SALT USE BY MULE DEER IN THE DESCHUTES NATIONAL FOREST OF CENTRAL OREGON

by

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Participation of the managers of the four cooperating

ranches permitted measurement of salt use by livestock. Special thanks are extended to Wayne Korish, manager of the Lundgren Ranch, for his interest, material assistance, and for the many kind favors extended during the time that I was engaged on the study.

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Mule deer taking salt at salt station located at China Hat Well Guard Station, Fort Rock district, Deschutes National Forest. September 4, 1953. Note "eye shine" of doe and fawn to right, rear.

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SALT USE BY MULE DEER IN THE DESCHUTES NATIONAL FOREST OF CENTRAL OREGON

INTRODUCTION

Measurements of salt use by Rocky Mountain mule deer, Odocoileus hemionus hemionus (Rafinesque), were accomplished in the Deschutes National Forest of central Oregon, during the period April 15, 1953, to September 15, 1953, to determine quantitative salt consumption, to observe the influence of salt upon deer distribution and to determine whether or not the amount of salt consumed by deer might make significant inroads on salt placed on the range by livestock operators for consumption by domestic livestock. As a corollary figure, data on salt consumption by domestic animals were procured on this same general range-area in order to permit comparisons with standards given by Mitchell (25, p.74) for the National Research Council. Also, some evaluation of the usefulness of salt as a deer management technique was obtained. Observations were primarily centered on a portion of the range of the Metolius deer herd, within the Sisters ranger district. However, additional measurements and observations of salt use were obtained from the Fort Rock ranger district, which was ecologically different and removed from the main study area.

The present study was a continuation of the long-term research investigation involving the measurement and

management use of salt for big game and domestic animals which was proposed by the Oregon State Game Commission in 1950. Field procedures were outlined by the Oregon Cooperative Wildlife Research Unit[1], under the leadership of Mr. Arthur S. Einarsen, Biologist, United States Fish and Wildlife Service. Intensive field work was carried out during the summers of 1951 and 1952 by Mr. William D. Barron, formerly graduate research assistant and presently with the Oregon State Game Commission.

The primary purposes of the study have been stated. Some consideration will now be given the specific objectives underlying the procedures employed in the several parts of the investigation in order to illustrate some of the problems encountered and the procedures devised and employed to solve them. Mention is also made of those measurements obtained in 1951 and 1952 that were omitted in 1953 and conversely additional measurements secured in 1953 are discussed. This brief introduction to the context of the manuscript follows:

No method was available or was devised during the three study periods to permit periodic total census of the deer occupying the experimental area. Thus, the

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1 Oregon State Game Commission, United States Fish and Wildlife Service, Wildlife Management Institute, Oregon State College, and Agricultural Research Foundation cooperating.

inability accurately to determine deer numbers constituted a limiting factor throughout the entire study. Without this critical figure, salt consumption per deer month could not be computed with the desired accuracy. However, qualitative methods were employed to a limited extent to determine deer numbers and in turn compute salt consumption per deer month. In place of a total census method, the deer track count gave a partial census, or an index to deer population trends on the experimental area. This did not entirely satisfy the objective, since it was not susceptible of conversion to deer numbers per unit area, but it did permit correlation of salt consumption with the index of deer numbers, enabling some conclusions as to seasonal fluctuations in salt consumption.

Additional salt stations were located at higher elevation sites, directly to the west of the experimental area, to facilitate determining whether or not seasonal fluctuations in salt consumption per animal did occur. No effort was made to determine deer numbers in this region, but inspection of the deer population trends on the main experimental area together with recorded salt use data from the two locations aided in evaluating the question of seasonal salt consumption.

The main objective of the fire tower cooperative deer salting study was to provide data on the rate of

deer salt consumption from a wider area and to measure regional differences if they existed. In this phase of the investigation, the determination of deer numbers remained the critical problem with which the study as a whole was concerned.

The objective underlying the aspect of the study concerned with the measurement of salt consumption by domestic animals was to permit comparisons of salt consumption rates, in the study region, with standards established for the National Research Council. Domestic animal salt consumption rates can be readily determined on different ranges. Therefore, if a direct relationship existed between salt consumption rates of deer and livestock, data on livestock salt consumption rates might serve as an indicator of the rate of salt consumption by deer in the same region.

A brief review of the literature pertaining to salt consumption by big game and domestic animals has been included. Prefacing this review is a discussion of the effects of salt on deer, both physiologically and from the standpoint of management. Also contained in the literature review section of this report is a summary of the present status of the big game salting programs in all the western states and the Province of British Columbia, pointing out the extent of salt use as a management

technique on big game ranges, the purposes or objectives of their salting programs and the scope of any investigations currently being conducted.

General descriptions of the study area follow and include descriptions of the location, climate and vegetation. The location of the experimental area and the area of higher elevation, on which salt stations were located in 1953, are described in detail.

Since this investigation was primarily associated with the Metolius deer herd, the fourth major section of the report is concerned with a limited description of the Metolius deer herd and its range. A knowledge of the deer herd, the location of its summer and winter range, migration routes followed and seasonal movement patterns may permit more intelligent interpretations of salt consumption data and the influence of salt on the dispersion of the deer.

Procedures used in the 1953 study are fully described, particular emphasis being given the changes or modifications in procedures formerly used. New methods employed in 1953 included the use of individual control salt blocks to permit precise measurement of weathering losses; the location of salt stations at higher elevations, to the west of the experimental area, to learn whether or not salt consumption per animal remained

relatively constant throughout the entire study period or actually decreased in late summer; and a method of estimating the numbers of deer visiting individual salt stations on the experimental area was devised to permit determination of salt consumption per deer month.

Some additional measurements were obtained in 1953 and conversely, certain phases of the 1951 and 1952 study were omitted. In 1953, salt consumption data were obtained from 22 higher elevation stations; some changes were made in the fire lookout sites, where deer salt consumption data were collected by the operators; and, in the measurement of the salt consumption rates of domestic livestock, data were obtained on salt consumption by sheep from one additional ranch. These changes in techniques and the inclusion of additional sources of data will be fully described under the section on procedures.

In 1951 and 1952, Barron (1, pp.26-36) had employed a photoelectric counting mechanism as an instrument to count deer visiting an individual salt station while the observer was not present. This data were correlated with daily, measured salt consumption to permit determination of the salt consumption per deer month. The set only operated part of the time due to electrical difficulties and was considered unsatisfactory because of continued malfunctioning during field use.

Results obtained by Barron in 1952 (1, pp.33-34), when the set was operating correctly, showed that in 228 deer visits to the station 53 ounces of salt were consumed. The average salt consumption per deer visit amounted to 0.3 ounce.

Because of the mechanical failure attendant to the operating of this counting mechanism, it was not used in 1953. Subsequent observations of deer behavior, obtained from direct observation of deer taking salt during the 1953 study period, indicated that results obtained might be of limited value without a satisfactory method of correcting for the repeated counts of an individual deer as it moved about the salt station.

One other phase of this problem, investigated by Barron in 1951 (1, pp.39-42), was not pursued in 1953. This was the salt and water relationships of deer, which were only incidentally observed during the present study.

The remaining major section of the manuscript is concerned with the results obtained and their interpretations. This material is presented in the same order as the procedures are considered. Included within this section are pertinent comparisons with the results obtained by Barron in 1951 and 1952.

REVIEW OF LITERATURE

Differences of opinion exist among biologists in regard to the nutritional needs of big game animals for salt. Considerable evidence is available to show that a physiological requirement does exist for salt in the animal body, as experiments with domestic animals have conclusively demonstrated. Maynard (24, pp.131-132) discussed the vital role of salt in water metabolism of the body. Mitchell (25, p.73) gave evidence that a physiological requirement does exist for salt among domestic animals. A report of research results to the Salt Producers Association (31, pp.1-6 and 11-14) contained progress reports on several current studies that have demonstrated that significant physiological effects result from withholding supplemental salt from domestic animals. Summary statements of research work supported by the Association are contained within this report. These summaries include studies of the quantitative requirements of domestic animals for salt and the actual role of the sodium ion and the chlorine ion in animal metabolism. Morrison, in Feeds and Feeding (26, p.103), summarized the functions of salt in the system in this statement: "Both sodium and chlorine are essential to animal life. They perform important functions in maintaining osmotic pressure in the body cells, upon which

the transfer of nutrients to the cells and the removal of waste materials depends. Chlorine is also required for formation of the hydrochloric acid in the gastric juice." Chapline and Talbot (8, p.3) reported detailed tests at the Wisconsin Agricultural Experiment Station in which dairy cows were deprived of free salt. Although the general health of the individual animals did not appear to be affected for periods of from less than one month to more than one year, in every case there was finally reached a condition of low vitality in which a sudden and complete breakdown occurred, from which recovery was rapid if salt was supplied. The critical stage was marked by a loss of appetite, a general haggard appearance, lusterless eyes, a rough coat, and a very rapid decline in live weight and yield of milk. However, it seemed probable that under conditions prevailing in the tests a dry cow or steer would suffer no great inconvenience if given no salt except that contained in the normal feed ration, which was calculated to contain about three-quarters of an ounce of sodium chloride a day. The salt requirements for lactating dairy cows was found to lie somewhere between 15 and 60 grams of salt per head per day, by S. E. Smith, P. D. Aines, and K. L. Turk, as stated in a report on Salt for Dairy Cows, a report to the Salt Producers Association (32, p.3). Guilbert and

Hart (14, p.20) reported that the physiological salt requirements of beef cattle appear to be very low, about 1.5 grams daily of sodium and less than 5 grams daily of chlorine being sufficient for growth. Thus, available evidence indicates that salt, whether free salt or salt contained in forages, water or other natural sources, is a physiological necessity for domestic animals. However, Murie (27, pp.309-312) questioned that wild game species need free salt, and stated that their requirements may be met through their adaptation to natural foods. He further pointed out that the metabolism of domestic animals may have been changed by selective breeding and that their salt requirements may have changed accordingly, which may explain their apparent requirement for supplemental salt in certain instances. Murie quoted Van Loon to state that recent investigations indicated the basic requirement for sodium chloride is small and indirect assimilation is easily incurred due to the profuse distribution in nature.

The role of sodium chloride in the nutrition of big game animals has not been thoroughly investigated. Furthermore, as Murie has suggested, it does not seem reasonable to assume that the same physiological requirements exist among deer and other wild species of big game as have been found to exist in domestic animals. However, that sodium chloride does play a vital role in

the metabolism of big game animals has not been disputed. The question, as yet unanswered, is whether or not supplemental salt is required in addition to that found normally in natural foods.

Big game animals, according to Murie (27, pp.309-310) are not at first attracted to salt, but later acquire a taste for it and once accustomed to eating salt continue to seek it eagerly and eat it with obvious relish. This predilection for salt among those big game animals exposed to it seems to be the vital link in the understanding of quantitative deer salt consumption.

Changes in the mineral content of forage as determined by regional and seasonal influences and changes in the food species available may furnish partial explanation for the variable consumption and powers of attraction that salt holds for deer and other big game on different western ranges. However, the acquisition of the salting habit to varying degrees is probably the yardstick by which deer salt consumption records should be measured. In other words, reports by investigators that a specific amount of salt was consumed per deer month probably reflects the degree to which the animal has acquired the salting habit and almost certainly should not be considered as a measure of deer salt requirements. This conclusion is supported by Murie's translation of a

statement by Dungern-Oberau, as it applies to deer of Germany, where artificial salt licks are in general use (27, pp.311-312): "It is a fact that the placing of salt licks for ungulates as a necessity for their care in preserves has been developed in the last ten years. Now one can scarcely enter a hoofed game preserve without coming upon an old or a new salt lick. Has the wild game's habituating itself to salt worked to its own benefits? We must make it clear that an artificial habit is involved. Then where, least of all in north German districts, does one find natural salt licks? It is a fact that in the remote as well as the more recent past a strong and healthy game population was to be found in Germany. This game was certainly better venison and apparently had better antlers than at present. This game had no mineral salts at its disposal. Yet all the ruminants in northern parts of Germany were thriving. Therefore we are not dealing with natural conditions when we give salt to our hoofed game.'

"Without doubt it is demonstrated that the game eagerly accepts the salt and that where salt is furnished the game assembles and is readily held there. It may now be asked, does this salt contribute to the health of the game, has it any wholesome effect whatsoever, or is it only a bait or luxury? On the other hand it could easily

be possible that salt has a harmful effect on the constitution of our ruminant game."

In concluding this review of literature pertaining to the physiological requirements of animals and the discussion of the supposed nutritional requirements existing in deer, it seems probable that deer may meet these requirements through salt supplied principally in natural forages. Murie (27, p.312), who made this same conclusion in an analysis of elk salt requirements, stated that the normal food supply undoubtedly contains the various mineral salts in quantity sufficient for the animals' physiological requirements. A rational use of salt for deer salting in those cases when evidence shows this mineral to be in short supply in natural forage on specific ranges might be governed by this recommendation given by William P. Dasmann in the California Deer Management Handbook (6, p.15). His summary follows: "If deer on some areas do need a salt supplement to their native diet (1) general herd deficiency is most apt to occur during the period when the animals turn to a fresh, green herbaceous diet; (2) nursing does may benefit from a supplement for five to six weeks after fawning; (3) there may be a deficiency in the late fall or winter on areas where non-deciduous browse is not available and deer must subsist largely on cured feed. The one time

when deer should not have access to copious quantities of free salt is when on a low protein diet and in a semi-starved condition. Heavy intake of salt under such circumstances is apt to aggravate their endemic condition and cause death."

The effects of salt on deer distribution have been early observed. Dixon (13, p.109) states that we have evidence that the native tribes of North America even before the coming of the white men to America were familiar with the fact that many of our species of deer and other big game animals visited natural salt licks. Case (7, p.79) also cited early evidence of deer distribution being influenced by natural salt deposits in licks. He observed that on the Clearwater Forest of northern Idaho, prior to the coming of the white man and for sometime afterwards, game was attracted to natural salt licks. Numerous reports appear in recent literature describing the use of salt in influencing big game animals particularly deer and elk, for various purposes.

Case (7, p.79) stated that experience on the Selway preserve indicated that a salting program may aid in effecting desired use of winter range and in producing better distribution of elk. Cooney (11, pp.3-7) stated that salt as a management tool in moving elk has been particularly successful on several areas in Montana where

heavily used natural licks were present on the winter range. Elk had remained on these areas well into the summer, creating heavy over utilization of forage before artificial salting was accomplished to draw them elsewhere. Following salting at higher elevations a marked lessening in the use of these concentration areas was noted. Many additional references mention the use of salt as a bait in trapping deer and other big game animals. Cooney (9, pp.106-107) described use of salt as a bait to facilitate trapping of mountain goats and stated that 24 goats were trapped, using salt as a bait, in the spring of 1941. Hunter (16, p.103) obtained favorable results from using salt in early winter trapping of bighorn sheep. However, the distribution of game has not been effected by salt placement in all cases. Honess and Frost (15, pp.95-96) reported that bighorn sheep in Wyoming were not induced to use salt by its placement along trails, in favorite feeding places and on bed grounds, and by its addition to hay fed during the winter of 1941. Thus, the salt apparently exerted no influence on these bighorn sheep. Leopold, et al (19, p.132) stated that many attempts were made to achieve better distribution of deer on California winter ranges by salting, but that no evidence was obtained that salt induced any general redistribution of the animals. He further observed that,

after three years of salting around the deer traps of Jawbone Ridge, salt attracted only the deer in whose home range it was placed. In 1952 and 1953, Black and Grogan (29, pp.7-11 and 4-6) conducted investigative work for the Oregon Cooperative Wildlife Research Unit on a mule deer winter range on the North Fork of Crooked River in central Oregon. The primary purpose of this work was to learn whether or not the movement of deer was influenced by the selective placement of salt on this range. Results obtained on this range indicated that salt consumption was negligible. Grogan's conclusion, in 1952, that the movement of deer on this range was not influenced by placement of salt blocks was confirmed by results obtained by Black in 1953.

Little information is available as pertains to the salt consumption of big game animals when free use of salt is permitted. Nichols (28, p.29), in experimental feeding of mule deer in Arizona, recorded salt consumption of 1/10 pound per month in summer and 1/20 pound per month in winter. Cooney (10, p.101) reported that the salt requirements of elk and deer in Idaho were determined to be eight and four pounds of salt per year in the more humid northern sections of the state. In the more arid southern portion, half these amounts appeared to be sufficient. Recommended requirements (probable consumption) for deer in Idaho would therefore amount

to 1/3 to 1/6 pound per month.

Literature pertaining to the recommended quantitative salt requirements of domestic animals, from the standpoint of management, is covered under a subsequent section of this manuscript, entitled: Analysis of the Domestic Animal Salt Consumption Data.

Summary of the Big Game Salting Programs in all the Western States and the Province of British Columbia

Game salting is an established practice and is considered an important phase of game management throughout the nation. It has been practiced for many years, particularly in the western states. In 1951, Cooney (10, pp.99-105) prepared a report on the scope of the salting programs, summarizing results obtained through a general questionnaire to all states. This report showed that 60 per cent of the 42 reporting states carry on salting programs and that the 11 western states indicated 100 per cent participation. He discussed the following aspects of game salting: (1) means of placement, (2) cost figures, (3) types of salt used, (4) research, (5) chief objectives, and (6) gave notes on Montana's salting program. His excellent summarization of the stated objectives of the salting programs of the various states follows: "The most important objectives of salting

include: range improvement by better game distribution; a more even utilization of available forage; the prevention of damage to private lands by holding game on desired ranges; the drawing effect in moving game from one range to another; the building up and holding of game on management areas; aiding in the establishment of transplanted game on new areas, as well as the beneficial dietary effects." It must be emphasized that these are in effect the stated objectives of all the states and that they have not been realized in some instances and in many cases they are not supported by research.

In an effort to obtain more current information on the salting programs of the 11 western states and the Province of British Columbia, with particular reference to the extent of research accomplished or in progress on big game salt requirements, a letter was sent to each of the states concerned, requesting this information. The results of this research by Black in 1954 (29, pp.8-9), as contained in the Oregon Cooperative Wildlife Research Unit Quarterly Report, were summarized in table I. This survey showed that salting is currently being used for big game management purposes in ten of the western states, but no management use was reported for the state of Nevada or for the Province of British Columbia. Stated purposes or objectives of the various big game salting practices

TABLE I

SUMMARY OF BIG GAME SALTING PROGRAMS IN ALL THE WESTERN STATES AND THE PROVINCE OF BRITISH COLUMBIA

State or Province	Extent of management use of salt	Purpose or objectives	Current research
Arizona	Salt distributed over most of big game ranges.	1. Public relations with stockmen. 2. Obtain better distribution of game herds.	Preliminary studies underway to evaluate effects of salting program.
California	Salt is distributed on deer ranges	Not specified.	Food habits laboratory, is conducting a P-R study to determine, if possible, the actual elements or element sought by deer when they use salt blocks or natural licks.
Colorado	Use limited to one or two isolated places and that was in an experimental nature.	1. To hold deer and elk on the higher ridges of their winter range.	Investigation of effect of salt on distribution of deer and elk.
Idaho	Big game salting has been practiced for a number of years.	1. To determine whether the influence of salt will retain the game longer on the summer range and induce an earlier drift from the	Practically the entire big game salting program is conducted under a Federal Aid project in an effort to obtain a more

TABLE I--continued

State or Province	Extent of management use of salt	Purpose or objectives	Current research
Idaho (cont.)		winter range. 2. Salt is not distributed for physiological needs.	equitable utilization and distribution of game on the range.
Montana	136,000 pounds of salt in block form were distributed over the big game ranges in 1953.	1. An attempt to accelerate the drift of game off the winter ranges as early as possible in the spring. 2. Attempt to lighten the game use on critical winter areas during the spring and summer months.	None specifically mentioned. Presumably investigations are being conducted to determine whether or not stated objectives are being realized.
Nevada	Salt has not been used as a management technique to date.	- - - - -	None.
New Mexico	Salt used routinely for deer, elk, and bighorn sheep.	1. Used as a lure to keep deer away from orchards and domestic crops. 2. Recompense stockmen for salt used by deer.	Investigative project in the Big Hatchet Mtns. concerning the use of salt of various kinds and its resultant use by the Mexican bighorn sheep.

