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The Coalville Deer Herd in Northeastern Utah: Its Ecology and Management

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THE COALVILLE DEER HERD IN NORTHEASTERN UTAH: ITS ECOLOGY AND MANAGEMENT

by

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A thesis submitted in partial fulfillment
of the requirements for the degree

of

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in

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Gary H. Hickman

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ITS ECOLOGY AND MANAGEMENT

by

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Utah State University, 1971

Major Professor: Dr. Jessop B. Low
Department: Wildlife Resources

The primary objective of this study on the Coalville Deer Management Unit adjacent to the corner of Wyoming in Utah was to determine the condition of the deer herd in relation to its range and population characteristics.

Postseason doe-fawn ratio was 100:77, while an adjusted doe-fawn ratio accounting for the unproductive female yearling segment was 100:105. The approximate net-productivity for 1964 was 44 percent compared to 27 percent in 1965. In 1964-65, the average age-class mortality rate for the male and female segments was 45 and 35 percent respectively. Preseason and postseason sex ratios were 64:100 and 60:100, respectively.

Mature deer were in good condition during the fall harvest. However, a few yearling males and approximately one-third of the fawns (both sexes) were not in good physical condition. Male deer weights, antler points, length of main beam, and antler diameter 1 inch above the burr increased with age. In contrast, female weights increased until they reached 2.5 years of age, with no significant gains thereafter. Antler diameter was considered a good indicator of physical condition.

The summer elevational distribution of deer coincided with the quaking aspen belt between 7,500 and 9,500 feet. Deer marked with streamers and collars did not substantially increase the summer distribution information above the tag returns. Five to 15 percent more marked deer were shot the first hunt after the tagging operation than in subsequent hunts. The average winter elevational distribution of the deer was 6,700 feet, although the depth of snow and other climatic variables changed each winter's elevational distribution.

Deer management in Unit 19 should be closely geared to deer winter concentration areas. Deer hunting regulations should be based on the winter range condition of the majority of the winter range concentration areas. Those winter range concentration areas in need of further deer population reduction to balance deer numbers with the winter range food supply should have postseason hunts after the fall migration.

Tag returns from the hunting season did not indicate differential movement of sex and age classes of deer from winter concentration areas to the summer ranges. The majority of the marked deer summered in the same major drainage where tagged, although fall returns were received from five major drainages. A few deer migrated 60 airline miles from their winter to summer ranges, but the majority migrated less than 15 miles from the tagging site. The mechanism triggering fall migration was snow depth, while new vegetation controlled the spring upward movement. All deer that wintered on the same range did not summer together.

In 1926, $0.25 range-use permits were required of deer hunters, while in 1965 the Range Owner's Protective Association (ROPA) assessed a $3.00 fee.

(117 pages)

INTRODUCTION

Deer are the most important big game animals in the United States from the standpoint of hunter interest, harvest and popularity. The mule deer (*Odocoileus hemionus*) is appropriately referred to as the "bread and butter" species of the western state game departments.

Mule deer in the western United States were so scarce at the turn of the century that when a rancher saw a deer track he told everyone about this rare phenomenon. However, by 1939 there were an estimated 1.4 million mule deer in the United States, and the 1948 census indicated approximately 1.7 million, with a harvest of 277,100 (Cronemiller and Bartholomew, 1950). In 1956 there were an estimated 2.8 million and a kill of 674,697 (U.S. Fish and Wildl. Serv., 1958).

Utah had a dearth of Rocky Mountain mule deer (*O. h. hemionus*) at the turn of the century, (Reynolds, 1960). Further unrestricted hunting was postulated as one of the primary reasons for the low deer population. In fact, the 1907 state legislature prohibited all big game hunting for five years.

In 1925, there were an estimated 18,421 mule deer in Utah and a harvest of 1,400 bucks. Ten years later the estimated deer population was 87,400 with a hunter kill of 11,648 bucks. In 1963, almost 30 years later, 178,980 deer hunters harvested 109,399 legal deer in the state (Sparks and others, 1963 and 1964).

Originally Utah was divided into four deer management areas. It was recognized in the early 1930's, however, that units encompassing

each deer herd's annual geographical distribution were needed to provide better management. The Utah Division of Fish and Game had delineated Utah into 69 deer management units by 1966.

History of the Coalville Unit

Bison (*Bison bison*) were reported in the Chalk Creek basin in 1860, and three men killed nine grizzly bears (*Ursus horribilis*) in Holliday Park at the head of the Weber River in 1885 (Wilde, 1965). Mr. Wilde further related that his father shot a deer 4 miles east of Coalville in 1912, but he personally did not see a live deer until 1920.

Deer management problems of too many deer were recognized in the Coalville Management Unit as early as 1942. An additional 600 special doe permits were then authorized by the Utah Division of Fish and Game. In contrast to the public land ownership pattern for most of Utah, almost 99 percent of the unit winter range is privately owned and has a history of heavy sheep and deer use. Only in recent years have landowners implemented some range conservation practices.

The Coalville deer populations reached a peak in the late 1940's. Winter ranges were severely degraded by heavy deer and spring-fall livestock use. Extensive numbers of "high-lined" junipers and heavily hedged browse plants were found on the winter ranges. Thousands of deer died of malnutrition during the severe winters of 1948-49 and 1951-52. In addition to the regular buck hunt, 2,100 special doe permits were issued in 1950 to help reduce the excessive deer population (Jones and others, 1953; and Huff, 1965).

The Utah State Division of Fish and Game became concerned about the reproductive status of the Coalville deer herd in 1963 because the 1962 postseason sex and age sample of 160 deer indicated a doe-fawn ratio of 100:29. Robinette (1956) reported a doe-fawn ratio of 100:81 for the nine western states, based on a November to January period.

To determine the summer distribution for better deer population management on the Coalville Deer Management Unit, the Utah Division of Fish and Game marked 248 deer during the winters of 1962-63 and 1963-64. Landowners in the Coalville Unit formed the Range Owner's Protective Association (ROPA) in 1947 and assessed range-use fees for the privilege of deer hunting on private land to control hunter and fisherman use.

This study was initiated and data was collected from September, 1964 through May, 1966.

Objectives

Primary objectives of this study were to determine the : (1) productivity, (2) physical condition, (3) seasonal distribution of the deer in the Coalville Management Unit, and (4) the history and trend of hunter range-use fees in Unit 19.

DESCRIPTION OF STUDY AREA

Location

The 686-square-mile Coalville Deer Management Unit is located in Summit County in northeastern Utah. Approximately 16.3 percent (112 sq. mi.) of the unit are U.S. Forest Service lands, and 83.7 percent (574 sq. mi.) are privately owned.

The study area, located within Herd Management Unit 19, is bordered on the north and west by U.S. Highway 189, on the south by the summit of the Weber River drainage and on the east by the Utah-Wyoming border and Utah Highway 150 (Figure 1). Elevations vary from 5,500 to 10,100 feet. Topography consit of rocky, coniferous covered mountain area, and juniper-sagebrush valleys. Mountainsides are dissected by many hollows and canyons. The main drainages are the Bear River, Echo Canyon, Grass Creek, and Chalk Creek. The latter three drain into the Weber River.

Geology

Geologically, the study area originated during the Lower Cretaceous Period approximately 120 million years ago. Today an abundance of gray and reddish conglomerate, as well as the Kelvin Conglomerate, Fowkes, Frontier, and Wanship Formations appear within the border of Management Unit 19 (Univ. Utah, 1957).

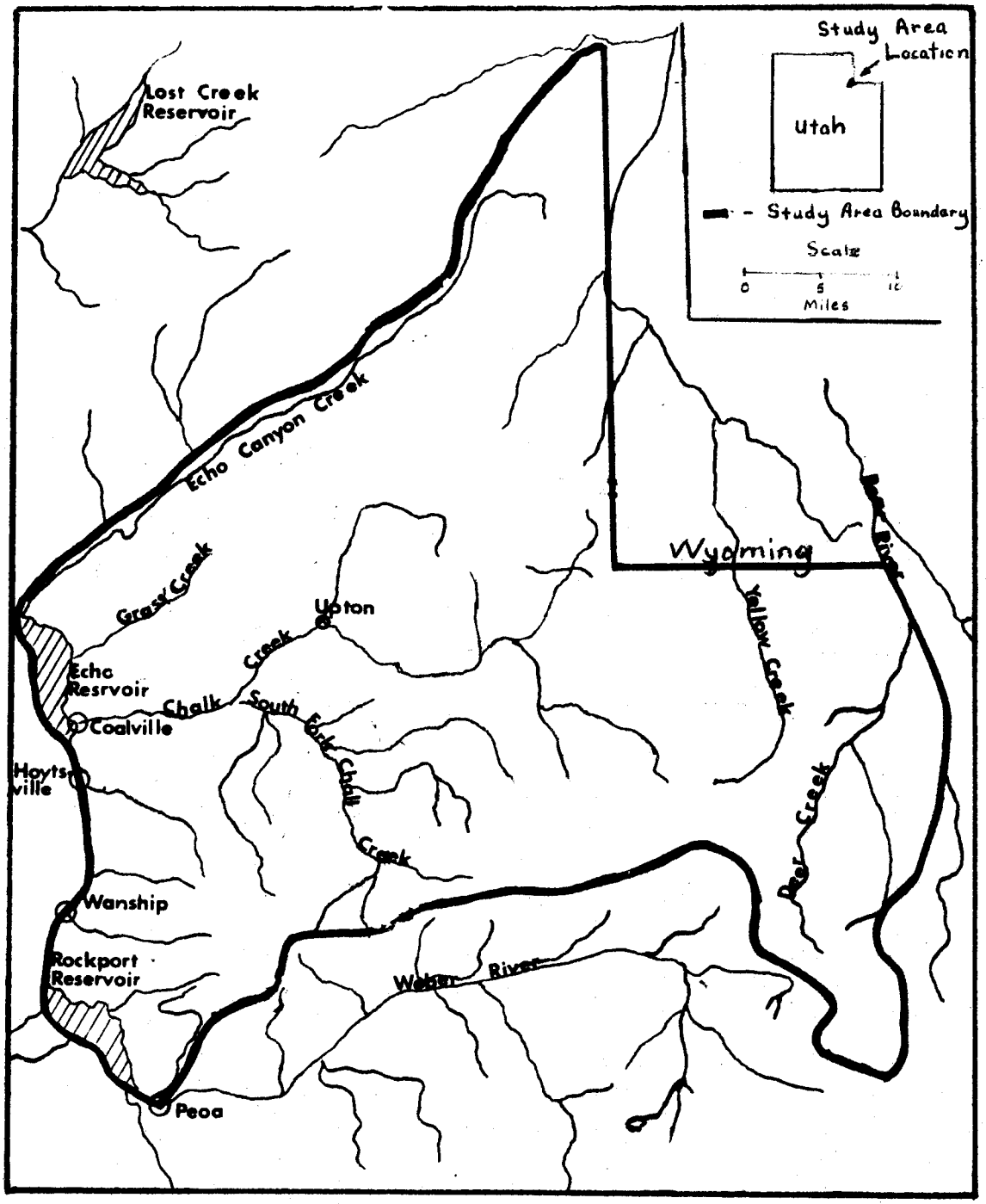

Figure 1. The study area located in deer management unit 19.

Vegetation

Seven major vegetative cover types, with intergradations, were represented in the study area. These were: (1) bunch grass (*Agropyron spicatum*), (2) sagebrush (*Artemisia tridentata*), (3) mahogamy (*Cercocarpus montanus*), (4) juniper (*Juniperus osteosperma*), (5) oak (*Quercus gambelii*), (6) aspen (*Populus tremuloides*), and (7) conifers (*Pinus sp.*). A sagebrush-mountain brush-bunch grass intergradation was the predominant cover on the winter range. A juniper cover type was found only on the west and south exposures with some isolated stands of mountain brush and sagebrush. The sagebrush types were the most productive for deer forage. Sagebrush-bunch grass dominated the summer range with an interpersion of aspen stands. Conifers dominated northern exposures at higher elevations (Utah Division of Fish and Game, 1965).

Fauna

Domestic livestock, particularly sheep, were the most abundant ungulates represented on the study area. Mule deer were the most abundant of the wild ungulates. Seventy elk (*Cervus canadensis nelsoni*) were observed during a January, 1965 snow-cat trip in the Grass Creek-Huff Creek-Porcupine Mountain area. Several Moose (*Alces alces*) also were observed during the spring, summer and fall 1965. A Rocky Mountain bighorn sheep (*Ovis e. canadensis*) was reported in the area in 1963 (Huff, 1965).

Carnivores were represented by the coyote (*Canis latrans*), bobcat (*Lynx rufus*), cougar (*Felis concolor*), and black bear (*Ursus americanus*). Beaver (*Castor canadensis*), mink (*Mustela vison*), and muskrat (*Ondatra zibethica*) were common furbearers in the study area. Small mammals

such as pine squirrels (*Tamiasciurus sp.*), white-tailed jackrabbits (*Lepus townsendi*), cottontail rabbits (*Sylvilagus nuttalli*), gophers (*Thomomys talpoides*) and mice, both indigenous (*Microtus sp.* and *Peromyscus sp.*) and exotic (*Mus musculus*), were found in the area.

Avian populations varied from season to season because of altitudinal and transcontinental migrations.

Rainbow (*Salmo gairdneri*) and cutthroat (*Salmo clarki*) trout were among the most abundant game fishes in the streams.

METHODS AND PROCEDURES

Productivity and Condition

Sex and age ratios were recorded from extensive field observations. The sex, age, and location of kill were recorded for all deer processed at the Chalk Creek checking station during 1964 and 1965.

All dead deer found in the study area were systematically examined for possible causes of mortality. The bone marrow test was used as an indicator of malnutrition (Cheatum, 1949). Physical condition of deer was determined at the fall deer checking station: (1) the relative amount of visible body fat (2) weights of segregated sex and age classes, and (3) antler measurements (number of points on each side, length of main beam, and diameter 1 inch above the burr). Age classes were determined by tooth replacement and wear.

Seasonal Distribution and Movement

The seasonal distribution, movement and migrational patterns of deer and influencing factors were recorded from field observations. Spring and fall migration routes were plotted from sight returns of marked deer, personal observations, and from personal interviews with people in the area. Summer distribution was determined by tag and sight returns of deer marked with ear tags, streamers, and collars. Winter distribution and concentration areas were delineated from aerial and ground reconnaissance and personal interviews with local people.

A total of 173 deer were trapped in the South Fork of Chalk Creek and marked with dark blue streamers during the winters of 1962-63 and 1963-64, and 75 deer were marked with yellow collars and streamers in Crandall Canyon. Another 232 deer were marked with light blue streamers and dark blue collars in the South Fork of Chalk Creek during January and February, 1965. White rubber letters and numbers were vulcanized to the collars for individual identification.

A total of 950 postcards, upon which the date, location, sex, color of streamer and collar of marked deer observed, and the name and address of the observer could be recorded, were distributed among local and professional people in the area.

History of Hunter Range Use Fees

The history and trend of hunter range use fees were compiled from personal interviews with local residents and landowners ~~and~~ in the study area.

LITERATURE REVIEW

Productivity

The fetal rate in five California studies ranged from 1.10 to 1.75, in Montana 1.60 to 1.70, in Idaho 1.85, in Oregon 1.70, and a Utah-Nevada study average fetal rate for 620 does was 1.56 (Bischoff, 1958; Blaisdell, 1954; Chatten, 1948; Cronemiller, 1951; Hudson, 1959; Hudson and Browman, 1959: Julander, Robinette, and Jones, 1961; Lassen, Ferrel and Leach, 1952; McKean, 1947; Robinette and Gashwiler, 1950; and Sears and Browman, 1955). Seventy-two to 98 percent of the does in the populations studied had conceived during the year of examination. However, there was some variation among age classes.

Robinette and Gashwiler (1950) examined 246 Utah deer and found 42.9 percent of the long yearlings barren, 35.7 percent produced singles and 21.4 percent had twin fawns. Of the 2-year-old does, 5.5 percent were barren, 41.7 percent bore singles, and 52.8 percent had twins. Twenty-five percent of the "prime" age category carried singles, 64.1 percent twins, 3.3 percent triplets, and 7.6 percent were barren. In the old age class, 11.8 percent of the sample population were barren, 42.6 percent had singles, and 45.6 percent twins.

Evidence from various studies indicates that the level of nutrition affects the fecundity of females, thereby creating regional variations in productivity (Cheatum and Severinghaus, 1950; Morton and Cheatum, 1946; Robinette, Gashwiler, Jones and Caren, 1955; and Severinghaus, 1951). Blaisdell (1954) found a significant decrease in the doe-fetal ratio as the

critical late winter and spring months passes. Robinette et al. (1955) found a 3 percent fetal mortality rate from conception to mid-pregnancy.

There are records of both male and female fawn breeding during the first year of life, although most investigators consider the reproductive capacity of fawns insignificant in the breeding potential of a mule deer herd. Mule deer generally are considered to fawn first at 2 years of age, and at a considerably lower rate than older does (Cowan and Wood, 1955; Robinette and Gashwiler, 1950 and Robinette et al., 1955).

Sears and Browman (1955) reported quadruplets in 2 of 64 does examined on the National Bison Range in Montana.

Blaisdell (1954) found a decrease from 1.34 embryos per doe to 1.07 fawns per doe by September. According to the 1965 Utah Big Game Investigations and Management Recommendations (Sparks, 1965), the 1964 preseason doe to fawn ratio for the northern two-thirds of Utah was 100:90 (815 does to 732 fawns). This included barren does as well as yearlings (fawns from last year). The southern one-third of Utah yielded 100:113 (658 does with 743 fawns).

Robinette (1956) found pigment scars (*corpora albicantia*) in 7 of 167 sets of ovaries from long yearling does. This indicated that 2.6 percent may have conceived as fawns. According to Robinette and Olsen (1944), the fawning season in central Utah is from June 5 to July 12 with the peak occurring during the last 2 weeks of June. The new-born fawns spend the first 3 or 4 weeks hidden, but by August follow the doe. He found a 10.8 percent fawn loss during the summer.

The posthunting season doe-fawn ratio for the northern two-thirds of Utah in 1964 was 100:74, while the southern one-third of Utah

reported 100:77, and the state-wide ratio was 100:75 (Sparks and others, 1965). The highest postseason doe-fawn ratio was 100:118 in Unit 27A, while the lowest was 100:28 in Unit 3. The postseason doe-fawn ratios from all herd units sampled in Utah for the following periods were:

Year(s)	Does	Fawns	Doe-Fawn Ratios
1949-1953	5,302	3,656	100:69
1954	3,457	2,359	100:68
1955	1,236	988	100:80
1957-1963	19,116	13,594	100:71
Totals*			
1949-1964	29,111	20,597	100:71

*(Based on data from Jones, 1953; 1955; 1956; and Sparks and others, 1965).

Mule deer productivity studies in Arizona, California, Montana, Nevada, and Oregon reported postseason doe-fawn ratios varying from 100:36 to 125 with averages between 52 to 88 fawns (Blaisdell, 1954; Dasmann and Hjersman, 1958; Gruel and Papez, 1963; Hansen and McCullock, 1955; Illige, 1954; Interstate Deer Herd Committee, 1950, 1951, and 1954; Lassen et al., 1952; Lovaas, 1958; Mace, 1956; and McKean, 1964).

Three California productivity studies reported April doe-yearling ratios of 100:12; 100:12; and 100:32 to 52, respectively (Blaisdell, 1954; Dasmann and Hjersman, 1958; and Lassen et al., 1952).

Mortality Factors

Figures on known losses, other than to legal hunting, for 1,513 deer were reported by the Washington Department of Game (1953). These were highway kill, 844 (56 percent); illegal hunting, 301 (20 percent);

malnutrition, 126 (8 percent); dogs 75 (5 percent); drowning, 65 (4 percent); trains, 55 (4 percent); fences, 22 (1 percent) wild predators, 15 (1 percent); and old bullet wounds 10 (1 percent). The estimated annual total nonhunting loss in the state was 25,000 deer.

Costley (1948), Robinette (1947), Robinette and Olsen (1944), and Van Etten and Bennett (1965) reported crippling losses at 10 to 42 percent of the legal kill. According to Costley (1948) the crippling loss amounted to 42 percent of the legal kill where bucks only were harvested on the Dixie National Forest in Utah, whereas only a 25 percent crippling loss occurred when any age and sex was taken. Hunters interviewed by Costley admitted to only 4 percent of the crippling loss.

Williams (1965) reported 2,446 deer-car accidents in Colorado in a 3 year period. The estimated damage to vehicles was $337,332 or $142 per accident. Seventy-one percent of the accidents happened between October and April on known deer crossings, and 64 percent of the accidents occurred between 4:00 and 10:00 p.m. Deer-car accidents were reduced by dimming headlights and driving slowly in deer crossing areas. Gillehan (1965) reported nine states field tested roadside mirrors with considerable success in reducing automobile-deer accidents. Reynolds (1965) reported a mule deer killed by lightning.

Robinette, Julander, Gashwiler and Smith (1952) quoted that the Utah Division of Fish and Game reported 30 to 50 percent deer herd losses from malnutrition during the severe winters of 1948 and 1949. Also reported was a 40 percent herd loss on a poor range during a mild winter, while he postulated the average herd loss during a moderate winter should not exceed 10 percent.

