The study of the natural history of the Roosevelt Elk, begun in 1937, has been carried on up to the September 1942, largely in Clatsop, Tillamook, Lincoln, Benton, Linn, Douglas, and Coos Counties. It was considered that these counties covered every type of habitat of this species to be found within its geographical range.

The study of available literature shows that this species was abundant in Oregon and Washington west of the summit of the Cascades in the early days, and as late as 1810 was abundant in the Willamette Valley. As early as 1856, settlers familiar with eastern elk recognized the Pacific Coast elk as being distinct from the eastern species.

In 1897, C. H. Merriam, Chief of the United States Biological Survey, described this elk as a distinct species, naming it Cervus roosevelti in honor of his friend President Theodore Roosevelt.

The validity of the characteristics which distinguish this species have at times been disputed by various naturalists, but this was due largely to errors or inability to distinguish these characteristics.

The former range of the elk was from the San Francisco Bay region north throughout the Coast Range of California and throughout Washington and Oregon west of the summit of the Cascades as far north
as the northern part of the Olympic Peninsula. At present it is
to be found only in the Coast Range Mountains of Washington, Oregon,
and northwestern California. In the Cascades it is found in
limited numbers in the Mt. St. Helens region of Washington, and
in Oregon in the Santiam and McKenzie watersheds.

Observations show that the Roosevelt Elk herds are of family
origin and family ties. These herds averaging 12 to 15 animals
are composed of several generations which because of maternal ties
remain together in a close family group. Males apparently lose
this attachment about the fourth or fifth year at physical and
sexual maturity, when they leave the herd. The herds have a
definite home range, varying from several hundred acres up to two
square miles. This range conforms to topography, natural barriers,
trails and other factors. The herd seldom leaves this range, and
marks it by means of many sign posts. These sign posts consist of
trees from which the animal scrapes the bark with the teeth or
antlers and on which it rubs its body. This behavior was frequently
observed and also photographed.

The herds are active and extremely variable in their behavior,
movements, and feeding. As a rule, however, a certain routine is
followed. No food preference in Oregon was noted, though it is
possible that in Washington such a preference does exist.

Cow elk have a deep hatred for dogs and are subject to fits
of rage at the sight of a dog. This rage at times amounts to a
state of hypnotic trance.

Younger animals and calves are quite playful and love to frisk
and play around pools or ponds in the evening.
The bulls shed the velvet early in August, though spike bulls may retain the velvet as late as September 15. The rut begins about September 1, and is over by October 1. The peak is usually passed the second week in September. Bulls may reach physiological sexual maturity the second or third year, but functional sexual maturity is not reached until physical growth and maturity is reached about the fifth year. Until that time the old bulls drive the younger ones out of the herd during the rut. One bull usually has mastery of a harem of cows.

Females do not reach sexual maturity until 28 months of age. Development of certain color markings of the female is believed to be an indication of sexual maturity. Twin calves are sometimes born, and have been observed, though rarely. Mothers with calves usually form a nursery group apart from the regular herd the first month of the calf’s life.

Observation during the hunting season after the animals had been protected for over 30 years, shows that the elk is a versatile and adaptable animal, capable of taking care of itself under any conditions. In shyness, intelligence, and keenness of senses, it is equal to any big game animal. Due to terrain and natural conditions, hunting the Roosevelt Elk is an extremely difficult sport. Various conservation and hunting practices in relation to this animal have been discussed.

The available range in Oregon alone is capable of supporting from 30,000 to 70,000 animals. Most of this land, due to the climate and other natural factors, is and never will be suitable for grazing uses and will always be forest land highly suited to the needs of
this species of elk.

The present herds, and even to a greater extent the potential herds, have a value far in excess of that derived from the limited grazing value of these lands.

Many questions and problems relating to these animals have not been solved and remain for future students to solve.
NATURAL HISTORY OF THE ROOSEVELT ELK

by

WILLIAM GRAF

A THESIS

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My interest in the Roosevelt Elk and its peculiarities and habits was aroused while I was actually far removed from its range and habitat. While travelling as a student in Germany in 1936, the striking similarity between the Roosevelt Elk and red deer not only of certain basic physical characteristics but of ecological characteristics as well were noted. These characteristics have of course been noted long before and by nearly everyone giving more than casual attention to the Roosevelt Elk. My interest was, however, aroused beyond the point where the meager literature would satisfy me, and I made plans to study the life and habits of this interesting and striking representative of our big game fauna.

Within the range of this elk is still to be found a remanent of that primitive wilderness which has disappeared from the rest of the United States, and which is to be found in but a few other localities on the entire North American Continent. In no other spot in North America can one find a combination of such magnificent mountains and truly primeval forests as are to be found from northern California to the Olympic Peninsula. It is a proper setting for a truly magnificent animal -- the Roosevelt Elk.

My field work and study of the Roosevelt Elk started early in 1937 and from that time on through 1938 was carried on jointly with my field study of reptiles and amphibia in the areas mentioned during this time. From 1938 on, except for a winter spent in graduate studies at Michigan State College all time was given to the study of the Roosevelt Elk in the field, and while the work was much
interrupted during the summer of 1942, observations were made at
intervals on certain herds up to September 1942.

As a matter of convenience and since it represents a cross-
section of the types of habitats and range frequented by these elk,
my work was confined to Oregon, and most of my work was done in
Clatsop, Tillamook, Lincoln, Benton, Douglas, Coos, Linn, and Lane
Counties. These counties comprise virtually the center of the
Roosevelt Elk range and present a cross-section of the typical
ecological and physiographical features of the Roosevelt Elk's
range and habitat.

Limited funds, time, and towards the last a curtailment of
field activities by war regulations have limited this work, and
I am truly aware of the fact that there is much that is unanswered
in this work. It would have been desirable to give some time to
certain specific ecological problems found in the Olympics. Yet,
it is utterly impossible to be in two places at once, especially
two places 300 to 400 miles apart. One must choose that which
seems the most important to the work in mind. I chose the basic
study of habits and behavior in preference to a localized ecological
problem. It would have been desirable to study in greater length
the rutting behavior of the herds. Yet it is possible to study
only one herd at a time in one season. To make observations on a
number of herds even remotely approaching a statistical series of,
say 50 herds, requires fifty consecutive years for completion. The
same applies to practically all other activities, such as birth,
antler shedding, and growth, etc., which are all seasonal.

It is hoped that the reader and critic will keep this in
mind and will appreciate the difficulties encountered in making such a study. Such work cannot be carried out in the laboratory, and one has no control over the subject and environment. Direct evidence can only be obtained by sight observations at a distance at the best with a pair of binoculars, and often only indirectly by observing the evidence left by a passing animal. An effort was made to carry on observations at all times of the year regardless of weather. Fully half of the photographs were taken while it was raining and storming, and most of the others at such early or late hours or in such deep shade that light was at a minimum. Only the good fortune of having some highly advanced and specialized film developing materials made these photographs possible. For the benefit of those particularly interested in this type of photography the following equipment was used:

A Leica m. G. camera with 135 mm nektor F.4.5. lens was used for all individual shots. For general views and groups a Summar F.2. 50 mm lens was used. The film was Standard 35mm ultra speed pan type. Exposures were all based on a Weston rating of 1000 in summer light and Weston 500 in winter light. A Weston Master Photoelectric Meter was used at all times. All film was developed in a special Von L Gold XX Developer supplied by the Mon Blank Laboratories of Fort Wayne, Indiana. This developer made possible 90% of the pictures since most of them could not have been taken with normal film emulsion ratings.

Automobile transportation was used to reach the study areas but all observations were made on foot. A 8X binocular was used as a help in these observations.
I am indebted to the following people:

To Dr. Kenneth L. Gordon, Professor of Zoology, who has been my advisor throughout this work. His advice and guidance in the study of this work has in no small measure contributed to any success I may have attained. His critical reading and correction of the manuscript has been invaluable.

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To the various members of Game Departments of California, Oregon, and Washington for the material and information which they so kindly placed at my disposal, and to the many Forest Service officials, forest guards, and lookouts whose willingness and cooperation helped me in a large measure in gaining my field observations.

To Allan Hofoed, caretaker of Ecola State Park, who passed on to me his own observations on elk, and who gave freely of his time and the facilities of the park in helping me observe and photograph the elk in Ecola Park.
TABLE OF CONTENTS

I. Early Records and the Roosevelt Elk as a Distinct Form

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reports of new form in early journals</td>
<td>1</td>
</tr>
<tr>
<td>Described as new species</td>
<td>1</td>
</tr>
<tr>
<td>Discussion of specimens from Olympics</td>
<td>3</td>
</tr>
<tr>
<td>On outlier characters</td>
<td>3</td>
</tr>
<tr>
<td>Color</td>
<td>7</td>
</tr>
<tr>
<td>Size</td>
<td>9</td>
</tr>
<tr>
<td>Heights</td>
<td>9</td>
</tr>
<tr>
<td>Identification characters</td>
<td>13</td>
</tr>
<tr>
<td>Relation to European elephant groups</td>
<td>18</td>
</tr>
<tr>
<td>Adaptation to surroundings</td>
<td>19</td>
</tr>
</tbody>
</table>

II. Range and Distribution

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original range</td>
<td>25</td>
</tr>
<tr>
<td>Eastern limits</td>
<td>25</td>
</tr>
<tr>
<td>Intermingling with other species</td>
<td>25</td>
</tr>
<tr>
<td>Distribution and numbers in California today</td>
<td>27</td>
</tr>
<tr>
<td>Distribution and numbers in Oregon today</td>
<td>27</td>
</tr>
<tr>
<td>Distribution and numbers in Washington today</td>
<td>31</td>
</tr>
<tr>
<td>Habitat</td>
<td>31</td>
</tr>
<tr>
<td>Life zones</td>
<td>34</td>
</tr>
<tr>
<td>Discussion of Washington habitats</td>
<td>36</td>
</tr>
<tr>
<td>Coast Canadian zone</td>
<td>36</td>
</tr>
<tr>
<td>Principal plants</td>
<td>38</td>
</tr>
<tr>
<td>Contacts with agriculture</td>
<td>38</td>
</tr>
</tbody>
</table>

III. Social Organization and Behavior of the Elk Herd

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development and size of herd</td>
<td>40</td>
</tr>
<tr>
<td>Bachelor groups</td>
<td>45</td>
</tr>
<tr>
<td>Interest of bull in social group</td>
<td>45</td>
</tr>
<tr>
<td>Organization of herd</td>
<td>46</td>
</tr>
<tr>
<td>Bulls in the herd</td>
<td>46</td>
</tr>
<tr>
<td>Maternal attachment</td>
<td>49</td>
</tr>
<tr>
<td>Voice</td>
<td>50</td>
</tr>
<tr>
<td>Play</td>
<td>58</td>
</tr>
<tr>
<td>Activity habits and routines</td>
<td>69</td>
</tr>
<tr>
<td>Effects of hunting on routine habits</td>
<td>63</td>
</tr>
<tr>
<td>Behavior of resting herd</td>
<td>65</td>
</tr>
<tr>
<td>Shaving bark from trees</td>
<td>71</td>
</tr>
<tr>
<td>Temperament</td>
<td>77</td>
</tr>
<tr>
<td>Driving with dogs</td>
<td>83</td>
</tr>
<tr>
<td>Resting and loafing grounds</td>
<td>85</td>
</tr>
<tr>
<td>Use of shelters - negotiation of obstructions</td>
<td>87</td>
</tr>
<tr>
<td>Carriage of cows - bulls</td>
<td>93</td>
</tr>
<tr>
<td>Recognition</td>
<td>96</td>
</tr>
</tbody>
</table>
IV. Home Range

- Size of range
- Use of range
- Adjoining ranges
- Food as a factor in use of range

V. Food

- In Washington
- Comparing Roosevelt elk with Rocky Mt. form
- Emergency food
- Death as a result of feeding

VI. Natural Enemies and Accidents

- Disease and parasites
- Predators
  - Wolf
  - Mountain lion
  - Coyote
  - Black bear
- Man
- Market hunting

VII. Development

- Sexual and physical maturity - bulls
- Adolescence
- Sexual maturity - cows
- Calving and "nurseries"
- Sex ratio

VIII. The Rut

- Physiological state and development
- Vigor and age
- Antler regression
- Antler characteristics, inherited
- Antler composition
- Antler shedding
- Durability of antlers
- Feeding on antlers
- Growth of antlers
- Peeling of velvet
- Polishing of antlers
- Coloring of antlers
- Sign posts by antlers
- Rut behavior
- Calling elk
- Rut willows
- Appearance and behavior of bull in herd
- Young bulls
Guarding of herd by bull ........................................... 168
Fights ........................................................................ 169
Sexual cycle .................................................................. 170
Sexual behavior of young bulls ................................... 171
Sexual receptivity and responsiveness ......................... 171
Breeding ...................................................................... 174
Ending of rut ................................................................ 176

IX. Rest History and Conservation

Early records of numbers ............................................. 179
Disappearance of elk .................................................... 182
Establishment of protective laws in Oregon .................. 183
Growth of elk herds in Oregon ..................................... 183
Opening of hunting season after 31 years of closure ...... 184
Conflict with agriculture .............................................. 186
Damage fund, need of .................................................. 187

X. The Roosevelt Elk as a Game Animal

Senses .......................................................................... 189
Distrust of man, adaptation to presence ......................... 192
Behavior after long closed season ................................. 193
Wildness and difficulty in hunting after protection ...... 194
Number of elk killed in Oregon .................................... 195
Home range attachment .............................................. 196
Difficulties in hunting elk ........................................... 198
As "dangerous game" .................................................... 199
As trophy - antler measurements ................................. 203
Vitality of elk ............................................................. 205
Loss of animals in hunting and reasons ....................... 206

XI. Conclusion

Potential range in Oregon ........................................... 213
Grazing in western Oregon ........................................ 215
Forest land in western Oregon and Washington .......... 217
Potential elk range capacity ........................................ 218
Grazing value and value of elk .................................. 218
Economic value as food etc ........................................ 219
Studies yet to be made ............................................... 219
Early Records and the Roosevelt Elk as a Distinct Form

That discriminating hunters must have recognized the Pacific Coast elk as a distinct and separate form from that of the eastern United States and Rocky Mountain form, is shown by the evidence presented in the Reports on the Mammals of the 47th and 49th Parallel in the Pacific Railroad Reports of 1860. J. G. Cooper in his report in 1857 states: "An intelligent farmer, who formerly hunted elk in New York State, told me that he considers these a different animal, being much larger, and having larger and differently formed horns." The notation of different horns shows the critical distinction which this farmer made between the two distantly separated species.

George Gibbs, in Suckley's report gives the observations of a Washington resident. "Judge Ford, long a settler in Washington territory, and an enthusiastic hunter, says that the elk of the Pacific coast is not the elk of the "Plains", but has a larger and coarser head. He has been, through life, familiar with game, and is positive that they are different animals."

Thus there can be little doubt that long before the turn of the 19th century the discriminating observers and hunters recognized the elk of western Oregon and Washington as a larger animal and having distinct and recognizable characteristics from those of its eastern relative. It was not, however, until 1897 that this animal was described as a new species. In that year having obtained a specimen through previous arrangement with the Emmet brothers of
Figure 1

Typical elaphine type antlers of the Roosevelt Elk. Note the proportionately heavy, straight, short beams and angular form and the cluster of short tines at the end of the beam.
Washington. C. Hart Merriam (12) accurately described and named the new species, giving the elk of the Olympics the name of *Cervus roosevelti* in honor of his friend President Theodore Roosevelt. The name has gone through several transitions. The present status of the Roosevelt Elk is that of a subspecies and among most mammalogists the name *Cervus canadensis roosevelti* Merriam, is in good standing, and is, in my opinion, the correct one. The type was collected on Mt. Blaine in the Olympics.

The question of difference between the Rocky Mountain form and the Roosevelt form has raised some controversy among naturalists particularly the earlier ones. Even today no two men writing on the appearance, color, and other features of the form under discussion will agree on all points. This variation is a natural one for no two people will see eye to eye in the matter of color shade, judgment of size, symmetry or dimensions. Some people can recognize small differences and fine details when observing animals in the field, others see these to a lesser degree or not at all. Some people never learn to see such fine points no matter how much practice they receive, for they obviously lack an ability which is as much a talent, subject to development of course, and a prerequisite in this field as is a fine sense of sound and tone discrimination in music or color balance and discrimination in painting.

Elliot (6) writing of the Roosevelt Elk which he collected in the Olympics at that time, states that he does not consider the color as differing from that of the Rocky Mountain form except in winter when it is darker and that there is some variation in
Figure 2

Typical canadensis type antlers of the Rocky Mountain Elk. Note the wide sweeping curve of the proportionately longer and lighter beam, the wide spread and the long terminal tines which sweep backwards in a characteristic curve.
this respect. When this darkness is absent he considers the two inseparable.

Of the five bulls killed he writes as follows: "all but one were old inhabitants of the Olympics". He does not elaborate on this statement but it is presumed that he means that the bulls were all old bulls. The antlers of the fifth one are not figured in the text, and apparently he was an immature one not suited for taxonomic comparison. Of the four antlers considered he continues, "Two of them, while belonging to very large bulls had but 5 points on each horn, but differed widely in their general shape and extent of spread."

"The third pair were evenly branched with decided cup at the crown surrounded by high points. The brow tines, however, project almost directly forward and were without the graceful upward curve seen in the typical style. The fourth was a very extraordinary pair, being palmated from the burr for nearly the entire length of the beam." He mentions that this bull was very old.

Comparing the pictures of the antlers in question with Mr. Elliot's statement, it is quite obvious that he overlooked the most important points of distinction either because he failed to take into account the reasons for their absence, or because he was looking for a particular distinguishing character which did not happen to be present, or perhaps because he did not recognize the overall distinguishing characteristics which are the features of this species. Perhaps all three factors were involved.

There are a number of reasons which lead one to suspect that the first two bulls which he considers very untypical of the
Roosevelt form, were very old bulls. First his rather vague statement that these were "old residents". This doesn't say how old but at least one can assume that they were fully matured. Further he says they were "very large" bulls, which again leads to the conclusion that at least they were fully matured. Thirdly, he states definitely that each antler possessed only 5 tines. In the light of these statements and after viewing critically his excellent figures of the antlers one can arrive at but one conclusion, namely that the bulls were both "very old" and past prime insofar as antler development is concerned. The presence of 5 tines in fully matured bulls, particularly when they present the spindly appearance of beam with greatly retarded terminal tines as these do, is a sure indication of old age, past the prime of life. These antlers are typical of such retarded antlers. Notwithstanding this, the antlers both present the typical short straight uncurved form of the Roosevelt type. Naturally in such retarded antlers no cup formation will be found, though in their prime they may well have showed such a formation. The difference in "shape and extent of spread" is part of the individual variation of any species. The fact that the bulls were very large and quite likely in good condition does not indicate that a bull is in his prime. For where food conditions are good throughout the year as they are throughout most of the range of the Roosevelt elk, bulls will maintain their maximum weights long after they have passed the age of maximum antler development. Bull No. 1 whose antlers are shown in figure 60 was a very old bull as indicated by the teeth which were worn almost to the gums. His antlers are typical of such a
bull and identical in character to Elliot's two. This bull weighed dressed (completely eviscerated, legs cut off at knee and hock, and with hide and head) three days after he was killed 737 lbs. He was in first class condition and fat. Bull No. 3 whose antlers are pictured in figure 62 was likewise an old bull past prime. He likewise was fat and in excellent condition and though not weighed he was equal if not larger in size than No. 1.

Elliot's third bull likewise shows the typical straight heavy beam with aborted terminal tines and as Elliot himself says, "with a decided cup surrounded by high points". Altogether this is an excellent type showing all the characteristics of the antlers of this species. The brow tines are simply freaks and do not enter into the picture at all. Such tines may be encountered in any form, and I have seen them even in the red deer. The fourth is obviously a freakish exaggeration of a condition which is not uncommonly encountered in the antlers of this form. When present it is usually confined to the juncture of the tine and beam and to a far lesser degree. The fact that this was a very old bull has no doubt considerable bearing on the peculiar form of the antlers. A more complete discussion of this point will be given under the development of antlers.

Skinner (24) says of the color of these elk: "A comparison of these elk with the others at any stated season shows that the body of this species is lighter in color, on the other hand, the face, innersides of the legs and underparts are redder; and the neck and outer parts of the legs are darker, in fact almost black. The mane is heavy and black."
I do not know at what distance Skinner made his examinations, but on the whole I think his color description is quite correct. Whether this lighter color to which he refers is characteristic or not is difficult to say. I have frequently noted certain individuals and particularly certain old bulls, among the Oregon elk which at a distance gave the appearance of having a very light gray, sometimes almost white body which contrasted sharply with the darker shoulders and hindquarters. This appearance was most apparent when viewing the animals at a distance and in strong light (out in the open) and particularly in sunlight. This is, I believe, due to a greater amount of gray showing among the hairs on this part of the body and particularly due to the white shaft of the hairs showing through the outer color and reflecting light to a greater degree. Since, however, not all animals show this feature it must be regarded as a peculiarity, perhaps a bleaching, of individuals.

Whether Skinner's statement refers to this same thing or whether it is to apply to all animals is not stated in his text. Since I have not had the opportunity to observe the Olympic elk myself, I am not able to criticize his statement.

On the whole the animals shown in the color plate are excellent examples of the typical color, with the exception that in many of them the rump patch, inner sides of legs and face markings are brighter reddish brown; the head is usually darker, blackish brown, sometimes almost a black. There are some which will be even lighter, though these are fewer. This variation in the picture is due to a slightly improper color balance in finishing the
Size is another point on which there seems to exist considerable difference of opinion among students, and particularly the layman. Bulletin No. 2 issued by the Oregon State Game Commission 1933, states, "The Roosevelt or Oregon coast elk has a much more rugged appearance, the beam of the antlers being heavier than that of the Rocky Mountain elk and the head and neck are much more rugged, although the Rocky Mountain elk generally develops greater weight.

Compare this with Skinner's (Murrelet 1936) statement. "The Roosevelt elk are large, fully a quarter heavier in weight than the Rocky Mountain variety of elk. Where a Rocky Mountain male would weigh 600 to 700 lbs. the Roosevelt elk weighs over 800 lbs. Where a Rocky Mountain female might weigh 400 to 500 lbs. the Olympic females do better than 500 to 600 lbs. At the same time the body is heavier, it is not so chunky, and the legs are longer, so that the whole animal is in better proportion, and carries head higher."

I have weighed only three bulls of this species myself. These were killed September 1, 1938, on the opening of the western Oregon elk season. All three animals were in superb physical condition and had a good layer of fat under the skin. I do not consider these three as being exceptional in any way from other mature bulls seen during that season or since that time. Bull No. 1 which has already been mentioned was part of a bachelor herd of at least 12 animals varying from spike bulls to fully matured bulls. At least 4 other bulls seen at the same time in the vicinity of this bull looked definitely larger than this one, one being
exceptionally large by comparison. The three bulls were all dres-
sed in the typical manner common among hunters in that region.
They were skinned, the head cut off, all internal organs removed,
the legs cut off at the knee and hock and the body quartered.
No. 1 was weighed without the neck, which was separated from head
and shoulders. Based on the weights of the necks of the other
two, it is estimated that it weighed at least 50 to 60 lbs. The
parts, that is head and antlers, hide and four quarters and rib
sections weighed 737 lbs. three days after being killed. The
weighing was done on the scales of an Astoria refrigeration plant.
Bull No. 2 of this group dressed in the same way and weighed in the
same way, including, however, the neck, weighed 750 lbs. Two other
bulls seen in the company of this one were fully as large if not
larger. No. 3 dressed and weighed in the same manner and with
the neck weighed 857 lbs. The hunter who killed this bull stated
positively that there was in the company of this bull another one
which was definitely larger in appearance, but due to the fact that
they separated and the larger one had wandered into the brush
before he got within range he had been forced to take the lesser
one. This bull was in the prime of life, whereas both the others,
especially No. 1 were much older. At the time that these three
bulls were killed, I heard of a bull killed near Cannon Beach which
weighed dressed 1100 lbs. I was not able to trace this report down
myself, but later mentioned this to a friend and was informed by
him that he was in that vicinity some time later and had met the
individual who had killed the bull in question and that this man
had told him that the weight was scale weight. The weight might
sound excessive, but at least one of the bulls in the herd from which No. 1 was killed was so definitely larger than this bull that he could easily have weighed 200 to 300 lbs. more. If we allow a fourth of the live weight for loss in dressing out as described, and I believe this is not excessive, it would mean that the three bulls weighed would have weighed from 1000 to 1200 lbs. live weight and the 1100 lb. bull reported would have weighed more than 1400 lbs.

It should be mentioned that the hunters who took bull No. 2 and 3 were both experienced elk hunters and had hunted elk at least 4 or 5 years in eastern Oregon. Both had argued vigorously that the Roosevelt elk could not be bigger than the Rocky Mountain form with which they had had experience. Both were much astonished at the size and weight of the Roosevelt form when they saw and weighed it. Bailey (3) says that the Forest Ranger Chris Morganroth of Washington estimated the live weight of a large bull at 1500 lbs. This would be a maximum equaled by that of the bull already mentioned. Donald McLean, Economic Biologist of the California Division of Fish and Game writes me that he personally witnessed the weighing of an old bull killed by a car near Orick, California. Weighed whole it tipped the scales at 797 lbs. This, assuming the bull was in prime condition, is light in comparison to the Oregon elk. Possibly the California variety of the Roosevelt Elk is lighter than the Oregon and Washington variety.

The appearance of an elk on the hoof is extremely deceptive especially when viewed from a distance and it seems impossible that an animal which carries itself so elegantly and lightly can weigh so much. One does not appreciate the weight and size until
Figure 3

Fully matured Roosevelt elk cow in late fall. Note the prominent bib which is well down on the mane proper, and is not part of the normal throat marking. The lighter "goatee" forms a slight wedge at the bottom of the bib. It is highly probable that the appearance of the bib is associated with sexual maturation.
one has viewed the massive musculature and bone structure at close
range in a skinned and sectioned specimen. These animals not-
withstanding their outward appearance, are very solidly built,
and it is a common experience for a man experienced in judging
stock to be deceived by this outward appearance and to underestim-
ate the weight. It would not surprise me therefore, on the basis
of this mistake on the part of men used to judging and handling
the Rocky Mountain form, that the Roosevelt form, size for size,
weighs heavier than the Rocky Mountain form.

In comparing the characteristics of the Roosevelt Elk with
those of the Rocky Mountain form a certain amount of overlapping
will be found. In a mixed herd, if such were possible, it would
be very difficult to classify certain "intermediate" individuals
as either one or the other form without closer examination than
is usually possible in the field.

