The fisher in Wisconsin. No. 183 1993

Kohn, Bruce E.; Payne, Neil F.; Ashbrenner, James E.
Madison, Wisconsin: Wisconsin Department of Natural Resources, 1993

The Fisher In Wisconsin

Technical Bulletin No. 183
Department of Natural Resources
Madison, Wisconsin
1993

Cover: Bernie Bradle (retired DNR wildlife manager) with first fisher caught accidentally by a predator trapper during the winter of 1957-58 in Forest County, Wisconsin. Photo: DNR

ABSTRACT

Fishers (*Martes pennanti*) were extirpated in Wisconsin during the early 1900's and reintroduced into the state during 1956-67. All dry-land trapping was prohibited near the 2 release sites to protect the fishers from accidental trapping losses. This reintroduced fisher population was studied from 1976-91 to develop appropriate habitat and harvest management strategies. Most of the field activities for this study were conducted in eastern Oneida County at a 70.5 mile^2 site (Monico Study Area) and a nearby 30.5 mile^2 site (Enterprise Study Area).

Twenty-three fishers were radio-collared during 1981-83. These fishers were located 1,666 times (mean = 72 locations/fisher), and mean annual home ranges were 15.3 mile^2 for males and 3.2 mile^2 for females. Home ranges of males were largest during spring (9.7 mile^2) while those of females were largest in fall (2.8 mile^2). Substantial overlapping of home ranges occurred, most of which (67%) involved juvenile males.

Mean daily distances moved by males (1.4 miles) was greater than by females (0.8 mile). Fishers moved farther in summer than in fall or winter, and during the night than day. Snowfall and snow depths >18 inches hindered fisher movements.

Fishers most often used closed-canopy, forested areas. Most forest types were used in proportion to their availability, but lowland mixed types were used more than expected while lowland conifer and shrub types were avoided. Interspersion of forest types provided high prey diversity and abundance.

Fisher abundance increased dramatically during the study period. In 1975, fishers were considered common only near the release sites. By 1988, they had expanded their range, and were well established in all areas with suitable habitat. Numbers of fisher tracks observed on winter track counts increased from 0.93 tracks/10-mile transect in 1977 to 3.10 in 1990, and the percentage of transects with fisher tracks present increased from 23% to 72%.

A conservative fisher trapping season was initiated in 1985 with about 300 animals harvested annually in the last 4 study years. Carcasses obtained from 919 fishers harvested during 1985-89 showed a sex ratio of near 50:50 and a mean age of 1.9 years. Calculated mean annual mortality rate was 46%, based on life table analyses. Pregnancy rates were 59% for yearlings and 81% for adults, and mean litter sizes were 2.13 for yearlings and 2.55 for adults.

The statewide fisher population was estimated by comparing the frequency of tracks on the statewide surveys to that observed on the Monico Study Area during 1981-83, which represented a "known" density of fishers. This provided a density estimate of 1 fisher/2.5 mile^2 or a total population of 6,000 fishers in 1991. We incorporated Wisconsin's harvest, age, and reproductive data into Minnesota's Furbearer Population Model. The resulting simulation showed the fisher population increased from 2,650 animals in 1977 to 6,000 in 1991, a trend similar to that suggested by the statewide track counts. It was estimated that the present population could withstand annual harvests up to 900 fishers.

Major management recommendations include further standardization of the statewide track counts, periodic updating of the fisher distribution map, continued refinement of the population model, lengthening the trapping season, and allowing trappers to take >1 fisher/year.

Key Words: Fisher, *Martes pennanti*, fisher population monitoring, fisher reintroduction, fisher habitat, telemetry, fisher movements, fisher distribution, fisher harvest strategies.

The Fisher In Wisconsin

Bruce E. Kohn, Neil F. Payne, James E. Ashbrenner, and William A. Creed

Technical Bulletin No. 183
Department of Natural Resources
P.O. Box 7921
Madison, Wisconsin 53707
1993

CONTENTS

2 INTRODUCTION

5 STUDY AREAS

6 METHODS
- Capture and Handling Techniques, 6
- Radio Tracking, 6
- Track Counts, 7
- DNR Questionnaire, 7
- Determination of Fisher Range, 7
- Carcass Collection and Analyses, 7
- Population Estimation and Modeling, 7

8 RESULTS AND DISCUSSION
- Trapping and Handling Efficiency, 8
- Home Ranges, 8
  - Annual Home Ranges, 8
  - Seasonal Home Ranges, 9
  - Home Range Overlap, 9
- Movements, 10
  - Daily Movements, 10
  - Hourly Movements, 11
  - Activity Patterns, 11
- Habitat Use, 12
- Expansion of Fisher Range, 14
- Fisher Population, 15
  - Trends, 15
  - Population Structure and Reproductive Rates, 16
  - Population Estimate on the Monico Study Area, 17
  - Statewide Fisher Population in 1991, 17

18 MANAGEMENT IMPLICATIONS
- Maintaining Fisher Management Areas, 18
- Standardization of Track Counts, 18
- Fisher Distribution Maps, 18
- Population Modeling, 19
- Future Harvest Strategies and Monitoring, 19
- Habitat Management, 19

20 APPENDIXES
- A. Data Sheet Used For Track Counts In The Oneida County Study Areas, 20
- B. Data Sheet Used For Northern Forest Track Counts, 21

22 LITERATURE CITED

Dedication

The authors dedicate this publication to the memory of Ned C. Norton who died June 20, 1993 at the age of 43 from Lou Gehrig's disease. We first met Ned in 1975 when he became involved in our bear research project as an M.S. candidate at the University of Wisconsin-Stevens Point. Since then we have known Ned as a student, co-worker, peer, and, most importantly, as a friend. We miss his enthusiasm, dedication, and tremendous sense of humor.

INTRODUCTION

The fisher (*Martes pennanti*) is one of the largest members of the weasel family. Males are 30-40 inches long (including the tail) and weigh 7-15 lbs. Females are about 2/3 as long and weigh about 1/2 as much. Their fur is usually dark brown to black with silver tipped hairs on the head and shoulders. Most fishers have irregular white markings on the throat and underparts. They are well-known as efficient predators on porcupines (*Erethizon dorsatum*) (Seton 1929, Schoonmaker 1938, Hamilton 1943).

Historically, fishers were common in most forested areas of Wisconsin (Jackson 1961), occurring as far south as Jefferson and Milwaukee Counties as late as 1852 (Schorger 1942). Extensive logging, wildfires, and unregulated trapping drastically reduced the fisher population in the early 1900s. Legal protection was given to the fisher in 1921, but their numbers continued to decline. The last verified observation of a native fisher in Wisconsin occurred in 1932 (Hine et al. 1975).

The U.S. Forest Service and the Wisconsin Conservation Department, now the Wisconsin Department of Natural Resources (DNR), cooperated to reestablish a fisher population during 1956-67 (Petersen et al. 1977). The main objective of this effort was to reduce the extensive damage to timber by porcupines (Olson 1966). Prior studies showed a decline in porcupine abundance with expanding fisher populations in New York (Hamilton and Cook 1955) and New Hampshire (Hamilton 1957). Sixty fishers (36 males, 24 females) from New York and Minnesota were released into the Nicolet National Forest during 1956-63, and 60 (30 males, 30 females) from Minnesota were released into the Chequamegon National Forest during 1966-67. "Fisher Management Areas" of 220,000 acres in the Chequamegon National Forest and 120,000 acres in the Nicolet National Forest were established (Fig. 1). Dry-land trapping was prohibited on these areas to reduce accidental trapping losses.

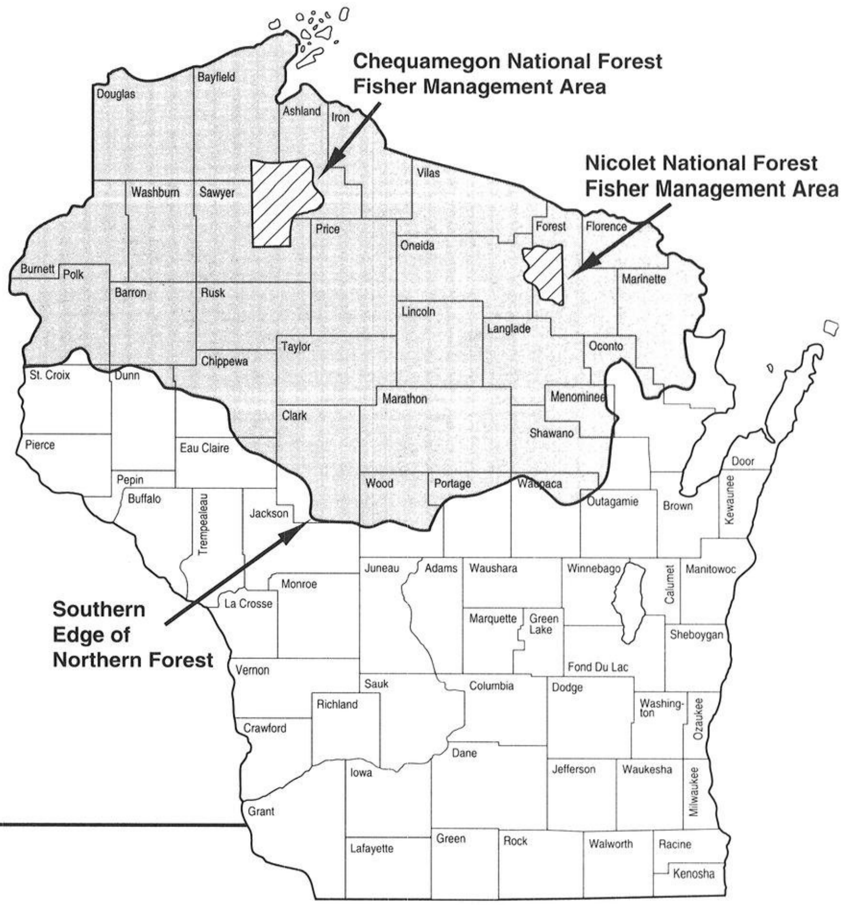


Figure 1. *Wisconsin's Northern Forest and Fisher Management Areas.*

Irvine et al. (1962) summarized fisher observations recorded soon after the releases on the Nicolet National Forest. They concluded that fishers were surviving in the area, but that most were still within a 30-mile radius of the release sites, and that there was still no positive proof that fishers were reproducing in the area. They felt "guarded optimism" about the success of the reintroduction.

Irvine et al. (1964) reported circumstantial evidence that fishers were reproducing in the area. They felt it was still premature to state that the releases were a success because they questioned whether or not the fishers could withstand unrestricted predator trapping and a bounty system outside of the closed area.

The fisher reintroduction was successful. Petersen et al. (1977) reported that fishers occurred throughout the northern quarter of Wisconsin by 1975 and were well established in 2 relatively small areas near the release sites. By 1981 fishers occupied all of the Northern Forest region but were common in only 1/3 of this area (Pils et al. 1983).

Considerable interest in establishing a fisher trapping season developed as fishers became more abundant and

PHOTO DNR

Male fisher kit found stranded in a mud puddle in May, 1962 on the Nicolet National Forest. This provided some of the first proof of reproduction in the newly introduced fisher population.

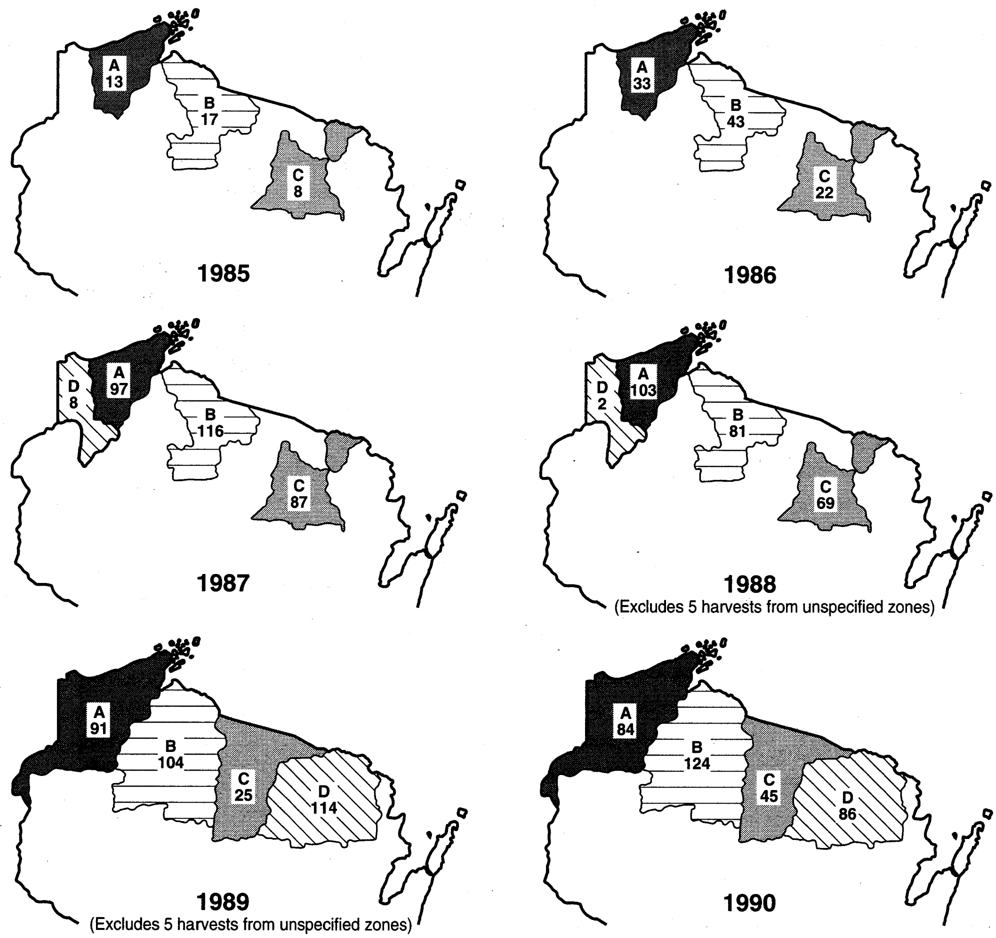


Figure 2. *Fisher trapping zones and harvests in Wisconsin, 1985-90.*

widespread. During the mid-1970's many fishers were being caught accidentally in traps set for other species. An experimental fisher trapping season was held in 1985 after much discussion within the DNR, with the public, and with several state and federal wildlife agencies.

