ALASKA DEPARTMENT OF FISH AND GAME
JUNEAU, ALASKA

STATE OF ALASKA
Jay S. Hammond, Governor

DEPARTMENT OF FISH AND GAME
James W. Brooks, Commissioner

DIVISION OF GAME
Frank Jones, Director
Donald McKnight, Research Chief

WOLF REPORT

by

Robert O. Stephenson

Volume XIV
Project Progress Report
Federal Aid in Wildlife Restoration
Project W-17-7, Job 14.3R (2nd half)
and
Federal Aid in Wildlife Restoration
Final Report
Projects W-17-3 through W-17-7, Jobs 14.4R and 14.5R

(Printed August, 1975)

PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperator: Robert O. Stephenson

Project No.: W-17-7 Project Title: Big Game Investigations

Job No.: 14.3R Job Title: Characteristics of Exploited Wolf Populations

Period Covered: January 1, 1975 to June 30, 1975

SUMMARY

Estimates of wolf abundance made in Interior and Arctic Alaska are reviewed. Data gathered in the northcentral Brooks Range indicate that wolf populations in the vicinity of Anaktuvuk Pass increased from a density of approximately 1 wolf per 124 square miles in spring 1971 to 1 wolf per 75 square miles in spring 1973. During the winters of 1973-74 and 1974-75 subjective observations made by the residents of Anaktuvuk Pass indicated that the wolf population in the vicinity of Anaktuvuk Pass showed no further increase over the level observed in 1973. However, in the eastern Arctic and in the vicinity of the Colville and Chandler Rivers northwest of Anaktuvuk there were indications of a significantly reduced wolf population. There was evidence of illegal aerial hunting in both areas during the winters of 1973-74 and 1974-75. Aerial surveys conducted in Game Management Unit 20A in Interior Alaska during late winter 1973, 1974 and 1975 indicated that wolf density there was on the order of 1 per 33 to 68 square miles with autumn populations comprising 200 or more animals in the 7,000-mi^2 area.

CONTENTS

BACKGROUND

The general background of wolf (*Canis lupus*) studies in Alaska has been discussed extensively in previous reports (cf: Rausch 1966, 1967, 1969; Stephenson and Johnson 1972). By virtue of intelligence, mobility, low population density relative to other large mammals and the remote character of its habitat wolves are difficult animals for which to obtain data reflecting population density.

In 1973 the Department initiated an effort to develop and refine techniques for aerial surveys and to apply these techniques in an effort to quantify wolf abundance in certain game management units. Extensive population surveys were conducted during late winter in Game Management Units 20 (1973, 1974, 1975) and 13 (1974). Prior to this time estimates of wolf abundance, based on various kinds of information, were made in Southeastern Alaska (Atwell et al. 1963), Southcentral Alaska (Rausch 1969) and Arctic Alaska (Stephenson 1975). Reliable data reflecting wolf population levels are valuable in assessing the impact of hunting on wolf populations as well as the interrelationships between wolves and wolf prey species.

OBJECTIVE

To assess wolf population levels and determine the characteristics of exploited wolf populations in Southcentral, Interior and Arctic Alaska.

PROCEDURES

In January 1974 a memorandum outlining basic procedures to be followed in conducting wolf surveys was distributed to Department personnel likely to be involved in wolf surveys. The procedures were outlined in cooperation with Department biologist Pete Shepherd, who has a great deal of experience in aerially tracking wolves. The following points constituted the basis for designing surveys.

1) Of crucial importance to the accuracy of a wolf survey is the presence of fresh snow. The confusion encountered in reading

tracks increases almost geometrically with the increasing density of animal tracks as time passes after a fresh snow. Ideally, aircraft and personnel should be available on a day's notice beginning in mid-February so the maximum amount of flying can be undertaken during the first two or three days following a fresh snowfall. A few inches of fresh snow is sufficient to allow distinguishing new tracks from old. The best survey conditions are encountered during clear weather following a fresh snowfall. Sunlight enhances track definition greatly.

2) Besides fresh snow and direct sunlight the greatest help in successfully doing these surveys is to have a pilot experienced in aerially tracking wolves and one who is familiar with the the area intended for survey. The best aircraft for these surveys are ski-equipped Super Cubs (PA-18's); preferably two or more of these aircraft should be used simultaneously in adjoining areas.

3) The larger the area surveyed, the less important become the inherent errors due to chance occurrence of "resident" wolves outside the survey area. Survey area boundaries are arbitrary and don't necessarily conform to the "territorial" boundaries of wolf packs. Wolf packs in Alaska can be expected to range over from about 500 to 5,000 mi^2 with most "territories" being in the lower end of that range. As a rule of thumb each survey should cover at least 1,500 mi^2 or more. This size area can be covered adequately in most terrain with a Super Cub in one day (4 to 7 hours of flying).

4) In designating areas to be surveyed consider differences in density of prey species and to the extent possible select survey areas representative of each major faunal association. Wolves are highly mobile and can quickly concentrate in areas with high prey densities. Not taking this into account could result in vastly inflated estimates of wolf numbers if results were extrapolated to an entire game management unit, for example.

5) Entire drainages, or large parts of drainages, may be designated as survey areas and this often makes navigation easier since drainages are usually bordered by more or less obvious landmarks. Flight routes should coincide in a general way with terrain on which tracks are visible and over which wolves are likely to travel. Drainage systems offer the greatest opportunity to aerially locate and follow wolf tracks in most areas and flight routes should conform to these with deviations to check lakes, trails, open ridges, knolls and other likely promontories. Wolves tend to travel on ridgetops and also seek these out as resting places. In areas where terrain is generally homogenous, transects a few miles apart should be flown. If such areas are small (on the order of 20 sq. mi. or less) and bordered by streams or other open areas which would

show tracks, flying the periphery is sufficient since wolves will rarely remain in heavy cover for long time periods when snow cover is heavy.

