SURVIVAL OF THE PRONGHORN ANTELOPE IN SOUTH CENTRAL OREGON DURING 1953 AND 1954

by

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (continued)

LIST OF TABLES

LIST OF TABLES (continued)

SURVIVAL OF THE PRONGHORN ANTELOPE IN SOUTH CENTRAL OREGON DURING 1953 and 1954

INTRODUCTION

Reported in this thesis are the findings of a field investigation concerned with the survival of young pronghorn antelope, Antilocapra americana oregona Ord, during the spring and summer of 1953 and 1954 on and near the Hart Mountain National Antelope Refuge in south central Oregon. The study was under the direction of the Oregon Cooperative Wildlife Research Unit[1]. It was aimed primarily at determining the following facts: (1) direct and indirect mortality factors which were important from birth to approximately three months of age; (2) the probable importance of each mortality factor; (3) extent of losses; and (4) productivity of the herds studied. Other data were collected and are included for the sake of adding to the knowledge of antelope.

The investigation was prompted by reports from field agents employed by the Oregon State Game Commission since 1946. Some of these workers reported normal birth rates followed by suspected heavy losses of young during the summer as evidenced by a wider disparity in kid:doe ratios in August and September. Some workers believe high kid mortality in recent years to be the chief cause for the antelope population in Oregon remaining static.

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1 Oregon State Game Commission, United States Fish and Wildlife Service, Wildlife Management Institute, Agricultural Research Foundation, and Oregon State College cooperating.

To afford a better understanding of the problem a brief review of antelope population trends in the United States as a whole and in Oregon will be given. This will be followed by a review of the circumstances which led to the often voiced opinion that kid loss during the summer has been exceptionally high the past few years.

Antelope Population Trend in the United States

Unfortunately accounts of early antelope numbers were very vague. Most frequently the old writings stated that antelope were "common", "very numerous", or "widely distributed". Seton (26, p. 426) believed that around 1870 antelope outnumbered buffalo. If this were true the population would have been over one hundred million. On the other hand Nelson (24, pp. 3-4) estimated the original numbers at not less than thirty to forty million.

An estimate of 17,000 in 1908 for the Western United States was given by Dr. T. S. Palmer (26, p. 427). From 1922 to 1924 an extensive survey was conducted by the United States Biological Survey. Nelson (24, p. 3) reports this survey revealed the antelope population in the United States to be approximately 26,000.

According to the United States Fish and Wildlife Service estimates the total population has been fluctuating from 131,555 in 1937 to an all-time high since that date of 273,196 in 1953 (33). This population trend is depicted in figure 1. From the above it is obvious that antelope numbers declined rapidly from the 1800's to the early 1900's and then rose steadily up to 1953.

Antelope Population Trend in Oregon

Early records of any value for Oregon are unobtainable. The first published census was made by Stanley G. Jewett in 1915 and 1924 (12, p. 9 and 24, pp. 46-47). He estimated a total of about 1,800 and 2,000 respectively. These animals were located mainly in Lake, Harney, and Malheur counties. In 1931 Jewett estimated not less than 5,000 antelope in Oregon (3, p. 74). Einarsen (12 p. 11) reports a population in Oregon of about 19,000 in 1939 with a gradual decline until approximately 9,600 remained in 1945.

Figure 1 shows the estimated population figures for Oregon from 1937 to 1953 which were derived from United States Fish and Wildlife Service reports (33). Of interest is a comparison of Oregon figures with the total population estimates for the United States. Total population figures for the United States show a rather constant rise from 1937 to 1943. A gradual decline occurred after 1943 until 1947. Since 1948 a continuous increase has been taking place. In contrast, available data from the Federal Government show that the Oregon antelope followed the national trend up to 1943 but in 1946 was reduced to the lowest recorded population since about 1931. A slight increase of approximately 5,000 animals was noted through 1950. After this date a reduction occurred followed by a leveling off at about 10,000 in 1952. Since this latter year an unchanging population has been reported.

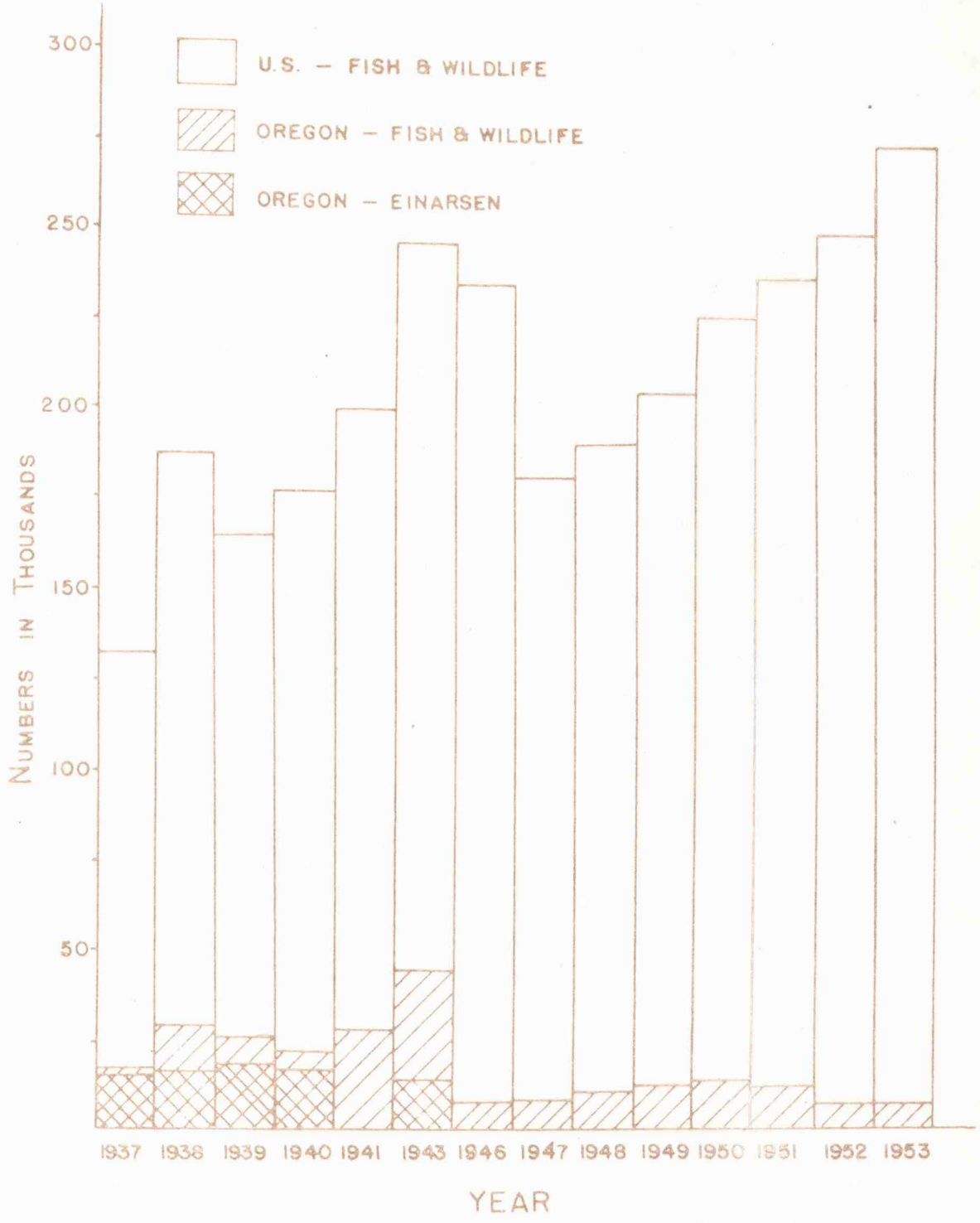

Figure 1. Estimated antelope population for the United States and Oregon as determined by the U. S. Fish and Wildlife Service from 1937 to 1953, exclusive of 1942, 1944, and 1945, and for Oregon by Einarsen in 1937 to 1940 to 1943.