As a rule, however, a number of readily recognizable char-
acteristics will serve to distinguish the Roosevelt Elk from any
other form that may be encountered within its range. With the
exception of confined park animals the only form which might be
encountered within the range of the Roosevelt Elk is the Rocky
Mountain or Nelson's Elk (Cervus canadensis nelsoni) and since
this form is also the one most often seen in our National Parks
it will be used as a standard for comparisons.

1. I have noticed on fully matured Roosevelt Elk cows a well
defined bib on the throat. This bib is fulvous or grayish buff.
In mature cows, that is cows three years or older, it is very dis-
tinct in the winter coat, less so in summer coat. It is absent in
Figure 4

The "goatee" or beard is here clearly seen as part of the mane which extends up under the throat in a narrow wedge. In many cows it is much longer than in this one.
yearlings (16 months) and calves of the year. It may be first noticed in two year olds (28 months when in winter coat) though at that age it is still indistinct and less well defined than in older animals. This characteristic is not developed fully until at least the third year and possibly not until the fourth year. I have not observed this bib on bulls of any age. In addition to this bib the cows show a curious characteristic, which though perhaps not distinguishing from the Rocky Mountain form is noteworthy of attention. It is the beard-like wisp of hair that overhangs the throat bib. It originates at the upper throat and base of chin as a narrow wedge of hair lighter in color than the throat bib and being five to seven inches in length. It is in fact a narrow continuation of the mane up into the throat area, the hair being sufficiently longer than the mane hairs proper to form a goatee-like tuft which can readily be distinguished in a number of the accompanying photographs. This character has been observed to a very slight extent on one 3 year old bull.

Mr. O. J. Murie, Biologist of the Fish and Wild Life Service kindly undertook to check these throat markings on the Yellowstone Park elk, and tells me that he has observed it in a number of animals at this time (January) of the year. From his information I would judge that a vertical light line under the chin is present in a highly variable form in the Rocky Mountain Elk, but I am not sure that the distinct bib as shown in my photos is present. He says that it is present but is not distinct as in the antelope and deer. Nor could he assign it to any age group and the majority of the elk did not show it. He observed two bulls which showed this marking.
Though heavily shaded, the "goatee" can here be readily distinguished as a lighter narrow wedge overhanging the indistinct throat bib which is almost obscured by the heavy shadow of the head.
It therefore, remains to be shown conclusively whether this, as a characteristic color pattern, is confined to the Roosevelt Elk only. On the basis of consistency and age correlation, I am inclined to believe that it is.

2. In males the antlers are of course conspicuous and are definitely distinct from those of the other forms. Compared to Nelson's Elk the antlers of the Roosevelt Elk are short and heavy beamed, with relatively little sweep or out-curving of the main beam as is characteristic in the Nelson Elk. Nor is there a back sweep of the terminal part of the beam. The antler as a whole shows a rather straight beam when viewed from front and side, and the beams tend to terminate in a hand or cluster of points which may form either a cup or crown or a palm. These characteristic differences can be easily recognized in the accompanying photographs. The crown or palm formation is sometimes encountered in other forms but usually only in freakish antlers resulting from old age or other causes.

3. The animals as a whole give a longer-legged, rangier appearance than does Nelson's Elk.

4. The winter coat is harsh and heavy and gives ample protection against rain and cold, and is shed early in June and again replaces the summer coat in August.

The summer coat is short and shiny and gives the animal a slick almost naked appearance in contrast to its shaggy, rough winter coat. The color is a soft brown contrasting less sharply with the black or blackish brown of head, neck, shoulders and legs. The chin, inner ear, eye ring, and rump patch are a rich fulvous or bright reddish
chestnut color at all times of the year.

Summed up, the points to observe in identifying the Roosevelt Elk are as follows:

1. Short, heavy and relatively straight antlers with marked tendency to form terminal crown or palm.
2. Overall darker animal with more brown and black on head, neck, chest, shoulders and legs.
3. Overall rangier, longer-legged appearance.

It is well known that similar environmental factors in widely separate regions tend to produce similarity in habits and physical characteristics in animals.

We are taught by geological history that the elk and other members of the deer family had its origin in the Old World and migrated from Asia across a once existing land bridge, to the North American Continent. It is interesting to note that today there is a complete chain of evidence linking the Roosevelt form, that is the elaphine type of antler development, with the most highly developed elaphine type, namely the European red deer. According to Heck (8) the European red deer is by virtue of its highest development of a recognizable and characteristic antler form, the oldest of these elaphine type of deer. There are various races of these deer across the entire Eurasian continent to the east coast of Asia, and the interesting thing about these races is that they show a progressive decrease in the development of the elaphine character of their antler form as one moves eastward towards the east coast of the Asiatic continent. The Roosevelt Elk should be considered part of this chain of elaphine races.
According to the description of Allen (1), it would seem that this elaphine character is much stronger in the Roosevelt form than in the last link on the Asiatic mainland, namely, *Cervus elaphus zanthopygus* Milne-Edwards, of Manchuria and northern Mongolia.

*Cervus elaphus*, the European red deer, is a forest dweller inhabiting the dense coniferous northern forest and the more southern deciduous forests. In keeping with accepted ecological rules such an environment tends to develop more compact physical extremities. The red deer follows these rules quite closely in its antler development. In comparison with antlers of other members of the genus *Cervus* which frequents open country, they are relatively short and straight with a comparative narrow spread. The Roosevelt Elk is likewise a dweller of dense forest lands and like the red deer has antlers with comparatively short heavy beams and narrow spread. The crown formation of the terminal points or tines in the red deer is very pronounced and is usually present in the form of 3 to 5 points forming a definite crown or cup. Though not as definite, the tendency towards this type of formation is readily recognized in the Roosevelt Elk.

The longer-legged, rangier build of the Roosevelt Elk may at first seem at variance with the above mentioned ecological rule, however, on closer examination of facts it will be seen that this is not so. Actually it will be seen that it may be a direct development due to ecological conditions peculiar to its range and habitat. The heavy growth of ferns and underbrush and particularly the dense vinelike tangle of salal (*Gaultheria shallon*) which is characteristic over most of its range forms a veritable "sea of vegetation" two
Figure 6

Three year old bull, cow and calf in surroundings which are typical of much of the range of the Roosevelt Elk. This mixture of salal and salmonberry is to be found under the lighter stands of fir, spruce and hemlock. Salmonberry and thimbleberry is likely to be commoner on the coastal slopes, and the salal more common on the inland slopes, though both are found everywhere and rapidly overgrow the logged off areas and old burns.
to three feet deep, through which the animal must literally wade. A short-legged man forcing his way through this tangle of brush and vines can readily appreciate the advantages of longer legs which would enable him to lift his feet higher and over the tangled mat instead of dragging them through it. It seems reasonable to suppose that the rangier, longer-legged build of these elk gives them an advantage in travelling through this type of undergrowth. It is worth mentioning here that another inhabitant of the same range, namely the Columbian Blacktail Deer, shows a specialized adaptation in connection with the heavy mat of undergrowth. Instead of running in a smooth gallop like the antelope or horse, it travels in high stiff-legged bounds, landing with feet bunched and taking off as though on steel springs. The high bounds carry the animal over the tops of the salal and fern mat, and the hidden logs and holes. This spring-like bounding with bunched feet not only clears the brush but is an admirable guarantee against stumbling over logs and other hidden obstacles, something almost impossible to avoid in the flat running gait of open land animals in this type of cover. Though one of gait, this adaptation in an animal which could not possibly develop legs of sufficient length serves quite as well as the elks' longer legs in overcoming the difficulty of travelling through its "sea of brush".

It has been stated by Seton (21), the bounding gait is an adaptation to rough steep terrain and that the mule deer of the more open but rough country has a similar gait. It should be pointed out that though mule deer country is more open so far as timber is concerned it is frequently characterized by heavy almost impenetrable
Figure 7

Typical of the dark gloomy hemlock and spruce forests of the coastal slopes of the Coast Range, showing fallen and decaying logs and the undergrowth coming in at the edge of an old clearing. -- western Douglas County
growths of chaparral, manzanita, sage brush etc. which offer the same obstacle to rapid running that the undergrowth of the Coast Range Mountains does. Also it has been noticed that both the mule deer and blacktail deer will often adopt the flat, smooth running gait when travelling over open ground, regardless of whether the ground was flat or not. Steepness of slope is not nearly as much of a handicap to the flat racing gait as is a tangled mat of brush and vines, though admittedly the bounding gait has advantages in negotiating steep slopes at high speed. Quite likely the adaptation is the result of both terrain and cover, though it seems the latter would be more pressingly influential.
Figure 8

Map showing former and present range of the Roosevelt Elk. Dotted line shows former range; solid line shows present range.
Range, Distribution, and Habitat

The original range of the Roosevelt Elk extended throughout the Coast Range Mountains from approximately the San Francisco Bay region north to the norther limits of the Olympic Peninsula. Thus its southern limits probably conformed quite closely with the limits of the dense humid coastal forests, ending where the cool dense forests of northern California give way to the dry scrub-covered hills typical of the coastal region south of the San Francisco Bay district. At present elk are still found in the Redwood forests of northern California Coast Range but are limited in number, though if properly controlled there is no reason why they should not become as numerous as in Oregon.

The extreme eastern limit of their range was originally to the summit of the Cascade Range in Oregon and some are still to be found on the western slope of the Cascades, notably in the Santiam, MacKenzie, and Willamette water sheds. Though to what extent these animals have maintained themselves intact from introduced Nelson's Elk in the Cascade region is not known. The herds are, however, much greater in number than generally credited by the Forest Service and Game Commission. It is quite likely that the two forms will interbreed and that eventually the identity of the Roosevelt Elk in this part of the range will be lost as a true species. On the other hand it is possible that the two species do not mix. The animals observed were of the eastern form and were observed chiefly near the summit on the eastern slope of the range.
Figure 9

Typical of the tangled mess left by a fire near the edge of a logging. Nine times out of ten such fires are started by criminal carelessness in burning slashing. Logging slashing does not start burning from spontaneous combustion, and since electric storms are rare throughout most of the Coast Range, the firing of this slashing must start from man's carelessness or stupidity. Typical Coast Range has little natural grazing range for cattle, and comparatively few cattle and sheep are grazed in them.
and presumably winter movements would be to lower levels on the east side and the two forms would maintain their identity as species just as do the mule deer and blacktail deer.

The present range has been considerably contracted at its southern limits and to some extent in the eastern limits. Mr. Donald M. McLean, Economic Biologist of California Fish and Game, tells me that the present distribution and numbers of the Roosevelt Elk in California are as follows:

"One herd of about 70 on Little River and Upper Redwood Creek in Humboldt County (No. 1 on map); a herd of about 160 on Lower Redwood Creek, Prairie Creek, and Gold Bluffs, and vicinity in Humboldt County (No. 2 on map); and a herd of about 30 on Upper Hunter's Creek north of the Klamath River in Del Norte County. The large band of 160 or so spends much of its time in Prairie Creek State Redwood Park." The numbers, states Mr. McLean, in 1925 were about 75 and the present numbers are from these 75 animals.

In Oregon they are found to a greater or lesser degree throughout the Coast Range from the Columbia River to the California line. The greatest concentrations are in Clatsop, Lane, Douglas, and Coos Counties, and to a somewhat lesser extent in Tillamook, Lincoln, and Curry Counties. They are also found in smaller numbers in almost every county extending into the Coast Range Mountains, and I have had reports of individuals and small bands in various parts of the mountains where the observer stated positively there had been no elk for the past 20 years. In the Cascades the chief herds, as accurately as I have been able to determine, are chiefly in the McKenzie watershed area and the
Figure 10

Open headlands along the Oregon coast. Such areas with a rich covering of grasses are found only on these headlands and a few higher peaks in the mountains. Natural meadows such as are common in the high alpine mountains do not occur, except in the higher parts of the Olympics and a few other places.
Santiam watershed. However, I am informed that a number of Rocky Mountain elk were planted in the Santiam district above Sweet Home. This is really unfortunate as the animals will probably interbreed. Where original stock is still present as there was in this region, it is highly undesirable to introduce a closely related form that will destroy the characteristics of the native form and thereby lose its own identity. There is also supposed to be a herd in the Mt. Hood region and another near Roseburg. As in the Coast Range small bands are appearing in new (or old') places in the Cascades and seem to be on the increase.

In 1938 the Game Department estimated that there were 3000 elk in Clatsop County -- the figures based on observations and estimates of field men -- likewise they estimated a total of about 3000 animals in Douglas and Coos Counties in 1941. I personally believe these figures are conservative, as figures based on field observation usually are. It is especially easy to underestimate total numbers based on observations made under conditions where observation is extremely difficult at best as it is in the Douglas and Coos forests.

In the report of A. V. Meyers, Biologist of the Oregon Game Department shows that 1243 hunters during the 1938 season reported sighting 10,441 elk. Obviously many of these were duplicates, yet one should keep in mind that 1243 hunters in the area hunted did not crowd the area excessively and the figure gives some support to the census figures. It is safe to say that there are probably in the State of Oregon not less than 7000 Roosevelt Elk.
Figure 11

Typical inland Coast Range covered with a heavy stand of virgin Douglas Fir. The open slopes in the foreground are the result of an old burn, and in the summer are covered with a dense stand of bracken fern which here often grows to a height of ten feet or more and forms an almost impassable jungle. Other such slopes are covered with salmonberry, thimbleberry, salal, hazel, vine maple, and other forms.
Thus, throughout its present range in the Coast Range Mountains from northern California to the northern tip of the Olympic Peninsula and in the Cascades of Oregon and Washington, there are not less than 16,000 Roosevelt Elk and perhaps more. Of this number probably not more than 1500 are found in the Cascade Mountains.

Of the Roosevelt Elk in Washington, Mr. Burton Lockhart, Biologist of the Department of Game says, "These elk are distributed in Washington in three herds or regional groups. The largest is the Olympic Peninsula herd, next is the Pacific County herd, and the smallest is a group in the Mt. St. Helens District of Skamania and Cowlitz Counties. There is some difference of opinion concerning the origin of the last group. I think that Leo Couch reported that they were from introduced Montana stock, but as a result of my investigations, I am of the opinion that they are a remnant of the native Roosevelt variety that remained in this portion of the Cascade Mountains. I am enclosing a map showing the general distribution of these herds."

The populations of these herds might be estimated roughly as follows:

Olympic Peninsula . . . 6000 to 8000
Pacific County . . . 2500
Skamania County . . . 500

It appears from this that in Washington the Roosevelt Elk has largely disappeared from the Cascade region except in the Mt. St. Helens district and the exact status of these animals is in doubt.

The habitat throughout the range, with the exception of the
high elevation of the Olympics and the higher elevations in the
Cascades is quite uniform. In general the range of this elk is
heavily timbered, the principal forests being Douglas fir, spruce,
hemlock in Oregon and Washington, and hemlock spruce, and redwoods
in northern California. The high alpine regions are characterized
by typical alpine conifers. In many sections of the west slope
of the Oregon Coast Range there are extensive alder forests com-
posed entirely of these trees so that this too may be considered
a typical form for even in the coniferous section it is the typical
cover found along streams and in the bottoms of the canyons and
ravines.

Natural clearings are often covered with dense growths of
bracken fern, excluding all other forms of growth. Often these
ferns grow to a height of 10 feet and form such a dense jungle
that they present an almost impenetrable barrier to a man on foot.
where bracken fern is lighter or not present it is replaced by
heavy and even more impenetrable growths of salmonberry and thimble-
berry. These two forms almost always come in on logged-off lands.
They grow into veritable jungles in these humid regions and the
tangled mass of logs and fallen limbs usually left by logging
operations so overgrown forms an impassible barrier second to
none. This is especially true of the west slope of the Coast
Range where the vegetation grows in almost tropical profusion.
Even the heavy forests have a dense undergrowth of sword ferns
and vine maple, salmonberry, thimbleberry etc. However, the heavy
spruce and hemlock stands of the coast slope often present a rel-
atively clean forest floor so far as vegetation goes, though even
Typical logged off area which was heavily burned after logging. Note the profusion of wasted timber on the ground which was cut and left. Such practice is common in the west where unselective logging is practiced. Such an area is worthless, and supports neither stock nor game, and because of the baked earth from the hot fire will continue to be unproductive for many years.
here sword fern is usually present. The more open Douglas fir of the inland slopes is usually heavily undergrown with salal and sword fern and vine maple. The salal in particular forms a very heavy and dense growth, in some places almost a mat-like growth and may reach a height of four feet.

As has been intimated the rainfall is heavy throughout this region and runs from 50 inches to 180 inches annually. Most of this falls during the winter months. Along the coastal slope, fog contributes much to the humidity during the summer months and helps keep the temperature at relatively low levels. Water is no problem to the elk, and almost every ravine has its rivulet of water, and larger streams with constant and heavy flows of water are to be found in almost every canyon at lower levels.

The highest point, except for the Olympic Peninsula, in the Coast Mountains is Mary's Peak which rises to slightly over 4000 feet in height. Most of the peaks are much lower than that, and the average is around 2000 feet. However, their steepness and the frequency of ravines and canyons on the slopes themselves and the heavy cover make the Coast Range one of the toughest and roughest regions that anyone may choose to investigate, outside of the tropical jungles.

From the life-zone standpoint the range of the Roosevelt Elk is for the most part Transition Zone with typical transition plant and animal forms. In the Olympics as well as in the Cascades, Canadian, Hudsonian, and even Alpine zones are encountered and in these regions the elk may and does frequent these higher zones during the summer months. However, in most cases the range of this
Figure 13

Typical Coast Range. The lighter gray in the background represents burns, the dark areas forested areas. In the right foreground a fresh logging can be seen.
elk seldom extends beyond the Canadian zone and that usually by summer herds, usually bulls, which move to the higher levels in groups while their antlers are developing.

Skinner (24) in his excellent observations of the Roosevelt Elk in the Olympics says of that region, "The forests are a wonderful stand of fine, large trees that have few equals anywhere. They are the best of the few remaining remnants of those magnificent forests once extending from British Columbia to California. Under these forests grow the lower trees and bushes, such as: devil's club, salmonberry, thimbleberry, huckleberry, snowberry, blackberry, salal, willow, alder and vine maple. These often grow densely, and, with the everpresent ferns, make a veritable jungle. Throughout most of the forests there are fallen logs, and in places these logs and growing bushes block all passage. Logs, rocks, growing trees and even the ground are covered with a dense mat of mosses, while both the standing shrubs and the living trees support numbers of fungi of various kinds." His description could apply equally well to the forested regions of Oregon, Washington or northern California where the logger has not denuded and scarred the hills sloping to the Pacific.

Mention should be made of the Coast Canadian zone encountered along the Oregon and Washington coastline. It is characterized by the presence of the jack pine and is a strip of territory varying from a few feet to perhaps one to two miles in width at the widest point. Aside from the jack pine, the plant forms, and also the animal forms, are the same as in typical transition country. This zone can be easily mapped to coincide with these parts of
Figure 14

A dense stand of hemlock and spruce showing the heavy growth of sword fern commonly associated with such habitats. The tender tips of the new fronds are readily taken as food in early spring.
the coast line which are exposed to the prevailing and severe ocean winds. Most plant forms are stunted and wind-bent by the prevailing winds. Aside from an ecological curiosity there is no value or point in classifying it in other than the regular transition zone.

Principal woody plants are as follows: On the Pacific slope in Oregon and Washington the hemlock, cedar, and sitka spruce are the chief conifers and the alder the chief deciduous tree. Willows, vine maple, salmonberry, thimbleberry, salal, elderberry, devil's club, blackberry and rhododendron are the most common shrubs and lesser trees. The inland slopes of the Oregon Coast Range and the west slope of the Cascades are largely covered with Douglas fir. Alder is the chief deciduous tree found in considerable quantities along all streams and in the more damp canyon bottoms. Otherwise the inland areas have the same shrub forms as the coastal slope, though rhododendron is not usually found on the east slope of the Coast Range. In southern Oregon myrtlewood is a common tree along many of the streams and canyon bottoms as is also elder. Northern California may best be characterized by its redwood forests throughout the range of our elk, though hemlock and spruce are also commonly found particularly in the north. Lesser plants will be mentioned under foods.

Except in the very marginal regions the Roosevelt Elk has little contact with the agricultural areas. Most of the range of this form is forested and has little agricultural value after being logged; and should, as it usually does, revert back to new forests. Contact with man's activities and man, outside of the hunting field, is usually in the vicinity of logging operations and logging
communities. There are of course the so called "mountain folk", individual families living throughout the mountain region, generally in the more remote regions, and doing limited and usually ineffective "farming" or "stock" raising on these "shoestring ranches" when they are not sporadically working in some nearby sawmill or logging camp. Much of the country is accessible by forest roads, though there are still many places which are seldom visited except by the occasional trapper or timber cruiser. Unfortunately some of the finest areas, have been and are rapidly being denuded of the forest cover by logging operations. In most of these cases the logging is done without regard to conservation of younger trees and the areas are systematically denuded of everything which can be called a tree as such, even though the biggest percent of these trees are not used, or for that matter are not useable.

Note: Since completing this manuscript, Mr. Stanley Jewett Sr., now with the Fish and Wild Life Service tells me that he is positive no Rocky Mountain elk have ever been liberated within the natural range of the Roosevelt Elk. Mr. Jewett is a recognized authority on wild life and natural history, and has been closely associated with the history of conservation in Oregon. It may, therefore, be accepted with certainty that there are no introduced Rocky Mountain elk west of the summit of the Cascades, though there is some possibility that an intermixing of the two forms may take place at the summit in certain areas, particularly the Three Sisters region.
The Social Organization and Behavior of the Elk Herd

The Roosevelt Elk, like other members of the genus Cervus, are quite social in the organization and behavior of the herds. Herds usually consist of 10 to 25 animals. The typical herd numbers 15 to 17 animals. In some instances herds may consist of 40 to 50 animals and in bygone days may have been even larger. As will be explained later, the herd formation, that is the formation of the true social herd is brought about by certain natural factors which limit it to its usual small size. On the other hand, the large herds of 50 to several hundred animals which may have been encountered at one time, and still are encountered in some sections, are usually winter herds formed by the merging of several social groups. Such large herds are seasonal, and usually wintering range, topography, etc. are responsible for their formation. The great Jackson Hole, Wyoming, winter herd is typical of this type of herd. Since there is little variation between winter and summer range where the Roosevelt Elk is found and food is plentiful throughout the year, winter herds are not found as such, and at best are comparatively small in size.

The social group of 15 to 17 is actually a family group made up of three or four generations of animals and is due to the close maternal attachment that persists among young elk until full sexual maturity is reached. In females it may persist longer. This was clearly evident in two herds which I closely observed for over two years. Data on one of these herds was supplied by Allan Kofoed, caretaker of Ecola State Park. His information covered the years
Figure 15

Typical ewe-necked appearance of a very old cow. Such cows are frequently the matriarchal leaders of the herd.
Figure 16

Part of a typical herd at the edge of one of their favorite loafing and resting grounds.
prior to the beginning of my observations, and it was definitely possible to identify members of this herd for a period of four years. Two young bulls in the second herd were first observed when they were one and two years old and undoubtedly born in that herd. They were observed as members of that herd well into the third year so that is can be said that the oldest bull remained with the family group into the beginning of the fifth year. Since bulls of five years and older are not part of the usual family group, it can be assumed with considerable certainty that bulls generally drift away from the family group at about 4 years of age, or at about the time when a young bull is approaching physical maturity and feels able to assume herd-bull duties and responsibilities. Both of the above herds numbered 15 animals each, and can be considered as typical examples of a family social group. Both herds had parallel and closely adjoining home ranges and showed close relationship among members in certain characteristics, particularly in antler structure.

Each herd had a yearling and a two year old bull the first year observed. One herd had 5 calves, two of which were twins; the other had 4 calves, and a like number in the other herd. Four to five cows of each were mature breeding animals, one or two of which were definitely much older than the rest. It was always one of these old cows who was matriarchal leader of the herd. Other herds of smaller or larger size observed were very similarly made up, and sexes and ages were approximately of the same proportion. It would appear then that a social group has its beginning with one or two animals and that subsequent growth of the herd is through a chain of maternal attachments through
This herd was feeding greedily on the foliage of fallen hemlock trees at the edge of a logging operation when first observed. One of the fallen tops can be seen in the background. Other food, such as green grass and a variety of shrubs was common, and all the animals are in excellent condition. Hemlock is here not an emergency food.
at least three generations and possibly four. Termination of the chain is brought about by a natural outgrowing of the attachments at physical and sexual maturity. There is little if any evidence to support the belief that totally unrelated elk are social in habit in the sense that certain birds and rodents are considered social. Herds formed during winter and therefore usually by forces outside of the animals themselves cannot be considered as evidence of true social instincts any more than confinement within artificial barriers can be considered evidence of the formation of a social group.

Sociable inclination to an extent is present though, and is best demonstrated by mature bulls which form bachelor groups during the summer months. Such groups number from 2 to a dozen or more and may in some unusual cases reach a hundred or more. The latter figure has been observed among the European Red deer, and whether such numbers are ever reached among the Roosevelt Elk is not known. In the case mentioned it should be noted that certain other external factors such as an extremely favorable summering spot with good food, etc. was the site of the gathering of this large bachelor herd.

On the other hand, mature bulls seem to have no interest whatsoever in the family group, at times other than the mating time. At best the social instincts of the elk are limited and somewhat interrupted with the seasons and the age of the animal. Among the cows the family group fulfills the social needs and instincts, and it may be for this reason that non-family socialization is not so apparent.
The social organization of the elk herd is strictly on the basis of a matriarchy. The matriarch is usually an old cow, if not the oldest in the herd. She is the undisputed leader at all times and always takes the lead when the herd moves along the trails. She is often gaunt and bony with age, and physically would be no match for any one of the younger cows of the herd. Yet none dispute her right to lead or boss them. On the trail the lead cow is followed by the other cows, the calves usually ranging close behind or in front of their respective mothers. Whether there is a social order throughout the rest of the herd, that is, an order where one cow dominates another, who in turn dominates a third, who is also dominated by the first and herself dominates a fourth, etc., is difficult to determine. It is a fact that the young immature cows usually are dominated by the older mature cows. Also certain ones among the older cows show an inferiority complex towards other members, but whether this is part of a pattern or merely an indication of timidity on the part of that particular animal is difficult to say.

The bulls, either young or old, almost invariably bring up the rear of the procession. The only notable exception to this order is when the herd makes off in sudden and disorganized flight, then it is everyone for himself, and though the herd may stay together no order is of course followed.

