USE OF SALT IN MANAGING MULE DEER AND DOMESTIC ANIMALS ON RANGE LANDS OF CENTRAL OREGON

by

WILLIAM DARLINGTON BARRON

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APPROVED:

Redacted for privacy

Head of Department of Fish and Game Management

In Charge of Major

Redacted for privacy

Chairman of School Graduate Committee

Redacted for privacy

Dean of Graduate School

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

USE OF SALT IN MANAGING MULE DEER AND DOMESTIC ANIMALS ON RANGE LANDS OF CENTRAL OREGON

INTRODUCTION

A field study of salt utilization by Rocky Mountain Mule Deer, Odocoilieus hemionus hemionus (Rafinesque), in relation to range management of both deer and livestock was conducted in the Deschutes National Forest of Oregon during portions of two consecutive years. The field study included the periods of April 10, 1951 to September 21, 1951 and April 3, 1952 to September 19, 1952. Additional observations and data are included from other locations in central Oregon to supplement the main study. The selection of the study areas, the planning and development of the program was limited by the finances, equipment and manpower available.

Attention was focused upon this investigation and future salting studies by the Oregon Game Commission, whose policy of salt use is to attempt the following: (1) to provide necessary minerals to correct nutritional deficiencies; (2) to cause earlier migrations of big game from problem winter ranges; (3) to induce more uniform use of forage on crowded summer and winter ranges where concentrations of game numbers occur; (4) to reduce game and livestock competition by encouraging more widespread game animal use on areas inaccessible to stock, and (5) to

alleviate game damage by drawing the deer away from problem areas. As this policy was not supported by the necessary factual data, observations were made to ascertain the actual effects of salting practices to corroborate or modify the policy.

Since this program was the first of a series of salting studies to establish a foundation for the previous mentioned policy, the Oregon Cooperative Wildlife Research Unit[1] will conduct further studies on the other aspects of salt use in the future. The basic objectives in such a long range experimental program are the measurement of salt used by big game animals in Oregon and an analysis of the use of salt as a game management technique. Although the specific purpose under consideration in this thesis was the measurement of salt consumption by mule deer, the conflict with livestock range salt use was included. Secondarily, the purpose of this study was to evaluate use of salt to control distribution of deer on the spring and summer range.

Many obstacles arose immediately when the problem of measuring the salt used by deer was undertaken in their natural habitat. The following are given as examples: variable deer population densities in the study area,

[1]Oregon State Game Commission, U.S. Fish & Wildlife Service, Wildlife Management Institute and Oregon State College cooperating.

abnormal animal behavior while under observation, and presence of other sources of salt in the region. Partial answers to these factors and others were necessary before any degree of sound information could be derived. A complete solution was not developed for each of the above, but substitution of methods gave fairly satisfactory results. For example, in obtaining data on deer populations, usually an elusive figure in deer management, only one choice of methods was apparent, that being an index to ascertain trends in deer numbers. The results were not specific but did determine the trends over the five square mile experimental tract. On the other hand, gathering data on salt use by domestic animals was a comparatively easy process. The total animal units were readily enumerated within the confines of range fences and salt consumption by livestock easily recorded from the weekly weighings of the salt blocks. The purpose for gathering data on both of these types of animals was to compare the respective volume of salt intake on a per animal basis.

Before such a comparison can be made, variations in cattle, sheep and deer food preferences must be considered since they are known to affect the volume of salt intake. Of the three animal forms considered, sheep and deer exhibit a closer similarity of food habits since a higher percentage of shrubs and forbs is eaten by both, whereas

cattle generally take a greater portion of grasses if available, (20, p.450). In addition to the different food preferences the intake of salt in the content of individual forage plants is variable, according to the season and state of plant maturity, (6, p.11) and (8, p.4).

HISTORY OF THE PROBLEM

Salting on big game ranges has been practiced since 1938 by the Oregon State Game Commission (15), especially where significant big game use of salt was thought to occur on summer range cattle allotments. The Oregon Cattlemen's Association was granted $450.00 from the Commission in that year to compensate for the salt believed taken by big game. This expenditure was based on an estimate for the purchase of 24 tons of salt. Each succeeding year an increased monetary grant was made until in 1951 the sum of $2500.00 was given to purchase 85 tons of salt.

The Game Commission policy also included distribution of salt for individual game ranges where District Game Agents have found the need paralleling the five basic principles outlined in the policy referred to earlier. During 1952, the following areas received salt allocations: Bend--one ton, Pendleton--four tons, Enterprise--three tons, Baker--one and three fifths tons, and Grants Pass--

one ton. In northeastern Oregon, aerial distribution was employed in the early spring months, while in Deschutes and Josephine Counties a truck was used for placement during the summer. Both deer and elk were considered in this big game salting program.

Other states such as Idaho, Montana and Colorado have similar salting problems and are engaged in range salting in an attempt to provide better animal distribution on their big game ranges. In each of these states aerial dropping is the major method employed for distributing the salt blocks.

To evaluate properly the overall problem of animal salting many factors having a bearing on their salt consumption should be kept in mind. Why animals should take salt, particularly the chlorides, is of primary importance. They often continue to take more than what is termed a minimum requirement. Although no minimum has been established for any class of animal, salt is still regarded a physiological necessity. Morrison, in his book of Feeds and Feeding (17, p.103) stated:

> "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."

In New Mexico, Lantow found native grasses to contain

.032 to 0.387 per cent chlorine, the content increasing as the season progresses, (12, p.19). Studies in Texas by Fraps showed native grasses to vary from 0.13 to 0.39 per cent salt, and the alfalfa averaged 0.98 per cent salt, (6, p.11). On certain alkali ranges in Montana, Lommasson proved that sufficient salt was present in the forage to maintain steers in good condition, (14, p.3). Although grasses are not eaten by deer in as great a volume as with cattle, these plants must be considered as a potential source of salt.

Evidence of how vital chlorides are to domestic animals was shown by the work of Babcock on dairy cattle that were deprived of salt, (2, pp.129-156). These milking cows showed no ill effects other than the presence of an abnormal salt appetite for a period up to one year. Then a sudden general physical breakdown would occur, characterized by loss of appetite, haggard appearance, lusterless eyes, rough coat, and a rapid decline in weight and yield of milk. Finally death would occur if salt was not supplied.

All of the previous statements point toward the complexity of this salting problem and indicate no simple solution.

GENERAL DESCRIPTIONS

GENERAL LOCATION

Both the deer and cattle study were located in the extreme southwestern part of Jefferson County, Oregon. This region is situated approximately ten miles from the summit of the Cascade Mountains on the eastern slope. The general terrain is cut by many small tributary streams and marked by undulating hills until the floor of the Metolius River Valley is attained. Numerous mountain meadows occur in the higher altitudes.

Identifying landmarks by which the area can be defined are Mount Jefferson to the northwest, Warm Springs Indian Reservation to the north, Green Ridge to the east, Black Butte to the south, Mount Washington to the southwest, and Three Fingered Jack Mountain to the west.

The elevations vary from 3000 feet in the Metolius Valley up to 10,500 feet on Mount Jefferson. In the experimental area the altitudinal range was 3000 to 3500 feet.

Numerous lava rock outcroppings occur through the area, indicating a comparatively recent geological origin. Many of these rock exposures are found on the slopes facing south where little or no vegetative cover exists.

CLIMATE

Annual precipitation of the territory ranges from 25 to 60 inches, with the greatest amount coming in the form of snow during the winter months. In the Metolius River area the average maximum depth of snow is approximately 24 inches but in severe winters sometimes reaches a depth of 48 inches. During such a severe winter as 1948 losses of deer become an acute problem due to the heavy snow covering food plants.

In the 1951 field period, rain occurred only twice during the last week of April and no further precipitation was noted until the snow came in the fall. During the 1952 field period, however, the seasons and the amount of precipitation were different, as rain fell on nine days, widely scattered through the spring and summer months.

The possibility of either early or late seasonal frost was always present, occasional frosts occurring in early June and again in mid-August. In 1952, summer temperatures ranged from 32 to 96 degrees F. during the period of June through early September. Daily fluctuations of 30 degrees between the maximum and minimum temperatures were not uncommon.

FLORA[2]

A climax type of Ponderosa Pine, Pinus ponderosa Douglas, exists throughout the deer testing area and covers a portion of the cattle ranches where data were collected. Douglas Fir, Pseudotsuga taxifolia (Poir) Britton, occurred as a component of the climax but was generally found only on the slopes facing north where moisture conditions were better. Western Larch, Larix occidentalis Nuttall, and Incense Cedar, Libocedrus decurrens Torrey, were occasionally found, being usually interspersed in the climax type on the more moist sites.

The shrub climax understory consists primarily of Bitterbrush, Purshia tridentata (Pursh), a major deer food. Buckbrush, Ceanothus velutinus Douglas, and Manzanita, Arctostaphylos patula Greene, make up the subdominant species. Other shrubs like Western Serviceberry, Amelanchier florida Lindley, Rabbitbrush, Chrysothamnus nauseosus (Pallas) Britton, and Willow, Salix spp. were distributed in isolated groups depending upon growth requirements.

In the grass union, Idaho Bunchgrass, Festuca idahoensis Elmer, dominates with Bottlebrush Squirreltail,

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[2]All common and scientific names used under the heading Flora are identical to those found in Morton Peck's Manual of the Higher Plants of Oregon.

Sitanion hystrix Nuttall, California Stipa, Stipa californica Merril and Davy, and Koeler's Grass, Koelaria cristata Linnaeus, following in that order of abundance. Only scattered islands of Wheat Bunchgrass, Agropyron spicatum (Pursh) and Sandberg's Bluegrass, Poa secunda Presl, are found on the exposed south slopes with the previously named grasses.

On the ranch areas utilized in this study, Ponderosa Pine is the climax forest type. Since the ranges and pastures have high water tables, a change in the nature of the plant flora has occurred from the usual grass union. Swamp grasses and sedges are now the characteristic plants instead of the normal bunchgrass association. Abundant clumps of Willow and Mountain Alder, Alnus tenuifolia Nuttall, are dispersed along the water courses.

PAST AND PRESENT LAND USE PATTERNS

The following section is included primarily to show the influence of salt and its availability to deer over the years, based on the use of salt in livestock range management and its relationship to land use.

The major portion of the land in the vicinity of the Metolius River is managed by the United States Forest Service on a multipurpose basis including forest management,

watershed protection, livestock grazing and recreation. Many small blocks of land however, are still found in private ownership, scattered throughout the valley and are surrounded by forest lands. Some of these tracts, originally homesteaded, were based upon a livestock economy. Many have since passed either into the summer recreational development in the case of those lands along the river or they have slowly reverted back to forest production.

Livestock, both cattle and sheep, originally grazed the valley floor and the higher elevations up to the Cascade summit. The Metolius Cattle Association, formed in 1928, functioned with 1200 head of cattle in this region for the summer and fall range, but only for a few years because of the constant increase of recreational values in the land along the river. These changing values brought about a shift in policy to exclude nearly 35 square miles of land out of a total of over 100 square miles from further livestock use. Operations by the association in 1930 were then moved to the south on the ranges in the Squaw Creek drainage, just east of the Three Sisters Mountains. The organization name was then changed to the Squaw Creek Cattle Association and is currently in operation.

Sheep men picked up the remaining parts of the old cattle allotments in the Metolius region and currently graze a band of 2600 sheep to the west of the deer

experimental area from July 1 to October 20 each year. A usual practice in the salting of sheep, when employing the one-night bedding system, is to give granulated salt every second night utilizing no permanent salt dispenser. Thus sheep only leave behind a small amount of salt unconsumed and that remains available for only a short time.

An indication of the wide distribution of salt stations in the range management salting plan for cattle is taken from Forest Service records for the year 1932. This plan called for 9850 pounds of salt to be placed at 97 posted locations between the first of June and the twentieth of September. On this Squaw Creek Cattle allotment, located twenty miles south of the deer study area, 1200 head of cattle were permitted to graze for 122 days between the two dates. Salt was thus constantly made available to deer in the same area.

Realizing that such salting practices had taken place for cattle and sheep in the outlying reaches of the Metolius drainage, the choice of the deer study area was made in that section where livestock were no longer an influence on the open range. Consequently, no interference with the experimental salting of deer occurred in the study.

