intervals for information, emergencies, or the rest and comfort of travelers.	Commissioner of Transportation

Appendix B. Common and scientific names of plants mentioned in the text.

Family	Common Name	Scientific Name
Aceraceae	Boxelder	*Acer Negundo*
	Red Maple	*Acer rubrum*
	Mountain maple	*Acer spicatum*
Alismataceae	Water-plantain	*Alisma Plantago-aquatica*
	Arrow-head	*Sagittaria* sp.
Anacardiaceae	Poison ivy	*Rhus radicans*
Apocynaceae	Dogbane	*Apocynum androsaemifolium*
Aralaceae	Sarsaparilla	*Aralia nudicaulis*
Asclepiadeceae	Swamp milkweed	*Asclepias incarnata*
Betulaceae	Alder	*Alnus* sp.
	Paper birch	*Betula papyrifera*
	Bog birch	*Betula pumila*
	American hazel	*Corylus americana*
	Beaked hazel	*Corylus cornuta*
Caprifoliaceae	Arrow-wood	*Viburnum* sp.
Ceratophyllaceae	Coontail	*Ceratophyllum demersum*
Characeae	Musk grass	*Chara* sp.
Compositae	Ragweed	*Ambrosia* sp.
	Common sunflower	*Helianthus annus*
	Goldenrod	*Solidago* sp.
Convolvulaceae	Dodder	*Cuscata Gronovii*
Cornaceae	Round-leafed dogwood	*Cornus rugosa*
	Red-osier dogwood	*Cornus stolonifera*
Cucurbitaceae	Wild cucumber	*Echinocystis lobata*
Cupressaceae	White cedar	*Thuja occidentalis*
Cyperaceae	Sedge	*Carex* sp.
	Hardstem bulrush	*Scirpus acutus*
	Softstem bulruch	*Scirpus validus*
Ericaceae	Bog-rosemary	*Andromeda glaucophylla*
	Leather-leaf	*Chamaedaphne calyculata*
	Bog-laurel	*Kalmia polifolia*
	Labrador tea	*Ledum groenlandicum*
	Cranberry	*Vaccinium Oxycoccus*
	Blueberry	*Vaccinium* sp.
Fabaceae	Hog-peanut	*Amphicarpa bracteata*
	Alfalfa	*Medicago sativa*
	Sweet clover	*Melilotus* sp.
Fagaceae	White oak	*Quercus alba*
	Bur oak	*Quercus macrocarpa*
	Black oak	*Quercus velutina*
Gramineae	Quack grass	*Agropyron repens*
	Big bluestem	*Andropogon Gerardi*
	Little bluestem	*Andropogon scoparius*
	Oats	*Avena sativa*
	Brome grass	*Bromus* sp.
	Bluejoint	*Calamagrostis canadensis*
	Japanese millet	*Echinochloa crusgalli var. frumentacea*
	Barley	*Elymus* sp.
	Red carnary grass	*Phalaris arundinacea*
	Timothy	*Phleum pratense*
	Common reed	*Phragmites communis*
	Indian grass	*Sorghastrum nutans*
	Wheat	*Triticum aestivum*
	Corn	*Zea mays*
Haloragaceae	Water milfoil	*Myriophyllum exalbescens*
Iridaceae	Blue flag	*Iris virginica*
Labiatae	Water-horehound	*Lycopus* sp.
Lentibulariaceae	Bladderwort	*Utricularia vulgaris*
Linaceae	Common flax	*Linum usitatissimum*
Loranthaceae	Dwarf mistletoe	*Arceuthobium pusillum*
Najadaceae	Pondweed	*Potamogeton* sp.
Oleaceae	Green ash	*Fraxinus pennsylvanica*
	Black ash	*Fraxinus nigra*
Pinaceae	Balsam fir	*Abies balsamea*
	Tamarack	*Larix laricina*

Appendix B (continued)

Family	Common Name	Scientific Name
	White spruce	*Picea glauca*
	Black spruce	*Picea mariana*
	Red pine	*Pinus resinosa*
	White pine	*Pinus strobus*
Polypodiaceae	Bracken fern	*Pteridium aquilinum*
Ranunculaceae	White baneberry	*Actea alba*
	Red baneberry	*Actea rubra*
	Meadow rue	*Thalictrum dioicum*
Rosaceae	Chokecherry	*Prunus virginiana*
	Red raspberry	*Rubus strigosus*
	Juneberry	*Amelanchier* sp.
Salicaceae	Balsam poplar (Balm of Gilead)	*Populus balsamifera*
	Tembling aspen	*Populus tremuloides*
	Willow	*Salix* sp.
Spagnaceae	Sphagnum moss	*Sphagnum* sp.
Tiliaceae	Basswood	*Tilia americana*
Typhaceae	Cattail	*Typha* sp.
Ulmaceae	American elm	*Ulmus americana*
Umbelliferae	Water-hemlock	*Cicuta bulbifera*
Urticaceae	Stinging nettle	*Urtice dioica*

Appendix C. Vegetative composition of the Thief Lake WMA, supplement, and proposed additions and deletions[1].

Type	Present WMA Boundary		Supplement		Proposed Deletion		Proposed Addition	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Deciduous Forest								
Aspen	5,261	15.8	8,483	33.7	261	17.6	38	11.8
Oak	18	T[2]	665	2.6	0	0	0	0
Upland brush	8	T	716	2.8	0	0	0	0
Bottomland hardwoods	66	0.2	0	0	0	0	0	0
Dozed	159	0.5	12	T	0	0	0	0
Mixed Deciduous-Coniferous	429	1.3	32	0.1	0	0	0	0
Pine Plantation	4	T	82	0.3	0	0	0	0
Old Field	825	2.5	536	2.1	13	0.9	88	27.4
Agricultural Field	1,876	5.6	2,917	11.6	1,127	76.1	76	23.7
Lowland Brush	7,867	23.6	8,937	35.5	80	5.4	102	31.8
Lowland Conifer								
Black spruce	1,763	5.3	220	0.8	0	0	0	0
Tamarack	1,357	4.1	81	0.3	0	0	0	0
White cedar	36	0.1	0	0	0	0	0	0
Black spruce-balsam fir	79	0.2	0	0	0	0	0	0
Wetlands								
Type II	4,286	12.9	1,679	6.7	0	0	17	5.3
Type III	828	2.5	441	1.8	0	0	0	0
Type IV	78	0.2	0	0	0	0	0	0
Type XIII	1,166	3.5	326	1.3	0	0	0	0
Gravel Pit	7	T	64	0.2	0	0	0	0
Thief Lake	7,142	21.5	0	0	0	0	0	0
TOTAL	33,255	99.8	25,191	99.8	1,481	100.0	321	100.0

[1] Areas calculated from Figure 3 with a Hewlett-Packard Digitizer.
[2] T = trace.

