THE INFLUENCES OF LOGGING PRACTICES ON COLUMBIAN BLACK-TAILED DEER IN THE BLUE RIVER AREA OF OREGON

by

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INTRODUCTION

An investigation concerning the influence of logging practices on Columbian black-tailed deer, Odocoileus hemionus columbianus (Richardson), (17, p. 799), was conducted during the period July 25, 1955, to September 12, 1957, on the H. J. Andrews Experimental Forest, Blue River, Oregon (Figure 1). The main objectives were to determine migrational habits, distributional patterns and site preferences of deer, and to evaluate the suitability of habitat changes in the area for deer. A nutritional project on deer browse, using percent crude protein as a criterion, related quality to exposure, season, elevation, and light intensity. This program was activated in an attempt to learn the influence, if any, the nutritional value, as indexed by crude protein content, has on deer movements and distribution. Such information would be valuable to the technician in managing deer populations.

Observations and sampling work on deer migrational patterns, population trends, movements within the research area, elevation and slope preference, seasonal habits, and the effects of food availability on population movements to and from the forest were also included.

Newly logged areas have numerically increased in Oregon and in the whole Pacific Northwest. It is known that deer generally favor new openings which are in different stages of plant succession. Since many of these timbered areas have been and will be cut in the Cascade mountains under the sustained yield plan of forest management, it would be advantageous to the game manager to understand the vegetative potential of this region for supporting deer.

Will the study area and similar lands support large populations of deer? Will support be seasonal, with these populations being pushed down into agricultural areas of conflict during the severe winter months? These questions should be answered in order to effectively manage Columbian black-tailed deer in this area.

This investigation marked the beginning of a projected long-term research program which was designed to find answers to these questions. The program was mostly of an observational nature since it was believed that important information could be collected by this method regarding the natural selection, reaction, and preference of deer as they were influenced by logging activities.

Research was conducted under the auspices of the Oregon Cooperative Wildlife Research Unit[1], directed by Mr. Arthur S. Einarsen, biologist of the United States Fish and Wildlife Service and leader of the Unit.

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

LITERATURE REVIEW

The majority of Columbian black-tailed deer studies have been conducted in areas where climate was not severe enough to necessitate deer migrations between definite winter and summer ranges. There was an abundance of literature pertaining to the non-migratory or typical populations of deer, but very little pertaining to migratory herds. Pertinent literature concerning both migratory and non-migratory deer herds was surveyed. Also reviewed was other literature directly related to the study.

Nutrition

Many investigators who have studied the nutritional variations of deer forage plants have used basically the following method: samples were taken from the current growth of plants, oven-dried, and then analyzed to determine percent crude protein. This was done by employing the methods of the Association of Official Agricultural Chemists (1). Only those portions of the current year's growth which were normally taken by the animal were used in analysis.

Bissell and Strong (2, p. 146) recognized the importance of individual plant variations in protein content. They stated that individual plants may vary as much as 20 percent. For this reason they collected twigs from as many plants as possible for each species sampled.

Hundley (14, p. 16, 17) collected samples of deer browse at two-month intervals and made an attempt to correlate these results with soils. This investigator also determined moisture content for browse species. In addition to crude protein and moisture, he determined the phosphorus content, ether extract, ash, crude fiber, and nitrogen-free extract of the species studied.

Swank (22, p. 3, 4), in testing Arizona chaparral browse species for nutritive content, clipped portions of the current twig growth on four dates during the year in order to determine the seasonal levels of nutrition. Samples were taken on burned and nonburned areas to determine differences, if any, of protein levels. A minimum of ten plants were used for each sample to control variance within species.

Hagen (10, p. 166, 173, 174) sampled deer browse species from summer and winter ranges to determine seasonal levels of nutrition. Samples consisted of the terminal two inches of current growth from several plants. The Association of Official Agricultural Chemists' method of analysis was used. Hagen also stated:

> "Chemical analysis of samples of deer forage plants show marked differences in composition of the various species. There are also great differences between the chemical composition of the forage plants utilized by the deer during the summer, and those plants utilized by the deer during the winter. The most significant contrast between 'good' and 'poor' forage species seem to be in crude protein content. Plants preferred by the deer and generally considered the best forage on the basis of range evaluation prove to be consistently high in protein, while the 'emergency' or 'stuffing' feeds are low in protein. Differences in fat and mineral content exist and may have a bearing on palatability and general nutritive value, but seem to be less important than protein content."

Bissell and Strong (2, p. 145, 146) chose crude protein as a primary indicator of the nutritional value of deer browse for the following reasons:

> "(1) Most American feeding standards for domestic ruminants are based upon the crude protein content of the feed, and thus, the benefits of the vast literature on livestock feeding may be utilized. (2) Protein is the foodstuff most important for maintenance and for growth. (3) The crude fiber content of plants is extremely important in influencing the digestibility of crude protein and in supplying energy through its own breakdown into soluble carbohydrates. However, the crude fiber determination was considered too lengthy to be applied to the large number of plant samples being evaluated. (4) Total ash is a meaningless figure in deer nutrition, although useful in the economics of commercial feed production. (5) Fat content of plants as a rule is very low in the plant structures which deer commonly eat, and the importance of fat in ruminant nutrition appears to be of little significance in their case.
>
> "It certainly is true that the approach may be oversimplified, since the calcium/phosphorus ratio, vitamin content, obscure growth factors, and specific amino acids or fatty acids in various plants actually may be limiting factors in deer nutrition."

Biswell, Taber, Hedrick, and Schultz (3, p. 463), working in California, recognized the importance of deer food palatability in relation to vegetative areas which are influenced by different environmental factors. They stated:

> "While the whole question of nutrition has not yet been thoroughly explored, there is evidence to indicate that the opened brush and the heavy brush may be compared for annual diet in the following manner: In the opened brush, the deer have available an excellent diet during four months of the year, foraging on abundant herbs and new sprouts (February-May), a good diet for another four months (November, December, January, June) when some green herbs are available and sprouts are still growing in the spring and early summer,

> and a poor diet during the remaining four months (July-October) when the herbs are dry and the browse plants are more or less dormant. In the heavy brush the deer have access to an excellent diet only two months of the year (April, May) when the brush is growing rapidly, a good diet during two months (March and June) when there is some shrub growth, and a poor diet for eight months (July-February) when there is little growth and the shrubs are largely dormant. In a wildfire burn the amount of succulent browse available in winter depends on when the area burned. If the fire is very late in the season there will be practically no crown sprouting until the following spring."

Bissell and Strong (2, p. 154), Swank (22, p. 13), and others found that protein content was highest at the beginning of the growing season, dropped during the season, and leveled off at a seasonal low during dormancy.

Migrations

Three basic ecological factors have been recognized as influencing migrations: 1) food and water requirements; 2) adverse climatic conditions; and 3) production and rearing of young (11, p. 242). Very little information has been published concerning migrations of the Columbian black-tailed deer. Jones (15, p. 5), who carried out studies in Washington from 1949 through 1953, stated:

> "Records indicate that during the winter when there are snowstorms the deer move off the high open hillsides to the lowlands for protective cover, returning to their home sites when the snow and winter storms abate."

The Oregon State Game Commission (20, p. 2) indicated that although winter concentrations are not common, they do occur in some areas.

Lindzey (16, p. 25), while studying the Columbian black-tailed deer in western Oregon during 1942, found the following to be true:

"The Oregon range has both migratory and non-migratory black-tailed deer, dependent upon topography and weather conditions. The more eastern deer migrate up and down the western slopes of the Cascade mountains, while the deer resident in the coast range of Oregon seldom make any movement even resembling this migration. The spring migration in the Cascades might be described as more of an infiltration, since the return to higher elevations is gradual. The fall migration is a definite movement, probably in direct response to climatic stimuli."

Coffman (6, p. 15) noted the following habits of the black-tailed deer in California:

"With the heavy snows on the higher ranges, the deer descend to the lower elevations and during the winter feed on such bunchgrass and browse as is available, utilizing moss, mistletoe and branches broken off by snow where the more palatable forms of forage are available.

"As the snows melt away they follow the snow line back to the higher ranges and during May and June scatter out through the mountains."

Distribution

The Columbian black-tailed deer generally prefer diversified habitats, containing edges, protective cover, and openings, together with abundant food, water, and moderate weather conditions. These conditions are typified in the Douglas-fir area of western Oregon where logging operations have been and still are extensive. Cahalane (4, p. 42), speaking of the Columbian black-tailed deer on the west coast of North America, recognized burned and logged areas as ideal deer habitat. Trippensee (23, p. 189), speaking of deer in general, gave the following information on deer habitat:

> "Although both the white-tail and the black-tailed deer are classed as forest inhabitants, neither prefers nor subsists well in stands of old-growth timber; both attain their greatest abundance under conditions of cover characterized by a diversity of types and age classes, which include a small representation of non-forested land and considerable areas of dense young stands and brush-land. .....the ideal is composed predominantly of young age classes, and only in regions of extensive lumbering operations, recent in origin, are these preferred conditions to be encountered."

The Oregon State Game Commission (19, p. 1; 20, p. 2), Jones (15, p. 4), and Lindzey (16, p. 55) all agreed that logged-over areas are ideal habitat for the Columbian black-tailed deer.

The period of time logged areas remain in favorable successional stages for deer use is an extremely important factor to consider. Trippensee (23, p. 189), again speaking of deer habitat in general, brought this out in the following statement:

> "Even in extensive recently cutover areas such preferred environmental habitat cannot be maintained longer than the dictates of natural succession permit."

Cowan (7, p. 605) in 1956, referring to the general habitat of Columbian black-tailed deer on the west coast of North America, stated that block cutting in Douglas-fir and hemlock forests produce an excellent diversified habitat where deer populations can thrive and shift as logged blocks grow up and new ones come into being.

Cowan also stated (7, p. 606) that the relationship between elevation and the cycle of logging operations was of major importance when considering the continuation of deer populations. He said that high elevation logging areas where snows drive deer out would not increase or sustain deer but that low, snow-free areas were of major importance.