One remaining source of raw salt supply in which the pattern of land use had no bearing, is that found in the natural licks where it exists as a mineral component of the

soil. The amounts of salt found in forage plants and in the water supply were not considered as a raw supply in this case. No such natural licks had been found in the region nor was any known to exist according to the residents. Several small depressions made by deer were found outside the study area, but later information revealed that these sites had been used as former salting grounds for cattle years ago. A location where deer had been observed to be licking the soil was found on the Lundgren ranch one-half mile south of the experimental area. According to the manager, who had an analysis of the soil made, sodium chloride was not present. It has been assumed, therefore, that no additional salt supply was available within range of the deer from the study area.

REVIEW OF THE LITERATURE

In Arizona, the salt requirements were found by Nichol (18) to be one pound for ten deer per month in the summer and half that amount in the winter. Indications were found that a diet predominately of legumes tended to increase salt demand. Water consumption was 1 to 1½ quarts per day per hundred weight of animal in winter and twice that in the summer.

Chase (5) reported that elk and deer in Idaho could

be detained by use of salt on summer pastures and thus protect the depleted winter range. Tests revealed that animals utilized salt to which strong flavors such as sulphur or tobacco juice were added, showing that medication of salt for controlling parasites and diseases might be possible.

The aerial drop method was employed by Gallaher (7) to distribute 23,000 pounds of block salt in Idaho forests, which otherwise are inaccessible because of snow in the spring, at a cost of 3¼ cents per pound. Distribution by airplane performed the work quickly although not quite as accurately as ground distribution. Inspection three weeks later had shown the salt to be completely consumed on the elk ranges and heavily used on the deer range. Use of salt blocks was definitely recommended since they lasted longer and were easier to handle.

Big game salting, as practiced in the northern Rocky Mountain region by Anderson and West (1), was carried out for the purpose of game animal distribution on the range, thereby eliminating over-grazing, particularly on winter ranges. The value of salting to supply dietary deficiencies was secondary. Salt was most heavily used when located at the head of minor drainages and on secondary ridges, at lower limits of summer range and on summer range proper. Placing salt in natural licks was found to be poor

practice for game animals. All salt distribution was suggested to be completed by June 15 in order to gain the maximum benefit.

On the elk summer range in Idaho, Young and Robinette (21) discovered that the use of salt licks increased from a few animals in June to approximately 150 by mid-July. Following this date, the numbers of animals using the licks decreased steadily to only a few animals during September and October. The elk had appeared make the greatest use of salt licks during the hours of darkness. Maximum utilization by elk occurred between July 26 and August 10. Salting on the summer range was considered of doubtful importance as a factor in lengthening the fall grazing period for big game.

Starker Leopold and his associates (13) pointed out from their three years of salting around deer traps on Jawbone Ridge in California, that salt only attracts the deer in whose home ranges it is placed. No evidence was obtained that salt induced any general redistribution of animals.

During the fall and winter months in Wyoming, Big Horn Sheep, Ovis canadensis canadensis Shaw, generally refused ordinary salt according to Honess and Frost (10). This was due to the fact that many plants normally contained sufficient salt to satisfy the animals.

Granulated salt was placed in small piles along trails, in favorite feeding and bedding grounds, on both summer and winter ranges to check salt consumption. Where feeding was carried on during the winter of 1941 salt was used sparingly on the hay. Yet, none of these practices induced the sheep to use salt.

FIELD METHODS

Since data were gathered in four general catagories, the description of the practices involved will be covered under separate headings. Each will be presented in the order of its importance.

WEEKLY DEER SALT CONSUMPTION DATA

The experimental area of 3500 acres is located three miles north of the town of Camp Sherman with the Metolius River as the east boundary; the north border is defined as starting at Bridge 99 and following a road one mile northwest intercepting the main logging road; as the west boundary, this road runs southwest for two miles and in a southeast direction for two and one-half miles; thence following Canyon Creek as a south boundary to its junction with the Metolius River, which forms the east border and back to the point of origin. A map is

presented to show the exact location of all salting stations and the general geographical relationships, figure 1.

A total of twelve salt stations was established imploying one small 5 pound block of white salt at each site. All blocks were weighed once a week, always on the same day of the week and the amount of salt consumed was recorded. This procedure was followed beginning in April of both summer field periods and continuing until late in September. In choosing the twelve stations, the following factors were considered: habitat variations, elevational differences, and normal deer summer range in order to give uniform salt distribution. Since the summer seasonal deer range in California was assumed to be from one-half to three-quarters of a mile according to Leopold (13, p.132), the salt blocks were spaced conforming to those interval-distances. 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 deer.

Weathering, which may cause a loss of salt weight on each station was accounted for by setting up a control station at the Wizard Falls Hatchery Headquarters. This salt block was placed on an eight foot pedestal to eliminate deer use and yet be exposed to the weather elements,

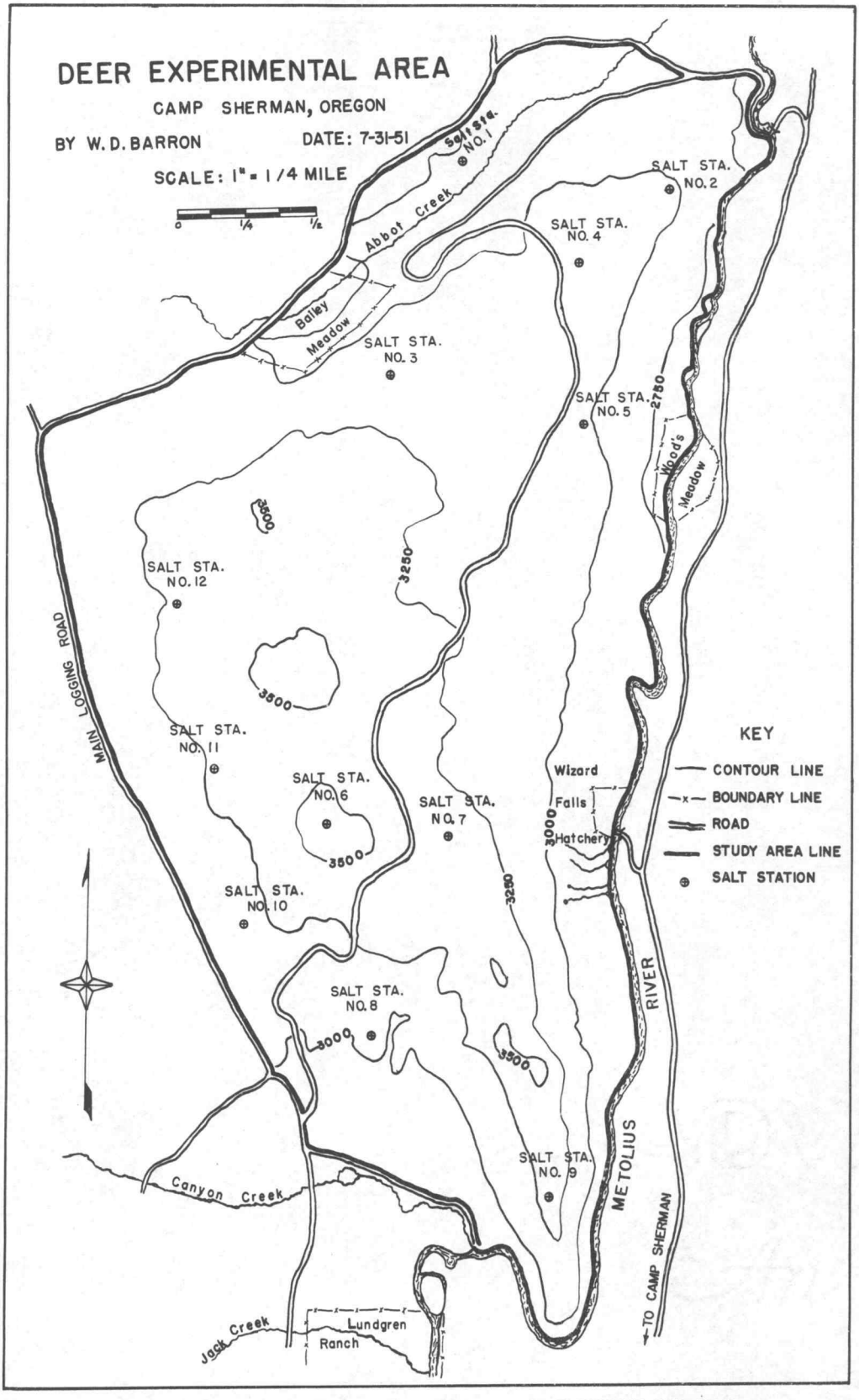

FIGURE 1 : MAP SHOWING LOCATION OF EXPERIMENTAL SALT STATIONS FOR DEER

figure 3. Losses for the entire season of 1951 were negligible. Using the standard five-pound block in 1952, a total of 1.4 pounds of salt was lost during the entire season from April to September. The rain and moist atmosphere dissolved this amount of salt.

A Hanson commercial type scale, graduated in ounces up to sixty pounds, was used in weighing salt blocks. This property of the scales to measure a wide range of weights proved highly useful since the same scale could be used in the cattle phase of the study where a fifty-pound block was standard size.

WEEKLY DEER POPULATION TRENDS

After acquiring the salt consumption information from the twelve stations such data would be valueless unless a means had been devised to obtain a direct relationship to deer numbers. The method employed gave population trends and not actual numbers as would be most desirable. Since a road having a fine sandy surface and ample car travel on it bisects the study area in a north-south direction, it was selected to make the weekly deer track count. The count was made the day before the salt weighings were taken. Methods, similar to those employed by the

Interstate Deer Herd Committee[3], were used where a track count was made to obtain index census counts. The major difference was the brush drag being used to obliterate the old tracks, on the Interstate Herd. In this case a sufficient amount of car travel removed the old tracks to make duplications of deer tracks possible. The counting was made possible with few duplications by an elapsed period of one week between the road track counts. Then, only the fresh tracks for the past 24 hours were recorded. Since car travel was usually abundant on Sunday, the day before the actual counting, all old tracks leading to the road would be obliterated or interrupted by wheel marks and all fresh tracks would generally be complete across the road if made within the past 24 hours.

DOMESTIC ANIMAL SALT DEMAND

Two cattle ranch owners granted access to their properties and permission to manipulate their range salting programs. The Lundgren ranch, almost bordering on the south boundary of the deer area, was used to gain information on combined cattle and horse salt consumption. Black

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[3]The Interstate Deer Herd Committee is a cooperative group consisting of representatives of the Oregon Game Commission, California Dept. of Fish and Game, U.S. Forest Service, Regions 5 and 6, organized to study deer livestock range problems on the winter range of the Interstate Deer Herd.

Figure 2. Mule Deer in the process of taking salt from an established salt station.

Butte ranch, located eight miles south of the town of Camp Sherman, provided information on cattle salting alone.

Simple methods were used, consisting of weekly weighings of each salt block on the range plus a constant check on the amount of animal use. Allowances due to weathering losses were made in the data and thus consumption per animal unit month was readily derived.

Selection of these particular ranches for use in the study was originally made on the basis of one having deer competition with cattle for salt and one with cattle alone. However, the Lundgren ranch did not continue having deer use their range for the duration of the field program. Since horses had been introduced with cattle, common usage of the salt supply did not permit separate information to be obtained on the cattle and deer salt competitive factor, the result was combined animal use. Nearness and presence of similar soil and climatic conditions were the other primary reasons for selection of the two ranches since salt consumption rate will be made with known standards to determine whether abnormal use prevailed.

DIRECT DEER OBSERVATION

Two observation periods of four hours each, one in the early morning and the other in the evening were employed as a means of obtaining accurate measurement of salt

Figure 3. A salt station elevated out of deer reach to assist in determining weathering losses.

Figure 4. View of the photo-electric deer counter as established in the study area.

consumption per deer. Locations of observation points were established at two of the salt stations in the experimental area and the third was situated outside and just to the west of the Lundgren ranch.

Tree platforms were built at stations nine and twelve, nearly 35 feet in the air so as to prevent human scent from interfering with deer movements. A closed car was used at the third station from which deer could be viewed without incurring undue suspicion. The distance from the observer to the animals was less than 50 yards in every case. With the aid of 7 by 50 binoculars, very close observations were possible for watching the manner of salt consumption as well as the amount taken by individual deer.