Accuracy of Population Estimates

Attention should be drawn to the fact that before the use of the airplane, population data are of doubtful accuracy. The following quote is from the report of Aerial Census of Interstate Antelope Herds of California, Idaho, Nevada, and Oregon, March 1949: "Prior to the use of the airplane in antelope census in Western States, the estimated populations based upon foot or horseback counts were usually two or three times greater than the actual population." In earlier times transportation was slow and difficult and perhaps very few were actually interested in total counts since there was little need for such knowledge. Also it has recently been noted during aerial surveys by the Oregon State Game Commission that slight movements in herd location occur and these herds may easily be missed on foot or horseback.

An example of how antelope population estimates may vary is illustrated in Figure 1. Included with the estimates of the total Oregon pronghorn population by the United States Fish and Wildlife Service are data for the years 1937, 1938, 1939, 1940 and 1943 from estimates published by Einarsen (12, p. 11). It will be noticed that these two different sources are far from being in complete agreement with each other. In the years 1937 through 1940 Einarsen's figures are from about 1,000 to 10,000 animals lower than those reported by the Fish and Wildlife Service. The two estimates for 1943 are different by over 30,000 antelope with the United States Fish and Wildlife Service indicating the higher population. These higher figures were believed to be partially influenced by a duplication

in reporting of animals by the various Federal agencies (33). Thus the above situation points out that caution should be used in interpreting census figures presented for the antelope. However, much reliance can be placed upon data obtained by the Oregon Game Commission since the inauguration of yearly aerial sample flights throughout the antelope range in 1947.

The important fact to be stressed from the census data presented is that the pronghorn population after its initial decline from early abundance has been gradually increasing, if data for the United States as a whole is considered, since the mid-forties while Oregon herds have remained static in size, for all practical purposes, since about 1946. Most of the increase as shown by total antelope numbers for the entire country has been through a steady rise in numbers in Wyoming and Montana while such states as Nevada, California, Idaho, and Arizona have had decreasing or stable populations.

Considering the fact that antelope were protected in Oregon from 1913 to 1938 (12, pp. 164-166) and that the hunting kill has been low, it appears that an abnormal situation exists. The small amount of hunting pressure on Oregon antelope can best be comprehended by examining table I which lists the number of hunters participating in the open seasons, the number of antelope taken, and per cent of the estimated population taken legally by hunters. Each year the number of hunters was regulated by a permit system. In no case was the kill in excess of 6% of the estimated total population. Thus, hunting cannot be considered as an explanation for an unchanging

number of animals. As guardians of a natural resource, game managers should strive to learn the causes and apply management techniques to correct the situation in so far as it is possible.

TABLE I.

NUMBER OF HUNTERS PARTICIPATING AND TOTAL ANTELOPE KILL DURING THE OPEN SEASONS FROM 1938 THROUGH 1954 IN OREGON.

Year	Number of Hunters+	Kill+	% of Est. Population++
1938	242	175	1
1939	292	214	1
1940	514	399	3
1941	2,471	1,378	5
1942	695	594	4
1943	1,119	691	5
1944	1,267	712	6
1945	799	328	3
1949	929	586	5
1950	1,422	679	5
1951	1,133	600	4
1952	1,075	448	4
1953	380	181	2
1954	568	330	-

+ Data obtained for years 1938 through 1952 from a special report prepared by the Oregon State Game Commission in 1953 entitled "Summary of Available Information on Antelope".
++Calculation based on the lowest estimate in figure 1.

Review of Reported Kid Loss in Oregon

High mortality among young antelope has been reported by A. B. Claggett, district game agent in Lake County, Oregon, since 1946 with exception of the year 1947 (8). His belief is that the mortality among antelope kids rather than excessive hunting or overpopulation

has been responsible for the lack of increase in antelope herds in Oregon. Claggett relates that a significantly high loss of kids occurs from the middle of June until the middle of July. In May 1953, an annual report submitted by Claggett tells of a loss for the three years previous of nearly 65% of the fawn crop during the summertime. He further states that this high loss was possibly caused indirectly by a scouring (dysenteric) condition with an undetermined primary cause. During the summer of 1952, Claggett found nine fresh kid carcasses. Of these, seven were noted to have scours. Adult loss was not believed to be contributing to the unchanging population. Most adult loss was attributed to old age. A check of winter ranges by Claggett has revealed no noticable die-off.

A report on field observations by District Game Agent Ellis Mason in the Harney County district also relates, ". . . a loss in the kids between the first of June and middle of August and the cause has not been determined" (20). "Five more dead kids were located this month making a total of 12 found during the past eight weeks." (18). "The antelope kid situation can be considered as serious, as they are not going to raise enough kids to keep the herds restocked if the condition continued." (19).

In comparison to reports submitted above, Cecil Langdon, district game agent for the Malheur district, has found no high loss among young kids. "It is doubted very much if the losses in our antelope are occurring in young kids, for the herd composition in the months of August and September will show a fairly good doe:kid ratio but a check made in early May shows a big decline from early fall figures."(15).

From the foregoing reports there were indications that high mortality among young kids is the possible basic cause for the failure of the Oregon herds to show normal increases at least in Lake and Malheur counties. The investigation which has taken place over the last two years was designed to either substantiate or disprove the theory of high losses of antelope kids. Data gathered should point the way to important factors which then can be pursued with follow-up investigations.

FIELD PROCEDURES

Study Areas

A majority of the observations made during both years of the study were confined to two definite areas. It was believed that concentrated effort on small herds and relatively small tracts of ground would give maximum information on the extent of losses among young antelope under the conditions which existed during the period of study. A third locality, a portion of the southern end of the Hart Mountain Refuge was visited periodically for purposes of comparison. An attempt was made to choose an area the extent of which would allow adequate coverage and have at the same time a minimum amount of herd movement back and forth over the boundary lines.

One of the plots was located in the immediate vicinity of the Hart Mountain National Antelope refuge headquarters and the other on a portion of Drake's Flat. These two areas are about 20 air line miles apart. The approximate location of each is shown in figure 2.

