PRELIMINARY REPORT

The Problem of Railroad-Moose Conflicts in the Susitna Valley, 1955-56.

by

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Results of a cooperative study sponsored
by the Alaska Railroad and the US
Fish and Wildlife Service

I - INTRODUCTION

The Problem

The Alaska Railroad passes through the range of some of Alaska's most abundant moose populations, in the Susitna Valley and on portions of the Kenai Peninsula. During part of each year, primarily in late winter, large numbers of moose appear in the vicinity of the right-of-way in certain favorite locations, some of which extend for considerable distances along the tracks. Many of these moose find their way to the plowed road bed, obstructing train travel, and often being killed or injured in the process. The number of moose killed varies with weather conditions and other factors, but it has totaled at least several hundreds annually in certain recent years. This represents an undesirable destruction of a valuable natural resource, as well as an additional expensive operating hazard for the railroad.

The data summarized in this preliminary report are some of the results of a cooperative investigation undertaken to determine possible means of alleviating or permanently solving this problem of railroad-moose conflict.

Method of Approach

The problem can be broken down into two major questions. (1) How can moose already on the tracks be removed without injury and without undue delay to rail operations? (2) How can moose be kept off the tracks and away from the right-of-way?

In attempting to answer the above questions and in laying ground work for future progress, the following principal lines of investigation were pursued:

<u>Moose behavior in relation to trains</u> - A series of moose versus train case histories were recorded from the cab of a train engine in an attempt to learn the behavior patterns of moose facing an on-coming train.

<u>Daily movements and activities</u> - Moose movements, local and seasonal, were studied; daily patterns of moose activity were recorded, and six periodic aerial counts were made of moose along the right-of-way between Anchorage and Talkeetna. Understanding of, and subsequent control of moose movements is likely to be the key to the problem.

<u>Moose scaring and saving techniques</u> - Following the initial observations, several moose scaring and saving techniques were evaluated.

<u>Preventative studies</u> - Experimental bulldozing and baiting were attempted in an effort to keep moose from entering the right-of-way.

<u>Browse studies</u> - A reconnaisance of available and utilized browse was made between Mile Post 172 and 235 as a basis for evaluating observed moose distribution.

Biological Data - Information on the age and sex composition, food habits, and breeding biology of the railbelt moose population was collected.

Acknowledgements

Funds for salary and expenses of a full-time investigator for a period of over four months were provided by the Alaska Railroad, and the task of conducting the project was facilitated in every way possible by railroad officials and personnel. Mr. Robert Julian, General Roadmaster, was especially helpful in introducing the investigator to the problems of railroad operations; and in procuring materials needed for conducting the study. The section personnel at Wasilla, Willow, Caswell, Sunshine and Talkeetna were very helpful in collecting information and specimens, providing transportation and offering many worthwhile suggestions.

The personnel of the Fish and Wildlife Service in Anchorage provided aircraft for the aerial counts, and aided the investigator in solving many other problems during the course of the investigation. Administrative matters were coordinated by Game Management Agent Holger S. Larsen, and technical supervision of the project was by P-R Leader Robert F. Scott.

II - MOOSE KILLED BY THE RAILROAD

Magnitude of Kill

One of the project's initial requirements was to determine accurately the number and location of moose killed by the railroad during the critical season. No complete kill records are available for any previous year, and various estimates of past moose kills are not consistent. They vary between 90 and 1500 moose kills annually.

At a December 1955 meeting, between Fish and Wildlife Service and Alaska Railroad officials, a system for reporting all railroad-killed moose was agreed upon. Thereafter, the Fish and Wildlife Service received a weekly report that indicated the date and location of each railroad-killed moose.

The weekly report is a compilation of all moose kills reported by the conductors of trains that struck moose during the previous week. The conductors report the moose to the dispatchers, who in turn include the reported moose on the daily report and the "morning lineup."

The section crews are informed of moose having been killed on their section through the morning lineup. In addition to the weekly report, the section crews were instructed to ship all moose heads, tagged with location and date of kill, to the Fish and Wildlife Service, Anchorage, Alaska. The data from the moose heads is especially valuable and the collection of this data should be continued. Between December 22, 1955, and April 15, 1956, 225 moose were reported killed by the railroad. Initial field observations indicated that about 35 per cent of the railroad killed moose were not being reported. In late April an inspection on foot of the Willow, Caswell and Sunshine sections revealed 219 different moose carcasses and gut piles in an area where 131 moose kills had been reported. This is a difference of 40 per cent. This difference, when applied to the total reported kill, yields a corrected total of 366 moose killed between December 22, 1955, and April 15, 1956. The corrected total kill figure for this period is probably a minimum, because it does not account for the moose still covered by snow or for the cripples which wander from the tracks before dying. Aerial surveys and personal observations indicate that this uncounted portion of the kill may exceed 5 per cent of the adjusted total kill for the critical period.

