



Biology of the elk calf, *Cervus Canadensis Nelsoni*  
by Donald E Johnson

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management at Montana State College  
Montana State University  
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Abstract:

A study of elk calves was conducted in southern Gallatin County, Montana, and northwestern Yellowstone National Park in 1949 and 1950.

A general physical description of the calving grounds with reference to location, vegetation, topography and climate is given with a list of the associated mammals. The calves were found by covering the calving grounds on horseback. Weights, standard measurements and other biological data were obtained. One hundred thirty-two calves were tagged with numbered metal stock ear tags and colored plastic markers composed of a large outer symbol alone or combined with a smaller inner symbol of contrasting color. Combinations of shapes, colors, sizes and ear to which it was attached identified the individual and drainage where tagged. Following the calving period observations were made on the marked calves.

The range and peak of the calving period were May 21 to June 12 and June 9, respectively. Sagebrush types contained 77 per cent of the calves, timber 11 per cent and "edge" 4.5 per cent. Calves found in open types averaged 73±7 yards from timber, while those in timber averaged 10.0 yards from open areas, illustrating the importance of "edge effect". According to age classes, determined by physical characteristics, average weights of calves were: newborn-1 day, 32.5; 2-4 days, 36.08; 5-7, 44.71; and 8-over, 53.18 pounds. Average standard measurements for the same age classes were: 38.31-2.05-15.46-4.38; 39.98-2.23-15.7-4.42; 42.36-2.24-16.2-4.7; and 44.32-2.29-16.61-4.77 inches. Weights of male calves exceeded that of females, for the above age classes as follows: it. it I, .22\$ 2.62 and .3it pounds, respectively. The sex ratio for 155 calves was 96 males : 100 females. Descriptions of coloration, glands, odor, reactions and voice are discussed. Average daily weight and measurement increases for 16 wild calves were 2.0 pounds and .69-.01-.10-.03 inches respectively, for the "first two" weeks. " Average daily gain" for " 1 captive" calf was 1.0" pound with "measurement" increases of .21-.01-.05-.01" inches "per" day over a " 31" day "period: " Certain activities such as walking, swimming, nursing, grazing, etc. are discussed. The average monthly distance that marked calves were observed from the calving grounds illustrated the general pattern of elk migration in the Gallatin drainage. Observations of 1949 markers (celluloid) showed 4 negative results in 8 late observations, while the 1950 marker (plastic) showed no completely negative results for the same number of observations, although 2 markers were damaged. Predation observations were limited to 2 suspected bear attacks on calves during the study but 2 1948 bear kills are reported. Insects appeared to be a major nuisance factor in the summer. Hunter kills during the fall represented the greatest mortality factor. The average annual calf harvest for 10 years was 91 animals.

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partial fulfillment of the requirements

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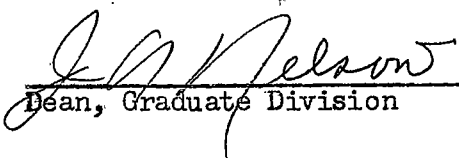
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TABLE OF CONTENTS

	Page
ABSTRACT . . . . .	3
INTRODUCTION . . . . .	4
METHODS . . . . .	5
GENERAL DESCRIPTION OF CALVING AREA . . . . .	12
CALVING . . . . .	14
Calving Period . . . . .	14
Relation to Cover Types . . . . .	18
PHYSICAL CHARACTERISTICS . . . . .	20
Weights and Standard Measurements . . . . .	25
Sex Ratio . . . . .	27
Coloration . . . . .	28
Glands . . . . .	30
Odor . . . . .	30
Reactions . . . . .	32
Voice . . . . .	32
Development . . . . .	35
ACTIVITIES . . . . .	36
Walking . . . . .	36
Swimming . . . . .	36
Nursing . . . . .	37
Grazing . . . . .	38
Play . . . . .	38
Relationship to Cow . . . . .	38
Movements . . . . .	39
EFFECTIVENESS OF THE MARKER . . . . .	41
MORTALITY AND NUISANCE FACTORS . . . . .	45
SUMMARY . . . . .	48
LITERATURE CITED . . . . .	51

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## ABSTRACT

A study of elk calves was conducted in southern Gallatin County, Montana, and northwestern Yellowstone National Park in 1949 and 1950. A general physical description of the calving grounds with reference to location, vegetation, topography and climate is given with a list of the associated mammals. The calves were found by covering the calving grounds on horseback. Weights, standard measurements and other biological data were obtained. One hundred thirty-two calves were tagged with numbered metal stock ear tags and colored plastic markers composed of a large outer symbol alone or combined with a smaller inner symbol of contrasting color. Combinations of shapes, colors, sizes and ear to which it was attached identified the individual and drainage where tagged. Following the calving period observations were made on the marked calves.

The range and peak of the calving period were May 21 to June 12 and June 1, respectively. Sagebrush types contained 77 per cent of the calves, timber 11 per cent and "edge" 4.5 per cent. Calves found in open types averaged 73.7 yards from timber, while those in timber averaged 10.0 yards from open areas, illustrating the importance of "edge effect". According to age classes, determined by physical characteristics, average weights of calves were: newborn-1 day, 32.5; 2-4 days, 36.08; 5-7, 44.71; and 8-over, 53.18 pounds. Average standard measurements for the same age classes were: 38.31-2.05-15.46-4.38; 39.98-2.23-15.7-4.42; 42.36-2.24-16.2-4.7; and 44.32-2.29-16.61-4.77 inches. Weights of male calves exceeded that of females, for the above age classes as follows: 4.41, .22, 2.62 and .34 pounds, respectively. The sex ratio for 155 calves was 96 males : 100 females. Descriptions of coloration, glands, odor, reactions and voice are discussed. Average daily weight and measurement increases for 16 wild calves were 2.0 pounds and .69-.01-.10-.03 inches, respectively, for the first two weeks. Average daily gain for 1 captive calf was 1.0 pound with measurement increases of .21-.01-.05-.01 inches per day over a 31 day period. Certain activities such as walking, swimming, nursing, grazing, etc. are discussed. The average monthly distance that marked calves were observed from the calving grounds illustrated the general pattern of elk migration in the Gallatin drainage. Observations of 1949 markers (celluloid) showed 4 negative results in 8 late observations, while the 1950 marker (plastic) showed no completely negative results for the same number of observations, although 2 markers were damaged. Predation observations were limited to 2 suspected bear attacks on calves during the study but 2 1948 bear kills are reported. Insects appeared to be a major nuisance factor in the summer. Hunter kills during the fall represented the greatest mortality factor. The average annual calf harvest for 10 years was 91 animals.

## INTRODUCTION

Although considerable data concerning elk have been published, very little quantitative information pertaining to the individual calf is available. Rush (1932), Young and Robinette (1939), Schwartz and Mitchell (1945) and others have contributed much to our knowledge. The present paper attempts to supplement the available information particularly with reference to elk calves.

The Gallatin elk herd, which ranges in the upper West Gallatin river drainage of southwestern Montana and northwestern Yellowstone National Park, provided an excellent opportunity for concentrated study. It is one of the more important herds in the United States. The average winter count for the period 1939 through 1949 was 1,700 while the average annual harvest over the same period was 550 (Angstman and Gaab, 1950). These elk are roughly divided into two groups, migratory and resident. The migratory animals, comprising the larger segment of the population, summer in the high "back" country of Yellowstone Park at elevations up to 10,000 feet. They winter along the northwestern park boundary at an elevation of approximately 7,000 feet, and within the Gallatin National Forest at elevations between 6,500 and 7,500 feet. The resident animals are distributed within the Gallatin Forest and apparently do not take part in the extensive seasonal movements.

