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Biology of white-tailed deer on winter ranges in the Swan Valley Montana

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Biology of White-tailed Deer on Winter Ranges in the Swan Valley, Montana

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FINAL REPORT

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Chapter 1

INTRODUCTION

The white-tailed deer (Odocoileus virginianus) has long been an object of particular interest because of its abundance, its almost continent-wide distribution, and its ability to adapt to a wide variety of conditions (Pengelly, 1961).

These inherent qualities have made the white-tailed deer the most sought after big game animal in the United States, and also "makes them the most susceptible of all to game management" (Taylor, 1956).

Winter ranges are generally considered to be the result of snow conditions that cause the movement of deer from their summer range to wintering areas in the relatively snow free lower elevations (Dixon, 1934). These winter ranges are usually areas of greatly restricted acreage compared to the summer range and the result is concentration of the deer and often deterioration of winter ranges due to overuse of the existing and available forage. This has led to the establishment of winter range as the principal limiting factor to big game (Olsen, 1938).

In summer, the Swan Valley white-tailed deer are found along the entire Valley from the summit of the Clearwater-Swan River Divide to Swan Lake, and also along the entire width of the Valley floor from the Mission Mountain Range on the west to the Swan Mountain Range east of the River. With the onset of snowfall in early winter, these deer converge into a small narrow belt along the Swan River from the Condon

Ranger Station to Goat Creek and in the Lion Creek Canyon. Much smaller concentrations occur in the Squeezer Creek Canyon.

Extensive logging operations have been conducted in the Swan Valley since 1955. The main objective of this study was to assess present conditions in the biology of white-tailed deer in the Swan Valley and how these conditions may have been affected by logging operations.

The specific objectives of the present study on the Swan Valley, white-tailed deer were:

1. To determine the percentage of browse utilized by deer on their winter range for comparison with earlier studies.

2. To investigate their habitat preferences as related to cover types.

3. To examine their food habits for comparison with a similar earlier study.

4. To evaluate their reproductive performance for comparison with other white-tailed deer herds.

5. To evaluate their physical condition for comparison with that of white-tailed deer on other ranges.

6. To obtain harvest data on the 1969 hunting season for comparison to earlier seasons.

7. To estimate winter mortality during the winters of 1968-69 and 1969-70.

8. To search for the presence of the brainworm (Pneumostrongylus tenuis) in white-tailed deer.

Chapter 2

DESCRIPTION OF STUDY AREA

Location

The upper Swan River Valley, in which the study area is located, extends from the Swan-Clearwater Divide north as far as the southern edge of Swan Lake. It is bounded on the east by the Swan Range and on the west by the Mission Range. The Swan River bisects the entire area and is parallel to Highway 209.

The winter range of white-tailed deer in the upper Swan Valley extends from Goat Creek south as far as Dog Creek with isolated patches along the River near Rumble and Buck Creeks. This portion of the Swan Valley comprised the major portion of the study area.

Land Ownership

The U. S. Forest Service (Flathead National Forest) and the Burlington Northern Railroad Company (B.N.) own about equal portions (alternating sections) of the upper Swan Valley. These comprise about 80% of the total area and the remaining 20% is approximately 10% state land (Montana State Forestry Department) and 10% is owned by private individuals or groups. Sixty-three percent of the land used by white-tailed deer in winter is privately owned; B.N. owns approximately 28% of the winter range, and other private holdings amount to about 35%. The U. S. Forest Service controls about 25% and the remaining portion (12%) is state owned.

Topography

The Swan Valley is approximately 40 miles long and ranges from 6 to 10 miles wide. The bordering Swan and Mission Ranges have elevations of 7000 to 10,000 feet. Elevations in the Valley range from 3,070 at Swan Lake to 4,200 at the Swan-Clearwater Divide. Much of the area has been glaciated in the past and the knob and basin topography of the Swan Valley resulted from the action of glaciers as they melted.

Geology

In the Mesozoic and Cenozoic eras, the sediments deposited in the Proterozoic, Paleozoic and Mesozoic eras were subjected to tremendous stresses, folded, broken by great faults, and elevated into the present day mountain ranges in western North America. The Swan Range was formed by such a fault early in the Cenozoic era (Deiss, 1958).

The mountains were almost covered by vast ice sheets during the Pleistocene, and the constant freezing and thawing and glacial movement created the cliff cirques and rugged scenery. The valleys were glaciated and the rock debris was carried to the lower valleys and left when the ice melted.

Climate

Complete, year-round climatological data has been available for 10 years at Lindbergh Lake and for 7 years at Swan Lake. The average snowfall at Lindbergh Lake is 147 inches and 141.4 inches at Swan Lake.

Annual temperatures range from -40^{o}F. to 100^{o}F., but these extremes are uncommon. The average maximum temperatures during November and December are from 30^{o}F. to 40^{o}F. In January (the coldest month) the maximum mean temperatures are around 30^{o}F. and rise into the mid-30^{o}F. range in February. In March the maximum mean temperatures are in the low 40s^{o} F. and in April they rise into the 50^{o} F.range. Swan Lake is generally a few degrees warmer then Lindbergh Lake. The growing season is about 149 days.

Chapter 3

HISTORY OF GAME, GAME HARVEST, AND LAND USE

Population Surveys

According to Bergeson, (1943) very little historical information on Swan Valley game herds was available and what was available was often contradictory. He suggested that the white-tailed deer reached a population high between 1900 and 1915. Large scale logging was at its peak in 1917 (on private land holdings), and it was the opinion of the local people that this reduced cover to such an extent that the deer population suffered. Bergeson also believed that the introduction of the buck law coupled with the reduction of the mountain lion were responsible for a steady increase in the deer population.

During the winter of 1934-35, the U. S. Forest Service conducted strip census counts along the entire Swan drainage and estimated that there were 4,975 white-tailed deer in the Swan Valley. The next winter, a similar study indicated a population of 5,676 deer and the F. S. authorities suggested that an either sex hunting season be initiated. They also believed that the deer population of the Goat Creek area should be reduced by 500 animals.

The first study conducted on the Swan Valley deer herd under the "Federal Aid to States in Wildlife Restoration Act" was undertaken by the Montana State Fish and Game Department. Bergeson (1943) established strip census routes and estimated a population of 5,511 deer in the Valley. Bergeson (*op. cit.*) also stated that the Swan Valley was capable of supporting more deer than it did. He mentioned localized areas where the range was being overbrowsed but said that these were negligible considering the large amounts of unutilized browse found even in areas of heavy deer concentrations. Rognrud (1949) later stated that the carrying capacity of Swan Valley was probably less than 6,000 deer. This figure was based on the appearance of overutilized localities in the Valley and his estimate of a population of 6,096 deer.

Census operations were repeated in 1950, 1951, and again in 1955. The 1951 survey indicated a population of 5,785 deer. In 1955, the survey showed a decrease to 2,022 deer attributed mostly to undesirable census conditions. Rognrud (1955) did, however, believe that there was evidence that white-tailed deer were not as numerous as in previous years. A similar but somewhat less intensive survey in 1958 estimated a deer population of 4,500 deer in the Swan Valley.

Game Harvests

The buck law was introduced in 1931. This, plus the reduction of the mountain lion, was believed responsible for the increase in the white-tailed deer population between 1931 and 1943. Very little information is available on harvests before 1952. Since then, checking stations have been operated periodically. The either sex deer season in the Swan drainage came into operation in 1951. Harvests since then have varied tremendously and the reported numbers taken depend upon hunting conditions and the intensity of checking station operations.

Range Condition

Bergeson (1943) said, "The majority of the winter range in the Swan Valley can be considered as underutilized, since large areas of available browse are either underutilized or comparitively unutilized.

To be sure, small localized areas of overbrowsing are to be found notably along trail #42 between Dog and Falls Creek, and Pony Creek; but in the light of available browse which is completely unutilized bordering these small localized areas this overutilization cannot be considered as serious."

Six years later Rognrud (1949) said that "important white-tailed deer winter ranges in the Swan Valley are beginning to have deteriorating range condition to measurement of utilization". During the winter of 1948-49 Casebeer and Rognrud (1949) conducted browse surveys on three white-tailed deer wintering areas in the Swan Valley. Their results indicated severe, over-browsed conditions in the Lion and Goat Creek areas. The range use on the area above Holland Lake was spotty and generally light. They proposed that 150 doe permits be issued every other year.

In 1958, four transects were established in the upper Swan area to measure browse utilization and conditions in some of the key winter ranges. Trend data from these key areas, namely, Goat and Lion Creeks, the Napa area, and Woodward Meadows, are now available. The amount of utilization that these areas received differed from year to year and was apparently due to variations in winter conditions. In some years, such as 1950 and 1952, some of these areas received such heavy use that the State Fish and Game Department conducted artificial feeding programs.

During the 1946-1954 period, the big game ranges in the Swan drainage were salted periodically in an attempt to relieve grazing pressure by big game on their winter ranges during spring and early summer. Records show that aerial drops of salt were made in the upper Swan and Mission Ranges in 1946 and 1947. In 1948, a total of 1,800 pounds were dropped at Condon and Swan Lake. The following year a total of 3,000 pounds were dropped. Approximately 12,000 pounds were dropped in the Swan drainage in 1952 and 1953. The last record of a salt drop was in 1954 in the upper and lower Swan and Mission Ranges.

Land Use

In 1933, it became Forest Service policy to allow no outside stock to graze on Forest Service land. However, there were a limited number of livestock that did graze on sections of private land located within the Forest boundary. Bergeson (1943) claimed that no appreciable damage was caused by livestock and that conflicting usage by domestic stock and wildlife was held to a minimum. In 1958, the U. S. Forest Service issued grazing permits for 276 cattle.

Private lands in the lower Swan Valley were logged about 1919. Limited cuttings occurred between 1919 and 1945. Since 1945, the logging industry has grown and in addition to increased cuttings on private land, timber sales were made on Forest Service land starting around 1955. In regard to the effects of these loggings, Rognrud (1949) said, "The increasing acreage of logged-over lands in the Swan should add to the white-tailed deer forage and range."

Numerous small farms are and have been present along the River in the past, but these are now merely places on which to live and income is supplemented with work elsewhere.

Other land uses in the past as well as the present include recreation (hunting and fishing), dude ranches, trapping, and summer homes.

Chapter 4

METHODS AND MATERIALS

RANGE STUDIES

The ecology of the white-tailed deer in the Swan Valley was investigated by analyzing range use, food habits, productivity, and conditions in relation to the winter range.

Browse Utilization

Utilization on the winter range was determined by measuring branches of serviceberry (*Amelanchier alnifolia*) and mountain maple (*Acer glabrum*) as described by Lyon (1970). This technique involved the measurements of the twig diameter at the initiation of the current year's growth and the length of the current year's growth. These values were used in calculating a regression equation for both plant species. The equations were then used to predict the pre-browsing length of the measured browsed twigs. Two diameter measurements were taken at right angles on each twig and averaged to obtain the mean diameter. Twig length was measured from the tip of the terminal bud to the basal bud scar. The individual plants measured were selected by the technique described by Cole (1958).

Track Counts

White-tailed deer track counts were conducted on the winter range in order to determine habitat preferences and the extent of the upper Swan Valley white-tailed deer winter range. Twenty-four transects were run between the Holland Lake road (Missoula County) and Goat Creek (Lake

County) (Figure 1). All transects ran from Highway 209 due east for one mile, and west as far as the Swan River. The writer conducted all transects and recorded tracks and trails crossed and the habitat types in which they occurred. All distances were pace distances.

Weather Observations and Measurements

A thermograph was set up approximately 5 miles north of Condon and operated from January until the end of May, 1970. Eight snow stations were located throughout the white-tailed deer winter range and weekly snow depths were recorded. These data were used in interpreting deer movements and changes in physical condition, habitat use, and food habits.

DEER STUDIES

Harvest

During the fall hunting season of 1969, two checking stations were set up on Highway 209, one at Lost Creek and another at the Beaver Creek road. All vehicles leaving the Swan Valley must pass one of these stations. Both checking stations were operated on weekends throughout the hunting season.

On each animal checked through the station, the following information was recorded: carcass weight (noting the extent to which the animal was field dressed), species, sex, and the general area where each animal was taken. Lower jaws and brains were collected with the hunter's consent.

Mortality

Winter mortality of the Swan Valley deer herd was investigated during late spring of 1969 and 1970 by running 22 transects between Dog Creek and

Goat Creek in Lake County. Each transect consisted of a strip 100 feet wide, which ran in an east-west direction from one mile east of Highway #209 west to the Swan River. All dead deer found within these strips were recorded, and the data were converted to deer losses per square mile.

During the winter of 1969-1970, highway-killed, white-tailed deer were examined to determine sex and age of the animals. Reproductive data, rumen samples, femurs, and standard measurements were also taken whenever possible.

Food Habits

Food habits of the white-tailed deer were determined by rumen analysis. These rumens were obtained from 6 road-killed animals and 26 animals collected under permit from the Montana Fish and Game Department. Two-quart samples were preserved in 10% formalin and sent to the Montana Fish and Game Department, Wildlife Investigations Laboratory at Bozeman for analysis. At the lab, a 1 quart sample from each rumen was washed through a 1/8 inch mesh screen to remove the small particles. The remaining material was separated by species and identified by me with the aid of a study area plant collection. The segregated portions were blotted dry with paper towelling and volumes measured by water displacement to the nearest .5 cc in a graduated cylinder. Material measuring less than .5 cc was recorded as being present in "trace" amounts.

Productivity

The reproductive tracts of 35 female deer were examined in order to study the degree to which reproduction might be affected by range conditions or other environmental factors. Fetuses were counted for comparison with those from other white-tailed deer herds. The number of embryos or fetuses were counted and the weight and crown-rump length of each fetus was measured.

Fawn:adult counts were made periodically from the beginning of February until the end of April in order to compare fawn:adult ratios with fetus:adult ratios.

Deer Condition

The physical condition of the white-tailed deer was measured throughout the winter in order to determine seasonal changes and to compare the Swan Valley deer with other herds. Standard measurements taken from collected deer were weight, body length, hindfoot length, height at the shoulder, heart girth, and weights of kidneys, kidney fat, hearts, heart fat, livers, and spleens. Kidney fat indices were calculated and expressed as the weight of kidney fat as a percentage of the kidney weight (Riney, 1955). A complete femur was taken from 28 road kills, 21 collected animals, and 1 carcass found intact in the study area, and the percent compression was measured by the technique described by Greer (1968). A sample, of each femur marrow collected, was analyzed at the Chemistry Station Analytical Laboratory, Bozeman, to determine the percent of femur fat.

Parasites

A total of 93 deer obtained from hunters, highway kills, and collections, under permit, were examined for the presence of the meningeal roundworm

(*Pneumostrongylus tenuis*). Obvious internal and external parasites were also noted.

Chapter 5

RESULTS

RANGE STUDIES

Browse Utilization

Stem length and diameter measurements of unbrowsed mountain maple and serviceberry twigs from a partially logged area were used in calculating prediction equations (Table 1). The plotted lines and their 95% confidence limits are shown in Figures 2 and 3.

Table 1. Correlation between twig diameter and length in serviceberry and mountain maple.

Species	Equation	r 1/
Mountain Maple	Y = -119.2 + 115.7X	.92
Serviceberry	Y = - 87.5 + 85.7X	.92

1/ the correlation between twig length (Y) and twig diameter (X).