The fact that the bulls always bring up the rear of any line, even when the line consists of only two or three animals and, that quite often the bull will lag considerably behind the cows in this procession, has given rise to a popular fallacy among laymen.
The male members of a herd are almost always the last of the line on the trail. These are part of a herd of 13 which crossed the steep slide on the open coast headlands. Notice how the "goatee" of the middle cow blows sideways in the wind, showing its detachment from the rest of the mane.
Sportsmen and popular writers never fail to point out the superior intelligence of the bull -- and this applies to almost every species of our deer family -- in letting the females take the lead and thereby expose themselves to the risk of the hunter first. That this habit of following a cow or doe does at times prove advantageous to the male is not disputed, but it should be pointed out that it just as often proves the undoing of the male where an experienced hunter is involved. Furthermore, when the matter is carefully examined and the facts analyzed it will be seen that this habit has nothing to do with sagacity or intelligence.

A herd bull when he is with the herd, which is during the rutting season, is primarily interested in keeping an eye on the harem and has to be in a position from which he can see any straying animal which must be rounded up and brought back to the herd. Obviously this cannot be done from the lead or even the center of the herd. Like any good herdsman, not excluding human ones, who must himself control his herd, he keeps his position at the rear or, at most, to one side from where he can best watch and control the members of the herd. Contributing to the false belief that a bull or buck is smarter than the females is his restlessness and constant watchfulness at the time of the year when he is with the members of the opposite sex. During this time of rut a bull is seldom at rest and is on his feet almost constantly, even when the rest of the herd is resting. If there is any conscious watch for an enemy, it is the watch for another bull who may surreptitiously try to drive off one of his harem.
Adolescent bulls, those under 5 years of age, who are part of the family group, take no interest in the social order of the group. Their interests are governed solely by their maternal attachment. They are content to merely be part of the herd, bringing up the rear of a procession, with the usual benefits if any, and thereby acquire their reputation for masculine sagacity.

When the rut is on the wane and the necessity, if not the actual urge to keep the herd together has passed, the rear guard position is continued more or less from force of habit, and the lagging behind the moving herd may be more and more marked.

The adolescent bull, that is one up to about 4 years of age, as will be shown later, takes no active part in the rut and consequently is not subject to the physical drain which the older bulls undergo. Once a herd bull moves in and takes over a herd these adolescent bulls are ruthlessly driven from the herd. Where there are a number of such fellows they form mutual companionship groups of two to three or four, hanging hopefully around the outskirts of the herd, always watching for a chance to sneak back in, and never quite making it. It is such "hangers on" who cause a herd bull most of his trouble, particularly the 3 and 4 year olds.

The desire to get back to the herd is as much dictated by family attachment as it is by the mating urge. As a matter of fact the former is probably the greater motivating factor, for these adolescent bulls are truly "mamma's boys" in every sense of the word. It is not unusual to observe one of these gangling fellows of 16 months of age with well developed spikes and as
large as his mother still nursing. Even older ones of almost two years of age have been seen to attempt to nurse a cow. Females past 12 months were not observed to nurse, and this may indicate greater maternal dependence and attachment of these adolescent bulls. Certainly it shows a close family attachment at this period of life. Cows, which in heavy timber or cover have the opportunity to wander far enough away from the influence of the herd bull, often showed considerable agitation in their effort to locate these young bulls and would call repeatedly and urgently. The calls are usually answered by the "mamma's boys" and a hasty reunion, accompanied by much squealing and calling, would be established, sometimes at breakneck speed. The excessive vocal demonstration is most often between two animals though at times others may join in to a lesser extent and it is obvious that it is a mother and son that are involved. Such demonstrations of family ties have been observed between a cow and three year old bull and certainly indicates a long lasting family tie. The fact that in all cases observed no cow was in heat and that no sexual demonstration was attempted or made by the bulls strengthens the evidence that the attraction was one strictly of family ties.

The Roosevelt Elk is quite highly vocal and has many calls and expressions and makes frequent use of its voice. While moving from one part of the range to another the calves try to stay with the mother, either just in front or behind her, but in rough or timbered country it is inevitable that the calves or cows lose their place in the line and become separated -- or an animal may tarry to nibble a choice bit of browse or for some
other reason lags after the rest of the herd has started moving. It is then that mother and calf call most frequently. The calls may be continual until the separated members are reunited. The call in such cases is a high pitched quarrelous squeal or neigh which might be written eeeyh or eeeyuh. These calls are short and high pitched and are used not only as location calls but can often be heard in a resting herd and are given in modified tones and with varying degrees of vigor. It seems to be a sort of general conversational means of expression, common to all ages and sexes. In fact this call is the basis for all calls and sounds uttered by these elk. The different calls are really merely modifications and variations of it, by more or less vigorous expression, or tonal modification and length of duration.

For example the challenge call of the bull in rut, commonly referred to as bugling or whistling, is really the basic call given with vigor and full force of the lungs. Consequently, it is long drawn out and much louder. It may in addition be varied or modified in various ways. The typical bugle may be written as eeeyuugh. It is given with a full breath and if one is close enough it starts with a hissing sound like a steam or air whistle which must pick up force before the actual tones start, and then actually starts on a high squealing note which is held through most of the call and finally drops off on a lower note and usually ends in a sort of grunt as the breath gives out. When highly excited, as by the presence of another bull, the call is terminated in a series of short squealing coughs or grunts so that it might be written as eeeeyugh-uhgh-uhgh-uhgh-uhgh-uhgh. When tired and
Figure 19

Bedded cow among typical surroundings on bedding ground.
near the end of the rut, or for other reasons, the same call may be started in the usual manner and then not finished, being either cut short or else letting it trail off halfheartedly without the final low grunt. At still other times, and these may be at any time of the season, the call may be given in full range and tone but so low that it is scarcely audible beyond 50 yards. At this time the hissing, air-valve sound is particularly noticeable.

Though cows have not been heard to give this full-throated bugle, there is no reason to believe that they cannot do so. The fact that the Rocky Mountain form does so quite frequently supports my evidence that the western species does so also. Murie (14) in his discussion of voices of the Rocky Mountain Elk, says that the cows which he heard giving this full bugling call were always heard in the spring, and that he believes this may be connected in some way with the fact that calves were in the vicinity. Possibly it has some connection with the approaching term of pregnancy. Dr. Lutz Heck (8) in his book on the Red Deer (Der Deutsche Edelhirsch) mentions that hinds (cows) also "roar" which in the red deer is the counterpart of bugling in our American elk. He states that this generally takes place just before or after dropping the calf. This corresponds closely with Murie's experience. A native of Douglas County related to me that he had heard an elk bugle repeatedly during early spring in a certain locality. Judging from the above evidence it is quite reasonable to assume that this was a cow. Certainly it would be highly unlikely to hear a bull so voice himself at this time of the year. As calving time approaches the expectant cow leaves the herd
The cow in the foreground, through her greater natural alertness and wariness, is a self-appointed sentry. She clearly shows that something has aroused her suspicion, though the rest of the herd is quite unaware of danger. If her suspicions are confirmed, a bark of alarm will start the herd into flight. This is typical of an old logging area.
and takes up her stand in some secluded spot where the calf is born. Here she remains until the calf is strong enough to travel, usually 3 to 4 days, though some have been seen following their mother from one part of the range to another when they were so young they could hardly stand on their legs. During this period of separation from the family group it would be natural for a highly vocal animal like this elk to give voice at times.

The warning or alarm call of the Roosevelt Elk is again the basic call, but is given so sharply and violently that it has the effect of a sort of explosive cough or bark. Due to its shortness much of the squealing note is eliminated. At times, however, the sound is a short coughing phewh. This sound can be given by any member of the herd, though usually by a cow, and only on very rare occasions by a young bull, serves to put all the members on full guard. This is usually the case when something is sighted but is not fully identified and cannot be scented or when vagrant air currents bring scent of danger which cannot be definitely oriented. All animals will focus their attention on the object of their alarm, or will try to locate the origin of a scent. In the latter case much restless movement may take place. The alarm does not immediately put the herd to flight, though usually, even if the danger is not identified or located, the herd may move off at a fast walk or trot, during which the call may be repeated more or less frequently. If the warning call is accompanied by flight on the part of the animal giving it, the rest of the herd takes to its heels without a second look. Usually if there is no doubt about the menace or its source, time is not wasted in giving
Bodies of water seem to hold an attraction for elk, and they often linger for some time around the ponds, wading and splashing in the water even in wintertime.
On warm summer evenings the younger animals make great sport out of racing, bucking and kicking through a shallow pond; and even old cows like this one will splash the water with a foot, sometimes sending showers of water over themselves.
warning calls but the discoverer of the danger takes to his or her heels and this is always sufficient evidence for all the rest of the animals to join in the dash for safety.

Play is the indulgence of the young, and on a summer evening a group of calves will frisk about much as one can often see a group of lambs frisking and chasing each other. A small knoll or bank is a favorite spot to chase up and down. Old cows rarely abandon their serious attitude toward life, but all members of the herd seem to enjoy wading and splashing in shallow pools or along the edges of a lake. On summer evenings at dusk or by moonlight a herd will spend much time around a lake or pond. The younger set particularly make a hilarious time of the occasion. Two or three yearlings will race madly through the shallows again and again, bucking and kicking and splashing like so many small boys. Even some of the older members, the two and three year old "ladies" catch the spirit of play and will join in a dash or two through the water and on occasions an old cow will unbend and slap the water with a front foot, sending up showers of water. Bulls, by which is meant those which have developed at least their first set of spikes, seem to be less demonstrative on such occasions. However, the adolescent bulls at least have their own form of amusement. After the rut, and throughout most of the winter until the period for shedding approaches, many sparring or fencing contests are indulged in. They may take place at any time of the day but are most frequent in the morning, particularly on cool frosty mornings. Two young bulls, a spike will engage a young five pointer as readily as one of his equal, will by mutual
consent lock antlers, but usually do little if any pushing. There is much rattling of tine against tine with a constant maneuvering for an advantageous position; however, it is always done without an actual display of force and neither appears to try to take undue advantage of the other even when such an advantage could be had. The favorite procedure seems to be to stand just close enough together to be able to reach the opponent and then to thrust and parry and counter thrust, sometimes stepping slightly this way or that but usually standing still. Sometimes it appears that a deliberate attempt is made to parry the opponents thrusts with as much antler clashing as possible, and on a still cold morning the rattle and clack of these harmless fencing matches can be heard for almost a half mile. Sometimes these fencing bouts last for only a minute or two, the opponents breaking off to wander off for a bit of grazing only to come back and spar for another minute or two. At other times a fencing bout will last for 15 or 20 minutes without interruption and often goes on intermittently for a whole morning.

The habits of the Roosevelt Elk, if one must make a commitment, are I believe, by choice diurnal where they are unmolested by man. However, their behavior pattern is extremely variable and for an observer to attempt to be dogmatic and conclusive about what an elk or a herd of elk will do, is to invite almost certain contradiction sooner or later.

As stated, where unmolested the elk seem to prefer to carry on their feeding activities during daylight hours as a rule, though as will be seen these rules are broken frequently and without much
The usual rule is for the herd to be abroad early in the morning and late in evening, resting during the middle of the day. This group is feeding on the mist-shrouded headlands along the coast about three quarters of an hour before sunup. By sunup they will have started for the timber, and by 9 or 10 o'clock will be bedded down on some favorite spot. These routines often varied for unexplainable reasons.
reason. The most typical routine is for a herd to rest at night and begin their activities at dawn or at about sunup, to feed for 4 to 5 hours and then to retire for 4 or 5 hours for a midday siesta. Then they again become active and will feed until dark. As the days grow longer and hotter in the summer time, the hours of feeding start earlier, the midday siestas grow longer and the evening hours start later and last longer into the night. Due to heat or purely from choice, feeding may suddenly take place entirely at night, particularly on moonlight nights. The fact that it is a moonless night must not be taken as a sign that the animals will not be active on those nights and may, therefore, be expected to appear abroad during the day. Even when undisturbed and where they are usually active during the day, it is not unusual to find the general elk population following one routine while one particular herd only a half mile or a mile away is following an entirely different one. For example, the routine followed by the elk populating a region will be to feed from early dawn to about 8 or 10 a.m., retire until about 3 p.m., and then feed until dark at which time they may bed down again. Yet separated only by an intervening ridge may be another herd of elk, having the same type of range and being subject to the same weather conditions, but feeding at night and resting during the day, even though the nights are entirely moonless. Such behavior tempts one to explain it on the basis of pure eccentricity on the part of the elk. There is other evidence that elk do things purely because they want to and without rhyme or reason. In general, and like any sensible animal, it is the habit of elk to retire to sheltered
Figure 24

Loafing around at the edge of the woods before bedding down early in the morning.
spots in times of storm and severe rain. Usually this is their habit and there is commonly a favorite resting and loafing place well sheltered from the wind and rain to which they retire. Yet try to explain on the basis of reason or rationality the fact that the entire herd takes its midday siesta in an open unprotected clearing whose only good point is a fine sea view, during a pouring all day, winter rain. The entire herd is a picture of contentment, each member comfortably bedded down, placidly chewing their cuds, water running in streams from their thick coats, a shower of spray flying up here or there as an animal shakes its head. Such unorthodox behavior has been observed a sufficient number of times to impress on me that almost anything can be expected, and if it were definitely proven to me that these elk are whimsical it would be no surprise.

Where hunted heavily, the elk become more nocturnal in their habits; in fact usually become entirely so. Then they will be seen only early in the morning for a very short period of time and late in the evening if at all. Necessity will cause elk and in fact all deer to take up nocturnal habits without any discomfort to themselves.

Whether animals have a sense of esthetic values is difficult to determine. Stanwell-Flether (25) in his article on wolves suggests that this may be possible and cites the cases of wolves visiting various choice viewpoints which the writer himself liked to visit. These points had nothing that would attract a wolf and the wolves had usually visited the spot before the writer arrived, thus removing the possibility that they followed
Somewhere among the bedded animals, is always one on its feet acting whether by instinct or by intent, as an effective sentinel.
him out of curiosity. Furthermore, the tracks in the snow indicated that the animal had gone directly to the spot and had done nothing but sit facing in the direction of the view. Similar instances of elk utilizing prominent view points during their rest periods when there was no advantage so far as shelter or proximity of feeding grounds were noted. Neither could it be considered that relief from insects was the motivating factor for these instances were observed more often during winter than summer, usually on clear rainless days. An advantage in spotting and escaping an enemy could not be considered either, for in fact a spot most frequently used in this manner was perhaps the most disadvantageous one in the entire series of resting and loafing spots on the herd's range. The steep high pinnacle had a relatively small and flat top which could be approached easily and on which the animals could be surprised without showing myself until the moment when I stepped over the edge. Neither did it have an advantageous avenue of escape as was common of all other such resting and loafing spots.

During the midday siesta a resting herd is not entirely the quiet and inactive picture that one might imagine. Seldom does an animal remain bedded down for more than half an hour without moving. Animals are always getting up to change their position or wander about a bit to stretch before lying down again. Usually there is an alert and wide awake animal somewhere about the edge of the herd, acting as an efficient sentinel, whether by intent or by instinct. Such sentinels seem always to be where they are hardest to see and where the stalker is most likely to stumble
Figure 26

Young bull in the act of lying down.
over them. Such sentinel duties are most seriously taken by the old lead cow. This is natural for by experience she is the most wary and it is natural that she or another old cow like her should be more watchful and on guard than the younger and less experienced animals. It is doubtful whether there is a conscious change of sentries — there is as was pointed out always at least one animal resting on its feet or getting up just to stretch, and naturally such animals are more on the alert than those who are half dozing, and an alarm comes usually from these animals.

Besides those mentioned many other interesting little activities go on among the animals of a resting herd. Though they may be observed at other times they are most often seen when the entire herd is at ease on its favorite loafing spot. There are favorite rubbing spots where animals like to rub themselves when the itching cannot be relieved with a hoof, teeth or a skillfully employed antler point, which makes an ideal back scratcher. In many ways in these habits, elk remind one more of horses or mules than of deer or cattle. For example, if an itching is to be relieved, the usual procedure when it can be reached with the head is to nibble or bite the spot vigorously in the manner that a horse does. Also two animals often indulge in a mutual exchange of nibbling on various parts of their anatomy, particularly such spots as are hard to reach by the animal itself. The animals usually take up positions so that the respective spots nibbled are correspondingly the same. One animal walks up to another and starts nibbling on its neck whereupon that animal will in turn nibble and chew on the correspondingly same spot on the first animal's neck. It is
Animals rarely remain bedded down for more than a half hour at a time, and every 20 to 30 minutes get up to stretch or turn around. This bull got up to relieve an itching. Unlike cattle, elk do not lick such an irritation with their tongue, but bite it as do horses or mules.
also to be noted that the reciprocating animal always chews or nibbles with approximately the same degree of vigor as the starter, and should the first animal, as has been observed, increase or decrease the vigor of its activity the other animal likewise modifies its action in the same way. Sometimes this sort of activity is indulged in for a considerable period of time in a sort of idle pastime manner as though there was no real purpose in it other than simply a mutual "back scratching" enjoyed by both participants. Bulls, especially the old fellows with good racks, are skillful in using their huge antlers as a convenient back scratcher and can be observed to make frequent use of them in this capacity.

In anger the ears are laid back against the neck just as a horse's are, and this at such times gives the animal a peculiarly equine, rather mulish appearance. When angered at another animal in the herd the ears are laid back and an attempt is made to snap or bite that member. Thus, the opened mouth with wrinkled lip enhances even more the mulish resemblance. The above action if particularly vigorous may be accompanied with blows from a front leg. The offending animal usually dodges such attacks nimbly. In unusual cases when a real altercation arises between two cows both front feet may be brought into play, the animals rearing on their hind legs and striking with their hoofs at one another. Such encounters are infrequent and brief with little damage done. After the rut, bulls have been observed to fight in the same manner, that is by rearing on their hind legs and striking at each other with the front feet. From observations (Heck et alii) on red deer
An elk can scratch his ear as skillfully as any dog, and the bulls are also very skillful in using the tips of their antlers as a back-scratcher.
and Rocky Mountain Elk this method is also employed by bulls after shedding and persists even after the antlers are well developed and the velvet has been shed. Apparently they are not yet sure of the strength of their weapons. This habit of rearing and using the front feet again is a decidedly equine habit.

Among the most interesting and unusual activities indulged in by the cows of the Roosevelt Elk is that of shaving the bark from trees and rubbing their heads and parts of their bodies on the exposed parts of the tree. This may take place on the feeding ground, along trails or on resting grounds and under all conditions of activity. Most usually it is observed around the loafing and resting spots. An animal will walk up to a tree, usually a young hemlock or alder, and start shaving the bark with the lower incisors. This cuts thin ribbons of bark, usually about \( \frac{1}{8} \) of an inch or so wide, which are permitted to drop to the ground at the base of the tree. There is no choice as to kind of tree, and almost every variety found within the range of the animal has been observed to be used. Furthermore, often a dead tree will be used. If it is a large tree such as the huge hemlocks and spruce trees, an exposed root or perhaps a low branch will be used. It has also been observed that around resting grounds the same tree will be used over and over, some of which have been completely peeled of bark at the height that can conveniently be reached by the animal. Often such well-used trees show by the aging of the exposed wood that they have been used for several years or more. After scraping 3 or 4 times, the animal will rub its muzzle, face, or head on the exposed part of the tree. At other times after
Figure 29

This young cow is nosing a "sign-post tree" preparatory to shaving it and rubbing herself against it.
Figure 30

Here she is scraping the bark with her lower incisors. The bark falls to the ground in characteristic narrow shavings, and is never eaten. Dead trees are frequently used, and many such posts show many years of repeated use.
Here, after a few minutes of industrious shaving, the cow is rubbing her chin against the shaved spot. The side of the head and neck, and even the shoulder may be rubbed in this way. Often after such a rubbing the head is rubbed against the flank or hip, then the bark shaving is resumed again. Such posts are most frequently seen about the bedding grounds and along well used trails, and presumably serve as territorial markers to identify home territory.
rubbing the face or muzzle on the tree, the head and muzzle will be rubbed against its own flanks and this may be repeated again and again. The described behavior takes place at any time of the year, but seems to be especially common during winter months and only cows and calves were seen to do this.

A subsequent observation of a somewhat similar behavior of a bull during the rutting season was observed and helps cast a light on the reason for this action. The bull was with his herd during siesta time, and as usual was wandering restlessly about on the edge of the herd. Presently he began to horn an alder sapling. Close observation from a distance of not more than 50 yards showed that he was actually scraping the bark, but with the base of his horns instead of his teeth. After scraping the base of his antlers vigorously, in fact quite violently up and down on the sapling, he would draw back and draw his muzzle carefully along the part scraped as though he were smelling the exposed part. This and the horning was the only point in which his action differed from that of the cows. Having reached the top of the mark with his nose, he would then rub his head and neck and shoulders on the sapling, then resume the scraping. At other times the head rubbing would be followed by a period of rubbing his head on his flanks and sides. This continued for about 5 minutes at which time the cows began to get restless and move off and he followed. The rubbing of the head on the tree and then rubbing their own flanks reminds one of nothing so much as the preening of a bird. The behavior of the bull suggests that this as well as that of the cows has the same purpose as the scent posts of dogs, coyotes and wolves, the clawing
Cow elk chasing a dog which was sent out to retrieve a stick tossed about 30 yards towards the cows. The cow in the left background was expected to do the chasing, but an unseen cow unexpectedly charged from another spot and almost caught the dog. The other cows of the herd, not shown in the photo, showed a calm almost indifferent attitude. Had these been domestic cattle, the entire herd including others not shown, would have charged pell-mell after the dog, crowding and getting in each other's way. Elk show a much greater degree of intelligence and judgment in their behavior than do cattle.
of the bark of a tree by bears and cats, and the scent patties of beavers. Quite likely it is a means of marking territorial occupation by a herd and serves to notify other elk of the presence of the other herd within that territory. The most logical explanation is that it is a sign post system, though just what the purpose of the flank rubbing is, is hard to say. Perhaps it helps to assure a stronger scent to the tree and is a means of transferring the body scent to the tree rather than anything from the tree to the body of the elk. None of the trees examined immediately after scraping showed any noticeable odor or juices on the scraped parts, and it is doubtful whether the animal would derive any insecticidal benefits from this rubbing even if that explanation were reasonable. In the case of the rutting bull such a scent post might have the additional purpose of warning any stray bull that the cows in that territory were also appropriated.

In temperament the Roosevelt Elk usually presents a picture of alert but unexcitable composure. On certain occasions the cows are, however, subject to almost uncontrolled demonstrations of rage. Mature cows all have a definite dislike for dogs, and either singly or in a gang will put to rout any dog that ventures near them. Bulls apparently are not aroused by dogs and show only mild curiosity if any interest at all. Some cows are more demonstrative in their anger than others, the older cows being the ones which are usually the most enraged. Calves of a year or so usually show only curiosity, but make no attempt to pursue a dog. This curiosity and rage exhibited by the cows has been used to my
Figure 33

The cow's charge halted a scant 4 feet from the camera with such suddenness that she skidded the last yard or two on her haunches with all four feet braced. Here, after whirling away a few paces she stands in indecision, fear of man and anger at the dog clearly manifest.
advantage on many occasions in obtaining pictures which would have been otherwise unobtainable due to the difficulty of approaching the animals. On a number of occasions the dog wandered away from me only to come racing back at full speed with an old cow hot on her heels. As was her habit, the dog would at such times head for "home and safety" which under those circumstances was between my feet, with the result that I have on a number of occasions been well showered with dirt and mud as an irate cow slid to a sudden halt not four feet away in response to my wild shouts and arm waving. It is doubtful whether a cow would deliberately charge a man even when accompanied by a dog. However a charge started after a dog who flees to his master might, in the blindness of rage, be carried so far as to overrun the man and trample him. It was noticed in the case of the cows which charged me indirectly while chasing my dog and were brought up short in front of me, that they required a very noticeable and definite effort in self-control to stop when they did. Even then for a second or two they would stand as though in doubt, all the hair from crown to rump erect and eyes blazing, undecided whether to continue or retreat. Then a sudden realization of their position and proximity to a human suddenly penetrated their rage-hypnotized brain and they would suddenly turn and dash away in fright. This curious phenomenon of "rage hypnotism" was observed clearly on several occasions and the following account may be considered typical.

While following a certain herd of elk which had become somewhat accustomed to me and my dog after almost two years of constant
This cow charged out of the timber in hot pursuit of my dog, almost crashing into my car in a public parking way in Ecola Park. Here she stalks angrily about the car where the dog took refuge. Notice the elevated rump and back hairs, and the flaring nostrils. She left only reluctantly after a minute or two.
following and stalking, it was noticed that certain individuals were quite persistent in their attempts to approach the dog; in fact their efforts would best be described as "trying to sneak up on the dog". The rest of the herd had as usual showed verying degrees of curiosity and anger towards the dog which always accompanied me. The dog definitely was a recognized mark of identification as much as the old and shabby field clothes I wore on these observation trips. After its customary attention, most of the herd went on about its usual business. Three cows, however, persisted in trying to get at the dog. None of these had calves. Finally the entire herd left the clearing in which they were feeding and resting, and only the three remained and when I moved out into the center of the clearing two of these left also. The third hung about at the edge of the clearing and when the dog was permitted to run out a dozen yards or so, the cow promptly began to walk towards the dog in the typical deliberate, paced gait affected at such times. The closer she approached the more erect became the hair on her neck, shoulders and rump. I sat down in the grass and decided to see just what she would do and how close she would come, hoping to obtain some close-up shots at the same time. The dog, at the first sign of the cow's approach had sensibly retreated to a position literally on my toes. I ordered her to lie down a few feet away. The cow kept her eyes fixed intently on every move the dog made and when after 5 or 10 minutes, I made no hostile move she would take a slow step closer. Any slight move by the dog would bring her a step or two nearer showing more and more signs of anger. When the distance had finally
been closed down to a mere dozen yards, it became quite evident that the cow was in a condition amounting to a state of hypnotic trance. The eyes stared unwaveringly at the dog and seemed completely unaware of me beside the dog. The eyes had a peculiar glassy and unnatural appearance and the hair on her head, neck, shoulders, rump, and even the back was completely on end, giving the animal a decidedly unreassuring and ungentle aspect. Slight movements of adjusting the camera, focusing, etc. brought no look of recognition nor drew the fixed gaze from the dog. At a distance of slightly less than 6 meters by the range finder the eyes were glazed and sightless in appearance and gave the animal a look of complete irrationality, which undoubtedly was a condition being rapidly approached, if not reached. At that point the cow hesitated, then gradually a trembling of the leg muscles became apparent and grew. The head was lowered and raised, and at the same time the feet were shifted this way and that, and finally there was a definite gathering of the hindquarters and bunching of the feet closer under the body, while the trembling grew even more violent. Here it was prudent to leap up with a few violent shouts and some arm waving. For a second or two the cow's stare remained fixed on the dog and then suddenly shifted to my shouting, gesticulating figure as though it had only then been noticed. The wild look was replaced by one of surprise and fear and the cow whirled and trotted away a dozen paces or so in a dazed and hesitating way; the hair still standing on end. This experiment was tried on several other cows with the same result in every case. The animals in question, though in a sense somewhat tame
in that I was tolerated by them, were nevertheless wild and still had a healthy respect for humans and not excluding myself. Therefore the above described condition was still to some extent controlled by a subconscious fear of man which did not permit a headlong approach of man and dog. It is possible that someone may try this on a park animal and is hereby strongly advised against trying the above experiment. The above animals had been under constant observation for over two years and the individual characters of each animal was known far better to me than it is the privilege and opportunity of the casual observer to know an animal. Many of our parks have elk, especially certain individuals around camp grounds which become quite tame and such animals are apt to be much more uninhibited by fear or respect for man. An attempt to try the dog experiment may end unpleasantly. A slight misjudgment of the temper or mental state of the animal may result in a person being trampled and seriously injured if not killed outright.

