

TECHNICAL BULLETIN NUMBER 4

A FIELD STUDY
OF THE
TIMBER WOLF (CANIS LUPUS)
ON THE
SUPERIOR NATIONAL FOREST, MINNESOTA



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Pittman-Robertson Project W-11-R-16

To Dave:
Good luck on
Ish Royale!
Mich

TECHNICAL BULLETIN NO. 4

1955



TABLE

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ACKNOWLEDGMENTS

The fine cooperation received from the project was largely responsible for the success of the project during the winter. Aerial observations were made by Robert Hodge with Warden Walter S. Elwyn West, Keith Maki and Frank

Wolf carcasses were received from the Minnesota Department of Game and Fisheries; Elwyn West and James R. of Ely including Frank Sr., Frank J. the Bureau of Game, and Game Ward

Field notes and observations were provided by Patrolmen Lloyd Nelson, Ray Thorp, Supervisor Morris Paterson who kept the Moose Lake area. Game Wardens warden F. W. Johnson, Pilot Robert H. Charles Ott, Arthur Allen, Matt Blae

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I wish to thank Mrs. Evelyn F. of the project.

Finally, I am grateful for the assistance of the Forest Service in Ely and Duluth, the Game of the Minnesota Division of Game and numerous hunters and trappers

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ACKNOWLEDGMENTS

The fine cooperation received from the individuals and agencies who assisted in this project was largely responsible for the quantity of data gathered during the course of six winters. Aerial observations were made by Game Warden Pilots Rodney Brevig and Robert Hodge with Warden Walter Sova as observer. Private pilots who assisted included Elwyn West, Keith Maki and Frank Baltich, Jr.

Wolf carcasses were received through the efforts of Northeast Airways of Virginia, Minnesota; Elwyn West and James Rolando of Ely Seaplane Service; the Baltich family of Ely including Frank Sr., Frank Jr., Joseph, and John; Refuge Service personnel of the Bureau of Game, and Game Wardens of the Bureau of Law Enforcement.

Field notes and observations were made by Refuge Supervisor Robert Jacobsen and Patrolmen Lloyd Nelson, Ray Thorpe, and Howard Peterson. Thanks are due Refuge Supervisor Morris Paterson who kept detailed notes through three winters in the Nina Moose Lake area. Game Wardens who assisted materially with field data include Supervisor F. W. Johnson, Pilot Robert Hodge, Walter Sova, Burton Ellig, Arthur Johnson, Charles Ott, Arthur Allen, Matt Blaeser, John Peil, and Ray Appleby.

Area Game Biologist Lester T. Magnus assisted directly by examining carcasses and recording field notes. Forest Ranger J. W. "Bill" Trygg offered valuable information concerning the early history of the area.

Dr. Arnold B. Erickson, Game Research Supervisor, Minnesota Division of Game and Fish, assisted in editing and offered welcome criticism during the course of the work. His encouragement played an important part in the completion of this report as a thesis. He edited the manuscript in its final form for publication.

Dr. William H. Marshall, Division of Entomology and Economic Zoology, University of Minnesota, acted as advisor during the preparation of the thesis and offered valuable and timely criticism. His assistance is sincerely appreciated.

I wish to thank Mrs. Evelyn F. Remer for doing the typing during the entire course of the project.

Finally, I am grateful for the assistance and information given willingly by the U. S. Forest Service in Ely and Duluth, the Bureau of Law Enforcement and the Bureau of Game of the Minnesota Division of Game and Fish, the Minnesota State Forest Service, and numerous hunters and trappers who are residents of the area.

During the course of this study, the writer was in the employ of the Bureau of Wildlife Development, (Pittman-Robertson Project W-11-R), Minnesota Department of Conservation at Ely, Minnesota.

THE STUDY AREA

The Superior National Forest was established in 1909 by President Theodore Roosevelt in northeastern Minnesota. It is bounded by Lake Superior to the east and by the Canadian Boundary on the north. Extensive data reported in this study are from the 4,100 square miles of the Superior National Forest, hereafter called the Forest, excluding the Kabetogama and Pigeon River Purchase Units and the Mesabi Ranger District.

Ely, a mining and tourist city of 6,000 and Grand Marais, population 1,100, are the only two communities over 1,000 located within the Forest. One major highway passes through the Forest, Highway No. 1, from Tower through Ely to Lake Superior. Secondary roads run northwest, northeast, and south from Ely and north from the highway along the shore of Lake Superior. No north-south road reaches the Canadian Border between the west boundary of the study area at Crane Lake, and the Gunflint Trail, northwest of Grand Marais.

This relatively undeveloped region has a tremendous recreational potential and has been the source of management policy disputes for thirty years. At the present time it is zoned by the U. S. Forest Service into the primitive "no-cut" area of 362,000 acres along the Canadian Border, and the "roadless area" of 1,038,700 acres. No commercial sales of timber are permitted in the "no-cut" area except for possible salvage operations. Timber harvest and management are practiced in the "roadless area," but the primitive nature of the Forest is retained as far as possible. Commercial developments are prohibited except as required in the harvesting of mature timber. Natural water levels are maintained and shorelines on lakes and streams, portages, and trails are protected from cutting for a distance of 400 feet (U.S. Forest Service 1950). In December, 1951, President Truman signed an Air Space Reservation Act which prevented the use of airplanes in the roadless area zone except for emergencies and governmental duties.

Three major game refuges comprising some half-million acres are located within the Forest boundary. These refuges have undergone several boundary changes since their inception in 1909 and now cover considerably less area. For the most part, the legal harvest of game and fur-bearers within the refuges has been negligible, and only within the past three years has a regulated harvest been allowed.

Most of the field work reported here was conducted during the winter of 1946-47 and during the five winters from 1948-49 through 1952-53. Summer work was largely limited to interviews and gathering weight and measurement data.

Aerial and ground work were concentrated in a 45-township area roughly rectangular in shape with headquarters in Ely (Fig. 1). This area, ten townships long from east to west, lies between Crane and Saganaga Lakes on the Canadian Boundary. It is from three to six townships wide and extends south to Tower and Birch Lake. Two and one-half townships in the southwest corner of this intensive study area are actually out of the Superior National Forest but they are included since cover types are identical to those found within the Forest. This 45-township area will be referred to in the text as the Border Study Area.

Travel in the area was limited to plane and snowshoes during the winter and plane, canoe, and hiking in the summer.

State cabins at Nina Moose Lake, Huntingshack River, Lake One, Lake Insula and Little Saganaga Lake facilitated winter work.

Physiography

Since geology influences the ecology of the study area, the primary earth features are described briefly. The dominant physical feature of the Superior National Forest is an ancient geological formation known as the Laurentian Upland. This striking rock formation extends south from Canada and is one of the major physiographic divisions of the North American continent. It originated during pre-Cambrian time and consists largely of granite and gabbro rock (Thiel, 1947). For the most part these rocks are covered only lightly by glacial gravels.

The general topography is hilly with altitudes ranging between 1,000 and 1,700 feet. The highest point in the state is found in the Misquah Hills, 2,230 feet above sea level in Cook County. Two major watersheds are involved in the drainage of the area. Most of the area is in the Hudson Bay drainage which flows westward along the Canadian Boundary while Lake Superior receives water from a narrow strip along the North Shore of the lake itself and from a level, morainic area in central St. Louis County.

The basic rock formation extends southward from the Canadian Border for a distance of from 30 to 35 miles to the region of Pelican, Vermilion, and Birch Lakes (Levrett and Sardeson, 1917). A second geological feature, which originates just south of Birch Lake and extends south and west for a distance of some 50 miles, is the Giants or Mesabi Range, an iron ore producing area of world renown.

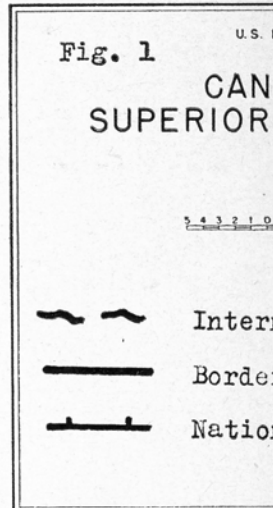
As a result of the scourings of four major glaciations, the rock hills have been rounded and smoothed. The valleys have been gouged bare or filled partially with glacial debris. The entire forest is dotted with a myriad of lakes and streams, most of which are navigable by canoe. The area, therefore, has developed into a canoe country which had its earliest beginnings with primitive Indian tribes who traveled between Lake Superior and the interiors of Minnesota and Canada. During the 18th century, these waters served as a great highway for a lucrative fur trade which flourished under the encouragement of the Hudson Bay, Northwest, and American Fur Companies. It was then the land of the colorful French Voyageur (Nute, 1944).

