TECHNICAL SESSION

Monday Afternoon—March 3

Chairman: CHARLES M. LOVELESS
Assistant Director, Denver Wildlife Research Center, Denver, Colorado

Discussion Leader: A. B. COWAN
Associate Professor of Wildlife Management, University of Michigan, Ann Arbor

DISEASE, NUTRITION, AND CONTROL

A SUMMARY OF WOLF STUDIES IN SOUTHCENTRAL ALASKA, 1957-1968

ROBERT A. RAUSCH
Alaska Department of Fish and Game, Fairbanks, Alaska

The purpose of this paper is to review wolf (*Canis lupus*) studies conducted in southcentral Alaska from 1957 through 1968. The study area, which was closed to wolf hunting in 1957, encompasses the Nelchina Basin caribou range, some 17,000 square miles (Skoog, 1968), plus an ill-defined peripheral area in which the "Nelchina wolves" often visit, emigrate to or immigrate from. The total area approximates 20,000 square miles (Figure 1). The study was initiated by the U.S. Bureau of Sport Fisheries and Wildlife in 1957 and was continued by the State following the transfer of game management authority to the new State in 1960.

The federal program was a statewide effort to assess the effectiveness of predator control techniques, to gather biological information on wolves, and to acquire accurate statistics on wolves and their prey (Scott, 1956). The Nelchina Basin study area (Game Management Unit 13 and the north one-half of Unit 14) was planned as a demonstration area where the interrelationships of wolves and their prey could be studied.

The State's program of wolf study has been equally widespread, but the objectives were to provide an understanding of the life history and dynamics of wolf populations under varying degrees of stress and

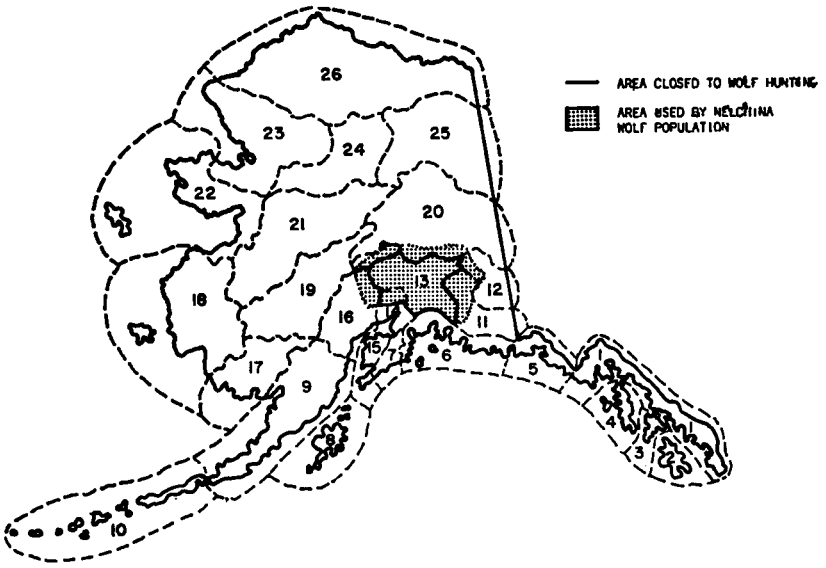


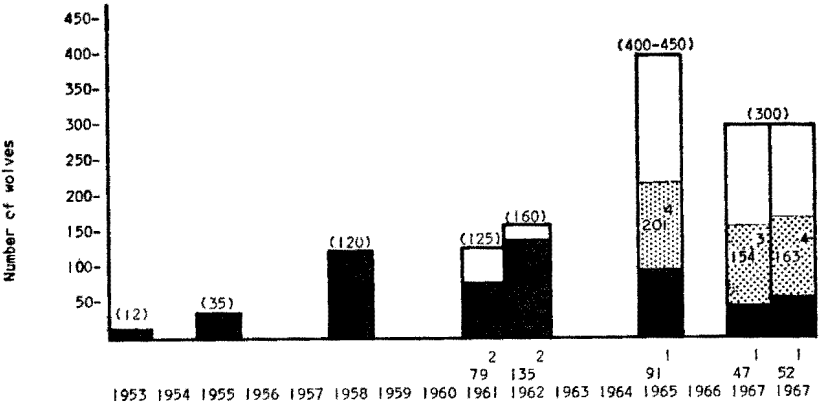
Figure 1.—Alaska game management units and wolf study area.

