STATUS AND MANAGEMENT OF FISHER (*MARTES PENNANTI*) IN PENNSYLVANIA 2008-2017

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December 2008

EXECUTIVE SUMMARY

The fisher (*Martes pennanti*) is a mid-sized terrestrial and arboreal carnivore and is the second largest mustelid currently found in Pennsylvania's forest ecosystems. Historic accounts suggest that, prior to colonial development, fisher were once found throughout forested regions in Pennsylvania. Subsequent wide-scale deforestation and dramatic alterations in forest structure and prey resources resulted in fisher population declines. Due to limited accounts of fisher during the last century, it is difficult to estimate the exact timing or progression of fisher extirpation in PA, but the last confirmed report, prior to the recent population recovery, was in Mifflin Co. in 1923.

Fisher populations are currently established and are expanding throughout much of southwestern, central, and northern Pennsylvania. This "present day" fisher population is the direct result of a large-scale reintroduction program within Pennsylvania and natural expansion from reintroduced populations in West Virginia and New York. The conservation and management of Pennsylvania's fisher population is of interest to hunters, trappers, and non-consumptive users alike. The development of a comprehensive fisher conservation and management plan is necessitated and prioritized by growing public interest and concerns about fisher population expansion in Pennsylvania. The foundation of Pennsylvania's fisher management approach lies in this plan's mission statement:

"*Promote stability and continued expansion of fisher populations within suitable habitats throughout the Commonwealth and minimize human conflicts and impacts on other wildlife populations"*.

The fisher management plan provides a comprehensive and current summary of fisher biology, historic and current status in Pennsylvania, population recovery, economic significance, public interest, and regional population and harvest management approaches. The plan also provides supporting objectives and strategies to achieve five species-specific goals related to population monitoring, habitat assessment, population enhancement, and development and implementation of a harvest management program. To assist with implementation planning, an appendix is included which provides target dates for specific project objectives. Successful implementation of this plan will require further acquisition and reallocation of resources within the agency and from outside sources. The feasibility of implementing a fisher harvest season is addressed using a conceptual fisher management model and a wildlife management unit-based decision matrix. The decision matrix is designed to provide guidance for harvest management decisions such as the timing, areas, and methodologies associated with a fisher harvest season.

SECTION I. MANAGEMENT GOALS, OBJECTIVES AND STRATEGIES

MISSION STATEMENT: Promote stability and continued expansion of fisher populations within suitable habitats throughout the Commonwealth and minimize human conflicts and impacts on other wildlife populations.

This mission statement requires continued work and new initiatives in the following species project areas: population monitoring, habitat assessment, population enhancement, and harvest management. These areas are directly addressed by the following goals and supporting objectives described below:

GOAL 1. Maintain viable fisher populations within the established distribution in Pennsylvania.

Objective 1.1: Annually determine status, spatial distribution, population trends, and relative abundance of fisher populations throughout the Commonwealth

Strategies

1.1.1. Annually assess spatial distribution, relative abundance, and population trends.
1.1.2. Estimate relative densities and minimum population size within the established statewide fisher distribution by 2009.

Objective 1.2: Annually assess genetic and demographic characteristics within established fisher populations.

Strategies

1.2.1. Annually assess fisher population demographics (sex ratios, age distribution, and reproductive parameters).
1.2.2. Assess genetic relatedness or uniqueness relative to potential source populations and potential management concerns by 2009.
1.2.3. Identify potential subpopulations within Pennsylvania's current statewide fisher distribution by 2009.

Objective 1.3: Develop numeric model(s) of population growth for fisher populations in Pennsylvania by 2009.

Strategies

1.3.1. Estimate age-specific fecundity and mortality rates.

1.3.2. Develop models to estimate long-term population trends within identified fisher subpopulations.

GOAL 2. DESCRIBE AND QUANTIFY COARSE-SCALE FISHER HABITAT SELECTION AND AVAILABILITY WITHIN PENNSYLVANIA.

Objective 2.1: Assess multi-scale habitat selection and limiting habitat features for fisher in Pennsylvania by 2009.

Strategies

2.1.1. Assess coarse-scale forest composition, type, structure, and pattern in areas of varying fisher density.
2.1.2. Quantify seasonal microhabitat site selection (resting sites and den sites) and use of standing dead and downed woody debris by fisher within the established distribution.
2.1.3. Evaluate recent fisher population expansion relative to landscape features and potential barriers to further fisher dispersal.

Objective 2.2: Estimate the abundance and spatial distribution of suitable fisher habitat relative to established fisher populations by 2009.

Strategies

2.2.1. Develop a statewide coarse-scale map of suitable habitat based on previous habitat selection studies.
2.2.2. Evaluate and rank wildlife management units using area composition and spatial distribution of suitability rankings.
2.2.3. Identify areas of suitable habitat that do not currently support fisher populations.

GOAL 3. PROMOTE NUMERIC AND SPATIAL EXPANSION OF FISHER POPULATIONS WITH HABITAT IMPROVEMENT AND CONTINUED POPULATION ENHANCEMENT.

Objective 3.1: Develop timber management recommendations to improve fisher habitat in managed second-growth forest types by 2009.

Strategies

3.1.1. Develop habitat recommendations for land managers, foresters, and private resource managers addressing the maintenance, removal, and creation of coarse woody debris and standing dead timber during silvicultural treatments and timing of timber harvest, salvage operations, firewood permitting, and snag removal operations relative to fisher habitat suitability and estimated parturition dates.

3.1.2. Identify and prioritize critical linkages among established populations relative to land ownership and potential fisher habitat improvement by 2009.

Objective 3.2: Evaluate the need for further fisher translocation and, where determined, translocate fisher from existing Pennsylvania populations into vacant suitable habitats to promote continued population expansion.

Strategies

3.2.1. Evaluate and prioritize potential population enhancement areas, as identified in 2.2.3, based on landscape patterns, wildlife management unit rankings, and distribution of other affected wildlife resources.
3.2.2. Develop protocols and guidelines for the translocation of live-trapped fisher into predetermined population enhancement areas.
3.2.3. Utilize incidental captures and active trap-and-transfer efforts to enhance fisher populations in specified WMUs.

GOAL 4. DEVELOP GUIDELINES AND PROTOCOLS FOR ASSESSMENT OF HARVEST FEASIBILITY AND IMPLEMENTATION OF A HARVEST MANAGEMENT PROGRAM.

Objective 4.1: Categorize WMUs according to the following fisher population objectives: reduction, stabilization, or expansion by 2009.

Strategies

4.1.1. Quantify relative amounts of predicted suitable habitat available and occupied by established fisher populations within each WMU.
4.1.2. Monitor annual numbers and distribution of fisher-related complaints and human- or wildlife-related conflicts within each WMU.
4.1.3. Evaluate and compare measures of relative abundance within and surrounding each WMU.

Objective 4.2: Evaluate and quantify impacts of varying harvest management strategies by 2009.

Strategies

4.2.1. Review and summarize harvest management strategies as employed throughout the Northeastern U.S. and Canada.
4.2.2. Conduct WMU-based harvest feasibility assessment based on suitable habitat, predicted fisher density, and sustainable carrying capacity.
4.2.3. Develop stochastic simulation models to evaluate sex- and age-specific harvest levels required to achieve WMU specific population objectives (4.1).

Objective 4.3: Develop management recommendations to achieve WMU-based population objectives and implement harvest management program by 2009.

Strategies

4.3.1. Provide annual WMU-based harvest recommendations including seasons, bag limits, and trapper participation.
4.3.2. Establish a reliable and enforceable fisher harvest reporting and pelt tagging system.
4.3.3. Develop protocols and support structure for tissue collection from harvested fisher.
4.3.4. Estimate and evaluate impacts of annual fisher harvest relative to WMU-based population objectives.

GOAL 5. INCREASE PUBLIC AWARENESS OF FISHER POPULATION STATUS, DISTRIBUTION, AND TRENDS THROUGHOUT THE COMMONWEALTH.

Objective 5.1: Increase public awareness of fisher life history, population origins and trends, and conservation significance in Pennsylvania beginning in 2008.

Strategies

5.1.1. Develop a PowerPoint presentation describing fisher life history, conservation significance, and management in Pennsylvania and distribute throughout PGC regions.
5.1.2. Develop and distribute a brochure describing the role of harvest management in maintaining a balance among forest carnivores and prey resources.

ACKNOWLEDGEMENTS

The development of the fisher management plan was largely necessitated and prioritized by the expansion of fisher populations throughout the Commonwealth. The successful restoration of fisher populations in Pennsylvania was greatly enhanced by the reintroduction project coordinated among the Pennsylvania State University and the PGC during 1994-98 with financial support from the Wild Resource Conservation Fund. We thank the many partners and participants in this successful effort.

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SECTION II. FISHER BIOLOGY

Taxonomy

The fisher (*Martes pennanti*) is a member of the order Carnivora, family Mustelidae. There are three subspecies of fisher recognized in North America including *M. p. pennanti* in the northeastern and northcentral areas including Pennsylvania, *M. p. columbiana* in the central and northwestern areas and *M. p. pacifica* in the far western United States (Hall 1981). Common names include black cat, fisher cat, tree otter, tree fox, fisher weasel, pekan, and Oochik (Cree), which early fur traders pronounced as "wejack" (Douglas and Strickland 1987, Williams et al. 1985). "Fisher" is the most frequently used common name and is thought to have originated due to the fisher's resemblance to a European polecat named "fichet".

Distribution

Historic accounts, fossil data, and fur harvest records suggest that fisher populations were relatively contiguous throughout forested habitats of Canada and northern regions of the U.S., extending from New England to the Pacific Northwest (Roy 1991). Although fossil evidence is lacking in some areas, fisher populations likely extended southward along all major mountain chains including the Sierras, Rockies, and Appalachians. Southernmost populations likely extended into California in the western U.S. and into North Carolina in the Eastern U.S. (Powell 1993, Figure 1).

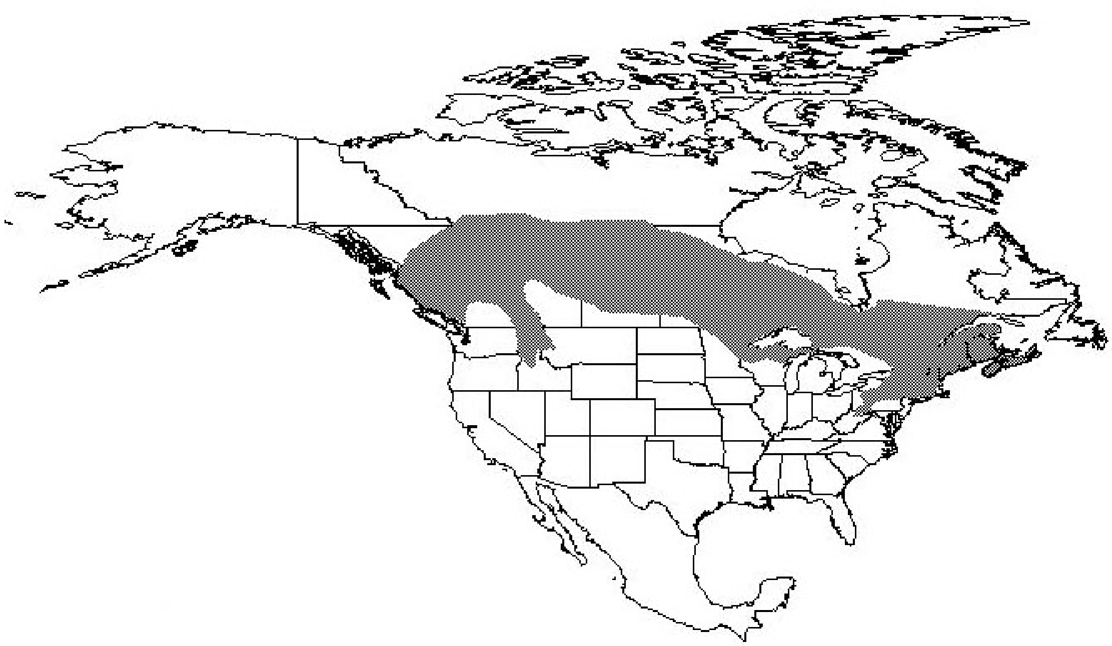


Figure 1. Current distribution of fisher throughout North America and Canada, 2008.