For the most part, the extremely soft water lakes are rock bottomed and deep and have been formed by glacial erosion. Some lakes in northern Cook County have depths of 100 feet and a few are over 200 feet deep (Zumberge, 1952). Despite altitudes of over 2,000 feet in Cook County, the area is mainly an undulating plain which slopes gently toward the northwest and southeast with the Mesabi Range as the axis.

Climate and Vegetation

Extremes in temperature are not the rule, but readings varying from 90° F. to -30° F. are likely each year. Readings of 106° F. and -50° F. have been recorded. Winters are long and frosts have occurred as late as mid-June and as early as August 24. Precipitation averages 27 inches per year, including snow of about 59 inches (U. S. Forest Service, 1950). Snow depth on the level seldom exceeds 30 inches and usually measures 20 to 26 inches during early February.

Summers are generally pleasant; winters are cold and dry with snow remaining light and fluffy—much to the sorrow of the snowshoer. A sharp departure from the averages cited is experienced along the shore of Lake Superior. This vast body of water has a tempering effect on climatic conditions. Also, the southern exposure of the Sawtooth Range, a series of high bluffs running northeast along the shoreline, moderates the temperature.

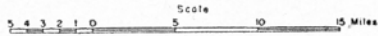


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Fig. 1

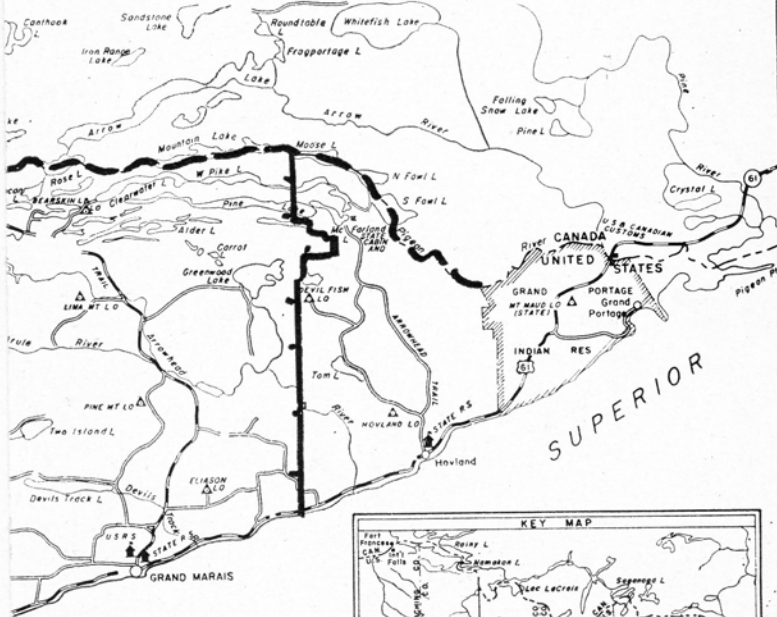
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FOREST SERVICE

CANOE COUNTRY
SUPERIOR NATIONAL FOREST
MINNESOTA
1953



LEGEND

-  International Boundary
-  Border Study Area
-  National Forest Boundary



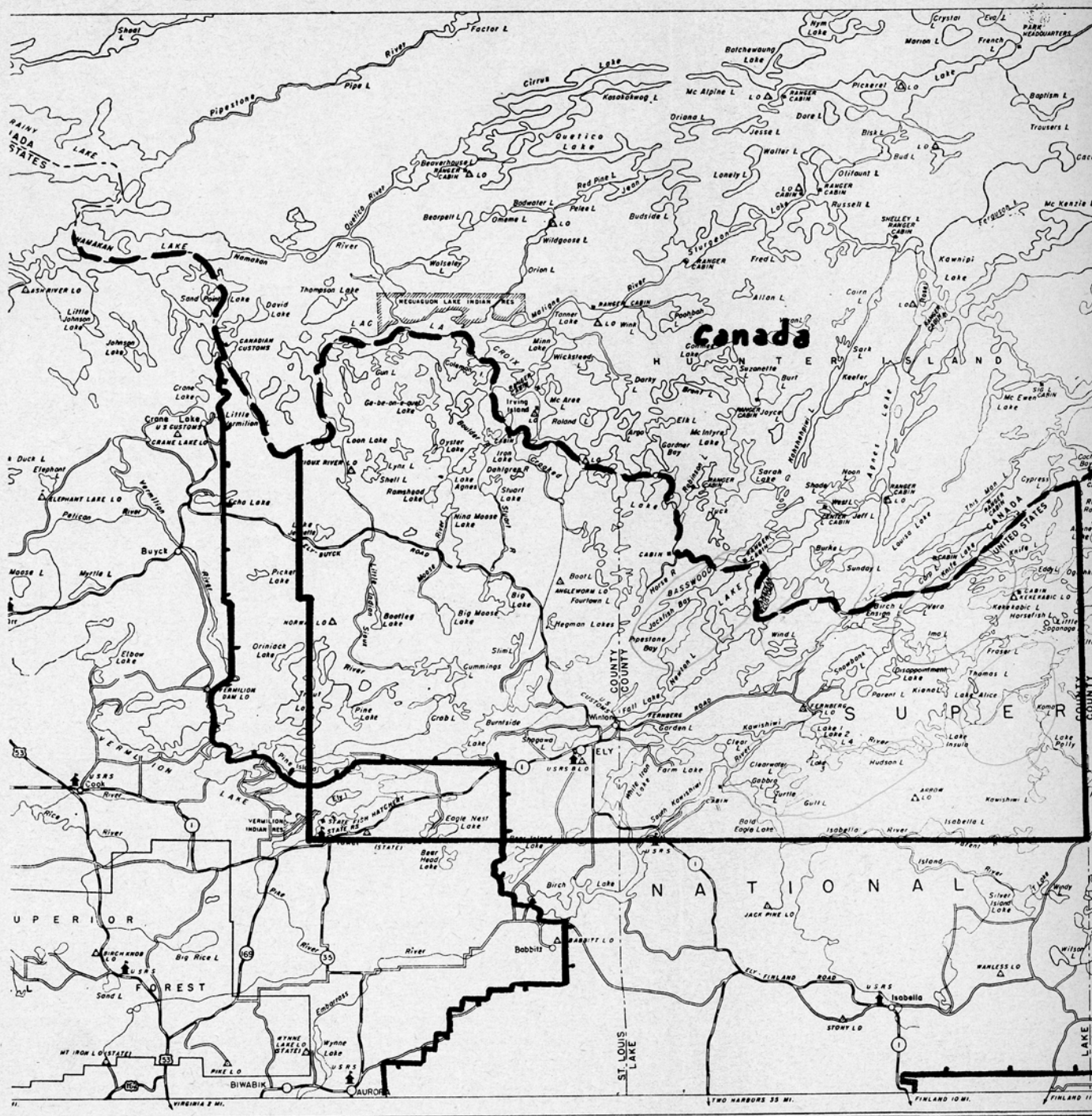




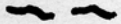
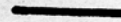
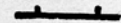
Fig. 1

