

WILDLIFE MANAGEMENT BULLETIN



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CANADIAN WILDLIFE SERVICE

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CANADA
DEPARTMENT OF
NORTHERN AFFAIRS AND NATIONAL RESOURCES
NATIONAL PARKS BRANCH
CANADIAN WILDLIFE SERVICE

WOLF CONTROL OPERATIONS,
WOOD BUFFALO NATIONAL PARK, 1951-52

by

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Wildlife Management Bulletins are produced to make available to wildlife administrators the information contained in reports which are submitted by officers of the Canadian Wildlife Service.

The reports do not, in most cases, cover extensive studies and are not written primarily for publication. Recommendations arising from the studies are not included.

INTRODUCTION

This study was undertaken for several reasons. First, it was considered important in connection with the bison investigation then in progress to have factual information on the role of the wolf as a predator and as a possible reservoir for tuberculosis. Second, more information was desired on certain aspects of wolf biology, including populations, reproduction, food habits, diseases and parasites, movements, and social organization. Third, it was desired to study practical methods of wolf control.

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HISTORICAL SKETCH

A detailed history of wolf control in Wood Buffalo National Park would be difficult to compile and would add little to this study. However, old files and reports available at Fort Smith have been consulted and the following generalizations are thought to be approximately correct.

In the 1920's, the wolf population was low. This is proved by the failure of the wardens of that day to take many wolves even though they were permitted to retain the bounty on all wolves taken by them. Reports indicated a gradual increase in the early 1930's and the situation was considered serious in 1934. Apparently this was followed by a reversal of the trend, for there is nothing more about the wolf menace until 1941-42, when serious attempts at poisoning were again made. The menace again subsided but interest in wolf control was being renewed in 1947, at which time the senior author took up residence at Fort Smith. In the opinion of the senior author, there was little change in the wolf population between 1947 and 1951.

The last organized control program was carried out in 1948-49, when 31 wolves were taken. This program was reported on by the senior author (Fuller, 1949).

DESCRIPTION OF THE AREA

Wood Buffalo National Park has been described by Soper (1939, 1941) and Raup (1935) and the interested reader is referred to these publications for details. However, a few brief notes are required to aid in the understanding of the present report.

The area hunted (Fig. 1) is divided naturally into two portions. One portion lies along the access road to Pine Lake and beyond, in the physiographic division known as the Alberta Plateau, the eastern boundary of which is a prominent limestone escarpment. Because this road was planned for ease of construction, it meanders considerably in order to take advantage of uplands and sandy ridges. Jack pine (Pinus Banksiana) and aspen poplar (Populus tremuloides) are the dominant trees along the road. There are a few short stretches of muskeg, but this type of country is avoided as much as possible. The length of the road, from its terminus at the time of the study to its junction with the old military road joining Fort Smith and Hay River, is about 60 miles.

The other portion is locally known as the Salt Plains, which is classed as part of the Mackenzie Lowlands. It consists of large prairies bordered for the most part with stands of white spruce (Picea glauca). Islands of spruce or aspen also occur. These prairies are crossed by an old military road, and by trails passable to heavy trucks.

In general, the uplands of the Alberta Plateau constitute summer range of the bison, while the Salt Plains are an important part of their winter range.

MATERIALS AND METHODS

During the last week of October, 1951, a preliminary survey was made to locate places frequented by wolves and suitable as poison stations. Then three aged bull bison were killed to provide meat for the baits. Poison stations were operated between November 1 and December 15, 1951, and between March 3 and March 30, 1952.

Two types of poison stations were used: cyanide guns (Coyote Getters) were placed at some stations, and large chunks of meat impregnated with strychnine at others (Figs. 3 to 6). Each strychnine-impregnated bait weighed between 60 and 100 pounds and contained from 20 to 40 cubes of strychnine, each weighing 2.18 grains. The remains of four buffalo killed by wolves were found; two of these were impregnated with strychnine, prepared bait was left at one of them, and coyote getters were placed around the fourth.

Along the Pine Lake road, advantage was taken of old wolf kills, wolf trails, and bison trails in making sets. The baits were placed just off the road, and no special care was taken to eliminate human sign. Sets were also made on the Salt Plains; in that area, the poison stations were usually located opposite points of timber or low shrubs and the baits were placed well out in the open to minimize the danger of taking valuable fur-bearers.

The crew was in the field six days per week during the autumn period, and all stations were visited at least twice each week. During the spring period, only the Salt Plains area was hunted, and the line was run thrice weekly.

Records of all wolf sign noted, and the condition of each set at each visit, were kept. All kills were individually tagged and numbered and taken to Fort Smith for storage. During the extremely cold weather of January and February, they were thawed and examined.

At the conclusion of the project, all baits and specimens were destroyed by deep burial.

RESULTS (TOTAL KILL)

The total known kill amounted to 59 wolves, 39 foxes, 19 ravens, two Canada jays, one coyote, and one lynx. Seven wolf carcasses had been attacked by ravens, and two had been severely damaged by other wolves, before they were picked up by the crew. The information derived from an examination of the 59 wolves is given in following sections of this report.

The sex of the two carcasses damaged by other wolves could not be determined. Of the remaining 57, 28 were males and 29 were females.

