

**THE MUNICIPAL
UNIVERSITY OF WICHITA
BULLETIN**

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of Moose in Yellowstone National Park**

by

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UNIVERSITY STUDIES NO. 28
WICHITA, KANSAS, MAY, 1954

The Municipal
UNIVERSITY OF WICHITA
Bulletin

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UNIVERSITY STUDIES

No. 28

VOLUME XXIX

MAY, 1954

NUMBER 2

Published during the months of February, May, August and October by the Municipal University of Wichita, Wichita, Kansas. Entered as second-class matter January 4, 1927, at the Post office at Wichita, Kansas, under the Act of August 24, 1912.

SUMMER HOME RANGE AND POPULATION SIZE OF MOOSE IN YELLOWSTONE NATIONAL PARK*

John F. McMillan

INTRODUCTION

A study was made during the summers of 1947, 1948, and 1949 of the moose (*Alces americana shirasi* Nelson) of Yellowstone Park. Determination of the home range and population density during the summer months constituted the part of this study with which this paper deals.

An area of approximately nine square miles was selected for intensive study in the Swan Lake Flat — Willow Park area. It lies in a general north-south direction paralleling the main park highway about midway between Mammoth Hot Springs and Norris Geyser Basin. Swan Lake Flat is a northern extension of the central plateau of Yellowstone Park, lying approximately between the Gardiner River and Swan Lake (**Figure 1**). It is covered with grasses, sage brush, willows, and sedges. Swan Lake is a shallow lake surrounded by a wide, marshy shoreline. Until recent geologic time Swan Lake was considerably larger than at present.

Willow Park, between Gardiner River and Winter Creek (**Figures 1, 2, 3**), is the valley of Obsidian Creek and is more or less completely covered with two species of willows, *Salix Geyeriana*

* This paper is extracted from a thesis presented to the Graduate Faculty, Department of Zoology, University of Michigan, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

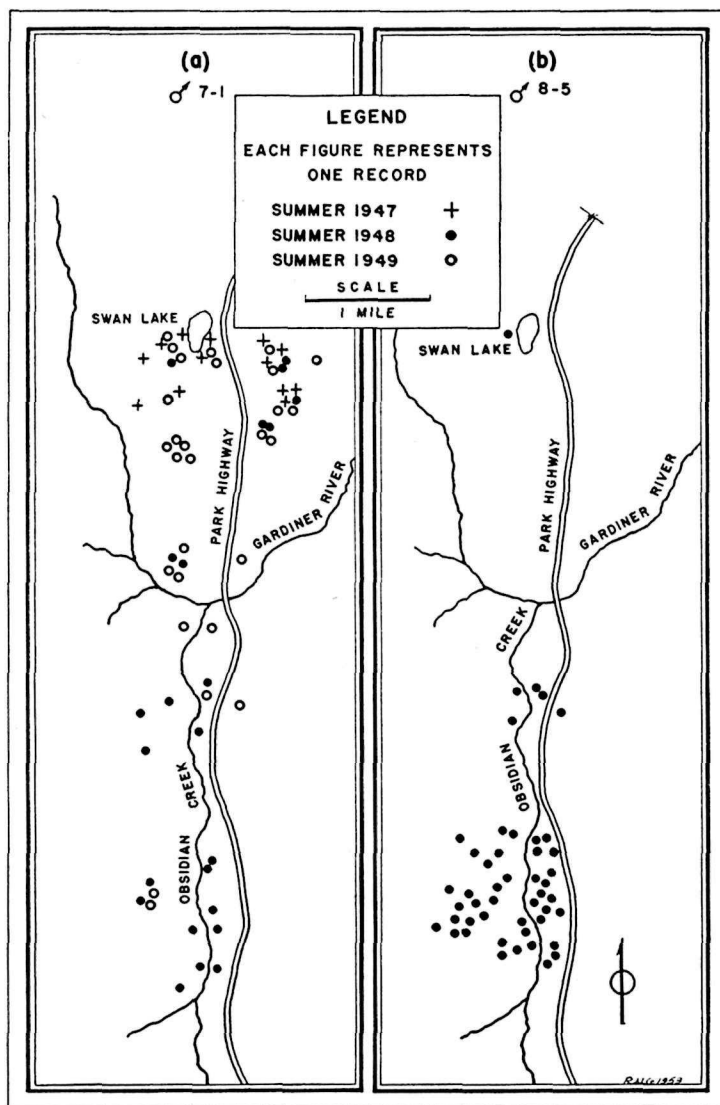


Figure 1
SUMMER HOME RANGES OF BULLS 7-1 AND 8-5.