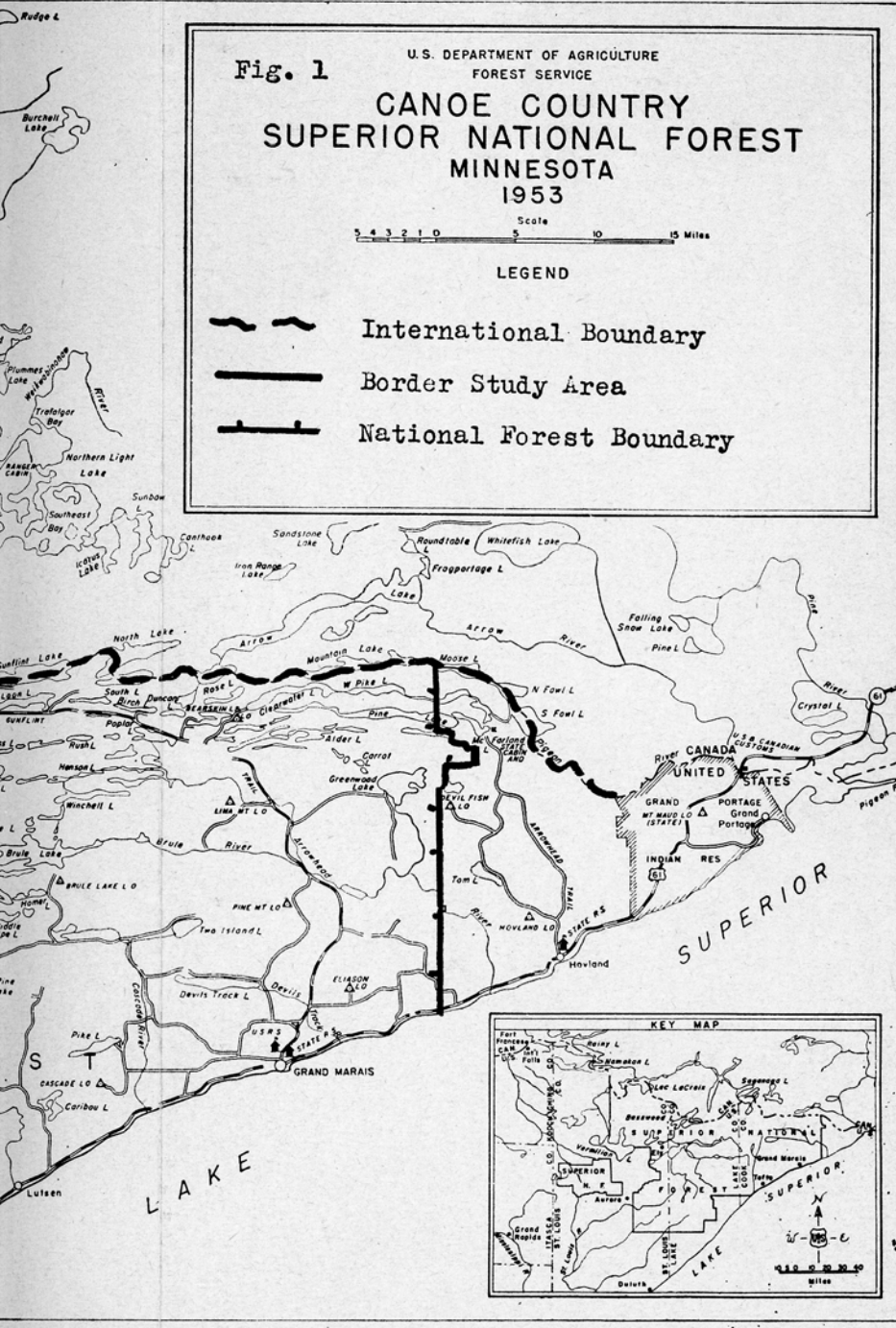
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FOREST SERVICE

CANOE COUNTRY SUPERIOR NATIONAL FOREST MINNESOTA 1953

Scale 0 5 10 Miles

LEGEND

-  International Boundary
-  Border Study Area
-  National Forest Boundary



According to Flint and Deevey (1951) the present forest cover has developed since the retreat of glaciers some 11,000 years ago. Potzger (1953) concludes that forest succession subsequent to glaciation has been chiefly among genera of conifers. Spruces (*Picea glauca* and *P. mariana*), and fir (*Abies balsamea*) were the initial forest cover. Jack pine (*Pinus Banksiana*) was undoubtedly the initial pine followed by white and red pine (*P. Strobus* and *P. resinosa*).

At the time pioneers first began to venture into the area, much of it was covered with an awe-inspiring stand of virgin red and white pine. This was part of the Great Lakes Forest, one of the finest stands of white pine known to man. During the period 1890-1920, most of this timber was eliminated by fire and ax. Some small areas escaped destruction and remain much the same today.

Following the devastations of logging and fire, a tremendous forest of paper birch, jack pine, and trembling aspen (*Populus tremuloides*) began to occupy the cuttings and burns. Balsam and spruce grew in the wetter spots. The swamps of tag alder (*Alnus rugosa*), white cedar (*Thuja occidentalis*), and black spruce remained much the same since they were too wet to burn and had little value as timber. The stands of aspen, birch, and jack pine have now reached maturity or over-maturity and reproduction of balsam is forming understories in many forests over much of the area.

Since the climate and soil are conducive to the growth of a coniferous forest, it is inevitable that conifers will once again become dominant unless fire and ax set back the natural succession. This is unlikely as the forest is afforded excellent fire protection and cutting is done under timber management plans. Due to the lack of seed trees, red and white pine will be relegated to the lesser species. Aerial timber surveys conducted by the U. S. Forest Service indicate that balsam fir is becoming more predominant and that management plans eventually must include this species as a major component in the forest.

At the present time more than 25 species of trees are found. The conifers such as jack, white, and red pines, black and white spruce, white cedar, tamarack (*Larix laricina*), and balsam are most abundant (U. S. Forest Service, 1941). Deciduous trees are represented by white birch and yellow birch (*Betula lutea*), aspen, black ash (*Fraxinus nigra*), red maple (*Acer rubrum*), balsam poplar (*Populus balsamifera*), and occasional hard maple (*Acer saccharum*), elm (*Ulmus americana*), oak, ironwood (*Ostrya virginiana*), and basswood (*Tilia americana*). Fruit bearing plants such as choke cherry (*Prunus virginiana*), fire cherry (*Prunus pennsylvanica*), Juneberry (*Amelanchier* spp.), and mountain ash (*Sorbus* spp.), are common everywhere.

Shrubbery consists of beaked hazel (*Corylus cornuta*), mountain maple (*Acer spicatum*), red osier dogwood (*Cornus stolonifera*), several honeysuckles, tag alder, and upland alder (*Alnus crispa*), many species of willow (*Salix* spp.), luxuriant growths of blueberries (*Vaccinium* spp.), and sweet fern (*Comptonia peregrina*).

Bracken fern (*Pteridium aquilinum*), spikenard (*Aralia nudicaulis*), and large leaf aster (*Aster macrophyllus*) form the most conspicuous ground cover in the forest while sedges (*Carex* spp.), and grasses are abundant along lake and stream shores and beaver meadows.

Cedar swamps and black spruce—sphagnum bogs are abundant although usually not large in size. The climax forest for the area is spruce—fir—white birch, according to Butters and Abbe (1953) with a jack pine—black spruce forest as a possible intermediary on the dryer locations.

WILDLIFE SPECIES — PAST AND PRESENT

When permanent settlers moved into northeastern Minnesota during the last half of the 19th century, the predominantly pine forests supported big game populations of moose (*Alces americana*), woodland caribou (*Rangifer caribou*), elk (*Cervus canadensis*), and white-tailed deer (*Odocoileus virginianus*) along with numbers of black bears (*Ursus americanus*). The above were listed by Herrick (1892) for northeastern Minnesota in an early natural history survey. Shiras (1921), however, stated that white-tailed deer were non-existent in 1870 along the North Shore of Lake Superior, although he found them abundant on later trips. Conversations with early settlers indicate that moose and caribou were more numerous than deer during the early days and that they were often a staple in the diet of the lumberjack. Carcasses were purchased from local Indians and market hunters.

In 1895 caribou were still common at Lake Vermilion. These animals disappeared, for the most part, during the first decade of the present century and were reported only as scattered individuals by 1920. In 1921, Ranger Oscar Heikilla reported a single caribou near Iron Lake on the Canadian Border. Caribou were finally dropped from Forest Service records in 1929.

While spending four summers (1912-1915) in the Kawishiwi District, C. E. Johnson (1922) saw no caribou but he received information that John Schafer, a local taxidermist, reported caribou common in the area up to 1900 and that specimens were taken along the Kawishiwi River in T 63, R 10 W. Johnson saw 132 moose during a nine-week period in 1912, but he saw only 132 deer during the entire four-year study. In 1920 Johnson saw only five moose during the period July 26 through September 4 in the same area. He noted, however, a great increase in beaver (*Castor canadensis*) from 1912 to 1920. Wolves (*Canis lupus*), fisher (*Martes pennanti*), bears, porcupines (*Erethizon dorsatum*), and hares (*Lepus americanus*) were common. Lynx (*Lynx canadensis*) and bobcats (*Lynx rufus*) were scarce, and marten (*Martes americana*) were very scarce by 1920.

Les Beatty, while acting as a packer on a George Shiras expedition into the newly established Superior National Forest in 1909, reported a total of 57 moose seen on Nina Moose Lake alone. Although common prior to 1900, marten were last carried on Forest Service records in 1919. No substantial evidence of their presence had been offered for at least 25 years until November 29, 1953, when Waino Starkman of Ely caught a marten in a trap set for bobcats near Burntside Lake.

The wolverine (*Gulo luscus*) never was common in the forest, and it is believed that the last in the state was taken in St. Louis County in 1934 (Franey, 1953).

At present, the white-tailed deer is the major big game animal, with moose seen occasionally. Black bears remain common and are much in evidence during years of berry crop failures. There is some indication that moose are holding their own or actually increasing in parts of the forest.

Upland game consists of snowshoe hares, ruffed grouse (*Bonasa umbellus*), spruce grouse (*Canachites canadensis*), and only occasional sharp-tailed grouse (*Pediacetes phasianellus*).