Dixon and Herman (1945) found the following parasites in mule deer in the Sequoia National Park in California: eye round worms

(*Thelazia californiensis*), chiggers (*Eutrombicula alfreddugesi*), nose bots (*Cephenomyia sp.*), tapeworm cyst (*Cysticercus sp.*), and ticks (*Dermacenter sp.*). Cowan (1948) reported granular tapeworm cysts (*Echinococcus granulosus*) in the mule deer in Jasper and Baniff National Parks.

Brigham (1954), Cahalane (1947), Horn (1941), Murie (1935), Murie (1940), and Robinette and Olsen (1944) reported coyote predation on deer. The latter reported 49 percent of the fawn crop taken by one coyote in a 500-acre enclosure. Numerous reports have been recorded of deer predation by cougars, bobcats, and golden eagles (Clausen, 1948; Dill, 1957; Hibben, 1937; Hickman, 1966; Matsen, 1948; McLean, 1925; Smith, 1945; Young 1958; and Young and Goldman, 1946).

Sex Ratios

Robinette (1956) reported a postseason average of 30 bucks per 100 does for the nine western states with some sex ratios as disproportionate as 7:100.

The Utah Division of Fish and Game (Jones, 1953; 1955; and 1956; and Sparks, 1964; and 1965) reported a postseason buck-doe ratio of 38.7:100 for 47,871 adult deer classified from 1949 to 1965. During the 1965 postseason, the Utah Division of Fish and Game classified 4,104 adult deer in northern Utah and 3,209 in southern Utah for buck-doe ratios of 34.4:100 and 37.2:100 respectively (Sparks, 1965). Robinette and Olsen (1944) recorded a buck-doe ratio of 38.4:100 for 2,529 postseason classified deer in central Utah.

Gruell and Papez (1963) reported a postseason sex ratio of 45 males per 100 females in northeastern Nevada, while December counts in

Washington resulted in 7.7 to 55.5:100 or an average of 33.3:100 over a 13-year period (Lauckhart, 1950). McKean (1947 and 1964) and the Interstate Deer Herd Committee (1950 and 1951) reported buck-doe ratios of 10 to 29:100, while 98 percent of the does were simultaneously pregnant with a potential fawn crop of 1.7 fawns per doe. Postseason doe-fawn ratios varied from 100:45 to 125.

Condition

A few investigators have used fat as an indicator of physical condition (Cheatum, 1949; Harris, 1945; Lovaas, 1958; Ransom, 1965; Riney, 1955, and Taber, White and Smith, 1959). Harris (1945) found that the change from good to poor physical condition can take place within a 6-week period. Adipose tissue was metabolized in the following chronological order: (1) over the rump, (2) between the skin and body, and (3) in the body cavity near the kidneys, intestines, and finally the heart.

Ranson (1965) concluded that kidney fat was not a reliable indicator of physical condition during the mobilization of femur marrow fat in whitetail deer. However, Riney (1955) formulated a reliable indicator of condition in red deer by weighing the kidney and the surrounding fat, which he called the "kidney-fat index".

Gerstell (1936) found that deer weights closely followed quantity and quality of available forage. Leopold, Riney, McCain and Tevis (1951) stated that changes in physical condition were directly correlated with the weather, the state of the range, and seasonal variations in the nutritive value of the forage.

Seasonal Distributions

Russell (1932) claimed the majority of the mule deer in Yellowstone National Park summered on ranges of intermediate altitudes (7,500 feet) and did not often go above timberline at 9,000 feet. Although, he found deer winter ranges from 7,000 to 8,000 feet above sea level on the east side of the Sierras in the Yosemite National Park.

Jensen (1941) reported 16 and 15 percent respectively of 83 and 193 tagged deer were returned by hunters the first fall following tagging operations.

According to Russell, seasonal movements of mule deer (0.5 to 100 miles) occur where seasonal climatic changes were very pronounced. However, he noted a nonmigratory mule deer herd residing at 7,500 feet elevation between Old Faithful and Madison Junction in Yellowstone National Park. The heat of the geyser regions caused large tracts of land to be entirely free from snow and the warm waters of brooklets and streams encouraged the growth of moss and grass along the banks during the winter. Russell found other Yellowstone summering mule deer migrating parallel with major drainages to winter ranges 10 to 60 miles distant. One exception was a wintering herd that crossed a major divide between two river systems.

The White River deer herd in northwestern Colorado migrated from 4 to 65 miles between the summer and winter range (Gilbert and Harris, 1959). Specific topographically oriented migratory routes were noted.

Gruell and Papez (1963) conducted an excellent 5-year study of seasonal movements of mule deer in the basin-and-range country of northeastern Nevada. Individual deer returned each year to the same

winter and summer ranges. Often, deer wintering together scattered to widely different summer ranges, and deer summering together scattered to widely separated winter ranges. Many migrating deer traveled far past potential destinations. Some fall migrants by-passed winter ranges 5 to 10 miles distant and moved 80 to 90 miles further. Migrants from other ranges did the same, only in opposite directions, forming a criss-cross migration.

There appeared to be little topographic orientation with respect to major drainages and mountain ranges. No differential movement between sexes occurred. Most migrational movements were direct, rather than circuitous. Gruell and Papez (1963, p. 420) stated that in predicting movement patterns in other areas:

> Apparently, oriented movements of mule deer are common in areas of bold topography such as the Sierra Nevada or the Colorado Rockies. In the more broken and variegated topography of basin-and-range, there is no strong orienting force to direct the movement of large groups of deer into a common pattern. In the latter case it becomes impossible to define a herd of deer.

Doman and Rasmussen (1944) reported 33 tags returned the fall following a mule deer tagging program in the Logan River Canyon in northeastern Utah. Twenty-four deer were killed within the Logan River drainage, eight immediately adjacent to or within 6 miles, and one approximately 10 miles past the upper end of the drainage. These data indicate that deer in this area confined movements to a single drainage system.

Zalunardo (1962) studied the movements of mule deer in south-central Oregon, and stated that deer from any one of four tagging areas did not move to a particular part of the summer range but were found throughout the area. Individual deer, however, returned to the same area of the

winter range each year. Movements ranged from 0.5 to over 60 airline miles, with a mean of 19.1 and a median of 18.0 miles. The majority were within 30 miles of winter range.

Seasonal movements of mule deer in California, as reported by Longhurst et al. (1952), differed as to region. There was relatively little seasonal movement of deer on the southern coast ranges. In interior southern California and on the northern coast ranges deer migrations consisted of a down-mountain drift wherever sufficient snow fell at higher elevations. An exception was noted in the Trinity Alps. There deer moved from the valleys to higher elevations during the wet season (winter), while green succulent forage was actively sought in the valleys during the dry season (summer). On the west slope of the Sierras, deer migrated up to 100 miles from the high mountains to winter along the lower slopes facing the central valley. In the Great Basin area all deer herd migrated to some extent (5 to 70 miles). In the southeastern desert of California, the deer were forced to concentrate near sources of permanent water during the dry season.

Leopold et al. (1951) concluded from the Jawbone Deer Herd study in California that main migration routes did not cross deep gorges or high divides. They concluded that each major watershed was a self-contained unit of deer range. Although, Ashcraft (1961) indicated deer summering in the McCloud Flats area of north-central California wintered on seven different winter ranges (12 to 39 miles distant), only two were down drainage from the summer range. He cited an instance of a belled doe returning to the same area on the summer and winter range for two consecutive years.

Movements of the Oregon-California interstate deer herd was as much as 100 miles from northern to southern extremities of the range (Fischer, Davis, Iversen and Cronemiller (1944). Rogers (1953) reported Washington marked deer traveled 4 to 20 miles with an average of 7 miles for 13 does.

Leopold et al. (1951) found, during a 3-year study of the Jawbone Deer Herd, only a fairly severe, general storm triggered the main downward mountain migration. In Yellowstone, Russell (1932) noted that a number of animals began migrating toward the winter range when the first snow storms occurred. Some of the first movements carried the animals over a route of 20 to 50 miles, all at levels regarded as summer range. The actual descent in great numbers was delayed until sever storms in November.

However, in Yosemite National Park the deer on the upper limits of the summer range (9,000 feet) responded to stimuli other than snow and began the migration in advance of fall storms, while the large part of the deer population in the heart of the summer range (7,500 feet) showed no great inclination to travel until snow storms occurred. Russell (1932) concluded that while snow in no way affected the food value of plants, it did effectively render plants inaccessible to deer. In this role, it is the causative factor in bringing about the fall movement of deer. Dixon's (1934) conclusions parallel Russell's (1932), although he believed deer in the Yosemite area avoided deep snow to decrease vulnerability to predation.

Longhurst, Leopold and Dasmann (1952) attributed seasonal movements of mule deer in the northern coast ranges of California to seasonal changes in vegetation, while deer in the Great Basin area of California and in southern California migrate only as far as forced by snow.

Fischer et al. (1944) reported the seasonal drop in temperature initiated fall migration of the Oregon-California interstate deer herd. However, Ashcraft (1961) reported that movements occurred readily as the available water supply was depleted. He postulated that the possession of water holes by campers and sportsmen could induce early migration during the dry season in southeastern California.

Russell (1932) reported grass as well as some other vegetation in the Yosemite National Park area produced green shoots immediately after the snow melted. For this reason, deer closely followed the retreating snow line. Above 6,000 feet the snow melted slower and low temperatures retarded plant development. At this stage of the upward movement, he found the timing of movements was similar to the Yellowstone deer, with animals reaching the heart of the summer range and higher levels about 3 weeks after the snow had disappeared. Leopold et al. (1951) observed deer concentrated 1,000 feet or more below the receding snow line. This also was thought to be more a response to the development of vegetation than to the actual snow line.

Russell (1932) briefly discussed breeding activities and the birth of young in relation to season movements and found no evidence that either was a causative factor.

Wright and Swift (1942) reported 99 percent of 28,207 deer migrated across a 25-mile segment of road toward the winter range during a 4-week period, in the White River area in northwestern Colorado. approximately 75 percent of the migration occurred during a 10-day period, with peaks of 2,800 deer crossing in 24 hours. Does and yearlings started to migrate before adult bucks.

RESULTS

Productivity

A total of 502 deer were classified on the Coalville deer management area December 20 through 31, 1965 for an overall doe-fawn ratio of 100:77 (Table 1). By major drainages, the Chalk Creek drainage doe-fawn ratio was 100:79 compared with ratios of 100:92 and 100:70 in the Echo Canyon area and along the Weber front between Coalville and Peoa, respectively.

In comparison, the 1964 November to December doe-fawn ratio for the northern two-thirds of Utah was 100:74 and the state-wide ratio was 100:75 (Sparks, 1965). The 15-year (1949-64) state-wide average doe-fawn ratio was 100:71 with 29,111 does to 20,597 fawns (Jones, 1953, 1955, 1956, and Sparks, 1965). Robinette (1956) gave a doe-fawn ratio of 100:81 for the nine western states, based on a November to January period.

Aldo Leopold (1933, p. 22) defined productivity as "the rate at which mature breeding stock produces other mature stock, or mature removable crop." According to Rasmussen and Koman (1947) and Robinette and Olsen (1944), a game manager can approximate the net productivity of a deer herd by checking the percentage of yearlings in the doe herd through aging legally killed animals. Robinette (1956) suggests that the net productivity of mule deer herds should range between 20 and 35 percent.

In my study area a total of 122 hunter-killed female deer were aged during the 1964 hunting season (Table 2). The percentage of

Table 1. Age composition and sex ratios for mule deer, Utah Management Unit 19, December 20-31, 1965.

Deer counts by Unit 19 drainages	Number of Fawns	Does	Bucks
1. Chalk Creek (62% of deer sample) Total--311 deer 79 fawns/100 does 62 males/100 does	102	129	80
2. Echo Canyon (7% of deer sample) Total--33 deer 92 fawn/100 does 83 males/100 does	11	12	10
3. Weber Front (32% of deer sample) (Coalville to Peoa) Total--158 deer 70 fawns/100 does 52 bucks/100 does	50	71	37
Grand total	163	212	127
Percent by group	32.5	42.2	25.3
Overall doe-fawn ratio	100:77		
Overall buck-doe ratio	60:100		

yearlings in the doe herd or net productivity was 44 percent. In October 1965, the percentage of yearlings in the doe herd for 135 classified female deer was 27 percent and according to Stapley (1966) the October, 1966 approximate net productivity was only 19 percent.

Table 2. Doe-fawn and doe-yearling ratios at the Utah Coalville Management Unit 19 checking station, 1964, 1965 and 1966.

Year	Fawns		Yearling Females	~~Yearling~~ Adult Females	Ratios		
	Male	Female			Doe-Fawn	Doe plus Yearling-Fawn	Doe-Yearling
1964	34	27	42	53	100:115	100:61	100:79
1965	26	30	28	77	100:73	100:53	100:36
1966[a]	—	—	12	51	—	—	100:20

[a]Stapley, 1966.

Condition

Several characteristics directly or indirectly describe deer or deer herd condition. During this study, condition was considered to mean proper or healthy state of the herd and was divided into two categories: (1) herd characteristics (mortality, reproductive rate, and sex ratios), and (2) physical characteristics (body fat, weights and antler measurements) of deer age classes.

Herd characteristics

Mortality. Sex, age, condition and possible causes of death were recorded for 63 dead deer necropsied during the spring and summer of 1965. Of these, the death of 40 percent was classified as winter mortality, 19 percent as fence fatalities, 18 percent from auto accidents, 14 percent appeared to have been shot (including three collected by the Utah Division of Fish and Game), and 6 percent were trap fatalities. Malnutrition appeared to be the cause of death of approximately half (12 of 25 deer) of those classified as winter losses. The cause of death was listed as unknown for the remaining 13 deer.

No crippling losses were acknowledged by 864 hunters personally interviewed during the 1964 and 1965 hunting seasons on the Coalville Unit. Only one of the 63 dead deer examined during the spring and summer of 1965 appeared to be a crippling-loss mortality.

Thirty-three (52 percent) of the 63 dead deer found were fawns; 16 (25 percent) were between 1.5 and 8 years of age; 6 (10 percent) were between 9 and 15 years of age, and the remaining 8 (13 percent) were unaged. Robinette (1949) and Robinette et al. (1957) reported 2.6 to 3 times as many fawns died as older deer during the winter period.

Parasites, such as nose bots (*Cephenomyis sp.*), tapeworm cysts (*Cysticercus sp.*) and ticks (*Dermacentor sp.*) were observed on and in dead deer. A complete examination for internal parasites was not conducted.

Large multiple fibroma nodules, as described by Honess (1939), were observed on the heads and necks of two bucks checked at the hunter checking station, and also on an old winter-killed buck in the South Fork of Chalk Creek. According to Herman and Bischoff (1950) these wart-like growths on the heads and necks of deer are caused by a virus and are entirely confined to the skin. The nodules are usually on the head, neck and shoulder areas and vary from minute warts to warts 8 to 10 inches in diameter. They did not think the nodules affected the meat, but may sap strength, stunt growth, or cause blindness if the growths are on the eye lids. The virus may be contracted by other animals through skin injuries, although epidemics among deer have not been reported.

On July 8, 1965, a dead fawn partially covered with dirt was found at the entrance of a badger's den near the Bear River. A front leg and some hair was found in the den. It was not ascertained whether the fawn was killed by the badger.

The mean annual mortality rates of the male and female segments of the population, based on the yearling and older age classes, were 45 and 35 percent, respectively (Table 3). The differential mortality rate between males and females is quite apparent and significantly different ($P =< 0.01$). However, there was no significant difference ($P =< 0.05$) between the slopes (b) (from plotted regression coefficents) of the two regression lines (Figure 2).

Table 3. Time-specific life-table calculated from the 1964 and 1965 deer harvest on the Utah Coalville Deer Management Unit 19.

	x Age (in years)	d_x Number shot	l'_x Alive at Start	d'_x Calculated deaths	q_x Mortality rate per year
MALES	1 1/3	162	162	72	.44
	2 1/3	90	90	55	.61
	3 1/3	35	35	-4	
	4 1/3	39	39	19	
	5 1/3	20	20	12	
	6 1/3	8	8	4	
	7 1/3	4	4	3	
	8 1/3	1	1	0	
	9 1/3	1	1	1	
Total		360	360	162	.45[a]
FEMALES	1 1/3	70	70	23	.33
	2 1/3	47	47	20	.43
	3 1/3	27	27	-3	
	4 1/3	30	30	12	
	5 1/3	18	18	15	
	6 1/3	3	3	1	
	7 1/3	2	2	0	
	8 1/3	2	2	1	
	11 1/3	1	1	1	
Total		200	200	70	.35[a]

[a] The mean mortality rate per annum of the age classes 1.33 to 11.33 years inclusive.

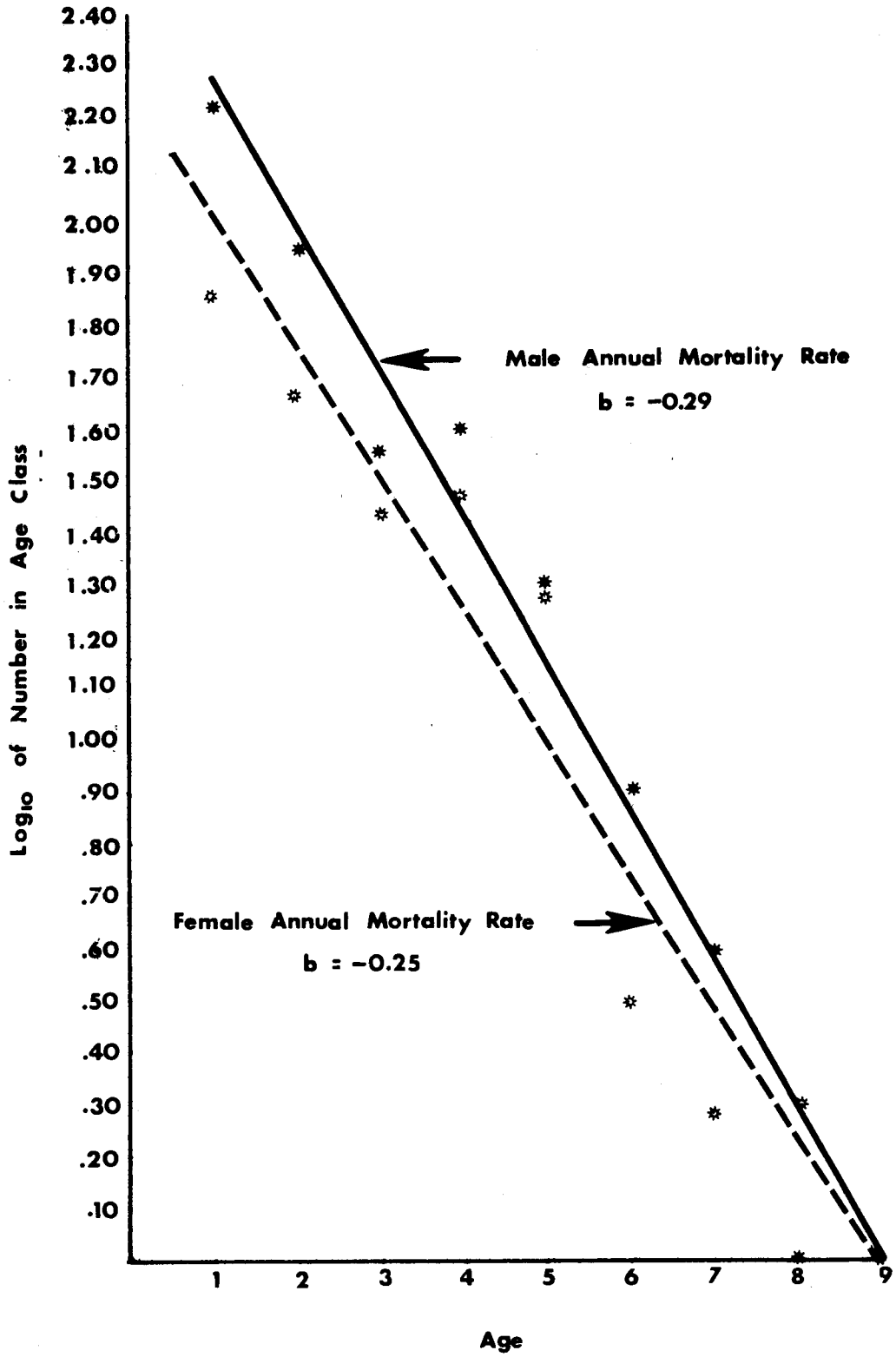

Figure 2. Regression lines comparing male and female annual mortality rates from Utah Deer Management Unit 19, 1964 and 1965 fall harvest age compositions.

The obvious discrepancy between the annual mortality rates, based on the yearling and older age classes and the regression line may be attributed to the significant differential mortality between the sexes of the yearling age class, as demonstrated by the time-specific life-table. No differential mortality between sexes was detected for fawns in the fall harvest, the January-March trapping and tagging operation, or in the 33 dead fawns posted during the spring of 1965 (Tables 4 and 5). However, the summer yearling buck to yearling doe ratio recorded in July 1965 was 62:100, practically the same as the postseason male to female ratio of 60:100. No detectable cause was found.

Sex ratios. There were 1.5 to 2 bucks killed per doe during the fall harvest of 1965 (Tables 4 and 5). The postseason herd composition counts resulted in a buck-doe ratio of 60:100 or 1.67 does per buck, compared with 31:100 buck-doe ratio on the Cache Deer Herd Unit (Sparks, 1965).