The inaugural season was designed to prevent any possibility of overharvest. An 11-day (December 1-11) season was held in 3 relatively small areas with high fisher densities (Fig. 2). The season bag limit was 1, and only 300 harvest permits were issued. A heavy snowfall (15"+) just 2 days prior to the season severely restricted access, and only 38 fishers were registered (Table 1). The 1986 fisher season followed the same format, and 98 fishers were harvested. More harvest permits were issued in 1987 (904) and 1988 (927) resulting in harvests of 308 and 260 fishers, respectively.

The area open to fisher trapping was expanded in 1989 to include most of the fisher range. There were 1,486 harvest permits issued and 334 fishers were trapped. In 1990, the number of harvest permits issued was increased to 2,450 in hopes of harvesting about 700 fishers, but only 339 were taken.

Questionnaires sent to harvest permit recipients from 1985-88 showed that a substantial proportion of them did not trap for fishers (Fruth and Pils 1985, Vander Hayden and Pils 1986, Cleven and Pils 1987, Pils et al. 1988). The proportion not trapping ranged from 47% in 1985 to 23% in 1988. Success rates for those who did trap for fishers during this period ranged from 24% in 1985 to 55% in 1987.

This study began in 1981 after fisher numbers had increased and interest had developed in establishing a trapping season. This report covers data collected through 1991 and includes file data from 1976-80. The objectives of this study were to: (1) determine fisher densities and potential harvest rates in Wisconsin; (2) develop a population model and monitoring system; and (3) establish appropriate harvest strategies. Fisher home ranges, movements, and seasonal habitat use also were examined. The study was designed to assure a safe harvest of fisher and a mechanism for quick adjustment in trapping regulations if the population began to decline. Powell's 1982 study of fisher ecology and other published literature were used to develop study methods.

Table 1. *Fisher harvests in Wisconsin, 1985-90.*

Year	No. of Harvest Permits Issued	No. Fishers Harvested			
		Males	Females	Unknown	Total
1985	300	19	16	3	38
1986	300	47	51	0	98
1987	904	145	162	1	308
1988	927	127	132	1	260
1989	1,486	179	155	0	334
1990	2,450	187	151	1	339

STUDY AREAS

Wisconsin's fishers reside almost exclusively within the Northern Forest region of the state (Fig. 1). This area (>15,000 mile^2) lies 45-47° North latitude and is about 90% forested (McCaffery 1986). Upland and lowland soil areas are well distributed with lowlands comprising about 20% of the area. About 35% of the forest is publicly owned, and most of the forest was logged and/or burned between 1890 and 1940.

The Monico Study Area (MSA) and the Enterprise Study Area (ESA) were chosen for the intensive portion of this study because they were readily available, were representative of the fisher range in Wisconsin, and we had some data collected previously from them on fisher populations. Both are located in east central Oneida County (Fig. 3).

The 70.5-mile^2 MSA is typical of much of Wisconsin's fisher range. Consolidated Papers, Inc. owns most of the area and intensively manages it for timber production. The area is open to the public for hunting, fishing and trapping. Elevations on the MSA range from 1584-1748 ft. The topography is characterized by ridges running southwest to northeast, separated by large, continuous blocks of wetland forest types.

Tree species commonly associated with the uplands included birch (*Betula* spp.), maple (*Acer* spp.), quaking aspen (*Populus tremuloides*), balsam fir (*Abies balsamea*), and white spruce (*Picea glauca*). Basswood (*Tilia americana*), hemlock (*Tsuga canadensis*), ironwood (*Ostrya virginiana*), and white ash (*Fraxinus americana*) also were present. Lowland conifers contained black spruce (*P. mariana*), northern white cedar (*Thuja occidentalis*), and tamarack (*Larix laricina*). Lowland hardwoods included American elm (*Ulmus americana*), black ash (*F. nigra*), and maple. Shrubs, mainly speckled alder (*Alnus rugosa*) and willow (*Salix* spp.) were common near lakes and streams. Curtis (1971) described the vegetation native to this region.

Mean temperatures range from 13 F in January to 68 F in July, and annual snowfall averages 59 inches (Wisconsin Statistical Reporting Service 1967). The economy of the locality is based on wood-product industries and tourism.

The 36 mile^2 ESA is located approximately 15 miles southwest of the MSA and comprises the Enterprise portion of the Oneida County Forest. Forest types, topography, and climate are very similar to those on the MSA. Most (99%) of the land is publicly owned and managed for timber production and recreation.

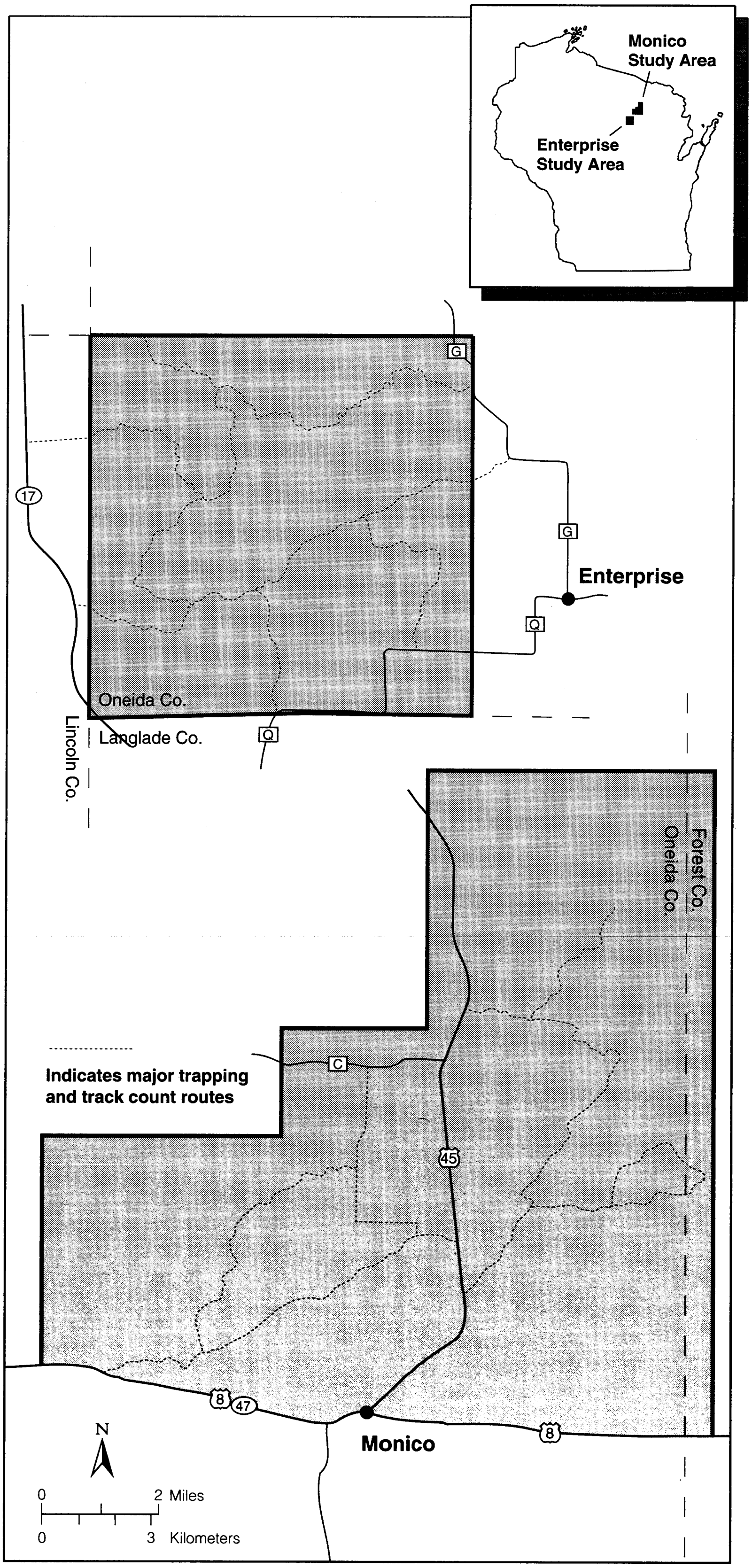


Figure 3. *Locations of the Monico and Enterprise Study Areas.*

METHODS

Capture and Handling Techniques

Trapping was conducted on the MSA from 1 August 1981 to 19 February 1982 and from 28 September to 17 November 1982. Fishers were captured in single-door live traps (Models No. 108 and 207.5, Tomahawk Live Trap Co., Tomahawk, WI).[1] Meat trimmings were used as bait, and putrefied fish, anise extract, and commercial fisher lures were used at times to help attract the animals. Traps were placed in cubby sets at 0.5-1.0 mile intervals in areas where fisher tracks had been observed or which appeared attractive to fishers.

Fishers captured in fall and summer were processed in the field, but those caught during winter were handled inside to prevent hypothermia. Ketamine hydrochloride (10 mg/lb) was used to immobilize fishers and was injected using a 3cc syringe while fishers were in the trap. If needed, a second, smaller dose was administered to induce or maintain anesthesia. Fishers were sexed and weighed, and a lower first premolar was extracted for aging. Teeth were X-rayed to identify juveniles by the presence of an open foramen (Kuehn and Berg 1981), and older animals were aged by counting annuli in the cementum (Strickland et al. 1982*a*). A numbered metal tag (Wingband Style 898, National Band and Tag Co., Newport, KY) was placed in each ear.

Radio Tracking

Fishers were fitted with neck-mounted transmitters in the 151 MHz range. Transmitters used in 1981-82 (Model SB2, AVM Instrument Co., Trinity, CA) were equipped with internal loop antennas and those used in 1982-83 (Model S2B5, Telonics, Mesa, AZ) had whip antennas. Collar circumference averaged 7.1 inches for females and 9.4 inches for males. Complete radio packages weighed 57-67 g.

Fishers were located with an AVM Model LA12 receiver (AVM Instrument Co., Dublin, CA) and a vehicle-mounted, 8-element Yagi antenna (Model 208, Telex Communications, Inc., Minneapolis, MN). Locations were considered acceptable when angles at the intersection of ≥ 2 bearings were $90^\circ \pm 30^\circ$. We monitored fishers in 8-hour, rotating shifts, and attempted to locate each animal at least once each day. Fisher activity patterns were determined by occasionally monitoring individual fishers continuously for 6- or 24-hour periods. Activity was determined by fluctuations in signal strength as animals moved.

Home ranges were determined by the minimum convex polygon method (Mohr 1947, Southwood 1966) excluding irregular movements (Burt 1943) and calculated with the computer program TELEM (Koehln 1980). Home ranges were analyzed by month and by climatic seasons of fall (October-November), winter (December-February), spring (March-May), and summer (June-September). Annual home range was defined as the area enclosed by all radio locations (minimum convex polygon) for an individual fisher during a year.

Habitat components within home ranges of fishers were identified from Wisconsin Wetland Habitat Inventory aerial photos (1:24,000) and consolidated into 6 major types: upland, lowland conifer, lowland hardwood, lowland mixed, shrub, and edge (200 ft on each side of a border between major habitat types). Availability of habitat types within the study area was determined by sampling random points (Marcum and Loftsgaarden 1980). Fisher selection or avoidance of habitat types was determined using the z-statistic (Neu et al. 1974, Marcum and Loftsgaarden 1980, Byers et al. 1984). Johnson (1984) described our radio tracking and habitat classification procedures in greater detail.

Fishers were captured in baited live-traps concealed in cubbies.

PHOTOS B KOHN

An immobilized fisher just prior to being radio-collared.

[1]Use of product names does not constitute endorsement by the Wisconsin Department of Natural Resources.

Track Counts

Track counts were initiated during December 1976 along routes bisecting the MSA and the ESA (Fig. 3) to document trends in fisher and other furbearer populations (Appendix A). Tracks were counted about 24 hours after a snowfall, and the distance surveyed each time depended upon road conditions and time available. Routes were driven with a 4-wheel-drive vehicle with 2 observers including the driver. Multiple crossings by the same animal were counted once. Generally, tracks <1/4 mile apart were considered to be made by the same animal.

Prior to 1986, track counts were conducted whenever snow conditions and time permitted. Beginning in 1986, 3 track counts were conducted in these areas each winter, generally before snow depths exceeded 12 inches.

Similar, but more standardized, track counts were begun during the winter of 1977-78 along 2, 10-mile transects in each of the 18 counties comprising the potential fisher range (Appendix B). Transects were selected and surveyed by wildlife management personnel stationed in those counties.

Wildlife personnel were instructed to select 2 permanent transects in each county along lightly-traveled roads through stands of mixed aspen, alder, and conifers. Large areas of unbroken hardwoods and pine were avoided, and transects were >10 miles apart. Track counts were conducted the first or second day after a snowfall during early winter (November-December) before roads became impassable and furbearer movement was inhibited. Counts conducted 2 days after a snowfall were halved for comparison with 1-day counts. These track counts were conducted only once each winter.