AUTOPSIES OF WOLVES

External Appearance

Few external abnormalities were noted. One specimen had lost some hair from the dorsum and may have been suffering from mange. Eleven others had scars on the legs, presumably caused by the crusted snow.

In colour, the animals varied from black (Fig. 7) to nearly white. The two which were lightest in colour were cream-coloured dorsally, and almost pure white ventrally. Thirty-four were classed as grey, although these had varying amounts of black, particularly on the dorsum. Two others were predominantly light brown or buff in colour, rather than grey. Twenty-one were black, which usually became silvery grey on the flanks and under parts.

Weights and Measurements

All specimens not too badly decomposed were measured and weighed. Measurements were taken with a steel rule calibrated in inches. Weights were taken on a platform scale with a sensitivity of half a pound. The findings are summarized in Table 1.

It may be noted that males were generally heavier and larger than females and that there was a considerable difference in size between the sexes even among pups as young as about six months of age.

It will also be noted that there was an overlap in both sexes between the largest pups and the smallest adults, in every category except the weights of males. A larger series of spring-caught males would undoubtedly reveal an overlap in this category also. Weights and measurements alone, therefore, cannot be relied upon as criteria of age.

Stomach Contents

The stomachs of all undamaged specimens were examined. In each case the stomach was removed and weighed, and then cut open so that the contents might be identified. Little difficulty was experienced in identification, in which reliance was placed chiefly on parts resistant to digestion, such as hair and bones.

Only two stomachs were listed as empty. The average weight of the remaining 47 stomachs examined was 5.3 pounds. The two heaviest stomachs weighed 11 pounds each. Notes on the occurrence of the various prey items are given below.

Bison.-Evaluation of the bison as a prey species is somewhat complicated by the fact that bison meat was used for bait. It was usually possible to identify bait meat, however, from its position in the stomach and also because the bison used in the preparation of baits were skinned before being cut up. Thus, bison hair found in the wolf stomachs could not have come from bait, except in the two cases where old wolf kills had been impregnated with strychnine without being skinned. In these cases, however, it was assumed that the wolves had returned to their kills and that the bison meat should be considered as a normal part of the diet.

Of 49 stomachs examined, 32 contained buffalo remains other than bait. Three others were from wolves taken at an old kill, raising to 35 the number of wolves which are considered to have used bison as a normal food item. This represents 70 per cent of the sample.

Six stomachs (12 per cent) contained only bison meat known to have come from the bait.

Coloured Fox.-Fox remains were found in three stomachs (6 per cent). There was no evidence around the baits to indicate that the foxes had been poisoned before they were taken by the wolves, so it is assumed that they were wild-caught.

The fox population was at a very high level, probably at or near a cyclic peak. Considering the density of the fox population, the infrequency of fox remains in the stomachs indicates that the fox is not a very important part of the wolf diet.

Varying Hare.-The hare population was still moderately high in the area although it is thought that the cyclic peak was passed in 1950-51. It is somewhat surprising, therefore, that only two stomachs (4 per cent) contained hare remains.

Wolf.-Two stomachs (4 per cent) contained wolf remains. The evidence indicated that these stomachs were from wolves that had fed on other wolves previously poisoned at the same station. When poison stations are not tended regularly, this form of cannibalism is noted more frequently.

Raven.-Raven remains were found in two stomachs (4 per cent). The evidence indicated that the ravens, too, had been previously poisoned and were eaten as carrion.

Caribou.-One stomach (2 per cent) was found to contain caribou remains. Caribou were present in fair numbers in parts of the area hunted and it is surprising that there was so little evidence of wolf predation on them.

Porcupine.-One stomach (2 per cent) was found to contain porcupine remains. Additional evidence was provided in the form of quills embedded in the muzzle of the wolf. This porcupine may have been taken as a result of inexperience on the part of the wolf, a small, young one weighing only 53 pounds.

Vegetable Matter.-Two stomachs (4 per cent) contained significant amounts of vegetable matter. In one, a quantity of moss was found, which was probably ingested only because it adhered to bait. In the other, twigs and grasses were found in the pyloric region of the stomach, and this may indicate that they were ingested before the bait, as a regular part of the diet.

Parasites and Diseases

Parasites.-One example of a mange-like condition was noted in a preceding section. No other external parasites were found.

The intestines of 49 wolves were examined for the presence of endoparasites. The commonest location was the duodenum and upper jejunum. The technique employed was to open the intestine and immerse it in water in order to float off the parasites without damage to the delicate scolices of the cestodes. This was not successful, and consequently only the genus of the cestodes was established. All belong to the genus Taenia, but probably more than one species is represented. The only nematode recovered was Toxascaris leonina. Determinations were made by Dr. L. P. E. Choquette, Institute of Parasitology, of Macdonald College, McGill University.

The incidence of parasitism in the sample and the degree of infestation in individual wolves are considered to be of some importance. The information on these subjects is summarized in Table 2. The incidence of parasitism apparently remained at about the same level (25 per cent) throughout the winter. There was no evidence that parasites were a serious detriment to the health of the hosts.

Diseases.-The main prey species of the wolf in this area has been shown to be the bison, which has a history of infection with tuberculosis. Although the Canidae are known to be highly resistant to tuberculosis, the lungs, livers, and lymph nodes of the wolves were examined to ascertain what role, if any, wolves might play in the dissemination of this disease. The results of all such examinations were negative.