TABLE I--continued

State or Province	Extent of management use of salt	Purpose or objectives	Current research
Oregon	Salting has been conducted since 1938. Twelve tons of salt were distributed on big game ranges in 1953.	1. Provide a nutritional supplement. 2. To lure animals away from concentration areas.	Present study initiated in 1951. Plans call for a continuation of this long range investigation in another region of the state.
Utah	60 tons of salt distributed on big game ranges in 1953.	Not specified.	Tentatively planning a study to determine the effect of salt in inducing deer back off their winter ranges earlier in the spring.
Washington	A considerable amount of salt has been distributed for big game during past years.	Largely a public relations gesture; replacing some of the salt that stockmen supply to game animals.	1. No intensive studies have been made to determine the value of salt in game management. 2. Conduct experiments in the Methow Valley to satisfy a request to use salt to control damage to orchards is planned for summer of 1954.

TABLE I--continued

State or Province	Extent of management use of salt	Purpose or objectives	Current research
Wyoming	Practice distribution of salt to big game on various feed grounds and winter ranges.	Not specified.	None.
British Columbia	No deliberate salting of big game ranges in this province other than that distributed by ranchers for use by domestic livestock.	- - - - -	None.

are listed in the table. Current investigations of both the nutritional effect of salt and its effect on big game distribution are being conducted in nine of the states. No research projects were reported for the states of Nevada and Wyoming and the Province of British Columbia.

GENERAL DESCRIPTIONS

Location

All field operations were conducted within the confines of the Deschutes National Forest in central Oregon on a site selected by the staff of the Oregon State Game Commission. The experimental area, the area on which the higher elevation salt stations were located, and the ranches on which data on salt consumption by domestic livestock were obtained were all located in the Sisters ranger district, in the northern part of the forest. This area is bounded by the divide of the Cascade Mountains to the west and the Metolius River on the east, a distance of about 12 miles. Salt consumption data collected through the fire tower cooperative deer salting study were obtained from fire lookout sites located in both the Sisters and Fort Rock ranger districts. The latter district is in the southeast part of the forest and the lookout sites selected were situated approximately

65 air miles southeast of the experimental area. This same study area was also used in 1951 and 1952. The extension into the areas of higher elevation to the west of the experimental area was made in 1953.

Figure 1 presents a topographical map of the main study area showing the location of each salt station at both the lower and higher elevation areas. It may be noted that elevations on the experimental area extend from about 2900 feet to 3600 feet. The remaining salt stations at the higher levels were situated at elevations ranging from about 3200 feet to 5200 feet. The various tower sites employed for collection of salt consumption data were all at elevations over 5000 feet, with some reaching an elevation of 6500 feet.

Important considerations in the original selection of the main study area, in 1951, were its moderate deer densities and the absence of domestic, grazing animals, with the exception of livestock on the fenced ranch pastures and the one band of sheep that grazed on the First Creek grazing allotment. Thus, no interferences by domestic livestock or by livestock operators were exerted during the course of the study.

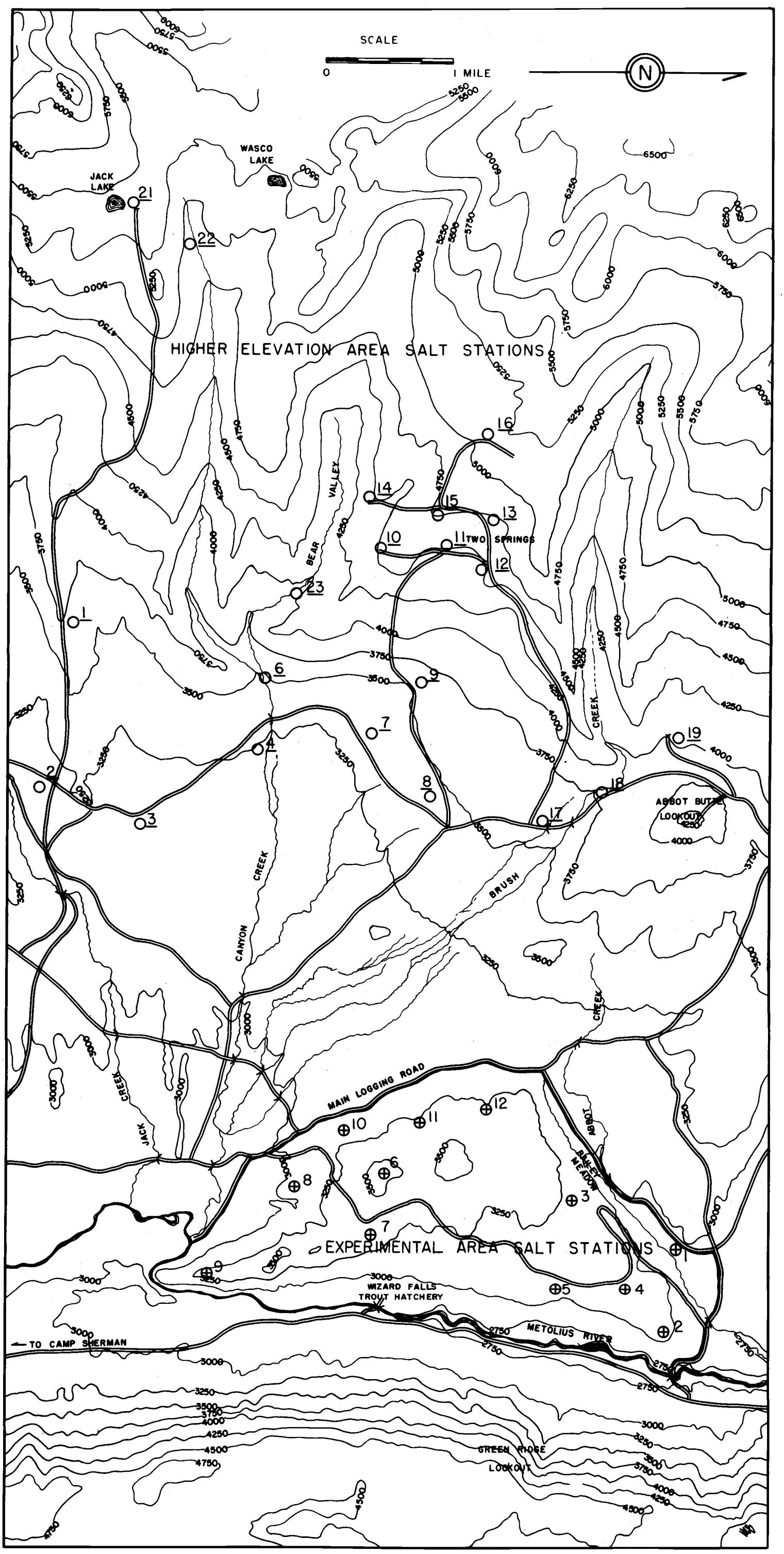

FIGURE 1· TOPOGRAPHICAL MAP OF THE MAIN STUDY AREA SHOWING THE LOCATIO OF SALT STATIONS ON THE EXPERIMENTAL AREA AND THE AREA OF HIGHER ELEVATIONS· THE BOUNDARY OF THE EXPERIMENTAL AREA IS INDICATED·

Climate

Climatological data are not available from weather stations situated on the study area. The nearest weather station was located at Redmond, Oregon, about 28 air miles to the east, but in an area of lower precipitation. Observations made on the study area, by the U. S. Forest Service, Forest and Range Experiment Station, in connection with a study of ponderosa pine, Pinus ponderosa Laws., reproduction, indicated that annual precipitation averaged about 25 inches. Barron (1, p.8) reported that the average maximum snow depth is approximately 24 inches, but in severe winters may reach a depth of 48 inches.

Rainfall records maintained by Barron (1, p.8) during the 1951 and 1952 study periods, showed that rain occurred only twice during the 1951 study period and that both occurrences were recorded in April. In the 1952 study period, rainfall was recorded on nine days widely scattered through the spring and summer months.

Vegetation

A detailed description of the vegetation can be found in Barron's thesis (1, pp.9-10). A ponderosa pine climax type occurs over the main study area and in the Sisters ranger district. Douglas fir, Pseudotsuga Carr., occurs as the second most important component of the

stand. The type remained the same throughout the region, but at higher elevations other tree species increased in numbers and abundance. U. S. Forest Service type maps of the region show that in Township 12 South, Range 8 East, the township on which the experimental area was located, ponderosa pine occupies 81 per cent of the stand; whereas in T 12 S, R 9 E, the area on which the higher elevation salt stations were located, ponderosa pine constituted only 61 per cent of the stand. Douglas fir and grand fir, Abies grandis (Dougl.) Lindl., occupied 33 per cent of the stand in this region of higher elevation, as compared to 13 per cent of the stand, volume on the experimental area.

No attempt was made to define the plant communities present throughout the study area, but U. S. Forest Service type maps are available giving information on timber types. Also, no attempt was made to retrace the fire and logging history of the region. Selective logging has been practiced in this region under Forest Service supervision for many years and is taking place at the present time. Serious fires have been recorded in the region. One recent fire extended over portions of the area where higher elevation salt stations were located.

The understory, browse cover was generally dense, composed primarily of bitterbrush, Purshia tridentata (Pursh); Ceanothus, Ceanothus velutinus Dougl.; and

manzanita, Arctostaphylos petula Greene. These plants were all taken by deer. Bitterbrush was the preferred browse species, a critical winter food and a food readily taken at all seasons. Other species of shrubs were found in the understory, but in reduced frequency of occurrence. Considerable ponderosa pine reproduction contributed to the generally heavy cover.

Herbaceous forbs were particularly abundant during the months of May and June and in late summer they were still available at higher levels. Observations indicated that both grass and forbs formed an important part of the deer's diet during late spring and early summer months.

The grass union present on the ranches was typical of irrigated pastures in central Oregon. Pastures on the Lundgren and Cake ranches were irrigated by flooding and pressure sprinkling respectively. Pastures on the Black Butte ranch were situated in an area possessing a high water table.

The plant association most commonly occurring over the Fort Rock ranger district was a ponderosa pine overstory and an understory of Ceanothus and bitterbrush, on the more moist parts of the district, particularly on the west and at higher levels. The remaining desert areas

were covered with a Juniper, Sagebrush community.

THE METOLIUS DEER HERD AND ITS RANGE

The major portion of the investigation of salt consumption was directly associated with the Metolius deer herd. Therefore, available data and information on this deer herd were obtained and is presented here in order that the location of the normal herd ranges and the movement patterns may be first understood before evaluation of the influence of salt is attempted.

The Metolius mule deer herd is relatively small-sized as compared to the other deer herds in the central region of Oregon. Some individuals show blacktailed deer, Odocoileus hemionus columbianus (Richardson), characteristics, indicating that hybridization may take place in the area. This condition probably has resulted from interbreeding taking place between the blacktailed herds and the mule deer herds intermingling on common summer ranges along the divide of the Cascade Mountains. The range of the Metolius herd cannot be readily delimited. For management purposes, however, it may be considered to extend from the summit of the Cascades on the west to the Lower Desert on the east. Northern boundaries generally follow the southern edge of the Warm Springs Indian Reservation. On the south, no physiographic features

exist to provide a natural boundary and in this area the herd occupies common summer ranges with the Tumalo herd. An arbitrary boundary that delimits the Metolius herd on the south with reasonable accuracy is the South Santiam Highway. The winter range of the herd, a much more critical area than the summer range, can be more readily assigned limits. These boundaries, as provided by Mr. Paul Bonn, the District Game Biologist of the Oregon State Game Commission, are shown in figure 2. It will be noted that an inner concentration area has been outlined within the larger winter range. Approximately 80 per cent of the herd is confined within this restricted area during periods of maximum concentration.

The herd statistics contained in table II were recorded in 1951, 1952, and 1953, by Mr. Paul Bonn (30, pp.8,10). The first part of table II contains population trend data. The second part of the table contains data on herd composition and includes male-female ratios and young-female ratios for the three years. A brief synopsis of migration and distribution records as pertain to the Metolius herd for 1952 and 1953 are presented by the date of occurrence. This information was also recorded by the District Game Biologist and was taken from the Annual Reports (Game) of the Central Region of the Oregon State Game Commission (29).

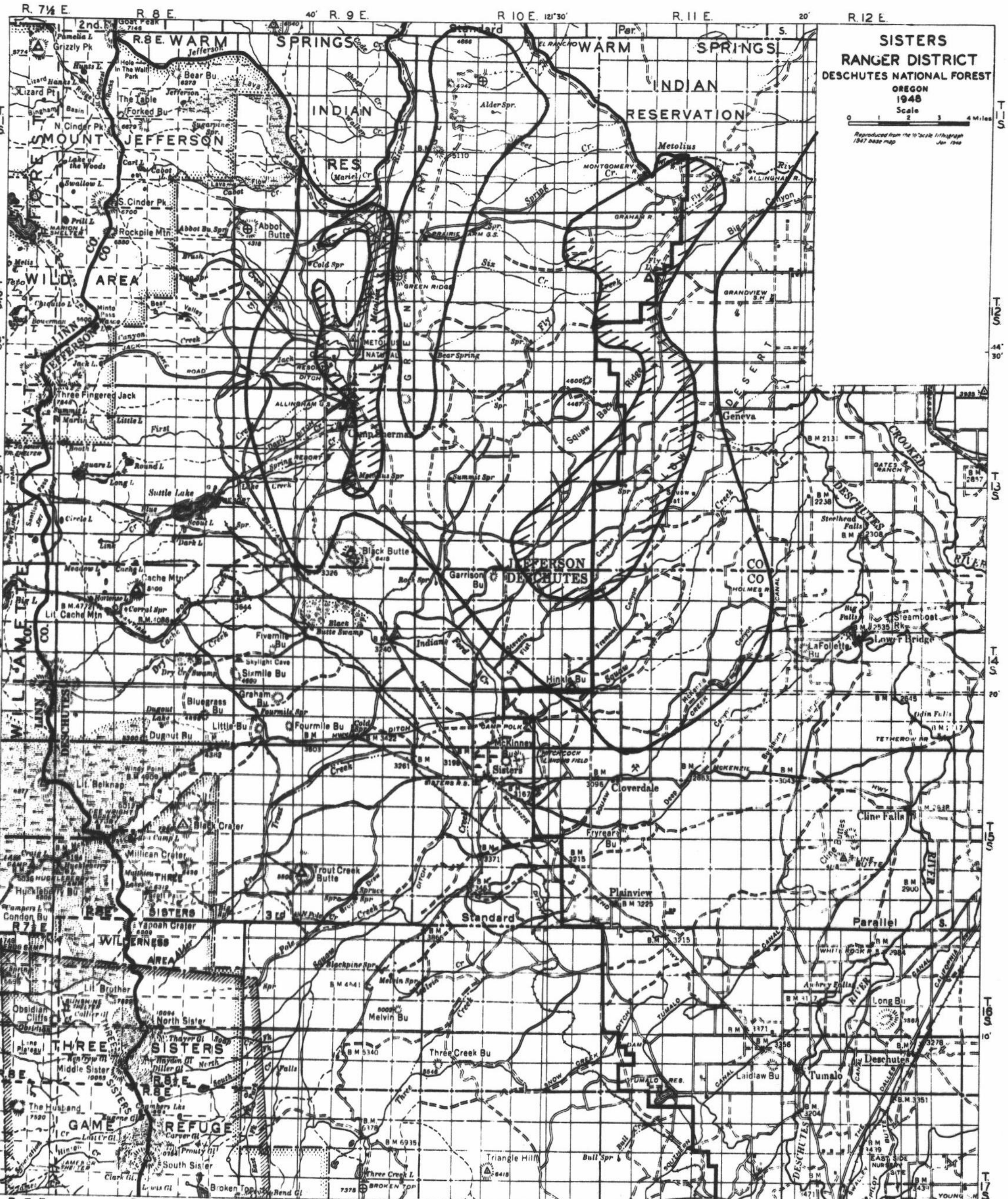

Figure 2. Map of the Sisters district showing the winter range boundaries of the Metolius herd.

TABLE II

METOLIUS DEER HERD POPULATION TRENDS AND HERD COMPOSITION DATA

Population Trends

Herd Range	Miles Traveled (1953)	Deer Observed (1953)	Deer Density per Mile 1951	1952	1953
Metolius	65	241	3.0	3.0	3.7
Central Region	545	3483	5.5	6.0	6.4

Herd Composition

Herd Range	Deer Classified (1953)				Bucks per 100 Does			Fawns per 100 Does		
	Bucks	Does	Fawns	Total	1951	1952	1953	1951	1952	1953
Metolius	50	132	89	271	38	39	38	48	72	67
Central Region	289	1245	886	2420	29	24	23	56	82	71

Notes on seasonal herd movements follow:

May 21, 1952. Deer were still held back from the high Cascades summer range in the Deschutes Forest, by deep snow.

June 21, 1952. On the east slopes of the Cascades in the Deschutes Forest deer are found to be well scattered through the entire area except for the slopes just now being freed of snow.

August 21, 1952. Deer are scattered in the Deschutes Forest and local concentrations are not as heavy as those found in 1951. Considerably more moisture during the early summer and corresponding improvement of range conditions seem to have contributed to this condition.

September 21, 1952. Deer in the Deschutes Forest have left most of the lower, drier slopes except for some of the water courses, but are still fairly evenly distributed in the higher country, and are found to be favoring heavy cover on the north slopes. Distribution in the Cascades seems to be fairly normal at higher elevations. Mountain climbers have reported seeing large bucks hanging around timberline areas. Most of the deer have pulled away from the lower Cascade ranges during the past three weeks. This is especially noticeable in the Metolius region and also in the upper Deschutes.

October 21, 1952. Very little deer movement has been

noted on the major deer ranges during the month.

December 21, 1952. A wind and snow storm hit the region just after the 1st of December and brought a sudden migration of deer on all ranges. Intermittent storms have occurred since then. The sudden, deep snows have pushed most of the deer on the Deschutes area out of the timbered sections of the ranges. The one exception being the Metolius range which is still quite open on the lower areas toward the lower Metolius River and the forested sections east of Green Ridge.

January 21, 1953. Many deer have moved back and become more widespread in distribution during the last three weeks along with the removal of snow by rain and milder temperatures. On most ranges, the deer have spread out as restricting snow has receded.

February 21, 1953. Deer on the Metolius range are found at practically all elevations. However, large numbers still remain at lower elevations, evidently working on new grass just greening-up.

March 21, 1953. The Metolius herd has shown a little westward movement, otherwise the distribution is approximately the same as in February.

April 21, 1953. Deer on the Metolius range have moved westward from the lower portion of the range east of Green Ridge. However, concentrations of deer are still

found in such areas as Squaw Creek, where a combination of early grass and water apparently hold a strong attraction for them. Many deer are still found in the upper Metolius River area, but this portion of the range is opening up fast.

A summary of these migration and distribution records, as they directly pertain to the Metolius herd, showed that in 1952 the herd had been kept off the upper limits of their summer range in May by deep snow, but were well scattered over their range by June. This condition generally continued through October, but some movement from the lower parts of the range was observed. Deer moved onto the winter range areas in November and December, but were not forced to concentrate in the restricted winter range areas. Outward dispersion was already noted in January 1953, along with the recession of restricting snow. By February, deer were generally distributed over their entire summer range, including higher regions, although occupancy of some areas was blocked by deep snow. Deer were still found in considerable numbers on the lower reaches of the Metolius River area in April.