The unbrowsed mountain maple twigs which were examined had a mean diameter of 2.62 mm and a mean length of 178.2. mm. The browsed mountain maple twigs had a mean length of 143.4 mm and a mean diameter of 3.74 mm. Inserting the browsed diameter measurements into the prediction equation and averaging them gave a predicted length of 308.9 mm. This indicates that utilization on mountain maple was 53.6%.

Similarly, unbrowsed serviceberry twigs had a mean diameter of 2.59 mm and mean length of 134.60 mm. Browsed serviceberry twigs had diameter and length measurements of 3.05 mm and 76.9 mm. On an immediately adjacent uncut area, these browsed measurements were 3.38 mm and 26.5 mm. The predicted browse length was 173.6 mm in the logged area and 202 mm in the uncut area. These values produced utilization levels of 54.6% and 86.9% in the cut and uncut areas respectively.

Browse utilization surveys have been conducted by the Montana Fish and Game Department since 1948 (Table 2). These survey results indicate a general reduction in browsing intensity in the Napa area, constant use in the Woodward block, and increased utilization since 1960 in the Goat and Lion Creek areas.

Track Counts

Six habitat types: (1) mature timber (53.2%). (2) immature timber (3.0%), (3) grassland (5.8%), (4) stream bottoms (12.8%), (5) clear cuts (10.3%), and (6) partial cuts (14.9%) constituted the percentages shown of the total transect lines sampled to obtain track and trail counts. Table 3 shows the number and percentage of deer tracks and trails encountered in each habitat type in approximately 24 miles of transect lines. A summary of each transect line is shown in Tables 20 and 21. The location of each transect is shown in Figure 3. These results indicate that 77% of the deer tracks and 83% of the deer trails were observed in the mature timber which constituted only 53% of total sampled habitat types. The distribution of deer tracks by habitat types are significantly different.

Table 2. Percent of browse leaders utilized on four areas in the Swan Valley from 1948 - 1969. 1/

YEAR	Serviceberry	Mountain Maple		
	Goat Creek	Lion Creek	Napa	Woodward
1948	--	82	--	--
1951	--	50	--	--
1958	84	85	54	86
1959	39	48	55	63
1960	46	68	79	88
1961	35	25	1	5
1962	60	58	32	89
1963	38	43	24	55
1964	57	84	21	77
1965	74	83	64	88
1966	78	51	17	34
1967	84	79	38	60
1968	78	76	9	59
1969	85	85	12	78

1/ Montana Fish and Game Department annual reports, 1948 - 1969.

Table 3. White-tailed deer use of various habitat types on the Swan Valley winter range, as determined by track and trail counts, from January through March, 1970.

TYPE	Number of observations	Percent of total observations of each type					
		Mature Timber	Immature Timber	Grass-land	Stream Bottom	Clear Cut	Partial Cut
Tracks	860	77	1	0.3	9	2	11
Trails	151	83	1	1	6	5	4

Table 4. Test of significance of difference between white-tailed deer track counts by habitat types from January, February, and March, 1970.

Habitat Type	O 1/	E 2/	$\frac{(O-E)^2}{E}$
Mature timber	660	458	89.1
Immature timber	5	25	16.0
Grassland	3	50	44.2
Stream bottom	81	110	7.6
Clear-cuts	16	89	59.9
Partial-cuts	95	128	8.5
			X = 225.3*
			d.f. = 5

* Significant at the 0.01 level.

1/ The observed number of track counts.

2/ The expected number of track counts assuming the null hypothesis that there is no difference in the distribution of track counts by habitat types.

(p. $<$ .01, Table 4). A chi-square analysis of trails in each habitat type also indicates that the distribution of trails are significantly different (p. $<$ 0.01).

Climate

The winter of 1969-1970 was characterized by mild temperatures except for a brief cold spell in December. The average monthly maximum and minimum temperatures at Lindbergh and Swan Lakes were a few degrees above normal (Tables 5 and 6). The temperatures on the study area were very similar to those at Lindbergh and Swan Lakes (Table 6).

Table 5. Mean monthly temperature and snowfall from 2 areas in the Swan Valley.

MONTH	No. of days in which temp. was above 32°F.	Maximum Temperature	Minimum Temperature	Total snow-fall in Inches	Maximum Depth on Ground
	LL 1/ SL 2/	LL/SL	LL/SL	LL/SL	LL/SL
NOVEMBER	24.7/28.1	38.7/41.7	22.2/25.2	18.3/12.8	12.5/ 6.4
DECEMBER	14.6/14.7	31.2/31.4	15.3/17.6	31.0/38.4	22.6/22.3
JANUARY	14.1/17.6	29.4/31.5	12.0/17.3	40.8/49.4	34.5/40.3
FEBRUARY	22.3/23.4	37.3/38.8	17.2/19.2	23.7/23.5	37.0/42.3
MARCH	27.5/28.4	42.8/44.6	17.9/20.1	24.5/13.5	38.5/35.0
APRIL	29.8/30.0	51.3/55.1	27.1/28.5	8.7/ 3.8	24.3/16.3

1/ Lindbergh Lake, 1959 - 1970 average.

2/ Swan Lake, 1963 - 1970 average.

Table 6. Comparison of 1969-70 temperatures and precipitation data between Lindbergh Lake, Swan Lake, and the study area.

MONTH	No. of days in which temp. was above 32°F.	Average Maximum Temperature	Average Minimum Temperature	Total Snowfall in inches	Maximum Depth on the Ground
	LL 1/ S.A. 2/ SL 3/	LL/SA/SL	LL/SA/SL	LL/SA/SL	LL/SA/SL
November	27/--/28	40.7/--/42.9	23.1/--/25.2	4 /--/ 5	2/--/ 2
December	17/--/15	33.1/--/33.5	17.4/--/21.4	18.6/--/36	13/--/20
January	14/12/17	29.3/36.6/29.7	13.0/23.5/14.8	51.0/--/61	29/27.7/44
February	25/26/26	38.7/39.9/38.6	18.0/19.1/20.9	32 /--/20	35/29.7/44
March	28/28/29	40.1/41.2/42.8	17.5/18.0/20.3	20 /--/15.5	19/29.8/41
April 4/	--/30/--	--- / 45.7/---	---/27.5/---	--- /--/---	--/25.1/---
May 4/	--/31/--	--- /64.7/---	---/35.9/---	--- /--/---	--/ 0 /---

1/ Lindbergh Lake

2/ Study Area

3/ Swan Lake

4/ No data for Lindbergh Lake and Swan Lake.

Lindbergh and Swan Lakes received a total of 125.6 and 137.5 inches of snow, respectively, from November until the end of March. Data were not available for April but temperatures were generally mild and only small amounts of snow fell. These results indicate an average winter at Swan Lake, but total snowfall at Lindbergh Lake was probably from 15 - 22 inches below normal. Data from a local resident who lives near the Swan River at the Lake - Missoula County line, suggested that approximately 103 inches of snow fell on the winter range during the winter of 1969 - 1970.

The accumulated snow depth on the winter range was approximately 9 inches in mid-January and reached a maximum depth of 30 inches during the first week of March (Table 7). Figure 1 shows the location of 8 snow stations on the study area, and data from these stations indicate a general northward increase in accumulated snow depth.

DEER STUDIES

Harvest

The data gathered by the operation of two checking stations is summarized in Tables 8 and 9. Results shown in Table 8 suggest that the percentage of animals 4 1/2 years and older, taken by hunters, has decreased since 1960.

The percentage of bucks, does, and fawns in the harvest varied from one year to another (Table 9). The number of bucks and fawns taken increased by 15.7 and 39% from the 1951-1959 average whereas the doe kill decreased by 44.8%.

Table 7. Accumulated snow depths (in inches) in the Upper Swan Valley during winter, 1969-1970.

	JANUARY			FEBRUARY				MARCH				APRIL			
STATION #	*16*	*23*	*30*	*6*	*13*	*20*	*27*	*6*	*13*	*20*	*25*	*1*	*8*	*15*	*22*
1	1.9	7.0	10.5	10.0	9.4	10.4	14.1	14.6	10.5	9.0	9.3	9.3	8.5	1.4	0
2	5.0	7.9	8.7	9.3	9.6	9.3	14.5	17.0	12.0	8.9	9.5	10.5	4.4	1.5	0
3	7.5	14.1	17.6	18.6	18.8	17.3	24.8	25.1	21.0	18.3	18.6	19.8	15.5	10.4	0
4	9.6	16.1	19.0	18.8	20.5	18.8	25.5	26.6	18.8	17.3	17.5	17.4	12.4	6.3	0
5	11.4	21.9	27.7	27.2	29.0	24.0	29.7	29.8	26.2	24.3	26.7	25.1	21.4	14.7	0
6	6.6	19.0	15.9	15.9	16.5	14.3	14.4	15.1	10.1	7.6	7.4	6.0	2.1	0	0
7	9.5	15.9	19.0	19.0	19.9	18.3	19.6	21.9	18.4	15.9	13.9	10.6	7.9	2.3	0
8	11.8	21.0	25.6	23.9	24.9	19.6	25.1	24.1	19.1	15.6	16.9	13.8	7.6	1.3	0

Table 8. Age composition of white-tailed deer harvest in Swan Valley 1953-1969.

YEAR	Age class by percentage 1/2	1 1/2	2 1/2	3 1/2	4 1/2+	SAMPLE SIZE
1953	9	33	24	5	29	21
1957	30	14	13	17	26	164
1958	18	47	6	12	17	68
1959	21	18	16	7	38	57
1/	19.0	28.0	14.5	10.3	27.5	
1962	23	36	14	9	18	22
1969	31	26	14	15	14	78

1/ 1953 to 1959 average.

Table 9. Percentages of bucks, does, and fawns in Swan Valley white-tailed deer harvest, 1951-1969.

YEAR	PERCENT OF HARVEST BUCKS	DOES	FAWNS	SAMPLE SIZE
1951	38	40	22	91
1953	51	23	26	66
1954	45	25	30	132
1957	38	45	17	297
1958	45	36	19	199
1959	32	48	20	193
1/	41.5	36.2	22.3	
1962	63	26	12	43
1969	49	20	31	78

1/ 1951-1959 average.

The average dressed weights of fawns and adults are summarized in Table 10. These results suggest that deer weights increase with age until the animal is at least 4 1/2 years old with males weighing more than females.

Table 10. Average dressed weights and calculated live weights (in pounds) by age class of deer from Swan Valley, Montana (collected during 1969 hunting season).

	MALES			FEMALES		
Age Class	Sample	Dressed Weight	Live Weight 1/	Sample	Dressed Weight	Live Weight 1/
1/2	10	65.6	86.1	7	61.0	80.3
1 1/2	10	114.5	147.1	2	107.5	138.4
2 1/2	3	161.3	205.6	3	116.0	149.0
3 1/2	4	162.5	206.2	3	118.3	151.9
4 1/2	5	181.8	231.2	-	-	-
5 1/2+	3	175.0	222.7	–	–	–

1/ Calculated from regression line

$Y = 4.15 + 1.2487 X$ where Y = live weight, and

X = dressed weight (Severinghaus, 1949b).

Mortality

The results of the dead deer survey indicate that there was no apparent difference in the number of winter killed deer between the winter of 1968 - 1969 and 1969 - 1970 (Table 11). The data indicates that 24.2 deer died per square mile on approximately 22 square miles of range sampled during the winter of 1968 - 1969. The following winter mortality dropped to 23.1 deer per square mile.

Table 11. Comparison of white-tailed deer winter mortality in the Swan Valley winter range between 1968-1969 and 1969-1970.

	1968 - 1969			1969 - 1970		
TRANSECT NO.	No. dead deer (in transect)	Area acres	No. dead deer per sq. mile	No. dead deer (in transect)	Area acres	No. dead deer per sq. mile
0	0	28.8	0	3	29.4	65.3
1	1	28.7	22.3	3	31.6	60.7
2	0	32.4	0	0	29.6	0
3	1	27.1	23.6	0	27.5	0
4	4	32.6	78.5	0	8.6	0
5	1	31.1	20.6	1	31.8	20.1
6	2	35.4	36.2	0	33.8	0
7	1	34.0	18.8	4	29.1	88.1
8	2	39.6	32.3	0	30.0	0
9	2	37.7	33.9	0	33.2	0
10	0	30.1	0	1	31.9	20.1
TOTALS	14	357.5	266.2	12	316.5	254.3
Average # dead deer/sq. mi.			24.2			23.1

The high number of fawns occurring in the sample of 56 road-killed deer suggests that fawns are more susceptible to this type of mortality than adults (Table 12).

Table 12. Age distribution of white-tailed deer by types of mortality on the Swan Valley winter range, 1969 - 1970 (sample size in parenthesis).

METHOD	PERCENTAGE					Sample Size
	Fawns	1 1/2	2 1/2	3 1/2	4 1/2+	
Harvest	31 (23)	26 (20)	14 (10)	15 (12)	14 (11)	76
Road Kills	45 (25)	16 (9)	14 (8)	11 (6)	14 (8)	56
Collections 1/	15 (4)	19 (5)	15 (4)	12 (3)	39 (10)	26
Summary	33 (52)	22 (34)	14 (22)	13 (21)	18 (29)	160

1/ Collected under permit from Montana Fish and Game Department.

Food Habits

The results of the analyses of the contents of 33 rumens are shown individually by month on Table 23 through 27, and are summarized in Table 13. These results indicate that the forage utilized by deer consists mainly of browse, both conifers and shrubs. The latter constituted a mean of 49% of all rumens examined and the former 21%. Forbs, grasses, and lichens accounted for 22, 8, and 1%, respectively, of the rumen contents.

Table 13. Percentages by volume of browse, forbs, and grass in rumens of white-tailed deer on Swan Valley winter range, 1970.

MONTH	Sample Size	Conifer Browse	Shrub Browse	Forbs	Grass and Grasslike Plants	Other Lichen
January	8	18.0	76.6	4.4	0.8	0.1
February	10	48.7	38.4	2.9	7.8	2.2
March	5	20.2	51.4	12.8	13.8	1.6
April	6	15.0	66.8	9.2	9.0	--
May	4	0.5	13.0	80.3	6.0	.3

Browse was the most frequently used winter food. In February, conifers were used heavily and in January, March, and April shrubs provided the major food supply. Grass-like plants were utilized to a fair degree from February until the end of April. In May, when green forbs appeared, they formed the major food source for the Swan Valley white-tails.

The most abundant individual plant species observed in deer rumens during the winter of 1969-1970 was Oregon grape (Berberis repens). It constituted 21% by volume of the total rumen contents and was observed in 61% of all rumens examined. Douglas-fir (Pseudotsuga menziesii) had a frequency occurrence of 76% and formed 12% by volume of total rumen content. Grasses had the highest frequency (82%) and constituted 8% of total rumen content.

Although the samples are too small to permit definite conclusions, it appears that the winter food habits of the Swan Valley white-tailed deer herd, as determined by rumen analysis, do not appear to have changed appreciably in the 12 years between 1958 and 1970 (Table 14). The only exception is grasses which constituted 4% of rumen.