The total annual kill for a 12-month period is not known; however, it is believed that at least 85 to 90 per cent of the railroad moose kill occurs during the critical winter months. Therefore, the total annual kill will probably not exceed 425-450 moose for 1955-56.

Location of Kill

The Alaska Railroad has approximately 500 miles of trunk line, most of which passes through moose range. The southern portion of the railroad, Anchorage to Seward (24 per cent of the total railroad mileage), accounts for 11 per cent of the total reported kill. There are several local critical areas, but the overall kill is relatively light.

The northern portion of the railroad, Anchorage to Fairbanks, is, for convenience of discussion, broken into three segments:

1. Anchorage - Wasilla
2. Wasilla - Curry
3. Curry - Fairbanks

1. The Anchorage - Wasilla Segment -- This segment (9 per cent of the railroad) accounts for 11 per cent of the reported kill; however, this segment traverses what is, perhaps, the greatest concentration of moose per square mile in Alaska. Fortunately, due to local climatological and browse conditions, and other factors discussed later, the ratio of moose killed versus the number of moose present is amazingly low.

2. Wasilla - Curry Segment -- The 90-mile segment from Wasilla to Curry (19 per cent of the railroad mileage) accounts for 68 per cent

of the total kill. The Willow, Caswell and Sunshine sections (Mile Posts 172-226) occupy the center of this segment and were selected as the major project areas of this investigation.

Of the total reported kill, 131, or 58.6 per cent, occurred on this 54-mile area (11 per cent of the total railroad mileage). Within this area are five local critical segments:

A. The Houston-Willow area, M.P. 172-186
B. The Willow Creek area, M.P. 186-188
C. The Kashwitna River-Caswell area, M.P. 196-203
D. The Goose Creek-Montana Creek area, M.P. 207-214
E. The north Sunshine area, M.P. 223.5-226.

These areas are further described below.

A. The Houston-Willow area, Mile Post 172-186 -- This area has very little winter moose browse adjacent to the right-of-way. There is, however, considerable browse on the right-of-way itself.

Twenty-seven moose were killed on this area during and immediately following the December 30, 1955-January 1, 1956, snow storm. Although the moose do browse along the tracks, the major track use is for travel. These moose appeared to be traveling from the Little Susitna flats (Mile Post 174) to the Lake Nancy area (Mile Post 182).

Aerial surveys and personal observation indicate that the number of moose wintering in this area dropped during the first half of January 1956. The cause or nature of this movement is not known.

B. The Willow area, Mile Post 188 -- A series of small tributaries of the Susitna River cross the track in this area. These streams serve as access routes for the moose. Upon gaining entrance to the right-of-way, many of these moose follow the tracks to the Willow airstrip which has a border of willow, aspen and birch; choice winter browse.

The majority of the sixteen moose killed on this two mile strip were killed during late December, 1955, and early January, 1956.

C. The Kashwitna River-Caswell area, Mile Post 196-203 -- In contrast to the previously discussed areas the critical kill period on this section occurred in late winter.

Another distinguishing feature of this section is the availability of major browse areas adjacent to the right-of-way at the Kashwitna River, M. P. 199, and at Caswell Creek, M. P. 201. Moose frequently enter the right-of-way several miles south of the Kashwitna River browse patch and walk to it. In addition, the moose wander on and across the track immediately north of the bridge. Complete congestion of this area is accomplished by large numbers of moose moving to and from the Caswell Creek area. Caswell Creek has a relatively broad flood plain whose principal vegetation is willow. Thirty-three moose were killed on this area. The majority of these moose were killed during late February and early March.

D. The Goose Creek-Montana area, Mile Post 207-212 -- The Kashwitna River-Caswell kill was exceeded only by the Goose Creek-Montana Creek area. Fifty-four moose were killed on this six mile portion of the railroad. The majority of these animals were killed during a two week period in February.

This segment contains the greatest acreage of high quality winter browse adjacent to the railroad on the entire project area. This browse area is west of the railroad and is bounded on the south by Goose Creek and on the north by Montana Creek. The moose have four avenues of approach, the Susitna River, Goose Creek, Montana Creek and a plowed road -- the railroad, leading to this food patch. This combination of accessibility and food proved to be a fatal one.

E. The North Sunshine area, Mile Post 223.5-226 -- The North Sunshine area is one of lesser total kill, but one of particular interest. Here, the moose, attracted by the browse surrounding the C.A.A. airfield at Mile Post 226, travel a portion of the railroad which is bounded on the east by a steep hill and on the west by the Susitna River. Thus, those moose which happen to meet a train are trapped and are usually killed. A total of 12 moose were killed on two miles of track south of the C.A.A. airfield.