Fisher populations declined during the 1800s and early 1900s throughout much of their range due largely to wide-scale deforestation and resulting changes in forest structure and prey resources. In some portions of their range, unregulated harvest and predator reduction programs may have further negatively impacted fisher populations.

Fisher populations have expanded dramatically during recent decades due to forest restoration, reintroduction efforts, and effective wildlife management and harvest management programs. Successful reintroduction efforts have occurred in Idaho, Michigan, Montana, New York, Pennsylvania, Vermont, West Virginia, and Wisconsin (Irvine et al. 1964, Weckwerth and Wright 1968, Pack and Cromer 1981, Berg 1982, Brown and Parsons 1983, Roy 1991, Krohn et al. 1995). Reintroductions in the western U.S. have generally been less successful than in the east and have not resulted in significant range expansion (Aubry and Lewis 2003, Heinemeyer 1993, Roy 1991).

Morphology and Physical Description

The fisher is a mid-sized carnivore with a well-furred body and full tail. The tail comprises about one third of a fisher’s total length. Although the majority of the pelage is dark to chocolate brown, fur on the tail, legs and rump is usually black, whereas fur on the back and shoulders is grizzled with gold and silver hoary variations enhanced by the presence of tricolored guard hairs (Coulter 1966). White areas or “patches” are common in the pelage and are most frequently found in the genital areas as well as the axellae of the forelimbs (Douglas and Strickland 1987). The face is triangular with wide and rounded ears. Fisher eyes have a horizontal oval pupil that produces a bright green eyeshine, or tapedal reflection, at night (Pittaway 1978). Fishers are digitigrade with five toes on each paw and sharp, curved, and semi-retractable claws.

The fisher is the largest member of the genus *Martes* and exhibits pronounced sex-related size dimorphism with males considerably larger than females. Adult males generally weigh 3.5-5.5 kg whereas adult females range from 2.0-2.5 kg. The heaviest fisher reported was a male from Maine that weighed 9.1kg (Blanchard 1964). Males are longer than females and range from 90-120 cm; females range from 75-95 cm (Powell 1993). Fisher reach adult length within about six months but continue to gain weight for several years. Male fisher skulls range from 110-130 mm in length whereas female skulls range from 95-105 mm. Male fisher skulls are 62-84 mm wide whereas females are 52-61 mm wide (Peterson 1966). Skulls of adult male fishers have a pronounced sagital crest that usually exceeds 1 cm in height (Figure 2). The dental formula for fisher is: I 3/3, C 1/1, P 4/4, M 1/2. Fisher skulls also exhibit an exposed lateral root of the fourth upper premolar (Anderson 1970).

Fishers are lean for their body size; generally 2.4-4.6% of their body mass is comprised of extractable lipid. Body fat in fisher has been directly related to prey abundance in their diet (Leonard 1980). Males usually have greater body fat deposits on the rump and shoulders than females. Abdominal body fat is first deposited on the mesenteries and then the kidneys. Abundance of mesenteric fat as well as tissue lipid content has been used as an effective indicator of fisher condition (Rego 1984, Gilbert and Keith 2001).

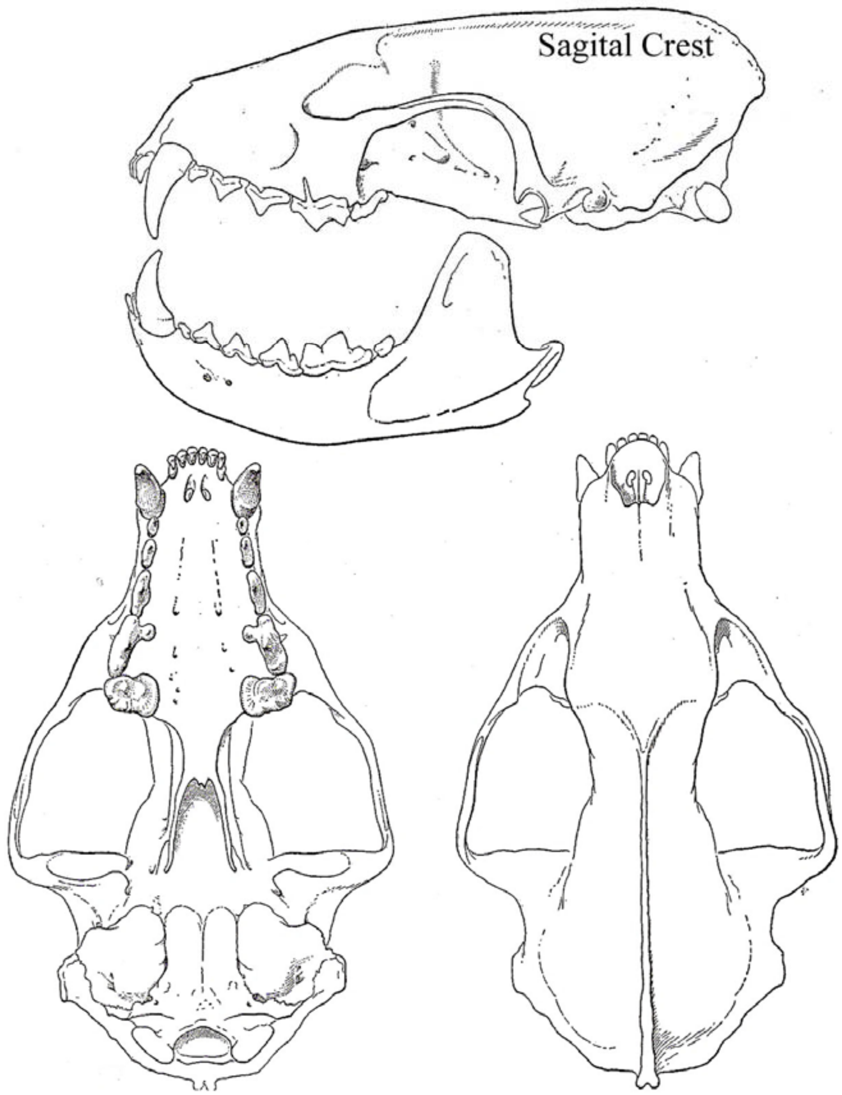


Figure 2. Fisher skulls depicting sagital crest for adult males (*adapted from Hall 1981*)

Reproduction

Fisher breeding occurs annually during March through late May. Both male and female fisher achieve sexual maturity by one year of age but limitations in size and development of the bacula may inhibit successful copulation by males (Frost et al. 1997). Fisher ovaries are completely encapsulated by bursa. The uterus has two horns and a common corpus uteri which allows migration of blastocysts among horns (Strickland et al. 1982). Male testes increase in size and weight during the breeding season. Female fishers generally breed at one year of age (Wright and Coulter 1967). Parturition has been reported from late February through May with the majority of litters produced during March and April (Powell et al. 2003).

Female fishers cycle into estrous and potentially breed 7-10 days after parturition (Strickland et al. 1982). The result of this complex reproductive adaptation is that successfully reproducing female fishers are impregnated most of the year, except for the 7-10 days post-parturition. Male fisher are polygymous and females are both polyandrous and selective during the breeding season. Fisher courtship behavior has been described as prolonged and vigourous (Hodgson 1937, Powell et al. 2003). Successful copulations have been reported to last from 20 minutes to 7 hours. (Hodgson 1937, Laberee 1941). Ovulation is thought to be primarily induced during copulation as stimulated by the size and shape of the bacula (Mead 1994); however, spontaneous ovulation has been noted among females who fail to breed during the primary reproductive period.

Implantation is delayed in female fisher. A fertilized zygote first develops into a blastocyst that then becomes inert in the uterus. During this period, the metabolic rate of the blastocyst is reduced and cell division ceases (Ewer 1973). Changes in day length during late winter induce uterine implantation and subsequently activate a gestation period of approximately 40 days (Frost et al. 1997). Observations from captive fisher suggest that individual female fisher implant at about the same time each year and subsequently produce litters and breed at consistent temporal intervals. Consequently, reported temporal variation in parturition dates most likely reflects sampling of fisher populations rather than annual temporal variation in implantation dates by individual female fisher.

Fisher litter size has been reported from one to six with an average litter size ranging from two to three neonates (Powell 1993, Frost and Krohn 1994, Frost et al. 1997, Powell et al 2003). Mean numbers of corpora lutea for fisher have ranged from 2.7 to 3.9 per pregnant female (Powell 1993). Comparison of reported estimates of implanted blastocysts, implanted embryos, placental scars and litter sizes across studies suggests that some in-utero losses or prenatal mortality occurs throughout the fisher's range (Powell 1993). Mean number of corpora lutea may vary by age with older females (e.g., 3.5-7 years) producing the largest litters (Douglas and Strickland 1987). Douglas and Strickland (1987) estimated a mean fecundity (corpora lutea per female examined) of 3.2 in Ontario. Corpora albicans (e.g., white bodies) are evident in parous females for up to nine months postpartum, but degenerate at variable rates among females and thus, depending on the timing of sample collection, may produce unreliable estimates of reproductive parameters (Douglas and Strickland 1987).

Estimates of fisher pregnancy rates vary throughout their range, due in part to difficulties in using placental scars to estimate this parameter. For example, 4 of 13 fishers that were known to have bred failed to have observable placental scars when they were harvested by trappers (Frost et al. 1999). Observations of corpora lutea suggest ovulation rates of 95% or greater (Shea et al. 1985, Douglas and Strickland 1987, Crowley et al.1990). Examination of 1,173 female Ontario fisher produced annual estimates of pregnancy ranging from 92.2%-96.8% per year (Douglas and Strickland 1987). Studies by Arthur and Krohn (1991) and Paragi (1990) reported denning rates of 65% for fisher in Maine. In California, Truex et al. (1998) reported that 50-60% of captured females showed evidence of lactation. Estimates for reproductive parameters in the southernmost populations of West Virginia, Maryland, and Pennsylvania are generally lacking.

Examination of pregnant females and captive populations suggest that the sex ratio at birth is 50:50. Fisher embryos can be sexed during late stages of development by the presence of a ridge that extends from the anus to the preputial orifice in males (Douglas and Strickland 1987).

Reproductive condition of female fishers can be derived in part from examination of soft tissue structures. Plantar glands on the hind feet of pregnant female fisher enlarge to >10 mm during January – May and reduce in size (<10 mm) during June (e.g., post-partum). Differences in nipple size between breeding and non-breeding females during August-September have been noted as well (Frost et al. 1999). Testosterone concentrations of male fishers begin to increase in December for adults and in January for juveniles. Maximum testosterone concentrations are realized in March for adults and in April for juveniles (Frost et al. 1997). Sperm production is maximized during March through May for adults and juveniles alike. Plantar glands on the hind feet of male fisher increase in size from <15 mm in December to >30mm in May. Reduction of plantar gland size is complete by June (Frost et al 1997). Adult male bacula are larger than juveniles and baculum weigh can be used to separate adults from juveniles (i.e., <1.5 grams for juveniles) (Douglas and Strickland 1987).