Additional information on herd movements were obtained from loggers and through interviews with Mr. Lee Morton, Forest Guard, Allingham guard station of the

Sisters district. When the spring break-up arrives each year, the deer from the east portions of the winter ranges move westward off of Green Ridge and cross the Metolius River freely onto summer range. The main part of the Metolius herd occupies the area round the head of the Metolius River temporarily during the winter and early spring months and then continues on up into the higher country in late June and July following the new herbaceous growths. This area approximately coincides with the restricted winter range area along the Metolius River as is shown in figure 2. Loggers reported that the greatest number of deer were seen along the main logging road, a section of which marked the west boundary of the experimental area in March 1953. This indicates that the bulk of the deer moved onto higher reaches of their summer range about this time and that the deer remaining on the experimental area were mainly resident deer. The deer on the east side of the river move out of the Metolius River area each year as summer highway traffic increases after June 1.

Analysis of the data contained in table II permits certain generalizations in regard to the Metolius herd in comparison with figures compiled from all deer herds of central Oregon for the three years of the study. The population trend for the Metolius herd, as revealed in

deer density per mile traveled by the observer, remained constant for the first two years, but increased noticeably in 1953. The trend data for the overall region showed this same pattern, but recorded deer density was about two times as great. This probably is indicative of lesser numbers of deer on the Metolius range and the difficulty to observe them due to the heavy cover. Inspection of the herd composition data for the Metolius herd shows no striking trends. The number of bucks per 100 does remained constant for the three years, but was more than one half times greater than the average for the region as a whole. This is probably due to the reduced hunting pressure exerted on the Metolius herd and again the heavy cover extending over the range acts to reduce the harvest of antlered deer. The number of fawns per 100 does was fairly stable, with exception of the smaller figure recorded in 1951. Generally the ratio compared favorably with the young-female ratio for the region.

PROCEDURES

Determination of deer salt use required two inter-dependent measurements. The exact amount of salt consumed by the deer and the number of deer consuming the salt were co-equal parts of the equation. Thus, in order to determine accurately the salt consumption per

individual animal it was necessary to obtain these measurements.

Measurement of Salt Consumption by Deer

Measurement of Salt Consumption at Salt Stations on the Experimental Area

Procedures followed in obtaining the measurements of actual salt consumed were essentially the same on the experimental area, the higher elevation salt stations, and at the fire lookout sites. They consisted of making regular weekly or biweekly weight measurements of the salt blocks located at the various stations. A specially designed platform was constructed to hold two, five pound blocks of plain white salt. One of the blocks was exposed to deer use and the other was exposed to weathering, but protected from animal use by one-half inch mesh hardware cloth (screen) which enclosed the block. This latter block was designated as a control block and the difference in weight between successive weighings represented the gain or loss resulting from exposure to the weathering elements. Thus, a control block immediately adjoining an exposed block was located at each station in order to measure effectively weathering action at the different station sites. This salt platform, showing the exposed and control salt blocks, is

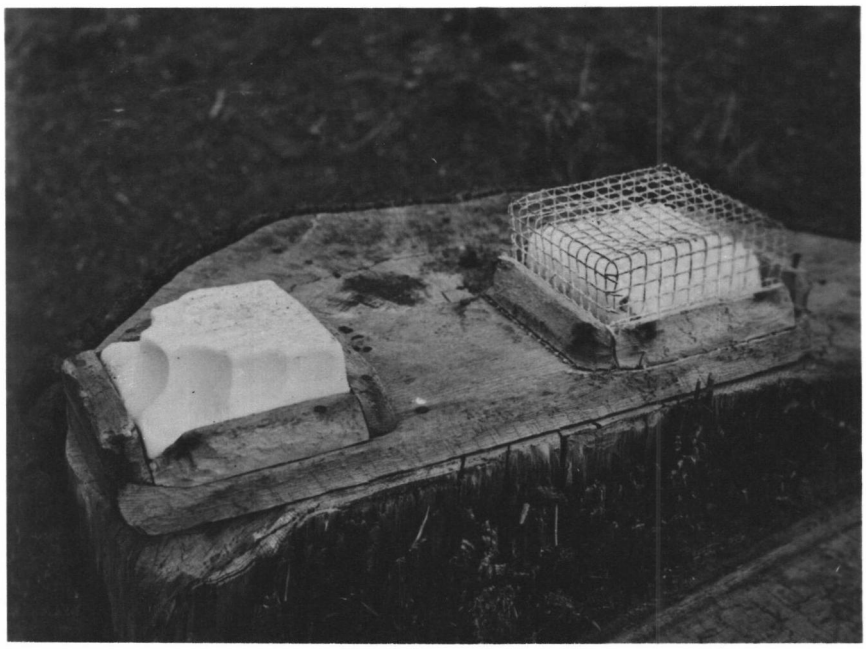

Figure 3. Salt platform used to hold block salt and to provide an accurate check on weight changes due to weather. Exposed block on left, control block under screen on right. Note porcupine sign (gnawing) on edges of platform.

Figure 4. Salt platform designed to hold half ground salt and to provide an accurate check on weight changes due to weathering.

illustrated in figure 3. A salt platform constructed to hold two small boxes of half ground salt was also designed to permit determination of salt weight changes due to weathering. This salt platform, shown in figure 4, was employed at two stations on the experimental area beginning on August 11, 1953.

The control block was located immediately adjacent to the exposed block in order that the effect of weather, particularly the micro-climate, could be compensated for. It was believed that significant differences existed in the weathering effect between stations and for this reason control blocks were located at each of the stations on the experimental area.

Twelve salt stations had previously been established by Barron (1, p.17); 8 stations were established on April 16, 1951 and 4 additional stations were located on June 12, 1951. The sites for the stations had been carefully selected to permit uniform salt distribution, habitat variation, elevational differences, and normal deer summer range were factors considered. Barron stated, "As many of the variations as possible were included when each station was located to prevent these factors from having a bearing upon the salt consumption of (the) deer".

Figure 1 contains a map showing the location of the 12 salt stations on the experimental area and their

location with respect to the topography of the area. These identical stations were relocated and used in the 1953 study. Their locations were facilitated by the aid of detailed descriptions prepared by Barron. Initial observations of deer activity at the stations were made on April 16-17, 1953, and initial salt placements were made on April 21, 1953.

Observations of deer activity, as indicated by tracks and other signs, together with salt weight measurements were made at these stations daily for the ten-day period following initial salt placement. This was done in order to learn when salt use first began at each of the salt stations and by interpreting the signs, primarily the number and density of tracks, an estimate of the number of deer that had visited the salt station during the 24-hour period between inspections was made. Thereafter, the stations were checked and the control and exposed blocks were weighed on Tuesdays of each week.

During the ten-day period during which daily observations and weight measurements were recorded, special care was taken to eradicate completely all deer signs on the exposed surface in a 6 to 8 foot radius about the salt station. A fir branch was used as a broom to brush this exposed area clear of tracks and other sign, following inspection and weighing of the salt blocks.

A postal scale, weighing up to 6 pounds and with one ounce graduations, was used at the start of the observation period to make the weight measurements. On April 30, 1953, a triple beam balance, calibrated in grams and tenths of grams, was put into use replacing the postal scale. The maximum weighing capacity attainable on the beams was 2610 grams, or 5 pounds 12 ounces, attained by the use of attachment weights. Two types of triple beam balances with identical graduations, capacities, and performance characteristics, were used during the study. The first type used was a "Cenco" triple beam balance made by the Central Scientific Company and the second type used was an "Ohaus" triple beam balance, manufactured by the Ohaus Scale Corporation. This latter balance was put into use on July 3, 1953, and was used throughout the remainder of the study. Figure 5 illustrates the balance being used in the field.

Precise weight measurements were obtained by following simple procedures: the salt blocks were taken from the platform, earth or other debris clinging to the blocks was carefully brushed off and the blocks were weighed separately and their weights were recorded to the nearest ounce or gram depending on the scale used. The blocks were then replaced in the platform. The exposed block was replaced with a new, five pound block when it

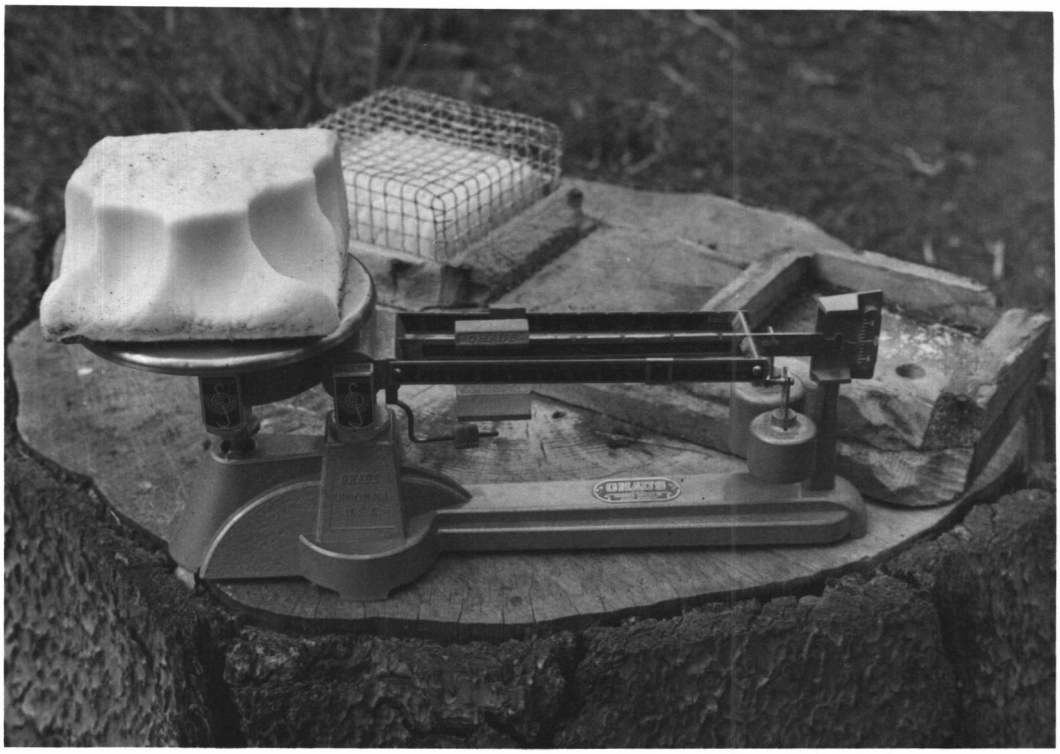

Figure 5. Triple-beam balance used in obtaining salt weight measurements.

had been consumed to the extent that only about one pound remained. No allowance, other than that measured by the weight differential in the control block, was made for unusual weather conditions, such as showers, which thoroughly wetted the salt blocks at the time of weighing. It was assumed that this effect would be approximately identical on both the control and exposed block and, therefore, actual usage could be accurately determined.

Measurement of Salt Consumption at Higher Elevation Salt Stations

A total of 22 salt stations were located at higher elevations to the west of the experimental area. Most of these stations were in a zone two to four miles west of the west boundary of the experimental area, on the upper reaches, but not beyond the extreme limits of the herd's summer range. Their locations with respect to the topography of the region are shown in figure 1.

By locating these salt stations in a line intersecting the normal drift of the deer moving onto this portion of their summer range and by analyzing the usage of salt on these stations as compared to those on the experimental area, it was believed that some indication might be gained as to the relative deer movements. Thus, if salt consumption on the experimental area decreased at the same

time as an increase in salt consumption was recorded at the higher elevation stations, it would be reasonable to conclude that the deer were not held on the experimental area by the salt, but continued to infiltrate into the higher portions of the range as the summer season advanced. Leopold (19, p.61) found that the summer seasonal range of mule deer in California was about one-half to three-quarters of a mile and if this same figure is applied to the Metolius herd, it is unlikely that the deer would have contacted these higher, westward stations, unless their movements were prompted by some other factor than salt demand.

Initial reconnaissance for possible locations of these higher elevation stations was made on May 27, 1953. Fourteen tentative station sites were located and fragments of salt blocks, amounting to about two pounds of plain white salt, were placed at each of the sites selected. A general survey of the area coupled with sightings of individual deer and the finding of an abundance of fresh tracks confirmed that deer were active in this area and were well distributed throughout this portion of their summer range. The purpose of placing this salt out was to allow the deer in the vicinity of the stations to find and begin using it. Thus, it was believed that two factors having a direct influence upon

salt consumption might be eliminated. These factors were: (1) the heavy initial salt consumption by animals that had not had access to salt for extended periods of time and (2) the elimination of the time interval required for all the deer to find the salt. Also, the degree of salt use, as revealed by a later check, was an excellent indicator as to the number of deer within normal range of each station. On June 4, 1953, twelve permanent salt stations were placed at higher elevation sites that had been tentatively selected on May 27, 1953. Four of the 14 sites first chosen were rejected and two new sites were added. Eight more stations were added on June 7, 1953, and at the same time one of the 12 previously located was removed, bringing the total number of stations to 19. One new station, number 16, was added on June 18, 1953. On July 3, 1953, station number 5 was removed and three additional stations were added. These were stations numbers 21, 22, and 23. This brought the number of stations to 22, which was the total number permanently located at these higher elevation sites. No further changes were made until this phase of the study was terminated and all salt blocks were removed on August 26, 1953.

Single, five pound blocks of plain white salt were placed out on simple wooden platforms; the blocks were

held in place by wooden cleats. Consideration was given to factors affecting deer range as discussed under salt placement on the experimental area. In all cases the platforms holding the salt were placed on the ground or nailed to stumps. Most stations were about one-half mile apart and were located near trails, openings in the cover that were frequented by deer, and other sites normally accessible to the deer. Weight measurements, at these stations, were not taken each week, but biweekly, on Thursdays. This was done because of the almost complete absence of human interference and because the salt consumption would not likely exceed five pounds during the two week interval between weight measurements. Control blocks were not used. An average of the weight changes recorded on the 12 control blocks on the experimental area was employed in computing actual salt consumption. Adjustments in the gross consumption figures derived were made by summing the weights of the salt blocks at each of the 22 stations, at each weight period, then multiplying this resultant sum by the average percentage weight change recorded on the 12 control blocks on the experimental area during the two-week interval most nearly corresponding to the biweekly weight measurements. This product was then deducted from the gross consumption figure to obtain the net salt consumption for each two

week period. This method of compensating for weight changes due to weathering was used because by the nature of these observations they were less intensive than those on the experimental area. In other words, no attempt was made to determine the number of deer using salt either on the entire area or at each individual station. The objective was to discern possible trends in salt consumption through comparison of salt consumption on the two groups of salt stations.

Measurement of Salt Consumption by Estimation of Deer Numbers at Salt Stations on the Experimental Area

The following procedures were designed to permit determination of salt consumption per deer month on the experimental area. The analysis of results thus obtained produced information on consumption per individual deer, variation in number of deer using the station daily, and an average usage figure or the number of deer per station per day.

Concurrently with the daily recording of salt usage at the 12 stations on the experimental area, an estimate was made of the number of deer using each station by counting tracks. The actual salt consumption was computed in the same manner as described under the section dealing with the measurement of salt consumption on the

experimental area. The estimate of deer numbers was accomplished by an inspection of the ground immediately surrounding the salt platform. By brushing the ground free of all tracks, within a radius of about 6-8 feet, it was possible to estimate the number of deer that visited the station during the following 24-hour period. Sections of trails leading into the individual stations were also cleared of tracks and in this way a close estimate of the actual number of deer visiting the station during the period preceding the next inspection and weight measurement could be ascertained. Likewise obliterating the tracks within an approximately 15-foot diameter circle surrounding the salt platform eliminated confused track patterns resulting from the nervous actions of the deer at the salt station and permitted an intelligent interpretation of the tracks. Barron (1, p.28) mentioned using daily track counts to check against the number recorded by a photoelectric counting mechanism. This device had been employed during the 1952 study period to obtain a count of the number of deer visiting an individual salt station.

Estimates of the number of deer using a salt station were recorded by individuals, in numbers from 1 to 10. In those instances when it was evident that more than 10 deer had used the station, the estimated number of deer

was recorded as 15 for purposes of computation.

To increase accuracy of the estimate, careful site preparation preceded each observation period during which deer salt consumption was observed directly. At the completion of the period of observation, tracks made by a known number of deer were closely scrutinized. Also, appraisal of normal deer behavior at the salt stations, as revealed by direct observation, contributed to the accuracy of this method.

Estimates of deer numbers at each individual station and the weights of both the exposed and control blocks were obtained during 9 of 10 consecutive days, beginning with the initial placement of salt at each of the 12 stations on the experimental area on April 12, 1953. These measurements were concluded on May 1, 1953.

Measurement of Salt Consumption by Direct Observation

In order to supplement the salt consumption measurements obtained by the method of periodically weighing salt blocks located at established salt stations, as previously described, individual salt stations were kept under observation for periods of several hours at a time. Initial observations of this nature were begun on April 21, 1953, and were continued at irregular intervals into September, terminating on September 4, 1953.

Observations were made at several stations. Stations 4, 8, 10, 11, and 12 were used on the experimental area and observations were also obtained at the Bailey and Duran Meadows, located on and near the experimental area respectively. In addition, observations were obtained at the China Hat Well guard station in the Fort Rock district of the Forest.

Observations obtained at stations 8 and 12 were made from tree platforms. The platforms were about 35 feet from the ground and at distances of 100 to 150 feet from the salt station. These tree platforms had been constructed by Barron (1, p.24) during the 1952 study period. He discusses factors considered in their location and their advantages in some detail. Advantages chiefly consisted of placing the observer in position to see clearly and hear activities at or in the vicinity of the station and at the same time to reduce to a minimum possibilities of disturbing normal deer behavior. Observations obtained at the remaining sites, with the exception of thos obtained on the consumption of half ground salt at the Duran Meadow, were made from a closed automobile. Again the distance of the observer from the salt station did not exceed 50 yards, except at the Duran Meadow, where observations were made from a hill overlooking the salt station and located about 100 yards

distant. In all cases, 7 x 50 binoculars were available to aid in observing details of deer behavior. These glasses were especially useful for seeing activity under poor light conditions.

Observation of deer taking salt was a relatively simple procedure. The exposed and control blocks were weighed upon arrival at the station and then a constant surveillance of the station was maintained. All activity about the station was observed and the behavior of the deer while taking salt was particularly noted. The number of minutes that a deer actually was engaged in taking salt was recorded. When the period of observation at the station was finished, the two salt blocks were again weighed and the amount of salt consumed was determined by subtracting the beginning and end of observation period weights.

It was not feasible to attempt to weigh the salt block after each individual deer visit for two reasons. First, the deer commonly came to the station in groups of two or more and secondly, the handling of the salt blocks while weighing them would leave scent about the station and the deer would be reluctant to take salt for periods of approximately one hour following this disturbance. Thus, in order to obtain maximum salt consumption in a single observation period, the total number of deer

taking salt and their combined time, in minutes spent taking salt was recorded. The total number of deer observed from the salt station, regardless of whether or not they took salt, was also recorded. This was done, to give some measure of activity as well as numbers of deer in the vicinity, in order to learn whether or not seasonal differences existed in the deer's desire for salt.

Fire Tower Cooperative Deer Salting Study

A cooperative investigation with U. S. Forest Service personnel involving the measurement of salt consumption of mule deer at several fire towers on the Deschutes National Forest was instituted in 1952 by Barron (1, pp.43-44). The study was designed to provide deer salt consumption data from a wider geographical area. The lookout operators are in a particularly advantageous position to secure this information, because deer numbers are generally small, relatively stable and as a result of constant observation the lookouts may identify many of the individual deer and very accurately estimate the number of deer using the salt; permitting determination of the critical figure with which this study is concerned, e.g. salt consumption per individual deer. This portion of the main study was continued with only minor

modifications in methods in 1953. It was made possible through the wholehearted cooperation received from all personnel of the Deschutes National Forest that were associated with the study.

Salt platforms containing both an exposed, five pound block of plain white salt and a corresponding screened, control block were located at each station. These platforms were very similar to the platforms used on the experimental area, as illustrated in figure 3. Household type scales with capacities of from 6 to 25 pounds were turned over to each operator to use in obtaining the weekly weight measurements. A copy of the instructions appended to each notebook given to the operators to facilitate their recording of data is repeated in appendix A, to explain fully the kind of observations that the operators were requested to make and the manner in which they were to be recorded. In addition to these items, a supply of salt, sufficient to provide for anticipated consumption, was provided each operator at the time of station establishment.