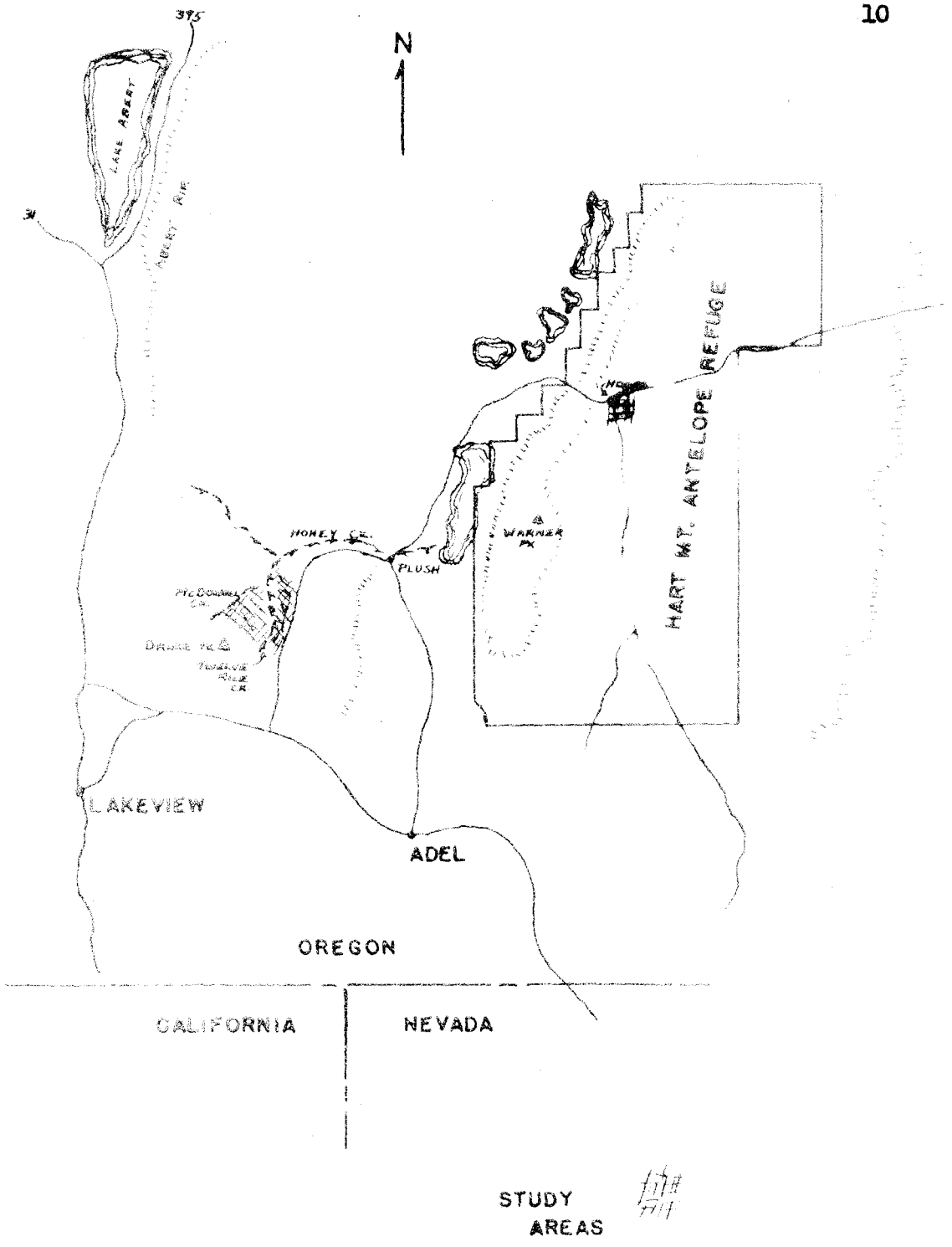

Figure 2. Sketch showing location of the Drake's Flat and Hart Mountain study areas.

In addition to these intensive study areas an attempt was made to keep in contact with ranchers, range riders, game personnel, and various state and Federal agencies throughout Lake, Harney, and Malheur counties. Their cooperation was requested in reporting kid mortalities.

Description of the Hart Mountain Study Area

Generally speaking, the Hart Mountain refuge is situated in south central Oregon in Lake county. It lies in the rough and rocky desert country which extends into northern Nevada and southwest Idaho. Most of this area is of volcanic origin which accounts for large areas being built up by successive lava flows. The west face of Hart Mountain rises abruptly from the Warner Valley floor, which is about 4,400 feet above sea level, to a height of 8,020 feet. The summit slopes to the east much more gently than to the west and gradually levels off at approximately 5,900 feet. A more or less level plateau is formed which extends eastward and finally drops off almost 1,000 feet into Guano Valley.

The study area is located on the Guano plateau near the refuge headquarters (figure 2) comprising approximately 13 square miles. Specifically the topography is far from being level. Rock outcroppings, rimrocks, and undulating ground levels all tend to disrupt the horizontal plane.

Temperatures fluctuate considerably from day to night and from season to season. Table II presents the maximum, average maximum,

TABLE II.

AVERAGE MONTHLY SNOWFALL, SNOW DEPTH, PRECIPITATION, GREATEST PRECIPITATION FALLING IN ANY ONE DAY, AVERAGE MAXIMUM AND MINIMUM AND MAXIMUM AND MINIMUM TEMPERATURES FOR EACH MONTH RECORDED AT THE HART MOUNTAIN WEATHER STATION IN 1953 AND 1954 (34)

Month	Snow Fall inches		Snow Depth inches Max.		Precipitation inches Total		Greatest Day		Temperatures °F Max.		Min.		Ave. Max.		Ave. Min.	
	'53	'54	'53	'54	'53	'54	'53	'54	'53	'54	'53	'54	'53	'54	'53	'54
Jan.	4.5	—+	2	5	.58	—	.16	—	57	50	12	-9	44.8	36.7	29.2	21.1
Feb.	13.0	1.0	6	0	.93	.20	.36	.18	59	62	8	15	42.0	48.8	22.2	25.8
March	16.5	21.0	6	6	1.02	1.09	.54	.27	62	63	11	0	45.0	43.2	24.8	20.2
April	4.0	2.0	2	1	.56	.62	.26	.21	74	71	13	15	51.5	56.3	26.5	28.0
May	8.5	3.0	0	2	3.35	1.25	.96	.70	70	85	21	13	52.6	69.4	30.2	33.3
June	2.5	1.2	0	0	1.22	2.32	.40	1.18	73	85	23	27	63.0	66.9	34.8	34.8
July	0	0	0	0	0	.03	0	.03	95	90	34	30	83.0	82.2	42.6	43.3
Aug.	0	0	0	0	.83	.16	.31	.14	91	93	35	29	77.1	76.6	42.8	38.8
Sept.	0	0	0	0	.02	.06	.01	.06	90	84	29	15	76.9	70.2	41.8	34.2
Oct.	T	0	T	0	.72	—	.22	—	77	—	21	—	59.8	—	32.0	—
Nov.	11.0	—	5	-	1.06	.65	.37	.34	60	68	9	4	49.5	54.0	31.0	27.8
Dec.	13.7	5.5	7	5	1.25	.29	.36	.17	55	60	8	-4	41.9	39.7	24.6	16.5
Total precipitation					11.54	6.67										

+ Dashes indicate data not available.

minimum, and average minimum temperatures for each month during the years of the study. The average monthly maximum temperatures during the spring and summer of 1953 and 1954 ranged from about 50 to 80° F while the average minimums for the same period varied from just below freezing up to around 40° F. Lowest daily temperatures occurred in January or February and the warmest in July and August.

Precipitation in this area is quite variable with a yearly average of about 10 inches. The average monthly snowfall, snow depth, and precipitation for both years is listed in table II. About 6½ inches of precipitation fell in 1954 and 11½ inches in 1953. Most of the rain falls throughout the spring months. Greatest monthly total and greatest precipitation during any one day was recorded for the month of May in 1953 and for June in 1954. Thunder showers sometimes occur during the summer. Snow depths in both years were greatest in December, January, February, and March with a maximum depth of 7 inches. In the main, snow was gone from the study area by April but light snow flurries fell in May and in the first part of June.

Water is normally present throughout the year on or in close proximity to the area in the forms of a permanent spring, a small creek, and several stock watering holes. These water sources were noticeably shorter in 1954 than in 1953.

Plants and animals present indicate the life zone to be the arid transition. The dominate cover type is sage brush, Artemisia tridentata (Nuttall) Peck. A considerable amount of hop sage, Grayia

spinosa (Hooker) Moquin-Taudon; and horsebrush, Tetradymia canescens DeCondolle, is mixed with the sage. Bitterbrush, Purshia tridentata (Pursh) DeCondolle; and rabbitbrush, Chrysothamnus viscidiflorus (Hooker) Nuttall and C. nauseosus (Pallas) Britton, are less common and are found in localized areas. Considering the area as a whole these shrubs usually compose of from about 50 to 70 per cent of the cover with grasses and forbs making up the remainder and fluctuating between the two for dominance. Grasses include cheatgrass, Bromus tectorum Linnaeus; bluebunch wheatgrass, Agropyron spicatum (Pursh) Scribner and Smith; Idaho fescue, Festuca idahoensis Elmer; and Stipa sp. Forbs, which are most prevalent in the spring and early summer, include Phlox sp., sagebrush buttercup, Ranunculus glaberrimus Hooker; larkspur, Delphinium sp.; tansy-leaved evening primrose, Oenothera tanacetifolia Torrey and Gray; and balsamroot, Balsamorhiza sp.