6) An important aspect of interpreting the results of these surveys consists of expressing the density of wolves in square miles per wolf. The area in square miles should be determined for each survey area using a planimeter or by enumerating townships. Doing this provides a common denominator for results so they may be compared with results from other studies in Alaska and elsewhere.

7) When wolf tracks are sighted, the first effort should be to establish the direction of travel and number of wolves involved. If tracks are fresh and in terrain in which they can be followed, this should be done as long as possible or until the wolves are located. The next best thing to seeing the wolves is to land and count the tracks on a lake or other opening where tracks indicate that pack members have spread out briefly. Larger packs warrant more careful attention than packs of only two or three animals and landing at the earliest opportunity can help to avoid confusion and error in determining numbers. When wolves are located they should be circled widely at an altitude of about 500 feet until a good count and description of the animals are obtained. The location of wolves and their tracks, the direction of travel and travel routes should be indicated on 1:250,000 maps. When there is a possibility of duplication in the enumeration of wolves based on the occurrence of tracks, they should be followed and/or intervening areas searched.

In addition to the points summarized above, the memorandum outlining proposed survey techniques including basic information relating to the differentiation of other large mammal tracks from those of wolves, general habits of wolves, ways to determine direction of travel of wolves from tracks, characteristics of wolf den sites, and suggestions as to physical and behavioral characteristics which can be used to differentiate pup from adult wolves during early winter were included. All of these suggestions were utilized during wolf surveys.

FINDINGS

Wolf Surveys, GMU 20, 1973

The most intensive survey efforts in GMU 20 were conducted in subunit 20A, a 7,000 mi^2 area adjacent to Fairbanks. A major decline in moose numbers in this important hunting area prompted intensive wolf survey efforts in order to provide basic information on wolf abundance necessary to assess the role of wolf predation in causing the decline in moose (*Alces alces*) numbers and in maintaining the moose population at a low level in the future. In 1973, however, surveys were also undertaken in adjacent portions of GMU 20.

Between March 13 and 27, 1973, 37 hours of flying were devoted to wolf surveys in areas adjacent to Fairbanks. The effort was marginally successful as only one sufficiently heavy snowfall occurred in March and the last two days of survey flying took place under thawing conditions. Areas surveyed included the entire Chena River drainage, the upper Charley River, the Yukon Fork of Birch Creek, the Salcha River, the upper portion of Beaver Creek, the Tanana Flats from Dry Creek west to the Totatlanika River and the Tatalina and Tolovana River drainages on the Minto Flats. The drainages and portions thereof surveyed totaled 9,030 square miles and observations of wolves and tracks suggested that 20 different packs totaling 101 wolves were present in the area surveyed. This indicates an average density of 1 wolf per 89 square miles. Densities indicated for specific survey areas ranged from 1 wolf per 33 square miles in the northern portion of the Tanana Flats to 1 per 140 square miles in upper Beaver Creek and the upper Charley, Salcha and Birch Creek areas. These figures should be regarded only as minimum densities, however, due to relatively poor snow conditions and light coverage given a number of areas.

It was evident that wolf densities were higher at lower elevations such as the Tanana Flats and the lower portions of drainages such as the Chena, than at higher elevations. This observed difference in wolf density probably corresponds to a similar difference in moose density which is generally maximal in lowland habitat at this time of year.

Wolf Survey, GMU 20A, 1974

During the first two weeks of March 1974 an attempt was made to determine wolf numbers in GMU 20A which encompasses 7,000 square miles of the Tanana Flats and northern Alaska Range. Heavy snowfall and high winds occurred between March 1 and 4. Following this storm survey conditions were excellent and a total of 8.2 hours were flown on March 5 and 6 in a 2,100 mi^2 area between the Totatlanika River on the west, Dry Creek on the east, with the foothills of the Alaska Range and the Tanana River forming the southern and northern boundaries, respectively. Fresh tracks indicated that a minimum of 43 wolves (in groups of 10, 6, 6, 5, 3, 3, 3, 2 and 2) were present in this area. The foothills and mountains south of this portion of the Flats could not be flown soon after the snowfall due to continued high winds in these areas. Information from two trappers whose traplines extend along the mountains and foothills between Dry Creek and the Tatlanika River suggested that an additional 49 wolves were located in a 1,300 mi^2 area south of the area surveyed by aircraft indicating as many as 92 wolves may have been present in a 3,400 mi^2 area, a density of 1 wolf per 40 square miles. If this density held over the remainder of the subunit a total of 175 wolves would be present in the 7,000 mi^2 area.

The reported 1973-74 harvest of wolves in GMU 20A, based on data from sealing forms, was 51 animals. This indicates that the 1973 autumn population may have been in excess of 200 animals, a density on the order of 1 wolf per 35 square miles.

Wolf Surveys, GMU 20A, 1975

During March and April 1975 a total of 53.5 hours were flown in both Helio Courier and Super Cub aircraft in an effort to determine wolf numbers in GMU 20A. Two inches of fresh snow on March 5 provided good survey conditions and 27.5 hours were flown on March 6, 7, 10, 11 and 13.