to continue using the Nelchina study area as a demonstration area (Merriam, 1964; Rausch, 1967). Here, as elsewhere, the primary big-game prey species, moose (*Alces alces*), caribou (*Rangifer tarandus*) and sheep (*Ovis dalli*), were the subject of concurrent studies designed to reveal their abundance, productivity, the magnitude of the harvest by hunters, and their overall well-being. The basic difference between the two phases of the study is that the federal work revolved around evaluating a predator control program whereas the studies of the state were designed to gain an understanding of wolf population dynamics.

This evaluation is comprised of six sections and it is based on data that were collected by biologists and cooperators over the past 15 years. The six sections follow: (1) the wolf population, (2) the moose population, (3) the caribou population, (4) the sheep population, (5) public opinion, (6) discussion and recommendations.

THE WOLF POPULATION

There are no estimates of wolf numbers in the Nelchina Basin prior to 1953, when Burkholder, as quoted by (Atwell, 1962), estimated that there were not more than 12 wolves remaining in the area following intensive predator control and bounty hunting from 1948 through 1953 (Figure 2). Subsequent estimates through 1960 were also based upon his general observations and knowledge of the area.



1. Individual wolves seen during census.
2. Wolves accounted for throughout the year.
3. 105 separate tracks, 9 instances where tracks could not be counted computed at 5 animals per pack, the average pack size in 1967.
4. Individual tracks seen.

( ) Maximum estimate.

Figure 2.—Wolf population estimates, 1953-1967, Unit 13, Alaska.

Starting in 1961 aerial censuses were used to assess the population status of wolves. These surveys were of varying intensity and cannot be considered precise. Wolves, however, tend to follow drainages and other routes that provide easy travel especially in midwinter. Furthermore, the fact that they travel in packs during this period tends to simplify the task of obtaining information on their abundance. Aerial surveys consisted of transects along drainages and contours and capitalized upon the knowledge of the area of various biologists and aircraft vendors. Wolves were tallied by location, color, and pack size. If tracks were seen and the wolves could not be located, landings were made where the wolves fanned out across a lake or in chase, and the tracks were counted. Duplication was minimized by making the counts promptly following snowfall and by plotting the locations of individual packs.

In wolf populations that are increasing, short-term fluctuations caused by high mortality to pups in a given year may significantly reduce their numbers in any one year, as pups may comprise 60 percent of the population. Thus, the observed variation between the 1958 estimate and the 1961 and 1962 censuses may represent real change rather than any inaccuracy in estimates or census techniques (Figure 2). Whatever caused the apparent year-to-year fluctuations is not particularly important to the long-term study. The important fact is

that the wolf population did increase rather slowly and reached a peak of abundance in 1965.

In 1967 duplicate surveys suggested a considerable reduction in wolf numbers (Figure 2). The reduction can be related to two or three events: (1) changes in migration patterns of Nelchina caribou; (2) illegal aerial hunting in Game Management Unit 13; (3) relatively poor survival of pups during the summer of 1967.

In 1965 most of the Nelchina caribou left their traditional winter areas and moved into Game Management Units 11 and 12 (Figure 1). Apparently large numbers of wolves accompanied them, and as these Units are open to wolf hunting, many were killed by aerial hunters. The harvest of wolves in these units increased from a total of 54 animals in 1964-65 to 164 in 1965-66.

Portions of the Nelchina caribou population continued this migration pattern in 1966 and 1967, and the harvest of wolves in Units 11 and 12 remained high (108 and 99 respectively) though they did not equal the 1965 harvest. This suggests that wolves were not as abundant, as demand for wolf pelts is good and bounty hunters are interested in hunting close to the supply stations available along the highways that transect this area.