At the time of initial contact, the operators were thoroughly briefed as to the purpose of this phase of the study and their part in it. Subsequently, after about a two-week interval, the operators were again visited to determine whether or not they were recording observations

properly and to answer questions. Additional visits were made throughout the summer to check on the success of this program.

Nine stations were employed during 1953, four of which were located in the Sisters ranger district and the remaining five of which were located in the Fort Rock ranger district. The first salt station was located at the Abbot Butte lookout on May 27, 1953. Initial weight measurements and continued observations were made until the lookout was manned on June 3, 1953. A salt platform, together with scales, a supply of salt and the notebook containing instructions was sent to the Black Butte lookout on June 19, 1953. These two stations, both located in the Sisters district, marked the initial placement of salt at the lookouts. The remaining two lookout sites used in this district, the Cache Mountain and the Trout Creek lookouts, were placed in operation on July 4, 1953.

Five stations were established in the Fort Rock district on June 19, 1953, with stations being located at lookouts on Pine Mountain, East Butte, and Spring Butte, and at the China Hat and Jones Well guard stations. Seven of the nine stations enumerated had been utilized to collect similar information during 1952. Lookouts at Pine Mountain, in the Fort Rock district, and at Black Butte,

in the Sisters district, were added in 1953. One station used during the 1952 study, the Drake Butte lookout, in the Maury Mountain district of the Ochoco National Forest, was not used in the present study. Observations were terminated in the Sisters district on August 24-26, 1953. In the Fort Rock district, they were terminated between August 27-30, 1953, with the exception of the Jones Well guard station, which was closed on August 10, 1953.

Determination of Deer Numbers by Deer Trend Counts on the Experimental Area

Deer track counts on the 5.6 mile long road bisecting the study area were begun on April 20, 1953, and were continued at weekly intervals throughout the study period, which terminated with a final count on September 7, 1953. This method of arriving at an index figure of deer numbers was patterned after the technique used by the Interstate Deer Herd Committee[2] (17, p.293) and was the method used by Barron during the two previous study periods. Barron (1, pp.19-20) described the procedures in detail and these were followed in the present study. For recording purposes, the road was subdivided into three sections,

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2 The Interstate Deer Herd Committee is comprised of representatives of the Oregon State Game Commission, the California Division of Fish and Game, and Regions 5 and 6 of the U. S. Forest Service.

of 1.4, 1.9 and 2.3 miles, from the south to the north end, to provide some indication of areas of occupancy and movements. Track counts were made on Monday morning each week, being normally begun at 7:00 a.m. and completed in about three hours or at 10:00 a.m. Normal automobile traffic was depended upon to obliterate old deer tracks and make possible the ready identification of the fresh tracks. It was assumed that traffic on the road would cease at approximately 9:00 p.m. on the day preceding the track count, producing a minimum track-accumulation period of about 10 hours. Thus, the number of crossings recorded represented a 10 to 13 hour period of track accumulation.

An attempt was made to facilitate making the track count through the use of a brush drag behind an automobile, a standard practice followed by the Interstate Deer Herd Committee (17, p.293). This was done on only one occasion, on April 19, 1953, but was discontinued when it was found that traffic over the road was satisfactorily eliminating old tracks.

Measurement of Salt Consumption by Domestic Animals

The primary purpose of this part of the investigation was to establish a basis for comparison of measured salt consumption rates of domestic livestock in the Metolius area with established standards of domestic animal intake,

to determine the difference in rate of consumption on the Metolius range. In including this phase of the study, cognizance was given the differences in food habits of cattle and sheep as compared to deer, but it was believed that inclusion of this data might aid in interpreting differences in the salt consumption rates of both livestock and big game occurring on ranges in different regions.

Measurements of salt consumption by domestic livestock were secured from four cooperating ranches in the Metolius area. Collections of salt consumption data at the Lundgren, Black Butte, and Circle-M ranches were obtained to provide comparative salt consumption records for the three years of the study period. In 1953, records of salt consumption by a herd of sheep on irrigated pastures at the Cake ranch were obtained in order to permit more accurate determination of salt consumption rates of sheep in the Metolius area. This ranch was situated about one mile southwest of Camp Sherman, being located about midway between the Lundgren and Black Butte ranches. Also, as in 1951 and 1952, salt consumption records of a band of sheep on the First Creek grazing allotment were secured. This grazing allotment is located in the Metolius area of the Sisters ranger district, extending from the west boundary of the experimental area

to the base of Three Fingered Jack Mountain.

Measurement of Salt Consumption by Cattle

Relatively simple procedures were used to obtain measurements of salt consumption. The ranch operators were contacted weekly to learn of changes in stocking numbers and the addition of salt. A Hanson commercial type scale, graduate in ounces, with a capacity of 60 pounds was used to obtain the weekly weight measurements at each individual salt station on the participating ranches. Every effort was exerted to gain the cooperation of ranch operators. For example, at the Lundgren ranch, arrangements were made with the manager to assume responsibility for the maintenance of salt at each station on the ranch. Also, sections of pipe were provided at the Black Butte ranch, which were set into stumps or in the ground at the designated salt stations to hold the salt block. This was done to eliminate undue salt losses due to leaching and trampling, resulting from having the salt block in contact with the ground, and in turn to permit determining actual salt consumption more accurately.

Wayne Korish, manager of the Lundgren ranch, was especially cooperative, and agreed to provide half ground salt for cattle in place of the block salt used in 1951

and 1952. This was done to determine whether or not the mineral content of the forage or of the water, or possibly other undetermined factors, were influencing salt consumption in this particular region. It was believed that if salt consumption rates were not substantially altered by substitution of this salt form, some undetermined factor was operating to limit salt consumption to a sub-standard rate. In order to facilitate the conversion to half ground salt, substantial salt boxes with a capacity of 50 pounds were constructed for holding the half ground salt.

Measurement of Combined Deer-Horse Salt Consumption

Salt consumption records were obtained for combined deer and horse salt usage at four stations on the Circle-M ranch. These stations were at separate locations which were removed some distance apart.

Measurement of Salt Consumption by Sheep

At the Cake ranch and on the First Creek Grazing Allotment, data were collected from the operators who were personally contacted from time to time throughout the study period. Consumption was determined by recording the amount of salt consumed and the stocking rate between designated dates.

RESULTS AND INTERPRETATIONS

Salt Consumption by Deer

Salt Consumption at Salt Stations on the Experimental Area

The same 12 salt stations used during 1951 and 1952 were relocated in 1953. Inspection of the area immediately surrounding the salt stations prior to salt placement showed that all stations were frequently visited by deer following removal of the salt in the fall of 1952. This is in sharp contrast to Barron's observation in 1951 (1, p.46) that many of the stations had little or no use until the deer located tham and that in four cases practically no use occurred during the entire 1951 study period. At most of the salt station sites observed during 1953, the deer had pawed the earth away from the point that the salt platform had previously been located, apparently in an effort to obtain salt. Some of the tracks in the exposed areas about the station were a week or more old, but many fresh tracks were in evidence. A reasonable explanation for this condition might be that deer, having established the habit of taking salt at one or more of these stations, returned to the same stations during their spring dispersion from winter concentration areas.

Results of the salt consumption measurements on the

experimental area have been tabulated in table III and are presented graphically in figure 6. During the 20 week period, April 21, 1953 to September 8, 1953, a total of 97,205 grams or 214.11 pounds of salt were used by deer. During this same period the total weight loss registered on the 12 control blocks was 10,779 grams or 23.74 pounds. The resultant net salt consumption amounted to 86,426 grams or 190.37 pounds. Consumption during the initial week of observation, April 21 to April 28, was 15.74 pounds, the highest net consumption recorded during the study period. However, consumption during the period May 26 to June 2, 1953, was 15.69 pounds.

The seasonal trend in salt consumption on the experimental area was consistently downward, as is indicated in figure 6. The heaviest salt consumption occurred during the first 10 week period, April 21, 1953 to June 29, 1953. During this period, the total net consumption amounted to 131.83 pounds, or 69 per cent of the measured consumption, as compared to a total net consumption of only 58.55 pounds in the remaining ten week period, July 7, 1953 to September 8, 1953.

Detailed results obtained from the deer track counts will be presented in a later section. However, some reference to the correlation between deer numbers and salt consumption is pertinent at this point: a downward trend

TABLE III

SALT CONSUMPTION DATA FROM STATIONS ON THE EXPERIMENTAL AREA

Date	Salt Station Number											
	1	2	3	4	5	6	7	8	9	10	11	12
21 April												
28 April	256	1219	299	638	369	284	425	978	86	1205	511	878
5 May	354	652	524	412	226	283	638	694	∤ 1	495	452	483
12 May	495	593	564	401	144	200	174	516	137	817	1173	705
19 May	323	780	740	193	283	143	483	642	197	868	764	658
26 May	436	502	501	604	302	344	517	557	333	495	897	926
2 June	591	1605	765	400	373	234	793	261	274	463	947	417
9 June	486	667	579	374	88	200	440	635	111	827	556	339
16 June	421	1133	626	292	146	356	531	564	∤ 14	141	435	482
23 June	494	572	730	307	413	180	318	613	202	305	681	431
29 June	619	831	576	349	312	383	503	517	223	555	933	494
7 July	513	478	292	186	413	189	502	386	147	531	316	437
14 July	377	619	311	175	126	39	412	419	106	269	408	405
22 July	417	817	547	197	248	83	360	362	204	259	311	295
28 July	257	816	470	215	313	56	308	155	126	89	206	268
4 August	209	300	194	33	274	42	282	192	93	230	337	225
11 Aug.	141	349	202	135	285	101	174	305	101	94	360	131
18 Aug.	185	188	194	32	212	27	98	40	57	137	38	94
25 Aug.	137	440	210	188	51	28	63	220	92	173	121	218
2 Sept.	265	214	258	66	89	44	271	204	38	503	426	113
8 Sept.	76	189	42	44	47	19	71	22	32	13	30	37
TOTAL												
Grams	7052	12964	8624	5241	4714	3235	7363	8282	2544	8469	9902	8036
Pounds	15.53	28.56	19.00	11.54	10.38	7.13	16.22	18.24	5.60	18.65	21.81	17.70

TABLE III--continued

Total Salt Consumption - by Dates						% wt.loss for two week intervals		
Date	Gross	Net	Total Weight Change	Pounds	Pounds	Total wt.	CB's	% weight change
21 April						28122		
28 April	7204	7148	- 56	15.74	-0.12	28066		0.002
5 May	5452	5212	- 240	11.48	-0.53	27826		0.009
12 May	6595	5919	- 676	13.04	-1.49	27150		0.024
19 May	6718	6074	- 644	13.38	-1.42	26506		0.024
26 May	9581	6414	-3167	14.13	-6.98	23674		0.119
2 June	7882	7123	- 759	15.69	-1.67	22915		0.032
9 June	6167	5302	- 865	11.68	-1.91	22050		0.038
16 June	6105	5113	- 992	11.26	-2.19	21058	-0.081	0.045
23 June	5447	5246	- 201	11.56	-0.44	20857		0.010
29 June	6137	6295	∕ 158	13.87	∕0.35	21015	-0.002	∕0.008
7 July	4975	4390	- 585	9.67	-1.29	20430		0.028
14 July	3710	3666	- 44	8.07	-0.10	20386	-0.030	0.002
22 July	4135	4100	- 35	9.03	-0.08	20351		0.002
28 July	3267	3279	∕ 12	7.22	∕0.03	20363	-0.001	∕0.001
4 Aug.	2364	2411	∕ 47	5.31	∕0.10	20410		∕0.002
11 Aug.	2703	2378	- 325	5.24	-0.72	18985	-0.014	0.016
18 Aug.	1337	1302	- 35	2.87	-0.08	18950		0.002
25 Aug.	1936	1941	∕ 5	4.28	∕0.01	18955	-0.002	---
2 Sept.	4717	2491	-2226	5.49	4.90	16729		0.117
8 Sept.	773	622	- 151	1.37	-0.33	16578		0.009
TOTALS	97205	86426	10779	190.38	23.76	lbs.464076		
	214.11 lbs.	190.37 lbs.	23.74 lbs.	lbs.				

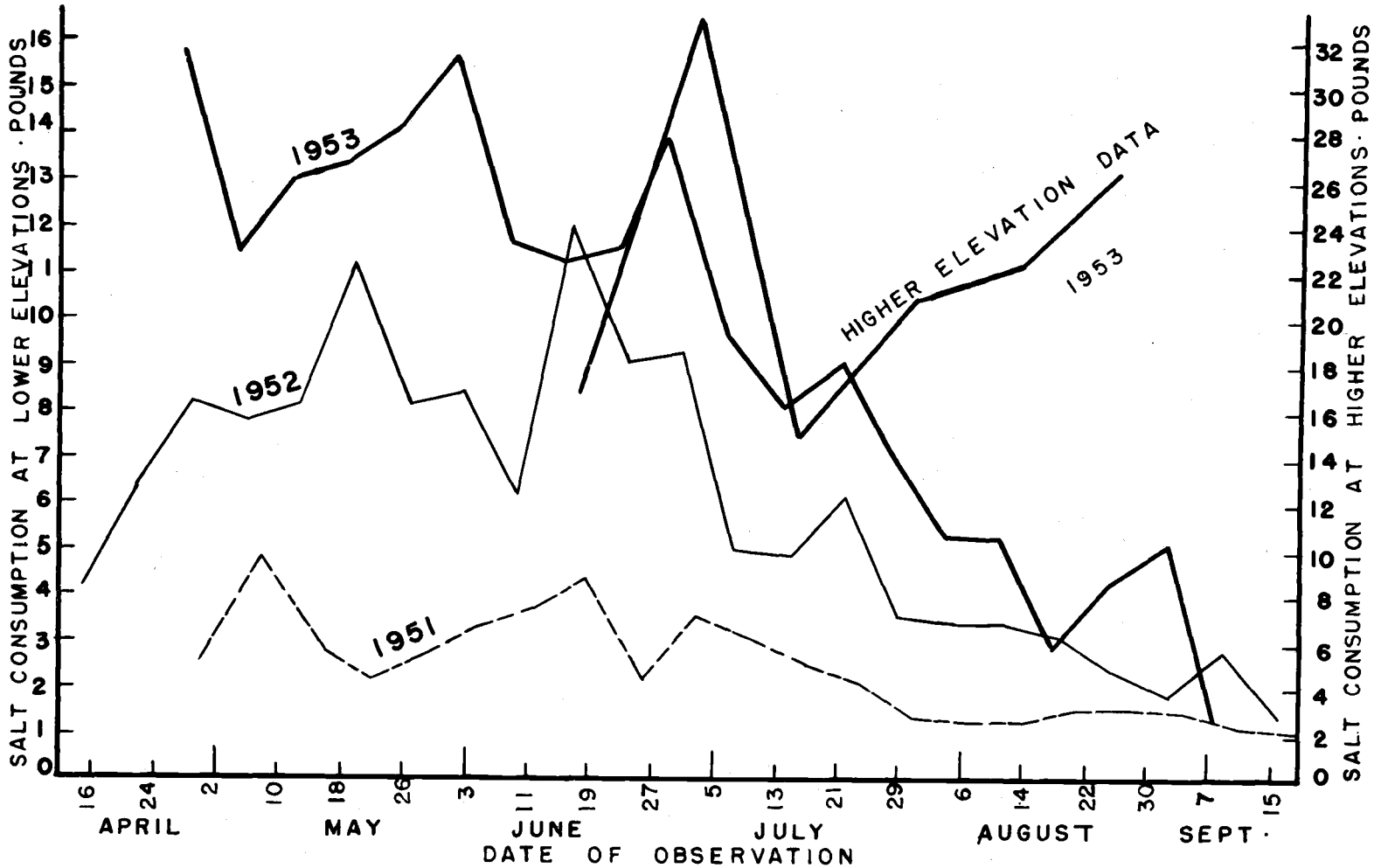

Figure 6. Deer salt consumptions at both the lower and higher elevation salt stations in 1953. Comparative salt consumption data from the experimental area for 1951 and 1952 are included.

in the number of road crossings recorded was clearly evident as is shown by the average number of crossings for each month, which were: April 228; May 177; June 155; July 132; August 81; and September 43. This is closely correlated with the measured salt consumption. However, the graphs of salt consumption, figure 6, and deer population trends, figure 12, do not directly coincide. Therefore, it may be assumed that if salt consumption were directly related to deer numbers, the method of determining trends in deer populations on the experimental area was not sufficiently sensitive to demonstrate this conclusively. Other factors in addition to deer numbers may have influenced salt consumption to the extent that a closer relationship between deer numbers and salt consumption was prevented. Barron, in 1951 and 1952, found a similar relationship between salt consumption and deer numbers. Heaviest salt usage generally coincided with peak trends in deer numbers and then tapered off later in the summer when deer numbers were lower.

Particularly interesting records were obtained from the weathering losses registered on the 12 control blocks on the experimental area. This loss is clearly shown in figure 7, which shows a comparison between a fresh five pound salt block and a screened, control block that had been exposed to weathering factors for 140 days, from

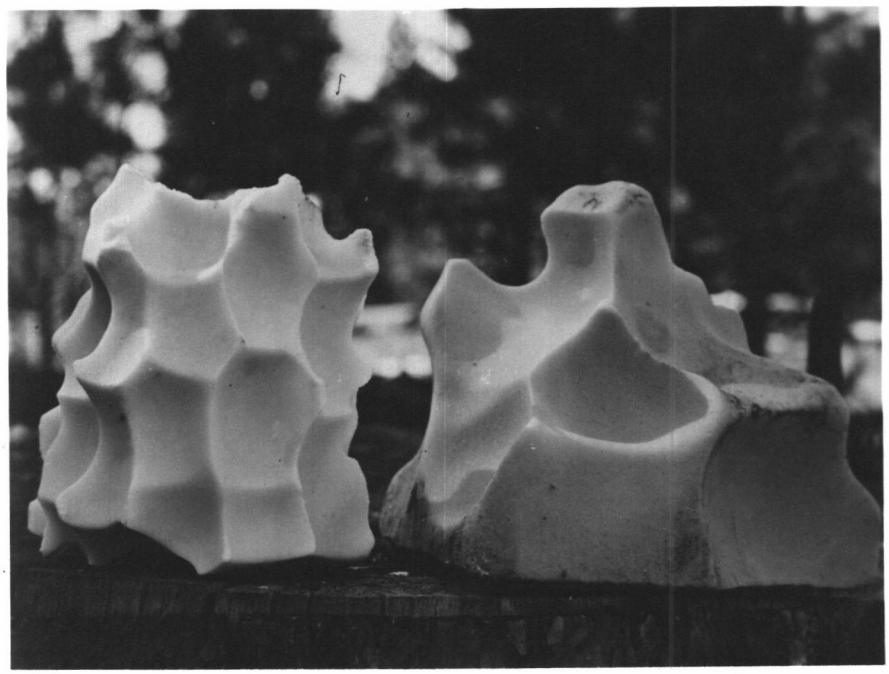

Figure 13. Typical sign of deer use (on left) and cattle use (right). Depressions formed in salt block by deer are approximately $1\frac{1}{2}$ inches across; those formed by cattle are approximately $4\frac{1}{2}$ inches across.

Figure 7. Results of weathering. The salt block on the left was a control block placed under a guard screen on April 21 and removed September 8, 1953; a total of 140 days. The block on the right is a fresh five pound salt block.

April 21, 1953 to September 8, 1953. The overall, average weight loss of the control blocks was 38.33 per cent. This was determined by dividing the total weight change by the total weight of the 12 control blocks on April 21, 1953. Percentage weight losses were computed for each weekly period and are presented in table III. Their range extended from an increase of 0.02 per cent to a weight decrease of 11.9 per cent. During two separate weeks, the percentage weight loss exceeded 11 per cent of the total weight of the control blocks, at the beginning of the weight period. The computation of percentage weight change was accomplished in much the same manner as for the overall per cent weight loss; the total weight of the control blocks at the beginning of the weight period was divided into the total weight loss for the week. Emphasis has been placed on this computation of percentage weight change because it was subsequently used to compute weight losses on salt used in other phases of the study, permitting determination of the approximate net salt consumption.