A light snowfall on March 22 provided marginal survey conditions but considering the late date and the small likelihood of better conditions occurring before the spring thaw an additional 26 hours were flown on March 25, 26 and 27. Most intensively covered were the flats and foothills from Dry Creek west to the Totatlanika River. During the latter period, however, the mountainous portions of the subunit including the upper Wood River, Yanert River, Moody Creek, upper Tatlanika and Totatlanika Rivers, upper Dry Creek and upper Little Delta River were surveyed. The total area encompassed by these surveys totals roughly 4,700 square miles, about 70 percent of the entire subunit. During this survey, which was more intensive that that done in the previous 2 years, groups of 6, 11, 11, 10 and 2 wolves were seen by Department observers; during the same time an additional pack of 11 wolves was seen by another reliable observer and fresh tracks combined with observations made by part-time residents of the area suggested that two additional packs consisting of 8 and 10 wolves inhabited the area surveyed. These data suggest that a minimum of 69 different wolves may have been present in the 4,700 mi^2 area, constituting a density of 1 wolf per 68 square miles. If this density held over the entire subunit a total population of 103 wolves would inhabit the area. Data from wolf sealing forms indicate that 59 wolves were taken legally by hunters and trappers in this unit during the 1974-75 season. The estimated late winter population of wolves plus the known human-caused mortality suggest that the pre-hunting season population was at least 190 wolves, a density of 1 wolf per 37 square miles, assuming stable home range boundaries for wolf packs in the area. Due to the unknown effects of natural mortality, unreported human-caused mortality and inaccuracies of survey techniques this estimate of wolf density probably represents a minimal figure.

Wolf Population Status GMU's 24 and 26, 1971-1975

An effort to evaluate changes in wolf population density in the vicinity of Anaktuvuk Pass was begun in late winter 1971. Population estimates were based primarily on ground observations of wolves and their tracks made by about 10 Nunamiut hunters and myself and on a limited amount of aerial survey work carried out during early and late winter in the 3,600 mi^2 area around Anaktuvuk Pass. The last estimate of numbers was made in spring 1973. Population estimates made during this period are included in Table 1. During these years the annual harvest of wolves by residents of Anaktuvuk Pass was monitored as well and these data are presented in Table 2.

Table 1. Summary of wolf densities estimated for the northcentral Brooks Range, 1971, 1972 and 1973.

Season and Year	No. Wolves Enumerated*	Area (sq. mi.)	Density in sq. mi. per wolf	Average Pack Size	Gray:Black Ratios
Spring 1971	29	3,600	1 wolf/124 sq. mi.	4.0	100:30
Fall 1971	45	3,600	1 wolf/80 sq. mi.	6.5	100:40
Fall 1972	315	30,000	1 wolf/95 sq. mi.	estimated from occurrence of active dens	
Fall 1972	55	3,600	1 wolf/65 sq. mi.	6.5	100:30
Spring 1973	51	3,600	1 wolf/76 sq. mi.	5.6	100:11

*Based on direct observations supplemented by the occurrence of tracks except for Fall 1972 estimate for 30,000 sq. mi. area which was based on the spatial distribution of active dens.

Table 2. Sex and age composition of wolves harvested by residents of Anaktuvuk Pass, winters 1971-72, 1972-73 and 1973-74. Animals of unknown sex and age were not included in the calculation of percentages. The adult classification includes wolves over one year of age (juveniles and adults).

Trapping Period	Male Pups		Female Pups		Male Adults		Female Adults		Total Pups		Total Adelts			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	Unk.	Total
1970-71	--	--	--	--	--	--	--	--	--	--	--	--		20*
1971-72	10	43	7	30	6	26	0	0	17	74	6	26	8	31
1972-73	24	41	11	19	15	25	9	15	35	59	24	41	5	64
1973-74	9	26	7	21	13	38	5	15	16	47	18	53	20	54
Total	29	25	25	22	34	29	14	12	68	59	48	41	33	149

*Approximate total of wolves taken, records of age and sex were not obtained in this year.

Density estimates suggest that this wolf population increased from a low density of 1 wolf per 124 square miles in spring 1971, to roughly 1 wolf per 65 to 75 square miles in spring 1973. Observations made by residents of the area during fall 1973 suggested no further increase, indicating that the increase in population may have slowed or stopped. In spring 1974 observations by residents of Anaktuvuk again indicated there had been no change in population. In April 1974 and 1975 moose surveys were flown on the Chandler, Anaktuvuk and Colville Rivers. Wolf sign was relatively scarce in both years, in marked contrast to conditions in winter 1973, and no wolves were seen during these surveys. The carcass of an adult male wolf which had been aerially shot was found on the Colville River and other indications of illegal aerial hunting were reported by Nunamiut trappers operating in the Killik River Valley and by a reliable guide who frequents the northcentral Brooks Range, suggesting that this may have caused a reduction in the number of wolves in certain areas. The area in the vicinity of Anaktuvuk was apparently not affected by aerial hunting. Further indications of illegal aerial hunting were noted in the eastern part of the North Slope between the Canning and Sagavanirktok Rivers. Biologists associated with the consulting firm of Renewable Resources, Inc. noted that, in comparison to the previous summer, wolves were quite scarce in this area and that most wolves that were seen showed a great deal of fear of aircraft which was also in contrast to observations made during the previous year. Rumors of illegal aerial hunting in this area were also noted. Thus, it appears that the wolf population in some areas of the North Slope may have decreased due to illegal aerial hunting and possibly other factors.