Anders and **S. Wolfii** Bebb var. **idahoensis** Ball. These willows are important food items of the moose (McMillan, 1953).^{*} Sedges and various grasses are found between the willow clumps.

The general elevation of the study area is 7,300 feet above sea level. On either side of Willow Park, ridges rise abruptly, extending as high as 7,500 feet above sea level. These ridges are covered with a dense growth of lodge pole pine, **Pinus contorta**, Englemann spruce, **Picea Engelmanni**, and alpine fir, **Abies lasiocarpa**.

POPULATION DENSITY OF THE STUDY AREA

The population density on the study area varies from a high in spring to a low in winter. Since the present study did not extend into the winter, no data were obtained at this season. Murie (1940) says that few moose are found on the north side of the park in winter. When snow melts, making the willows available, there is a decided drift into the area. Later, as the insects become more bothersome, moose move to higher elevations. Another possible factor affecting the drift away from the willow flats is the constant daily presence of park visitors attempting to see the moose from the closest range possible. Individual moose exhibit different degrees of tolerance to this interference. The more timid react more quickly, and apparently some leave the area until tourist visitation lessens. Perhaps some of the cows about to calve move out and do not return, with few exceptions, until late August and early September. The mid-summer population is considered large for moose and is fairly constant.

Whenever it was found possible to pick out some

^{*} For references see page 16.

distinguishing character each moose was given a number. For example, in number 7-1 the first figure refers to an animal observed in 1947; the second designated the first animal that could be recognized that season. Various criteria were used to identify the moose when seen. Sex, size, color, length and shape of the bell, general physical condition, scars and blotches on the pelage were criteria used most frequently. In the case of bulls, antlers formed excellent identifying characters.

The population size in 1948 was calculated by using the same principle employed by Olsen (1938) in computing deer populations in Minnesota. The 1949 population was estimated by this method and also by direct count. This was done to check the accuracy of Olsen's method which involves the basic technic as set forth by Lincoln (1930). In this study the numbers of recognized individuals seen in two one-week periods, July 1-7 and July 8-14, 1948, were chosen as the basis for computation because by this time the number of moose seen daily was fairly constant and remained so for the rest of the summer. Also, by this time practically all of the moose that were recognized by number during the entire summer had been so identified.

The formula used in arriving at the density of population is:

$$\frac{\text{Number identified in first week}}{\text{Number seen in second week that were identified in first week}} : : \frac{\text{Total population}}{\text{Total number seen in second week}}$$

Calculation of density from this proportion is based on the assumption that the unidentified moose would be seen on the area as frequently as the identified ones. It was believed that unidentified moose were not recognized individually because they were

seen less frequently. Possibly they were transients passing through the area. It seems that the fifteen unidentified moose seen during the second week is on the conservative side of the estimate.

By applying the above formula, the population size in 1948 was found to be thirty-three. The direct count in 1949 showed twenty-nine moose on the area. The difference of four between the population of 1948 and 1949 may be due to actual fluctuation of numbers or it may indicate the experimental error in gathering the data needed to apply the Lincoln Index formula. The possibility of errors in the direct count is slight because the low willows and open woods did not provide hiding places for moose when the area was covered systematically.

In order to determine the variation in results obtained by the two methods the 1949 census was also computed by the Lincoln Index method in the same manner as described for 1948. A population of 33.3 individuals was obtained, as compared with twenty-nine by direct count. The difference in population as determined by the two methods may indicate that the Lincoln Index is less reliable than a direct count where small numbers are concerned. A difference of one in the equation could make a difference of as much as three in the result. It is believed, therefore, that a direct count on a small area is the more accurate of the two methods.

