

Large predators, other than wolves. Both coyotes and bobcats kill occasional deer in the Forest. The food of the bobcat in Minnesota, however, is primarily snowshoe hares. Deer is eaten but it is largely carrion (Rollings, 1945). Examination of stomach contents from seven coyotes indicated deer remains were largely carrion as they consisted of hide, hair, cartilage, and bones. Five of the seven stomachs contained hare remains. The coyote population is low in the wilderness areas of the Forest and it is not a threat to the deer population.

Starvation. Considerable numbers of deer were lost through starvation in 1933, 1937, 1939, 1943, 1948, and 1950. Mortality checks showed estimated losses of 11,000 in the Forest in 1937 of which 17 per cent were starvation, and 6,500 in 1939 of which 55 per cent were starvation (Stenlund, 1949). Approximately 200 dead deer were reported within a radius of 20 miles of Ely in 1950 and one starved deer was found per each two acres during a check made in the Brule River deer yard. Starvation is the major factor causing declining numbers in the Forest deer herd during the past twenty years.

Decreased reproductive potential. Range deterioration is accompanied by decreased reproduction in does. Among 1,334 deer examined in the Forest there was a ratio of 0.61 fawn per doe. The statewide ratio is 0.7 fawn per doe and on especially heavily over-browsed range in St. Croix Park, the ratio was 0.34 fawn per doe in 1945. Gunvalson (1952) concludes that fawn per doe averages are lower in areas which have been protected from hunting for a long time and have suffered known starvation losses.

In contrast, a fawn per doe ratio of 1.4 existed in the Mud Lake Refuge in 1949. Herd size in this area was kept down by hunting before the population could cause drastic deterioration of the range.

THE EFFECTS OF WOLF PREDATION ON GAME POPULATIONS

White-tailed Deer

Early theories on predation advanced the thought that large predators served as culling agents on big game herds by removing only diseased, aged, or crippled animals and that this proved of benefit to the herd since only the most agile animals were left to breed. Recent studies show that wolves are not as choosy as once suspected.

In order to obtain data concerning wolf-killed deer in the Forest, two approaches were used. During three winters, field notes were kept on all deer found that had been killed by wolves (Table 10). Most of these were on lakes where they had been driven by the wolves. In the final tabulation, any kills which were of a doubtful nature were discarded. A large blood spot, scattered bones, signs of a struggle, actual wolf tracks and trails, and wolf droppings were often found at kills which were classed as definite. There was no evidence that any deer were killed on lakes by any other predator than the wolf with the exception of one deer killed by coyotes.

The sex ratio of 82 wolf-killed deer was 100 males to 100 females. Since the sex ratio of fawns, as indicated by hunting kill statistics, is 96 males to 100 females (Stenlund et al, 1952), there is no indicated preference by the wolves for either sex.

Table 10 — Sex

Winter	Total Deer	Male	Female
1948-49	28	6	11
1949-50	30	9	6
1950-51	28	11	4
1951-52	22	9	5
1952-53	5	..	2
TOTALS	113	35	28
PERCENTAGES		5670	44

A comparison of hunter bag o evaluate possible preference of wolf during four hunting seasons, 1946- to checks made during the 1952 se kill of 1,168 deer. In addition, sta show fawns making up 23 per cen from 1942 through 1949 (Gunvalso wolves (25.7 per cent as shown in a chi-square test of these percenta

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A sample of 45 deer jaws exam that deer up to 6½ years old provi

Table 11 — Age of
by T

Winter	Fawns	1	2
1950-51	4	..	1
1951-52	2	..	1
1952-53	1	1	..
TOTALS	7	1	2
PER CENT	20	*Estimated to be	

20 3 6

Table 10 — Sex and Age of Wolf-Killed Deer

Winter	Adults				Fawns				Total
	Total Deer	Male	Female	?	Total	Male	Female	?	
1948-49	28	6	11	5	22	..	..	6	6
1949-50	30	9	6	6	21	..	6	3	9
1950-51	28	11	4	4	19	2	7	..	9
1951-52	22	9	5	4	18	4	..	..	4
1952-53	5	..	2	2	4	..	..	1	1
TOTALS	113	35	28	21	84	6	13	10	29
PERCENTAGES		56.7%	44.0%		74.3	3.2%	68.0%		25.7

A comparison of hunter bag check data and age data from Table 10 was made to evaluate possible preference of wolves for fawns. Age data obtained at checking stations during four hunting seasons, 1946-1949, in the Forest (Stenlund et al, 1952) in addition to checks made during the 1952 season, show fawns made up 22.3 per cent of a hunter kill of 1,168 deer. In addition, statewide averages as reported on hunters' report cards show fawns making up 23 per cent of the kill of approximately a quarter-million deer from 1942 through 1949 (Gunvalson et al, 1952). The percentage of fawns killed by wolves (25.7 per cent as shown in Table 10) is slightly higher than these averages, but a chi-square test of these percentages indicated no significant difference between them.

