

**COMMON NAME:** Wolf  
**SCIENTIFIC NAME:** *Canis lupus*

**COMPILER:** Camryn Lee  
**NO. CITATIONS:** 122 of 133 in database

**DATE OF LAST UPDATE:** December 23, 1996

## **HABITAT USE AND DIET INFORMATION**

### **A. Habitats used for different functions**

Landscape diversity, based on GIS mapping, is higher in pack areas versus non-pack areas. Territories had significantly less agricultural areas, deciduous forest, and large lakes, and more mixed conifer hardwood forest and forested wetlands than non-pack areas. Packs are primarily on public lands. (Mladenoff 1995, #20349).

In Minnesota, wolves changed winter activities, movement patterns, social behavior and feeding behavior in response to changes in deer distribution and mobility that were induced by snow (Fuller 1991, #20376).

### **B. Habitats used in different seasons**

In Alberta, when snow depth was greater, wolves remained at kill sites longer and moved around less (Fuller and Keith 1980, #20222).

In the Arctic, wolves used same den site 5 of 8 years; 2 years they used dens within 2.8 km of traditional den site; 1 year they moved their den site 24 km from the previous traditional den site after a photographer crawled into the traditional den and filmed the pups (Mech 1995, #20597).

Natal den was located along the edge of a large dry meadow in Glacier National Park, MT (Kehoe 1995, #20577).

In Minnesota, 69% of den sites were new sites, 31% were previously-used dens. Den site selection seems due to tradition, availability and distribution of prey, influence of neighbor packs and these factors interacting. (Ciucci and Mech 1992, #20526).

In Minnesota, wolves hunt in smaller groups during mild winters with shallow snow. They travelled farther and more often and spent less time with the pack in mild versus severe winters. Wolves used cover less and killed fewer deer if snow was shallow. Deer were killed more often in deer concentration areas versus other areas if the winter is severe. They also scavenged less in mild versus severe winters. When snow is shallow, deer are more widely distributed and difficult to capture. Therefore, wolves change their habitat use patterns, hunt more, and in smaller groups, and consume their kills more completely in mild winters. (Fuller 1991, #20376).

### **C. Home ranges**

In Minnesota, there was some overlap of territories. There were 1.3 wolves/100 km<sup>2</sup> in the winter, 0.7 to 2.9 wolves/100 km<sup>2</sup> in the summer. Minimum territory size was 54 km<sup>2</sup> for 2 animals and 555 km<sup>2</sup> for 3-4 animals; mean was 189 km<sup>2</sup>. Home range was generally larger in winter than summer. (Fritts and Mech 1981, #20219).

In Minnesota, home range size in summer averaged 54-226 km<sup>2</sup>, and was about the same as winter territory. Each winter, home range averaged 78-153 km<sup>2</sup>; 0-30% of wolves left territories each month. Pups left in Jan - March, adults in Sept-April. Wolves left territories temporarily, moving 5-105 km and being absent for 3 - 118 days. Where deer were the main prey, territory size related to deer density and wolf numbers directly related to ungulate availability (Fuller 1989, #20224).

In Montana, the home range of a colonizing pack was mainly in BC in 1985 and mainly in Glacier National Park the following year (Pletscher et al. 1991, #20368).

In MI, wolves may be in smaller groups to maximize food intake and immediate reproductive possibilities. (Thurber and Peterson 1993, #20637).

In Alberta, winter home range was 357-1779 km<sup>2</sup>, summer home range was 195-629 km<sup>2</sup> (about half the size of the winter range). Territory sizes of various wolves and packs ranged from 95-1779 km<sup>2</sup>, and density of wolves ranged from 40 km<sup>2</sup>/wolf to 273 km<sup>2</sup>/wolf (Fuller and Keith 1980, #20222).

In Minnesota, wolves killed deer along territory edges as an extreme measure that they do not resort to unless desperate (Hoskinson and Mech 1976, #20243).