Mammals frequently seen other than antelope include the Rocky Mountain mule deer, Odocoileus hemionus hemionus (Rafinesque); black-tailed jackrabbit, Lepus californicus wallawalla Merriam; least chipmunk, Eutamias minimus (Bachman); and the Belding ground squirrel, Citellus beldingi (Merriam). Bobcats, Lynx rufus Merriam; coyotes, Canis latrans Merriam; and badgers, Taxidea taxus Mearns, are less numerous. The most frequently observed bird is the horned lark, Otocoris alpestris merrilli Dwight. Sage grouse, Centrocercus urophasianus (Bonaparte); and short-eared owls, Asio flammeus (Pontoppidan), are not uncommon while the golden eagle, Aquila chrysaetos (Linnaeus), occurs in small numbers only.

In addition the faunal life was supplemented by the presence of several hundred head of cattle on portions of the study area during the late spring and summer months.

The Drake's Flat Study Area

Figure 2 shows the location of the Drake's Flat study area which consists of approximately 18 square miles. Drake's Flat is a plateau overlooking Warner Valley on its west side. Elevation above sea level varies from around 5,000 to 5,500 feet. Thus, Drake's Flat is from several hundred to about 900 feet lower in elevation than is the Hart Mountain study area. The terrain is rolling in nature and in most sites is very rocky with outcrops of ledges and surface rubble. Several draws traverse the area in a north and south direction.

In general, weather is somewhat less severe on Drake's Flat than Hart Mountain. The nearest weather data available for comparison was obtained from the Plush station which is 12 miles from Drake's Flat but is about 1,000 feet lower in elevation. Table III lists the monthly snow fall, snow depth, precipitation, and temperature records for 1953 and 1954. In all comparisons a slight adjustment should be made due to the difference in elevation. The average maximum and average minimum temperatures would be somewhat lower on Drake's Flat with less precipitation and correspondingly more snow fall. Maximum temperatures are higher at Plush than at Hart Mountain while the minimums are usually one or two degrees up to eight degrees higher. More precipitation falls on Hart Mountain than at Plush. Total precipitation

TABLE III.

AVERAGE MONTHLY SNOWFALL, SNOW DEPTH, PRECIPITATION, GREATEST PRECIPITATION FALLING IN ANY ONE DAY, AVERAGE MAXIMUM AND MINIMUM AND MAXIMUM AND MINIMUM TEMPERATURES FOR EACH MONTH RECORDED AT THE PLUSH, OREGON WEATHER STATION IN 1953 AND 1954 (34)

Month	Snowfall inches		Snow Depth inches Max.		Precipitation inches Total		Greatest Day		Temperatures °F Max.		Min.		Ave. Max.		Ave. Min.	
	'53	'54	'53	'54	'53	'54	'53	'54	'53	'54	'53	'54	'53	'54	'53	'54
Jan.	—+	0	—	0	—	.94	—	.22	—	56	—	8	—	41.4	—	23.7
Feb.	—	T	—	T	—	.46	—	.24	—	64	—	18	—	53.3	—	28.2
March	—	—	—	3	—	.67	—	.17	—	64	—	10	—	48.8	—	24.6
April	1.0	0	0	0	.26	.43	.12	.21	80	80	20	22	57.4	63.2	30.2	33.4
May	T	0	T	0	2.80	.88	1.00	.37	78	93	24	18	59.9	74.5	35.0	39.0
June	T	T	0	0	1.06	.95	.26	.35	81	95	32	28	69.1	71.2	40.4	39.9
July	0	0	0	0	0	0	0	0	99	96	40	39	88.5	88.1	50.3	50.7
Aug.	0	0	0	0	.46	.17	.39	.08	97	99	42	38	81.7	80.1	49.2	44.9
Sept.	0	0	0	0	T	.07	T	.05	96	91	34	22	81.7	75.3	44.2	37.0
Oct.	0	0	0	0	.41	.21	.24	.18	83	78	22	13	64.5	65.0	34.1	31.2
Nov.	0	0	0	0	.64	.55	.32	.30	63	69	18	6	54.7	57.0	35.0	29.4
Dec.	—	—	2	—	.57	.32	.26	—	58	—	15	—	44.6	—	26.0	—
Total precipitation					6.20	5.65										

+Dashes indicate data not available.

at Plush for 1953 and 1954 was approximately 6 and 5½ inches respectively. The yearly average is around 8 inches. Snow depth did not exceed two inches during either year at Plush while Hart Mountain had up to a 7-inch maximum.

Open water is quite plentiful throughout the year. Two creeks, McDowell and Twelve Mile, a spring, several stock watering holes, and a temporary runoff water in several draws furnish the water supply.

The flora and fauna of Drake's Flat are in many respects similar to Hart Mountain but with several notable exceptions. For instance, a considerably greater amount of the total area is covered with grass. According to local ranchers, a fire occurred over a part of the area in 1945 which removed large expanses of sagebrush. At the present time the burned areas are reverting back to sage but are still predominately covered by such grasses as cheatgrass, bluebunch, wheatgrass, Idaho fescue, and stripa. Figure 3 pictures a typical portion of the Drake's Flat study area showing fingers of grass among the sagebrush. A small, central portion of the study tract, which is flat and low and well watered, is covered almost entirely with lupine, Lupinus sp..

Antelope occurred in larger numbers on Drake's Flat. Bobcat and coyote sign was quite rare in comparison to the Hart Mountain area. White-tailed jackrabbits, Lepus townsendi Bachman, were occasionally seen while the black-tailed jackrabbits were not as numerous. The number of sage grouse observed was very low on Drake's Flat. Domestic sheep, cattle, and horses were present at various intervals throughout the summer in their respective order of abundance.

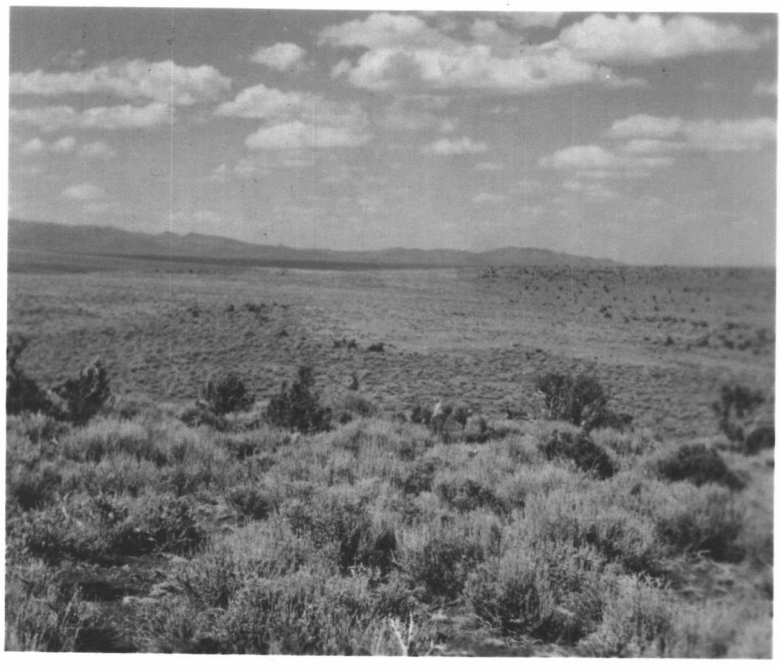

Figure 3. A typical portion of the Drake's Flat study area showing the expanses of sage brush penetrated by fingers of grass as result of a fire in 1945. Note that sage brush is sparsely scattered in the burned over area. Bitterbrush, the darker bushes, are seen to be scattered among the sage.