3. Curry-Fairbanks segment -- This segment, 46.8 per cent of the total railroad mileage, accounted for 8.88 per cent of the total reported kill. This portion of the railroad is not considered a critical kill area.

Critical Kill Dates

When plotted graphically, a definite correlation is found between seasonal fluctuations in snow depths, moose abundance along the tracks, and variation in moose fatalities by dates. During the last two weeks in February and the first week in March, an average of 50 inches of snow covered the ground in the critical kill areas. At this time aerial counts of moose within one-eighth mile of the tracks reached their highest point. Furthermore, reported moose kills for this period totaled 115 (50 per cent of the winter's total).

Future critical dates will probably also coincide with periods of deep snow and associated concentration of moose along the tracks.

III - REDUCING THE MOOSE KILL

The problem of alleviating the railroad moose situation has been divided into two major questions: A. How can the moose once on the tracks be removed from the right-of-way without injury, and without undue delay to the railroad operations? B. How can moose be kept off the tracks and away from the right-of-way? These are discussed below.

A. How can moose be removed from the tracks without injury and without undue delay to the railroad operation?

In seeking an answer to this question, and in trying to determine why a moose remains on the track in face of an oncoming train, 101 case histories of moose versus train were observed from the cab of a train engine. Twenty-four of these moose were killed.

Moose Behavior

It is difficult to characterize a moose's reaction to a train because, while they appear genuinely frightened, they do not exhibit a consistent response pattern in expressing their fear.

The "average moose," when frightened by a train, usually attempts to leave the tracks. The moose, using his front feet as "feelers," tests the snow adjacent to the tracks. If he sinks in to his belly and bogs down, he extracts himself, returns to the track, ambles along a few paces and repeats the above process. Generally the moose succeeds in leaving the tracks on his first or second attempt, but of those cases actually observed, 23 animals, or about 20 per cent, failed and were killed.

Numerous daylight observations reveal that moose are frightened by the appearance of a train. It is not known whether this fact stems from their seeing or hearing the train. However, moose in the Mantanuska Valley generally ran at right angles away from the tracks and moose several hundred yards from the train are frightened.

Unfortunately, the moose encountered on the tracks at night do not respond in this manner. They generally do not run until the train is within a few hundred yards and frequently make no attempt to run. They often stare at the train, although it is doubtful that the moose can see anything other than the train's headlight. These different day-night responses are not fully understood. Certainly, the direction, both day and night, that moose can run from the tracks is dictated by the snow depths adjacent to the tracks.

Moose apparently are most active in early evening and at night. The six aerial surveys, on which 631 moose were counted within 1/8 mile of the tracks between Anchorage and Talkeetna, revealed only 10 moose on the tracks. In addition, 71 per cent of the moose counted were lying down. On the one late afternoon flight on February 9, 1956, 50 per cent of the 100 moose counted were standing and moving about. While riding the local freight or "peddler" from Curry to Anchorage on Sundays, 16 moose were observed on the tracks. Only one of these moose was struck by the train. This low ratio of moose on the tracks versus moose killed may in part be attributed to the slow speed (20 mph) and subsequent greater control of this train. However, the moose seem more willing to yield the right-of-way in the daytime.

Several long-time trainmen corroborated the investigator's belief that moose are not on the tracks as often in the daytime and that they will leave the right-of-way more readily during daylight hours.

Remedial Possibilities

This study of moose behavior and activities suggested several possible means for temporarily removing moose from the tracks or otherwise reducing the kill. These are as follows:

1. Operate trains through the critical area between Houston and Talkeetna during daylight hours, whenever it is economically feasible.

2. Manipulate headlights and horn to frighten the moose from the tracks.

3. Operate trains at reduced speeds through critical areas.

4. Spread the snow berm as soon as possible after the initial plowing operation.

1. Daylight train operations - Moose habits, as discussed in another section of this report, indicate that trains operated in the daytime will probably kill significantly fewer moose than those operated at night. However, the economics of train operation must be taken into consideration in evaluating this proposal.

2. The horn blast - It is standard procedure to sound the train's horn when a moose or any other animal is sighted on the tracks. The sound of the horn does frighten moose; however, this fear, usually expressed in action, does not always have the desired effect of removing the moose from the track. Generally, the moose will attempt to leave the right-of-way immediately following the first horn blast. However, should the moose encounter deep snow it will immediately return to the tracks.