Table 14. Comparison of percent rumen content of Swan Valley white-tailed deer between 1958 and 1970.[1/]

MONTH	Sample Size		Conifer Browse		Other Browse		Forbs		Grass and Grasslike Plants		Other Lichen, etc.	
	1958	1970	1958	1970	1958	1970	1958	1970	1958	1970	1958	1970
January	2	8	30	18	49	77	14	4	7	1	Tr	Tr
February	3	10	35	49	57	38	5	3	3	8	Tr	2
March	2	5	24	20	73	51	2	13	1	14	Tr	2
April	2	6	20	15	70	67	5	9	5	9	Tr	Tr
May	-	4	--	1	--	13	-	80	-	6	--	Tr

1/ 1958 sample from Montana Fish and Game Department annual report, 1959-1960.

contents in 1958 and increased to 8% in 1970. Forbs, grasses, and lichens were observed in the rumen during each month of observation in 1958 and again in 1970.

Productivity

The reproductive data collected from 35 does indicated an average pregnancy rate of 57.1% for all age classes, 100% for yearlings, and 88.2% for adults. The 3 1/2 year age class was most productive and of 13 female fawns examined, none appeared to be pregnant (Table 15). The mean fetal rate for pregnant does was 1.60.

Table 15. Reproduction of female white-tailed deer collected from the Swan Valley during the winter, 1969-1970.

Age Class	No. of Females	Number Pregnant	Fetuses	Fetuses/Female
Fawns	13	0	0	0.0
1 1/2	5 1/	5	6	1.20
2 1/2	5	4	6	1.20
3 1/2	5	5	9	1.80
4 1/2	5	4	8	1.60
5 1/2	-	-	-	--
6 1/2+	2	2	3	1.50

1/ Includes female that aborted (presence of caruncles on uterine wall).

Comparison of the Swan Valley females with other populations (Table 16) suggests that the Swan Valley does, especially fawns, are less productive than doe, white-tailed deer from other areas.

Table 16. Productivity of white-tailed deer from the Swan Valley compared to other fertility levels reported in the literature (sample sizes in parenthesis).

	CONCEPTION RATES % Fawns		Yearlings		Adults		Fetuses/ Female Fawn	Fetuses/ Adult Female	Fetuses per Female
Illinois 1/	41.3	(160)	95.5	(110)	96.7	(362)	0.41	1.81	1.39
Maine 2/	24.1	(54)	80.8	(78)	95.9	(74)			
Massachusetts 3/	58.8	(17)	92.0	(50)	98.8	(86)	0.59	1.74	1.61
Manitoba 4/									
Whiteshell	0.0	(10)	90.0	(10)	100.00	(36)	0.00	1.70	1.39
Turtle Mtn.	25.0	(16)	100.0	(7)	97.5	(39)	0.31	1.85	1.45
Duck Mtn.	30.0	(10)	100.0	(7)	100.0	(24)	0.30	1.77	1.41
Michigan 5/	58.5	(70)	100.0	(29)	93.3	(45)			
Swan Valley, Mont.	0.0	(13)	100.0	(5)	88.2	(17)	0.00	1.45	0.91

1/ Roseberry and Klimstra (1970).
2/ Banasiak (1961).
3/ Shaw and McLaughlin (1951).
4/ Ransom (1967).
5/ Ryel and Fay (1961).

A doe collected on May 20, 1970 was not gravid, but large caruncles on the uterine wall indicated that she had been pregnant.

Fetal counts and weights taken from 14 does are recorded in the appendix (Table 28).

Fawn:Adult Ratios

The classifications of 327 white-tailed deer during this study indicated a fawn:adult ratio of 45 fawns:100 adults. These results were compared with those from the Swan Valley from 1935 to 1967 (Table 17). Table 17 indicated wide fluctuations in these ratios from one year to another.

Table 17. White-tailed deer fawn/adult ratios from the Swan Valley, 1935-1970. 1/

YEAR	ADULTS	FAWNS	UNCLASSIFIED	FAWNS/100 ADULTS
1935	19	56	1,122	294
1936	49	21	1,522	43
1941	17	20	6	117
1943	45	56	17	124
1949	188	68	115	36
1950	214	87	--	41
1955	61	42	74	69
1958	167	99	139	59
1959	207	68	--	33
1960	77	30	--	29
1961	19	8	--	42
1962	80	33	--	41
1963	59	31	--	53
1964	234	90	--	38
1965	188	108	--	58
1966	33	17	--	52
1967	--	--	--	51
1970	225	102	--	45

1/ Montana Fish and Game Department annual reports, 1935-1967.

Physical Condition

The kidney fat indices and the femur fat contents generally decreased from January to the end of May. The summarized results are shown in Table 18 with individual results recorded in Tables 30 and 31. However, variations among both indices of the same sex and age class were high, even within the same month.

Table 18. Comparison of kidney fat indices and femur fat contents of Swan Valley white-tailed deer, January to May, 1970.

SEX & AGE	Kidney Fat Index					Femur Fat 1/				
	J	F	M	A	M	J	F	M	A	M
Fawns (M)	100.8	28.8	-	-	-	-	45.1	36.1	-	-
Fawns (F)	68.5	27.7	7.2	-	8.9	84.5	82.4	58.1	44.6	0.4
Bucks	19.1	17.9	-	-	10.0	85.8	75.4	58.2	24.2	11.6
Does	83.6	43.8	23.1	9.6	8.1	91.9	92.8	39.7	5.5	21.6

1/ Ether Extract.

Fawns generally had higher kidney fat indices than adult bucks but lower than adult does. The limited data on adult males suggest that the kidney fat indices were approximately 19% in January and remained below that level during the duration of the study. It appears that the condition of adult females peaked in December - January, and declined until the end of May when the project terminated.

Despite high variations between individuals of identical sex and age classes, the femur fat content (ether extract) generally followed the same downward trend established by the kidney fat indices. These results, however, indicate that fawns were in poorer condition (lower femur fat content) than adults. The femur-fat content of adult bucks was lower than that of adult does in January and February but higher in March and April.

The femur-fat content of road-killed deer was compared to that of collected deer. The sample is too small to permit definite conclusions, but the results indicate that the road-killed deer had a higher femur-fat content than those collected under permit (Table 19).

Table 19. Comparison of the percentages of fat in femur marrow samples between road-killed and collected white-tailed deer from the Swan Valley, 1970 (expected value in parenthesis).

MORTALITY TYPE	AGE					TOTALS
	Fawns	1 1/2	2 1/2	3 1/2	4 1/2+	
Road Kills	53.1(53.2)	41.0(46.9)	71.4(59.1)	68.1(56.0)	43.7(62.1)	277.3
Collections	38.2(38.0)	39.2(33.5)	29.8(42.2)	28.1(40.0)	62.8(44.4)	198.1
TOTALS	91.3	80.2	101.2	96.2	106.5	475.4

$X^2 = 27.0$
d. f. = 4

Femur-fat contents were graphed against the kidney fat indices of 25 white-tailed deer (Figure 4). The results indicate (with one exception) that the kidney fat index decreased to an index of about 20 without an appreciable change in the fat content of femur marrows.

After this point was reached, the fat content of femur marrow decreased sharply and had wider ranges than when the kidney fat index remained above 20.

A comparison of the compression of femur marrows and the ether extraction showed that marrow having 0% compression had a range of 82.9 to 97.5% fat content and averaged 89.9% (Table 20).

Table 20. Comparison of percentage of compression of femur marrow and femur fat content (ether extraction) of Swan Valley white-tailed deer, January to May, 1970.

Percent Compression	Sample	Percent Fat Ether Extraction Average	Range		
0-	13	89.9	82.9	--	97.5
1-5	5	81.6	75.9	--	90.8
6-10	5	55.6	39.7	--	64.3
11-15	1	60.0	--	--	--
16-20	4	47.8	33.5	--	56.9
21-25	6	17.1	1.9	--	44.7
26-30	5	12.5	2.9	--	33.1
31-35	3	1.2	0.4	--	2.9
36-40	3	19.3	0.2	--	40.1
41-50	2	10.2	0.3	--	20
51-60	1	0.2	--	--	--

Early stages of decreased fat content were discerned by a 1 - 5% compression, with an average fat content of 81.6%. As the percentage of compression increased beyond 20%, the range of femur-fat content doubled. This suggests that the compression technique has limitations when 20% compression is reached.

Parasites

Examinations of brains from 93 white-tailed deer of all ages and both sexes failed to reveal a single specimen of the brainworm (*Pneumostrongylus tenuis*). Behrend and Witter (1968) found that 84% of all white-tailed deer they examined in Maine harbored the parasite.

Eight of twenty-six deer examined (30%) were harboring the liver fluke (*Fascioloides magna*). One animal had an abscess the size of a grapefruit just under the skin in the right flank. Dr. Nakamara, Department of Zoology, University of Montana, Missoula, examined the abscess, and tentatively identified it as containing caseous lymphadenitis (*Corynebacterum ovis*).

Chapter 6

DISCUSSION

RANGE STUDIES

Browse Utilization

Techniques used in determining browse utilization vary from estimating overall percentage (Cole, 1958), or length utilization (Dasmann, 1951), to before and after browsing measurements of marked twigs (Dasmann, 1948).

Various definitions of the term "twig" are available in the literature. Telfer (1969) used twig to mean that part of a branch distal to the point where branch diameter would, if air dried, equal the largest diameter observed for the stub of a browsed branch of that species. By this definition, a twig could contain growth produced in several growing seasons. In this study, a twig refers to that portion of the plant produced during the last growing season, and is often referred to as the current annual growth. Utilization refers to the reduction, by browsing, in length of current annual growth.

The regression analysis, used in analyzing the relationship between twig diameter and twig length, suggests a linear relationship. Scatter diagrams for my data provide further evidence that the relationship is linear.

Lyon (1970) stated that the relations of twig weight and length to twig diameter varied significantly from site to site, by size of plant, and by location of twigs on the plant; but he reported that in practical applications, the variations between the latter two could be circumvented by randomizing the sampling procedure. He also stated that a distribution of 65 measured twigs could predict the population mean with ± 10% of the sample mean and that these predictions would be correct about 95% of the time.

Site is the variable that cannot be randomly stratified. Therefore, I calculated my own regression equations for serviceberry and mountain maple for a partially logged portion of the Lion Creek area (Table 1). These equations yielded utilization values of 53.6% on mountain maple and 54.6% on serviceberry. Lyon (1970) found that at 60% utilization of serviceberry, the estimated utilization (using the regression equation) within 10 percentage points is relatively high. Therefore, in my opinion, the estimated percent utilization of serviceberry in the Lion Creek Canyon area is a good estimate of actual utilization. Stickney (1966:205) showed that when 100% of all twigs are browsed, utilization is approximately 60%. Since the percentage of serviceberry twigs which were browsed approached the 100% level, and the browse surveys revealed 54.6% utilization, my results are comparable to those of Stickney (1966).

An examination of my regression equations shows that for serviceberry and mountain maple twigs having the same diameter, the length of mountain maple produced is 33.7% greater than for serviceberry. Since the utilization values are quite similar (53.6% for mountain maple and 54.6% for serviceberry), it appears that mountain maple forms a greater portion of the browse diet of deer than serviceberry. This is based on the assumption that the browsing was exclusively by deer; since I observed no elk or elk tracks in the area during the winter, I think the assumption is valid.

The mean diameter of browsed twigs of serviceberry and mountain maple are greater than those of unbrowsed twigs. This, in my opinion, reflects deer use and indicates either that a preference for larger twigs exists, or that larger twigs are browsed because they are more readily seen. In spite of these differences between the means of browsed and unbrowsed twigs, the regression equation is still a good indicator of utilization because the ranges in individual diameters of browsed twigs falls between the ranges in unbrowsed twig diameters used in calculating the regression equation.

The differences between serviceberry utilization on the logged and unlogged areas probably reflects differences in habitat preferences. The partially logged area lies between Lion Creek and the south-west facing slope of the unlogged Lion Creek Canyon. In the winter, "travel lanes" were abundant in the logged areas; these trails connected the creek bottom with the relatively snow-free uncut portions above. Relatively few tracks left these trails in the partially logged area. This would explain the difference in utilization between the two areas. The logged areas, however, also are on southwest facing slopes and were snow-free before the remaining portion of the valley. Deer probably used these logged areas in late winter or early spring, prior to moving to their summer range. This could explain the degree of browsing on the logged area.

Using Lyon's (1970) combined equation for all sites, utilization percentages of 66 and 90 for serviceberry on the cut and uncut areas respectively were obtained. The equation derived for this study yielded percentages of 54.6 and 86.9 respectively. In both cases, Lyon's equation over-estimated utilization, but the difference decreases with an increase in utilization. These results agree with those of Lyon (op. cit) indicating that at low to moderate utilization levels, a regression equation derived for a particular site will predict the true utilization better than a combined equation for all sites. Although the equation used in estimating serviceberry utilization in the uncut area was derived from data of the logged area, the similarity in utilization levels in the uncut area between my equation and that of Lyon (1970) suggests that the estimate is fairly accurate and indicates a difference in utilization levels between the cut and uncut areas.

Track Counts

The distribution of deer tracks and trails (Tables 3 and 4) indicates that the deer wintered almost exclusively in uncut areas and that clear-cuts were very lightly used. Literature on the effects of timber stand removal on wildlife is numerous and the generally accepted beliefs are aptly summarized by Krefting (1962); "The best and most far-reaching method yet devised for improving deer habitat is the use of various cutting practices. When logging is accomplished on a rotation basis, it produces a variety of different age classes of trees and this usually results in a maximum amount of food, and cover."

Logging generally increases the amount of browse produced on an area (Beall, 1962; Krefting, 1962; Lay and Taylor, 1943; Morton and Sedam, 1938; and Westall, 1954). Their studies show an increase in the amount of browse following logging, but they do not relate the amount of browse produced to the amount of browse available to wildlife during the winter. Since the condition of the winter range is generally accepted as the major limiting factor, the amount of browse available to the animal on its winter range is an important factor.

Reynold's (1962 a) Colorado studies showed an increase in vegetation and in deer use following logging, but he stated that the study area was on deer summer range. His other study (Reynolds, 1962 b) reflected relatively equal use of clearcuts by deer up to a distance of 700 feet from the forest edges. His results were based on pellet group data and may reflect spring, summer, or fall rather than winter use. I observed numerous pellet groups in the Swan Valley clearcut areas, but my track count results indicated that these clearcut areas were not used by deer during the winter. However, as soon as the snow disappeared from these cutover areas, the deer moved into them. This would account for the presence of the deer pellet groups.

Limited literature is available regarding detrimental effects of logging practices. Swift (1953) stated that even though cutting was beneficial to the creation of deer habitat in Wisconsin, the restriction of cutting of coniferous cover species within deer yards was an important consideration as those species were valuable as cover. Pengelly (1963) believed that large scale clearcuts at higher elevations often did not contribute to the amount of winter deer ranges, and he recommended that the clearcuts be small and scattered. Hosley (1956) made reference to a Maine deer study that indicated that if islands of conifers were left in large cuttings, the deer will use the areas around these, but since I observed no clearcuts with islands of conifers in them, I do not know whether this type of behavior occurs in the Swan Valley.

Krull (1964) believed that during the severe weather of midwinter, deer moved into uncut areas because of the shelter they provided, but prior to and after this time use was greater on cut areas where food was more plentiful. The absence of deer tracks in the Swan Valley clearcuts is, in my opinion, partially caused by increased snow depth in these areas. The fact that snow depth is greater in clearcut areas than in surrounding uncut areas was shown by Berndt (1965).