During three winters, 1950-1953, lower jaws were collected from wolf-killed deer (Table 11), and aged according to the method described by Severinghaus (1949). Although the sample of aged jaws is small, the percentage of fawns (20 per cent) compares favorably with the Forest ratio of 22.3 per cent and the state average of 23 per cent.

Of adult deer (Table 11) only two, or 7 per cent, were considered old; all others were in the prime of life. Most deer jaws were obtained from areas where little hunting was done; thus one would expect a good number of old animals. There is no indication that wolves tend to take old animals in preference to those in the prime of life.

A sample of 45 deer jaws examined during the 1952 hunting season also suggested that deer up to 6½ years old provided the bulk of the hunter take in the Ely area.

Table 11 — Age of Wolf-Killed Deer as Determined by Tooth Examination

Winter	Fawns	Age by Years								Over 8	Total
		1	2	3	4	5	6	7	8		
1950-51	4	..	1	6	3	..	2	1	..	1*	18
1951-52	2	..	1	..	1	3	3	..	..	..	10
1952-53	1	1	..	..	4	..	2	..	..	..	8
TOTALS	7	1	2	6	8	3	7	1	0	1	36
PER CENT	20	*Estimated to be 12 or 13 years old.									

20 3 6 18 43 9 20 3 3

The number of diseased or crippled deer among those killed by wolves is unknown. It is believed, however, that their numbers are negligible. There is no evidence that Superior National Forest deer suffer from any serious disease or heavy parasite infection. Undoubtedly a number of crippled deer roam the woods after hunting season, but there is little or no hunting in the areas from which most of the jaws from wolf-killed deer were obtained.

Just how many deer do wolves kill? If sufficient data were at hand to answer this question irrefragably, many problems in predator-prey relationships would be solved. Again, as in attempting to determine a circuitous travel route for wolves, it would be necessary to follow or backtrack wolf trails for several weeks to find the answers.

Dunne (1939) reported following wolf packs in Ontario for one or two days at a time. On one occasion ten wolves killed three deer in a small area. Fresh snows prevented trailing for a longer period.

Ainer Snyder, veteran trapper of Buyck, Minnesota, followed a pack of nine wolves for four days during the winter of 1928. Seventy-two wolf-killed deer were found, often three or four in one area. This was during the period when the Forest deer herd was near its peak in numbers.

Olson (1938) concluded that wolves killed a deer per $1\frac{1}{4}$ square miles (0.8 deer per section) in the Forest annually when the population of deer approximated eight per section.

Although no single pack was followed to determine exactly how many deer were killed, it appears from scattered field notes on travel and on packs remaining in the vicinity of kills, that a pack of three wolves kills a deer every four days during the winter.

Depth of snow has considerable effect on locations where deer are killed. During average winters, wolf-killed deer are first found on lakes in December. In severe winters wolf kills begin to appear on the lakes in late November and are found regularly through February. The winters of 1951-52 and 1952-53 were abnormally mild with little early snow. As a result, few wolf-killed deer appeared on the lakes and most deer attempted to outrun wolves in the woods.

During the winter of 1948-49, a total of 61 wolf-killed deer was reported by all reliable sources. Most of these appeared on the lakes and were found from the air. During 1949-50, a total of 53 wolf-kills were reported and 60 were reported in 1950-51. Observations of wolf-killed deer, therefore, remained relatively stable during the three-winter period. Reports dropped drastically during the following two winters due to the lack of snow in the woods and restrictions on air travel.

With an estimated wolf population of 240 animals in the 4,100 square-mile Forest study area, and every three wolves killing a deer each four-day period approximately 3,000 deer are killed during the five-month period, November through March. Another 3,000 are probably taken during the seven-month period, April through October, for an estimated take of 6,000 per year, or 1.5 deer per section, annually.