Known variability in weight changes between stations was the reason a control block was included at each individual station. That such variability existed is demonstrated by weight changes- losses- recorded during the period May 19, to May 26, 1953, on control blocks,

on the experimental area. The losses on blocks 1 through 12 were 310, 308, 298, 303, 239, 223, 162, 196, 297, 273, 288, and 270 grams respectively, marking extreme variations of 162 to 310 grams. Thus, data collected during 1953 has emphasized the importance of accurately compensating for changes in the weights of the exposed salt due to weathering factors.

In a preliminary attempt to determine the relative consumption rate of half ground salt, this form of salt was placed out in specially designed containers as shown in figure 4 functioning in a manner similar to the platforms designed to hold the five pound blocks of salt. Stations 5 and 12 were selected for replacement of the block salt with the half ground form, because of the relatively uniform salt consumption and the moderate level of intake recorded at these stations. During the three weeks preceding the use of half ground salt and beginning with consumption recorded on July 28, 1953, an average of 291 grams of salt was consumed, with a range of 274 to 313 grams, at station number 5. During the same period an average of 208 grams of salt was consumed at station number 12, with a range of 131 to 268 grams. During this same three week period, at the remaining 10 stations, net salt consumption averaged 219 grams. Following the substitution of the half ground salt on August 11, 1953,

consumption averaged 100 and 116 grams, with ranges of 47 to 212 grams and 37 to 218 grams, at stations 5 and 12 respectively, in the four weeks terminating with the final weight measurements on September 8, 1953. During this same four week period, net block salt consumption averaged 137 grams per week at the remaining 10 stations.

In this exploratory use of half ground salt, it may be concluded that no significant differences in the rate of salt consumption existed in comparing the two forms of salt. Additional results on the use of half ground salt by deer are presented under the section on salt consumption by direct observation.

Comparisons with salt consumption data obtained in 1951 and 1952 show a continued year-to-year increase in salt consumption. Total salt consumption recorded by Barron was 51.3 and 137.3 pounds during the successive periods April 16, 1951 to September 18, 1951 and April 8, 1952 to September 16, 1952. It should be noted that consumption during 1951 may have been materially lowered through the employment of only eight salt stations on the experimental area from April 16, 1951 to June 12, 1951, and 12 thereafter. Net salt consumption during corresponding 20 week periods in 1952 and 1953 were 125.3 pounds and 190.38 pounds respectively, showing a net increase of 51.9 per cent. The volume of salt consumed

and the trend in salt consumption, in 1951 and 1952, are compared graphically with the 1953 results in figure 6.

In analyzing the patterns of salt consumption at the 12 stations during the three successive study periods, it is evident that stations number 2 and 3 showed consistently highest usage. The highest consumption was recorded at the same five stations in 1952 and 1953, although they were not in the same order each year. This same pattern was mainly repeated at those stations showing the lowest consumption rates during the three years. Apparently site factors largely determined the rate of salt consumption and the usage pattern established following the initial salt placement in 1951 was not materially changed.

Food habits studies, in relation to salt consumption and measurement of the mineral contents of the preferred deer foods were not a part of this research study. But certain observations in regard to the browsing habits of the deer, as influenced by the salt, were noted particularly on the experimental area and at other locations where salt stations had been established. Reference is made to the excessive browsing, noted especially on bitterbrush plants, the preferred browse species, immediately adjacent to the salt stations. This condition is illustrated in figures 8 and 9, the first

Figure 8. Normal growth of bitterbrush plant growing on the experimental area, showing unbrowsed leader growth.

Figure 9. Bitterbrush plant "hedged" by heavy deer browsing as a result of its close proximity to a salt station on the experimental area.

illustration showing the normal growth form of a bitterbrush plant growing on the experimental area and the second showing a bitterbrush plant "hedged" by heavy deer browsing as a result of its close proximity to a salt station on the experimental area. It must be emphasized that this condition did not occur over a sufficiently large area to warrant concern on the experimental area. In fact, excessive browsing occurred only in a small area about the salt stations. Nevertheless, since the condition did occur, it is suggested that it might become a serious factor in a long-term salting program, particularly where large numbers of mule deer were involved, as on a circumscribed and highly critical winter concentration area.

Analysis of the salt consumption data, obtained on the experimental area, points to a possible use of measured salt consumption data as a direct census method or as an indicator of population trends. It is not intended to propound a theoretical census method, but to suggest this idea for possible study. In any case, game biologists could certainly make a rapid appraisal of the periods of deer use on different portions of an individual herd range, gain some insight into the numbers of deer present and otherwise supplement direct observations of deer by strategically locating salt blocks on deer ranges

and inspecting them at regular intervals. It is believed that this method might prove superior to the use of other indirect signs of deer abundance and activity, such as droppings, deer beds, tracks etc.

Far more information on deer salt consumption is necessary before the method could be used. However, when procedures have been devised that will permit the precise determination of salt consumption per deer month it may be feasible to compute deer numbers directly. Important corrections would be requisite and would include the following factors: (1) proper corrections for seasonal differences in salt consumption, if this is conclusively demonstrated to exist, and (2) the determination of correction factors for other conditions that may affect salt consumption. With this information, salt stations could be randomly located on herd ranges, weight measurements could be obtained at suitable intervals and deer numbers could be computed directly, employing procedures similar to those used in the deer pellet group count census method described by McCain (22, pp.431-440).

Salt Consumption at Higher Elevation Salt Stations

Twenty-two salt stations were established in 1953 at higher elevation sites, directly west of the experimental area. This was done in an attempt to learn whether

or not salt consumption per animal remained fairly constant throughout the study period, or actually decreased in late summer. The objective was to correlate salt consumption on the experimental area with consumption at the higher elevation stations, in order to determine whether or not salt consumption at the higher levels increased with a decrease in both salt consumption and deer numbers on the experimental area at a lower elevation. Results obtained from these observations have been tabulated in table IV.

During the 12 week period, June 4, 1953, to August 26, 1953, the total gross weight of salt used, at these higher elevation stations, was 66,060 grams or 145.51 pounds. The average percentage weight loss recorded on the 12 control blocks on the experimental area, occurring over the nearest two-week interval, was used to compute the total weight loss between biweekly weight measurement intervals at the higher elevation stations. This weight loss was computed by multiplying the percentage weight change by the total weight of the salt, at the 22 stations, exposed at the beginning of the period of measurement. The weight loss was thus computed to be 5,243 grams or 11.55 pounds; the resultant net consumption amounting to 60,817 grams or 133.96 pounds. It is recognized that the allowances made for salt losses

TABLE IV

SALT CONSUMPTION DATA FROM HIGHER ELEVATION SALT STATIONS

Date	Salt Station Numbers										
	1	2	3	4	5	6	7	8	9	10	11
4 June											
18 June	234	607	492	431	336	missing	776	805	257	1320	389
3 July	361	487	437	925	341	∕ 13	1235	669	384	1324	1041
16 July	108	642	527	468		30	416	491	525	540*	549
31 July	571	893	95	767		51	541	424	321	564	399
14 August	484	862	531	569		331	400	668	466	450	391
26 August	465	662	590	406		561	398	592	313	666	601
TOTAL	2223	4153	2672	3566	677	960	3766	3649	2266	4864	3370

* Block overturned.

TABLE IV--continued

Date	Salt Station Numbers											
	12	13	14	15	16	17	18	19	20	21	22	23
4 June												
18 June	1220	1477	1020	107		506	915	∕ 32	353			
3 July	1386	1596	1321	621	67	892	1116	463	338			
16 July	652	694	353	157	231	336	494	257	326			
31 July	694	480	232	178	192	281	987	552	654	204	285	109
14 August	763	454	333	316	218	398	738	551	606	361	433	246
26 August	816	586	552	382	545	395	644	571	593	601	858	211
TOTAL	5531	5287	3811	1761	1253	2808	4894	2362	2870	1175	1576	566

TABLE IV--continued

Date	Total wt of Exposed salt at beginning weight period	Total Gross Wt salt used	Total Wt Change	Total Net Wt Salt Consumed	Total Net Wt Salt Consumed (Pounds)
4 June	43993				
18 June	38502	11213	3563	7650	16.85
3 July	34461	14991	77	14914	32.85
16 July	40354	7796	1034	6762	14.89
31 July	32531	9474	40	9434	20.78
14 August	37036	10569	455	10114	22.28
26 August		12017	74	11943	26.31
TOTAL		66060	5243	60817	133.96
		145.51 lbs.	11.55 lbs.		

resulting from weathering are only approximations. In other words, despite the use of the average per cent of weight loss, based on the 12 control blocks, average site conditions at the 22 higher elevation salt stations might have differed measurably. In addition, precipitation in this area may have been significantly different from that occurring on the experimental area; the combined effects producing a slightly different percentage weight change than that recorded on the experimental area. However, this was the best available means of securing this important correction, since time limitations prevented the use of individual control blocks at these stations and it was believed to be far superior to visual estimate methods.

Results obtained followed the hypothesis postulated, e.g. the salt consumption at these stations of higher elevation increased in the latter part of the summer coinciding with the decreased salt consumption recorded at the lower elevation stations on the experimental area. Net salt consumption increased from 16.85 pounds, during the initial period of observation, June 4, 1953 to June 18, 1953, to 32.85 pounds in the next measurement period, June 18, 1953 to July 3, 1953. This two-fold increase probably can be accounted for by the fact that salt had not previously been made available in this area and, therefore, all the deer had not immediately located the

salt stations. Also, additional deer may have moved into the area. Inspection of the track-count data obtained on the experimental area at the lower elevation during this period showed a gradual dispersion, but there were no discernible trends that might indicate a rapid movement to regions of higher elevation. In any event, an upward trend in salt consumption was evident, as is shown graphically in figure 6. The distinctly counter trends in salt consumption on the two areas are immediately apparent in the same figure.

In considering salt consumption data collected from both the experimental area and the higher elevation salt stations, evidence points to a continued shift in deer distribution, a progressive infiltration into the higher portions of their summer range, with the advancement of summer, irrespective of salt availability. Barron (1, p.67) arrived at much the same conclusion, stating that salt on the experimental area apparently did not prevent a drift to other areas (of higher elevations).

Daily Salt Consumption at Stations on the Experimental Area

Estimates of deer numbers at each individual station and the weights of both the exposed and control blocks were obtained during 9 of 10 consecutive days, beginning

with the initial placement of salt at each of the 12 stations on the experimental area on April 21, 1953. These measurements were concluded on May 1, 1953. The results of this part of the study were tabulated and are contained in tables V and VI, which show both the daily salt consumption and the daily estimated numbers of deer at each of the 12 stations on the experimental area. Weight measurements were made initially with a household type scale registering in pounds and ounces. These figures were converted to grams in order to facilitate comparisons with the deer salt consumption data subsequently secured on the experimental area, at higher elevation salt stations, and with deer salt consumption data obtained through direct observation.

Results indicated that the deer found the salt immediately following placement at 8 of the 12 stations; three additional stations showed usage within two days and the remaining station showed usage on the third day. The number of deer visiting the 12 stations was variable during the ten-day observation period, as an inspection of table V shows. Sixteen deer were estimated to have visited the 12 stations on the first day following salt placement; a high of 84 deer was reached on the eighth day and 77 were recorded on the final day's estimate. The average number of deer visiting the 12 stations during

TABLE V

DAILY SALT CONSUMPTION DATA FROM STATIONS ON THE EXPERIMENTAL AREA

Date (1953)	Salt Station Number												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
April 21													
April 22	0	28	0	0	56	0	42	142	0	0	0	85	353
April 23	28	28	0	86	58	57	0	227	0	142	113	28	767
April 24													
April 25	57	709	85	367	226	113	226	368	29	312	114	567	3173
April 26	114	100	29	58	29	86	29	99	0	311	43	0	898
April 27	57	42	113	141	14	28	14	71	0	340	57	142	1019
April 28	0	312	71	∤14	∤14	0	14	71	57	100	100	56	753
April 29	85	114	99	241	29	142	0	99	28	241	70	171	1319
April 30	57	0	∤28	57	28	14	29	29	∤29	∤86	142	∤28	185
May 1	28	169	141	43	28	14	0	57	15	∤28	127	42	636
	426	1502	510	979	454	454	354	1163	100	1332	766	1063	9103

TABLE V--continued

Date	Total Gross Wt of Salt Used	Total Weight Change	Total Net Wt Salt Consumed	Total Net Wt Salt Consumed (Pounds)	Deer Days of Use	Deer Weeks of Use	Deer Months of Use	Net Salt Consumption per Deer Month (Pounds)
21 April								
22 April	269	+85	354	0.78	16	2.29	0.53	1.47
23 April	510	+257	767	1.69	40	5.71	1.33	1.27
24 April								
25 April	3232	-59	3173	6.99	134	19.14	4.47	1.56
26 April	781	+116	897	1.98	66	9.43	2.20	0.90
27 April	1532	-512	1020	2.25	76	10.86	2.53	0.89
28 April	780	-27	753	1.66	71	10.14	2.37	0.70
29 April	1233	+ 86	1319	2.91	84	12.00	2.80	1.04
30 April	384	-199	185	0.41	41	5.86	1.37	0.30
1 May	749	-112	636	1.40	77	11.00	2.57	0.54
TOTAL	9469	-365	9104	20.07	605	86.43	20.17	1.00

TABLE VI

DAILY ESTIMATED NUMBERS OF DEER THAT VISITED STATIONS ON THE EXPERIMENTAL AREA

Date (1953)	Station Number												Totals
	1	2	3	4	5	6	7	8	9	10	11	12	
April 21													
April 22	0	2	1	0	2	1	1	5	0	1	0	3	16
April 23	2	2	1	3	1	2	3	15	0	5	3	3	40
April 24													
April 25	4	15	5	15	15	10	7	15	3	15	15	15	134
April 26	7	4	4	7	2	2	3	10	2	15	10	0	66
April 27	10	4	6	4	1	0	4	6	1	15	10	15	76
April 28	0	15	7	3	1	4	1	10	1	15	10	4	71
April 29	9	10	7	10	2	10	0	10	0	8	8	10	84
April 30	7	0	1	4	2	5	1	0	2	5	10	4	41
May 1	4	10	10	10	4	2	3	6	2	6	10	10	77
TOTALS	43	62	42	56	30	36	23	77	11	85	76	64	605

the ten-day period was 60.5 per day. At the same time, the salt intake was closely correlated with deer numbers as is shown in figure 10. Also, following establishment of usage at all stations on April 24, 1953, the total number of deer that were estimated to have visited the stations each of the successive days was remarkably consistent. This indicates that the deer numbers on the experimental area were probably fairly constant during this initial ten-day period.

The total weight of salt used at the 12 stations during the ten-day period was 9,469 grams. Total weight change was computed at 365 grams loss. The resultant net salt consumption was 9,104 grams, or 20.05 pounds. The total estimated number of deer days of use was 605 days, or 20.17 deer months. The net salt consumption was approximately 1.00 pounds per deer month. The net salt consumption per deer visit was 15 grams or 0.54 ounces. This was about two times the average amount of salt consumed per deer visit as obtained through direct observation of deer licking salt. This was determined to be 6.27 grams, or 0.22 ounces per deer visit.

In order to calculate the salt consumption on a deer month basis it was necessary to make three somewhat arbitrary assumptions, which were: (1) one deer day of use was based on one deer visit, (2) individual deer took

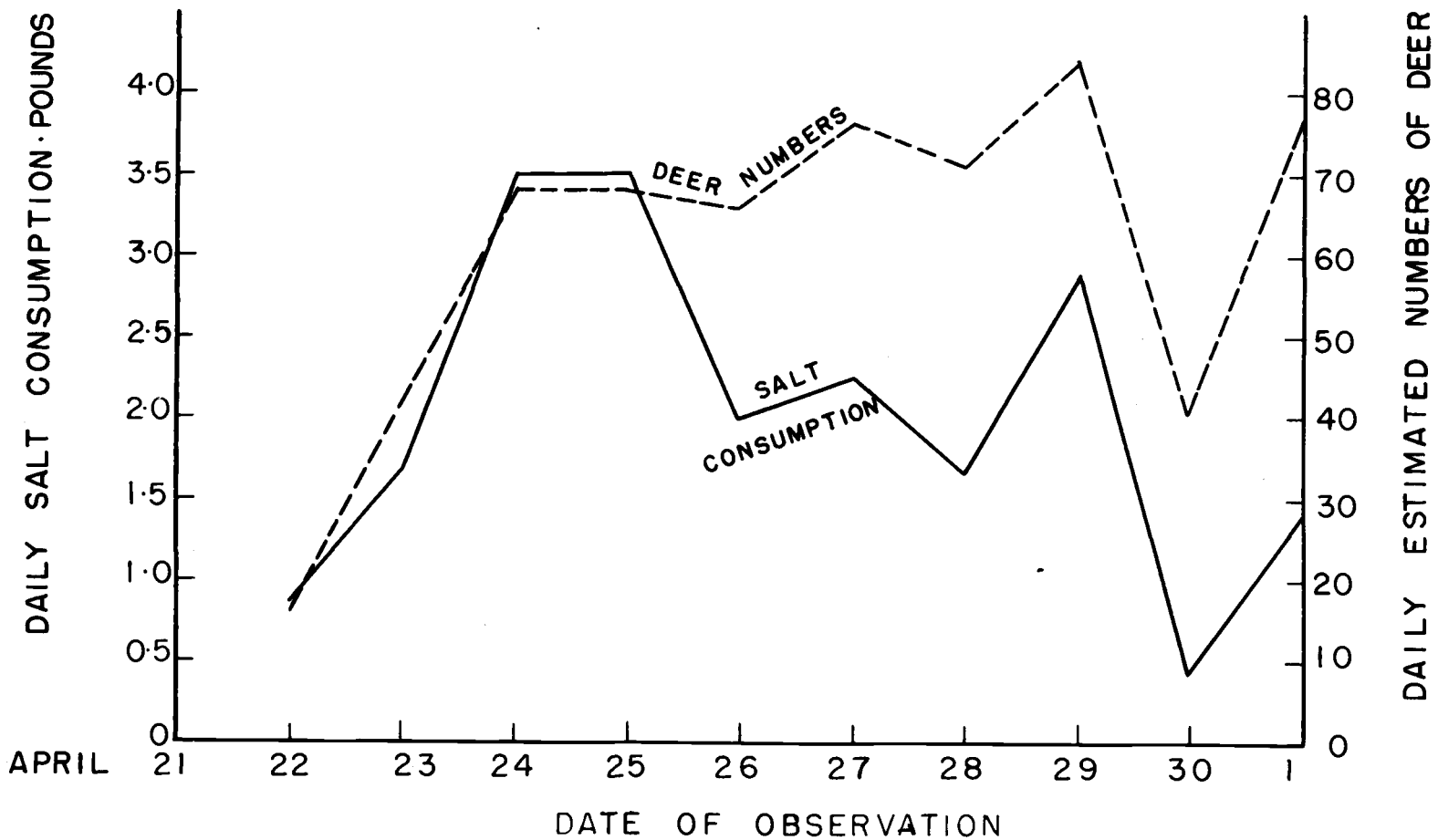

Figure 10. Daily deer salt consumption and estimated numbers on the experimental area for the initial ten days of the 1953 study.

salt once each day, and (3) each deer enumerated represented an individual. These assumptions may be reasonable, but are not supported by sufficient observations and some obvious deficiencies exist.

The fluctuations in daily net salt consumption, as shown in table V, on the basis of net salt consumption per deer month are probably not significant because of the small size of the sample. Inspection of the total daily intake figures show a downward trend, which may indicate that salt consumption per deer can be expected to fall off shortly after salt has been initially made available in the spring.

