WOLF CONTROL - TAKE SOME AND LEAVE SOME

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Abstract: From January 1976 through July 1978 wolf (Canis lupus) control was conducted in a 7262 km^2 (2804 mi^2) area in the upper Susitna River Basin of southcentral Alaska in an effort to improve moose (Alces alces) calf survival. Sixty wolves were killed by Department personnel by shooting from helicopter and fixed-wing aircraft. While control was in progress spring wolf densities were reduced by an average of 51% of precontrol densities. Repopulation of the area occurred annually through immigration and reproduction, requiring constant control effort to keep wolf densities at low levels. When control terminated in summer 1978 the wolf population grew quickly and within one denning season had increased to within 81% of the precontrol level and by 1980-81 had exceeded it. Costs of removing instrumented versus noninstrumented wolves were compared; it was less expensive to radio-collar members of packs before initiating control. We speculate that wolf control would be more economical and effective if 2-3 adult members of each pack were radio-collared and not removed.

Connolly (1978) in his review of predator control in North America stated that a selective review of the literature can reinforce any desired view on the subject of predation. This is still the case today. Predator management to benefit wild ungulates has almost gone full circle on the North American continent within the last 75 years. Early in the century wolves were considered vermin and widespread control by poisoning, trapping, "denning" and aerial shooting along with habitat destruction nearly eradicated wolves from large areas of their range. In the 1940's (Connolly 1978) predators began to be viewed as valuable components of the ecosystem serving to cull out the weak, sick and young of wild ungulates. This latter sentiment led to the curtailment of many control efforts in the U.S. and Canada. Since the early 1970's, a number of biologists have suspected that predators were solely or partially responsible for depressing ungulate populations, thus requiring some form of control, but certainly not eradication. Regardless of the view held, the subject of predator control quickly polarizes the public and wildlife managers into factions forcing the manager to select an option which will probably satisfy neither group.

One of the fears expressed by opponents of wolf control efforts is that the program will eliminate viable wolf populations. Although most wolf populations seem quite capable of responding to heavy harvest pressure if suitable habitat and prey remain, there is limited knowledge concerning the effectiveness and length of time for a wolf population to rebound from control. The most notable exception occurred in Alaskan Game Management Units (GMU) 13 and 14 where the Federal government, through aerial shooting and poisoning reduced wolf numbers within a 51,800 km^2 (20,000 mi^2) area to approximately 12 individuals in 1953

(Rausch 1967). Unfortunately the size of the wolf population prior to control was not known. However, with complete closures of hunting and trapping the population increased reaching a maximum of 350 to 450 wolves by 1965 (Rausch 1967; 1969).

Beginning in the early 1970's some Alaskan biologists suspected that wolf predation was preventing several ungulate populations from increasing. Consequently in 1975 two studies were proposed to test the hypothesis that wolves were controlling selected ungulate populations. The proposals were met with heated reactions from a portion of the public and resulted in several environmental groups filing a civil suit enjoining the Alaska Department of Fish and Game (ADF&G) from conducting wolf control. In 1976 the cases were dismissed from court and the control program was initiated.

This paper describes the wolf control study in a portion of GMU 13, its costs and effectiveness, the response of the wolf population during and following control, and presents a recommendation for making such control programs more effective. The paper will not discuss effects of lower wolf densities on moose, which will be described elsewhere (Ballard et al. In Prep.). This paper is based on the premise that once decision makers decide that wolf control is necessary, such programs should be efficient, conducted in a humane manner, and that the objective not be permanent eradication of wolf populations.

STUDY AREA

Wolf control was conducted in a 7262 km^2 (2804 mi^2) portion of GMU 13 in the upper Susitna River Basin of southcentral Alaska from

January 1976 through July 1978 (Fig. 1). Boundaries of the area were as follows: the Alaskan Range on the north; the Maclaren River on the east; the Maclaren and Susitna Rivers on the south; the confluence of Deadman Creek with the Susitna River northward to the headwaters of Brushkana Creek, downstream to Brushkana Creek's confluence with the Nenana River and then northwest upstream to the Alaska Range on the west.

While wolf control was in progress, wolf radio-telemetry studies were conducted in several other portions of GMU 13 (Ballard et al. 1981). The main study area comprised those portions of the Unit lying east and south of the control area (Fig. 1).

Vegetation, topography, weather patterns, etc. have been described elsewhere (Skoog 1968; Rausch 1969; Bishop and Rausch 1974; Taylor and Ballard 1979).

METHODS

Wolves were located from fixed-wing aircraft (Piper PA-18 Super Cub) for control, capture, or censusing by searching snow covered lakes, streams, and ridgetops for foottracks according to methods described by Stephenson (1975). Wolf censuses were conducted a minimum of twice per year. Wolves were captured and radio-collared according to methods described by Ballard et al. (1981; 1982).