The 1973-74 harvest of wolves by residents of Anaktuvuk Pass was slightly lower than that of previous years. As in the previous two years the data show a preponderance of pups suggesting that reproduction has remained at a level commensurate with the harvest in the area. The high percentage of pups (59 percent) in the harvest for the three winters for which detailed data were obtained is probably greater than the actual percentage in the population because pups are more susceptible to trapping and ground shooting than are adults. It is interesting to note that only 12 percent of the 116 wolves of known sex and age taken by residents of Anaktuvuk during the past 3 winters have been females older than 1 year of age. The preponderance of males has been discussed in a previous report (Stephenson and Sexton 1974). The gray:black ratio of wolves in the 1973-74 harvest was 100:11 as in the previous year.

DISCUSSION

Several authors have made estimates of wolf abundance in various areas of North America. Mech (1970) reviewed population estimates made prior to 1970. Table 3 includes the figures he compiled plus estimates made since that time.

Results of current studies in Interior and Arctic Alaska suggest that wolf densities are at levels ranging from 1 wolf per 35 to 70 square miles and 1 wolf per 65 to 100 square miles in these areas, respectively. These densities correspond most closely to those reported

Table 3. Reported densities for North American wolf populations.

Location	Area (sq. mi.)	Density of wolves (sq. mi./wolf)	Authority
Isle Royale, Michigan	210	7-10	Mech 1966, Jordan et al. 1967
Algonquin Park, Ontario	1,000	10	Pimlott et al. 1969
Ontario	10,000	100-200	Pimlott et al. 1969
Minnesota	2,490	10	Olson 1938
Minnesota	4,100	17	Stenlund 1955
Minnesota	4,203	10.6[1]	Mech 1973
Minnesota	717	9.2	Van Ballenberghe et al. 1975
Coronation Island, Alaska	30	3[2]	Merriam 1964
Mt. McKinley Natl. Park, Alaska	2,000	50	Murie 1944
Mt. McKinley Natl. Park, Alaska	1,500	33 (24-42)	Haber 1968
Unit 13, Alaska	20,000	50	Rausch 1967
Southeast Alaska	7,500	25-40	Atwell et al. 1963
Saskatchewan	--	40-83	Banfield 1951
Northwest Territories	480,000	60-120	Kelsall 1957
Northwest Territories	384	6.9[3]	Kuyt 1972
Manitoba-Saskatchewan	1,274	7.8[3] (7.8-13.8)	Parker 1973
Manitoba-Saskatchewan-Northwest Territories	109,000	200[4]	Parker 1973
Western Canada	4,200	87-111 (10[5])	Cowan 1947
Baffin Island	1,800	120	Clark 1971

1. Average for two winters, 1971-72 and 1972-73.
2. Artificial situation; four wolves stocked.
3. Temporary concentration of wolves on winter range of Kaminuriak caribou herd.
4. Total year round range of Kaminuriak caribou herd.
5. Maximum abundance on winter range.

previously in Mt. McKinley Park, Southcentral Alaska and northern Canada. The general level of wolf abundance in much of Alaska appears to be a good deal lower than that observed in more southerly latitudes, probably reflecting a similar difference in the abundance of ungulate prey species. Van Ballenberghe et al. (1975) have reviewed available data relating to wolf populations on Isle Royale, Michigan; Algonquin Park, Ontario and northeastern Minnesota concluding that food supply has been a primary determinant of the ultimate densities reached by these populations. These authors suggest that environments rich in food lower the threshold of mechanisms which act to lower the productivity of dense wolf populations.

Although direct measurements of indicators of biological productivity of Interior, Southcentral and Arctic Alaska are not available for comparison with those of more southerly latitudes, it is clear that with some exceptions the ungulate prey biomass per unit area is considerably less in much of Alaska, probably being reflected in the generally lower densities observed in wolf populations here.

There are indications that during the winters of 1973-74 and 1974-75 illegal aerial hunting has reduced the number of wolves in at least certain areas of the North Slope. There is also an indication that the wolf population in GMU 20A, as indicated by the surveys conducted in March 1974, is somewhat lower than that suggested by the 1973 and 1974 surveys. However, the 1974-75 harvest of wolves from 20A was apparently somewhat higher than that of the previous 2 years due, in part, to an increased amount of illegal aerial hunting. This indicates that the autumn population of wolves may still have been in excess of 200 animals as in the previous 2 years.

Wolf surveys, as currently conducted by the Department, in all likelihood provide relatively close approximations of the population levels of wolves in certain areas. There are, however, a number of factors that make the accuracy of these population estimates inadequate for detecting small fluctuations in population size that could be of biological significance. One of the most important of these is the fact that wolf packs with territories lying only partly within a survey area such as GMU 20A may not be detected during a survey due to their chance occurrence outside the area. Alternatively, a pack may be observed in a survey area and its numbers included in the population attributed to the area when in fact only a small portion of its territory lies within the survey area or its presence is of only a transient nature. The larger the survey area the less important would be this effect.

There are a number of ways in which survey techniques could be improved. Wolf studies in Minnesota (Mech 1970, 1973; Van Ballenberghe et al. 1975) have shown that radio telemetry provides the basis for making highly accurate population estimates. The territories of radioed packs and the total number of wolves in them can be firmly established by intensive radio tracking. The presence of at least a few radioed packs in an area such as GMU 20A could greatly augment survey efforts by providing basic information on wolf territory size in this habitat type and by providing relatively precise data on wolf territories and pack sizes for part of the area so aerial surveys can be intensified on unradioed packs with contiguous territories.