Physical characteristics

Body fat. Based on the amount of adipose tissue around the kidneys and under the skin, 90.4 percent of 655 deer checked during the 1964 and 1965 hunting seasons were found to be in good shape. In the adult class 2.3 percent of the bucks and 7.7 percent of the does were in the fair category. None were placed in the poor category. Eight (4.9 percent) and two (2.9 percent) of the male and female yearlings respectively were in fair condition. No female yearlings were found in poor condition, although 1.9 percent of the yearling males were in poor condition. Approximately 27 percent (15 percent fair and 11.7

Table 4. The sex and age structure of deer examined at a checking station during the 1964 season on Utah Deer Management Unit 19.

Sex	Age class (years)									
	Fawn	1 1/3	2 1/3	3 1/3	4 1/3	5 1/3	6 1/3	7 1/3	8 1/3	9 1/3
MALES:										
Sample size	34	95	38	20	17	8	5	3	1	1
Percentage	15.3	42.8	17.1	9	7.7	3.6	2.3	1.4	0.5	0.5
Total--222										
Percentage over 3 1/3 years of age--25%										
FEMALES:										
Sample size	27	42	21	6	10	11	3	1	1	—
Percentage:	22.1	34.4	17.2	4.9	8.2	9	2.5	0.8	0.8	—
Total--122										
Percentage over 3 1/3 years of age--26.2%										
MALE & FEMALE:										
Sample size	61	137	59	26	27	19	8	4	2	1
Percentage	17.7	39.8	17.2	7.6	7.8	5.5	2.3	1.2	0.6	0.3
Percentage over 3 1/3 years of age--25.3%										

Table 5. The sex and age structure for deer examined at a checking station during the 1965 season on Utah Deer Management Unit 19.

Sex	Age class (years)										
	Fawn	1 1/3	2 1/3	3 1/3	4 1/3	5 1/3	6 1/3	7 1/3	8 1/3	9 1/3	11 1/3
MALES:											
Sample size	26	67	52	15	22	12	3	1	—	—	—
Percentage	13.1	33.8	26.3	7.6	11.1	6.1	1.5	0.5	—	—	—
Total--198											
Percentage over 3 1/3 years of age--26.8%											
FEMALES:											
Sample size	30	28	26	21	20	7	0	1	1	0	1
Percentage	22.2	20.7	19.3	15.6	14.8	5.2	0	0.7	0.7	0	0.7
Total--135											
Percentage over 3 1/3 years of age 37.7%											
MALE + FEMALE:											
Sample size	56	95	78	35	42	19	3	2	1	0	1
Percentage	16.8	28.5	23.4	10.8	12.6	5.7	0.9	0.6	0.3	0	0.3
Total--333											
Percentage over 3 1/3 years of age--31.2%											

percent poor) of the male fawns examined were in less than good shape, while 35 percent (21.1 percent fair and 14 percent poor) of the female fawns examined fell into the same categories.

Weight and antler measurements. Male deer weights, antler points, length of main beam, and diameter of the antler measurements or weights could be used for aging criteria because of the overlapping confidence limits ($P =< 0.05$). In contrast, female deer weights increased until 2.3 years of age, but had no significant weight gains thereafter (Figure 3 to 6 and Appendix Tables 10 to 17).

The mean weight of each age class for male and female deer respectively, were significantly different ($P =< 0.05$) comparing 1964 with 1965. No significant differences existed in 1965 between the average weights for each age class of the respective sex on the Coalville and Cache Deer Herd Units. Average weights for the Cache Deer Herd in 1965 compared favorably with the average weights of the Coalville deer herd in 1965 and compared favorably with other deer herds considered in good condition in Utah (Jones et al., 1956; Julander et al., 1961; Rasmussen, 1939; Stoddart and Rasmussen, 1945), Arizona (Illige, 1954), and Oregon (Cliff, 1939).

A statistical comparison of the right antler points denoted a significant difference ($P =< 0.05$) between 1964 and 1965 respective age classes. However, no significant difference was found in the mean number of left antler points between 1964 and 1965 respective age classes or respective age classes of the Coalville and Cache Deer Management Units.

Antler-point data indicated a definite increase of antler points with age. Generally speaking, yearlings had "forked horns";

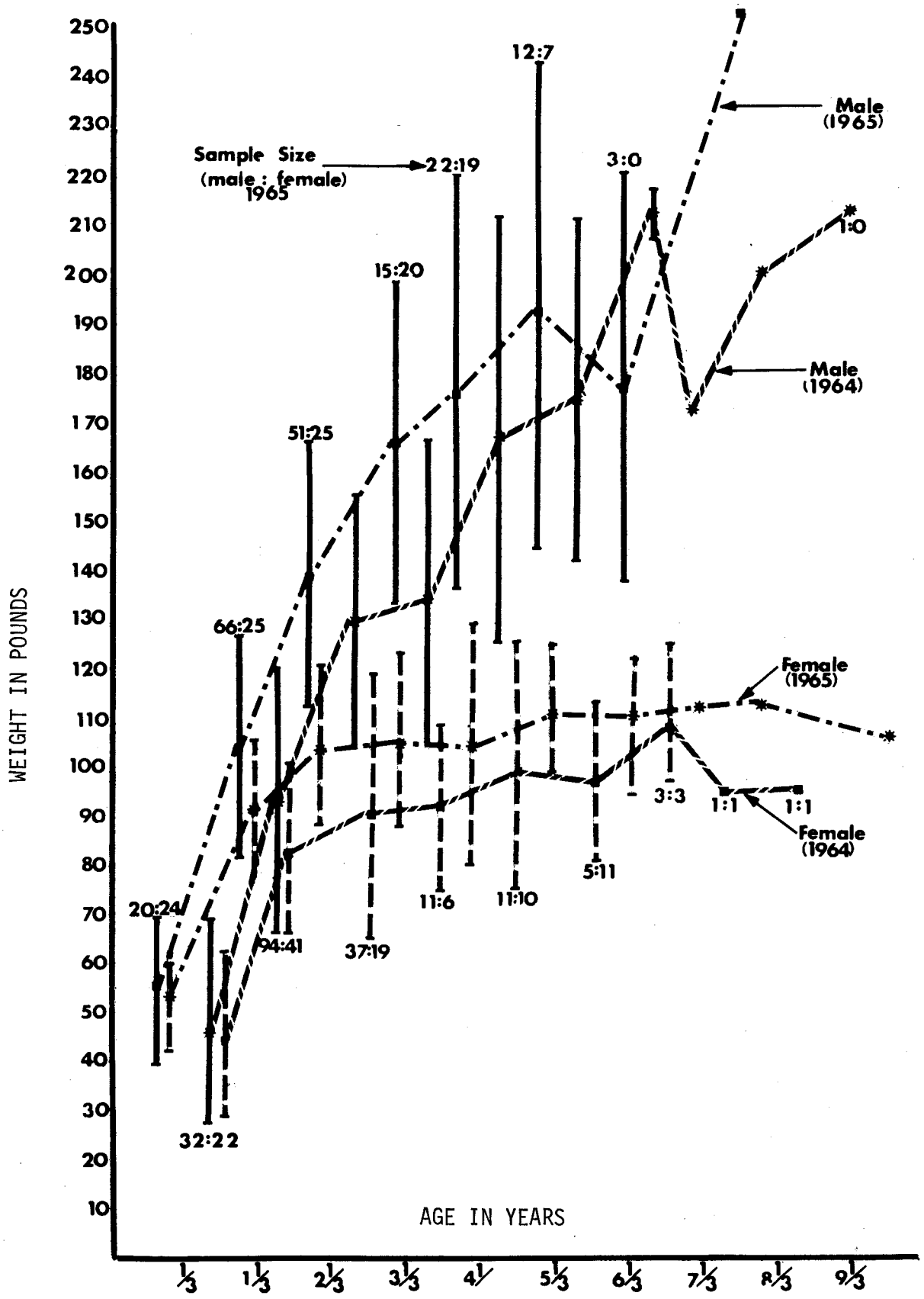

Figure 3. The mean weight and 95 percent confidence limits for male and female deer from Unit 19, fall 1964 and 1965.

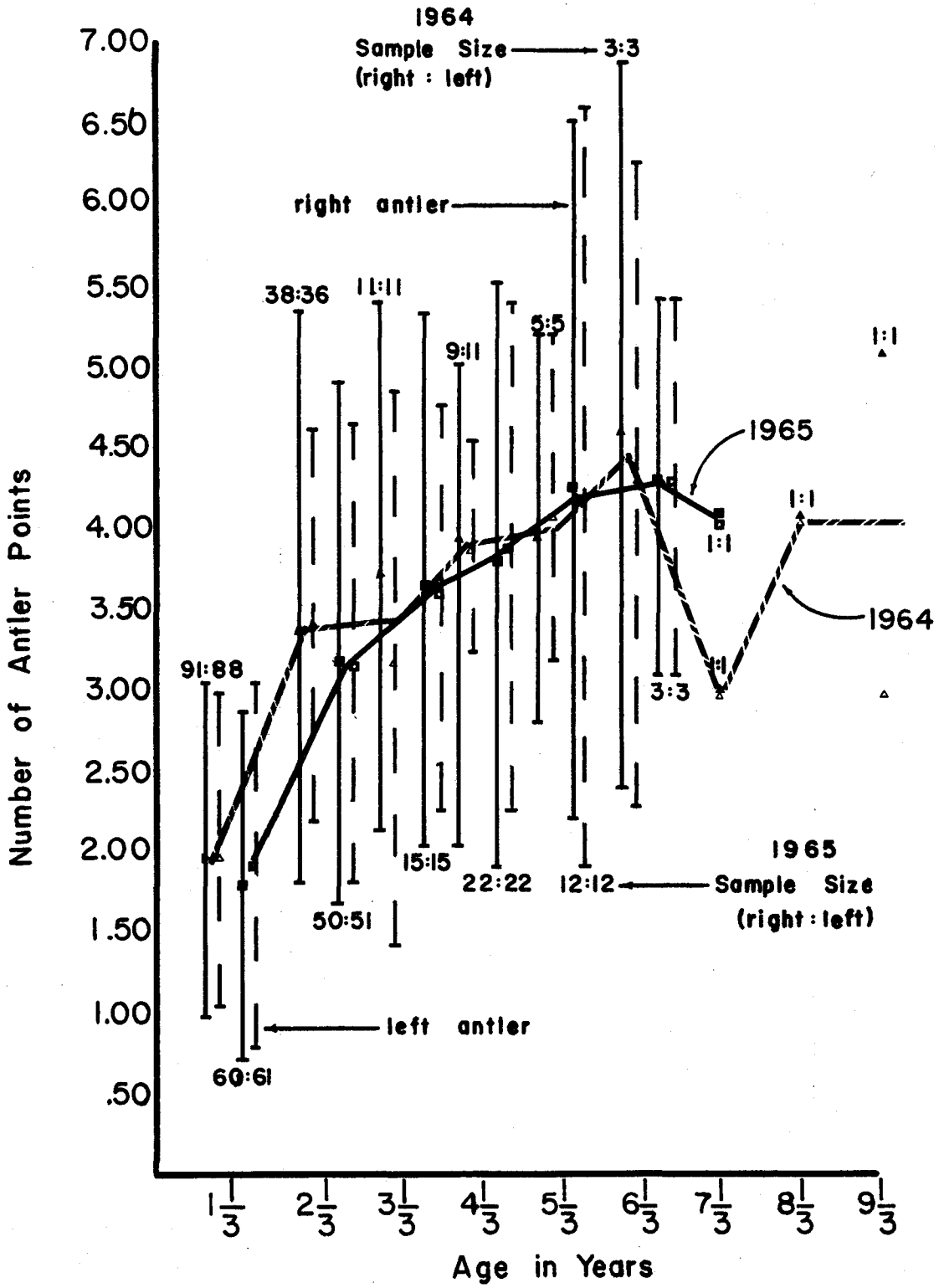

Figure 4. Mean number of antler points on each side and the 95 percent confidence limits, Unit 19, fall 1964 and 1965.

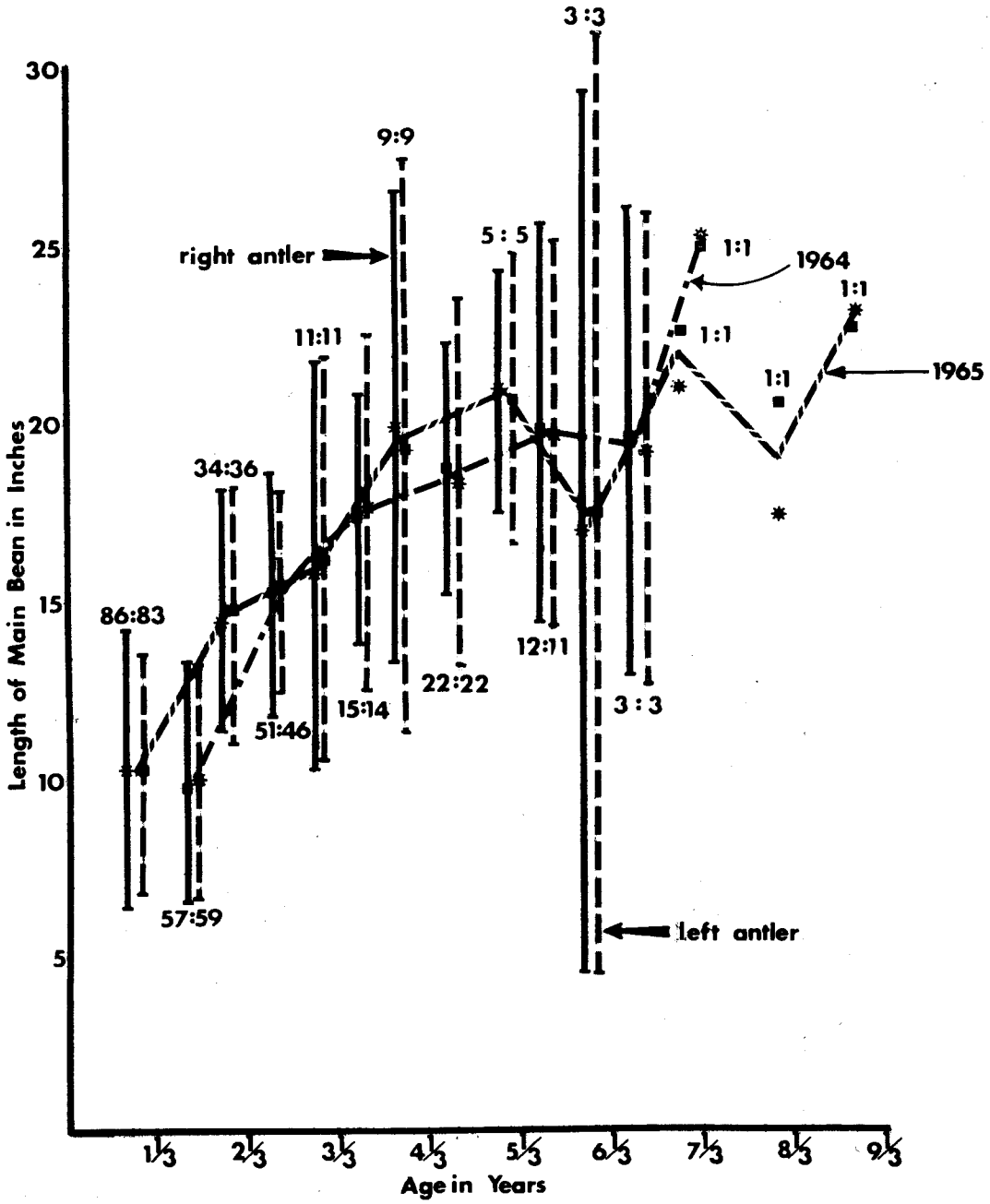

Figure 5. Mean length of the main beam of the antler and the 95 percent confidence limits, Unit 19, fall, 1964 and 1965.

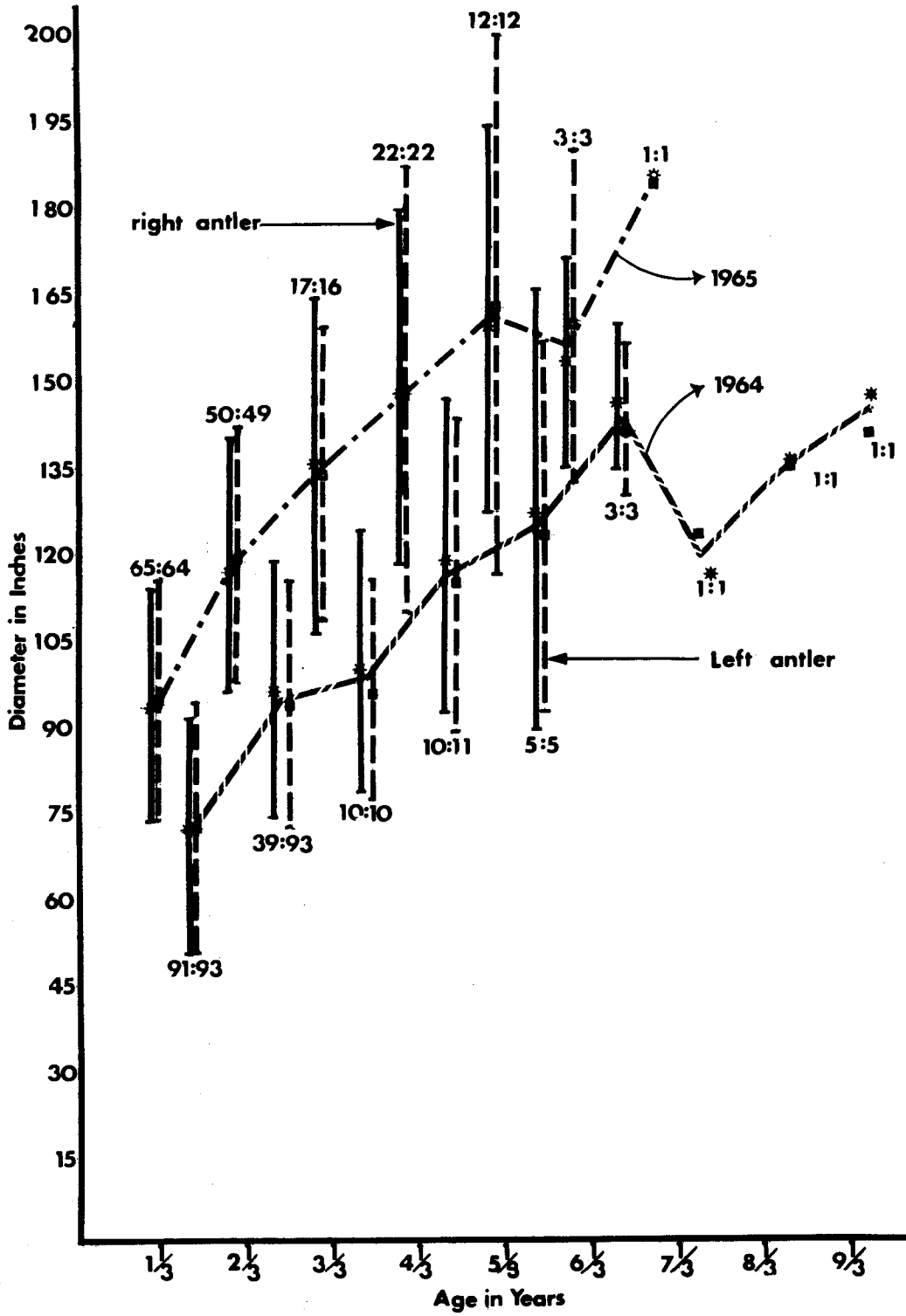

Figure 6. Mean diameter of the antler one inch above the burr and the 95 percent confidence limits, Unit 19, fall, 1964 and 1965.

2-year-olds three points; 3-year-olds three to four points; 4-year-olds four points; and the 5 and 6-year-olds had four or more points.

The length of the main beam was the least consistent of the physical characteristics. No significant difference ($P =< 0.05$) was found in the length of the main beam between 1964 and 1965 respective age classes. The Coalville deer herd in 1965 had shorter main beam lengths with the exception of the 2-year-old age class, than did the Cache Deer Herd in 1942 and 1950.

The difference between 1964 and 1965 antler diameters 1 inch above the burr was highly significant ($P =< 0.05$) (Figure 6). It suggested a correlation between the diameter of the antler 1 inch above the burr and the weight of the deer. Cronemiller (1947) and Severinghaus (1950) also found positive relationships between antler beam diameter, deer size, and range condition.

Seasonal Movements and Distribution

Summer distribution

The summer distribution from sight and tag returns of mule deer wintering in the South Fork of Chalk Creek and the Crandall Canyon-Pine Creek area showed that deer were migrating into the following five major drainages: (1) Weber River, (2) Provo River, (3) Bear River, (r) Duchesne River, and (5) Diamond Fork. The majority (49 of 70 or 70 percent) of the returned tags were from the Weber River Drainage, while 7, 4, 1 and 9 tag returns respectively came from the Provo, Duchesne, Diamond Fork and the Bear River Drainages.