During the summer of 1949 and 1950 a study was made of the calves, particularly those of the migratory herd.

Thanks are extended to the Montana Fish and Game Department for permission to conduct the study, for financial support and equipment. Other members of the department, to whom acknowledgements are due, are: J. E. Gaab, R. L. Hodder, V. E. Sylvester, J. B. Angstman, and A. R. Brazda for aid in the field. The writer further extends his grateful appreciation to Dr. Don C. Quimby, Montana State College, who directed the study.

#### METHODS

To satisfactorily study the calves in the field a suitable marking technique for recognition of individuals is desirable. A review of the literature on animal marking (summarized by Manville, 1949) failed to reveal a liquid marking material which would be suitable for the study. An attempt was made to find such a material. Forty Hereford steers were experimentally marked with commercial house, auto and sheep branding paints, aniline dyes, inks and various bleaches. None exhibited all of the desired properties; color fastness, retention to the hair, ease of application and visibility.

Marking mammals and birds with plastic symbols has been recorded by Trippensee (1941) and Hosley (1942). Following their principles, colored plastic ear markers attached by livestock ear tags were used. (Howitt Plastics Company, Portland, Oregon supplied the material.) The color of the symbols indicated the year the animal was tagged; red and white for 1949 and blue and yellow for 1950. Manipulation of colors and shapes provided 48 combinations. Two inch squares, circles,

half circles or triangles either plain or with 1 inch inner symbols of the same shapes cemented by acetone were used (Fig. 1). Each symbol, when duplicated for attachment to the opposite ear, doubled the total number of possibilities. The shape of the outer symbol indicated the drainage where a calf was tagged while the inner symbol identified the individual animal, except when certain large symbols alone identified both individual and drainage (Fig. 1).

Locating the recently born calves was accomplished by searching the sagebrush slopes and timber edges during May and June (Fig. 2) on horseback and at the same time observing unusual actions of singles or small groups of females which occasionally indicated the presence of calves in the vicinity. By blowing across a blade of grass held taut between the thumbs and heels of the hands a tone, similar to the call of a calf, was created. This tone appeared to excite the female elk and many times their suspicious actions disclosed the location of their calves.

When located, the calves were tagged in both ears; one with a numbered metal stock tag only, the other with a numbered metal stock tag to which a plastic marker was attached (Fig. 3). Weights with a steelyard or spring scales (Figs. 4 and 5), standard measurements with a steel tape, dental observations and notes concerning physical characteristics were obtained.

Following the calving period, additional data were collected by observing the marked calves through 6 and 8 power binoculars and a

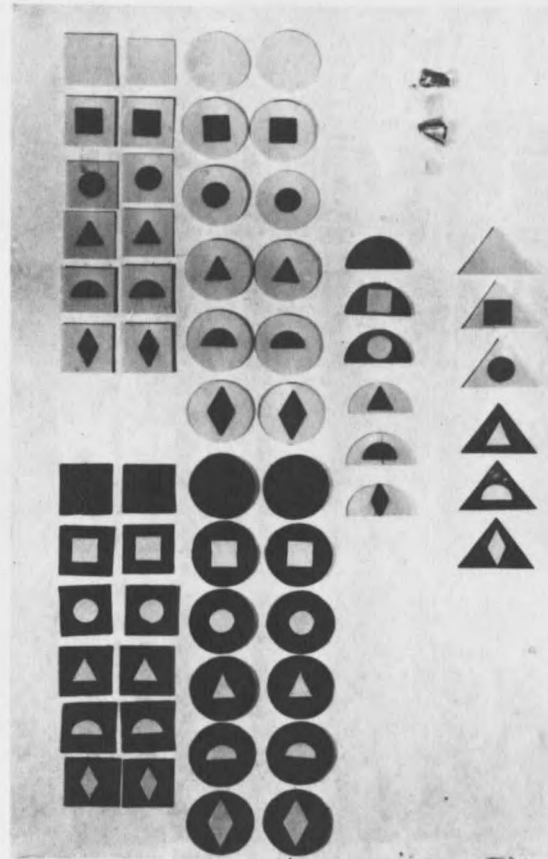


Fig. 1. Plastic ear markers showing all combination arrangements for two drainages (squares and circles). Total number of possibilities for half circles and triangles not shown. Two numbered metal stock ear tags are shown in upper right hand corner.





Fig. 2. Riders searching for calves in a sagebrush type on the calving ground, showing approximate interval used.



Fig. 3. An ear marker attached to an elk calf (note metal stock tag on opposite ear).



Fig. 4. Weighing a calf using a steelyard.



Fig. 5. Weighing a calf using a spring scale.

20 power spotting scope. To make these observations, it was necessary to follow the migrating herds to their summer range. This was accomplished with saddle horses and a pack outfit.

Some supplementary information was secured by observing a captive calf.

#### GENERAL DESCRIPTION OF CALVING AREA

The major part of this calving area is drained by a 19 mile segment of the West Gallatin River and 6 of its tributaries (Taylor Fork, Tepee Creek, Daly Creek, Sawmill Gulch, Lodgepole Gulch, and Fan Creek). The area is characterized by broad open slopes with open timber stands (Fig. 6). Big sagebrush (Artemisia tridentata) is the dominant plant in the open areas while Lodgepole Pine (Pinus contorta) is the dominant timber species. The timber stands, which often become very dense on north exposures, may be made up of mixtures of Douglas Fir (Pseudotsuga taxifolia), Quaking Aspen (Populus tremuloides), Engelmann Spruce (Picea engelmanni) and Lodgepole Pine. Other plants found in the calving area are as follows: grasses and sedges - Festuca idahohensis, Stipa spp., Koeleria cristata, Carex spp., Bromus carinatus, Agropyron smithii, A. spicatum, Calamagrostis rubescens, Elymus condensatus; shrubs - Artemisia cana, Dasiphora fruticosa, Chrysothamnus spp., Gutierrezia spp., Arctostaphylos uva-ursi, Salix spp.; forbs - Lupinus spp., Phlox spp., Antennaria spp., Aster spp., Achillea lanulosa, Potentilla spp., Eriogonum spp., Fragaria spp., Erythronium spp., Dodecatheon pauciflorum, Erigeron spp.



Fig. 6. A portion of the Gallatin calving grounds showing sagebrush slopes and open timber stands (mainly Lodgepole Pine).

Elevations within this area range from approximately 6,700 feet to 10,000 feet. Maximum calving elevations found during this study, however, did not exceed 9,000 feet, with the bulk of the calves found between approximately 7,000 feet and 7,400 feet.

Temperature and precipitation records were kept during the two calving periods included in this study. These records compiled on a weekly basis will be found in Table I.

Associated with this calving area are various mammals of which elk, moose, mule deer, coyote and black and grizzly bear can be included as major influents. In addition, porcupine, woodchuck, golden-mantled and armatus ground squirrels, chipmunk, red squirrel, beaver, muskrat, badger, pika, and snowshoe hare are encountered. On one occasion two buffalo were observed.