DNR Questionnaire

A Mammal Observation Questionnaire was sent each summer to all DNR field personnel requesting that they report numbers of 10 mammal species of special interest (including fishers) they had observed during the past 12 months. Numbers of observers and numbers of animals observed in each county were tabulated annually.

Determination of Fisher Range

DNR wildlife managers in northern Wisconsin were contacted in 1981 to update the fisher distribution map prepared by Petersen et al. (1977). Managers were provided a copy of that map, a summary of the furbearer track counts conducted to date (Thompson 1981), and a map showing locations where trappers reported accidentally catching fishers. They used these background materials and their personal knowledge of fisher distribution to delineate areas where they felt fishers were common (≥1 per 4 mile^2), less common (1 per 4-8 mile^2), or rare (<1 per 8 mile^2). These maps were collated into a statewide distribution map and returned to the managers for review. USGS topographical maps and additional discussions with wildlife managers helped delineate areas with similar fisher densities. Similar procedures were used to document the distribution and densities of fishers in 1988.

Carcass Collections and Analyses

Successful trappers were required to register their fisher at a DNR station and surrender the carcass at that time. The sex, date of harvest, and harvest zone were recorded for each carcass, and a canine tooth was extracted and sent to Univ. Wis.-Stevens Point for age determination. Ages were tabulated by year class and sex and analyzed following life-table procedures described by Allee et al. (1949) and Caughley (1966). Female reproductive tracts were stored in 10% formalin until ovaries were hand-sectioned and corpora lutea were counted (Wright and Coulter 1967).

In this study, the term "juveniles" refers to radio-collared fishers followed during the period they were 0.5 - 1.5 years old. The term "kits" refers to fishers harvested during their first fall (<1 year old).

Population Estimation and Modeling

Fisher densities were calculated for the MSA using capture/recapture ratios (Schnabel 1938) and home ranges of radioed fishers. The statewide fisher population was estimated by comparing the frequency of tracks on the statewide surveys to that observed on the Monico Study Area during 1981-83, which represented a "known" density of fishers. We also incorporated our data into the furbearer population model developed by the Minnesota DNR (Berg and Kuehn 1989) to estimate Wisconsin's fisher population. That model has been used for fisher, marten (*Martes americana*), bobcat (*Felis rufus*), coyote (*Canis latrans*), and otter (*Lutra canadensis*) and has been accepted by 11 other states.

Data used included: (1) registration totals; (2) sex ratios of kits, yearlings, and adults; (3) pregnancy rates and inutero litter sizes for yearling and adult females; and (4) estimated non-harvest mortalities. Numbers of fishers in the starting population were adjusted in each run to determine which estimate produced population trends that matched most closely our other population data. The model then allowed us to simulate the impacts of various harvest strategies on the fisher population.

RESULTS AND DISCUSSION

Trapping and Handling Efficiency

We captured 31 fishers a total of 80 times on the MSA during 1981-82. These included 9 juvenile and 10 adult males, and 5 juvenile and 7 adult females (Table 2). Females weighed 4.7-6.0 lb, and males 9.0-15.0 lb.

Trapping success varied among trapping periods (Table 3). Overall trapping success during 11 August 81 to 1 February 82 averaged 1.5 captures/100 trapnights, but was best during the September-October and February-March periods. Deep snow and extreme cold severely reduced success in December and January.

Trapping success was much higher during 28 September-17 November 82 (6.8 captures/100 trapnights) because we were more familiar with fisher habitat and movements on the MSA. Arthur (1988) reported 0.4 captures/100 trapnights while live-trapping fishers in Maine.

No major problems were encountered with the use of ketamine hydrochloride for anesthetization. Fishers were immobilized about 2.5 min after injection and remained so for about 40 min, similar to results reported in Maine (Arthur 1988). No fishers died due to handling, and no serious trap injuries were observed.

Rigid live-traps were more reliable than those designed to collapse for transportation and storage. Two fishers escaped from collapsible traps when fasteners failed or were undone. Fasteners should be crimped tight when using collapsible traps.

Steck (1990) found that fishers could be live-trapped quite easily in December and January (when our success was poorest) if traps were cleaned thoroughly and any tainted snow was removed from the trap site after each capture. This was not necessary during September-November and February, but these precautions should be considered when trapping during mid-winter. Fishers might be more wary of other fishers at this time of year.

Table 2. *Sex and age classes of fishers at first capture on the Monico Study Area, 1981-82.*

Age Class	Males	Females	All Fishers
Juv.	9	5	14
1	4	2	6
2	0	3	3
3	2	1	3
4	2	1	3
Totals	19*	12	31

* Ages not obtained for 2 adult males.

Table 3. *Trapping effort and efficiency on the Monico Study Area, 1981-82.*

Trapping Period	No. of Trap-Nights	No. Of Captures	Captures/100 Trap-Nights
11 Aug 1981 - 4 Sep 1981	459	3	0.7
28 Sep 1981 - 17 Oct 1981	359	7	1.9
11 Dec 1981 - 31 Jan 1982	578	1	0.2
1 Feb 1982 - 19 Feb 1982	626	19	3.0
28 Sep 1982 - 19 Oct 1982	279	29	7.2
1 Nov 1982 - 17 Nov 1982	451	30	6.7
All Trapping Periods	1,752	80	2.9

Home Ranges

Annual Home Ranges

We located 23 fishers 1,666 times (mean = 72 locations/fisher, range 11-193) over a period averaging 163 days/fisher (range 25-237) during August 1981-August 1983. No males were available for radio tracking during August, September, and October 1981, and June, July, August, and September 1982. No females had functional radio-collars during June, July, August, and September 1982.

Males had larger ($t = 2.38$, $P > 0.1$) annual home ranges than females (15.3 vs. 3.2 mile^2), and the annual home range within sexes was similar for juveniles and adults (Table 4). The smaller size (Kelly 1977), bioenergetics (McNab

Table 4. *Annual home range of fishers on the Monico Study Area, 1981-83.*

	Males			Females			
Year	Juv.	Adult	All	Juv.	Adult	Unk.	All
1981-82							
No. fishers	2	2	4*	2	5	1	8
Mean no. locations**	76	53	64	21	71	51	56
Area							
Mile^2	10.9	19.3	15.1	4.0	2.6[a]	2.0	2.9
SD	7.1	13.8	10.2	0.3	1.9	–	1.6
1982-83							
No. fishers	4	2	6	1	4	0	5
Mean no. locations	64	103	77	64	100	–	92
Area							
Mile^2	16.9	12.5	15.4	2.8	3.8	–	3.6
SD	7.3	1.0	6.1	–	2.0	–	1.8
Combined							
No. fishers	6	4	10	3	9	1	13
Mean no. locations	68	78	72	35	84	51	70
Area							
Mile^2	15.1	15.7	15.3	3.6	3.2	2.0	3.2
SD	7.6	9.1	7.7	0.7	1.9	–	1.6

* One juvenile male was located only 4 times and is not included.
** Mean number of radio locations used to determine home range.
a One adult female was located only 11 times and its home range calculated from those 11 locations (0.7 mile^2) was by far the smallest.

1963, Powell and Leonard 1983), and maternal responsibilities (Strickland et al. 1982*b*, Powell 1982) of females probably limited their home ranges.

Arthur et al. (1989*a*) reported home ranges of Maine fishers during May-January to be 9.8 mile^2 for males and 4.7 mile^2 for females. Kelly (1977) reported home ranges of fishers in New Hampshire to be about 8 mile^2 for adult males, 10 mile^2 for juvenile males, and 6 mile^2 for females, but only 1 home range included movements during the breeding season. Two juvenile female fishers in Manitoba had winter home ranges of 8 mile^2 from 45 locations in 64 days, and 6 mile^2 from 25 locations in 24 days (Raine 1982). Powell (1982) calculated home ranges to be 6-13.5 mile^2 for 1 female and 3 males in northern Michigan. The home ranges of 3 adult males in California averaged 5.4 mile^2, but only 1 of these was monitored during winter (Buck et al. 1979). Reported differences in home range size probably reflected habitat quality and inconsistencies in seasons when fishers were monitored (see "Seasonal Home Ranges").

Seasonal Home Ranges

Home ranges of males were largest during winter (8.4 mile^2) and spring (9.7 mile^2) while those of females were largest during fall (2.8 mile^2) (Fig. 4, Table 5). Home ranges of both sexes were smallest during summer, probably reflecting higher prey abundance.

Small home ranges of females during April-July probably reflected abundant food, their inability to travel far with a litter, and their reluctance to travel far from the den. Larger home ranges of females in fall may have reflected independence from their litter and juvenile dispersal. Juvenile fishers disperse during late summer or early fall (Douglas and Strickland 1987). The large fall home range of 1 juvenile female (8.3 mile^2) increased the mean for all.

Male home ranges were largest during February-May. Breeding activity begins in February with long movements by males searching for receptive females (Leonard 1980). Breeding usually occurs during late March or April (Douglas and Strickland 1987) within 10 days after parturition (Powell 1982).

Home Range Overlap

In 1981-82, 4 males shared a mean of 16% of the area of their annual home ranges with other males and 17% with females (Fig. 5). The 8 radio-collared females shared a mean 15% of their annual home ranges with other females and 47% with 1 or more males. Monthly home ranges for ≥2 fishers were available for November-December, 1981 and February-May, 1982, but overlap was observed only during the breeding season.

Six of 12 fishers occasionally shared home ranges in 1982-83 (Table 6, Fig. 6). Juveniles were involved in 81% of the locations in another fisher's home range, and most (67%) overlapping of home ranges involved juvenile males. Male home ranges overlapped 10 times more often than did those of females. Adult ranges overlapped only 10 times, none of which occurred between adult females.

The areas shared by males in 1982-83 comprised 35% of their annual home range, while those shared by females comprised 80% of theirs. Of the 52 times fishers were located within another fisher's home range, 58% were between sexes. Those shared areas comprised 13% of the male and 69% of the female home ranges.

Of the 21 times adult fishers were located in another adult's home range, 17 occurred between males and females (4 in winter, 7 in spring, 2 in summer, 4 in fall). Only 4 instances of intrasexual overlap occurred between adults. It involved 2 males in spring and summer.

Overlap of home ranges by fishers has been documented previously (de Vos 1952, Coulter 1966, Kelly 1977, Buck et al. 1979, Leonard 1980, Powell 1982, Raine 1982,

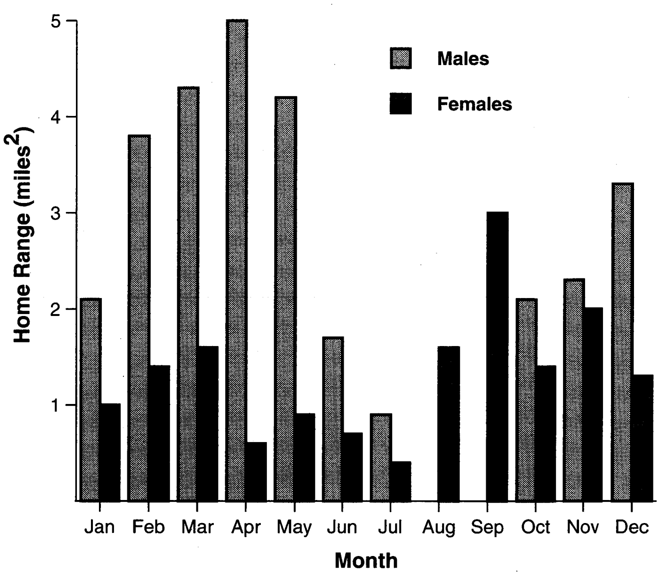


Figure 4. *Mean monthly home ranges of 23 fishers on the Monico Study Area, 1981-83.*

Table 5. *Mean seasonal home ranges (mile^2) of fishers on the Monico Study Area, 1981-83.*

	Fall		Winter		Spring		Summer	
	N*	Area	N	Area	N	Area	N	Area
Males	6	3.7	6	8.4	4	9.7	4	2.7**
Females	6	2.8	5	2.1	4	2.2	2	1.1
Juveniles	6	4.3	5	7.5	2	10.0	2	1.8
Adults	6	2.2	6	3.9	6	4.6	4	2.3
All	12	3.2	11	5.6	8	5.9	6	2.1

* N = Sample Size.
** Data available for only July.