Development

Newborn fishers are altricial and are born completely dependent on maternal care with their eyes and ears closed (Hodgson 1937, Coulter 1966, LaBarge et al. 1990). Juvenile fishers are immobile until about three weeks postpartum (Hienemeyer 1993). Juveniles open their eyes at 6-8 weeks of age. Deciduous teeth erupt at 6 weeks and canines erupt at 7-9 weeks of development. Fisher pelage has been described as silver–gray until 3-4 weeks of age turning to the characteristic chocolate brown variation thereafter. At 10-12 weeks of age all kits are completely chocolate brown and exhibit the tricolored guard hairs characteristic of adults (Coulter 1966). Fisher “molt” in September with a new coat being completed by November (Coulter 1966).

Juvenile fishers weigh less than 50 grams at birth and reach 0.5 kg by 40-50 days postpartum. Fishers reach adult size by early autumn, which is when pronounced sex-related size dimorphism becomes apparent. Fishers rely solely on lactation until 8-10 weeks, when they begin to exhibit some predatory behaviors (Powell 1993). At four months of age, young fishers are efficient at attacking the head and neck region of small prey. Maternal female fishers spend extensive time with the kits during the first week and progressively less time thereafter (Leonard 1980). Intra-specific strife within litters has been observed by 3 months of age and juvenile fishers are generally intolerant of litter-mates by 5 months of age (Coulter 1966, Paragi 1990).

Mortality

Among forest carnivores , fishers are generally short-lived and most studies have documented a maximum lifespan of eight years within most wild populations (Weckworth and Wright 1968, Kelly 1977). The oldest documented wild fisher was 10.5 years of age (Arthur et al. 1992) and one captive fisher was documented to exceed 10 years of age (Powell et al. 2003).

Incidence of disease in fisher is relatively low although field studies have documented sarcoptic mange (Coulter 1966), Aleutian disease, leptospirosis, toxoplasmosis, trichinosis (Douglas and Strickland 1987) and rabies. Parasitism has also been reported including 14 genera of nematodes, 2 genera of cestodes, 2 genera of trematodes as well as various protozoans (Powell et al. 2003). Fisher are thought to serve as a primary transmission route for sylvatic Trichinosis in boreal environments of Canada (Douglas and Strickland 1987). Pesticides and residuals such as DDT, chlordane, dieldrin, Mirex, and PCBs have been detected in fisher tissues, but effects on reproduction, longevity, or general health condition have not been well documented (Douglas and Strickland 1987).

Due to the fishers’ size, strength, and arboreal abilities, they are rarely preyed upon by other forest carnivores, but predation has been reported by mountain lion, coyote, wolverine, golden eagle, wolves, and lynx (Krohn et al. 1994, Douglas and Strickland 1987, Roy 1991). Intraspecific strife has been noted among adult males and litter-mates and intraspecific mortality has been documented in captive populations.

Regulated trapping is a significant source of mortality within many fisher populations. Fishers are relatively easy to capture and males are generally more susceptible to harvest than are females due to increased mobility and larger home ranges. It is unknown whether human-related harvest mortality is compensatory or additive (Douglas and Strickland 1987).

Habitat Selection

In the most general sense, fisher occupy mesic, confer or mixed conifer forest with abundant physical structure (i.e., downed woody debris) on the forest floor. Lancaster et al. (2008) found that fisher abundance was positively related to the proportion of landscapes containing forest cover. Fisher are generally believed to avoid areas lacking overhead cover but degree to which fisher will tolerate varying levels of forest fragmentation has not been well studied. Significant structure on or near the forest floor is most important during winter periods as it may provide subnivian spaces in which to forage and rest (Buskirk and Ruggerio 1994).

Although late successional forest appears to be a significant requirement in some western populations, this does not seem to be the case in the eastern U.S., where fisher occupy deciduous forest stands at varying successional stages. Varying silvicultural practices, combined with extensive gypsy moth-related or other pathogen-caused forest mortality, may provide adequate structure on or near the forest floor to support eastern fisher populations.

Most studies of habitat selection have been conducted to evaluate stand use and microsite selection. These studies have generally concluded that fisher prefer mid–to-late succession conifer stands, but will inhabit partial or entirely deciduous stands as well (Powell et al. 2003). Powell (1994b) found that fisher selected pine and lowland conifer habitats, particularly for resting sites. In these studies, fisher exhibited greater selection for resting sites than foraging areas. Conversely, Weir and Harestad (1997) found no apparent landscape-level trends in habitat selection. Seasonal patterns of habitat selection are not well documented but selection is thought to be less apparent during summer than during winter (Kelly 1977). Fisher avoid habitats associated with deep soft snow during winter because of their relatively heavy foot loadings (Krohn et al. 1995). In general, fisher select the most structurally complex forest stands available, particularly at or near the forest floor.

There have been several studies that addressed natal den site selection for both American marten (*Martes americana*) and fisher. Most sites have been documented in cavities of very large logs, snags, or live trees (Ruggerio et al. 1998). Nearly all natal-dens have been located very high in hollow trees. Leonard (1980) suggested that females select for cavities high in the canopy, as protection from ground predators, with relatively small openings that provide protection from larger aggressive male fisher. Female fishers alternate from one to three hollow trees while raising each litter (Powell 1997). Nesting areas within these trees are typically flat and barren of any type of nesting material. Very little evidence of nesting is apparent after juvenile fishers leave the nest site. In northern studies, more than half of the fisher natal den sites observed have been located in aspen (*Populus spp*.) trees (Powell et al. 2003). No studies of den site selection have been conducted in southern populations in the eastern U.S.; further research is needed in this area.

Allen (1983) developed a hypothetical fisher habitat suitability index model for annual habitat evaluation. This model described optimal forest conditions as stands comprised of large diameter trees (e.g., >15inches dbh), 80% canopy closure, multiple canopy structures, and less than 50% deciduous species composition. The model further specified that stands with 50-90% conifer composition would provide optimal conditions during winter periods. Subsequent studies and trends in fisher population expansion in deciduous forests of the eastern U.S. suggest that the conifer components described in Allen's model (1983) may not be limiting factors for fisher survival and reproductive success. Similarly, Thomasma et al. (1991) suggested that Allen's model placed unjustifiably high values on conifier stands.

Foraging and Prey Selection

Fishers are active throughout the year, maintain a relatively high metabolic rate, and store very little energy as fat reserves. These elements combine to elevate selective pressures towards foraging efficiency, particularly during winter periods (Powell et al. 2003, Davidson et al. 1978, Buskirk et al 1988). Fishers effectively forage within the forest canopy but most predation occurs on the forest floor (Powell 1980, Raine 1981). Fishers rarely forage under snow cover due to their relatively large body size (Raine 1983). Fishers utilize two characteristic foraging strategies: area-restricted and directional. Area-restricted foraging involves a "zig-zag" approach to foraging designed to surprise prey occupying temporary refugia and has been described among other mustelid species. Directional foraging involves concentration of effort in high prey areas (e.g., areas of high hare density). Fishers have also been shown to minimize the amount of time spent foraging in forest openings (Buskirk and Powell 1994). Fishers generally capture their prey rapidly and rarely pursue prey for long distances (Raine 1981).

Fishers are primarily crepuscular in their activities but seasonal variations have been documented (Arthur and Krohn 1991). Fishers are active approximately 30% of each day during winter. Daily activity increases during reproductive periods, particularly for males. Daily activity for females is lowest during pregnancy and increases as juveniles develop and disperse from natal home ranges (Leonard 1980). Weir and Corbould (2007) found that diurnal activity increased for males and females with ambient temperature, diurnal activity increased for males during the breeding season, and diurnal activity decreased for females during breeding periods.

Fishers are omnivorous and capable of exploiting diverse prey resources as determined by local abundance and availability of preferred prey. In general, they rely primarily on rodents, lagomorphs, insects, and various sources of carrion. As with many forest predators, diet is most diverse during summer and more restricted during winter. Fisher diet in the temperate eastern U.S. is believed to be more diverse and variable that in northern or western populations (Zielinski et al. 1999).

Where fisher diet studies have been conducted, snowshoe hare and porcupines have been the primary prey species identified (Powell 1993, Martin 1994). In locales where hares and porcupines are either not abundant or unavailable, fisher diet has been observed to be much more diverse including small mammals, reptiles, insects, fruits, and fungi (Zielinski et al. 1999). Fishers consume fruits of shrubs and trees, primarily during summer (Stevens 1968), and serve as mammalian seed dispersers in forest ecosystems (Powell et al. 2003). Although various small mammal species have been identified in fisher diet studies, voles are rarely identified as a dominant prey item. Fisher diet seems to be consistent with optimal diet choices (Powell 1993). There is evidence of fisher predation on white-tailed deer (*Odocoileus virginianus*), but the frequency and effects of such predation are thought to be limited. Most predation on deer is believed to be directed towards juveniles during their first month of age is by large adult male fisher. Because of their larger body size, male fisher may have a greater availability of varying size prey than females, but studies have not documented any significant sex-related variation in diet or other sex-related resource partitioning.

Density and Spatial Organization

Initial estimates of fisher density came from historic studies that utilized snow tracking methodologies (Hamilton and Cook 1955, Coulter 1966). These studies produced estimates as high as one fisher per 2.56 km^2. More recent studies utilizing recapture models and radio-telemetry have consistently produced lower estimates (Table 1, Powell et al. 2003). Estimates of fisher density vary by region, season, and habitat suitability, but have ranged from 0.08 to 0.31 fisher per km^2.

Table 1. Fisher density estimates throughout the U.S. and Canada (Powell et al. 2003)

Location	Fisher/km^2	Method	Source
Ontario	0.15	Harvest	Douglas and Strickland 1987
New Hampshire	0.11	Livetrapping	Kelly 1977
New Hampshire	0.13-0.26	Livetrapping	Kelly 1977
Maine (Summer)	0.09-0.34	Livetrapping	Arthur et al. 1989
Maine (Winter)	0.05-0.12	Livetrapping	Arthur et al. 1989
Maine	0.09-0.38	Livetrapping	Coulter 1966
Michigan Upper Penninsula	0.08	Trapper Survey	Peterson et al. 1977
Michigan Upper Penninsula	0.08	Livetrapping	Powell 1977
California	0.31	Livetrapping	Buck et al. 1983
British Columbia	0.008-0.011	Livetrapping	Weir and Corbould 2006
Massachusettes	0.21-0.25	Mark-Resight	Fuller et al. 2001

Most studies have consistently reported extensive intrasexual territoriality within fisher populations (Powell 1994a). Thus, average fisher home range size is generally inversely correlated with population density. Powell (1994a) estimated mean home range size of 38 km^2 for male fisher and 15 km^2 for females, based on six independent studies. Estimates from individual studies ranged from 19 km^2 to 79 km^2 for males and 15 km^2 to 32 km^2 for females. Fuller et al. (2001) reported an average annual home range size of 10km^2 for male fishers and 7.6km^2 for females in Massachusetts.

Home range size varies bimodally by season with the smallest ranges occupied in mid-winter, expanding during reproductive periods (e.g., April, May, and June) and then reduced until early winter when they expand again (Kelly 1977).

Variations in spatial patterns and degree of intrasexual overlap have been documented (Powell 1994a). The degree of intrasexual home range overlap may be directly related to the spatial distribution and availability of limiting resources (Powell et al. 2003). Preliminary estimates of home range use from Pennsylvania suggest that fishers use areas smaller than reported in other studies and with significant intrasexual and intersexual overlap (Figure 3). Similary, Koen et al. (2007) reported that home ranges within recolonized fisher populations in Ontario were consistently smaller than those reported in the literature and observed up to 71% overlap of adjacent intrasexual home ranges.