#### CALVING

##### Calving Period

By estimating the age of the calves when found, using physical characteristics (Table II), calculated birth dates were determined and the calving period delimited. Extremes were May 21 and June 12 with the peak of births for the two years occurring June 1 (Fig. 7). In northern Idaho, a June 1 peak was also reported (Rust, 1946). Rush (1932) found extremes on the northern Yellowstone herd of May 13 and June 10, while Schwartz and Mitchell's (1945) were May 14 and July 10, during their Olympic Peninsula study.

Table I  
Average Weekly Temperature and Precipitation Record  
During the Calving Period

Week of	Temperature (°F.)			Precipitation (inches)		
	High	Low	Mean	Rain	Snow	Total Ppt.
1949						
May 15-21	55	34	44.5 <sup>a</sup>	No record		
22-28	60	36	48	.12	T	.12 <sup>d</sup>
29-June 4	53	38	45.5	.70	T	.70
5-11	66	38	52	.28		.28
12-18	65	38	51.5	.89		.89
1950						
May 15-21	64	26	45 <sup>a</sup>	.41	.14	.55
22-28	57	28	42.5	.34		.34
29-June 4	55	30	42.5 <sup>b</sup>	.22	T	.22
5-11	62	35	48.5 <sup>b</sup>	.60	T	.60
12-18	67	30	48.5 <sup>c</sup>	.72		.72

a for 6 days  
b " 4 days  
c " 2 days  
d " 1 day



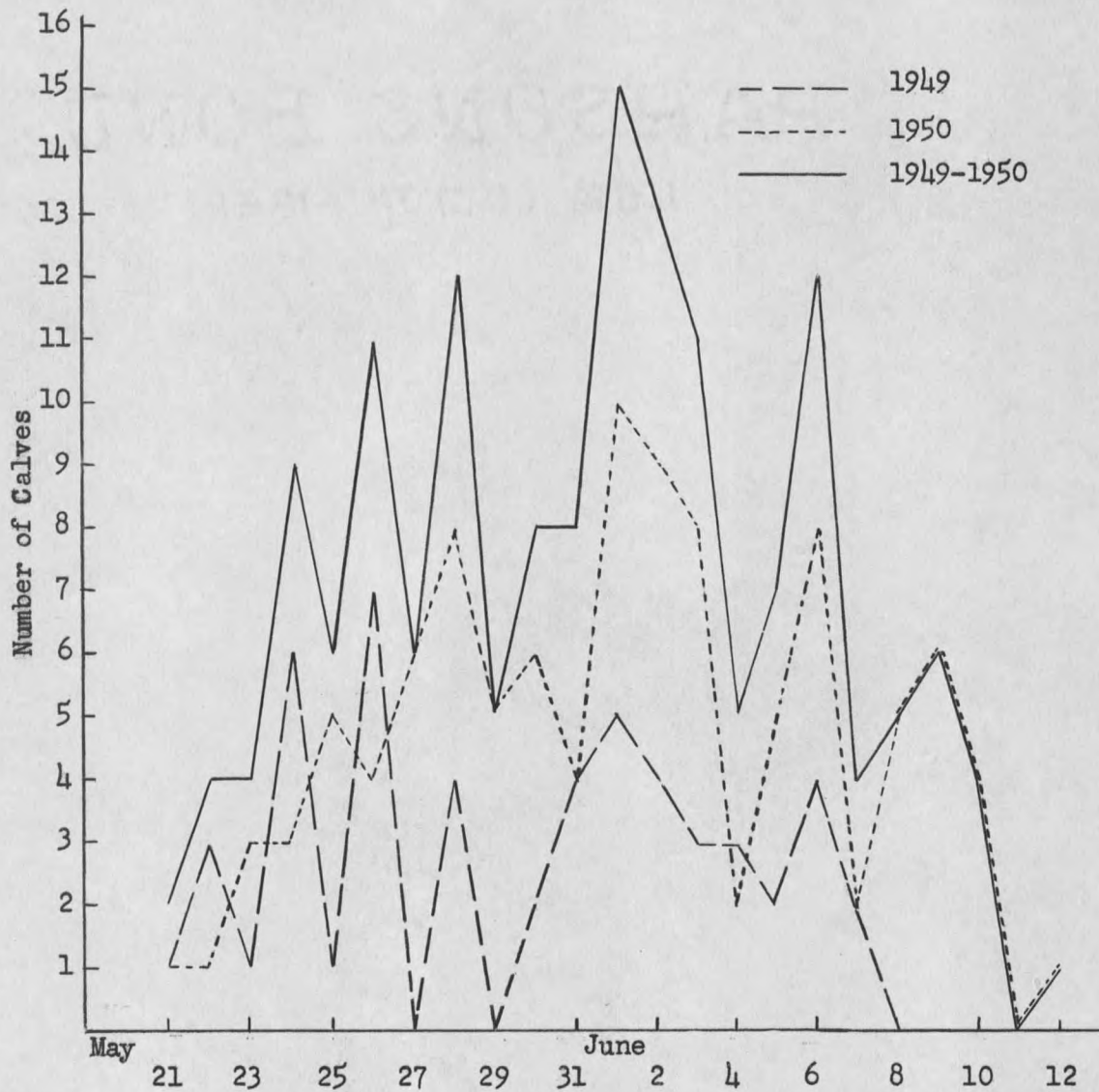


Fig. 7. Birth dates of 158 elk calves calculated from approximate age when found.

Some late calving was suspected in the Gallatin when 2 calves were observed on July 12 and July 14, respectively, which were much smaller than other calves in the same groups. These calves appeared sturdy and well developed but neither seemed to exceed the size of calves which were being aged at 5 and 6 days during the tagging operation in May and June. A late birth observation was recorded by Schwartz and Mitchell (1945) on July 10 for the Roosevelt elk. Among white-tailed deer in New York, Cheatum and Morton (1946) indicate that late births resulted from two factors; recurrent estrus among adult females and fawn breeding. No evidence of calf breeding among elk is known to the writer. The examination of 21 female elk calves by Walter Kittams in Yellowstone National Park during the 1949-1950 elk reduction program (personal communication) in which none were pregnant suggests that calves do not breed. Heape reported that the female elk (Cervus canadensis) "in captivity" experiences a continuous series of diestrous cycles lasting three weeks (from Asdell, 1946). This could explain the late calves observed in this study, if the same cycle is exhibited by wild elk.

All evidence encountered during this study indicated female elk gave birth to only 1 calf per season. Asdell (1946) reported 1 is the usual number, "but occasionally 2 and 3" are born at a time. "Twins are uncommon" according to Rust (1946). Both Rush (1932) and Schwartz and Mitchell (1945) found no evidence of twin pregnancy.

## Relation to Cover Types

The calving area in the Gallatin is located mainly on the upper limits of the winter range, as was also found to be the case in other areas studied (Rush, 1932, Darling, 1937, Young and Robinette, 1939, and Rust, 1946). It consists of several vegetative types. The more important calving types are as follows: sagebrush (Artemisia tridentata), timber (Pinus contorta, Populus tremuloides or both), sagebrush and cinquefoil (Dasiphora fruticosa), cinquefoil and grass (Festuca spp., Stipa spp., Agropyron spp.), sedge (Carex spp.), sedge and low willow (Salix spp.), low willow and "edge". The ecotone between sagebrush and timber is referred to as the "edge type" in this study. Three types exhibit more xeric characteristics than the others, sagebrush, timber and edge. Calves are recorded in Fig. 8 according to the vegetative type where they were found. Newborn calves are recorded separately. Approximately 77 per cent of all calves were found in sagebrush types, 11 per cent in timber and 4.5 per cent on the edge of timber and sagebrush. For the newborn calves the percentages were 42, 33, and 25, respectively. The data for newborn calves are more indicative of place of parturition than that for all calves because very probably they had not moved. In this sample, however, the data for all calves support that of the newborn with regard to preference for drier sites.