Reproduction

Males.-One testis was removed from each specimen and examined in the laboratory. The volume was determined by displacement of water in a graduate; then smears were made from the testis proper and from the epididymis, and stained with eosin. During the autumn trapping period, the testis volume varied from 7 cc. to 28 cc. and averaged 15.1 cc. in 18 specimens. All testes were quiescent, but one specimen (volume, 28 cc.) had a few sperms in the epididymis. It is not known whether these were residual sperms from the preceding breeding season or indicated the onset of a new breeding cycle. The former interpretation is favoured because no spermia were demonstrated in the seminiferous tubules.

Of eight males taken in March, 1952, one was a pup whose testis had a volume of 10 cc. and contained no demonstrable sperms. Another was a very old animal whose testis had a volume of 14 cc. and was also lacking in spermatogenic activity. The remaining six were mature males with testicular volumes of 23 to 45 cc. (average 33.6 cc.). Spermatogenesis was very obvious in the testes of all six.

Females.-Particular attention was paid to the females taken in March, 1952. The horns of the uterus of each specimen were opened longitudinally and the inner surface was examined for scars and embryos. The ovaries were removed and cut into thin slices with a sharp scalpel, and the number of large follicles or corpora lutea was recorded. Vaginal smears were also made by scraping cells from the vaginal mucosa.

One pup showed no signs of oestrus.

One mature female, taken March 21, was just visibly pregnant and six probable implantation sites were counted. However, only five corpora lutea were found in the ovaries. The uterus had been discarded before the ovaries were examined so this discrepancy remains unexplained.

The other three mature females had pigmented areas in the uteri which were probably placental scars. From the numbers of these (12, 12, 10) it is thought that they may have represented two previous pregnancies. A specimen taken March 5, 1952, had six follicles and no corpora lutea, one taken March 10 had one follicle and three corpora lutea; and one taken March 21 had no follicles and five corpora lutea.

The vaginal smears were difficult to interpret, possibly because slow freezing and thawing at atmospheric temperatures had altered the histology. The cells appeared to be somewhat shrunken and misshapen. The only phenomena clearly observable were the presence of large numbers of leucocytes in the smear from the pregnant animal, and the elongated, nucleated cells in the specimen of March 5 which had no corpora lutea in the ovaries. This latter specimen was obviously in pro-oestrus, so that oestrus may occur between March 5 and March 21.

General Condition

The general condition of the animals was judged by the amount of their fat reserves. Forty-eight specimens were literally rolling in fat. It was concentrated subcutaneously in the dorsal region, inter-muscularly in the ventral body wall, and intra-abdominally in the lumbar region and in the intestinal mesenteries and renal capsule. Nine specimens had smaller amounts of fat, and one with no fat was found. Apparently the wolves in that region were almost all in excellent condition.

AGE DETERMINATION AND AGE RATIOS

Age determination was based on two criteria -- the weights of the animals and certain dental characteristics. In Figure 2, the frequency distribution of the weights of 23 males and 26 females is shown graphically. It will be noted that the curve for the females is continuous, while that for the males is discontinuous. When the evidence from the teeth was considered also, it was found that all males weighing less than 85 pounds (where the break occurs in the graph) were young of the year, while those weighing more than 90 pounds were all more than one year old. For the females, the best dividing line was at 70 pounds. No adult female weighed less than 70 pounds and only one pup, which was taken in March and was, therefore, nearly a year old, exceeded this weight.

In using dental characters, two primary age classes were set up: (1) animals less than one year of age, and (2) all older animals. In the pups of the previous spring there was a marked absence of wear on the molars, and the incisors retained their points. In the older animals, the points on the incisors had become blunted, and areas of wear on the molars were evident. Another character used was the size of and wear on the canine. Although no measurements were taken, the canines of the young animals were plainly smaller than those of the adults, and they were without visible wear on the tips.

A sub-class of aged animals was also established arbitrarily on the basis of extreme tooth wear.

Dental characters alone were used in estimating the age of the nine partially destroyed carcasses for which weights could not be obtained.

The relative abundance of the age classes in the sample of 58 wolves examined was 11 young of the year (19 per cent) to 47 adults (81 per cent). Nine of the adults (15.5 per cent) were classed as aged. The ratio of young to adults was a little less than one to four (11:47). This ratio is much lower than was anticipated. Assuming an average litter of six young per pair of adults, the expected ratio of young to adults in the catch would be 3:1. The difference between the observed and expected ratios is highly significant (chi-square = 94.0).

There appear to be two possible explanations of the difference: (1) a bias in favour of the capture of adults, and (2) a very high juvenile mortality. In a later section, it is shown that there is, in fact, a bias in favour of the capture of adults. The adult male is usually dominant in the pack and so is usually the first to feed on the poisoned bait; therefore, in cases where only part of a pack is destroyed, adults are the more likely to be taken. However, if a whole pack is destroyed at one bait at the same time, this bias disappears. The records include three examples of packs totally destroyed (Nos. 1, 2, and 4, Table 3). The age ratio in this sub-sample of 13 was three young to ten adults (1:3.3) which is in fair agreement with the sample as a whole. It is necessary to conclude, therefore, that there is a high mortality of young wolves.