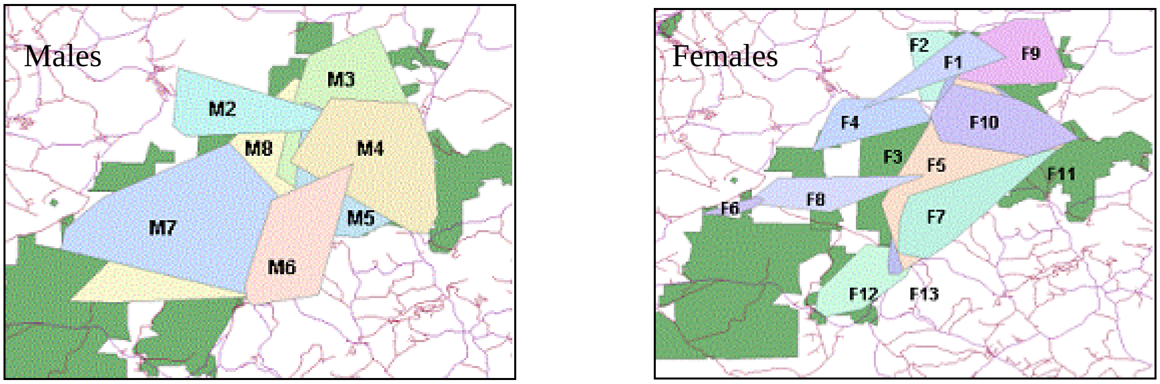


Figure 3. Preliminary home ranges of eight male and 13 female fisher in Cambria Co. PA. from July – March 2007. (Note: Shaded area is SGL 26, Blue Knob S.P., and Gallitzin S.F., Larkin 2007)

Scent-marking via anal gland secretions is believed to play a significant role in territory maintenance but physiological and behavioral accounts are generally lacking. Pittaway (1984) observed a fisher dragging its belly and hindquarters on stumps and mounds of snow as well as depositing urine and anal secretions. This behavior was believed to be related to territory maintenance.

Population Dynamics

Fisher population fluctuations are directly related to changes in local prey populations. Where fishers rely heavily on snowshoe hare as a primary prey resource, they may exhibit a 10-year cyclic response with a three-year lag as hare populations fluctuate (Bulmer 1974). Fisher in the eastern United States are generally not thought to be cyclic and are not prey regulated in the presence of cyclic prey resources (Leonard 1980). Age structure of fisher populations varies with fluctuations in population density and rarely stabilizes (Bulmer 1975). Older cohorts are predominant when prey resources decline or are limiting (Douglas and Strickland and 1987). Conversely, juveniles dominate the age structure during periods of population increases or high prey abundance (Thompson and Colgan 1987). The age structure of harvested fisher populations generally exhibits fewer of older age animals, particularly males (Douglas and Strickland 1987).

Population Genetics

An understanding of the genetics of Pennsylvania's fisher population is important for obtaining baseline knowledge regarding the genetic character of populations that may serve as potential sources of individuals for natural recolonization of suitable habitat currently devoid of fishers in Appalachia.

Several recent studies have examined genetic variation and structure among fisher populations (Kyle et al. 2001, Vinkey et al. 2006, Wisely et al. 2004, Drew et al. 2003, Williams et al. 2000). While no genetic work has been published for Pennsylvania fisher, results from other studies provide some generalizations regarding the species' genetic status. For example, in contrast to other closely related mustelid species (i.e., wolverine and American marten), fisher demonstrated relatively high levels of genetic structure across the northern portion of its range (Kyle et al. 2001). Despite a significant historical population decline of fisher in New York, the level of genetic variation in the state's remnant fisher population has not been severely impacted (i.e., heterozygosity = 0.62, Kyle et al. 2001).

The fisher is one of the most commonly translocated mammals in North America (Williams et al. 2000, Drew et al. 2003). A study of a reintroduced fisher population in Montana revealed that the species had never actually been extirpated from the state (Vinkey et al. 2006). Rather, researchers detected unique haplotypes not found in individuals from the source population. It was concluded that individuals found in west-central Montana are partially the descendants of a relic population. Williams et al. (2000) used an analysis of allozyme markers to examine potential genetic consequences of fisher translocations in the eastern United States. This research, in contrast to that of Kyle et al. (2001), found little genetic subdivision among populations. These conflicting results may be due to the use of allozyme markers by Williams et al. (2000) compared to microsatellites by Kyle et al. (2001). Microsatellites have been found to show clear genetic differentiation in other mammalian studies where allozyme markers detected little variation (Paetkau et al. 1998 as cited in Kyle et al. 2001).

Founder population size can have obvious effects on the genetic variation found within reintroduced fisher populations (Mils 2007). Drew et al. (2003) did not report reduced genetic diversity within a reintroduced fisher population in southern Oregon (n=54 founders). In contrast, Kyle et al. (2001) reported a decrease in genetic diversity within two reintroduced fisher populations in eastern Canada where 70 and 17 fishers founded the populations. Kyle et al. (2001) reported a reduction of genetic diversity in reintroduced populations compared to adjacent indigenous populations. Williams et al. (2000) detected differences in allele frequencies between New Hampshire (source) and West Virginia (reintroduced fisher). Additionally, they identified an allele that was present in high frequency in the West Virginia population but absent in the New Hampshire population.

Interestingly, genetic diversity of fisher was found to be lower in the Sierra Nevada Mountains, a western population located at the periphery of the species range, compared to that reported by Kyle et al. (2001) in the species core northern range (Avg. He = 0.28 vs. 0.62 in core). The results of Kyle et al. (2001), Drew et al. (2003) and Wisely et al. (2004) indicated that genetic diversity within fisher populations decreased from the center of the species range to its southwestern periphery. Furthermore, genetic diversity within fisher populations was further reduced along the Pacific distributional peninsula (Cascade and Sierra Nevada mountains) to its southern most tip (southern Sierra Nevada Mountains). These finding are particularly relevant to Pennsylvania's fisher population as it too is at the periphery of the species current range.

SECTION III: HISTORIC AND CURRENT STATUS OF FISHER IN PENNSYLVANIA

Historic Distribution In Pennsylvania

Historic data suggest that fishers were distributed in forested ecosystems of Pennsylvania prior to intensive deforestation during the 1800s. However, spatial records of historic distribution and relative abundance are relatively sparse. Fisher likely occurred at varying densities throughout most forested regions with the possible exception of the far southeastern counties. Historic fisher distribution in the northwest area of the state is unknown, but there are historic records from adjacent counties in Ohio (Williams et al. 1985).

Skeletal remains of fisher have been discovered at numerous paleontological and archeological sites with the oldest records from Bedford and Washington counties dating back 11,000 years (Williams et al. 1985). There are very few historic records of individuals captured or killed in Pennsylvania with only five documented in scientific collections (Williams et al. 1985). Prior to recolonization that occurred during recent decades, the most recent fisher captures had occurred in Lancaster Co. in 1921 and in Mifflin Co. in 1923 (Williams et al. 1985). There are records of sightings and tracks during subsequent decades, including a report from Wayne Co. in 1982, but most of these records were either anecdotal in nature or were otherwise unconfirmed.

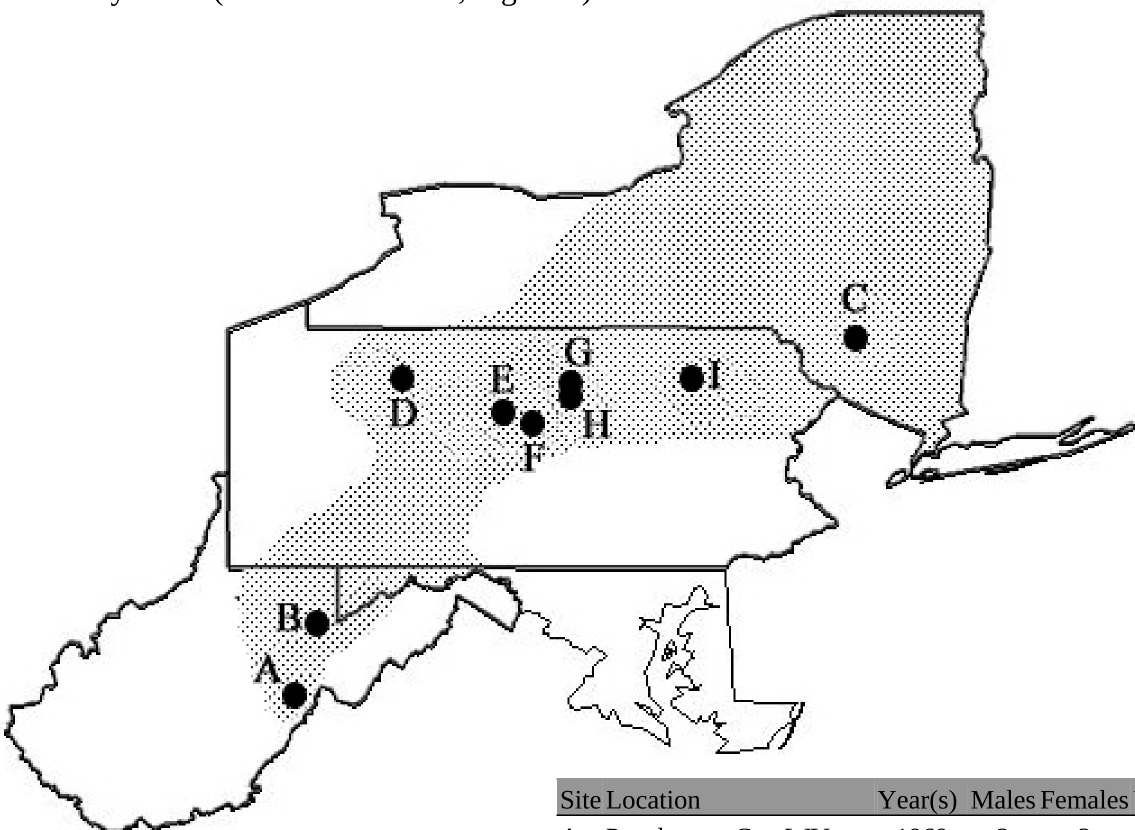
Historic accounts suggest that fisher populations initially began to decline in southwestern Pennsylvania as colonial development substantially increased in these areas. Subsequent declines occurred steadily as forest habitats were cleared throughout the Commonwealth (Williams et al. 1985). The last remnant populations were believed to have been in Clearfield, Elk, Cameron, Clinton, Potter, and Sullivan counties (Rhoades 1903). Historic reports of fur dealers and shippers suggest that prior to fisher extirpation, relatively few fisher pelts were traded (Rhoades 1903). Due to the secretive nature of fisher and the scarcity of records and accounts during the last century, it is difficult to estimate the exact timing or progression of fisher extirpation in Pennsylvania. The fisher is not referenced within the PGC’s Regional Mammal Surveys that were conducted in the 1940s with Pittman-Robertson funding.

Fisher Population Recovery

Pennsylvania’s present day fisher population is the direct result of reintroduction programs and natural expansion from adjacent states. During 1969, West Virginia reintroduced 23 fisher obtained from New Hampshire. Fisher populations in West Virginia have since expanded throughout the state and into western Maryland and northern Virginia (Rich Rogers WVDNR, Pers. Comm.). Current populations in southwestern Pennsylvania likely originated from natural expansion of West Virginia’s population beginning during the 1980s and by 1992, fisher sightings were confirmed as far north as Cambria Co. Similarly, New York transferred 30 fishers from the

Adirondacks into the Catskills Region (2 sites in Utica Co., NY) during 1979 and current populations in northeastern Pennsylvania may have been colonized or enhanced by natural dispersal from New York. The timing and reported sighting in Wayne Co. in 1982 lends some credibility to this concept.

Most recently and significantly, during 1994-1998, a total of 190 fishers (87 males, 97 females, 6 of unknown sex) were reintroduced among six sites throughout northern Pennsylvania (Serfass et al. 2001, Figure 4).