The presence of man is apt to inhibit the displays of rage against a dog in elk not used to the sight of man, but only so long as the man is in sight or so long as the dog does not approach too closely. Hunting with dogs has been in disrepute for many years so that elk do not associate dogs with being hunted by men, and are that much less inhibited in their reaction to dogs. It was related by Allan Kofoed to me that some years ago a certain farmer living in the hills had been bothered by a herd of elk which came into some of his fields and allegedly were damaging his crops. Though this man was an inveterate elk poacher and
Figure 35

Typical baddy ground under the huge spruce and hemlocks among the sword ferns. The spot is a bench on the side of a ravine, typical of the spots chosen.
though it was difficult to see where any damage was done to his fields if such they could be called, the Game Commission assigned a guard to watch his field and frighten the herd away. This was done more to remove any possible claim of being forced to shoot an elk in self-defense by the farmer, a thing that had happened before, than to justify the farmer's claim. The guard possessed two hounds which he considered particularly experienced and tough, since they were experienced cougar and bear dogs, and he supposed that all that would be necessary would be to set his dogs on the herd and drive them back into the timber and the trouble would be over. When the elk entered the field, the dogs were turned loose and set on the elk. The herd, charged by the baying hounds, fled to the forest but were caught up with before they quite reached it. A cow hard pressed by the two dogs promptly turned and the in-experienced dogs, inexperienced at any rate with elk, closed in with the result that one was instantly killed from a blow from the cow's front hoof. The other dog was somehow called off and saved, otherwise it too would probably have been killed. The guard gave up chasing elk with dogs, a wiser if sadder man.

The resting or loafing grounds of the Roosevelt Elk are prominent landmarks within the range of a herd. The shoulder of a ridge, the top of a prominent knoll or the benches along the sides of a ravine or hill are the favorite resting places of elk. Such places are usually well protected from sun or rain by large spruce, hemlock or other conifers, and the ground is usually free of brush, windfalls or other litter. Whether from a man's or an elk's point of view, the spots are always ideal
Another favorite bedding spot much used by elk. This was in second growth hemlock on the side of a knoll overlooking an open canyon.
for the purpose intended and used for, namely to rest, loaf and pass the time. Various advantages are enjoyed from these spots. Usually the vantage point gives a good view of the avenues of approach and avenues of retreat are likewise open and handy for the herd. A high point gives the animals a distinct advantage in scenting danger for scent is usually carried upward and regardless of wind conditions it was found through many unsuccessful attempts that it is practically impossible to stalk elk up hill regardless of how good the cover or other advantages offered in such a stalk. Under the huge trees among the sword fern an elk can slip quietly around the ridge on the same level or disappear over the edge of the knoll or bench without being heard, much less seen.

Not always are the prominent points chosen for these spots. During extreme storms sheltered spots are chosen. These are usually low and in some ravine or pocket in the side of a ridge and are well protected from the wind. As in the other cases, litter-free ground is preferred. Such sites are usually crowded with growths of salmonberry, thimbleberry, alder or vine maple, which may form a close canopy overhead, but have the ground surprisingly clear of rubble, limbs, etc. The heavy shade excludes all but some grasses and sorrels and the ground is usually moist and soft and often covered with a deep layer of rotting leaves and mulch. For an elk it is an A-1 bedding ground and is used frequently for such proposes. Resting and loafing spots often overlook well-traveled trails and many a person, hunter or hiker has unknowingly passed beneath the calm and undisturbed gaze
Figure 37

Elk bed among the ferns in heavy timber. Beds are often used over and over on favorite grounds.
of an elk if not a whole herd. Such instances have actually been observed a number of times while watching a herd of resting elk. In one instance two hikers passed beneath an old cow at a distance of not more than 25 yards. The cow scarcely interrupted her cud chewing as the two people passed by. Had they seen her and stopped, the cow would have been on her feet instantly and off into the brush. In bedding down, elk have a particular liking for a spot near the base of a large tree or stump, and an overhanging log is always a favorite spot. For some reason a small mound or hump has a particular attraction and when present on the bedding and loafing ground is almost always used over and over. In fact all beds are used over and over by the animals when on the same grounds, probably not only because they are the favorite positions but because with use the spots become cleared of rocks, and other undesirable objects, and make a smoother more comfortable resting place.

Herds which frequent the more open, treeless logged off areas use the same judgment in selecting their resting spots. Overhead shelter from large trees is, of course, lacking, but brush and smaller shrubs and trees are numerous. Logs of all sizes and in all positions are common in such areas and the animals like to bed down beside a log or stump. Where logs are piled over one another and there is space beneath, an elk will unhesitatingly bed down under such a protecting log. This is especially true during rainy and stormy weather. In one instance a herd was observed to move up a ravine around a large windfall area and a stalk was executed over the windfall area by walking on top of the
A small knoll in a dense stand of Coast Range timber showing the dense undergrowth of salmonberry. This was a favorite resting and bedding ground of elk.
numerous crisscrossed logs. On arriving at the point where the herd was expected, nothing was to be seen of them and while standing there overlooking the edge of the windfall of huge uprooted hemlocks and spruce, a cow suddenly crawled out from beneath a pile of hemlocks. Grass and ferns somewhat obscured the exit, but her sudden increase in stature indicated either a very low door or else a high spot just in front of the door. She wandered about a bit and then disappeared again under the logs; her rump elevated high as she went under. This is clearly evident in the accompanying photo. A minute or two later a spike bull and another cow emerged from under the logs on the high side and then disappeared under them after wandering about a bit. It had been raining a steady cold drizzle all morning and the animals had apparently taken shelter under the logs. Shortly thereafter they left, having become suspicious of my presence; and the spot was examined. Three large hemlock trees had fallen so that in piling up a log lean-to was formed, roofing over a spot about 4 by 10 feet and about 4 feet high in front and not over 3 feet high in the back. That the three animals had bedded down under this natural roof was not surprising, but the opening through which the cow had left at the back and then reentered was a surprise for it was so low that I had to stoop to my hands and knees to conveniently manage the exit. The opening could not have been over 30 inches in height.

In another instance a herd consisting of a yearling bull, a three year old bull with well developed 5 point antlers, and 15 cows and calves of all ages and sizes were started and then
Figure 39

Showing the kind of tangled situation that an elk may be found in. This cow is crawling under a windfall of logs by an opening scarcely 30 inches high. They have at times been seen to actually lay partly on their sides to scramble under a low passage way.
followed under ideal tracking conditions. The trail finally led to the edge of a freshly logged area where it was blocked by a wall of tangled treetops from the felled trees. The trees near the edge of the logging had been felled in an outward direction so that the tops had piled on and into some heavy second growth timber. The felled tops and the smashed young trees formed what appeared to be an impassable barrier some 30 feet in depth and 10 to 12 feet high. Trunks, one to two feet in diameter, and limbs of all sizes were in a hopeless tangle, yet the trail of the herd led right up to and disappeared in this hopeless impassable looking tangle which extended in a solid line as far as could be seen on either side. For the elk to go over it was impossible, and limbs of 4 to 6 inches in diameter cannot be brushed aside. The tracks clearly showed that the herd had been in no hurry when they entered the tangle at a walk, and the tracks in the wet clay were unmistakable and led through the tangle of logs and limbs and had to be followed on hands and knees at times. That a herd of 17 animals, most of them large and the one bull bearing a fair rack of antlers could have crawled through that tangle was hard to believe, and had I not myself followed those fresh tracks through the tangle and subsequently started the herd again but a short distance away I would certainly not have believed that an elk would deliberately venture into such places, much less manage to get through.

Though the Roosevelt Elk is a large and heavy animal, it is by no means slow or clumsy. In walking, the smooth rhythmic stride and the lightness and springiness of the step give the appearance,
and rightly so, of beautiful muscular coordination and a poise and control that is seen only in wild animals. It is generally seen in cows and younger animals. Bulls, especially the old fellows, give quite another impression. During the fall, beginning with the shedding of the velvet and through the rut, the stride of the bull is heavy and deliberate with a dragging arrogance. It gives the impression of tremendous reserve power behind it. The entire appearance and the force displayed in action in no way belittles this impression. A wild elk is literally a dynamo of tremendous force with the precision and coordination of a professional athlete. Anyone having the opportunity to observe a herd of these animals has this fact impressed upon him almost continuously.

An obstacle such as a log 3 or 4 feet in height is cleared lightly and without apparent effort. A log as high as 5 feet across a trail is bypassed if possible. If it is not passable, it is simply gone over. An elk will walk up to it, survey it for a second or two and leap lightly to the top, poise for an instant, and then leap just as lightly down on the other side. The pause before leaping up on a log or over a large log is characteristic during undisturbed travel and seems to stem from the desire to avoid snags which might be present on top or on the blind side. It was observed in a number of cases that logs, across trails, which had a short snag sticking up directly over the trail would cause the animals to move to one side of the trail to clear the log at a point where it was free of snags. When thoroughly frightened the animals will clear all obstacles and hinderances in reckless abandon, regardless of the terrain. This, as a rule, is only in
case of extreme panic such as when surprised by a hunter and being
fired on.

The ordinary flight of a herd of elk from danger is usually
very orderly and follows a pattern of known routes of travel within
their home range. After the initial rush, the pace usually settles
to a steady trot which may be interrupted by intermittent periods
of walking or galloping; the herd usually travelling in single
file and in the usual order. A typical example of a herd in flight
may be cited. A herd of some 20 animals was started by a hunter
and galloped a minimum of a half mile up the slope of a mountain
having a grade of 10 to 30 degrees. This was over rough terrain
strewn with logs and slashing of the worst kind, yet the flight
was not headlong or reckless, though somewhat disorderly, and
extraordinary only in its speed and in the obstacles and the ter-
rain and distance covered. It gives an excellent idea of the
physical power of these animals.

What is the speed of an elk? None were ever clocked, but
in a case already mentioned where my ever-present pointer dog was
sent towards a herd to induce a charge by a cow for the purpose of
obtaining pictures, gives some indication. The cow expected to do
the chasing failed to do so, but an unseen cow in the brush behind
her burst forth with such suddenness and on such a dead run that
she almost caught the dog, which had to do its utmost to stay ahead
of her. The dog is young, is as fast as any bird dog, and was in
excellent condition. It can be said with conviction that she, the
dog, was certainly doing her best, and the cow certainly gave the
impression of doing likewise. It is probably conservative to say
that both animals were doing not less than 25 miles per hour, which for the short distance involved in which to pick up momentum and stride is doing well for both dog and elk.

The ability of a wild animal to recognize an individual among humans is well demonstrated by the 15 animals in the Ecola Park herd. This herd was first observed in the fall of 1940. The caretaker, Allan Kofoed, by use of salt blocks gained the confidence of the herd and was tolerated by them, particularly about his cottage and around the public grounds where they came to feed at night and in the evenings. And though not wild, the animals were not tolerant of strangers and usually were gone from the public spots long before anyone began to arrive. It was not common for the everyday visitor to see the animals unless he arrived very early in the morning, and then he might only see them leaving for the forest. During the summer season when visitors became numerous, the herd retired completely from the picnic areas and was seldom seen, even at night.

When I first began observing this herd, they were decidedly distrustful even on the park grounds, in short, I was just another park visitor. Off the grounds and in the forests, even only 300 or 400 yards away from the picnic area they reacted to my approach just as any other wild herd would have, and were just as hard to stalk. Gradually they became more and more tolerant so that by the winter of 1941, I could follow them from the salt grounds or picnic grounds into the forest at a reasonable distance without disturbing them seriously, and soon after that was able to meet them in the woods at any time without causing them to take flight at my
approach -- providing I showed up in my usual attire of old battered brown and tan field clothes, draped with the usual collection of photographic paraphernalia and was accompanied by my brown pointer dog. Any deviation from this usual appearance was sufficient to arouse suspicion. The clothes, and the dog not less, were my trade mark and the absence or change of one or both of these marks would be sufficient to put every animal on the alert and sooner or later they became restless and would move away, or if stalking or any other subterfuge was attempted they would promptly take to their heels and disappear into the densest part of the home range. By the fall of 1942, it was possible to follow the herd about all day without causing any interruptions in their behavior or routine. At a distance of 50 to 60 yards I could tag along all day or sit near one of their loafing spots and observe everything that went on without having them pay the slightest attention to me. It made no difference whether the herd was near the public grounds or a mile away in the wildest and remotest part of their range. The dislike or distrust for strange clothing or other change in my usual appearance remained right up to the last observations and contacts had with the herd in the fall of 1942. They had a particular aversion to being stalked, and any attempt to approach unseen, would if I was discovered send them off in flight. If, however, I approached without attempting to cover my approach, and especially when I announced myself with a mild rendition of "Yankee Doodle" or "Little Brown Jog", whistled in my own inimitable style, the animals would after a perfunctory glance return to their activities
without further attention. Even my dog became an accepted member, and so long as it stayed with me aroused no curiosity and was ignored; in fact the presence of the dog seemed to give the herd an added sense of trust and security that was lacking when the dog was absent even though I was dressed in my usual and accepted field clothes. It is possible that the trust of another four-footed animal in me had the effect of increasing their trust in me; perhaps it was purely a recognition trade mark that gave the additional assurance.

It is often argued that deer in general depend on their sense of smell for recognition of danger, etc. yet here the animals clearly depended on their sense of sight, associating those things they could see in identifying me. If at times, as sometimes happened, I stopped in at the park for a quick check on the movements of the herd, and was not dressed properly, it would be impossible to approach the herd as I have already described, yet they could undoubtedly smell me, and I am sure there could have been no difference in the smell at such times. At such times I often returned within the hour, dressed in my formal "elk attire" accompanied by my dog, and my presence would arouse no more than a glance or two and perhaps a yawn from some of the members of the herd. I was then just another member, or perhaps a necessary nuisance to be tolerated and permitted to tag along. It was a status achieved by very few humans outside of the public grounds, and even there as late as the fall of 1942, the herd did not tolerate the public too close or too long and would generally leave for more remote parts of the range as people would arrive.
IV

Home Range

The home range of the elk herd is its home and castle; within it an elk meets an emergency with composed and calm judgment. He knows where he wants to go and the best way to get there. Outside of his home range he is a bewildered and lost stranger in a strange land. He does not know what to expect along a trail; it may lead to safety or into a blind pocket. It is not surprising then that elk like to stick to well-established ranges where they know their way around, and for one man to try to drive a herd, much less a member of a herd from his home range is a difficult job indeed. The exception of this attachment for the home range is, of course, the mature bull during the rutting season. An unattached bull compelled by the force which causes him to seek out the herds, will do considerable wandering. However, where there is a fairly proper proportion of bulls to cows as is the case throughout most of the Roosevelt Elk's range, most large bulls soon find a herd and thereby acquire a home range, and need only be guided by the rest of the herd to be entirely familiar with it in a short time.

The average size of the home range of a herd is from one to ten square miles and usually conforms to the topography so that its boundaries are formed by natural topographical features. A basin, a series of flats and benches, a canyon or a series of ridges often form the basis of the limits of the home range. Often a prominent forest trail, logging road or skidway forms a boundary
on one side while a high steep ridge or some other unfavorable feature of the topography forms another. In some cases a trail or road may form the center or core of the range though usually such prominent travelways form the boundaries rather than the cores of the range. In either case the outer edges of the range are usually bounded by prominent trails with many branches leading off into and across the range. In some cases these boundary trails form a very prominent demarcation line and the inner side will show heavy usage with many lesser trails leading off into the home range, while the outer side may present a completely unused appearance with a solid wall of ferns and underbrush, interrupted here and there by a deer trail or two.

The general routine of a herd is to cover the territory in a circuit over a period of one to three weeks, depending less on the size of the territory than on the mood and restlessness of the herd. The herd may linger several days, sometimes a week in one spot, and then suddenly move to the other end of the range. At other times they move slowly from day to day, changing their stand every evening or morning and covering their circuit once a week with calendar precision. At still other times they may move back and forth between two distant areas within their range every day. These moods usually can be depended on to last for a definite time so that if the herd is moving slowly but steadily this may go on several weeks or a month. If the movements are abrupt and between widely separated points, this too can be expected to continue for some time, though usually sporadic or sudden movements are not as long lasting as the more deliberate and consistent
activity which is the more common and more dependable. But in any case a close acquaintancehip with a herd and its range will permit the observer to anticipate the whereabouts of a herd with considerable exactness. Springtime seems to bring on more irregular and sporadic movements, particularly to parts of the range which may have been completely ignored throughout the preceding months.

Closely adjoining ranges seldom overlap to any extent and there is little trespassing by one herd on the range of another. Where there is a slight overlapping, it is noticed that those portions overlapping are but seldom used by either herd and usually much less so by one herd than by the other.

Along the coast, feeding and food probably has little to do with the movements within the home range. Here the climate is so constant throughout the year that food plants are present in abundance in all seasons. In the interior and on the eastern and inland slopes where there is a considerable change in temperature and humidity during the seasons, there may be seasonal movements. A herd may commonly be seen on certain high open ridges and slopes during spring when green shoots are plentiful and plants are still tender. As the season advances and the stems and leaves of the plants become tough and hard and the weather becomes hotter, the herd may move down into the canyons and heavy timber where shade and the later and younger plants offer more satisfactory food conditions. Along the east slope of the Coast Range it was noticed that certain herds showed a marked tendency to retire deeper into the mountains. Cover or elevation was here probably not the factor
for there was no marked increase in the elevation farther towards the interior of the range and the cover was relatively uniform. However, there is a marked difference in the humidity and temperature between the regions bordering the outer reaches of the range and the areas deeper in the mountains. The latter are noticeably cooler and more humid during the heat of summer. Consequently, when the areas toward the edges (and I speak here in rather a broad sense and not of a sharply defined line as forming the edges) may be relatively dry and hot and plants no longer send out new shoots and the new stems are already tough and hard while the more inner areas are cool and moist and plants may still be blooming, may in fact continue to bloom intermittently throughout summer. The cause of the movement here undoubtedly is both temperature and food. Whether there is a seasonal movement in altitude in the Cascades of Oregon cannot be stated definitely for observations in that section were limited and inconclusive. However, a definite and well-known fall and spring migration of the blacktail deer and Rocky Mountain elk is known to exist. This usually is initiated in the fall with the first heavy storms which occur in late September and early October. After one or two such heavy storms and if the weather turns cold at the higher altitude which is often the case, with accompanying snow, the deer start moving down and the entire upper reaches of the blacktail range in these mountains may be cleared of deer within the short period of a week or two. It would not be surprising, therefore, if elk were likewise affected. In fact it must be accepted as a fact for the snowfall in these sections is so heavy and deep that the animals
would not be able to survive through a winter. The Olympic Mountains which are even higher in elevation undoubtedly also have a definite fall and spring movement of elk between the upper and lower levels. In the Cascades, at least, where the numbers of the elk population is relatively small and due to the fact that elk are probably not so readily affected by sudden changes of the weather, the movement to lower levels in the fall and the reverse in spring is not nearly as spectacular and therefore less noticeable than that of the blacktail deer.
Food

The food of the Roosevelt Elk is varied, and as already stated the feeding habits are rather cosmopolitan and with the exception of the spruce and perhaps some of the lesser herbaceous plants, every type of the commoner plant forms is fed on. I would hesitate to compile a list of plants used by these elk in Oregon, for it would include virtually every form within the range of the elk. All the conifers have been observed to be fed on with the exception of spruce. The best guide to what an elk will eat is those plants which are sprouting new shoots or leaves. Inland, where grass dries up and becomes tough in the summer, the elk is largely a browser. On the open headlands on the coast where the grass grows the year round, elk will graze at any time of the year. The animals may graze for several days almost exclusively on the grasses of these headlands and meadows and then may suddenly take up feeding in the forest or cut-over land and browse almost exclusively; nor is there a seasonal fluctuation. Such periods of intermittent browsing and grazing have been observed at all times of the year.

Skinner (23) lists foods of the Olympic elk in an order of preference. The foods are substantially the same as those taken by the animals in Oregon, as can be expected, for there is little difference in the primary flora of the two regions. However, I cannot list a similar order of preference, or for that matter
Figure 40

A squirrel's eye-view of elk feeding on the steep slopes of coast headlands. The surf may be seen in the upper background.
any order of preference for any time of the year. The only order
followed, when there is any preference, is that of palatableness
when there is a variation of this according to season. In the
more inland regions the leaves and upper parts of plants become
tough and unpalatable as summer advances, and the animals will then
move into deeper and heavier cover where due to the moisture and
shade the growth of plants is retarded and tender shoots and leaves
remained later if not throughout the summer. Or, where the animals
feed on the upper parts of the plant, such as the salal when the
top leaves and shoots first appear, they will take to feeding down
among the basal parts of these plants where in the dense growth
young shoots and leaves appear all summer long. For this reason
salal is a particularly favored plant in these sections, and I
cannot agree with Skinner's classing it in the low order of pre-
ference that he does. His classification of Western Hemlock as
an emergency ration does not agree with my observations at all. I
have seen elk of all ages and at all times of the year browse on
Western Hemlock and when there was plenty of other types of food
present. I have observed elk feeding greedily on the tips of hem-
lock twigs on trees overturned by a storm when only the day before
they were grazing extensively on the profusion of seaside-bent
grass of the open headlands. This was in early spring. They have
often been observed about the edges of logging operations feeding
in the same way on felled trees. Such observations have been made
in the fall, winter, and in spring when there was a profusion of
all the other foods present which Skinner lists as preferred by
the elk. Ferns of all kinds were taken. The tips of the tenderest
Figure 41

Cow grazing in tall grass in an old homestead clearing in July. On the coastal slopes green grass is present at all times of summer due to the heavy mists and fogs which at times are almost a rain.
parts are usually taken in the spring, but the tips and shoots are taken whenever they appear, and in the dense stands of bracken fern and under the heavy forest cover this means that there are always some new fern fronds appearing and these are taken the whole summer through. The only consistency shown in the feeding by elk was in their avoidance of dry or tough and old grasses and foliage. Otherwise all types of green food was taken indiscriminately. I have frequently followed the Ecola Park herd while it was feeding and could never see a preference. In one morning I have seen them take practically every plant listed in Skinner's list, but the preference might well have been completely reversed, starting with hemlock at the edge of a logging, and working through everything in his list and adding dried fungus picked from rotten logs. Everything that came before them was grist for the mill. Yet the next day the entire herd would spend all morning on a headland feeding on grass, would retire for the midday and return for more grass in the evening. And again the next day the herd would spend its entire feeding time on an open hillside feeding on the shoots of salal and other small shrubs. The taste for the dry fungus has never been explained. The observations were made in winter and the animals seemed to obtain some pleasure from this material, though I could not detect any taste in the dried musty remains that would attract an animal, but then an elk's taste may differ from a human's. The roots of the Chinese dandelion seem to be sought greedily by elk in the fall, and they are literally gouged out of the ground on the open headlands and in the clearings where they are found. The leaves of salmonberry, thimbleberry, alder,
Cow feeding on dried fungus which she has picked from the log. This was in winter, though food was plentiful in this area. Probably the fungus has something that elk like, but what it is is not known.
and willow are all taken readily and are a common food though I would not list them over any one or another form.

Murie (15) speaking of the feeding habits and range conditions of the Olympic Elk states, "In the first place the Olympic elk are primarily browsers, whereas in the Rocky Mountain States, grasses are important in elk ecology, in the Olympics browse is all important especially in the limiting winter season.

A considerable variety of shrubs grow in the Olympic forests and the elk have a wide range in taste, but the chief diet comprises a limited number of species. The principal ones are salmonberry, vine maple, huckleberry, and to some extent salal. These species are abundant and within reach. Alder is abundant, but not so palatable and the elk browse on it only occasionally. There are others which are eaten at every opportunity. The large maple *Acer macrophyllum*, is very toothsome but the elk must be content with fallen leaves or limbs, since most of the tree is out of reach. Douglas fir and hemlock are both eaten, and various other species are utilized, but for everyday use, the staff of life, during the season of heavy snow the first three mentioned must be relied upon - - salmonberry, vine maple, and huckleberry, with the help of salal on some ranges."

In a measure these statements support Skinner's list of preferred plants and it may be that the Olympic elk have a preference among the same plants utilized by their Oregon cousins. Certainly I would be the last one to be surprised at this deviation from my usual observations for as I have pointed out, the behavior of these elk is hard to predict or standardize. I do not, however, see why
a food like salal and hemlock should be classed as an emergency food when these foods are in common use in regions where there are no emergencies. I believe that this is an error based on a common fallacy in interpreting an observation. An observer sees animals feeding largely on a certain plant during a time of year when other foods may be covered by snow or otherwise unavailable and the conclusion is drawn that this food is eaten only during times of emergency. It is natural that when other foods are at hand that no one food will be made conspicuous by being fed on alone. I have examined the filled paunch of a freshly killed bull in September and found it completely filled with salal. This was at a time of year when salmonberry, thimbleberry, huckleberry, and all the other preferred foods were present in overwhelming abundance. I have made exactly the same observation in the case of the Columbia Blacktail deer found throughout the same range as the Roosevelt Elk, and which also has been credited with using salal only as emergency food.

There may be one explanation to this conflicting evidence. This may be that an animal, elk or deer, forced to a monotonous diet for a long period of unfavorable weather conditions, may become tired of it to the extent that when other foods become available, the deer or elk turns to these new food plants and completely ignores its winter diet. On the other hand, in regions of uniform weather conditions where there is no limitation of foods, all foods are mixed and taken without much preference since the animal can vary its diet before it tires of any particular food plant. As mentioned, it has been noted that here animals were observed to graze for two to three days, sometimes even a
week or more, and then suddenly take up feeding on browse entirely, and this may be only on one particular type of browse, or it may be indiscriminate browsing. There is evidence that animals do have a sense of taste, and could become tired of certain foods for a time just as humans do. Murie further in his discussion of foods mentions the overstocked Hoh River country in the Olympics, throwing some light on conditions in the Olympics. He says "Salmonberry has almost disappeared on the upper part from over use. Huckleberry has in some cases been browsed to club shape and the vine maple in reach has been eaten down to coarse twigs. This heavy browsing is less dangerous to the plant life than to the elk themselves. In an area of heavy rainfall plant life would eventually recover but disease has appeared among the elk, the same ailment that afflicts the elk in other ranges where coarse, sharp feed is eaten. Each severe winter some of the elk die, from Necrotic Stomatitis in part, at least."
VI

Natural Enemies and Accidents

Enemies can be listed in the following order:

1. Diseases and parasites
2. Predators
3. Man

The first is so little known that not much can be said about it. The deer tick *Dermocentor albipictus* is commonly found on them as is probably and to a lesser extent the Spotted Fever Tick, *Dermocentor venustus*. Black flies and mosquitoes are not what one may consider a real pest within the Oregon range of this species. Diseases have not come to my attention except that Orr (16) mentions three elk that died of lung worm in a park in California. If any effect the elk, they must be of little consequence for any disease of widespread effect would sooner or later draw the attention of some observer.