The autumn age ratio was nine young to 36 adults (1:4), while in the spring there were two young and 11 adults (1:5.5). This suggests that a differential mortality continues through the winter, but the sample is too small for much reliance to be placed upon it.

The implications of these findings are interesting and important. An observed autumn ratio of young to adults of about 1:4 instead of the expected 3:1 indicates a mortality of about 90 per cent of the pups within six months of birth, before they are old enough to become a serious menace to big game. If this is so, it seems uneconomical to offer rewards for the destruction of wolf pups. Some idea of the rate of increase in the population may also be had from these data. With an age ratio of 1:4, eight adults (four pairs) are required to rear one pair of living young to the age of six months. Or, stated another way, each pair requires, on the average, four years to raise two pups to sexual maturity, i.e., to replace themselves in the wolf community. As a corollary, in a stable population, about one-quarter of the adults are removed from the breeding population each year. Some of these are removed by various mortality factors, while others, the extra adults observed in packs, continue to

live but apparently take no part in the reproduction of the species. Furthermore, if all animals were breeders, the average life span of those surviving their first year would be five years--one year before maturity and four years as breeders. The presence of non-breeders tends to raise the life expectancy.

BEHAVIOUR

Movements

Obviously, circuital movements cannot be studied adequately by the methods employed in this study. However, on each trip along the Pine Lake road, a record was kept of the number, location, and direction of all wolf tracks. At the conclusion of the study, these were plotted on a chart, and one example of regular movement appeared. This is summarized below:

- Nov. 16 - 8 tracks northbound mile 56 to mile 48, where female bison killed by these wolves.
- Nov. 16 - Dead bison autopsied and impregnated with strychnine.
- Nov. 22 - 8 wolves appeared at dead bison; 4 were killed and the others escaped. A second pack of 8 passed the bait, southbound, left road at mile 54 and was never tracked again.
- Nov. 27 - 4 tracks, southbound, mile 44 to mile 46.
- Dec. 10 - 4 tracks, southbound, mile 60 to 62.
- Dec. 11 - 4 tracks, northbound, in pursuit of bison, mile 51 to mile 52.

The evidence strongly suggests that the four wolves tracked November 27 and December 10 and 11 were survivors of the original pack of eight tracked on November 16 and partially eliminated on November 22. Apparently these animals included the part of the road between mile 44 and mile 62 in their circuit. The intervals between appearances were six, five, 13, and one days. In the final instance they reversed their direction and were in pursuit of prey.

A second example of regular movement of a pack was seen on the Salt Plains, where one bait station must have been on the periphery of the range of a large pack. This pack consisted of 11 wolves. One was taken on the first visit, December 5, 1951. Ten wolves visited the bait on December 7 and two were taken. Eight returned December 12 and one was taken. This station was discontinued December 15 and re-established early in March, 1952. On March 12, seven wolves appeared and one was killed. Another was taken on their next visit, March 21, and finally two more were

taken on March 26, after which the station was discontinued. Tracks showed that there were three survivors. The evidence strongly indicates that the wolves all belonged to one pack, since the number of wolves coming to the bait, at each visit after the first, as determined by a count of the tracks, tallied with the number of known survivors from the previous visit. Also, the behaviour of this pack was the same at each visit: they left the spruce forest at approximately the same point, went directly to the bait, and returned to the woods.

In this instance the visits of the pack to the bait were at intervals of two and five days in December and nine and five days in March.

Response to Roads

It has frequently been reported by other observers (Young and Goldman, 1944; Banfield, 1951; Thompson, 1952) that wolves will follow roads. This is amply confirmed by observations made during the present investigation, when, in fact, the success of roadside sets depended upon this trait.

During the autumn period, the Pine Lake road was kept open with a snow plough and the wolves took advantage of the easier travelling on the day after the passage of the plough. Before operations could be resumed on the Salt Plains in March, it was necessary to have a trail ploughed with a caterpillar tractor. On March 21, two wolves were taken at a bait station where no previous sign of wolves had been seen all winter. When they were back-tracked, it was seen that they had followed the ploughed road for a mile and a half to the bait. A dead wolf on this trail is shown in Figure 8.

Response to Old Kills

It is apparent that in this area, at least, wolves will return again and again to their kills. The most outstanding example was at an old kill found during the preliminary survey in late October, when it was already so reduced to skin and bones that there was no flesh in which to implant strychnine. A piece of poisoned meat was placed by this old kill at the beginning of the operation and seven wolves were subsequently taken in three separate visits to it. Wolf trails were noted there late in the following spring after the bait had been removed for several months.

Of the three other wolf kills of bison located, one was fresh and the other two partially devoured when found. As previously stated, two were treated with strychnine and Coyote Getters were placed around the third. Wolves were subsequently taken at each of these stations.

Response to Baits

In most cases, the baits were handled with bare hands. The metal drill and hammer used in placing the strychnine were not "descented". Little care was taken to eliminate human tracks. More care was taken to avoid leaving scent on the cyanide guns because most of the gun is metallic.