Each animal was timed while actually licking the salt and its specific reactions and conflicts with other deer were recorded. A typical description of a sequence observed from inside the closed car on the evening of May 22, 1952 is as follows: At 7:20 pm (Pacific Daylight Time) a yearling doe came to the salt after her natural suspicion had subsided; she licked intermittently for a total of seven minutes. The doe paused at intervals and the tongue would move in and out from one side of the mouth to the other. Use of the lower incisor teeth was never observed. An adult buck appeared at 7:27 and chased the doe away. The buck then licked the salt until 7:45 at which time a

slight noise disturbed him, but he returned at 7:49 and continued taking salt until 8:00, pausing for three minutes and then resuming until 8:15 when he departed. Soon the same doe returned at 8:18 and licked for three minutes when a second buck and doe appeared. The first adult buck reappeared simultaneously and a conflict ensued which resulted in the younger buck giving ground or retreating. The older buck resumed the position at the salt block for four minutes before leaving. Now the second buck was able to take his turn. A third adult buck and doe arrived but only this new buck took salt, driving all others away and then licking for ten minutes. Departure of the third buck at 8:47 permitted the second buck to return and lick until 8:52 when he finally left. The third adult doe came again and was able to get salt this time until 9:05 when she seemed to lose interest and left the area. A total of only two ounces of salt was consumed by the six deer during the entire period of 83 minutes. The consumption figure was obtained by weighing the salt both before and after the deer use. Each deer displayed the same licking habits as those first described.

When deer licked the five-pound salt block they left a very characteristic narrow but deep tongue impression as shown in figure 5. The width of the impression made by deer usually measures from 1½ to 2½ inches and can be

considered a distinctive field character in identifying deer use of block salt.

MISCELLANEOUS RELATED PHASES OF THE SALTING PROGRAM

Many facets of related salting information have been employed for gathering data having a direct bearing on the main salting study. They are mentioned here under the miscellaneous heading as follows: the photo-electric deer counting mechanism, deer and horse salt competition, salt and water relationships of deer, and the fire tower cooperative deer salting program.

PHOTO-ELECTRIC DEER COUNTING MECHANISM

Previous attempts were made by Maxwell Wilcomb and Robert Scott of the Oregon Cooperative Wildlife Research Unit to develop a deer counting apparatus by employing a photo-electric cell principle. Their tests were conducted on the Interstate Deer Herd migration route in 1946 without too much success, due to human interference with operating equipment during the hunting season.

With the generous assistance from the Physics Department of Oregon State College, and specifically Dr. Duis Bolinger, who designed the apparatus, development of a satisfactory mechanism was accomplished. All of the mechanical imperfections and disadvantages have not as yet

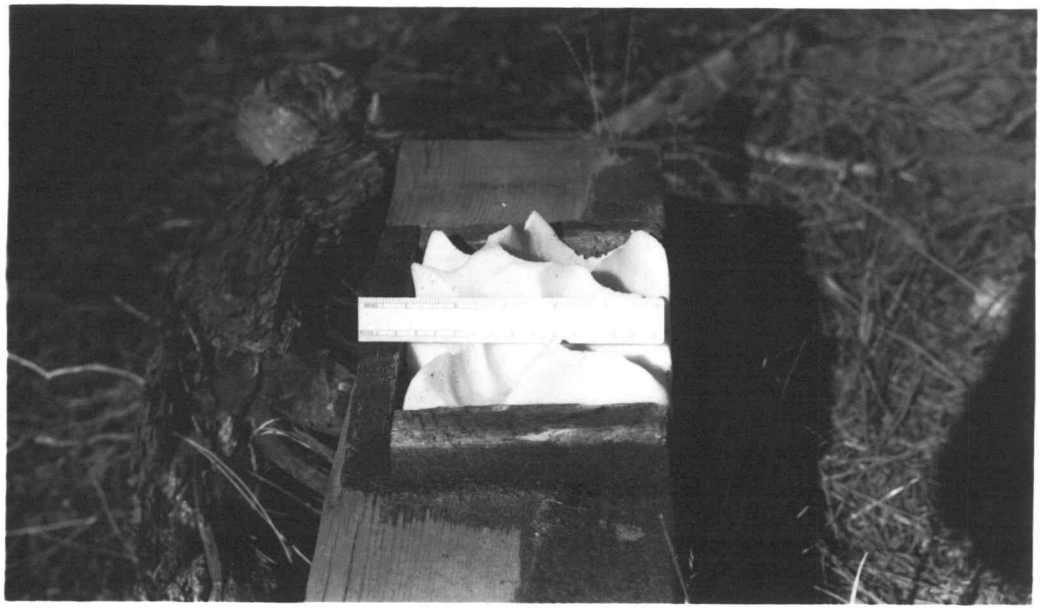

Figure 5. The effects of deer licking on a five-pound salt block showing the narrow one and one-half inch tongue depression.

Figure 6. The results of cattle licking on a fifty-pound salt block showing the wide four and one-half inch tongue depression.

been corrected so as to allow perfect operation, nor have all of the possibilities for its application been investigated. Proof had been attained of proper functioning so as to record the deer passing through the light beam. An electric circuit diagram is included to indicate the comparative simplicity of design and operation, figure 7.

Salt consumption data was obtained, in the absence of personal observation, by keeping daily weight records of the salt used, and of deer numbers as recorded by the counting device. These were then compared to the number of individual deer tracks entering the corral to check on the accuracy of the recording equipment.

In July of 1951, salt station No. 12 was selected as a location for the counting equipment where converging deer trails formed a natural opening. The opening permitted the construction of a corral of seine netting five feet high, having an entrance of 22 feet and a depth of 30 feet. Choice of this station was made deliberately because of the moderate deer use, which afforded a comparison of deer numbers by both tracks and the photo-electric counter recordings. The two box units of the counter were located at each side of the entrance of the corral having light beam passing between them. Deer passed through this beam to reach the salt in the back of the enclosure, figure 4.

An ordinary electric flashlight element was used first,

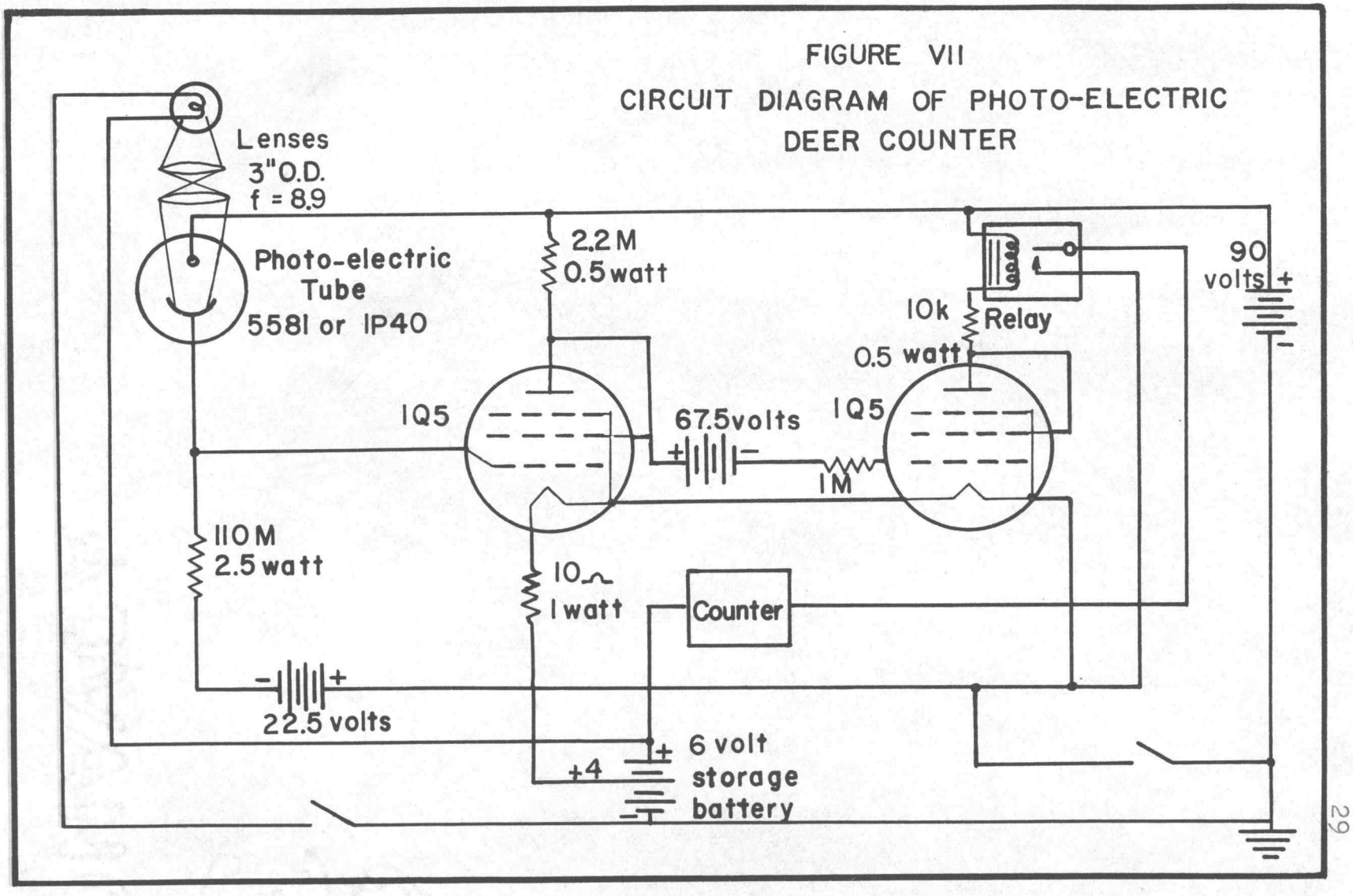

FIGURE VII
CIRCUIT DIAGRAM OF PHOTO-ELECTRIC
DEER COUNTER

which had a visible spectrum range of 4000 to 7000 Angstrom Units[4]. The power source was provided by a 6-volt storage battery which required a recharge after each 96 hours of continuous operation.

Since the deer had been utilizing the salt of station 12 prior to construction of the corral, little fear of the apparatus on the part of the deer was apparent until the set was placed in working order. Deer would attempt to pass between the two units many times without going inside the corral, thus breaking the light beam. The count on the mechanical recorder would then indicate a larger number of deer than were actually present. Consequently an analysis of the tracks made by the deer along the path of the light beam seemed to indicate that they were extremely sensitive to the light emitted from the Tungsten filament in the flashlight bulb. After a period of adaptation to this light and the sound of the equipment, two specific deer entered the corral without causing any abnormal count to be recorded and obtained the salt they wanted. Any new individual that appeared invariably reacted in the following manner: deer would walk along the light beam and try to enter in several places, paw the earth, or then suddenly bolt. Due to the breaking of the light beam the counter

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[4]Angstrom Unit--a unit of length, used especially in expressing the length of light waves, equal to one hundred millionth of a centimeter.

would indicate a very high number of animals, yet observation of the tracks showed that none had entered the enclosure. These observations were based entirely upon an analysis of the deer tracks in and near the corral entrance. Only two instances of perfect functioning, without inaccuracies in counting, occurred in 1951.

In the 1952 season, a number of modifications were made in the apparatus. First, the corral entrance width was increased from 22 to 38 feet, primarily to reduce the cause of fear on the part of the deer from being enclosed. A change in the lighting system was required so as to permit use of a more concentrated beam of light without simultaneously increasing the power supply.

A second major change was to provide a small optical system to facilitate focusing the light into a narrower beam thus enabling the counter to function despite a greater distance between the units at each side of the corral. Two Plano-Convex lenses, 94 mm. in diameter, having a focal length of 229 mm. were fitted into the visors of each box unit. The set was designed to permit effective operating distances up to 100 feet, although in this case the units were spaced only 38 feet apart. Third, an infra-red sensitive photo-cell was substituted in place of the one responding to the light of the ordinary flashlight bulb. No other changes in the electrical apparatus

was required. An infra-red filter, Kodak Wratten Type No. 89B, was inserted in the path of the light beam. This type of filter permitted passage of light waves on the red end of the spectrum measuring 6500 to 9500 Angstrom Units, becoming invisible to the human eye near 7200. All light waves below 6500 were excluded by this filter. Upon the first tests deer still seemed to show an awareness of the presence of these light waves.