This method of estimating deer numbers by inspection of tracks about individual salt stations enabled computation of salt consumption per deer month and accordingly provided information that might not otherwise have been obtained. It was not without limitations, however, chief of which was the difficulty of estimating deer numbers in excess of ten at an individual station. In fact, in those instances when it was evident that more than ten deer had used the station, a relatively arbitrary number of 15 deer was recorded for purposes of computation.

Salt Consumption Data Obtained by Direct Observation

Results obtained from direct observation of deer salt

consumption on the experimental area and other locations during 29 observation periods have been tabulated in table VII. Forty-five, or 35 per cent of the 130 deer observed from observation sites, were seen to take salt. These deer were engaged in this process for a total of 809 minutes. Individual deer were occupied in taking salt an average of 18.0 minutes. The total amount of salt consumed during this period was 282 grams, 9.94 ounces, or 0.62 pound. The average amount of salt consumed per deer visit was 6.27 grams, or 0.22 ounce.

Somewhat different results were obtained when the observations of those deer that did not lick the salt block directly, but concentrated their attention on the salt platform, the object upon which it was mounted, or the soil immediately below the platform, are omitted. The following computation also excludes the observation recorded on April 21, 1953, because the deer observed in that instance spent 177 minutes of the 205 minutes recorded at the station licking the salt platform instead of the exposed salt block: On this basis, 36 deer, or 38 per cent of the 130 deer observed, took salt. Their combined time spent taking salt was 422 minutes, during which time they consumed 254 grams of salt, 8.95 ounces, or 0.56 pound. The average amount of salt consumed per deer visit was 7.06 grams, or 0.25 ounce. This was

TABLE VII

SALT CONSUMPTION DATA OBTAINED BY DIRECT OBSERVATION OF DEER LICKING SALT AT STATIONS ON THE EXPERIMENTAL AREA AND OTHER LOCATIONS

Date Observed (1953)	Station Number	Time-interval of observation (P.D.S.T.)	Total No. of deer seen from Station	No. of Deer Taking Salt	Total Minutes Spent Taking Salt (per individual deer)	Total Amount of Salt Consumed	Age and Sex of deer Taking Salt
April 21	8	6:00 pm-11:30 pm	2	1	205	28[4]	Adult.Buck[3]
April 22	8	6:00 pm-7:30 pm	5	1	7	-	Adult. Doe
April 23	8	5:45 am-9:10 am	6	2	19	14[4]	Yearling
					19		Adult. Doe
		6:10 pm-9:00 pm	9	2	18	28[4]	Adult.
					13		Adult.
April 24	8	5:50 am-8:30 am	15	12	126	71[4]	Mostly adults 2 yearlings and 1 buck identified.
April 30	8	6:15 am-9:00 am	7	0	0	0	
May 12	12	6:50 am-9:30 am	2	0	0	0	
May 13	8	5:10 am-10:40 am	4	2	14	12	Yearling
					14		Yearling
		5:20 pm-8:10 pm	3	0	0	0	
May 15	4	5:10 am-10:40 am	2	1	18	16	Adult.Buck
		5:10 pm-8:15 pm	0	0	0	0	
May 20	11	5:15 am-10:00 am	1	0	0	0	
		5:15 pm-8:15 pm	0	0	0	0	
May 21	11	5:15 am-10:30 am	3	3	21	53	Adult.Buck
					33		Adult. Buck
					90[6]		Adult.Buck
		5:15 pm-8:20 pm	3	2	11	10	Adult.Buck
					5		Adult.Buck

TABLE VII--continued

Date Observed (1953)	Station Number	Time-interval of observation (P.D.S.T.)	Total No. of Deer Seen From Station	No. of Deer Taking Salt	Total Minutes Spent Taking Salt (per individual deer)	Total Amount of Salt Consumed	Age and Sex of Deer Taking Salt
May 22	10	4:30 pm-8:15 pm	8	2	15	11	Adult.Buck
					19		Adult.Buck
May 29	11	4:30 pm-8:00 pm	1	1	3	5	Adult.Buck
June 3	11	4:30 pm-8:15 pm	4	0	0	0	
July 9	China Hat G.S.	6:00 pm-9:15 pm	9	2	4	14	Adult.Doe
					36		Adult.Doe
July 10	China Hat G.S.	5:30 am-8:15 am	5	1	12	14	Adult.Doe
August 12	Duran Meadow	6:00 pm-8:00 pm	4	0	0	0	
August 13	Duran Meadow	4:30 am-9:00 am	7	5[7]	7[6]	6(half ground)	Adult.Doe
					4		Fawn
					4		Fawn
					1		Adult.Doe
					16[6]		Adult.Doe
		6:00 pm-8:00 pm	2	1	12[6]	0	Adult.Doe
August 14	Duran Meadow	4:20 am-9:00 am	1	1	23[6]	--	Adult.Doe
August 20	Duran Meadow	6:15 pm-8:00 pm	3	0	0	0	
August 21	Duran Meadow	4:00 am-9:00 am	3	2	12[4]	--	Adult.Doe
					12[4]		Adult.Buck
	8	6:00 pm-7:50 pm	0	0	0	0	

TABLE VII--continued

Date Observed (1953)	Station Number	Time-interval of Observation (P.D.S.T.)	Total No. of Deer Seen From Station	No. of Deer Taking Salt	Total Minutes Spent Taking Salt (per individual deer)	Total Amount of Salt Consumed	Age and Sex of Deer Taking Salt
August 22	Duran Meadow	5:00 am-8:10 am	3	1	10[6]	--	Adult.Doe
Sept. 4	China Hat G.S.	5:30 am-10:20 am	18[7]	3	2		Adult.Doe
					2		Fawn
					2		Fawn

3 Includes those deer that took salt directly.
4 Original weight measurement recorded in pounds and ounces; converted to metric units.
5 Identification to sex not positive
6 Deer did not lick the salt block directly at all; attention was concentrated on the salt platform, the object upon which it was mounted, or the soil immediately below the platform.
7 Includes number of fawns that took salt.

slightly above the figures computed for the average consumption of all deer attempting to obtain salt at the salt stations. The average number of minutes per deer visit, based solely on those deer taking salt directly from the salt block, was 11.7. This was a considerably shorter interval than the 18.0 minutes per deer visit computed on the basis of inclusion of the time individual deer spent licking about the salt station.

Most of the observations were made during the months of April and May 1953, 6 and 11 periods being recorded respectively. Accordingly, certain comparisons have been made and are presented here; Eighteen of 44 deer observed took salt during the month of April, as compared to 11 out of 27 in the month of May. In both cases the percentage of deer observed to take salt was 41 per cent of the total observed in April and May. One hundred and forty-one grams of salt were consumed in 407 minutes during the month of April, as compared to 107 grams consumed in 243 minutes during May. The average amount of salt consumed per deer visit for the month of April was 6.65 grams, consumed in an average of 11.9 minutes per deer visit, as compared to an average consumption of 11.3 grams consumed in an average of 15.3 minutes per deer visit during May. These averages were based only on the deer that were observed to lick the salt block directly and exclude the

observation recorded on April 21, 1953 and the 90 minute observation occurring on May 21, 1951.

This limited number of observations permits no strict comparisons or conclusions as to seasonal salt consumption trends by mule deer. It is probable that the salt consumed per individual deer visit was about the same during each of the two months, or approximately 7 to 11 grams. Reference to table VII shows one striking trend in regard to the sex of the deer taking salt. During the month of May, of the 11 deer observed to take salt, excluding two yearling unidentified as to sex, all of the deer were bucks. During the other months of the study, extending to September, only does were observed to take salt in almost every instance.

Using the average figures obtained from all observations, but with the exclusion of those observations listed in paragraph two of this section of the report, comparisons were made with the results obtained by similar direct observations made in 1952 by Barron (1, pp.62-63). This investigator observed 25 instances of deer taking salt during 9 observation periods. This number of deer consumed 12 ounces of salt during a total of 631 minutes, for an average of about one-half ounce per deer visit. The average number of minutes per deer visit was 25.2. For purposes of computation of salt

consumption, Barron listed fractional parts of an ounce (the scale used by Barron recorded only to the nearest ounce) as traces. Two traces were considered equal to one ounce. In general the results obtained in 1953 were in agreement with Barron's observation that deer never took more than one ounce per deer visit and usually much less. Results in 1953 showed an average of one-quarter ounce of salt consumed per deer visit, as compared to about one-half ounce in 1952. Also, in 1953, the average number of minutes per deer visit was determined to be 11.7, which was less than half the figure obtained in 1952. The computed rate of salt consumption in 1953 was one ounce in 47.2 minutes, or 4 deer visits. In 1952, Barron found that the rate of consumption was one ounce of salt for each 52 minutes spent at the block, or about two deer visits. However, in comparing results obtained, by Barron in 1952 by photo-electric counting procedures[8], it is interesting to note that 53 ounces of salt were consumed in 228 deer visits, or an average of 0.23 ounce of salt per deer visit, which was almost the identical figure computed by direct observation procedures in 1953.

The study of deer behavior was not a primary purpose

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8 In this procedure, salt consumption data were derived by maintaining daily records of the salt used and deer numbers, as recorded by the photo-electric counting mechanism, and as checked by the deer tracks entering the corral.

of this phase of the study, but an insight may be gained into the importance of salt to the deer, its powers of attraction, and other related phenomena by studying their behavior about the salt stations. For this reason, a detailed account of the behavior of an individual deer at a salt station has been presented, essentially as observed and recorded in the field. This particular observation occurred at station number 8, on the experimental area, April 21, 1953. The description of the behavior of the deer in the presence of the salt station was typical. However, this instance was unusual to the extent that this was the first time that salt had been made available on the experimental area in 1953 and it was by far the longest period of time that an individual deer was observed to be active about a salt station without extended interruptions. The field notes follow:

6:00 p.m. Took up position in the tree platform overlooking the salt station.

6:15 p.m. First deer activity observed; two were feeding at about 125 yards, moving diagonally in front of station.

6:25 p.m. Two deer now to the north of the station about 100 yards distant ... moved out of sight.

7:35 p.m. Sighted single, adult deer approaching station along trail from northeast. This deer was

probably a buck.

7:40 p.m. This same deer came directly up to the station, stopped about five feet away, looked around and seemed to check the air for strange scents and then abruptly moved to the salt platform and began licking on the screened control block. This end of the platform was toward the deer and it made no effort to shift around or check the other block. The deer did not change its stance. After a few preliminary licks over the screen, it concentrated its licking at the end of the screened control block near the end of the platform. The control block was apparently close enough to the screen that the deer could reach the salt with its tongue.

7:56 p.m. Heard another deer moving in vicinity. It snorted three times.

8:01 p.m. This second deer moved up the same trail as was taken by the deer licking at the salt platform.... paused for a moment, then jumped over a log and moved up toward the second deer to chase it away. This action was not violent and no contact was made. The first deer immediately returned to licking the control block while the second deer jumped back over the log, a distance of about 15 feet from the station, and looked on....

8:04 p.m. The second deer moved up again, but the first deer chased it away a second time and immediately

returned to licking the control block, paying no more attention to the second deer.

8:15 p.m. The second deer had moved around and approached platform from the opposite direction, but was again chased away. The first deer was observed to raise a forefoot as if to strike, as it moved toward the other deer, but no contact was made.

8:18 p.m. The second deer again approached and the performance was repeated; there was absolutely no hesitancy on the part of the first deer to move out. The second deer turned and moved away as soon as the first left the platform.

9:15 p.m. The deer at the platform discontinued its
9:25 p.m.
9:31 p.m. licking momentarily and turned away, but did not move more than a body length before it immediately turned and returned to the block. These movements were repeated two or three times at each time noted.

9:50 p.m. The deer at the salt station was apparently frightened by some sound that I did not detect. It leaped ahead a few steps, listened, then quickly returned to licking the control block.

10:08 p.m. At times indicated, the deer discontinued
10:10 p.m.
10:29 p.m. licking momentarily, turning as if to leave, but each time returned to the salt platform. When the animal swung its head back over the salt platform,

several times it swung directly over the exposed block, but it did not try to lick it.

10:30 p.m. The deer pawed dirt at base of the platform. By this time so much saliva had spilled out over the edge of the platform into the soil that there was probably some salt in it. It was impossible to distinguish whether or not the animal licked the soil, but it appeared to.

10:37 p.m. The deer turned away to leave, but again returned and this time it apparently discovered the exposed salt block for the first time. It immediately began licking vigorously and continued until 11:05 p.m.

11:05 p.m. The deer had apparently satisfied its desire for salt and moved away undisturbed.

The deer referred to in the extract from the field notes above was actively engaged in taking salt for a period of 205 minutes, discounting the brief intervals during which it was interrupted or turned away from the platform. Although the scales then in use could not detect the amount of salt consumed, inspection of the depressions left in the salt blocks indicated that some salt had been removed from both the screened control block and the exposed block. The total consumption was estimated to be approximately one ounce.

During the time the deer was at the salt platform

it interrupted its licking continuously to look and listen, staring and listening intently in one direction and then another. These interruptions were momentary and were seldom over 90 seconds in duration. The deer did not change its stance for long periods, either being disturbed or moving away as if satiated before changing position. This characteristic stance, the four legs slightly spread, the front legs extended forward, and the tense mannerism, is depicted in the frontis and is illustrated especially well in figure 11.

Fire Tower Cooperative Deer Salting Study

Excellent cooperation of the U. S. Forest Service personnel engaged in this study was realized. Data from eight of the nine stations were complete and suitable for use in comparing salt consumption on a regional basis. Results have been tabulated in table VIII.

In analyzing the results by districts, far greater utilization in the Fort Rock ranger district precludes strict comparisons with results obtained in the Sisters ranger district. In the Fort Rock district, 5,078 deer days of use were recorded as compared to 535 days of use in the latter. Salt consumption per deer month was determined to be 5.55 ounces or 0.35 pound in the Sisters district and 8.66 ounces or 0.54 pound in the Fort Rock

Figure 11. Typical stance assumed by mule deer while taking salt. Salt station located at the China Hat Well guard station. September 4, 1953.

TABLE VIII

SUMMARY OF DEER SALT CONSUMPTION DATA OBTAINED FROM FIRE LOOKOUTS IN THE SISTERS AND FORT ROCK DISTRICTS OF THE DESCHUTES NATIONAL FOREST

Inclusive dates observations obtained (1953)	Station	Deer Days Use	Deer Weeks Use	Deer Months Use	Net Salt Consumption (Ounces)	Net Salt Consumption (Pounds)	Net Salt Consumption Per Deer Month (Ounces)	Net Salt Consumption Per Deer Month (Pounds)
Salt Consumption per Deer Month. Sisters District.								
June 7 to August 26	Abbot Butte LO	183	26.14	6.10	32	2.00	5.25	0.33
July 4 to August 24	Cache Mtn. LO	107	15.28	3.57	32	2.00	8.96	0.56
July 4 to August 24	Trout Creek LO	245	35.00	8.17	35	2.19	4.28	0.27
Totals for district		535	76.42	17.84	99	6.19	5.55	0.35
Salt Consumption per Deer Month. Fort Rock District.								
June 19 to August 27	East Butte LO	231	33.00	7.70	127	7.93	16.49	1.03
June 19 to August 28	Spring Butte LO	556	79.43	18.53	136	8.50	7.34	0.46
July 10 to August 10	Jones Well GS	807	115.3	26.9	224	14.0	8.33	0.52
June 19 to August 30	China Hat Well GS	3484	497.71	116.13	979	61.19	8.43	0.53
Totals for district		5078	725.44	169.26	1466	91.62	8.66	0.54
Totals for both districts		5613	801.86	187.10	1565	97.81	8.36	0.52

district. These results were based on salt consumption totaling 6.19 pounds and 91.62 pounds in the Sisters and Fort Rock districts respectively. Since nearly 70 per cent of the use in the Fort Rock district was recorded at the China Hat Well guard station, consumption in this district was also computed on the basis of data recorded at the three stations showing deer use closely paralleling that obtained in the Sisters district. Use at the East Butte lookout, Spring Butte lookout and Jones Well guard station totaled 1,594 deer days or 53.13 deer months; resulting in an average consumption rate of 9.17 ounces or 0.57 pound per deer month at these stations.

No consistent trends in salt consumption were revealed at three stations in the Sisters district, although Cache Mountain lookout recorded much reduced usage in August as compared to July. Consumption in August was 0.21 pound per deer month as compared to 1.21 pounds per deer month in July. This was based on a total consumption of 6.19 pounds of salt over 17.83 deer months of use.

Results obtained in the Fort Rock district did not reveal significant trends in salt consumption. Reduced demands were recorded in August at the Spring Butte and East Butte lookouts, but increases in the consumption per deer month were noted at the Jones Well and China Hat Well guard stations. However, because of the smaller number of

deer visiting these two lookout stations, it is reasonable to expect that their estimates of deer numbers were more precise. Accordingly, a downward trend in salt consumption with progression of the season may also have taken place in this district.

Results obtained by this method in 1953 showed greater salt consumption per deer month at four stations in the Fort Rock district than at the three stations located in the Sisters district. Barron (1, pp.44-45) in analyzing data collected from most of the same stations in 1952, obtained similar results. He found an average salt consumption of 0.18 pound per deer month in the Sisters district, whereas an average of 0.34 pound was evident in the Fort Rock district. His results were based on 1.6 pounds of salt consumption in 9.25 deer months of use at two stations in the Sisters district and 30.8 pounds of salt consumption in 93.25 deer months of use at three stations in the Fort Rock district.

Too much reliance cannot be placed on results in 1953 because of a certain shortcoming in the method. This was the observer's inability to census accurately the number of deer using the station. This was particularly true of the two guard stations that showed extremely heavy usage and necessarily made the computation of deer months usage at these stations subject to considerable error. Also,

the limited number of observations obtained restricts inferences that may be made in regard to deer salt consumption on the two areas.

Notwithstanding, results obtained during 1953 seem to substantitate the observations made by Barron in 1952; namely, that a lower salt demand does exist in the Sisters district as compared to the Fort Rock district. He suggested that the salt consumption differences encountered on the two widely separated areas may have resulted from differences in precipitation. He pointed out that precipitation in the Fort Rock district during the period April to September was only one half that of the Sisters district during the same period.