Wolf densities in both the control area and in the remainder of GMU 13 were estimated on the basis of known numbers of wolves within instrumented packs, sightings by both the public and ADF&G personnel, observations of tracks, and harvest records. Density estimates were

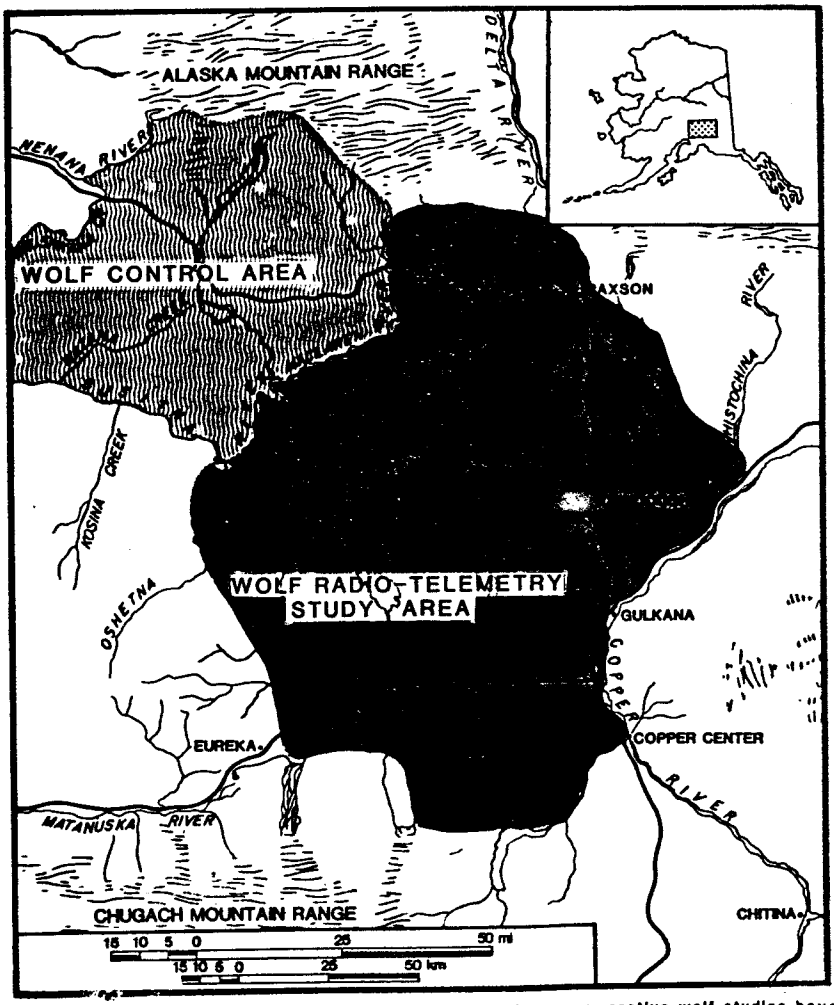

Figure 1. Boundaries of wolf control area and area where comparative wolf studies have been conducted from 1975 – 1982 in southcentral Alaska.

made for two periods: (1) fall - prehunt population comprised of adults, yearlings and pups and (2) spring - post hunt population prior to denning comprised of all wolves ≥10 months old. Age classes of harvested wolves were determined based on fusion of the epiphysis to the diaphysis of the longbone (Rausch 1967) or by tooth replacement and wear. Because instrumented wolves rarely occupied elevations above 1219 m (4,000 ft) elevation, wolf densities were based on the area (km^2) below this elevation (Ballard et al. 1981). Wolf territories in the control area were determined on the basis of sightings of instrumented and noninstrumented wolves, track counts and ADF&G sightings. In some cases territory boundaries were estimated based on their spatial relationship to known locations of other wolves.

Both instrumented and noninstrumented wolves were killed by shooting from either helicopter or fixed-wing aircraft. An attempt was made to retrieve all wolf carcasses to obtain biological specimens for other studies (Nielson 1977; Holleman and Stephenson 1981) and to salvage the hides. The area was open to both public hunting and trapping while the control program was conducted, and Alaska game regulations require that all harvested wolves be reported to an authorized representative for sealing of hides within 30 days of taking.

RESULTS

From January 1976 through July 1978, 60 wolves were killed by Department personnel as part of the control program in GMU 13: 40 wolves from 8-9 packs in 1976, 12 wolves from 3-5 packs in 1977, and 8

wolves from 3-4 packs in 1978.

Several months prior to initiation of wolf control, 6 wolves from 5 packs and 1 single were captured and equipped with radio-collars using helicopter darting techniques (Ballard et al. 1982). These wolves were studied from April 1975 to March 1976 in an effort to enumerate population density and distribution. Territory sizes, movements, and food habits are reported elsewhere (Ballard et al. 1981; In Prep.). Distribution of known and suspected territories within the wolf removal area are depicted in Fig. 2. All packs successfully denned in 1975 except for the Butte Creek pack which was comprised of 3 adult males. The population estimate for the study area was 36 wolves as of January 1976 (Table 1). In January and March 1976, 29 wolves were killed by shooting from helicopter and 2 were killed by trappers in fall 1975. Approximately 86% of the previous fall's estimated population of wolves were removed.

During 1975-76, wolf studies were also being conducted outside the removal area to gain further insight into wolf food habits, territoriality and population dynamics (Ballard et al. 1981). Following removal of wolves from the study area between March and August 1976, at least 3 radio-collared wolves were known to have immigrated into the control area. All 3 wolves subsequently paired with other wolves which were either immigrants or wolves which had not been removed in spring 1976. By late May 1976 the area wolf population was estimated at 11 wolves (Table 1). Three of the immigrating (2 were radio-collared) wolves were removed in control efforts during summer 1976.