During the peak deer population in the Superior National Forest in 1939, deer census drives on 22 areas showed an average of 12.2 deer per section, or a total of 50,000 deer on the 4,100 square-mile area (Fredine, 1940). Although no deer drives have been made since 1940, it is believed that the present population is about nine deer per section, or

37,000 in the study area. A wolf kills 1 per cent of the herd each year. Actually little or no hunting is done, due to

Hunting checks made on a ten-section area removed only 0.65 deer per section during the fall. In some areas accessible to hunters they only remove 2.15 deer from a section. In some areas accessible to hunters during the fall. In other areas deer are killed by a hunter's gun. It appears, then, that an annual crop of deer in parts of the Forest, mean, however, that hunters would have been able to eliminate the deer population were eliminated. Intensified hunting would produce more deer for a time in the Forest, but range deterioration and lead to large losses occur every third or fourth year.

The ruffed grouse is a prominent game animal in the Forest. Evidently it has been present in the Forest since December 2, 1896, had an article which mentioned birds from a market hunter who stated the prevailing price of \$1.80 per dozen.

During the seven-year period 1945-51, the number of grouse in the Forest varied from eleven birds per section (Unpublished U. S. Forest Service Report).

Drumming counts conducted during the winter of 1949 to 105 per square mile in 1953 (Unpublished U. S. Forest Service Report).

Stomach analyses on 24 wolves and compared with analyses of 27 turkeys in occurrence of grouse remains. Results show that the wolf has little or no effect on the grouse population.

Another forest prey animal is the hare. Since 1945 hares have been taken in the Forest. There is no evidence that the wolf has little or no effect on the hare population.

Although wolf stomach analyses have shown that wolves feed on beaver whenever available, there is no evidence that the wolf has little or no effect on the beaver population.

37,000 in the study area. A wolf kill of 6,000 deer annually, therefore, removes about 16 per cent of the herd each year. Actually, many of these deer are taken from areas where little or no hunting is done, due to inaccessibility or established game refuges.

Hunting checks made on a ten-township area during 1947-1949, showed that hunters removed only 0.65 deer per section (Stenlund et al, 1952). The wolf, therefore, appears to harvest more of the present deer crop than does the deer hunter, although together they only remove 2.15 deer from a section, or 24 per cent of the existing estimated population. In some areas accessible to hunters wolves kill deer which could provide hunting during the fall. In other areas deer eliminated by wolves would never hear the report of a hunter's gun. It appears, then, that hunters and wolves together are removing the annual crop of deer in parts of the Superior National Forest. It does not necessarily mean, however, that hunters would be able to harvest more deer consistently if the wolf population were eliminated. Intensive wolf control and closed hunting seasons would produce more deer for a time in the areas accessible to hunters, but would also hasten range deterioration and lead to larger starvation losses during the severe winters which occur every third or fourth year.

The Ruffed Grouse

The ruffed grouse is a prominent constituent of the bird life in the Superior National Forest. Evidently it has been present in numbers for at least six decades and undoubtedly was common along the edges of the original pine forest. The Ely Miner for December 2, 1896, had an article which reported that the local game warden seized 825 birds from a market hunter who stated that 50,000 had been shipped from Tower at the prevailing price of \$1.80 per dozen.

During the seven-year period 1934-1940, the population of one census area in Cook County varied from eleven birds per section in 1935 to 133 birds per section in 1940 (Unpublished U. S. Forest Service Data).

Drumming counts conducted during the present high show populations from 59 per square mile in 1949 to 105 per square mile in 1952 in northern Minnesota (Petraborg et al, 1953).

Stomach analyses on 24 wolves taken during the low grouse population of 1946-1947 and compared with analyses of 27 taken during 1951-1952 showed no significant increase in occurrence of grouse remains. Ruffed grouse form only a minor part of the wolf's diet.

Snowshoe Hare

Another forest prey animal is the snowshoe hare. Its numbers vary depending upon the habitat. Since 1945 hares have been common in the Forest in brushy and lowland areas. There is no evidence that hares are important in the winter diet of the wolf and the wolf has little or no effect on hare populations in the Forest.

Beaver

Although wolf stomach analyses showed no beaver remains, reports received indicate wolves feed on beaver whenever they are caught on land or ice.