The tendency of moose to leave the tracks at the sound of the initial horn blast has a definite moose-saving possibility. The following examples, taken from the investigator's field notes, illustrate the technique that can partially alleviate the moose kill and avoid unnecessary delay of trains. On January 6, 1956, while riding a northbound night freight (No. 26) from Anchorage to Curry, 17 moose were encountered on the tracks; two were killed. The engineer, after sighting a moose on the tracks did not sound the train's horn until within 50 to 150 feet of the moose. In all cases, except the two previously mentioned instances, the moose jumped from the tracks. Since the engine was very close to the moose, the moose did not have an opportunity to re-enter the tracks until after the train had passed.

To further illustrate the value of this technique, the following example, taken from field notes, is presented. On February 13, 1956, while riding No. 26 between Anchorage and Curry, eleven moose were encountered on the tracks; eight were killed. The engineer sounded the train's horn as soon as he sighted a moose. Usually, the moose would jump from the tracks, but would have time to re-enter the tracks before the engine had passed. Continued horn blowing irritated the moose, and although they usually attempted to outrun the train, one bull did turn and charge it. The train was pulling over 2,000 tons at about 40-50 mph. Stopping safely in less than one quarter of a mile was not possible, and the moose which attempted to outrun the train could not be avoided. In addition to killing eight moose the train was three hours late at Curry.

This technique of timing the horn blast with the train's speed is not a permanent solution to the railroad moose problem, nor does it work all the time, but it will reduce moose fatalities and help prevent unnecessary train delays.

3. Speed - Train control is dependent upon speed and momentum. A freight train pulling over 2,000 tons cannot safely stop within a quarter of a mile. Train control and speed appear to determine moose fate in some areas.

From Anchorage to Wasilla the Alaska Railroad winds along a narrow bench between Knik Arm of the Cook Inlet and the foothills of the Chugach Mountains. This results in a great number of curves and turns on the railroad, and a maximum speed of 30 mph. Freight trains seldom attain this maximum speed.

Aerial surveys and personal observations indicate that there are more moose per mile of track through the Anchorage to Wasilla area than on any other segment of the railroad. However, only 22 moose were reported killed on this 45 mile segment of the railroad. In addition to the favorable browse and local climatological conditions discussed in another section of this report, the moose have more time to get off the track because of the slower maximum speeds and greater train control. Snow depths between Anchorage and Eklutna and Pittman to Willow are not directly comparable, but they are similar. The snow from Anchorage to Eklutna was deep enough to cause moose considerable trouble. Six moose were reported killed on this segment, while twenty-two moose were reported killed on the shorter Pittman-Willow segment. The moose population between Anchorage and Eklutna was very great, whereas, the apparent winter population from Pittman to Willow was low. Aside from the previously indicated differences, the major difference between these two segments seems to be speed and train control. The maximum speed permitted from Anchorage to Eklutna is 30 mph; the maximum permitted speed from Pittman to Willow is 49 mph.

The portion of track from Mile Post 195-225 accounted for 75 reported moose kills between February 9, 1956, and March 10, 1956. During this period 115 kills were reported between Mile Posts 4 and 420. Thus, 65 per cent of this kill occurred on 7 per cent of the kill area. A slow order on the 30 miles of track from Mile Post 195 to 225 would probably have saved many moose and considerable expense to the railroad, because it was on this segment of the track that a moose caused an expensive derailment.

4. <u>Snow Removal</u> - This past season's study indicates that moose gather on the tracks in great numbers during and immediately following major snow storms. At least 50 moose were killed during the December 30, 1955-January 1, 1956, snow storm. Those moose killed during the snow storm probably cannot be avoided. However, some of those killed following the initial snow removal operation may be saved by spreading the wall of snow adjacent to the tracks as soon as possible in the critical areas. The snow wall, or berm, adjacent to the tracks discourages moose from leaving the right-of-way once they have entered it. Removal of this obstacle allows the moose to leave the tracks if they are so inclined. Interviews with several long-time engineers indicate that this snow spreading operation saves many moose.

The temporary expedients discussed in this section will not solve the moose-railroad problem, but they may partially alleviate the situation until a more permanent solution has been devised.

IV - KEEPING MOOSE FROM THE TRACKS

<u>Why Do Moose Use the Right-of-Way?</u>

The concentrations of moose present along the railroad during the winter months, in contrast to the sparse summer population, suggests that the moose are for some reason either attracted or forced to the railroad in winter.

The openings in the forest, created by the railroad and associated civilization, produce miles of high quality, available, winter moose browse, principally willow, aspen and birch. In addition to the browse created by the edge effect of the openings, the attendant civilization has caused several small fires along the right-of-way. Some of these burned areas now contain excellent stands of winter moose browse.