In many cases the baits were taken soon after they were set out. It is quite likely that some baits were still tainted with human scent when the wolves took them; for example, the remains of a buffalo were discovered on March 2 and impregnated with poison on March 4, and three wolves were poisoned at this station on the night of March 4-5.

A few instances of avoidance of the baits were noted. For example, tracks were noted in the vicinity of one station on December 1 and 8 but no wolves took the bait until December 12, when two were killed. The four survivors were trailed for about two miles and it was noted that they left numerous scats containing bison hair. This bait may have been avoided because the wolves had another kill in the vicinity and were not hungry.

In general, the wolves exhibited little caution in approaching poison stations, although they usually circled the baits at various distances before they began eating. Mature animals displayed no more caution than younger ones. The death throes of one or more members of the pack did not seem to frighten off the survivors, except in one instance, quoted above as an example of regular movement, where four survivors of a pack of eight consistently avoided the bait after the first encounter with it.

Pack Formation and Social Organization

In six instances, all or most of a pack was destroyed. The age and sex composition of these packs is shown in Table 3. The interesting thing shown by the data is that in all of the packs except one there was at least one extra adult. Murie (1944) observed extra adults at the East Fork River den in both 1940 and 1941. He suggested that the extra adults might be related to the parents, but probably were not their yearling offspring.

Between October 30 and November 15, 1951, many urinating posts were noted, particularly along the first 11 miles of the Pine Lake road. Boulders, clumps of tall grass, and shrubs were used as urinating posts and it was obvious that some had been used repeatedly. After November 15 there was a decline in utilization of the posts, and after one or two snowfalls they were no longer to be found. There are three possible explanations for their disappearance:-

1. Snow covered the urinating posts and this may have decreased their attractiveness to other wolves.

2. The wolves ranging in this area may have been taken at nearby poison stations. In particular, the Salt Plains were only a few miles from the portion of the road where urinating posts were used most frequently, and several baits were available.

3. The formation of packs may have reduced the need for scent posts. During the period of utilization of the urinating posts most of the tracks seen on the road were those of single wolves and the urinating posts were being used by singles. Probably many of these single wolves were absorbed into packs.

A record was kept of the number of wolves involved in each visit to a bait, whether or not any were killed. The number of wolves was determined by inspection of the tracks. During the autumn period, there were judged to be 11 packs, eight singles and three pairs, making up a total of 76 wolves. Of these, 62 or 82 per cent were in packs. In the spring period there were proportionately fewer wolves in packs (13 out of 19 or 68 per cent), but whether this implies spring break-up of the packs, or reduction of packs by poison, or merely sampling error, is not known.

A dominance hierarchy within the pack was clearly shown on two occasions. The composition of the two packs is shown in Table 3 (Nos. 1 and 4). In Pack No. 1, the oldest male (the male parent?) took the bait, which weighed approximately 25 pounds, and carried it about 400 yards to where he ate and died. The others followed him and their tracks crossed and recrossed his many times. The younger male then carried the bait approximately 100 yards farther, ate part of it, and died. From there the bait was carried a little distance by one of the females, and all three females were found near it in its final position. A similar pattern was followed by the members of Pack No. 4. The adult male took the bait first and died at the site of the station. The bait was then dragged away by one of the females, and both females fed and were killed. It is assumed that the adult female did most of the dragging because this bait weighed more than 100 pounds, which was probably too heavy a load for the pup.

In both these examples male dominance was indicated. During the breeding season in March, however, there was some evidence that the dominance changed. Two wolves, a male and a female, visited a station, and tracks showed that the female carried the bait, which weighed about 30 pounds, while the male followed a course parallel to hers at a distance of about 30 feet. After the female had eaten some of the bait and died, the male carried it another 100 yards into the forest where he was found dead. Both had relatively empty stomachs (two pounds in each) so that the male probably did not yield precedence because he was satiated.

EVALUATION OF THE CONTROL PROGRAM

Effect On The Wolf Population

The number of animals in the various packs visiting the baits was determined by counting the tracks, both approaching and leaving the poison stations. Thus, it is possible to make a reliable estimate of the

number of survivors, and, because the number killed is known, to derive a figure expressing the efficiency of the program. After making allowance for possible duplication, it is estimated that there were originally 12 packs, containing a total of 68 wolves, using this area. Forty of these (59 per cent) were killed.

It is more difficult to appraise the effect on singles and pairs because the possibility of duplication in track counts cannot be ruled out. However, the evidence indicates that wolves travelling alone or in pairs were at least as vulnerable to poisoning as those travelling in packs; for example, only one survivor was recorded from four pairs that came to the baits (a kill of 88 per cent). Assuming that none of the singles and pairs had been associated with packs and that the poisoning efficiency for singles and pairs was the same as that estimated for the packs (59 per cent), then the 59 wolves taken were from a maximum population, before poisoning, of 100.

At the other extreme, if all the singles and pairs were survivors of packs partially destroyed by the poisoning program, then the 68 wolves in packs constituted the minimum population before poisoning, and the poisoning efficiency was 59 out of 68, or 82 per cent.

Neither of these extreme views is tenable. The pre-poisoning population was likely about 85 wolves, and the poisoning efficiency about 70 per cent.