Another way in which the usefulness of wolf survey efforts could be increased is by conducting the surveys after the first tracking snow in early winter. This is desirable for a number of reasons:

1) Wolf packs with pups 5 to 6 months of age are more cohesive at this time of year than in late winter when the greater traveling ability of pups and the effects of the breeding season increase the tendency for packs to split temporarily.

2) Wolf population estimates made at this time of year would avoid the necessity of having to take into account human-caused and natural mortality which has reduced numbers by some indeterminant and variable percentage.

3) For the above reason, and because pups are more easily distinquished from adults in the early winter, a census effort could provide some insight into pup survival in various years whereas a late winter census cannot.

4) The tendency of wolves to travel in existing trails, both those made by prey species and themselves, during late winter when snow depths are greatest makes the determination of numbers based on tracks more difficult.

5) The concentration of moose in lowland habitats is maximal during late winter. This could alter the distribution of wolf packs considerably making the data of little value in determining the summer distribution of active dens. Knowledge of summer distribution is valuable in assessing the potential impact of wolves on the young of prey species.

6) There could be at least some increase in efficiency by combining the wolf survey effort with fall moose surveys currently conducted in most areas of the Interior and Arctic.

The greatest single obstacle to conducting wolf surveys in early winter is that overcast skies are prevalent in much of Alaska during this season and day length diminishes rapidly. These factors lessen the number of days providing the tracking conditions necessary for conducting the surveys.

ACKNOWLEDGMENTS

Thanks are extended to the following Department personnel for their help in carrying out wolf surveys in Unit 20: Mel Buchholtz, Wayne Heimer, Bob LeResche, John Coady, Oliver Burris, Dale Haggstrom and Bill Griffin. The residents of Anaktuvuk Pass deserve special thanks for their help in the wolf studies in the Arctic.

LITERATURE CITED

Atwell, G., P. Garceau, and R. A. Rausch. 1963. Wolf investigations. Fed. Aid in Wildl. Rest. Proj. W-6-R-3, Work Plan K. 28pp.

Banfield, A.W.F. 1951. Populations and movements of the Saskatchewan timber wolf Canis lupus knighlii in Prince Albert National Park, Saskatchewan, 1947 to 1951. Wildl. Mgmt. Bull. Ser. 1, No. 4. 24pp.

Clark, K. R. F. 1971. Food habits and behaviour of the tundra wolf on central Baffin Island. Univ. Toronto. Ph.D. Thesis. 223pp.

Cowan, I. M. 1947. The timber wolf in the Rocky Mountain National Park of Canada. Can. J. Res. 25:139-174.

Haber, G. C. 1968. The social structure and behavior of an Alaskan wolf population. Unpubl. M.S. Thesis. Northern Michigan Univ. 198pp.

Jordan, P. A., P. C. Shelton, and D. L. Allen. 1967. Numbers, turnover, and social structure of the Isle Royale wolf population. Am. Zool. 7:233-252.

Kelsall, J. P. 1957. Continued barren-ground caribou studies. Can. Wildl. Serv., Wildl. Manage. Bull. Ser. 1, No. 12. 148pp.

Kuyt, E. 1972. Food habits of wolves on barren-ground caribou range. Can. Wildl. Serv. Rep. Ser. No. 21. 36pp.

Mech, L.D. 1966. The wolves of Isle Royale. U.S. Nat. Park Serv., Fauna Ser. 7. xiii + 210pp.

_________. 1970. The wolf: the ecology and behavior of an endangered species. Nat. Hist. Press. 384pp.

_________. 1973. Wolf numbers in the Superior National Forest of Minnesota. N. Cent. For. Exp. Stn., St. Paul, Minnesota. 10pp. (USDA For. Serv. Res. Pap. NC-97).

Merriam, H. R. 1964. The wolves of Coronation Island. Proc. Alaska Sci. Conf. 15:27-32.

Murie, A. 1944. The wolves of Mt. McKinley. U. S. National Park Service, Fauna Ser. 5. 238pp.

Olson, S. F. 1938. A study in predatory relationship with particular reference to the wolf. Sci. Month. 66:323-336.

Parker, G. R. 1973. Distribution and densities of wolves within barren-ground caribou range in northern mainland Canada. J. Mammal. 54(2):341-348.

Pimlott, D. H., J. A. Shannon, and G. B. Kolenosky. 1969. The ecology of the timber wolf in Algonquin Provincial Park. Ont. Dept. Lands and Forests Res. Rep. (Wildlife) No. 87.

Rausch, R. A. 1966. Wolf studies. Fed. Aid in Wildl. Rest. Proj. W-6-2-5 and 6, Alaska.

________. 1967. Some aspects of the population ecology of wolves, Alaska. Am. Zool. 7:253-265.

________. 1969. Report on statewide wolf population studies. Alaska Fed. Aid in Wildl. Res. Rept. Proj. W-17-1. 37pp.

Stenlund, M. H. 1955. A field study of the timber wolf (Canis lupus) on the Superior National Forest. Minnesota Dept. Conserv. Tech. Bull. 4. 55pp.

Stephenson, R. O. 1975. Wolf report. Alaska Fed. Aid Wildl. Rest. Prog. Rept. Proj. W-17-6 and W-17-7. Juneau, Alaska. 11pp.

________ and L. J. Johnson. 1972. Wolf report. Alaska Fed. Aid in Wildl. Rest. Prog. Rept. Proj. W-17-3 and W-17-4. 51pp.

________ and J. Sexton. 1974. Wolf report. Alaska Fed. Aid in Wildl. Rest. Prog. Rept. Proj. W-17-5 and W-17-6. Juneau. 28pp.