Determination of Deer Numbers

Deer Trend Counts

Results of the track counts are tabulated in table IX and are illustrated graphically in figure 12. The number of crossings recorded ranged from 228 on the initial count made on April 20, 1953 to 40 crossings recorded on the final count tallied on September 7, 1953. Averages of the weekly counts, representing the total number of crossings recorded following one night's period of track accumulation, for each month were April 228, May 177, June 155, July 132, August 81, and September 43. Although the

TABLE IX

DEER TRACK COUNT DATA SHOWING POPULATION TRENDS ON THE EXPERIMENTAL AREA

Date (1953)	Number of Crossings	Average Number of Crossings per Month
April 20	228	
April 27	(count not made)	April 228
May 4	221	
May 11	120	
May 18	175	
May 25	191	May 177
June 1	117	
June 8	148	
June 15	117	
June 22	238	
June 30	154	June 155
July 6	157	
July 13	145	
July 20	113	
July 27	112	July 132
August 3	54	
August 10	99	
August 17	92	
August 24	78	August 81
September 1	46	
September 7	40	September 43
TOTAL	2645	Average 132

number of observations used to determine monthly mean crossings were not the same, a downward monthly trend was clearly indicated. Maximum activity occurred during April, May, and June, the maximum number of crossings (238) being recorded on June 22, 1953. Notwithstanding the shortcomings of this method, a significant difference between the number of crossings recorded in the initial

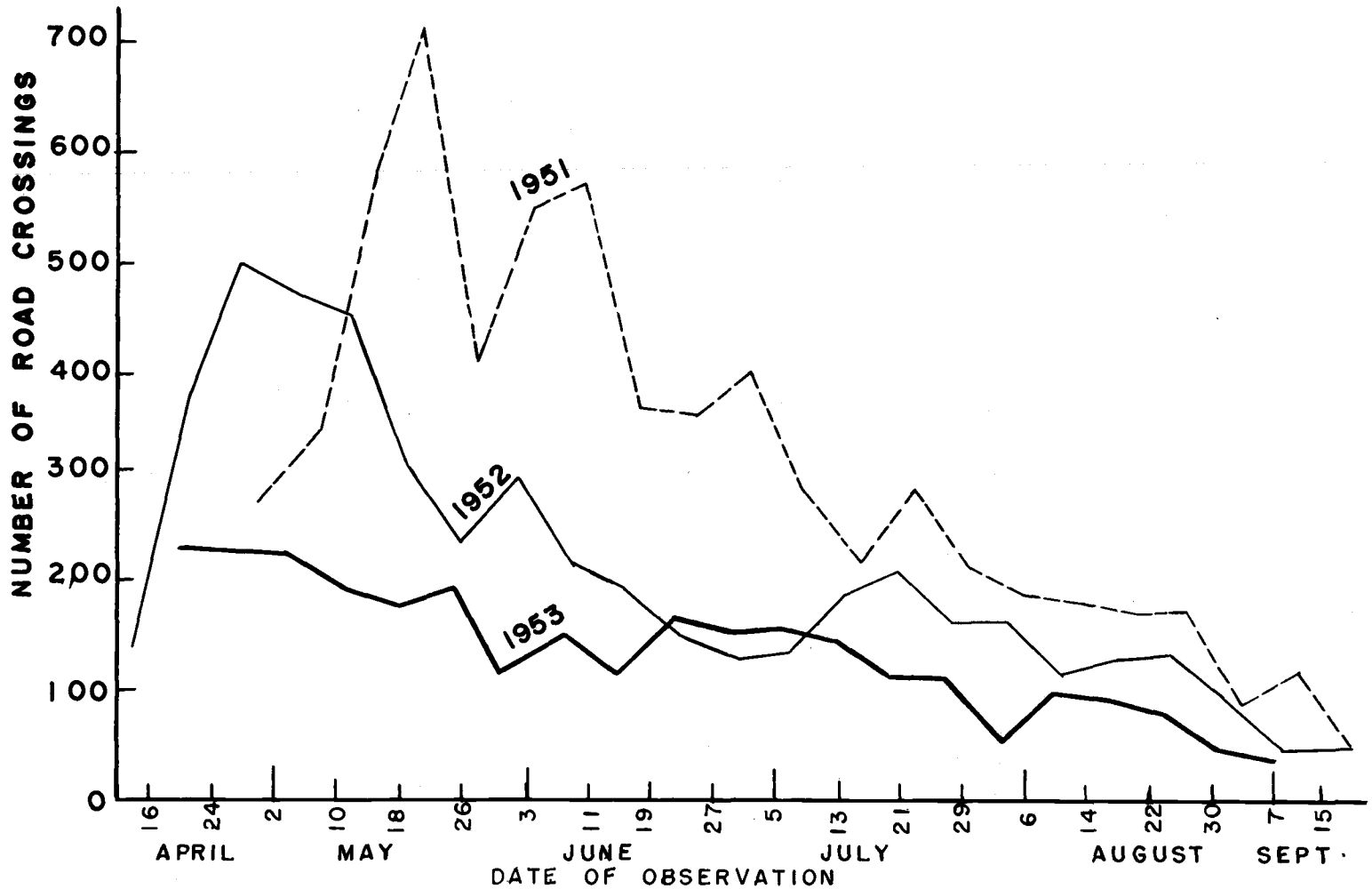

Figure 12. Deer population trends on the experimental area for 1951, 1952 and 1953.

and final period of observation did take place.

Deer track count data obtained during 1951 and 1952, as taken from Barron's report (1, pp.47, 50-51), showed a greater number of crossings, particularly in 1951 when track counts ranged from 269 on the initial count on April 30, 1951 to a peak of 698 recorded on May 21, 1951. In 1952, track counts again ranged upward following the initial count on April 14, to a peak of 487 on April 28. The average number of crossings recorded were somewhat lower in 1952 than were obtained in 1951, an average of 307 crossings were recorded in 1951 as compared to an average of 211 in 1952, but peak numbers in 1952 were still more than two times as large as maximums recorded in 1953. The average number of crossings determined by track counts in 1953 were 132. The downward trend in deer numbers with advancement of the season, as shown in figure 12, was also clearly evident in both 1951 and 1952.

The index to deer numbers derived by this method, under conditions existent on the experimental area in 1953, was not considered to be sufficiently accurate to indicate small fluctuations in deer numbers. As used, it was assumed that the number of crossings were proportional to deer numbers occupying the area irrespective of weather influence on deer movements, that the period of track accumulation was constant, and that all new crossings were detected. All three assumptions were considered

deficient, particularly the latter, as average tracking conditions since the initial count were not optimum, but were considered only fair. It was estimated that a variation of plus or minus 20 per cent existed between the actual number of crossings and the number of crossings recorded. Thus, the deer trend count, as an index to deer numbers, was not entirely satisfactory for the purpose intended, because weekly variations were of such magnitude that a possible direct relationship between deer numbers and salt consumption was obscured.

Recent work with deer track counts by Tyson (36, pp.3-15), working with the whitetailed deer, Odocoileus virginianus ssp., in Florida indicate that it may be developed into a total census method. Procedures followed in enumerating the tracks were similar to those described in this paper. In Tyson's study, systematic track counts were started in July 1950 and were continued during July and August for three years. Analysis of results were based on two assumptions. (1) Deer usually return to the same general location to spend the day and (2) nightly activity of deer is confined to about one mile daily range of travel. It was determined that the population density, in deer per square mile, was equal to the number of tracks per mile divided by the average daily range expressed in miles. A formula was developed to

determine total August adult populations. The accuracy of the method was checked by a drive census carried out during February, 1952, and a check on the drive was accomplished by track count methods during the following summer. The drive counts showed slightly less deer and the track check of drive areas indicated more deer than were calculated by the summer track count census method.

This method might have been satisfactorily employed on the experimental area to determine total deer numbers. Modifications might have been necessitated, in view of the different species of deer and the different habitat involved. In any event, future studies of deer salt consumption should not overlook consideration of the application of this new census method to determine deer numbers.

In summation, it has been shown that the measurement of salt use by mule deer involves two primary considerations: one, an accurate determination of the number of deer occupying a given area (on which salt stations have been established) or using a specific salt station; and two, an accurate measurement of the salt consumed. These two considerations are of equal importance. Salt consumption can be accurately measured, as was indicated in the preceding section. Thus, the limiting factor remaining is the inability to determine

deer numbers with equal accuracy.

Salt Consumption by Domestic Animals

Salt Consumption by Cattle at the Lundgren Ranch

Through the cooperation of the ranch manager, arrangements were made to provide cattle with half ground salt on this ranch, in 1953, in place of the salt in block form used during 1951 and 1952. This was done to determine whether or not the actual demand for salt was below normal. In 1951, salt consumption per animal unit month had been 0.74 pound and in 1952 it had been 0.62 pound, as determined by Barron (1, pp.53-54).

Between June 6, 1953 and September 2, 1953, 1284.30 pounds of half ground salt were used by cattle; this group was comprised wholely of steers. Total weight loss, computed by a procedure similar to that described under salt consumption results from higher elevation stations, was computed at 52.46 pounds. The net salt consumption amounted to 1231.84 pounds and occurred over 558 animal unit months' use, or 2.21 pounds net salt consumption per animal unit month was recorded. A summary of this information is contained in appendix B. Analyzing the data further, it may be noted that stocking rates varied from 41 to a peak of 267; this latter number was maintained from July 21, 1953 to August 25, 1953. Net,

weekly salt consumption per animal unit month ranged from 3.99 pounds during the initial ten day period, June 6, 1953 to June 16, 1953, to 1.11 pounds during the week of August 11, 1953 to August 18, 1953. Stocking rate data and animal unit's use were computed to show actual grazing time and for this reason, two short intervals when salt was not available have been disregarded in the computation. No salt was available to 222 head on July 24-25, 1953 and again on August 17-20, 1953, but it was believed that the increased consumption, subsequent to being deprived of salt did not materially change the rate of salt consumption. This failure to maintain salt constantly available and disturbances resulting from switching stock between pasture subdivisions were probably the determinant influences in the variable, weekly salt consumption rates recorded.

At the Lundgren Ranch in 1951 and 1952, Barron (1, pp.53-54) obtained net salt consumption rates of 0.74 pound per animal unit month and 0.62 pound per animal unit month respectively. In both years salt was supplied in the block form. In 1951 plain white salt was supplied and in 1952 a mixed variety was made available. In this latter case, necessary corrections were made to permit determinations of net salt consumption.

Cattle and horses utilized the salt in 1951 and

consumed a total of 236.3 pounds of salt in 321 animal unit months of use, during the period June 6, 1951 to September 21, 1951. In 1952, 263.8 pounds of salt were consumed in 437 animal unit months use, during the period April 24, 1952 to September 19, 1952. Weathering loss, in both years, was determined by visual estimate at the time of weighing and was not included in the total consumption figures.

Salt Consumption by Cattle at the Black Butte Ranch

The gross amount of salt used during the period April 20, 1953 to August 31, 1953, was 1263.24 pounds. The total weight loss was computed to be 141.51 pounds and the resultant net consumption was 1121.73 pounds, which occurred over 1196.63 animal unit months of use. Net consumption per animal unit month was 0.94 pound. A summary of salt consumption and stocking rate data is contained in appendix C. The ranch was stocked entirely with cattle, about half of which were steers. Stocking from April 20, 1953 to May 24, 1953 consisted of 32 yearlings. This stock was removed on the latter date and on May 21, 1953, 285 head of steers, about equally divided between yearlings and 2-year olds, were added to one large pasture unit on which they were held until August 31, 1953. On May 24, 1953, 58 cows with 56 calves were added to

other ranch pastures, increasing the stocking to 343 animals. The calves were not considered in computing consumption data since it was assumed that their salt demands would be satisfied by their dams. This stocking remained unchanged throughout the remainder of the study period.

Results must be qualified by the fact that the entire salting program was not handled directly by the ranch manager. A party that had leased a large pasture which was stocked with 285 head handled most of the salt placement on this pasture. Thus, a reported consumption of 300 pounds of salt, occurring between May 21, 1953 and June 8, 1953, was not actually weighed, but subsequent inspection of the salting stations indicated that the salt had been consumed. Primarily for this reason, salt consumption was recomputed for the period June 8, 1953 to August 31, 1953. Gross salt usage during this period amounted to 867.36 pounds. Weight loss was computed at 59.92 pounds; the resultant net consumption amounted to 807.84 pounds. That amount of salt was consumed over 960.40 animal unit months' usage, during which stocking remained constant at 343 head. The net salt consumption was 0.84 pound per animal unit month, or 0.10 pound less than the overall salt consumption rate.

Inspection of weekly salt consumption rates,

subsequent to June 8, 1953, as shown in appendix C, indicates that a downward trend in salt consumption probably occurred with advancement of the summer. Variability in weekly consumption figures was probably largely due to the fact that salt was not constantly available at all stations in the large pasture. The recorded salt consumption subsequent to June 8, 1953 ranged from 1.10 pounds per animal unit month during the week of June 8, 1953 to June 15, 1953, to 0.48 pound per animal unit month during the week of August 24, 1953 to August 31, 1953.

Results obtained by Barron (1, pp.54-55) on this same ranch in 1951 and 1952 showed a considerably lower consumption rate. In 1951, 600.3 pounds of salt were consumed in 902 animal unit months of use, resulting in an average of 0.66 pound consumption per animal unit month. In 1952, 948.3 pounds consumption was recorded in 1,761 animal unit months' use, resulting in an average consumption of 0.54 pound per animal unit month. A mixed variety of block salt had been supplied in both years. Necessary correction factors were applied and weathering losses were deducted from listed results.

In analyzing results obtained from both ranches, during the three years of the study, wide differences in average salt consumption per animal were apparent. In

the three years of the study, stocking at both ranches was not uniform, but no attempt was made to weight the results according to the stocking or the age of the animals present. Consumption results could not be segregated into adults and yearling classes, although variation in salt demand may be influenced by the size, age, and sex of the individual animal. Thus, differences noted in 1951 and 1952 may be attributed to variations resulting from differences in stocking rates, animal age classes, and to seasonal climatic differences. The greatly increased salt consumption recorded at the Lundgren Ranch in 1953 can unquestionably be attributed to the use of half ground salt. No explanation is apparent for the sizable increase in per animal consumption obtained at the Black Butte Ranch in 1953.

Salt Consumption by Horses and Deer at the Circle-M Ranch

Salt totaling 243.75 pounds was used in 73.57 horse months of use plus an undetermined amount of deer use, during the period April 22, 1953 to September 2, 1953 at the Circle-M ranch. The total weight change was computed at 18.87 pounds and the net consumption recorded was 224.88 pounds. Salt consumption and stocking rate data is shown in appendix D. Based entirely on the known horse usage, average net salt consumption per animal unit month was

determined to be 3.06 pounds. Stocking rates were variable, particularly during the first six weeks, because of frequent shifting of the stock. From June 2, 1953 to August 25, 1953, stocking remained constant, with the exception of one change. On August 25, 1953, 20 head of horses were added to the number already present, bringing the stocking rate to 39 animals. Available salt was completely used before the final weight measurements were recorded, producing a much lower weekly net consumption rate for the week of August 25, 1953 to September 2, 1953. For this reason, the salt consumption rate was recomputed to exclude data collected on and after August 25, 1953. Results thus obtained showed 225.16 pounds of salt used in 63.97 horse months' use. Total weight change was computed at 14.15 pounds; the resultant net consumption amounted to 224.88 pounds per month, or 3.30 pounds net salt consumption per animal unit month. Consumption data may have been altered by the fact that part of the horses were away from the ranch pastures on several occasions, for one or more days duration, during which time no salt was supplied them. A proportionately large amount of the total salt used had been consumed by deer. No attempt was made to estimate the total amount consumed by deer, nor was a deduction made for those periods when horses were removed from individual pastures, but salt still remained

available to the deer. An indication of the amount of salt that was consumed by deer was the 23.17 pounds of salt use recorded at the salt station on the Bailey Meadow, during the period June 23, 1953 to August 18, 1953. Gross consumption per week during this period is shown in appendix D under station number one. The last week's measurement was made precisely by replacement of the salt block formerly present with a five pound block fixed on the standard salt platform. Weight measurements were obtained with a triple beam balance. The trend in deer salt consumption, at this station, generally followed the trend in weekly deer salt consumption recorded at station number three that was located about one-quarter mile to the east. Both stations were located on the experimental area. Deer utilized the salt in competition with horses at the three other stations, but observations indicated that deer use was probably greatest at station number one, on the Bailey Meadow. Thus, it is readily apparent that the salt consumption per horse month was actually much lower than the figure indicated. It was probably about half the computed rate of consumption, or approximately 1.5 to 2.0 pounds per animal unit month.

Repeated observations indicated that the deer took salt freely while the horses were present in the pasture, and that they took salt more frequently at night, whereas

the horses satisfied their wants mainly during the daylight hours. The characteristic sign of deer salt usage was noted at all salt stations used exclusively by deer. It facilitated distinguishing between deer usage and cattle and/or horse usage on salt blocks in common usage. Deer licking a salt block left relatively small, cup-shaped tongue depressions as compared to the wide depressions produced by cattle and horse use. This condition is illustrated in figure 13.

In 1952, Barron (1, p.58) obtained results of 2.6 pounds consumption per horse month at the Bailey Meadow, but no records were obtained in 1952 at other pastures operated by the Circle-M Ranch, which were under essentially similar conditions of combined horse-deer usage. Computations were again based entirely on known horse usage and the amount of salt consumed by the deer was disregarded. Total consumption in 1952 was 50.5 pounds (1, pp.36-39) during the period June 2, 1952 to September 19, 1952, and occurred in 16 horse months plus an undetermined number of deer months use. Similar evidence of heavy salt use by deer was noted. During the period July 18, 1952 to August 18, 1952, 8.9 pounds of salt were used by deer while no horses were present in the Meadow.

The actual salt consumption rate of the horses was

probably about the same in both 1952 and 1953 and if a significant increase did exist in 1953, it probably resulted from increased deer salt consumption, which followed the increased consumption recorded on the experimental area.

Salt Consumption by Sheep at the Cake Ranch

Between the successive date of May 26, 1953 to September 18, 1953, 830 pounds of half ground salt were used by a band of 575 sheep. The herd consisted of 295 head of ewes plus 280 lambs. The lambs were not considered in computing the total sheep month's of use, since it was assumed that their salt demand would be supplied by their dams. Total salt-weight loss, due to weathering, was computed at 98.7 pounds; the resultant net consumption was 731.3 pounds over 1034 sheep months of use, or an average net salt consumption per animal unit month of 0.71 pound. Stocking remained constant until August 1, 1953. A change in the stocking was made on that date by the removal of 65 ewes. The remaining units of usage were based on a stocking of 230 ewes.

Salt Consumption by Sheep on the First Creek Grazing Allotment

Three thousand pounds of plain white, half ground

salt were consumed by a band of 2,200 sheep during the period June 1, 1953 to September 1, 1953. This band was grazed on the Spring Creek grazing allotment, located to the east of the experimental area, from June 1, 1953 to July 7, 1953, and the remainder of the time was spent on the First Creek grazing allotment. The band consisted of 1,100 head of ewes plus 1,100 head of lambs. The lambs were not included in computing the consumption rate. Consumption per animal unit month was 0.89 pound, occurring over 3,377 sheep months of use. Salt was not constantly available and consumption was arbitrarily limited by the herder who distributed a 50-pound sack of half ground salt on the bedding grounds, daily or at two day intervals. Thus, consumption might have been higher had the sheep been provided with all the salt that they would consume.

In 1952, Barron (1, p.56) reported a consumption rate of 0.30 pound per animal unit month, based on a band of 2,600 ewes and lambs ranging on these same allotments during the period May 20, 1952 to October 20, 1952. Two thousand pounds of salt were consumed by 1,200 adult ewes over 6,160 animal unit months' use. The lambs were not considered in computing the total sheep months of use, since it was assumed that they made no definite salt demand. The wide difference in salt consumption between

1952 and 1953 was very likely due to more salt being made available and in turn consumed in 1953.

Analysis of Domestic Animal Salt Consumption Data

Since the salt consumption standards given by Mitchell (25, p.74) were the best available, they were used as a basis for analyzing the salt consumption by cattle, horses and sheep obtained in the Metolius area in 1953. At the outset, these standards should be qualified in order that strict comparisons will not be made or that the consumption figures given by Mitchell will not be considered as absolute. Mitchell, in listing the figures, which represent ad libitum consumption of salt, has stated that many variable factors influencing consumption discount the practical value of any estimates of salt consumption. Mitchell's data were taken from Morrison, who in turn had used original data compiled by Hensel, and Chapline and Talbot. The two reports were compiled in 1921 and 1926 respectively. The figures given by Mitchell were largely taken from Hensel's work done at the Kansas Agricultural Experiment Station. A complete tabulation of these standards were listed by Barron (1, p.59).

The standards for cattle ranged from 1.8 to 7.5 pounds per head per month and for steers on pasture ranged from 1.2 to 2.4 pounds per head per month. Average salt

consumption at the Lundgren ranch was 2.21 pounds per animal unit month for steers fed half ground salt while on irrigated pasture, which falls within the range given for steers while on pasture. Salt consumption at the Black Butte ranch was determined to be 0.84 pound per animal unit month, or slightly below the lower range limit given for steers on pasture. However, it must be considered that cattle comprised more than half of the total animal units on this ranch. The standard consumption figures for cattle range much higher than for steers and accordingly the results pointed to consumption measurably below listed standards. The wide difference between the salt consumption on the two ranches was apparently due to the difference in the form in which the salt was supplied. The cattle consumed more half ground salt than salt in the block form. In addition, as pointed out under the preceding discussion of results obtained at the Black Butte ranch, salt was not constantly available at all the salt stations at this ranch throughout the study period.