By late fall 1976 the wolf population within the 7300 km^2 (2800 mi^2) area was estimated at 20 (Table 1). Distribution of pack sightings suggested that at least 3 pairs successfully denned and reared pups in

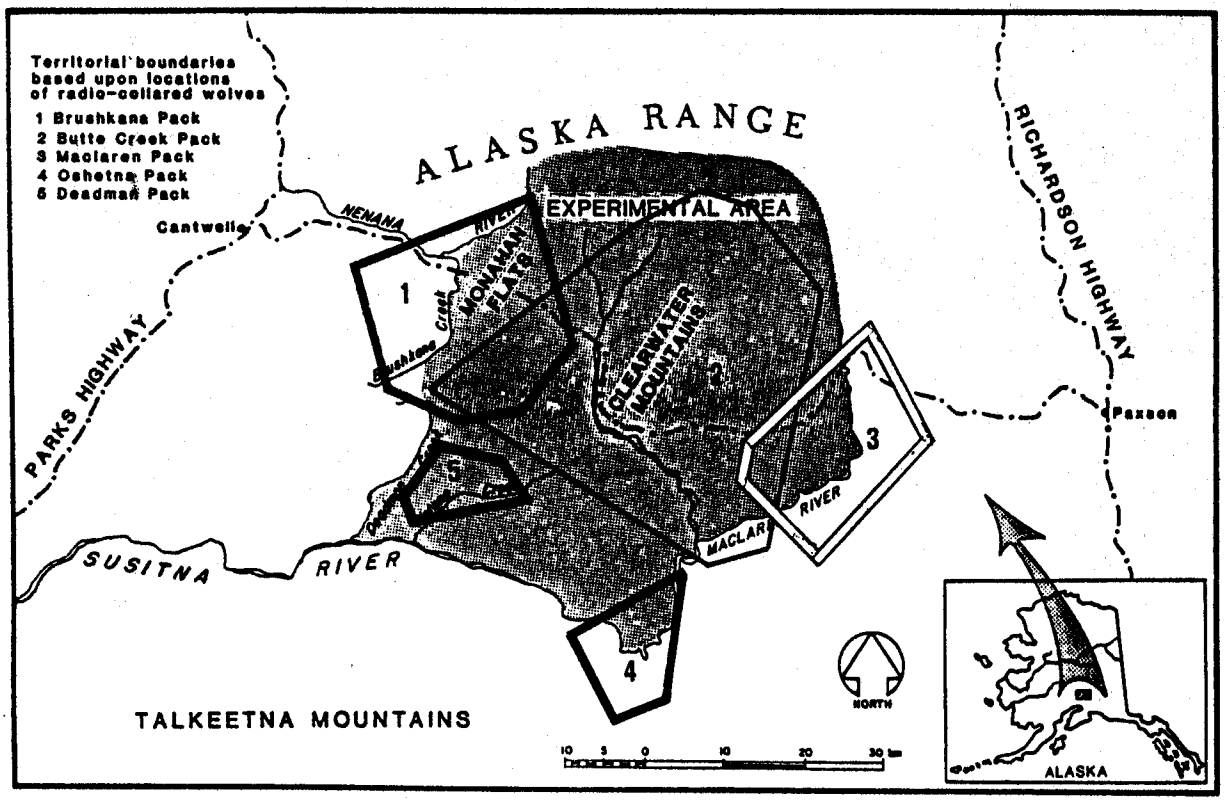

Figure 2. Distribution and territorial boundaries of wolf packs in the wolf control area during 1975 and 1976 prior to wolf removal.

Table 1. Numbers and density of wolves estimated to occupy the Susitna River study area from spring 1975 through spring 1982 (from Ballard et al. In Prep).[1/]

Pack Area	Spring 1975	Fall 1975	Spring 1976	Fall 1976	Spring 1977	Fall 1977	Spring 1978	Fall 1978	Spring 1979	Fall 1979	Spring 1980	Fall 1980	Spring 1981	Fall 1981	Spring 1982
Brushkana River-Butte Creek	7	12	2	7	1	2	2	2	3-4	3-4	?	3-4+	3	5+	2
Coal Creek	6?	10?	2	2	2	4	1	4	3-4	10	6	7-8	3	11	2?
Clearwater Creek			3	3	2	0	1	2	0	?	2	?	?	?	?
Maclaren River	2	6	?	?	1	0	0	0	0	5	?	5	4	3+	1
Middle Fork of Susitna River			1	2	0	2	2	0	0	0	2	2	1	?	?
Watana-Deadman Creeks	2	5	2	4	2	6	1	3	2+	7	5	14	8	15	7
Subtotal	17	33	10	18	8	14	7	11	10	26	15	33	19	34	12
Lone Wolves (10% of subtotal)	2	3	1	2	1	1	1	1	1	3	2	3	2	3	1
Total	19	36	11	20	9	15	8	12	11	29	17	36	21	37	13
Habitat miles^2/wolf (1858 mi^2)	98	52	169	93	206	124	232	155	169	64	109	52	88	50	143
km^2/wolf (7262 km^2)	254	135	438	241	534	321	601	401	438	166	275	135	228	130	370

1/ Wolf population estimates do not coincide with numbers of wolves killed because several wolves were killed outside of control area.