Appendix D. Thief Lake WMA public use survey; methods, analysis, and results.

A public use survey was conducted to supply additional information on the types and amounts of recreational use occurring on the area. Information on the attitudes and demographic characteristics of area users was also obtained.

SURVEY PERIOD

The survey, conducted in 1978, was divided into two subperiods, June 15 - September 15 (summer) and September 16 — December 31 (fall/winter), because of differences in the intensity and types of use on the area. The summer period is a time of warm weather activities such as fishing, camping, and boating, while hunting predominates during the fall/winter period. Public use of the area from January through May is extremely low according to the resident manager. Since time and funding was not adequate to survey the entire year, this period was not sampled.

SAMPLING TECHNIQUES

Questionnaires were distributed to parked vehicles encountered along a predetermined route which included the major access points, parking lots, and roads of the management area (Figure 1). For each vehicle encountered, the vehicle type, license plate number, time of day, and approximate location were recorded on a tally sheet. A closed, road-blocking technique was not feasible because of the dispersed points of access along the roads bordering and bisecting the WMA.

Each subperiod was stratified by weekday units (Monday - Friday) and weekend units (Saturday - Sunday). One sample day was drawn from every other weekday unit and one from every other weekend unit, with a random start for selecting the first unit sampled. Within each unit selected, one sampling day was drawn at random. The survey route was reversed from one sample unit day to the next.

Additional public use surveys were conducted on three other WMA's in northwestern Minnesota concurrent with the Thief Lake WMA survey. Because of time and personnel constraints, only one area could be surveyed per day. When conflicts in surveys occurred on the same day between the four WMA's, the extra route(s) were reassigned to the nearest day within the sampling unit.

Only vehicles parked along the portions of the route paralleling or entirely within the WMA boundary were tallied and given a questionnaire.

Starting times for each route during the June 15 — September 15 period alternated between 10 a.m. and 3 p.m. to better cover expected evening use of the area. For the September 16 — December 31 period, each route alternated between 8 a.m. and 1 p.m. to better comply with hunting hours. The enumerator recorded the starting and ending times of each survey route.

QUESTIONNAIRE

A questionnaire (Figure 2) and stamped business reply envelope were clipped on the windshield of each vehicle encountered along the survey route (Figure 1). The questionnaire consisted of 14 questions which could all be answered by a simple check or short answer. The questionnaire was designed to be completed on a visitor-party basis. A map of the WMA divided into three compartments was attached to each questionnaire. An individual identification number was stamped on the upper right hand corner of each questionnaire to facilitate tabulating and checking questionnaire returns.

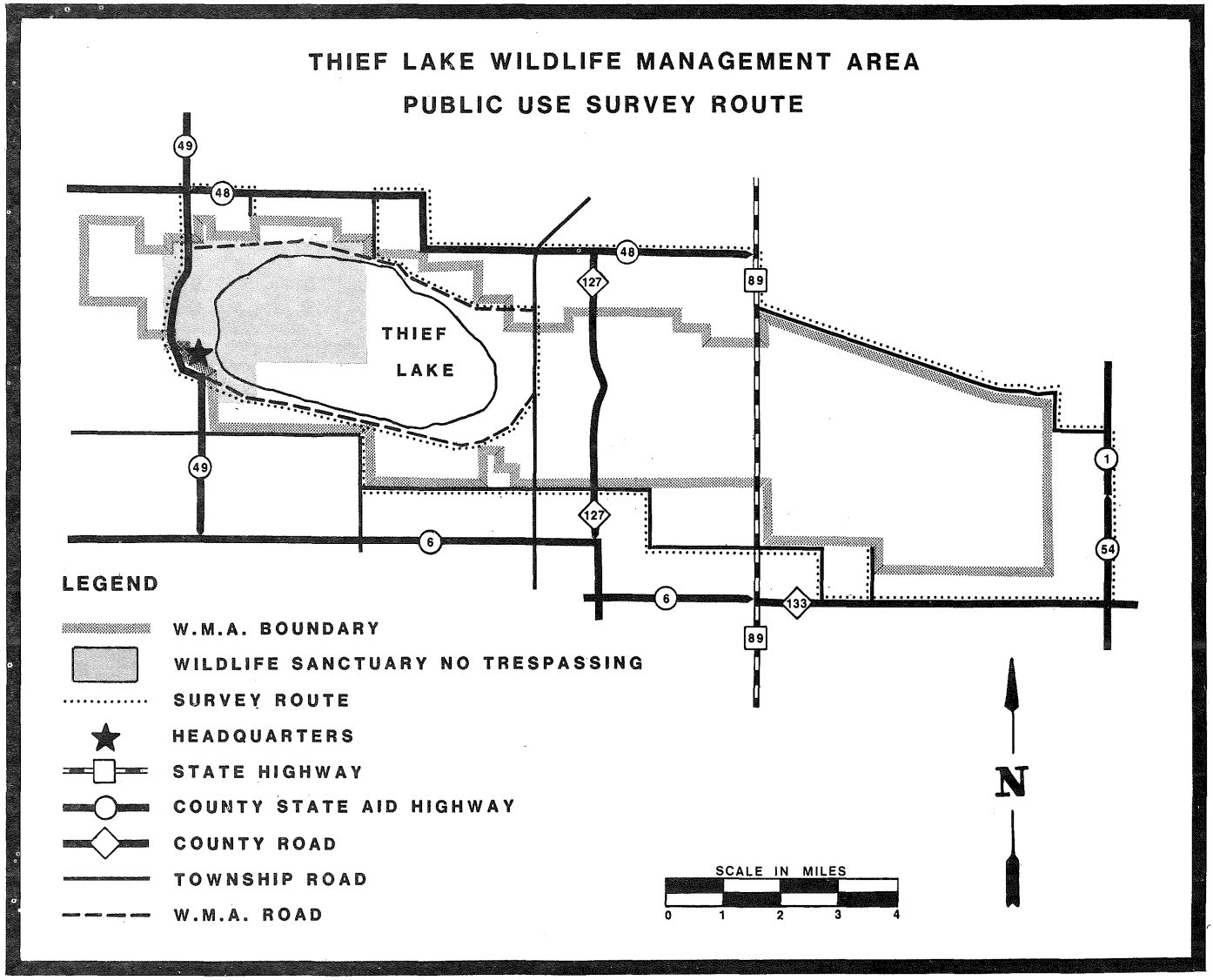

Figure 1

Dear Visitor:

The Department of Natural Resources is preparing a long range management plan for the Thief Lake Wildlife Management Area and we would like your help. After your visit today, please complete the following questionnaire, put it in the attached envelope, and drop it in a mail box. No postage is required. It is important that you complete this even if you have filled one out on a previous day.

Thank you.

Sincerely,

David B. Vesall

David B. Vesall, Director
Division of Fish and Wildlife
Department of Natural Resources

THE QUESTIONS START ON THE BACK OF THIS PAGE

1. Did you, or any member of your party use the Thief Lake Wildlife Management Area today? (Please refer to the attached map if you are unsure of the area's exact boundaries).

   Yes - (go to question 2).

   No - (thank you, do not answer any more questions, just mail the questionnaire to us in the envelope provided).

2. Please indicate the age, circle the sex, and write the hometown of each person in your vehicle that used the area today. Don't forget yourself.

	Age	Sex	Hometown
1.	____	Male/Female	_____
2.	____	Male/Female	_____
3.	____	Male/Female	_____
4.	____	Male/Female	_____
5.	____	Male/Female	_____
6.	____	Male/Female	_____

3. Approximately how many times has each party member visited the Thief Lake Wildlife Management Area in the last 12 months?

Party Member Number (from question 2.)	Number of Visits last 12 months
1.	_____
2.	_____
3.	_____
4.	_____
5.	_____
6.	_____

4. Following is a list of activities. Find the activities your party participated in on the area today. In the space provided, write in the number of hours your party spent on each activity.

____ duck hunting
____ goose hunting
____ controlled goose hunt
____ ruffed grouse (partridge) hunting
____ sharptailed grouse (Chickens) hunting
____ deer hunting
____ trapping

The list is continued on the next page.

4. Continued -

____ fishing
____ snowshoe hare hunting
____ Hungarian partridge hunting
____ camping
____ snowshoeing
____ skiing
____ boating
____ canoeing
____ hiking
____ snowmobiling
____ firewood gathering
____ bird watching
____ observing nature
____ photography
____ drawing/painting
____ berry picking
____ picnicking
____ gathering wild food other than berries
____ other, describe_____

5. If any party members hunted or fished, please list the species you were after, the number your party took, and any hunting cripples that were lost.

Species	Take	Cripples Lost
(Example): Ruffed Grouse	0	1
1. _____	____	____
2. _____	____	____
3. _____	____	____
4. _____	____	____
5. _____	____	____
6. _____	____	____

6. Did you hunt with a dog?

   ____ Yes ____ No

7. What time did you arrive at the area? ____ Hour ____ A.M. ____ P.M. ____/____/____ Date (month/day/year)

8. What time did you leave? ____ Hour ____ A.M. ____ P.M. ____/____/____ Date (month/day/year)

Continued on the back of this page.

9. On the next page is a map of the Thief Lake Wildlife Management Area. The unit is divided into numbered zones. Please check those zones your party used today. You may keep the map if you like.

Zones

____1 ____2 ____3

10. How would you describe the quality of your visit to the area?

____ Very good
____ Good
____ Fair
____ Poor
____ Very poor

11. What do you like about the area?

_____

_____

_____

12. How could the area be improved?

_____

_____

_____

13. What amount of money did your party spend on this trip for such things as lodging, transportation, beverages, tobacco, ammunition, etc., in:

   A. Marshall County _____ (Dollars)

   B. Other counties _____ (Dollars)

14. If your party hunted geese, would you be willing to pay a fee to defray the expense of operating the controlled goose hunt?