Predators are few, and those which might normally prey on the elk are becoming fewer in numbers all the time if they are not already on the verge of extinction.

In the latter category can be placed the Western Timber wolf and mountain lion. Of the two capable of preying on these elk the wolf was perhaps the more able and dangerous. It is interesting to speculate whether these wolves ever deliberately attacked a family herd. From the numerous observations of the reaction to dogs, it is very doubtful whether such a herd could be successfully attacked by other than a teamed group of wolves. Certainly a single
wolf would stand little chance of succeeding in an attack other than a surprise attack on a calf or at best a yearling near the edge of a herd. Calves, particularly early in the spring, before the mother and calf joined the herd again, undoubtedly suffered heavily. Webster (28) mentions this in his book on the Roosevelt Elk. At present these wolves are few in number, and though a handful are still found in the wildest regions of Oregon and perhaps in the Olympics, they cannot be considered of importance to the life of the Roosevelt Elk.

The only other predator worth mentioning would be the mountain lion. A mature cow would be a real handful for a lion, and a bull, even a yearling, and certainly older ones, would be more than a handful for a lion. An instantaneous kill would be almost out of the question on such a large and heavy quarry, and the heavy cover would give the plunging elk at least an even if not more than an even chance of shaking the attacker off. In the typical heavy cover a lion would certainly end up badly bruised and shaken should he attack a mature animal and fail to disable his victim immediately. It is also very highly probable that once dislodged the attacker would become the attacked if not by his intended victim then by the other members of a herd.

Seton (22) relates the observation of one of his guides in trailing a bull elk. A lion also had tracked the elk and on catching up with the bull had watched the bedded bull from a distance of 30 yards, and had evidently decided it was unwise to attack the bull. Seton also relates the observation of another guide who had trailed a mountain lion ten miles and had found three cows killed
Evidence such as this can often be found, particularly around much used bedding and resting grounds. This particular animal did not, however, die of old age. Jittery soldiers challenged this cow at night as she wandered through the brush near their parked truck, and when she failed to halt the third time, they opened fire, result -- probably one of the first casualties on the Pacific Coast after Pearl Harbor.
by the lion. The lion had dragged each about 150 yards and had covered them with brush and snow. This was in winter in snow and no other mention is made of the conditions. Obviously they are in no way the same as in the mild winter range of the Roosevelt Elk in Oregon.

Another incident mentioned by Saton is that of a bear killed by a bull as told by Mortimer Kerry. These incidents all refer to the Rocky Mountain Elk.

However, when all is said and done, it is doubtful whether attacks on mature animals ever occur except under conditions of extreme hunger. Calves are in all probability taken, but that is another matter. It should be noted that there are many and easier sources of food for a mountain lion within the range of the elk. The mountain lion, contrary to those who would have us believe he eats nothing but fresh deer meat, has a varied diet and will take what is easiest to obtain. Many lion droppings examined while observing the elk showed that mountain beaver (Aplodontia), which is very common throughout most of the range of the Roosevelt Elk, was a common victim of the mountain lion, and many other small rodents from squirrels to rabbits frequently went into his diet. Deer hair was the only other outstanding evidence found in these droppings, and elk hair or other fragments of elk were never found in the droppings. This all supports what is already a well-known fact, namely that cats whether wild or tame, are not noted for their stupidity nor are they noted for their habit of making a living the hard way.
The coyote, formerly almost absent in the coastal regions is increasing rapidly, but does not enter the picture as an important predator of elk. Except for the rare occasional newborn calf which a coyote might kill in the absence of its mother, there is little that a coyote or even a pack of coyotes could do to harm an elk, much less a herd. Even a calf would be a poor bargain with its mother close by for protection.

Seton (21) quoted Dan McCowan, a hunter-naturalist, who witnessed a coyote trampled to death by the cows of a herd under exactly the same circumstances which I have witnessed and described under the reaction of elk to dogs.

The black bear may be mentioned as a possible and very occasional predator. Due to the feeding habits of black bears and the abundance of other desirable foods more easily obtainable and the fact that black bears are not by nature killers of big game, it is probably one of the rarities of nature for a black bear to attack an elk. Accidental chancing upon a very young calf would perhaps tempt a bear and might end disastrously for the calf if the mother was absent.

Man, as is always the case, is the real and most dangerous predator of these elk.

Market hunting, chiefly for hides and teeth, as well as just plain slaughter without even utilizing the carcasses, was chiefly responsible for the reduction, to the verge of extinction, of our formerly large herds of Roosevelt Elk.

Few officials, with whom the matter has been discussed at one time or another, have admitted that there is any poaching
going on today that can be considered of any consequence. They will concede that elk are killed illegally now and then but that it is not prevalent enough to be of great consequence. Their mistake lies in the lack of first-hand knowledge and understanding and experience with people throughout the elk ranges.

I have visited few elk areas both close to and far from human habitation without sooner or later finding evidence of illegal elk shooting, either through field evidence such as remains of kills, or actual admission by residents in the area, admitting that they hunt elk illegally.

Evidence of illegal elk hunting can be obtained in two ways. One is by the usual methods employed by law enforcement agencies when such are in operation. At best this is difficult and at worst it is useless.

The other method, and for the purpose of this work it is far the best so far as results are concerned and the knowledge obtained, is to know the people and the country concerned; know them and work with them so that a common understanding of their problems and their outlook on these matters can be had -- in fact so that one can be one of them. When it is possible for an individual to do this wherever he goes, he will also enjoy their frank confidences. One can then, without asking, learn their viewpoints, their feeling and attitude on conservation and hunting. If one cares to discuss it, (not as a violation or a crime, for few look on their hunting as such) out of season hunting, whether pheasant, deer, or elk will be discussed freely and without embarrassment.
Many of the people who are inveterate out of season hunters feel that it is their constitutional right to hunt whenever they please and wherever they please so far as public land is concerned. This is particularly true of the older generation, many of whom came and settled the land in days when hunting was unrestricted. They therefore feel that the restrictions are unjust if not, in their opinion, outright unconstitutional and since they themselves have no influence in changing this, they feel they are morally justified in hunting out of season whenever they feel like it and can get away with it. Another argument which I heard over and over is that "I bought a license and therefore I have bought a deer, elk or whatever is covered by the license." If they do not get their game within the allotted season, they feel that they are entitled to get it whenever they can, or the game department should refund their license. Most of them are willing to let the department keep the license and see to it themselves that they get their money's worth.

As already suggested a big contributing factor for this out of season hunting, besides the attitudes mentioned, is the fact that there is little danger of apprehension. Out of the hundreds of such hunters known to me during the past 15 years, many of whom I know intimately as neighbors and friends, there is hardly a single one who would stand out as an individual who would continue to hunt illegally in the face of even a minor threat of apprehension. The fact that most of these people have hunted all their lives and had never met or even seen a game patrol officer in the field is no small factor in their disregard and disrespect of the game law.
With their attitude and outlook on the matter and no enforcement, it is no wonder that they come to accept illegal hunting as part of their everyday life. When an occasional arrest is made, it is no wonder that they feel they have been wronged rather than that the arrest was justified.

I contend and have always contended, on the basis of my personal, first-hand acquaintance with this class of violation, that an intelligent and consistent patrol in the field would stop 90% of this type of poaching. In certain instances where such illegal hunting was virtually being flouted in the face of the law, a wave of arrests would take place and the area would be patrolled for a time. The results were always conspicuous by the suddenness and completeness of cessation of all poaching activities in those localities. Equally conspicuous was the resumption of these activities when official interest in these areas was withdrawn and the patrol ceased.

Like the four-legged predator, the average poacher does not kill an elk with the same lack of consideration that he does a deer. An elk is after all a more difficult problem. Once killed it is not possible to dispose of it as easily as a deer. It is no mean task to dress and care for and transport an elk carcass in the field. Apprehension in the field is not the poacher's chief worry for it is all too well known how infrequently the law strays from the paved road. It is the transportation of the meat to the home and the disposing of it there that is more apt to result in apprehension. To a certain extent again the rule that a predator will take what is most plentiful and most easily obtained with
the least undesirable consequences applies here to the two-legged variety as well as the four-legged ones already mentioned.

Notwithstanding all this, there is a certain amount of illegal elk hunting going on throughout the state at all times. Communities and families living in convenient proximity to elk herds are usually of the class having the viewpoints already mentioned, and when an opportunity presents itself, it is all too often taken. This is particularly true of the more inaccessible and remote areas and communities, whereas the reverse is often true in the case of deer shooting. It was noticed that coincident with this condition these remoter and more primitive areas have not shown the same rate of response in population increase as more accessible and often heavily used sections of the country. Ordinarily the reverse would be expected, everything else being equal.

Illegal elk hunting though it exists is unquestionably not as extensive as deer hunting. However, in view of the relatively fewer stock animals and the much slower rate of increase, even a very limited amount of such hunting can seriously retard the normal rate of increase of a herd.

Market hunting to most people is a thing of the past, and few realize that it still exists today. Market hunting does exist in Oregon and to a far greater degree than is realized. By ways and means already mentioned, I have known of three well organized market hunting enterprises, the meat being disposed of to certain hotels of the larger cities of Oregon and Washington. In at least one of the cases, a regular truck pick-up schedule was maintained weekly. The latest of these enterprises was just prior to the
beginning of the war. Stricter control of the activities of trucks, and any extensive hauling operations by war-time regulations has probably curtailed such enterprises to a large extent. However, local small-scale operations would be little affected. To what extent elk are involved is hard to say. With the exception of one case, the operations noted were all concerned with market hunting of deer. The one exception was a matter of opportunity as could be expected. In the case of the well-organized group, an elk would present no problem and would in fact be a bonanza to the hunter. Because of difficulties already mentioned, the small-time market hunter would shy away from elk. In full justice to the ordinary, everyday out-of-season hunter, it should be stated that as a body they seriously frown on market hunting. They hunt only for themselves and do not waste meat, and market hunting is a bit too much on the side of hoggishness in their opinion and therefore a waste.

To a certain extent the war will have a definite effect on illegal hunting. Meat shortages and high prices will have a tendency to increase such hunting in those communities conveniently located near deer and elk areas. Game law enforcement has already fallen below even its already low peace time standard, and this will in no way help the situation.

Accidents in the course of an elk's life are not uncommon. This is not unusual when one considers the terrain and habitat in which an elk lives. It is only necessary to look at some of the pictures showing the conditions under which elk live to see this. The commonest accidents are those suffered from falls, snagging.
Family portrait. Cow with twin calves on July 3. This cow did not breed the preceding fall. Whether this was due to the extra strain of raising two calves or whether cows commonly breed only on alternate years is yet to be determined. Probably the former was the reason. Note white scar hair which shows on the rump of female calf and the long winter hair still present. Note the sleek appearance of the animals in comparison to those of preceding figures in winter coat.
and broken limbs. During the spring of 1942, the Ecola Park herd showed up with a perfect epidemic of accidents. Early in June a cow with a calf showed up with a broken hind leg. I did not see this cow as she did not stay with the rest of the herd, but according to Allan Kofoed, caretaker of the park, the leg was broken between hock and knee. She appeared to be in good health and was nursing her calf. Due to war time restriction on travel it was impossible to follow this information up to see how she fared. When last heard of in July, she was faring well. Food would be no problem, particularly at that time of year and she would have to move very little to meet her requirements. A yearling bull calf turned up about the same time with a badly wrenched hip, and he too got along fairly well, though he seemed poorer than the rest. In September he seemed nearly recovered. A yearling female was seen early in the spring and appeared badly snagged across one hip and flank. The hair on the snagged places grew in white and are clearly apparent in the picture. Also it can be seen that while the rest of the animals are in the short summer coat, this animal still shows winter coat over the injured region -- this was early July. Just how the accident occurred is difficult to explain. The appearance of the broken leg and wrenched hip so close together suggests the possibility that the herd was badly frightened and perhaps crowded into or through a bad windfall or log pile at break-neck speed.

Bones are frequently found in the woods. I have come upon this evidence of an elk's death most frequently on and around spots that are typical of the resting spots used by elk. In most cases
Figure 45

Close-up of the female calf shown in preceding figure. The big unhealed scars, and the healed ones on the rump with their white hairs are here clearly seen. Long rump hairs are still old winter coat which in a healthy animal is completely shed by the first of July.
the bones were old and bleached and it is difficult to say whether the animal died a natural death or was shot. In either case it is a likely place for the animal to die. Usually the large size of the bones indicated an older animal.

Webster (28) mentions a number of cases related to him by competent observers who witnessed accidents or saw the results of accidents in the Olympics. In one case five bulls were seen to start across difficult terrain around the head of a glacier and the person witnessing the start managed to arrive at the spot where he expected to see the five bulls cross but only four bulls arrived. Backtracking in the snow was easy and it was soon found that one bull had lost his footing in venturing too far out on an ice field and had slipped over the edge of a cliff into a crevasse some 800 feet deep.

In another case a young bull was observed with a broken "stifle joint" which was believed to have occurred in jumping a log. More likely it was the result of falling in a tangle of logs or catching the leg between logs in running through a windfall. The animal was weak and could hardly stand and had to be killed.
Unlike the female, male elk show sex activity at a very early age. Bull calves of 6 months will try to mount a cow at opportune moments. Whether this manifestation of the sex urge (which appears to be largely of a psychological nature) goes with physiological sexual maturity is not known. Probably it is merely a form of sex play such as is manifest by certain birds and animals at an early age and where there is no corresponding physiological maturity. Young spike bulls of 16 months of age (in their second autumn) give every indication of being sexually mature and at least show the usual symptoms of rut and are capable of mating with a cow, though whether such matings are fertile is not known.

This early maturation of the sex instinct in bulls is, it seems, completely wasted. It meets discouragement on every hand, even past the age when the cows have reached functional sexual maturity. The young calf in his attempts at sex play is likely to be rewarded with a not ungentle kick in the ribs by the outraged cow. As a proud young bull, even up to and including his fourth season, he is forced to carry on a sneaking existence on the outskirts of the herd, torn between his desire to join the herd and his fear of being caught by the old harem king. This goes on year after year until he himself has reached physical maturity and can dispute the possession of a herd of his own.

Such maturity is probably never reached before the fifth rutting season. Even a bull in his fourth season can readily be distinguished by his general adolescent appearance.
These adolescent characteristics are manifest in a number of ways and they can be recognized as readily as those of a 16 year old human youth. The adolescence is markedly shown in a characteristic slightness of facial bones, compared to the heavy-set burliness of an old bull. There is an overall slightness of body and like the adolescent youth that he is, a young bull gives a gangling, narrow chested, light-shouldered appearance. This, with his lighter mane and thinner neck, readily sets an immature bull off from a fully matured one even when the antlers are not visible. In addition to typical physical characteristics, there is also a typical psychological difference which sets him apart from the mature bull. This is the already mentioned close maternal or family-group tie which exists between these adolescent youngsters and the herd. As stated, these bulls stay with the family herd throughout their adolescence at least up to the fourth season and seem to miss their "mammas" almost as badly as some callow twelve-month old calf. Their complete maturation is in part at least marked by complete independence from the family herd except during the rutting season.

As in the bull, exact time of sexual maturity in cows is hard to determine and the age at which they start reproducing is not known. However, one thing is certain, breeding age is not reached before the third breeding season after birth, that is at about the age of 28 months. So far as my observations go no breeding activity of yearlings (16 months old in the second breeding season) was ever noted. A possible clue to the sexual maturation is the completion of the color pattern as shown by the
Cow and calf in abandoned homestead clearing, a favorite place for nursery groups. The spots are still clearly evident, but are lost by the end of August.
appearance of the fulvous or tan throat bib already described. This bib is entirely absent in calves and 16 month old females, and is only slightly noticeable if at all, in 28-month old cows. It probably reaches its full distinctness in the fourth year. In a number of instances cows showing bib markings and typical physical features corresponding to a 28-months old stage showed up with calves the following spring. Mills (13) in examining 129 cows killed for the purpose of reducing the Yellowstone herd found that 74.4% were pregnant and among these was one 21-month old cow which contained a normal fetus. Two other cows of the same age, on examination showed that the ovaries were unscarred by ovulation and had, therefore, not reached sexual maturity. Rush (20) in his studies of the elk of Montana and Wyoming concludes that the cows do not breed until the fall of the third year or until they are about 30 months of age. These findings agree with my own conclusion based on the direct observation of animals in the field, that the Roosevelt Elk cows do not breed until about 28 months old. The difference in figures is due to the slightly earlier breeding season in the case of the Roosevelt Elk. Mills' instance of the cow which bred at about 17 months of age must simply be taken as the exception to the rule, which is inevitable in the case of biological rules.

The throat bib, when taken into account with other characteristic indications of age, such as facial maturity, body slightness and carriage, is an excellent criterion to the animal's age. In cows there is a noticeable tendency to sway-backness with increased age. A 28-month old cow shows a noticeable contrast in the straighter
back and firmer body lines as compared with an older though certain- 
tainly not an aged cow. The carrying of a heavy calf in pregnancy 
perhaps contributes to this sway-backed condition in older cows.

The calves are born in May. The cow disappears from the herd 
several days before the calf arrives and gives birth to the calf 
in some isolated thicket where she and the calf remain until the 
calf is strong enough to follow her. This may be a week or longer, 
but I have had one instance reported to me where the cow returned 
to the areas frequented by the rest of the herd while the calf 
was so young that it could walk only a short distance between 
rests and would fall frequently. The general rule is for cows 
to remain away from the herd during the first month of the calf's 
life, only rejoining the herd when they happen to meet on common 
ground. I have noticed that during this period, the cows with 
calves, that is the cows from the same herd, frequently form a 
"nursery group". Three or four cows with calves will range to- 
gether away from the rest of the herd. The calves of such a 
group form a "kindergarten" -- playing and romping together, and 
often resting and sleeping together. By July these cows joined 
the old herd quite regularly, though they can even then be found 
grouped together as a unit within the herd.

The spotted coat of the calf begins to fade in July and by 
September only very weak and faded traces may be seen in the 
younger animals.

Twins do occur, though how frequently is not known. One 
such pair was observed in the Ecola Park herd and several others 
have been reported to me, but were not verified.
Figure 47

A typical nursery or kindergarten group. The cows with calves tend to form a separate social group during the first month of the calves' life, remaining generally away from the main herd. The main herd is generally rejoined in July, though the nursery group still will tend to form a separate group within the herd. Here the third cow has wandered off leaving her calf in charge of the other two cows. Though suckling is not tolerated by such a charge by other cows they will protect and defend it against intruders as readily as their own.
The sex ratio of bulls to cows is difficult to determine, but we can arrive at a fair estimate from the following figures. My own observations are based on a relatively small number of animals since they were confined to typical herds within typical areas observed year after year, based on a total of 10 different herds numbering 155 animals in the aggregate. Of these animals there was one bull for every 2.6 cows and 1 calf. I believe that the proportion of bulls is slightly high here due to the fact that on several occasions bachelor herds were sought out and this raised the proportion of bulls observed.

A field report by A. V. Meyers, Biologist of the Oregon State Game Department, gives the ratio of bulls to cows observed in Clatsop, Douglas, and Lincoln Counties by field men. These figures also were based on relatively few numbers and give a ratio of 1 bull for every 4.9 cows.

A report by Mr. Meyers on the 1938 elk season in Clatsop County gives the reports of elk seen by the 1243 hunters over a period of 7 days. These hunters averaged slightly less than three days in the field, and though duplication undoubtedly took place, it can be expected that the duplication was in the order of the sex proportion. Since the rut was well started on September first of that year and the bulls were active and noisy, it is to be expected that bulls, which are more difficult to find and see earlier in the summer, were to be found quite as easily if not more so than the cows. These 1243 hunters reported a total of 10,441 sight records divided in the following ratio: large bulls - 4; spikes - 1; cows - 16; calves - 5; or 1 bull for 3 cows and
Twin calves still suckling in late September. This is common among all calves and may account for the failure of a cow with a calf to breed. Lactation in some animals inhibits the sexual cycle.
1 calf. I believe that this can be accepted as a fairly accurate indication of the true sex ratio of the Roosevelt Elk, especially since all three sources of observation support each other. Three herds wherein the calf population could be observed closely enough to determine the sex ratio, had a total of 15 calves, 4 in one, 5 in another herd, and 6 in the third. Four of these were bull calves and 11 were females. This shows a ratio similar to that given above. I am satisfied that the normal ratio in normal optimum populations is 1 bull for 3 to 4 cows.
The rut itself is the attainment of the peak of a chain of interrelated events directed towards that end. This chain of events is started anew with the shedding of the old antlers and beginning of a new set of antlers. Just what the physiological state of the organs and glands of the body have to do with this cycle cannot be stated positively. However, from analogy with other known forms, it can be assumed with some degree of certainty that the primary sex glands and accessory glands are at this period of antler shedding at their lowest functional level. The exact mechanism which initiates and controls the growth, the size, shape and structure, the blood supply, the rut itself, and again the shedding, is not known and can only be conjectured.

Further evidence of the close link between the primary sex glands and the antlers and their control by these glands is shown in the fact that as the sexual potency declines, as evidenced by the decline in fertility with old age, the size and structure of the antlers also declines. As already pointed out, physical vigor and appearance need not necessarily show a corresponding decline and a bull may appear to be in full vigor of life and in excellent flesh at this stage of life. Seton (21) quotes Judge Canton on the case of the bull in his elk herd. "At first his progeny were reasonably numerous, but during the last three years of his life, they gradually diminished from a dozen down to a single fawn in 1875, with about 25 females, more than half
of which had previously produced fawns." He mentions that this bull was able to hold the herd, but was forcibly removed and replaced by a younger bull whereupon 12 fawns were produced the next year. Quite clearly this points to diminished sexual potency at old age even though physical vigor was undiminished. There is nothing said about the antler growth produced by this bull, but from my first-hand studies of the red deer management in Germany, I do know that in this closely allied form antler regression goes hand in hand with old age. And it is a practice among range managers to kill off all such bulls showing age regression because of their undesirability as breeding stock. These bulls or stags, even though their antlers are no longer prime, are still able to hold the herd against younger bulls. It is commonly assumed by many that the prime requisite for holding the herd against competition is large antler development. This is not true. Vogt's (27) best herd bull was deposed as herd bull in the prime of life and at a time when he developed his largest antlers, and also the largest antlers of any bull in the herd. Actually oversize antlers can be a handicap especially against a heavier bull. Body weight and physical vigor is the prime requisite and since, so long as food is plentiful, the physical vigor does not decline and the body weight does increase with age this naturally gives the oldest bull the advantage over a younger but lighter bull. The presence of regression characteristics which were evident in heads taken by hunters and examined at checking stations, showed that these characters were always present in animals of relatively old age as indicated by
Figure 49

Typical result of extreme old age regression in antlers. This bull, according to a competent and experienced observer was extremely old, though very fat and otherwise in excellent condition. -- Photo, courtesy of A. V. Meyers, Biologist, Oregon State Game Department.
the condition of their teeth. This has also been noticed in mule
deer, and quite likely this is true of all antlered deer.

An example of extreme old age antler regression is shown
in figure 49. These antlers are those of a Rocky Mountain elk
killed in Eastern Oregon and were photographed by A. V. Meyers,
Biologist of the Oregon State Game Commission. Mr. Meyers tells
me that this bull was extremely old and was in excellent condition
and very fat. He says that there was absolutely nothing wrong
with the bull and to all appearances he was normal except for
the antlers. As usually seen the regression shows in decreased
length of terminal tines, a slighter, more spindly appearance of
the beam towards the upper half, while the burr remains normal
throughout life even in such stubs as shown, and finally a de-
crease in the number of tines beginning with a loss of the ter-
mina n one s first. If the animal lives long enough, the result
is eventually as shown in the photo, though this condition is
here in normal wild herds rarely encountered for probably the
animal rarely lives to such an extreme stage. The fantastic
forms with peculiar thickenings along the beam and multiple pointed
tines and extreme branching in old bulls is probably due to attend-
ing physiological disorders which upset the normal regulation of
the antlers grown. In normal and healthy animals even in old
age, antlers develop along the same characteristic line and
pattern year after year and antler shapes are transmitted as a
characteristic to the progeny. The progeny of a bull can readily
be recognized by the typical antler structure which may be trans-
mitt ed in great detail (see Heck 1935 and Vogt 1936). In the
regions frequented by the bull shown in figure 57, two other bulls were seen which showed such a remarkable similarity in antlers as to number of points per side, tine formation and general shape that it was thought that it was one and the same bull in the case of two which were apparently of the same age and size and occupied closely adjoining ranges. Only because it was possible to check the presence of both bulls by driving from one range to another within a few minutes was it possible to identify them as separate bulls. The third bull occupied the range on a succeeding year and was a definitely younger and smaller bull than that in figure 57, yet his antlers were strikingly similar in number of tines, shape and tine formation to that of his predecessor. I do not doubt that all three of these bulls were very closely related.

There can be little question that the antler growth and development is closely interrelated with and controlled by the sex glands and other glands closely interrelated with the sex glands and their function. The gonads are the chief functional glands involved directly in the sex cycle of any mammal, and they are in measure controlled and acted upon by the pituitary, the thyroid, the parathyroid, and others, and in turn exert some regulatory effect on these glands. Antlers are true bones composed chiefly of calcium and phosphorus, the utilization and use of which is controlled and regulated chiefly by the parathyroid, and thyroid and indirectly by the action of the pituitary acting on these glands.

From this it can be seen that the mechanism involved in the development of what at first seems as a simple bone growth is
after all not so simple and presents a very complex and delicately balanced relationship. Since no specific work has been done on this interrelationship, a statement in this respect would be merely a guess.

A number of facts are known and from these we can draw some definite conclusions.

Antlers of deer are true bony structure and are composed chiefly of calcium phosphates, in other words minerals normally found in bones of the skeletal system. A question naturally arises as to whether antlers are ever grown at the expense of the bones of the skeleton. It is known of course that the body system can remove these materials from the bones and does so under certain conditions. It is, however, doubtful that this takes place during the development of the antlers. A number of well-known facts point to the reverse of this condition. When there is question of calcium and phosphorus need between the antlers and the bones, the antlers must suffer and the bones receive the material.