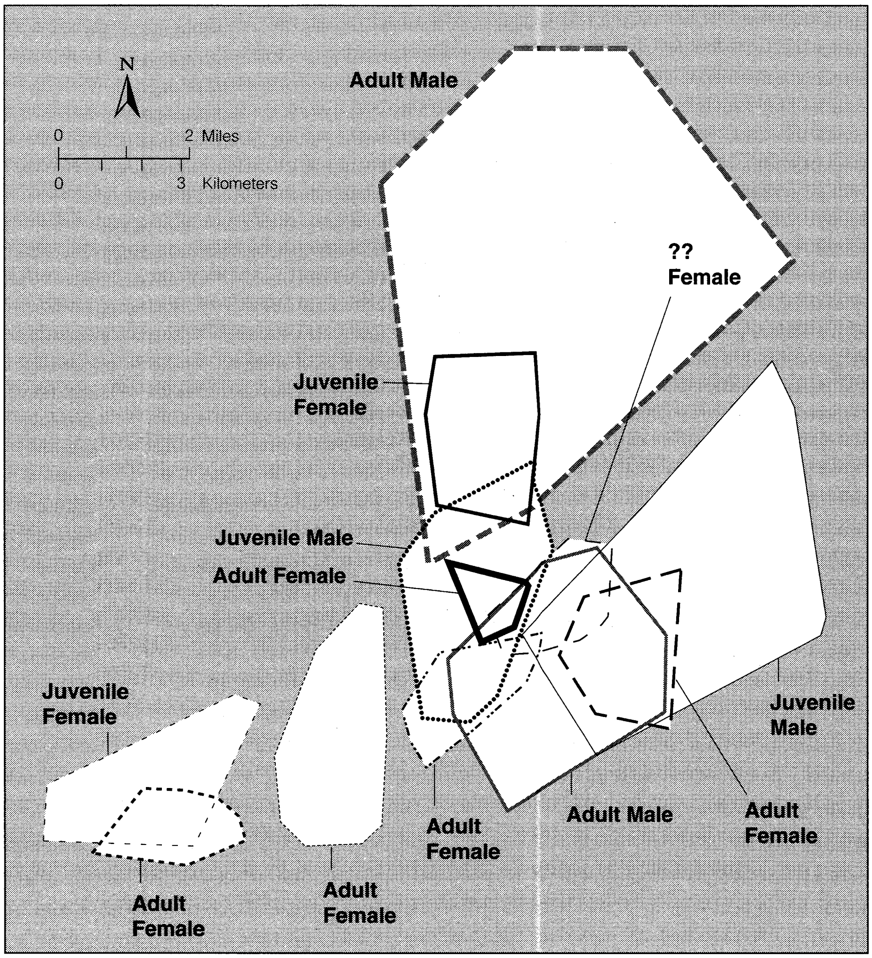


Figure 5. *Composite home ranges of radio-collared fishers on the Monico Study Area, 1981-82.*

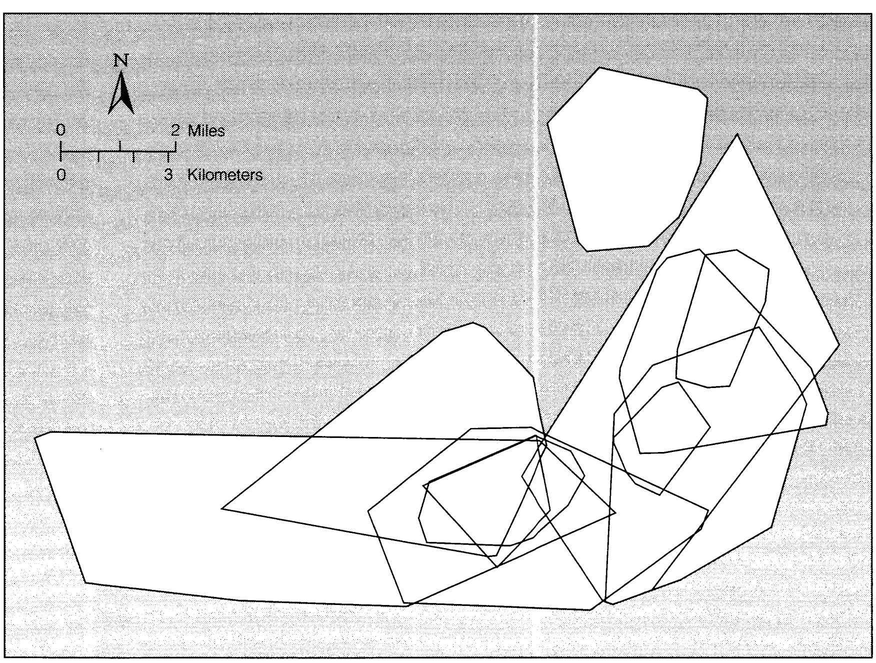


Figure 6. *Composite home ranges of radio-collared fishers on the Monico Study Area, 1982-83.*

Arthur et al. 1989*a*). Our data, and those of Arthur et al. (1989*a*), suggest males are territorial against males and females against females. Powell (1979) reviewed studies supporting this pattern in other mustelids.

Most overlap occurred during spring and fall 1982. Juvenile dispersal in late summer and fall (Powell 1982, Strickland et al. 1982*b*), and more movement by males during the breeding season probably increased the overlap during these seasons.

Movements

Daily Movements

The average time elapsed between 739 locations of 13 fishers observed during August 1981-August 1982 was 23.2 hours (range 12-37). The mean daily distance moved by males (1.4 miles) was longer (t =6.17, $P < 0.001$) than for females (0.8 miles) (Table 7). Differences in mean daily movements also existed between age classes (t =2.91, $P < 0.01$) and among sex/age classes (F = 20.21, $P < 0.001$). Adult males moved farther ($P < 0.05$) each day than any other sex/age class.

Mean daily movements differed by month (Fig. 7). The mean daily distance traveled by males was lowest in January (0.6 miles), but was relatively stable (1.3-1.7 miles) during the rest of the year. Mean daily movements of females were also lowest in January (0.3 miles), and ranged from 0.9-1.3 miles during February-March and August-December. Mobility of adult females during April-May was probably restricted by new-born kits. Reduced daily movements of both sexes during November probably were caused by human activity and the abundance of carrion (unrecovered dead deer and gut piles) resulting from the firearm deer season.

Maximum distances moved in 1 night were 4.6 miles for adult males, 2.9 miles for adult females, 2.8 miles for juvenile males, and 2.0 miles for juvenile females.

De Vos (1952) reported 1 fisher traveled 60 miles in 3 days in Ontario. In Michigan, fishers often traveled about 3 miles daily with perhaps 1 or 2 rest periods (Powell 1982). Trappers reported that fishers traveled irregular circuits 40-100 miles long and 8-20 miles wide, visiting certain areas regularly (de Vos 1952). Buck et al. (1979) also observed circuitous movement patterns regardless of season.

Daily snowfall and snow depths >18 inches restricted fisher movements. Fishers traveled less on days when it snowed ($r = -0.28$, $P < 0.01$) and on days when snow depths exceeded 18 inches ($r = -0.25$, $P < 0.05$). Raine (1983) thought that snow depths $\geq$8 inches began restricting movements of fishers and martens.

Our analyses did not consider the condition of the upper snow layer. Crusts developed from occasional thawing and freezing can support a fisher, thus reducing the impact of snow depth on fisher mobility.

Hourly Movements

The mean time between locations was 1.1 hour (range 1-5). Males moved farther per hour (0.2 mile) ($t = 4.66$, $P < 0.05$) than females (0.1 mile) (Table 8). Hourly movements also differed ($F = 14.49$, $P < 0.05$) among sex and age classes. Adult males moved farther (0.3 mile) than did juvenile males (0.2 mile) and adult females (0.1 mile). No hourly movement data were available for juvenile females. Juvenile males also moved farther than adult females.

Mean hourly movements were greater ($P < 0.05$) in summer (0.3 mile) than in fall and winter (0.1 mile), and also ($P < 0.10$) during the night (0.2 mile) than day (0.1 mile). The maximum distances traveled in 1 hour were 1.3 miles for males and 0.5 mile for females.

Activity Patterns

Fisher were active 614 (37%) of the 1,666 times located, but activity varied ($\chi^2 = 27.55$, $P < 0.01$) throughout the day (Table 9). Daily activity peaks occurred between 5:00 and 7:59 a.m. and between 7:00 and 11:59 p.m.; fishers were least active from noon to 4:59 p.m.

Monitoring continuously during 24-hour periods in November, December, and February (1 time period/month), and 6-hour periods in December (N = 2), February (N = 4), May (N = 3), and June (N = 3) revealed similar activity patterns. Peaks of activity occurred between 4:00 and 7:59 a.m. (67% active, N = 21) and between 7:00 and 11:59 p.m. (67% active, N = 30). Fishers were least active (15% active, N = 53) between 11:00 a.m. and 4:59 p.m. Activity during 1-hour time periods ranged from 0% (noon-1:59 p.m. and 4:00-4:59 p.m.) to 83% (8:00-8:59 p.m. and 11:00-11:59 p.m.). All of these data indicated that fishers are most active near sunrise and sunset, and more active at night than day.

Powell (1977) monitored 4 fishers in Michigan between 7:30 a.m. and 10:30 p.m., and observed 1-3 activity periods/day, each 2-5 hours long. Kelly (1977) determined that fishers were most active at sunrise and sunset, and least

Table 6. *Numbers of times fishers were located in another fisher's home range, 1982-83.*

	Between Males (N = 6)	Between Sexes	Between Females (N = 6)	Total
Annual				
All fishers	20	30	2	52
Adults	2	8	0	10
Fall				
All fishers	10	26	6	42
Adults	0	4	0	4
Winter				
All fishers	15	20	2	37
Adults	0	4	0	4
Spring*				
All fishers	8	10	0	18
Adults	2	7	0	9
Summer*				
All fishers	2	2	0	4
Adults	2	2	0	4

* Might be underrepresented because radio contact was lost with 3 juveniles by March, and 1 adult female was found dead in April.

Table 7. *Mean daily movements (miles) for 13 fishers on the Monico Study Area, 1981-82.*

	Males			Females			Total		
	N*	Mean	SD	N	Mean	SD	N	Mean	SD
Juveniles	52	1.2	0.7	17	1.2	0.6	69	1.2	0.7
Adults	23	1.9	1.2	171	0.7	0.7	194	0.9	0.8
Total	83	1.4	0.9	209	0.8	0.6	292	1.0	0.8

* N = number of recorded movements.

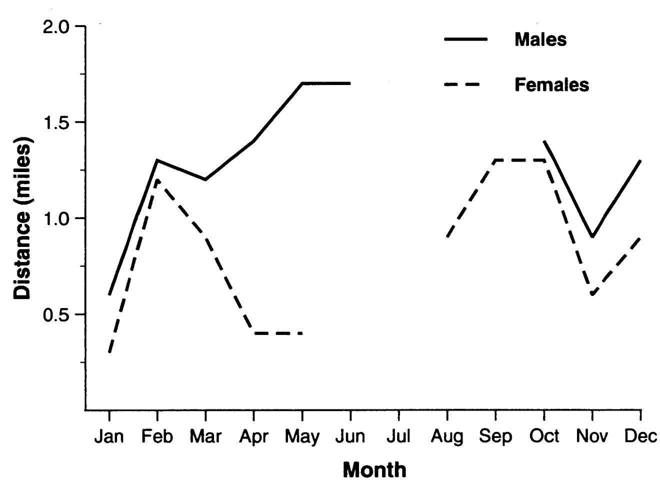


Figure 7. *Mean daily movements by month of 13 radio-collared fishers on the Monico Study Area, 1981-82.*

Table 8. *Hourly movements of fishers on the Monico Study Area, 1981-83.*

	No. Hourly Movements	Mean Distance (miles)
Males		
Adults	38	0.3
Juveniles	37	0.2
All	75	0.2
Females		
Adults	64	0.1
Juveniles	0	–
All	64	0.1
Season		
Summer	55	0.3
Fall	23	0.1
Winter	60	0.1
Spring	0	–
Period of day		
Night	50	0.2
Day	89	0.1

Table 9. *Daily activity patterns of fishers on the Monico Study Area, 1981-83.*

Time Period	No. of Locations	No. (%) Active
Midnight-4:59 a.m.	127	52 (41)
5:00 a.m.-7:59 a.m.	105	54 (51)
8:00 a.m.-11:59 a.m.	509	200 (39)
Noon-4:59 p.m.	591	141 (24)
5:00 p.m.-6:59 p.m.	119	49 (41)
7:00 p.m.-11:59 p.m.	215	118 (55)
All	1,666	614 (37)

active between 8:00 and 11:59 a.m. He also observed that fishers were active 74% of the times located, but obtained 93% of his locations between 7:00 a.m. and 2:59 p.m.

Although snow and extreme cold reduced the activity of fishers, chi-square analyses showed no relationship between fisher activity and cloud cover, wind velocity, or precipitation. The crepuscular activity pattern of fishers generally coincided with that of their prey.

Habitat Use

Fishers did not use habitat types in proportion to their occurrence (Table 10). Annual use of the lowland mixed type was higher than expected, while lowland conifer and shrub types were avoided. Although fishers were located most often in forested upland (44% of all locations) and edge types (31%), it was proportional to availability.

Northern hardwoods and mixed stands of northern hardwoods and conifers accounted for 90% (73% and 17%, respectively) of fisher locations within the forested upland type. Of locations within the edge type, 43% occurred along the edges of upland mixed and lowland mixed types, and 24% occurred where shrubs bordered lowland conifers or northern hardwoods.

Fishers used forested upland and edge types most often in every season, but again proportional to availability (Table 11). Fishers seemed to prefer the lowland mixed type in all seasons and avoided lowland conifers. Use of the shrub type was greater than expected in summer (when leaves were on), and less than expected the rest of the year. Arthur et al. (1989*b*) reported that fishers in Maine avoided deciduous stands in all seasons, preferred conifer stands in all seasons except summer, avoided shrub stands in winter and spring, avoided wetlands in all seasons except fall, and used mixed stands proportional to occurrence in all seasons.

Males used lowland mixed habitat types more than expected ($\chi^2 = 24.49, P < 0.05$), while females used upland types more than expected and avoided lowland conifer and shrub types ($\chi^2 = 42.64, P < 0.05$). Adults avoided lowland conifer and shrub types ($\chi^2 = 22.76, P < 0.05$), and juveniles avoided lowland conifer ($\chi^2 = 20.50, P < 0.05$).

Resting sites and dens are special habitat components (Thomas et al. 1979*a*). Fishers were located 38 times at 34 individual resting sites during October 1982-April 1983. Tree cavities comprised 26 (76%) of the sites. Downed hollow logs were used 4 times, stick nests in conifers twice, and brush piles and windfalls once each. Tree species used for resting sites included yellow birch (35% of all observations), maple (21%), and northern white cedar (18%). Balsam fir, American elm, and quaking aspen were used once each.