In the preceding paragraph it was shown that the characteristics of the vegetative types were of great importance as far as the

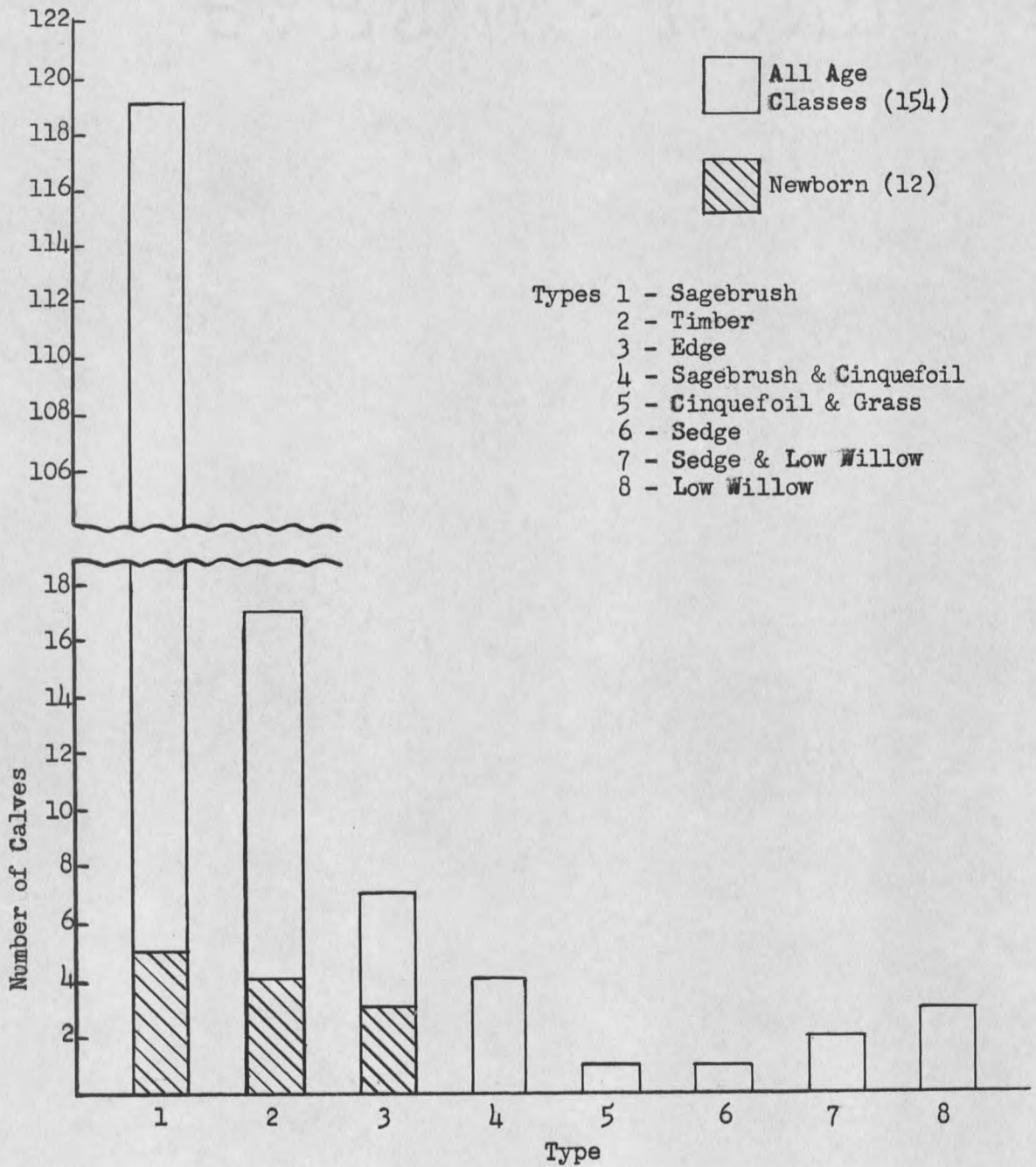


Fig. 8. Vegetative Types Where 154 Elk Calves Were Found.

location of calves was concerned. It also appears that the relationship of open and timber types to each other is very important, e.g., the distances calves were found from the boundaries of these type groups. Fig. 9 shows the distances calves found in open areas were from the timber. The extreme distances are 0 (edge) and 500 yards, with a mean of 73.7 yards. Fig. 10 shows the distances calves found in timber were from the open areas. In this case, the extreme distances are 0 and 40 yards; the mean, 10.0 yards. During the calving season, the vast open sagebrush types seemed to be most productive (yield the greatest number of calves) only in those portions in close proximity to timber. This illustrates the importance of "edge effect" and appears to emphasize Leopold's (1933) "law of interspersion".

#### PHYSICAL CHARACTERISTICS

During the calving season certain differences were recognized among the calves. After handling a relatively small number, it was readily seen that these were due to differences in ages. In the field all physical characteristics for each calf were recorded, particularly those pertaining to the amount of moisture on the hair, dentition development, condition of naval, hardness of hooves and dew claws, and general stature and stability. After calving season, all similar physical characteristics were grouped. Certain limits of development were immediately observed from the data thus delimiting ranges for specific age classes. Table II contains the final