The many tributaries of the Susitna River, generally flowing from east to west and crossing the tracks at right angles, provide another source of browse as well as access to the railroad.

The food patches, edges, burns, and river bottoms have a common connecting link -- the railroad. This combination of food, access routes and a plowed road may not initially attract the moose, but it probably serves to hold the moose once they have discovered its possibilities.

Sex and Age Composition

The following chart (Table I), based on 230 moose heads and jaws largely from the Willow, Caswell and Sunshine sections, indicates that no one age or sex group is responsible for the train versus moose problem. The predominance of females (62 per cent of the sample, and 68 per cent of all moose above age class II) may reflect the effects of hunting pressure, an unbalanced sex ratio, or seasonal habitat preferences.

TABLE NO. 1

Sex and Age Classifications of the Railroad-Killed Moose

* Age Classification	Number of Jaws	Per Cent of Total	Females	Males	Unidentified
0	49	21	27	22	
I	20	9	10	10	
II	7	3	5	2	
III	17	7	7	10	
IV	23	10	13	9	1
V	32	14	19	13	
VI	29	13	18	10	1
VII	22	10	20	1	1
VIII	14	6	11	3	
IX	17	7	16	1	
Totals	230	100	146	81	3

Total bulls/100 cows. 57
Young bulls/100 bulls 20
Calves/100 cows 45-47
(percentage depends upon whether Class II females are included as adult cows)
Calf per cent in total sample 21
Young bull per cent in total sample 4
Young bull/100 bull calves. 45
Total per cent females in sample 62
Per cent females above age Class II 68

*The age classifications are based on the moose dentition key constructed by Calvin I. Lensink (P.R. Quarterly Report V.10 No. 2, 1955, pp 3-15) and on the age characteristics listed by Randolph L. Peterson (North American Moose, University of Toronto Press, 1955).

Moose Movements

Before effective action to keep moose off and away from the right-of-way can be undertaken, it is necessary to know what portion of the railbelt moose population is using the right-of-way.

Most authorities state that, providing adequate food is available, moose are relatively sedentary animals. The Susitna Valley moose do travel; however, the age or sex composition of the moose and the distance and direction of these seasonal movements are not adequately known. Aerial surveys, track counts, interviews, and marking experiments were tried in an attempt to learn more of the individual range and movement patterns of the railbelt moose population.

Moose tracks observed during six aerial surveys flown between January 5, 1956, and February 15, 1956, indicated a definite east-west altitudinal movement, principally along the drainage systems. It was impossible to determine the direction of the tracks, but perhaps they were in both directions and represented local movements.

Moose track observations, made afoot and from a gas car, suggested local movements along and across the track. These observations did help determine local critical areas, but shed little light on any major moose movement.

A number of long-time valley residents were interviewed. These interviews suggested several seasonal movement patterns.

Section personnel and local residents at Wasilla state that great numbers of moose move from the north along the right-of-way through the Wasilla area and into the Matanuska Valley during November and December. They also state that there is a reversal of this migration in late March and April.

Willow area people believe moose move from the Talkeetna Mountain foothills to the Susitna River area during late November, December and January. Mr. Richard Drew, a resident of the Caswell area since the 1930's, and a professional guide, indicated that the moose move from the foothills of the Talkeetna Mountains to the lower areas in November, December and January. However, he believes that some moose do cross the Susitna River from the west, coming to the tracks. Personal observation in January, February and March at Montana Creek revealed that moose do cross the Susitna River in both directions.

Talkeetna residents insist that the winter moose population in that area arises from great numbers of moose crossing the Susitna River, coming to the railroad area shortly after the river freezes over.

Moose Marking Project

Marking moose in an effort to determine the extent and magnitude of seasonal moose movements was proposed. One suggested system for marking moose incorporated the use of paint, a flame thrower, and a helicopter. The flame thrower was supplied by the United States Army and the helicopter by the United States Air Force.

The flame thrower was ground tested in March 1956; two moose, a cow and calf, were sprayed with international orange enamel. The flame thrower-paint system worked satisfactorily. The flame thrower has an effective moose marking range of 60-70 feet.

On April 3, 1956, the first marking attempt from a helicopter was conducted. The results were not satisfactory. The principal difficulty stemmed from the dissipation of the paint stream, caused by the wind blast from the helicopter's forward motion and from the roter blast. No further marking experiments were attempted. On May 11, 1956, Mr. Robert Hinman reported seeing an orange moose calf. The calf was about four to five miles from the original marking site on Fort Richardson. No further marking experiments were attempted.

This work done this year was insufficient to yield definite results in determining the extent or nature of seasonal moose movements in the Susitna Valley. Further investigation is warranted.

IV - HOW CAN MOOSE BE KEPT OFF THE TRACKS?