1976. The origin of the 3 pairs was unknown. We suspected they had immigrated into the area. One radio-collared adult male which had been observed alone during winter 1976 moved into the area in June and became associated with a denning female. Whether they had paired earlier in the year and the female had been missed during radio-tracking flights is unknown.

During winter and summer 1976-77 an additional 16 wolves were removed from 3-5 packs by shooting from fixed-wing aircraft. Suspected distribution of these packs based upon track counts and sightings are presented in Fig. 3. Assuming correct estimations of the ranges of these packs, much of the available wolf habitat within the removal area remained occupied but at lower densities (45% of the pre-control fall 1976 population).

During spring 1977, 7 of 8 wolves located just south of the study area were also killed by Department personnel by shooting from a helicopter. These wolves were removed because moose movement studies suggested that a large number of moose were wintering and calving outside the removal area and were therefore occupying areas with relatively higher wolf densities (Ballard and Taylor 1980). The pack was comprised of 4 adults and 4 pups. One adult female remained and by spring 1978 had been joined by an adult male believed to have immigrated into the area. They denned in 1978 and produced 6 pups. This pack was not included in density calculations because wolf control only occurred in spring 1977. The recovery of this pack to its original size within slightly more than a year was typical for packs after control ceased.

Data suggested that at least 2 pairs successfully reared pups in spring 1977 (Watana-Deadman and Coal Creek packs, Table 1). However, if these data were accurate they suggest that litter size and/or pup survival

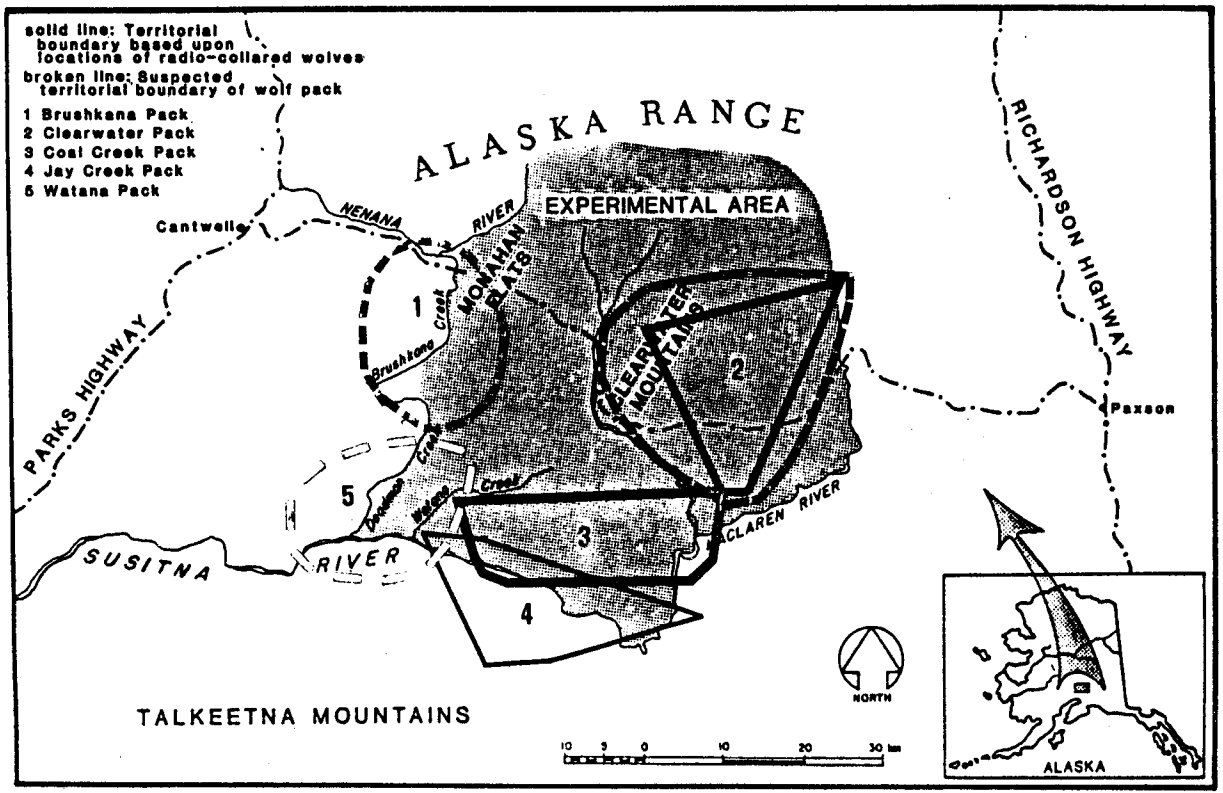

Figure 3. Known and suspected territorial boundaries of wolf packs in the wolf control area from summer 1976 through mid-winter 1976-77.

was low, because other packs in the remainder of GMU 13 typically have 6 pups (Ballard et al. 1981; In Prep.). By fall 1977 the control area population had increased to 15 wolves; a 66% increase from spring 1977 but an overall decrease of 58% and 25% from fall population estimates for fall 1975 and 1976, respectively.