First of all, if the food is low in these materials, the antlers always show the effect of this deficiency whereas the skeletal system may develop normally. This suggests that body needs are met first and the antlers take what is left over. Whether bones suffer any degree of decalcification under these conditions, not noticeable by superficial examination, is not known.

A more definite answer to the question of supply is given in the case of injuries sustained by deer. Male deer suffering
A spike bull, September 12, still in the velvet, though the rut is well advanced. Yearlings like this one commonly shed the velvet 3 to 5 weeks later than older bulls.
broken bones show definite and corresponding effect in the developing antlers. Interestingly enough it is the antler opposite the side of the injury which shows the effect. If the injury is on the left side of the body, it will effect the right antler and vice versa. The breaking of major bones such as a leg bone, will cause a marked retardation and malformation of the corresponding antler, definitely showing a want in essential minerals needed diverted to mend the broken bone. Notwithstanding the foregoing, the growth of the antlers is a time of considerable strain on the body system, for in a short period of about 5 months a bull's system must supply him with from 15 to 50 lbs. of bone material. On the basis of Vogt's (27) figures on Red deer that approximately 10% of live weight is skeletal weight, a large Roosevelt Elk bull would produce about 100 lbs. of bone in 52 months, the approximate time needed in reaching full size and stature. This is roughly 2 lbs. per month of growth. A bull this size could at prime be expected to produce antlers of 40 to 50 lbs. This is produced in a period of $3\frac{1}{2}$ to 4 months or at better than 10 lbs. of bony material per month or not less than 5 times the amount per month required in developing a skeletal system. It is no wonder bulls exhibit symptoms of "growing pains" during this period.

Whether it is a reflection of this strain on the system or not, it is noticeable that bulls in general spend much of their time lying down during the period of antler growth. Such resting is much more common than that noticed in cows during the same period of time. It is especially conspicuous in a family herd having a number of young bulls.
Antler shedding in bulls varies considerably, and is dependent on many factors. Age, physical condition (nutrition), injuries and diseases all have their effect on the time of shedding. They also have a similar effect on the maturation and the shedding of velvet of the antlers.

Fully matured bulls in normal and good condition shed the earliest. In the Roosevelt Elk this is usually late March. Young immature bulls, particularly the yearlings and two year olds, may retain their antlers up to the second week in April. A fully matured bull in poor physical condition due to age or food, or due to injuries, may shed much later, usually more or less corresponding with the seriousness of his condition. Extremely serious injuries may even result in the retention of antlers until a very late date. In a measure at least this points to a protective mechanism for if antlers of an animal in extremely poor condition were shed at normal time, the prompt renewal of growth of the new antlers would place an additional burden on the system. A postponement of two to four weeks may mean the difference between prompt and normal recovery or a very slow recovery, if at all.

Webster (28) writing of the Olympic elk, states that Mr. Hume, an apparently reliable and experienced observer, saw a bachelor herd of 15 large bulls on April 17, all of them still carrying their antlers. This is indeed unusual, as Mr. Webster says, for the bulls to be carrying their antlers.

After the antlers are shed they presumably deteriorate rapidly, particularly in the humid climate of the Pacific
A two year old bull. Antlers usually show 3 tines, sometimes 4, and occasionally in a very vigorous specimen 5, though this is unusual. Such adolescent bulls remain with the family herd up to the fifth season before assuming independence and herd bull duties.
Northwest, and except under favorable protected conditions probably would not last more than a few years. Evidence of the durability of a pair of antlers is the pair from Coos Mountain in Coos County. I picked them up near the top of the mountain in the fall of 1941. Except for the tips of the tines which had been gnawed by squirrels and mice, the antlers were in perfect condition and only very slightly weathered. I judged that they were not over a year old. Later I described the place where I found the antlers to a naturalist friend who is familiar with the Coos Mountain area, and he was quite positive that they were the antlers of an illegally killed bull, the remains of which he had found in 1936. He had carried the antlers out to the point along the trail and had left them there rather than carry them the remaining three miles to the road. He confirmed the identity of the antlers on sight. Thus, these antlers had been exposed to the weather for six years and the only damage was that done by the rodents. The antlers were in fairly heavy hemlock timber, but otherwise unprotected. The fifty pairs of antlers uncovered by fire as described in the chapter on past numbers and history of the elk is further evidence of the durability of these antlers.

There has been a longstanding controversy as to whether deer or elk "consume" their own antlers. This has been disclaimed by most scientific men and many eminent field naturalists. There is, I believe, some evidence that elk do feed on their antlers to some extent, whether they consume them or not.
Antlers are usually shed in March though in some cases may be retained well into April. Growth of the new antlers is usually well under way by the end of April. This photo was taken May 14. Courtesy – Allan Kofoed
Dr. Heck (8) gives undisputable evidence that at times such feeding on antlers does take place. A forester brought to him for examination two antlers, the ends of which were chewed off in a peculiar chisel shape clearly unlike that of the work of rodents. The forester observed that there were absolutely no other tracks except that of the red deer around the antlers in the snow.

Webster also mentions such evidence related to him by a reliable witness. In this case the man actually observed the bull elk feeding on an antler. He said that according to the observer the elk scraped the antler with his incisor teeth. Webster says he has seen many antlers showing these tooth marks and has evidence in grass and moss where an elk has pushed an antler about while so engaged. A squirrel obviously could not push a heavy antler about and assuming that Mr. Webster and his observers are competent in their observations, and I fail to see how this could be otherwise, I believe that naturalists will have to revise their old standards a bit and accept the fact that, in some instances at least, elk do eat at least parts of shed antlers. Certainly there is nothing more unusual about an elk chewing on a bony material having a high content of a mineral that the animal likes than there is about an elk feeding on the dry nutritionless fungus on a rotten log.

The growth of the new antlers is notably under way ten to fifteen days after shedding, when short thick knobs begin to show growth is rapid and by early June the new antlers have usually reached their maximum dimensions even in 3 and 4 year olds. Yearlings will show only 4 inch knobs by July. At this time they are
by the middle of July the antlers are almost complete, and by the end of the month they will have reached their full size, and the velvet will be ready to peel. This photo was taken July 16. Courtesy - Allan Kofoed, Caretaker, Ecola State Park
Peeling of the velvet starts in early August in the older bulls and by the end of August the antlers are polished clean. This shows a typical three year old bull.
still soft and well supplied with blood. From here on the antlers become more and more ossified. With the cutting off of the supply of blood to the antlers, there is a change in the velvet, and towards the end of July and early August the velvet begins to crack and peel in strips. According to some observers (Heck (8) on other forms and in confined animals) this peeling usually starts at the top and progresses downward, though it may begin at other points also. Heck also mentions that "drops of blood" were evident around a break in the velvet of a stag's antler which had begun to peel and that the stag gave the impression that the process of peeling was not without pain as he rubbed his antlers. He leaves the impression that even up to the time of peeling some blood is retained in the skin of the velvet and also that nerve connections are maintained.

He mentions that at the physiological stage when the velvet is matured and ready to shed, the stags are plagued by an "itching" which causes them to rub their antlers against over-hanging limbs, bushes, grass, and even their own bodies. Eventually the skin is broken and begins to peel in bloody strips from the antlers.

These strips of velvet, particularly those near the base, hang down in annoying strands and dangle before the face and over the eyes. This will usually cause a bull to try to free himself of the annoying and bothersome strips. This attempt to free himself gives rise to persistent and prolonged rubbing against trees and shrubs. The energetic, often violent belaboring of trees and shrubs, at a later date is quite another matter arising from a distinct and separate cause.
Underneath the velvet, the new antlers, like all true bone, are white or grayish white in appearance, and the characteristic color of the antlers as usually seen is acquired and varies with natural factors and conditions involved. The peeling of the velvet may, and usually does, leave a certain amount of dried blood deposited on the antlers and subsequent rubbing against trees in attempts to free himself of the annoying strips of peeling velvet will add a certain amount of dirt and bark juices to the surface of the antlers. It is, however, during the period preceding the true rut and the rut itself that the antlers receive their final color and polish. By the middle of August the last of the mature bull's antlers are naked and free of velvet and only the younger bulls of 1 and sometimes a 2 year old will show velvet-clad antlers, and these may be retained until even after the rut. This is especially true of spike bulls.

The old bulls at this time, though still associating in bachelor groups and tolerating each other, show definite signs of restlessness and an approach of the rut. From the middle of August on, much aimless wandering may go on among some; others may remain at a favorite spot. All, however, indulge in definite rut signs, namely the slashing and belaboring of trees and shrubs. There is nothing apathetic or careful about his procedure, and whereas the weeks preceding when they were still freeing themselves of the bothersome velvet, the antlers may have been used with some degree of care, perhaps reminiscent of the days when they were still soft and tender. The violence of these attacks rises as the days approach September and the time of full rut. It is during this period of
Young hemlock stripped of its limbs and bark by bull in the rut. Note the limbs piled around the base and the packed and trampled spot where the dog is standing. In a wet or marshy spot this would form a wallow. Fog and rain is beginning to shroud the slopes in the background.
slashing and horning of trees and shrubs that gives the antlers their final color and polish. For example, a bull who may range through alder covered ravines and polished his antlers almost exclusively on alder will have antlers of a distinct reddish yellow color from the juices of the alder bark. Other bulls working on small conifers, the bark of which contains much pitch will pick up a much darker, sometimes almost black stain. So it is not unusual to see bulls showing all varieties of antler colors from light yellow to reddish brown and almost black. In most cases the darker color is near the base of the beams. This is due to the fact that most of the slashing of the trees is done with the basal part of the beam. This part, therefore, acquires the deepest color. The characteristic candle-like whiteness of the tips of the tines is due to the severe polishing these extremities receive in digging and gouging the soil. This naturally polishes them free of all dirt and stain otherwise acquired and leaves them in their natural whiteness of true bone.

Skinner (24) mentions the color of the antlers of the Roosevelt Elk of the Olympic Peninsula and says, "when having more than five points per antler, are apt to be reddish". He goes on to say that this is not just surface color but extends into the antler itself. This does not agree with my observations on the elk in Oregon and the antler color varies as described and due to the reasons given. The antlers which I have at hand show no extension of the color below the surface. I have been careful to note the predominate types of trees in the vicinity of the animal observed and the ones used, and in all cases the colors usually agreed with the types of stains left by the bark
of the trees used. I have noted on several occasions in the case of antlers of elk and deer when accidentally shot off, that there is often considerable trace of blood in the antler near the basal part and basal tines, especially near the center or core and that these stained the bone a reddish brown or brown. This is early in the season (September). It may be the color observed by Skinner is from the blood left in the bone on ossification, though he does not think so.

This slashing of trees and the ground is directly linked with the rut urge. It is not entirely a senseless act, expressing a desire to fight, to challenge or to frighten away other bulls as is generally taken for granted. Often there is a quite orderly pattern to this display of violence. The details of this behavior of the bull scraping and marking a "sign post" has already been described in the chapter on social behavior.

After witnessing such a performance, the tree used by the bull was closely examined. The appearance of the lacerated bark and trunk with its numerous deep and narrow more or less parallel cuts and gashes was identical to many similar trees and saplings seen throughout the range. These signs had for a long time puzzled me for they were not uncommon and are fairly distinct from more or less smoothly polished appearance of a sapling trunk which has been slashed in the usual challenge display. Such work usually presents a frayed and tattered appearance, but since it is done more with the more upper parts of the antlers which are relatively smooth and have no sharp fine tubercles such as are found on the basal parts, particularly around the burr, they are bare but more
smooth and not so torn and scraped.

These sign posts are common throughout the home range of any herd of elk, every bedding ground and loafing spot has them, and they are common along the trails. A strange animal would immediately know when it was entering the range of another herd, and likewise a home animal would have a means of recognizing its own territory, particularly at night. In the case of bulls there can be little doubt that a bull would be warned that the territory and the herd was already in possession of another bull.

It may be suggested that the described behaviorism has some relation to ectoparasites, and the act is an attempt by the animal to rid itself of these pests. This was the first thought that entered my mind when the act was first observed. However, close examination of many such sign posts immediately after the animal had worked on them has yielded no evidence to support this view. Most of the trees used, hemlock, spruce, alder, willow, yew, and others, showed nothing that would be of insecticidal value to the animal. There is, particularly in winter, no juice or sap present in any noticeable quantity, neither was any odor ever detected that might have such a benefit. The rubbing of the heads and other parts is not very violent, in fact is usually of a more gentle, massaging action. Utilizing the bark as food is completely out of the question. The fine thin strips of bark shaved by the cows' teeth are permitted to drop to the ground and always litter the ground around the base of the tree. Nor are these shavings dropped accidentally for direct observations have been made with glasses at distances as close as 50 yards, and it was plain to see that these shreds of bark were not even taken into the mouth
either purposely or accidentally and no chewing or even licking was ever observed during this behavior.

The hunter and the casual observer usually credit most of the animals that come to his attention, and particularly the deer tribe, with rather simple social life and intelligence. Yet even these brief observations into the intimate side of the life of the elk show interesting and heretofore unmentioned social behavior. It is not out of place here to say that were the entire facts of these and other animals' social relationships and systems of communication known and fully understood that it would be found that this side of their life is far more complex than ever before realized.

There is another type of antler slashing and rubbing which differs from the case described. This is the true manifestation of the combative and challenging spirit of the rut. It is noisy and violent and is accompanied by much bugling particularly during the early part of the season and after the bull has found a herd. It consists solely of slashing and gouging to shreds and tatters smaller trees, saplings, shrubs, and ferns and in violently digging or gouging in the ground with the antlers. Not uncommonly the tines of the antlers are chipped or broken in the latter process. Such action is particularly violent when in the presence of other bulls, either when in sight or even when only in hearing distance of the other bull. A young sapling, even of considerable size may be slashed and whipped about with such violence as to be completely stripped of all its limbs. The power displayed by a full grown bull is astounding and I have seen a 3 to 4 inch spruce bent flat to the ground by the twisting antlers of a large bull, only to
have it whip upright again when released. One must try bending such a spruce to appreciate the strength displayed. Rotten logs are a favorite subject in these times, and a bull will scatter one far and wide with his antlers, often getting down on his knees to gouge and dig in the log and the ground under it. Occasionally a tangle of ferns and vines becomes caught in the antlers so that an old bull will go about sometimes for a whole day looking as though he were carrying a load of hay on his rack. Throughout the rut, and particularly the early stages of the rut and the days just preceding it when bulls are highly excitable and particularly demonstrative, they can be approached by employing a rather simple subterfuge. This works best with the more unsophisticated individuals in regions where they have had little experience with man and the rifle, and is best practiced in heavy cover. A stout stick banged, rattled and scraped against the brush and limbs of trees and an occasional whistling imitation of the bugling of the bull, even poorly imitated, serves to assure the bull that the animal approaching him is another elk. Under such conditions, it is quite possible to approach without the slightest caution, in fact the approach should be made with as much crashing of limbs and brush as possible — in other words attempt to imitate the action of a truculent and combative bull who cares little who hears him or how he wades through the cover. To attempt this subterfuge and to try to make a noiseless stalk while beating the club against limbs and tree trunks in imitation of the antler rattling and slashing of a bull is to arouse suspicion, for such a bull simply does not travel like a thistel-down, and even the most unsophisticated quarry
can tell that something is wrong.

Using this method of approach in heavy cover, I have been able to approach wild, mature bulls as close as 15 yards without arousing their suspicion. On stepping into plain view they would stare in paralyzed astonishment for a few seconds, and then crash away in full flight. I have noticed at such times that if all noise was stopped and I remained absolutely quiet for 4 or 5 minutes, the animals would become suspicious as though wondering what had become of the braggart and what was wrong with him. When such suspicion began to show itself to the point where the animal was almost ready to withdraw, some industrious belaboring of a sapling with much rattling against limbs and some heavy crashing about in the underbrush would immediately allay his suspicion. In a region where the elk has been much hunted, particularly towards the end of the hunting season, such a subterfuge must be performed with a much greater degree of exactness and care, and even then it may not fool the intended victim. Where hunted, the elk quickly lose their trust in man and become the wildest and wariest of all big game.

In some sections, rutting wallows are a common feature during the rutting season. These have been observed in one particular area notable for its deforested condition and therefore being much drier and hotter than other similar but not deforested areas. It is, therefore, difficult to state whether the wallows are a part of the sign post behaviorism of the rut, or whether they are merely a method of gaining relief from the heat and insects that are more bothersome in these regions. Probably both factors enter into the case.
No bulls were ever observed in the act of wallowing though many were seen covered almost from head to foot with dried mud, and the assumption that they wallow is merely from inference. The wallows are usually in a thicket of alder or willows in a ravine or around a spring in some canyon, and the ground is damp and boggy with much leaf mold and litter covering it. The surrounding trees and shrubs show hard and violent use, and there is much evidence of sign post activity and there is usually a strong musky odor around these spots, and in the more recently used wallows the odor is almost nauseating in strength. This is, I believe, not due to a glandular excretion but is the characteristic odor of the fecal matter of these elk. It is particularly strong in bulls. However, it is very noticeable in the case of all animals at all times of the year, and is particularly strong and pungent on a damp quiet morning. This peculiar musky scent can be readily detected under such conditions even as much as 4 or 5 hours after a herd has passed. Naturally around such wallows this scent will be many times intensified from the frequent use, and in the damp surroundings it clings and is at times overpowering. Whether the elk come to these spots intentionally to wallow and use the trees for their sign post and displays as a matter of convenience, or whether because they happen to start working on a tree in these spots and in the course of much trampling and gouging around form a wallow which is used as a matter of convenience is an unanswered question. Probably the reader could choose either reason and be right in either case. The European Red deer stags, according to Dr. Heck (8) indulges in mud wallowing regularly during the rutting season when such
A bull herding a cow back to the main herd. This was the second week of the rut. Earlier in the season the cow would probably have been brought back much faster. In this case the cow had been left by the herd and had started calling to the herd, and had been answered by the bull who met her halfway and escorted her back in an unusually leisurely manner.
wallow are available. These wallows are used purely for the benefit of the rest and relief derived during a period of strenuous existence. He mentions nothing of the sign post behaviorism in his excellent and complete book.

With the approach of the rut the old bulls become restless and less tolerant of each other. From ten days to a week, more or less depending on individual variation, prior to the first of September the family herds of cows which up to now were without bulls other than the youngsters become the focus of attention of the old bulls.

It is always a source of wonder and surprise to observe a herd from December to August, day after day without sign of a bull other than the adolescent youngsters, and then suddenly find the herd attended by some black-maned, gray-backed old fellow, herding and bossing them as though this particular herd had been reserved just for him and had awaited his coming all the time.

The first week is a lively, noisome time, cows are unruly, their unruliness augmented by the unceremonious ousting of their adolescent sons who themselves have more than a platonic interest in the matter at hand. These young bulls miss the security and company of the herd to which they are accustomed and persist in trying to get back in the herd, calling frequently in high, short squeals, and often drawing the worried and anxious cows away from the herd. With one or two cows persistently trying to escape from the herd and others naturally wandering away, a bull is hard put to keep his eye on all, and his efforts to keep the cows together under such conditions drive him frantic. He dashes after one cow
Figure 57

A cow being shouldered by a bull toward the end of the season. From force of habit more than anything else, he is blocking the cow's wandering from the herd, though he has lost most of his interest in the herd. At this time of the season, bulls generally treat the cows less roughly and with more consideration.
and screams his exasperation and rage at another one wandering off in another direction. At such times one is reminded of a sheep dog frantically circling his flock. His treatment of cows at such times is not gentle, if such can ever be said of his behavior. A cow must respond promptly when herded back, and any failure or slowness to respond will bring the bull in a headlong rush and if the cow is so foolhardy as to permit herself to be caught off guard will receive a blow or jab from the heavy rack that will promptly awaken her. As a rule cows avoid any close approach of a bull at such times and dodge nimbly out of his way.

A week after the season has advanced the cows, having learned the futility of resistance and unruliness, become more tractable and apparently resign themselves to the bull's tyranny. Then if a cow wanders far enough away to attract the attention of the bull, he needs only to walk towards her a few short steps, with perhaps a low squeal to send her back to the herd. Sometimes a cow still refuses to come immediately; then the slouching walk quickens sharply and the squeals may become sharper and more rapid and insistent; warily the cow watches the bull, and when there is no doubt that he really means business she starts walking reluctantly back, making a final scrambling dash around and past the old tyrant, who with perhaps an extra admonishing squeal or two stalks arrogantly back to the herd. Not infrequently in dense cover the members of a herd become separated and opportunities for straying are greater and are harder to prevent. Under such conditions a cow may frequently get left by a herd so far as to lose sight of it. She may have been busily feeding or perhaps
Immature bulls are not tolerated in the herd during the rut by the herd bull. These two spike yearlings hang wistfully about the edge of the herd hoping to rejoin their former companions.
was reluctant to leave her bed. When she does notice the absence of the herd she begins to call in short squealing calls not unlike that of the bull, who usually answers and comes after the lady to escort her back. The lady usually preceding him rather hurriedly and with all dignity thrown to the four winds. Under such circumstances the bull does not hurry but walks slowly with frequent stops and calls, usually meeting the cow half way. Bulls do, however, at times show some consideration towards a cow, gently nudging her with the muzzle or gently shouldering at her back towards the herd. This is usually reserved for those cows in the immediate vicinity of the herd and which are not deliberately straying.

The young bulls who hang wistfully around the edge of the herd at a discreet and safe distance are the herd bull's chief worry. Sooner or later they try to rejoin the cows, the young spike bulls because of lonesomeness and the older 3 year olds because they too feel the urge of the season and because they would like to drive a cow off for themselves. Few are ever successful in getting to a cow which is in estrus, though occasionally this does happen. Most bulls are too watchful to permit a youngster to sneak past their guard, but occasionally a bull is careless, or towards the end of the rut becomes fatigued, and a young bull has little difficulty in approaching to the outskirts of a herd and even in mingling with the stragglers, though this is about as far as their ambitions are ever fulfilled.

The watchfulness and ability to detect the presence of these hangers-on by the old bulls is often positively uncanny. The bull
Seeking mutual solace in each other’s company, they graze peacefully side by side. Spikes do not usually show much rutting behavior.
shown in figure 57 was such an indefatigable fellow that even towards the end of the season when he was completely physically fatigued, the approach of a young bull would put him on his feet with an angry squeal, stepping menacingly towards the youngster. A typical incident will illustrate the alertness shown day after day right up to the last of the rutting season.

The big bull had his herd in the bottom of a narrow ravine, heavily overgrown with ferns and salmonberry and other brush. The entire herd was well bunched and most of them were bedded for the afternoon. The bull, with over half the rutting season behind him and showing the strain of the preceding three weeks in his gaunt sides and hanging head, had also bedded down. His position was such that his sight of the other animals was completely obscured by the five to six foot ferns and tangled brush, logs and stumps. The three year old hanger-on of this herd had followed the herd, but had remained about 150 yards down the ravine and higher up. He also had bedded down. The old bull was well aware of his presence in the vicinity and had chased him away from the outskirts of the herd several times before they had entered the ravine. For several hours nothing unusual happened; cows got up stretched, yawned and bedded down again; others stood about or browsed fitfully on the salmonberry leaves. At least one or two were always on their feet and moving about, the bull with drooping head and closed eyes was by all indications getting some much needed rest. He appeared to be quite asleep. To all appearance he had lost interest in what happened to his harem and it looked like the three year-old was at last to have his inning. He finally got up and deciding that all was clear, edged slowly and very carefully
down into the ravine and towards the cows. His approach was cautious and clearly he was not sure just where the old tyrant was located and what he was doing. After many stops, he approached to within 50 or 60 yards of where the old bull still dozed, and to less than half that distance from the nearest cow. The old fellow, with his nose propped on the ground, seemed oblivious to everything about him, and it looked like nothing short of a bomb under him would arouse him. Suddenly and without any noticeable warning he lunged to his feet and with an angry squeal started towards the youngster who was still obscured from his sight. The three year old hastily scrambled up the side of the ravine to his original position.

There were few if any air currents moving at the time and even if there had been, it is remarkable that the apparently dozing bull should be able to detect a difference in the position of the younger bull, a matter of about 100 yards. It is even more remarkable that he should be able to distinguish between the movements of his cows and those of the young bull. Yet so decided and clear cut were his actions and so accurate his location of the interloper that there could be no misinterpretation of his actions. The whole incident was witnessed from a ringside seat not more than 75 yards away on the rim of the ravine.

Fights among old bulls do occur, and though I have not had the great fortune to be a witness at one of these affairs, several have been reported to me by loggers whom I met on my field work. These both were observed the first week in September, and therefore at the start of the rut. Webster (28) tells of such a battle related to him by Grant Humes, a resident of the Olympics who witnessed the affair. It lasted for ten minutes before the two bulls
parted, and consisted largely of violent shoving matches and neck twisting. He mentions particularly that neither animal took advantage of an opening to deliver a thrust at the exposed body of the other, though both bulls showed the skill of experts in whipping their bodies out of range of the other's antlers when they found themselves exposed to a thrust. In another related instance he tells of, and shows a photo of, a bull killed by another in a fight. Though not witnessed, the observer found the animal immediately after the fight. Its neck was broken, apparently by the savage twisting of his opponent and the skull was split lengthwise. The latter was believed due to an antler striking the ground when the bull fell.

Prior to close observation of actual breeding activities of the Roosevelt Elk, I had the impression that among elk and deer in general, the physiological sexual peak in the males was attained in the course of time with the advent of fall and that the full expression of the sex urge was brought about by the presence of a female in heat or estrus. In other words it was thought that it was the condition of estrus in a female which stimulated a bull to physical activity and the bulls were in a state of "responsiveness", that is, correspondent to the female's estrus conditions, well in advance of the fall rutting season. Similar impressions are held by most people. This may be brought about through association with the habits of domestic cattle, where the bull is in a state of sexual "responsiveness" throughout the year and the presence of the estrus condition in a cow is all that is necessary to bring on sexual activity. This in a measure was responsible for
my own false impression.

In the Roosevelt Elk, and quite probably in all other forms, there is no doubt that the bulls have a definite physiological sexual cycle which develops and attains its peak quite independent of any stimulation by the presence of cows in the estrus condition. So that if a cow should attain the state of estrus in advance of the regular season, as sometimes happens, it is doubtful whether fertile mating would take place, even if an old bull happened to be about. Also the psychological behaviorisms, the bugling, tree-slash and fighting typical of the normal rut, would probably be absent. It is very probable that bulls do not attain the complete negative sexual state manifest by cows at times other than during the rut, and a normal physical reaction may take place. A complete negative condition if it is ever present would undoubtedly be during and immediately after antler shedding time.