The standards given for horses range from 3.3 to 3.75 pounds per head per month. At the Black Butte ranch the salt consumption, determined by basing animal unit months use entirely upon known horse usage, was 3.06 pounds per animal unit month. But when an allowance was

made for deer salt intake, the actual salt consumption for the horses was estimated to be somewhere between 1.5 to 2.0 pounds per animal unit month. Thus, the 1953 results on the study area were somewhat lower than listed standards.

The standards given for sheep, specifically for pregnant ewes, were 0.78 pound per head per month. In 1953 results obtained from ad libitum consumption by sheep on the irrigated pastures of the Cake ranch were 0.71 pound per animal unit month. Consumption by sheep on the First Creek grazing allotment was 0.89 pound per animal unit month. Thus, results were very similar to standards developed in other regions.

Interpretations of this salt consumption data must be further limited when due consideration is given the factors that influence salt consumption by domestic animals. Stanley (33, pp.143-145) stated that evidently the composition of forage, the amount of feed available, and climatic conditions have a distinct influence on the amount of salt actually consumed by cattle.

In conclusion, the paucity of literature pertaining to average domestic animal salt consumption precludes any statements as to the relative salt consumption by domestic animals in the Sisters district of central Oregon. It may merely be stated that recorded salt

consumption figures for all domestic animals on cooperators' ranches in 1953 fell within the range of available salt consumption standards and were generally higher than figures recorded in the same area in 1951 and 1952.

Deer competition with livestock for salt during 1953 did not present a serious problem. On the two ranches where salt consumption data on cattle was obtained and at the one ranch where salt consumption data on sheep was obtained, no significant salt intake occurred by deer. Small numbers of deer were observed on each of these ranches in several instances, but inspection of the salt blocks did not reveal any discernible deer usage, as indicated by tracks or by the characteristic depressions formed by deer licking the salt block. At the Circle-M ranch, a minor problem did exist as a result of the proportionately large amounts of salt consumed by the deer. This was probably brought about by the location of the ranch pastures on ranges already occupied by deer.

SUMMARY AND CONCLUSIONS

An investigation of salt use by mule deer was conducted on the Deschutes National Forest of central Oregon during the spring and summer of 1953. This was the third successive year that measurements were obtained in this area to determine salt consumption per deer month

and to learn the extent of deer-livestock competition for salt. A second objective was to observe the influence of salt upon deer distribution in order to evaluate its usefulness as a management technique.

Quantitative deer salt consumption data were secured from a series of salt stations located at two levels on the summer range of the Metolius deer herd. Salt weight measurements were accomplished at weekly and biweekly intervals and individual control salt blocks were utilized to enable precise correction for weight changes due to weathering. The computed net salt consumption was correlated with a deer population index. Deer population trend data were obtained by weekly track counts on a road bisecting the experimental area, in order that changes in the relative, seasonal salt consumption could be detected. For a short period at the outset of the study, daily deer salt utilization measurements and estimates of numbers were secured at stations on the experimental area to calculate salt consumption per deer month. Many direct observations were made of deer taking salt at several stations throughout the course of the investigation to study deer behavior and to learn the amount of salt consumed per deer visit. A cooperative study with U. S. Forest Service personnel was designed to obtain measurements on salt intake per deer month from a wider

area. Domestic animal salt consumption data were obtained from several cooperating ranches near the main deer study area to permit comparison with recorded standard livestock salt utilization figures.

The literature was reviewed and includes a summary of the big game salting programs in all the western states and the Province of British Columbia. The study areas were briefly described and limited descriptions of the Metolius deer herd and the location of its summer and winter ranges are given.

Sizeable quantities of salt were readily consumed by the Metolius deer herd. In 1953, 214.11 pounds of salt were used at the 12 salting stations on the experimental area. The salt loss due to weathering was 23.74 pounds and the resultant net utilization by deer was 190.37 pounds. The seasonal trend in salt consumption was consistently downward, with 69 per cent of the total measured consumption occurring during the first half of the study period. Deer population trends as determined by the track count were closely correlated with the downward trend in salt consumption. The monthly mean number of road crossings extended from a peak of 228 in April to the low September average of 43. It was concluded that no seasonal change in the rate of deer salt use took place. Barron noted this same general pattern

of salt intake and deer population trend relationships in 1951 and 1952.

Total salt consumption has increased each year since the study was initiated, with nearly four times as much salt being consumed on the experimental area in 1953 as in 1951. It appears reasonable to conclude that salt consumption per individual deer is increasing on this area. Increased salt use seems to be result of an acquired taste. It was concluded that sufficient salt is contained in natural deer foods to meet nutritional requirements and that the deer do not require supplemental salt.

Twenty-two salt stations were established at higher elevation sites, directly west of the experimental area, to learn whether or not seasonal changes in salt utilization occurred. Results showed that salt consumption at the higher elevations on the main study area increased concurrently with the decrease in both salt consumption and deer numbers on the experimental area. In considering salt use data collected from both the experimental area and the higher elevation salt stations, evidence points to a continued shift in deer distribution, a progressive infiltration into the higher portions of their summer range, irrespective of salt availability.

A qualitative method was used to determine salt

consumption per deer month by estimating the numbers of deer visiting individual stations on the experimental area. The average number of deer visiting the 12 stations during the ten day period in April was about 60 per day. During this interval the gross salt usage was 20.86 pounds, weathering loss was 0.80 pound, and the resultant net consumption was 20.05 pounds. In this experiment salt consumption amounted to about one pound per deer month.

A figure for the average amount of salt consumed per deer visit was obtained by direct observation of deer licking salt at stations on the experimental area and other location. Thirty-six deer or 38 per cent of the 130 deer observed actually took salt directly from the salt blocks. Their combined time spent taking salt was 422 minutes, during which time they consumed 254 grams of salt, or 0.56 pound. The amount of salt taken per average deer visit of 11.7 minutes was 7.06 grams or one-quarter ounce. About twice this amount was observed consumed per visit in 1952. No seasonal fluctuations in deer salt consumption were observed by this method. A field note was presented to illustrate deer behavior in the presence of a salt station.

Mule deer salt utilization data from a wider area and information on regional differences in this factor

showed greater salt use per deer month at four stations in the Fort Rock district than at three stations in the Sisters district. Salt consumption per deer month was determined to be 0.35 pound in the Sisters district as compared to 0.54 pound in the Fort Rock district. Barron, in analyzing data collected from most of the same stations in 1952, obtained similar results.

Salt consumption per animal unit month for steers supplied with half ground salt on the Lundgren ranch was 2.21 pounds. For cattle supplied with block salt on the Black Butte ranch, utilization was 0.84 pound per animal unit month. Data on the salt intake of two bands of sheep were computed at 0.71 and 0.83 pound per animal unit respectively. Computed consumption rates fell within the range of standard salt consumption figures, with the exception of the lower salt intake on the Black Butte ranch, but were higher than results obtained at most of the same ranches in 1951 and 1952. Combined deer-horse salt utilization was observed on one ranch. Proportionately large amounts of salt were consumed at this ranch by deer and constituted a minor problem. With this exception, deer did not compete with domestic animals for salt on the ranches where measurements were obtained.

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APPENDICES

APPENDIX A

INSTRUCTIONS APPENDED TO EACH NOTEBOOK USED BY LOOKOUT OPERATORS TO RECORD SALT USE DATA

Oregon Cooperative Wildlife Research Unit Fire Tower Cooperative Deer Salting Program

Instructions for Recording Salt Use Data:

I. Minimum observations

1. Record daily, the number of individual deer sighted in the immediate vicinity of the lookout tower.

2. Estimate the average number of deer that were in the immediate vicinity of the lookout each week and record each Monday in the space provided.

3. Weigh the exposed block and the control block on Monday of each week, regardless of deer use or lack of use, recording weights on the attached form. Extreme care must be exercised to obtain accurate weight measurements with the scales provided. It is recommended that the salt block be placed on the scale repeatedly until two identical successive readings are obtained--noting that the indicator hand returns to zero each time the block is removed. Weights should only be recorded to the nearest ounce.

II. Additional observations

1. Record the number of minutes spent at the salt

block by an individual deer while engaged in taking salt. No attempt need be made to compensate for the time that the animal's attention was diverted from the salt block or for brief intervals that it turned away from the block. Following is an example of the method to use in recording this type of observation: (1) Date: 7 July, 1953, (2) Age and sex of animal: 4-pt buck or adult doe, etc., (3) Total number of minutes spent at the salt block: 22 minutes, (4) Time: 8:30 pm to 8:52 pm (the time the deer began taking salt- 8:30 pm -to the time it left the salt block- 8:52 pm).

2. Daily salt weight measurements where the number of individual deer taking salt has been recorded. Also, if a group of 4, 5 or more deer regularly take salt in either the morning or evening period, a before and after salt weight measurement would provide useful data on consumption per individual animal (on which information is decidedly limited).

3. Where it is possible to identify positively an individual deer by some physical characteristic, etc., a record of the number of times this animal takes salt during the week would be particularly important information. This type of observation should be recorded as in the following example: (1) Age and sex of animal: 2-pt buck, (2) Identifying characteristic: white patch on

left hind quarter, (3) Date and time: 7 July, 8:46 am to 8:55 am; 3:39 pm to 3:51 pm. 8 July, 7:40 pm to 8:01 pm. 9 July, 8:05 am to 8:09 am; 12:15 pm to 12:21 pm etc.

4. Observations of other animal species taking salt, as for example a porcupine. Records of observations of this nature should include data as pertinent to observations of deer taking salt, reference paragraph 1.

5. Observations of deer behavior at the salt station: Did the deer take water before or after taking salt or not at all (where applicable)? Did adult animals and larger animals show dominance over smaller animals at the salt station? Did individual deer or an identifiable group of deer take salt at a regular period each day? What was the response of the deer to inclement weather conditions, i.e. did this affect their visits to the salt station? These and many similar observations of deer behavior would be helpful and interesting. Records of this type of observation should include: date, time, kind and number of animals involved, followed by a brief description of the behavior observed and, when applicable, a note on weather conditions.

APPENDIX B

SALT CONSUMPTION AND STOCKING RATE DATA FROM THE LUNDGREN RANCH

Date (1953)	Salt Station Numbers											
	1	2	3	4	5	6	7	8	9	10	11	12
6 June												
16 June	46.50	11.00										
23 June		17.75	17.00									
30 June		43.00	15.00	41.50								
7 July		46.87	12.50	18.50								
14 July		46.88	10.75	35.00								
21 July			18.00	21.50	47.50	42.50						
28 July			13.00	25.50	12.75	28.00	45.00	35.25	6.75			
5 August	8.00		11.50	29.50				64.75	43.25			
11 August	1.37		9.00	22.00				30.75	14.75	28.75	20.75	
18 August			10.75	21.00				19.25	18.75			
25 August			10.05	19.55	50.24	33.29	32.30					
2 September			13.45		17.64			29.20	52.96			13.50
TOTALS	55.87		141.00		128.13		77.30		136.46		20.75	
		165.50		234.05		103.79		179.20		28.75		13.50

COMPLETE TOTAL 1284.30

APPENDIX B--continued

Date (1953)	Total Gross Wt. Salt Used (Pounds)	Total Wt Change (Pounds)	Total Net Wt. Salt Consumed (Pounds)	Stocking Rate	Animal Days of Use	Animal Weeks of Use	Animal Months of Use	Net Salt Consumption per A.U.M. (Pounds)
6 June								
16 June	57.50	3.00	54.50	41	410	58.57	13.67	3.99
23 June	34.75	0.62	34.13	41, 56	527	75.29	17.57	1.94
30 June	99.50	⁄1.15	100.65	101, 131, 141	937	133.86	31.23	3.22
7 July	77.87	2.63	75.24	141, 142, 157	991	141.57	33.03	2.28
14 July	92.63	0.23	92,40	142, 157, 173	1070	152.86	35.67	2.59
21 July	129.50	0.48	129.02	173, 191, 209 225	1435	205.00	47.83	2.70
28 July	166.25	⁄0.34	166.59	267	1869	267.00	62.30	2.67
5 Aug.	157.00	⁄0.65	157.65	267	2136	305.14	71.20	2.21
11 Aug.	127.37	5.06	122.31	267	1602	228.86	53.40	2.29
18 Aug.	69.75	0.67	69.08	267	1869	267.00	62.30	1.11
25 Aug.	145.43	--	145.43	267	1869	267.00	62.30	2.33
2 Sept.	126.75	41.91	84.84	267, 253	2024	289.14	67.47	1.26
TOTALS	1284.30	52.46	1231.84		16739	2391.29	557.97	2.21

APPENDIX C

SALT CONSUMPTION AND STOCKING RATE DATA FROM THE BLACK BUTTE RANCH

Date (1953)	Salt Station Number									
	1	2	3	4	5	6	7	8	9	10
20 April										
27 April	4.00									
4 May	1.87									
11 May	4.75									
18 May	4.00									
25 May	12.75	5.88	6.25		10.00**	10.00**	10.00**	10.00**	10.00**	10.00**
1 June	17.00*	13.12	8.75		20.00**	20.00**	20.00**	20.00**	20.00**	20.00**
8 June	17.25	2.50	2.88		14.00**	20.00**	20.00**	20.88	20.00**	20.00**
15 June	20.12	4.50	14.37	1.25	6.00		27.50	21.87		8.75
22 June	24.13		4.25	1.12			19.00	21.13		9.25
29 June	18.00		3.75	0.63			3.50	6.12		20.50
6 July	6.50		9.75	4.50	16.62	15.00		30.75		11.50
13 July	18.50			7.75	13.63	21.25	4.25	19.75	4.50	8.00
20 July	16.87			14.00	8.13	13.75	3.75	3.75	10.25	9.00
27 July	10.51			8.62	9.37	0.75	8.25	0.00	7.13	7.75
3 August	8.49			2.00	13.12	3.75	3.63	5.50	6.37	6.50
10 August	12.38		11.75	6.50	12.88-	8.00	5.87	12.00	5.38	5.25
17 August	0.00	20.25			6.50	4.62	5.50	7.50	2.62	4.13
24 August		11.00			8.50	5.88	4.75	8.00	2.75	5.37
31 August		16.75			5.75	7.75	6.25	8.50	4.50	3.00
Totals	197.12	74.00	61.75	46.37	144.50	130.75	142.25	192.00	93.50	149.00
Totals	135.50	52.50	43.87	46.37	100.50	80.75	92.25	141.12	43.50	99.00

* by interpolation
** by estimation

APPENDIX C--continued

Date (1953)	Salt Station Number 11	12	13	Total Gross Wt. Salt Used (Pounds)	Total Wt. Change (Pounds)	Total Net Wt. Salt Consumed (Pounds)	Stocking Rate
20 April							
27 April				4.00	0.10	3.90	32
4 May				1.87	0.43	1.44	32
11 May				4.75	0.99	3.76	32
18 May				4.00	1.00	3.00	32
25 May				84.88	52.06	32.82	32, 317, 343
1 June				158.87	15.29	143.58	343
8 June				137.51	12.12	125.39	343
15 June				104.36	16.27	88.09	343
22 June				78.88	2.81	76.07	343
29 June				52.50	✗ 1.43	53.93	343
6 July				94.82	7.75	86.87	343
13 July				97.63	0.66	96.97	343
20 July				75.75	0.47	75.28	343
27 July				52.38	✗ 0.41	52.79	343
3 August				49.36	✗ 0.61	49.97	343
10 August	6.50			86.51	5.73	80.78	343
17 August	6.00			57.12	0.73	56.39	343
24 August	6.00	0.00	0.00	52.25	--	52.25	343
31 August	6.75	2.50	4.25	66.00	27.55	38.45	343
Totals	25.25	2.50	4.25	1263.24	141.51	1121.73	
CONSUMPTION FROM 8 JUNE TO 31 AUGUST							
Totals	25.25	2.50	4.25	867.36	59.92	807.84	

APPENDIX C--continued

Date (1953)	Animal Days of Use (Rate x 7)	Animal Weeks of Use	Animal Unit Months of Use	Net Salt Consumption per A.U.M. (Pounds)
20 April				
27 April	224	32.00	7.47	0.52
4 May	224	32.00	7.47	0.19
11 May	224	32.00	7.47	0.50
18 May	224	32.00	7.47	0.40
25 May	1390	198.57	46.33	0.71
1 June	2401	343.00	80.03	1.79
8 June	2401	343.00	80.03	1.57
15 June	2401	343.00	80.03	1.10
22 June	2401	343.00	80.03	0.95
29 June	2401	343.00	80.03	0.67
6 July	2401	343.00	80.03	1.09
13 July	2401	343.00	80.03	1.21
20 July	2401	343.00	80.03	0.94
27 July	2401	343.00	80.03	0.66
3 August	2401	343.00	80.03	0.62
10 August	2401	343.00	80.03	1.00
17 August	2401	343.00	80.03	0.70
24 August	2401	343.00	80.03	0.65
31 August	2401	343.00	80.03	0.48
Totals	35900	5128.57	1196.63	0.94
CONSUMPTION FROM 8 JUNE TO 31 AUGUST				
Totals	28812	4116.00	960.40	0.84

APPENDIX D

SALT CONSUMPTION AND STOCKING RATE DATA FROM THE CIRCLE-M RANCH

Date (1953)	Salt Station Number 1	2	3	4	Total Gross Wt. Salt Used (Lbs.)	Total Weight Change	Total Net Wt. Salt Consumed
22 April							
29 April	11.62				11.62	0.10	11.52
6 May	7.76				7.76	0.33	7.43
16 May	9.37				9.37	0.70	8.67
20 May	13.38				13.38	0.47	12.91
25 May	3.74				3.74	--	3.74
26 May	1.00				1.00	0.76	0.24
2 June	6.00				6.00	1.62	4.38
9 June	7.25	5.13			12.38	1.94	10.44
16 June	0.00	3.50			3.50	3.92	✓ 0.42
23 June	11.00	8.75		3.50	23.25	0.97	22.28
29 June	4.50	7.25		3.75	15.50	✓ 0.89	16.39
7 July	4.00	3.00		6.25	13.25	2.68	10.57
14 July	4.12	3.50	6.25	2.38	16.25	0.28	15.97
21 July	3.63	3.63	4.88	3.12	16.26	0.25	15.01
28 July	4.25	3.12	8.00	5.00	20.37	✓ 0.11	20.48
4 August	2.12	3.75	5.37	4.50	15.74	✓ 0.18	15.92
11 August	1.38	2.62	6.38	4.50	14.88	1.19	13.69
18 August	1.17	0.13	2.87	6.00	10.17	0.12	10.05
25 August	3.89	0.48	1.87	5.50	11.74	--	11.74
2 Sept.	4.88	1.58	5.63	6.50	18.59	4.72	13.87
Total	105.06	46.44	41.25	51.00	243.75	18.87	224.88
TOTALS (excluding 25 August to 2 September)	100.18	44.86	35.62	44.50	225.16	14.15	211.01

APPENDIX D--continued

Date (1953)	Stocking Rate	Animal Days of Use	Animal Weeks of Use	Animal Unit Months of Use	Net Salt Consumption per A.U.M. (lbs)
22 April					
29 April	9	63	9.00	2.10	5.49
6 May	9	63	9.00	2.10	3.54
16 May	9	90	12.86	3.00	2.89
20 May	8	32	4.57	1.07	12.07
25 May	0, 8	8	1.14	0.27	13.85
26 May	8	8	1.14	0.27	0.89
2 June	8, 16	67	9.57	2.23	1.96
9 June	16	112	16.00	3.73	2.80
16 June	16	112	16.00	3.73	--
23 June	16, 19	127	18.14	4.23	5.27
29 June	19	114	16.29	3.80	4.31
7 July	19	152	21.71	5.07	2.08
14 July	19	133	19.00	4.43	3.67
21 July	19	133	19.00	4.43	3.39
28 July	19	133	19.00	4.43	4.62
4 August	19	133	19.00	4.43	3.59
11 August	19	133	19.00	4.43	3.09
18 August	19	133	19.00	4.43	2.27
25 August	19, 39	173	24.71	5.77	2.03
2 September	36	288	41.14	9.60	1.44
Total		2207	315.29	73.57	3.06
TOTALS (excluding 25 August to 2 September)		1919	274.15	63.97	3.30