In Canada, territory size increased in winter vs summer. Average summer home range was 233 km<sup>2</sup> (100-476 km<sup>2</sup>). Winter home range average was 424 km<sup>2</sup> (198-850 km<sup>2</sup>). Average annual home range of 4 lone wolves was 2191 km<sup>2</sup>. (Bjorge and Gunson 1989, #20514).

In Canada, a pack of 8 wolves ranged over a 224 km<sup>2</sup> area in the winter. Daily distances travelled by the pack ranged from 0 to 21 km. Total linear distance travelled in 46 days was 327 km. Wolves travelled less in January due to snow conditions; snow was deep without a crust, so soft and fluffy that a snowmobile was unable to travel. (Kolenosky 1972 #20257)

In Minnesota, density was 1 wolf/23.6 km<sup>2</sup>. Home range of a wolf is about the same as pack territory. Home range varied from 49-145 km<sup>2</sup>. Territories in summer/autumn didn't overlap. Virtually no suitable wolf habitat was unoccupied. (Ballenberghe et al. 1975, #20324).

#### **D. Food habits (by season if applicable)**

In Alberta, 88% of winter kills were in lowland habitats; wolves killed mostly young, old, and debilitated moose. Female calves and adult bulls were also taken. Summer diet was moose and beaver. Per capita consumption decreased due to increasing pack size. Average kill rate = 1 moose/4.7 days. Average food consumption was 6.1 kg/wolf/day one year and 4.9 kg/wolf/day the next year. Summer foods (by percent in scat) ranged from 21-75% moose and caribou, 13-52% beaver and muskrat, 3-20% snowshoe hare. Minor foods included microtines, red squirrel, porcupine, fish birds, and garbage. Wolves also ate an adult wolf that was not a pack member. Adult moose supplied 74% of the biomass for all packs. Local beaver populations directly related to the percent occurrence of beaver in scats. (Fuller and Keith 1980, #20222).

In Minnesota, more kills were made in center of territories than along edges. Diet was mainly deer and moose (94% of biomass eaten). Also ate hare, beaver, livestock, fruit, rodents. Livestock was 3% of diet and suspected to be mainly carrion. Wolf pack members ate, in winter, an average of 1.63 kg/day/wolf. In spring, up to 51% of all deer killed were fawns. (Fritts & Mech 1981, #20219).

In Alaska, wolves are subject to harassment from aerial hunters and learn to avoid alpine areas where caribou calve and summer. Wolf territory included parts of caribou calving grounds, remains of 13 adults and 67 calf caribou were found at 2 dens and 1 rendezvous site of the wolf pack. After wolf population declined due to hunting and trapping, caribou herd increased. (Bergerud 1988, #20171)

In Minnesota, of 6 deer that died, the oldest ones were killed by wolves, while younger ones were killed by hunters. (Hoskinson and Mech 1975, #20243).

In Canada, during January, pack killed 29 deer or an average of one every 2.2 days or 3.2 deer/week. In February the pack killed at a relatively constant rate of 1 deer every 2 days. Maximum rate of predation was 8 deer in 8 days. The longest period between kills was 102 hours, in March. Distances between kills ranged from 0.3 to 43 km and averaged 15 km. Mean distances between kills in January was 6 km, in Feb was 15, in March was 20 km. The average age of deer showing a marked selectivity for older deer. Wolves were successful in kills 46% of the time. The longest chase was 5.6 km, the mean distance for a successful chase was 0.6 one year and 2.1 km the other year. It was estimated that the pack of 8 killed 70 deer during the 5 month winter season (Kolenosky 1972, #20257).

In MI, daily food per wolf in winter was inversely related to the size of the pack, with greater variance for small groups. Summer diet included moose, beaver, snowshoe hare; winter diet consisted of moose, scavenged fish remains at campgrounds, beaver (Thurber and Peterson 1993, #20637).