A Kodak Wratten Filter, Type No. 87, which would only pass those light waves above 7200 Angstrom Units was utilized with results similar to those described above. Since these rays were not visible in the daylight, it was found necessary to focus the lenses at night when the light could partially be seen. Deer appeared to respond unfavorably to this light beam the same as with the others.

A fourth change involved the deadening of the sound of the electric counter by means of insulation. Despite the effort, the relay which activated the counter still produced some noise whenever an animal interrupted the beam of light.

Upon application of the four major changes in the field, the deer still reacted the same as before and the general hesitancy of deer to enter the corral was not entirely eliminated. By accident, the real cause was discovered for the unnatural actions of the deer while

entering the corral. The set was not in operation at the time of the discovery but the lighting system was still functioning without any filter, when two deer entered the corral showing no indication of balking. Tests were then begun using the flashlight element as the light source without the counter part of the equipment in operation. A total of 26 deer visits were made thereafter with no evidence, shown by their tracks, of balking. The filter No. 89B was then inserted in front of the light source, eliminating all visible light waves below 6500 Angstrom Units, and the deer reacted the same as without the filter. Next, the No. 87 filter, which removed all visible light waves below 7200 units, was substituted for the first filter and the deer reacted the same as before. As soon as the entire apparatus was placed in operation again the deer immediately began to balk, or hesitate at the point where the light beam crossed the corral entrance.

The deer behavior described indicated that the sounds produced by the operation of the equipment, rather than the type of light utilized, constituted the limiting factor of this counting device. Elimination of the sound of the equipment was not possible prior to the end of the field period in September, 1952 and so the final testing was not made. Due to the acute hearing qualities possessed by deer, silent operation of the recording mechanism was found

to be essential in order to produce consistent accuracy with this type of apparatus.

There were 228 deer visits to this counter station, covering a period from April 24 to September 16, 1952. In order to account for the small quantities of salt taken by deer as traces, two recorded traces of salt were considered for purposes of tabulation as one ounce, making a total of 53 ounces of salt consumed. The average was 0.23 of an ounce of salt per deer visit. At no time did an individual deer take more than one ounce of salt, table I.

In developing the photo-electric counter to the point of proven operation, certain advantages in the equipment were noted. The apparatus was designed to be independent of a fixed power source and operated on a 6-volt direct current battery circuit. Simple construction enables a layman to build the electrical parts by following directions, at a fairly low cost. Total costs, not including the battery charger, was $40.00 if all materials were purchased. Costs may be considerably cheaper where improvising is possible. The wet batteries would function for periods longer than 96 hours if so required, but were recharged every four days to obtain maximum long service from them.

Indications of some of the disadvantages in field operation were also noted. Excessive weight and bulkiness

TABLE I

DEER SALT CONSUMPTION DATA FROM COUNTER STATION SHOWING THE HISTORY OF DEER VISITS AND THE AMOUNT OF SALT CONSUMED IN 1952

Date of Observation	Number of Deer Visits	Amount of Salt Consumed	Date of Observation	Number of Deer Visits	Amount of Salt Consumed
4-24	1	Trace	7-8	3	Trace
5-7	8	1 oz.	7-9	4	Trace
5-7	4	Trace	7-11	1	Trace
5-8	2	Trace	7-14	6	1 oz.
5-13	2	Trace	7-15	4	Trace
5-14	6	1 oz.	7-18	7	2 oz.
5-15	8	2 oz.	7-22	6	2 oz.
5-16	8	2 oz.	7-25	5	1 oz.
5-17	4	1 oz.	7-26	0	
5-19	7	Trace	7-28	2	Trace
5-20	6	Trace	7-29	1	Trace
5-21	9	1 oz.	7-31	0	
5-21	4	Trace	8-2	2	Trace
5-27	4	1 oz.	8-4	0	
6-3	5	1 oz.	8-5	3	Trace
6-4	1	Trace	8-6	3	Trace
6-5	0		8-7	1	Trace
6-6	1	Trace	8-8	4	1 oz.
6-8	5	1 oz.	8-9	0	
6-9	0		8-12	5	1 oz.
6-10	1	Trace	8-14	3	1 oz.
6-12	6	2 oz.	8-15	2	Trace
6-13	5	1+ oz.	8-19	3	1 oz.
6-15	8	2 oz.	8-21	4	Trace
6-16	4	1 oz.	8-22	3	Trace
6-17	2	Trace	8-25	1	Trace
6-18	0		8-26	0	
6-19	3	1 oz.	8-29	3	1 oz.
6-20	3	1 oz.	9-2	8	2 oz.
6-22	5	1+ oz.	9-4	1	Trace
6-23	3	1 oz.	9-5	0	
6-24	0		9-8	0	
6-30	2	Trace	9-9	0	
7-1	6	2 oz.	9-11	0	
7-2	4	1 oz.	9-12	0	
7-3	2	Trace	9-16	2	Trace
7-4	2	Trace			

Totals: 146 Days 228 Visits 37 ounces and 32 traces
Average: 0.23 ounces*/deer visit *2 traces = 1 ounce

of the box units reduced mobility somewhat; the sensitive set is disturbed too easily by movement of the units; alignment of the lenses was also disturbed by the same movement; repairs are hampered without good testing equipment and a certain amount of electrical experience; sensitivity to moisture and temperature changes plus acid corrosion on the contacts caused failure too often for consistent results; the optical system and filters were extremely hard to align properly unless done after dark; daily attention was required to obtain reliable results. Sunlight and its influence on the photo-cells had to be watched very closely. Since the sun contains all the light waves in the spectrum at a high intensity, far surpassing the small artificial light source, interruption of the light beam by the sun would put the mechanism out of operation.

DEER AND HORSE SALT COMPETITION

It was possible to gather data from the Bailey Meadow, located in the northeast corner of the deer study area only during 1952 as salting for horses was done there only intermittently in 1951. Salt for livestock was the only other source available to deer in the testing area outside of the stations placed specifically for them in this study. When the horses took salt they would invariably use both

the upper and lower incisors to gnaw on the blocks leaving characteristic tooth marks. Horses were found to be the only large animal utilizing their teeth in taking salt. Teeth marks were not in evidence in the case of deer, sheep and cattle.

Horses and other livestock in small numbers used the same salt ground on this fenced pasture for the last twenty-five years since the commercial cattlemen abandoned the Metolius valley area. Deer have learned to use the same salt ground heavily during this identical period. Evidence of the amount of soil removed over the years by both deer and livestock can be seen in figure 8.

Many observations of deer licking the soil or the salt block itself were made at the Bailey Meadow during the summer of 1952. The maximum number of deer actually seen at one time on the site was ten. When salt was placed on the location it was immediately subjected to a heavy deer demand in addition to the use by the horses. A record of the total salt consumption by both species of animals on this same meadow was kept in 1952 and is shown in table II.

The significant indication from the data presented in table II was the 8.9 pounds of salt consumed by deer from July 18 to August 18, 1952 while no horses were in the pasture. Such evidence definitely showed deer to be competitors for the horse salt at this one location. In the

TABLE II

RESULTS OF COMBINED DEER AND HORSE SALT USE FOR 1952

Date Salt Weights Were Taken	Weight of Salt Consumed During Period (in pounds)	Stocking Rate (Horses)
6-2		
6-6	4.0	8
6-13	6.3	8
6-20	5.4	6
6-27	4.5	7
7-4	3.1	3
7-11	3.3	3
7-18	2.5	0
7-25	2.4	0
8-1	2.0	0
8-8	2.0	0
8-15	2.3	7 (4 days)
8-22	1.4	0
8-29	5.7	8 (1 day) 6 (5 days)
9-5	2.0	6
9-12	2.0	6
9-19	1.6	6

week beginning August 15 a decreased consumption occurred from 2.0 to 1.4 pounds while no horses were present. When the horses were present, the combined use dropped down to 1.6 pounds in the third week of September. A gradual decline in the volume of salt taken by deer during the summer was evident from these data. By comparing the rate of consumption on the Bailey Meadow to that of the remainder of the deer study area, the maximum volume of 3.1 to 6.3 pounds was taken during the period June 2 to July 11. The deer population trend for that same period was 294,

relatively high to account for the heavier salt use. A heavy volume of salt, 5 to 12 pounds per week, was being consumed during the same period in the other part of the experimental area, coinciding with the large amount taken in the horse meadow.

If horses consumed an average of 1½ ounces of salt per day per animal, using the standard given by Morrison, a total of 128 pounds would be consumed for the 16 horse months of use which had prevailed on the Bailey Meadow. Instead of 128 pounds only 50.5 pounds of salt was taken and part of that was credited to deer; consequently the horses must have taken a subnormal quantity of salt or obtained the rest of their alleged needs from some other source (17, p. 103).

SALT AND WATER RELATIONSHIPS OF DEER

Need for information on the salt and water relationships was evident because of the bearing water availability may have on deer salt consumption. The two objectives for undertaking this part of the study at Swamp Wells in the Fort Rock District of the Deschutes National Forest were as follows: To determine whether deer would consume salt in a decreasing amount away from an isolated water source and to learn if deer must have water immediately after having salt. Since Bentley had proven that such was not the case

Figure 8. A denuded area surrounding an old livestock salt ground which was also heavily used by deer on the Bailey Meadow.

with cattle, the question arose as to whether deer habitually follow the same pattern (3, p. 832).

A series of 16 stations, each having the usual five-pound size salt block, was established radiating out from the single water hole, situated in a natural depression. Ten stations were spaced in a straight line one-fifth of a mile apart on the north and south sloping approaches. Three salt stations each were established up the hills on the east-west lines. Weekly weighings of the salt blocks were to show whether a decreased consumption existed as the distance from the water increased.

By camping near the water source and taking direct observations of all deer coming to the salt and then watching closely the need for water, the question of determining whether or not deer require water after taking salt was to be answered. Wild horses interfered with the study to such an extent that conclusive information was impossible to obtain on the salt gradient phase and thus the data was excluded from presentation here. The phase on the salt and watering habits was continued although only three instances of deer taking water without venturing near the salt were observed in the summer of 1951. Cases of this kind did not prove or disprove that deer take water immediately after licking salt but they did show the importance of water and the decreasing demand for salt in the dry range

areas late in summer.

In 1952 indications that deer did not have to have water after taking salt were observed at the China Hat Guard Station in the Fort Rock District. On August 28, 1952, a period of observation was spent at a water trough where salt also had been placed. Three bucks appeared in the early morning and licked the salt, one at a time, varying the duration of their licking from eight to twelve minutes. Finally these deer departed without once taking water, which was located only a few feet away. One of these bucks returned 40 minutes later for water, remaining only three minutes. A doe with twin fawns appeared next. All three took water first, then licked the salt a few times before departing.

Again on September 17, 1952, two does and two fawns were observed at China Hat Guard Station taking water but no attention was paid to the salt. This apparent avoidance of salt in the late summer agrees with the findings of the Metolius study where salt was found to have its least attraction to deer during the late summer.

These observations indicate what may be expected if more work were to be devoted to the watering habits of deer in relation to salt.

FIRE TOWER COOPERATIVE DEER SALTING PROGRAM

Aid from the United States Forest Service, in the form of cooperation on the part of eight fire tower lookout operators, was given in collecting information on Mule deer salt use. Three sites were located in the Sisters District and four in the Fort Rock District of the Deschutes National Forest. The remaining one was located in the Maury Unit of the Ochoco National Forest in Central Oregon.

Each tower operator was contacted personally and instructed in the operational details necessary and the objectives of this phase of the study, with the understanding that their fire duties would always take precedence. The extent of the program in 1952 covered a period from the last of June until the first of September. The procedure was as follows:

1. One 5-pound plain salt block was placed within 100 feet of the tower base so as to permit direct visual count by the operator of individual deer coming to the salt.
2. Postal scales were provided to weigh the salt always once each week on the same day.
3. A control block was employed to evaluate weathering loss. This block was also to be weighed at the same time as the block available to the deer.

4. Forms were provided on which to record the date, individual numbers of deer observed during the week, the total weight of the salt block used by the deer each week and the weight of the control block.