   A. $3-5 dollars per party? ____ Yes ____ No

   B. $5-10 dollars per party? ____ Yes ____ No

Figure 2

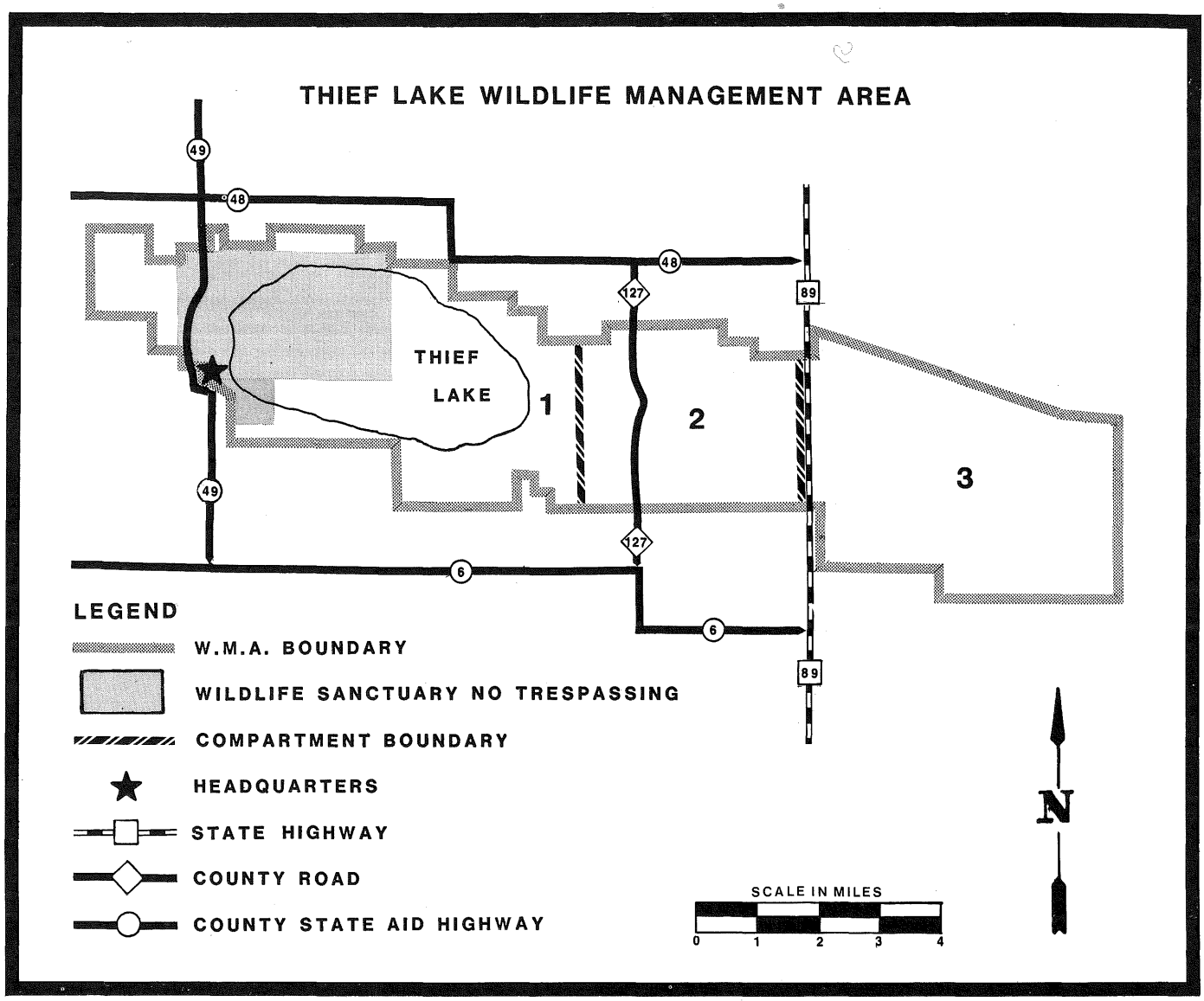

Figure 2

Visitors were requested to complete and return a questionnaire even if they had done so on a previous day. No attempt was made to contact nonrespondents.

RESULTS AND ANALYSIS

Between June 15 and December 31, 1978, 33 survey routes were completed. Fifteen of these 33 routes were run during the summer period (June 15 — September 15) and 18 during the fall/winter period (September 16 — December 31). Routes were approximately equally divided between weekends and weekdays with 16 and 17, respectively. The average driving time per route was 4 hours and 30 minutes.

A total of 446 questionnaires was distributed to area users, 162, 36 percent, were returned. Visitors were encountered more frequently during the fall/winter period and on weekends than weekdays (Table 1).

Data was expanded assuming that use levels for similar sampled and non-sampled days during a sample period (summer and fall/winter) would not differ significantly. The visitors length of stay and the amount of immigration and emigration by visitors during the driving time required to complete one survey route, however, will affect use estimates. If visitors stay less than the average driving time to complete one survey route, they may not be counted. To compensate for this, a correction factor was used when the data were expanded.

The correction factor was based on the distribution of the length of stay of parties responding to the questionnaire. For each sample period, the sample day was divided into two to three subperiods based on the average driving time (A.D.T.) for the survey route (see below). Depending on their length of stay, respondents were placed in one of these categories. The percentage of respondents in each category was calculated. Each category was assigned a multiplication correction factor (M.C.F.) based on its proportion of the total sample day. For example, the "less than A.D.T." category was assigned a M.C.F. of three because it represented about one-third of the sample day. In this manner, it was possible to expand use estimates and compensate for parties which may not have been sampled because their length of stay was short. An example of this distribution method follows:

Subperiod	Number Parties	Percentage	M.C.F.
Less than A.D.T.	x	$x/n = X_1$	$3 = M_1$
A.D.T. - 2 x A.D.T.	y	$y/n = X_2$	$2 = M_2$
Greater than 2 x A.D.T.	z	$z/n = X_3$	$1 = M_3$
TOTAL	n		

Table 1. Average number of questionnaires distributed per route by period and type of day.

Period	Type of Day	
	Weekend	Weekday
Summer (June 15 — Sept. 15)	0.3	0
Fall/Winter (Sept. 16 — Dec. 31)	40.6	8.8
Total (June 15 — Dec. 31)	22.9	4.6

Estimates of party use were first calculated separately by sample unit (weekend/weekday), then combined to obtain estimates of total use for that sampling period. The units of public use are reported as party visitor-days, visitor-days, and use-days. A visitor-day is defined as one individual using the area on one day, regardless of the length of stay. A party visitor-day is one party or group of visitors using the area on one day, regardless of their length of stay or party size. A use-day is one person using the area for one activity, such as hunting or fishing, on one day. One person may account for as many use-days as activities participated in on one day, but he only accounts for one visitor-day.

In addition, the fall/winter period was divided into two subperiods to better estimate variations in hunting pressure. Use estimates were calculated separately for each subperiod and then totaled. The subperiods and corresponding hunting types are as follows:

September 16 — September 30 and November 1 — December 31	Grouse, firearms-deer, and snowshoe hare hunting
October 1 — October 31	Waterfowl hunting

An expanded average party visitor-days/route figure was calculated by summing the average number of parties/route times the percentage of parties in each A.D.T. subperiod times the appropriate M.C.F. The formula and its notations follows:

$$\overline{x} = \sum_{i=1}^{3} \overline{p}\,(X_i)\,M_i$$

where $\overline{x}$ = expanded average party visitor-days/route

$\overline{p}$ = average number of parties/route

X_i = percentage of parties in the i^{th} A.D.F. subperiod

M_i = M.C.F. for the i^{th} A.D.F. subperiod

Total party visitor-days for each sampling period (summer and fall/winter) were calculated by multiplying the expanded average party visitor days/route by the number of weekdays or weekend days in the sample period. An estimated seven and 2,690 party visitor-days occurred during the summer and fall/winter periods, respectively. Total visitor-days were estimated by multiplying party visitor-days by average party size; 19 and 7,291 visitor-days occurred during the summer and fall/winter periods, respectively.

Table 2. Spatial distribution of activities by percentage on the Thief Lake WMA reported by 158 parties June — December, 1978.