Illegal hunting, particularly in the northwestern portion of Unit 13 commenced on a large scale in 1965 and continued through 1966. The effort in 1965 was considerable, and I estimate that 64 wolves were taken.

If the 1965 estimate of the wolf population was accurate, then the combination of illegal hunting and the kill of wolves following caribou into Units 11 and 12 should not have been sufficient to depress the population severely, as wolves have the potential for increasing by 50 to 60 percent each year if conditions are optimal for pup survival. In fact, pups comprised 60 percent of the wolves killed in Unit 13 and adjoining areas in 1966. As mentioned earlier, high natural mortality in young-of-the-year in heavily exploited populations may contribute importantly to a population reduction similar to that which occurred in the Nelchina wolf population.

Information obtained from the carcasses of 60 wolves killed in Units 11, 12 and 13 in 1967-68 showed that pups comprised 45 percent of the sample, whereas they comprised 60 percent (153 animals) of the sample obtained in 1966 from the same area. The change is more striking if one pack of nine containing eight pups is excluded from the 1967 sample. Obviously pup survival was excellent in this pack, which was larger than average.

Pack size during the winter seems directly related to the abundance of wolves (Rausch, 1967) and the average size of packs in the

Nelchina has declined from 9.7 (22 observations of packs of two or more wolves) in 1965 to 6.2 (39 observations of packs of two or more wolves) in 1967. At present all indices to population abundance (harvests, censuses, age composition and average pack size) suggest the wolf population has declined from the recorded high of 1965. The causes for the decline remain obscure—probably no one factor is responsible for the change in population level. Man's interference, first through illegal aerial hunting followed by a legal aerial hunt in 1968 which removed 120 wolves after the 1967 population estimate had been made, are the obvious factors. The importance of natural population controls should not be overlooked. The combination of kill by humans, plus lowered survival of pups appears to have reduced the Nelchina population at a time when it was approaching a population density of one wolf per 50 square miles. Wolf populations in individual drainages undoubtedly exceeded this average density.

The basis for most problems between wolves and humans revolves around the former's dietary habits. Wolves eat big game that men covet. Because the effects of this utilization of big game has never been adequately quantified, man has assumed the effects are largely undesirable. Slowly, ever so slowly, this broad proposition is being split into manageable questions that should eventually measure each situation in proper perspective. In Alaska we are still attempting to measure what wolves eat during the various seasons when they have a choice of foods, as they do in Unit 13. The primary sources of big game prey in the study area are caribou, moose, and sheep. Caribou are the most abundant followed by moose and sheep (see sections on individual species).

A listing of dead ungulates observed in Unit 13 from 1957 to 1968 reveals 71 moose, 61 caribou, and 1 sheep. Most, but not all, of these animals were killed by wolves. Some undoubtedly had died of malnutrition. In 1962 examination of 45 dead animals suggested only 18 had been utilized by wolves. However, snow depths were tremenddous in 1962, and a large number of moose perished. Carcasses of caribou and sheep disappear more rapidly than moose and therefore may be poorly represented in aerial observations of kills. Examination of the contents of 47 wolf stomachs collected during the special hunt in 1968 revealed the following items: moose 24, caribou 5, empty 17, raven and moose 1. Moose are much larger than either caribou or sheep and therefore constitute more meals per animal. This may have influenced the stomach analysis data, but it does not diminish the importance of moose in sustaining these wolf populations.

Wolves do use a variety of foods, including other wolves, even during the winter, but the overall importance of small mammals is not

known. I assume that snowshoe hares (*Lepus americanus*) may be important food items, especially during periods of abundance and during the summer months. Studies conducted in Canada (Pimlott, 1967) and on Isle Royale National Park (Shelton, 1966) show that beaver (*Castor canadensis*) are used extensively in some situations. Marmots (*Marmota caligata*) and ground squirrels (*Citellus parryii*), available only during summer months, may also be used (Murie, 1944).