These data were collected at the end of the period and tabulated in table form. Three stations failed either to have sufficient deer use, or fire duties caused too many ommissions in the data to make them of value. The incomplete information from these stations was omitted in the compilations. Although the remaining results are not conclusive they are indicative of what regional variations may exist in deer salt consumption from other ranges. In the Sisters District a salt consumption average of 0.18 pounds per deer month was found whereas in the Fort Rock District an average of 0.34 pounds was evident. Precipitation in the areas where the lower value existed generally averaged 8 inches high as compared to the higher salt intake occurring in the near desert zone where the precipitation averaged 4 inches for the period April to September. Comparisons of the two salt consumption averages point toward a lower salt demand in the Sisters District, the region of the highest rainfall, table III.

TABLE III

COMPARISON OF DEER SALT CONSUMPTION BETWEEN SISTERS AND FORT ROCK DISTRICTS OF DESCHUTES NATIONAL FOREST--Obtained from Fire Tower Program, 1952.

Location of Towers	Dates of Use	Deer Months of Use	Total Salt Consumed (in pounds)	Average Salt Use Per Deer Month	Average Annual Rainfall for Period April to September*
Abbot Butte (Sisters Dist.)	7-31 to 8-27	3	0.5	0.17	8 inches
Cache Mountain (Sisters Dist.)	7-28 to 9-1	6¼	1.1	0.18	
Jones Wells (Fort Rock Dist.)	6-25 to 8-29	47¼	14.2	0.30	4 inches
Spring Butte (Fort Rock Dist.)	7-31 to 9-4	20	7.0	0.35	
East Butte (Fort Rock Dist.)	7-6 to 8-30	26	9.6	0.37	

*Source of Data--1941 Yearbook of Agriculture, Climate and Man.

RESULTS AND ANALYSIS

WEEKLY DEER SALT CONSUMPTION AND POPULATION TRENDS

During the period April 16, 1951 until September 18, 1951, twenty-two consecutive weeks, 51.3 pounds of plain white salt were consumed by deer at twelve salt stations. Weathering as an influence on the loss of salt was almost non-existent during this period, although in 1952 it amounted to nearly 20 per cent by weight of a single five-pound standard block. Since 1951 was the first year that salt was provided in the study area, many of the stations had little or no use until the deer located them. Low usage of individual stations was attributable to the variations in time of placing the blocks. In four cases practically no use occurred at all. Consumption of salt varied from 2.6 to 4.8 pounds with the heaviest use prevailing from May until mid-June in 1951, as shown in table IV.

Salt consumption from the last of April to the first of July, 1952 followed the same pattern as in 1951. All twelve salting locations established in 1951 were used for a period extending from April 8 to September 16, 1952. For a 24 week period in 1952 the amount of salt taken was 137.3 pounds. Two possible causes are given for this higher use in 1952, (a) formation of habit patterns by

deer, and (b) earlier availability of salt by two weeks. An increase in deer numbers was not included because the population trends did not indicate a major change in deer numbers. The heavy use occurred in a period from the end of April until the first of July. A gradual decrease in demand from the high of 6 pounds to 1.4 pounds, similar to that of 1951 which decreased from 3.6 to 1.1 pounds, is shown in table V.

When salt consumption data from 1951 and 1952 were correlated with the time of consumption and the deer population index the following significant results were obtained. Heaviest salt usage generally took place coinciding with the peak trends in deer numbers and then tapered off into the fall season when deer numbers were lower as seen in figure 9. The reduced numbers of deer utilizing the salt reflected the lower powers of attraction for salt in the study area and did not imply that fewer deer consumed a correspondingly smaller amount of salt. Peak trends ranged from 269 to 698 on the road track counts in 1951 when the salt consumption reached a high of 2.2 to 4.8 pounds per week, table VI. Although in 1952 the peak trend ranged in numbers from 216 to 487, the salt consumption varied from 6.2 to 12.0 pounds per week. The wide difference in the volume of salt used between the two years totaled 76 pounds or an increase of 168 per cent in the

TABLE IV

DEER SALT STATION CONSUMPTION DATA FOR 1951

Date of Weighings	1	2	3	4	5	6	7	8	9	10	11	12	Total in Pounds
4-16													
4-30		0.8					0.4		1.4				2.6
5-8		0.8	1.4			0.6	0.5	1.2	0.3				4.8
5-16		0.7	0.1	0.4		0.6	0.2	0.6	0.0			0.3	2.9
5-22		0.5	0.1	0.6		0.2	0.3	0.3	0.2			0.0	2.2
5-29		0.2	0.7	0.2		0.0	0.3	0.4	0.1			0.8	2.7
6-5		0.1	1.1	0.2		0.6	0.1	1.0	0.1			0.2	3.3
6-12		1.8	0.7	0.2		0.3	0.4	0.1	0.0			0.2	3.7
6-19	0.3	0.8	1.0	0.1	0.0	0.6	0.3	1.0	0.0	0.0	0.0	0.3	4.4
6-26	0.1	0.3	0.6	0.0	0.0	0.5	0.0	0.4	0.0	0.0	0.0	0.3	2.2
7-3	0.0	0.7	0.5	0.4	0.1	0.8	0.2	0.4	0.0	0.0	0.0	0.5	3.6
7-10	0.1	1.3	0.1	0.6	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.7	3.1
7-17	0.3	0.6	0.3	0.1	0.0	0.0	0.0	0.4	0.1	0.0	0.3	0.5	2.6
7-24	0.0	0.7	0.5	0.1	0.0	0.0	0.1	0.5	0.0	0.0	0.1	0.2	2.2
7-31	0.1	0.4	0.3	0.0	0.0	0.3	0.0	0.1	0.0	0.0	0.0	0.2	1.4
8-7	0.0	0.4	0.3	0.2	0.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0	1.3
8-14	0.1	0.2	0.0	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.4	0.1	1.3
8-21	0.0	0.0	0.7	0.0	0.0	0.2	0.2	0.1	0.0	0.3	0.0	0.1	1.6
8-28	0.0	0.7	0.4	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	1.6
9-4	0.1	0.6	0.2	0.0	0.0	0.0	0.0	0.2	0.1	0.3	0.0	0.0	1.5
9-11	0.3	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	1.2
9-18	0.0	0.3	0.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.2	1.1
													51.3

TABLE V

DEER SALT STATION CONSUMPTION DATA FOR 1952

Date of Weighings	1	2	3	4	5	6	7	8	9	10	11	12	Total in Pounds
4-8													
4-15	0.4	0.3	0.7	0.4	0.0	0.5	0.2	0.7	0.0	0.6	0.0	0.4	4.2
4-22	0.1	1.2	0.8	0.4	0.5	0.3	0.7	0.4	0.2	0.8	0.0	1.0	6.4
4-29	0.7	1.8	1.9	0.5	0.2	0.3	0.3	0.9	0.0	1.0	0.1	0.5	8.2
5-6	0.6	1.8	1.3	0.2	0.1	0.3	0.2	0.9	0.0	1.2	0.2	1.0	7.8
5-13	0.6	1.0	1.5	0.8	0.1	0.1	1.0	0.8	0.3	0.7	0.7	0.6	8.2
5-20	0.8	2.2	2.3	0.4	0.0	0.6	1.0	0.8	0.3	1.2	0.9	0.7	11.2
5-27	2.0	0.4	1.5	0.2	0.6	0.3	0.4	1.0	0.1	0.2	1.0	0.5	8.2
6-3	0.5	0.9	1.6	0.5	0.2	0.5	1.1	0.5	0.1	0.5	1.5	0.4	8.4
6-10	0.2	0.9	1.5	0.5	0.3	0.5	0.7	0.6	0.1	0.5	0.3	0.1	6.2
6-17	0.6	1.5	1.8	0.7	0.3	0.8	1.2	1.3	0.1	1.2	2.2	0.3	12.0
6-24	0.8	1.3	1.4	0.1	0.3	0.1	0.6	1.4	0.6	1.0	1.0	0.5	9.1
7-1	1.3	0.6	1.5	0.7	0.4	0.4	0.9	1.1	0.4	0.6	1.1	0.3	9.3
7-8	0.1	1.0	0.7	0.6	0.1	0.2	0.5	0.5	0.3	0.1	0.7	0.2	5.0
7-15	0.3	1.1	0.8	0.3	0.0	0.0	0.7	0.7	0.2	0.4	0.3	0.1	4.9
7-22	0.1	1.4	1.3	0.4	0.1	0.1	0.5	1.3	0.0	0.0	0.6	0.3	6.1
7-29	0.5	0.5	0.4	0.4	0.1	0.0	0.3	0.4	0.1	0.3	0.4	0.2	3.6
8-5	0.1	0.6	0.8	0.2	0.1	0.1	0.6	0.2	0.0	0.3	0.3	0.1	3.4
8-12	0.4	0.6	0.5	0.2	0.1	0.1	0.1	0.3	0.1	0.4	0.5	0.1	3.4
8-19	0.3	0.5	0.7	0.2	0.2	0.1	0.5	0.2	0.0	0.3	0.1	0.1	3.2
8-26	0.3	0.2	0.2	0.3	0.0	0.0	0.2	0.5	0.0	0.5	0.1	0.1	2.4
9-2	0.3	0.3	0.3	0.2	0.1	0.1	0.3	0.1	0.1	0.0	0.0	0.1	1.9
9-9	0.2	0.7	0.6	0.0	0.0	0.2	0.1	0.5	0.0	0.3	0.0	0.2	2.8
9-16	0.0	0.0	0.4	0.1	0.1	0.1	0.0	0.3	0.0	0.0	0.4	0.0	1.4
													137.3

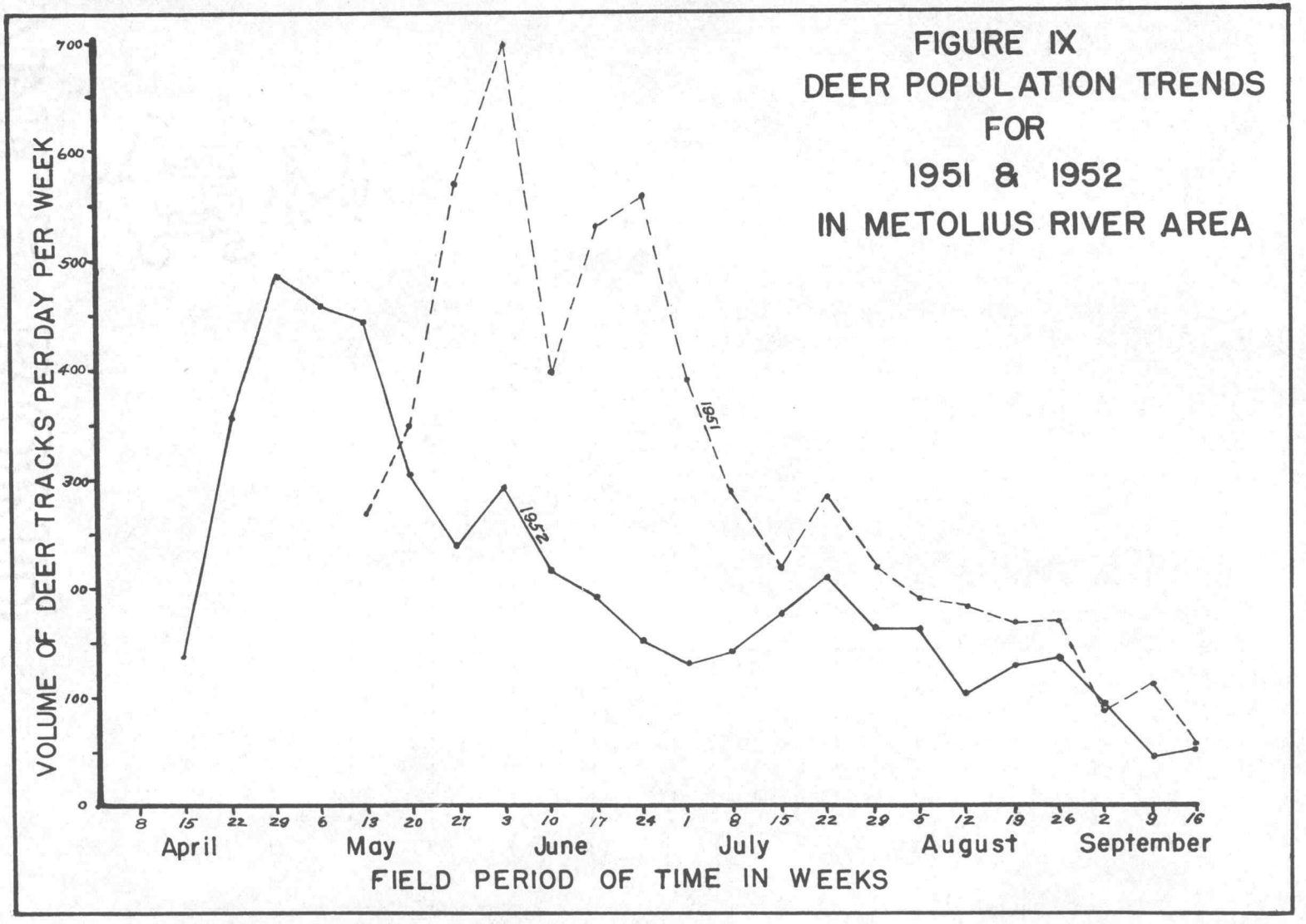
FIGURE IX
DEER POPULATION TRENDS
FOR
1951 & 1952
IN METOLIUS RIVER AREA
VOLUME OF DEER TRACKS PER DAY PER WEEK
700
600
500
400
300
00
100
0
1951
1952
8 15 22 29 6 13 20 27 3 10 17 24 1 8 15 22 29 5 12 19 26 2 9 16
April
May
June
July
August
September
FIELD PERIOD OF TIME IN WEEKS