Activity	Compartment		
	1	2	3
Hunting			
Waterfowl	92[a]/45[b]	7/18	1/4
Upland small game[c]	78/8	15/8	7/7
Deer	34/5	34/26	32/44
Camping	81/16	13/14	6/11
Observing nature	76/7	20/10	4/4
Bird watching	76/5	18/6	6/4
Boating/canoeing	69/3	23/6	8/4
Photography	85/4	15/4	0/0
Hiking	67/2	11/2	22/7
Firewood gathering	86/2	0/0	14/4
Picnicking	63/2	25/4	12/4
Berry picking	33/<1	0/0	67/7
Trapping	50/<1	50/2	0/0
Percent by compartment	78	14	8

[a] Percent accross the row = relative amount of a single activity in each of three compartments.

[b] Percent down the column = relative amount of each activity within each compartment.

[c] Includes ruffed grouse, sharp-tailed grouse, gray partridge, and snowshoe hare hunting.

Estimates of use days by recreational activity for each sample period were calculated by multiplying the total estimated number of visitor-days in that period by the percentage of parties participating in each specific activity. For example, 80 percent of the parties responding were waterfowl hunting. A total of 7,310 visitor-days were estimated; therefore, 0.80 x 7,310 = 5,811 estimated waterfowl hunter use-days. All members of a party were assumed to participate in all recreational activities checked on the questionnaire. Use-day estimates by recreational activity total more than the estimate of total visitor-days, as respondents may participate in more than one activity per day. Hunting, camping, and nature observation generated the most use-days (Table 20, page 33.)

No attempt was made to correct for nonresponse bias. It was assumed that user characteristics for respondents and nonrespondents would not differ significantly.

Additional survey results concerning the distribution and percentage contribution of visitor use by season and type of day and the percent of respondents participating in various recreational activities are described in the Public Use section (pages 32-37).

Spatial Distribution. Visitor distribution by activity was examined by requesting users to indicate which portions of the WMA they used during their visit. A map of the management area, divided into three compartments (Figure 8, page 34), was attached to each questionnaire. Visitor use by activity and compartment was tallied and percentages were calculated for the amount of each activity by compartment and the contribution of each activity to the total use in each compartment (Table 2). For example, 92 percent of the waterfowl hunters responding hunted in Compartment 1, and waterfowl hunting accounted for 45 percent of the total use calculated for this compartment (indicated as 92/45 on Table 2).

Among the 158 parties responding to the questionnaire, 78 percent of all activities occurred in Compartment 1, which included Thief Lake and the controlled goose hunting zone. Compartment 3, the eastern third of the WMA, was the least used area.

Visitor Characteristics. Attitudes and characteristics of area users were described in the Public Use section (pages 32-37). Demographic characteristics described include age, sex, and current place of residence. Attributes describing the respondent's visit include party size, length of visit, distance traveled, number of previous visits, expenditures, and opinions on the quality of their visit and the management area.

The responses of users to questions asking what they liked about the WMA and how the WMA could be improved are summarized in Tables 3 and 4. Characteristics of the unit which were most important were its wild and scenic qualities, its abundance of game, especially waterfowl, and the general quality of the hunting experience. Seven percent of the respondents felt that no improvements were needed. The most frequently cited needed improvements involved camping areas and water access sites. Several respondents felt that changes in the controlled goose hunt were needed.

Vehicles were encountered by the enumerator in the following proportions: standard pickup truck, 39 percent; passenger cars, 29 percent; four-wheel drive vehicles, 19 percent; vans, 8 percent; motor homes, 5 percent. Most pickups had bed covers or campers attached. In addition to the motor homes and vans two camper-trailers and one bus were encountered.

Table 3. Most important characteristics of the Thief Lake WMA as reported by 148 respondents surveyed, June — December, 1978.

Characteristic	Number of Responses	Percent[1]
Area appearance (wildness, scenery, solitude)	33	22.3
Hunting quality	28	18.9
Parking, camping areas, and access	25	16.9
Waterfowl hunting	18	12.2
Abundance and variety of wildlife	17	11.5
Large area open to public hunting	13	8.8
Uncrowded conditions	11	7.4
Controlled goose hunt	9	6.1
Waterfowl hunting	9	6.1
WMA personnel	8	5.4
Management and/or development	8	5.4
Close to home	7	4.7
Thief Lake and wetland habitat	3	2.0
Everything	3	2.0
Miscellaneous	3	2.0
Forest habitat	2	1.4
Nothing	2	1.4
Friendly people	1	0.7
Opportunity for diverse activities	1	0.7

[1] The summation of percentages exceeds 100 because respondents could report more than one characteristic.

Table 4. Improvements needed on the Thief Lake WMA as reported by 137 respondents surveyed, June — December, 1978.

Characteristic	Number of Responses	Percent[1]
Trash cans	40	29.2
Controlled goose hunt (blinds, regulations, enforcement)	19	13.9
Camping areas/parking/water access	15	10.9
Miscellaneous	14	10.2
Better posting of refuge and controlled hunting zone	12	8.8
No improvements needed	10	7.3
Habitat improvements	10	7.3
Remove steel shot regulation	9	6.6
Toilet facilities	7	5.1
Road maintenance	6	4.4
Uncertain	6	4.4
Water wells	5	3.6
Changes in refuge boundary and regulations	5	3.6
Expand the area	4	2.9
Fewer hunters	4	2.9
Enforcement of regulations	3	2.2
More information available to the public	2	1.5
Water level management	2	1.5
Increase game populations	2	1.5
Winter feeding of deer	2	1.5
Stop feeding waterfowl	1	0.7
DNR personnel attitudes	1	0.7
Expand headquarters	1	0.7
Remove 4 p.m. closure	1	0.7

[1] The summation of percentages exceeds 100 because respondents could report more than one characteristic.

Appendix E. Wildlife/Forestry Coordination Policy.

PREAMBLE

As state administered lands are to be managed for compatible multiple use benefits, unless otherwise dedicated by law, both the Divisions of Forestry and Fish and Wildlife are jointly charged with the responsibility of achieving the goal of integrating forest and wildlife management recognizing other multiple use purposes. The following policies and procedures are meant to ensure that integration takes place.