THE RESEARCH AREA

Lookout Creek Drainage is a small 15,000-acre watershed tributary to the Blue River, which is in turn a tributary to the McKenzie River of Oregon. In 1948 the complete drainage of this creek was set aside by the Pacific Northwest Forest and Range Experiment Station as a laboratory for testing logging methods, reforestation, and watershed management on a commercial scale. This area, which lies within the Willamette National Forest, was named the "H. J. Andrews Experimental Forest." Approximately two-thirds of the drainage is covered by a 400-year-old stand of Douglas-fir, <u>Pseudotsuga</u> <u>menziesii</u> (Mirb.) Franco, timber which is representative of the old-growth forests in the Cascade Mountain Range of Oregon.

Topography

Lookout drainage is in the general shape of a triangle with the apex (pointing west) at the mouth of the stream. It ranges in elevation from 1400 feet at its mouth, to 5250 feet at its northeast terminus, and 5300 feet at Lookout Mountain near the Southeastern corner of the drainage. Lookout Creek heads on the north side of Lookout Mountain. Two main tributaries run into Lookout, Mack and McRae Creeks. Mack heads on the south side of Lookout Mountain and McRae heads at the northeast corner of the drainage. McRae is separated from Lookout Creek headwaters by a low ridge dropping down into the center of the drainage (Figure 1).

In general, the experimental forest is a steep drainage with 60 to 70 percent north slopes being common. South slopes are, on the average, more gentle. There is some rolling and level topography on both slopes at the lower elevations.

Logging Activities

Logging began under the staggered setting system (Figure 2) in May, 1950, with a long term plan in view. A small number of units have been logged each year. From a total of forty-one to date, twenty-seven were used for sampling work. They range in size from 0.7 to 70.5 acres and have been labeled with numbers and letters for identification (Figure 3). Logging was carried out on both north and south slopes and at elevations of from 1500 to 4100 feet. Tractor logging was conducted on slopes averaging from 5 to 20 percent to the landings and high lead logging was used on slopes averaging from 20 to 80 percent to the landings. All units were slash burned after logging had been completed.

Vegetation

The vegetation of Lookout Creek Drainage is associated with sixty to one-hundred inches of precipitation, approximately seventy-five percent of which falls between November and April. Very dry conditions prevail throughout the summer months. The dominant cover

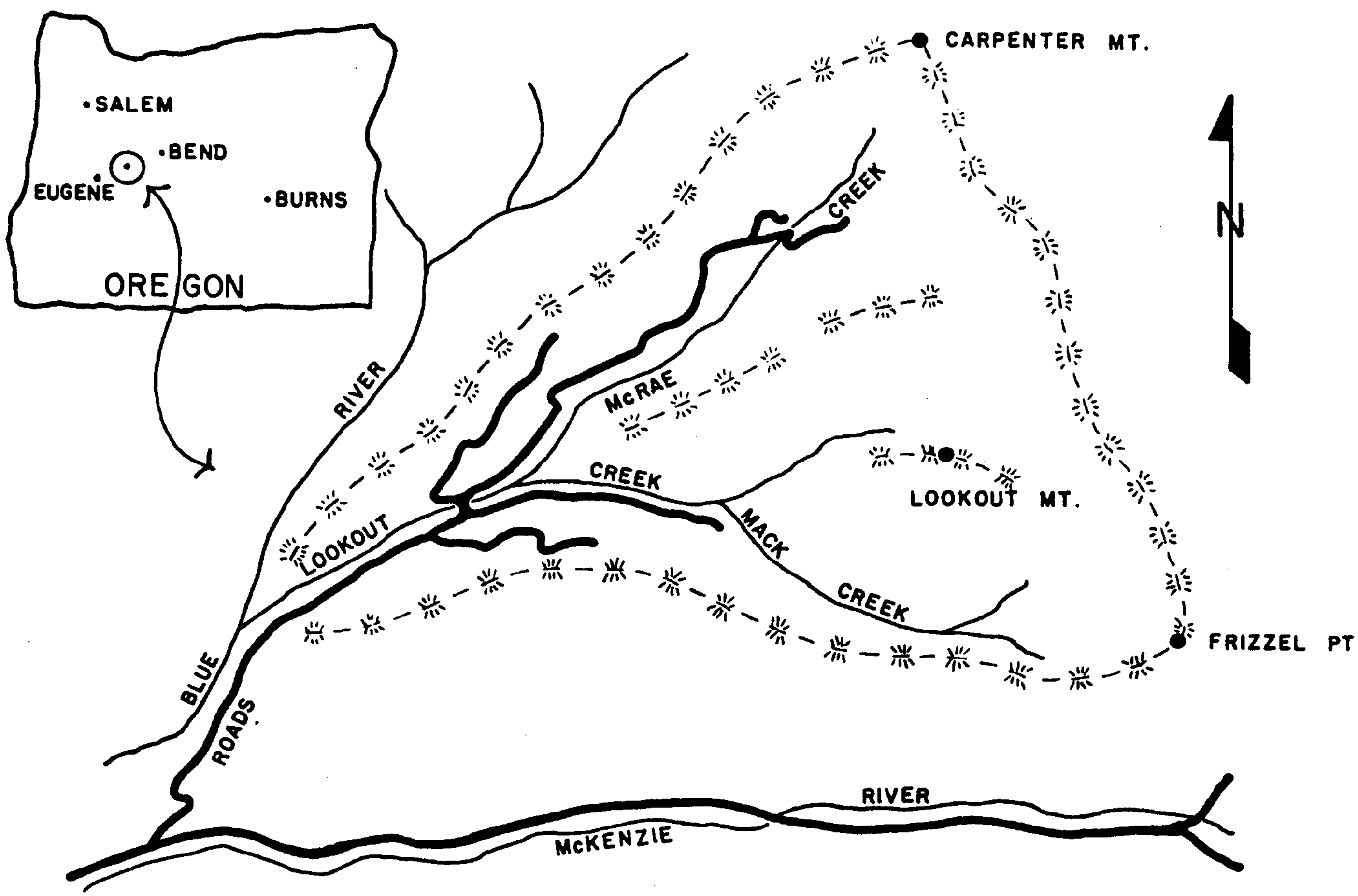

Figure 1. H. J. Andrews Experimental Forest with inset showing the approximate location in Oregon.

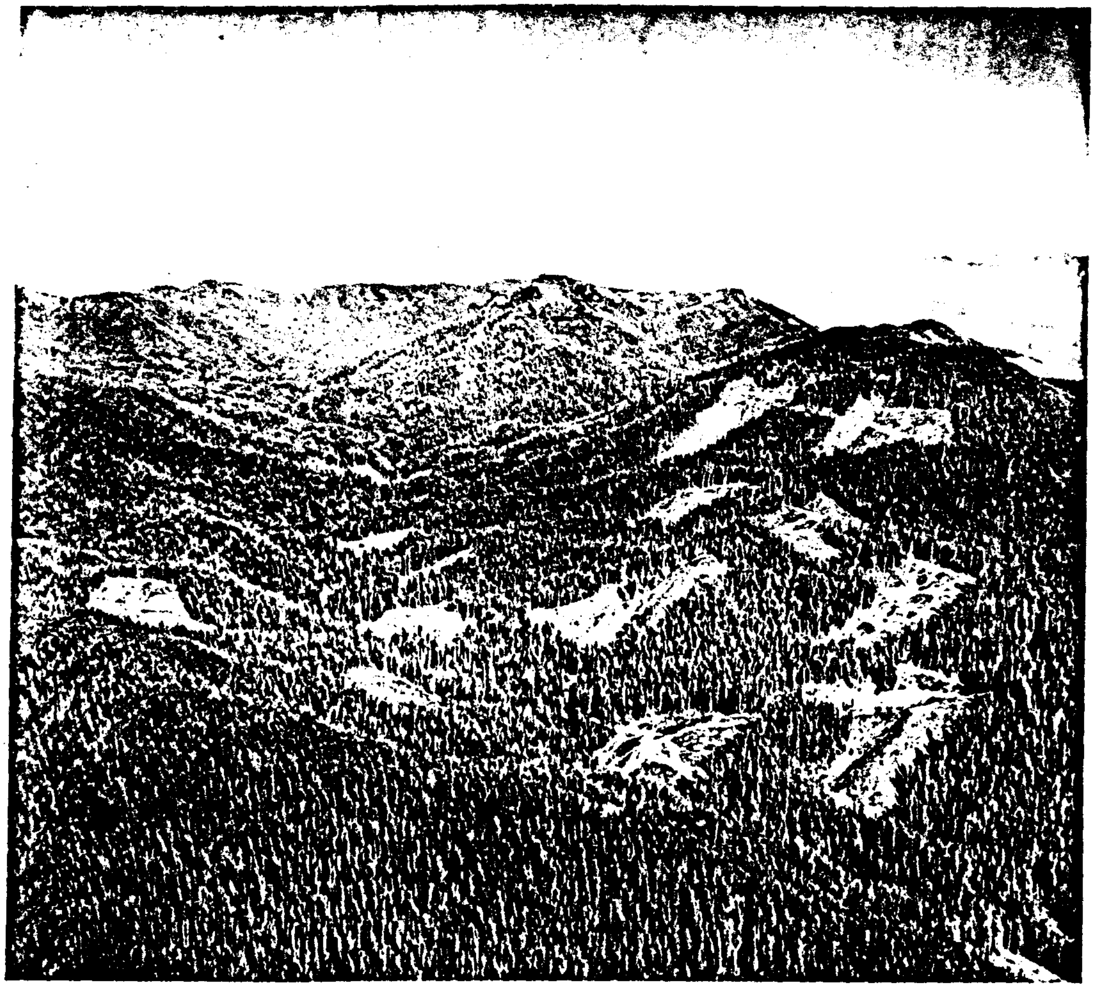

Figure 2. Aerial photograph showing a staggered setting system of logging in the H. J. Andrews Experimental Forest. Photo courtesy of the U. S. Forest Service.