So far all observations of out of season sex activity have been made on immature bulls. As already described, calves and young bulls 8 to 12 months old have been observed to mount or try to mount cows and other calves. Whether this is due to yet unstabilized physiological regularity of the reproductive system is not known. None of the psychological behaviorisms as described have ever been observed outside of the usual time of rut. An incident witnessed in a herd during the early stages of the rutting season is of interest in connection with this problem.

The herd consisted of 17 animals - 6 were calves, two were bulls, one a three point, two year old, and the other a spike yearling, the rest were cows of various ages. They were browsing
in a natural amphitheater from the rim of which it was easy to observe everything that went on in the herd. The date was August 29, and several bulls could be heard challenging from the heavy timber below the mouth of the amphitheater-like depression. One of the bulls, a very large bull, emerged from the timber some 150 yards from the cows and proceeded to give a beautiful demonstration of his feelings, bugling incessantly and slashing the young spruce trees with a violence that threatened to uproot some of them. The emergence of this bull was shortly followed by a second bull of equal size, but some 100 yards to one side of the first one. This one was no less violent in his physical and vocal demonstration. A third could likewise be heard farther in the timber but did not show himself. The two visible bulls gradually worked closer to the herd, though whether through mutual respect or by accident did not approach each other. Both bulls were well aware of the cows and the presence of the two young bulls among them, for the latter made their presence known by frequent high-pitched adolescent bugling. Certainly there was no possible doubt that the two old bulls were well aware of each other, yet they always managed to remain about 150 yards apart regardless of how they shifted about. Neither one made any move to take over the herd and acted as though he was the sole occupant of the stage even though at times one or the other passed so close to a cow that she would move briskly away from him.

Surprisingly enough it soon became quite evident that at least one cow was in a state of estrus and complete sexual receptivity, for on three occasions she permitted the spike
yearling to mount her and copulate successfully. That the bulls must have been aware of the condition of this can hardly be doubted for on several occasions both old bulls had approached to within 30 yards. Yet on each occasion they acted as though they were completely unaware of the cow's presence much less her condition. No hostile move was made towards the young bulls or towards each other at any time, nor did the two young bulls show any animosity towards each other, this, however, is not unusual for immature bulls rarely show animosity towards each other and live peacefully together through the rutting season though under somewhat different conditions. During this observation the 2 year old bull likewise showed no interest in the cow, though he often bugled like the others.

These reactions again raise the question of whether the spike yearling had physiologically reached a peak in his sexual cycle or whether his behavior would have been the same in the presence of a cow in estrus regardless of the time of the year. One thing is certain however, and that is that the two mature bulls and the immature two year old had not reached a physiological state where they could be stimulated to sexual activity by the presence of a cow in a state of full sexual receptivity. It is, therefore, quite possible that in the older bulls, and particularly the mature ones there is a physiological state of sexual "responsiveness" corresponding to the sexual "receptivity" of the cow and that it is quite as sharply marked in season as that of the cow.

The period of estrus or heat in a cow is probably not over two days in length from the onset of the period to its finish, and
the period of receptivity to a bull is much less, probably only the last half of the period, if that.

The approaching period of estrus in a particular cow is evident to a bull well in advance as can be judged from his sudden attentiveness to that cow. As much as 24 hours prior to estrus a bull will single out the cow and remain in her immediate vicinity, following her about wherever she goes as much as his herd duties permit. As the time draws closer to the actual estrus condition, the bull's advances become more insistent and the cow is constantly forced to dodge the bull to avoid being hemmed in against some natural barrier or blind alley. At this stage the bull's entire attention is focused on that particular cow, even to the point of neglecting the rest of the herd. The bull's activity soon develops into a strenuous marathon tag contest which may last 15 to 20 hours or more. The cow usually finds some natural block or obstacle such as a windfall, or an impenetrable clump of shrubs and takes refuge behind this. In one instance observed the tag stage of this activity began early in the afternoon, the cow taking refuge behind the upturned roots of a large blowdown. Whenever the bull started to circle the obstacle, the cow moved around the other way and would take up her interrupted grazing on the other side, while the bull glared in exasperation across the pile of roots and earth. For a minute or two the bull would stand watching the cow, then tentatively he would take a step or two around the pile of roots and earth, and the ever alert cow would likewise step an equal distance around the other way. This see-saw would continue for four or five minutes, until finally the bull's patience would break and he
would dash madly around the windfall only to find himself alone, with the cow calmly browsing on the other side as though nothing really extraordinary was going on. The air of apparent nonchalance that a cow can display at such times is truly remarkable, and is matched only by the bull's apparent exasperation and appearance of frustration. After a series of such futile attempts to catch the cow, the bull would throw caution to the wind and dash madly around and around the windfall in a futile attempt to run the cow down. However, the cow always managed to keep the roots of that windfall between herself and her suitor. Finally pressed too hard, the cow dashed up the hill and took refuge behind an old windfall heavily overgrown with briars and brush. This larger obstacle made it much less difficult for her to avoid the bull and afforded more leisure time to graze and browse. The bull's activity was in no way lightened and in fact his efforts had to be redoubled. Throughout the afternoon and until it was too dark to see, there was scarcely a minute when he was still and not once did he take a minute off to feed or rest. On returning the next morning the endurance contest was still in progress at the same spot going on unabated as it probably had throughout the night.

The cow appeared to be in fine fettle and grazed at every opportunity. The bull still rushed futilely from side to side or around the brush pile, but his rushes were less frequent and he definitely looked badly fatigued and winded. At times he appeared almost on the verge of giving up. This continued until about 11 o'clock when without any warning or noticeable change in attitude, after just neatly having dodged around the brush pile,
the cow stood still and the bull, no doubt much astonished, found himself on the same side of the barrier with the cow only a few feet in front of him. For a second he just stood there, and then quickly mouted the cow and copulated successfully. Two subsequent copulations took place, the second one four or five minutes after the first and the last one about 30 seconds after the second one. This last one apparently was the climax and was of such violence that the bull's hind feet were jerked not less than two feet from the ground and the cow driven to her knees with such force as to throw her head first into the tangle of limbs and vines of the windfall in front of her. For a minute or two the cow and bull just stood there, then separated, the bull going towards the herd, and the cow taking an opposite direction at a steady direct pace, walked away from the herd and the bull and disappeared over a ridge several hundred yards away. This behavior in itself was rather unusual, but its purpose, or where the cow went is not known. She undoubtedly returned again, for a day or so later the herd was counted and was present in its usual number. The bull completely exhausted, returned to the herd which had remained nearby throughout the night and morning, and made himself comfortable under a shrub for a well-earned rest.

Such "tag marathons" to a greater or lesser degree, repeat themselves as often as there are mature breeding cows in the herd. In this herd of 12 cows and calves, there were probably 5 or 6 such cows which would come into heat, and it is not likely that the non-receptive period of estrus was any shorter in the others than in the one observed, nor the behavior of the bull and cow any different.
Other observations in other herds bear this out. This means that almost a whole day if not more, is spent in a high state of physical and nervous activity and excitement, without food or water in the case of the bull. These periods taking place largely during the first half of the rutting season are enough to bring an animal to a state of physical exhaustion. Add to this the constant and extremely strenuous duties of keeping his herd together during the earlier days, and to lesser extent throughout the season, and it is no wonder that the once magnificently powerful bull is reduced to a gaunt, dragging and exhausted wreck, scarcely able to hold his proud head up under the weight of its heavy crown. At such times at the end of the rut every rib can be counted, the hip bones protrude and the belly is drawn and thin as though it had not contained food for weeks, which in truth it probably did not. The eyes are glassy with fatigue and the steps are dragging and slow. During these last days a bull will stand, his heavy head drooping lower and lower until it seems his muzzle will rest on the ground, -- yet let a young bull approach the cows too closely and that apparently dead spark suddenly flames to life, the drooping head comes up, a perfunctory, if perhaps weak, grumbling challenge issues from his throat, the feet which a few seconds ago dragged with weariness, suddenly find new life and with purposeful stride he advances toward the interloper. Close observation plainly shows that at such times it takes an almost painful effort for the bull to do this, yet if need be he can even manage a shambling trot to impress the callow youngster that he is still lord and master of his harem--none ever care to accept his
challenge.

With the beginning of October when the rut is finally over, everything is quiet and in the days following rest and more rest and food are the sole interest of the bull. He may remain with the herd until late winter, but sooner or later he will disappear to take up a more solitary existence where he can fully recuperate in some isolated and dense thicket. From this period on until fall, and particularly during the period of new antler growth these old bulls are about the shyest and most difficult of all animals to observe.

From this period on, old bulls may often be seen in bachelor groups or bachelor associations. They number from two to a dozen or more in number, and are most common from February to August. The groups are formed partly as the result of a mutual desire for company, and to some extent through a natural tendency of several bulls naturally drifting to certain favored habitats during this time. Especially favorable ravines, with plenty of food, water, and cover, high ridges, and the high alpine meadows of the higher mountains are favorite localities. There is no particular rule for locating such bachelor groups. Their existence depends on local conditions and factors. One must become acquainted with the range and its various peculiarities and the natural factors such as weather, food, insects, pests, etc. to be able to guess the probable whereabouts of a group of bulls, and even then the frequent deviation from the normal behavior makes this difficult at best.
Early definite records of the Roosevelt Elk and its abundance are scarce but wherever they occur the words "innumerable, abundance, large numbers," etc. are used in describing the numbers of animals that ranged the forests and valleys.

The earliest record that came to my attention is that found in the Journal of Alexander Ross, (19) "Adventures of the First Settlers of the Oregon or Columbia River." (1810 - 1813). Ross describing the country on a trip up the Willamette River to the Oregon City falls says, "between these high lands lie what is called the valley of the Willamette, the frequent haunts of innumerable herds of elk and deer." And thus we have a record, not only of the numbers but also of the fact that the elk were found generally in the Willamette Valley. It may be said that such a casual reference as Ross makes is of little value in determining former numbers. However, in reading Ross's journal one is instantly struck by the close and detailed observations that he makes and it is apparent that he is far above the average class of observer. He makes his statements from his own experience and I doubt not that if the numbers of elk appeared innumerable then one can accept that statement at face value and consider the herds ranging in the valley as being very numerous.

J. G. Cooper (4) in his report in 1857 says: "The elk is abundant in the dense forests of the Coast Range, and found in less numbers in the other wooded portions of the territory. It is very wary and difficult to kill at most times, but is often shot on
on the small prairies, near the heads of rivers, where it feeds in the evening and early morning. In severe winters, also, when they leave the mountains, and in large herds descend to the warmer prairies along the coast, they are tracked in the snow to their lairs, and shot. Many frequent these prairies every winter, returning in early spring to the mountains. In some places the Indians formerly surrounded the herds, and gradually narrowing their circle, succeeded in killing many. It is almost useless to hunt them in the forest, where the dense underbrush gives them every advantage over their persuer."

George Suckley (26) says, "Elk are found in the Rocky, Cascade, and Coast Ranges of mountains, they are perhaps, most abundant on the last mentioned chain throughout its whole course through Oregon and Washington territories. In the latter they are especially abundant in the headwaters of the branches of the Chehalis River, and also on the northern slope of the Coast (Olympic Mts.) Ranges, back of Fort Discovery, and Sekwim Bay. Near the last locality they are very abundant during the winter, being driven down by the snows on the mountains. They run in large droves, following well beaten trails, and at that season are an easy prey to the hunters. In January, 1837, two men in the vicinity of Sekwim Bay killed eleven fine elk in one day."

These statements bear out evidence of the former abundance of the elk in these territories. Suckley's statement that they were "perhaps more abundant" in the Coast Range than in either the Rocky or Cascade Mountains is extremely interesting since most early observers always ascribe the greatest numbers to the Rocky Mountain region.
More recent but nevertheless of equal interest, is the information given me personally by Arthur S. Linarsen, a former resident of Camano Island, Island County, Washington, and at present U. S. Fish and Wild Life Cooperative Director at Oregon State College. In 1914, a severe fire had burned a large logged off area adjoining a stand of superb virgin timber. Mr. Linarsen says he and four other boys, soon after the fire, were hunting along the edge of the burn and while on the burn close to the timber discovered numerous shed elk antlers. These antlers were to a large extent burned to ashes and many would crumple to dust at the touch of the hand, but notwithstanding this he collected not less than 50 pairs which still withstood handling, many of them almost intact. He says that he believes the reason these numerous shed antlers withstood decay and weathering as well as the ravages of the fire was due to the fact that they were covered by a deep layer of moss and forest litter accumulated under the once magnificent forest that had stood there. The 50 pairs of antlers were collected in an area not over a square mile in extent. None had any skull attachments and were definitely shed. This spot was also the highest point on the island, and this sheds some light on the concentration of antlers as elk and particularly the bulls when they leave the herds to go off by themselves or in bachelor groups favor the higher ridges and points and it is to be expected that their antlers would drop off in these areas. This not only is an indication of the numbers of animals that must have been present in early days, but also on the durability of the antlers. At that time none of the residents of
Camano Island could remember the presence of elk. He says he did find an old man who had married into an Indian tribe who told him that there had been lots of elk on the island.

The history of the Roosevelt Elk from the time of white man's establishment was merely a duplication and a repetition of that of the buffalo, the antelope, the elk of the eastern states and many lesser forms.

Meat hunting for early survey parties, railroad groups, and lumber and mining camps can be justified as a necessity to supply food which otherwise could not be had. This, however, was followed by hide hunting and professional market hunting; those who hunted game for sale long after there was no need for it. Chiefly such game went to the larger cities. Perhaps the worst and most wasteful slaughter of the elk was that by the tusk hunters who took nothing but the big canine tusks of the large bulls and left the carcasses to rot. Not even the hides were used. These tusks or teeth were in demand as ornamental watch chain emblems by many people. Though less dramatic and not so well known, because of the nature and habits of the elk, this slaughter was none the less shameful and wasteful as that of the buffalo and other forms brought to the verge of extinction. So great was this drain that in the short period of about 30 years, largely the '70 - '80 - '90's, the elk of Washington, Oregon and California were reduced to a bare handful of their former number. California suffered the most, probably due to its earlier and heavier settlement; and the shiftless men attracted by the easy money to be made in the gold camps who later turned to hide and tusk hunting.
The Olympics and the more remote deep forests of the Oregon Coast Range country were the last strongholds of these elk and I doubt not that it is only due to the remoteness of these areas and the difficulties of reaching the areas in the early 1900's that these elk survived.

Early in 1900 Oregon established laws limiting the killing of elk, but 1907 saw the last open elk season in Oregon.

From 1908 until 1938 the Roosevelt Elk remained on the protected list. The increase in numbers is difficult to estimate in the early years of their protection. Information from forest service records and private reports is vague and often conflicting.

Bailey (3) gives the first really definite figure for 1926 on the Roosevelt Elk. In this year the official game census lists some 395 Roosevelt Elk. This is in his chart given in the text on Rocky Mountain Elk. Under the Roosevelt Elk he complicates the census figure by bringing in figures for the Rocky Mountain form. He says, "On that forest the number reported for 1926 on the Crater was 16, the Siskiyou 25, the Santiam 80, Mt. Hood 130, and the Cascade 225 elk. This total of 436 elk on the national forests of Oregon probably covers the greater part of the Roosevelt Elk in the state in 1926. In 1929 (presumably he is still speaking of the Roosevelt Elk) the forest service reported on the Cascade 245, Crater 70, Deschutes 60, Mt. Hood 129, Santiam 30, Siuslaw 270, a total of 843 elk for western Oregon. Most of these, however, were introduced Rocky Mountain Elk."

Although he says "western Oregon", these forests also contain the eastern limits of the Roosevelt Elk range, and since no specific
areas are mentioned it is hard to tell whether or not he is speaking of the Roosevelt Elk. For 1926 he says of the figure for these forests that they compose the Roosevelt Elk population, but for 1929 mentioning the same forests he says "most of these are, however, introduced Rocky Mountain elk."

Bulletin No. 2 issued by the Oregon Game Commission lists by counties the elk population in 1937. The total number of elk for counties within the range of the Roosevelt Elk is given as 2075 animals. Coos county heads the list with 700 and Clatsop with 500, Douglas with 200, Curry 100, Lane 400, Lincoln 100, Linn 25, Tillamook 100.

In 1933 the first elk season was declared, but due to protests from the public, Clatsop County was stricken from the area opened to hunting. In 1938 it was estimated that the number of elk in Clatsop County had increased to 3000 and a season was declared.

The seven day 1938 elk season in Clatsop County was perhaps the most strictly regulated and best managed hunting season in the history of the state up to that time. The Forest Service and Game Departments cooperated superbly and handled the whole matter to the satisfaction of most of the crowd of 1243 hunters. The management and handling of this season and area was largely as a result of experience in the first season in eastern Oregon in 1933.

Checking stations were established at strategic spots leading into the hunting area and all hunters were required to check in at some station. It was required that a hunter must show adequate equipment to be able to properly take care of an elk and that he was equipped with a rifle of minimum specifications, and while in
the latter case these minimum specifications are too low, it shows a trend in the right direction.

Since September first is often still a dry month and presents a considerable fire hazard, no hunter was permitted to drive into the hunting area off the highway. A man was permitted to pack in but was not allowed to build a fire; he had to "cold camp" a consideration quite necessary under the conditions prevailing. The Forest Service helped out with trucks and pick-up cars on the forest roads and hauled hunters into the forest and let them off at any desired spot and also picked up the elk carcasses after they were brought out to the roads. This delivery service was run on a two hour schedule and worked well to the satisfaction of everyone.

The fact that the rangers and wardens had a close check on everyone and knew just about where the man would do his hunting, gave them a good measure of control over the men even though few police officers were in the field. The fact that violations of any kind were practically nonexistent and no accidents from wild and careless shooting took place, and the fact that subsequent seasons have been merely a repetition of the first in striking evidence of my contention relating to control of violations. These conditions are in striking contrast to the first elk season in eastern Oregon in 1933. Authentic reports of indiscriminate shooting and wasted animals were common and it was directly because of this that public sentiment was aroused to the point that the laws and regulations were revised to those in effect at the present time.

Checking stations where hunters are required to check through on entering and leaving an area are highly desirable; they help
keep track of persons in an area and thereby help fix the blame for violations if such came to pass. In the controlled elk areas they are notably absent, whereas in deer hunting where no such checking is required, shooting first and looking for antlers afterwards is not at all uncommon. Stock killing is another atrocity that takes place every year. Only this fall a reliable observer hunting on a well known stock ranch in eastern Oregon personally found the carcasses of several shot calves in the vicinity of a camp just vacated by hunters. In this case the shooting was deliberate hoodlumism, as part of the calves had been used for meat. Whether deliberate or accidental, such behavior is unexcusable. The final and crowning evidence for needed control that is lacking is Oregon's annually high bag of hunters shot "in mistake for a deer." Deer hunting is poorly controlled and the number of hunters killed always ranks this state high among those striving for top honors for this dubious recognition. Controlled checking with at least some field patrol would do much to remedy this condition.

One of the worst thorns in the side of the Game Department is that of complaint of damage to private property by game. Not infrequently the farmer or landowner takes it into his own hands to correct the conditions and kills game illegally, all too frequently this claim of self-protection of property is but an excuse for illegal killing of game.

It results in many useless and fruitless trials to convict and punish such offenders, for jury sympathy is almost always with the culprit, not as a result of fact but merely as a result of a
natural sympathy.

In many cases there is actual damage. In the case of the Roosevelt Elk the nature of its habitat is such that there are few places where it comes into conflict with agriculture. When there is damage, it should be paid for by those most immediately benefiting by the presence of the elk, namely the hunters and sportsmen.

At present the Game Department has neither legal nor moral ground under which they can prosecute a man claiming to have shot an elk, deer, etc. in protecting his crop whether his claims are false or not.

To stop such killing fairly and effectively, a damage fund or damage insurance fund should be set up and maintained by every game department. The fund should be derived from the general license fund.

1. Such a fund should be controlled entirely by the game department and not outside departments.

2. Inspection of damage should be done by some authority on farm crops such as the county agent and a representative of the game department.

3. Payments should be in accordance with current prices or prices prevailing at such time as when the farmer would have sold the crop; and should be made promptly on determining the damage value.

4. A flat filing or inspection fee should be charged in the event inspection authorities disallow the damage claim. This would discourage false or exaggerated claims by unscrupulous people.

5. The State Legislature should have nothing to do
with the determining or payment of damage. It is no position
to determine this cost or pass judgment on such damage.

It must be constantly kept in mind that game must sooner or
later in any area be maintained on the basis of its value to the
people who benefit from it. In most cases this is the sportsman
who pays the hunting fee.

Where game is out of control and is in such conflict with
agriculture that it is simply a liability, it will have to be
removed. Such conditions are as much poor management as is the
overstocking of a ranch to the point where the stock is starving
for lack of sufficient range.

In this way the game department would have both legal
and moral support and the latter is, I believe, the more pertinently
necessary to guarantee adequate control and maintain the necessary
feeling of goodwill and cooperation needed in the efficient manage-
ment and control of any natural resource.
The Roosevelt Elk as a Game Animal

Hunted fairly and in a sportsmanlike manner the Roosevelt Elk has few equals in the range of big game on this continent. To depend entirely on one's ability to pass unseen, unheard and unscented through the forest and thus approach a herd of elk or a bull is, when the animals are not being driven about by other hunters, one of the most difficult achievements. The task is worthy of a skilled hunter's best efforts. The sight, hearing and sense of smell in these animals is second to none. The sense of sight of the deer family in general is highly underrated through a common observational fallacy. Most deer depend largely on their ears and nose to warn them of danger and because of the limited visibility in the woods they depend less on their eyes. Perhaps an even greater reason for not depending on or using their eyes is the fact that their keen ears or nose warns them long before they see the danger that is approaching. Thus through habit these animals come to associate danger or an enemy with certain smells or sounds, and few animals who live to a ripe age and come to be the wariest, ever really learn to associate the appearance of an enemy with its smell or the sounds it makes. Consequently, when that enemy is seen and no sound or smell is attendant, such an otherwise wise and wary deer or elk may stand in dumb wonderment and give the hunter an easy shot. The result of such an experience is to credit that animal with very poor eye sight for, why, if its sight had been good did it not flee? That probable reason for this behavior has already been stated. There can be no other reason for I have
observed the keeness of sight on various occasions not only of
elk but the various smaller deer and the moose. The latter is
in most quarters of its range notorious for its supposedly poor
eyesight. While studying the European moose (Alces alces L.) in
East Prussia, I had the error of this contention impressed on me.
The area where the moose were found was close to a small resort
village and was traversed by many forest roads which were much
used by hikers. Under these conditions the moose could not de-
pend on scent, for the scent of man must have been ever present.
That this was the case was proven to my complete satisfaction
after stalking both bulls and cows with the wind blowing directly
from me to the animal without alarming them in the slightest. In
one case, two resting bulls were stalked to within 40 yards under
such conditions and in another case a cow was approached to within
a dozen yards. In each case the animals became aware of my presence
through the accidental breaking of a twig and fled at a full run,
in the case of the cow, without even a verifying look. I have
tested the hearing and sight of bulls on several occasions and in
every case these senses were equal to the best I have observed in
any wild animal. At a distance of 200 yards in a fairly dense
stand of Norway pine, I have had a bull moose jerk his head around
and gaze fixedly at the tree from behind which I had momentarily
waved my hand, exposed no further than to my wrist. After a few
minutes when nothing appeared he resumed his browsing. This was
repeated until, though he could not see me, he finally became
suspicious and left. In another case during a strong wind storm
when twigs and small limbs were breaking and falling frequently, I
tested the hearing of a bull at a distance of 200 to 300 yards by snapping a pencil thick twig. The result was the same as in the eye test except that after the second twig was broken he made off in a swinging trot. The same observations were made in the case of the red deer, fallow deer, and roe. All these animals were wild, in fact much wilder than animals in primitive areas where they have only infrequent contact with men. The ability to recognize detail has already been noted in the case of the Lcola Park herd. This marked dependency of eyesight was here probably developed for the same reason as in the case of the European deer and moose mentioned. In this case also the animals paid no attention to scent when approached with the wind, but showed alarm at the slightest sound or sight of approach, even in my case until I showed myself fully and was recognized. In another instance three cows of another herd were observed feeding in a deep ravine on the open headlands overlooking the ocean. A stalk was made, approaching them from above and in such a way that the wind which was drawing up the ravine from the beach could not carry my scent to them. On a well-worn path which I was using I approached to within 65 - 70 yards and since the surf was so deafening I made no special effort to step quietly. It was so noisy in this ravine that I could not hear even my own steps, yet when about 55 to 60 yards from the animals one of the cows threw up her head and looked in my direction. After a minute of looking she finally quieted her suspicions and looked away whereupon I took several more steps as before; instantly the cow's head turned toward me with a bark of alarm, and a second later she and her companions
had fled up the ravine and into the timber. Sight here did not enter the picture as I was well screened by a high wall of salmon-berry. Since the wind was constantly and strongly blowing in my favor the only cause for the alarm could be the hearing of my normal footfall above the roar of the surf. This at that distance and under the conditions was a truly remarkable demonstration of keen and discriminating hearing. Other demonstrations of keen eye sight of elk has convinced me that these animals have eyes quite the equal of any other animal not excepting the highly reputed pronghorn antelope. This animal has acquired its reputation for keen eyes through the conditions of vast unobstructed views prevailing in their habitat. It is natural that under these conditions an animal should come to depend on its eyes first and its nose and ears secondly. The same is true of the wild horse and others. Where conditions for seeing have been similarly favorable the elk show a keenness of sight just as great as that of plains animals.

Orr (16) says, "It is my impression that Roosevelt Elk fail to show the same distrust of man as normally is exhibited by deer. Individuals that were encountered while feeding or resting did not bound away but usually walked off sedately or trotted until they came to a rise, from which vantage point they could view their pursuer. A number of the elk that were encountered were reluctant to move far when disturbed during the middle of the day, especially in thickets of spruce surrounded by ample cover of brush, the aroused animals often arose and moved around the thickets so as to keep from sight, instead of attempting to run off."
This is true of elk which have been protected for many years and especially in areas where human intruders are frequently met with.

It has been my experience as observer in two areas opened to hunting after more than 30 years of closed season, that the Roosevelt Elk is extremely versatile in adjusting himself to the prevailing conditions.

There was much unfavorable comment on the opening of the 1938 season. It was the prevailing opinion of many of the residents in the elk country that the elk would be slaughtered like farm cattle because they were so tame. Stories of men with dogs (?) sent out to scatter and drive the herds farther into the forests, etc. were common at filling stations and wayside inns.