Thirty-two of the 73 (44 percent) tag returns were recovered in the Kamas Deer Management Unit 20 (Figure 7). In fact, 33 percent of all tag returns were recovered in the Weber River Drainage east of Oakley in Unit 20. Twenty-one of 53 (40 percent) tag returns for deer tagged in the South Fork of Chalk Creek were recovered from Unit 20, while 11 of 20 (55 percent) tag returns for deer marked in the Crandall Canyon-Pine Creek area were recovered in the Kamas Management Unit. Almost 2 and 10 percent, respectively, of the deer marked in the South Fork of Chalk Creek and Crandall Canyon were returned from Unit 23B; 1.9 percent (South Fork) from the Heber and Diamond Fork Units; and 7.5 percent (South Fork) from Unit 24. Two of the 20 (10 percent) Crandall Canyon-Pine Creek deer tag returns were recovered in the Lost Creek Management Unit 6.

Forty-seven percent of the tag returns for deer tagged in the South Fork of Chalk Creek were within the boundaries of Unit 19, while only 25 percent of the Crandall Canyon-Pine Creek tag returns were recovered within Unit 19.

The sight returns of marked deer revealed a completely different picture than did hunter tag returns (Figure 8). Only 6 of 57 (10.5 percent) reported sightings from both winter ranges were recorded in Unit 20. No Crandall Canyon-Pine Creek marked deer were observed there. One of five (20 percent) sightings of the Crandall Canyon-Pine Creek marked deer were observed in Unit 23B. The rest of Crandall Canyon-Pine Creek marked deer (4 or 80 percent) were observed in the Coalville Unit. Two (3.8 percent) of the sighted South Fork deer were

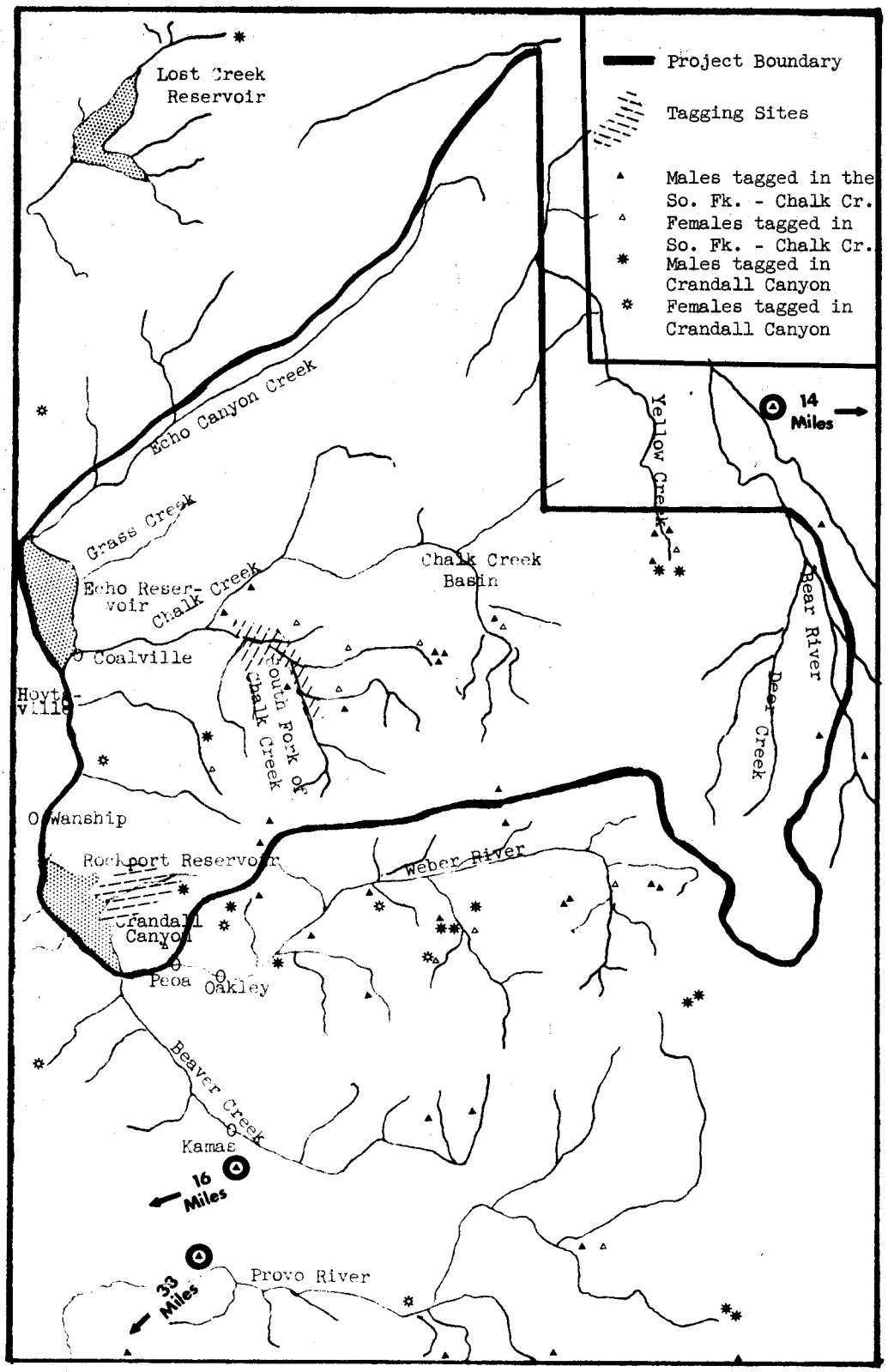

Figure 7. Return locations of deer ear tagged in the South Fork of Chalk Creek and Crandall Canyon areas.

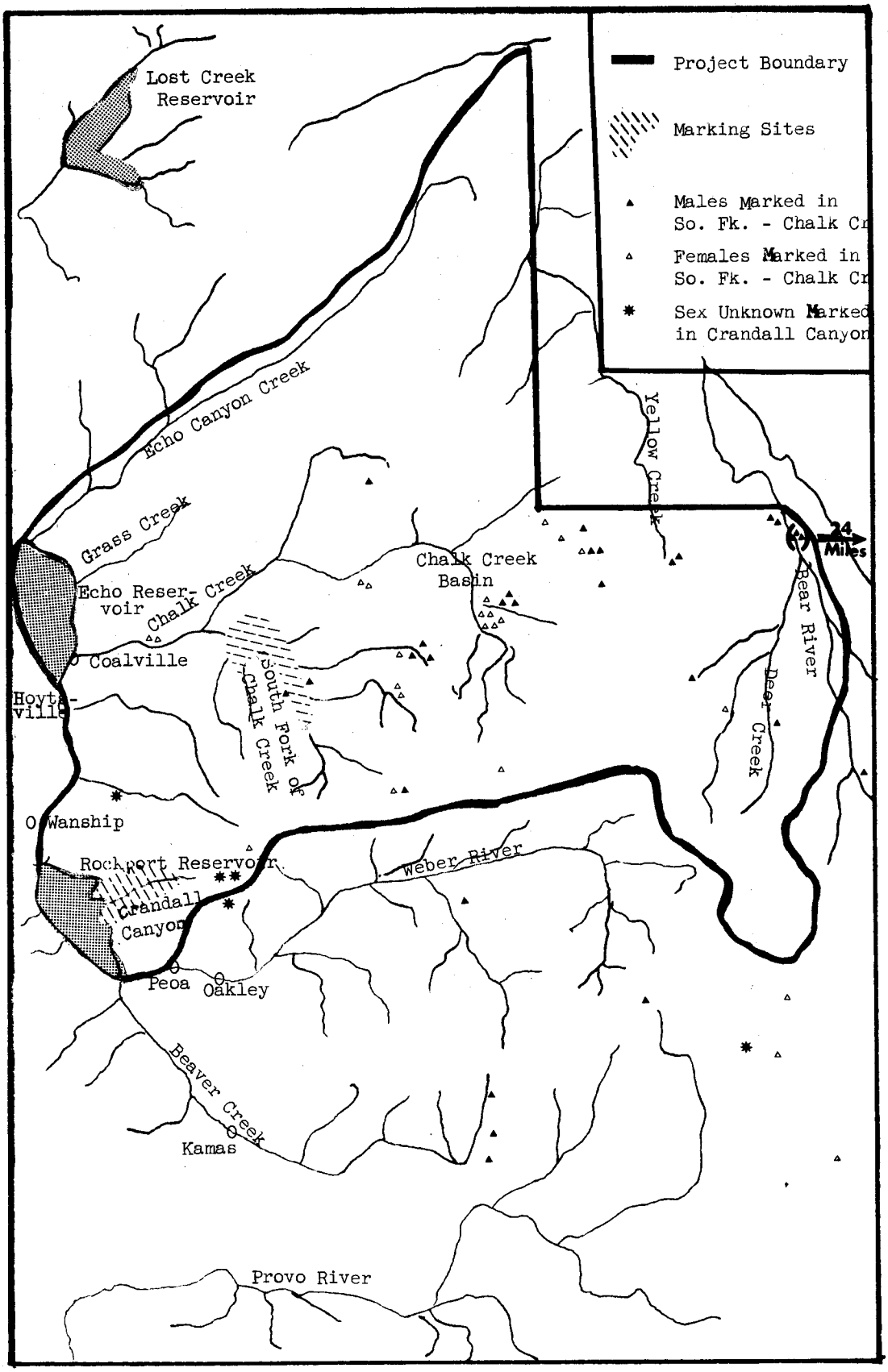

Figure 8. Sight return locations of deer streamered and collared in the South Fork of Chalk Creek and Crandall Canyon areas.

observed in Unit 23B; four (7.7 percent) in Unit 24 and 40 (77.0 percent) were observed in the Coalville Unit. Thus 44 of 57 (77 percent) marked deer observed were within the Coalville Unit.

A more concentrated effort on the part of the observer in the Coalville Deer Unit may in part account for the differential summer dispersion between sight and tag returns. Although the general public had ready access to most of Unit 20, little access was allowed in Unit 19 except along the Bear River.

Deer in Unit 19 summered from the bottom of the winter range (5,500 feet) to the top of the highest mountain (10,100 feet). However, the majority were observed in the quaking aspen belt between approximately 7,500 and 9,500 feet.

Winter distribution

On March 10, 1965 mule deer were found by aerial reconnaissance from 5,500 to 7,500 feet in elevation. This included Ree's Creek in Echo Canyon, the west side of Porcupine Mountain in Chalk Creek, in the upper extremities of the Winter Quarters in the South Fork of Chalk Creek, and from Coalville to Peoa along the Weber River Front.

Concentrations were observed in: (1) Aspen Creek (Echo Canyon), (2) the south side of the Narrows, (3) the South Fork of Chalk Creek (Chalk Creek Drainage) and in (4) Pecks, Hixon, Cheery and Crandall Canyons and Pine Creek along the Weber Front between Coalville and Peoa. The heart of the winter range in March, 1965 was at approximately 6,700 feet, but this could have changed due to snow depth and climatic variables which effect each year's winter distribution.

Movement

Utah deer hunters returned 70 tags (14.6 percent) from 480 deer marked during a 5-year period ending in March, 1966 (Table 6). Twenty (20 percent), 16 (11 percent), and 20 (9 percent) of the deer tagged during the winter of 1961, 1964, and 1965 respectively, were returned the following fall. The second fall, following the tagging operations in 1961 and 1964 on the Coalville Deer Management Unit, 4 and 3 percent of the tags from marked animals were returned by hunters. During the fall of 1963, 3 percent of the deer tagged in 1961 were reported by hunters.

The mean distance of 70 tag recoveries from the tagging sites was 13.9 miles. With one exception, the differential movement between age and sex was not found to be significant ($P \leq 0.05$) for any given year and for a given wintering area. In general, the distance traveled by those animals marked and returned in 1964 and 1965 were comparable regardless of sex and age, but were not comparable with those tagged and returned in 1961 without regard to sex and age (Table 7).

One male deer, tagged as a fawn and killed as a 3-year-old, had migrated 61.5 airline miles from its winter area. However, an adult female was harvested the following October within 0.5 miles of the tagging site (Table 8).

Female fawn mean tag-recovery distances compared statistically ($P \leq 0.05$) with all other tag-recovery distances regardless of winter range, sex or age (Table 6). Although equal numbers of male and female fawns were tagged, it was of interest that twice as many male

Table 6. Deer tag return distances and comparisons of the sample variances (S^2) and sample means ($\bar{y}$) of tag return distances South Fork of Chalk Creek and Crandall Canyon 1961, 1964 and 1965.

Year Tagged	Year Retd.	Tagging location	Treatment identification letter	Sex	Age[a]	n	$\bar{y}$ (miles)	S^2	S	[b]Significantly different than equality ($P = < 0.05$)
1965	'65	So. Fk. Chalk Cr.	A	Male	Fawn	3	6.7	25.81	5.08	O
			B	Female	Fawn	2	8.7	42.32	6.50	
			C	Male	Year.	7	10.4	27.80	5.27	KNOR
			D	Male	Adult	3	19.0	183,25	13.54	
			E	Female	Adult	5	12.5	149.64	12.22	
1964	'64	So. Fk. Chak Cr.	F	Male	Fawn	3	11.4	19.26	4.39	
			G	Male	Year.	2	9.3	.50	.71	NRK
			H	Male	Adult	5	16.4	97.47	9.87	R
			I	Female	Adult	2	11.1	3.12	1.77	N
		Crandall Canyon		Male	Year.	1	5.4			
				Female	Adult	1	1.3			
			J	Male	Adult	2	16.4	41.22	6.42	
1964	'65	So. Fk. Chalk Cr.	K	Male	Fawn	2	21.4	36.12	6.01	CNG
				Female	Adult	1	12.0			
				Male	Adult	1	1.9			
		Crandall Canyon		Male	Year.	1	11.1			
1961	'61	Crandall Canyon	L	Male	Fawn	2	3.8	16.24	4.03	O
				Female	Fawn	1	17.4			
				Male	Year.	1	13.6			

Table 6. Continued

Year Tagged	Year Retd.	Tagging location	Treatment identification letter	Sex	Age[a]	n	$\bar{y}$ (miles)	S^2	S	[b]Significantly different than equality (P = <0.05)
		So. Fk. Chalk Cr.		Female	Fawn	1	8.2			
				Male	Fawn	1	30.0			
				Female	Year.	1	15.2			
			M	Male	Adult	5	22.7	202.66	14.25	C
1961	'61	So. Fk. Chalk Cr.	N	Female	Adult	2	1.2	.98	.99	OIGKR
		Crandall Canyon	O	Male	Adult	4	19.7	25.46	5.04	NACL
			P	Female	Adult	2	7.6	33.62	5.79	
1961	'62	Crandall Canyon	Q	Female	Fawn	2	12.5	92.48	9.62	
				Male	Fawn	1	30.3			
		So. Fk. Chalk Cr.		Male	Adult	1	1.3			
1961	'63	So. Fk. Chalk Cr.	R	Male	Fawn	2	35.6	1336.44	36.56	CGHN
		Crandall Canyon		Male	Year.	1	2.8			
1961	'65	So. Fk. Chalk Cr.		Male	Adult	1	18.3			
		Crandall Canyon		Male	Year.	1	30.0			

[a]Age when tagged.

[b]Using the F-Distribution ($S^2n \neq S^2n$) N,O; McC; G,R; H,R; N,R

or

Using the t-Distribution ($\bar{y}n \neq \bar{y}n$) A,O; C,K; C,O; C,R; G,N; K,N; N,I; L,O; G,K

Table 7. Deer sight return distances and comparison of the sample variances (S^2) and sample means ($\bar{y}$) of returns, South Fork of Chalk Creek and Crandall Canyon, 1961, 1964 and 1965.

Year	[a]Streamer color	Treatment identification letter	Sex	N	$\bar{y}$	S^2	S	[b]Significantly different than equality (P = 0.05)
1965	Light blue	A	Male	9	9.88	42.62	6.53	B,E,F,G,H
		B	Female	17	7.60	12.80	3.58	All except D
		C	Unknown	2	6.80	5.78	2.40	B,H
	Dark blue	D	Male	4	15.80	26.80	5.17	H
	Yellow		Female	1	29.70			
			Unknown	1	23.40			
1964	Dark blue	E	Male	3	30.10	219.55	14.83	A,B,H
		F	Female	2	22.50	1.80	1.34	A,B,H,
		G	Unknown	8	19.50	67.21	8.20	A,B,H
		H	Unknown	4	2.83	.48	.69	All with no exceptions

[a]Deer were tagged with light blue in 1965 and dark blue streamers in 1964 in the South Fork of Chalk Creek, and with yellow streamers in the Crandall Canyon area in 1964.

[b]Using the F-Distribution $S^2n \neq S^2n$ = A, B - A, H - B, E - B, G - B, H - C, H - E, H - G, H

or

Using the t-Distribution $\bar{y}n \neq \bar{y}n$ = A, E - A, F - A, G - F, H - D, H - B, C - B, F

Table 8. Movements of mule deer from literature references compared to present study in Unit 19.

Location	Distance in Miles	Reference
NW Colorado	4-65	Gilbert & Harris, 1959
Yellowstone National Park	10-60	Russell, 1932
NE Nevada	5-90	Gruell & Papez, 1963
Northern Utah	5-45	Doman & Rasmussen, 1944
South Central Oregon	5-90	Zalunardo, 1962
W. Slope Sierra Mts., Calif.	30-50	Longhurst, et al., 1952
NE California	5-70	Longhurst, et al., 1952
Southern California	Few, if any	Longhurst, et al., 1952
W. Slope Sierra Mts., Calif.	4-30	Leopold, et al., 1951
North Central California	12-39	Ashcraft, 1961
Western Washington	4-20	Rogers, 1953
Northern Utah	0.5-62	Present study

fawns were returned by hunters. Only one marked female yearling was recovered in comparison with 12 yearling males.

Ten percent (51) of 480 marked deer were observed between July and October in 1964 and 1965. Twenty-eight (12 percent) of 232 marked deer in the South Fork of Chalk Creek during the winter of 1964-65 were observed between July and October 1965, although seven of the observations may have been duplicates. Five (0.4 percent) of the deer marked in the South Fork of Chalk Creek in 1964 were seen between July and October 1965, while 13 (10.6 percent) of the deer marked in the South Fork of Chalk Creek were observed between July and October, 1964. Four (16 percent) of the deer marked in Crandall Canyon were observed between July and October 1964 (Table 7).

Sight returns in 1964 showed that one male had traveled 41.4 airline miles from the South Fork of Chalk Creek wintering ground. However, in July one male was observed only 0.6 miles from the tagging site.

A mean distance of 12.7 miles was recorded for 51 sight returns from the tagging areas in both the South Fork of Chalk Creek and Crandall Canyon winter ranges. The differential movement between the years 1964 and 1965 and the two marked winter concentration areas (South Fork of Chalk Creek compared to the Crandall Canyon-Pine Creek concentration area) were significantly different ($P = <0.05$) (Table 7). There was a significant difference between the distance that the sexes moved in 1965, although none was evident among the sight returns in 1964 from the South Fork of Chalk Creek. The distances traveled by males marked in 1964 and sighted in 1965 compared favorably with all sight

returns from deer marked in Chalk Creek, but did not compare with distances traveled by those marked in the Crandall Canyon area.

Mechanisms triggering migration

The mechanism triggering fall migration of the deer wintering in Unit 19 appeared to be snow depth. Joe Boyer (an 83-year-old Coalville resident), Wayne Jones, and David Clark (Personal Communications, 1965) stated that in many years they had observed the deer migrating from the summer range in single file the day after a severe snow storm. Mr. Boyer stated that he had seen as many as 300 deer in a migrating herd. Clairon Huff (Personal Communication, 1965), while on range reconnaissance in northern Utah, observed the start of fall migration when the snow cover increased from 18 to 24 inches. I observed signs of heavy migration from the summer to the winter range the day following a 3-day snowstorm on November 28, 1965.

When the green grass appeared in the spring, deer on the Coalville Unit concentrated on meadows and southerly exposed slopes, while a few deer tracks were observed just above the melting snow line.

Spring migration

No indication of spring migration was observed on the winter range during a horseback reconnaissance on April 19, 1965. On April 25, however, a buck with light blue streamers was found entangled in a fence 7 miles east of the tagging area, and deer tracks were observed 8 miles further east. On May 21, sheepherders on the East Fork of Chalk Creek, Chalk Creek Basin on the south side of Utah Highway 133 and the West Fork of Yellow Creek reported seeing a few deer, but

indicated the main migrational herd had not come through at that time (Johnson, Personal Communication, 1965; Rydalch, Personal Communication, 1965; and Kiste, Personal Communication, 1965).

Claude Johnson (1965) stated that on May 15 deer started migrating through the Chalk Creek basin and around the northern ridge from Porcupine Mountain and crossed the Wyoming border traveling east into Yellow Creek. He reported that the migrational peak around the northern rim of the basin was on May 23 (Figure 9).

Dan Rydalch (1965) stated that while riding herd on cattle in past years on the Rigby Meadows (halfway between Yellow Creek and the Rigby Ranch) he observed deer migrating through in "strings" of 7 to 14 between June 15 and 25. However, he stated that on June 2, 1965, deer were traveling east in single file through the East Fork of Chalk Creek in small herds of 5 to 14.

Deer tracks were observed along the snow line at 8,700 feet and 7,900 feet along Utah Highway 150 following the Bear River on the north side of the Uinta Mountains, and 8,200 feet in the East Fork of Chalk Creek between May 25 and 27, 1965. Jack Young (Personal Communication, 1965), a snow surveyor, stated that in past years deer were at approximately 10,000 feet by late May but the snow depth in 1965 on the snow course was 60 inches where no snow had been present in the past 25 years.