In Minnesota, deer and hare were the main prey in winter and spring, beaver were secondary prey in April and May. Adult wolves ate about 19 deer per year, 11 of which were fawns, or about 2 kg of deer/wolf/day (Fuller 1989, #20224).

Deer are more vulnerable to wolf predation while migrating between seasonal ranges. Deer that travel through unfamiliar terrain and changing climatic factors increase their vulnerability to wolf predation (Nelson et al. 1991, #20414).

In Canada, diet was highly versatile and adaptable. Primary prey were deer, moose, and beaver. Other species taken, in decreasing order of frequency include; muskrat, hare, vole, black bear, porcupine, woodchuck, mouse, flying squirrel, raccoon, wolf, bog lemming, birds, turtle, eggs, and vegetation. Amounts varied between years. Beaver were most predominant in the summer diet. Garbage was scavenged in the summer (Voigt 1976, #20325).

In Minnesota, primary summer prey was deer (55%), moose (13%), beaver (9%), vegetation, hare, rodents, birds, fish. In June/July, 50% of deer eaten were fawns, so fawn are a significant part of diet after peak fawning season. Vegetation was also a significant part of

the diet, especially fruit bearing shrubs, such as raspberries. Winter food was 66% deer, 21% moose. (Ballenberghe et al. 1975, #20324).

In Canada, wolves ate about 0.12 kg/wolf/day. (Bjorge and Gunson 1989, #20514).

Prey declines were due to decreased range quality, severe weather, hunting, and predation. Estimated wolf population in Alberta is 4200 wolves. (Gunson 1992, #20230).

In Alaska, diet was caribou, moose, and deer. Wolves are strongly dependent on large ungulate prey in winter, and prey selection depends on availability. Wolves that depend mainly on caribou for food, may move as much as 360 km to caribou winter range to maintain contact with a food source. (Holleman 1981, #20241).

In Alaska, wolves made a kill every 1.7 days. Prey species selection was a function of availability. Calf moose were killed 6 times more often than adults. (Burkholder 1959, #20185).

In Canada, in the winter, the time between consecutive kills decreases with increasing snow depth. Deep snow hinders elk travel. Wolves scavenge whenever they get an opportunity. (Huggard 1993, #20245).

In Minnesota, wolves accounted for 51% of deer mortalities (Kunkel and Mech 1994, #20395).

Kill rate per wolf was 1 elk every 14 days. In the winter, wolves prey more heavily on old elk and calf elk. Other prey include moose, deer, beaver and hare. (Carbyn 1983, #20189).

In Minnesota, primary prey in summer was deer, followed by beaver. Wolves resort to secondary prey when primary prey is less available. Wolf depredation of domestic livestock was inversely related to the severity of the prior winter (Mech et al. 1988, #20269)

In MT, wolves killed mainly deer fawns and elk calves, more than hunters did. Also killed older elk and deer. Wolves killed more male elk and deer. Colonizing wolves kill more fawns/calves than established populations (Boyd et al. 1994, #20175).

In Canada, diet was mainly moose, elk, deer. Most elk were calves, moose were usually old moose (>9.5 years) (Bjorge and Gunson 1989, #20514).

## **DEMOGRAPHIC CHARACTERISTICS**

### **A. Reproduction information**

In Alberta, mating activity was observed in February and March. Den sites were first located in mid-May and April. Mean litter size was 3.9 pups. (Fuller and Keith 1980, #20222).

In Canada, wolves produced pups every year. (Bjorge and Gunson 1989, #20514).

In the Arctic, females did not produce pups every year (Mech 1995, #20597).

In Montana, denning date varied from year to year; it changed by 1 month in 1986. In 1987, den site was <1 km from the previous year den. (Boyd et al. 1993, #20519).

In Glacier National Park, MT a pack of 17-18 wolves attacked and chased a grizzly bear sow and cub that came too close to the wolves den site (Kehoe 1995, #20577).