THE WOLF, TH

During times when optimum wolf populations have had little effect, concludes for the Rocky Mountain, there evidence here that, under certain game irruptions. Under existing conditions, lynx, wolverine, mountain lion, grizzly bear, and other predators, the annual net increment to the game population is small, and the percentage of which becomes carrion following

Similar conditions existed in the deer population, 1925-1940, and to malnutrition.

During that peak population period, which may have been doubled or even tripled, the world population was kept in check by the overpopulation by the hunter and gatherer. These conditions would have been maintained had the world remained present.

Under present conditions, the herd continues to suffer losses to starvation, but continues to suffer losses to starvation. Two abnormally mild winters, 1951-52 and 1952-53, due to alleviation of browsing pressure, have resulted in future are inevitable. From a purely economic standpoint, a herd is necessary to prevent widespread overgrazing of the range. From the hunter's point of view, the herd is overhunted. The problem is to provide better hunting opportunities in order to provide better hunting opportunities, likely that with natural plant succession, some starvation losses will occur.

During the one year out of three when, then, is definitely beneficial because of the deer on overburdened range. During the two years when the areas accessible to hunters which cover 60% of the areas, deer taken by wolves are not taken by hunters. Deer do not compete with the hunter.

At present, figures show that in the hunting pressure, only the annual increase in consecutive annual hunting seasons. The Forest deer herd suffered uniformly in the hunting pressure. Under these conditions it is suggested that the hunting pressure should be reduced in the hunting seasons until field surveys show

THE WOLF, THE DEER, AND THE HUNTER

During times when optimum feeding conditions exist for deer, it is apparent that wolf populations have had little effect in reducing overall deer numbers. Cowan (1947) concludes for the Rocky Mountain National Parks of Canada that, "There is thus further evidence here that, under certain circumstances, predators are powerless to prevent game irruptions. Under existing circumstances the predators present—coyote, wolf, fox, lynx, wolverine, mountain lion, grizzly and black bear—together are not taking the annual net increment to the game herds, nor even removing the cull group, a large part of which becomes carrion following death from disease, parasitism, or malnutrition."

Similar conditions existed in the Superior National Forest during the peak period of the deer population, 1925-1940, and to a certain extent exist today as deer are still lost to malnutrition.

During that peak population period when the deer harvest could and should have been doubled or even tripled, the wolf was of direct benefit to the herd. If reduction of the overpopulation by the hunter and the wolf had been great enough, better range conditions would have been maintained and the deer population would have been larger at present.

Under present conditions, the reduced deer herd offers fewer targets for the hunters but continues to suffer losses to starvation every three or four winters. During the past two abnormally mild winters, 1951-52 and 1952-53, some hardwood browse has recovered due to alleviation of browsing pressure on normal winter range, but severe winters in the future are inevitable. From a purely biological standpoint, further reduction of the deer herd is necessary to prevent widespread heavy losses from starvation and further deterioration of the range. From the hunter's viewpoint this is undesirable; he already believes the herd is overhunted. The problem resolves itself into allowing starvation one spring in order to provide better hunting success during the three or four succeeding falls. It is likely that with natural plant succession and the accompanying deterioration of deer range, some starvation losses will occur periodically even with a reduced deer herd.

During the one year out of three or four that starvation normally occurs, the wolf, then, is definitely beneficial because it removes animals, and alleviates browsing pressure on overburdened range. During the three subsequent years, wolves eliminate deer in areas accessible to hunters which could possibly be harvested by hunters. In inaccessible areas, deer taken by wolves are not available to hunters. In such areas the wolves do not compete with the hunter.

At present, figures show that in areas which sustain both wolf predation and hunting pressure, only the annual increment is removed from the deer herd. Despite eight consecutive annual hunting seasons and continuous wolf predation, the Superior National Forest deer herd suffered uniformly severe losses during the spring of 1950 due to starvation. Under these conditions it is sensible game management to maintain annual hunting seasons until field surveys show cause to do otherwise.

THE WOLF, THE WILDERNESS, AND NATIONAL FOREST POLICY

It is generally agreed that wolf control is of little value in inaccessible wilderness areas. Grange (1949) in discussing predator control states, "Wilderness areas should receive no predator control, except in the case of sanctuaries for species on the verge of extinction; and there only after competent field study."

Young (1944) suggests that little wolf control work remains in the United States and that areas still exist where wolves may be allowed to continue living with little molestation. In discussing the general predation question, Presnall (1950) quotes J. Dewey Soper and Ira Gabrielson in concluding that predators take only surplus animals in wilderness conditions where hunting is not practical. "On such areas and on areas where predators do not jeopardize livestock or game on or near the area, the Fish and Wildlife Service does not advocate or practice predator control."