Van Ballenberghe, V., A. W. Erickson, and D. Byman. 1975. Ecology of the timber wolf in Northeastern Minnesota. Wildl. Monogr. No. 43:1-43.

PREPARED BY:

Robert O. Stephenson
Game Biologist II

APPROVED BY:

Frank Jones
Director, Division of Game

Donald E. McKnight
Research Chief, Division of Game

SUBMITTED BY:

John J. Burns
Acting Regional Research Coordinator

FINAL REPORT (RESEARCH)

State: Alaska

Cooperator: Robert O. Stephenson

Project Nos.: W-17-3 through W-17-7 Project Title: Big Game Investigations

Job No.: 14.4R Job Title: The Spring and Summer Food Habits of Alaskan Wolves

Job No.: 14.5R Job Title: The Conditions and Characteristics of Ungulate Prey Taken by Wolves

Period Covered: July 1, 1970 to June 30, 1975

SUMMARY

The analysis of wolf scats collected at dens and rendezvous sites in Southcentral and Arctic Alaska suggests that ungulate prey species usually constitute the most important source of food for wolves during the denning season, with various small mammals being, in some cases, an important supplement. At one den on the North Slope lemmings, voles and ground squirrels apparently constituted the bulk of the diet. The species of ungulates and small mammals in the diet, and their frequency of occurrence, appear to vary with geographical, seasonal and annual differences in availability. The examination of carcasses of moose killed by wolves during winter in Southcentral and Interior Alaska suggests that during winters of average snowfall the average age of adult moose taken tends to be greater than in the population as a whole while during exceptionally severe winters young adults become more vulnerable to wolf predation, as do calves. The nutritional condition of wolf-killed moose, as indicated by fat content of femur marrow, appears to be average. Selection for moose which might be weak due to poor nutrition is not evident.

CONTENTS

BACKGROUND

Indications of a very low population of wolves (*Canis lupus*) on the North Slope in 1970 prompted the initiation of population monitoring and other studies in this area. These studies included work on the ecology of wolf den sites, the spring and summer food habits of wolves and the condition and characteristics of ungulate prey taken by wolves.

In 1973 and 1974 wolf population surveys were conducted in Interior Alaska as well. Work in Arctic Alaska was discontinued in 1975 and the emphasis in wolf studies shifted to Interior and Southcentral Alaska because of the need for obtaining basic information on wolf abundance necessary to assess the role of wolf predation in causing and maintaining low ungulate populations in certain areas. Carcasses of ungulates killed by wolves have been collected in conjunction with field work in the Arctic and wolf and moose (*Alces alces*) surveys in the Interior. Wolf scats have been collected at dens in Arctic and Southcentral Alaska and analyzed to provide qualitative information on the summer diet of wolves denning in various habitat types. This report summarizes data obtained from wolf scats and the carcasses of wolf-killed prey.

OBJECTIVES

To determine the food habits of wolves during the spring and summer in Interior and Arctic Alaska.

To determine the physical condition and characteristics of ungulate prey taken by wolves in Interior and Arctic Alaska.

PROCEDURES

The results of summer food habits studies discussed in this report were derived from wolf scats collected at dens and rendezvous sites. When located, these areas were thoroughly searched, all scats being collected and stored in individual plastic bags for later analysis in the laboratory. The method of analysis has been described in detail in a previous report (Stephenson and Johnson 1972). Results of scat analyses were expressed as the percentage of the total number of adult or pup scats in which a particular food item occurred.

The carcasses of ungulates killed by wolves were in most cases located from aircraft, and visited by either landing nearby or, if that were not feasible, by landing at the kill site with a helicopter at a later date. The cause of death was determined through examination of tracks and position of legs at the time of death as described previously (Stephenson and Johnson 1972). Whenever possible sex was determined and a long bone, preferably a femur, and incisor teeth were collected to assess age and nutritional condition at the time of death. Age was determined from cementum annuli counted in thin sections of incisor teeth. The fat content of bone marrow was established using the dry-weight technique described by Neiland (1970).

FINDINGS

Summer Food Habits of Wolves

Data from scats collected at dens and rendezvous sites have been presented in two previous reports (Stephenson and Johnson 1972; Stephenson 1975) and only a brief review will be attempted here.

Data from scats collected in both the Arctic and Southcentral regions of Alaska indicate that during summer ungulate prey species are of primary importance in the summer diet of wolves in these areas. Small mammals do, however, constitute a significant portion of the diet in some cases and a variety of other items including birds, fish, insects, and, occasionally, vegetation and soil or rocks are also ingested.

The composition of the summer diet appears to vary with geographical, seasonal and annual differences in prey availability. Wolves at dens located in mountainous terrain where Dall sheep (*Ovis dalli*) are relatively abundant may rely on this species to a large degree. Data from dens located in the higher elevations of the Itkillik, Okokmilaga and Etivluk River drainages in the northcentral Brooks Range showed a preponderance of sheep remains. During the last several years, at least, caribou (*Rangifer tarandus*) have been rare in this area during the early summer when wolves are denning and moose, although resident year-round, are present at very low densities.