Several experiments were tested this past season in an effort to keep moose from entering the right-of-way. In addition, there are several other experiments of merit that have not been tested. The following experiments were conducted during the past winter:

1. Bulldozing trails and feed yards.

2. The use of salt as a moose lure.

Bulldozing Project

The availability of food and good walking on and along the tracks are two attractions believed responsible for many moose fatalities. Creation of alternate trails and artificial browse areas, by bulldozing, was attempted in an effort to determine if the moose would use these trails and associated feed yards in preference to the railroad and its associated browse areas.

The first such trail was constructed from Houston to Willow in late January. This area was selected because it was the critical kill area at that time. The trail roughly follows the proposed Alaska Road Commission to Willow, and has been partially cleared. The trail is located east of the railroad to Mile Post 183 where it crosses to the west, follows the north edge of Nancy Lake for a short distance and then continues along a low ridgeline to Willow. The south portion of the trail (Mile Post 176-183) roughly parallels the Alaska Railroad and traverses some reasonably good moose browse. The portion from Mile Post 183 to Willow airstrip is about one mile from the railroad and except for the Willow airstrip, does not pass through good moose browse.

A number of small feed yards, formed by bulldozing down aspen, birch and willow patches along the trail, were made in conjunction with the trail-making operation.

Prior to the completion of this trail on February 2, 1956, about 20 moose had been killed on this project area. From February 2 to March 15, 1956, 3 moose kills were reported. It is believed that the bulldozed trails did reduce the moose kill; however, other factors, principally a reduction in moose abundance in this area, also probably influenced the kill reduction.

The trail and associated feed yards were filled with snow in mid-February, and reopening of the trails was not effected due to an equipment shortage. Therefore, an accurate evaluation of the effectiveness of this moose trail-feed yard experiment is not possible.

Despite the partial filling of the trail and feed yards, moose did use them. The trails on Willow airstrip supported six and possibly eight moose for the remainder of the winter. By April these moose had nearly exhausted the browse created by the bulldozing operation and were barking aspens and willows extensively. They had been able to keep the trail partially open throughout the winter and they refused to leave the hard paths even when chased by humans.

An inspection of the trail from Willow to Mile Post 183 revealed no moose actually wintering on it, though sporadic use was indicated by tracks and browsed trees. From Mile Post 183 to Houston, eight to twelve moose spent the winter feeding on the browse adjacent to the trail and in the feed yards. By mid-April they had exhausted their food supply and a few moose wandered onto the tracks and were killed.

Results in this project area indicate that moose will localize in small areas provided that food and walking conditions are favorable.

Following completion of the Houston-Willow trail, another project was started in the excellent browse area near Montana (Mile Post 209). Unfortunately, a heavy snowfall necessitated the transfer of the bulldozer equipment to other areas before the project was completed.

Several trails had been constructed in this area prior to the snow storm. These trails were visited from time to time throughout the winter. Moose used the trails extensively for travel and browsing. In addition, the moose used one of the trails, which ran to the right-of-way, to gain entrance to the tracks. This area, which was one of great moose concentration, continued to have a high rate of moose kills; however, the project was not completed and evaluation of its effectiveness is impossible.

A cost estimate for the bulldozing project is included in Table II.

Salt

Salt blocks were placed on Willow airstrip and at Mile Post 203.5 in the Caswell area in an effort to determine if moose could be attracted by salt. These salt blocks were placed on brush piles near known moose concentrations (one was placed on a bulldozed trail). There was no indication that the moose had any interest in this form of salt during the late winter or early spring months.

Suggested experiments

Cattle guards -- A modified cattle-"moose guard" was constructed in the railroad shops and shipped to Willow. Unfortunately, a bulldozer was not available to construct a trail at the proposed installation site and the moose guard could not be tested this year.

There are several local areas where this device, in conjunction with dozing and proposed fencing experiments, may alleviate the current moose problem. Discussion of actual placement of moose guards is incorporated in another portion of this report.

"Why don't you fence the entire track?" is a persistent question. Fencing would be desirable if: -- if it is economically feasible, -- if we knew what type of a fence to construct, -- if we knew what type of materials to use in building the fence, and -- if we knew how the moose would react to a fence.

Obviously these "ifs" can be answered only by limited experiments. Limited fencing in conjunction with moose guards and bulldozing would provide an opportunity to evaluate cost effectiveness, type of material needed, and minimum construction requirements of a moose-proof fence, as well as provide a test for the moose guards.