Phillips (1939) goes one step further in advocating the "restoration of mammals to as near a primitive condition as possible in suitable areas, even if that should mean re-introduction of a once-despised predatory species!"

Regarding the policy of the U. S. Forest Service in dealing with predation in wilderness areas, predator control is discouraged unless well-founded reasons are presented. Furthermore, any species in danger of extinction is to be investigated thoroughly. The fact that natural predation in remote areas may be beneficial is recognized (U. S. Forest Service, 1952).

Even more specific is the plan of management of the Superior National Forest "roadless areas" which suggests that, "The increasing use of the fishing resources and the maintenance of desirable numbers of wolves, fisher, and other rare animals present special problems of wildlife management." (U. S. Forest Service, 1950.)

For the most part, the "roadless areas" are inaccessible to hunters. Furthermore, much of the area produces fewer deer than found nearer roads and developments. Although the home range of some wolf packs invade accessible areas, there are considerable areas where the wolves are of actual benefit to the existing deer population. A small, stable population of wolves and deer has existed in the Insula-Little Saganaga-Knife Lakes area for at least 25 years. Deer feed is not abundant or extensive but where it is found it is not over-browsed. It appears that this area will continue to support both wolves and deer for years to come. It is ideally suited for maintaining a reasonable wolf population and since it was not cut during the early logging days, it also provides primitive vegetative habitat and other animal populations which are of inestimable value from an ecological view. The current study has shown the value of using primitive wilderness areas as controls for comparing with disrupted or developed areas. These primitive habitats and animal populations will become even more valuable in the future as outlying areas are developed further.

The "no-cut" area and parts of the "roadless" area of the Superior National Forest afford an excellent opportunity to establish permanent study areas for animal and plant ecology investigations. The timber wolf is an integral part of these wilderness areas and a reasonable population should be maintained. It is not only a major component of the ecological community, but as the recreational value of this unique area increases, the howl of the timber wolf will continually remind visitors that this lake country of the Superior National Forest is wild country—wilderness country—remaining today much the same as it existed during the era of the French Voyageur some 200 years ago.

The Superior National Forest extends from the Canadian border to the north and Lake Superior to the west. The winter of 1946-47 and the five following winters the wolf was concentrated in a 45-township area. The study was done in an area of 4,100 square miles.

The dominant physiographic features of the Superior National Forest are the ancient Laurentian Upland rock formations and the Superior Lake.

Pollen studies indicate coniferous forest cover since the last glacial period 1885-1920 caused a major climatic change in plant and animal life.

Big game populations of caribou, moose, and elk, and caribou.

The major timber wolf range in the Superior National Forest is in the north. Wolves prefer the wild, heavily wooded areas. The wolf population in the Forest Service area is estimated at 100.

Although wolves and deer are present in the Superior National Forest, populations of both are higher in the north. The wolf population is declining to the east and west. Wolf populations have been present for at least 25 years. The cutover areas have recently more wolves, because the wolves are not hunted in the uncut areas.

Apparently wolves travel home from the north often encroach upon them during the winter.

During three winters a total of 51 observations were made of flying time.

It is estimated that the Forest Service area of 4,100 square miles or one wolf per square mile has a larger number of wolves than the area across the International Border. Wolf populations in 1940 and have since declined to a level of 100.

Records of eight wolf litters were made in the Superior National Forest, for an average of 6.4.

Sixty-seven stomachs taken from wolves were empty. Remains of three mammals were found. Deer comprised 95.5 per cent of the contents. Hare, porcupine, and ruffed grouse were found. Wolves continue to take big game and the study is of increasing importance because of the decline in big game.

SUMMARY

The Superior National Forest, located in northeastern Minnesota, is bounded by Canada to the north and Lake Superior to the east. Field data were gathered during the winter of 1946-47 and the five winters from 1948 through 1953. Intensive field work was concentrated in a 45-township area with Ely as headquarters. Extensive work was done in an area of 4,100 square miles.

The dominant physiographic feature of the Forest is the southern extension of the ancient Laurentian Upland rock formation from Canada.

Pollen studies indicate conifers and jack pine, especially, have formed the dominant vegetative cover since the last glacial period. Extensive logging operations during the period 1885-1920 caused a major disruption of the natural plant succession. The subsequent changes in plant and animal communities were a direct result of this disruption.