It appears that all of the small mammals commonly found on the North Slope, with the exception of the red-backed vole (*Clethrionomys rutilus*) and shrews (*Sorex* sp.), are utilized to some degree during the summer months. These species include the singing vole (*Microtus miurus*), tundra vole (*M. oeconomus*), collared lemming (*Dicrostonyx groenlandicus*), brown lemming (*Lemmus trimucronatus*) and ground squirrel (*Spermophilus undulatus*). Although small mammal remains occurred in scats collected at all dens, both on the North Slope and in Southcentral Alaska, only at one den did the contents of scats suggest that small mammals were the predominant item in the diet. At a den on the Sagavanirktok River near Atigun Canyon the remains of microtines and ground squirrels occurred in 84.7 and 25.3 percent, respectively, of 190 scats. This den had been used in 1973 by three adult wolves and 15 wolf pups (probably two litters). The predominance of small mammals in these scats is surprising in view of the fact that the den is located only a few miles from Atigun

Canyon which supports a large number of Dall sheep. Caribou and moose also frequent the area. There is no obvious explanation for the prevalence of small mammal remains observed at this den.

Caribou constituted the primary prey of three adult wolves and six pups at a den on the Arctic Coastal Plain north of Sagwon. Adult and calf caribou remains occurred in 52.4 and 17.1 percent, respectively, of 82 scats collected at the den on July 9, 1974, shortly after the wolves had left the den. Small bands of bull and yearling caribou were consistently present in the area during early summer.

In a collection of 59 wolf scats from a den on the upper Canning River, caribou (calves and adults) and sheep were the predominate food items although microtine remains occurred in 40.7 percent of the scats.

Sixty scats collected at a rendezvous site near a den on the Delta River, GMU 13B, contained primarily remains of adult moose and microtines (30 and 33.3 percent, respectively) but also contained significant amounts of moose calf, caribou adult, caribou calf, snowshoe hare (*Lepus americanus*) and ground squirrel remains suggesting a relatively diverse diet.

In 1,157 scats collected in July 1972 at a wolf den on Mt. Drum, GMU 11, snowshoe hare remains were the single most predominant item (35.7 %) with moose calf and adult and calf caribou remains occurring in 16.6, 24.8 and 27.4 percent, respectively, of the scats. This suggests that ungulates comprised the major portion of the diet with snowshoe hares constituting an important supplement.

In 79 wolf scats collected in August 1971 at a wolf den near Sinona Lake, GMU 13C, the remains of moose calves occurred in 67 percent, adult moose in 23 percent and snowshoe hares in 13 percent of the scats.

Conditions and Characteristics of Ungulate Prey

Table 1 includes data from 25 moose carcasses examined during the present study. Twenty-one of these were collected in GMU 20A during the winters of 1973-74 and 1974-75. Of the 25 moose carcasses examined only two were judged to have resulted from death due to starvation (hereafter referred to as winter-kills) according to criteria established by Johnson (Stephenson and Johnson 1973). In only one of these instances did the results of marrow analyses corroborate the cause of death as starvation: a 12-year-old bull found near the mouth of Clear Creek (no. 94223) showed very low fat reserves and was located in heavy brush unlike most of the wolf kills. Wolves had fed on the carcass, however.

DISCUSSION

To date, the analyses of wolf scats collected at dens suggest that ungulate prey species usually constitute the most important source of food for wolves during the denning season with various small mammals being in some cases an important supplement.

The species of ungulates and small mammals actually present in the diet, and their frequency of occurrence appear to vary with geographical,

Table 1 -
ble 1. Data from moose carcasses representing natural mortality, primarily wolf predation, Interior-Arctic Alaska, 1973-75.

Accession number - cession umber	Species	Date of Collection	Sex	Age	Marrow Analysis % fat	Cause of death	Degree of utilization (%)	Location of Kill	Remarks
94221 - ~~4221~~	moose	4/5/75	M	15	85	wolf kill	100	mouth Wood River	Wolf tracks abundant at kill site. Pack 11 wolves observed in area.
94222	moose	4/5/75	unk	14	93	wolf kill	100	Tatlanika River	Wolf tracks abundant at kill site. Pack 11 wolves observed in area.
94223	moose	4/5/75	M	12	10	possible winter kill	50	Clear Creek, Tanana Flats	Had been fed upon by wolves
94224	moose	4/5/75	F	11	91	wolf kill	75	Salchaket Slough	
93451	moose	3/25/74	F	12	43	wolf ?	90	Tanana Flats	#5 radio collared moose
93527	moose	2/18/75	F	14	92	wolves	65	Snow Mountain Gulch	#15 radio collared moose 5 gray & 1 black wolf on carcass when specimen collected
94194	moose	2/22/75	F	4	87	wolves?	65	Wood River	
94197	moose	2/20/75	unk	12	90	wolves?	?	Snow Mountain Gulch	Collected by Jim Davis
94214	moose	3/25/74	F	13	55	possible winter kill	50	Salchaket Slough	Extensive wolf trails around carcass
94215	moose	3/25/74	unk	16	98	wolves?	100	8 mi N Wood R. Buttes	Tibia collected
94216	moose	3/25/74	F		88	wolves?	100	Top Wood R. Butte	Molars collected
94218	moose	3/25/74	unk	12	55	wolves?	100	2 mi N Waugaman's	
94228	moose	4/20/74	unk	2	39	wolves?	80	Snow Mountain Gulch	
94293	moose	4/12/74	unk	10	78	wolves?	60	Dry Creek	
94294	moose	6/6/75	F	11	56	wolf kill	100	Hogan Hill, Unit 13	killed by wolves ca. 5/1/75
	moose	3/27/73	F		85	wolf kill	--	Pah River, Kobuk Unit 23	Collected by Robert Pegau
	moose	3/27/73	unk	calf	46	wolf kill	--	Pah River, Kobuk Unit 23	Collected by Robert Pegau calf of above cow
	moose	4/10/73	F	adult	95	wolf kill	100	Siksikpuk R, Unit 26	No incisors available
	moose	11/29/74	M	5	--	wolf kill	100	Delta Creek	12 wolf beds and 3 wolves observed
	moose	4/15/75	unk	calf	--	wolf kill	100	Snow Mountain Gulch	
	moose	11/73	F	17	--	wolf kill	--	Wood River Buttes	
	moose	11/73	-	calf	--	wolf kill	--	Wood River Buttes	calf of above cow
	moose	11/73	M	8	--	wolf kill	--	Montana Cr., Wood R.	
	moose	11/73	M	9	--	wolf kill	--	Dry Creek	
93463	moose	5/20/75	M	6	--	wolf kill	100	Three mile Creek	radio collared moose killed ca. 4/20/75