Comparison of Strychnine Baits and Cyanide Guns

The relative efficiency of cyanide guns and strychnine baits was determined by calculating the number of set-days required by each to kill one wolf. On this basis, strychnine was nearly twice as effective as cyanide--18.6 set-days per wolf for strychnine compared with 36 set-days per wolf for cyanide.

Other advantages of strychnine, which cannot be demonstrated mathematically, are:

1. A whole pack may be taken at one strychnine bait station, whereas, the explosion of the first cartridge of a cyanide gun often frightens away the survivors.
2. Strychnine is the easier and safer to handle, and the strychnine bait stations are the easier to tend.
3. Fewer wolves escape from the strychnine. Only two wolves are known to have recovered after ingesting strychnine, whereas in three out of five cases, cyanide guns fired by wolves failed to kill.

4. Foxes or ravens may spoil a cyanide-gun set by accidentally discharging the gun. They may also be a nuisance around a strychnine bait, and may lower its efficiency, but they seldom render it useless.

Apparently the only advantage of the cyanide guns is their selectivity. No foxes were taken with cyanide guns, whereas 39 were destroyed by strychnine (one per 27.3 set-days). One lynx and several ravens and Canada jays were taken by strychnine, whereas none of these was represented in the cyanide gun kill. The only coyote taken was killed by a cyanide gun.

SUMMARY AND CONCLUSIONS

1. An experiment in wolf control was carried out in an area accessible by truck from Fort Smith, N.W.T., from November 1 to December 15, 1951, and from March 1 to March 30, 1952. Buffalo meat and carcasses of buffalo killed by wolves were poisoned with strychnine pellets. Cyanide guns (Coyote Getters) were also used. All sets were visited at least twice weekly. The area in which the experiment was carried out is described briefly, and a short history of previous control efforts is given.

2. Fifty-nine wolves, 39 foxes, 19 ravens, and one lynx were taken.

3. The average weight of the adult male wolves was 98.2 pounds, and of the adult females 85.4 pounds. Measurements were also taken and recorded.

4. In colour, the wolves ranged from black to nearly white. There were 21 black, 34 grey, two buff, and two cream.

5. Bison was the most important item of diet, with 70 per cent occurrence in stomach contents. Fox, raven, hare, caribou, porcupine, and vegetable matter were also found in the wolf stomachs.

6. About 25 per cent of the wolves were infested with intestinal worms. The degree of infestation was light in most cases. The most common cestodes were species of Taenia, while the only nematode was Toxascaris leonina.

7. The breeding season was just beginning when the program terminated. All prime males taken in March were producing spermatozoa. One aged male and one male under one year of age had quiescent testes. One of five females examined was pregnant and was found to have six implantation sites. The ovaries of two other females contained corpora lutea, but no implantation sites could be found in the uteri.

8. Nearly all wolves were extremely fat. Fat was found subcutaneously in the lumbar region, intraperitoneally in the renal capsule and the intestinal mesentery, and intermuscularly in the ventral abdominal wall.

9. Some aspects of wolf behaviour are presented. There was some evidence of regular circuital movements. Ploughed roads seemed to be preferred. Old wolf kills were visited frequently even after they had been reduced to skin and bones. Most of the wolves showed no fear of the bait stations or of any residual human scent. Evidence of a social structure and dominance hierarchy within the pack is presented.

10. The ratio of young to adult wolves was found to be about one to four. This was contrary to expectations based on a litter-size of six young per pair (a ratio of three young to one adult). It is concluded that this reversal in the ratio must have come about mainly as a result of a heavy juvenile mortality.

11. An attempt is made to evaluate the success of the experiment in terms of the proportion of the initial wolf population which was destroyed. It is estimated that about 70 per cent of the wolves initially present were taken.

12. The efficiency of cyanide guns is compared with that of poisoned baits. Poisoned baits were found to be the more efficient in destroying wolves, but the less selective under the conditions encountered. Poisoned baits are also considered easier and safer to handle, and, for purposes of wolf control, are considered to be the best means presently available.

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Table 1. Weights and Measurements of Wolves Classified by Age and Sex.

Note.- Weights in pounds and measurements in inches.

Sex	Age	No. Specimens	Total Length		Tail Vertebrae		Hind Foot Length	
			Av.	Range	Av.	Range	Av.	Range
M	Pups	5	61.0	57-64	16.2	15-18	11.4	11-12
	Adults	21	66.7	62-72	17.3	14.5-19	12.3	11.5-13.5
F	Pups	5	58.6	54-66	14.2	12-15	11.2	10.5-12
	Adults	23	62.4	58-67	15.7	13-18.5	11.5	10.5-12.5

Sex	Age	No. Specimens	Height		Weight	
			Av.	Range	Av.	Range
M	Pups	5	27.6	26-29	76.2	64-83
	Adults	21	30.0	28-35	98.2 ⁽¹⁾	90-116
F	Pups	5	26.0	24-28	65.4	53-76
	Adults	23	28.9	27-31	85.4 ⁽²⁾	70-100

(1) Based on 18 specimens

(2) Based on 21 specimens

Table 2. Incidence and Degree of Parasitism in a Sample of 49 Wolves.