Catching and Tagging New-Born Kids

One of the first tasks undertaken each spring was catching and tagging young antelope shortly after birth. The majority of those caught were believed to be from one to six days old. The purpose of catching the young kids was to note their general health condition, to make several measurements, obtain sex ratios, and to ear-tag each one in an effort to determine extent of losses through ratio of total tagged kids and tagged mortalities found throughout the summer. In other words, the total number of kids tagged is to the tagged mortalities found as the total kid population is to the total kid mortalities. The accuracy of this ratio depends upon tagging a sufficient number of kids and a good estimation of the total kid population. Noting the apparent health of the new-born kids appeared to be the most logical starting point of the study. This was judged superficially by apparent vigor, condition of the flesh and pelage, body temperature, and weight.

Kids were usually located by carefully watching does, particularly those which were alone and did not appear to be pregnant. After some experience it became an easy matter, in most cases, to distinguish between pregnant and non-pregnant does at the beginning of the "kidding season" especially if they were observed at less than about 300 yards. Distinction was based primarily upon whether the abdomen was distended or not. It soon became possible to mentally compare body sizes. Some does became extremely "fat" while others increased but slightly in size. Often the action of a doe would be the clue in determining if she had dropped a kid

and was nursing. Normally, the nursing does would feed in an erratic manner, perhaps even back and forth over the same ground. Frequently glances would be made in all directions. Alertness seemed to increase as the doe neared the spot where she had previously dropped her kid or where the kid had lain down after previous nursing. As a rule when a doe would approach quite near to her kid she would walk or trot in a straight line towards the kid. As she would come near, the young antelope would jump up and begin nursing. After nursing, the doe would usually leave the immediate vicinity. The kid would perhaps walk around for a while and then lay down. It was of utmost importance to closely watch the kid after nursing had been completed. In most cases the kids from several days to one week old would most likely move around after the doe had left the area. After the kid had lain down the spot was marked by noting the nearest recognizable landmark. Large rocks, tall bushes, differences in vegetation color, or patterns formed by sage brush were used to pin-point kid location. One observer would visually mark the spot through binoculars and then direct another observer to the kid by using hand signals. A white or red handkerchief, depending upon the background, was used to increase the visibility of hand movements. This method proved to be effective up to distances of at least three-quarters of a mile. California workers successfully utilized "walkie-talkies" in locating kids up to three miles (31). If the marked spot had been reached and kid was not visible a red or white handerchief was placed on a clump of sagebrush. Both observers would then search the general area

systematically in a grid fashion keeping orientated by the marked bush.

Upon spotting the kid one worker would usually approach very slowly from the rear while the other would attempt to keep the kid's attention by whistling or walking back and forth at a distance of about 20 feet or so. It was then possible to quickly grab the kid. A shallow net with a six foot handle was used in some cases. The hoop of the net was 22 inches in diameter and the webbing was one inch mesh. The technique of capture was much the same by hand as with the aid of the net except the net made it unnecessary to approach quite as close. The net became advantageous when twins were found close together. In this case both kids could be caught at the same time and one could be restrained under the net while the other was being tagged. Of all the kids observed and not captured it was not believed that the use of the net would have increased the number of captured animals. Fish and Wildlife Service Biologist O. V. Deming, who caught kids on the Sheldon and Hart Mountain refuges during 1954, believed that the net allowed capturing of kids older than would have been possible without its use.

Upon capture of the young antelope the following data were recorded: approximate age, sex, whether one of a set of twins or if a single, anal temperature, weight, shoulder height, cannon bone length, and any unusual conditions. Age was difficult to estimate but such characters as nature of the hair, i.e. whether

very curly or not and if wet with embryonic fluid, whether the umbilical cord was still round and fleshy or shriveled up, and relative size of animal, and amount of activity previous to capture were all used as indicators. Sex was easily distinguished by the small black mark below the ear of the male and the absence of this mark on the female. In all cases, the sex was checked by inspecting the external genitals. Whether a kid was one of a set of twins or a single was determined by observing the doe for a sufficient period of time before attempting the capture. If a doe nursed a single kid and then wandered off to a distance of one-half mile or so without nursing another kid she was recorded as having only a single. Normally, a doe with twins would have them close together so she could nurse them both within a matter of minutes. If two kids were actually observed nursing one doe then that doe was recorded as having two kids. Temperature was taken with a standard rectal thermometer and recorded after remaining in the anus for two minutes. In conjunction, amount of activity before taking temperature was noted. A small spring scale with a capacity of 25 pounds was used to weigh the young kids. A burlap sack was wrapped around the body and the scale attached to this. Body measurements were taken with a steel tape and recorded to the nearest one-half inch. Height was difficult to measure accurately because some of the kids would not stand which made it necessary to hold them at what was believed to be the proper height.

On Drake's Flat a sheep-type aluminum tag was placed at the mid-point of the anterior portion of the right ear of each kid.

On the Hart Mountain refuge the doe kids were ear cropped and tagged with an ear tag while the buck kids were tagged with an aluminum triangle, 1 3/4 inches long on each side, attached with an ear tag. This latter type of marking was initiated by the United States Fish and Wildlife Service on both the Sheldon and Hart Mountain Antelope refuges in an attempt to determine migrational routes and distribution between states and between refuges. Different ear crops and colored triangular tags were used to designate different areas on each refuge.

During the 1953 season only one worker was on hand to catch and tag kids. Some aid was given, however, by the Hart Mountain refuge staff. All tagging was confined to the immediate vicinity of refuge headquarters. In 1954 two observers worked as a team and spent the very first part of the kidding season on the Hart Mountain study area and the latter half on the Drake's Flat area. Mr. O. V. Deming and Ellis Mason caught and marked kids on Hart Mountain throughout most of the kidding season in 1954.

Observation of does commenced on May 10 of the 1954 season. Beginning about 4 or 5 a.m. each morning a search would be made for does. If one was sighted and there was doubt if she was still pregnant she would be observed for awhile. Usually one worker would stay and watch while the other searched for another doe to watch. Does were observed each morning until about 10 or 11 a.m. and then again beginning at 2 or 3 p.m. until near dark. On May 25, camp was set up on Drake's Flat and tagging operations continued until May 31.

Since there was some question as to whether kids which had been handled were abandoned some work was done on this phase of the problem. When the terrain or circumstances made it possible to observe tagged kids they were watched until the doe returned to the area. Reaction of the does was recorded.

Determining Production

To obtain some idea of kid production per adult doe a record of nursing kids was kept. In other words if one, two, or three kids nursed a single doe after she had been watched for what was believed a sufficient length of time they were definitely assigned to her. Knowing the average number of kids produced per doe during each season would make it possible to better interpret proportion of does to kids. Thus if a low doe:kid ratio turned up one could postulate whether this was due to increased mortality or due to poor productivity.

In 1953 this record was kept throughout the summer on both study areas. There are certain factors, however, which would tend to bring inaccuracies into the picture using this method. First, since the observations extended over a three month period and were concentrated in two general areas, chance duplication might weight productivity to a higher per cent of single or twin kids. Secondly, mortalities during the summer would distort figures. Thirdly, perhaps a single kid was assigned a doe while another kid of hers might have been lying down at a considerable distance away. This

factor would apply more in July and August when the kids move around quite extensively. Finally, the smallness of the sample size is a disadvantage.

During the 1954 season, kids were assigned to individual does only during the period when kids were tagged. It is believed that more accurate figures were obtained since when only several days old the young antelope tend to remain relatively close together and thus the doe nurses twins in a matter of minutes as a rule.