Big game populations of caribou, moose, elk, and deer once existed. Apparently the only animals which once inhabited the area but are no longer found are the wolverine, elk, and caribou.

The major timber wolf range in Minnesota covers approximately 12,000 square miles. Wolves prefer the wild, heavily wooded, but not necessarily virgin, forests of the north. The wolf population in the Forest is the largest remaining in the United States.

Although wolves and deer are found generally throughout the Border Study Area, populations of both are higher in the cutover area north of Ely than in the uncut areas lying to the east and west. Wolf and deer numbers have been lower in the uncut areas for at least 25 years. The cutover and burned over area supports more deer, and consequently more wolves, because the habitat is more suitable for deer than that found in the uncut areas.

Apparently wolves travel home ranges with indefinite boundaries and other wolves often encroach upon them during their travels.

During three winters a total of 634 flying hours was logged and 151 wolves were seen in a total of 51 observations. Eight wolf observations were made every 100 hours of flying time.

It is estimated that the Forest supports a population of 240 wolves on an area of 4,100 square miles or one wolf per 17 square miles. It is possible that the area supports a larger number of wolves than that found in the Quetico Provincial Park of Ontario across the International Border. Wolf numbers reached a high during the period 1925-1940 and have since declined to a level above and below which they fluctuate.

Records of eight wolf litters were received, the largest being nine and the smallest four, for an average of 6.4.

Sixty-seven stomachs taken from winter-killed wolves were examined, of which 16 were empty. Remains of three mammals and one bird constituted the stomach contents. Deer comprised 95.5 per cent of the total contents by volume and 80.4 per cent by occurrence. Hare, porcupine, and ruffed grouse together made up 4.5 per cent of the total contents by volume. Otter, moose, mink and beaver are also taken during the winter. Wolves continue to take big game during the summer, but smaller animals are believed to be of increasing importance because of greater availability.

A total of 156 wolves was weighed and measured. The largest male weighed 112 pounds and measured 69 inches. The largest female weighed 80 pounds and measured 61¼ inches. It is evident that male pups weigh 50 pounds or more by November and female pups weigh 40 pounds or more. It is likely that any wolf weighing more than 85 pounds is a male.

One hundred twelve observations of wolves were made from the air and on the ground and a total of 318 wolves was seen for an average of 2.8 wolves per observation. Single wolves (48) made up 41 per cent of all observations. The largest pack recorded was one of 15.

Travel routes are governed largely by topography. Apparently trails are used consistently for years, but definite circular routes were not proven. A single large wolf was clocked at 35 to 40 miles per hour for a distance of four miles while running on a lake.

The total take of wolves by man approximates one wolf per 41 square miles in the major wolf range of St. Louis, Lake, and Cook Counties (6,984 square miles). This annual take approximates 41 per cent of the wolf population. Since it is believed that the number of wolves has remained relatively stable during the past five years, it is possible that the bounty system is controlling their numbers. However, it is not known if the wolves would increase if all bounty payments were removed. Natural controls appear to keep wolf numbers down in areas where little or no predator control is maintained.

Intestines of 18 wolves were examined for parasites. Sixteen contained parasites in the small intestine. Three species of tapeworms and one of roundworms were found.

Of 156 wolves examined, 100, or 64 percent, were males. Of 58 shot from planes and 45 snared, 60 per cent were males in each instance. Perhaps this unbalanced sex ratio is a natural control on wolf numbers in the Forest.

Another natural control may be that of established home ranges with broad boundaries.

The number of nonproductive female wolves remains unknown.

The original white-tailed deer population was low in the Forest. The build-up to a peak period reached in the 1930's was due to three conditions: (1) The transformation of a virgin coniferous forest relatively devoid of extensive good deer habitat into a second growth hardwoods forest capable of supporting large numbers of deer; (2) the presence of thousands of acres of unbrowsed cedar swamps; (3) the several restrictions placed on deer hunting.

The decline in deer numbers was not due to overhunting or wolf predation but due to starvation as a result of general range deterioration. Extensive starvation occurred six times in the 20-year period 1933-1953. This range deterioration was due to four conditions: (1) The almost complete elimination of cedar as an available food; (2) overbrowsing of hardwoods; (3) the second growth timber reached maturity; (4) natural succession toward a coniferous forest.