Site	Location	Year(s)	Males	Females	Unknown
A	Pocahontas Co., WV	1969	2	3	3
B	Tucker Co., WV	1969	4	7	4
C	Ulster Co., NY	1970	NA	NA	30
D	Allegheny NF	1996-98	36	25	0
E	Quehanna Wild Area	1995	9	14	0
F	Fish Dam Wild Area	1994-95	12	13	0
G	Pine Creek	1995-96	15	19	3
H	Kettle Creek	1998	0	1	3
I	Sullivan /Wyoming Co.	1995-96	15	25	0

Figure 4. Fisher reintroduction sites within West Virginia, New York, and Pennsylvania relative to generalized fisher distribution (shown as gray shading).

Fisher Population Monitoring in Pennsylvania

Because fisher are secretive and occur at relatively low densities in Pennsylvania's forest ecosystems, census techniques are not currently available to determine annual fisher populations. The PGC currently uses a combination of fisher population indices (e.g., postal surveys and field methods) to monitor changes in fisher distribution and relative abundance throughout the Commonwealth.

Incidental Fisher Captures

As fisher populations have expanded throughout the Commonwealth, reports of incidental fisher captures have steadily increased with the most noted increase occurring in 2005 (Table 2). Fishers are typically captured in legally-set foothold traps and are released at the capture site by trappers or local wildlife conservation officers. Fisher mortalities associated with killing-type sets (e.g., conibears and submergence sets) have been reported but are relatively rare. Two fishers captured in cable restraints have also been reported since these devices were legalized in 2005.

Table 2. Estimated number of fishers captured and released during annual[a] furtaking seasons (*based on the Furtaker Survey*).

Season	No. of Respondents	No. of Furtakers	Reported No. of Fisher Captured	Estimated No. of Fisher Captured
1999-2000	1,557	17,414	5	56
2000-2001	1,681	18,551	1	11
2001-2002	1,553	19,410	6	75
2002-2003	1,779	20,676	11	128
2003-2004	2,204	22,454	10	102
2005-2006	2,412	23,941	83	824
2006-2007	2,436	26,589	87	950
2007-2008	2,994	28,033	105	983

a *Furtaker Survey was not conducted during 2004-2005 season*

Reports of incidental fisher captures provide annual trends in relative fisher density and distribution. Two independent survey mechanisms, the annual Furtaker Survey and the annual wildlife conservation officer furbearer questionnaire, are currently used to monitor incidental fisher captures. These techniques are not designed to provide complete counts of incidental fisher captures, but rather to monitor temporal trends in fisher abundance and distribution.

The annual Furtaker Survey is a mail questionnaire sent to approximately 20% of licensed furtakers to assess harvest levels for various furbearers. Since 1999, furtakers have been asked to report the number and locations of fisher captured incidentally in traps set for other furbearers. These incidental captures have been recorded by county prior to 2006 and thereafter by WMU. There has been a general increase in the numbers of fisher captured and released during 2000 to present (Table 2). If the number of fisher captured/trapper is extrapolated to all furtakers, this survey suggests that during the 2006-2007 season, trappers captured and released 950 fishers. The greatest number of incidental captures have been reported in WMUs 2C, 2D, 2E, 2F, and 2G in recent years (Table 3).

Table 3. Number of incidental fisher captures reported by WMU as reported during the annual Furtaker Survey (1999-2008).

	Furtaking Season							
WMU	1999-00	2000-01	2001-02	2002-03	2003-04	2005-06	2006-07	2007-08
1A	0	0	0	0	0	0	0	0
1B	0	0	0	0	0	0	1	8
2A	0	0	0	0	0	1	1	0
2B	0	0	0	0	0	0	0	0
2C	1	1	1	8	4	3	33	44
2D	0	0	0	0	0	36	1	10
2E	0	0	0	0	1	7	19	1
2F	1	0	1	1	1	20	9	8
2G	1	0	1	1	2	5	9	11
3A	0	0	0	0	0	1	1	1
3B	0	0	1	0	0	1	2	1
3C	2	0	2	1	0	3	4	4
3D	0	0	0	0	0	0	2	4
4A	0	0	0	0	0	2	1	0
4B	0	0	0	0	0	0	0	1
4C	0	0	0	0	0	0	0	2
4D	0	0	0	0	0	3	3	3
4E	0	0	0	0	0	1	1	3
5A	0	0	0	0	0	0	0	0
5B	0	0	0	0	0	0	0	0
5C	0	0	0	0	0	0	0	0
5D	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	2	0	0	4
Total	5	1	6	11	10	83	87	105

Incidental fisher captures are also estimated annually using a standardized furbearer questionnaire sent to all wildlife conservation officers (WCOs). For law enforcement efforts, the 67 Pennsylvania counties are divided into 135 WCO districts. The furbearer questionnaire surveys WCOs concerning furbearer related issues (e.g., nuisance complaints, unsolicited reports, and incidental captures of protected species) in their respective districts. The survey is mailed to WCOs after the completion of all trapping seasons to insure that incidental captures attributed to trapping are reported. In districts where WCOs are relatively new, they collate information from the previous WCO, or from WCOs in surrounding districts. Numbers of unsolicited reports of fisher captures to WCOs have been steadily increasing since 2001 in all regions with established fisher populations (Table 4).

Table 4. Number of fisher captures and observations reported to WCOs (1997-2007).

Survey Season	No. Districts Reporting	No. Incidental Fisher Captures	No. Reported Fisher Observations
1997	123	10	60
1998	123	9	67
1999	127	6	94
2000	123	8	82
2001	137	6	105
2002	122	9	106
2003	133	20	206
2004	122	31	303
2005	123	49	349
2006	118	86	385
2007	133	132	481

Fisher Observations

Fisher observations are received by PGC staff through a variety of methods including unsolicited reports to WCOs, unsolicited reports via regional PGC staff, unsolicited reports through the PGC website, and solicited reports on the annual game take survey. Unsolicited reports of fisher sightings to WCOs have been steadily increasing during recent years (Table 4) with the greatest increases observed in the Southwest and Northcentral regions. Efforts to catalog reports received by Internet and phone are ongoing; summaries are not currently available.

The game take survey is a postal questionnaire sent annually to approximately 2% of all licensed hunters. Survey recipients are asked to report fisher sightings by WMU while engaged in a variety of hunting seasons. The state-wide fisher sighting index was greater during 2007 than during previous years (Table 5). Efforts are underway to evaluate and stratify survey results relative to hunter efforts and annual changes in fisher distribution.

Vehicle-caused Fisher Mortalities

WCOs annually provide information on observed fisher mortalities (e.g., vehicle-caused, illegal harvest, and disease). When feasible, carcasses are collected and examined to determine sex and age and to estimate productivity. The PGC currently uses a 3-year running average to monitor changes in the annual number of vehicle-caused fisher mortalities. The 3-year running average approach is employed to temper the effects of WCO position vacancies.

Table 5. Reports of fisher sightings by various types of hunters from the annual Game Take Survey[a], 2001-2007.

Year	Season	N (%)	Effort Days	Fisher Observations: No. Observed	Fisher Observations: SI[a]
2001	Spring Gobbler Hunters	2,785 (24.8)	12,735	90	0.71
	Firearms Deer Hunters	8,628 (76.9)	40,254	152	0.38
	Archery Deer Hunters	3,237 (28.8)	36,439	134	0.37
	All Hunters	**11,221 (100.0)**	**89,428**	**376**	**0.42**
2002	Spring Gobbler Hunters	2,423 (24.8)	10,952	43	0.39
	Firearms Deer Hunters	7,176 (73.3)	33,412	170	0.51
	Archery Deer Hunters	2,816 (28.8)	31,396	95	0.30
	All Hunters	**9,777 (100.0)**	**75,760**	**308**	**0.41**
2003	Spring Gobbler Hunters	2,728 (27.3)	12,147	49	0.40
	Firearms Deer Hunters	7,388 (73.8)	34,133	95	0.28
	Archery Deer Hunters	2,923 (29.2)	27,137	63	0.23
	All Hunters	**10,005 (100.0)**	**73,417**	**207**	**0.28**
2005	Spring Gobbler Hunters	2,845 (21.7)	12,327	104	0.84
	Firearms Deer Hunters	7,213 (55.0)	35,011	107	0.31
	Archery Deer Hunters	3,065 (23.4)	28,674	125	0.44
	All Hunters	**13,123 (100.0)**	**76,012**	**336**	**0.44**
2006	Spring Gobbler Hunters	2,580 (20.7)	10,243	121	1.18
	Firearms Deer Hunters	6,865 (55.0)	32,609	230	0.71
	Archery Deer Hunters	3,025 (24.3)	32,065	109	0.34
	All Hunters	**12,470 (100.0)**	**74,917**	**460**	**0.61**
2007	Spring Gobbler Hunters	2,369 (25.1)	9,467	70	0.73
	Firearms Deer Hunters	5,736 (60.9)	57,500	270	0.46
	Archery Deer Hunters	2,832 (30.0)	13,445	171	1.27
	All Hunters	**9,415 (100.0)**	**80,412**	**511**	**0.63**

[a] Game Take Survey not conducted in 2004.
[b] SI = Sighting Index = Observations/Effort * 100

There has been a steady increase in the number of reported vehicle-caused fisher mortalities each year since this effort began in 1996 (Figure 5). The 3-year running average has increased at an exponential rate since 2000.

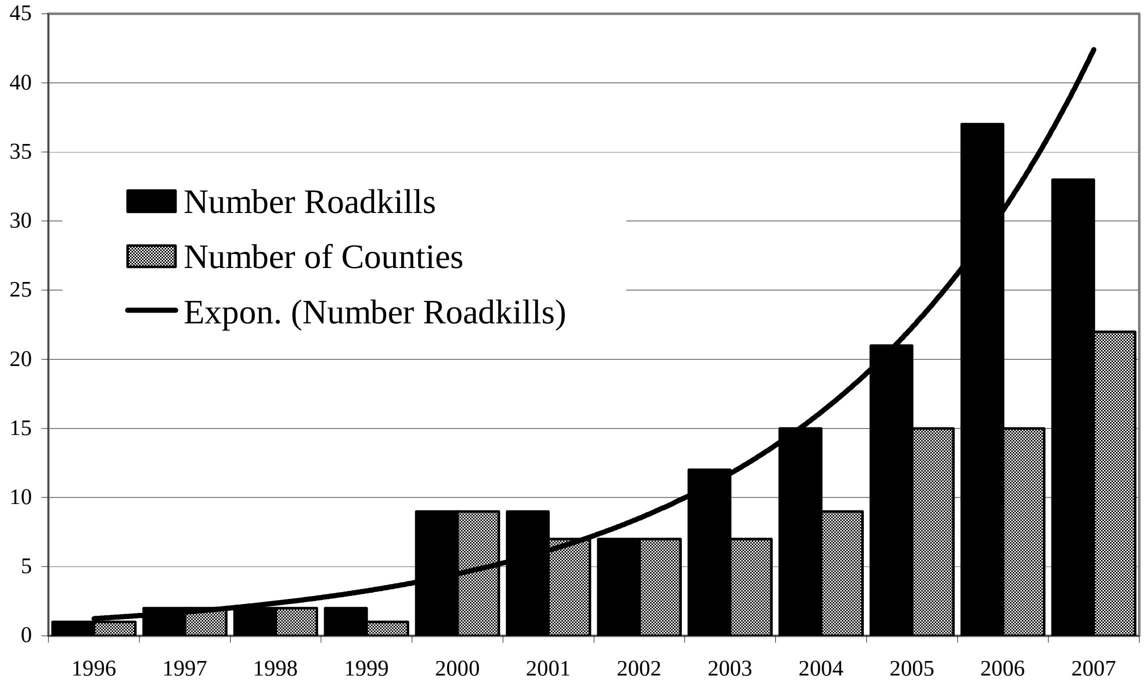


Figure 5. Numbers of vehicle-caused fisher mortalities and counties they occurred in during 1996-2007.