Date Taken	No.	Number Infected with:			Degree of Infestation	
		Taenia spp.	Texas-caris sp.	Both	Light	Heavy
Autumn, 1951	36	6			2	4
			1		1	
				1	1	
Spring, 1952	13	3			2	1
				1	1	
Total	49	9	1	2	7	5

Table 3. Composition of Six Wolf Packs Partly or Entirely Destroyed.

Pack No.	No. in Pack	No. Taken	Survivors	Age of Males			Age of Females		
				Pups	Mature	Aged	Pups	Mature	Aged
1	5	5	Nil	Nil	2	Nil	2	1	Nil
2	5	5	"	"	3	1	Nil	Nil	1
3	11	8	3	3	2	Nil	"	2	1
4	3	3	Nil	Nil	1	"	1	1	Nil
5	8	4	4	"	2	"	Nil	1	1
6	6	3	3	"	2	"	"	1	Nil

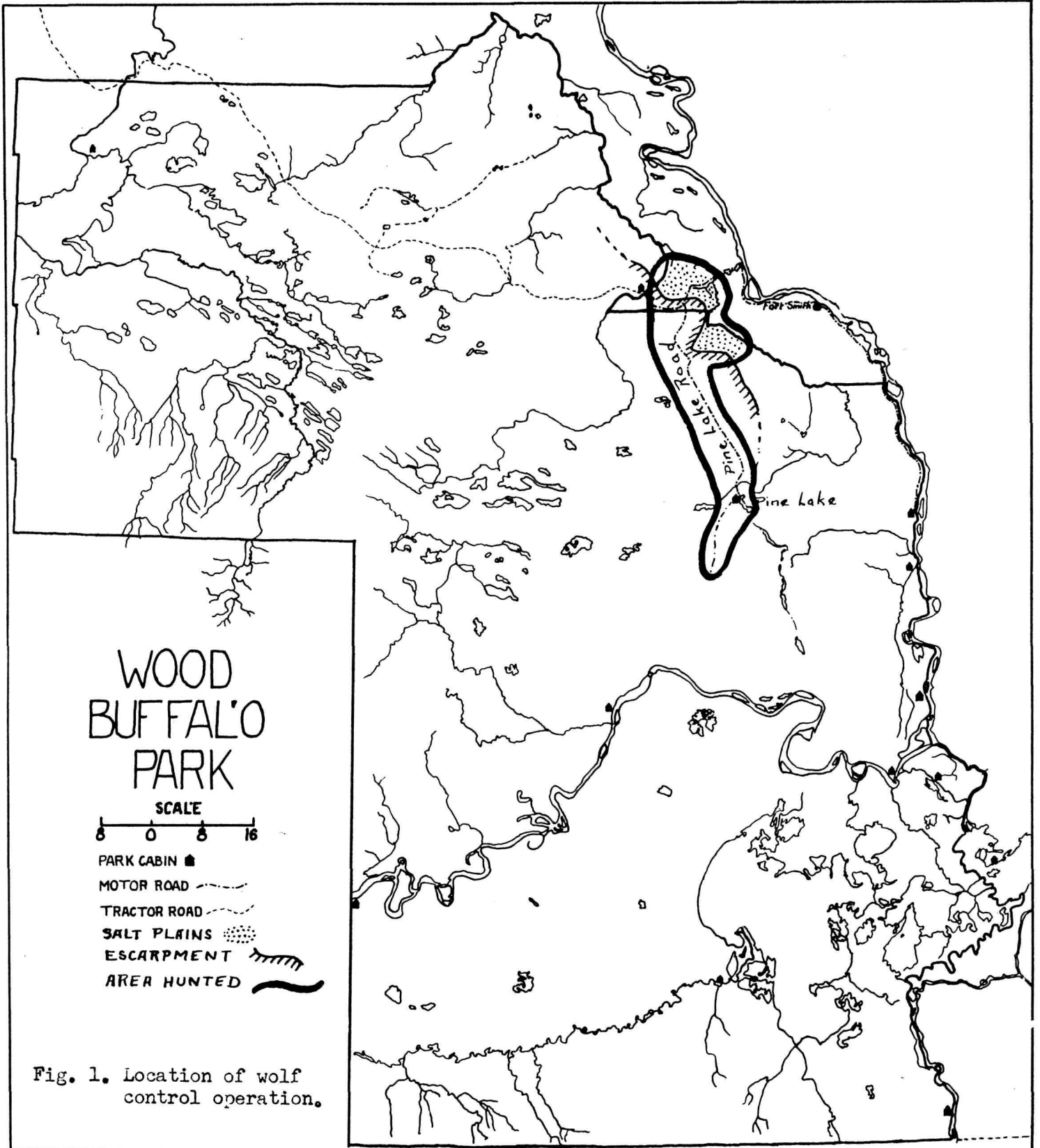


Fig. 1. Location of wolf control operation.