In Minnesota, survival of pups was estimated to be 44% from birth to age 6 months (Ballenberghe et al. 1975, #20324).

In Minnesota, there was evidence of breeding Feb 2 - March 3. Females went into dens in mid-March to late April, average April 8. Pups were moved from natal dens June 2 - July 16. Average litter size was 4.6 pups for established packs and 4.1 for new pairs. Productivity varied between years, maximum number of surviving pups was 6. (Fritts and Mech 1981, #20219).

In Minnesota, births were in the second week of April, pups stayed in dens about 25 days before moving to second den site. Dens were used up to 6 consecutive years. Dens were in large, excavated, hollow logs (60-90 cm dbh logs of Pinus sp.) (Fuller 1989, #20552).

Average litter size in Alaska decreased as ungulate biomass/wolf declined. Therefore, wolf productivity declines as prey availability/wolf population declines. There appears to be a level of prey availability below which adult females suppress/delay cycles. There appears to be a direct relationship between wolf productivity and nutritional status. (Boertje 1992, #20359).

Females start using den sites anywhere from Mar 22 to May 9 in Minnesota. Wolves stayed in dens 16-67 days, average 36 days. Dens were located randomly with respect to smaller territory center, but in larger territory, dens tend to be more central. Denning wolves tend to avoid areas where influence of adjacent packs is more likely (Ciucci and Mech 1992, #20526).

In Minnesota, wolves had 1 litter/year with average of 6.6 pups at birth (range 4-8). Annual survival of pups to > 5 months old = 0.64. (Fuller 1989, #20224)

Wolves are not adapted to close inbreeding. Study shows that wolf inbreeding results in decreased juvenile weight, decreased productivity, decreased longevity, and blindness (Laikre and Ryman 1991, #20156).

In Minnesota, adults had the highest pairing and denning success, yearlings had moderate success, and pups had low success. (Gese and Mech 1991, #20378).

## **B. Mortality factors**

In Minnesota, humans were the main cause of mortality, with a peak in autumn. Over-winter losses ranged from 11-21%. (Fritts & Mech 1981, #20219).

Video recordings in wolf dens documented that wolves practiced infanticide (McLeod 1990, #20409).

In Alberta, mortality was due to trapping and early pup deaths. Starvation, intraspecific strife, accidents, and possibly mange contributed also. (Fuller and Keith 1980, #20222).

Minimum annual mortality in Minnesota was 20%, but may be as high as 40%/yr. Nearly all mortality was human caused and related to hunting and trapping. Hunting and trapping account for 73% of known wolf mortality. (Ballenberghe et al. 1975, #20324).

Humans were the primary cause of wolf mortality in MI and AK. In Minn, mortality was mainly due to shooting, trapping, and highways, followed by starvation and intraspecific conflicts. (Fritts 1985, #20221).

In Minnesota, mortality was highest in Nov/Dec. (Fuller 1989, #20224)

In Minnesota, highway mortality was regular due to heavy vehicle traffic. (Ballenberghe et al. 1975, #20324).

In Montana, mortality was primarily human caused (Boyd et al. 1994, #20175)

Some parasites may affect canid hosts. It is unknown if parasites found in NE Minn may be harmful to wolves. Food stress due to decreased prey populations may make wolves more susceptible to parasites. (Byman et al. 1977, #20364)

In Minnesota, more than 80% of mortality was human caused. Per capita biomass of prey available likely affects pup survival. (Fuller 1989, #20224)

Main mortality factors were trapping, shooting, and poisoning, in Manitoba. (Carbyn 1983, #20189).

In Glacier National Park, Montana, of 14 wolf mortalities, all were human caused. (Pletscher et al. 1991, #20368)

### **C. Dispersal rates and distances**

In Minn., most packs become nomadic in September. High rate of dispersal by yearlings in their second winter, before winter. No known cases of juvenile wolves staying with pack past breeding age, nearly all dispersed in fall. Lone wolves readily found unused areas and mated. They avoided pack territories. Edges of parental territories appeared to be preferred sites for colonization, maybe because they were familiar areas, and adjacent pack may be more tolerant of their own progeny colonizing the edge of their territory. (Fritts and Mech 1981, #20219).