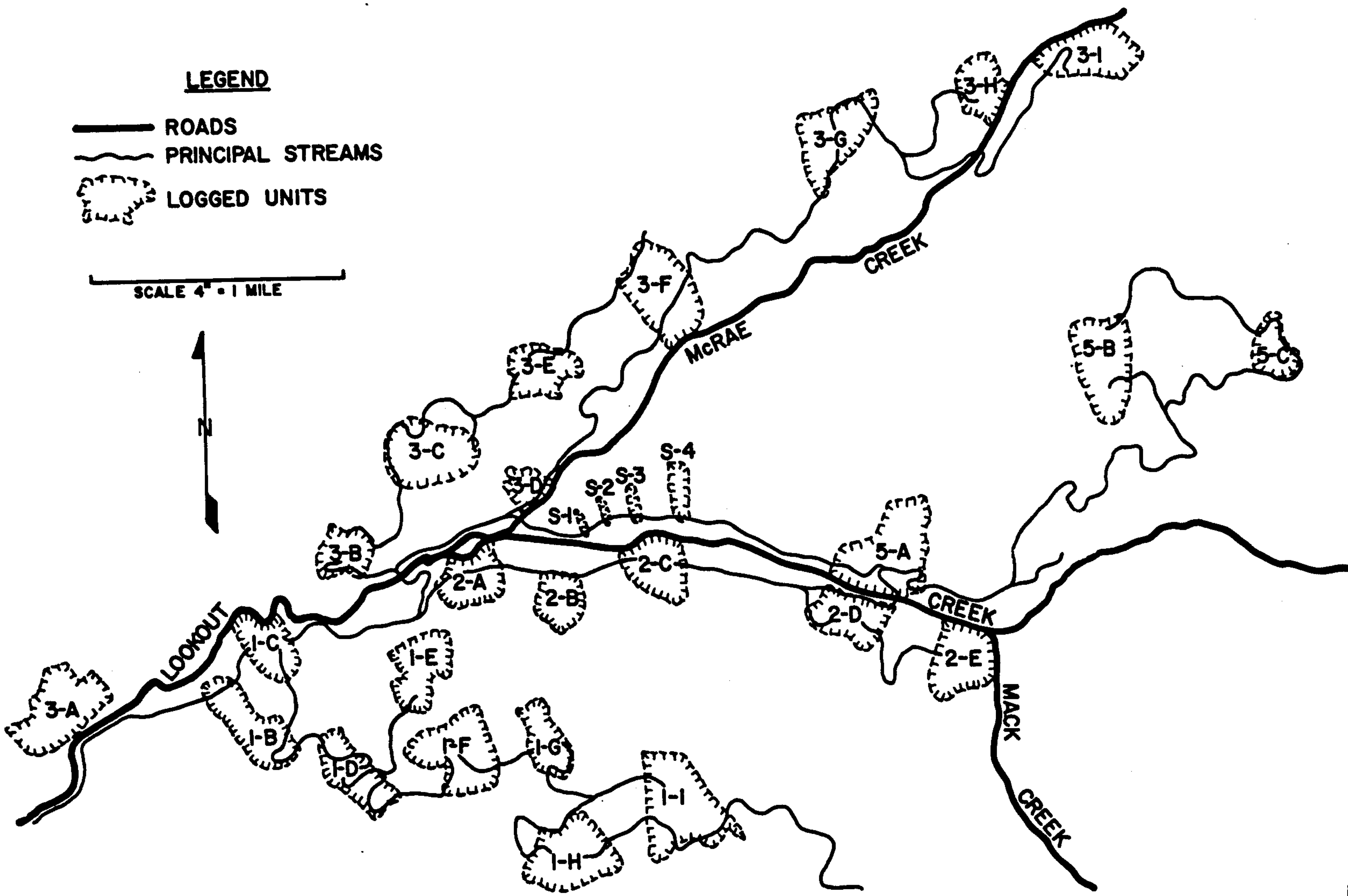

Figure 3. Map of the H. J. Andrews Experimental Forest showing logged units and roads.

consists of Douglas-fir with western red-cedar, Thuja plicata Donn., and western hemlock, Tsuga heterophylla (Raf.) Sarg., scattered throughout. The typical understory consists of vine maple, Acer circinatum Pursh.; Pacific yew, Taxus brevifolia Nutt.; salal, Gaultheria Shallon Pursh.; sword fern, Polystichum munitum (Kaulf.) Presl.; huckleberry, Vaccinium spp.; and wild blackberry, Rubus vitifolius C. & S., (21).

The vegetation in the logged-over areas consists of the residual climax and invading seral species common to the west slope of the Cascades. The more common species are included in the following list:

Bigleaf Maple	Acer macrophyllum Pursh
Vine Maple	A. circinatum Pursh
California Hazel	Corylus californica (A.D.C.) Rose
Willow	Salix spp.
Dogwood	Cornus Nuttalii Aud.
Rhododendron	Rhododendron macrophyllum D. Don
Elderberry	Sambucus spp.
Salal	Gaultheria Shallon Pursh
Hairy Manzanita	Arctostaphylos columbianus Piper
Sticky Laurel	Ceanothus velutinus Dougl.
Blue Blossom	C. thyrsiflorus Esch.
Huckleberry	Vaccinium spp.
Blackberry	Rubus vitifolius C. & S.
Thimbleberry	Rubus parviflorus Nutt.
Western Blackcap	Rubus leucodermis Dougl.
Sword Fern	Polystichum munitum (Kaulf.) Presl.
Fireweed	Epilobium angustifolium L.
Hedge Nettle	Stachys spp.

During the greatest seasonal period of deer use, between June and September, low and medium elevation north slope units are presently characterized by extensive and dense stands of fireweed, abundant vine maple scattered throughout, scattered elderberry, and a spotty profusion of wild blackberry vines. The fireweed gave these units the appearance of having a permanent dense vegetative cover. However, after the fireweed died back in the fall, the units showed a very low percent vegetative cover. High elevation and south slope units were characterized by an open and sparse vegetative cover throughout the year.

Animal Species

Some of the more important mammals (17) and birds (9) found in the H. J. Andrews Experimental Forest are included in the following list:

Mammals	
Columbian black-tailed deer	*Odocoileus hemionus columbianus* (Richardson)
Black bear	*Euarctos americanus altifrontalis* (Elliot)
Cougar	*Felis concolor oregonensis* Raf.
Bobcat	*Lynx rufus pallescens* Merriam
Coyote	*Canis latrans umpquensis* Jackson
Raccoon	*Procyon lotor pacificus* Merriam
Weasel	*Mustela* spp.
Mink	*Mustela vison aestuarina* Grinnell
Beaver	*Castor canadensis pacificus* Rhoads
Porcupine	*Erethizon dorsatum epixanthum* Brandt
Birds	
Sooty grouse	*Dendragapus fuliginosus fuliginosus* (Ridgway)
Ruffed grouse	*Bonasa umbellus sabini* (Douglas)
Mountain quail	*Oreortyx picta palmeri* Oberholser
Band-tail pigeon	*Columba fasciata fasciata* Say
Mourning dove	*Zenaidura macroura marginella* (Woodhouse)
Wood duck	*Aix sponsa* (Linnaeus)

Weather

Lookout Creek drainage is in a transitional zone between the high Cascade mountains and the Willamette Valley. The weather was erratic between years and within years. Heavy snows and cold temperatures occurred during the last half of November and the first of December, 1955. By the end of December, most of the snow had been melted by heavy rains. Heavy snows occurred again in January, 1956, and deep snow persisted until April when it began melting. The upper north-slope units were not clear of snow until late May.

METHODS AND PROCEDURES

Methods and procedures used in this investigation were developed to facilitate the sampling of a deer population which inhabited a relatively small range (15,000 acres) characterized by extremes in elevation, exposure, and topography. The staggered setting system of logging used in the research area greatly influenced the development of study techniques.

Nutritional Study

Vegetative samples from thirteen plant species were collected and analyzed for percent crude protein content (Table 1). Personnel from the Oregon State College Agricultural Chemistry Department made the crude protein determinations by using the Association of Official Agricultural Chemists' method of analysis (1).

TABLE 1
Species list of plants sampled for nutritional analysis

1.	Vine Maple	*Acer circinatum* Pursh
2.	Western Red-Cedar	*Thuja plicata* Donn.
3.	Sticky Laurel	*Ceanothus velutinus* Dougl.
4.	Hairy Manzanita	*Arctostaphylos columbiana* Piper
5.	Salal	*Gaultheria Shallon* Pursh
6.	Wild Blackberry	*Rubus vitifolius* C. & S.
7.	Thimbleberry	*Rubus parviflorus* Nutt.
8.	Salmonberry	*Rubus spectabilis* Pursh
9.	Huckleberry	*Vaccinium* spp.
10.	Elderberry	*Sambucus* spp.
11.	Giant Fireweed	*Epilobium angustifolia* L.
12.	Hedge Nettle	*Stachys Emersoni* Piper
13.	Sword Fern	*Polystichum minutum* (Kaulf.) Presl.

Nutritional samples were taken from two elevations on the north slope: 1,500 and 4,000 feet, and two elevations on the south slope: 1,500 and 2,500 feet. These collections were taken in logged units and in adjacent timbered areas having reduced light. Only clippings of the current year's growth were used. Samples were taken at the same locations and in the same manner on August 15 and October 15, 1955, and on January 15 and June 15, 1956, on the north slope and on June 1 and June 15, 1956, on the south slope.

The study was expanded in August, 1956, to include samples taken from both north and south slopes at different times and various elevations. After having received the analysis reports on the first year's samples, it was apparent that a test was needed to determine whether differences in percent crude protein content were produced only by a differential in seasonal plant development between elevations and between north and south slopes or whether differences were caused by other factors also.

Hellmers (12, p. 324), Einarsen (8, p. 311), Hagen (10, p. 174), Bissell and Strong (2, p. 154), and others who worked in different geographic and climatic areas reported that, in general, protein content was highest in spring growth and lowest during the dormant months. From general observations, it is known that plants, within the same species, at different elevations begin spring growth at different times. Plants at high elevations begin growth later in the spring than plants at lower elevations because of cold temperatures and delayed snow melt. Also, south slopes where higher temperatures develop earlier in the year than north slopes at a given elevation, and with all other factors being equal, begin plant growth earlier in the spring than north slopes. Samples were collected at staggered time intervals between low and high elevations and between north and south slopes in an attempt to collect plant species in the same developmental stage at all locations.

Following the guide range managers use of 100 feet in elevation being equivalent to one day later in beginning of spring growth (13, p. 7), samples beginning August 9 were collected at 1,500 feet, and thirty-four days after the first samples at 4,000 feet. Nine days were added at the high elevation to compensate for the delay of spring vegetation growth due to late spring snow packs. Having no guide for making sample collections in relation to exposure, a nine-day interval was arbitrarily selected. South-slope samples were collected on August 1, 1956, and north-slope samples were taken August 10, 1956.