Beaver, mink (*Mustela vison*), skunk (*Mephitis mephitis*), and weasel (*Mustela* spp.) are common furbearers with otter (*Lutra canadensis*) showing a strong comeback in the past 15 years. Fisher, which are protected, are occasionally caught accidentally.

Porcupines, red squirrels (*Sabrinus*) are common throughout *mota monax*, least chipmunk (*Reithrodontomys bog lemning* (*Synaptomys cooperi*), muskrat (*Ondatra zibethica*). (G

Important larger mammalian (*Canis latrans*), red fox (*Vulpes* (*Urocyon cinereoargenteus*). Rec present has been noted (Bue and

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Description a

Young and Goldman (1944) buffalo wolf (*Canis lupus nubilus*) believed to be extinct. The eastern Minnesota, Wisconsin, and Michigan the skull exhibiting a "remarkable" laid with black on the neck and base and massive head typical of the



FIG. 2. Timber wolf

Porcupines, red squirrels (*Sciurus hudsonicus*), and flying squirrels (*Glaucomys sabrinus*) are common throughout the area. Other rodents include the woodchuck (*Marmota monax*), least chipmunk (*Eutamias minimus*), gray chipmunk (*Tamias striatus*); bog lemming (*Synaptomys cooperi*), meadow mouse (*Microtus pennsylvanicus*), and muskrat (*Ondatra zibethica*). (Gunderson and Beer, 1953.)

Important larger mammalian predators other than the timber wolf are the coyote (*Canis latrans*), red fox (*Vulpes fulva*), bobcat, occasional lynx, and a few gray fox (*Urocyon cinereoargenteus*). Recently, the possibility of cougars (*Felis concolor*) being present has been noted (Bue and Stenlund, 1952).

Apparently the only mammals which inhabited the area prior to 1900 but no longer are found are the wolverine, elk, and caribou.

THE TIMBER WOLF

Description and Distribution in Minnesota

Young and Goldman (1944) listed two subspecies of wolves for Minnesota. The buffalo wolf (*Canis lupus nubilus* Say) which ranged west from Lake of the Woods is believed to be extinct. The eastern wolf (*Canis lupus lycaon* Shreber) occurs in northern Minnesota, Wisconsin, and Michigan. It is described as a small dark colored subspecies, the skull exhibiting a "remarkably slender rostrum." In color it is generally gray overlaid with black on the neck and back. The animal possesses the long legs, powerful jaws and massive head typical of the species *Canis lupus*. Winter pelt colors vary from an



FIG. 2. Timber wolf habitat in the Fernberg Lookout area.

almost coal black to a grayish white. Most, however, are dark gray with lighter underparts and dark markings on the back and top of the tail. The summer pelt tends more toward brown and rust.

The wolf has been a continual resident of Minnesota since early times. During the period that it ranged freely over the entire state, buffalo and elk provided it with food on the southern and western prairies; deer were preyed upon in the Big Woods of the central part of the state; and in the northern coniferous zone, moose and caribou were the most common prey animals (Swanson et al, 1945).

Minnesota is not without its early wolf stories. Herrick (1892) reports the problems of an early settler, Mr. John D. Wilcox, who was treed by a half dozen or more wolves for two hours. The animals finally began to fight among themselves and then disappeared.

Not as fortunate was a "Swede" in Chisago County near the Sunrise River who was attacked by wolves, "and is said to have been wholly eaten up, not a bone being left, except his feet, which were gnawed as far down as the wolves could reach into his boots; only shreds and small scraps of his clothing were found."

In another encounter with three pursuing wolves, Wilcox foiled their attempts at gaining a meal by dropping burning birch bark in his trail. The wolves did not follow beyond the fires and consoled themselves with "howls of rage and disappointment."

Herrick also reports wolves still common in Wright County during 1884-5.

Swanson (1945) listed the timber wolf as rare in Minnesota except in the area north of Lake Superior and a "strip perhaps 75 miles westward."



FIG. 3. Islands and points of Basswood Lake are favored travel routes for wolves.

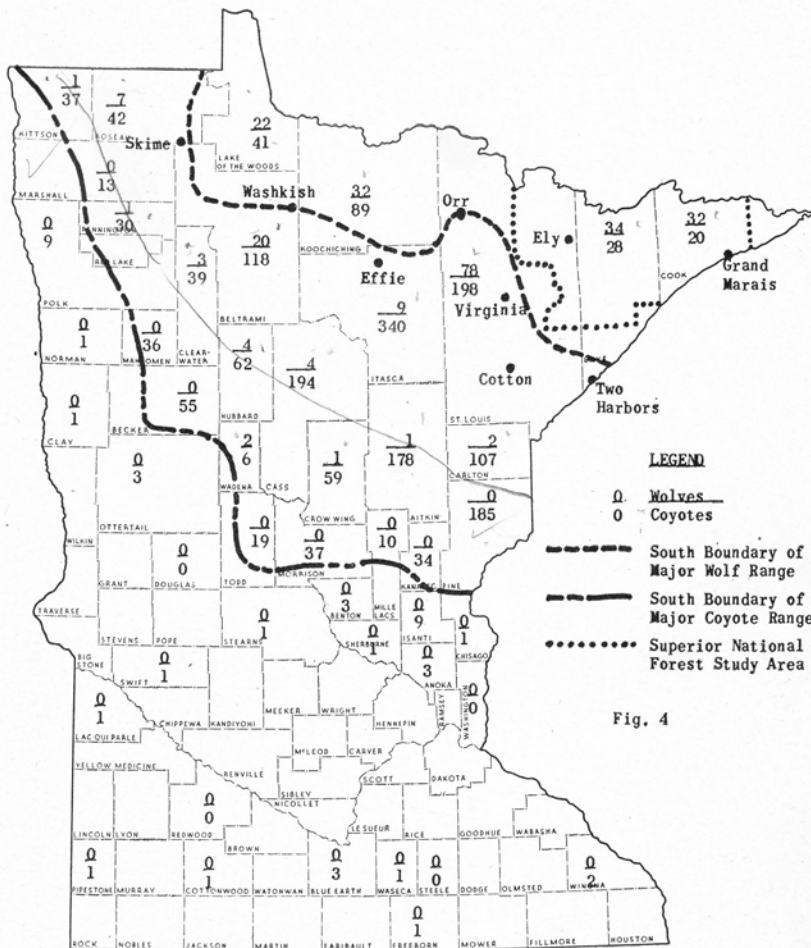
Major Range and Average Wolves and Coyotes



MAJOR RANGES AND AVERAGE
TIMBER WOLVES AND COYOTES

The major timber wolf range in Minnesota (Fig. 4). It runs from Cook County in the north to St. Louis, Koochiching, northern Beltrami, and Cass counties in the south. This is an east-west distance of about 75 miles. The number of wolves vary considerably within this range, but are most common, and the animals breed and are most abundant south of this range for a distance of about 25 miles. The first wolf was dug from a den in Cass County

Major Range and Average Annual Bounty Take of Timber Wolves and Coyotes in Minnesota, 1950-1952



MAJOR RANGES AND AVERAGE ANNUAL BOUNTY TAKE OF
TIMBER WOLVES AND COYOTES IN MINNESOTA, 1950 - 1952.

The major timber wolf range in Minnesota today lies in the northern tier of counties (Fig. 4). It runs from Cook County on the east through Lake, northern and eastern St. Louis, Koochiching, northern Beltrami, Lake of the Woods and eastern Roseau Counties. This is an east-west distance of 260 miles. Although actual numbers of animals may vary considerably within this range, timber wolves are seen occasionally, sign is relatively common, and the animals breed and raise their young in this area. Occasional wolves are found south of this range for a distance of about 75 miles. For example, three wolf pups were dug from a den in Cass County (S 32, T 139, R 25 W) in April, 1951, by Ralph

Olds. This den was located 120 miles south of the Canadian Border and 75 miles south of the major wolf range. The major range covers approximately 12,000 square miles. The southern boundary begins just above Two Harbors on Lake Superior in Lake County. It runs west to Highway No. 4 then north to the region of Aurora, thence north along the south shore of Lake Vermilion to the region of Orr and Nett Lake. Here it jogs south to Effie, west and north to Waskish and Four Towns and finally north to the Canadian Border through Skime and Salol in Roseau County.

The coyote is found in every county in the state. The largest numbers occur just south of the timber wolf range in the counties which support hardwood and mixed hardwood-conifer types. Numerous settled and farmed areas are scattered throughout this forest. In the major timber wolf range, the coyote is less conspicuous, and in the lake area along the border, coyotes are found only occasionally. Lake and Cook Counties, both in timber wolf range, pay bounty on more big wolves than coyotes. To the south and west coyote numbers decline sharply in the primarily agricultural areas of the state.