Between fall 1977 and summer 1978 an additional 8 wolves from 3 packs were removed. Suspected distribution of packs occurring in the area was determined on the basis of track counts, sightings and historical use of certain areas by certain packs (Fig. 4). By spring 1978, wolf densities within the area were at their lowest level (58% and 27% lower than springs of 1975 and 1976, respectively).

During the spring of 1978 2 packs were suspected to have denned; a single radio-collared adult female (Coal Creek Pack) which had dispersed into the area in late fall 1976 raised at least 3 pups and the Watana pack probably raised 2 pups.

Data collected on annual pup production and survival in the wolf removal area suggests that pup survival of single adult wolves was lower than that of packs containing 2 or more adults. This seems logical considering the dependency of the post-estrous female and her pups on other pack members for food. Observations of 4 radio-collared pairs of wolves outside the control area suggested that litter sizes of 6 pups were successfully produced and raised (Ballard et al. 1981). Therefore, pairs of wolves appear to have reproductive success similar to that of larger packs.

Wolf control terminated in July of 1978. Apparently pup production and survival, and dispersal of wolves were quite low from spring through

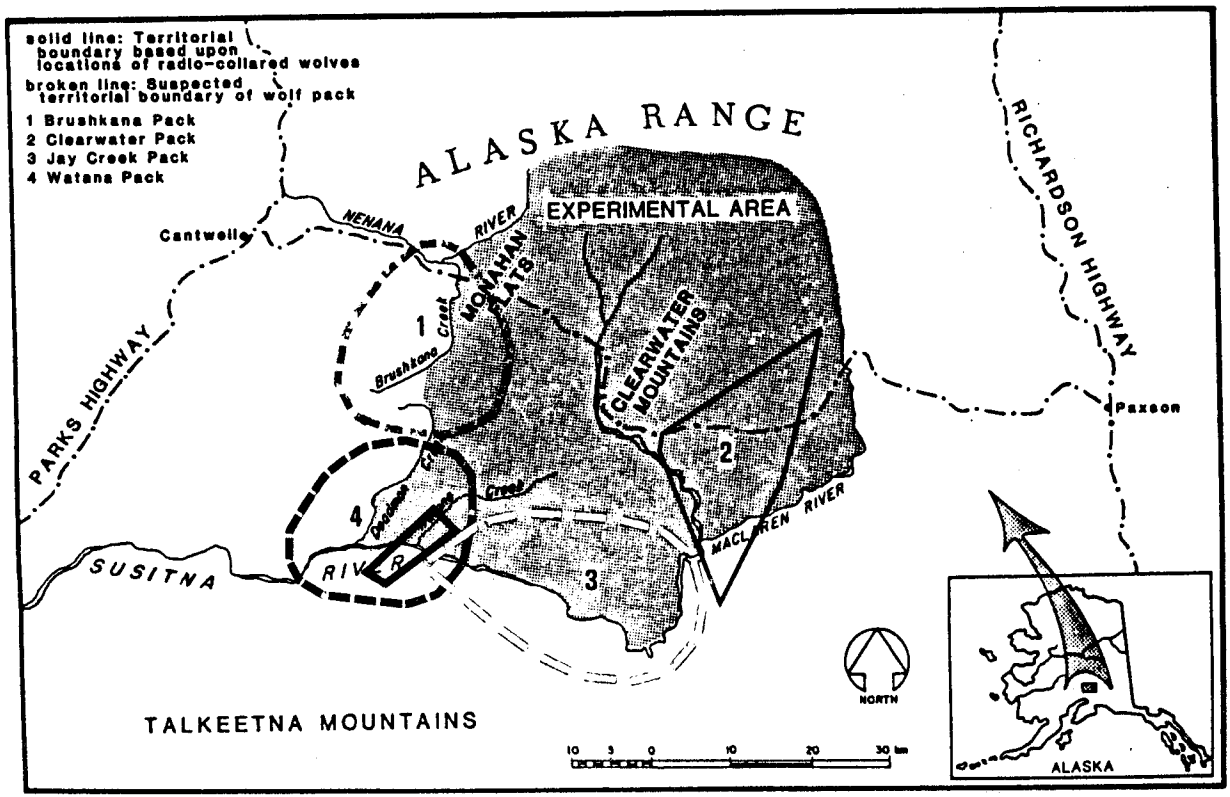

Figure 4. Known and suspected distribution of wolf packs in the wolf control area during 1977 - 1978.

fall 1978 because the population was estimated at only 12 wolves by fall. Overwinter (1978-79) survival of the remaining wolves appeared high. Trapping records indicated that only 1 wolf was taken and, consequently, the population did not decline (Table 1).

A minimum of 3 packs denned in 1979 and by fall the population had increased to 29 wolves. Therefore within 1 denning season following the termination of wolf control activities, the population had increased to 81% of the estimated pre-control population. Based upon harvest data and wolf density estimates, from 38-41% of the population was taken by public hunting and trapping activities during 1979-80 and by the 1981-82 season this wolf population's growth was limited by public hunting and trapping when 55-65% of the fall population was removed. Thus with the area open to public hunting and trapping when control terminated the annual rate of increase in density was 142% in 1979, 23% in 1980 and 4% in 1981.