GENERAL POLICY

1. All State Administered Lands (unless otherwise dedicated by laws)

The Department shall strive to implement the practices delineated in the Forestry Wildlife Guidelines To Habitat Management on all state administered lands. Such implementation is important since manipulation of forest vegetation is the key to managing for wildlife as well as timber products. Successful management for these two purposes depends upon achieving the desired combination and distribution of age classes by forest types in conjunction with stated multiple-use policies and overall sustained forest and wildlife goals. Therefore *both disciplines will follow* these guidelines when planning and implementing forestry and wildlife management practices recognizing that whenever possible wildlife management objectives should be met through forest management practices. These guidelines will be expanded and updated as new techniques are developed.

A. Forestry Administered Lands Outside of State Forests in Wildlife Management Areas.

1. To the extent possible on lands determined to have significant wildlife and significant forestry values, wildlife management objectives should be met through forestry management practices. However, where long term forest management objectives are in conflict with long term *wildlife objectives on specific tracts of land* transfer of custodial control, lease or acquisition shall be considered. However, this should be considered *only* where critical habitat conditions cannot be met through cooperative planning.
2. Lands determined to have primary value for wildlife with relatively low values for forestry should be acquired or custodial control transferred to the Division of Fish and Wildlife.

B. Wildlife Management Area Lands Within State Forests

Where overlap of unit boundaries occurs, i.e., state forest and state wildlife management areas, cooperative agreements relative to administration shall be established. These agreements shall become part of the forest management and wildlife management area plan. However, where long term forest management objectives are in conflict with long term wildlife objectives on specific tracts of land, transfer of custodial control, lease or acquisition shall be considered.

2. Other Non-DNR Lands

Wildlife and forestry personnel should seek to establish cooperative agreements with other public land management agencies, or private or industrial landowners for the purpose of meeting wildlife and forest management objectives. Private Forest Management assistance should consider the Forestry Wildlife Guidelines To Habitat Management.

SPECIFIC POLICY

1. Forestry/Wildlife Guidelines to Habitat Management

Forestry/Wildlife Guidelines To Habitat Management should be developed by the Division of Fish and Wildlife six months after this policy has been approved. Upon development these guidelines shall be reviewed by the Forestry/Wildlife Task Force. Upon agreement of the Task Force, the guidelines shall be submitted to the Division Directors of Forestry and Fish and Wildlife for joint approval. Subsequent changes or additions shall be brought to the attention of the division level of Forestry and Fish and Wildlife. Upon joint agreement at the division level, the guidelines or changes will be forwarded to the field for implementation. Until these guidelines are completed, it shall be the responsibility of the area wildlife manager to inform the area and districts of desired practices. In the interim the 1972 Forest Wildlife Habitat Management Plan Procedure shall be used as a guideline with special emphasis placed on the site disturbance map.

A. The following points need to be covered in the Forestry/Wildlife Guidelines To Habitat Management to be developed by the Section of Wildlife with input from the Division of Forestry.

1. Habitat composition goals. Habitat composition goals need to be developed so that any district in the state has something to work with. It should be recognized that these goals provide a general framework within which the area manager has leeway to develop more specific objectives.
2. Compartment analysis. The guidelines should define a procedure for getting a specific compartment analysis to the districts.
3. Forestry practices: The specific types of modifications (size, design, etc.,) to forestry practices, e.g. timber sales, site preparation, roads for habitat enhancement need to be addressed.
4. Openings: The guidelines should develop a system for dealing with wildlife openings created from forestry practices, e.g. the Spoden method.
5. Special Wildlife Considerations: Those considerations needed for special wildlife species or wildlife concentrations, e.g., eagles, osprey, prairie chickens etc. need to be addressed.
6. Habitat development projects: The guidelines should develop a method for handling and keeping tract of habitat development projects, e.g. browse strips, impoundments, prescribed burns.

B. The task force which developed the wildlife/forestry coordination policy shall meet in one year following implementation of the above policy to determine how well the policies and procedures are working and to recommend any changes that may be necessary. This task force should be expanded, at that time, to include representatives from forestry and wildlife from the prairie transition and agricultural areas of the state.

C. The Department will develop an in-house policy for reviewing all proposals for land acquisition, land exchange, boundary revisions, land sales and easements.

D. To improve coordination and cooperation between the Divisions of Forestry and Wildlife, wildlife and forestry personnel, within the primary forested area of the state shall have a common office, when the opportunity exists.

E. The Department should initiate forest and wildlife research projects on mutually important tree species such as white cedar, oak, and others to address wildlife and forestry values.

F. Management plans for all DNR management units will have input from all divisions prior to public release or public information meetings.

G. The Divisions of Fish and Wildlife and Forestry need to develop a joint policy on the use of prescribed fire.

H. A policy statement or cooperative agreement(s) should be developed to address problems between fish management and forest and wildlife management practices.

GENERAL PROCEDURAL POLICY

As a general rule, assigned Forestry and Wildlife staffs should attempt to review *all* management practices at *joint meetings* (see specific management practices) since such meetings foster better working relationships, promote understanding and favor mutual agreements. It is hoped that these meetings will encourage more frequent contact between staffs.

If upon notification of a specific practice a discipline opts to *not* review a specific practice then lack of review shall indicate there are no concerns. Any differences in judgement in interpreting this policy or procedure or in deciding any particular management project or program which cannot be resolved shall be immediately referred to the next higher level of the Department organization. Under no circumstances is one level or division to delay a decision on a proposal of another because of disagreement. It should be referred to the next level of supervision with recommendations as to why it should not be approved.

Disagreements that cannot be resolved at the division directors' level will be immediately referred to the Planning and Environmental Review Team (PERT). PERT will review the problem and forward its recommendations for resolution to the Commissioner's office for making a decision.

SPECIFIC PROCEDURAL POLICY

Notification on each of the following specific management practices (1-13) shall be by "speed letter". A "speed letter" shall be initiated by that discipline level proposing an action. The speed letter shall be forwarded to the identified staff level and discipline for each activity below.

Upon receipt of notification the reviewer has two options

1. No review needed — sign pink copy and return to initiator
2. Request review meeting. Following this meeting one of the following actions shall take place.
   A. Review and approve — sign pink copy, state approval and return to initiator.
   B. Review and disapprove — sign pink copy and list non-approved project with an explanation and copy of memo sent to next higher level of review.