The mean dbh of all den trees was 22 inches (SD = 5, range 11-43). Deciduous trees averaged 24 inches dbh (SD = 6, range 17-43), and conifers 16 inches (SD = 3, range 11-21). Fishers used live and dead trees 13 times each as shelters.

Cavities in large trees were used most often as resting/denning sites. Fishers spent 2-3 days at a time in these cavities during snowstorms and severely cold weather. Temporary den sites were usually near a food source and used for only a few days.

Fishers might regularly use particular resting/denning sites. We found fishers reusing 4 sites 16-22 days apart. De Vos (1952) observed a fisher using certain dens repeatedly, but Coulter (1966) and Powell (1977) did not.

In April 1983, 2 maternal dens were located ≥20 ft above the ground in live maples. One den had also been used in 1982. Most maternal dens are found high above ground in large deciduous trees (Leonard 1980, Powell 1982). Such sites provide protection from severe weather and predators, including male fishers (Allen 1983).

Fisher habitat use is influenced by food availability, cover, denning sites, topography, and weather conditions. Of these, food is probably the most important (Strickland et al. 1982*b*). The preferred habitat of fishers has been described as spruce forests (Hamilton 1943), virgin forest (Matthiessen 1959), mixed stands, conifers, and cedar swamps (de Vos 1952), young forests that followed cutting, burns, or agricultural use (Coulter 1960), extensive tracts of mature spruce-fir and hardwoods (Coulter 1966), wetlands and mixed stands of hardwoods and softwoods (Kelly 1977), open hardwood forests and lowland spruce-fir, spruce-aspen, and alder (Powell 1978), and coniferous ridges (Raine 1983). Arthur et al. (1989*b*) thought that

Fishers systematically investigated porcupine dens within their territories. Two fishers were captured at this den site.

Table 10. *Annual use of habitat types by fishers on the Monico Study Area, 1981-83.*

Habitat Type	Coverage (% of Area)	No. (%) of Locations		
		1981-82*	1982-83	Total
Forested upland	43	214 (40)	429 (47)	643 (44)
Lowland conifer	10	41 (8)**	51 (6)**	92 (6)**
Lowland hardwood	2	10 (2)	26 (3)	36 (3)
Lowland mixed	8	76 (14)**	98 (11)**	174 (12)**
Shrub	4	25 (5)	23 (3)**	48 (3)**
Edge	32	168 (32)	287 (31)	455 (31)

*Eight locations in other habitat types were omitted in 1981-82 for comparison between years.
**Significant at $P < 0.05$; Bonferroni z-test.

Table 11. *Seasonal use of habitat types by fishers on the Monico Study Area, 1981-83.*

Habitat Type	Coverage (% of Area)	No. (%) of Locations			
		Summer	Fall	Winter	Spring
Forested upland	43	83 (38)	163 (46)	223 (50)	174 (41)
Lowland conifer	10	13 (6)*	17 (5)*	30 (7)*	32 (8)*
Lowland hardwood	2	3 (1)	17 (5)	9 (2)	7 (2)
Lowland mixed	8	26 (12)*	38 (11)	44 (10)	66 (16)*
Shrub	4	20 (9)*	9 (3)	9 (2)*	10 (2)
Edge	32	76 (34)	111 (31)	134 (28)	134 (32)

* $P < 0.05$; Bonferroni z-test.

fisher habitat quality in Maine declined when stand composition exceeded 75% conifers, and that forest openings ≤12 acre helped maintain forest diversity and prey abundance.

Allen (1983) surveyed the literature and developed a hypothetical habitat suitability index model for fishers. Optimal conditions included >50% closure of the tree canopy, ≥2 stories in the tree canopy, and overstory trees >10 inches average dbh with >50% deciduous trees. This model has not been adequately tested for year-round use throughout the fisher's range.

Fishers avoided the lowland conifer and shrub types in Wisconsin. Lowland conifers lack a diverse understory due to reduced light penetration, cold temperatures, and wet soils (Barbour et al. 1980) which likely results in reduced abundance of prey species. The shrub type probably was avoided due to lack of overhead cover and denning sites.

Fishers often used areas of interspersion (edge habitat type), probably because prey species were more diverse and abundant, a characteristic of ecotones (Odum 1971, Thomas et al. 1979*b*). Fishers are generalized predators of small- to medium-sized herbivores, especially meadow voles (*Microtus* spp.), deer mice (*Peromyscus* spp.), snowshoe hares (*Lepus americanus*), and porcupines (Powell 1982), which occupy many habitat types.

Snowshoe hare use of uplands increases at night (Pietz and Tester 1983), probably leading fishers to forage there more then. Fishers also search uplands for porcupines (Brander and Books 1973, Powell and Brander 1977). In winter, fishers probably forage for red squirrels (*Tamiasciurus hudsonicus*) and ruffed grouse (*Bonasa umbellus*) in uplands, where grouse resting sites and red squirrels are more abundant (Raine 1983).

Fishers are efficient predators on porcupines. After killing the porcupine, they normally enter the body cavity through the stomach and consume the carcass within the hide.

Fishers used habitat types with little overhead cover (e.g. alder thickets) more often during summer when deciduous leaves provided maximum concealment. Monotypic forest (e.g. upland conifers) provided year-round cover but were seldom used, probably because they lacked structural diversity resulting in a limited abundance of prey.

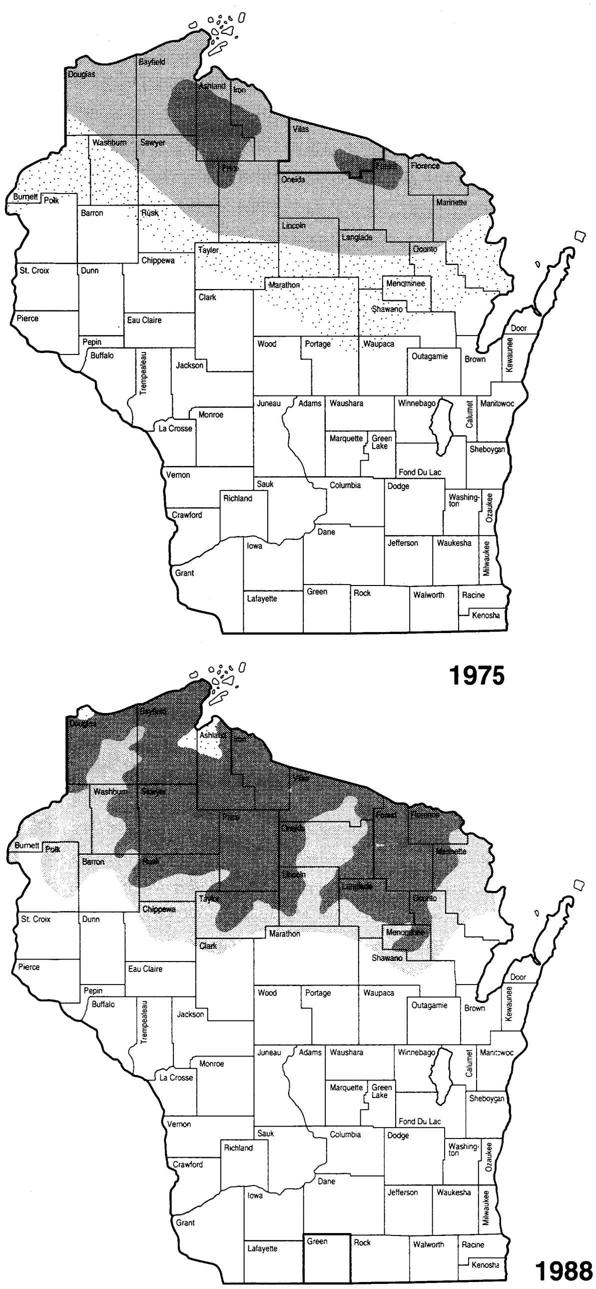
Fishers avoided open bogs in November, December, and January but used them often in February. Leonard (1980) reported that snow crust, such as occurred in February, allowed fishers easier travel in bogs than elsewhere.

Our data indicate that fishers most often use closed-canopy, forested areas containing enough large trees for potential den sites (upland northern hardwoods and conifers) interspersed with areas of high prey diversity and abundance (edge types and lowland mixed types). Fishers in Wisconsin might be better adapted to deciduous and transitional habitat types as Arthur et al. (1989*b*) found in Maine.

Expansion of Fisher Range

Fisher distribution maps prepared in 1975 (Petersen et al. 1977), 1981 (Kohn et al. 1982), and 1988 (Kohn et al. 1989) documented increases in fisher range and numbers since their reintroduction into Wisconsin (Fig. 8). In 1975, fishers were considered to be "common" in only 2 small areas near the original release sites. The population on the Chequamegon National Forest apparently expanded faster than that on the Nicolet National Forest. Petersen et al. (1977) felt this was because releases on the Chequamegon site occurred within 11 months compared to 7 years on the Nicolet site. They estimated there were 1,000-1,500 fishers in Wisconsin in 1975.

The fisher population continued to expand rapidly. By 1981, fishers occupied all of the Northern Forest and were considered to be "common" in about one-third of this area. Quite large acreages of suitable habitat still had



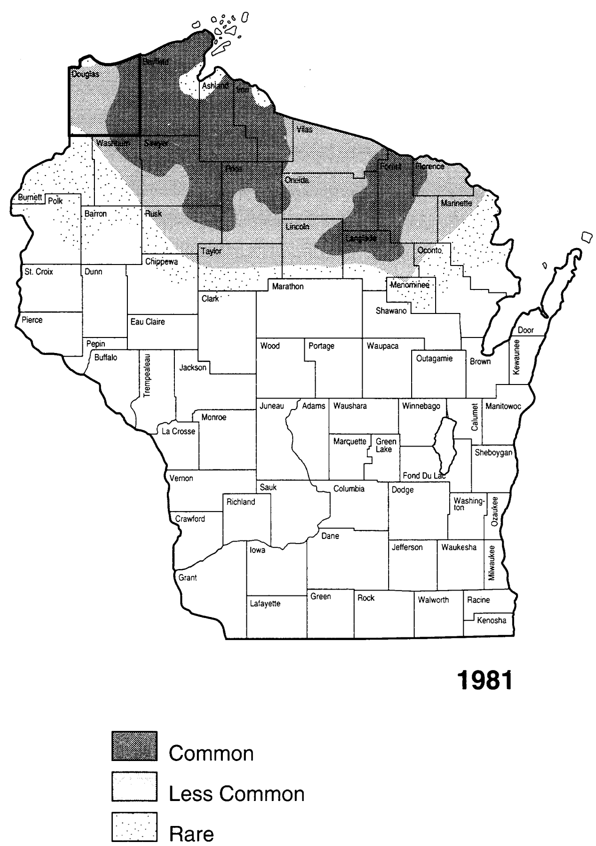


Figure 8. *Distribution and relative abundance of fishers in Wisconsin in 1975 (Petersen et al. 1977), 1981, and 1988.*

PHOTO: B. KOHN

Fisher Management Units were established within the Nicolet and Chequamegon National Forests to protect them from being accidentally caught by predator trappers.

low density fisher populations. The lack of suitable habitat also prevented the southward expansion of the fisher.

The area occupied by fishers remained static from 1981-88, but densities increased. By 1988, fishers were well established in all suitable habitat, and had reached a density of ≥1 per 4 mile^2 in an area covering about two-thirds of the Northern Forest. This was approximately 30 years after the fisher reintroduction efforts on the Nicolet National Forest and about 20 years after they were released into the Chequamegon National Forest.

Fisher Population

Trends

Track counts along routes bisecting the MSA and ESA showed a definite upward trend in the fisher population in Oneida County during this study (Table 12). Numbers of fisher tracks observed increased from 4.8 per 100 miles during the winter of 1976-77 to 50.0 in 1990-91. Prior to 1986 it was difficult to compare annual results due to variations in miles surveyed, snow depths, and timing. During the last 5 years numbers of fisher tracks observed on the more standardized counts initiated increased >50% .