Distribution and suspected territorial boundaries of wolf packs in the control area from spring 1980 through spring 1982 are depicted in Fig. 5. Excluding the Butte Creek Pack which was comprised of 3 males in 1976, the distribution of wolf packs from 1980-1982 was quite similar to that prior to removal (Fig. 2), suggesting that nearly all available wolf habitat in the study area was occupied shortly after control ceased.

DISCUSSION

The original objective of the wolf control study was to reduce wolf densities to as low a level as possible in the control area. Figure 6 compares the estimated wolf densities within the wolf study area from

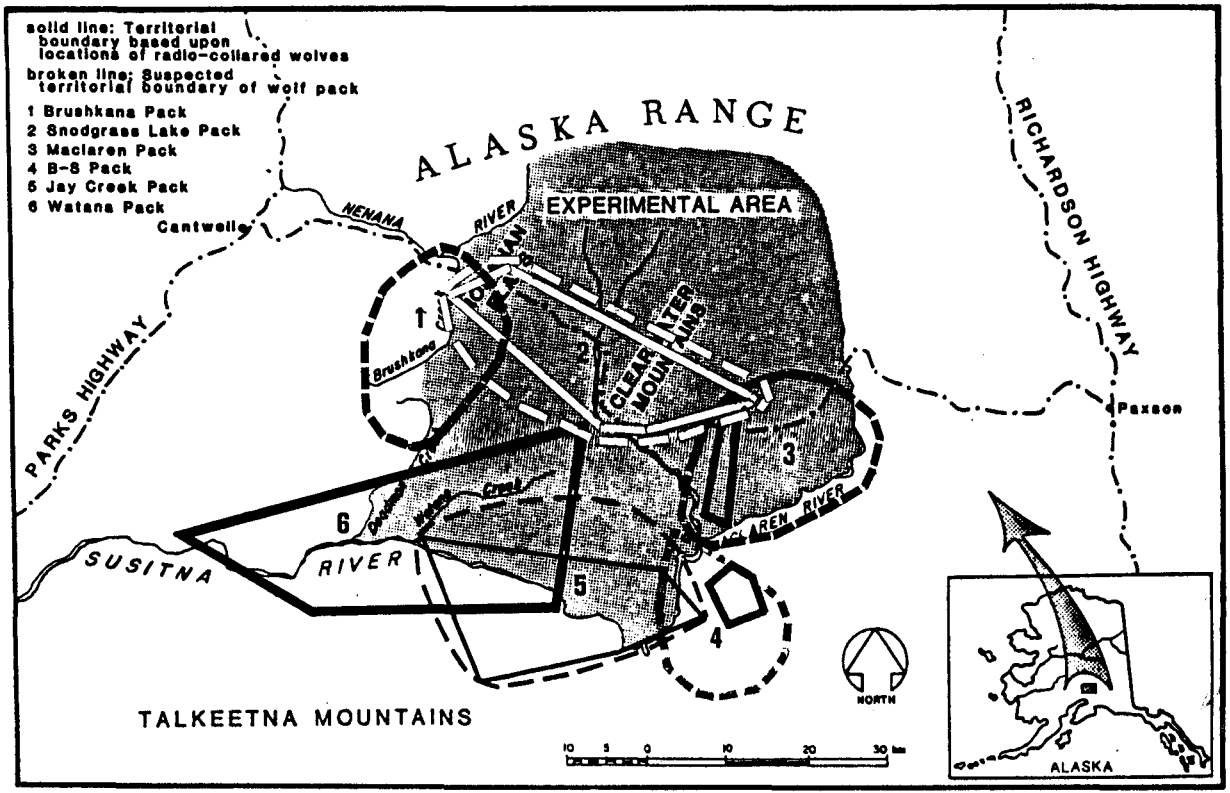

Figure 6. Known and suspected territorial boundaries of wolf packs inhabitating the wolf control area from 1980 - 1982.