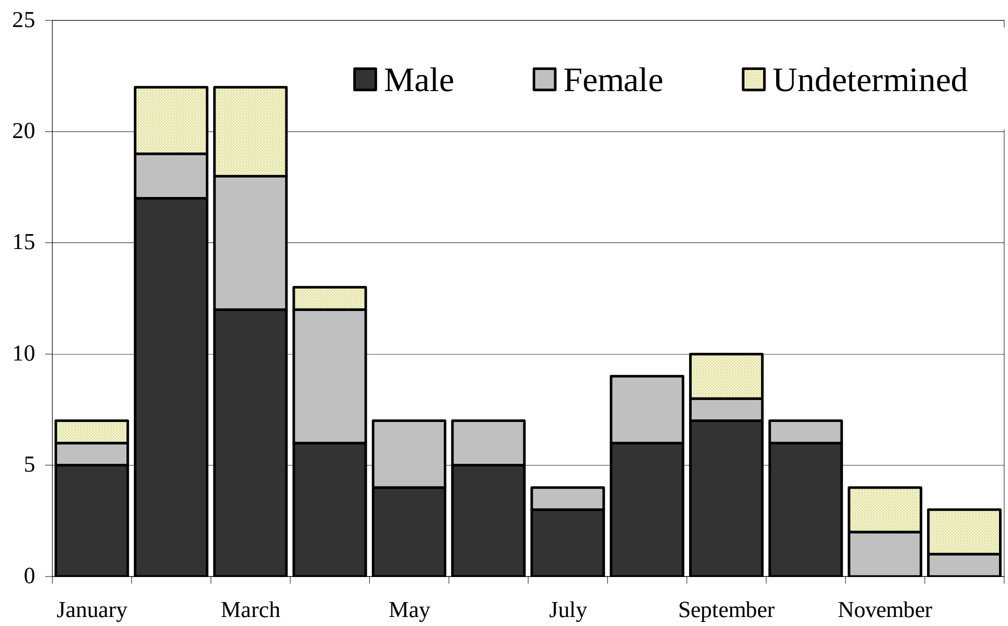


Figure 6. Temporal and sex distribution of 176 vehicle-caused fisher mortalities during 1996- 2007.

Vehicle-caused fisher mortalities are reported most frequently during February, March and April and may be related to increased movements related to the reproductive season (Figure 6). Also, an apparent increase in mortalities during August and September may be related to increased movements by juvenile fisher. Sixty-four percent of all reported vehicle-caused fisher mortalities have been males. As of 2007, WCOs have reported vehicle-caused fisher mortalities from 34 counties (Figure 7).

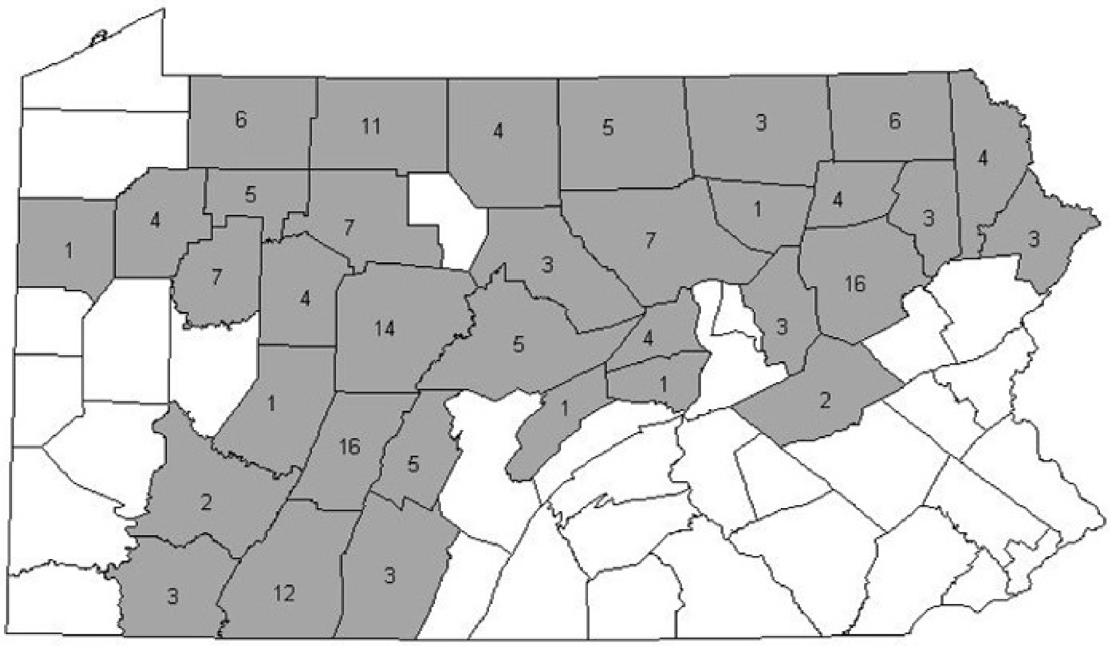


Figure 7. Spatial distribution of 176 vehicle-caused fisher mortalities reported during 1996-2007.

Current Distribution

Fisher populations are currently established throughout southwestern, and most central and northern areas (Figure 8). Based on the 2007 WCO furbearer questionnaire (See Fisher Population Monitoring in Pennsylvania), 75% of WCOs surveyed reported fisher populations existing within their districts. This distribution is further supported by the spatial distribution of reported vehicle-caused mortalities and public sightings. Fisher populations have been confirmed in fourteen WMUs.

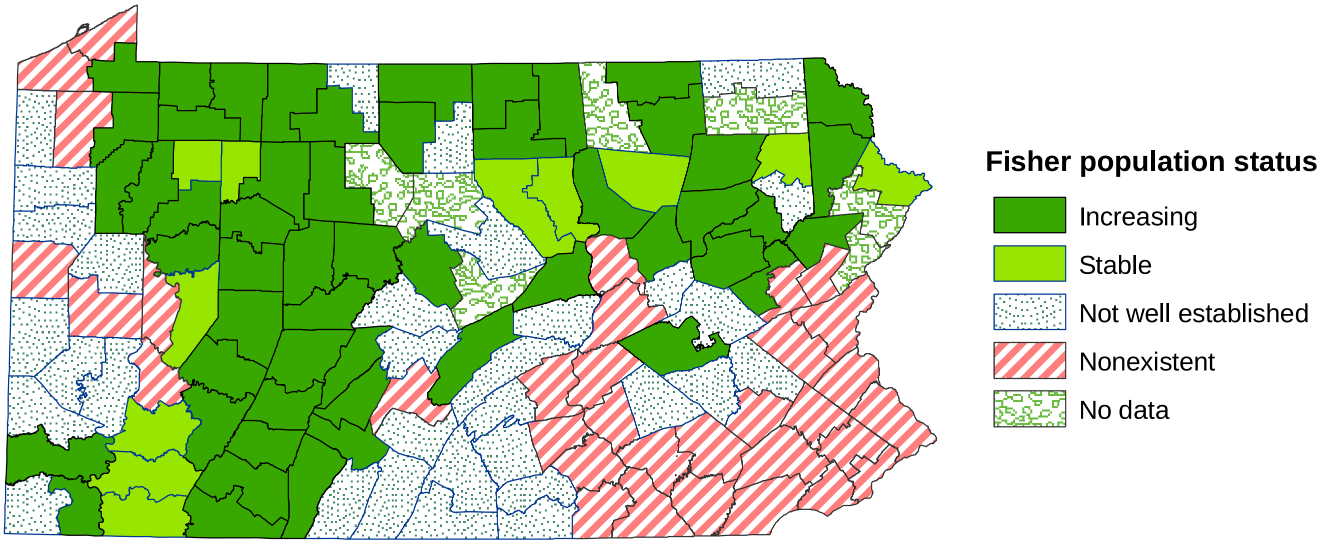


Figure 8. Distribution and status of fisher populations based on the 2006-2007 WCO furbearer questionnaire.

Fisher Research

Current research efforts in Pennsylvania include field studies to estimate fisher density in select study areas and to estimate a probability of detection using hair sampling methodologies and genetic identification techniques. These efforts are ongoing via a contracted research project with the Indiana University of Pennsylvania (IUP) as of the development of this plan.

Examinations of fisher carcasses from vehicle-caused mortalities and accidental kills are conducted annually by PGC staff and IUP staff to estimate demographic and reproductive parameters. Fisher carcasses are periodically submitted for complete necropsy and additional pathology work if cause of death cannot be determined or if a fisher is dispatched due to abnormal behavior or suspected presence of disease.

SECTION IV. ECONOMIC SIGNIFICANCE, RECREATIONAL VALUE, AND PUBLIC INTEREST

Economic Significance

Fisher pelts have been a valuable commodity throughout the history of the North American fur trade and prices paid for fisher pelts have periodically reached relatively high levels. Prices as high as $450 per pelt were paid by fur dealers during the mid 1980s (Douglas and Strickland 1987) and recent pelt prices have exceeded $100 per prime fisher harvested from surrounding states. Pelts of female fisher are generally more valuable than males due to color variations, but improved dying techniques have mitigated these sex-based discrepancies (Douglas and Strickland 1987). The economic significance of historic fisher pelt exports from Pennsylvania is generally unknown, but relatively few fisher pelts were apparently exported prior to population reduction in the late 1800s.

Commercial production of fisher pelts by fur farming was most common during the 1920s and 1930s due to relatively high pelt prices. Difficulties in developing successful captive breeding methods limited profitability of these efforts (Douglas 1943). Although allowed by regulation, there are currently no commercial fisher propagation operations in Pennsylvania.

Established fisher populations may also provide economic benefits in that they may limit porcupine–related damage to timber resources and human property. Several investigations have reported that fisher population reintroduction or expansion generally reduced porcupine populations but did not extirpate porcupines from affected areas (Brander and Books 1973, Powell and Brander 1977, Earle and Kramm 1982). The economic benefits of fisher-related porcupine declines have not been well described or quantified. Established fisher populations may also benefit timber resources as fisher serve as long range seed dispersers for a variety of high-value tree species (e.g., black cherry).

Fisher depredation on poultry and livestock operations has been documented in Pennsylvania. Most complaints have involved losses of poultry and domestic fowl. The extent and value of fisher related losses has not been deemed significant but may increase as fisher populations continue to expand.

Recreational Value and Public Interest

The conservation and management of Pennsylvania's fisher population is of interest to hunters, trappers, and non-consumptive users alike. Trappers and hunters have expressed interest in participating in regulated harvest opportunities for fisher. The PGC currently sells greater than 20,000 furtaking licenses annually and the current cost of this license is $20.00 (i.e., >$400,000 expended). The opportunity to pursue and potentially harvest a fisher in Pennsylvania would add substantially to the value derived from purchasing the annual furtakers license.

Fisher are a carnivore of great interest to naturalists and a variety of outdoor enthusiasts. Because fisher are secretive predators and are rarely observed in the wild, seeing a fisher in Pennsylvania's forests heightens the wilderness experience sought by outdoor enthusiasts (e.g., hikers, campers). Fisher occur at relatively low densities, even in areas that provide optimal habitat conditions. Consequently, fisher will never be observed as frequently as some high-density furbearers (e.g., gray fox, red fox, raccoon) and it will always be a unique and thrilling experience to observe a fisher in its natural environment.

Because fisher are efficient forest predators, numerous interest groups have expressed concerns over expanding fisher populations. Potential impacts of a growing fisher population on other wildlife populations have concerned consumptive and non-consumptive users alike. Gilbert and Keith (2001) suggested that expanding fisher populations negatively impacted juvenile bobcat survival in Wisconsin. Similarly, Erdman et al. (1998) reported significant goshawk mortality (nestlings and adults) and warned that successful fisher restoration efforts could have unanticipated conservation consequences for other wildlife species. Fisher have been observed climbing bald eagle nest trees (Dykstra 1992) and attempting to prey upon nestlings (Taft and Stewart 1999). Potential impacts on threatened or endangered wildlife populations should be considered as fisher populations continue to expand in Pennsylvania. Further research on fisher-related impacts on other wildlife species is needed to better understand WMU based population objectives and the need for further population enhancement.