Track Observations

A track observation method was employed during the spring, late summer, and fall periods when deer were moving into and out of the research area. Road banks were checked from the time snow conditions would permit deer entry in the spring until the date deer tracks were observed in all logged units, and again during the fall months when deer began to leave the forest. Roads were cut through logged units in such a manner that deer must cross them while feeding through the units. In this way an estimation could be made of the yearly period of deer use.

Daylight Observation Samples

Early morning observation samples were taken during the late summer of 1955, and summer and fall of 1956 to study deer activity. Samples beginning at daylight and continuing for approximately two hours were conducted by traveling over roads through logged units. A short period was used for sampling as it was thought that deer activity would be greatest at that time and that the activity would be comparable between units for only a short time. It would be questionable whether movement could be compared between a sample which was taken at daylight in one logged unit and one which was taken three, four, or five hours later in another logged unit.

Observational samples were obtained by stopping at strategic locations and studying the entire unit with the aid of 7 x 50 binoculars. Then the unit was traversed by walking from bottom to top. Deer were counted and, whenever possible, notes were taken pertaining to sexes, estimated ages, general conditions, feeding activities, and locations in the logged unit. After a unit was covered in this manner, the investigator proceeded to the next unit. The one disadvantage apparent in this method was the relatively small amount of area that could be covered in one sampling period.

Night Spotlight Samples

Night spotlight deer samples were taken during the summer of 1955, the summer and fall of 1956, and the summer of 1957. During 1955, a small number of units were sampled each night until all were sampled over a period of four nights. The units were separated into groups, numbers one, two, three, and five, according to the date they were logged. The first group was logged in 1950, and the others were logged in successive years with the last group being cut in 1954-55. One complete sample of all the units was taken during the summer of 1955. In 1956 it was decided to change the procedure by taking a sample including all units each night and by taking several samples during the summer. This modification of the previous method was found to be more satisfactory for the following reasons:

(1) Time taken to sample the total area was reduced to a minimum. Time spent in traveling from headquarters to the observational area and back was decreased to less than one-fourth the time previously taken.

(2) Count duplications were for the most part eliminated. Since the logged units were scattered throughout the area, it was improbable that a recorded deer would move to an adjacent unit ahead of the observers.

(3) A more accurate determination could be made of the relationship of deer movements to individual units, elevations, and slopes, and the relationship between deer movements and seasonal changes. Samples could have indicated a general population shift or movement throughout the entire study area, whereas taking samples in only a few units each night might not have, if movements had been of short duration.

Twenty-seven units were sampled each night for twenty nights between August 6 and October 10, 1956. Between June 28 and September 12, 1957, eight samples were taken. These all-unit samples were obtained during the hours of maximum darkness. They began at approximately 9:00 p.m. each night and terminated at varying times depending upon the number of deer seen. The minimum time spent in one night was a two-hour period when no deer were observed; and the maximum time spent totaled five and one-half hours when sixty deer were observed. Approximately sixty miles of roads were traveled each night, approximately thirty miles of which were utilized in actual spotlighting.

The road system in each unit was very advantageous to spotlight sampling from a vehicle. Virtually all parts of each of the twenty-seven units sampled were visible from some point along the road. All roads in timber corridors were sampled while driving between units.

This method employed the use of a vehicle, preferably a pickup, a driver and assistant, a spotlight, and binoculars. The assistant, either seated on the right front seat or standing in the pickup bed, used the spotlight to pick up deer-eye reflections. If an observation was made while the vehicle was moving, the driver stopped and assisted by attempting, with 7 X 50 binoculars, to identify the deer as to sex, number of antler points, approximate age, general physical condition, and whether it was feeding or bedded down.

The vehicle was driven steadily at a low speed until a strategically located observation point was reached in a given unit. Stops were made between observation points only if deer were spotted.

The spotlight was used in the following manner: while the vehicle was under way, the passenger swept the visible area using short, fast, horizontal, flipping motions of the light and gradually working it up and down the slopes from the roadside to the limit of the unit or to the effective limit of the light. While performing this operation, either the passenger whistled or the driver intermittently honked the vehicle horn to draw the attention of the deer. With the deer facing the observers, eye reflection was very easily seen even with the light moving very fast. At strategic locations, the vehicle was stopped and the accessible area was searched thoroughly with the light.

The spotlight used in this study during the summer and fall of 1955 consisted, externally, of a large headlight type case with a pistol grip attached at the base, an off-on switch just above, and a 15-foot cord extending from the handle to the terminals on the

vehicle's battery. Internally it consisted of a large reflector and a common spotlight bulb, all enclosed by a front glass cover such as in early-day car headlamps.

The spotlight used during the summer and fall of 1956, and summer of 1957, consisted of a six-volt sealed-beam unit with a bakelite pistol grip, an on-off switch just above, and a cord approximately twenty feet long reaching from the base of the pistol grip to the battery terminals. This spotlight was commercially designated by the Unity Manufacturing Company as a six-volt, sealed-beam, portable marine searchlight, rated at approximately 95,000 candle-power.

An evaluation of the two spotlights could be made only by comparing their performance. The bulb type unit used during 1955, by comparison, was bulkier and heavier than the portable marine searchlight. It projected a wider beam and a maximum projection through comparatively dust-free air of approximately 200 yards. The sealed-beam unit, characterized by a very concentrated beam, projected light through comparatively dust-free air for approximately 350 yards. These are approximate maximum distances at which reflection from deer-eyes could be detected with the naked eye, not the distance at which details were visible. The ability to detect animals and animal details at night was extremely variable and dependent on two major factors: (1) the amount of dust and foreign material in the air which reduced the effective distance of light penetration; and (2) the degree of angle to the ground surface on which the deer was standing. There was difficulty in detecting details at maximum distances when the spotlight beam was projected parallel to the ground surface, particularly where there was a shrub layer varying in height. The reflection of light from the ground and/or shrubbery, and the resulting general diffusion of light along the path of the beam that resulted made it difficult at short distances and at times impossible at long distances to detect antlers.

When projecting the spotlight from a road to a point across a draw or canyon, which was generally the case in the H. J. Andrews Experimental Forest, the light beam was at an angle to the ground, which eliminated most reflection and diffusion except in the immediate vicinity of the deer.

Some difficulty was experienced in determining the presence of antlers because of bright eye reflection. At distances varying from under 100 yards to the effective limit of the spotlight, reflection would occasionally block the ears and antlers from sight if the deer were directly facing the observer. Also, the smaller the antlers, the less reflection it took to block them out.

After use and comparison of both spotlights, the Unity marine searchlight was recommended as the better of the two for night spotlight sampling work.

DEER FOOD NUTRITION

History

Numerous studies have been undertaken to ascertain the food quality of big game forage plants. However, the majority of these inquiries have shown only seasonal or average nutritional levels without attempting to correlate them with the physical environment in which plants are found. This correlation should be important in the management of wild animals that inhabit areas which exhibit extreme topographical, and hence environmental, changes.

In the Cascade Mountain Range of Oregon, deer prefer and concentrate in open or logged areas. With increased logging in this mountainous region, large acreages are being cleared which will increase deer habitat. In order to effectively manage these areas for deer, it would be desirable to collect information on plant nutritional quality as it relates to elevation, exposure, and light intensity changes. This information should be valuable to the game manager in determining areas of high plant nutritional potential and in manipulating populations accordingly.

Comparison of Elevations

In 1955, low and high elevation samples were taken on the same dates (August 15, and again on October 15) to establish the differences in stage of plant development between elevations (Table 2).

TABLE 2.
Comparison of percent crude protein in plants at two elevations on north-slope logged areas, 1955.

Species	August 15 Low Elev.	High Elev.	Difference	October 15 Low Elev.	High Elev.	Difference
Fireweed	11.15	23.00	+12.85	13.29	21.10	+7.81
Elderberry	14.63	22.10	+ 7.47	10.20	20.00	+9.80
Wild Blackberry	10.20	13.95	+ 3.75	10.18	11.79	+1.61
Sword Fern	8.08	11.30	+ 3.22	9.15	9.55	+ 0.40
Thimbleberry	10.85	13.15	+ 2.30	7.50	16.74	+ 9.24
Vine Maple	11.55	10.65	-0.95	10.05	11.50	+ 1.45
Sticky Laurel	7.60	8.85	+ 1.25	---	---	---

Low elevation samples showed lower protein levels than did high elevation samples in every case except one which was the vine maple sample taken on August 15, 1955, when crude protein content was less by 0.95 percent. The data definitely show a difference in plant development between elevations.

During 1956, north-slope low and high elevation samples were taken on staggered dates, August 9 and September 12, respectively, in an attempt to sample plants at the same stage of vegetative development. If stage of development was the only factor influencing protein levels, the samples should show no over-all difference in quality. Table 3 shows three low elevation samples having the highest protein content and four samples having lower protein levels. No general differences in protein levels were shown between elevations, which indicated that plants were in the same general stage of development.

Comparison of Exposures

On June 15, 1956, both south and north-slope samples were taken in open and canopied areas to check on the difference in stage of plant development. All samples taken on north-slope open areas showed higher levels of protein than did those on the south slope except for salal which was 0.73 percent lower. Samples which indicated a consistently higher level of protein on the north slope showed that the north-slope vegetation was in an earlier stage of seasonal development (Table 4). Then samples from south and north slopes were taken on staggered dates, August 1 and August 9, 1956, respectively, in an attempt to sample vegetation on both slopes in the same stage of development. Samples listed in Table 5 showed no consistent slope differences, which indicated all plants were in the same general stage of development.

Comparisons of Light Intensities

Samples were taken in logged areas and adjacent areas of reduced light to determine what influence light reduction had on protein levels of browse plants. Clippings were taken on January 15, and June 15, 1956. During the growing season in June, no consistent difference was shown between open areas and areas of filtered light. However, during the dormant season in January, samples showed consistently lower protein content in samples from areas of reduced light, except for one sample of salal which was 0.31 percent higher (Table 6).

Discussion

In the Blue River region of Oregon, vegetation on south slopes began growth earlier in the spring than did north-slope vegetation. The new growth might have drawn deer onto south slopes while north-slope vegetation was still in a dormant state.

TABLE 3.
Crude protein samples taken at two elevations and on two separate dates on a north slope, 1956, at the same approximate stage of vegetative development.