It should be pointed out that mortality data, that is, number of kid mortalities per square mile or per 100 does, is worthless unless it is related to that which is produced.

Determining Mortality Factors and Extent of Loss

For the most part cause of death was determined by locating fresh carcasses. Since definite areas were covered intensively, a carcass count would give an idea of mortality for each particular herd. Carcasses were found by continually covering the ground within the study areas on foot or horseback. In several instances dead animals were sighted from a considerable distance by scanning the ground through binoculars from a high vantage point. At times carcasses were located by the presence of vultures, Carthartes aura Wied, or ravens, Corvus corax Wagler, on the dead animal. Searching on horseback increased ground coverage to a great extent. Depending on the density and height of vegetation, horseback-vision, in relation to area visible from any one point, was at least one-third

to one-half times greater than foot-vision. This was of course due to the added height of the observer.

Each day that a search for mortalities was made, a section of the study area was chosen for intensive coverage. Most time was spent in those particular sites where the animals were most frequently seen. Some times the particular site was covered in a systematic manner while frequently a random coverage was made.

Whenever a carcass was found its location was plotted on a map and various data recorded as follows: date, approximate date of death, approximate age of animal, sex (if distinguishable), cause of death, and general appearance and position of carcass (see figure 4). Approximate date of death was purely a matter of judgment based upon condition of flesh, hide, bones, and general overall appearance of the carcass. If death had been recent, that is, occurring less than one or two months previously, then estimation of date of death was believed to be quite reliable. In most cases only the month rather than specific date was recorded. If mortalities were found which occurred in previous years then just the year was recorded. Because of lack of an accurate method of standard for aging carcasses which have been exposed from one to several years, it is believed that some error is present in those estimated to have occurred in 1953. Some carcasses placed in the 1952 or older class may have belonged in the 1953 class and vice versa. Age of animal at time of death was estimated by comparison of size to kids under current observation and from the calculated date of death. Kids which had died in previous years were aged

Figure 4. Shown is an observer after locating a yearling buck carcass while riding horseback through the Drake's Flat area. Notes were recorded, the lower jaw and cannon bone were collected, and the remains covered with rocks.

by length of the diastema (Interdentary space of the lower jaw) and stage of tooth eruption when the lower jaw was present. When not present, age was determined by length of the cannon bone (metacarpal). State of tooth eruption is much more accurate than cannon bone or diastema measurements (11, p. 48).

Age estimation by tooth eruption, length of diastema, and cannon bone length was based upon work by Sumner A. Dow, Jr. Dow wrote a master's thesis at Montana State University in 1952 entitled, "An Evaluation of Some Criteria for Age Determination of the Pronghorn (Antilocapra america ORD)" (11). His material was based upon an experimental herd of 15 antelope. On the basis of Dow's cannon bone and diastema measurements of these animals, which were from 44 days to 20 months old, age groups were tentatively formulated for the use in this study as shown in table IV.

TABLE IV.

METHOD OF ESTIMATING AGE OF ANTELOPE MORTALITIES ON BASIS OF CANNON BONE AND DIASTEMA LENGTHS AS FORMULATED FROM MEASUREMENTS ON EXPERIMENTAL ANIMALS BY SUMNER A. DOW, JR. IN MONTANA

Method	Estimated Age in months	Length in mm.
Cannon Bone[1] Length	0-1	0-179
	2-6	180-189
	7-11	190-198
	12+	200+
Diastema[2] Length	0-2	0-39
	3-6	40-54
	7-9	55-59
	10+	60+

1. Based on 13 animals
2. Based on 16 animals

There is considerable variability in these measurements but they at least afforded a fair estimate of age. In some cases the lower jaw could not be found so the length of the cannon bone was the only means of estimating age.

A valuable criterion for determining if an animal was over 14 to 20 month old was presented by Dow. This was based on the extent of closure of the epiphyseal groove of the cannon bone. Ossification of the epiphyseal groove was found complete in all specimens from 14 to 20 months old. Due to this fact care must be taken in collecting cannon bones of young kids since the distal end is easily displaced. Without the distal end, cannon bone measurements are approximately 10 mm. shorter.

Dow found that dentition of the lower jaw was the most reliable means of age determination. Table V presents the main tooth eruption criteria used for aging antelope. This method was in complete agreement with estimated age based upon probable date of death of current mortalities.

Sex was determinable if the head of the carcass had not been disturbed too much. If the carcass was fresh no difficulty was encountered in sexing. If the carcass was old the size of the horn core was the basis of separating sexes. In adults, does were easily distinguished from bucks by the possession of cores usually less than about one inch long. Buck kids, as a rule, possess definite "buttons" on the skull just above the eye orbit. Buechner (5, p.291) related that Elliott, in Colorado, found "buttons" on 5 out of 6

males while of 9 females only 3 showed presence of "buttons". These kids were all less than 1 week old. So, this method of sexing young kids is not absolutely reliable but it is, nevertheless, valuable for sexing kid mortalities having occurred in previous years. In doubtful cases where "buttons" were present but small, no sex was recorded.

TABLE V.

AGE DETERMINATION BASED UPON ERUPTION OF THE PREMOLAR AND MOLAR MANDIBULAR TEETH AS FORMULATED FROM DATA DETERMINED BY SUMNER A. DOW, JR. IN MONTANA

Teeth	Age in Months
3rd Premolar*	0-1+
1st Molar	
one cusp++	1+-2
two cusps	2-6
2nd Molar	
one cusp	6-8
two cusps	8-12
3rd Molar	
one or two cusps	12-16½
three cusps	16½+

* Deciduous
++ Cusps above gum line

Cause of death could not be ascertained in many cases due to advanced decomposition of carcasses. Decomposition was rapid in the summer time due to high day time temperatures, particularly at ground level. Carrion-eating birds, such as the vulture and raven, usually located animals soon after death and began devouring portions of the carcass

Carrion beetles also entered carcasses soon after death. Small mammals undoubtedly played a destructive part also. Due to these various disturbances, autopsies could be performed with reliability only if an animal was found less than two days after death. Dead animals less than several days old were rushed either to the California Fish and Game Mobile Laboratory or the Veterinary Diagnostic Laboratory at Oregon State College for examination.

In addition to the above data the general appearance of the carcass was recorded. For instance it was noted whether the carcass was for the most part completely intact, most bones present but scattered, or if only a portion of the skeletal structure was present. After each carcass was examined it was covered with rocks or buried to avoid duplication in reporting.

Determining Losses from Herd Composition Data

During both years of the study, ground and aerial herd composition counts were made on both study areas at least twice during the summer. In addition a portion of the southern end of the refuge was surveyed for comparison. The purpose of these composition counts was to compare the ratio of does to kids obtained early and late in the summer in order to determine extent of losses. Losses on each area as determined by carcass counts acted as a good countercheck. Even with the various inherent inaccuracies, which are discussed later, any prevalent and significant loss of kids should become apparent through this method.

Doe:kid ratios were obtained by covering each study area in a pre-arranged manner. This was accomplished by either two or three Unit personnel. After taking herd composition data the first season, various factors which affected the accuracy of these counts became obvious. In the first place it was learned that the maximum observing distance with binoculars (7 x 50 power) for taking accurate composition figures was about 400 yards, except under very favorable conditions. Greater distances opened the way to increasing error.

Certain complications are involved in calculating a doe:kid ratio which concern inherent qualities of the antelope. In June the kids frequently "bunched up" in small groups with only one or possibly several does near by. At first sight one would be led to believe that production was astounding. But this of course was due to the fact that does leave their young in the care of other does for various periods of time. Also, kids spend a great deal of time lying down during the first month or so. If a hurried count were made a few kids might be missed.