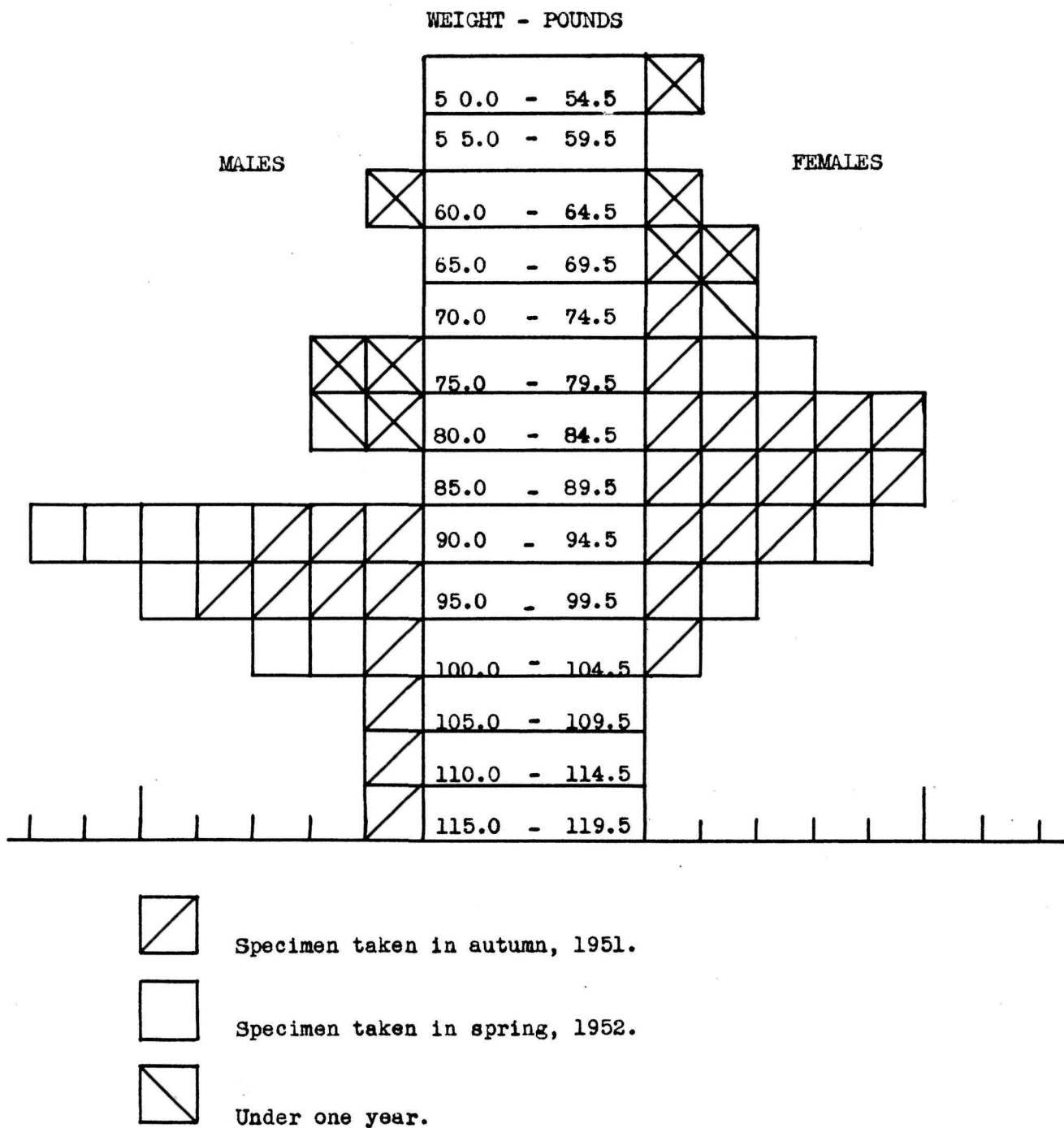


Fig. 2. Frequency distribution of the weights of 23 male and 26 female wolves.



Fig. 3. Loading frozen buffalo meat into a truck, from a platform where it was stored in safety from vermin and protected by tarpaulin against ravens and jays.



Fig. 4. Drilling holes in frozen meat to receive strychnine pellets.



Fig. 5. Introducing strychnine into the holes with forceps.



Fig. 6. Tamping in a pellet with a willow stick. The holes were closed with a few blows of a hammer.



Fig. 7. A dark-coloured wolf that died at the bait.

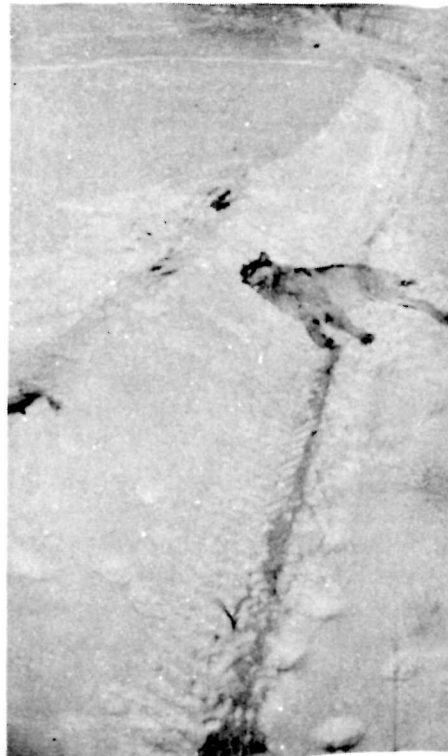


Fig. 8. Wolf tracks and a dead wolf on the freshly-ploughed trail over the Salt Plains. Wolves readily used roads and trails after the plough had passed.