MOOSE POPULATIONS

Records of the abundance of moose in the Nelchina Basin are not available prior to 1952 when the first aerial surveys were flown by the U.S. Fish and Wildlife Service, Office of River Basins. Interviews with long-time residents suggest moose have been abundant in portions of the area for at least 30 to 50 years. Sex and age composition counts from a number of separate areas within the study unit have been gathered every year since 1952. Sample sizes with the exception of 1959 have been adequate to reveal general trends in each year. Pooling information from all moose populations within the study unit may mask local variations that are important to annual management decisions. But for the purposes of a general examination of the status of moose within this area of over 20,000 square miles, I have assumed there is sufficient similarity in two of the basic indices to population condition, calf survival and annual harvest of males, to draw some inferences about possible competition between man and wolves for the use of this resource. Supplementary data such as pregnancy rates and age composition of the moose herd, which are too detailed to present here, support this view for specific areas.

Calf production is portrayed in Figure 3, and the annual harvests are shown in Table 1. There appear to be three peaks and troughs of calf survival to about 6 months that are not of equal amplitude. The extreme high production of 1953-54 cannot be adequately explained. Most of these counts were made on the central portion of Unit 13 where production of calves has been good for years. This may have biased the production figure for 1953-54. Similar population explosions of moose have been observed from time to time on a number of moose ranges in Alaska. Subsequent crashes in calf survival have invariably followed these highs, though the total population almost always remained high at least initially. The lowest estimates of calf survival—1956, 1962, and 1965—all correspond with extremely severe winters, with 1962 being the most dramatic; at least I have the greatest amount of information concerning this die-off of moose. In 1966, 1967, and 1968 the calf crop remained fairly low generally but

was good locally in those areas where hunters are killing a significant number of moose.

Moose winter range deteriorated throughout the late 1950's and early 1960's. Many stands of willow (*Salix* spp.) exhibited in excess of 50 percent dead stems. Now, however, slow recovery is evident.

Over the entire period of study wolves may have depressed moose populations locally or held them at static levels, but it is extremely doubtful that they depressed the numbers of moose in the unit as a whole, particularly in view of the fact that two of the lowest periods of calf survival, 1956 and 1962, occurred before wolves were truly abundant. The annual kill by hunters, another measure of the availability of moose, shows little fluctuation in annual harvests since accurate records of harvest commenced in 1963 (Table 1). Hunting pressure since 1963 has not increased rapidly, though in 1968, concurrent with increased exploration for oil throughout Alaska, there was an increase in both resident and nonresident hunting. About

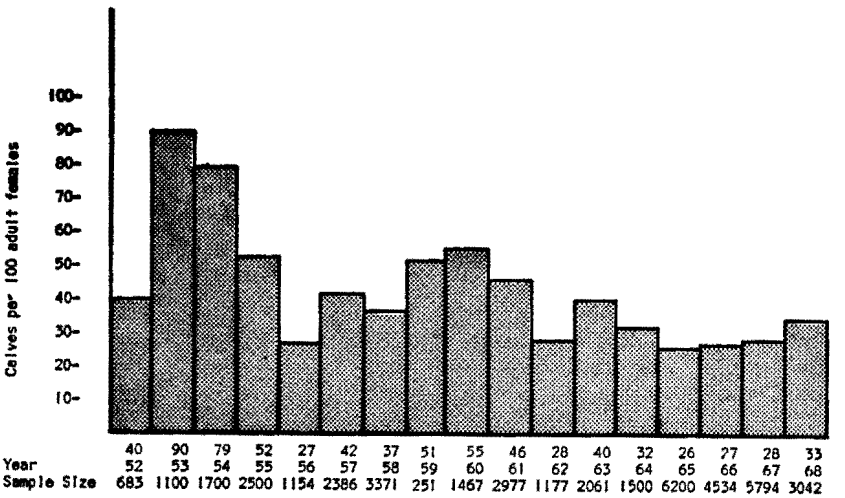


Figure 3.—Moose calf survival to mid-winter, Melchina Basin, Unit 13, 1952-1968.