The Montana Creek area, Mile Post 207-212, on which 50 moose were killed this past winter, is particularly well suited to a fencing, moose guard, and bulldozing experiment. Here, the Susitna

River roughly parallels the railroad, on the west, and is no farther than one mile from the tracks along the entire segment. The southern portion of this area contains excellent browse, located between the tracks and the Susitna River. The northern portion of this area is used as a highway by moose traveling to good browse at Mile Post 213-124. Many of these problem moose enter the tracks at the confluence of Montana Creek and the Susitna River at Mile Post 211. The high steep banks on the northern portion of this problem area are a barrier to moose attempting to enter the tracks in most places. The few gaps could be fenced with a minimum of effort and cost.

Bulldozing trails through the snow and stands of aspens on the southern portion of this area should localize some of the moose and keep them from wandering onto the right-of-way.

There are two logical positions for moose guards. One at Mile Post 207.9 between two cut banks, and the second at Mile Post 212 where a steep cliff on the east and a ledge on the west would prevent moose from going around the cattle guard.

V - ECONOMIC ASPECTS

Cost and disposition of the railroad killed moose

The chart shown in Table II, supplied by the Alaska Railroad, summarizes estimated costs for butchering moose and other activities through March 1, 1956. The estimate is based on 175 reported moose.

TABLE II

Cost of Handling Moose to March 1, 1956

Moose Pass	Estimated	30 hrs.	Straight Time	$ 70.00
Hunter	"	40 hrs.	"	94.00
Portage	"	40 hrs.	"	94.00
Kern	"	40 hrs.	"	94.00
Campbell	"	30 hrs.	"	70.00
Birchwood	"	50 hrs.	"	117.00
Wasilla	Actual	99 hrs.	"	235.00
Willow	"	280 hrs.	"	658.00
Caswell	"	300 hrs.	"	705.00
Sunshine	Estimated	150 hrs.	"	350.00
Talkeetna	"	50 hrs.	"	117.00
				$2,604.00
	Total Overtime Taken from Payroll			278.00
			Total	$2,882.00

(Carried Forward)	$2,882.00
Two dozers began ploughing moose trails on January 25, 1956	
One Operator worked 9 days	
One Operator worked 13 days	513.00
	$3,395.00
Fuel, etc.	100.00
Total	$3,495.00

TABLE III

The ratio of salvaged versus unsalvaged moose on the three project sections.

Section	Salvaged	Unsalvaged	% Salvaged
Willow	38	12	76.0
Caswell	30	50	37.5
Sunshine	27	67	30.3
Totals	95	129	42.4

Adjusted Cost Figures

The Caswell and Willow sections, two sections that kept records of time expended on salvaging moose, salvaged 68 moose, and had a total expenditure of 1,363 dollars worth of labor, or an average cost of 20 dollars per salvaged moose. Mr. Whalen (Chief Clerk in Engineering) suggested that another five dollars per salvaged moose could be added for transportation and handling charges. These figures confirm Mr. Cook's (Superintendent of Engineering, The Alaska Railroad) earlier estimate of twenty five dollars cost per moose salvaged.

Forty-three per cent (95 of 219) of the railroad-killed moose were salvaged on the three project sections. If this is representative of the entire railroad, 158 moose were salvaged. The adjusted total expenditure for salvaging and transporting moose then becomes 4,266 dollars.

Cost of removing unsalvaged carcasses

The unsalvaged carcasses are removed from the right-of-way in the spring. This removal is accomplished by pulling the carcasses away from the tracks, using a gas car, rope and tackle arrangement or by burning them. This arrangement is illustrated in picture. The investigator timed several days of moose removal operations on the Willow and Caswell sections and found that the average labor cost of removing a moose carcass amounts to approximately ten dollars. If the estimated total of 158 salvaged moose is correct, then about 200 moose were unsalvaged and subsequently removed in the spring at an estimated cost of 2,000 dollars.

The section that attempted to burn moose found that burning is not a successful nor economical means of removing unsalvaged carcasses.

Damage

In late February, 1956, a moose caused the derailment of a loaded flatcar at Montana. The exact manner in which the moose caused this derailment is not known. In all probability the moose, struck by the train's engine, either rolled under the train and later some portion of the moose fell under the flatcar's wheels and was sufficient to derail it, or the moose struck by the train fell alongside the track and while threshing about fell under the flatcar's wheels, derailing it. Mr. Whalen has estimated the cost of this derailment at $3,000.00.

The combined direct costs to the railroad for salvaging, transporting, spring removal and damage caused by moose is estimated at about $10,000 for the winter of 1955-56.

Value, Real and Potential, of Salvaged, Railroad-Killed Moose Meat

This winter's estimated total of 158 salvaged moose yielded an estimated total of 63,000 pounds of usable meat. This estimate is based on 388 pieces of salvaged meat received in Anchorage. These pieces averaged 125 pounds each, yielding 48,500 pounds of meat. Since all salvaged meat above Curry was shipped to Fairbanks and the meat salvaged south of Anchorage was generally shipped to Seward, the estimated total of 63,000 pounds seems reasonable.