Fall migration

A total of 270 sets of deer tracks in fresh snow were counted crossing Utah Highway 133 on November 28, 1965 after 3 days of snow and cold weather. One-hundred seventy-nine of the tracks were observed crossing the road at four major crossings between the Bear River and

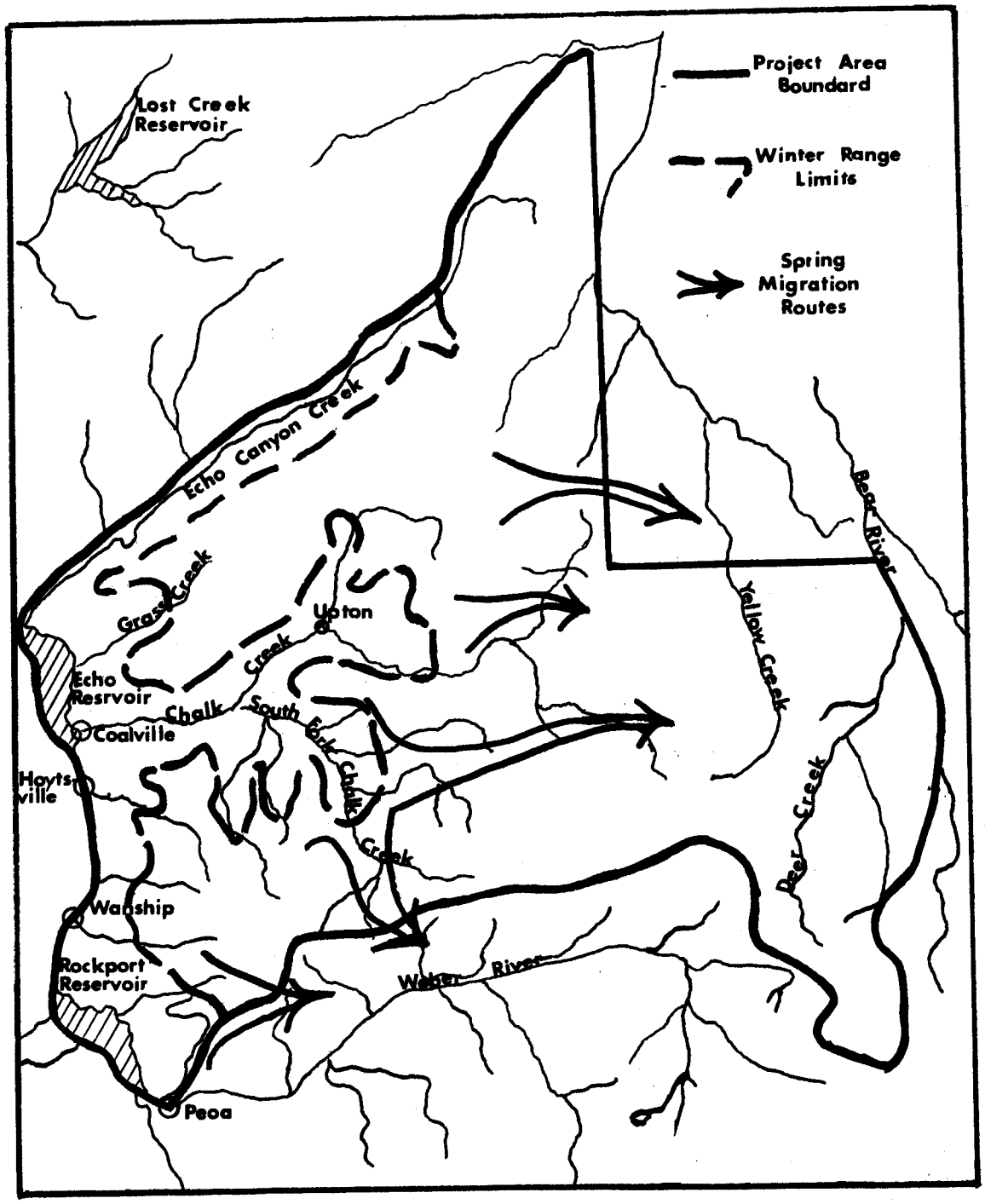

Figure 9. Spring migration routes of the Coalville Deer Herd as determined by observations and tag and sight returns of marked deer.

the Pine Cliff Camp. Ninety-one tracks were observed heading west across the road in the East Fork of Chalk Creek (Figure 10).

All migration trails between the Bear River and Pine Cliff Camp were oriented toward the Huff Creek-Grass Creek winter range below Porcupine Mountain. The deer tracks in the East Fork of Chalk Creek were oriented toward the winter range in the South Fork of Chalk Creek, although some migrant deer have been reported crossing to the Porcupine Mountain side 1.5 miles east of Upton (Boyer, 1965). Tracks in the snow on the summer range side of the road indicated that deer were migrating in single file. The deer scattered at the road's edge, but regrouped within 100 yards on the winter range side of the road.

Hunter Range-Use Fees

Fees for the privilege of access to private lands have long been in existence. In Europe, game on private land belongs to the landowner. There the recreational demand for hunting has given sufficient incentive to manage wildlife as an important economical land resource. Often, only well-to-do Europeans, who can afford to lease the hunting rights, enjoy the privilege of hunting.

The payment of range-use fees in the pursuit of wildlife on private lands in the United States is limited, but gaining in popularity. Most landowners, by permission, will allow hunting and fishing by others on their property. It is when some "sportsmen" abuse these privileges by the willful destruction of property that the landowner takes on an exclusion attitude. However, with the present emphasis on recreation, landowners are beginning to recognize the potential recreational value of their lands and are beginning to develop this resource.

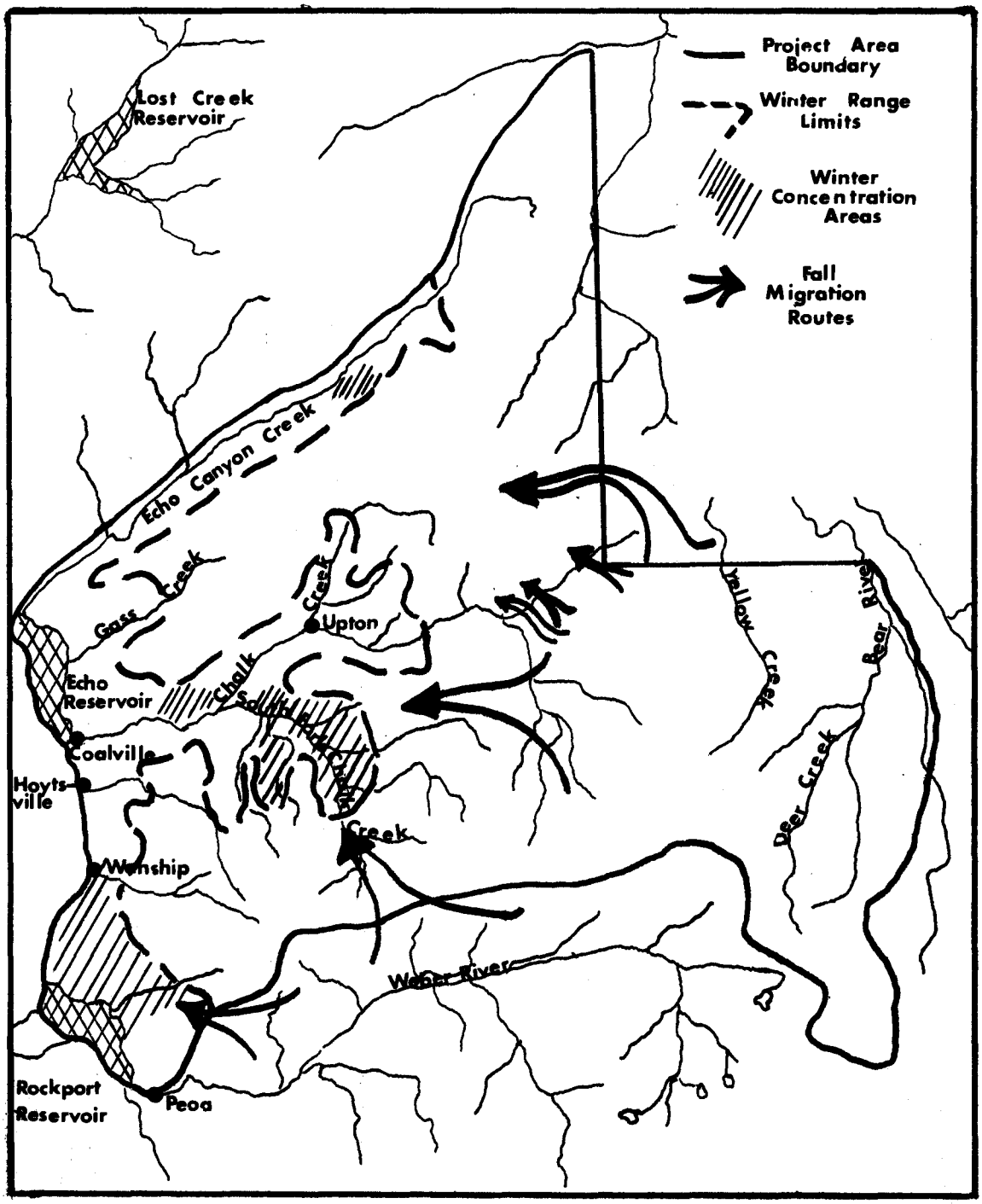

Figure 10. The deer winter range concentration areas and fall migration routes on the Coalville Deer Herd Unit.

Pre-association fees

George and Troy Blonquist levied a $0.25 range-use fee per deer hunter on their 15 sections of land in the South Fork of Chalk Creek in 1926. This represented only 3 percent of Deer Management Unit 19. By 1931 they had raised the fee to $0.50, by 1936 to $1.00, and in 1940 was increased to the present rate (1965) of $2.00 per hunter.

Howard Haines owns approximately 14 sections in the East Fork of Chalk Creek. He initiated an access fee of $1.00 per hunter in 1950 and increased the fee to $2.00 in 1963. The East Hoytsville Cooperative Association, with approximately 37 sections in the Spring and Cheery Canyon areas, assessed deer hunter fees in 1944 to raise money for the local church. They then joined the Echo-Chalk Creek Range Owners' Protective Association upon its initiation in 1947.

Echo-Chalk Creek Range Owners' Protection Association

The Echo-Chalk Creek Range Owners' Protective Association (ROPA) was organized in 1947 by Tom Moore, a landowner and business man in Coalville who was also president of the association for the first 6 years.

ROPA was established as a non-profit corporation with established by-laws and policies for the purpose and objective of preserving and protecting the range land and property of the landowners from general public abuse, including both hunters and fishermen.

Originally ROPA controlled 589 (90 percent) of the 642 square miles of land within the association's boundaries. A full time range rider position was established in 1950 as an enforcement measure. The president, secretary, and the range rider's positions were salaried.

Most of the major landowners joined the organization at the initiation, with the exception of the 1000 Peaks Land Company, which joined about 1953. A small tract of land which the Newtons bought in the Fish Creek area in the mid-1950's has also since been added. By 1965, approximately one-fourth of the total acreage in the association has been withdrawn from the association's original size.

The ROPA members believe they will know whether the organization will remain intact after the deer season of 1966. The association members feel that ROPA fulfilled the original objectives of the organization and is worthy of future operation.

DISCUSSION

Some western fish and game departments use the postseason doe-fawn ratios as an expression of deer herd productivity. However, there is one and possibly two variables which render these productivity figures inaccurate for comparative purposes or for herd productivity expressions. These are the (1) unproductive yearling female segment which is counted in the postseason doe-fawn ratio as part of the productive adult female herd and (2) possible differential mortality favoring the fawns during the hunting season.

One needs only to look at the approximate net productivity in Unit 19 (1964--44 percent; 1965--27 percent; and 1966--19 percent) to see the significance of this yearling percentage variable of the unproductive yearling female segment (Table 2). The large unaccounted variable of the unproductive yearling segment can be closely estimated by checking the percentage of yearlings in the doe herd in the fall harvest then subtracting this unproductive percentage from the observed does in the immeidate postseason doe-fawn classifications. By using this adjustment, the 1965 productivity expressed as the postseason doe-fawn ratio is 100 adult does to 105 fawns.

Hunter-induced differential mortality favoring the fawns is illustrated in the following computations from Utah Deer Management Units 1, 2, 7, 19, 22, 23A, 23B, 25, 26, 27B, 28A, and 38 (Stapley, 1966).

Preseason

Year	Doe	%	Fawn	%	Doe:Fawn
1964	617	52	580	48	100:94
1965	324	60	220	40	100:68
1966	1063	50	1045	50	100:98
Total	2004	52	1845	48	100:92

Postseason

	Year	Doe	%	Fawn	%	Doe:Fawn
	1964	948	55	790	45	100:83
	1965	570	53	499	47	100:88
	1966	1026	50	1007	50	100:98
Total		2544	53	2296	47	100:90
Harvest Classification						
	1964	690	75	224	25	100:32
	1965	1013	74	348	26	100:34
	1966	1795	66	931	34	100:52
Total		3498	70	1503	30	100:43

However, if does and fawns are grouped as a population, then divided as a percentage thereof and the hypothesis that the pre and postseason sample size and methodology are acceptable, there appears to be no significant change in the doe or fawn population percentage between the pre and postseason counts, at least not in numbers to the extreme suggested by the harvest classifications. This would result from (1) a possible small harvest in comparison with the total population which did not significantly influence the total population composition, or (2) increased fawn mortality. Orphan fawn survival may not be what investigators and managers have assumed in the past. Deprived of its mother, the fawn would be at the bottom in the social structure of the deer herd and would not have the frame of reference to life dangers as if it were responding to its mother's "coaching". Robinette (1970) found, during either-sex hunts in a study in central Utah, that hunters leave 60 fawns dead in the field for every 100 brought out while 53 does are left dead for every 100 brought out. This would not account for the total fawn mortality, when comparing pre and postseason doe-fawn composition percentages with that of harvest classification. However, this may vary with deer densities, sex ratios, season of hunt, hunting pressure and success.

Doe to yearling ratios during the legal harvest in 1962, 1963, 1964, and the corresponding previous winter's postseason doe to fawn ratio are presented in Table 9 for Deer Management Units 1, 2, 7, 19 and 20 (Sparks, 1965). An unrealistically higher doe-yearling ratio, when compared with the previous winter's postseason doe to fawn ratio, was exemplified in 1962 in Management Unit 7, in 1963 in Management Unit 19, and in 1964 in Deer Management Units 2 and 19. This may raise some questions about the validity of the ratios without considering the productivity computations. However, possible explanations may be inadequate sample sizes of either or both postseason doe-fawn ratios or fall doe-female yearling ratios, biased sampling techniques, or a greatly increased mortality rate among the does 2.5 years and older.

Population growth or decline are the direct results of the birth rate (BR) and/or mortality rate (MR) and/or immigration rate (IR) and/or emigration rate (ER). A growing population exhibits a BR and/or IR $>$ MR and/or ER. Conversely in a declining population the BR and/or IR $<$ MR and/or ER. When the BR and/or IR are equal to the MR and/or ER, a stabilized population is the result.

The objective of most deer managers is to produce annual sustained crops of deer for recreational and economic purposes in harmony with the major uses of land and water. The Coalville deer herd has a carrying capacity limited by the growth of deer forage on the winter range. Theoretically, the deer manager strives to stabilize a deer herd at or just below the winter-range carrying capacity, that is BR/or IR = MR and/or ER.

Table 9. The fall harvest's older doe to yearling doe ratios compared with the preceding postseason doe-fawn ratios.[a]

Management unit number	1962		1963		1964	
	January	October	January	October	January	October
	Postseason Doe-fawn	Harvest [b] Doe-yearling	Postseason Doe-fawn	Harvest [b] Doe-yearling	Postseason Doe-fawn	Harvest [b] Doe-yearling
1	100:73	100:36	100:73	100:50	100:62	100:22
2	100:87	100:42	100:88	100:73	100:65	100:127
7	100:39	100:90	100:50	100:41	100:45	100:44
19	100:63	100:27	100:29	100:71	--	100:61
20	--	100:63	100:50	100:43	--	100:36

[a] Sparks, 1965.

[b] Female yearlings only

The approximate weighted or combined 1964 and 1965 net productivity of the Coalville deer herd was 35 percent (130 adult female deer and 70 yearling female deer)(Table 2). The mean, annual mortaltiy rate based on a time-specific life table analysis of yearlings and older age classes is 45 and 35 percent for the male and female deer-herd segments, respectively (Table 3). No winter emigration or immigration was observed or reported among marked deer between the Coalville and adjacent deer management units.

Under a given carrying capacity the annual deer crop may be maximized by manipulating sex ratios, leaving only enough bucks for breeding purposes. According to McKean (1947 and 1964) and the Inter-State Deer Herd Committee (1950 and 1951) postseason differential sex ratios of 10:100 to 29:100 were sufficient for 98 percent female conception rate. The postseason sex ratio of 60:100 on the Coalville Unit contains more males than needed for breeding purposes. The excess males may displace reproductive females.

Annual age-class differences in weight and antler diameters between 1964 and 1965 for the Coalville deer herd appeared to be attributable to better than average summer range conditions in 1965. Previously, when sheep grazed this area in the spring and early summer the vegetation responsed only enough to be grazed again in the fall. However, during 1965 the vegetative growth was such that 3 weeks after the sheep had grazed through the area there were few signs of defoliated vegetation.

Severinghaus (1950) recorded 4,873 deer antler diameters in the New York Adirondack Mountains during a 5-year study. They

secured considerable evidence that antler growth and size are influenced by the quality and quantity of forage that deer eat during the previous winter. They also noted that the influence was particularly pronounced in the 1 1/2-year-old and to a lesser extent in the 2 1/2-year-old age class, with no significant differences in the prime age classes.

In contrast, my data demonstrated an increase in antler diameter from the 1 1/3-year-old through the 5 1/3-year-old age class. The increased differential in the prime age classes (3 to 5 years) reflected in the study, however, is attributed to the summer range conditions or forage availability. The Utah and New York studies would indicate that seasonal availability or quantity of forage affect different age classes in different ways.

A prerequisite for a delineated deer management unit is that its borders encompass both summer and winter ranges of a particular deer herd. Deer Management Unit 19 encompasses several winter concentration areas and creates management problems unique to each concentration area. Deer marked in the Crandall Canyon-Pine Creek and South Fork of Chalk Creek winter concentration areas were not observed nor reported outside of the respective winter concentration areas, which agrees with Zalunardo's (1965) findings on winter range movements. Zalunardo found the mean winter range movement was less than 0.25 mile with a variation from 0 to 2.5 miles. Wintering deer herd management problems in the Crandall Canyon-Pine Creek area are separate from those of the South Fork of Chalk Creek, the Narrow, or the Aspen Creek deer wintering concentrations.

The tag returns from deer marked in the South Fork of Chalk Creek and the Crandall Canyon areas did not show returns on the north side of

Chalk Creek in Unit 19, although three marked deer were reportedly sighted there. Comparatively few marked deer were observed in the Weber River drainage above Oakley. However, enough tags were returned from the area to consider extending the southern border of the Coalville Unit to include all of the Weber River drainage above Oakley.

The summer distribution of the Coalville deer herd, as determined by the tag and sight returns, closely coincided with the quaking aspen belt of Chalk Creek, Weber River (above Oakley), and Yellow Creek drainages. Whether hunting caused the deer to seek heavier cover in the dense aspen stands was not determined. However, more deer were observed in the aspen stands during the summer than in any other cover type.

Deer that summered together may or may not winter together in the same deer herd management unit. If deer are managed by manipulating population numbers through deer removal on the summer range to keep in balance with the winter concentration area food supply, then the deer manager by setting the harvest regulation for one summering area is actually dealing with deer populations from "X" number of deer management units. Obviously the "X" number of deer management units with respective winter concentration areas do not have equal carrying capacities even within the same unit. This gives rise to the immediate question on which winter concentration area should the summer herd removal be based.

Certainly, management priority should be given to the deer herd on the winter concentration area in the worst condition. This may mean overharvesting deer from some winter concentration areas to effectively bring another winter concentration area population in balance with its winter food supply. An alternative would be to schedule fall hunts on

the winter concentration areas after the fall migration with hunting regulations set for individual concentration areas. The disadvantage of this alternative is that the hunting quality and recreation man-hours may drastically decrease and the crippling losses may soar.

A plan to solve this problem would base hunting regulations on the winter range condition of the majority of the winter range concentration areas in "X" number of Units represented by deer on a given summer range where the actual hunting takes place. Those winter range concentration areas in need of further deer reduction to balance with the food supply should have postseason hunts after the fall migration has taken place.

Three elevationally unstratified browse utilization transects located in the South Fork of Chalk Creek, Spring Canyon and Grass Creek have been a part of the deer management program on the Coalville Deer Management Unit for over a decade. The Grass Creek browse transect has not been read since 1953 and the Spring Canyon Transect has been read only three times in the past 10 years (Sparks, 1964 and 1965). Neither the Grass Creek nor Spring Canyon transects were located in the 1965 delineated winter concentration areas. The browse utilization transect in the South Fork of Chalk Creek was on the extreme upper limits of the normal winter range. All transects were based on key forage species, namely mountain mahogany (*Cercocarpus montanus*) and antelope bitter brush (*Purshia tridentata*). With little additional time and man power the range trend also could be measured.