Climate

Data on winter temperatures during 1969-1970 suggest a relatively mild winter since, despite a total of 63 inches of snowfall by the end of January, the maximum accumulated snow depth was only 28 inches. An additional 20 inches, which fell during February, increased the snow depth by only 2 inches while 20 inches of snow in March accompanied a decrease of 3 inches.

Although the data on snow stations (Table 7) are based on a small sample, I believe they represent a typical pattern. Station numbers

1 - 5 inclusive were located in open areas whereas 6 - 8 inclusive were placed in timber, and the latter are therefore not representative of the actual accumulated snow depth. The northward increase in snow depth (Table 7 and Figure 1) is, at least partially, caused by a rain shadow created by the Mission Mountains. The elevations of this network of mountains are much higher in the southern portion of the area and gradually decrease as they extend further north. This would explain what is generally called a "snow belt" which lies roughly between Goat Creek and the town of Swan Lake.

Severinghaus and Cheatum (1956) mention the migration of white-tails from the divide between the Clearwater and Swan River drainages, south down the Clearwater and north down the Swan River. My data indicate that in so doing, they are moving to an area of greater snow-fall.

DEER STUDIES

Harvest

Data on the age composition and the percentage of bucks, does, and fawns harvested (Tables 8 and 9) indicate wide ranges between 1951 and 1969. These differences are at least partially caused by differences in hunting conditions and by variation in the intensity of checking station operations. The 1969 hunting season was characterized by a lack of precipitation and mild temperatures making hunting difficult. Since younger, less-experienced deer are more vulnerable (Taber and Dasman 1958, and Taber and Rognrud 1959), these age classes in the kill were probably more highly represented than they existed in the population, particularly during the early part of the hunting season. During a single weekend of checking station operations in mid-November, the kill of adult bucks (2 1/2 years and older) outnumbered the remaining kill of 2 to 1. This ratio may not represent the actual ratio of the kill for that weekend since hunters are more likely to stop and report a buck than a doe, but it is indicative of an increase in the buck kill during that weekend, and is probably caused by the onset of the breeding season. If I had not operated a checking station during that weekend, the percentages of bucks in the harvest would be much lower. The fawn:doe ratios based on hunter kills are discussed in the reproduction section of this report.

Since the intensities of past checking stations are unknown, the variabilities in sample numbers probably reflects hunting conditions, checking station intensity, and population trends, but the relative importance of each is unknown.

In spite of the biases discussed above, the data in Table 8 suggest that the percentage of old animals in the population has decreased since 1951. This trend may be the result of the introduction of an either sex season in 1951 and increased hunting pressure in the past 20 years. The high recorded kill from 1957 to 1959 is partially attributable to the presence of two continuously operated checking stations in the Swan Valley during those seasons. Montana Fish and Game reports for this period describe the winters from 1957 to 1960 as being mild to unusually mild. Increased reproduction and good hunting conditions also may have contributed to the high reported kill.

Field dressed weights of hunter killed deer were generally higher during this study than those reported for Montana white-tailed deer by Mackie (1964), with the Swan Valley fawns weighing an average of 6 pounds more. Adult deer from the Swan Valley also appear to be slightly heavier, although limited data on them prevents definite conclusions. However, when compared to Minnesota fawns (Erickson et. al. 1961), the Swan Valley male and female fawns averaged 9.7 and 11.3 pounds less than the Minnesota males and females (See discussion section on reproduction).

Mortality

Variations in the number of dead deer per square mile found between transect lines during the dead-deer surveys (Table 11) prevents statistically valid conclusions. However, this type of information can be of value in determining trends in the population and in the habitat.

Data collected on the dead-deer surveys indicate no major difference in mortality between the two winters of this study. However, an examination of climatological data indicates that during the winter of 1968-1969, the area was characterized by below normal temperatures and above normal precipitation, whereas, during the following winter, temperatures were normal to slightly above normal and precipitation was at or slightly below normal.

Although data are limited and too variable to permit definite conclusions from being drawn, they suggest that winter mortality is relatively high during a normal winter.

Road Kills

Data on the road-killed deer suggest a fawn:adult ratio of 83:100. However, the fawn:adult ratio I observed during the winter was 45:100. This indicates that the fawn:adult ratio observed from road-killed deer is not representative of the actual age ratio and suggests a higher mortality rate in the fawn sizes. This may be partially caused by deer behavior since during their first winter, fawns generally stay with the does (Hawkins and Klimstra, 1970). I observed that does crossing the highway generally led and their fawns would follow, often by several hundred feet. Motorists seeing a deer crossing the highway probably assume that there is only one, and/or concentrate on the deer crossing the highway and don't see the approaching fawn, which may be trying to join its mother because something, such as an automobile, disturbed it.

Food Habits

According to Hosley (1956) the type of food utilized by deer is dependent on several factors. First, there are marked regional differences. Plants utilized by deer in Florida are different from those used by deer in western Montana since few species are available in both areas. Second, a plant may be favored in one area and yet, almost untouched in another region because of the presence of a more palatable species. Third, the density of a deer population determines what plant species ranks as number one in an area. As the population builds up, the most palatable species disappear first, followed by others in order of decreasing desirability. If overpopulation reaches a critical stage, the animals have available in quantity only foods of low nutritional value. Lastly, differences can also occur from winter to winter since during a season of light snow deer can feed on low growing plants that would be unavailable under normal conditions.

In the Swan Valley, white-tailed deer (Table 13) rely heavily on browse during winter and utilize grass in spring. This pattern of forage utilization is typical of northern deer (Hill, 1956). The increased use of browse results from the reduced availability of low growing plants due to snow conditions as well as to a higher nutrient content in browse. The type of conifer browse preferred by white-tailed deer in the Swan Valley is Douglas-fir. Adams' (1949) studies of Montana whitetails indicated that deer preferred ponderosa pine to Douglas-fir. Nellis (1964) and Knoche (1968) reported similar findings for mule deer. My results show that lodgepole pine had the same frequency of occurrence and a higher percent of total rumen content than ponderosa pine; this indicates that lodgepole pine is also preferred to ponderosa pine. Since the density and distribution of these conifers on the study area are relatively unknown, it is impossible to say whether results on conifer use reflect food preferences or are merely indicative of higher densities and greater distributions of Douglas-fir and lodgepole pine. Both are more numerous on the study areas than ponderosa pine.

The plant species most heavily utilized by deer during the winters of 1958-59 and again in 1969-70 was Oregon grape. This low growing plant may not occur so frequently in the diet of deer when snow is deep. The winter of 1969-70 was relatively mild, with light snowfall and this probably accounts for the high occurrence of Oregon grape in the diet. Serviceberry and mountain maple are considered excellent deer foods, although they comprised only a small portion of the diet during this study. This may be explained by the fact that they are not abundant in all areas.

Forbs and grasses were utilized throughout the winter of 1969-70, which was mild with below normal snow depths. Grasses formed only a minor portion of the diet in January and February (4%) but in spring (March, April and May) their use increased to 10%. My winter results on grass-use are similar to those of Allen's (1965) whitetail studies in eastern Montana. He recorded an average volume of 6% grasses in deer rumens during the winter, but his spring observations showed an average volume of 43%.

Green forbs appeared in late April and immediately became a major item in rumens. One rumen collected on May 6 contained 97% forbs of which dog tooth-violet (Erythronium grandiflorum) constituted 80%.

Lichens (Allectoria spp) appeared in all months of the study in 1970 and for similar months in 1958, but generally only in minute quantities; however, one rumen contained 21%. These results do not support past local theories that Allectoria spp was a basic winter food for deer in the Swan Valley. Studies by Norris (1943) revealed that succulent grass would pass through the stomachs of ruminants in less than 10 hours, whereas coarse forage, such as straw, could be found in the stomach up to 4 days after an animal was fed. He concluded that stomachs could show large percentages of coarse browse, which had been eaten over a period of days, suggesting that browse is the chief diet while in reality rapidly digested succulent forage may have been consumed in larger amounts.

Allectoria spp or "tree moss", as it is locally known, is a very small and hairlike plant and because of its size, could be rapidly digested. Because of its size, it is also possible that "tree moss" could get "lost" among the rumen contents, since most rumens examined contained it even though the individual specimens were so small that separation from other plants was impossible. Based upon this characteristic and the findings of Norris (1943), tree moss forms a greater proportion of the diet than the results indicate. On the same basis, conifer browse may constitute a lower percentage than revealed by my findings.

Productivity

Although the data are too limited to show definite conclusions, they strongly suggest that the fetal rates of the Swan Valley deer are lower than reported in the literature (Table 15). My results indicate a pregnancy rate of 57.1% for all age classes as compared with 67% by Roseberry and Klimstra (1970; calculated from data in Table 1). They reported a 97.1% pregnancy rate for yearlings and adults, compared to 91% for this study. The mean fetal rate of 1.60 for gravid does from this study were lower than reported for Manitoba by Ransom (1967) and for Illinois by Roseberry and Klimstra (1970).

It is also lower than reported for mule deer on the National Bison Range in Montana (Nellis, 1964) and similar to the rate reported for the Rattlesnake mule deer in Montana (Knoche, 1968). The absence of breeding among the Swan Valley female fawns is in direct contrast with the evidence reported in the literature (Table 16). Roseberry and Klimstra (1970) reported that 41.3% of Illinois fawns were gravid. The incidence of breeding among fawns has been shown to vary widely in different parts of the range of white-tailed deer and within smaller regions according to quality of habitat. In New York, pregnancy rates ranging from 3.4 to 32.3% (Cheatum and Severinghaus, 1950) and 4.2 to 36.2% (Morton and Cheatum, 1946) have been reported for areas offering poor to excellent deer habitat. Ransom (1964) stated that reproduction in fawns was a good indicator of range quality and varied from 0 fetuses per fawn in poor habitat to 1.25 in good range.

On the basis of no apparent reproduction by fawns in the Swan Valley, it appears that the Swan Valley winter range is in poor condition. Cheatum and Severinghaus (1950) suggested that fawns in northern New York failed to reproduce because of poor post natal nutrition resulting in poor over-all physical condition; fawn weights supported this explanation. Cheatum and Severinghaus (op. cit) also believed that a vigorous winter would adversely affect not only the developing embryos but also lactation. An inadequate quantity and quality of milk would have a retarding effect on the growth of the fawns.

The winter of 1968-69 in the Swan Valley was considered severe. Pregnant does surviving the winter probably were in poor condition and lactation probably placed a further drain on these does. Unless lush summer range was available, they may have had a reduced reproductive potential in the ensuing 1969 rut (Verme, 1965 and 1969). This could explain the low fetus rates for adult does in this study.

As discussed above, the physical condition of fawns is of prime importance if they are to breed as fawns. Cheatum and Severinghaus (1950) used weights as indicators of physical condition. Erickson et al (1961) reported that approximately 20% of the Minnesota white-tails bred as fawns. Average dressed weights of fawns collected during the first half of November were 75.3 and 70 pounds for males and females. Fawns collected during the same time of year in the Swan Valley averaged 65.6 and 61 pounds dressed weight for males and females, indicating that Minnesota fawns were considerably heavier than those in the Swan Valley. These data also suggest that fawns in the Swan Valley may not have been physically mature by the onset of the breeding season.

Cheatum and Morton (1946) and Roseberry and Klimstra (1970) found that the peak of fawn breeding occurred 4 - 5 weeks later than the peak for adults. Therefore, it is possible that I missed some embryos in January; since I did not examine their ovaries, I cannot conclude that fawns did not breed as fawns although the absence of embryos and fetuses in the March and April samples suggests that breeding did not occur.

Leopold et al. (1951) stated that a sample of 50 deer, if classification is made with considerable care, is adequate to indicate accurately the composition of a deer herd and will not vary by over 5% from the results of a much larger sample. Since any doubtful classifications were omitted from the sample, I feel that the fawn:adult ratio indicated is accurate.

The ranges in fawn:adult ratios are at least partially caused by winter conditions. Fawns are generally considered to be more susceptible to winter mortality than adults. A mild winter followed by another mild winter would probably reflect a high fawn:adult ratio, since during the first winter does would fare comparatively well and produce healthy offspring which could in the ensuing mild winter comprise a substantial proportion of the population. Conversely, two consecutive severe winters, or even a severe winter followed by a normal one, would probably produce low fawn:adult ratios. The unusually high ratios found in 1935 (Table 17) are, in my opinion due to the inability of the U. S. Forest Service recorders to distinguish between fawns and adults because including ova losses, prenatal mortality, and postnatal mortality (such as hunting), the value produced would far exceed the biotic potential of white-tailed deer.

There are numerous data available on the ratio of adult males to adult females. Morton and Cheatum (1946:246) list ratios of adult males to adult females for various ungulate species ranging from 38 adult males:100 adult females to 100 adult males:100 adult females. Combining the adults of known sex and age classes of deer found in the 1969 dead-deer survey and from known road-killed deer, the adult male:adult female ratio is 81.8 males:100 females. Assuming this ratio to be representative of the actual ratio in the population (based on a sample of 22 adult females and 18 adult males), the fawn:adult ratio of 45:100 adults could be estimated as 81.8 fawns:100 does. This figure is probably a better estimate of the actual ratio in the population than the figure of 153 fawns:100 does collected from hunters, since hunter biases do not affect the former ratio to the same degree.

Sex ratios high in females are sometimes blamed for lowered breeding potential in the Adirondacks but the general consensus is that in deer, a ratio of one male to 3 or 4 females is sufficient for breeding of all females (Morton and Cheatum, 1946). A ratio of 81 adult males:100 adult females is more than adequate from this standpoint.

Physical Condition

An initial comparison of the kidney fat index between the Swan Valley white-tails and those reported by Taber et al. (1959) for mule deer in Montana, indicate that the seasonal cycle of condition is similar for both deer herds. Bucks had lower kidney fat indices than does and fawns, having declined rapidly during the rut (Nellis, 1964; Taber et al., 1959). Nellis (1964) and Cooperrider (1969) stated that physical condition of Montana mule deer does on the National Bison Range and on Rock Creek declined in condition from January until March, levelled out in April and increased slightly in May. My results indicated that the Swan Valley white-tailed does declined in condition, at least until the end of May.

Since Harris (1945) and Cheatum (1949) found that marrow fat is the last fat reserve to be used by deer, I obtained the percentage of fat in femur marrow from 49 deer to determine whether further deterioration in condition had escaped detection by the kidney fat index method. In comparing the femur fat content of bucks and fawns, both were at approximately the same level in January, but condition of fawns dropped faster and remained below the buck level for the duration of the winter, except April. This is in direct contrast to the kidney fat index, which indicated bucks to be in poorer condition than fawns.

The marrow fat content of does was higher than that of bucks during January and February but dropped below the buck level in March and was even lower in April, apparently because of the additional energy required by the gravid does. This also contradicts the kidney fat index method which indicated that bucks were in poorer condition than does throughout the winter. A comparison of femur fat content between the Swan Valley white-tailed does and the Rock Creek mule deer does (Cooperrider, 1969) suggested that the white-tailed does were in poorer shape than the mule deer does even though the winter was milder in the Swan Valley.

A comparison between the femur fat content and the kidney fat index of 20 was reached. These results were similar to those of Ransom (1965) although he found that below an index of 30, the femur marrow content dropped sharply. Since the fat content of femur marrow is accepted as a good indicator of physical condition (Harris 1945, Cheatum 1949, Riney 1955), it must be concluded that kidney fat indices do not reflect condition as well as the femur fat once the kidney fat index drops below 20. Figure 4 also shows that the kidney fat indices did not decrease to 0 but remained at a level of 5 or higher.