SEX RATIO

Three summers of field observations show a decidedly unbalanced sex ratio of one bull to three cows. The small numbers involved may account for part of this imbalance, but the greater part of it is due, unquestionably, to the fact that a considerable number of bulls are killed during hunting season in

the immediately adjacent areas of Idaho, Montana, and Wyoming.

Table 1

NUMBER OF MOOSE KILLED IN WYOMING, MONTANA AND IDAHO IN THE YEARS 1945-48.

State	1945		1946		1947		1948	
	Bulls	Cows	Bulls	Cows	Bulls	Cows	Bulls	Cows
Wyoming	101	29	177	29	138 ¹	42 ²	187 ⁴	27
Montana ³	80	0	80	0	95	0	80	0
Idaho	0	0	26	0	24	0	27	0

¹Of this number 55 were from Jackson Hole area.

²Of this number 10 were from Jackson Hole area.

³Number of permits issued only. No figures available on number actually taken.

⁴Twelve of this number not sexed.

HOME RANGE

There are considerable data to show that moose ordinarily have a very limited range. To study this aspect of moose ecology more accurately some method of marking would have to be devised so that extent of range could be studied from a large number. Any method of marking which would require close contact with even young calves would be quite hazardous and was not undertaken in this study. Young (1946) discusses a method used in marking deer in which an arrow tipped with a sponge rubber ball soaked in paint is shot from a bow at the animal, thus leaving a blotch of paint which serves as a means of identification. The effectiveness of this means for marking moose is questionable, but conceivably it could be used.

A record was kept of the identified animals to

learn their daily range and the general rate of movement. The home range of each animal found daily on the study area was observed to be made up of two components: (1) the willow flats where it feeds, and (2) a narrow margin of woods on the slopes of the ridge bounding the west side of the willow flats. In going back and forth between the feeding and bedding grounds, the same route is taken frequently enough to form rather well defined paths. This behavior, however, is not as pronounced in moose as in bison and elk. In two places in Willow Park the moose utilized the tops of old beaver dams as pathways across particularly marshy spots. Moose were seldom seen to go farther back into the woods from the willows than 250 yards. As the willow flats are wider than one-half mile in only a few places, the total east-west movement, an alternate coming and going from the feeding grounds, would not exceed eight or nine hundred yards. On only a very few occasions were any of the identified moose seen to range as widely as three or four miles between any two successive observations.

A total of 782 observations were made of thirty-eight adult moose over a three year period with respect to home range. The number of observations for each animal ranged from three to fifty-one in any one season. Two of the moose were observed for three summers and two were observed for two successive summers. Nine of the thirty-eight were never observed outside of a one square mile area. An additional twenty-three were never observed outside of a two square mile area. With one exception, all thirty-eight were found to restrict their home range to two square miles at least two-thirds of the time. The size of the ranges was measured by

plotting observations on a map made to scale from a U. S. Geological Survey topographic map of the area.

Summer home range maps of six representative animals, two bulls, one cow with a calf, and three mature, barren cows are included. Two are of moose observed for three summers, one for two summers, and three for one summer. All show a decided preference for that side of the highway where the willows afford the greatest protection. Gardiner River willows are found only on the west side of the road. On Swan Lake Flat willows and aquatic plants are evenly distributed and moose are found as frequently one place as another. Moose were seen to cross to the east side of the highway in the Willow Park area, which lies to the south of the Gardiner River, on only six occasions in three summers.

Bull 7-1, recognizable because of a broken leg, was the widest ranging animal of all those observed, in spite of his injury (**Figure 1a**). On two successive days he was seen at points four miles apart. However, in the summer of 1947 he was never observed outside of the same one square mile area. In 1948, however, he ranged more widely, but even then he was within an area of two square miles more than half the time. In 1949 he restricted himself to a range of two square miles 95 per cent of the time.