The first herd observed, and my first sight of Roosevelt Elk, was the herd of 17 described in connection with sex behavior of a yearling spike bull and two mature bulls and a disinterested 3 year old bull. These animals were observed as described, at a distance of not less than 350 yards. Wind and cover was entirely in favor of my party which consisted of three hunters and a guide besides myself. After the action described had taken place, we remained in our concealed position and watched the herd for some time. The other three in their discussion of the next day's plans to bag one of the bulls grew careless and raised their voices to a moderately low conversational tone which was sufficient to alarm the herd. This in view of the fact that a logging crew was working within plain hearing distance in the bottom of the canyon and the men's voices could be heard shouting back and forth. The herd after
shifting nervousness around for a few minutes withdrew at a slow trot towards a clump of timber, away from us. The alarm was definitely caused by our voices as every animal except the calves and two old bulls looked fixedly in our direction at the first alarm. This herd maintained its range within a fourth mile of a logging community. Possibly this may have been the reason for their suspicious nature.

The next day, the opening day of the season, I was in a large basin, virtually in the center of the elk hunting area, and had an excellent opportunity to hear the terrific barrage as the shooting got under way. From about 8 o'clock until 11 o'clock the bombardment was almost continuous. Had an elk been accounted for by every shot it is doubtful if a single animal would have remained alive in that entire basin which was a good five miles across. In the afternoon the shots were scattered and very sporadic. From my own observation of a herd under fire, and reports of other hunters, it was apparent that the elk were at first bewildered at the first shots and did not always act promptly to save themselves. This may have been as much due to the fact that in hilly country it is often very difficult to orient the direction from which a shot has been fired due to the echoes. In my own case this was definitely the case, and the bulls stood around looking this way and that to see where the shot had come from. Notable was the fact that on the second day, though just as many hunters were entering the area, as was proven by the check at the gate on the road leading into the basin, there were, however, only a scattered half dozen shots fired in this area. The
third day not a single shot was fired within hearing in this basin. All my observation in this case was made from very nearly the same locality so that a fair comparison was had, nor was this due to the elk having left the basin. In the area where I hunted, the herds sighted the first day were still present the third morning and the fresh tracks could be seen on the trails every morning, but the animals themselves were extremely hard to sight. The records of the game department also showed that of the 294 bulls killed the entire season, most of them had been killed the first three days, and of these the greatest number had been taken the first day. 1243 hunters killed 294 bulls, or a success ratio of a little over 23%. Compare this with the antelope season of 1938 also opened for the first time after a long season of closure. 295 hunters bagged 175 antelope or about 59%. In 1939 despite the report by the game department that weather was bad and roads bad so that hunters could not get into the main antelope areas, 292 hunters bagged 214 antelope, showing a success ratio of 73%. During the 1939 elk season, 1587 hunters tried their luck, but bagged only 227 elk showing a success ratio of only a little over 14%. In 1940, 1343 hunters went out and ran up a success ratio of 14.1%. In Douglas and Coos Counties only 184 bulls were bagged, showing, according to the Game Department figures, a success ratio of only 18.8%. Compare these figures with those of the 1939 antlerless deer season in Grant County. Does as well as bucks were permitted to be taken and this undoubtedly added to the bag, but on the other hand this area had been hunted for years prior to this season and deer should have been wild regardless of sex. 15,646
hunters bagged a total of 10,881 deer with a success ratio of over 65%. Though these figures on the deer are not quite fair as the season was much longer, it, nevertheless, shows that even starting from scratch an elk is well able to take care of himself in any company.

Home range attachment is a characteristic which is a handicap to the elk during the hunting season, and were it not for this I am certain that the figures would have been even lower and in favor of the elk instead of those given. For example, during the 1941 season in Douglas and Coos Counties, I had spent two weeks just prior to the opening of the season in one of the best areas on a picture-taking expedition, and for the purpose of studying the rutting activities. This area is very heavily timbered and the burns and loggings are old and heavily overgrown with brush and ferns. It is one of the most difficult parts of the coast range in which to observe animals. With three keen senses against my single and comparatively, poor single sense of location, I found it difficult to find elk and approach them closely enough to observe them with any degree of accuracy. Though I had spent almost a whole week before this main trip in this and adjoining areas in scouting it out, I was able to see only 13 animals in the last two weeks. This was partly due to working mostly in one home range and most of the animals except for 6 bachelor bulls were all of this one range. However, the difficulty was also to a large extent due to the disadvantages already stated. During these two weeks I found signs of many different herds in the adjoining ranges and repeatedly started them from their bedding.
grounds without seeing them. On many of these occasions, it was irrefutably impressed on me to what lengths these elk would go to stay within their home range and particularly on their known trails. A herd started near the end limit of their range would instead of taking an easy and direct route of escape by simply crossing an easily negotiable low ridge would circle around me and head back into their territory. I have had single animals do this in order to get to a path by which I had made my stalk only a few minutes before me. The same observations were made on many occasions before and after this time both on this and other areas.

The disadvantage to the elk here lies in the fact that the hunting seasons are crowded into a short week and all the hunters therefore are concentrated into the same areas. Most of the hunting is done in the areas which are the most accessible with the result that these areas are even more crowded than they would otherwise be. Thus with hunters scattered clear across the elk's home range and working from the roads into the forests, it would be to the animal's advantage to retreat into the remoter parts, the roads to which are almost always open because of this tendency to work from the roads inward. Instead of this the herds persist in sticking to their home ground and are driven from one part of their range to another, and no sooner have they eluded one hunter than they run into another with the result that sooner or later someone gets a bull out of the herd. A great many of the bulls are killed thus, by coming to the hunter rather than the hunter going to the bull. I am convinced that were hunters forced to hunt these elk strictly on the merits of their own skill, without
the inadvertent chance of having a dozen other hunters drive a
herd to them, that the success ratio in an area like that Douglas
County area just described, would be below 5%. The forest rangers
and fire wardens in that area as well as the residents who were
all familiar with that country and the elk, were in complete sup-
port of my observations on the difficulty that a single man would
have in hunting elk successfully there. Under the conditions pre-
valing during the season, chance plays a larger role than does
hunting skill, and this is even more apparent when one considers
that of the many hunters the biggest portion of them were strangers
in the area and were entirely unfamiliar with the location of the
herds except insofar as they may have been directed by forest or
game officials or a kindly resident.

There is another feature in the hunting of these elk which
tries the sporting qualities of the hunter to the utmost. This is
the extremely rough terrain with its jungles of trees and impene-
trable underbrush, logs, ravines etc. Good areas and burns are
often even worse, especially the old ones where the tangle of
fallen logs and limbs have not yet decayed but have been covered
by masses of salmonberry, thimbleberry and bracken ferns and other
brush. Actually to find and kill an elk is really the easiest part
of the task. By comparison transporting the carcass out to the
road and car is a herculean task that has discouraged more then
one aspiring elk hunter. Few, especially those not used
to the coast range country ever give a thought to this part
of the work. The game department requires that all parts except the
viscera of an elk must be checked and tagged as a provision against
wasteful killing by those interested only in a set of antlers. On several occasions I have pointed out this minor detail in the elk hunt to obviously uninitiated parties and have had the satisfaction of seeing them peck up and leave. I have shown a large bull who had his stand in a small elder draw at the bottom of a fairly deep canyon head to an enterprising hunter. This bull had maintained his stand there for over a week and was a solitary old fellow and due to the exit out of this ravine would have been a fairly easy stalk. The man was cheerfully willing to leave his rifle at home and go out with me unarmed and watch that bull through my glasses. By his own fervent statement that bull "was safe until judgment day". The sides and head of this canyon had at one time been covered by second growth hemlock which had been lightly burned and then flattened by a heavy windstorm so that the weathered poles of trees ranging from 2 to 6 and 8 inches were scattered like jackstraws all over the canyon sides surrounding the bull's ravine. This bull was subsequently killed by a party, and it took 8 men all morning to carry the parts of the carcass a distance of not over 600 yards to the top of the canyon to the road.

Though a bull elk has the physique and the weapons to be potentially dangerous as an opponent, he definitely cannot be classed as dangerous game. A wounded bull cornered and approached rashly would without question charge a man, and unless killed instantly would certainly attempt and probably succeed in killing a man.

I have had related to me many harrowing and close escapes from charging bulls which had been fired upon by the hunter. These tales
Bull No. 1, a very old bull who has passed his prime, and whose antlers showed the typical spindly beams and retarded terminal tines characteristic of such bulls. The bull was fat and in excellent physical condition.
in all cases were clearly the result of misinterpretation of behavior, embellished with a greater or lesser amount of imagination and developed and grown with time until the narrator himself was firmly convinced of all the details. In every case, from the statements of the hunter himself, the animal was unaware of the presence or whereabouts of the hunter and was in fact unaware of any danger until the first shot was fired. At the shot the bull would "whirl around, leap into the air, etc." and come charging down on the hunter who would fire shot after shot until the "enraged" bull was finally dropped "at the very feet of the hunter".

It is obvious that not knowing from where the shot came and numb from the shock of the bullet the bull simply charged away in the direction he happened to be pointed when he recovered sufficiently to try to flee. That that direction was towards the hunter was purely accidental. At best it is difficult to locate shots in timber and hill country and an animal half dead and thoroughly scared, running purely on its reflexes and remaining energy will continue in whatever direction it is headed, governed only by its instinct to run until its strength gives out. The result -- a ferocious enraged bull charges the hunter with vengeance in his eye -- and is stopped only in the nick of time by the cool hero.

As a trophy the head of a Roosevelt Elk need not take second place to any form. The relatively short and consequently heavy beams have a massiveness about them that lends a distinctiveness found in no other similar head. Comparatively the Roosevelt Elk heads have a narrower spread and maximum spreads will fall considerably short of those of the Rocky Mountain form. The largest
Figure 61

Bull No. 2, killed by poachers in Coos County. These antlers were first found in 1935 and left in the woods until they were again found in 1941. Other than some gnawing by rodents at the tips of the tines no appreciable deterioration or weathering took place. These are good prime antlers of a mature bull.
record that I can find so far as spread is that given by Webster (28). The bull which he mentions as having been killed in a fight with another bull had a spread of 52 inches and he says that he was told of another one which measured 54 inches. The 52 inch spread had a beam length of 47 inches. Webster says that a Mr. Shear, a fur dealer of Tacoma had for years a standing offer of $500 for a head with a spread of 60 inches or over and that as far as he knows it was never collected.

Other than these I have found no recorded figures of measurements in the literature, though antlers were discussed and pictured in some of this literature. It is too bad that the investigators did not give the measurements. The best set of antlers which have come to my attention is a pair owned by Amil Lemke, of Seaside, Oregon. Mr. Lemke kindly permitted me to photograph and measure these antlers. He tells me that they were taken from a bull killed over 40 years ago in that vicinity. This head is listed as No. 5. The measurements of four other typical antlers are also given. The numbers correspond to those discussed in the text under characteristics of the elk. They may be considered as typical of prime adult bulls.

No. 1 Weight -- 16 lbs.
Length--left beam 39\(\frac{1}{2}\) in. -- right beam 39 in.
Number of points -- left 6; right 6
Circumference just above burr - left 9 3/4 in.; right 9 3/4
Spread -- 38 in.

No. 2 Weight -- 22 lbs.
Length -- left beam 46\(\frac{1}{2}\) in. -- right beam 43\(\frac{1}{2}\) in.
Number of points -- left 6; right 7
Circumference just above burr - left 10\(\frac{1}{2}\) in; right 10\(\frac{1}{2}\) in.
Spread -- 41 in.
Bull No. 3, killed illegally just prior to the opening of the 1941 hunting season while being observed in rutting behavior. This bull was also past prime age and the antlers are underweight for their dimensions, though they are still a superb trophy. These antlers were taken in older habitat and were a beautiful reddish brown while No. 2 taken in coniferous timber were a deep dark chocolate color.
No. 3 Weight -- 20 lbs.
Length -- L. beam 45 1/2 in. -- R. beam 45 3/4 in.
Number of points -- L. 7; R. 7
Circumference just above burr -- L. 10 5/8 in; R. 10 3/4
Spread -- 44 2/3 in.

No. 4 Length -- L. beam 41 1/2 in. -- R. beam 41 1/2 in.
Number of points -- L. 8; R. 7
Spread 51 in.

No. 5 Weight with cranial skull (today) 48 lbs.
Length, left beam outside measure from pedestal to tip 50"
Length, right " " " " " " " 49"
Number of points -- L. 6; R. 7
Circumference just above burr, L. 12 1/8; R. 11 5/8 in.
Spread -- 47 in.

One of the worst examples of sportsmanship, thoughtlessness, and wastefulness is the use of a rifle of inadequate power in the hunting of Roosevelt Elk. A bull elk is tremendously massive in body and bone and his vitality is astounding.

In contrast to the days of the past when a hunter depended on his skill with a rifle for his food, today's hunter is inexperienced in every way in at least 75% of the cases. He is not familiar with the animal's habitat, habits and range. Neither is he skilled in the use of a rifle, particularly in actual use against big game. Most hunters use their big rifles only during the hunting season and then perhaps only for a week or two. They rarely fire more than a couple of dozen shots per season. Such a man cannot hope to become a cool shot who can judge his range instantly and correctly, hold his fire until the right moment and then place his shot in a vital area. To stop an elk in his tracks with a sub-standard rifle he must hit the brain or neck vertebra. To stop one with a body shot, a heart shot is almost imperative. And to hit such small areas by choice requires withholding fire until one is within a range which insures the hitting
Figure 63

Bull No. 4, antlers had been nailed to a garage for many years along the highway in the Coast Range. No data on the bull was available. Notice the curious swellings on each beam above the third tine.
of these areas without the chance of missing the vital spot and having the animal run off to die a lingering death, a total loss to all. A lung shot or a shot in any other part of the anatomy other than the heart will rarely stop a bull, and he will travel for a fourth mile to two or three miles before he succumbs. This is not infrequently the result of using sub-standard rifles by poorly experienced hunters. Into this class of rifles belong all the old standbys of the deer hunter. The 30/30, .32 Sp., 250/3000, and others of like class. I have seen and examined a bull which had 14 bullets from a standard 30/30 Winchester, scattered throughout his anatomy. This is a striking example of the vitality of these elk. At least two of the bullets had struck in the neck and head region and the same bullets from, say a 30/06 or .270 class of rifle would have dropped that bull in his tracks. In this case the bullet had just barely missed the brain case, and the other one the neck vertebra. A close miss of such vital areas with a heavy rifle is sufficient to drop an animal from the concussion alone. The sub-standard rifle simply does not have this shocking power. Several of the other bullets in the chest area would have likewise dropped the bull had they been fired from a more powerful rifle. As it was, at least ten of the shots were needless and served only to spoil much good meat.

Someone will immediately say that this was due to poor shooting at excessive range. True. But how is one to teach a man that skill not only in shooting, but also of accurate effective range judgment and most important of all the self-control, which are acquired only by experience and which few hunters can get today.
Bull No. 5, antlers owned by Amil Lemke of Seaside, Oregon. This is a superb set well above the average, and in measurement, symmetry, and weight are of record proportions.
Nor can you under present laws keep such a man out of the forest. I have observed this type of hunter every season for the past 14 years. Yet consider this same man would have shot no less accurately for to do so would have meant missing the target entirely with a more powerful rifle and the same hits in head or neck region would have dropped the bull, likewise one or more of the body shots. As it was it was pure fool's luck that this hunter did not lose a fine trophy and some 700 lbs. of meat which would have been wasted. Another typical example of a sub-standard rifle in the hands of an inexperienced, though more skilled man, was that of the bull shot six times with a 250-3000 Savage. Again fool's luck, and not his skill with his rifle prevented this bull from being lost and wasted. This bull confused and stunned by the first bullet fired from a range of about 200 yards, ran directly towards the hunters standing in a prominent elk trail, and was hit four times more in the chest region before he dropped literally at the hunters' feet. It is true that many of the frontal shots were marginal and did not strike a vital area, but the first shot in the chest and at least one of the subsequent ones from the front should have dropped that bull within 50 yards had a more powerful rifle been used. As it was, a head shot at close range was necessary to stop the bull. Had that bull turned the other way when he started to run he would have been out of sight before another shot could have been fired and probably have been lost. The 737 lb. bull already described in another part of this work was found to have a 30/30 bullet lodged against the side of one of his lumbar vertebra. From the position of the bullet,
it appeared that it had entered the body diagonally from the rear just in front of the hip, possibly in the rump itself and had plowed through the heavy flesh of the rump and the lumbar muscles and spent itself against the heavy bone without doing any apparent damage. Fortunately the animal had recovered completely, but all too often such a wound becomes infected and eventually, whether directly or indirectly, results in the death of the animal. Again a proper rifle would have brought the animal down with a broken back on the spot.

It has been frequently said of the 30/30 caliber that more game has been killed with this cartridge than with any other cartridge in use. That is probably quite true. The same can also be said of the bow and arrow, for certainly this weapon was used for thousands of years before even a rifle was invented. It may also be said of the 30/30 cartridge that it has wounded and crippled more game than almost any other cartridge. The fact that it has had such wide and universal use is that it was the first modern smokeless powder cartridge developed and because of its superiority over old black powder cartridges came into wide use. This does not mean we must continue to use it in the face of superior cartridges. The question today is not, will the gun kill the animal, but how quickly will it kill it. Almost any bullet fired into an animal will eventually cause its death. An animal that may run a quarter of a mile or more after being hit can easily be lost in the heavy cover where tracking conditions are poor at best.
Into the category of sub-standard rifles for elk, should go all rifles having a **muzzle energy value** of the 30/30, 32 sp. or 250/3000 class or less than these.

It is to be emphasized that a uniform value of comparison like the muzzle energy in ft. lbs. should be used in comparing the power of rifle, bullet diameter, bullet weight or the velocity of the bullet alone does not give a comparison of relative power. Energy depends on a combination of bullet weight and velocity. The caliber of the bullet has nothing whatever to do with this in modern ballistics. Nevertheless, this is still a common fallacy supported by many people. In days of muzzle leading rifles loaded with black powder where maximum velocities were approximately the same regardless of the size of the ball, naturally the bigger and heavier the ball the more powerful was the rifle. Today with extreme velocities ranging close to 5000 ft. sec. a bullet of comparatively insignificant weight is more effective in stopping a large animal with one shot than were the old black powder rifles hurling a bullet which weighed several ounces. Most efficient among these modern rifles today are the class known as 25 cal. magnums shooting light bullets around 4000 ft. sec. Practical experiments and field experience by men having the opportunity to test these calibers shows that a minimum bullet weight 90 to 100 gr. should be used in connection with such loads. Thus, it can be stated that in cartridges using bullets weighing 100 gr. or over the ft. lbs. of energy delivered by that bullet can be used as a standard for comparing the desirability of that load on big game which from experience included all game from deer.
(small deer) on up. The reason for limiting the weight of bullet to a minimum standard is that if the velocity is sufficiently high even a bullet of 60 gr. or even less can develop mechanically measurable ft. lbs. of energy comparable to that of rifles proven effective on big game. But that in the case of the extreme light bullet of say 50 to 75 gr. there is not sufficient weight present in the bullet to hold it together on impact with the result that it disintegrates on impact and will not penetrate through the heavy muscle layers of an animal as large as a deer and is apt to result in only crippling the animal. As stated this has been tried and proven by many rifle experimenters and hunters within the past five years.

From practical experience by widely experienced big game hunters shows that for elk a rifle developing a minimum of 2000 ft. lbs. of energy at the muzzle is necessary for reasonable and humane shooting. Thus if we adopt this as the minimum standard and specify that within that no bullet regardless of other specifications should have a minimum weight of 90 gr. we will place no limitation on type of rifle one may choose but will eliminate inefficient guns, as they should be eliminated.

It should be the earnest desire for every man who desires to class himself as a sportsman to do his killing as quickly, efficiently and humanely as possible. His rifle is the means to this end and it is up to him to see that he has the proper and most efficient tools available. There are no excuses in this field.
Conclusion

Unlike the Rocky Mountain elk, which in many parts of its range comes in direct conflict with agriculture in one form or another, the range and habitat of the Roosevelt Elk is such that there is little opportunity for it to encroach upon, and conflict with agricultural interests. In many parts of Oregon, Washington, and other states the range of the Rocky Mountain elk closely adjoins or is on stock range or other agricultural lands, and particularly during winter time when they come down from the high summer range, the elk become troublesome and often a nuisance, doing much damage to the hay supply of ranchers and stockmen. These conflicts and the problem of winter range are not present throughout the range of the Roosevelt Elk, except under certain conditions in the Olympics.

Much of the former range of the Roosevelt Elk is now unpopulated by these elk, and there is ample room for expanding and increasing the present herds, particularly in southwestern Washington, Oregon, and northwestern California. Oregon has perhaps the most extensive range of these states. The western slope of the Oregon Cascades alone could easily support an elk population equal to that of the entire present eastern Oregon population. This means about 10,000 elk, and there would be little or no conflict with agriculture or ranching that could not be controlled or rectified.

The accompanying map shows the distribution of cattle and sheep, the only interests which might conflict with the elk. It
This little bird’s-eye view is the first accurate picture ever made of the state’s major land uses. It is a reduction and generalization of a large-scale map of the state (30 x 36 inches) made by the authors, showing land use and types of farming in much greater detail.
Figure 65

Map showing distribution of agricultural lands. The heavy black line running north and south just east of the Willamette Valley (large black area) indicates the summit of the Cascades and west of this, particularly in the northern half, there is very little grazing land in the mountains themselves. Taken from Scudder and Hurd. (22)
can be clearly seen that the cattle and sheep of western Oregon are confined to the river valleys, whereas in eastern Oregon they are uniformly distributed over the more uniform grazing lands. Grazing land in western Oregon is confined to the Willamette Valley and small Coast Range river valleys. These comprise only a minor part of the Coast Range area and are almost absent in the rugged Cascades which break off abruptly into the Willamette Valley.

There is a good reason why the western Cascades and the Coast Range will never be grazing land. This area is a natural timber growing region, and it will become even more important as such in the future as timber is depleted from other areas. Due to the humid climate, deforested areas rapidly become covered by a jungle of brush and ferns which crowd out grasses. Only by immediately sowing grasses after a "clean" logging or a fire can a grazing range of sorts be established, and even this sooner or later reverts back to brush. An unsowed logged area becomes useless as pasture in 5 to 10 years.

With the increased value of these timber lands, the future will see a complete disappearing of present wasteful and stupid logging operations, and selective logging will be used entirely. This will eliminate even the temporary sown range land, for selective logging leaves too much timber standing but opens up the forest floor to the light, which brings in the jungle-like growth of lesser shrubs and trees and ferns, all excellent browse for elk but entirely unsuited for cattle and sheep.

Ecola State Park, which comprises but 480 acres of typical
Beef cattle production is a range grazing enterprise in Oregon. General location of the range is indicated by the cattle distribution. Central Oregon and the Blue Mountain regions are the heaviest producers. See maps, pages 35 and 36.

In Western Oregon farm sheep, in Eastern Oregon range sheep, a total of more than 2 million produce 8 per cent of the gross agricultural income of the state. One of the most profitable livestock enterprises on farm and range. See maps, pages 35 and 37.
Figure 66

Showing distribution of livestock which is the chief user of forest grazing land. Note how this distribution corresponds to the description and statements in the text. There has been little change in this respect in western Oregon since these maps were made. Taken from Scudder and Hurd (22).
Coast Range land, was the home of a normal and typical herd of 13 to 18 elk which ranged entirely within the Park boundaries, though they were in no way confined or fed artificially. At most, 480 acres was the extent of their territory, actually that used was much less. Separated by a ridge was an adjoining range inhabited by a like number of animals which used little if any more territory. The animals, except for several very old cows, were fat and healthy throughout the year. These areas are typical of Coast and Cascade Ranges.

That part of western Oregon and Washington lying west of the Cascade summit has an area of slightly more than 50,000 sq. miles, and of this 43,000 sq. miles are timber land. Of this Oregon has 23,000 sq. miles and Washington has 20,000 sq. miles. Very little of this can be converted into agricultural land suitable for cultivation, that which will be cleared for such purposes will be along the river bottoms, and amounts to less than 1% of the total mentioned.

Andrews and Cowlin (2) in the report from which the above figures are taken state. "On the logged-off land and burns, where there is more of the succulent herbage, the rough topography, large quantities of down timber and other debris, and the rank growth of shrubs make the movement of livestock difficult."

Due to this, "grazing", they state, "has been limited." Further they state, "A number of attempts to use cut over Douglas fir land for livestock range have been temporarily successful, but as a general rule the results have not justified this practice on any
The majority of elk herds observed on the basis of their home range, use about 30 to 150 acres per animal in the herd. On the basis of one animal per two hundred acres, this would mean that western Oregon could handle 75,000 elk.

Certainly western Oregon is easily capable of supporting not less than 35,000 elk without in any way crowding its carrying capacity.

During normal times, such a herd would have a tremendous value both as game, and from the aesthetic point. During critical times such as these, such a herd has a potential food value which cannot be ignored.

Compared with livestock the value of such a herd of elk is well worth considering. Andrews and Cowlin (2) state that in the period 1925 - 1935, 14,000 cattle and 150,000 sheep grazed on the "very limited" grazing lands of Oregon and Washington, the annual average grazing fees amounting to $20,000 in these areas. This sum for two states is certainly not large. The limited county seasons on elk alone in Oregon produced an average of over $8,000, in license fees, and value to the state as a whole was much greater, for it has been estimated that the average big game hunter spends about $100 on a hunting trip in food, clothes, transportation, equipment etc. If we cut this in half, it still amounts to $60,000 for one county alone. Consider what this would be if the elk population were at its maximum. For western Oregon this means roughly about 10 times the above figures.
With present meat shortcases and higher prices of meats, such potential sources cannot be ignored, and should receive serious and considerable thought especially when the range is useless for other purposes, and maintenance costs are but an insignificant fraction of that of caring and keeping cattle and sheep.

During wartime emergency, western Oregon should be capable of producing 4,000,000 lbs. of elk meat without seriously depleting its herds. While this cannot fill our regular need, it is a not to be ignored addition in critical times.

I have attempted to give an insight into the life and habits of a not only interesting, but valuable member of our fauna. The student reading this need not consider the work complete with nothing left for him to do in this field. Many questions are only poorly answered or not at all.

More complete observations are needed on cows which leave the herds to give birth to the calves.

The question whether cows breed on alternate years is in doubt.

Correlation of color markings with sexual maturity needs to be determined in greater detail.

More observations in regard to diseases and parasites are needed.

Antler shedding and early growth needs to be studied in greater detail.

Many of these observations will have to be made at opportune moments and the gaps filled in gradually.
Besides this, there is the entire field of the conservation and the economic status of the animal.

I have perhaps at times wandered quite far from the pure study of the natural history of this elk, but it must be kept in mind that today there is no animal within our country whose life is not closely and irrevocably linked with the economic life of this country. I hope that my deviation from the pure natural history study will serve to stimulate further thought and studies in these fields with regard to this animal. If it succeeds in this, then any criticism I may bring on myself will be well worth while.
Bibliography