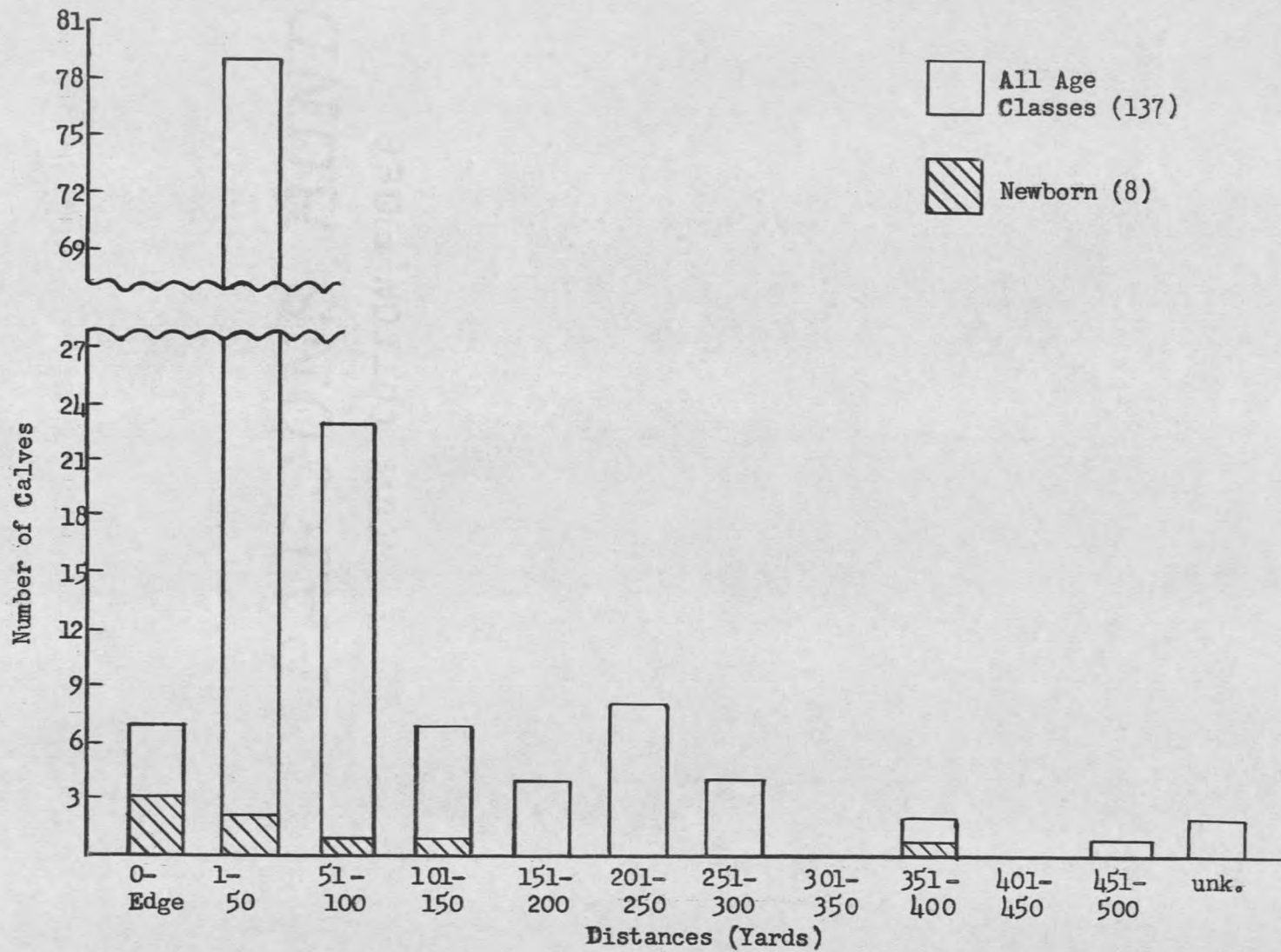


Fig. 9. Approximate Distances 137 Elk Calves found in Open Areas were From Timber.



Fig. 10. Approximate Distances 24 Elk Calves Found in Timber were from Open Areas.

Table II

Characteristics Used For Age Class Determination  
of Elk Calves

Age Class	Characteristics		
	Moisture on Hair	Dentition	Naval
A (newborn & 1 day)	Wet or dry & matted. Dampness inside ears.	Front <u>Incisors</u> covered by membrane or protruding through membrane 1/8" or less. Upper <u>Canines</u> -not through. <u>Cheek Teeth</u> -not through or barely so.	Bloody, moist, approx. 1/2" to 3/4" dia.; not scabbed. Portion of umbilical may or may not be present; if present, moist.
B (2 through 4 days)	Dry*	Front <u>I's</u> - protruding 1/8" to 1/4". <u>UC's</u> not through. <u>CT</u> - just through or protruding approx. 1/16" or less.	Bloody or lightly scabbed about 1/2" dia. Portion of dried umbilical may be present.
C (5 through 7 days)	Dry*	Front <u>I's</u> - protruding 1/4" to 3/8". <u>UC's</u> barely through. <u>CT</u> - through gums over 1/16".	1/2" to 3/4" dry scab.
D (8 days & over)	Dry*	Front <u>I's</u> - protruding 3/8" to 5/8". <u>UC's</u> just through or protruding approx. 1/8" or more. <u>CT</u> - same as above only more so.	1/8" to 1/4" scab or entirely healed.

\*Moisture may be present on the calf if it has been recently licked by the cow. If licked during nursing generally only the posterior regions of the calf will be moist.



Table II (Continued)

Characteristics Used For Age Class Determination  
of Elk Calves

Age Class	Characteristics		
	Hooves	Dew Claws	Stature & Stability
A	Entirely soft or less than $\frac{1}{2}$ hoof hardened. Walking surface ragged with slight to no grass staining present.	Entirely soft & brittle or only upper $\frac{1}{4}$ " hardened.	Unable to stand or very insecure & wobbly on feet. Legs spread well apart if standing. Somewhat humped posture when standing.
B	All hardened; walking surface smooth (not ragged) & showing much grass staining.	Entirely hard or just the extreme tips soft.	Somewhat wobbly to very sturdy. Posture generally erect.
C	Same as above	Entirely hard	Very sturdy & erect.
D	Same as above	Same as above	Same as above

compilation of these data according to age classes: A, newborn through 1 day; B, 2 through 4 days; C, 5 through 7 days; and D, 8 days and over. It is believed that this table illustrates the physical characteristics by age classes as accurately as is possible from the data available.

#### Weights and Standard Measurements

Each calf was weighed and measured in the field by methods described previously. Means and ranges of weights and standard measurements (total length, tail, hind foot and ear) were determined for each age class and recorded in Table III. Obviously, weights and measurements are not sufficient for determination of age of calves as shown by the range of extremes for the various age classes (see Table III).

Weights and estimated daily ages were recorded for 22 Rocky Mountain elk calves in the Sun River area of Montana by R. F. Cooney in 1939 (personal communication). Although the means exceeded those of Gallatin calves, individual weights fell well within the range of Gallatin extremes.

Rush (1932) reported that "the average weight of a calf at birth is 37 pounds....", with extremes of 23 and 45 pounds. This average weight exceeds the Gallatin mean by 4.5 pounds. "Typical measurements" for a 3-5 day old Roosevelt elk were given by Schwartz and Mitchell (1945) as follows: 37.0-1.5-16.5-4.75 inches. This elk (Cervus c. roosevelti) is reported by the same writers as larger

Table III

## Weights and Standard Measurements of Rocky Mountain Elk Calves

Age Class	Weights (in pounds)		Number of Calves	Standard Measurements (in inches)			
	Number of Calves	Mean and Range		Total Length	Tail	Hind Foot	Ear
A (Newborn through 1 day)	23	32.5 (19-45)	23	38.31 (30.0-44.0)	2.05 (1.5-2.75)	15.46 (14.0-17.0)	4.38 (4.0-5.0)
B (2 days through 4 days)	48	36.08 (21-48)	49	39.98 (36.0-45.75)	2.23 (1.75-3.0)	15.7 (13.5-16.75)	4.42 (4.0-4.75)
C (5 days through 7 days)	47	44.71 (34-59)	49	42.36 (38.0-46.25)	2.24 (2.0-2.75)	16.2 (15.25-17.25)	4.7 (4.25-5.0)
D (8 days and over)	22	53.18 (40-79)	22	44.32 (41.5-49.5)	2.29 (2.0-3.0)	16.61 (15.25-17.5)	4.77 (4.5-5.25)
Totals	140		143				

than the Rocky Mountain elk although calf measurements for both are very similar (see Table III).

Weights of male calves exceeded female calves as follows: Age Class A, 4.41 pounds; B, .22 pounds; C, 2.62 pounds; and D, .34 pounds.

Weights and standard measurements of 2 moose calves and 3 mule deer fawns from the Gallatin area are listed below for comparison. Robinette and Olsen (1944) reported that mule deer fawn at birth averaged 7.2 (5.0-9.9) pounds. This would suggest that the Gallatin fawns listed below were very young.