In Alberta, distance travelled and size of an area over which the pack ranged changed each year. Average straight line distance between daily locations was 9 km (1977) and 5.7 km the next year. Average straight line distance between kills (cumulative straight line distance between successive locations) was 44 km during 1 year (range of 11-81 km) and 25 km the next year (range of 3-61 km). Travel rates were as great in daytime as at night. In Alberta, deep snow and cold temperatures reduced travel. Packs showed no recognizable circuits of

travel, but most activity was within 15 km of a specific lake. (Fuller and Keith 1980, #20222).

In MI, lone wolves were not restricted to marginal areas between packs, but rather ranged throughout the island among other pack territories. Movements of small transient groups also overlapped with those of established packs (Thurber and Peterson 1993, #20637).

Natural pack disruption and movements of wolves may allow enough genetic exchange to maintain healthy populations (Kennedy and Kennedy 1991, #20391).

In Minnesota, dispersing wolves travelled 5-100 km away for 1 - 265 days, most formed new packs, most dispersal was in Nov-Jan and Mar-May. Each month, up to 30% of wolves left territory. 79% of wolves that left were alone. Pups tend to leave in the fall. Dispersal rates were 17% of adults, 49% of yearlings, and 10% of pups greater than 5 months old. (Fuller 1989, #20224)

In Alaska, wolves travelled an average of 15 miles/day, range of 6 to 45 mi/day. (Burkholder 1959, #20185).

In Minnesota, adults ranged up to 13 km from rendezvous sites during the day. Pups went up to 7 km but less than adults. Movements of < 3 km were common. Pups began to range widely in October. (Ballenberghe et al 1975, #20324).

In Canada, wolf movements appeared largely independent of weather conditions. Travel was observed under all conditions, but when there was rain/freezing rain, the wolves usually sought shelter. (Kolenosky 1972 #20257)

In MI, highest percentage of single wolves occurred when numbers of wolves were low. Mean pack size decreased with lower wolf density. Movements of transient groups of wolves overlapped those of more established packs. Lone wolves traveled through territories of established packs much more than expected, but one was killed by a pack near a moose she had killed in their territory. Lone wolves were harassed but not often killed by residents. (Thurber and Peterson 1993, #20637).

In Minnesota, when snow was shallow, more deer dispersed. Wolves spent less time hunting together and reverted to more summer like hunting behavior. Deep snow may encourage individuals to travel together, follow in the tracks of others, and reduce energy demands. (Fuller 1991, #20376).

In Minnesota, 8% of adults, 75% of yearlings, and 16% of pups dispersed. Most dispersed at 11-12 mos old. Both sexes dispersed equally. Wolves dispersed mainly in Feb.- April & Oct-Nov. Adults dispersed short distances versus yearlings. Pups moved short and long distances. Yearling and pup dispersal rates were highest when population increased/decreased, and were lowest when population was stable. Wolves travelled 8-354 km from their territories. They left territories for 2 - 40 days, ave of 14 days, max. distance travelled was by a male. Mean distance was 88 km for males, 65 km for females. Mean minimum distance travelled by adults, yearlings and pups was 36 km, 87 km, and 95 km, respectively. Adults usually dispersed <50 km from their territories. Most adults travel to

adjacent/nearby territories. Yearlings and pups travel to nearby or very distant territories. Wolves that disperse farther were often unsuccessful with mating/reproduction. (Gese and Mech 1991, #20378).