Track counts in the 18 counties comprising the primary fisher range also showed definite increases in the population and distribution of fishers since 1977 (Fig. 9, Table 13). Mean

Table 12. *Fisher track counts on the Monico and Enterprise Study Areas.*

	Monico Study Area		Enterprise Study Area		Both Areas	
Winter	Miles Surveyed	Tracks per 100 miles	Miles Surveyed	Tracks per 100 miles	Miles Surveyed	Tracks per 100 miles
1976-77	119.6	3.3	68.2	7.3	187.8	4.8
1977-78	62.9	1.6	76.2	1.3	139.1	1.4
1978-79	66.9	4.5	77.9	7.7	144.8	6.2
1979-80	82.0	34.1	89.4	20.1	171.4	26.8
1980-81	45.6	15.4	62.7	9.6	108.3	12.0
1981-82	158.8	29.0	–	–	158.8	29.0
1982-83	179.7	20.6	47.2	21.2	226.9	20.7
1983-84	85.2	22.3	55.8	34.1	141.0	27.0
1984-85	85.2	24.6	64.2	46.7	149.4	34.1
1985-86	–	–	–	–	–	–
1986-87	63.9	28.2	64.2	35.8	128.1	32.0
1987-88	63.9	23.5	64.2	37.4	128.1	30.4
1988-89	63.9	39.1	64.2	45.2	128.1	42.2
1989-90	63.9	32.9	64.2	40.5	128.1	36.7
1990-91	63.9	42.3	64.2	57.6	128.1	50.0

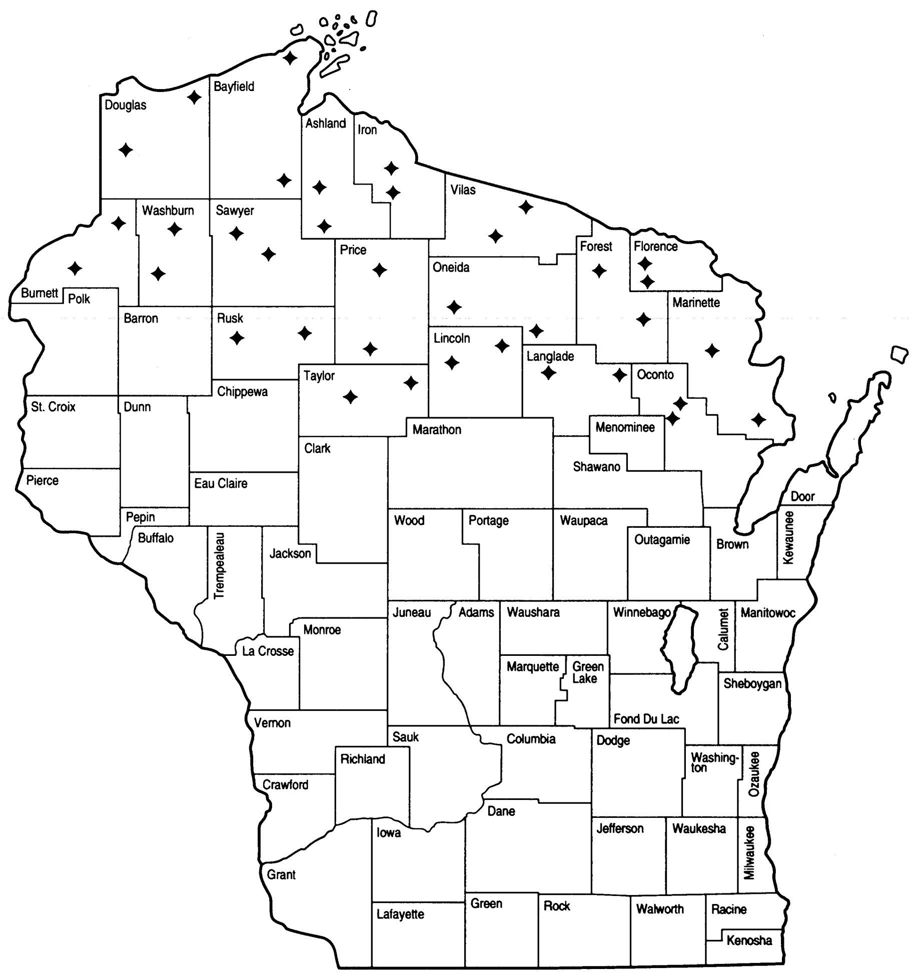


Figure 9. *Location of Northern Forest track count transects.*

numbers of fisher tracks observed increased from 0.93/route in 1977-78 to 3.10 in 1990-91, and the percentage of transects with fisher tracks present increased from 23% to 72%. Annual results of these surveys were influenced somewhat by the number and location of transects surveyed and the time of winter they were surveyed, but the upward trend in the fisher population was still obvious.

Responses to the Mammal Observation Questionnaire also indicated increasing fisher numbers (Table 14). Numbers of fishers seen/observer increased steadily from 0.11 in 1980 to 0.34 in 1988. In 1989, the number dropped to 0.24, but still exceeded the observation rates prior to 1986.

Population Structure and Reproductive Rates

Carcasses were obtained from 919 fishers harvested from 1985-89. The sex ratio of these animals (49 males:50 females) was not significantly different from 50:50 (Table 15). Strickland et al. (1982*b*) reported that generally there was a preponderance of females in fisher harvests due to trapper selection for the more valuable fur of females. Douglas (1953) thought that where quotas are strictly enforced, some trappers may register only females and discard males because of their less valuable fur. The short season length (11 days) during this study probably reduced the opportunity for most trappers to select for females or discard males.

Ages of fishers harvested from 1985-89 were combined because annual samples were small and trapping zones changed. Mean ages for males (1.9 years) and females (2.0 years) were almost identical. Fifteen fishers (6 male, 9 females) were >7 years old, the oldest being 10 years. Powell (1982) believed that wild fishers live a maximum of about 10 years. Mean annual mortality rates calculated from life-table analyses were 47% for males and 45% for females. Calculated mortality rates were overestimates because the population was increasing rather than stable as required for life-table analyses.

Kits comprised 48% of the fishers harvested, yearlings 23%, and adults 29%. Coulter (1966) reported that 36% of the fishers harvested in Maine were kits, with a higher proportion of kits in areas where the population was increasing rapidly. The percentage of kits in the harvest has ranged from 60% to 70% in Minnesota (Berg and Kuehn 1989), and Strickland et al. (1982*b*) found that kits consistently comprised 70-80% of the fishers harvested in Ontario.

The ratio of kits to adult females (>30 months old) in the harvest during 1985-89 was 3.2:1. Strickland and Douglas (1980) thought that a kit:adult female ratio <4.0:1 indicated overharvest. We agree this might be true in areas which have had a history of rather liberal trapping seasons, but it is not the case in Wisconsin. Our fisher trapping seasons have been extremely conservative, and other indices indicate that the fisher population is increasing rapidly.

We counted corpora lutea in ovaries of 262 fishers harvested during 1985-89. Detected pregnancy rates for yearlings (59%, N = 135) and adults (81%, N = 127) in this sample were lower than reported elsewhere. Also, mean

Table 13. *Track counts conducted by the Bureau of Wildlife Management in Wisconsin, 1977-89.*

Winter	No. Routes Surveyed	No. Tracks Observed	Mean No. (SE) Tracks/Route	No. (%) Routes With Tracks
1977-78	30	28	0.93 (0.51)	7 (23)
1978-79	32	19	0.59 (0.30)	5 (16)
1979-80	35	41	1.17 (0.36)	13 (37)
1980-81	34	46	1.35 (0.56)	12 (35)
1981-82	23	26	1.13 0.37)	10 (48)
1982-83	25	36	1.44 (0.44)	10 (40)
1983-84	20	26	1.30 (0.61)	6 (30)
1984-85	33	70	2.12 (0.91)	13 (39)
1985-86	21	35	1.67 (0.41)	13 (62)
1986-87	na*	na	1.77	na
1987-88	31	na	1.81	16 (52)
1988-89	26	na	1.96	18 (69)
1989-90	36	90	2.50 (0.46)	26 (72)
1990-91	31	96	3.10 (0.70)	22 (71)

* na = original data not available.

Table 14. *Fishers seen and reported on Mammal Observation Questionnaires, 1980-89.*

Year	No. Observers	No. Fishers Seen	No. Fishers Seen per Observer
1980	334	35	0.11
1981	308	30	0.10
1982	328	41	0.13
1983	276	49	0.18
1984	243	49	0.20
1985	na*	na	0.20
1986	na	na	0.28
1987	233	75	0.32
1988	232	78	0.34
1989	172	42	0.24

* na = original data not available.

Table 15. *Age classes of fishers harvested in Wisconsin, 1985-89.*

	No. (%) in Age Class		
Age Class	Males	Females	Both Sexes
Kit	238 (53)	200 (43)	438 (48)
1	82 (18)	129 (28)	211 (23)
2	45 (10)	62 (13)	107 (12)
3	46 (10)	30 (6)	76 (8)
4	22 (5)	19 (4)	41 (4)
5	9 (2)	12 (3)	21 (2)
6	5 (1)	5 (1)	10 (1)
7+	6 (1)	9 (2)	15 (2)
Totals	453	466	919
Mean age (yr)	1.9	2.0	1.9
Mean mortality (%)	46.6	44.5	45.8

numbers of corpora lutea found per pregnant yearling (2.13, N = 79) and adult female (2.55, N = 103) were lower than expected. A review of the literature by Strickland et al. (1982*b*) showed pregnancy rates for adult females ranging from 85-100%, with a mean litter size of 2.9.

The low pregnancy rates and mean numbers of corpora lutea might have resulted from our hand-sectioning the ovaries. Strickland et al. (1982*b*) reported a mean of 2.3 corpora lutea in 21 pairs of ovaries when hand-sectioned, but a mean of 3.2 when these same ovaries were sectioned with a microtome.

Population Estimate on the Monico Study Area

During our first full trapping effort (11 August 1981 to 19 February 1982), 7 fishers were captured before 1 February and 12 were captured afterwards. Of these 12, 4 had also been captured before 1 February, providing an estimate of 21 fishers (95% CL = 6-62) on the MSA. The second full trapping effort (28 September to 17 November 1982) provided a more reliable population estimate due to the larger number of animals involved. During this effort, 16 individual fishers were captured before 1 November and 19 were captured afterwards. Of those 19, 11 had also been captured before 1 November, providing an estimate of 28 fishers (95% CL = 13-50) on the MSA, or an average density of 1 fisher/2.5 mile^2. Although statistically weak, that estimate was corroborated by the density estimate determined from the radioed fishers.

Annual home ranges of 9 (5 males, 4 females) of the 11 fishers monitored during 1982-83 fell almost entirely within the MSA. The 27 mile^2 area of the convex polygon enclosing these 9 home ranges (Fig. 6) was used to calculate a minimum density of 1 fisher/3.0 mile^2. We probably did not radio-collar all of the fishers within this area. If there were only 2 unradioed fishers within the area, the density would have been 1 fisher/2.5 mile^2, identical to the estimate calculated using capture/recapture ratios. Therefore, we were confident in our estimate of 28 fishers on the MSA at that time.

Maximum densities of fishers reported elsewhere include 1 per 1.0 mile^2 in New York (Hamilton and Cook 1955), 1 per 1.0-4.5 mile^2 in Maine (Coulter 1966), and 1 per 1.1-4.1 mile^2 in Maine (Arthur et al. 1989*a*). Coulter (1966) doubted that the high fisher density found on his study area could be sustained.

PHOTO: B. KOHN

Typical fisher habitat within the Monico Study Area.

Statewide Fisher Population in 1991

Track counts on the MSA averaged 24.5 fisher tracks/100 miles during 1981-83 (Table 16). Individual track counts varied considerably but not significantly when averaged for each winter. The exceptionally high number of fisher tracks observed on 25 February 1982 probably reflected the approach of the breeding season. During this period, fishers circle, back-track, separate, and rejoin extensively (de Vos 1952, Coulter 1966), making it difficult to distinguish tracks made by individuals. Excluding that track count, the number of fisher tracks observed/100 miles would have averaged 23.4 for the winter of 1981-82, and 21.8 for both winters. We feel the latter figure (22 tracks/100 miles) provides the better estimate of fisher track frequency in an area with a "known" density of 1 fisher/2.5 mile^2.

The frequency of fisher tracks observed by wildlife management personnel on transects scattered throughout the fisher range have approached or exceeded 22 tracks/100 miles since 1988-89. Therefore, we feel the mean density of fishers throughout the 15,000 mile^2 Northern Forest is now similar to that on the MSA during 1981-83. This provides an estimate of 1 fisher/2.5 mile^2 or a total population of 6,000 fishers in 1991.

Table 16. *Fisher track counts on the Monico Study Area during the intensive study period.*

Date	Miles Surveyed	Tracks Observed	Tracks per 100 Miles
1982-83			
15 Dec 81	26.4	5	
22 Dec 81	23.1	4	
29 Dec 81	26.4	9	
19 Jan 82	14.3	4	
3 Feb 82	24.2	6	
8 Feb 82	22.2	4	
25 Feb 82	22.2	14	
1981-82 Totals	158.8	46	29.0
1982-83			
15 Nov 82	21.3	1	
7 Dec 82	21.3	3	
20 Dec 82	21.3	7	
2 Jan 83	21.3	8	
11 Jan 83	18.3	5	
12 Jan 83	18.3	5	
15 Jan 83	19.4	2	
16 Jan 83	17.2	2	
7 Feb 83	21.3	4	
1982-83 Totals	179.7	37	20.6
Both Winters	338.5	83	24.5

We modeled Wisconsin's fisher population from 1977-91 by incorporating our harvest, age, and reproductive data into Minnesota's Fisher Population Model (Berg and Kuehn 1989). The simulation indicated the fisher population increased from about 2,650 animals in 1977 to 6,000 in 1991 (Fig. 10). This seemed reasonable because it paralleled the trend shown by track counts and produced a population estimate close to that calculated above.

In modeling the population we assumed that 200 fishers were caught accidentally each year during 1977-84, and that unregistered trapping mortality equaled the registered harvest since the season began in 1985. This assumption was based on numbers of fishers accidentally caught and turned in by trappers and general impressions of DNR personnel. Berg and Kuehn (1989) estimated that unregistered trapping mortality was 22% of the registered harvest in Minnesota. Unregistered trapping mortality will probably decline in Wisconsin with more liberal seasons, because more trappers will be able to legally register fishers they catch accidentally.

Berg and Kuehn (1989) reported that 16% of the fall fisher population can be harvested in Minnesota without decreasing the population. Therefore, we feel that Wisconsin's current population of 6,000 fishers can sustain harvests up to 900 animals annually if unregistered trapping mortality drops to the same level as in Minnesota. This would be a much higher harvest level than has been achieved to date.