<u>Species</u>	<u>Date</u>	<u>Age</u>	<u>Sex</u>	<u>Wt.(lbs.)</u>	<u>Stand. Meas.(ins.)</u>
Moose	6-2-49	approx. 1-2 days	♀	25.0	29.0 (total length only)
Moose	6-16-50	over 10 days	♂	49.0	41.25-1.25-17.0-5.5
Deer	6-4-50	unk.	♀	7.5	25.0 -3.5 - 9.5-3.75
Deer	6-4-50	unk.	♂	8.5	25.0 -3.5 -10.0-4.0
Deer	6-12-50	unk.	♂	7.5	21.75-2.0 - 9.0-3.75

#### Sex Ratio

Sex ratio data were secured from 155 calves during the study. This information, combined with data obtained by other authors, is listed in Table IV.

Table IV

Calf Sex Ratios for Three Subspecies of Cervus canadensis

Authority	Subspecies	No. in sample	Sex Ratio ♂♂ : 100 ♀♀
Angstman and Gaab (1950)	<u>C.c. nelsoni</u>	470	97 : 100
Present study	<u>C.c. nelsoni</u>	155	96 : 100
Rust (1946)	<u>C.c. nelsoni</u>	unk.	89 : 100
Schwartz and Mitchell (1945)	<u>C.c. roosevelti</u>	94	64 : 100
Banfield (1949)	<u>C.c. manitobensis</u>	10	25 : 100

These data do not support the suggestion of Banfield (1949) that there is a high male prenatal mortality. The findings of the present study strongly suggest a near one to one sex ratio which is supported by the large sample of Angstman and Gaab (1950).

## Coloration

Coloration of the calf pelage may vary considerably from a uniform reddish-buff color with very indistinct spotting (Calf No. 91) to an exceedingly dark brown with brilliant spots. The typical calf coloration is light brown with a dark brown to black streak approximately  $1\frac{1}{2}$  inches wide. It usually extends from about 1 inch behind the ears to the edge of the buff colored rump patch. This patch extends forward approximately 4 inches from the tail root and covers the posterior portion of both thighs. Usually 1 row of white spots parallel the dark streak on either side of the midline. Irregular spotting occurs on the sides but never overlapping into the rump patch (Fig. 11). Occasionally the dorsal streak may be indistinct



Fig. 11. Calf skin showing spotting arrangement,  
dorsal streak and rump patch.

or absent and only extend part way to the rump patch.

#### Glands

Hamilton (1939) describes four skin glands of the deer tribe. Two of these are prominent on the elk calf. The preorbital gland, continuous anteriorly and ventrally with the orbit, is approximately  $\frac{1}{4}$  inch in diameter and  $\frac{1}{4}$  inch deep. The metatarsal gland, is situated approximately 5 to 6 inches below the flexed metapodial joint on the outside of each hind foot (Fig. 12). It is approximately  $1\frac{1}{2}$  inches long and  $\frac{3}{4}$  inch wide and consists of a tuft of white hair surrounded by longer hair of the same color as the pelage. From the observations this gland, on the young calves, is odorless to the human nose.

#### Odor

Apparently the newborn calves are odorless. Three days during the 1949 calving period a German Short Hair Pointer accompanied the tagging crew and failed to locate any calves. Once he was observed to pass within 5 feet of one. A newborn calf which was found entirely wet (approximately 4 hours old) gave off no detectable odor to the fieldmen. Older calves, completely dry, also failed to have a noticeable odor except that of the sagebrush in which they were generally lying. Rush (1932) reports that a horse was observed to graze within a foot of a hiding calf without smelling it.



Fig. 12. Elk calf showing prominent metatarsal gland (also note ear tag and marker).



## Reactions

Calves, when approached, are generally found hiding in the sagebrush (Fig. 13). When observed from a distance through binoculars they are seen to move their heads and occasionally even change positions but when approached they become motionless. This behavior is seemingly of a protective nature because they are difficult to see in the motionless position. It has been observed that they often obtain an apparent sense of security when a piece of sagebrush is placed over their heads even after being handled.

The keenness of the senses is difficult to evaluate by observations. Two newborn calves were observed to walk out of the timber to the riders. After being released, it was not uncommon to see calves approach and follow horses (Fig. 14). The calves on other occasions ran to the cows when the latter were standing within sight or hearing range of the released calves.

## Voice

As mentioned previously, the voice of the calf is not unlike the sound made by blowing across a blade of grass. It is very high-pitched, shrill and emitted for short durations at rather frequent intervals. This sound was heard when the animals were being handled and also when large numbers of elk were moving or disturbed. Murie (1932) recorded, "The call of the elk calf may be written E-e-e-e-e-uh!".



Fig. 13. Elk calf hiding in a sagebrush type.



Fig. 14. Elk calf, after release, following horse.

## Development

Certain aspects of calf development were observed in the wild and from one captive. Weights and measurements were recorded each time a tagged wild calf was recaptured. Approximately every two weeks a captive calf was weighed and/or measured. The average daily weight increase for 16 wild calves was 2.0 (.83 to 3.12) pounds, while average daily measurement increases were: .69 (0.0 to 1.75) - .01 (0.0 to .04) - .10 (0.0 to .25) - .03 (0.0 to .06) inches. These increases were based on observations extending over periods of 2 to 14 days. The captive calf, which was reared on domestic cow's milk, showed smaller increases: weight 1.0 (.37 to 1.62) pound; measurements .21 (.19 to .24) - .01 (0.0 to .02) - .05 (.04 to .06) - .01 (0.0 to .03) inches per day over a 31 day period. The weight of this calf on August 10 was 77 pounds, showing an average gain of 1.0 pound per day over the 53 day period. Over approximately the same period measurement increases were .29-.01-.04-.02 inches per day.

Five weights and 9 measurements were secured from calves approximately 7 months old during December 1949 in Yellowstone Park (some of these data previously published, Quimby and Johnson, in press). Average standard measurements were 67.8 (61.25 to 75.75) - 4.78 (4.0 to 5.5) - 22.36 (20.25 to 24.0) - 7.14 (6.75 to 7.5) inches. Total weight, 251.5 pounds, was secured for one. For 4 others, the calculated total weights from visceral weights were 234, 291, 195 and 246 pounds where visceral weight is 1/3 of total weight (Quimby

and Johnson, in press).

Calf spotting, which generally becomes very distinct shortly after birth, is lost during the first pelage molt in August and September. The first evidence of adult shedding was observed August 5 while calf shedding was first observed August 11. Spotting fades gradually from the dorsal parts ventrally until complete disappearance. The first observation of a completely molted calf was August 17. No calves were observed with spots after September 7; the pelage was generally lighter colored and very similar to that of the yearling.

#### ACTIVITIES

##### Walking

Nine of 12 newborn calves were unable to walk and 3 of these unable to stand. The calves capable of walking were very unstable and unable to progress more than a few yards. Six calves, approximately 1 day old, did not attempt to stand, while 5 ran unsteadily after being handled. Seemingly the calves do little moving until about the third or fourth day at which time they are generally good runners. After 6 or 7 days the calves must be approached cautiously as they are quick to gain their feet and are very fast runners.

##### Swimming

Only 1 calf was observed swimming. This calf, approximately 4 days old, was hidden on the opposite side of the river from the grazing cow. After it was tagged and released the calf ran upstream

approximately 100 yards, jumped into the swollen river, which was about 4 feet deep and 60 feet wide, and swam across to the cow. Rush (1932) and Schwartz and Mitchell (1945) both reported calves swimming.