The time between successive sight records of various individuals ranged from one to sixteen days. Cow 8-15, for example, was observed only five times in the summer of 1948, but always on the same square mile. The longest interval between any two successive observations was sixteen days. It is not assumed that this cow never moved beyond the small

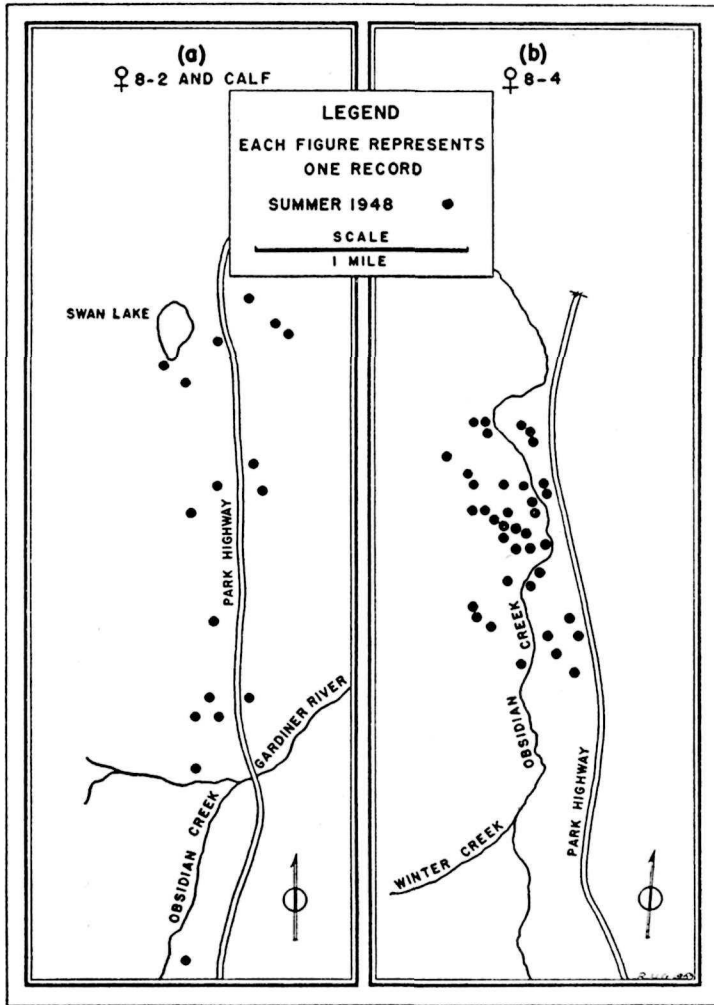


Figure 2

SUMMER HOME RANGES OF COW 8-2 AND
CALF AND COW 8-4.

area during this interval, but it indicates that her home range was limited.

Bull 8-5 was seen fifty-one times during the summer of 1948 with the longest interval between successive observations being three days. Ninety-six per cent of the records of this bull show him to be within an area of two square miles (**Figure 1b**). The first record of the season (June 4) shows him feeding in the marsh surrounding Swan Lake. By June 15 he had moved to the Willow Park area and remained there until September 6, after which no further observations were made. Eighty per cent of the records show him to be within a one square mile area.

Cow 8-2 and calf were recorded seventeen times between June 6 and September 5, 1948 (**Figure 2a**), with intervals between successive observations ranging from one to eleven days and a maximum distance moved between successive observations of approximately one and one-half miles.

Cow 8-4 (**Figure 2b**) was the most frequently observed cow in the three seasons, having been recorded thirty-eight times between June 1 and September 8, 1948, with intervals between successive observations ranging from one to seven days. From general appearance this cow was estimated to be no more than three or four years old. She had no calf and was in excellent physical condition. All records for her are well within a two square mile area, with a maximum distance between successive points of observation not exceeding three-fourths of a mile.