In Quebec, dispersal seems to be more of a dynamic, gradual process over a few months or years. Dispersal begins at about 10 months old, with an average of 3 forays/year. As adults, 6 of 7 forays became permanent. Yearlings were the most loosely associated pack members. Sex and prey abundance influenced tendency of yearlings to leave their packs temporarily. Yearlings wander more than adults, for prolonged periods of time and with no attempt to visit the pack. Age of wolf is the main factor influencing solitary living and extra-territorial movements. Yearlings are more likely to travel alone and for long periods. If habitat saturation is high, dispersing wolves may have to travel great distances before they can settle. Low prey abundance may prompt subordinate animals to initiate excursions more frequently. Higher social stress within packs before and during breeding (Feb/Mar) may explain the increased tendency to leave packs in Feb/March. Wolves in low prey areas have weaker territorial habits in winter than wolves with ample prey. (Messier 1985, #20410).

#### **D. Population and age structure**

In Minnesota, population seemed to have a high percentage of young wolves during all seasons. Size of social units ranged from 2 to 9, average 4.3. Population was at low density due to human caused mortality, but after legal protection the population increased and recruitment exceeded mortality. (Fritts & Mech 1981, #20219).

In Alaska, potential rate of wolf population increase seems to decline in lean years (Boertje 1992, #20359).

In Canada, a pack of eight wolves included 1 adult male, 1 adult female, three juvenile males, two juvenile females, and one animal of unknown sex and age (Kolenosky 1972, #20257).

In Alberta, numbers increased 21%/year. Differing density was due to food availability. About 13% of wolf population were loners. Packs were comprised of 2 - 9 adults and pups. (Fuller and Keith 1980, #20222).

Winter densities averaged 1/158 km<sup>2</sup> (range of 73-273 km<sup>2</sup>, 20 packs totaled 144 wolves, estimated that 13% are loners. Differences in wolf density relate to ungulate abundance. (Fuller and Keith 1980, #20222).

Decreasing deer population will probably result in decreasing wolf density in Ontario (Voigt 1976, #20325).

In Minnesota, pups = 46% of pack in November. Pack size was about 13 wolves in early winter and 9 in late winter. (Fuller 1989, #20224)

In Minnesota, more males were produced if wolf populations were at high density, stable to declining. Sex ratio was equal, but more females were found where the pack had been exploited for a long time. (Mech 1975, #20268)

In Canada, 23% of wolves were <1 year old. (Bjorge and Gunson 1989, #20514).

In Minnesota, food supply is the primary determinant of ultimate wolf population density. Population was 40% pups, 29% yearlings, 31% adults, so that 69% of the population was less than 19 mos old. Pack sizes ranged from 5 - 10 wolves. Adult male female ratio was equal. Population density was 24 km<sup>2</sup> per wolf. (Ballenberghe et al. 1975, #20324).

### **E. Responses to introduction programs**

Wolves can be released into areas that already have a wolf population without reducing survival rate. Relocated wolves survived well compared to resident wolves. Since humans were the main cause of mortality, releases should be in areas with the least human access, like National Parks. Wolves move extensively after release. Only releases into large non-agricultural areas are likely to succeed. Wild wolves survive better than wolves reared in captivity due to lack of affinity for humans. The probability of a successful reintroduction is proportional to the fear and avoidance of humans (Fritts 1985, #20221).

Wolves that were removed from areas where they had preyed on livestock and released away from those areas did not stay at release site for long. Pups stay longer, but all eventually leave. Members of the same pack/different pack don't stay together, they exhibit a homing tendency. Homing success is inversely related to translocation distance. Extensive movements of displaced wolves can be expected in reintroduction/translocation programs, thus increasing human-wolf conflict potential. Translocating a depredating wolf is therefore not a good idea. Also, wolves that depredate livestock shouldn't be reintroduced to areas where there is any potential for livestock depredation. The use of 6-9 month old wolves is best for re-establishment attempts. (Fritts et al. 1984, #20220).