Population Data

It was not possible to determine the actual number of wolves inhabiting the 45-township study area. Population estimates, therefore, were derived indirectly through the use of indices. These indices included historical records and population estimates established elsewhere, ground observations of wolves, wolf signs, and wolf-killed deer in areas used by wolves, aerial and ground observations of home ranges, and the number of wolves observed from an airplane flying over the study area.

The number of wolves on which bounty was paid during the study period was not used as a population index for the following reasons: records prior to 1950 did not separate coyotes from wolves; bounty records are based on a calendar year whereas the study period is based on a winter season from November through March and interpretation of bounty figures becomes involved; bounty data for St. Louis County cover some areas not included in the study; and legislative action in 1951 failed to provide immediate bounty payments and the incentive for taking wolves was lost during part of that year.

Historical records and populations established elsewhere. Seton estimated a primitive wolf population in North America of two million animals or one wolf per three and one-half square miles (Olson, 1938).

In working with 33 to 55 wolves in Jasper National Park, Canada, Cowan (1947) estimated a population of one wolf per 111 square miles of summer range and one per ten square miles of winter range.

On the barrens of northern Canada, Clarke (1940) estimated a wolf per sixteen square miles for a total population of 36,000 wolves in 600,000 square miles of caribou country.

Again in Alberta, Rowan (1950) reported a pack of eight ranging over twenty townships or one wolf per 90 square miles. Banfield (1951a) estimated populations of one wolf per 39.5 square miles, one per 58 square miles, and one per 63 square miles during three winters in Prince Albert Park, Canada. On Sibley Peninsula in Lake Superior, de Vos (1950) estimated a population of one wolf per six square miles.

Thompson (1952) estimated one animal per 40 to 50 square miles in the area inhabited by wolves in northern Wisconsin.

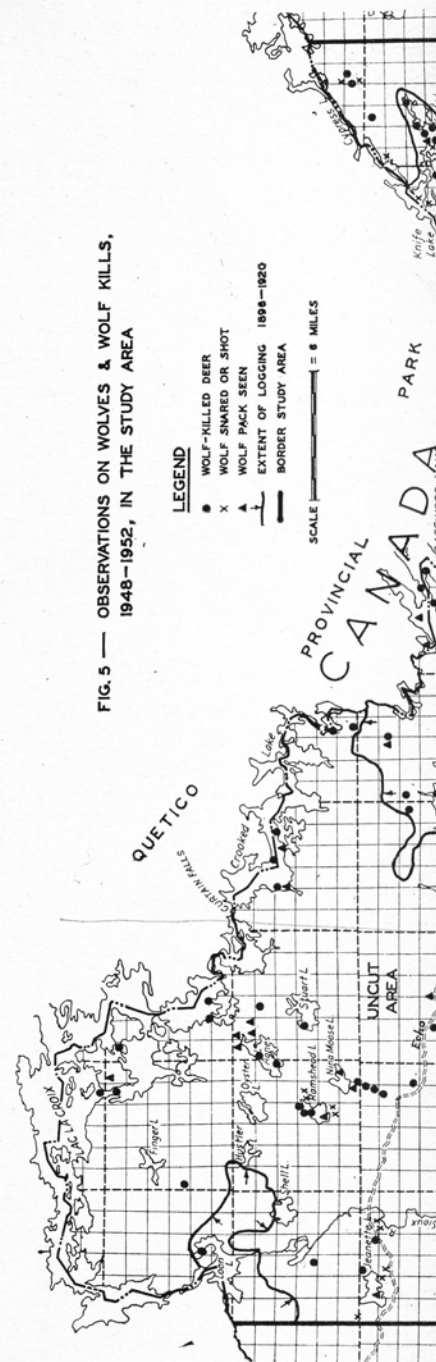


FIG. 5 — OBSERVATIONS ON WOLVES & WOLF KILLS, 1948-1952, IN THE STUDY AREA

There are data to indicate that the wolf population in the Superior National Forest is the largest remaining concentration in the United States. Vogt (1948) presents records of the U. S. Forest Service, National Park Service, and U. S. Fish and Wildlife Service, which indicated all remaining wolves were on National Forests and most on the Superior National Forest in Minnesota. Swift (1951) reported that U. S. Forest Service records indicated the largest population of wolves on the National Forests in the United States was on the Superior and remaining stationary at an estimated 800 wolves in 1945. This is approximately one wolf per seven square miles.

Stanley P. Young (1953) registers the opinion that the Forest now has and has had for some time, the largest population of wolves remaining in the United States.

It is of considerable interest to note that Olson (1938), who conducted the only previous study on wolves in the Forest predicted that, ". . . in the fringe of wilderness along the northern borders of the lake states are all the wolves that are left, and at the present rate of depletion, the area encompassed by the Superior National Forest in northeastern Minnesota will soon include most of the remaining animals of the species in the United States." At that time he estimated a population of one wolf per ten square miles in a study area of 2,500 square miles.

Early records of the Superior National Forest show estimates varying from 300 wolves in 1914 to 600 in 1920 and 460 in 1931. Since these estimates varied with the changing acreage of the Forest and the Rangers concerned with making the reports, it would be difficult to reduce these figures to a square-mile basis with any accuracy.

In general, Game Warden, Forest Service personnel, trappers, and the author's observations indicate that the wolf population reached a high point during the period 1925-1940, declined gradually through 1946, dropped more definitely in 1947 and 1948, and has remained relatively stable since the last date at a level below the high population of the 1930's.

Areas used by wolves. During the winters 1948 through 1952, records (Fig. 5) were kept of actual wolf observations, wolf-killed deer, and wolf trails in the Border Study area in order to establish a pattern of wolf activity, if possible.

Individuals and packs moved freely over the area with wolves, wolf tracks, and wolf-killed deer appearing everywhere in varying numbers. It was the opinion of pilots operating out of Ely that wolf packs and travel had been disrupted to a certain extent by extensive hunting from the airplane during the winters of 1946-47 and 1947-48.

It is especially significant to note that concentrations of wolf activities and deer populations occur concurrently in the cutover area. This area comprises some ten townships and lies north and northeast of Ely to the Canadian Border. The area was logged in the early days (1896-1920) and the resultant second growth timber supports a deer population which is considerably larger than that found in the uncut areas lying to the west and east. Since jack pine, balsam, and spruce were not taken to any extent in early logging days, this area was not clear cut and still supports a good coniferous stand of trees. Only choice white and red pine were removed. Cedar, alder, spruce, and tamarack swamps remained untouched as did some virgin stands of aspen and birch.

The two uncut areas to the east and west of the cutover area were not logged during the heyday of Paul Bunyan's ax for a variety of reasons. These areas are rockier and the topography is rougher making for more difficult logging. There was less red and white

pine and more jack pine. Finally, in the midst of the falling timber, including cutting regulations prevented the forest

Travelers in these uncut regions noted the scarcity of game life of any kind. The Lake country produced only a single marten, extremely light in the Lake Insula area. The Nina Moose Lake area produced no moose. On the Trail, a Forest Service road running from Supervisor Robert Jacobsen and Patrolman Twin Lakes to Sawbill Lake during the last fifty miles, found wolf sign only on the north side near the cutting boundary. Travelers found no wolf sign while traveling the same route in February. Paterson and Lou Wheeler again observed no wolf sign except for a wolf track on the Schroeder

The uncut areas apparently have a lack of suitable habitat and food. Wolves were scarce in the Little Saganaga Lake country 25 years ago. It was scarce in the area then. Likewise, the higher in the cutover Snowbank Lake country toward Little Saganaga.

It is evident that although populations are both found in greater numbers in areas of more abundant deer browse plants

Attempts to keep detailed notes on areas of wolf activity it was not possible to keep, therefore, of observations concerning wolf activity. More specific data on wolf activity in the winter of 1948-49, 53 in 1949-50, and

In summarizing results of ground observations on deer, it was my opinion and the opinion of others that the population has remained relatively stable

Home range observations. Although observations of deer and wolf sign appear to have been disrupted in the period, enough observations were made

In 1948-49 a pack of seven or eight wolves was observed in the Lake country. Total area covered is about 150 square miles. The iwi River-Lake One-Lake Three-Ensigns area has a population of one wolf per 18 square miles of the same area.

Another pack of nine was observed in the Lake Vermilion area. This pack was seen on Lake Vermilion. This is the only pack of nine seen in the area.

pine and more jack pine. Finally, the Superior National Forest established in 1909 in the midst of the falling timber, included these two uncut areas where the accompanying cutting regulations prevented the former large-scale operations.