TABLE VI

RESULTS OF DEER TRACK COUNT SHOWING POPULATION TRENDS

Date-1951	Weekly Count	Date-1952	Weekly Count
		4-14	138
		4-21	361
4-30	269	4-28	487
5-8	336	5-5	459
5-15	569	5-12	441
5-21	698	5-19	303
5-28	398	5-26	237
6-4	540	6-2	294
6-11	559	6-9	216
6-18	358	6-16	195
6-25	352	6-23	151
7-2	392	6-30	131
7-9	287	7-7	138
7-16	216	7-14	188
7-23	283	7-21	211
7-30	214	7-28	163
8-6	187	8-4	163
8-13	183	8-11	119
8-20	173	8-18	131
8-27	174	8-25	135
9-3	87	9-1	94
9-10	118	9-8	48
9-17	54	9-16	50

second year, figure 10. This seems to imply a "learned taste" for salt.

Salt, if it was a means of holding deer on this experimental summer range, became progressively less effective after the first of July as evidenced by the decreasing trend in deer numbers after that time. The lowest figure in the trend data was 54 and 50 for the two years respectively, occurring late in September. Low salt use of 1.1

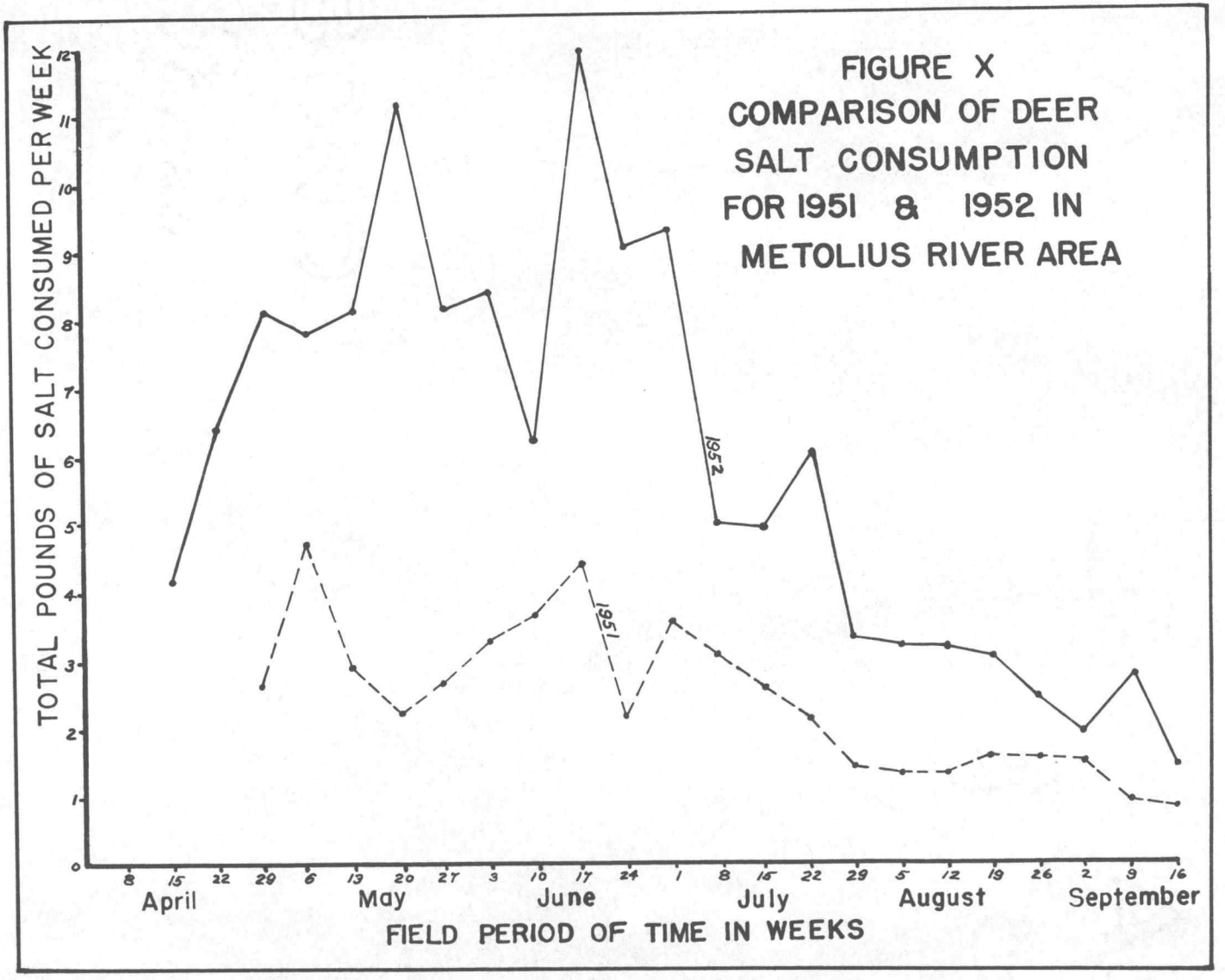
FIGURE X
COMPARISON OF DEER
SALT CONSUMPTION
FOR 1951 & 1952 IN
METOLIUS RIVER AREA
TOTAL POUNDS OF SALT CONSUMED PER WEEK
0
1
2
3
4
5
6
7
8
9
10
11
12
1952
1951
8 15 22 29 6 13 20 27 3 10 17 24 1 8 15 22 29 5 12 19 26 2 9 16
April
May
June
July
August
September
FIELD PERIOD OF TIME IN WEEKS

and 1.4 pounds also occurred during the same time the trends were at their low for the year. This result happened in both years. The demand for salt appears to be of a seasonal influence.

DOMESTIC ANIMAL SALT DEMAND

In 1951 the Lundgren Ranch used ordinary white salt in its combined cattle and horse operation, beginning June 6 and ending September 21. A total of 236.3 pounds of salt was consumed, not including the weathering loss, with 321 Animal Unit Months[4] of use, or an average of 0.74 pounds per animal per month. The cattle consisted of mixed sex and age classes, including bulls, steers, cows, yearling heifers and calves, with cows predominating. None of the calves were considered in computing the number of animal units of use on the salt as their supply comes from the cows.

At the same ranch in 1952, 263.8 pounds of salt consisting of a mixed variety of iodized, white and bone meal, during a period from April 24 to September 19, were consumed. A 70 per cent correction factor was necessary for the bone meal blocks because that type contains only 30 per cent

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[4] Animal Unit Month--a term employed in range management defining the period that one adult animal utilizes a unit of range, based on a 30 day month.

salt. The stocking rate was 437 Animal Unit Months giving an average of 0.62 pounds of salt per animal per month.

Stock was introduced on the Lundgren pastures five weeks earlier in 1952 than in 1951 making artificial feeding of hay necessary twice during the summer period due to a grass shortage. The fact that alfalfa hay is known to have a higher salt content than many of the other forage plants in the dry state could partially account for the reduced salt consumption in the second year (6, p.11). The salt use by horses is generally higher than cattle when considered on an individual basis. Since 13 horses were present each year, a volume difference in salt consumption was justified when comparing the two ranches in the study (16 p. 74).

Black Butte Ranch employed four types of salt in their cattle operations, iodized, mineralized, sulfurized and bone meal, with the last type having the necessary 70 per cent correction factor applied. Weathering losses were again not included in the following totals. An average of 0.66 pounds of salt per animal per month was obtained from 902 A.U.M. of use and a consumption of 600.3 pounds of salt in 1951. In 1952, 948.3 pounds were consumed, with 1761 A.U.M. of use, or an average of 0.54 pounds per animal per month.

When a comparison of the two yearly averages at both

ranches were made, the consumption per animal varied greatly. The Lundgren ranch dropped from 0.74 in 1951 to 0.62 pounds in 1952, and at the Black Butte Ranch the salt demand was reduced from 0.66 to 0.54 pounds of salt per animal month during the same periods. The principle reason for employing this average figure of salt consumption in reference to livestock was the variation in salt demand of individual animals due to size, age and sex differences. These differences were in addition to the influence of the soil, forage and climatic conditions affecting salt consumption. The average results were the best possible available indication of the salt demand for a specific region, without making an intensive controlled experiment.

In analyzing the domestic animal salt consumption from both ranch sources, no apparent heavy spring seasonal demand occurred which was followed by continued decreasing use into the fall. This pattern of use is normally expected on dry ranges. Experiments in Kansas with two-year-old steers showed their salt requirement to be 2.83 pounds per head per month in the spring but only 1.20 in October (9, p.181). Chapline and Talbot recommended 2.0 to 2.5 pounds of salt per head per month for range cattle in the western states when the feed was succulent but only 1.0 to 1.5 pounds later in the season (4, p.30). Since the pastures at both ranches used in this study were in a

succulent stage for the entire season no pronounced decline was perceptible in the salt data as the season advanced. Deer salt consumption, however, did coincide with the pattern described by Chapline and Talbot because their food habits must conform to the natural condition of the vegetation, thus reflecting the changing degree of succulence through the season.

A source of salt consumption data on sheep was also obtained in 1952. A flock of 2600 ewes and lambs were being grazed on the United States Forest Service allotment adjoining, and to the west of the deer study area. With 1200 adult ewes in the band a total of 2000 pounds of salt was used covering a five month period, May 20 to October 20. An average of 0.30 pounds of salt per sheep per month was consumed. Lambs were not considered as making any definite salt demands in this instance and therefore were not included when the average was computed.

When the final results of the three groups of domestic animals were compared with the standards as given by Mitchell for the National Research Council, a low intake of salt was evident in each case (16, p.74). A low intake was considered to be a value significantly below the normal animal salt intake and the same applies to a condition of high consumption as given in table VII. These council standards were compiled from the most reliable sources in

the field of animal nutrition up to 1937, covering the United States as a whole.

When results from the Black Butte Ranch were compared to the standards in table VII the following factors had some bearing on those results. Cattle on this ranch were divided into 325 cow months and 577 steer months of salt use to give the average of 0.66 pounds of salt consumed per animal month in 1951. In 1952 the result was 0.54 pounds of salt per animal month with the classes segregated into 653 cow months and 1108 steer months of salt use. If the ranch consumption data is compared with those listed in table VII, the value for steers, 0.84 pounds, was considerably higher than the 0.66 and 0.54 pound average obtained from the Black Butte Ranch. As was mentioned, cows formed approximately a third of the animals using the salt and normally would have an even higher salt demand than steers. Thus a statement can be made that in general the combined salt consumption was below normal average for cattle on this ranch during the two years.

At the Lundgren Ranch the stocking was heavier in cows to give the 0.74 pounds per animal month in 1951. There were 213 cow months, 59 steer months and an additional 49 horse months of salt use. Results for 1952 showed 0.62 pounds per animal month with the classes broken down into 277 cow months, 97 steer months and 53 horse months of salt

use. Both cows and horses as individual classes normally consume more salt than steers as shown by the values in table VII. Yet, in the combined total, the average salt demand of horses and cattle was lower by 0.10 pounds when the higher value of 0.74 was used for comparison.