SECTION V: FISHER MANAGEMENT PROGRAMS IN THE U.S. AND CANADA

Fisher Management Approaches

A variety of management approaches have been developed to maintain and expand fisher density and distribution and to allow sustainable harvest of fisher within existing populations. As fisher populations have expanded in the eastern U.S., these management regimes have generally transitioned from reintroduction and protection based programs to sustainable harvest management. In many cases, this transition has occurred rapidly (Coulter 1966, Kohn et al. 1993, Powell 1993) due to recolonization of improved successional habitats and a number of successful reintroduction programs (Serfass et al. 2001, Powell 1993, Slough 1994, Kohn et al. 1993). In general, fisher are protected throughout most of their western range but are legally harvested throughout Canada, the Midwest and most of the eastern portions of their range (Ray 2000).

In the Northeast, fisher are annually harvested in nine states and four Canadian provinces (Figure 9). Regulated trapping is the most common method used to harvest fisher and most seasons occur during November and December (Table 6). Five states utilize season bag limits to regulate harvest by individual trappers.

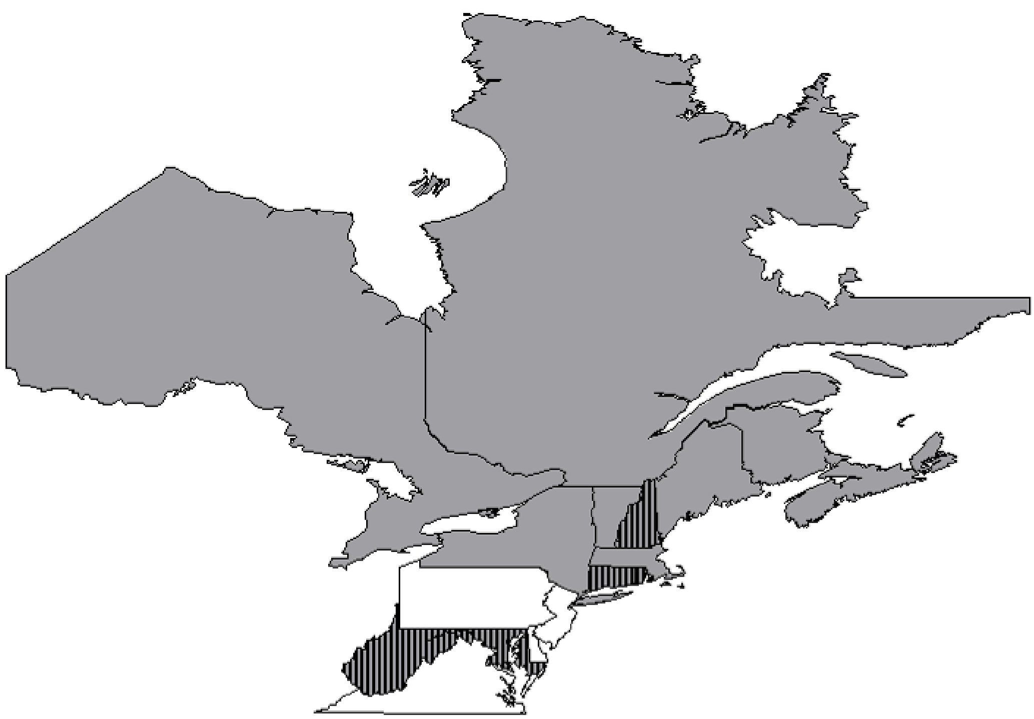


Figure 9. States and provinces that currently provide fisher harvest opportunities (shaded jurisdictions allow regulated harvest and vertical bars indicate states with bag limits).

Table 6. Harvest management and population monitoring methods applied to fisher populations in the Northeastern U.S. and Canada.

	Population Monitoring					Harvest Management			Harvest Estimation					
Jurisdiction	Hunter Survey	Track Counts	Roadkills	Sightings	Other	Trapping Season	Bag Limit	Season Length	Mail Survey	Pelt Tagging	Fur Reports	Trapper Reports	Other	None
Connecticut			●	●		●	●	26 days						●
Delaware														●
Maine		●				●		30 days		●				
Maryland	●					●	●	80 days		●	●			
Massachusetts				●		●		21 days		●				
New Brunswick		●			●	●		30 days			●		●	
Newfoundland														●
New Hampshire	●				●	●	●	31 Days				●		
New Jersey														●
New York	●		●	●		●		46 days		●				
Nova Scotia	●					●		44 days			●	●		
Ohio														●
Ontario					●	●		30 days			●	●		
Pennsylvania	●		●	●	●									●
Prince Edward Isl.														●
Quebec					●	●		60-125 days			●			
Rhode Island	●		●	●		●	●	23 days		●				
Vermont						●		30 days	●	●	●			
West Virginia						●	●	88 days		●				

Harvest Management

Because it is largely impractical to estimate population size on an annual basis,wildlife managers rely on a variety of indices to estimate harvest related impacts on population size and growth (Douglas and Strickland 1987). Differential harvest vulnerability among males and females and among age cohorts can be evaluated as measures of harvest intensity. Adult males and juveniles are more vulnerable to harvest than adult females and are generally overrepresented under low levels of exploitation. Similarly, adult females are underrepresented in the harvest sample during periods of low exploitation. Douglas and Strickland (1987) suggest that the ratio of juveniles to females >2.5 years of age is an appropriate ratio to monitor harvest intensity. Comparisons of this ratio to expected age distribution in the population, based on fecundity rates, provides a basis to compare the harvest of adult females in the population. Based on management programs in Ontario, harvest ratios of 5-7 juveniles per female > 2.5 years of age are generally thought to indicate stable or increasing fisher populations. The harvest sex ratio also provides a measure of population-based harvest intensity as the ratio of yearling females to yearling males will generally be skewed towards females in heavily trapped populations.

Population modeling efforts have been employed to simulate potential impacts of harvest on fisher population stability and growth. Douglas and Strickland (1987) suggested that, based on their population models, greater than annual 25% removal of the population by harvest caused subsequent population declines. Harvest rates of 20%-25% generally resulted in population stability. Similarly, Coulter (1966) suggested that fisher populations would decline if harvest rates exceeded 30% of the preseason population. A population modeling effort in Minnesota found that, due to lower fecundity rates, 15-20% harvest rates stabilized fisher populations in that region (Douglas and Strickland 1987).

Annual fisher harvest levels are most commonly regulated by a combination of season length and bag limit restrictions. Season length in the northeastern U.S. and Canada ranges from several weeks to several months (Table 6). The timing of harvest season can be used to moderate the impact of harvest on population growth. In general, earlier seasons result in a greater proportion of juveniles in the harvest (Douglas and Strickland 1987) and thus have less impact on population growth. Earlier seasons may also increase the likelihood of compensatory harvest-related mortality. Five states also use bag limits to control the fisher harvest; bag limits range from one to 15 fisher per season. No states or provinces use special permits or quotas to limit hunting or trapping effort. Pelt tagging and trapper and furbuyer reports are the most commonly used methods to estimate fisher harvests in states and provinces.

Population Monitoring

Fisher populations and harvest levels are monitored by state agencies using a variety of field and survey based methodologies. Hunter/trapper surveys, roadkills, and public-based reported sightings are most frequently used methods to track changes in fisher distribution and relative density (Table 6). Winter track counts were frequently used in the previous decades to monitor fisher populations but have been discontinued in many states due to logistic constraints and variable sensitivity to significant population changes.

Most states and provinces employ from one to four independent measures to monitor fisher population trends and range expansion. The PGC currently employs four independent measures to monitor population expansion (See Fisher Population Monitoring in Pennsylvania). Continued annual evaluation of these measures is needed to assess population changes and to implement management decisions. If the harvest of fishers is permitted, harvest success per trapper effort will provide an additional population index.

Fisher Management Guidelines for Pennsylvania

Effective fisher management in Pennsylvania requires continued monitoring of fisher populations, assessment of fisher habitat suitability relative to population distribution, and implementation of appropriate and conservative harvest management regulations. The fisher is currently listed as a “furbearer” within the Game and Wildlife Code (Appendix II) and can be legally harvested within an established season as dictated by the Commission.

Because fisher populations occur at varying densities throughout Pennsylvania and because some areas of suitable habitat have likely not yet been colonized, WMU-based management recommendations will be needed to address state-wide population objectives. If fisher population increase is the desired WMU-based goal, limited trap-and-transfer efforts could be considered to enhance fisher populations in WMUs that contain large tracts of suitable fisher habitat but have low or variable fisher population density. Similarly, varying harvest strategies will be employed within WMUs depending upon relative fisher density (as determined by current methodologies), availability of suitable fisher habitat, and unit population goals (Table 7). Numerous objectives and supporting strategies, particularly those described in 4.1 and 4.2 will lead to WMU-based assessments of harvest feasibility (Appendix I). WMU-based population objectives and harvest feasibility will be reviewed annually by PGC staff as fisher populations continue to expand and as variable harvest strategies are implemented and assessed in specific areas (Figure 10).

Various support networks (e.g., regional staff for fisher tagging and carcass collection) and preparations will be needed to accomplish supporting strategies to initiate a fisher harvest season. Appendix I provides a temporal framework to accomplish specific objectives that relate to harvest management guidelines as described in Table 7.

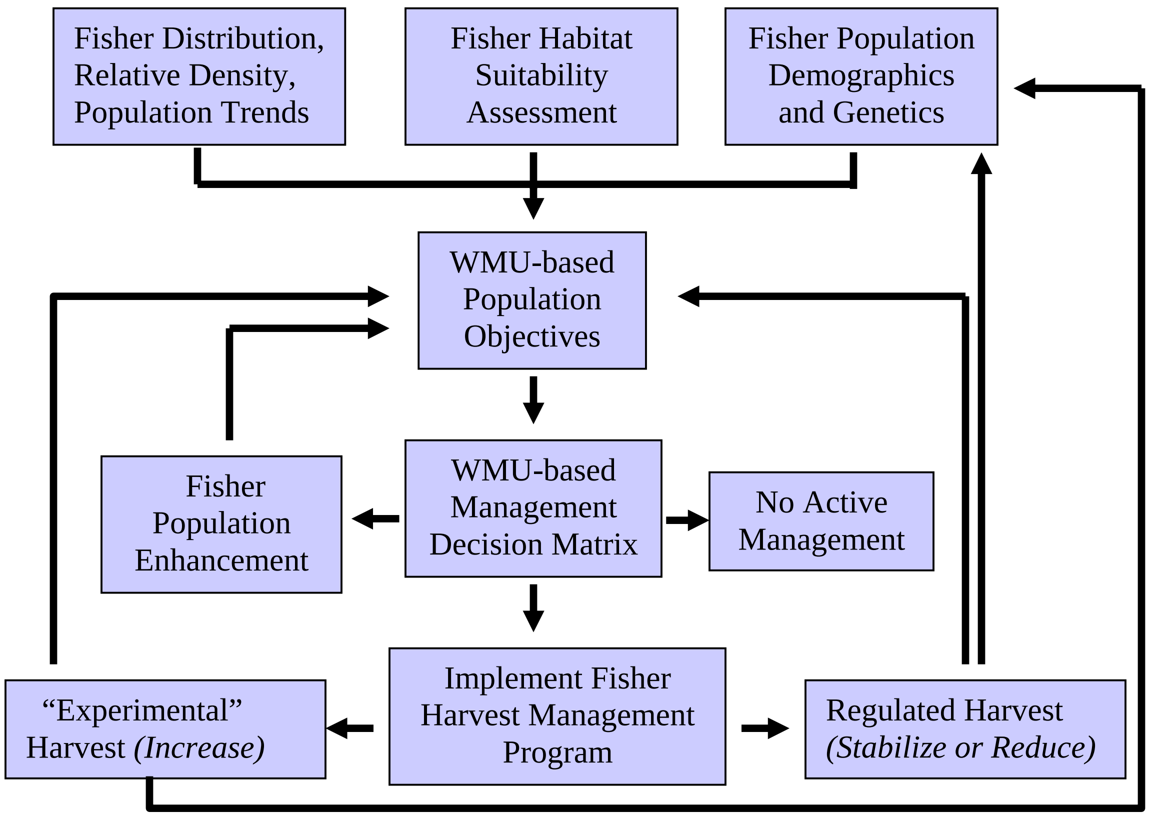


Figure 10. Conceptual Fisher Management Model for Pennsylvania.