Time schedules for review are noted under specific activities to be reviewed. Mutually agreeable arrangements concerning waiver of review for certain categorys of projects may be proposed by memo, at the regional level, for joint approval at the division director level, e.g., non-review by forestry of wetland acquisition in the farmland area of the state when necessary to alleviate creating a cumbersom review and approval process.

To assure that integration of management will take place Forestry and Wildlife staffs shall adhere to the following procedural polices:

1. Site Preparation -
   Planting/Seeding -
   Timber Stand Improvements-

Area wildlife and district (or area) forestry personnel will review draft plans, ideally at a joint meeting(s), at the time such plans (down to the site) are proposed. Such review should take place within two weeks of notification unless some other time interval is arranged. Review shall include approval, modification or suggestions of alternative projects. Any changes in the planned projects shall be reviewed within five working days of notification of change.

2. Vegetative Management;
   Timber Sales and Non-Commercial
   Stand Regeneration

Area wildlife and district forestry personnel shall review the "planned annual cut" and non-commercial stand regeneration proposals at a joint meeting at the time such management activities are planned. Such review should take place within two weeks of notification from Forestry or Wildlife unless some other time interval is arranged. Review shall include approval, modification, or suggestions of alternative projects. Any changes in the planned annual cuts or non-commercial stand regeneration proposals shall be reviewed within five working days of notification of change. Any work outside of the planned area is considered a change.

3. Roads and Trails -

Area wildlife and district forestry personnel will review all new road and trail project proposals, ideally at a joint meeting(s), as such roads and trails are planned. Such review should take place within two weeks of notification, unless some other time interval is arranged. Review shall include approval, modification, or suggestions of alternative projects. Any changes in planned projects shall be reviewed within five working days of notification of change.

4. Agricultural Leases -

Area wildlife and district and area forestry personnel will review all agricultural leases as they are proposed. Such review should take place within two weeks of notification unless some other time interval is arranged. Review shall include approval, modification, or suggestions of alternative projects.

5. Forest Inventory -

Area wildlife, district and area forestry personnel, and the inventory project leader will review the inventory project before field work starts. Such review should take place within one month of notification unless some other time interval is arranged. Review shall include approval, modification, or suggestions on the type of field information needing emphasis within the individual area.

6. Significant Wildlife Conditions -

Area wildlife and district forestry personnel will notify each other of significant wildlife conditions, e.g. bald eagle nest sites, heron rookeries, osprey nest sites, etc. (listed by the non-game program) and emergency situation i.e. deer starvation etc. as soon as they become aware of such conditions on any land. Review of forest management considerations relative to significant wildlife conditions shall take place as soon as possible following notification. Wildlife recommendations shall be given priority consideration if such conditions are confirmed as significant or of any emergency nature.

7. Significant Forest Conditions -

Area wildlife and district forestry personnel will notify each other of significant forest management opportunities e.g. unique soil conditions for a high value species, when they become aware of such opportunities on any land. Review of wildlife management considerations relative to significant forestry opportunities shall take place within one month of notification.

8. Boundary Changes, Acquisition, Land Exchanges, Land Sites, Easements, and Leases -

Area wildlife and area forestry personnel will notify each other of all proposals for boundary changes, acquisition, land exchanges, land sales and easements.

On wildlife management projects the wildlife management area land acquisition proposal (G.F. 300) shall constitute notification for all acquisition, easement, and boundary changes for that wildlife management area. These shall be review internally with the two divisions at all levels prior to official public release and/or submittal for legislative consideration. Following approval of the respective directors, all levels shall be notified of the decision prior to official public releases.

9. District or Forest Management Plan -

Development of district or forest management plans shall be the responsibility of forestry. The wildlife management recommendations for this plan are to be developed by wildlife personnel and will address browse management, cover management, openings, impoundments, significant wildlife conditions, access roads and other priorities needed during the life of the management plan. Review, by each discipline, shall be conducted according to a jointly agreed upon management plan schedule. Review shall include approval, modification, or suggestions of alternatives.

10. Wildlife Management Area Plan -

Development of Wildlife Management Area plans shall be the responsibility of wildlife. The forestry management recommendations for this plan are to be developed by forestry personnel to cover the life of the management plan. Review, by each discipline, shall be conducted according to a jointly agreed upon management plan schedule. Review shall include approval, modification, or suggestions of alternatives.

11. Wildlife Projects Initiated by Wildlife -

a. Forestry Administrated Lands: All proposed wildlife projects on forestry administered lands will be reviewed by district, area and regional personnel prior to implementations. Such review will take place within 1 month of notification from wildlife unless some other time interval is arranged. Review shall include approval, modification, or suggestions of other alternatives.

b. Non-DNR Forestry Administered Lands: Area wildlife personnel will inform appropriate forestry personnel of planned and desired wildlife projects and conditions on non-DNR forestry lands when they are proposed so as to foster greater opportunities for cooperation and achieving optimum forestry and wildlife benefits. Such projects and conditions include but are not limited to planned development and treatment of openings, browse management, cover management, impoundments, significant wildlife conditions, etc.

12. Forest Projects Initiated by Forestry -

Wildlife Administered Lands: All proposed forestry projects on wildlife administered lands will be reviewed by area and regional personnel prior to implementation. Such review will take place within 1 month of notification from forestry unless some other time interval is arranged. Review shall include approval, modification, or suggestions of other alternatives.

13. Wildlife Projects Initiated by Forestry on Forestry Administered Lands -

All proposed wildlife projects on forestry administered lands will be reviewed by area and regional wildlife personnel prior to implementation. Such review will take place within 1 month of notification from forestry unless some other time interval is arranged. Review shall include approval, modification, or suggestions of other alternatives.

Appendix F. Regulations relating to the public use of wildlife management areas, Commissioner's Order No. 1961.

No use shall be made of any state-owned wildlife management area except in accordance with the following regulations:

Section 1. *Entry and use.*

(a) Those parts of wildlife management areas posted "STATE GAME REFUGE — NO TRESPASSING" or "WILDLIFE SANCTUARY — NO TRESPASSING" shall not be entered except as authorized by an agent of the Commissioner.

(b) No part of any wildlife management area may be entered or used during the hours 10:00 P.M. to 5:00 A.M. if so posted at the major access points.