Another complication arises during the first part of September when the majority of kids appear to be only one to three inches shorter in height than the does. Most persons not having an adequate acquaintance with antelope use the height of kids as the only means of distinction from does. An attempt was made to pick out certain characteristics which might aid in easy recognition of kids. The comparative size of the rump patch appeared to be a good means even in September. The kids' rump patch, even when extended, was

noticeably smaller than that of does or bucks. This feature is especially good when a herd is moving away from the observer.

On the other hand if one is offered a side view then the length of the kid's body and the distance from the end of the muzzle to the eye may be used. Naturally the body of the kid is shorter than that of the adults. As to the muzzle to eye difference it almost seems that the eye of the kid is half-way from the end of the muzzle to the back of the head while on the doe the eye appears about two-thirds of the head length back from the end of the nose. This distance was measured on two adult does and found to be 7½ and 8 inches. In contrast the same measurement on two kids, both about 2½ months old, was 5 and 5 3/4 inches. An antelope approximately 10 months of age had a nose to eye measurement of 6 inches. Thus it may be that this method is usable up until the kids reach an age of 8 or 10 months. Figure 5 is a sketch of a kid and doe antelope showing the difference in distance from the eye to the end of the muzzle. This distance on the kid represents about 5½ inches compared to approximately 8 inches for the doe. The size of the doe's head in the sketch is somewhat smaller than it should be. More exact measurements are needed to see exactly how long this criteria is valid. Also the general head shape of the kid is different from that of the doe. The kid's head is more rounded while the doe's is much flatter. Thus it appears that a considerable elongation of the muzzle occurs from birth up to maturity.

Horn size and shape may be a great help at times. The buck kid has horns in September which are wide and vary from one to two

Figure 5. Sketch of kid (top) and adult doe (bottom) heads showing the difference in the distance from the end of the muzzle to the eye. This measurement on the kid represents about 5½ inches, attained at about 3 months of age, and about 8 inches on the doe. Note also the roundness of the kid's head and flatness of the doe's head. (Sketch by Jim Wickander)

inches in length. If does have horns, they may be of varying lengths but are usually thin. This horn difference is another good identifying mark if there is a doubt whether the observer is looking at a doe or a buck kid. The above methods were used to distinguish kids which were seen alone in particular. After observing antelope for several months the comparative size of the body, rump patch, and distance from snout to eye seemed firmly engrained in the mind allowing for easy identification of even lone animals. Also experience was gained there were certain unexplainable features which readily aided in distinguishing kids from does.

Another factor which might lead to misinterpreting the ratio of does to kids is the increased activity of bucks near the end of August and particularly during the early portion of September as the rut begins. During preliminary antics the bucks often caused the herds to split into small groups which may or may not have been of proper composition. For the first time kids were regularly seen alone in September. In early September one buck was observed with eight does and seven kids. This herd buck was being continually bothered by another buck who followed behind but upon occasion would attempt to break away with some of the does. At one time a kid fell behind the group without the slightest attention from the herd buck. However the does were kept in as tight a group as possible.

Thus it is evident that if a reliable doe:kid ratio is to be obtained it must be taken during the months of July and August. The person taking the composition should be somewhat familiar with the herds and areas, and extreme caution must be used beginning the

middle of August in distinguishing between does and kids. The above factors also lead to the realization that one can not go from herd to herd rapidly and expect to obtain accurate ratios.

Herds larger than about 50 animals were quite hard to classify since the animals, shifting about, resulted in duplication. If however a large herd was bedded down, or at least a large percentage of the animals, then accurate counts were possible but usually required considerable time in comparison to small groups.

Aerial counts were made by Mr. William Lightfoot and Mr. Ellis Mason in a "Super-Cub". Each area was covered in a grid fashion. If animals were bunched up it was sometimes necessary to make a second pass over the herd.

Growth of Kids

Since an important consideration in herd composition work was distinguishing does and kids, particularly near the end of the summer, some attention was devoted to noting growth of kids. At first a record was made comparing the relative height of the kids and does as the summer progressed. For example it was recorded whether the kid was one-half, two-thirds, or perhaps three-quarters the height of the doe. An attempt was made in 1954 to estimate doe and kid heights throughout the summer by using mil-scale binoculars mounted on a tripod. The Mirakel Repair Company, Mount Vernon, New York, etched a scale marked in five and ten mils on one of the optics. The height or length in inches of an animal was estimated by determining the height or length in mils at a certain distance. Each

mil-scale division represented one in 1,000. This would mean that at 1,000 feet a man six foot tall would be 6 mils high. A table was constructed which converted mil readings, taken at various distances, into inches. The distance from the point of observation to the animal was measured with a 300 foot cord.

Observing Animals

In 1953 a considerable amount of time was spent in observing herds or small groups of antelope in an attempt to find distressed animals or to learn of factors which might influence survival. Whenever a kid was seen which had scours (dysentary) or appeared to be abnormal in his actions or condition, he was watched and followed as long as possible. Animals were often observed from a trailer house. With no movement outside the animals soon ignored its presence and went about unconcerned. A truck was also used as an observation post and this could be done successfully if approach was slow and not too close. On foot it seemed more essential to maintain a down-wind position to prevent causing alarm. At times close views were obtained by crawling to the top of a ridge and sitting in back of sage brush or bitterbrush. Antelope could best be seen on clear sunny days with the sun behind the observers back. Binoculars greatly facilitated watching minute happenings. Heat waves during the warmer days hindered observations somewhat. On these days it was found best to observe in the early morning and late afternoon.

In several cases young antelope were collected for autopsy after they had been observed for a sufficient length of time to record actions and to be sure their physical condition was abnormal.

Collecting Blood and Viscera

Since it was conceivable that mature animals harbor certain parasites and may carry diseases which would have a direct bearing on kid survival, samples of blood and viscera were collected from hunter kills during the open season. The 1954 hunting season was split into two sections according to area. During the first season, August 21 to 26, a trip was made to the Sycan Marsh and Silver Lake area. Hunters were sought and if they had bagged an antelope an attempt was made to locate the viscera and collect blood if the kill was made less than several hours before. The second season, August 28 to September 2, was spent near Jacob's Reservoir and Jack Lake which are just south of the Hart Mountain refuge southern boundary. Prior to the opening date some of the hunters were interviewed as they passed through the refuge headquarters and requested to mark, by some means, the site where they cleaned their kill. In some cases vials were given the hunters for a blood sample. Hunters' camps were visited beginning just before noon until about dark. Excellent cooperation was received from most hunters. In one instance a couple enthusiastically brought in a coke bottle full of blood and felt badly because they were unable to collect the viscera of their kill. They offered to take someone to the area. From all indications it is likely where hunters must enter and leave

on one road to establish a station and issue cloth sacks for viscera and vials for blood. These could be collected either empty or full as they left the area or during the season as the area is patrolled. This technique was tried with good success during the 1954 archery deer season on the Hart Mountain refuge from September 11 to 30. Upon the recommendation of Mr. O. V. Deming of the United States Fish and Wildlife Service gunny sacks and vials with tight fitting rubber stoppers were given to the hunters as they obtained a permit to hunt. Generally a sack and one or two vials was given to each party unless they requested more. They were asked to place the entire viscera in the sack and hang it in the shade in such a manner that it could be seen without too much difficulty. The various camps were visited each day during the beginning of the season. Some hunters brought viscera in with them while others described where they had hung the sacks. Vials of blood were of course collected whenever a hunter had taken a sample from his kill. All in all the hunters showed great interest and were especially pleased to know that someone was trying to find out something about "their" deer.