The latter results appear to conflict with statements made by Harris (1945) and Cheatum (1949). Harris claimed that femur fat is not mobilized until all other fat reserves have disappeared and Cheatum stated that the fat content of femur marrow did not fall below 50% until fat within the body cavity was exhausted. My results for white-tailed deer agree with those of Ransom (1965) who reported that small amounts of fat were present on the kidneys of white-tailed deer during the final stages of starvation.

The third method used to assess physical condition was the compression of femur marrow (Greer, 1968). This method appears to be fairly accurate as an indicator of conditions as long as compression of femur marrow remains below 20%. Beyond this point, there is too much variability in the fat content of femur marrow (Table 20). Greer's (1968) results on elk showed that the variability of femur fat was greatly increased when a 15% compression was attained and therefore are quite similar to those of this study. Greer (1968) stated that broad categories of 10 or 20% fat content may be adequate to indicate an animals condition and in Greer's (1969) paper, he proposed that 0-20, 20-50, 50-80, and 80-100% fats were generally indicative of poor, fair, good, and excellent conditions respectively. On that basis, it appears that the does of Swan Valley were only in fair condition in March and in poor condition in April. Bucks and fawns were in fair condition in April and in poor condition in May.

Some of my samples were frozen for 4 months before being analyzed and, therefore, it is quite probable that the fat content is lower than the results indicate. Greer (1968) stated that some marrows frozen for extended periods before chemical analysis may give a 5-10 percent higher fat content than a fresh sample.

Comparisons of the femur fat content between deer collected under permit and road-killed deer indicate that the road-killed deer were in better condition physically than those collected under permit. However, since femur fat content values were not available for both males and females of all age classes in the two types of mortality, and because differences occur in the femur fat content between sexes and age classes, no definite conclusions can be made.

Parasites

The absence of the brainworm in 93 white-tailed deer strongly suggests that this parasite is not present in the Swan Valley population. Behrend and Witter (1968) found an 84% occurrence in Maine. Evidence was not found for high levels of parasites and these apparently do not limit deer in the Swan Valley.

Chapter 7

MANAGEMENT CONSIDERATIONS

Figure 5 shows the mid-winter distribution of white-tailed deer during the winter of 1969-70. The portion of winter range paralleling the Swan River is quite accurately indicated on the map and is based on data from track counts and from inspection with the aid of a snowmobile. Those portions of the winter range in the Lion and Squeezer Creek Canyons are only approximations, but, in my opinion, quite realistic.

Approximately equal portions (80%) of the upper Swan Valley are controlled by the U. S. Forest Service and the Burlington Northern (Northern Pacific) Railroad Company. The remaining portion is about equally divided between the Swan River State Forest (10%) and private individuals or groups (10%). However, only 25% of the winter range is controlled by the U. S. Forest Service. Approximately 12% is controlled by the State. The major portion (63%) is privately owned with B. N. controlling 28% and other private landowners in control of 35%.

According to Rognrud (1949), logging on private land reached its peak around 1915-1919. Since clearcutting was not popular at that time, this type of timber removal was probably restricted to clearing land for homesteads. Most commercially cut areas were selectively logged. This probably provided enough cover and at the same time increased available browse and thus was probably at least partially responsible for the increase in the deer population reported in the literature.

Since 1955, clearcutting has been conducted on a wide scale in the Swan Valley with a consequent decrease in total winter range equal to the acres logged on what formerly constituted winter range.

Consider for example, the area between Barber and Goat Creeks and extending 3 miles east of the river. Of this total area, approximately 45% has been logged to such a degree that, based on my track count results, it is no longer suitable as winter range. In essence, this has reduced the available winter range in this area by almost 50% and forced the white-tails to winter elsewhere. This might explain the present range conditions in areas such as the Lion Creek Canyon.

The apparent preferences of white-tails for valley bottoms, particularly along streams, pose serious problems in their management, since almost all of this habitat is privately owned and much of it is grazed by cattle. Furthermore, white-tails prefer cover to food and will use heavy cover in spite of insufficient forage (Carter 1951, Pengelly 1961, and Webb 1948). Carter (1951) also stated that snow depth was a primary factor in limiting winter range use by white-tails and was second only to cover.

Therefore, it seems safe to say that the status of the Swan Valley white-tailed deer will depend primarily on the land use practices on mostly private land adjoining the Swan River and to a lesser extent Lion Creek. Logging on these areas at a rate equal to or faster than that at which natural succession will provide new winter ranges will add to the already severely reduced carrying capacity of the winter range.

Chapter 8

SUMMARY

During the winter of 1969-70 an ecologic study of white-tailed deer was conducted in the Swan Valley of western Montana. The objectives were to analyze food habits, reproduction, physical condition, and factors affecting habitat preferences and distribution. Comparison of the 1969-70 winter weather data with a 10-year average revealed that the winter was milder than normal with above average temperatures and below average snowfall.

Food habits were studied by the analyses of deer rumens. Rumen analyses indicated that the two most important species of plants in the diet of white-tailed deer were Oregon grape and Douglas-fir. Non-conifer browse was the most important type of food followed by conifer browse. Total browse constituted over 60% of rumen contents. In spring forbs were the major type of food utilized by deer. The utilization of grasses in spring also increased considerably.

Browse utilization studies were conducted to compare browsing levels in logged and unlogged areas. The utilization of serviceberry was found to be much higher in the undistrubed than in the disturbed areas.

Reproductive rates were calculated from fetal counts and were lower than any reported from other white-tailed deer herds. Not a single female fawn examined was pregnant.

Physical condition of deer collected from January through May was similar to the conditions found in other Montana herds. The number of deer harvested annually has varied tremendously; however, the percentage of deer in the 4 1/2+ age class has been reduced since the 1950's. Deer weights were similar to those of other Montana white-tailed deer, but fawns were considerably lighter than those of other states.

Habitat preferences were investigated by conducting track count transects throughout the winter range. The distribution of track counts by habitat type differed significantly, and was considered to reflect a comparably greater use of uncut areas during the winter.

The major conclusions of the study are:

(1) Reproductive rates, condition indices, and browse surveys indicate that the present winter range is overpopulated.

(2) White-tailed deer prefer the mature timber habitat type and avoid clearcut areas during the winter. The net result of cutting to date is a reduction in winter range equal to the amount of cutting conducted on what formerly constituted the winter range.

(3) The white-tailed deer, in migrating to their winter range move to an area of greater snowfall.

LITERATURE CITED

Adams, L. 1949. The effect of deer on conifer reproduction in northwestern Montana. J. Forestry 47(11):909-913.

Allen, O. A. 1965. Food and range use habits of white-tail deer on Missouri River bottomlands in northcentral Montana. M. S. Thesis. Montana State Univ., Bozeman. 41 pp.

Banasiak, C. F. 1961. Deer in Maine. Maine Game Div. Bull. 6. 159 pp.

Deall, M. in Krefting, L. W. 1962. Use of silvicultural techniques for improving deer habitat in the Lake States. J. Forestry. 60(1): 40-42.

Behrend, D. F., and J. W. Witter. 1968. Pneumostrengylus tenuis in white-tailed deer in Maine. J. Wildl. Mgmt. 32(4):963-966.

Bergeson, W. R. 1943. Swan River deer study. (unpubl.) Montana Fish and Game Dept., Helena. Quart. report. 5 pp. mimeo.

Berndt, H. W. 1965. Snow accumulation and disappearance in lodgepole pine clearcut blocks in Wyoming. J. Forestry 63(2):88-91.

Carter, R. L. 1951. An environmental analysis of winter game range in western Montana. M. S. Thesis, Montana State Univ., Missoula, 88 pp.

Casebeer, R., and M. Rognrud. 1949. A browse utilization study of big game winter range within the Flathead National Forest of the continental management unit. (unpubl.) Montana Fish and Game Dept., Helena, Quart. report. 37 pp. mimeo.

Cheatum, E. L. 1949. Bone marrow as an index of malnutrition in deer. New York State Conserv. 3(5):19-22.

_______, and G. H. Morton. 1946. Breeding season of white-tailed deer in New York. J. Wildl. Mgmt. 10(3):249-263.

_______, and C. W. Severinghaus, 1950. Variations in fertility of white-tailed deer related to range conditions. Trans. 15th N. Am. Wildl, Conf. p. 170-190.

Cole, G. F. 1958. Range survey guide. Montana Dept. Fish and Game, Helena. 22 pp.

Cooperrider, A. Y. 1969. The biology and management of the bighorn sheep of Rock Creek, Montana. M. S. Thesis. Univ. Montana, Missoula. 93 pp.

Dasmann, W. P. 1948. A critical review of range survey methods and their application to deer range management. California Fish and Game 34(4):189-207.

_______, 1951. Some deer range survey methods. California Fish and Game 37(1):43-52.

Deiss, C. 1958. Geology of the Bob Marshall Wilderness. pp. 8-19. In Guide to the Bob Marshall Wilderness, U. S. Forest Service, Missoula, Montana. 36 pp.

Dixon, J. S. 1934. A study of the life history and food habits of mule deer in California. California Fish and Game 20(3-4):181-282 and 315-354.

Erickson, A. B., V. E. Gunvalson, M. H. Stenlund, D. W. Burcalow, and L. H. Blankenship. 1961. The white-tailed deer of Minnesota. Tech. Bull. 5. Minnesota Dept. Cons. 64 pp.

Greer, K. R. 1968. A compression method indicates fat content of elk (Wapiti) femur marrows. J. Wildl. Mgmt. 32(4) 747-751.

____, 1969. Femur marrow reveals the condition of game animals. Montana Fish and Game Dept., Helena. Game Research Sect. 7 pp.

Harris, D. 1945. Symptoms of malnutrition in deer. J. Wildl. Mgmt. 9(4):319-322.

Hawkins, R. E. and W. D. Klimstra. 1970. A preliminary study of the social organization of white-tailed deer. J. Wildl. Mgmt. 34(2):407-419.

Hill, R. R. 1956. Forage, food habits, and range management of the mule deer. Pp. 393-414. W. P. Taylor (Editor), The Deer of North America. Stackpole Co., Harrisburg, Pennsylvania and Wildl. Mgmt. Inst., Washington, D. C. 668 pp.

Hosley, N. W. 1956. Management of the white-tailed deer in its environment Pp. 187-259. W. P. Taylor (Editor, The Deer of North America. Stackpole Co., Harrisburg, Pennsylvania and Wildl. Mgmt. Inst., Washington, D. C. 668 pp.

Knoche, K. G. 1968. The ecology of the Rattlesnake Creek, Montana mule deer winter range. M. S. Thesis. Univ. Montana, Missoula. 152 pp.

Krefting, L. W. 1962. Use of silvicultural techniques for improving deer habitat in the Lake States. J. Forestry 60(1):40-42.

Krull, J. N. 1964. Deer use of a commercial clear-cut area. New York Fish and Game Jour. 11(2):115-118.

Lay, D. W. and W. P. Taylor. 1943. Wildlife aspects of cutover pine wood land in eastern Texas. J. Forestry 41(6):446-448.

Leopold, A. S., T. Riney, R. McCain and L. Tevis, Jr. 1951. The Jawbone deer herd. California Div. Fish and Game, Game Bull. 4. 139 pp.

Lyon, J. L. 1970. Length and weight-diameter relations of serviceberry twigs. J. Wildl. Mgmt. 34(2):456-460.

Mackie, R. J. 1964. Montana deer weights. Montana Wildl. Winter: 9-14

Montana Fish and Game Depart. Annual Reports. 1942-1969.

Morton, G. H., and E. L. Cheatum. 1946. Regional differences in breeding potential of white-tailed deer in New York. J. Wildl. Mgmt. 10(3): 242-248.

Morton, J. N., and J. B. Sedam. 1938. Cutting operations to improve wildlife environment on forest areas. J. Wildl. Mgmt. 2(4):206-214.

Nellis, C. H. 1964. The mule deer of the National Bison Range: population dynamics, food habits, and physical condition. M. S. Thesis. Montana State Univ., Missoula. 146 pp.

Norris, J. J. 1943. Botanical analyses of stomach contents as a method of determining forage consumption of range sheep. Ecology 24:244-251.

Olsen, O. 1938. Winter range as a limiting factor in big game management. Univ. Idaho Bull. 33(22):20-22.

Pengelly, W. L. 1961. Factors influencing production of white-tailed deer on the Coeur d'Alene National Forest, Idaho. U. S. Forest Serv., Northern Region, Missoula, Montana. 190 pp.

_______, 1963. Deer and timberlands in the northern Rockies. J. Forestry 6(10):734-740.

Ranson, A. B. 1964. Deer Reproduction in Manitoba. M. S. Thesis. Univ. Alberta, Edmonton. 75 pp.

Ransom, A. B. 1965. Kidney and marrow fat as indicators of white-tailed deer condition. J. Wildl. Mgmt. 29(2):397-398.

______, 1967. Reproductive biology of white-tailed deer in Manitoba. J. Wildl. Mgmt. 31(1):114-123.

Reynolds, H. G. 1962a. Effect of logging on understory vegetation and deer use in a ponderosa pine forest of Arizona, U. S. Forest Serv., Rocky Mtn. Forest and Range Expt. Sta., Fort Collins, Colorado, No. 80. 7 pp.

________, 1962a. Use of natural openings in a ponderosa pine forest of Arizona by deer, elk, and cattle, U. S. Forest Serv., Rocky Mtn. Forest and Range Expt. Sta., Fort Collins, Colorado, No. 78. 4 pp.

Riney, T., 1955. Evaluation conditon of free-ranging red deer (Cervus elophus), with special reference to New Zealand. New Zealand Jour. Sci Techol. 36(5):429-463.

Rognrud, M. 1949. A study of big game in the continental and adjacent units. (unpubl. rep.). Montana Fish and Game Dept. 188 pp.

_______, 1955. Western Montana big game surveys. (unpubl.), Montana Fish and Game Dept., Helena, annual report:90-107.

Roseberry, J. L., and W. D. Klimstra. 1970. Productivity of white-tailed deer on Crab Orchard Wildlife Refuge. J. Wildl. Mgmt. 34(1):23-28.

Ryel, L. A., L. D. Fay. 1961. Deer biological data 1960-61. Michigan Dept. Conserv. Report 2344. 25 pp.

Severinghaus, C. W. 1949a. Tooth developement and wear as criteria of age in white-tailed deer. J. Wildl. Mgmt. 13(2):195-216.

___________, 1949b. The live weight-dressed weight and live weight-edible meat relationships (in deer). New York State Conserv. 4(2):26.

___________, and E. L. Cheatum. 1956. Life and times of the white-tailed deer. Pp. 56-186. W. P. Taylor (editor), The Deer of North America. Stackpole Co., Harrisburg, Pennsylvania and Wildl. Mgmt. Inst., Washington, D. C. 668 pp.

Shaw, S. P., and C. L. McLaughlin. 1951. The management of white-tailed deer in Massachusetts. Massachusetts Div. Fisheries and Game Res. Bull. 13. 59 pp.

Stickney, P. F. 1966. Browse utilization based on percentage of twig numbers browsed. J. Wildl. Mgmt. 30(1):204-206.

Swift, E. 1953. Modification of forest practices in the Lake States for wildlife habitat betterment. J. Forestry 51(6):440-443.