Travelers in these uncut regions during both winter and summer often remark as to the scarcity of game life of any kind. Four days of snowshoeing in the Little Saganaga Lake country produced only a single wolf track in February 1952. Deer sign was extremely light in the Lake Insula area during the same winter. Four days of travel in the Nina Moose Lake area produced no deer sign and little wolf sign except along the Echo Trail, a Forest Service road running through the west half of the uncut area. Refuge Supervisor Robert Jacobsen and Patrolman Howard Peterson, while traveling on foot from Twin Lakes to Sawbill Lake during January and February of 1949, a distance of some fifty miles, found wolf sign only on Gabbro and Bald Eagle Lakes. These are on and near the cutting boundary. Travel through the uncut area produced only light deer sign. While traveling the same route in February of the same year, Refuge Supervisor Morris Paterson and Lou Wheeler again observed wolf sign only on Gabbro and Bald Eagle Lakes except for a wolf track on the Schroeder Trail.

The uncut areas apparently have not supported good game populations due to the lack of suitable habitat and food. Wardens Art Allen and Charles Ott, who worked in the Little Saganaga Lake country 25 years ago as state trappers, stated that deer sign was scarce in the area then. Likewise Urho Salminen, formerly a state trapper working from Winton, was of the opinion that 20 to 30 years ago deer and wolf populations were higher in the cutover Snowbank Lake-Thomas Lake areas than they were further east toward Little Saganaga.

It is evident that although populations of both deer and wolves exist in the virgin areas, they are both found in greater numbers in the cutover area north of Ely because of more abundant deer browse plant species on the logged and burned over lands.

Attempts to keep detailed notes of wolf tracks were not successful because in many areas of wolf activity it was not possible to separate individual tracks. General notes were kept, therefore, of observations concerning wolf signs gathered by all field personnel involved. More specific data on wolf-killed deer showed that 61 were found during the winter of 1948-49, 53 in 1949-50, and 60 in 1950-51.

In summarizing results of ground observations on wolves, wolf tracks, and wolf-killed deer, it was my opinion and the opinion of the field observers involved that the wolf population has remained relatively stable during the five-winter period, 1948-1953.

Home range observations. Although aerial and ground observations show that wolves and wolf sign appear to have been distributed over much of the Forest during the study period, enough observations were made on some packs to define reasonable home ranges.

In 1948-49 a pack of seven or eight hunted the Basswood Lake-Horse Lake-Range Lake country. Total area covered is unknown. A pack of seven also hunted the Kawishwi River-Lake One-Lake Three-Ensign Lake area. This pack covered at least four townships or one wolf per 18 square miles. However, smaller packs were also hunting edges of the same area.

Another pack of nine was observed on Trout Lake and Vermilion River. Later 12 were seen on Lake Vermilion. This probably was the pack of nine with three new additions.

A pack of two hunted the Agnes-Ramshead-Stuart Lake area of about a township in size. This approximates one wolf per 18 square miles. Again, other wolves encroached upon the southern portion of this range as three were snared.

Two were taken from the Carp-Birch-Sucker Lake area and then no tracks were seen for a period of two weeks when once again wolves were ranging the same area. The same winter four wolves were taken from the Fraser Lake area. No sign was seen for about three weeks when signs of a pack of five appeared.

Ed Dilley, U. S. Forest Service, reported a pack of five hunting a 50-square mile area near Isabella—one wolf per ten square miles—in 1950-51.

A pack of three hunted the area around Big, Rice, Cummings, Burntside, and Grassy Lakes in 1948-49. In 1949-50, it is believed the same pack of three hunted the same general area.

On the east side of the cutover area, a pack of three or four hunted south from Knife Lake on the border to Lake Insula and covered the following lakes: Kekekabic, Thomas, Alice, Fire, Parent, Disappointment, Boot, and Ensign; roughly 85 square miles or one wolf per 20 square miles. In 1950-51 it is believed the same pack with an additional wolf hunted this same area which increased the population to one per 17 square miles for this area.

Observations on the Big Lake-Grassy Lake pack of three and the Knife Lake-Lake Insula pack of three to five, over a two-winter period suggest little change in their numbers.

Aerial observations. During the five winters, 1948-1953, records were kept of aerial observations of wolves by Warden Pilots Rod Brevig and Robert Hodge and Observer Walter Sova. An observation consisted of one or more wolves sighted at one location at the same time (Table 1). Planes used during the patrols were a Piper Cruiser and an Aeronca with cruising speeds of about 90 miles per hour. Patrols flown did not follow established routes but covered the area at random. In 1951-52, a total of 90 hours was flown, nine observations were made and 25 wolves were seen. In 1952-53, a total of 76.5 hours was flown, five observations made and ten wolves seen. Samples for these two winters were considered inadequate and the data have not been included in Table 1.

Although the number of observations of wolves per 100 hours flown remained relatively stable during the three-winter period, the number of wolves seen per 100 hours did

Table 1 — Aerial Observations of Wolves

Date	No. Flying Hours	No. Observations	Total Wolves	Observations per 100 Hours	Wolves per 100 Hours	Average* Pack Size
1948-1949	184	14	60	7.6	32.6	3.4
1949-1950	186	17	30	9.1	16.1	2.2
1950-1951	264	20	61	7.6	23.1	2.9
Totals:	634	51	151
Averages:	8.0	23.8	2.9

*From Table 6.

not. The total number of wolves seen. This is due to the fact that the average in 1949-50.

In 1950-51, observations per 100 ally increased because the average p

Since there is no other evidence 51 per cent in 1949-50 and subsequent by wolves seen per 100 hours data, data are more nearly indicative of the per cent increase from 1948-49 to 1951-52 winter.

Although no single population in population, it is believed that the signs, and wolf-killed deer are the discussed suggests that the timber wolf five-winter period.

Present density. Using these t can arrive at a rough average estim mation and for a discussion of such to the deer herd and the significance

These general estimates are as f and 273 wolves existed during the st 240 wolves or one wolf per 17 squar same data to the entire major wolf 7,000 square miles of territory lyin roughly half the population which (1938).

Canadian wolf influx? Much l bers of Canadian wolves cross the b serves as a vast reservoir of breedin Much of the Quetico Park is similar lations of large mammals. Rocks a and deer are as scarce there as the Study Area.

Bounty was paid on only 48 w through January 15, 1953. Twenty- the Park report the population as pr few signs (Harkness, 1953). It is er area in Minnesota supports a larger cial Park in Ontario.

Dens

With the density of cover, rugge standable why so few dens are found by trapper Joel Mattinen. It was l

not. The total number of wolves seen per 100 hours decreased by 51 per cent in 1949-50. This is due to the fact that the average pack size decreased from 3.4 in 1948-49 to 2.2 in 1949-50.

In 1950-51, observations per 100 hours decreased, but wolves seen per 100 hours actually increased because the average pack size increased from 2.2 wolves to 2.9 wolves.

Since there is no other evidence to suggest that the wolf population was reduced by 51 per cent in 1949-50 and subsequently increased by 43 per cent in 1950-51 as indicated by wolves seen per 100 hours data, it is my opinion that the observations per 100 hours data are more nearly indicative of the wolf population changes. These data suggest a 20 per cent increase from 1948-49 to 1949-50 and a 17 per cent decrease during the following winter.

Although no single population index alone is thought to be representative of the wolf population, it is believed that the general ground and aerial observations on wolves, wolf signs, and wolf-killed deer are the most reliable. The sum of all indices used and discussed suggests that the timber wolf population has remained relatively stable over the five-winter period.

Present density. Using these two estimates of the density of wolf populations one can arrive at a rough average estimate for comparison with previously published information and for a discussion of such aspects of the management of the wolf as it relates to the deer herd and the significance of wolf-control methods now being used in the area.

These general estimates are as follows. On the Forest Study Area itself between 205 and 273 wolves existed during the study period. The mean of these extremes is taken as 240 wolves or one wolf per 17 square miles on the 4,100 square-mile area. Applying the same data to the entire major wolf range indicates between 300 and 400 wolves in some 7,000 square miles of territory lying in St. Louis, Lake, and Cook Counties. This is roughly half the population which inhabited the area in the 1930's according to Olson (1938).

Canadian wolf influx? Much local opinion is to the effect that considerable numbers of Canadian wolves cross the border regularly and that the Quetico Provincial Park serves as a vast reservoir of breeding wolves. Evidence at hand does not bear this out. Much of the Quetico Park is similar to the uncut areas in Minnesota in having low populations of large mammals. Rocks and jack pine are conspicuous features of the park, and deer are as scarce there as they are in the Little Saganaga country of the Border Study Area.

Bounty was paid on only 48 wolves in the Park during the period April 1, 1950, through January 15, 1953. Twenty-two Treaty Indians who run registered trap lines in the Park report the population as practically nil. In addition, aircraft reports reveal very few signs (Harkness, 1953). It is entirely possible that the cutover Basswood-Knife Lake area in Minnesota supports a larger population than exists in the uncut Quetico Provincial Park in Ontario.