Deer hunting pressure in the Forest is generally light when compared with that found throughout the state. Since the decline in deer numbers, the deer population has fluctuated above and below a plateau depending on wintering conditions.

Bobcats and coyotes take occasional victims.

Starvation has been the major factor.

Range deterioration has been a factor. A ratio of 0.61 fawn per doe exists as compared to 1.0 in the past.

There is no apparent preference for deer killed is close to that found in the past. Fawn deer over adults during winter. That taken by hunters. Neither is there any preference for those in the Forest available in most cases.

Indications are that a pack of wolves kills 1.5 deer during the winter. It is estimated that 1.5 deer are killed during the winter. In other terms, 1.5 deer are killed per section, or 16 per section in parts of the Forest. or 24 per cent of the estimated population. mates the annual increment to the population.

Wolf predation on ruffed grouse and grouse population. The wolf has killed grouse.

Wolves take occasional beaver. The destruction of beaver food supplies would be a further loss for food.

The moose population was decimated. Indications are that moose numbers are recovering. The exact effect of wolf predation on the herd might recover more quickly if the population were larger.

Fox, bobcats, coyotes, and birds of prey take occasional victims as wolf-killed deer are used as bait.

During the peak period in the 1930's, the deer population was maintained a higher deer population for a period. Under existing conditions, losses and yet offers fewer targets for wolf predation to the deer herd during starvation periods. areas during years with mild winter. natural control and help stabilize deer numbers during seasons and wolf predation, the Forest population is maintained.

The U. S. Forest Service discloses well-founded reasons are presented. of the Forest afford an excellent opportunity for ecology study plots. A reasonable estimate of the animal is an integral part of the Forest.

Bobcats and coyotes take occasional deer but they are not important big game predators.

Starvation has been the major decimating factor in the Forest deer herd.

Range deterioration has been accompanied by decreased reproduction in does. A ratio of 0.61 fawn per doe exists as compared with 0.7 fawn per doe statewide.

There is no apparent preference by wolves for either sex of deer as the sex ratio of deer killed is close to that found in deer taken by hunters. Wolves show no preference for fawn deer over adults during winter months and take fawns in a proportion similar to that taken by hunters. Neither is there any indication that wolves tend to take aged animals in preference to those in the prime of life. Apparently wolves kill the first deer available in most cases.

Indications are that a pack of three wolves kills a deer approximately every four days during the winter. It is estimated that 3,000 are killed during the five-month period November through March, and another 3,000 during the seven-month period following. In other terms, 1.5 deer are killed per section annually from an estimated deer population of nine per section, or 16 per cent of the herd. Hunters remove less than one deer per section in parts of the Forest. Both hunter and wolf remove 2.15 deer per section, or 24 per cent of the estimated population from areas accessible to hunters. This approximates the annual increment to the herd during years with normal weather.

Wolf predation on ruffed grouse showed no increase during the recent high in the grouse population. The wolf has little or no effect on hare numbers in the Forest.

Wolves take occasional beaver when they are caught away from water. Deterioration of beaver food supplies would increase wolf predation as beaver are forced to travel further for food.

The moose population was decimated by hunting, alteration of habitat, and disease. Indications are that moose numbers have increased during the past four years. Although the exact effect of wolf predation on moose is unknown, it is possible that the moose herd might recover more quickly if completely relieved from wolf pressure.

Fox, bobcats, coyotes, and birds such as ravens and eagles benefit from wolf predation as wolf-killed deer are used extensively by these animals for food.

During the peak period in the deer population the wolf was of benefit to the herd because any reduction of the overpopulation at that time helped the range and maintained a higher deer population for a longer period than would otherwise have been possible. Under existing conditions the reduced deer herd continues to suffer starvation losses and yet offers fewer targets for deer hunters. The wolf continues to be of benefit to the deer herd during starvation winters but competes with the hunter in accessible areas during years with mild winters. In inaccessible areas, wolf predation may effect a natural control and help stabilize deer numbers. Despite eight consecutive deer hunting seasons and wolf predation, the Forest deer herd suffered a severe starvation loss in 1950.

The U. S. Forest Service discourages predator control in wilderness areas unless well-founded reasons are presented. The "no-cut" area and parts of the "roadless" area of the Forest afford an excellent opportunity to set up permanent animal and plant ecology study plots. A reasonable wolf population should be maintained in these areas as the animal is an integral part of the wilderness.

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