Taber, R. D., and R. F. Dasmann, 1958. The black-tailed deer of the chaparral/its life history and management in the North Coast Range of California. California Dept. Fish and Game, Game Bull. No. 8 163 pp.

______, and M. T. Rognrud. 1959. On the use of antler development and kill-structure in the management of migratory big game. School of For. Mont. State Univ., Missoula. 7 pp. minio.

______, K. L. White, and N. S. Smith. 1959. The annual cycle of condition in the Rattlesnake, Montana mule deer. Proc. Montana Acad. Sci. 19:72-79.

Taylor, W. P. 1956. (Editor). The Deer of North America. Stackpole Co., Harrisburg, Pennsylvania and Wildl. Mgmt. Inst., Washington, D. C. 668 pp.

Telfer, E. S. 1969. Twig weight-diameter relationships for browse species. J. Wildl. Mgmt. 33(4):917-921.

U. S. Climatalogical Bulletins, U. S. Weather Bureau, Helena, Montana 1959-1970.

Verme, L. J. 1965. Reproduction studies on penned white-tailed deer. J. Wildl. Mgmt. 29(1):74-79.

_____, 1969. Reproductive patterns of white-tailed deer related to nutritional plane. J. Wildl. Mgmt. 33(4):881-887.

Webb, W. L. 1948. Environmental analysis of a winter deer range. Trans. 13th N. Am. Wildl. Conf. p.442-450.

Westell, C. E., Jr. 1954. Available browse following aspen logging in lower Michigan. J. Wildl. Mgmt. 18(2):266-271.

IX

APPENDIX

Figure 1. Map of study area showing location of weather station, snow stations, and track-count transect lines.

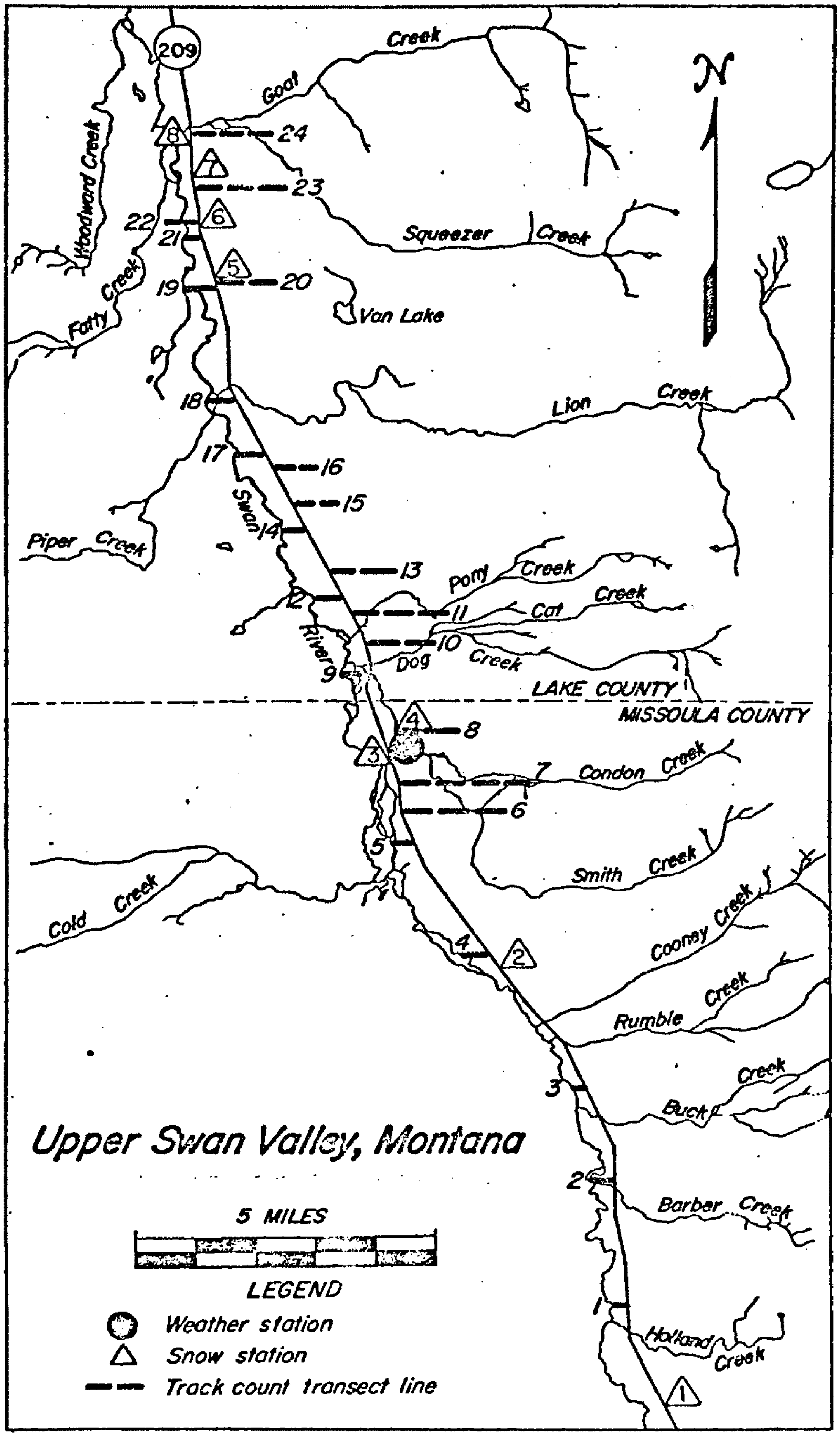
209
N
Goat
Creek
Woodward Creek
Squeezer
Creek
Fatty Creek
Van Lake
Lion
Creek
Swan
River
Piper Creek
Pony
Creek
Cat
Creek
Dog
Creek
LAKE COUNTY
MISSOULA COUNTY
Condon
Creek
Smith
Creek
Cold
Creek
Cooney Creek
Rumble
Creek
Buck
Creek
Barber
Creek
Holland
Creek
Upper Swan Valley, Montana
5 MILES
LEGEND
Weather station
Snow station
Track count transect line

Figure 2. Twig length-diameter relationships for serviceberry. (dotted lines indicate 95% confidence limits).

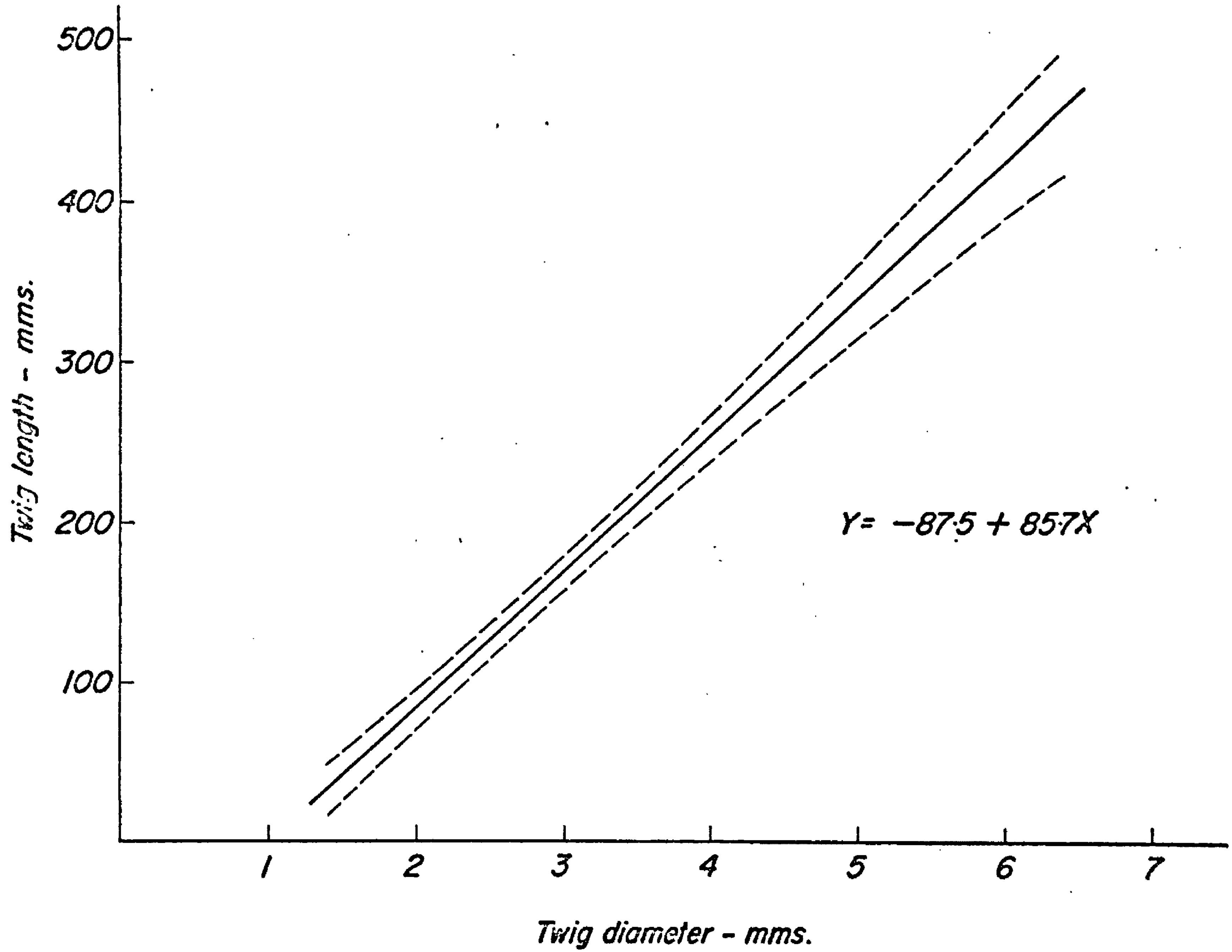
Y= −87·5 + 85·7X
Twig length - mms.
Twig diameter - mms.
100
200
300
400
500
1
2
3
4
5
6
7

Figure 3. Twig length-diameter relationships for mountain maple. (dotted lines indicate 95% confidence limits).

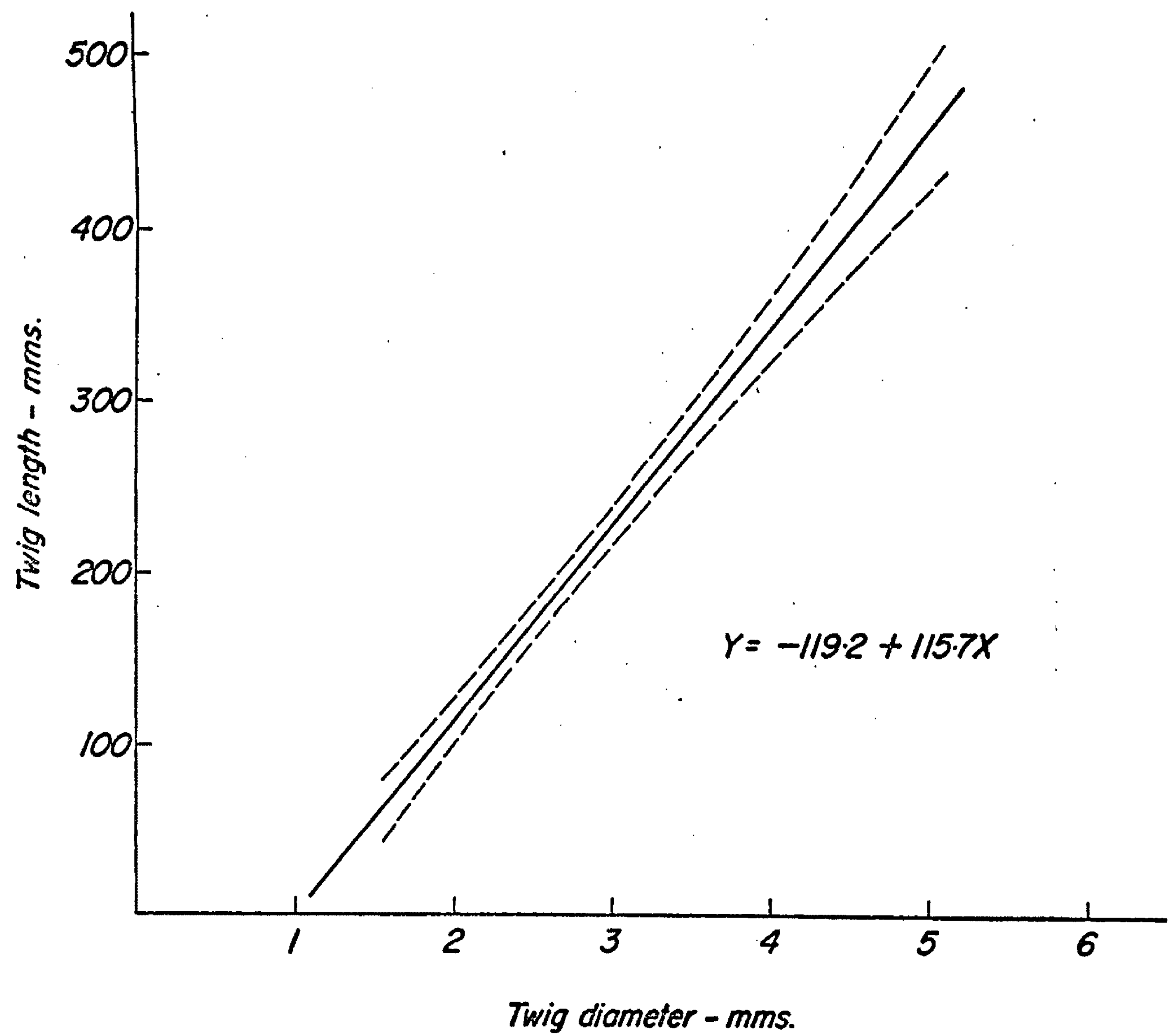
Y= −119·2 + 115·7X
Twig length - mms.
Twig diameter - mms.
500
400
300
200
100
1
2
3
4
5
6

Figure 4. Scatter diagram of percentage femur fat plotted against kidney fat indices of 25 white-tailed deer.