TABLE 1. HARVEST OF MOOSE, CARIBOU, AND SHEEP, UNIT 13, 1963–1967.

	Moose		Caribou[1]	Sheep
	♂	♀		
1963	1,385	343	3,000	132
1964	1,213	394	8,000	156
1965	1,213	No Season	7,100	143
1966	1,336	181	4,800	154
1967	1,217	314	4,000	152

[1] Caribou harvests prior to 1963 are: 1957, 3,500; 1958, 2,500; 1959, 4,000; 1960, 5,500; 1961, 8,000; 1962, 3,500.

4,000 moose hunters use the Nelchina Basin, and with the existing roads, lakes, rivers, and airfields, 1,200 to 1,400 male moose are about all these people will harvest.

In 1965 I estimated the total moose population within the area to be between 25,000 and 30,000 animals. At present I see no reason to readjust this admittedly rough estimate. Approximately 6,000 moose were counted on selected portions of the area during annual sex and age-composition surveys in 1965 and 1967. In all probability the moose population will continue to fluctuate in abundance, and the best correlation with population adjustments will be with the interactions of moose, winter range, and the extremes of climate rather than with the influences of man or wolves. This prediction could change with the advent of more liberal seasons, or through construction of additional access.

THE CARIBOU POPULATION

Caribou in the Nelchina Basin and associated areas have been subjected to comprehensive studies since the late 1940's. Skoog (1968), who did much of the work starting in the middle 1950's and early 1960's, believes the Nelchina Basin is a core area, one possessing all the attributes of good caribou range. The caribou story has been one of constant increase from the early 50's until 1965 when many of the animals left what traditionally was thought of as "The Nelchina Wintering Areas." By 1962 the population was estimated at about 70,000 plus or minus 18,000 based upon a random stratified census (Siniff and Skoog, 1964).

Harvests have been erratic, ranging from 2,500 upward but never exceeding 8,000 animals even with an August 10 to March 31 season and with a bag limit which has varied from two to four to three animals per hunter (Table 1). The accessibility of animals to the roadside hunters apparently determines the magnitude of the kill. It should be noted that Skoog (1968)and others predicted that seasonal movements of the herd would become erratic as herd size increased. These predictions have been borne out (see Wolf Populations).

In the spring of 1967, an aerial photography census of the calving segment, primarily cows and newborn calves using the traditional calving grounds, supplemented by detailed composition counts during the rut, suggested a fall population of 66,000 animals (Hemming and Glenn, 1968). This estimate, however, did not include the animals in several peripheral areas. Clearly a substantial population remains on the traditional areas at least part of the year, and the populations in the surrounding areas have increased substantially either by egress from the Nelchina herd or from natural increase, probably for both reasons.

The annual kill by humans mentioned earlier is greatly influenced by the proximity of the herd to the highway system. Increased harvests depend upon an increased number of hunters or better access. Competition between man and wolves for caribou has not occurred at this time. Calf crops are good and caribou abundant.

THE SHEEP POPULATIONS

Studies of Dall sheep in this area have been limited to an accurate assessment of harvest (since 1963) and periodic aerial surveys (since 1949). Sport hunting for three-quarter curl or larger rams may have altered the sex composition of the population, but probably has not influenced total numbers. Wolves seem to have had little impact on total abundance of sheep. In the Talkeetna Mountains, part of Unit 13 and adjoining 14, Scott (1951) estimated a population of 626 sheep. In 1967 Nichols and Erickson counted 1,295 sheep on this range (Nichols and Erickson, 1968). The Watana Mountain sheep population, near the center of the best wolf range in Unit 13 and isolated from other sheep range, persisted throughout this study, and 222 were counted in 1967. The harvest of three-quarter curl rams in Unit 13 has been remarkably stable since 1963, the only period for which accurate records are available (Table 1).

While wolves undoubtedly use sheep, food habits studies mentioned earlier suggest sheep were not important components of the winter diet of these wolf populations. Unusual winter conditions may cause sheep to be more available to wolves (Murie, 1944). The extent that wolves eat sheep during the summer has not been determined. This is one of the objectives of current studies. Wolves denning in or utilizing alpine areas eat sheep during the summer months, but the significance of this use to the welfare of a trophy species is conjectural.