Species	Low Elev. Aug. 9	High Elev. Sept. 12	Difference
Elderberry	11.72	19.02	+7.30
Sword Fern	7.35	9.75	+2.40
Vine Maple	9.35	11.47	+2.12
Thimbleberry	9.30	10.15	+0.85
Hairy Manzanita	6.07	5.70	-0.37
Fireweed	14.13	12.95	-1.18
Wild Blackberry	8.95	7.08	-1.87

TABLE 4.
Comparison of percent crude protein in plants from a north and south slope and from logged and canopied areas, June 15, 1956.

Species	Open N.	Open S.	Difference	Canopied N.	Canopied S.	Difference
Elderberry	28.30	25.25	- 3.05	34.03	19.90	-14.13
Fireweed*	29.14	17.26	-11.88	---	---	---
Sword Fern	21.46	16.24	- 5.22	18.23	14.06	- 4.17
Vine Maple	14.13	10.55	- 3.58	14.61	9.23	- 5.38
Wild Blackberry	18.16	14.44	- 3.72	18.99	15.11	- 3.88
Salal	15.96	13.68	- 2.28	15.10	15.83	+ 0.73

* Does not grow in canopied areas.

TABLE 5.

Comparison of percent crude protein in plants from logged areas on a north and south exposure and on two dates. August, 1956.

Species	August 9 N.	August 1 S.	Difference
Sticky Laurel	9.02	11.67	+2.65
Elderberry	11.72	13.22	+1.50
Sword Fern	7.35	8.73	+1.38
Hairy Manzanita	6.07	6.35	+0.28
Vine Maple	9.35	9.45	+0.10
Wild Blackberry	8.95	9.00	+0.05
Salal	5.95	5.90	-0.05
Western Red-Cedar	8.18	6.53	-1.65
Fireweed	14.13	10.13	-4.00

TABLE 6.
Comparison of percent crude protein in plants between logged and canopied areas at low elevations on north exposures, 1956.

Species	June 15 Open	Canopied	Difference	January 15 Open	Canopied	Difference
Elderberry	28.30	34.03	+5.73	---	---	---
Wild Blackberry	18.16	18.99	+0.83	8.39	8.32	-0.07
Western Red-Cedar	4.74	4.95	+0.21	5.57	4.88	-0.69
Vine Maple	14.13	14.61	+0.48	---	---	---
Huckleberry	12.19	12.12	-0.07	---	---	---
Hedge Nettle	20.93	21.07	+0.14	---	---	---
Salal	15.96	15.10	-0.86	6.25	4.83	-1.42
"	---	---	---	5.70	4.43	-1.27
"	---	---	---	4.49	4.80	+0.31
Sword Fern	21.46	18.23	-3.23	10.04	6.30	-3.74
" "	---	---	---	8.88	5.29	-3.59
" "	---	---	---	7.31	5.97	-1.34

The growing season of vegetation begins roughly one day later for each 100-foot rise in elevation. Because of this relation between stage of plant development and elevation, an influence might be exerted on deer to change feeding and living areas, moving up in elevation in response to a change of food palatability as summer and fall seasons progress.

At any given time during the growing season high elevation vegetation was nutritionally better than low elevation vegetation in regard to protein content.

Data collected during the winter season indicated a very low protein level in plants available to deer in timbered areas regardless of elevation. There was no indication that during the winter high elevation habitat had any nutritional advantage over other elevations. Protein levels of food plants become unimportant during the winter when deep snow prevents deer from using an area. Information collected to date indicates that low elevation open areas have a higher potential for use as deer wintering areas than do canopied areas because of the differential in protein levels as shown in Table 6.

MIGRATIONS

History

The H. J. Andrews Experimental Forest was virtually covered by mature Douglas-fir before logging began. It was poorly suited for large deer populations because of a lack of openings and adequate food. The best habitat available near this drainage was the numerous high mountain meadows situated along its northern and eastern boundaries, several old openings along the south edge of the watershed which had been timbered but were cut in 1946, and two large burns that ran from the McKenzie River valley to the south edge of the research area. One of the burns occurred in 1937 and the other in 1948-1949. All of these units had deer populations before portions of the H. J. Andrews Experimental Forest were cut. According to Wustenberg (24), who carried out studies in the research area in 1951-52, the drainage itself had very few deer. The main deer population was limited to the high openings mentioned previously. Morse (18) spent from July 28, 1953, to September 4, 1953, in the research territory on a general study of wildlife. During his period of work, he observed a total of only nine deer in the drainage. Chew (5) spent the summer of 1954 in the same locale studying wildlife. During the general course of daily investigations from June 18 through September 6, he made 42 deer observations in the lower elevations, from 1,400 to 2,750 feet.

Although sampling was not consistent during the first few years of logging operations, the information does indicate a steady increase of deer as openings were produced.

Fall, 1955

When research began August 1, 1955, deer were scattered throughout the forest. Tracks were observed in all logged patches and on high mountain trails around the edge of the watershed. From general observations it was noted that tracks were more numerous on low elevation north-slope openings. These sites were characterized during the summer months by a dense cover of fireweed which afforded much better protection than did vegetation on higher, younger, or south-slope units.

Most of the fireweed plants had dried to the point of being unavailable for deer food by October 1. Most other perennial food plants were still available. During September a gradual decrease in deer and deer tracks was noticed. During the last part of September, early morning observations were made to determine the whereabouts of the deer population. No deer were seen and only an occasional track was encountered. Neither deer tracks nor animals were observed moving out of the mouth of the drainage to indicate a premature migration to the low elevation wintering areas.

Deer seemed to become wary during September and October and were seldom seen although a small number of tracks were observed at all elevations. During the last half of October and November, deer tracks were observed only in the upper elevations (3,000 to 4,000 feet) on the north slope. No tracks were observed on the south slope.

Snow began falling in the upper elevations on October 26 and increased to a depth of approximately 15 to 20 inches by November 16. By the same date, snow at low elevations had reached a depth of twelve inches.

Deer remaining in the area began a concentrated downward movement on November 17 which decreased to a few stragglers by November 22. Tracks of deer were observed coming out of the timber along the last two miles of Lookout Creek drainage and moving down to the Blue River and McKenzie River valleys. During the summer preceding this movement, a maximum of 22 deer was observed in one night's spotlight sample of all logged units. This was only a portion of the deer present. At the time of fall migration, tracks of only eight to ten deer were observed leading from the study area. The remaining deer which summered in Lookout drainage were not accounted for.

During the migration period, most of the deciduous food plants were in a dormant state. Wild blackberry, salal, and sword fern foliage was present although covered with snow (Table 7). Bare twigs of vine maple and California hazel were noted as being browsed lightly.

TABLE 7.
Available deer browse in logged units.

Species	Nov. 9, 1955 Bare Ground	Nov. 16, 1955 12" to 20" - snow
Wild Blackberry	Abundant	Abundant - covered
Salal	Common	Common - covered
Sword Fern	Common	Common - covered
Vine Maple	Common	Bare twigs
Willow	Common	Bare twigs
Elderberry	Scarce	Bare twigs
Sticky Laurel	Scarce	Scarce
Huckleberry	Scarce	Bare Twigs

Observations indicated that plant dormancy which decreased the amount of available forage, and heavy snows which covered the bulk of available deer food were instrumental in effecting an abrupt downward deer migration. At the same time, a concentration of deer tracks was noted leading down from the Blue River drainage proper. This observation substantiated the conclusion that an abrupt deer migration occurred in the whole Blue River region.

No deer were observed wintering in the study area. The upper limit of the deer wintering range was observed to be the mouth of Lookout Creek drainage at an elevation of about 1,300 feet.

Spring - Summer, 1956

Observational deer surveys were begun April 15 in anticipation of deer movements into the research area. Logged units and road cutbanks were checked by track surveys for the occurrence of deer. Fresh tracks were first observed in south slope units 3-A, 3-B, and 3-C, on May 8, but none were found in the remaining units on this date. This earliest animal movement coincided with the beginning of spring plant growth on the low elevation south slopes. The deer slowly filtered into the other available clearings, and tracks were observed in all openings by May 28. Approximately 20 days were required for the deer to spread throughout Lookout Creek drainage. They moved a distance of six airline miles from the upper limit of their wintering grounds to the logged unit farthest from the drainage mouth. As a group, the deer traveled roughly three-tenths of an airline mile a day; this indicated a very gradual infiltration into summer quarters.

From tracks observed during May, there appeared to be very few animals in the area although all logged units had been visited by deer.

Night spotlight deer samples taken during the summers of 1956 and 1957 indicated an increase in animal numbers through the middle of the summer and then a decrease for the remainder of the season. On May 6, 1956, no deer were observed in the study area. On June 28, 22 deer were counted during one night spotlight sample in 27 units. Deer numbers increased until a season maximum of sixty deer was seen on August 14, 1956, during a sample of all units. From this date on, animal numbers decreased as shown by subsequent samples until no deer were seen during two samples taken in October (Figure 4). The 1957 night spotlight samples were taken by Bruce Wyatt, Carl F. Anderson, and James D. Yoakum, graduate research assistants with the Oregon Cooperative Wildlife Research Unit.

Discussion

There was no indication of an obvious downward fall migration out of Lookout Creek drainage before snow fell in November, 1955. There was no information gathered in this study which would indicate a clear-cut or logical reason for an early downward fall movement.

Since deer actually moved out of the logged units during August and September, it can be assumed from limited signs that they moved up and out of the drainage into high mountain meadows, old burns and old logged units which were their habitat before logging began in the study area. A downward fall migration from those openings not within the boundary of the H. J. Andrews Experimental Forest but which support part of the study area deer herd, would occur along routes other than through the study drainage, leaving only a few to pass down through. This would account for the relatively few deer observed moving down from Lookout Creek drainage with the advent of snow.