The average bull moose killed by a hunter and processed at a cold storage locker weighs about 500 pounds. Seventy-nine per cent of the railroad-killed moose were of comparable size. Thus, the average railroad killed moose probably yields about 400 pounds of salvaged meat. If 158 moose were salvaged, and allowing 400 pounds per salvaged moose, the total is 63,200 pounds. This is approximately the same as the earlier estimate.

It is difficult to place a dollar and cent value on this salvaged meat, which is distributed to destitute native villages and local charitable institutions. However, salvaged moose meat, based on the adjusted cost of 4,266 dollars, represents an expenditure by the railroad of 7 cents per pound. A local cold storage plant operator, who has had considerable experience in processing moose meat, suggested that railroad-killed moose meat should be worth 25 cents a pound at current meat prices. Therefore, the salvaged meat has an intrinsic value of 15,750 dollars; three times the salvage cost.

Of the estimated total kill of 366 moose, 208 were not salvaged. Examination of 219 kills revealed that only about 10 per cent of the moose were completely destroyed. The author believes that a more accurate reporting system plus cooperation from the section crews would double the amount of salvaged meat.

Public Relations

The cost of salvaging a moose has been estimated to be twice the cost of spring carcass removal. However, unsalvaged moose are responsible for the unfounded rumors that "thousands of moose are slaughtered by the Alaska Railroad." Local residents as well as transients, who see and count the same moose throughout the winter, are largely responsible for the exaggerated moose kill estimates. As an example, the investigator talked to several local people, including guides and other professional people, who insisted that upwards of 1500 moose had been killed by mid-February of this year.

Several sections attempted to bury the unsalvaged moose in snow. This, an added expense, was not successful because the carcasses were still present when the snow thawed. Gut piles, from salvaged moose, are more easily concealed, and salvage costs are only slightly higher than the expense of later carcass removal. The value of the salvaged moose meat plus the public relation factor will justify a determined effort to salvage all railroad killed moose.

SUMMARY

From January 3, 1956, to May 15, 1956, an investigation of the moose versus railroad conflict was carried on in the Susitna Valley.

A system for reporting railroad killed moose was devised. The railroad reported 225 moose kills between December 22, 1955, and April 15, 1956. An adjusted total of 366 were believed killed during the above period.

A study of moose-train behavioral responses was made. This study suggested the following temporary moose-saving techniques:

1. Timing the horn blast

2. Daylight train operation

3. Reduced speeds in critical areas
   (during the most critical period of the winter, 65 per cent of the kills were concentrated on a 7 per cent section of track)

4. Spreading the snow berm as soon as possible in critical areas.

In attempting to keep moose from the right-of-way, the following experiments were conducted:

1. Bulldozing trails parallel and adjacent to the right-of-way.

2. Creating feed yards by bulldozing through patches of aspen, birch and willow.

These experiments led to the following conclusions: Bulldozing trails and feed yards will localize moose in some areas. The favored winter browse species in this area is aspen. Muskeg areas are difficult to negotiate in the winter. Proposed bulldozer routes should be marked in the fall. Further investigation of this method is needed, principally in establishing trails and feed yards before the snow depth becomes critical.

The effectiveness of salt as a moose lure was tested, with negative results.

A cattle-"moose guard" was constructed, but was not installed due to a shortage of equipment.

Approximately 60,000 pounds of useable moose meat was salvaged and distributed to welfare agencies during the winter.

Approximately 10,000 dollars were expended by the railroad for salvaging, transporting and removing moose carcasses and for repairing damaged equipment.

Considerable biological data pertaining to the status of the railbelt moose population was gathered and will be presented later in a technical appendix to this report.

RECOMMENDATIONS

1. It is recommended that the moose kill reporting system and the moose head collection system be continued.

2. Daylight train operation, when economically feasible, slow orders in critical kill areas, and horn blast timing should be further tested and evaluated for moose-saving effectiveness.

3. Further experimentation with bulldozed trails and feed yards is warranted.

4. Cattle guards placed in conjunction with bulldozed trails and feed yards should be tested as planned.

5. The study of seasonal moose movements and moose population shifts should be continued, and results scrutinized for possible leads to additional methods of permanently diverting moose from the immediate railbelt area.

6. This project has yielded much factual information on the current moose problem and has established a sound basis for future work. It is believed that continuation of the study and experiments for another year would yield even more pertinent information, with a correspondingly greater liklihood of approaching a permanent solution.