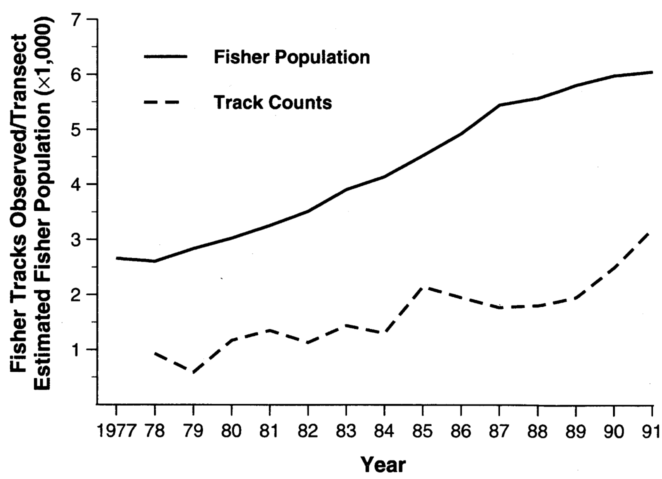


Figure 10. *Fisher population trends in Wisconsin as shown by the population model and winter track counts, 1977-91.*

MANAGEMENT IMPLICATIONS

Maintaining Fisher Management Areas

The fisher reintroduction program was successful. We now have 6,000 fishers in Wisconsin, enough to provide ample opportunities for both consumptive and nonconsumptive users. However, we recommend that the Fisher Management Areas in the Chequamegon and Nicolet National Forests, which are closed to dry-land trapping, be maintained to protect the newly reintroduced pine marten populations.

Standardization of Track Counts

Winter track counts provide valuable information regarding population trends of fishers and of snowshoe hares, their primary prey. The track counts should be continued, but their precision can be improved by running all transects each year and running them under similar conditions each year. Timing of this survey is critical due to differences in fisher mobility. Mean daily distances moved by fishers were 1.1 miles in December, 0.5 mile in January, and 1.3 miles in February.

Track counts should not be conducted immediately after the deer firearms season in late November. The tremendous amount of recent human activity and abundance of carrion reduced fisher movements during the week after deer season. And, snow depths ≥18 inches and temperatures ≤0 F reduced fisher movements. Therefore, we recommend that track counts be conducted during the last 3 weeks of December each year. Fishers are quite mobile then, snow depths are usually <18 inches, and long periods with temperatures <0 F are uncommon.

Track count data will become even more significant when we refine and validate the fisher population model. Reliable population models cannot be developed without an independent index to population trends (Johnson 1982). Data collected on snowshoe hare populations might help us interpret trends in future fisher populations.

Fisher Distribution Maps

The fisher distribution map should be updated every 10 years using procedures similar to those in this study. Wildlife personnel outside the present fisher range should be included in future documentation of range expansion. There is some evidence that fishers are becoming established in the Central Forest portion of the state (Mike Gappa, DNR, pers. comm.)

Population Modeling

The fisher population model should be updated and refined as additional data become available. Model validity will improve with a longer harvest history.

Numbers of fishers killed accidentally/illegally could not be determined, but likely equalled or exceeded the registered harvest. Many trappers reported catching fishers in traps set for other species. Some fishers were released if not injured too seriously, some were surrendered to the DNR, but many of those found dead in the trap were likely discarded or sold illegally. A longer trapping season and increased bag limit would permit a higher proportion of fishers trapped to be registered, utilized, and accounted for in the population model.

Fisher carcass collections should be continued to provide data for refining the population model. Ovaries should be sectioned with a microtome rather than by hand to improve estimates of fisher reproductive rates. If pregnancy rates and litter sizes do not vary from year to year, analysis of reproductive tracts could be discontinued. The aging of harvested fishers should be continued because the ratio of kits:adult females may indicate when future registered harvests are controlling the population.

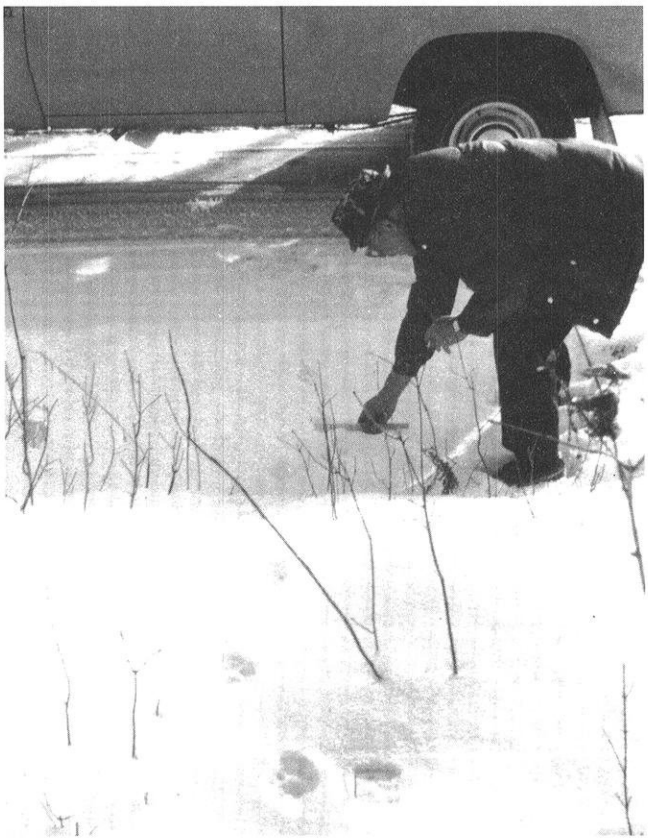


PHOTO: B. KOHN

Furbearer track counts conducted along driveable roads one day after snowfall provided an index to fisher and other furbearer population trends. In this case, the observer is measuring and recording tracks left by a bobcat crossing the road.

Future Harvest Strategies and Monitoring

Wisconsin should increase the legal harvest of fishers to a level that will minimize numbers of animals caught and wasted. Past registered harvests (38-339) have been far below the level (up to 900 annually) the fisher population can sustain.

We feel the fisher trapping season should be lengthened from 11 days to a season from November 1-December 31. And, the DNR should seek authority to increase the bag limit if needed to meet harvest goals. By monitoring the fisher population we can insure that future harvests do not endanger this resource.

Whenever possible, live-trapping fishers for research and monitoring purposes should be done during fall. Fishers are quite easy to capture then, family groups have broken up, and road access is usually good. In addition, captured animals are not exposed to extremely cold temperatures while in the trap or while being handled.

Habitat Management

Wisconsin does not manage habitat specifically for fishers. But, forest management now practiced on Federal, state, and county lands in northern Wisconsin will maintain the current high quality fisher habitat. The interspersion of habitat types in Wisconsin's managed forests provides the cover, den trees, and abundant prey necessary to maintain a healthy fisher population. We feel strongly that well-managed forests will provide better and more continuous habitat for fishers than those where timber harvesting is prohibited.

PHOTO: J. TRASKA

Wisconsin fisher.

Appendix A. Data Sheet Used For Track Counts In The Oneida County Study Areas

TRACK COUNT FORM

General Location:____________________ Date:____________________

Nights Since Snow:________ Snow Depth:________ Temperature:________

Time Start:________ End:________ Observers:____________________

Checkpoint	Mileage	Numbers of Tracks at Each Location			
		Bobcat	Coyote	Fisher	Other

Appendix B. Data Sheet Used For Northern Forest Track Counts

NORTHERN FOREST FURBEARER TRACK COUNT

County ____________ Route No. and Location ____________

Date ____________ Snow Depth ____________ Nights Since Snow ____

Observers ____________

Mileage	Enter "X" for Each Track Set						Notes	Snowshoe Hare*	
		Bobcat	Coyote	Fisher	Otter	Fox		Present	Absent
0.0-0.5									
0.5-1.0									
1.0-1.5									
1.5-2.0									
2.0-2.5									
2.5-3.0									
3.0-3.5									
3.5-4.0									
4.0-4.5									
4.5-5.0									
5.0-5.5									
5.5-6.0									
6.0-6.5									
6.5-7.0									
7.0-7.5									
7.5-8.0									
8.0-8.5									
8.5-9.0									
9.0-9.5									
9.5-10.0									

*Record hare track occurrence only for initial tenth mile of each interval.

Summarize weather conditions (approximate wind, temperature range, snow depth, etc.) existing on night(s) preceding count.

LITERATURE CITED

Allee, W. C., O. Park, A. E. Emerson, T. Park, and K. P. Schmidt
1949. Principles of animal ecology. W. P. Saunders Co., Philadelphia, Pa. 837 pp.

Allen, A. W.
1983. Habitat suitability index models: fisher. U.S. Dept. Int., Fish Wildl. Serv. FWS/OBS-82/10.45. 19 pp.

Arthur, S. M.
1988. An evaluation of techniques for capturing and radiocollaring fishers. Wildl. Soc. Bull. 16:417-21.

Arthur, S. M., W. B. Krohn, and J. R. Gilbert
1989*a*. Home range characteristics of adult fishers. J. Wildl. Manage. 53(3):674-79.

1989*b*. Habitat use and diet of fishers. J. Wildl. Manage. 53(3):680-88.

Barbour, M. G., J. H. Burk, and W. D. Pitts
1980. Terrestrial plant ecology. Benjamin/Cummings. Menlo Park, Calif. 604 pp.

Berg, W. and D. Kuehn
1989. Fisher, 1988-89. pp. 42-43 *in* Status of wildlife populations, fall 1989 and 1981-1988 hunting and trapping harvest statistics. Sect. of Wildl., Minn. Dep. Nat. Resour., St. Paul 120 pp. [unpubl. rep.].

Brander, R. B. and D. L. Books
1973. Return of the fisher. Nat. Hist. 82:52-57.

Buck, S., C. Mullis, and A. Mossman
1979. A radio telemetry study of fishers in northwestern California. Calif.-Nev. Wildl. Trans. 1979:166-72.

Burt, W. H.
1943. Territoriality and home range concepts as applied to mammals. J. Mammal. 43:346-52.

Byers, C. R., R. K. Steinhorst, and P. R. Krausman
1984. Clarification of a technique for analysis of utilization-availability data. J. Wildl. Manage. 48:1050-53.

Caughley, G.
1966. Mortality patterns in mammals. Ecology 47 (6):906-18.

Cleven, J. R. and C. M. Pils
1987. 1987 fisher tagging report. Wis. Dep. Nat. Resour. Bur. Wildl. Manage. 10 pp.

Coulter, M. W.
1960. The status and distribution of fisher in Maine. J. Mammal. 41:1-9.

1966. Ecology and management of fisher in Maine. State Univ. Coll. of For., Syracuse Univ., Ph.D. Thesis. 183 pp.

Curtis, J. T.
1971. The vegetation of Wisconsin. Univ. Wis. Press. Madison. 657 pp.

de Vos, A.
1952. The ecology and management of fisher and marten in Ontario. Tech. Bull. Ont. Dep. Lands and Forests. Wildl. Ser. 1. 90 pp.

Douglas, C. W.
1953. Fluctuations in sex ratios of fisher and marten during the 1952-53 trapping season, White River District. Ont. Dept. Lands, For., Fish, Wildl. Manage. Rep. 14. 14 pp.

Douglas, C. W. and M. A. Strickland.
1987. Fisher. pp. 510-29 *in* M. Novak, J. A. Baker, M. E. Obbard, and B. Malloch, eds. Wild furbearer management and conservation in North America. Ont. Min. Nat. Resour., Toronto.

Fruth, K. and C. M. Pils
1985. The 1985 fisher tagging report. Wis. Dep. Nat. Resour., Bur. Wildl. Manage. 9 pp.

Hamilton, G. T.
1957. Resurgence of the fisher in New Hampshire. Appalachia 23(12):485-97.

Hamilton, W. J., Jr.
1943. Mammals of the eastern United States. Comstock Publishing Co., Ithaca, N.Y. 432 pp.

Hamilton, W. J., Jr. and A. H. Cook
1955. The biology and management of the fisher in New York. N.Y. Fish and Game J. 2:13-35.

Hine, R. L., R. F. Nicotera, L. M. Christenson, C. E. Germain, J. B. Hale, H. D. Hettrick, B. Les, and L. A. Posekany
1975. Endangered animals in Wisconsin. Wis. Dep. Nat. Resour., Madison. 12 pp.

Irvine, G. W., B. J. Bradle, and L. T. Magnus
1962. The restocking of fisher in Lake States forests. Paper presented at 24th Annual Midwest Fish and Wildl. Conf., Des Moines, Iowa.

Irvine, G. W., L. T. Magnus, and B. J. Bradle
1964. The restocking of fisher in Lake States forests. Trans. 29th N. Am. Wildl. Conf. 29:307-15, Las Vegas, Nv.

Jackson, H. H. T.
1961. Mammals of Wisconsin. Univ. Wis. Press, Madison. 504 pp.

Johnson, D. H.
1982. Population modeling for furbearer management. pp 25-37 *in* G. C. Sanderson, ed. Midwest furbearer management. 43rd Midwest Fish and Wildl. Conf., Wichita, Kans. 195 pp.

Johnson, S. A.
1984. Home range, movements, and habitat use of fishers in Wisconsin. , Univ. Wis.-Stevens Point. M.S. thesis. 78 pp.

Kelly, G. M.
1977. Fisher (*Martes pennanti*) biology in the White Mountain National Forest and adjacent areas. , Univ. Mass., Amherst. Ph.D. thesis. 178 pp.

Koehln, G. T.
1980. A computer technique for analyzing radio telemetry data. Proc. Natl. Wild Turkey Symp. 4:262-71.

Kohn, B. E., W. A. Creed, and S. A. Johnson
1982. Fisher populations and harvest strategies. Wis. Dep. Nat. Resour. Perf. Rep. Pittman-Robertson Proj. W-141-R-17. 6 pp. (mimeo).

Kohn, B. E., W. A. Creed, and J. E. Ashbrenner
1989. History and status of Wisconsin's fisher population. Wis. Dep. Nat. Resour. Res. Findings 23. 4 pp.

Kuehn, D. W. and W. E. Berg
1981. Use of radiographs to identify age-classes of fisher. J. Wildl. Manage. 45(4):1009-10.

Leonard, R. D.
1980. The winter activity and movements, winter diet, and breeding biology of the fisher (*Martes pennanti*) in southeastern Manitoba. Univ. Manitoba, Winnipeg. M.S. thesis. 180 pp.