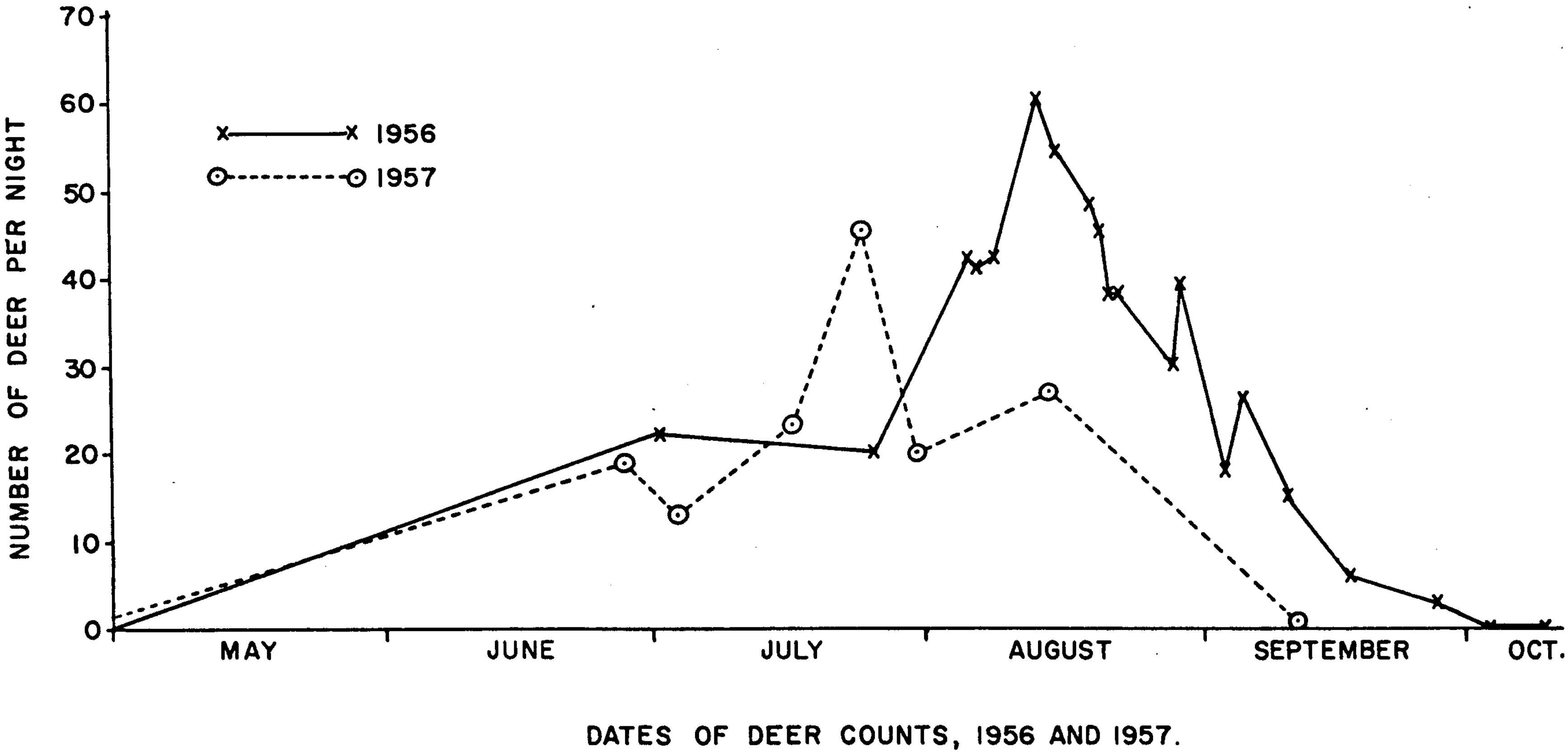

Figure 4. Numbers of deer observed on various dates during night spotlight samples, 1956 and 1957.

In 1956, deer began moving toward their summer range as soon as new vegetative growth became available for food on approximately May 8. As shown by track observations, this movement was very gradual. It would seem logical that deer wintering closest to the summer range, in this case Lookout Creek drainage, would be the first to reach the research area. Deer farthest from the summer range would take much longer to reach it. Abundant food, including dense patches of fireweed in the lower elevation logged units, produced ideal fawning areas where animals were observed raising their young. Deer moved into the area with the advent of spring plant growth; some females paused to bear and raise fawns and others took advantage of the abundant food supply. During this time, deer numbers increased as more moved in from the farthest reaches of the wintering grounds. It seems probable that as the summer became hot and dry, as fawns developed and grew strong enough to travel during August, and as the vegetation began to lose its spring tenderness, the deer began seeking higher, cooler areas where food plants were still relatively tender and desirable. Information gathered on the small winter migration, on fluctuating deer populations, and on changes in plant food quality, would support this supposition of a movement to higher elevations during the last of August and during September.

It was shown through night spotlight sample data (Figure 4) and track observations that not all of the deer were actually permanent summer residents in the H. J. Andrews Experimental Forest logged areas, but were animals that used the area only as a temporary home for a part of the summer period. The openings were believed to be a transitional zone between wintering grounds and late summer and fall ranges.

DISTRIBUTION

Many factors influence the distribution of deer in any herd range. Those factors felt to be most important in the area which was studied included exposure - vegetation, elevations, age of logged openings, available water, nocturnal activities, and logging activities.

Exposure - Vegetation

North-slope logged areas were characterized by a much heavier vegetative cover during the spring, summer and fall seasons than were south slope openings. Low elevation cleared units produced a heavier vegetative cover than did high elevation openings. North-slope low elevation open areas were characterized by dense stands of fireweed, which reached a maximum height of approximately seven feet, and by a more dense cover of vegetation than north-slope high elevation and south-slope units.

It was shown by data gathered during night spotlight deer samples that more deer occupied north-slope logged areas of dense vegetation than other clearings. During 1956 spotlight sampling, a total of 587 deer were observed. Of those deer, 318 were observed on the north-slope areas and 269 were counted on the south slopes. During August, when the majority of the deer were seen, 278 were observed on north slopes and 218 on south slopes (Figure 5).

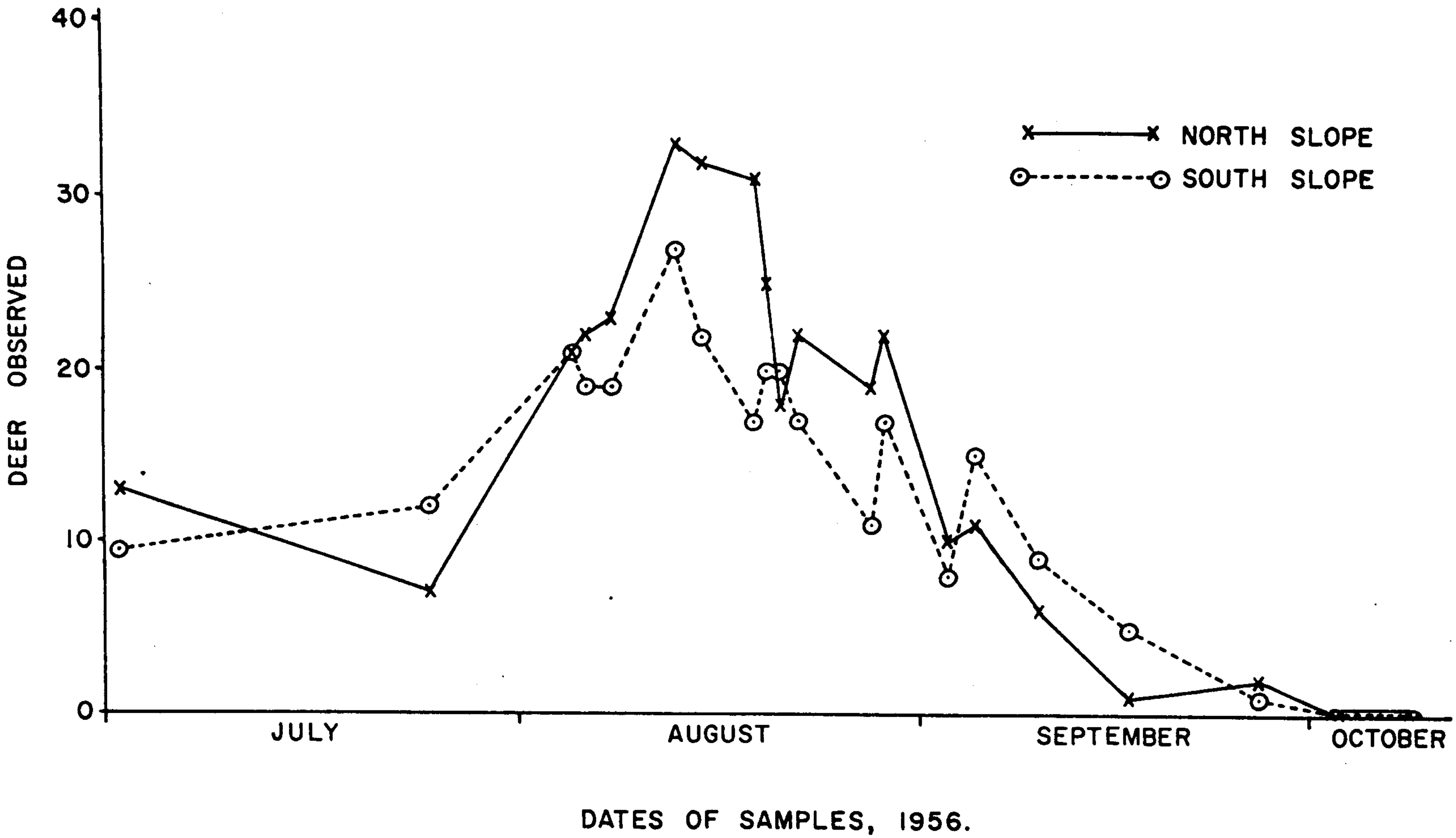

Figure 5. Slope aspect preference of deer in the H. J. Andrews Experimental Forest, 1956.

Elevation

Night spotlight samples were taken at all elevations during each sample period. Since each period consisted of only a few consecutive hours each night, different elevations were considered comparable for studying deer activity. Samples taken during 1956 and 1957 were used. The comparison of acres per deer was used. The elevation range was divided into two elevation classes: 1,500 - 2,500 feet for low areas and 2,500 - 4,000 feet for high openings. Deer numbers from all samples taken in 1956 and 1957 were totaled for each year. To determine the total number of acres sampled, the acreage from each logged unit was multiplied by the number of times it was viewed during sampling. Then the total number of acres sampled in an individual logged opening was divided by the total number of deer counted in the same logged area, to give a figure of acres per deer. The acres per deer for all openings in each elevation range were summed and the average taken. In 1956, the average number of acres used per deer at the low elevation was 39; at the high elevation, 79.5. In 1957, the average acres used per deer at the low elevation was 52.2; at the high elevation, 114. Data shown in Figure 6 indicate that low elevation areas were used consistently by more deer than high elevation openings.