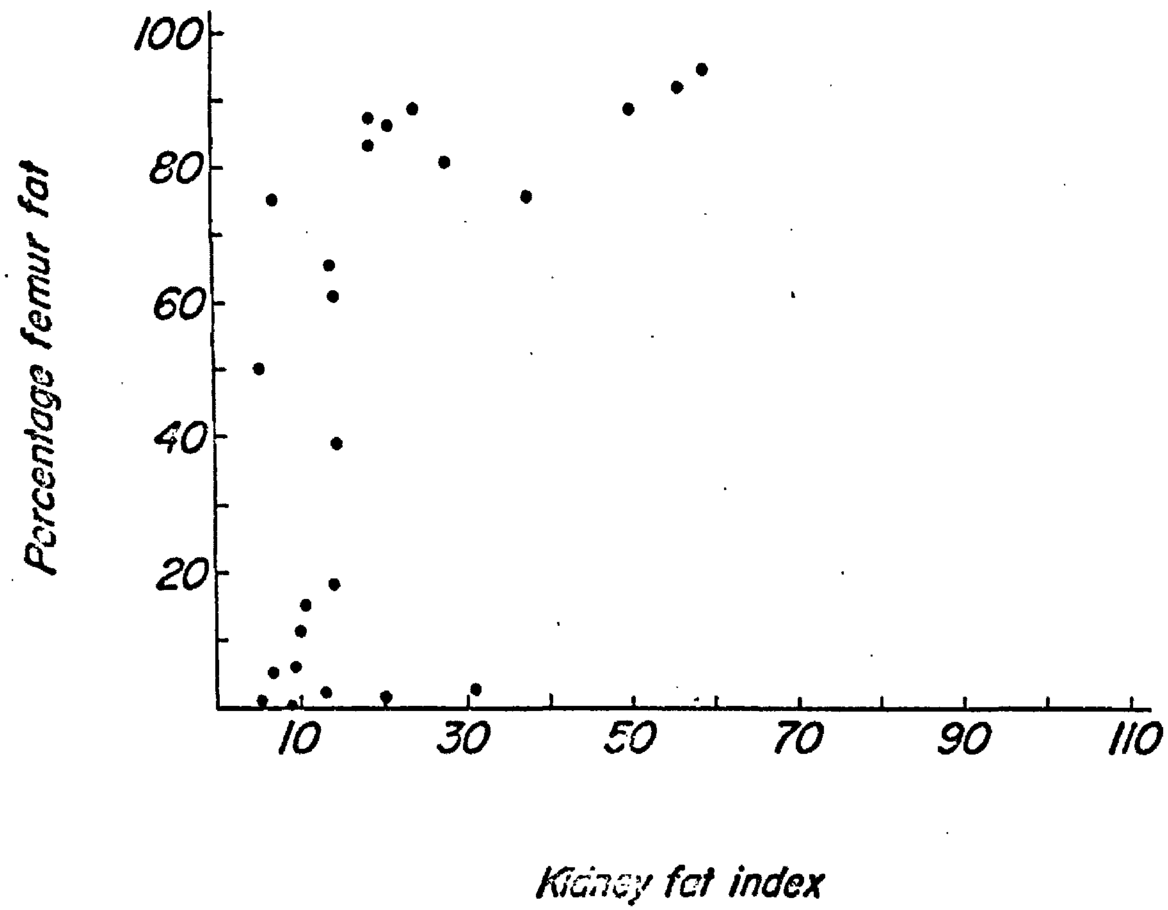
Percentage femur fat
100
80
60
40
20
10
30
50
70
90
110
Kidney fat index

Figure 5. Map of study area showing mid-winter distribution of white-tailed deer.

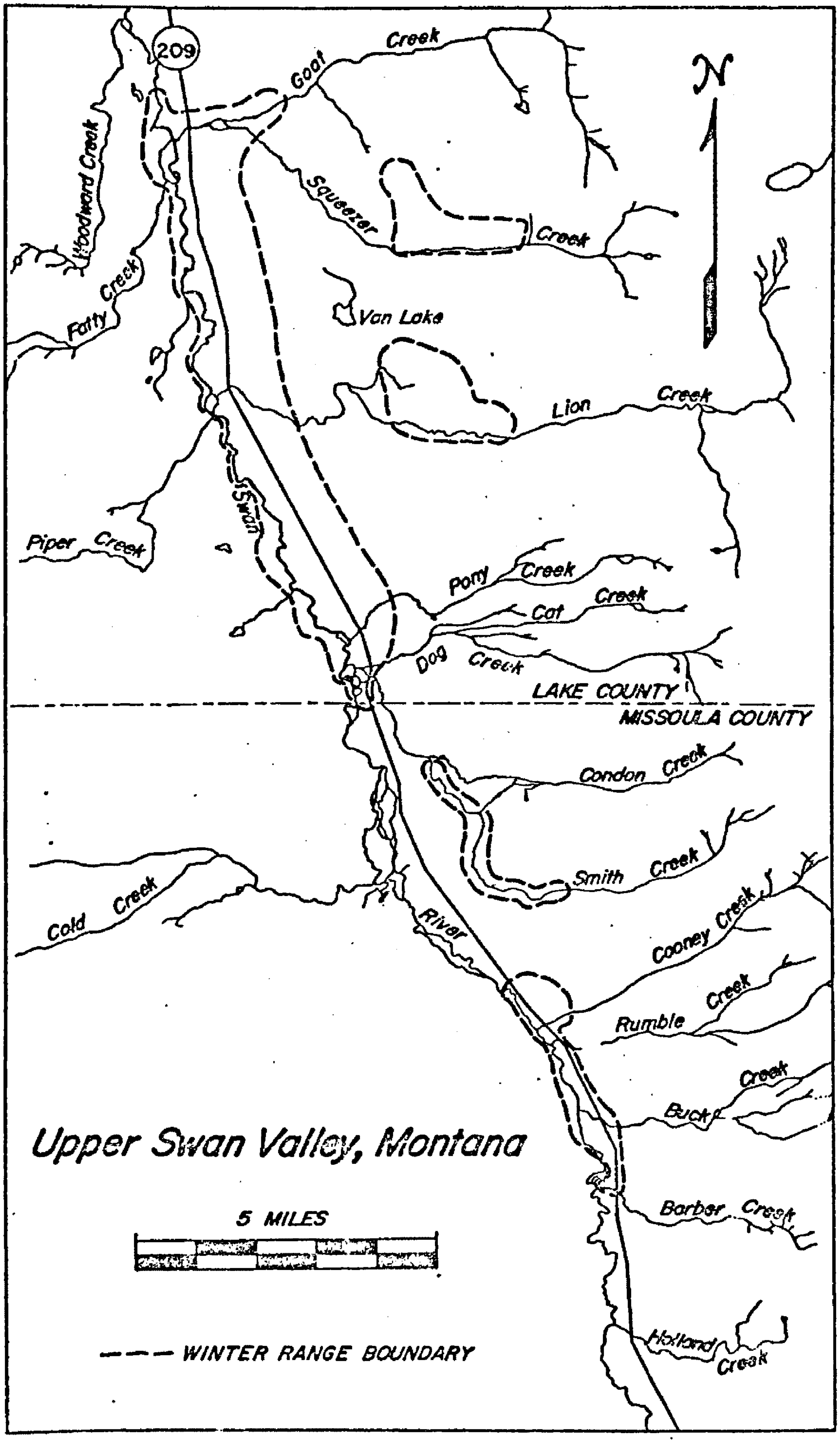
209
Goat
Creek
Woodward Creek
Fatty Creek
Squeezer
Creek
Van Lake
Lion
Creek
Piper Creek
Swan
Pony
Creek
Cat
Creek
Dog
Creek
LAKE COUNTY
MISSOULA COUNTY
Condon Creek
Smith Creek
Cold Creek
River
Cooney Creek
Rumble Creek
Buck
Creek
Barber Creek
Holland
Creek
Upper Swan Valley, Montana
5 MILES
WINTER RANGE BOUNDARY

Table 21. Track Counts by Cover Types, 1970

Month	Transect #	Paced Distance	# Tracks per 100 Paces Mature Timber	Immature Timber	Grassland	Stream Bottom	Clear Cuts	Partial Cuts
January	10	643	3.3(418)	--	--	1.9(53)	2.9(.72)	--
February	1	271	0(88)	0(183)	--	--	--	--
	2	342	4.7(191)	--	--	0.0(151)	--	--
	3	179	8.9(56)	--	--	--	0.0(123)	--
	4	366	0(140)	--	--	0.0(34)	--	0(192)
	5	367	0(150)	--	--	0.0(217)	--	--
	6	1856	11.9(1035)	--	0.0(425)	2.7(300)	2.4(41)	1.8(55)
	7	2120	2.4(595)	1.3(381)	0.4(236)	0.0(261)	0.0(163)	0.2(484)
	9	270	0(39)	--	--	0.0(231)	--	--
	12	718	9.0(522)	--	--	--	--	15.8(196)
	14	333	19.8(333)	--	--	--	--	--
	16	386	5.2(213)	--	--	--	0.6(173)	--
	17	472	25.3(170)	--	--	5.6(178)	--	14.5(124)
	18	680	6.3(320)	0(35)	--	24.5(49)	3.5(200)	0.0(76)
	19	726	13.1(183)	--	--	11.3(337)	--	20.4(206)
	21	774	16.4(609)	--	0.0(55)	--	--	0.0(110)
	22	213	20.2(213)	--	--	--	--	--
	23	1794	0.3(678)	--	--	0.0(402)	--	0.0(714)
	24	2483	.04(1977)	0.0(29)	0.0(160)	--	0.0(90)	0.0(227)
March	8	1305	2.4(255)	--	0.0(160)	1.2(169)	.7(271)	.4(450)
	11	570	0.0(488)	--	--	--	0.0(82)	--
	13	1727	3.9(956)	--	--	3.4(298)	0.0(364)	0.0(109)
	15	1196	9.0(721)	--	--	--	0.0(475)	--
	20	1100	0.3(760)	--	1.1(176)	--	--	0.0(164)

Table 22. Trail Counts by Cover Types, 1970.

Month	Transect #	Paced Distance	# Trails Per 100 Paces Mature Timber	Immature Timber	Grassland	Stream Bottom	Clear Cuts	Partial Cuts
January	10	643	1.00(418)	--	--	1.9(53)	2.3(172)	--
February	1	271	0(88)	0(183)	--	--	--	--
	2	342	3.1 (191)	--	--	0.0(151)	--	--
	3	179	8.9(56)	--	--	--	0.0(123)	--
	4	366	0.0(140)	--	--	0.0(34)	--	0.0(192)
	5	367	0.0(150)	--	--	0.0(217)	--	--
	6	1856	1.6(1035)	--	0.0(425)	0.3(300)	0.0(41)	1.8(55)
	7	2120	0.7(595)	0.3(381)	0.0(236)	0.4(261)	0.0(163)	0.0(484)
	9	270	0.0(39)	--	--	0.0(231)	--	--
	12	718	2.9(522)	--	--	--	--	0.5(196)
	14	333	3.0(333)	--	--	--	--	--
	16	386	1.4(213)	--	--	--	0.0(173)	--
	17	472	2.9(170)	--	--	0.0(178)	--	0.0(124)
	18	680	0.6(320)	0.0(35)	--	2.0(49)	0.0(200)	0.0(76)
	19	726	3.8(183)	--	--	0.9(337)	--	1.5(206)
	21	774	3.0(609)	--	1.8(55)	--	--	0.9(110)
	22	213	6.1(213)	--	--	--	--	--
	23	1794	0.1(678)	--	--	0.0(402)	--	0.0(714)
	24	2483	0.0(1977)	0.0(29)	0.0(160)	--	0.0(90)	0.0(227)
March	8	1305	0.4(255)	--	0.0(160)	0.0(169)	0.0(271)	0.0(450)
	11	570	0.6(488)	--	--	--	0.0(82)	--
	13	1727	0.9(956)	--	--	0.7(298)	1.1(364)	0.0(109)
	15	1196	0.3(721)	--	--	--	0.0(475)	--
	20	1100	0.1(760)	--	0.0(176)	--	--	0.0(164)

Table 23. Food Habits During January 1970

Compound Species	Collection Number 1000	1001	1002	1003	1004	1005	1006	1007	$\overline{X}$
Jucom	2	tr	5	41	6	1	-	-	6.9
Picon	-	-	2	-	-	-	63	1	8.3
Pipon	2	-	-	tr	-	-	-	-	2.5
Psme	1	1	-	-	1	tr	4	14	2.6
Thpl	tr	-	-	-	-	-	-	-	tr
Conifer Total	5	1	7	41	7	1	67	15	18.00
Acgl	5	-	1	-	2	-	-	-	1.0
Amal	3	7	1	2	-	tr	-	1	1.8
Aruv	tr	3	1	17	2	-	-	-	2.9
Bere	69	83	62	3	66	27	1	-	38.9
Beoc	-	-	4	-	-	-	-	-	.5
Ceve	-	-	-	35	-	51	1	-	10.9
Cost	-	-	-	-	-	-	-	8	1.0
Libo	-	-	tr	-	-	-	-	-	tr
Losp	-	-	3	-	-	-	-	-	.4
Rosp	tr	-	-	-	-	-	-	2	.3
Sasp	-	-	2	-	-	tr	-	-	.3
Sysp	-	-	-	-	-	2	-	tr	.3
Unid. Browse	12	4	-	-	11	8	30	74	18.6
Total Browse	89	97	84	57	81	88	32	85	76.62
Cesp	-	-	-	-	-	4	-	-	.5
Unid forbs	5	2	3	1	12	7	1	-	3.9
Total Forbs	5	2	3	1	12	11	1	-	4.4
Grass & Grasslike Plants	-	tr	6	1	tr	-	-	-	.8
Other Lichen	1	-	-	-	-	-	-	-	.1

Table 24. Food Habits during February 1970

Component Species	Collection Number 21	28	31	35	36	1008	1009	1010	1011	1012	$\bar{X}$
Abgr	-	-	-	-	-	33	-	-	-	-	3.3
Laoc	-	-	-	-	-	-	3	-	-	-	.3
Pico	-	40	-	-	66	-	tr	2	-	-	10.8
Pipo	-	-	-	25	-	-	-	-	-	28	5.3
Psme	51	34	13	32	17	5	17	62	18	-	24.9
Unid. Conifer	-	-	-	-	-	41	-	-	-	-	4.1
Total Conifer	51	74	13	57	83	79	20	64	18	28	48.7
Acgl	-	-	-	-	-	-	12	-	-	-	1.2
Alte	5	-	1	-	-	-	-	-	-	-	.6
Amal	-	-	-	-	3	2	6	3	-	-	1.4
Bere	-	-	2	-	-	-	-	-	-	-	.2
Cost	-	1	1	-	-	6	-	4	-	-	1.2
Posp	-	-	5	-	-	-	-	-	-	-	.5
Vasp	-	-	-	-	tr	-	-	-	-	-	-
Unid. browse	37	16	52	37	13	12	41	29	36	60	33.3
Total Browse	42	17	61	37	16	20	59	36	36	60	38.4
Ptaq	3	-	-	-	-	-	-	-	-	-	0.3
Fragariasp	-	-	-	-	-	-	-	-	-	tr	tr
Unident. forb	3	2	3	2	-	-	-	-	12	4	2.6
Total Forb	6	2	3	2	-	-	-	-	12	4	2.9
Grass & Grasslike Plants	1	7	23	4	1	-	-	tr	34	8	7.8
Other Lichen	tr	-	tr	-	-	1	21	tr	-	-	2.2

Table 25. Food Habits During March 1970

Component Species	Collection Number 41	1013	1014	1015	1016	$\overline{X}$
Laoc	-	-	-	-	3	.6
Pico	-	-	-	-	tr	tr
Pipo	36	6	4	tr	-	9.2
Psme	5	3	-	4	18	6.0
Thpl	-	-	-	2	-	.4
Unident. Conifer	20	-	-	-	-	4.0
Total Conifer	61	9	4	6	21	20.2
Acgl	-	3	-	1	-	.8
Amal	-	1	-	5	-	1.2
Aruv	11	-	-	-	7	3.6
Bere	8	-	1	2	33	8.8
Libo	-	1	-	-	-	.2
Posp	1	-	-	-	-	.2
Rosp	-	-	2	2	-	.8
Shca	tr	10	-	-	-	2.0
Sysp	-	-	tr	1	-	.2
Unident. browse	9	43	54	53	9	33.6
Total Browse	29	58	57	64	49	51.4
Frsp	-	-	-	1	-	.2
Unident. forbs	-	21	19	18	5	12.6
Total forbs	-	21	19	19	5	12.8
Grass & Grass-like Plants	2	12	20	11	25	13.8
Other Lichen	8	-	-	-	-	1.6