Present management of the Coalville Deer Herd Unit is based largely on the winter browse transects and deer herd population characteristics.

This is deer management in retrospect; necessary, but they should be combined with future projected winter concentration area carrying capacities. For a given winter concentration area, the carrying capacity is a reflection of range condition and availability which are influenced by both winter and summer precipitation. On years of predetermined food shortage, due to poor precipitation growing conditions, postseason hunts should be held.

Private land ownership and hunter range use fees do not appear to have affected the number of hunters using the Coalville Unit as compared with adjacent management units (Sparks, 1963, 1964 and 1965). The average income bracket or class of hunters buying a range-use permit appears to be representative of the Utah Citizenry (Figure 11). Private land ownership does provide a maze of road leading to most parts of the unit. According to Johnson (1965), auto access roads are important to create optimum hunter distribution. He found 75 percent of the Kaibab deer were killed within 1 mile of the road. However, ~~this~~ study ~~was done when~~ as land was withdrawn from the Range Owners Protection Association, ~~and~~ many roads were closed, even those leading to open ROPA areas.

Hunters appear to be activated by habit. In 1964 and 1965, 55 percent of 864 hunters had purchased a range-use permit for four or more years, even though 80 to 90 percent of the hunters resided in Salt Lake, David and Weber Counties (Figure 12 and Sparks, 1965). After having hunted an area for several years, a hunter is reluctant to go to a different area. The average hunter in the Coalville Unit had purchased a range-use permit for 5.8 years.

How much the traffic will bear in terms of increased range-use fees is not known. If the fees are raised to a point deterrent to hunters,

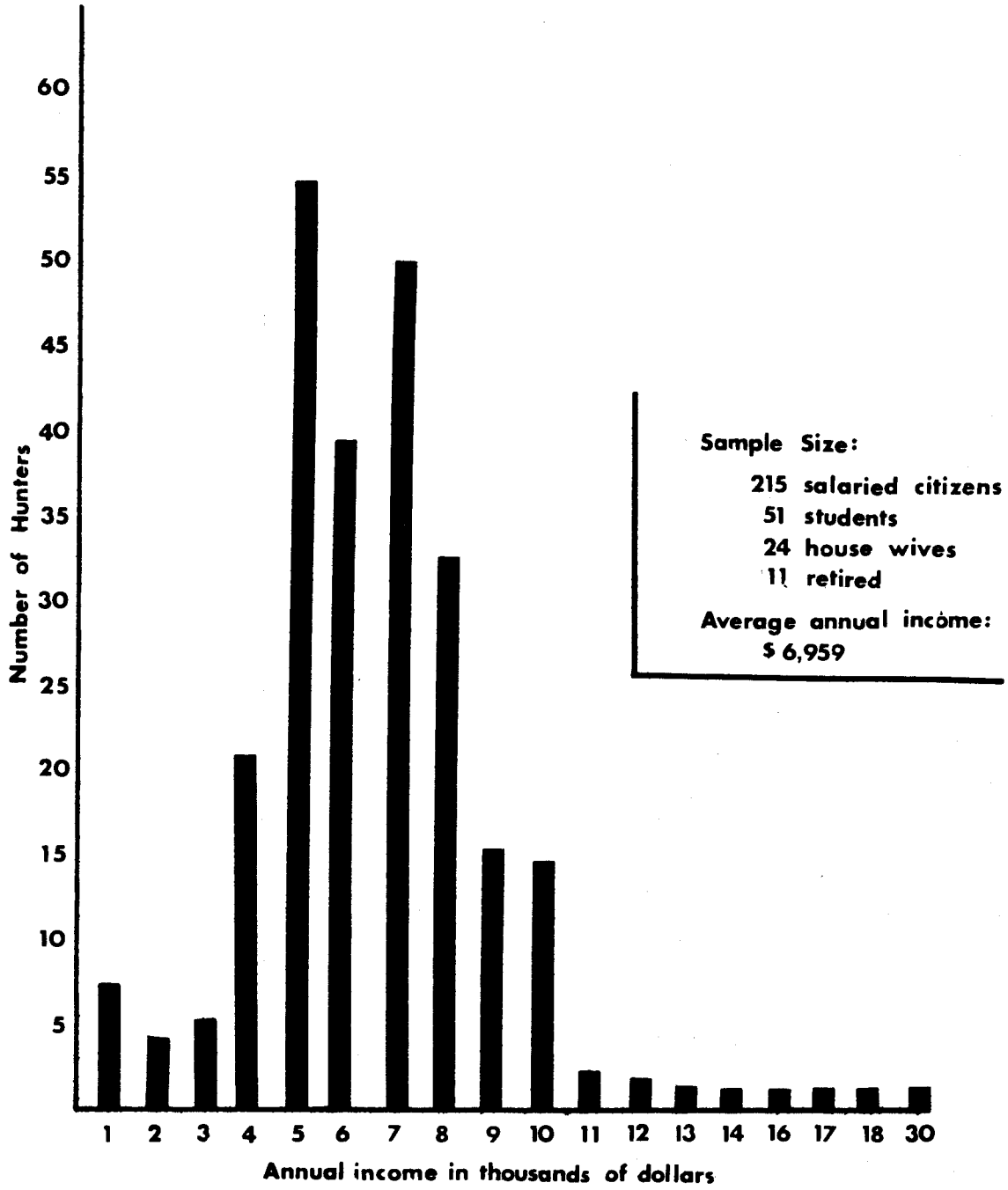

Figure 11. The annual income of salaried hunters checked through the deer checking station in 1965 on Utah Deer Management Unit 19.

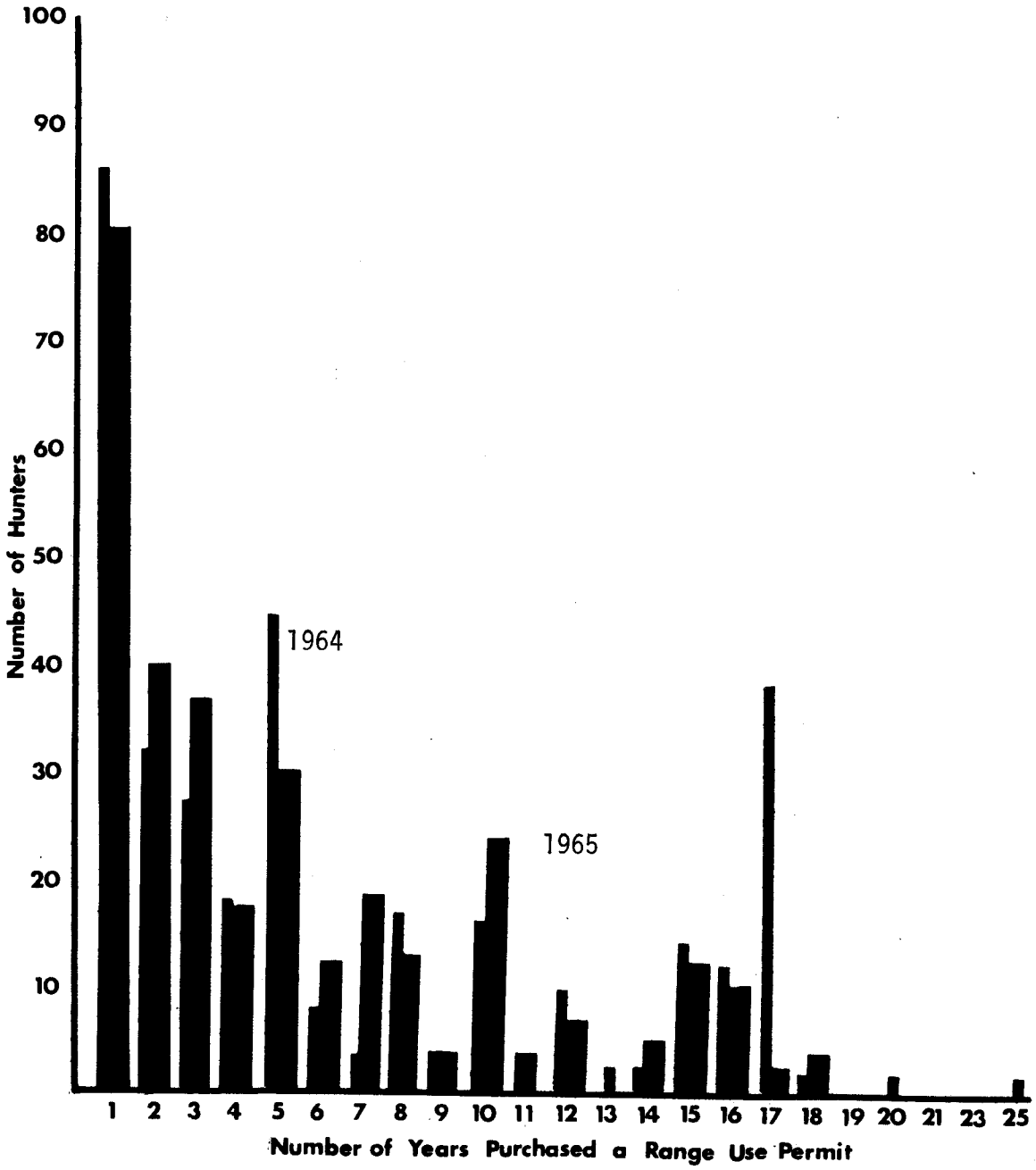

Figure 12. A cross-section of Unit 19 hunters depicting the number of years that they had purchased a range-use permit for access to hunt deer on Utah Deer Unit 19.

an underharvest of the deer population may occur as hunters develop interests in other hunting areas.

Proper range management in terms of livestock numbers and use has been seriously considered by the ranchers in the area, although implementation has been slow. Range management practices that were being implemented, besides manipulation of livestock numbers and season and length of use, were rotational grazing by fencing, and reverting brush and timber to grasslands. Spraying of brush in Unit 19 was above winter range elevational limits and did not affect deer management. Woven wire fences for rotational grazing on winter ranges increased the fawn mortality rate. A lower fence with only one or no strands of barbed wire above it would be a sufficient deterrent to the livestock, while catching fewer fawns. However, the present high woven wire fence with two strands of barbed wire above it was required of the ranchers to receive government subsidies for fence construction.

RECOMMENDATIONS

Since mule deer management of Unit 19 is being given high priority in the plans of the Utah State Division of Fish and Game, management should be refined in order to insure a higher sustained annual yield or harvestable crop of deer. In this light, the following recommendations are suggested for Unit 19:

1. A study should be initiated to determine effects of doe:fawn differential mortality on the postseason doe:fawn ratio. The effects of deer population densities, hunter pressure and hunting regulations on differential mortality should also be determined.
2. Deer management should be further geared to deer winter concentration areas, with periodic checks to insure their locations. Within the winter concentration areas, the following refinements are suggested:
   a. Reproductive data should include net reproductive figures as well as postseason herd composition adjusted for the unproductive yearling female segment.
   b. Range utilization transects should be randomly relocated, taking into consideration cover-type, aspects, and winter elevational distribution of deer.
   c. Pellet group plots should be randomly selected, permanently marked, swept each fall, and read each spring along with the utilization transects.

d. Range trend could be recorded with little additional effort by the establishment of permanent 100-foot line intercept transects along the browse utilization transects. The basal intercepts of both grasses and forbs could be recorded in hundredths of a foot, while crown intercepts of all browse should be recorded.

e. Physical condition of the herd may be made by comparing the current year's antler diameters with respective age class diameters of previous years.

f. Further attention should be given to the method of taking the postseason herd composition to insure that sampling is elevationally stratified and to classify all deer within recorded groups.

3. The southern boundary of Unit 19 should be temporarily extended to include all of the Weber River drainage now in Unit 20.

4. The summer distribution of deer on the south side of the Narrows in Chalk Creek and in Aspen Creek, as well as in Deer Management Units 5, 6, 8, 20, 21, 23B should be determined as a basis for alteration of herd unit boundaries.

5. Because streamered and collared deer did not substantially increase the information on summer distribution, additional effort should be made to collect ear tag returns from hunters in the field to increase the accuracy of deer distribution.

6. A study should be initiated to determine the height and type of fencing required to hold cattle, but minimize the hazard to fawns.

7. Special trophy hunts should be organized in Unit 19 when the buck-doe ratio exceeds 30:100. Trophy hunts should be held as soon as the deer are concentrated on the winter range and should be limited to permittees under the supervision of the local conservation officer. Trophy records should be kept on each animal bagged. The following advantages would be derived from a trophy hunt program.
   a. No adverse affect on productivity would result. At the same time the winter range would carry fewer animals through the critical winter period.
   b. Good public relations would result by informing and showing the permittees concentrations of deer wintering on the winter range and the related problems resulting from these concentrations.
   c. Highly publicized trophy records would attract more out-of-state hunters, and consequently more revenue during the general season.
8. Full use should be made of aerial surveying technique in obtaining field data from this Deer Herd Unit.

SUMMARY

The management and ecology of the Coalville deer herd were studied from September 1964 through May 1966, to determine the herd's productivity, condition, summer and winter distribution and migraotry routes, and to record the history and trend of hunter range-use fees.

1. The postseason doe-fawn ratio (100:77) were above those for the northern two-thirds of Utah (100:74), but equal to those in the southern third of the State (100:77). The low postseason doe-fawn ratio (100:29) recorded in 1962 on the Coalville Management Unit may have been the result of inadequate sample size or improper data gathering procedures.
2. The postseason doe-fawn ratio should be adjusted by subtracting the unproductive female yearlings from the doe numbers. The doe-fawn ratio with this adjustment would have been 100:105.
3. The approximated net productivity of the Coalville deer herd in 1964 was excellent (44 percent) and in 1965 was good (27 percent) by Robinette's (1956) standard of measurement.
4. The physical condition of the Coalville deer herd was good to fair. The condition as indicated by herd characteristics were as follows: (a) Net productivity--excellent; and (b) sex ratio--poor. The condition based physical characteristics were: (a) body fat--good; and (b) weight and antler measurements--good.

5. Approximately twice as many male deer were present in the postseason herd as needed for breeding purposes.
6. Male weights increased with age, while female weights did not increase after the age of 2 1/3 years.
7. The mean number of points per antler, antler beam length, and antler diameter 1 inch above the burr increased with age.
8. The diameter of the antler 1 inch above the burr appears to correlate directly with the weight and was the best measurement to indicate body condition.
9. Summer distribution of the deer was in the quaking aspen belt at approximately 7,500 to 9,500 feet elevation. The average winter distribution of deer in March 1965 was at 6,700 feet elevation.
10. The southern boundary of Unit 19 should be temporarily extended to include all of the Weber River drainage above Oakley now in Deer Management Unit 20. The upper end of the deer winter range should be extended in Echo Canyon to include the bottom of Ree's Creek.
11. The marking of deer with streamers and collars did not substantially increase the information above that of ear tagging on the summer distribution of the deer.
12. A significantly larger number of tags (20 percent) were returned the first hunt after the deer were tagged than from the subsequent hunts (4 percent).
13. Deer management on the Coalville Unit should deal separately with each of the four winter deer concentration areas, namely

the (a) South Fork of Chalk Creek, (b) Aspen Creek, (c) south side of the Narrows, and (d) Pecks, Hixon, Cherry and Crandall Canyons.

14. Hunting regulations should be closely based on the winter range conditions. Winter range concentration areas in need of further deer reductions to balance deer numbers with food supply should have postseason hunts after the fall migration.
15. Deer migrated a maximum of 60 airline miles from the Unit 19 wintering areas, although the majority migrated less than 15 miles.
16. The mechanism triggering fall migration of the deer was snow depth, while vegetation growth, as the snow line receded, controlled the spring movement.
17. Spring movement to the summer range started on April 25 in 1965 and progressed upward with the receding snow line.
18. The range-use permits thus far have not adversely affected the management of the Coalville Deer Herd.

LITERATURE CITED

Ashcraft, Gordon C., Jr. 1961. Deer movements of the McCloud Flats Herds. California Fish and Game 47(2):145-152.

Bischoff, Arthur I. 1958. Productivity in some California deer herds. California Fish and Game 44(3):253-259.

Blaisdell, James A. 1954. A progress report on the Boyle Deer Herd. Professional 33rd Annual Conference Western Association State Game and Fish Commission, June 1-3, 1953. p. 132-139.

Boyer, Joseph. 1965. Personal communication. Coalville, Utah.

Brigham, James H. 1954. Summer mortality of juvenile blacktail deer in Western Washington. Murrelet 35(3):39-42.

Cahalane, V. H. 1947. A deer-coyote episode. J. Mamm. 28(1):36-39.

Chatten, John E. 1948. Breeding season and productivity in the interstate deer herd. California Fish and Game 34(1):25-31.

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

Cheatum, E. L. and C. W. Severinghaus. 1950. Variations in fertility of white-tailed deer related to range conditions. Trans. Fifteenth N. Amer. Wildl. Conf. p. 170-190.

Clark, David. 1965. Personal communications. Upton, Utah.

Clausen, N. M. 1948. Golden eagle attacks young deer. Yosemite Nature Notes 27(9):107-109.

Cliff, Edward P. 1939. Relationship between elk and mule deer in the Blue Mountains of Oregon. Trans. Fourth N. Amer. Wildl. Conf. p. 560-569.

Costley, R. J. 1948. Crippling losses among mule deer in Utah. Trans. Thirteenth N. Amer. Wildl. Conf. p. 451-458.

Cowan, I. McT. 1948. The occurrence of the granular tapeworm (*Echinococcus granulosus*) in wild game in North America. J. Wildl. Mgmt. 12(1):105-106.

Cowan, I. McT., and A. J. Wood. 1955. The growth rate of the Black-tailed deer (*Odocoileus hemionus columbianus*). J. Wildl. Mgmt. 19(3):331-336.

Cronemiller, F. P. 1947. Probable errors in sample measurements of deer kill. J. Wildl. Mgmt. 11(1):103-104.

Cronemiller, F. P. 1951. Some dynamics of a mule deer population. J. Wildl. Mgmt. 15(2):206-208.

Cronemiller, F. P. and Paul S. Bartholomew. 1950. The California mule deer in chaparral forests. California Fish and Game 36(4): 343-365.

Dasmann, Wm. P., and Henry A. Hjersman. 1958. Deer survival and range forage trends on Eastern California winter ranges. California Fish and Game 44 (1):51-72.

Dill, H. H. 1957. Bobcat preys on deer. J. Mamm. 38(1):63.

Dixon, J. S. 1934. A study of the life history and food habits of mule deer in California. California Fish and Game 20(1):15-20.

Dixon, Joseph S. and Carlton M. Herman. 1945. Studies on the condition of California mule deer at Sequoia National Park. California Fish and Game 31(1):3-11.

Doman, E. R. and D. I. Rasmussen. 1944. Supplemental winter feeding of mule deer in northern Utah. J. Wildl. Mgmt. 8(4):317-338.

Fischer, G. A., J. C. Davis, F. Iversen, and F. P. Cronemiller. 1944. The range of the interestate deer herd. U.S. Dept. Agri. Forest Serv., Region 5. 20 p. (Mimeographed)

Gerstell, R. 1936. Pennsylvania's field game investigations. Proc. First N. Amer. Wildl. Conf. p. 365-368.

Gilbert, Paul and John Harris. 1959. How far do deer travel? Colorado Outdoors 8(2):18-20.

Gillelan, G. Howard. 1965. Deer mirrors: 9 states test them to cut road kill. Outdoor Life 135(2):24-26.

Gruell, George E. and Nick J. Papez. 1963. Movements of mule deer in northeastern Nevada. J. Wildl. Mgmt. 27(3):414-422.

Hansen, W. R., and C. Y. McCullock. 1955. Factors influencing mule deer on Arizona brushlands. Trans. Twentieth N. Amer. Wildl. Conf. p. 568-588.

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

Herman, Carlton M. and Arthur I. Bischoff. 1950. Papilloma, skin tumors in deer. California Fish and Game 36(1):19-20.

Hibben, F. C. 1937. A preliminary study of the mountain lion. University New Mexico. Biol. Ser. Bulletin 318 5(3):1-59.

Hickman, Gary L. 1966. The ecology of the golden eagle in Southwestern Idaho and Southeastern Oregon. U.S. Fish and Wildl. Serv. Unpubl. progress report. 103 p.

Honess, Ralph R. 1939. A freak deer herd. J. Wildl. Mgmt. 3(4):360.

Horn, E. E. 1941. Some coyote-wildlife relationships. Trans. Sixth N. Amer. Wildl. Conf. p. 283-286.

Hudson, Paul. 1959. Fetal recoveries in mule deer. J. Wildl. Mgmt. 23(2):234-235.

Hudson, Paul and Ludvig G. Browman. 1959. Embryonic and fetal development of the mule deer. J. Wildl. Mgmt. 23(3):295-304.

Huff, Clairon. 1965. Personal communications. Ogden, Utah.

Illige, Denis J. 1954. Productivity data of Arizona mule deer. Proc. 33rd. Ann. Conf. Western Assn. State Game and Fish Comm. p. 117-127.

Interstate Deer Herd Committee. 1950. Fourth progress report on the cooperative study of the Interstate deer herd and its range. California Fish and Game 36(1):27-53.

Interstate Deer Herd Committee. 1951. The Devil's Garden deer herd. California Fish and Game 37(3):233-272.