Marcum, C. L. and D. Loftsgaarden
1980. A nonparametric technique for studying use vs. availability of environmental components. J. Wildl. Manage. 44:963-68.

Matthiessen, P.
1959. Wildlife in America. Viking Press, New York, N.Y. 304 pp.

McCaffery, K. R.
1986. On deer carrying capacity in northern Wisconsin. pp 54-69 *in* Trans. 22nd Northeast Deer Tech. Comm. Vt. Fish Wildl. Dep., Waterbury. 88 pp.

McNab, B. K.
1963. Bioenergetics and the determination of home range size. Am. Nat. 97:133-40.

Mohr, C. 0.
1947. Table of equivalent populations of North American small mammals. Am. Midl. Nat. 37:223-49.

Neu, C., C. Byers, and J. Peek
1974. A technique for analysis of utilization-availability data. J. Wildl. Manage. 38:541-45.

Odum, E. P.
1971. Fundamentals of ecology. 3rd edit. W. B. Saunders Co., Philadelphia, Pa. 574 pp.

Olson, H. F.
1966. Return of a native. Wis. Conserv. Bull. 31(3):22-23.

Petersen, L. R., M. A. Martin, and C. M. Pils
1977. Status of fishers in Wisconsin, 1975. Wis. Dep. Nat. Resour. Res. Rep. 92. 14 pp.

Pietz, P. J. and J. R. Tester
1983. Habitat selection by snowshoe hares in north central Minnesota. J. Wildl. Manage. 47:686-96.

Pils, C. M., B. E. Kohn, E. Boggess, B. Berg, and J. Stuht
1983. Fisher and marten management in the Upper Midwest. pp 29-34 *in* Proc. Midwest Furbearer Workshop, Poynette, Wis.

Pils, C. M., G. A. Bartelt, and B. Dhuey
1988. 1988 fisher harvest report. Wis. Dep. Nat. Resour. Bur. Res. 10 pp.

Powell, R. A.
1977. Hunting behavior, ecological energetics and predator-prey stability of the fisher (*Martes pennanti*). , Univ. Chic., Chicago. Ph.D. thesis. 132 pp.

1978. A comparison of fisher and weasel hunting behavior. Carnivore 1:28-34.

1979. Fishers, population models, and trapping. Wildl. Soc. Bull. 7:149-54.

1982. The fisher: life history, ecology, and behavior. Univ. Minn. Press, Minneapolis. 217 pp.

Powell, R. A. and R. B. Brander
1977. Adaptations of fishers and porcupines to their predator prey system. pp 45-53 *in* R. Phillips and C. Jonkel, eds. Proc. 1975 Predator Symp. Univ. Mont., Missoula. 268 pp.

Powell, R. A. and R. D. Leonard
1983. Sexual dimorphism and energy expenditure for reproduction in female fisher (*Martes pennanti*). Oikos 40:166-74.

Raine, R. M.
1982. Ranges of juvenile fisher (*Martes pennanti*) and marten (*Martes americana*) in southeastern Manitoba. Can. Field-Nat. 96:431-38.
1983. Winter habitat use and responses to snow cover of fisher (*Martes pennanti*) and marten (*Martes americana*) in southeastern Manitoba. Can. J. Zool. 61:25-34.

Schnabel, Z. E.
1938. Estimation of the total fish population of a lake. Amer. Math. Monthly 45:348-52.

Schoonmaker, W. J.
1938. The fisher as a foe of the porcupine in New York State. J. Mammal. 19(3):373-74.

Schorger, A. W.
1942. Extinct and endangered mammals and birds of the Upper Great Lakes Region. Trans. Wis. Acad. Sci., Arts and Letters 34:24-57.

Seton, E. T.
1929. Lives of game animals. Vol.2. Doubleday, Doran Co., New York, N.Y. 746 pp.

Southwood, T. R. E.
1966. Ecological methods. Methuen and Co., Ltd. London. 391 pp.

Steck, M.
1990. The 1990 translocation of fisher in the Upper Peninsula of Michigan. 20 pp. [unpubl. final rep.].

Strickland, M. A. and C. W. Douglas
1980. The status of fisher in North America and its management in southern Ontario. pp 1443-57 *in* J. A. Chapman and D. Pursley, eds. Worldwide Furbearer Conference Proceedings. Frostburg, Md.

Strickland, M. A., M. K. Brown, and G. R. Parsons
1982*a*. Determining the age of fisher from cementum annuli of the teeth. N. Y. Fish Game J. 29:90-94.

Strickland, M. A., C. W. Douglas, M. Novak, and N. P. Hunziger
1982*b*. Fisher. pp 586-98 *in* J. A. Chapman and G. A. Feldhamer, eds. Wild mammals of North America: biology, management, and economics. Johns Hopkins Univ. Press, Baltimore, Md. 1147 pp.

Thomas, J. W., R. G. Anderson, C. Maser, and E. L. Bull
1979*a*. Snags. pp 60-77 *in* J. W. Thomas, ed. Wildlife habitats in managed forests, the Blue Mountains of Oregon and Washington. Agric. Handb. No. 533. U.S.D.A. For. Serv.

Thomas, J. W., C. Maser, and J. E. Rodiek
1979*b*. Edges. pp 48-59 *in* J. W. Thomas, ed. Wildlife habitats in managed forests, the Blue Mountains of Oregon and Washington. Agric. Handb. No. 533. U.S.D.A. For. Serv.

Thompson, D. R.
1981. Winter track counts of furbearers and snowshoe hare, 1980-81. Wis. Dep. Nat. Resour. Survey Rep. 3 pp.

Vander Hayden, M. and C. M. Pils
1986. 1986 fisher tagging report. Wis. Dep. Nat. Resour., Bur. Wildl. Manage. 10 pp.

Wisconsin Statistical Reporting Service
1967. Wisconsin weather: causes, variations, and effects. Wis. Stat. Rep. Serv., Madison. 31 pp.

Wright, P. L. and M. W. Coulter
1967. Reproduction and growth in Maine fishers. J. Wildl. Manage. 31(1):70-86.

Approximate Metric-English Equivalents	
1 ha = 2.48 acres	1 L = 1.06 qt
1 m = 3.28 ft	1 g = 0.035 oz
1 cm = 0.39 inches	1 kg = 2.21 lb
1 km = 0.62 miles	1 metric ton = 1.10 tons
1 m^2 = 1.20 yd^2	

Acknowledgments

This was a cooperative project involving the Wisconsin Department of Natural Resources and the Univ. Wis.-Stevens Point. The authors would like to give special acknowledgment to Scott A. Johnson and Dennis R. Lamb (Univ. Wis.-Stevens Point M.S. degree candidates) who collected and analyzed the data obtained from the radio-collared fishers during 1981-82 and 1982-83, respectively.

Consolidated Papers, Inc. allowed us access to their land (which comprised most of the Monico Study Area) and cover type maps for these properties, and plowed the roads making winter work possible. The U.S. Forest Service, Wisconsin Trappers Association, Minnesota Bear Guide Association, and Max McGraw Wildlife Foundation provided partial financial support for the work done on the Monico Study Area.

DNR Wildlife Management personnel conducted most of the Northern Forest track counts and aided in the collection of fisher carcasses. DNR Bureau of Research staff members Robert Dumke (Bureau Director) and Eugene Lange (Chief, Technical Services) gave the support, guidance, and advice needed to complete this study.

Bernard Bradle (retired DNR wildlife manager very actively involved in the fisher releases on the Nicolet National Forest) provided us with much of the historical perspective for this report.

Midge Strickland (Ontario Ministry of Natural Resources) and David Kuehn and William Berg (Minnesota Department of Natural Resources) critically reviewed the manuscript and provided many valuable suggestions.

This research was funded in part by the Federal Aid in Wildlife Restoration Act under Pittman-Robertson Project W-141-R.

About the Authors

Bruce E. Kohn is a biologist with the Northern Wildlife Research Group, Bureau of Research, Wisconsin Department of Natural Resources. His mailing address is Department of Natural Resources, P.O. Box 576, Rhinelander, WI 54501.

Dr. Neil F. Payne is a professor of wildlife with the College of Natural Resources, University of Wisconsin-Stevens Point. His mailing address is College of Natural Resources Building, University of Wisconsin-Stevens Point, Stevens Point, WI 54481.

James E. Ashbrenner is a research technician with the Northern Wildlife Research Group, Bureau of Research, Wisconsin Department of Natural Resources. His mailing address is Department of Natural Resources, P.O. Box 576, Rhinelander, WI 54501.

William A. Creed (now retired) was Group Leader of the Northern Wildlife Research Group, Bureau of Research, Wisconsin Department of Natural Resources. His mailing address is Department of Natural Resources, P.O. Box 576, Rhinelander, WI 54501.

Production Credits

Betty Les, Managing Editor

Kent Klepinger, Technical Editor

Michelle Jesko, Figure Preparation/Layout/Production

Central Office Word Processing

TECHNICAL BULLETINS (1985-1993)

No. 156 Aquatic community interactions of submerged macrophytes. (1985) Sandy Engel

No. 157 An evaluation of beach nourishment on the Lake Superior shore. (1985) John W. Mason, Melvin H. Albers, and Edmund M. Brick

No. 158 Distribution and movement of Canada geese in response to management changes in east central Wisconsin, 1975-1981. (1986) Scott R. Craven, Gerald A. Bartelt, Donald H. Rusch, and Robert E. Trost

No. 159 Distribution and relative abundance of fishes in Wisconsin. VII. St. Croix River basin. (1986) Don Fago

No. 160 Population dynamics of stocked adult muskellunge (*Esox masquinongy*) in Lac Court Oreilles, Wisconsin, 1961-1977. (1986) John Lyons and Terry Margenau

No. 161 Fish species assemblages in southwestern Wisconsin streams with implications for smallmouth bass management. (1988) John Lyons, Anne M. Forbes, and Michael D. Staggs

No. 162 A compendium of 45 trout stream habitat development evaluations in Wisconsin during 1953-1985. (1988) Robert L. Hunt

No. 163 Mercury levels in walleyes from Wisconsin lakes of different water and sediment chemistry characteristics. (1989) Richard C. Lathrop, Katherine C. Noonan, Paula M. Guenther, Therese L. Brasino, and Paul W. Rasmussen

No. 164 Water quality and restoration of the lower Oconto River, Oconto County, Wisconsin. (1989) Richard A. Rost

No. 165 Population dynamics of smallmouth bass (*Micropterus dolomieui*) in the Galena (Fever) River and one of its tributaries. (1989) Anne M. Forbes

No. 166 Bibliography of fishery investigations on large salmonid river systems with special emphasis on the Bois Brule River, Douglas County, Wisconsin. (1989) Robert B. DuBois

No. 167 Wisconsin recreation survey-1986. (1989) Linda J. Penaloza

No. 168 A postglacial vegetational history of Sauk County and Caledonia Township, Columbia County, South Central Wisconsin. (1990) Kenneth I. Lange

No. 169 A review of fisheries habitat improvement projects in warmwater streams, with recommendations for Wisconsin. (1990) John Lyons and Cheryl Courtney

No. 170 Ecosystem responses to growth and control of submerged macrophytes: a literature review. (1990) Sandy Engel

No. 171 The sport fishery for, and selected population characteristics of, smallmouth bass in Pallette Lake, Wisconsin, 1956-1984. (1990) Michael H. Hoff and Steven L. Serns

No. 172 Restoration of canvasback migrational staging habitat in Wisconsin: a research plan with implications for shallow lake management. (1991) Rich Kahl

No. 173 Evaluation of a catch and release fishery for brown trout regulated by an unprotected slot length. (1991) Robert L. Hunt

No. 174 Boating pressure on Wisconsin's lakes and rivers: results of the 1989-1990 Wisconsin recreational boating study, phase 1. (1991) Linda J. Penaloza

No. 175 Distribution and relative abundance of fishes in Wisconsin. VIII. Summary report. (1992) Don Fago

No. 176 Electric fencing for duck and pheasant production in Wisconsin. (1992) Ronald C. Gatti, James O. Evrard, and William J. Vander Zouwen

No. 177 Population biology and management of the walleye in western Lake Superior. (1992) Stephen T. Schram, Terry L. Margenau, and William H. Blust

No. 178 A survey of the aquatic insects of the Lower Wisconsin River, 1985-1986, with notes on distribution and habitat. (1992) Richard A. Lillie and William L. Hilsenhoff

No. 179 Evaluation of trout habitat improvement structures in three high-gradient streams in Wisconsin. (1992) Robert L. Hunt

No. 180 Boater attitudes and experiences: results of the 1989-1990 Wisconsin recreational boating study, phase 2. (1992) Linda J. Penaloza

No. 181 The fishery of the Yahara lakes. (1992) Richard C. Lathrop, Susan B. Nehls, Clifford L. Brynildson, and Karen R. Plass

No. 182 Aquatic macrophyte ecology in the Upper Winnebago Pool Lakes, Wisconsin. (1993) Rich Kahl

No. 183 The fisher in Wisconsin. (1993) Bruce E. Kohn, Neil F. Payne, James E. Ashbrenner, and William A. Creed

Printed on recycled paper.

Copies of the above publications and a complete list of all technical bulletins in the series are available from the Bureau of Research, Department of Natural Resources, Box 7921, Madison, WI 53707.

PUBL-RS-183-93

Department of Natural Resources
RS/4
Box 7921
Madison, WI 53707

DO NOT FORWARD
ADDRESS CORRECTION REQUESTED
RETURN POSTAGE GUARANTEED

BULK RATE
U.S. POSTAGE
PAID
MADISON, WI
PERMIT 906