Table 26. Food Habits During April 1970

Component Species	Collection Number 68	1017	1018	1019	1020	1021	$\overline{X}$
Psme	2	58	-	20	1	-	13.5
Unident conifer	-	-	9	-	-	-	1.5
Total conifer	2	58	9	20	1	-	15.0
Amal	-	-	-	1	-	-	.2
Aruv	1	-	1	-	-	-	.3
Bere	91	-	77	2	94	52	52.7
Ceve	-	-	-	-	tr	-	tr
Cost	-	5	-	-	-	-	.8
Libo	-	-	2	-	1	5	1.3
Pamy	-	-	1	-	2	1	.7
Unident browse	-	24	6	34	1	-	10.8
Total browse	92	29	87	37	98	58	66.8
Frsp	tr	-	1	-	-	20	3.5
Unident forbs	6	3	-	11	1	13	5.7
Total forbs	6	3	1	11	1	33	9.2
Grass-like plants	tr	10	3	32	tr	9	9.0
Other Lichen	-	-	-	-	tr	-	-

Table 27. Food Habits During May 1970

Component Species	Collection Number 1022	1023	1024	1025	$\bar{X}$
Psme	tr	2	-	-	.5
Total conifer	tr	2	-	-	.5
Bere	-	1	2	-	.8
Sysp	-	18	9	13	10.0
Vasp	-	-	-	4	1.0
Unident browse	-	-	5	-	1.3
Total Browse	-	19	16	17	13.0
Ergr	80	2	2	-	21.0
Frsp	11	13	15	4	10.8
Lusp	5	7	2	-	3.5
Thve	1	-	-	-	.3
Unident forb	-	55	53	71	44.8
Total forbs	97	77	72	75	80.3
Grasslike plants	3	1	12	8	6.0
Other (lichen)	-	1	-	-	.3

Table 28. Counts and weights of fetuses from female white-tailed deer collected in the Swan Valley

Number	Age of Doe	Date	Fetuses Right No.	Right Sex	Left No.	Left Sex	Unknown	Weights (gross) Right	Left	Unknown
1000	1 1/2	1-6-70	1	N.D.[1/]	1	N.D.		No data	No data	
1001	3 1/2	1-6-70	1	N.D.	1	N.D.		No data	No data	
1006	4 1/2	1-29-70	1	F	1	F		61.8	56.6	
1010	4 1/2	2-12-70	1	M	1	F		156.0	135.0	
1011	1 1/2	2-20-70	1	F	0	N.D.		223.0	N.D.	
1012	6 1/2+	2-26-70	1	M	1	F		208.2	187.7	
1013	1 1/2	3-5-70	0	N.D.	1	F		N.D.	226.7	
1015	4 1/2	3-12-70	1	M	1	M		420.5	432.8	
1016	4 1/2	3-24-70	1	F	1	M		605.6	636.0	
1017	1 1/2	4-2-70	1	F	0	N.D.		493.3	N.D.	
1019	3 1/2	4-15-70	1	M	1	M		1009.0	932.0	
1020	6 1/2+	4-22-70					1			N.D.
1021	2 1/2	4-29-70					1			N.D.
1024	3 1/2						2			1994 1909

1/ No data

Table 29. Weights, measurement & condition indexes from Swan Valley white-tailed deer.

No.	Sex	Age	Whole Weight	Dressed Weight	Heart Girth	Height of Shoulder	Body Length (1)	Hind Foot Length	Tail Length	Liver Wt.	Spleen Wt.
January 1970											
1000	F	1 1/2	120	88	-	36.2	56.7	18.1	10.0	720	110
1001	F	3 1/2	127	95	37.4	38.2	52.8	18.1	9.8	-	-
1002	M	1/2	83	55	29.9	34.8	48.0	17.1	9.8	545	95
1003	M	4 1/2	185	134	40.1	-	59.4	19.7	13.0	1445	215
1004	F	1/2	72	52	29.5	34.8	47.3	17.1	11.4	520	70
1005	M	4 1/2	195	135	42.3	40.1	57.7	20.1	13.0	1500	185
1006	F	4 1/2	108	78	34.6	35.4	60.6	17.3	10.6	810	200
1007	M	2 1/2	140	102	38.4	38.2	56.7	19.7	12.6	1015	185
February 1970											
1008	M	5 1/2	152	110	38.0	40.9	59.6	19.3	11.6	1210	178
1009	M	1 1/2	159	117	40.6	41.7	64.6	19.5	11.8	1175	202
1010	F	4 1/2	130	95	35.8	-	61.4	19.1	10.6	-	120
1011	F	1 1/2	115	72	38.8	37.2	52.0	18.7	11.6	525	130
1012	F	6 1/2+	120	75	36.8	38.6	53.1	18.5	10.6	715	105
21	F	1/2	-	-	-	-	-	-	-	-	-
28	M	1/2	-	-	-	-	-	-	-	-	-
31	F	2 1/2	-	-	-	-	-	-	-	665	160
35	M	1/2	72	52	30.3	35.4	47.8	18.1	10.6	340	95
March 1970											
1013	F	1 1/2	85	60	31.7	36.6	55.1	18.1	11.0	-	350
1014	F	1/2	58	40	28.5	31.3	40.9	16.1	9.8	380	70
1015	F	4 1/2	100	70	34.1	38.2	53.0	18.5	10.8	595	135
1016	F	4 1/2	105	75	36.2	37.6	53.1	17.9	11.0	661	134
37	F	1/2	45	-	23.2	28.7	39.4	15.0	7.9	-	-
38	F	3 1/2	85	-	30.7	33.5	47.4	17.3	12.2	-	-
April 1970											
1017	F	1 1/2	93	68	33.7	37.6	55.5	19.5	11.0	560	120
1018	F	4 1/2	110	80	35.6	40.2	64.2	19.3	12.2	765	125
1019	F	3 1/2	105	72	34.1	39.0	55.7	18.9	12.2	665	180
1020	F	6 1/2+	105	70	32.3	37.0	60.4	18.5	10.2	690	110
1021	F	2 1/2	93	65	32.7	38.0	51.8	18.3	10.6	565	140
68	F	2 1/2	-	-	33.9	36.4	54.7	17.7	-	545	140
May 1970											
1022	F	1/2	52	38	27.8	32.1	46.1	16.9	10.6	490	--
1023	M	2 1/2	112	85	32.5	37.4	54.3	18.9	11.6	1025	425
1024	F	3 1/2	127	85	32.5	36.2	56.7	18.5	12.0	1120	155
1025	F	2 1/2	90	68	32.7	36.8	54.5	18.5	12.2	860	115

1/ Tip of nose to base of tail along curvature of spine.

Table 30. Chemical analyses of femur marrow from white-tailed deer.

Number	Sex	Age	Month	How Obtained	Ether Extract	Per cent Compression
12	N.D. [1/]	1/2	Jan.	R.K. [2/]	83.8	1.0
14	F	1/2	Jan.	R.K.	84.5	0.0
15	F	2 1/2	Jan.	R.K.	90.8	1.0
1005	M	4 1/2	Jan.	Shot	82.9	0.0
1006	F	4 1/2	Jan.	Shot	92.9	0.0
1007	M	2 1/2	Jan.	Shot	88.7	0.0
19	F	1/2	Feb.	R.K.	83.7	0.0
21	F	1/2	Feb.	R.K.	81.1	2.0
24	F	3 1/2	Feb.	R.K.	93.0	0.0
26	F	2 1/2	Feb.	R.K.	95.7	0.0
27	M	1/2	Feb.	R.K.	60.0	11.0
28	M	1/2	Feb.	R.K.	75.9	1.0
29	F	2 1/2	Feb.	R.K.	95.7	0.0
35	M	1/2	Feb.	R.K.	0.53	32.0
36	F	3 1/2	Feb.	R.K.	94.2	0.0
1008	M	5 1/2	Feb.	Shot	86.4	0.0
1009	M	1 1/2	Feb.	Shot	64.3	10.0
1010	F	4 1/2	Feb.	Shot	94.1	0.0
1011	F	1 1/2	Feb.	Shot	89.5	0.0
1012	F	6 1/2+	Feb.	Shot	87.7	0.0
38	F	3 1/2	Mar.	R.K.	51.8	17.0
39	M	1 1/2+	Mar.	R.K.	84.1	1.0
40	M	1/2	Mar.	R.K.	44.7	22.0
41	M	1/2	Mar.	R.K.	48.7	20.0
45	M.	3 1/2	Mar.	R.K.	33.5	20.0
46	M	1 1/2	Mar.	R.K.	56.9	16.0
47	F	1 1/2+	Mar.	R.K.	20.0	48.6
48	F	5 1/2	Mar.	R.K.	63.1	7.0
50	F	1/2	Mar.	R.K.	40.1	37.0
51	M	1/2	Mar.	R.K.	17.7	37.0
57	M	1/2	Mar.	R.K.	33.1	26.0
2	M	6 1/2+	Mar.	Carcass	0.20	60.0
1013	F	1 1/2	Mar.	Shot	2.9	34.0
1014	F	1/2	Mar.	Shot	76.0	1.0
1015	F	4 1/2	Mar.	Shot	60.7	10.0
1016	F	4 1/2	Mar.	Shot	39.7	10.0

Chemical analyses of femur marrow from white-tailed deer. (cont.)

Number	Sex	Age	Month	How Obtained	Ether Extract	Per Cent Compression
64	M	4 1/2	Apr.	R.K.	24.2	22.0
66	F	1/2	Apr.	R.K.	0.31	42.0
67	F	1/2	Apr.	R.K.	89.0	0.0
68	F	2 1/2	Apr.	R.K.	3.2	30.0
69	F	1 1/2+	Apr.	R.K.	2.9	30.0
1017	F	1 1/2	Apr.	Shot	0.19	38.0
1018	F	4 1/2	Apr.	Shot	18.9	26.0
1019	F	3 1/2	Apr.	Shot	6.0	25.0
1020	F	6 1/2+	Apr.	Shot	1.9	25.0
1021	F	2 1/2	Apr.	Shot	4.5	27.0
1022	F	1/2	May	Shot	0.4	35.0
1023	M	2 1/2	May	Shot	11.6	25.0
1024	F	3 1/2	May	Shot	50.1	10.0
1025	F	2 1/2	May	Shot	14.4	23.0

1/ No data.
2/ Road kill.
3/ Reported as percent of whole sample (including moisture)
4/ Greer (1968).

Table 31. Comparative condition indices of Swan Valley white-tailed deer. (Monthly averages for fawns and adults in parentheses.)

Collection Number	Month	Age	Kidney Fat Index		Ether Extract		Percent Compression
A. Males							
1,002	Jan.	1/2	100.8	(100.8)	---		----
1,007	Jan.	2 1/2	23.9		88.7		0
1,003	Jan.	4 1/2	14.6	(19.1)	---	(85.8)	----
1,005	Jan.	4 1/2	18.9		82.9		0
27	Feb.	1/2	---	(28.8)	60.0		11
28	Feb.	1/2	37.5		75.9	(45.1)	1
35	Feb.	1/2	20.0		0.5		32
1,009	Feb.	1 1/2	13.6	(17.9)	64.3	(75.4)	10
1,008	Feb.	5 1/2	21.1		86.4		0
40	Mar.	1/2	---		44.7		22
41	Mar.	1/2	---		48.7	(36.1)	20
51	Mar.	1/2	---		17.7		37
57	Mar.	1/2	---		33.1		26
46	Mar.	1 1/2	---		56.9		16
39	Mar.	1 1/2+	---		84.1	(58.2)	1
45	Mar.	3 1/2	---		33.5		20
2	Mar.	6 1/2+	---		0.2		60
64	Apr.	4 1/2	---		24.2	(24.2)	22
1,023	May	2 1/2	10.0	(10.0)	11.6	(11.6)	25
B. Females							
14	Jan.	1/2	-- -		84.5	(84.5)	0
1,004	Jan.	1/2	68.5	(68.5)	---		--
1,000	Jan.	1 1/2	120.0		---		---
15	Jan.	2 1/2	---	(83.6)	90.8		1
1,001	Jan.	3 1/2	75.3		---	(91.9)	---
1,006	Jan.	4 1/2	55.6		92.9		0
19	Feb.	1/2	---	(27.7)	83.7	(82.4)	0
21	Feb.	1/2	27.7		81.1		2
1,011	Feb.	1 1/2	52.3		89.5		0
26	Feb.	2 1/2	---	(43.8)	95.7		0
29	Feb.	2 1/2	---		95.7		0
31	Feb.	2 1/2	45.5		---	(92.8)	---
24	Feb.	3 1/2	---		93.0		0
36	Feb.	3 1/2	---		94.2		0
1,010	Feb.	4 1/2	58.8		94.1		0
1,012	Feb.	6 1/2+	18.7		87.7		0

Table 31. (Continued)

Collection Number	Month	Age	Kidney Fat Index		Ether Extract		Percent Compression
50	Mar.	1/2	--	(7.2)	40.1	(58.1)	37
1,014	Mar.	1/2	7.2		76.0		1
1,013	Mar.	1 1/2	30.8		2.9		34
47	Mar.	1 1/2+	--		20.0		49
38	Mar.	3 1/2	--		51.8	(39.7)	17
1,015	Mar.	4 1/2	14.3	(23.1)	60.7		10
1,016	Mar.	4 1/2	14.2		39.7		10
48	Mar.	5 1/2	--		63.1		7
66	Apr.	1/2	--		0.3	(44.6)	42
67	Apr.	1/2	---		89.0		0
1,017	Apr.	1 1/2	5.0		0.9		38
69	Apr.	1 1/2+	---	(9.6)	2.9		30
68	Apr.	2 1/2	---		3.2		30
1,021	Apr.	2 1/2	6.8		4.5	(5.5)	27
1,019	Apr.	3 1/2	9.3		6.0		25
1,018	Apr.	4 1/2	14.4		18.9		26
1,020	Apr.	6 1/2+	12.5		1.9		25
1,022	May	1/2	8.9	(8.9)	0.4		35
1,025	May	2 1/2	10.9	(8.1)	14.4	(21.6)	23
1,024	May	3 1/2	5.2		50.1		10

Table 32. List of plant names and abbreviations.

Abbreviation	Scientific Name
Abgr	Abies grandis
acgl	Acer glabrum
Alte	Alnus tenuifolia
Amal	Amelanchier alnifolia
Aruv	Arctostophylos uva-ursi
Beoc	Betula occidentalis
Bere	Berberis repens
Cesp	Centaurea spp.
Ceve	Ceanothus velutinus
Cost	Cornus stolonifera
Ergr	Erythronium grandiflorum
Frsp	Fragaria spp.
Jucom	Juniperus communis
Laoc	Larix occidentalis
Libo	Linnaea borealis
Losp	Lonicera spp.
Lusp	Lupinus spp.
Pamy	Pachistima myrsinites
Pico	Pinus contorta
Pipo	Pinus ponderosa
Posp	Populus spp.
Psme	Pseudotsuga menziesii
Ptaq	Pteridium aquilinum
Rosp	Rosa spp.
Sasp	Salix spp.
Shca	Sheperdia canadensis
Sysp	Symphoricarpos spp.
Thpl	Thuja plicata
Thve	Thalictrium venulosum
Vasp	Vaccinium spp.