Interstate Deer Herd Committee. 1954. Eighth progress report on the cooperative study of the Devil's Garden interstate deer herd and its range. California Fish and Game 40(3):235-266.

Jensen, Dale. 1941. Deer trapping and tagging. Idaho Wildl. Rev. 14(1):8-9.

Johnson, Claude. 1965. Personal communication. Upton, Utah.

Jones, Dale A. and others. 1953. Utah big game mangement hand book. Utah State Department Fish and Game Dept. Information Bull. 8. 217 p.

Jones, Dale A. and others. 1955. Utah big game investigations and management recommendations. Utah State Dept. Fish and Game Dept. Information Bull. 19. 207 p.

Jones, Dale A. and others. 1956. Utah big game investigations and management recommendations. Utah State Department Fish and Game Dept. Information Bull. 25. 213 p.

Jones, Dale A., W. Leslie Robinette, and Odell Julander. 1956. Influence of summer range condition on mule deer reproduction in Utah. Proc. 36th Ann. Conf. W. Assn. State Game and Fish Comm. p. 195-199.

Jones, Wayne. 1965. Personal communication. Upton, Utah.

Julander, Odell, W. Leslie Robinette, and Dale A. Jones. 1961. Relation of summer range condition to mule productivity. J. Wildl. Mgmt. 25(1):54-60.

Kiste, Ray. 1965. Personal communication. Upton, Utah.

Lassen, R. W., C. M. Ferrel, and H. R. Leach. 1952. Food habits, productivity and condition of the Doyle mule deer herd. California Fish and Game 38(2):211-225.

Lauckhart, J. B. 1950. Determining the big game population from the kill. Trans. Fifteenth N. Amer. Wildl. Conf. p. 644-649.

Leopold, Aldo. 1933. Game management. Charles Soribner's Sons, New York. 481 p.

Leopold, A. S., T. Riney, R. McCain, and L. Tevis. 1951. The jawbone deer herd. Dept. of Nat. Resources, State of Calif. Game Bull. 4. 139 p.

Longhurst, William M., A. S. Leopold, and R. R. Dasmann. 1952. Managing deer on private land. Calif Agr. 10(5):4, 10.

Lovaas, Allen L. 1958. Mule deer food habits and range use, Little-Belt Mountains, Montana. J. Wildl. Mgmt. 22(3):275-283.

Mace, R. U. 1956. Analysis of Oregon's big game study program. Proc. 36th Ann Conf. W. Assn. State Game and Fish Comm. p. 183-187.

Matsen, J. R. 1948. Cats kill deer. J. Mamm. 29(1):69-70.

McKean, John W. 1947. Interstate deer herd study. Proc. 27th Ann. Conf. W. Assn. State Game and Fish Comm.

McKean, John W. 1964. The interstate deer. Oregon State Game Comm. Bull. 19(1):3, 6-7.

McLean, D. D. 1925. The golden eagle as a deer enemy. Yosemite Nature Notes 4(4):27.

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

Murie, A. 1940. Ecology of the Coyote in the Yellowstone. U.S. Dept. Interior. National Park Service. Faunal Series No. 4. 206 p.

Murie, O. J. 1935. Food habits of the coyote in Jackson Hole, Wyoming. U.S. Dept. Agric. Circ. No. 362. 24 p.

Ransom, A. Brian. 1965. Determining age of white-tailed deer from layers in cementum of molars. J. Wildl. Mgmt. 30(1):197-199.

Rasmussen, D. L. 1939. Mule deer range and population studies in Utah. Trans. Fourth N. Amer. Wildl. Conf. p. 236-243.

Rasmussen, K. I. and E. R. Koman. 1947. Planning of management programs for western big game herds. Trans. Twelfth N. Amer. Wildl. Conf. p. 2-4, 210.

Reynolds, Hudson G. 1965. Mule deer killed by lightning. J. Mamm. 46(4):676.

Reynolds, Temple A., Jr. 1960. The mule deer--its history, life history and management in Utah. Utah State Dept. Fish and Game. Info. Bull. 60-4. 32 p.

Riney, T. 1955. Evaluating condition free-ranging red deer (*Cervus elaphus*) with special reference to New Zealand. New Zealand J. Sci. and Tech., Sect. B. 36:429-463.

Robinette, W. Leslie. 1947. Deer mortality from gunshot wounds. U.S. Fish and Wildl. Ser. Leafl. 295. 8 p.

Robinette, W. Leslie. 1949. Winter mortality among mule deer in the Fishlake National Forest, Utah. U.S. Fish and Wildl. Serv. Spec. Sci. Report 65. 15 p.

Robinette, W. Leslie. 1956. Productivity--The annual crop of mule deer. From the Deer of North America p. 415-431. Wildlife Mgmt. Inst., Ed. by W. P. Taylor. p. xix, 668.

Robinette, W. Leslie. 1970. Personal communication. Denver, Colorado.

Robinette, W. Leslie and Jay S. Gashwiler. 1950. Breeding season, productivity, and fawning period of the mule deer in Utah. J. Wildl. Mgmt. 14(4):457-469.

Robinette, W. Leslie, Jay S. Gashwiler, Dale A. Jones and Harold S. Caren. 1955. Fertility of mule deer in Utah J. Wildl. Mgmt. 19(1):115-136.

Robinette, W. Leslie, Jay S. Gashwiler, J. B. Low and D. A. Jones. 1957. Differential mortality by sex and age among mule deer. J. Wildl. Mgmt. 21(1):1-16.

Robinette, W. Leslie, O. Julander, J. S. Gashwiler, and J. G. Smith. 1952. Winter mortality of mule deer in Utah in relation to range condition. J. Wildl. Mgmt. 16(3):289-299.

Robinette, W. Leslie and Orange Olsen. 1944. Studies of the productivity of mule deer in Central Utah. Trans. Ninth N. Amer. Wildl. Conf. p. 156-161.

Rogers, John R. 1953. Report of the deer herds in District #5. Wash. Dept. Game. 13 p. (Mimeographed)

Russell, C. P. 1932. Seasonal migration of mule deer. Ecol. Mono. 2:1-46.

Rydalch, Dan. 1965. Personal communication. Upton, Utah.

Sears, H. S. and L. G. Browman. 1955. Quadruplets in the mule deer. Anat. Rec. 122(3):335-340.

Severinghaus, C. W. 1950. Variations by age class in the antler beam diameters of white-tailed deer related to range conditions. Trans. Fifteenth N. Amer. Wildl. Conf. p. 551-568.

Severinghaus, C. W. 1951. A study of productivity and mortality of corralted deer. J. Wildl. Mgmt. 15(1):73-80.

Smith, B. E. 1945. Wildoat predation on deer. J. Mamm. 26(4):439-440.

Sparks, Earl A. and others. 1963. Big game harvest report. Utah State Dept. Fish and Game Dept. Informational Bull. 64-1. Unnumbered.

Sparks, Earl A. and others. 1964. Utah big game investigations and management recommendations 1964. Utah State Dept. Fish and Game Dept. Informational Bull. 64-3. Unnumbered.

Sparks, Earl A. and others. 1965. Utah big game investigations and management recommendations 1965. Utah State Dept. Fish and Game Dept. Informational Bull. 65-6. Unnumbered.

Stapley, Homer and others. 1966. Utah big game investigations. Utah State Dept. Fish and Game Dept. Bull. 66-6. Unnumbered.

Stoddart, L. A. and Di, I. Rasmussen. 1945. Big game--range livestock competition on western ranges. Trans. Tenth Amer. Wildl. Conf. p. 251-256.

Taber, R. D., Keith L. White and Norman S. Smith. 1959. The annual cycle of condition in the Rattlesnake, Montana mule deer. Proc. Mont. Acad. Sci. 19:72-79.

University of Utah. 1957. Geologic map of Utah, NE Quarter.

U.S. Fish and Wildl. Serv. 1958. Big game inventory 1956. Wildl. Leafl. 395 p.

Utah Division of Fish and Game. 1965. Utah big game range inventory 1965. Publication 66-3. 96 p.

Van Etten, Robert C., and Carl L. Bennett, Jr. 1965. Some sources of error in using pellet-group counts for censusing deer. J. Wildl. Mgmt. 29(4):723-729.

Washington Department of Game. 1953. Monthly summary of deer losses from protector's reports 1952. Wash. Dept. Game. 12 p.

Wilde, Louis 1965. Personal interview. Coalville, Utah.

Williams, Jesse E. 1965. Deer, death and destruction. Colo. Outdoors 13(2):1-3.

Wright, E. and L. W. Swift. 1942. Migration census of mule deer in the White River region of northwestern Colorado. J. Wildl. Mgmt. 6(2):162-164.

Young, Jack. 1965. Personal communication. Heber, Utah.

Young, S. P. 1958. The bobcat of North America. The Wildlife Mgmt. Inst., Washington, D.C. ed. 1, p. xiv, 193.

Young, S. P. and E. A. Goldman. 1946. The puma, mysterious American cat. Amer. Wildlife Inst., Washington, D.C., ed. 1, p. xiv, 358.

Zalunardo, Raymond Alfred. 1962. The range and movements of mule deer in a central Oregon herd. Unpublished MS thesis. Oregon State Univ. Library, Corvallis, Oregon.

Zalunardo, Raymond Alfred. 1965. The seasonal distribution of a migratory mule deer herd. J. Wildl. Mgmt. 29(2):345-351.

APPENDIXES

Table 10. Sixty-three dead deer posted during 1965 on Management Unit 19.

Date 1965	Location	Sex	Age	Condition	Cause
2/6	Lodgepole in S.F.	female	fawn	poor	Trap fatality
1/16	Lodgepole in S.F.	female	3 1/2	poor	Trap fatality
1/10	Lodgepole in S.F.	female	2 1/2	poor	Trap fatality
2/13	Redrocks in S.F.	male	fawn	poor	Trap fatality
2/21	5 mi. up Chalk Cr.	female	4 1/2	?	Auto accident
3/30	5 mi. up Chalk Cr.	female	1 1/2	?	Auto accident
3/30	5 mi. up Chalk Cr.	male	fawn	?	Auto accident
4/18	4 mi. up Chalk Cr.	male	3 1/2	fair	Shot by someone
4/18	4 mi. up Chalk Cr.	female	fawn	poor	Shot by someone
4/18	South Fork Jct.	female	6	good	Auto accident
4/18	Huff Creek Jct.	female	6	fair	Fence accident
4/19	Top of winter Quarters	male	3	poor	Large growths on neck & malnutrition
4/19	Top of Winter Quarters	male	15	poor	Malnutrition a factor
4/25	4 mi. East of Upton	male	?	good	Fence accident
4/27	Lodgepole in S.F.	?	fawn	poor	Malnutrition had been previous years death
4/27	Lodgepole in S.F.	?	?	?	?
4/28	Top of Winter Quarters	male	fawn	poor	Malnutrition a factor
4/28	Top of Winter Quarters	male	fawn	poor	Malnutrition a factor
4/28	Top of Winter Quarters	female	fawn	poor	Malnutrition a factor
4/28	Top of Winter Quarters	female	fawn	fair	Predation ?
4/30	Crandall Canyon	?	fawn	good	Fence accident
4/30	Crandall Canyon	?	fawn	good	Fence accident
4/30	Crandall Canyon	?	fawn	good	Fence accident
4/30	Crandall Canyon	?	fawn	good	Fence accident
5/2	2 mi. below Upton	female	3	good	Auto accident
5/3	Reed's Canyon in S.F.	female	4	good	Collected by USDF&G
5/3	Cotton Canyon-Rockport Reservoir	female	fawn	good	Unknown
5/4	Crandall Canyon	male	fawn	good	Unknown
5/4	Crandall Canyon	male	fawn	poor	Malnutrition a factor
5/4	Crandall Canyon	female	10	good	Collected by USDF&G
5/4	Crandall Canyon	female	9	good	Collected by USDF&G--had cyst of tapeworm & deformed tooth structure.
5/10	Echo Canyon	male	?	?	Auto accident
5/10	Echo Canyon	?	fawn	?	Auto accident
5/10	Echo Canyon	female	?	good	Auto accident
5/11	Cotton Canyon-Rockport Reservoir	?	fawn	?	Unknown
5/12	Blonquist's upper place	female	1 1/2	good	Unknown (tagged)

Table 10. Continued.

Date 1965	Location	Sex	Age	Condition	Cause
5/12	Blonquist's upper place	?	fawn	poor	Malnutrition a factor
5/12	Blonquist's upper place	male	10	poor	Malnutrition a factor (tagged) (4 point)
5/12	Red Rocks in S.F.	male	?	good	Shot during hunting season (4 point)
5/12	Red Rocks in S.F.	female	9	poor	Malnutrition factor (tagged)
5/12	Red Rocks in S.F.	?	fawn	?	Unknown
5/12	Red Rocks in S.F.	male	fawn	poor	Malnutrition factor (tagged)
5/12	Red Rocks in S.F.	?	fawn	good	Unknown
5/12	Red Rocks in S.F.	male	9	poor	Malnutrition factor (tagged)
5/16	2 mi. up Clark's Canyon	?	?	?	Fence accident
5/16	2 mi. up Clark's Canyon	?	?	?	Fence accident
5/16	2 mi. up Clark's Canyon	?	?	?	Fence accident
5/27	Narrows or 4 mi. up Chalk Cr.	female	4	good	Shot by someone
5/30	Top of Winter Quarters	female	fawn	?	Unknown (tagged)
5/30	Jct. of Hay Hollow & Fish Cr.	male	fawn	?	Unknown (tagged)
6/1	4 mi. up Chalk Creek	female	7	good	Shot by someone
6/1	Grass Creek	?	fawn	good	Predator kill
6/1	1/2 mi. above S.F. Jct.	?	fawn	good	Fence accident
6/1	1/2 mi. above S.F. Jct.	?	fawn	good	Fence accident
6/2	ridge between East Fork and Taylor's Hollow	?	fawn	good	Unknown
6/2	ridge between East Fork and Taylor's Hollow	?	fawn	good	Unknown (both found by fence)
6/4	Narrows	female	7	good	Auto accident
6/13	Mouth of Robinson Creek in Echo Canyon	female	?	good	Auto accident
7/8	3 mi. W-NW of Hatch Cabin on the Bear River	?	1 wk.		Found covered with soil in front of new badger den
7/22	Jct. of South Fork	female	1 1/2		Hunter kill but left hanging in tree

Table 10. Continued.

Date 1965	Location	Sex	Age	Condition	Cause
9/3	West side of S.F. 3 mi. above Blonquist upper ranch	?	1 wk. (at death)	?	No broken bones--cause unknown
9/4	Bear River upper camp ground	female	1 1/2	good	Auto accident.

Table 11. The sample size (n), mean (U), sample variance (S^2), standard deviation (S), and the 95 percent confidence level of the mean are calculated from the recorded weight of each age class during the 1964 deer season on the Coalville Deer Managment Unit 19.

Age	Fawns		1 1/2	
Sex	Male	Female	Male	Female
n	30	22	94	41
U	49±20.5328 *S-$\bar{t}$(.05)(47)	45.9±17.2394	95.9±25.6282 *S-t($\bar{.}$05)(154)	85.1±17.0996 *S-t($\bar{.}$05)(53)
S^2	105.4	74.3	164.2	73.1
S	10.2664	8.6197	12.8141	8.5498

Age	2 1/2		3 1/2	
Sex	Male	Female	Male	Female
n	37	19	11	6
U	130.2±25.6048	93.2±30.8740	134.2±30.8740	92.0±22.2350
S^2	163.90	151.9	238.3	123.6
S	12.8024	12.3247	15.4370	11.1175

Age	4 1/2		5 1/2	
Sex	Male	Female	Male	Female
n	11	10	5	11
U	166.6±44.5198	101.1±26.1074 **NS-t($\bar{.}$05)(17)	174.9±32.8086	97.6±14.5326
S^2	495.5	170.4	269.1	52.8
S	22.2599	13.0537	16.4043	7.2663

Age	6 1/2		7 1/2	
Sex	Male	Female	Male	Female
n	3	3	1	1

Table 11. Continued.

U	210.0±5.292	108.8±14.1984	170	96
S^2	7.0000	50.4000	0	0
S	2.6460	7.0992	0	0
Age	8 1/2		9 1/2	
Sex	Male	Female	Male	Female
n	1	1	1	0
U	200.0	96.0	212.0	0
S^2	0	0	0	0
S	0	0	0	0

*There is a significant difference at the 5 percent level of the Student's t-distribution between the mean weights of the particular age class of each sex respectively between years of 1964 and 1965 on deer Management Unit 19, at the respective degrees of freedom.

**There is not a significant difference at the 5 percent level of the Student's t-distribution between the mean weights of the particular age class of each sex respectively between years of 1964 and 1965 on deer Management Unit 19, at the respective degrees of freedom.

Table 12. The sample size (n), mean (U), sample variance (S^2), standard deviation (S), and the 95 percent confidence level of the mean, are calculated from the recorded weight of each age class during the 1965 deer season on the Coalville Deer Managment Unit 19.

Age	Fawns		1 1/2	
Sex	Male	Female	Male	Female
n	20	24	66	25
U	55.3±15.4142	53.3±12.6174	104.6±21.1092	91.4±16.1122
S^2	59.4	39.8	111.4	64.9
S	7.7071	6.3087	10.5546	8.0561

Age	2 1/2		3 1/2	
Sex	Male	Female	Male	Female
n	51	25	15	20
U	137.5±27.4146	104.5±16.2234	163.5±32.1060	104.3±20.3960
S^2	187.8898	65.8	257.7	104.0
S	13.7073	8.1117	16.0530	10.1980

Age	4 1/2		5 1/2	
Sex	Male	Female	Male	Female
n	22	19	12	7
U	175.2±44.3758	106.2±23.0738	192.4±47.5942	111.9±13.1072
S^2	492.3	133.1	566.3	42.95
S	22.1879	11.5369	23.7971	6.5536

Age	6 1/2		7 1/2	
Sex	Male	Female	Male	Female
n	3	0	1	1

Table 12. Continued.

U	177±42.0	0	251	113.5
S^2	441	0	0	0
S	21	0	0	0
Age	8 1/2		11 1/2	
Sex	Male	Female	Male	Female
n	0	1	0	1
U	0	115.5	0	107.5
S^2	0	0	0	0
S	0	0	0	0

Table 13. The sample size (n), mean (U), sample variance (S^2), standard deviation (S), and the 95 percent confidence level of the mean are calculated from the recording of the antler points of the right and left antlers respectively of each age class during the 1964 deer season.

Age	1 1/2		2 1/2	
Antler	Right	Left	Right	Left
n	91	88	38	36
U	2.09±1.0602	2.07±.9962	3.32±1.4782	3.39±1.1076
S^2	.2810	.2481	.5462	.3587
S	.5301	.4981	.7391	.5988

Age	3 1/2		4 1/2	
Antler	Right	Left	Right	Left
n	11	11	9	11
U	3.73±1.5726	3.18±1.7476	4.00±1.0000	3.91±.6030
S^2	.6182	.7636	.2500	.0909
S	.7863	.8738	.5000	.3015

Age	5 1/5		6 1/2	
Antler	Right	Left	Right	Left
n	5	5	3	3
U	4.00±.0000	4.20±.8946	4.67±2.2760	4.34±2.0000
S^2	.0000	.2000	1.3333	1.0000
S	.0000	.4473	1.1380	1.0000

Age	7 1/2		8 1/2	
Antler	Right	Left	Right	Left
n	1	1	1	1

Table 13. Continued.

U	3	3	4	4
S^2	.0000	.0000	.0000	.0000
S	.0000	.0000	.0000	.0000

Age	9 1/2	
Antler	Right	Left
n	1	1
U	5	3
S^2	.0000	.0000
S	.0000	.0000

Table 14. The sample size (n), mean (U), sample variance (S^2), standard deviation (S), and the 95 percent confidence level of the mean are calculated from the recording of the antler points of the right and left antlers respectively of each age class during the 1965 deer season.

Age	1 1/2		2 1/2	
Antler	Right	Left	Right	Left
n	60	61	50	51
U	1.7±1.0924	1.9±1.1528	3.28±1.5670	3.14±1.3866
S^2	.2983	.3322	.6138	.4807
S	.5462	.5764	.7835	.6933

Age	3 1/2		4 1/2	
Antler	Right	Left	Right	Left
n	15	15	22	22
U	3.7±1.5976	3.6±1.2650	3.8±1.7982	3.9±1.5708
S^2	.6381	.4000	.7554	.6168
S	.7988	.6325	.8991	.7854

Age	5 1/2		6 1/2	
Antler	Right	Left	Right	Left
n	12	12	3	3
U	4.4±2.1442	4.3±2.2760	4.3±1.1548	4.3±1.1548
S^2	1.1742	1.3333	.3333	.3333
S	1.0721	1.1380	.5774	.5774

Age	7 1/2	
Antler	Right	Left
n	1	1

Table 14. Continued.

U	4	4
S^2	.0000	.0000
S	.0000	.0000

Table 15. The sample size (n), mean (U), sample variance (S^2), standard deviation (S), and the 95 percent confidence level of the mean are calculated from the measurements of the length of the main beam of the right and left antlers respectively in inches of each age class during the 1964 deer season.