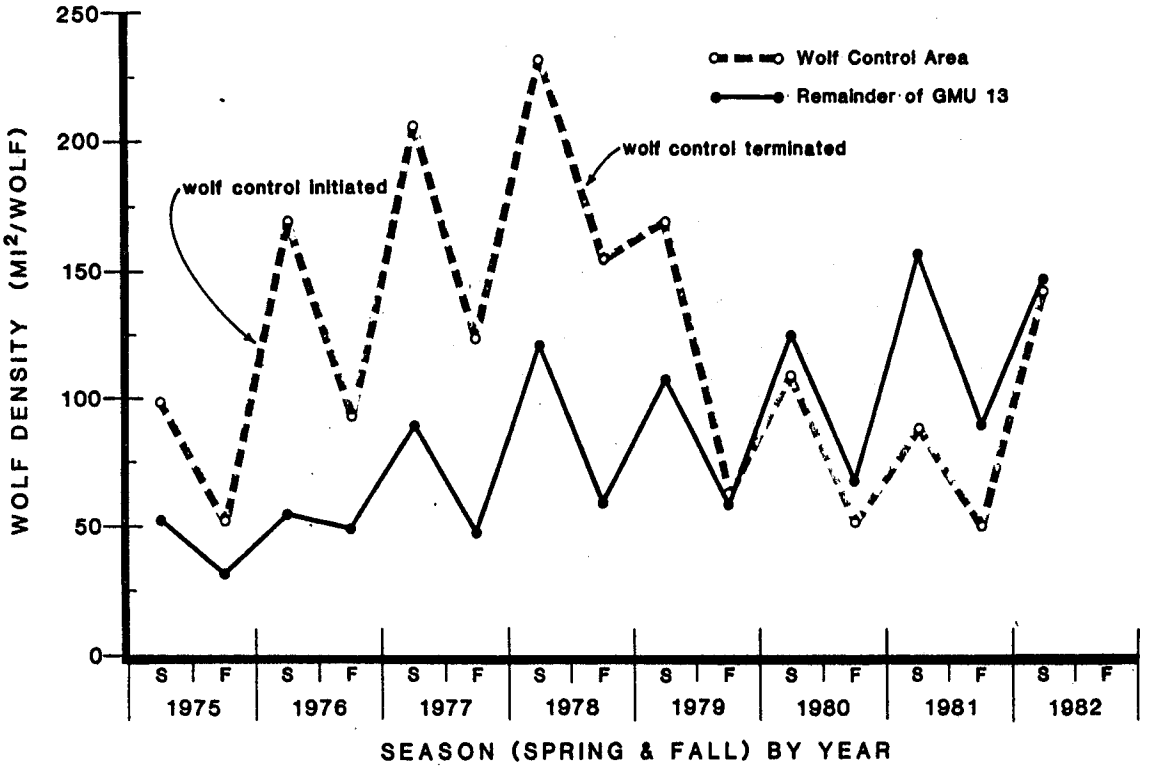

Figure 6. Comparison of estimated wolf densities between wolf control area and remainder of Game Management Unit 13 from spring 1975 through spring 1982 (from Ballard et al. in prep.).

spring 1975 through spring 1982 with the remainder of GMU 13 where wolf numbers, not subject to Department control, were subjected to fairly heavy public trapping and hunting pressure. Spring densities within the study area from 1976-78 were reduced from precontrol levels (1975) by 42% to 58%. Fluctuations in wolf density from fall to spring were similar between the wolf control area and the remainder of the Unit except that densities were considerably lower in the wolf control area. While control was in effect spring densities in the control area were an average of 57% lower than in the noncontrol area, ranging from 47% lower in spring 1978 to 67% lower in 1976. Fall densities were similar: 47% lower in 1976 to 61% lower in fall 1977. Differences in densities, however, may not have been entirely related to wolf control because precontrol densities in the wolf control study area were 37% lower in spring 1975 and 17% lower in fall 1975 than in the remainder of GMU 13.

Following termination of wolf control in summer 1978, however, differences in wolf density between the areas steadily decreased and by fall 1979 were quite similar (9% lower) and by spring 1980 were higher than in the remainder of the Unit (13% higher in spring 1980 and 24% higher in fall 1980). When wolf densities were at their lowest level in the control area (spring 1978) densities within the remainder of the Unit were also low. Because the Unit densities were relatively low we suspect the magnitude of dispersal was also greatly reduced and probably influenced densities to some degree in the removal area. Wolf densities in surrounding areas were not particularly high following control efforts, ranging from 1 wolf/151 km^2 (58 mi^2) in fall 1979 to 1 wolf/315 km^2 (122 mi^2) in spring 1978 (Ballard et al. 1981). Earlier, wolf densities in much of the Unit had been considerably higher, ranging

1975 through spring 1982 (from Ballard et al. in prep.).

from 1 wolf/97 km^2 (38 mi^2) in fall 1975 to 1 wolf/161 km^2 (62 mi^2) in spring 1975. Therefore the control area wolf population recovered quickly even though wolf densities outside appeared to be well below saturation levels. In any case, with the wolf densities which existed outside the study area, immigration was significant and efforts to maintain low wolf densities required annual control efforts. Control areas of similar size and wolf density elsewhere would also require constant effort to maintain low wolf densities. However, the response of a wolf population to control will vary depending on the level of harvest and whether adequate numbers of wolves exist outside the control areas for immigration to occur.

Comparison of age ratios of harvested wolves between the wolf control area and the remainder of GMU 13 from 1975 through 1977-78 lend some support to this hypothesis (Table 2). Although there were no significant differences in age ratios, the control area population was comprised of a high percentage (60% 1977-78) of adults, which we suspect were immigrating into the area.

Prior to initiation of wolf control in spring 1976 public hunting and trapping annually accounted for an average of 11 mortalities from 1971-72 through 1974-75 (range of 17 in 1971-72, when aerial hunting was permitted, to 3 in 1972-73). Public harvests from the control area accounted for 4 to 15% of the Unit harvest prior to control. Excluding aerial hunting in 1971-72 the average harvest was 9 wolves. Therefore at least during the first year of control ADF&G efforts more than tripled the mortality in the wolf population over that taken by public hunting and trapping. During the years of wolf control the public killed 2-4 wolves annually.