PUBLIC OPINION

Measuring change in public opinion over a period of time is indeed frustrating. Often individuals who have changed most insist that they have not altered their opinions at all. If, however, written and oral statements are useful in measuring these changes, then the Alaskan attitude toward wolf management has undergone dramatic change in the past 15 years.

The history of wolf management through the use of bounties, poison, and aerial shooting is documented in several publications (Lensink, 1959; Rausch, 1961 and 1964). Official programs for wolf destruction had widespread public support from 1915 through the early 1950's. In the late 1940's and early 1950's an expanded program under the U.S. Fish and Wildlife Service encountered some public

opposition because poisons—strychnine and cyanide—were not selective. Often bears (*Ursus arctos* and *U. americanus*), fox (*Vulpes fulva*), wolverine (*Gulo gulo*), and ravens (*Corvus corax*), were killed. Public criticism of the predator program and recognition by professional biologists that caribou, moose, and sheep were sufficiently abundant to provide for both subsistence and recreational hunting seem to have been responsible for convincing the public that it would be "safe" to close Unit 13 and part of Unit 14 to wolf hunting. Nevertheless, the idea was criticized, and at least one sports club conducted an independent investigation into the entire predator control problem. They concluded that predator control in some form was desirable.

During the period 1957 through 1963 wolf populations in Unit 13 increased several fold but their relative scarcity and the obvious abundance of big game seem to have had a tranquilizing effect on the public. As the wolves became more abundant and were frequently seen by local residents and as guides started having difficulty in obtaining trophy moose in some parts of Unit 13 following the 1962 die-off, there was a considerable outcry for opening the area to wolf hunting and trapping. In 1965 a limited trapping and hunting season was authorized by the Board of Fish and Game (the Department's regulatory body).

Political pressures continued to mount, culminating in an aerial-hunting season in 1967-68. A dispute arose between the Board and the Department over implementation of the hunt. Eventually the Board ruled that the hunt would be for 300 wolves, and the hunt proceeded.

The pressures were not entirely one-sided, however, as those citizens favoring rational management of the wolf population mounted an attack against aerial hunting, poison, bounties, and formal predator control in general. In 1968 the State legislature enacted a law requiring written consent from the Board of Fish and Game before any state agency could use poison; enacted a law giving the Board sole authority for establishing or abolishing bounties on wolves, wolverine, and coyotes; and considered, but did not pass, a bill that would have made it illegal for anyone to shoot animals from an airplane. At no time during the dispute did anyone advocate returning to a formal predator control policy in southcenteral, interior, or arctic Alaska.

DISCUSSION AND RECOMMENDATIONS

In Unit 13 during the period of 1953 to 1967 human utilization of the wildlife resource undoubtedly increased. In fact, it is probably the most important recreation area in Alaska. Access to the area

through road construction and improvement and technical advances in design and construction of airplanes, tracked vehicles, and other off-the-road vehicles have contributed to this increased exploitation. Recently, the sales of hunting licenses and the distribution of moose harvest and sheep harvest tickets suggest that proportionately fewer residents are buying hunting licenses. However, total sales continue to increase because immigration rates are high.

Management of this complex of carnivores and ungulates must recognize changes in human attitudes as well as changes in the numbers of animals and their habitat. The Nelchina wolf population probably will be most beneficial to all interests if it is managed at a level where some sport hunting and trapping can be allowed each year. I suggest that to attain this goal there should be from 200 to 300 wolves in the fall population. Downward population adjustments of wolves might be advisable following exceptionally severe winters or other major catastrophies to ungulates, such as disease. For example, brucellosis is prevalent in the Nelchina caribou herd but at a low level. Under optimal conditions of stress or other unknown factors it could become a major decimating factor resulting in a much reduced survival of calves. Then serious thought might be given to reducing utilization by wolves and humans; however, there is no assurance that intense exploitation of the caribou might not be the "best cure."