Age	1 1/2		2 1/2	
Antler	Right	Left	Right	Left
n	86	83	34	36
U	10.1±3.7376 *NS-t(.05)(127)	10.1±3.2762 *NS-t(.05)(125)	14.8±3.3550	14.7±3.3484
S^2	3.4923	2.7047	2.8287	2.8182
S	1.8688	1.6381	1.6775	1.6742

Age	3 1/2		4 1/2	
Antler	Right	Left	Right	Left
n	11	11	9	9
U	15.9±5.6030 *NS-t(.05)(17)	16.3±5.5968	19.8±6.6264	19.4±7.8580
S^2	7.8546	7.8375	10.9757	15.2425
S	2.8015	2.7984	3.3132	3.9290

Age	5 1/2		6 1/2	
Antler	Right	Left	Right	Left
n	5	5	3	3
U	20.95±3.3168	20.8±3.9564	17.0±12.3792	17.7±13.1370
S^2	2.7687	3.9187	38.3125	43.1458
S	2.7687	3.9187	38.3125	6.5685

Table 15. Continued.

Age	7 1/2		8 1/2	
Antler	Right	Left	Right	Left
n	1	1	1	1
U	21	22.5	17.5	20.5
S^2	.0000	.0000	.0000	.0000
S	.0000	.0000	.0000	.0000

Age	9 1/2	
Antler	Right	Left
n	1	1
U	23	22.75
S^2	.0000	.0000
S	.0000	.0000

*There is not a significant difference at the 5 percent level of the Student's t-distribution between the mean antler beam lengths of the particular age class of the years 1964 and 1965 at the respective degrees of freedom.

Table 16. The sample size (n), mean (U), sample variance (S^2), standard deviation (S), and the 95 percent confidence level of the mean are calculated from the measurements of the length of the main beam of the right and left antlers respectively in inches of each age class during the 1965 deer season.

Age	1 1/2		2 1/2	
Antler	Right	Left	Right	Left
n	57	59	51	46
U	9.8±3.4316	9.9±3.2670	15.-2±3.5302	15.08±3.0132
S^2	2.9489	2.6904	3.1235	2.2913
S	1.7158	1.6335	1.7651	1.5066

Age	3 1/2		4 1/2	
Antler	Right	Left	Right	Left
n	15	14	22	22
U	17.3±3.5478	17.4±5.0398	18.7±3.6154	18.1±5.0802
S^2	3.1559	5.5346	3.2826	6.4626
S	1.7739	2.3499	1.8077	2.5401

Age	5 1/2		6 1/2	
Antler	Right	Left	Right	Left
n	12	11	3	3
U	19.98±5.4180	19.80±5.3640	19.5±6.5566	19.3±6.5372
S^2	7.3461	7.1977	10.7500	19.6875
S	2.7090	2.6820	3.2783	3.2686

Age	7 1/2	
Antler	Right	Left
n	1	1
U	25	25
S^2	.0000	.0000
S	.0000	.0000

Table 17. The sample size (n), mean (U), sample variance (S^2), standard deviation (S), and the 95 percent confidence level of the mean are calculated from the measurements of the diameter of the right and left antlers respectively inches of each age class recorded during the 1964 deer season.

Age	1 1/2		2 1/2	
Antler	Right	Left	Right	Left
n	91	93	39	38
U	.72±.2126 *S-t(.05)(139)	.73±.2296	.98±.2208 *S-t(.05)(81)	.96±.2190
S^2	.0113	.0132	.0122	.0120
S	.1063	.1148	.1104	.1095

Age	3 1/2		4 1/2	
Antler	Right	Left	Right	Left
n	10	10	10	11
U	1.02±.2410	.98±.2028	1.22±.2770	1.19±.2842
S^2	.0145	.0103	.0192	.0202
S	.1205	.1014	.1385	.1421

Age	5 1/2		6 1/2	
Antler	Right	Left	Right	Left
n	5	5	3	3
U	1.30±.3898	1.27±.3224	1.50±.1200	1.44±.0000
S^2	.0380	.0260	.0036	.0000
S	.1949	.1612	.0600	.0000

Age	7 1/2		8 1/2	
Antler	Right	Left	Right	Left
n	1	1	1	1
U	1.19±.0000	1.25±.0000	1.38±.0000	1.38±.0000
S^2	.0000	.0000	.0000	.0000
S	.0000	.0000	.0000	.0000

Table 17. Continued.

Age	9 1/2	
Antler	Right	Left
n	1	1
U	1.50±.0000	1.44±.0000
S^2	.0000	.0000
S	.0000	.0000

*There is a significant difference at the 5 percent level of the Student's t-distribution between the mean diameter of the antler of the particular age class of the years 1964 and 1965.

Table 18. The sample size (n), mean (U), sample variance (S^2), standard deviation (S), and the 95 percent confidence level of the mean are listed below from calculations taken from measurements of the diameter of the right and left antlers respectively of each age class recorded during the 1965 deer season.

Age	1 1/2		2 1/2	
Antler	Right	Left	Right	Left
n	65	64	50	49
U	.95±.2088	.96±.2208	.0117	.0133
S^2	.0109	.0122	.0117	.0133
S	.1044	.1104	.1082	.1153

Age	3 1/2		4 1/2	
Antler	Right	Left	Right	Left
n	17	16	22	22
U	1.38±.2938	1.37±.2584	1.52±.3144	1.52±.4024
S^2	.0216	.0167	.0247	.0405
S	.1469	.1292	.1572	.2012

Age	5 1/2		6 1/2	
Antler	Right	Left	Right	Left
n	12	12	3	3
U	1.64±.3310	1.67±.3762	1.56±.1844	1.65±.2890
S^2	.0274	.0354	.0085	.0209
S	.1655	.1881	.0922	.1445

Age	7 1/2	
Antler	Right	Left
n	1	1
U	1.88	1.88
S^2	.0000	.0000
S	.0000	.0000

Table 19. The sample size (n), mean (U), sample variance (S^2), standard deviation (S), and the 95 percent confidence level of the mean are calculated from the recorded weight of each age class during the 1965 deer season on the Cache Number 2 Management Unit.

Age	fawns		1 1/2	
Sex	Male	Female	Male	Female
n	13	8	39	20
U	54.8±21.6888	49.8±10.6768 *NS-t(.05)(14)	108.1±23.0130 *NS-t(.05)(73)	88.8±17.9778 *NS-t(.05)(39)
S^2	117.6	28.5	132.4	80.8
S	10.8444	5.3384	11.5065	8.9889

Age	2 1/2		3 1/2 plus	
Sex	Male	Female	Male	Female
n	28	13	24	29
U	143.4±31.5720 *NS-t(.05)(49)	106.1±9.6328	183.7±63.7200 *NS-t(.05)(28)	108.3±21.9364
S^2	249.2	23.2	1,015.1	120.3
S	15.7860	4.8164	31.86	10.9682

*There is not a significant difference at the 5 percent level of the Student's t-distribution between the mean weights of the particular age class of each sex respectively between the Coalville and Cache deer herds, at the respective degrees of freedom.

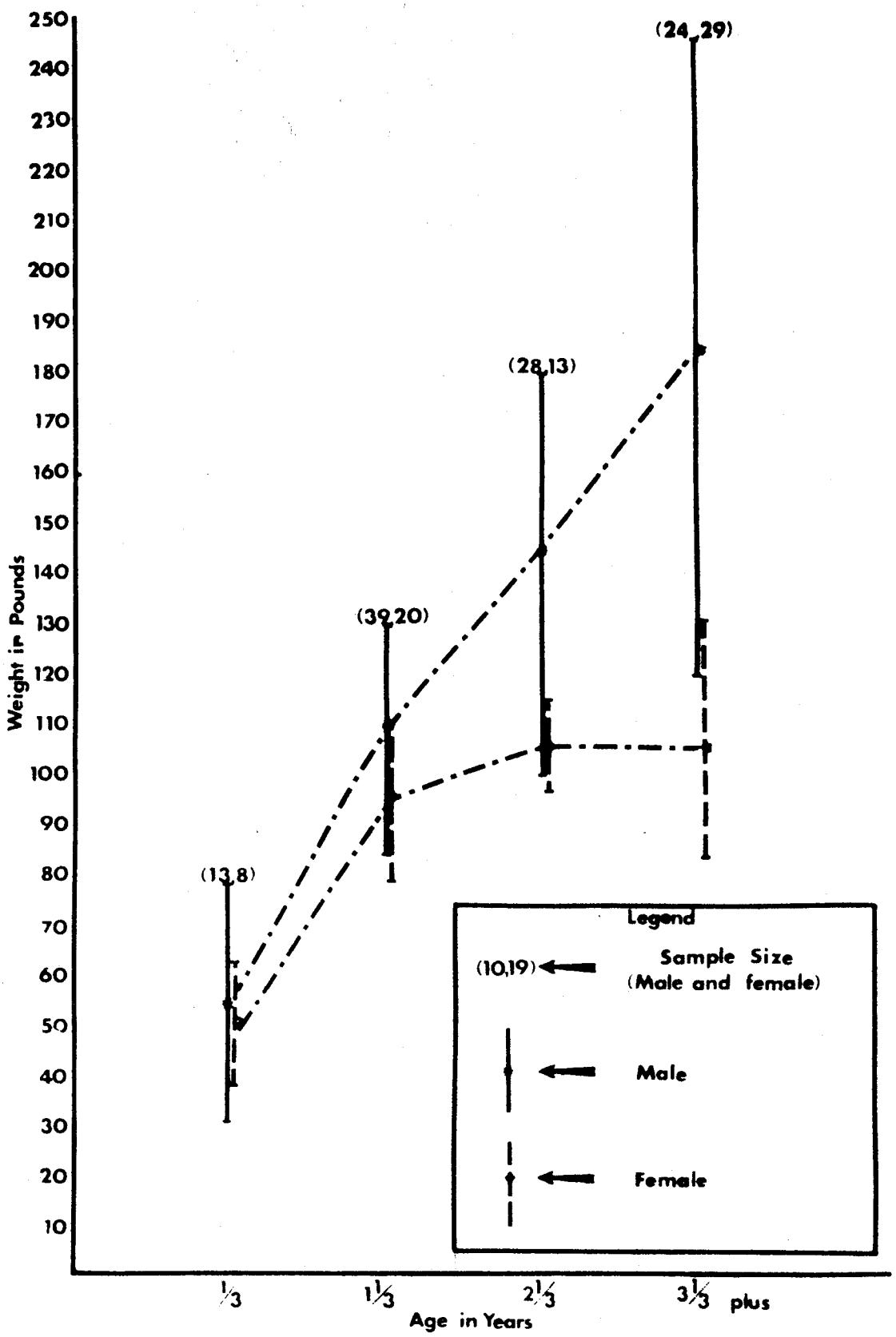

Figure 13. Mean weight and 95 percent confidence limits of deer examined on the Cache deer management unit during the fall of 1965.

Table 20. Average weights of the Cache deer herd, 1939-1950 (Hill, 1952).

Age	*Hog-dressed Weight Pounds		**Calculated Live Weight Pounds	Sample size
Male fawn at birth			7.66	17
Female fawn at birth			7.32	10
Male fawn at 8 weeks			27.69	4
Female fawn at 8 weeks			27.58	3
Male fawn, fall hunt	58.70	***NS-t(.05)(12)	85.00	305
Female fawn, fall hunt	52.60	NS-t(.05)(7)	76.00	194
Yearling doe, fall hunt	94.96	S-t(.05)(19)	138.00	64
2 yr. doe, fall hunt	99.10	S-t(.05)(12)	143.00	111
Mature doe, fall hunt	108.10	NS-t(.05)(128)	157.00	302
Bucks by antler point classes				
1 x 1	101.30		147.00	23
1 x 2	109.70		159.00	38
2 x 2	114.40		166.00	533
2 x 3	123.90		180.00	132
3 x 3	147.00		213.00	200
3 x 4	170.00		247.00	105
4 x 4	185.50		269.00	267
4 x 5	192.70		280.00	29
5 x 5	196.50		285.00	25
6 x 6	227.00		329.00	3
More than 6 points	231.00		335.00	2

*Entrails, heart, liver and lungs removed; head, legs and hide intact.
**The first 4 entries in this column are actual live weights and the rest were calculated on a 30.8 percent bases (Doman and Rasmussen, 1944).
***Comparison with the weights recorded for 1965 on the Cache deer herd.

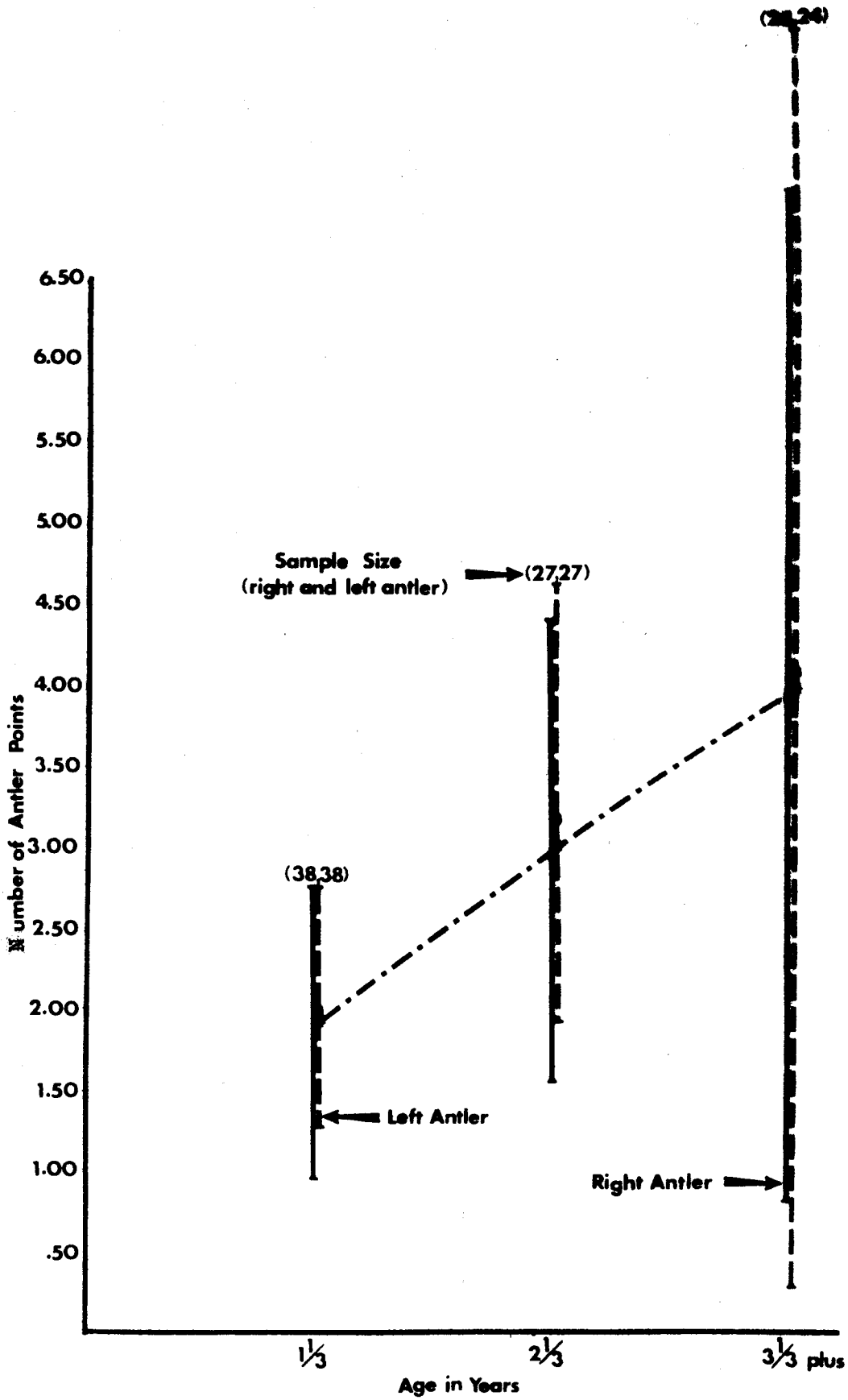

Figure 14. Mean antler points and 95 percent confidence limits for deer examined in the Cache management unit #2, 1965.

Table 21. The sample size (n), mean (U), sample variance (S^2), standard deviation (S), and the 95 percent confidence level of the mean are calculated from the recorded antler points of the right and left antlers respectively of each age class during the 1965 deer season on the Cache Number 2 Management Unit.

Age	1 1/2		2 1/2	
Antler	Right	Left	Right	Left
n	38	38	27	27
U	1.92±.8548	2.03±.7334	3.1±1.3504	3.3±1.3588
S^2	.1827	.1344	.4558	.4615
S	.4274	.3667	.6752	.6794

Age	3 1/2 plus	
Antler	Right	Left
n	24	24
U	4.1±3.2878	4.2±3.9560
S^2	2.7228	3.9112
S	1.6439	1.9780

Table 22. Comparison of Cache mule deer antler measurements by age classes, 1942 and 1950 (inches) (Hill, 1952).

Age	1942		1950	
	*Av. antler diameter	Av. length main beam	Av. antler diameter	Av. length main beam
Yearlings	0.736 **(138)	11.9 (136) ***S-t(.05)(60)	0.765 (34)	12.30 (43) ***S-t(.05)(60)
2 yr. olds	0.985 (112)	17.25 (117) ***S-t(.05)(60)	0.915 (20)	15.32 (23) ***NS-t(.05)(60)
Mature	1.31 (145)	22.36 (146)	1.21 (50)	21.54 (58) ***S-t(.05)(60)

*Antler diameter measured 1 inch above the burr.

**Figures in parenthesis indicate size of the sample.

***A comparison significance and none significance between Coalville measurements in 1965 and the Cache in 1942 and 1950.

SUGGESTED POLICIES AND BY-LAWS

"Our statutes set up quite a different procedure for the formation of a non-profit corporation than for an ordinary business corporation. A meeting of the members must be held, and an affidavit of the chairman and/or secretary of the meeting following substantially and form of the statute stating the facts and the outline of the organization constitute the articles of incorporation. It is recommended that such a meeting be held as soon as practicable and the matters necessary for incorporation be considered and decided. Some of such matters, together with suggestions and typical provisions follows:

1. Name of Corporation. The name of the corporation shall be ECHO-CHALK CREEK RANGE OWNERS' PROTECTIVE ASSOCIATIONS or Echo-Chalk Creek Range Owners' Protective Association, Inc., IF DESIRED.

2. Duration. To exist for _____ years. (25 or 50 years, any period up to 99 years)

3. Election of officers. A president, vice president, secretary, and treasurer (or the latter two combined in one officer). All of whom shall also be directors and members, excepting the secretary, who may be a disinterested person hired for the job, (if desired). Perhaps five other directors, or only five including the officers. How many to constitute a quorum?

4. Tenure of office and manner of election. The officers and directors to be elected annually and to hold office for one year, such elections to be held at an annual meeting of the corporation on the _____ day of _____ of each year (or the second Monday of June of each year). The said officers and directors to be elected by majority vote of the members present at said meeting, who shall be notified by mail addressed to members' addresses as shown on the books and records of said corporation, at least two weeks before such meeting, certified proxies in writing to be votable at such meeting.

5. Power to adopt and amend by-laws. The board of directors shall have the power to adopt and amend by-laws by vote of a

Figure 3. Suggested policies and by-laws drawn up by a legal representative in 1947 for the Echo-Chalk Creek Range Owners' Protective Association.

majority of said board at any regular of special meeting called for the purpose, or at any regularly called business meeting of said board of directors.

Or, it may be desired to vest such power of adoption and amendment of by-laws in the membership as a whole.

6. Purposes and objectives. The members of this corporation shall be owners of range land in Summit County, Utah, and the purposes and objectives of the corporation are to preserve and protect the range land and property of the members from abuses of hunters and others going upon the said lands; to prohibit, limit, regulate and control the public in and from entering upon said lands without written permission first had and obtain; and to do every and all acts and things whatsoever, in accordance with law, to promote, preserve, regulate and protect the property and interests of the members within the area hereinafter set forth. The several clauses contained in this statement of purposes shall be construed both as purposes and powers and the statements contained in each clause shall be in no wise limited or restricted by reference to or inference from the term of any other clauses.

7. Non-profit. The corporation does not contemplate pecuniary gain or profit of the members thereof, nor does it contemplate engaging in any type of business or enterprise for the purpose of accumulating profits. All monies acquired through membership fee, assessments, hunting fees, donations or from any other source, shall be used solely for the operating expenses and the furthering of the purposes and objects of the corporation. (If desired, could purpose). Add: or by majority vote of the members, for any civic, charitable or public.

8. Question of stock, original assessments, etc. A nonprofit corporation ordinarily contemplates members and not stockholders. However, the very nature of our association requires, for the purpose of assessments and perhaps for voting also, something similar to stock, although we perhaps would do well to denominate it something other than stock. Assessments on the basis of acreage, and also membership fees, can easily be handled without actually issuing shares of stock. And if it is desired to have voting powers on the basis of acreage, that can be done by calling them votes, or shares without having any actual capital stock. An original assessment, or more accurately a membership fee, has been discussed on the basis of 1/4 cent per acre. This should be clearly decided.

9. Power to assess in future. Vested in board of directors or members as a whole at the annual meeting? Majority or 2/3?"

VITA

Gary Lain Hickman

Candidate for the Degree of

Master of Science

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Professional Experience: 1966 to present Wildlife Biologist, Division of River Basin Studies, Bureau of Sport Fisheries and Wildlife, U.S. Fish and Wildlife Service.