Table 2. Comparison of age structure of harvested wolves between the wolf control area and the remainder of GMU 13 of southcentral Alaska from 1975-76 through 1977-78.

Year	Area	Age of harvested wolves[1/]		Chi x^2, significance level
		Pup	Adults	
1975-76	Control Area	12	18	.12, $P < 0.70$
	Remainder GMU	28	36	
1976-77	Control Area[2/]	8	12	.89, $P < 0.70$
	Remainder GMU	40	37	
1977-78	Control Area	4	8	2.16, $P < 0.10$
	Remainder GMU	59	47	

1/ Includes wolves harvested by public.

2/ Excludes Keg Creek Pack.

During the first 2 years of the wolf control program an attempt was made to remove all members from each pack. Beginning in late winter 1977-78 one wolf from each pack was captured and radio-collared and the remaining members were killed by shooting from a helicopter. The logic behind this approach was that the remaining single pack member would continue to occupy the pack area and be joined by immigrating wolves. Thus the area would continue to be occupied and additional wolves would be relatively easy to locate for control purposes. Two adult males and 1 adult female were radio-collared and left in the control area in late winter 1977-78. One male disappeared within 3 weeks of capture. Another male was joined by 2 adult females, both of which were removed, and then it too disappeared from the area. The single pregnant adult female remained in her pack territory, successfully raising 3 pups. This wolf's transmitter prematurely failed in summer 1978 and the pack of 4 wolves remained in the study area when control efforts terminated.

In retrospect, the practice of not removing all pack members so that territories would continue to be occupied by established pack members was sound. Leaving single wolves however, led to disruption of behavior and eventual dispersal. Rather than removing all but 1 pack member we recommend that biologists leave 1-2 female and 1-2 male adult members of each pack and that all be radio-collared. This approach would have a number of advantages. Of foremost importance biologists would have highly reliable information on the number of wolves occupying an area and would not be solely dependent on snow conditions for either censusing or conducting wolf removal. These smaller packs would continue to occupy and presumably defend and scent mark a territory. Thus, immigrating wolves would either join the existing pack or would be

forced to settle elsewhere. Although leaving both sexes will probably insure that each pack will produce a litter, the annual production could easily be removed since the adults would be radio-collared. The levels of immigration and reproduction experienced during this study when attempts were made to remove entire packs suggests that annual recruitment will occur and thus it would be highly desirable to have the ability to locate packs at any time for census and control purposes. Allowing radio-collared individuals to remain in the area and produce pups would probably insure that the recruitment would be removed since removal would not be dependent on snow conditions or terrain. Leaving just members of one sex will probably not produce desired results because such groups would not be socially cohesive and both immigration and emigration would probably occur and there would be few, if any, advantages to having these individuals radio-collared.

Depending on objectives, one potential disadvantage of leaving 2-3 adult members within each pack is that some predation will continue to occur. However, if immigration and reproduction occur at the same levels as documented in this study some predation will occur regardless. Peterson (1977) suggested that wolf packs preyed upon ungulates at relatively constant rates regardless of pack size. However, the smallest pack studied was comprised of 9 individuals. From 1978 through 1980 predation rates of pack sizes ranging from 2 to 9 individuals were studied by Ballard et al. (1981; In Prep.). One adult pair of wolves averaged one moose kill per 8.3 days while packs ranging from 4-9 individuals averaged one kill per 4.2 days. If 2-3 individuals per pack were retained during control operations, as we propose, it appears that predation rate per pack would be reduced about 50%.

Costs associated with removing instrumented and noninstrumented wolves were compared. Cost figures for wolf control from January - March 1976 were not available. Therefore, figures reported here are for summer 1976 through 1978 prorated at 1982 costs. Costs for instrumented wolves included all search and capture costs including radio-collars (approx. $800/wolf) but did not include manpower or monitoring costs which would be variable depending on project objective. Costs for noninstrumented wolves included search time but not manpower. Removal of instrumented wolves averaged approximately $770 per individual while noninstrumented wolves averaged $873 per individual. Because of reduced search time it was cheaper to control wolves by instrumenting a few members of each pack beforehand. If, as we propose, instrumented wolves were not removed, the anticipated removal costs would be much lower and ultimately control would be more effective because wolves would only have to be captured once every 1-3 years depending upon the life span of the radio-collar, other mortality and dispersal.

Costs were lower in control efforts conducted in 1981-82 in northern Alaska subsequent to this study, in those programs where radio-telemetry was employed and the instrumented wolves were not removed. In GMU 20 E wolves were captured with steel traps by an experienced trapper. Trapped wolves were radio-collared, released and subsequent control was performed by shooting from fixed-wing aircraft and helicopter. Costs in this program averaged $700 per harvested wolf. In comparison, in GMU 20-A where wolves were located from fixed-wing aircraft and then shot from helicopter, costs averaged $1,900 per harvested wolf. We conclude that incorporation of radio-telemetry into wolf control programs by either

helicopter darting or trapping is both cost and biologically effective for long term control and monitoring programs. We recommend that in programs where wolf control is to be continued for more than 1 year 2-3 adult members, preferably of both sexes from each pack be captured, radio-collared, and not removed during subsequent control efforts.

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