seasonal and annual differences in availability. Cases in which caribou, moose or sheep have been the primary ungulate species in the summer diet are evident in the data as are cases where microtines and ground squirrels or snowshoe hares have been the primary small mammals represented.

In a general way these conclusions agree with previous studies of wolf summer food habits as reviewed by Mech (1970) and Frenzel (1974).

The data presented in Table 1 are not sufficient to allow firm conclusions to be drawn regarding the characteristics of wolf-killed moose. A few comments can be made, however. Excluding calves, which constitute a relatively small proportion of the sample, the mean age of 18 moose dying of natural causes in Unit 20A during the winters of 1973-74 and 1974-75 was 10.6 years based on cementum layers. The mean age for bulls (n=6) was 9.2 years, for cows (n=6) 11.8 years, and for adults of unknown sex (n=6) 11.0 years. In comparison, the average age of moose taken by hunters in Unit 20 is about six years. The average age of bulls and cows taken by hunters in Unit 20A in 1973 was 5.6 and 7.7 years, respectively (Annual Report Survey-Inventory Activities, Alaska Dept. Fish and Game, Part II, 1975). This suggests that moose taken by wolves tend to be somewhat older than the average adult moose in the population. The mean percent fat in femur marrow in 18 moose was 71.4 percent suggesting that the majority of these moose were in relatively good nutritional condition at the time of death.

Johnson (Stephenson and Johnson 1973) reported data in a sample of 57 moose killed by wolves in Southcentral Alaska during the unusually severe winter of 1971-72. Marrow samples of eight wolf-killed adult moose averaged 75.8 percent fat. Marrow samples from 14 moose calves killed by wolves averaged 21.8 percent fat while samples of 11 calves known to have died from malnutrition averaged 6.8 percent fat. In Alaskan moose it appears that adult animals with 20 percent or less and calves with less than 10 percent fat in their long bone marrow are approaching death through starvation/malnutrition (John Coady and Charles Lucier, pers. comm.). Johnson also reported that the mean age of moose killed by wolves, excluding calves, was 3.0 and 8.6 years for bulls and cows, respectively. The mean ages for bulls and cows in the 1971 hunter harvest for the area were 3.2 and 6.7 years, respectively, suggesting that under these conditions of extreme snow depth relatively old moose were not over-represented in the sample of wolf kills. In addition, calves comprised 56.1 percent of the wolf-killed moose while comprising only 15.8 percent of the autumn 1971 moose population, suggesting a high vulnerability of calves to wolf predation due to excessive snow depths. These findings parallel those of Peterson and Allen (1974) who noted an increase in the occurrence of young adults and calves among wolf-killed moose during winters with more severe snow conditions. Calves comprised 11 percent of the 1973-75 sample of wolf kills from 20A, which compares to 12 percent calves for the 20A population in autumn 1974, suggesting that the vulnerability of calves was not drastically increased by the average and above average snow depths in the winters of 1973-74 and 1974-75. The sample from Unit 20A is not sufficiently large to provide a solid basis for this comparison, however.

The data from Interior and Southcentral Alaska suggest a tendency for wolves to take relatively old adult moose during winters of average severity. During exceptionally severe winters younger adults apparently become more vulnerable to wolf predation, as do calves.

ACKNOWLEDGMENTS

Thanks are extended to Richard Shideler for his aid in analyzing scats and to Edward Kootuk for his valuable help in analyzing femur marrow and sectioning teeth of moose for age determination. John Coady contributed specimens from several wolf-killed moose.

LITERATURE CITED

Frenzel, L.D. 1974. Occurrence of moose in food of wolves as revealed by scat analyses: a review of North American studies. Le Nat. Can. 101:468-479.

Mech, L.D. 1970. The wolf: the ecology and behavior of an endangered species. Nat. Hist. Press. 384pp.

Neiland, K.A. 1970. Weight of dried marrow as an indicator of fat in caribou femurs. J. Wildl. Manage. 34(4):904-907.

Peterson, R.O. and D.L. Allen. 1974. Snow conditions as a parameter in moose-wolf relationships. Le Nat. Can. 101:481-492.

Stephenson, R.O. 1975. Wolf report. Alaska Fed. Aid in Wildl. Rest. Prog. Rept. Proj. W-17-6 and W-17-7. 11pp.

______________ and L.J. Johnson. 1972. Wolf report. Alaska Fed. Aid in Wildl. Rest. Prog. Rept. Proj. W-17-3 and W-17-4. 51pp.

PREPARED BY:

Robert O. Stephenson
Game Biologist

SUBMITTED BY:

John J. Burns
Acting Regional Research Coordinator

APPROVED BY:

Frank Jones
Director, Division of Game

Donald E McKnight
Research Chief, Division of Game