Dens and Litter Sizes

With the density of cover, rugged topography and large inaccessible areas, it is understandable why so few dens are found. The one wolf den studied by the author was found by trapper Joel Mattinen. It was located on a sandy south-facing slope covered by a

dense stand of balsam trees and consisted of two large-sized tunnels dug toward each other and four small holes scattered about 15 feet away from the main den. The small holes appeared as though they had been dug by the pups. This den was used by wolves at least two springs and then abandoned because of trapping activities. A fox was caught at the entrance to one of the smaller tunnels the year after the wolves left.

Trapper Oliver Anderson reported finding a wolf den in a hollow log near Grand Marais. Refuge Supervisor Robert Jacobsen reported finding what he believed to be a timber wolf den under a rocky cliff near Bootleg Lake.

Reports on the size of eight different wolf litters were received. The litters consisted of nine, eight, seven, three litters of six, five, and four pups each, for an average of 6.4 pups per litter. These included a litter of six found by veteran wolf trapper Ainer "Buck" Snyder near the dead body of a female caught in a snare. The young evidently were born while the female was struggling in the snare and were observed to be suckling the dead mother when found. No information was available as to the sex of the pups in the eight litters.

Food Habits

It is the wolf's insatiable quest for fresh meat that has brought the wrath of the world on his shoulders. If he could be bred to live on a diet of hazel brush, the bane of forester and game man in the Superior National Forest, he no doubt would become saint instead of sinner. Until that day, it appears that the wild wanderer will continue to feed largely on big game.

Wolf kill observations and scat analyses were used by Cowan (1947) in determining feeding habits in the National Parks of Canada. Examination of 420 scats disclosed that big game occurred in 80 per cent and that rodents occurred in 18 per cent, on an annual basis. Rodent occurrence increased in the summer and big game decreased. Big game occurred in 69 per cent of the scats even during the summer.

In examining 1,174 wolf scats collected in the Mt. McKinley National Park, Murie (1944) found big game made up 69 per cent of the total number of food items classified. Rodents made up 27.5 per cent.

In the United States, Stebler (1944) examined seven Michigan wolf stomachs in which deer and hare were equally important. He states, however, that "Field observations, on the other hand, indicate that in winter deer form the dietary main-stay of this carnivore."

In Wisconsin, Thompson (1952) found that deer occurred in 97 per cent of 435 scats examined. Hare and meadow mouse occurred only in 5 per cent and 2 per cent of the scats, respectively. Red-backed mouse, cottontail rabbit, insects, egg shells, and chipmunk, each occurred in less than one per cent of the scats.

In the Superior National Forest, Olson (1938) concluded that the "major portion of the food of the wolf during the summer months is grouse, woodmice, meadow voles, fish, marmots, snakes, insects, and some vegetation." During the winter the wolves fed on deer and hares.

Examination of ten wolves taken from 1936 to 1939 in Minnesota showed deer in nine out of ten stomachs and the only other food a red-backed mouse (Young and Goldman, 1944).

Winter food habits. Food habits were determined by analyses of contents of 50 stomachs collected from October through March each year. Of these, 10 were empty. A total of 33 was examined of which

Those wolves which were shot for material. Most stomachs taken from snared wolves often live for days before contents. Table 2 summarizes the analysis over the five-year period. Pine needles feeding or fighting snares were not

Table 2 — Winter Food Habits (Fifty-one Stomachs, 1945-49)

Species	No. Stomachs
Deer	41
Hare	4
Porcupine	4
Ruffed Grouse.....	3
Unknown Mammal.....	2

DEER—Deer remains in wolf stomachs are usually found whole, deer hair, hide, and bones. Wolves prefer fresh meat and prefer to kill it themselves. Data collected from wolf kills and aerial observations show that wolves usually take their first heavy meal after the first heavy meal they retire to the carcass after several hours and resume their meal.

Game Wardens Art Johnson and Art Johnson reported that a passed deer which had died of unknown cause was found over a dead fawn without touching it. This indicates that wolves bypassed a moose carcass with the data which show wolves often feed on fresh meat. In the opinion of Young (1944) that wolves do not eat putrid or dried animal remains. Most of the items in wolf stomachs are actually fresh.

During the winters of 1945-46 and 1946-47, many carcasses which were only partly eaten were found. In some of these cases in which only the intestines were eaten, it is believed that the population is believed to be lower at that time. It was believed to be higher at that time but is not clear.

Winter food habits. Food habits of wolves in the Superior National Forest were determined by analyses of contents from 67 stomachs gathered during the months of October through March each year. During the winter of 1946-47, a total of 34 was collected of which ten were empty. During the four winters from 1948 through 1952, a total of 33 was examined of which six were empty.

Those wolves which were shot from an airplane proved the best source of food habits material. Most stomachs taken from wolves that had been trapped or snared were empty. Snared wolves often live for days after being caught and therefore utilize the stomach contents. Table 2 summarizes the analyses of stomach contents of 51 timber wolves taken over the five-year period. Pine needles and shredded wood picked up accidentally while feeding or fighting snares were not listed as food.

**Table 2 — Winter Food Habits of Timber Wolves
(Fifty-one Stomachs, October through March, Five Years)**

Species	OCCURRENCE		VOLUME	
	No. Stomachs	Per Cent	Total cc.	Per Cent
Deer	41	80.4	28,956	95.5
Hare	4	7.8	237	.8
Porcupine	4	7.8	9	trace
Ruffed Grouse	3	5.9	1,005	3.3
Unknown Mammal.....	2	3.9	102	.3

DEER—Deer remains in wolf stomachs consisted of chunks of fresh venison swallowed whole, deer hair, hide, and bones. Generally wolves eat little carrion. They prefer fresh meat and prefer to kill it themselves. Two stomachs in the food study were actually taken from wolves which were shot while feeding on a freshly killed deer. Tracks and aerial observations show that wolves often feed more than once on the same carcass. After the first heavy meal they retire to a nearby hill or ridge to bed down. Upon returning to the carcass after several hours, they drive off feasting ravens, eagles, and small birds and resume their meal.

Game Wardens Art Johnson and Art Allen reported two instances where wolves passed deer which had died of unknown causes. In one case, the wolves actually stepped over a dead fawn without touching it. Antoon de Vos (1949b) cites a case in which wolves bypassed a moose carcass without investigating. Banfield (1951b), however, cites data which show wolves often feed on old caribou carcasses during migrations. It was the opinion of Young (1944) that wolves preferred fresh meat of their own killing to putrid or dried animal remains. Murie (1944) also discussed the caching habits of wolves in which items are actually buried in the snow.

During the winters of 1945-46 and 1946-47, airplane operators reported many deer carcasses which were only partly eaten. Refuge Supervisor Morris Paterson also investigated cases in which only the internal organs were eaten. In recent winters, most carcasses have been almost completely consumed within a short while. Although the deer population is believed to be lower at the present time than in 1945, the wolf population was believed to be higher at that time and the explanation for the unused carcasses is not clear.

In December 1953, while Warden Pilot Robert Hodge and Warden Walter Sova were flying over Basswood Lake they saw a pack of five wolves. One wolf was carrying a small animal which it dropped when the plane approached. The animal proved to be a freshly killed adult male mink. The only mark on the mink was a tear in the belly through which some intestines and the liver had been pulled.

Summer food habits. No systematic study of wolf stomachs or scats was made during the summer, April through September, as few wolves are taken during this period and scats are difficult to find.

Evidence at hand and from other studies indicates that deer continue as an important item in the summer diet. Of 148 summer scats collected in Wisconsin, Thompson (1952), found deer in 141, of which 45 per cent contained fawn remains. He concludes, ". . . would seem that the wolves preyed upon a slightly higher proportion of fawns than adults." Beatty and Odell (1923) found a freshly killed adult deer in the Moose River in the Forest while making a summer beaver survey. The back and liver were eaten away. Murie (1944) found garbage in five scats and was of the opinion that wolves frequent garbage dumps readily.

During June 1950, F. B. Hubachek (1950) came upon the freshly killed carcass of a fawn on his property on Basswood Lake in the Border Study Area. Wolf sign was evident and wolves were seen commonly in the area during the summer for the first time to his knowledge. Later evidence showed that a litter of wolves had been raised in the vicinity. The wolf litter and adults frequented Mr. Hubachek's property all summer and a pack of three or four actually chased a deer between the buildings and down a road. The cook later saw an adult wolf approach within 60 yards of the camp before it turned off.

Stomach analyses were made on seven wolf pups trapped during September 1950. Of these, five were taken near the garbage pit on the Hubachek property. It is understandable then, that four stomachs contained garbage. Two stomachs contained ruffed grouse remains, one of which had three different grouse. Three contained evidence of deer of which two cases were fawn hooves. One stomach contained hare claws and 300 cc. of grass. Another contained 350 cc. of grass. Gravel and a single grasshopper were probably picked up incidental to feeding.