Sec. 2. *Hunting and trapping.*

(a) Protected wild animals may be taken on wildlife management areas by hunting or trapping during the established seasons therefore in the zones in which they are located unless the wildlife management area is specifically closed by Commissioner's Order. Upon request by an agent of the Commissioner, all persons shall report animals taken on wildlife management areas and submit them for inspection.

(b) Unprotected wild animals may be taken on wildlife management areas from September 1 through the last day in February unless the wildlife management area is specifically closed by Commissioner's Order. Nuisance animals may be controlled under permit issued by a wildlife manager.

Sec. 3. *Commercial fishing.*

The taking of minnows and other live baits for commercial purposes may be allowed only under permit from the wildlife manager and only on wildlife management areas over 2,000 acres in size.

Sec. 4. *Watercraft.*

Use of motorized watercraft is permitted only on the following Wildlife Management Areas except where posted otherwise by agents of the Commissioner:

(a) In the Gores Wildlife Management Area (Mississippi River Pool 3, Dakota and Goodhue Counties) motorized watercraft may be used without limitation on size.

(b) In the Lac qui Parie Wildlife Management Area (Big Stone, Chippewa, Lac qui Parle, and Swift Counties) motorized watercraft may be used without limitation on size.

(c) In the Mud-Goose Wildlife Management Area (Cass County) motorized watercraft powered by motors of 10 horsepower or less may be used *except during the waterfowl season.*

(d) In the Orwell Wildlife Management Area (Ottertail County) motorized watercraft powered by motors of 10 horsepower or less may be used.

(e) In the Roseau River Wildlife Management Area (Roseau County) motorized watercraft may be used in the main channel of the Roseau River. Motorized watercraft powered by motors of 10 horsepower or less may be used elsewhere on this management area during the waterfowl season only.

(i) In the Talcot Lake Wildlife Management Area (Cottonwood and Murray Counties) motorized watercraft may be used on Talcot Lake *except during the waterfowl season.* Such watercraft are not permitted on the river and marshes.

(g) In the Thief Lake Wildlife Management Area (Marshall County) motorized watercraft powered by motors of 10 horsepower or less may be used.

(h) In the Walnut Lake Wildlife Management Area (Faribault County) motorized watercraft powered by motors of 10 horsepower or less may be used in that portion of the area known as South Walnut Lake.

Sec. 5. *Vehicles.*

(a) Regulations in this Section do not pertain to Federal, State or County highways or Township roads.

(b) No person shall operate an all-terrain vehicle, hang glider, air boat, or hover craft in a wildlife management area. No person shall operate a snowmobile in any wildlife management area without the written permission of the wildlife manager in charge thereof in that part of the state lying south and west of a line described as follows. U.S. Highway No. 2 from East Grand Forks easterly to Bemidji; thence southerly along U.S. Highway No. 71 to Wadena; thence easterly along U.S. Highway No. 10 to Staples and U.S. Highway No. 210 to Carlton; thence east in a straight line to the easterly boundary of the state.

(c) Motor vehicles may be operated on the following wildlife management areas, but not in excess of 20 mph. They may be operated only on established roads, and no vehicle may be driven beyond a sign prohibiting vehicular use or beyond any man-made vehicle barrier.

1. Carlos Avery Wildlife Management Area (Anoka and Chisago Counties)
2. Hubbel Pond Wildlife Management Area (Becker County)
3. Mille Lacs Wildlife Management Area (Kanabec and Mille Lacs Counties)
4. Red Lake Wildlife Management Area (Beltrami County)
5. Roseau River Wildlife Management Area (Roseau County)
6. Thief Lake Wildlife Management Area (Marshall County)

(d) Vehicles are prohibited on all other wildlife management areas except they may be operated, not in excess of 20 mph, on those routes designated by signs as being for travel purposes.

(e) No vehicle shall be parked where it obstructs travel.

Sec. 6. *Aircraft.*

Unauthorized use of aircraft below 1000 feet AGL (above ground level) over a wildlife management area is prohibited except in emergencies.

Sec. 7. *Firearms and target shooting.*

Target, trap, skeet, or promiscuous shooting is prohibited.

Sec. 8. *Disorderly conduct.*

Obnoxious behavior or other disorderly conduct is prohibited.

Sec. 9. *Disposal of waste and abandonment of property.*

Disposal or abandonment of garbage, trash, spoil, sludge, rocks, vehicles, or other debris or personal property on any wildlife management area is prohibited. Boats, decoys, and other equipment must not be left unattended overnight except traps on those wildlife areas open to trapping.

Sec. 10. *Destruction or removal of property.*

Signs, posts, fences, buildings, trees, shrubs, vines, plants,

or other property may not be destroyed or removed except that marsh vegetation may be used to build blinds on the area, and edible and decorative portions of plants (except wild rice) may be picked for personal use. Wild rice may not be harvested unless the area is specifically opened by commissioner's order.

Sec. 11. *Private property or structures.*

No person shall construct or maintain any building, dock, fence, billboard, sign, or other structure on any wildlife management area, except that ducks blinds may be erected but shall not become private property or be used to preempt hunting rights. It is unlawful to construct, occupy or use any elevated scaffold or other elevated device for the purpose of hunting, watching for or killing big game, except that portable tree stands may be used for this purpose provided they are removed each day at the close of hunting hours and do no permanent damage to trees in which they are placed.

Sec. 12. *Private operations.*

Soliciting business, agricultural cropping, beekeeping or conducting other commercial enterprises on any wildlife management area is prohibited except by lease agreement.

Sec. 13. *Introduction of plants or animals.*

Plant and animal life taken elsewhere shall not be released, placed, or transplanted on any wildlife management area except as approved by the wildlife manager.

Sec. 14. *Animal trespass.*

Livestock, horses, and other domestic animals, except dogs being used for hunting purposes, shall not be permitted on wildlife management areas except under cooperative agreement or permit prepared by the wildlife manager.

Sec. 15. *Camping.*

No person shall camp on any wildlife management area except by permit or in designated areas during the hunting season.

Sec. 16. *Other compatible uses.*

Wildlife management areas may be used for hiking, wildlife observation, sport fishing, and other wildlife-related uses provide such uses are not inconsistent with sections 1 through 15 of this order.

Sec. 17. These regulations do not apply to persons engaged in official Department of Natural Resources operations or research projects approved by the Department of Natural Resources.

Sec. 18. Commissioner's Order No. 1948 is hereby superseded.