## **POPULATION LOCATIONS/ DENSITIES**

### **A. Geographic locations and season(s) where studied in the CRB**

Glacier NP, Montana (Boyd et al. 1993, #20519).  
 Glacier NP, Montana (Kehoe 1995, #20577)  
 Glacier NP, Montana (Pletscher et al. 1991, #20368)

### **B. Distribution within the CRB**

Northwest Montana and central Idaho

In the N. Cascades of WA, wolves responded to simulated howling in early August from within wilderness areas where human activities are minimal. A low wolf population is suspected in this area (Gaines et al. 1995, #20553)

### **C. Seasons of use within the CRB = all**

In Glacier National Park, Montana, year-round; however only one of the 4 packs stays in the USA all year, the other pack goes into BC. (Pletscher et al. 1991, #20368)

### **D. Areas of known species population strongholds**

In 1990, Glacier National Park population was about 34. There were 4 packs, average rate of increase was about 30% per year from 1984 to 1990. (Pletscher et al. 1991, #20368)

**E. Known extirpations:** *No information found*

## **SPECIES RESPONSES TO DISTURBANCE INCLUDING MANAGEMENT**

### **A. Effects of roads**

In Minnesota, road density within 2 km of site of death was higher where humans caused the mortality. Road density was higher where wolves died of human related causes. Most territories were relatively roadless. No home ranges had road densities  $>0.72$  km/km<sup>2</sup>, range was 0.15 to 0.72 km/km<sup>2</sup>. 11% of wolf mortality was due to being hit by a vehicle. Road densities were higher outside of wolf territories. (Fuller 1989, #20224)

In Wisconsin, pack core areas with den and rendezvous sites are in areas where road density is lower, i.e.,  $\geq 0.23$  km/km<sup>2</sup> in 80% of use area versus 0.74 in non-pack areas. No portion of any pack area is in areas of  $> 1.0$  km/km<sup>2</sup> road density. Road density was the main predictor of wolf pack radio-telemetry locations. The areas that were least likely to have wolf packs in the area were the areas w/ high road density. (Mladenoff 1995, #20349).

In Alaska, wolves used habitat near roads 43% less than non-roaded areas, they had to be at least 2.1 km from a road for the roads to have no influence on wolves. Wolves avoided year-round heavy use roads and non-refuge lands but were attracted to gated closed roads with limited human access. Roads may influence spatial organization of packs and avoidance behavior. (Thurber et al. 1994, #20322).

In Minnesota, highway mortality was regular due to vehicle traffic (Ballenberghe 1975, 20324).

### **B. Effects of human disturbance not associated with roads (e.g., trails, snowmachines, etc.)**

In Alberta, appeared that disturbed sites (near an oil extraction plant) support higher densities of wolves than surrounding areas. Wolves in poor condition may be able to survive because of the alternate food source and packs may not have to kill moose as regularly. (Fuller and Keith 1980, #20222).

In Minnesota, packs frequented dumps within territories. The occurrence of human activity within a territory habituated wolf packs to human presence. (Ballenberghe 1975, 20324).

In Minnesota, the number of human residences was higher outside wolf territories (Fuller 1989, #20224)

In the Arctic, wolves moved their den site 24 km from the previous traditional den site after a photographer crawled into the traditional den and filmed the pups. (Mech 1995, #20597)

In Wisconsin, human population density is lower in pack territory, 1.52/km<sup>2</sup> vs 5.16/km<sup>2</sup> in non-pack areas. Wolves heavily selected areas that are remote from human influence and with lower road density. (Mladenoff 1995, #20349).

In Minnesota, females den site location was influenced by nearby availability of garbage dumps, i.e., artificial food source (Ciucci and Mech 1992, #20526).

In Alaska, human presence caused wolf avoidance of settled areas and year-round roads. Continual exposure to harvest is not required to separate wolves from human activities. Gated/seasonal closures away from settled areas provide wolf travel corridors with low human impact. (Thurber et al. 1994, #20322).