Of the dozen scats examined in the field during the summer months, all contained deer hair or deer hair and bones. Several also contained small mammal bones and hair.

Dave Rutford reported that on September 20, 1953, a male wolf had killed and eaten a female beagle at his summer home in Cook County while the occupants were gone. On the following day the wolf was shot while it was carrying away the second beagle. The remains of the female dog were found in the wolf's stomach.

In April 1951 two wolves killed an adult buck near Grand Marais. Wardens Art Johnson and Art Allen believed they had frightened the wolves from the kill as the deer was still warm and the wolves only had time to eat a hole in the brisket.

Wolves are capable of killing moose during the summer. Maurice Quafe of Grand Marais reported his son observed a wolf swimming after a bawling yearling moose on a pothole near Northern Light Lake in September 1952. When approached by the boat the wolf swam to shore and disappeared. The moose climbed on shore and continued to bawl. It had already been wounded on the hind flank. The fisherman believing the animal to

be safe left, but reported the incident to Oliver Anderson, a local trapper. Anderson, upon investigation, found the remains of the moose near the shore and evidence that not one but three wolves had been present at the kill.

In Lake County in the summer of 1921, Johnson (1921) examined a wolf stomach and found moose hair and hide. He believed the remains to be carrion. In September 1912 he observed a wolf feeding on a moose carcass which was floating in the Kawishiwi River. The wolf actually had to tread water to feed. In this case the moose was also carrion.

Apparently wolves continue to make big game the most important part of their diet during the summer, but smaller mammals and birds may be more important during summer than in the winter.

Weights and Measurements

A total of 156 wolves was weighed and measured although measurements were not complete in all cases. Since most carcasses were frozen at the time of examination, measurements were not taken in cases where the animal had assumed an unnatural position. The largest male weighed 112 pounds and measured 69 inches (body 51¼ inches, tail 17¾ inches). The largest female weighed 80 pounds and measured 61¼ inches (body 45 inches, tail 16¼ inches). Of 88 males, 48 or 57 per cent weighed between 70 and 84 pounds. Of 66 females, 33 or 50 per cent weighed between 55 and 69 pounds (Table 3).

Table 3 — Winter Weights of 144 Wolves, November to March

Pounds	FREQUENCY	
	Males	Females
45 - 49.....	..	9
50 - 54.....	2	8
55 - 59.....	3	12
60 - 64.....	5	11
65 - 69.....	7	10
70 - 74.....	13	5
75 - 79.....	18	3
80 - 84.....	17	2
85 - 89.....	7	..
90 - 94.....	5	..
95 - 99.....	2	..
100 - 104.....	3	..
105 - 109.....	0	..
110 - 114.....	2	..
TOTALS.....	84	60

Whether or not an animal had fed recently had considerable effect on its weight. After a hearty meal the stomach may make up 20 per cent of the total weight. The engorged stomach of a 75-pound female weighed ten pounds. Young (Young and Gold-

man, 1944) describes trial feedings of meat at a single meal. In another case the wolf weighed 33 pounds 3 ounces.

Because wolves do not mature considerably within the same age group, weights of the wolves graded into classes indicated pups or adults. A simple method of the field investigator to age wolves was to chart the weights brought out through the season. Wolves weighing 50 pounds or more by November date. Female pups reach weights of 50 pounds that any wolf weighing more than 80 pounds and early October weighed as little as 30 pounds (Table 4).

Table 4 — Summary of Weights, May to September, 1950

Date	Number of Wolves	Weight Range (Pounds)
September, 1950.....	10	45 - 69
September, 1950.....	10	45 - 69
September, 1950.....	10	45 - 69
September, 1950.....	10	45 - 69
October 1, 1949.....	10	45 - 69
October 2, 1950.....	10	45 - 69
October 11, 1950.....	10	45 - 69
October 11, 1950.....	10	45 - 69
October 31, 1950.....	10	45 - 69
October, 1950.....	10	45 - 69
October 2, 1951.....	10	45 - 69
May, 1950.....	10	45 - 69

Frequency graphs of body length were made for males from 41 to 48 inches in males and from 41 to 48 inches in females.

Field workers at the present time are studying the behavior of family groups. That is, a wolf pack consisting of a territorial old or bachelor wolves who join with a female and her pups. This trend of thought but add that, the study of several wolf families to form a large family. After intensive observation of family groups (1944) concluded that small packs of wolves were made up of two or more families.

The number of animals in a pack of wolves or pairs may separate from the group in a day or two or may hunt

man, 1944) describes trial feedings on 90-pound male wolves which ate 18 pounds of meat at a single meal. In another trial feeding the stomach of an adult weighed 19 pounds 3 ounces.

Because wolves do not mature during the first year, and because weights can vary considerably within the same age groups due to empty or full stomachs, the charted weights of the wolves graded into one another so that no definite breaks in the curve indicated pups or adults. A simple technique has not been developed which will allow the field investigator to age wolves readily by carcass examination only. Examination of the charted weights brought out the following points, however. Male pups apparently weigh 50 pounds or more by November as all males weighed at least that much by that date. Female pups reach weights of 40 pounds or more by November. It is also likely that any wolf weighing more than 85 pounds is a male. Wolf pups taken in September and early October weighed as little as 28 pounds for males and 31 pounds for females (Table 4).

**Table 4 — Summer Weights of 12 Wolves,
May through October**

Date	Weight in Pounds	Sex
September, 1950.....	37	F
September, 1950.....	28	M
September, 1950.....	38	M
September, 1950.....	32	F
October 1, 1949.....	28	M
October 2, 1950.....	31	F
October 11, 1950.....	53	F
October 11, 1950.....	48	F
October 31, 1950.....	37	F
October, 1950.....	64	M
October 2, 1951.....	36	M
May, 1950.....	55	F

Frequency graphs of body lengths showed the highest frequencies occurred from 43 to 48 inches in males and from 41 to 45 inches in females (Table 5).

The Wolf Pack

Field workers at the present time are of the opinion that wolf packs are made up of family groups. That is, a wolf pack consists of adults plus one or two litters and occasional old or bachelor wolves who join the group. Young and Goldman (1944) follow this trend of thought but add that, "At times, however, there may be an intermingling of several wolf families to form a large pack; but the duration of such bands is short." After intensive observation of family groups in Mt. McKinley National Park, Murie (1944) concluded that small packs consist of single family groups, and that large packs were made up of two or more families.

The number of animals in a pack often changes during the course of travel. Single wolves or pairs may separate from the group and travel on their own. They may rejoin the group in a day or two or may hunt separately for a week or more.

**Table 5 — Body Lengths of 116 Wolves,
November to March**

Inches	FREQUENCY	
	Males	Females
37.....	0	1
38.....	1	3
39.....	0	1
40.....	0	2
41.....	4	6
42.....	0	9
43.....	9	6
44.....	6	6
45.....	8	8
46.....	9	2
47.....	13	0
48.....	11	0
49.....	4	0
50.....	0	0
51.....	2	1
52.....	0	2
53.....	1	0
54.....	1	0
TOTALS.....	69	47

Olson (1938) observed personally and received reports from others of packs numbering from five to thirty animals in the Forest during a 25-year period.

In the present study most observations of wolves were made by game wardens and refuge patrolmen while flying patrols or doing predator control work. Private airplane operators also assisted in the early stages of the study. Only occasional animals were actually seen by observers on the ground.

Refuge Supervisor Robert Jacobsen observed the tracks of a pack of 15 wolves in 1951 on the Moose River. He followed them to a point on Nina Moose Lake where the pack had separated. Before this pack had reached the Moose River tracks showed that when it crossed the Echo Trail it had consisted of only 12 animals. Three additional animals joined the pack en route to Nina Moose Lake. This was the largest pack recorded during the study.

At first glance, Table 6 might suggest that the size of the pack has been decreasing steadily since 1948. This is not entirely true. In part the apparent decrease in pack size probably resulted from the number of hours of airplane observation during the several years. For example, in 1948-49 there were more hours of flying, more cooperators flying, and more observations of wolves than in any other year. Table 6 shows that packs up to six animals held up well for three winters when the bulk of the observations was made.

It is surprising to note that single wolves, a total of 48, made up 43 per cent of all observations. Single wolves and pairs totaled 72 observations and 96 individuals. They made up 64 per cent of all observations and 30 per cent of all wolves seen.

Table 6 — Wolf Observations During Five Winters, 1948-49 through 1952-53

Winter	Number of Animals in Pack												Total Observations	Average Pack Size
	1	2	3	4	5	6	7	8	9	10	11	12		
													Total Wolves	