Methods for utilizing the surplus wolves should include sport hunting and trapping. If surpluses exist by midwinter, I recommend regulated recreational aerial hunting even though it is controversial. The Nelchina Basin has so many lakes, ridges, rivers, and other terrain features where aircraft can land to retrieve wolf carcasses that general aerial hunting without adequate controls can only lead to severe management problems resulting from overutilization of the wolf resource. This may have occurred in 1968.

A great deal of worthwhile information concerning the rate at which a protected wolf population may increase and its effect upon lightly hunted moose, caribou, and sheep was obtained. I conclude that at the level of exploitation experienced during the study, there was no significant conflict between humans and wolves for utilization of the ungulate resource. However, direct competition is inevitable as human utilization of the ungulate resource approaches annual net production.

In the future wolves may be extirpated from large areas of suitable habitat either intentionally or inadvertently. In fact, this happened in Units 7 and 15 (Figure 1) about the turn of the century and in large portions of Units 13, 14, and 16 in the late 1940's and early 1950's. The study conducted in and adjacent to Unit 13 provided future

game managers with some insight into the potential of wolves to repopulate suitable habitat even in the face of continued exploitation.

Wolves were generally distributed throughout Unit 13 by 1960-1962, shortly thereafter bounty hunters commenced killing a few in portions of Units 14 and 16 where wolves had been absent or extremely rare for several years. By the mid-1960's wolves were seen in the Matanuska Valley, Alaska's most intensively developed agricultural area, and a pack was sighted within a few miles of Anchorage. Finally, in 1968 a pack of 10 wolves was seen on the Kenai National Moose Range, Unit 15, by Department personnel. Wolves had been absent from this area for 60 to 65 years.

I cannot prove that the reestablishment of wolves in areas adjacent to Unit 13 resulted from egress of Unit 13 wolves, but the circumstantial evidence is compelling.

Public attitudes toward wolves in Alaska have changed during the past 15 years, and the Nelchina study may have been extremely important in this education effort. Most of the public clearly wants a rational management of all game including carnivores. Furthermore, direct control of carnivores by the Department will probably be limited to trapping, aerial shooting or chemo-sterilants if the latter become practicable. The use of poisons, strychnine, 1080, or cyanide, none of which is truly selective, in southcentral, interior, and arctic Alaska, cannot be justified, nor will the public accept such antiquated management tools.

The study resulted in one major disappointment which stemmed from the Department's inability to defend the study when the wolves reached a peak of abundance in 1965. This failure, which included inability to enforce regulations, failure to communicate effectively with the public, and an open disagreement with the Board of Fish and Game, was, in my opinion, due to the fact that very little effort had been made to educate the public about the goals of the long term study. Perhaps this phase of the study was doomed to failure from the beginning, as the site selected was already recognized as one of Alaska's prime big game ranges, and human reaction to competition from wolves, real or imagined, could have been predicted.

Future studies designed to measure the interrelationships of wolves, mixed stocks of big game, and recreational hunting should procede only after a thorough public information program reveals broad support for such an endeavor. Furthermore, such sites should not encompass areas where human utilization of the ungulate resource is approaching the sustained yield. Few such areas remain in Alaska—Mt. McKinley Park and Katmai National Monument are unsuitable because man as a hunter is excluded and the arctic wildlife range does

not have a good cross section of ungulate prey. Perhaps only the Tanana Hills in Unit 20 has the desired species and other characteristics necessary for a similar research project.

SUMMARY

Wolves were protected from 1957 to 1968 in an area of southcentral Alaska encompassing approximately 17,000 square miles. Wolf numbers increased from 12 in 1953 to 400 to 450 by 1965. At this point illegal aerial hunting, legal hunting of wolves that followed the Nelchina caribou into Units 11 and 12, and relatively poor survival of pups during the summer of 1967 resulted in lowered wolf populations by late 1967. A further reduction took place in early 1968 when Unit 13 was reopened to aerial-hunting.