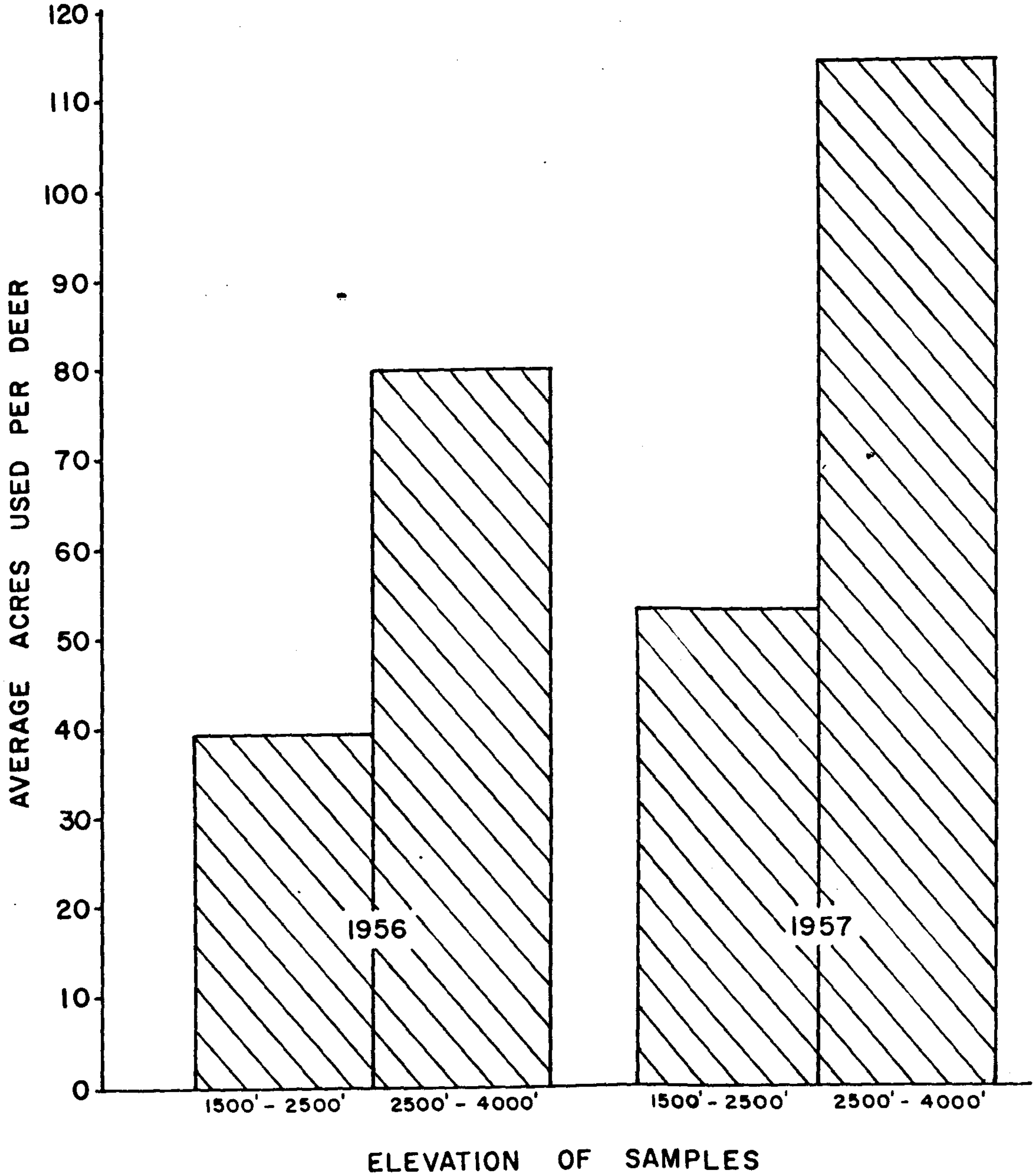

Figure 6. Elevation preference of deer in the H. J. Andrews Experimental Forest, 1956 and 1957.

Age of Logged Openings

At the time this study took place, logging had been carried on for five years. A few areas were cleared each year. This cutting pattern produced openings of various ages, each age represented by a different density of vegetation due to successional stages of plant growth. Units were placed in yearly age groups beginning with the areas cleared in 1950 and ending with logged openings cut in 1955. Units cut in 1950 showed a use of 14 acres per deer from samples taken in 1956, and 23.3 acres per deer from samples taken in 1957. Units cut in 1955 showed a use of over 500 acres per deer from samples taken in 1956, and from samples taken in 1957 no deer were observed using the areas. Units logged in 1951, 1952, 1953, and 1954 did not show a steady increase of deer use as might be expected. This was believed to be due to the confounding of elevation and slope variations with the age of units which influenced successional vegetation growth. Units cut in 1950 showed heavier deer use than more recently opened areas and those logged in 1955 showed less use than older age groups; but patches cleared in 1951, 1952, 1953, and 1954 show no definite known correlation (Figure 7).

Available Water

Data were collected on deer population density in relation to year-around availability of water in or near individual logged units.

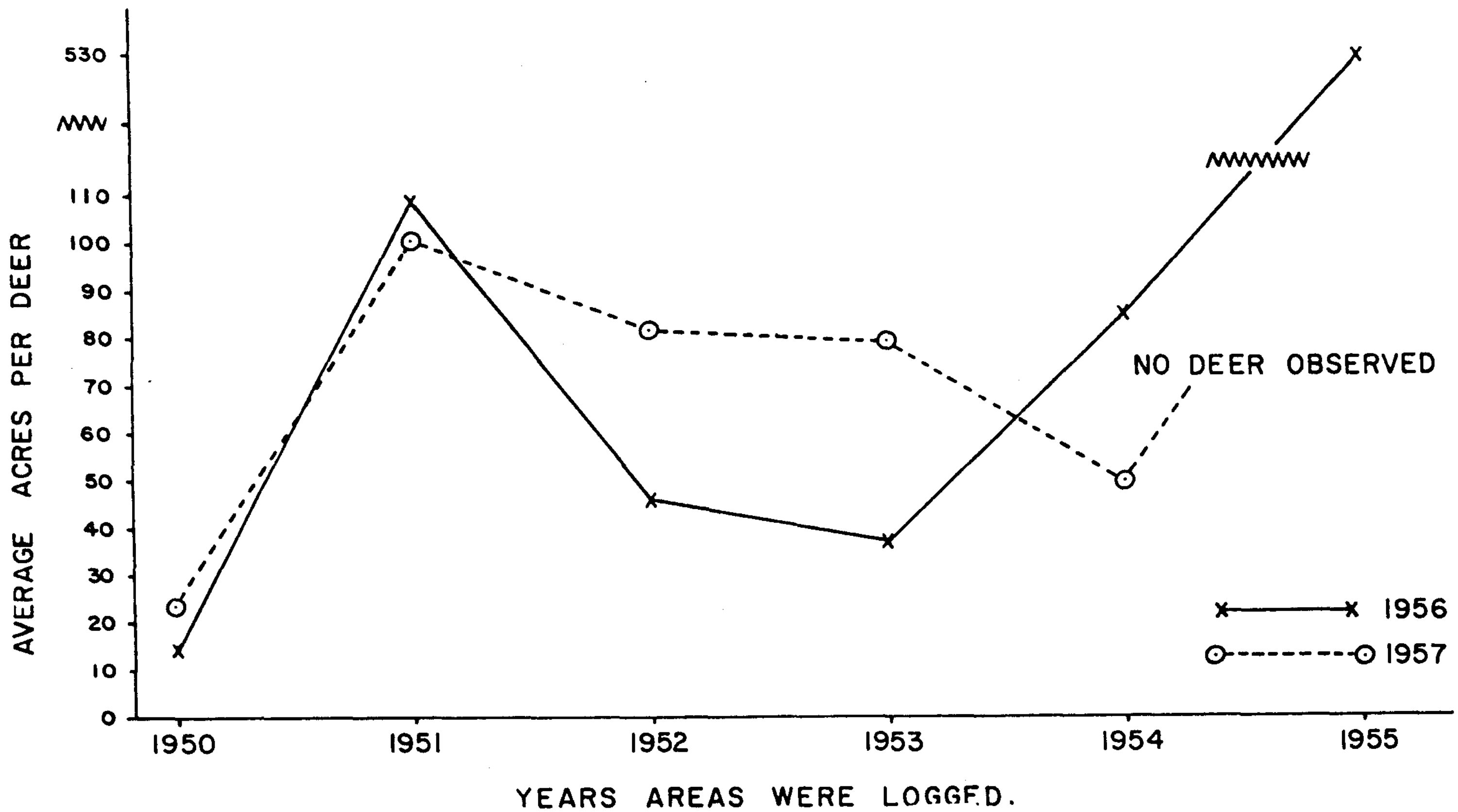

Figure 7. The age of logged units in relation to deer use shown from night spotlight samples, 1956 and 1957.

All openings except one had available water within their boundaries or nearby. The one exception, unit 1-H, averaged 264 acres per deer during 1956, and during 1957 no deer were observed using the unit. Unit 1-I, which was logged at approximately the same time, was on the same slope, at approximately the same elevation, and of approximately the same steepness, but had year-around water available, showed a use of 64 acres per deer in 1956 and 23 acres per deer in 1957.

The limited information gathered indicated that available year-around water was an important influence on the distribution of deer in the study area.

Nocturnal Activity

From night spotlight deer samples, data were collected on bedding and feeding habits. In the years 1956 and 1957, a total of 640 deer were observed during 23 night sample periods. Of this total, 66 percent were observed feeding, 28 percent were bedded, and for six percent, activities were undetermined.

Logging Activity

Logging was conducted each year during the season of deer use in the H. J. Andrews Experimental Forest. Loud noises from blasting, power saws, trees falling, heavy logging trucks traveling roads, and heavy duty machinery being operated were continuous on normal workdays throughout the study period. From distributional patterns determined from night spotlight deer samples and from daily observations, no general intimidation of deer was noted. Deer were disturbed only when individuals were in close proximity to sudden loud noises. Then deer were startled only enough to move from the immediate vicinity until the noise ceased. No deer concentrations were noted that would indicate logging was an attraction to deer. From observations made during 1955 and 1956, logging activity could not be considered as an influence in deer distribution or activities; however, specific studies on deer curiosity in relation to logging activities might reveal some degree of correlation.