Comparison of the data obtained from the combined horse and deer salt use with the horse standards showed a difference of 0.70 pounds to exist between 2.6 pounds and 3.3 pounds of salt. Since a large amount of deer salt use was included in the data taken from the study area, the actual amount taken only by horses was considerably lower than the 2.6 had indicated. The amount taken by deer alone was impossible to segregate, but was known to be large. Horses as a group here were then concluded as taking a lower than normal supply of salt.

When the values for sheep were weighed against the standards, a low rate of salt consumption was indicated also. Since the band of sheep consisted of 1200 ewes with their lambs, the contrast was made using the value of 0.78 pounds for pregnant ewes. The result obtained from this flock was 0.30 pounds of salt consumed per animal month. A wide difference of 0.48 pounds existed between the standard and the average found in this specific flock of sheep. As a conclusion, sheep as well as the other types of domestic animals can be said to make lower salt demands

TABLE VII

COMPARISON OF DOMESTIC ANIMAL SALT STANDARDS WITH STUDY RESULTS

National Research Council Nutrition Standards	Animal Salt Data from Metolius Valley Region
Cattle Cows--1.8 to 7.5 lb/head/month Steers--.84 lb/head/month on Pasture--1.2 to 2.8 lb/head/month	Cattle Black Butte Ranch 1951--0.66 lb/head/month 1952--0.54 lb/head/month Cattle and Horses Lundgren Ranch 1951--0.74 lb/head/month 1952--0.62 lb/head/month
Horses 3.3 to 3.75 lb/head/month	Horse and Deer 1952--2.6 lb/head/month
Sheep Winterfed lambs--.33 lbs/head/month Pregnant ewes--.78 lbs/head/month	Sheep ewes with lambs 1952--0.30 lb/head/month

for the Metolius region.

Results were obtained on a dry range cattle salting program from the Squaw Butte-Harney Range Experiment Station near Burns, Oregon. The average volume of salt consumed by 128 yearling steers was 0.04 pounds of salt per head per day or 1.2 pounds per month during the period

May 14, 1952 to September 15, 1952 (11). Direct comparison of these data to the Metolius Valley cattle salting information has to be qualified since the ranges employed in the Camp Sherman area were not in a dry state. If cattle normally take more salt when fed on green succulent forage the average rate of salt consumption of 0.66 and 0.54 pounds obtained certainly was low by the standards of 1.2 to 2.8 pounds shown in table VII. The rate of salt demand obtained from the dry range near Burns is considerably higher and near the standard. Thus, the results point toward a reduced need for salt supplements by both deer and livestock in the regions immediately adjacent to the Cascade Mountains of central Oregon. This statement is supported in the case of cattle by the above dry range data and for deer by the results as listed in table III taken from dry range areas. Data from the table showed an average of from 0.30 to 0.37 pounds of salt consumed per deer month for the dry range areas and 0.17 to 0.18 for the ranges receiving higher precipitation.

So many variants exist affecting the mineral composition of forage plants, that when comparisons of animal salt consumption are made from one region to another they should be weighed according to the factors governing such composition. Orr of Scotland, in his pasture studies, found that the wide differences in mineral content of

pasture plants were dependent upon the species of plant, the stage of growth, climatic conditions and the nature of the soil (19, p.33). Such factors would certainly affect the salt demands of all animals regardless if kept under pasture conditions or not.

Deer competition for cattle salt in the Metolius River area was found to be practically non-existent. Occasionally deer were seen on the two cattle ranches included in the study as were other evidences of their presence on the other ranches in the valley. At no time did their desires for salt amount to any measurable volume on these ranches. The characteristic deer tongue impressions were never found on the salt blocks even to a slight degree. Judging from the low intake of from ¼ to 1 ounce per deer visit found in the vicinity of the ranches, many deer have to be present to utilize a sufficient amount of cattle salt before that loss could be measured. These results were obtained by direct and indirect observation. In no instance were deer observed in concentrations large enough to effect obvious inroads on cattle salt. The individual deer's salt use was found to be very small. Only one instance of heavy deer competition for domestic animal salt was uncovered. This case occurred at Bailey Meadow in the deer study area and involved a few horses and many deer. Deer tongue impressions were in evidence on the salt blocks even though

horses were using them.

DIRECT DEER OBSERVATIONS

On nine different occasions as shown in table VIII, both in the early morning and evening, 25 instances of deer licking salt were observed. Their time spent at salt varied from 7 to 52 minutes each. A total of 631 minutes were spent by these 25 deer, with 12 ounces of salt being consumed in that time. Traces of salt were listed in the tabulations in order to account for the small weights consumed that were not measurable on the scales. Two traces of salt were assigned a value of one ounce so they could be totaled in the amount of salt consumed; otherwise, these quantities would not be included as being taken by the deer. For each 52 minutes spent at the block an ounce of salt was consumed. The deer never took more than one ounce per visit and usually it was much less.

Considerable fighting took place among the deer to gain priority of access to the salt. Competition was extremely keen in the early spring but became less as the season advanced. Longer periods of time elapsed between their visits late in the summer since fewer deer could be found coming to salt during the regularly scheduled morning and evening observation periods each week. Not only did they come less frequently but they spent a shorter time licking

salt. Disturbance would cause a cessation of their activities more easily at this time.

TABLE VIII

A LISTING OF THE OBSERVATIONS OF DEER CONSUMING SALT IN METOLIUS REGION

Date of Occurrence	Deer Numbers	Minutes Spent At Salt	Time of Day (P.D.S.T.)	Amount of Salt Consumed	Sex and Age
5-22-52	1	29	6:15 AM		A. Doe
	2	17			
		17	7:14 AM		A. Does
	1	26	7:14 AM		Y. Buck
	1	28	8:10 AM		Y. Buck
	1	42	8:30 AM		A. Buck
	1	17	9:49 AM	4 oz.	Y. Buck
5-22-52	1	15	7:20 PM		Y. Doe
	1	45	7:27 PM		A. Buck
	1	19	8:26 PM		Y. Buck
	1	13	8:52 PM	2 oz.	A. Doe
5-29-52	1	30	8:43 AM		A. Doe
	1	15	8:43 AM		Y. Doe
	1	24	8:43 AM	Trace*	Y. Buck
6-11-52	1	24	7:14 PM		A. Doe
	1	31	8:25 PM		Y. Doe
	1	21	8:25 PM	1 oz.	Y. Buck
6-26-52	1	52	6:55 AM	1 oz.	Y. Doe
7-3-52	1	44	6:40 PM		A. Buck
	2	25			
		17	8:26 PM	2 oz.	A. Buck
7-9-52	1	21	6:09 AM	Trace	Y. Buck
8-7-52	1	7	7:13 PM	Trace	A. Doe
8-13-52	2	26			
		26	7:02 AM	Trace	Y. Buck
TOTALS	25	631		12 oz.	

*For purposes of tabulation 2 traces were considered an ounce.

Average: Each deer spent 25 minutes and consumed ½ ounce or less.

SUMMARY

Two successive six-month, spring and summer periods in 1951 and 1952 were spent in central Oregon to complete the study. The mule deer salting phase of the investigation received the most intensive work. This work was on an area frequented basically by deer. Establishment of twelve salt stations was completed the first year and the weekly deer track counts were undertaken. The weekly salt consumption data were thus tied to an index of the deer population throughout the period of the study.

Development and testing of a photo-electric deer counting device was undertaken to obtain deer salt use data, employing ordinary light and a small corral the first year. Four major changes were made in the second year as follows: The entrance width was increased; an optical system was added; infra-red cells and filters were employed; and most of the noise resulting from operation was eliminated. The set was designed to count deer without error but did so only on a few occasions.

Salting data were obtained on two ranches simultaneously with the deer study, one having cattle alone and the other with a cattle and horse operation during these same two-year periods. The information was used for comparative purposes to determine whether the domestic animal salt

consumption was abnormal or not.

The salt and water relationships of deer was studied in the Swamp Wells area of the Deschutes National Forest, without conclusive results. Information was obtained on the watering and salt use pattern of deer to a limited extent in both years. The first year the work was carried on at Swamp Wells and the second was located at the China Hat Guard Station of the same national forest.

In the second year, three new aspects of the deer salting problem were introduced. First, the direct observation of deer utilizing salt was carried out at three locations in the Metolius region, two of which employed tree platforms and the remaining one using an enclosed car. Deer reactions and mannerisms, time spent at the stations and amount of salt consumption were recorded. Second, data were obtained on a horse and deer salt consumption problem found in the deer study area. Only a few horses were involved but since the deer outnumbered them by a wide margin the amount of salt consumed by the deer became an important factor. Another feature which helped to foment this salt competition was the long history of salt being placed in the one location. Third, a fire tower cooperative deer salting program was instituted in July of 1952 using eight locations, seven being in the Deschutes National Forest and one in the Ochoco National Forest. The results

were not necessarily conclusive but a higher rate of salt consumption by deer was shown in the dryer regions of central Oregon as compared to the Metolius area, due to regional variations of soil, climate, moisture and plant differences.

CONCLUSIONS

1. The heaviest deer salt demand in 1951 occurred between May 1 and July 10 in the Metolius area, with the peak in deer numbers being reached the last week in May.

2. In 1952 the heaviest deer salt use showed up between May 22 and the first of July, with the peak in deer numbers coming the last week in April and the first week in May. If weather is an influence on the volume of salt consumption its correlation follows: The greatest salt consumption occurred during the spring and summer of 1952, the year of heavier rainfall as compared to 1951.

3. The amount of salt use by the Mule Deer tapered off in both years with the decline commencing the first week in July and continuing to its lowest point in mid-September.

4. Deer numbers, according to the track count index, were at their lowest point in mid-September, coinciding with the low salt demand.

5. A distinct salt use habit on the part of deer was evident in the second year, occurring without any major change in deer numbers.

6. The indications were that salting as a means of holding deer on the experimental range became progressively less effective after the first of July. Salt apparently did not prevent a drift to other areas.

7. In the combined cattle and horse salting ranch program, salt consumption averaged 0.74 pounds and 0.62 pounds per animal unit month for the two consecutive years.

8. The cattle ranching operation showed an average salt consumption of 0.66 pounds and 0.54 pounds per animal unit month during the two summer grazing periods.

9. Deer were not a competitive factor for cattle salt at either one of the two ranches where data were collected, nor at any of the other ranches in the Metolius area. In one case deer consumed a sufficient amount of salt placed for horses to be considered a problem during the period when peak deer numbers were present.

10. Domestic animal salt consumption data were compared to the National Research Council Standards on farm animal nutrition and found to be below the normal average for cattle, horses and sheep.

11. Regional variations in salt demand for both deer and livestock in central Oregon pointed toward a higher

salt demand by both groups of animals in the dryer range regions when compared to the Metolius area.

12. Field identification of salt blocks licked by cattle can readily be discerned by the characteristic wide but shallow depressions caused by their tongues, measuring four inches and up in width.

13. In the case of salt blocks licked by deer, field diagnosis can be made by the narrow 1½ to 2 inch depressions, usually deeper than wide, caused by the smaller deer tongue.

14. By direct observation of deer licking salt, an average of slightly less than one-half ounce of salt per deer visit was seen consumed during the 1952 spring and summer season in the Metolius valley.

15. With the aid of the photo-electric deer counting device plus the indirect track observations, an average of one-quarter of an ounce of salt per deer visit was found to be consumed in the deer study area at one salt station during the 1952 summer period.

BIBLIOGRAPHY

1. Anderson, I.V. and R.M. West. The distribution of salt for game animals. United States Forest Service, Northern Rocky Mountain Region Field Notes on Wildlife 2(7), 1941. 4p.

2. Babcock, S.M. The addition of salt to the ration of dairy cows. Madison, University of Wisconsin, 1905. pp.129-156. (Wisconsin Agricultural Experiment Station Annual Report No.22)

3. Bentley, J.L. Automatic recording of salting and watering habits of cattle. Journal of Forestry 39: 832-836. 1941.

4. Chapline, W.R. and M.W. Talbot. The use of salt in range management. United States Department of Agriculture, Department Circular 379, 32p. 1926.