Table 7. WMU-based fisher management decision matrix.

		FISHER HABITAT SUITABILITY BY WMU (Strategies: 2.1.1, 2.2.1, 2.2.2, 2.2.3)		
		Suitable fisher habitat comprises ≥50% area of the WMU	**Suitable fisher habitat comprises <50% and ≥15% area of the WMU and totals >400 km^2**	**Suitable fisher habitat comprises <15% area of the WMU or totals <400 km^2**
FISHER POPULATION STATUS AND TRENDS (Strategies: 1.1.1, 1.1.2, 1.3.2)	**Fisher populations are stable or increasing within ≥70% of suitable habitat within the WMU during the previous 3 years**	REGULATED HARVEST *- Standard Season* *- Bag Limit = 1* *- Mandatory Reporting* *- Carcass Collection*	RESTRICTED HARVEST *- Short Season* *- WMU Harvest Quota* *- Bag Limit = 1* *- Mandatory Reporting* *- Carcass Collection*	NO HARVEST RECCOMENDED
	Fisher populations are stable or increasing within ≥30% but <70% of suitable habitat within the WMU during the previous 3 years	RESTRICTED HARVEST *- Short Season* *- WMU Harvest Quota* *- Bag Limit = 1* *- Mandatory Reporting* *- Carcass Collection*	NO HARVEST RECCOMENDED CONSIDER POPULATION ENHANCEMENT	NO HARVEST RECCOMENDED
	Fisher populations are stable or increasing within <30% of suitable habitat within the WMU during the previous 3 years	NO HARVEST RECCOMENDED CONSIDER POPULATION ENHANCEMENT	NO HARVEST RECCOMENDED CONSIDER POPULATION ENHANCEMENT	NO HARVEST RECCOMENDED
	Fisher populations not established in WMU during the previous 3 years	NO HARVEST RECCOMENDED CONSIDER POPULATION ENHANCEMENT	NO HARVEST RECCOMENDED	NO HARVEST RECCOMENDED

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Appendix I. Timetable for completion of objectives and supporting strategies.

Objective	Strategy	By End of Fiscal Year										Staff
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
1.1 Annually determine status, spatial distribution, population trends, and relative abundance of fisher populations throughout the Commonwealth	1.1.1 Annually assess spatial distribution, relative abundance and population trends.	●	●	●	●	●	●	●	●	●	●	BWM
	1.1.2 Estimate relative densities and minimum population size within the established statewide distribution by 2009.		●	●	●	●	●	●	●	●	●	BWM
1.2 Annually assess genetic and demographic characteristics within established fisher populations.	1.2.1 Annually assess fisher population demographics (sex ratios, age distribution, and reproductive parameters).		●	●	●	●	●	●	●	●	●	BWM
	1.2.2 Assess genetic relatedness or uniqueness relative to potential source populations and potential management concerns by 2009.		●	●								BWM
	1.2.3 Identify potential subpopulations within Pennsylvania's current fisher distribution by 2009.		●	●	●							BWM
1.3 Develop numeric model(s) of population growth for fisher populations in Pennsylvania by 2009.	1.3.1 Estimate age-specific fecundity and mortality rates.		●	●								BWM
	1.3.2 Develop models to estimate long-term population trends within identified fisher subpopulations.	●	●	●	●	●	●	●	●	●	●	BWM
2.1 Assess multi-scale habitat selection and limiting habitat features for fisher in Pennsylvania by 2009.	2.1.1 Assess coarse-scale forest composition, type, structure, and pattern in areas of varying fisher density.		●	●								BWM
	2.1.2 Quantify seasonal microhabitat site selection (resting sites and den sites) and use of standing dead and downed woody debris by fisher within the established distribution.	●	●	●								BWM (IUP)
	2.1.3 Evaluate recent fisher population expansion relative to landscape features and potential barriers to fisher dispersal.		●	●								BWM (IUP)

Appendix I (Cont.)

Objective	Strategy	By End of Fiscal Year										Staff
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
2.2 Estimate the abundance and spatial distribution of suitable fisher habitat relative to established fisher populations by 2009.	2.2.1 Develop a statewide coarse-scale map of suitable habitat based on previous habitat selection studies.		●									BWM
	2.2.2 Evaluate and rank wildlife management units using area composition and spatial distribution of suitability rankings.	●	●									BWM
	2.2.3 Identify areas of suitable habitat that do not currently support fisher populations.	●	●									BWM
3.1 Develop timber management recommendations to improve fisher habitat in managed second-growth forest types by 2009.	3.1.1 Provide habitat recommendations addressing the maintenance, removal, and creation of coarse woody debris and standing dead timber during silvicultural treatments and timing of timber harvest, salvage operations, firewood permitting and snag removal.		●									BWHM
	3.1.2 Identify and prioritize critical linkages among established populations relative to land ownership and potential fisher habitat improvement by 2009.		●	●								BWM/ BWHM
3.2 Evaluate the need for further fisher translocation, and where determined, translocate fisher from existing Pennsylvania populations into vacant suitable habitats to promote continued population expansion.	3.2.1 Evaluate and prioritize potential population enhancement areas, as identified in 2.2.3, based on landscape patterns, wildlife management unit rankings, and distribution of other affected wildlife resources.		●									BWM
	3.2.2 Develop protocols and guidelines for the translocation of live-trapped fisher into predetermined population enhancement areas.	●	●									BWM
	3.3.3 Utilize incidental captures and active trap-and-transfer efforts to enhance fisher populations in specified WMUs		●	●	●							BWM/ REGIONS

Appendix I (Cont.)

Objective	Strategy	By End of Fiscal Year										
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
4.1 Categorize WMUs according the following fisher population objectives: reduction, stabilization,or expansion by 2009.	4.1.1 Quantify relative amounts of predicted suitable habitat available and occupied by established fisher populations within each WMU.		●									BWM
	4.1.2 Monitor annual numbers and distribution of fisher-related complaints and human- or wildlife-related conflicts within each WMU.		●	●								BWM/ REGIONS
	4.1.3. Evaluate and compare measures of relative abundance within and surrounding each WMU.		●	●	●	●	●	●	●	●	●	BWM
4.2 Evaluate and quantify impacts of varying harvest management strategies by 2009.	4.2.1 Review and summarize harvest management strategies as employed throughout the Northeastern U.S. and Canada.	●	●									BWM
	4.2.2. Conduct WMU-based harvest feasibility assessment based on suitable habitat, predicted fisher density, and sustainable carrying capacity.	●	●									BWM
	4.2.3 Develop stochastic simulation models to evaluate sex- and age-specific harvest levels required to achieve WMU specific population objectives.	●	●	●	●	●	●	●	●	●	●	BWM
4.3 Develop management recommendations to achieve WMU-based population objectives and implement harvest management program by 2009.	4.3.1 Provide annual WMU-based harvest recommendations including seasons, bag limits, and trapper participation.		●	●	●	●	●	●	●	●	●	BWM
	4.3.2 Establish a reliable and enforceable fisher harvest reporting and pelt tagging system.		●	●								BWM/ REGIONS
	4.3.3 Develop protocols and support structure for tissue collection from harvested fisher.			●	●	●	●	●	●	●	●	BWM/ REGIONS
	4.3.4 Estimate and evaluate impacts of annual fisher harvest relative to WMU-based population objectives.			●	●	●	●	●	●	●	●	BWM

Appendix I (Cont.)

Objective	Strategy	By End of Fiscal Year										Staff
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
5.1 Increase public awareness of fisher life history, population origins and trends, and conservation significance in Pennsylvania beginning in 2008.	5.1.1 Develop a PowerPoint presentation describing fisher life history, conservation significance, and management in Pennsylvania and distribute throughout PGC regions.	●	●									BIE
	5.1.2. Develop and distribute a brochure describing the role of harvest management in maintaining a balance among forest carnivores and prey resources.		●									BIE

Appendix II. References to fisher in Pennsylvania State Regulations.

From Chapter 34: Game and Wildlife Code.

Sec. 102. Definitions.

“Furbearers.” Unless otherwise modified by regulation of the commission, the term includes the badger, the **fisher**, the mink, the muskrat, the opossum, the otter, the pine marten, the striped and spotted skunk, the beaver, the raccoon, all weasels, the red and gray fox and the bobcat.

From Chapter 58:

§ 147.131. Sale of wildlife and wildlife parts.

> (a) Wildlife or parts of wildlife accidentally killed on the highway or by other causes, illegally taken, shot for crop damage or live deer removed from the wild, may be sold to a person under the following minimum fee schedule:
>
> (10) Bobcat, otter and **fisher** -- $100.

Appendix III. Summary of review processes and public input.

The initial draft of the fisher management plan was submitted during February 2008 to the Mammal Technical Committee, an advisory group within the Pennsylvania Biological Survey, to solicit input and editorial review. Three members of the MTC provided either written or oral comments and suggestions regarding plan content, structure and timeline for implementation. Concurrently, the fisher management plan was circulated internally within the PGC to solicit input from region and bureau associated staff.

During May 11th to June 11th 2008, the fisher plan was posted on the PGC's website to solicit public input and comments. A PGC news release announced the posting and solicitation for public comment. Interested constituents were directed to a dedicated email account to provide comments. A total of 29 comments were received addressing the plan. Additionally, 2 comments were received from individuals through a generalized PGC comment email account, and one set of comments was received directly by bureau staff through a personal email account. Table 8 relates numbers of times generalized topic areas were related in the comments received. Two comments contained no content relative to the fisher management plan.

Table 8. Generalized topic areas addressed within 32 public comments.

Generalized Topic Area	No. of Comments	Related Structure
Pleased that fisher populations are expanding within the Commonwealth	17	*Mission Statement*
Not pleased that fisher populations are expanding within the Commonwealth	5	*Mission Statement*
Concern that growing predator populations will impact other wildlife	7	*5.1*
Concern that growing predator populations will cause human-wildlife conflicts	2	*5.1*
Reported recent fisher conflict or complaint	1	*1.1*
Indicated that fisher are abundant in their area	7	*1.1*
Indicated that they had not seen a fisher	3	*1.1*
Reported recent fisher sightings	9	*1.1*
Support the establishment of a fisher season	11	*4.1, 4.2, 4.3*
Do not support the establishment of a fisher season at this time	5	*4.1, 4.2, 4.3*
Feel that the timeline for implementation takes too long	4	*Mission Statement*
Feel that the timeline for implementation is too rapid	4	*Mission Statement*
Generally support the implementation of the plan as drafted	12	*Mission Statement*
Suggested revisions to the plans content, structure or timeline	6	*NA*
Provided editorial review and associated revisions	3	*NA*

During September 2008, a synopsis of the fisher management plan was presented to the Northeast Fur Resources Technical Committee (NEFRTC) at an annual meeting held at the Huntington Ecological Center in Newcomb, NY. The NEFRTC is comprised of wildlife managers and furbearer specialists from throughout the northeast states and eastern Canadian Provinces. The meeting was well attended by representatives from two Canadian provinces and all but two NE states. During a subsequent discussion, participants provided input on the plans objectives, content and timeline.