#### Nursing

Calves were first observed to nurse on June 27. Throughout the study no definite nursing pattern was apparent. Duration of nursing ranged from less than 30 seconds to 1 3/4 minutes, evidently at the cow's discretion. On July 1, a yearling was observed to nurse for approximately 30 seconds, assuming a kneeling position. Rush (1932) reported a similar observation on July 19. Darling (1937) reports both yearling and calf nursing the same hind (cow) as not at all unusual among Scotland's red deer (Cervus elaphus). For the nursing calves the kneeling position, as well as the standing position, was commonly observed after August 7. After August 2, "practically all of the calves observed nursing" by Young and Robinette (1939) were in kneeling positions.

Between December 20 and 29, 1949, 46 female elk over 2 years old were examined (data secured in Yellowstone National Park and published with their permission). Twenty were found to be lactating while the remainder were dry. From these few data it would appear that a high percentage of the calves were still nursing.

### Grazing

One captive and 2 wild calves were observed grazing June 26 and 27, respectively, when approximately 3 to 4 weeks old. Intense grazing by calves was not commonly observed much before July 10 (6 to 8 weeks of age). This is similar to the findings of Rush (1932) and Young and Robinette (1939) although somewhat later than those reported by Schwartz and Mitchell (1945).

### Play

On four occasions Gallatin elk calves were observed playing a type of tag; first one chased the other, then vice versa. Twice calves were seen to play this game in shallow pools. Similar antics were reported for Idaho elk calves by Young and Robinette (1939). Darling (1937) described 4 types of play observed among the red deer calves of Scotland, one of them being this game of tag.

### Relationship to Cow

A very close relationship between cow and calf was observed throughout the study with a few exceptions. Four cows were observed with 13 calves (no other adult females in the immediate area). This may have been an example of certain cows acting as "guards" while others were grazing (Schwartz and Mitchell, 1945) or serving in the capacity of "nursemaids" as reported by Einarsen (1948) among antelope. Two calves were observed playing alone on a lake shore August 18 approximately 1/2 mile from the herd. When frightened, they quickly rejoined the others.

## Movements

This portion of the study was aided by the use of plastic ear markers previously described. One hundred thirty-two calves were marked. When a marked calf was observed or killed by a hunter, its location was recorded. Airline distance from the place of tagging was then calculated (Table V).

Airline distances could be recorded quite accurately when individual identifications could be made but in cases where the drainage symbol only was recognizable they were approximate.

Thirty-two observations were recorded at distances from 0 to 19 miles from the calving area during the two years, as follows: 3 in June, 7 in July, 4 in August, 12 in November, 4 in December and 2 in January. For the summer months all observations were at generally higher elevations above the calving grounds. The average distance for June was 3 airline miles, 11 for July, and 8 for August. Observations for November and December were below the calving area, 3 and 2 airline miles, respectively. One observation in January was 4-5 miles above the calving ground, while the other was in another drainage 18 miles away. These data suggest the general pattern of elk migration for this drainage; i.e., the calves are born on the upper winter range after which they begin a movement to the generally higher elevations of the summer range. The maximum elevations are reached in July. During August the direction of movement is reversed. In November and December the animals are on



Table V

## Observations of Tagged Calves

Calf No.	Date Tagged	Date Observed	Movement (Miles)
24	6-12-49	6-28-49	2-3
29	6-12-49	6-28-49	2-3
21	6- 4-49	7-26-49	8
31	6- 4-49	8- 5-49	5-6
unk.	unk.	12- 1-49	approx. 0
unk.	unk.	12- 1-49	approx. 1
unk.	unk.	12- 1-49	unk.
75 *	6- 6-49	12-21-49	3-4
3	6- 3-49	1-12-50	4-5
29 **	6-12-49	1-19-50	18
167	6- 2-50	6-28-50	2-3
unk.	unk.	7- 9-50	approx. 11
127	6-11-50	7-11-50	11-12
148	6- 9-50	7-11-50	10
83	6- 1-50	7-15-50	9
136	6- 3-50	7-15-50	8
unk.	unk.	7-26-50	approx. 17
unk.	unk.	8- 8-50	approx. 8
unk.	unk.	8- 8-50	approx. 12
unk.	unk.	8- 8-50	approx. 8
unk.	unk.	11-10-50	approx. 2-3
unk.	unk.	11-10-50	approx. 1
23 *	6-12-49	11-13-50	18
140 *	6-10-50	11-15-50	1
78 *	6- 6-49	11-17-50	1-2
158 *	5-30-50	11-21-50	0
126 *	6-11-50	11-23-50	4
128 *	6-11-50	11-24-50	3-4
107 *	6-11-50	11-24-50	3-4
163 *	6- 3-50	11-24-50	0
99 *	6- 2-50	11-24-50	6
120 *	6-11-50	11-24-50	3-4

\* Hunter kill

\*\* Moved out of Gallatin drainage

the winter range generally at elevations lower than the place of birth.

The above data indicate a true migration involving a movement away from and return to an area. One observation for January is atypical in that this animal was trapped in the Yellowstone drainage which supposedly supports a herd distinct from the Gallatin herd. Other data suggesting an intermingling of the two herds are available from calves marked on the Yellowstone during the spring of 1950 by the Montana Fish and Game Department. About 60 were marked with striped plastic ear markers. Twelve were observed on the same summer range (high range between the Yellowstone and Gallatin drainages) used by a portion of the Gallatin herd. The Yellowstone calves had moved about 9 to 13 airline miles from the tagging area.

#### EFFECTIVENESS OF THE MARKER

Hunter kills and observations late in the season provided information on the durability of the markers. To date, 8 calves tagged in 1949 have been observed or killed after the first summer. Three had retained the marker for 6 months and 1 for  $7\frac{1}{2}$  months. On the negative side, 1 calf had lost the marker by  $7\frac{1}{2}$  months after tagging. One killed in December 1949 had lost both metal and plastic tags. One ear was split. Two other 1949 calves killed during November 1950 had no markers. All markers used during the 1949 season were of a thin celluloid nature and seemingly less durable than the thicker plastic markers used in 1950 (Howitt Plastics Co.).

No completely negative results have been found for the 1950 markers. Eight had remained 6 months on calves killed in November 1950. Six were in perfect shape. Two symbols were damaged: a large triangle had a corner broken off and only 1/3 remained of a large circle. Fig. 15 shows 3 of the undamaged and the 2 damaged symbols. Both damaged symbols showed breaks which were very smooth and clean, possibly indicating they were broken while in the hands of the hunters. From these few data, it appears that the plastic type-marker showed considerable promise for big game mammal marking as far as durability was concerned.

The maximum range of visibility for positive identification of the smaller symbols (individuals) was approximately 100 yards with 6 or 8X binoculars. Ranges approaching 200 yards were not found excessive using a 20X spotting scope if caution was exercised. These ranges can be altered appreciably due to the extent of timber cover, daylight brightness and animal movements. Table VI illustrates these ranges and conditions of observations made of 14 Gallatin and 12 Yellowstone marked calves. It will be noted that identification of outer symbols (drainages) has been made at 250 to 350 yards with 20X and at 150 to 200 yards with 6X, both under rather poor light conditions. Trippensee (1941) recorded a table of ranges of visibility for colored markers of generally smaller size used on small game. Some were easily distinguishable at 5 to 300 feet with naked eye, 8X or 10X glasses.



Fig. 15. Plastic ear markers which had remained attached approximately 6 months (returned on hunter kills).