5. Chase, G.W. The use of salt in controlling the distribution of game. Journal of Wildlife Management 2:74-81. July, 1938.

6. Fraps, G.S. and Lomanitz. The salt or sodium chloride content of feeds. College Station, Texas Agricultural and Mechanical College. 1920. 11 p. (Texas Agricultural Experiment Station Bulletin 271)

7. Gallaher, Charles. Some observation on game salting. United States Forest Service, Northern Region News. October, 1938. pp.27-28.

8. Goss, Alfred. Ash analysis of some New Mexico plants. New Mexico College of Agriculture and Mechanical Arts, 1903. 14p. (New Mexico Agricultural Experiment Station Bulletin 44)

9. Hensel, R.L. The best kinds and grades of salt to use. 1921, 181p. Sanders Publishing Company, Chicago, Illinois. Breeder's Gazette 80.

10. Honess, R.F. and N.W. Frost. A Wyoming Big Horn Sheep study. 1942, 127p. Cheyenne, Wyoming. (Wyoming Game and Fish Department Bulletin No.1)

11. Hubbard, F.E. Personal communication of October 3, 1952.

12. Lantow, J.L. The assimilation of calcium and phosphorus from different mineral compounds and their effect on range cattle. Las Cruces. New Mexico College of Agriculture and Mechanical Arts, 1933. 19p. (New Mexico Agricultural Experiment Station Bulletin 214)

13. Leopold, A.S., T. Riney, R. McCain and L. Tevis. The Jawbone deer herd. 1951. 139p. (Sacramento, California Department of Fish and Game, Game Bulletin No. 4)

14. Lommasson, T. The value of salt on alkali ranges in southeastern Montana, 1929. 3p. Spokane, Washington (Northwestern Scientific Association Paper)

15. Mace, Robert. Personal communication of August 20, 1952.

16. Mitchell, H.H. and F.J. McClure. Mineral nutrition of farm animals, 1937. p.74. National Research Council Bulletin 99.

17. Morrison, F.B. Feeds and feeding. 20th Edition. New York, Morrison Publishing Company, 1936. 1207 p.

18. Nichol, A.A. Experimental feeding of deer. Tucson, University of Arizona, 1938. 39p. (University of Arizona Technical Bulletin 75)

19. Orr, J.B. Minerals in pastures and their relation to animals nutrition. London, H.K. Lewis & Company, 1929. 150p. (Rowett Research Institute, Aberdeen, Scotland)

20. Stoddart, L.A. and A.D. Smith. Range management. 1st Edition, New York. McGraw-Hill, 1943. 547p.

21. Young, V.A. and W.L. Robinette. A study of the range habits of elk on the Selway game preserve. Moscow, University of Idaho, 1938. 48p. (University of Idaho Bulletin Vol.34 No.9)

APPENDIX A

LUNDGREN RANCH CATTLE AND HORSE SALTING DATA--1951

Date of Weighings	1	2	3	4	5	6	Totals	Animal Weeks on Pasture
	Station Numbers							
6-6								
6-11	.4	.2	1.7				2.3	46
6-20	.3	.3	6.9				7.5	46
6-29	.5	4.9	0.1				5.5	46
7-5	2.0	3.5	1.3				6.8	46
7-12	1.5		0.8				2.3	46
7-20	7.9		6.9				14.8	98
7-27	14.4		10.9				25.3	98
8-3	12.2		5.1				17.3	109
8-10	7.0		6.1				13.1	109
8-17	13.5		2.1	2.0	8.1	9.7	36.2	109
8-24	9.5		1.3	0.0	1.1	2.8	14.7	106
8-31	22.5		6.2	1.5	1.8	4.5	36.5	106
9-7	4.0		9.8	0.6	1.9	2.5	18.8	106
9-14	6.2		1.3	0.3	1.4	4.8	14.0	106
9-21	7.0		10.7	1.1	0.7	1.7	21.2	106
							236.3 pounds	1283 weeks

$$\frac{248.1}{321} = .74 \text{ \# Salt Consumed / AUM}$$

$1283 \div 4 = 321$ AUM

321 AUM composed of:
- 213 cow months
- 59 steer months
- 49 horse months

APPENDIX B

LUNDGREN RANCH CATTLE AND HORSE SALTING DATA--1952

Date of Weighings	Salt Station Numbers 1	2	3	4	5	6	7	8	9	10	Totals	Animal Weeks on Pasture
4-25												
5-2	1.3	0.4	0.0								1.7	36
5-9	1.2	0.6	1.2	4.0	4.6						11.6	74
5-16	0.9	0.6	6.3	2.3	2.1						14.9	73
5-23	0.4		7.4	5.4	10.3						23.5	105
5-30	0.8		4.0	9.2	5.5						19.5	105
6-6	1.0		4.3	5.9	4.0						15.2	105
6-13	0.1		2.9	9.5	3.5	2.2					15.5	107
6-20	0.9		1.6	2.9	4.3	2.2	4.5				16.4	108
6-27	0.3		0.7	2.9	3.0	2.2	4.6				13.7	108
7-4	1.3		0.5	2.0	4.6	3.4	3.1				14.9	108
7-11	0.1		0.0	6.0	6.0	1.0	1.6				14.7	72
7-18	1.0		0.4	0.4	3.5	0.5	1.3				7.1	72
7-25	0.0		0.1	4.4	0.1	0.1	2.9	1.0	1.0		9.6	72
8-1	0.4		0.5		0.4	0.1	2.0	2.0	4.7		10.1	71
8-8	0.8		0.0		0.0	0.0	2.2	1.6	5.8		10.4	71
8-15	0.0		0.0		0.0	0.2	1.6	0.7	10.3	1.2	14.0	71
8-22	0.7		0.0		0.0	0.0	2.8	2.8	1.3	1.0	8.6	71
8-29	0.1		0.0		0.8	0.5	1.4	2.0	1.7	0.6	7.1	71
9-5	0.0		0.0	8.0	2.5	1.4	0.0	0.2	0.7	0.0	12.8	71
9-12	0.3		0.4	3.7	7.6	1.0	2.6	0.8	0.8	0.0	17.2	71
9-19	0.4		0.1	0.0	0.0	0.0	1.7	0.3	2.8	0.0	5.3	67
											263.8#	1709 weeks

1709 ÷ 4 = 427 A.U.M. 263.8 ÷ 427 = .62 pounds salt consumed/AUM
427 AUM composed of 277 cow months, 97 steer months, 53 horse months

APPENDIX C

BLACK BUTTE RANCH CATTLE SALTING DATA--1951

Date of Observations	Station Numbers												
	1	2	3	4	5	6	7	8	9	10	11	12	13
6-14													
7-6	22.8	13.1	3.5		8.2					8.5	4.7		
7-12	13.0	4.9	1.7		2.5					4.5	2.2		
7-20	14.7	4.9	0.8		0.4					2.2	4.3		
7-27	8.7	2.9	1.9	5.0	6.7	4.0	1.7	0.8		2.4	1.5		
8-3	5.8	2.5	2.1	4.9	4.0	3.2	4.8	2.0	1.6	7.0	3.8		
8-10	5.8	2.5	2.2	3.3	1.8	1.8	1.7	0.0	1.9	2.5	1.4		
8-17	1.0	2.1	2.8	4.8	2.4	3.2	4.0	1.4	2.4	2.4	2.0		
8-24	5.2	1.3	1.1	2.0	0.9	1.6	0.5	0.9	2.3	2.4	2.0		
8-31	8.4	1.6	2.8	1.8	2.1	1.7	3.6	1.8	2.7	2.7	1.9	0.0	3.2
9-7	16.5	17.8	1.3	1.8	2.4	2.3	0.5	0.8	1.6	4.0	2.3	0.0	1.0
9-14	14.8	16.7	1.8	2.0	1.1	1.7	1.4	1.3	0.7	2.1	2.9	0.7	2.2

Appendix C continued on Page 74

APPENDIX C--continued

Date of Observations	Station Numbers 14	15	16	17	18	19	20	21	Totals	Stocking Rate in A.U. weeks
6-14										
7-6		11.8							72.6	621
7-12		3.2							32.0	207
7-20		6.0							33.3	207
7-27		5.0			7.0				47.6	280
8-3		4.2	3.2	3.0	6.8	1.8			60.7	311
8-10		2.2	4.6	3.2	4.0	5.1			44.0	311
8-17		1.0	2.9	3.0	2.5	4.0			41.9	311
8-24		2.3	2.2	1.2	2.4	4.1			32.4	311
8-31	0.0	4.5	4.5	6.3	4.4	2.5	6.4	8.7	71.6	331
9-7	0.0	2.6	3.4	5.4	4.8	6.8	5.0	9.4	89.7	381
9-14	0.8	2.3	0.9	3.7	2.1	4.3	4.6	6.4	74.5	339
									600.3#	3610 weeks

3601 ÷ 4 = 902 A.U.M. 600.3 ÷ 902 = .66 pounds/A.U.M.

902 A.U.M. composed of 325 cow months and 577 steer months.

APPENDIX D

BLACK BUTTE RANCH CATTLE SALTING DATA--1952

Date of Observation	Station Number 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
4-25																
5-2	2.6															
5-9	7.7															
5-16	4.4															
5-23	3.3															
5-30	6.8				6.0											
6-6	14.8	11.2	13.0		28.5	3.1	1.6	4.5	2.8		5.5	5.8		5.5	6.0	
6-13	0.8	6.1	4.7		12.2	7.5	6.7	5.2	4.3		11.8	9.5		6.4	8.5	
6-20	1.2	3.2	6.2	1.6	0.2	7.0	9.7	10.2	6.9	1.6	14.3	13.2	1.9	9.7	6.5	1.5
6-27	2.9	5.8	5.4	3.5	1.8	8.5	10.0	6.3	5.5	3.2	2.2	9.2	6.9	10.1	5.9	4.5
7-4	1.6	3.3	4.2	5.4	4.8	5.9	7.2	5.5	5.5	6.0	9.8	1.2	9.6	6.3	1.4	4.4
7-11	1.0	2.5	2.0	2.9	3.2	3.2	2.2	5.0	3.3	3.7		2.0	4.2	4.7	6.7	3.7
7-18	0.6	1.1	2.0	2.4	3.8	3.9	4.5	4.6	2.8	4.1		1.6	5.4	3.9	4.1	4.0
7-25	0.9	1.2	2.3	3.1	2.7	4.6	2.5	2.2	3.4	5.2		3.5	6.6			8.3
8-1	1.1	0.3	6.2	2.1	5.3	2.8	2.5	2.6	3.0	4.7		1.0	5.2			9.2
8-8	5.4	1.2		1.5	5.8	1.8	0.9	2.0	2.8	3.0	0.9	1.0	3.4		4.0	7.4
8-15	3.2	2.7		4.4	4.9	4.0	3.9		2.2	5.0	2.9	4.1	1.5		6.6	2.3
8-22	4.6	2.4		4.6	0.1	3.4	2.2		2.0	4.3	4.8	5.9			5.8	2.3
8-29	5.0	4.8		3.5	7.6	3.3	3.0		0.9	2.8	3.0	2.6			5.8	
9-5	4.7			3.0	2.5	3.3	2.4		1.0	2.1	1.2	2.4			3.6	
9-12	6.8			2.8	3.4	5.6	5.0			1.2	6.0	6.2			5.2	
9-19	6.2			2.9		4.0	4.5				4.4	8.5			3.1	

Appendix D continued on page 76

APPENDIX D--continued

Date of Observation	Totals	Stocking Rate in A.U. weeks
4-25		
5-2	2.6	11
5-9	7.9	11
5-16	4.4	11
5-23	3.3	58
5-30	12.8	227
6-6	102.3	497
6-13	83.7	470
6-20	94.9	477
6-27	91.7	477
7-4	82.1	477
7-11	45.8	477
7-18	48.8	426
7-25	46.5	442
8-1	46.0	442
8-8	41.1	442
8-15	47.7	442
8-22	42.4	442
8-29	42.3	373
9-5	26.2	280
9-12	42.2	280
9-19	33.6	280
	948.3	7042

7042 ÷ 4 = 1761 A.U.M. 948.3 ÷ 1761 = .54#/A.U.M.

1761 A.U.M. composed of 653 cow months and 1108 steer months