In Alaska, disturbed wolves hunt more under tree cover and less in alpine area (where caribou calve) than undisturbed wolves. More wolf tracks were observed prior to legal hunting than after. (Bergerud 1988, #20171)

**C. Species response to direct effects of grazing:** *No information found*

**D. Species response to direct effects of burning:** *No information found*

**E. Species responses to timber management practices:** *No information found*

## **MANAGEMENT RECOMMENDATIONS (SORTED BY LEVEL OF REVIEW)**

### **Peer-reviewed journal:**

Human related wolf mortality is correlated with the distribution and density of roads, so regulating road access, especially in hunting season, can control human caused wolf mortality. (Fuller 1989, #20224)

A prerequisite for wolf management is accurate monitoring of population density and harvest (Fuller 1989, #20224).

Management decisions re: wolf and ungulate density and harvest by humans can be made using equations that incorporate estimated wolf density, annual ungulate kill/wolf, ungulate density, potential rates of increased ungulate numbers, and harvest. (Fuller 1989, #20224)

GIS spatial information can identify priority areas for management of multi-ownership lands, as well as monitoring and landscape analysis. For a species that crosses International boundaries, multi-agency coordination can be important for successful wolf management. (Mladenoff 1995, #20349).

In Minnesota, management needs to consider that drastic changes may occur in timber harvest practices, ungulate abundance, human population density and distribution, legal status of wolves, impact of wolves on livestock, and public attitudes toward wolves. Wolf density is limited by ungulate numbers, but wolf population reductions relate to human caused mortality. (Fuller et al 1992 #20225).

Monitoring of road density and road distribution is recommended to ensure that  $< 0.7$  km/km<sup>2</sup> is maintained on all lands as a state and federal priority for wolf management. (Fuller et al. 1992, #20225).

If wolves are the main factor limiting ungulate prey populations, then managers can wait for natural increases in prey populations while reducing hunting or decreasing numbers of wolves. Great caution should be used in harvesting ungulates in ecosystems where wolves occur. Ungulate mortality from severe winters, hunting, and wolf predation can all be additive. (Gasaway et al. 1983, #20227).

Combined cooperative efforts and sharing of information is critical to joint management efforts in behalf of wolf populations that cross international borders (Pletscher et al, 1991, #20368)

Maximum fawn rearing success is attained when mature does predominate in the breeding population. Management of harvest to produce such an age structure may be an important strategy where predation of neonates decreases deer recruitment, especially where other options (predator control) are limited and predators and hunters compete. (Pletscher et al. 1991, #20368)

The likelihood of wolf depredation of livestock is related to the severity of the prior winter, thus depredation can be anticipated. (Mech et al. 1988, #20269)

All reintroduced wolves should be radio-tagged and monitored routinely so that movements, behavior and fate can be determined. Also, negative conditioning of reintroduced animals can increase fear and avoidance of humans. (Fritts 1985, #20221).

Management of wolves in Minnesota is linked to the political process. (Ballenberghe 1975, #20324).

Heavy exploitation of wolves may have enhanced the value of caribou calving grounds by decreasing wolf density and the frequency of wolves hunting above tree line. (Bergerud 1988, #20171)

Wildlife managers should strive to keep caribou numbers high because range conditions, when predators are present, are generally not limiting and can support a large herbivore biomass. Such a prey base can support a larger, more consistent wolf population. However, wolves in such a system may still have to be managed to prevent negative recruitment and to reduce the magnitude of predator-prey oscillations that may span decades if left unperturbed (Bergerud 1988, #20171).

#### **Other Sources:**

The objectives of preserving or restoring the esthetic and scientific values of representative natural ecosystems/their community units requires broad ecological considerations. (Cole 1971, #20348)

An area of 3000 km<sup>2</sup> may be of adequate size to protect viable core wolf populations (Fritts and Carbyn 1995, #20551).

#### **LITERATURE CITED:**

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