Table VI

## Conditions of Observations of Marked Calves

No. Obser.	Magni- fication	Distance Obser. (Yd)*	Daylight Brightness	Time	Symbol Obser.	
					Outer	Inner
<u>Gallatin Marked Calves</u>						
1	8X	100 - 150	Bright	12:00 M	X	X
1	8X	150 - 200	Bright	2:00 PM	X	X
1	8X	100	Bright	3:00 PM	X	X
1	20X	100	Dull (cloudy)	2:30 PM	X	X
1	6X	30	Dull (rain)	11:30 AM	X	X
1	6X	150 - 200	Dull (dusk)	7:00 PM	X	
1	20X	80 - 100	Bright	11:30 AM	X	X
1	20X	80 - 100	Bright	3:00 PM	X	X
1	6X & 7X	20	Bright	12:00 M	X	X
1	6X & 7X	40	Bright	12:00 M	X	X
1	20X	250 - 350	Dull (rain)	2:00 PM	X	
1	6X	150	Bright	10:00 AM	X	
1	20X	100 - 200	Dull (timber)	3:00 PM	X	
1	20X	100 - 200	Dull (timber)	3:00 PM	X	
<u>Yellowstone Marked Calves</u>						
6	6X & 8X	150 - 200	Dull (cloudy)	2:00 PM	Only outer symbol used	
2	20X	250	Dull (rain)	12:00 M	"	" " "
1	20X	150 - 200	Dull (cloudy)	12:00 M	"	" " "
2	20X	100	Bright	11:00 AM	"	" " "
1	6X	200	Dull (timber)	1:00 PM	"	"

\*Estimated

## MORTALITY AND NUISANCE FACTORS

All suspected predation or accident observations encountered during this study are recorded in Table VII with three observations made by Montana Fish and Game Department personnel in 1948. Two cases of black bear predation were actually observed (Cases 1 and 2), both in 1948. Cases 4 and 9 appear to fit Murie's (1948) descriptions of bear inflicted wounds on cattle in which he found injuries in the lumbar region of the back and in the facial region. The lumbar punctures in Case 4 on one side were 3 inches apart and  $2\frac{1}{2}$  inches on the other side. These measurements are similar to those found on a yearling domestic cow by Murie, which strongly suggests that the Gallatin case was an unsuccessful attack by a bear. Cases 5 and 6 showed no evidence of injuries. Schwartz and Mitchell (1945) found a few dead young each calving season, the cause of which they attributed to general weakness or pneumonia. Although rough field analyses of bear scats were frequently made, no calf remains were identified. Eight per cent of more than 100 bear scats examined by Schwartz and Mitchell (1945) contained evidence of fawns in the diet. No evidence of coyote predation was encountered in the Gallatin although an unsuccessful attempt, due to the aggressiveness of the cow, was observed.

One accident record was suspected (Case 10) when a calf was found dead in a steep-sided creek but no evidence of injuries were found on its body.

Table VII  
Mortality Records

Case No.	Date	Cause of Death	Remarks
1	6- -48	Black Bear	Observed killing calf. Tooth punctures on either side of spine in lumbar region. Two long wounds left front shoulder (by J. E. Gaab).
2	6-12-48	Black Bear	Observed killing calf (by G. H. Sherman).
3	6-10-48	Unknown	Black bear observed eating on calf carcass (by J. E. Gaab).
4	6-13-49	Bear (?)	Calf found alive - died during day. Deep wound, 3" long, penetrating left thigh. Two punctures on either side of spine in lumbar region penetrating body cavity.
5	6-11-50	Unknown	No external signs of injuries. Carcass intact.
6	6-11-50	Unknown	No external signs of injuries. Carcass intact.
7	6-13-50	Unknown	Calf dead several days - carcass approx. 1/3 devoured. Injuries, if any, not determined.
8	6-14-50	Unknown	Carcass scattered and badly deteriorated. Injuries, if any, not determined.
9	6-16-50	Unknown	Head badly lacerated, rostrum crushed. Dentary broken, tongue severed approx. $\frac{1}{2}$ " from tip except for small portion $\frac{1}{2}$ " wide. No body injuries observed.
10	6-25-50	Drowned (?)	Found dead in creek approx. 2' wide and 3' deep. No injuries observed.

Between 1939 and 1949 the average annual calf harvest by hunters was 91 animals for the Gallatin (Angstman and Gaab, 1950). Of the 132 calves marked 11 are known to have been killed during the regular hunting seasons (1 during the 1949 season, 10 during the 1950 season). Both seasons were controlled with kills set at 700 head each year.

Intense insect infestations appear to be a major nuisance factor in July and August. During this time the high windy ridges are seemingly desired by the elk. If such areas are unavailable some protection from the insect attacks is evidently obtained by bedding down in tall sedge meadows.



## SUMMARY

1. A study of elk calves was conducted during 1949 and 1950 in southern Gallatin County, Montana and the northwestern portion of Yellowstone National Park.
2. A description of the calving ground is given with reference to location, vegetation, topography, climate and associated mammals.
3. Calving areas were covered on horseback to find the calves; weights, standard measurements and other biological data were obtained.
4. One hundred thirty-two calves were tagged with numbered metal stock ear tags and colored plastic markers composed of a large outer symbol alone or combined with a smaller inner symbol of contrasting color. Combinations of shapes, colors, sizes and ear to which it was attached identified the individual and drainage where tagged. Observations were made after the calving season particularly on the marked calves.
5. The range and peak of the calving period was found to be May 21 to June 12 and June 1, respectively.
6. A few specific vegetation types were found to contain most of the calves: sagebrush types, 77 per cent; timber, 11 percent; and "edge", 4.5 per cent. The average distance calves found in open areas were from timber was 73.7 yards, while those in timber averaged 10.0 yards from open areas, illustrating the importance of "edge effect".

7. According to age classes, determined by physical characteristics, the average weights of calves were: newborn-1 day, 32.5; 2-4 days, 36.08; 5-7, 44.71; and 8-over, 53.18 pounds. Average standard measurements for the same age classes were: 38.31-2.05-15.46-4.38; 39.98-2.23-15.7-4.42; 42.36-2.24-16.2-4.7; and 44.32-2.29-16.61-4.77 inches.
8. Weights of male calves were found to slightly exceed that of females for the above age classes as follows: 4.41, .22, 2.62, and .34 pounds, respectively.
9. For 155 calves examined, the sex ratio was 96 males : 100 females.
10. Descriptions of coloration, glands, odor, reactions and voice are discussed with some illustrations.
11. Average daily weight and measurement increases for 16 wild calves for the first two weeks were 2.0 pounds and .69-.01-.10-.03 inches, respectively. One captive calf gained, on the average, 1.0 pound daily and increased .21-.01-.05-.01 inches per day over a 31 day period.
12. Certain activities such as walking, swimming, nursing, grazing, etc. are discussed.
13. The average monthly distance that marked calves were observed from the calving grounds illustrated the general pattern of elk migration in the Gallatin drainage.

14. Observations of 1949 markers (celluloid) showed 4 negative results in 8 late observations, while the 1950 marker (plastic) showed no completely negative results for the same number of observations, although 2 markers were damaged.
15. Observations of predation were limited to 2 suspected bear attacks on calves during the study, but 2 1948 bear kills are recorded. Insects appeared to be a major nuisance factor in the summer. Hunter kills presented the greatest mortality factor during the fall. The average annual calf harvest for the last 10 years was 91 animals.

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