Cow 7-8 was observed for three summers to range well within a two square mile area (**Figure 3a**), with a maximum distance between successive observations of one and one-half miles. This cow

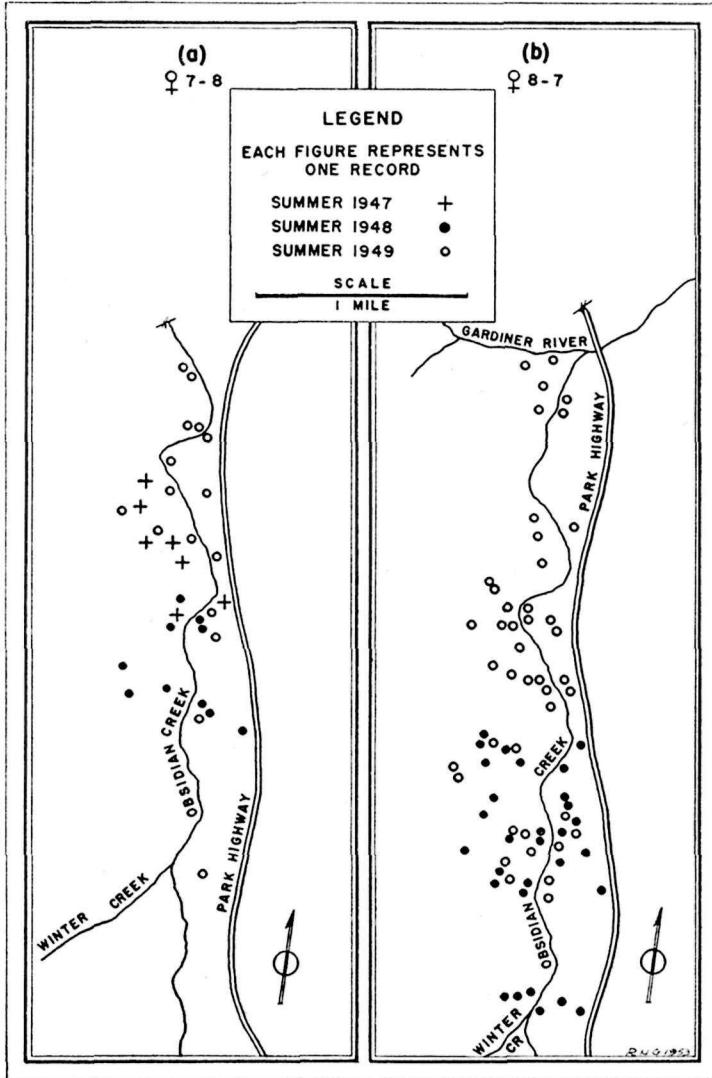


Figure 3

SUMMER HOME RANGES OF COWS 7-8 AND 8-7.

was barren each summer. She was in excellent condition and the reasons for her barrenness are unknown.

Cow 8-7 was observed thirty-seven times during the summer of 1948 and forty-three times in 1949 with a maximum interval of three days between observations. During 1948 her range (**Figure 3b**) was greatly restricted because of her extreme lameness. She ranged somewhat more widely in 1949 but still had considerable difficulty in walking. The seat of her difficulty appeared to be in the left hip joint. This cow was first seen June 29, 1948, within a few hours after giving birth to a still-born calf. The placental membranes were not completely shed for several days after the first observation. This is the latest record obtained in this study for the birth of a moose calf.

Frequently an individual will remain within the protective cover of a single clump of willows for several days. Murie (1934) cites an instance of a large bull remaining four days within a patch of willows two hundred yards square, moving only when disturbed. Cow 8-6 calved in a clump of willows twenty-five yards in diameter. The calf was first seen on June 30, 1948, and was estimated to be a week old at the time. This cow and calf were never seen outside this clump until July 12. A small stream bordering the clump made it unnecessary for the cow to leave to drink.

SUMMARY

This study was conducted during the summers of 1947, 1948, and 1949, in the Willow Park-Swan Lake Flat area of northwestern Yellowstone Park.

The summer population of the approximately nine square mile area was found to be thirty-three in

1948 and twenty-nine in 1949. The Lincoln Index method and direct counts were used to determine the population.

The sex ratio was found to be one bull to three cows. The unbalanced ratio is believed to be due largely to hunting in the states surrounding the park.

The summer home range of moose appears to encompass an area of less than one square mile to rarely more than two square miles. This range is based on 782 observations of thirty-eight adult moose over a period of three summers.

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