Studies of ungulate prey, moose, caribou, and sheep, show that their utilization by wolves did not interfere significantly with human recreational use of the same resource. Competition between the two predators could create problems if human utilization approaches the net annual increase of ungulates.

ACKNOWLEDGMENTS

I gratefully acknowledge the contributions of a large number of individuals who initiated or conducted phases of the study. Unfortunately, not all of them can be named here. The study was initiated through the efforts of Robert F. Scott, John Buckley, Maurice Kelly, Urban Nelson, and Clarence Rhode (Deceased); Bob Burkholder was the principal investigator through 1960; Gerry Atwell, Richard Winters, Ronald Skoog, Richard Bishop, and Arthur Bratlie (deceased) conducted field investigations and surveys of wolves from 1961 through 1967. Robert Weeden criticized and improved the manuscript.

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DISCUSSION

FRANK BARICK (North Carolina): We are very much concerned in North Carolina about the impact of dogs, stray dogs primarily, on deer. Did your study include an evaluation of the amount of food ingested by wolves in relation to body weight and, if so, whether this might serve as some basis for reading values into potential impact of stray dogs throughout the Southern Appalachians or wherever they might be?

MR. RAUSCH: This particular phase of the study did not attempt to evaluate the amount of food necessary to sustain a wolf. We have, however, looked at 1,000 or 1,500 killed, from aircraft, and made some measurements on the amount of moose or caribou or sheep in the digestive system.

It might be best if we got together and discussed the data. It doesn't differ too much from what Dave Mech published.

MR. LA SALLE (Minnesota): How did you count your wolves?

MR. RAUSCH: Our census in later years consisted of flying over drainages, on contours, over most of the area, using a 150 Super-Cub following fresh snowfall, and locating the packs. In places where we could not locate the packs, we landed when they fanned out from the chase or fanned out on the lakes.

MR. LA SALLE: There is an interest in our Minnesota Legislature at the present time to give the timber wolf in Minnesota more protection. There has been no bounty on the wolf for four years. One bill has been introduced to make the timber wolf a State animal. We are hopeful the timber wolf in Minnesota will gain some form of legal protection.

FROM THE FLOOR (New York): You indicated that wolves were found to prefer moose over caribou. Are moose easier to catch than caribou?

MR. RAUSCH: I wish I could answer that. There are about 25 to 30 thousand moose in my opinion in the area and perhaps upward of 70,000 caribou. Yet we find the wolves take more moose than caribou. I really don't know whether moose are easier to catch.

MR. R. W. STUART (North Dakota): Is there much of a seasonal preference for moose?

MR. RAUSCH: Yes. I should have pointed out that the data we have are primarily from the November through April, and my comments relating to what they seem to prefer and to what they are eating should be confined to that period of time. I frankly don't know what they are eating in summer; and it could be

small mammals. Possibly even sheep, during some other months, may be significant.

DR. A. B. COWAN: You have suggested failure of the reproductive effort on the part of the wolves; in other words, mortality of pups—this, occurring in the seeming face of plenty—violates a few of our normal concepts of population dynamics. Have you any suggestions as to the cause of the mortality?

MR. RAUSCH: I probably should say no.

It seems to me that the critical time for a wolf population is shortly after pupping or when the pups are still around the den. The food must be available in good supply at that time. During the period that this wolf population was building up, the snowshoe hare was also extremely abundant. They crashed in about 1965. Pup production did go down thereafter.

I am not implying that they are dependent upon snowshoe hare, but at times hares are a significant portion of the wildlife. It is just an idea.

MR. C. T. BLACK (Michigan): You refered to developments on the North or Arctic Slope that might affect the future of the wolf in Alaska. What are these developments and what are the portents for the future of the wolf?

MR. RAUSCH: The developments concern extractions of what some people believe to be one of the largest oil deposits in the world, and it is proceeding at a fairly rapid rate. Wolves there are extremely vulnerable to aircraft hunting and other forms of hunting. They exist on true tundra, and they have been depressed in this area before. There are now thousands of people working up there; there may be more thousands.

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