Discussion

The system of logging used in the study area, that of cutting patches of timber at various elevations and on different slopes, produced many interrelated influences, few of which were believed to show a potential significance when studied individually.

During 1950, three units were logged on the north slope at a low elevation. In 1951, four areas were logged on the north slope at a high elevation. In 1952 one high elevation north-slope unit, four low elevation north-slope units, and two low elevation south-slope areas were logged. During 1953, both low and high south-slope units were cleared. Areas cleared during 1954 and 1955 were situated on south slopes at various elevations.

Because of the system of logging used, the relationship of deer distribution and activity to any single influence was confounded by many other factors. Even though studies of exposure-vegetation and elevation indicated a definite preference by deer for north slopes and low elevations, this was not a completely true picture of preference since north-slope units were the oldest.

If all logged areas had been the same age, a truer picture of deer preference would have been produced. If all areas had been logged in the same environmental situation but cleared over a period of years, information on deer preferences for particular aged openings would have been more accurate. With all other factors being equal, older units, within certain minimum age limitations, by virtue of having a more developed growth of invading seral vegetation, should be more desirable. Again, with all other factors being equal, low elevation openings should be more desirable than high openings because of less precipitous terrain, more moderate weather conditions, and better plant growth due to a longer growing season and more available moisture supplied by late season drainage. It follows that in the area under study and in similar situations, with other conditions being constant, north-slope units, except during the early spring, would evidence heavier use by deer than south slopes because of better plant growth produced by more moisture and more favorable temperature conditions.

The whole discussion thus far leads to the conclusion that heaviest deer concentrations are found where and when conditions produce optimum vegetation growth and available water for feeding, hiding, and raising young. In the study area, these conditions were best met on logged units exhibiting the combined conditions of relatively old age, low elevation, north exposure, and available water.

A preference by deer for north-slope units was indicated from data discussed earlier and illustrated in Figure 5. The greatest confidence was placed in samples taken during the last of July and the month of August in both 1956 and 1957 because the maximum number of deer were observed then. Few deer were observed during the samples taken in June, early July, late September, and October. This placed more importance on individual animal movements, which was undesirable, rather than on general group movements. During the July and August period mentioned above, enough deer were observed to reduce individual animal importance and to produce more reliable information on general herd activities.

A sampling discrepancy in the deer use comparison of logged areas was produced by a difference in vegetation density and height between north and south slopes. Since dense tall vegetation on north slopes provided better concealment for deer than sparse low vegetation on the opposite slopes, fewer animals would have been observed in the former situation than in the latter. General deer preference for north-slope units, as shown in Figure 4, is likely conservative because of concealment under the taller vegetation.

The data collected relating to nocturnal activities indicated a high level of feeding and movement at night in the deer population of the Blue River region. Disturbance of deer during spotlighting was believed to have been slight as animals were observed in the process of bedding down while in the bright beam of the light. Very few deer showed alarm while being observed with the use of the spotlight.

GENERAL DISCUSSION AND CONCLUSIONS

Climate, and vegetation variations in relation to density, distribution, and food quality were two of the more important factors influencing deer population preferences, movements, and activities in the H. J. Andrews Experimental Forest and adjacent areas.

Climate directly influenced deer movements through severe late fall and winter snows which were partially responsible for the downward migration of deer to wintering areas. Indirectly, it influenced deer through vegetation. Climatic differences between north and south slopes and between elevations affected the food quality, density, and distribution of vegetation. The food quality was influenced by climate only in relation to different exposures and elevations where various climates cause differences in seasonal plant development on any given date during the growing season. In the H. J. Andrews area, plant crude protein levels on any given date during the growing season were the highest at high elevations. In comparing north and south exposures, plants on north-slope areas on any given date during the growing season were higher in crude protein content than those on south-slope areas. Also during the season of plant growth, crude protein content of plants showed no general difference between open and timbered areas. However, during the winter or period of plant dormancy, open areas exhibited higher protein levels than did timbered areas.

Differences in vegetation density and distribution were believed to be the primary influences which determined the pattern of deer use within the study area. The vegetation differences were, in turn, believed to be a direct result of the varying ages, elevations, and exposures of cut units. These differences in the physical characteristics of logged areas produced different environmental conditions under which vegetation communities must have necessarily developed along separate lines, or similar lines but different stages in relation to time. It was found that deer favored areas which produced dense, tall, shrubby and herbaceous vegetation. In the study territory and surrounding region, these characteristics were exhibited to the greatest extent on relatively old, low elevation, north-slope logged units.

It was believed that deer food quality, measured by percent crude protein in this study, influenced deer distribution to some degree although a positive correlation between deer movements and varying plant food quality was not found. During the winter or period of plant dormancy, the relatively high percent crude protein levels found in deer browse on logged or open areas as compared to timbered areas or reduced light, indicated that deer might have concentrated in the openings to avail themselves of higher quality food. This was brought out by Einarsen (8, p. 310, 312) in his study of deer food quality in relation to open and canopied areas in the coast range of Oregon in 1946. He found that, during the winter, open areas produced higher protein levels in deer food, and larger, more numerous, and healthier deer than did densely timbered areas.

Data collected on the influence of water on deer distribution showed that adequate year-around water must be available. However, it was shown that all but one logged unit had water available and therefore water could not be considered important in the study area or similar surrounding habitat.

From limited observations it was found that logging activity was not a factor influencing deer movement or distribution; however, specific studies along this line might reveal some correlation.

The study area was found to be in a transitional zone where deer were limited to a seasonal occupation of the habitat because of heavy snows which pushed them out during the winter months. The H. J. Andrews Experimental Forest was used by deer only during the spring, summer, and fall seasons.

It was determined that deer in the study area and surrounding territory carried out both a short, abrupt, fall migration from the research area to lower elevations along the Blue River and McKenzie River valleys, and a gradual spring migration from the wintering grounds back to the research territory.

It was believed that the study habitat favorably influenced the increase of deer population numbers up to the level of the carrying capacity of the wintering grounds. The study drainage was found to be a concentration area for deer which were supported by the lower elevation winter habitat. If this winter habitat coincided with human habitation, a maximum population of supported deer would produce conflicts. Increased seasonal deer habitat, produced by continued logging at high elevations, could allow deer population numbers to reach the peak of the carrying capacity of the wintering area much sooner than if deer remained dependent on natural forest openings. This would necessitate the application of intensified management practices sooner than might be expected under other conditions.

RECOMMENDATIONS FOR FURTHER STUDY

The pattern of the early fall movement of deer from the research area was not positively determined during this study. If the deer actually moved up to the natural habitat which was used before logging began, this information would be extremely important to game managers in anticipating the intensity of use, and length of time these newly logged areas would be used by deer. The actual extent of the winter range used by deer in the study area was not determined. This information would be desirable for determining the degree to which deer are conflicting with human habitation, and the amount of habitat area which support the deer.

Since vegetation density and distribution were of primary importance in influencing deer population concentrations, it was felt that vegetation studies were needed which would supply sound knowledge of successional plant development, including composition and cover density, in relation to time. Studies should be focused on vegetation relationships between exposures and different elevations.

It should be recognized that the H. J. Andrews Experimental Forest and adjacent areas are not typical of the most productive Columbian black-tailed deer ranges found on the west coast of North America. Similar ranges encompassing large areas are used by deer, but because of high elevations there is a long season of non-use.

Therefore, it is important to realize the limitations of this area when considering policies pertaining to Columbian black-tailed deer management.

SUMMARY

A projected long term program was begun in August, 1955, to study the influences of logging practices on Columbian black-tailed deer in the 15,000 acre H. J. Andrews Experimental Forest which is located in the west-central Cascade mountains of Oregon. The objectives are: to determine migrational habits, distributional patterns, and site preferences of deer, and to evaluate the suitability for deer of habitat as modified by various logging practices in the area.

The beginning phase of this program, concluded in September, 1957, included the following objectives: to learn how variation in protein content within the same plant species, collected at different elevations and slopes, affected deer movements and distribution. Data taken on deer migrational patterns, population trends, movements within the research area, elevation and slope preferences, seasonal habits, and the effects of food availability on population movements to and from the forest were also included.

Results indicated that vegetation growth began earlier in the spring on south slopes than on north slopes, that on any given date during the growing season crude protein levels were higher at high elevations than at low elevations, and that on any given date during plant growth, north slope vegetation exhibited higher crude protein levels than did south slope plants. During the growing season no general difference was shown in crude protein levels between open

areas and timbered areas of low light intensity. However, during the period of plant dormancy, studies showed that plants from timbered locations were lower in crude protein content than those from open or logged units.

Deer were observed to migrate from the research area during late fall to low elevation wintering grounds along the Blue River and McKenzie River valleys. This migration was precipitated by heavy snows and a reduction in available forage. A gradual spring migration of deer moving from wintering areas back to the research drainage was observed. Deer moved onto south slope openings with the beginning of spring plant growth.

From deer night spotlight samples and track observations taken during the springs, summers and falls of 1956 and 1957, it was shown that the deer population fluctuated continually. Numbers increased until the middle of summer, and then decreased until no animals were observed and few tracks were found during late fall. It was found that the study drainage was a transitional zone for use and that few deer spent the full spring, summer, and fall seasons in the logged openings. It was believed that deer moved to older, established openings around the perimeter of the research watershed during late summer and fall.

Climate and vegetation variations were two of the more important factors influencing deer preferences, movements, and activities in the H. J. Andrews Experimental Forest and adjacent areas. It was

felt that variations in plant nutritional levels had some influence on deer distribution but no definite correlation was found.

The study habitat was believed to have the potential for favorably influencing the increase of deer numbers up to the level of the carrying capacity of the wintering grounds. Increased seasonal deer habitat, produced by continued logging at high elevations, could allow deer population numbers to reach the peak of the winter area carrying capacity much sooner than if deer remained dependent on natural forest openings. This would necessitate the application of intensified management practices sooner than might otherwise be expected.

It should be recognized that the H. J. Andrews Experimental Forest and adjacent areas are not typical of the most productive Columbian black-tailed deer ranges found on the west coast of North America. Similar ranges encompassing large areas are used by deer, but because of high elevations and deep winter snows, there is a long season of non-use. Therefore, it is important to realize that such areas have limitations when considering policies pertaining to Columbian black-tailed deer management.

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