Directions for collecting samples were obtained from Dr. Paul Allen, of the Oregon State College Diagnostic Veterinary Laboratory. It would have been desirable to collect the entire abdominal viscera but this involved large containers. Usually only a portion of the stomach (abomasum) and short sections at intervals along the intestinal tract were taken. These were tied with string at each end and preserved by injecting a 10 per cent formaldehyde solution into

the specimen with a small hypodermic needle. Blood was collected in small vials from the heart, if possible, or from the body cavity. Some of the blood collected several hours after death was found to be useless for examination. Once the blood was collected it was placed under refrigeration before the end of the day. Best results were obtained when the serum was poured from the settled blood cells.

FINDINGS

Data from New-Born Kids Captured

In 1953, from May 20 to June 3, seven kids were tagged and released near the Hart Mountain refuge headquarters. The ratio of males to females was 40:100. Of these seven kids three were from two sets of twins and three were single kids. This represents 40 per cent twins. No measurements were taken on these kids nor were any abnormalities recorded.

The first young antelope observed in 1954 was on May 18 on the Hart Mountain study area. Observations indicated that a majority of the kids were born between May 25 and 28 on both areas. A total of 17 kids was captured and released on Drake's Flat and three on the refuge. Table VI lists all the data recorded for the 20 kids captured. The earliest time of capturing a kid was 6:05 a.m. and the latest 6:20 p.m. Most captures (11) were made in the mornings between 6 and 10 a.m. The sex of the 20 kids was 12 males and 8 females giving a ratio of 150:100. If the sample size is increased by including 19 kids caught by Federal and State game

TABLE VI.

ANTELOPE KIDS TAGGED ON DRAKE'S FLAT IN 1954

No.	Date	Sex	Twin	Single	Age Days	Weight Pounds	Cannon Bone Length "	Temperature °F	Shoulder Height"	Time of Tagging
1	5/25	F		x	2-3	8 3/4	5 7/8	101.2	-	9:45 a.m.
2	5/25	M	x		2-3	8 1/2	6 1/4	102.3	18 1/2	1:25 p.m.
3	5/25	F	x		1	8 1/2	6 1/4	101.7	16 1/2	3:30 p.m.
4	5/25	M	x		1-2	9 1/2	6 1/2	102.9	19 1/2	3:45 p.m.
5	5/25	M		x	3-4	12 1/2	5 3/4	102.2	19 1/2	6:20 p.m.
6	5/26	F		x	2-3	8	6 1/2	101.5	17 1/2	4:40 p.m.
7	5/27	F		x	3-4	9	6 1/4	102.1	15	8:15 a.m.
8	5/27	M	x		2-3	10	6 1/2	102.4	20	8:35 a.m.
9	5/27	M	x		2-3	10 1/2	6 1/4	103.3	20 1/2	8:40 a.m.
10	5/27	M		x	4-5	12	6 1/2	100.5	21 1/2	8:50 a.m.
11	5/28	M	x		4-5	9 3/4	6	100.1	19 1/2	7:20 a.m.
12	5/28	F	x		1	9	6	100.4	18 1/2	7:30 a.m.
13	5/28	M	x		1-2	10	6	103.3	20	7:40 a.m.
14	5/28	M	x		1	8	6	103.6	-	5:10 p.m.
15	5/30	M		x	4-5	12 3/4	6	103.5	20	6:30 p.m.
16	5/30	M	x		3-4	9 3/4	6 1/4	101.9	18	6:45 p.m.
17	5/31	F		x	5-6	11 1/2	6	103.0	20 1/2	9:35 a.m.
18+	5/18	M		x	1-2	9	6 1/2	104.4	-	6:45 a.m.
19+	5/19	F		x	1-2	7	6 1/4	101.4	-	7:00 a.m.
20+	5/23	F	x		1-2	8 1/2	5 3/4	102.3	-	6:05 a.m.

+These three kids were tagged on Hart Mountain.

personnel on Hart Mountain during the 1954 kidding season the ratio is 117:100 (males:females). These unbalanced ratios are most likely due to the small sample size. Yet, sex ratios just following birth obtained in other areas have seldom shown equal sexes. Usually the females outnumber the males. Wyoming, for instance, arrived at a male:female ratio of 89:100 from a sample of 106 young kids (4, p. 35). From some 300 kids taken at the Charles Sheldon and Hart Mountain refuges between 1942 and 1947 for restocking purposes, the male: female ratio was approximately 45:55 (82:100) (12, p. 123).

A male:female ratio of 84:100 was found from embryo counts of 18 adult does in California (7, p. 329). Thus a preponderance of females does not appear to be abnormal.

Since the antelope is a polygamous species no critical developments in reproduction is likely from the presence of a larger number of females than males. The predominance of males in the sample of 39 kids from Hart Mountain and Drake's Flat may be due to chance alone. If it reflects the "true" ratio then the deviation from the expected of more females than males may be due to unfavorable habitat conditions. Trippensee (30, p. 186) for example suggests that distorted sex ratios in white-tailed deer, Odocoileus virginianus leucurus (Douglas), at birth in Pennsylvania are often attributed to poor quantity and quality of available browse. The poorer the habitat in this respect the more distorted the sex ratios. Taber (29, p. 97) points out that in the genus Odocoileus at birth there is a tendency for males to outnumber females by from ten to twenty per cent. He suggests that a secondary sex ratio (sex ratio at birth)

which is equal or one in which females outnumber males might indicate a considerable abortion-rate. In accordance with this reasoning it might be speculated that abortion has resulted in an unbalanced sex ratio at birth in the two areas studied, although such a condition is not substantiated by evidence.

The length of the cannon bone (metacarpal) and shoulder height were measured as a possible aid in placing mortalities into age groups and for comparing kid and doe stature. Cannon bone measurements for the 20 kids captured in 1954 averaged 6.2 inches with a range of 5 3/4 to 6 1/2 inches (Table III). These measurements were all within the length class for animals estimated to be one month old or less (Table IV). Shoulder height will be discussed under the heading "Growth of Kids".

Weight was recorded as a possible index to general condition. The average weight of the 20 kids was 9.65 pounds with a range of 7 to 12 3/4 pounds. If the weights are arranged according to estimated age the average weight of kids 1, 2, 3, 4, and 5 days old is 9.0, 9.15, 10.4, 11.5, and 11.5 pounds respectively. The lack of positive criteria for aging kids, the small sample size, and individual variation probably accounts for the inconsistent progression of weight increase. The above weights compare favorably with data from other states. Dow weighed six live fawns, which were from one to 24 hours old, and arrived at an average of 8.3 pounds with a range of 5.8 to 10.0 pounds (11, p. 14). In Wyoming of 106 kids tagged in 1953 the smallest weighed 6 3/4 pounds (4, p. 34). No average weight was given. California

tagged 24 kids in 1954 and obtained a weight average of about 9 3/4 pounds (6, p.1). These kids were from several hours to six days old. According to Buechner (5, p. 291), Elliott caught a one day old fawn weighing 7.5 pounds and two weighing 5.5 pounds each. Two other kids estimated to be six days old weighed 11.75 and 12.75 pounds. Kid weights, then, obtained on the two study areas compared favorably with those in other portions of the antelope range.

Body temperatures were taken to determine the "normal" and as a means of finding pathological conditions if they existed in the new-born antelope. Temperatures ranged from 100.4 to 104.4°F with an average of 102.2°F (Table VI). The males averaged 102.5° while the females averaged 101.7°. The amount of activity prior to taking temperatures seemed to have little correlation with temperature. Buechner (5, p. 317) reports that an old buck had a temperature of 103.5°F. This buck was diagnosed as having an intestinal disorder. No other reference to temperature of antelope has been found in the literature. Leopold (16, p.44) found an average of close to 104°F for trapped mule deer, Odocoileus hemionus californicus (Caton), in California with apparently no sexual or age-class differences. Two captive male black-tailed deer fawns, Odocoileus hemionus columbianus (Richardson), four months old had a mean temperature of 101.8 and 101.9°F (10, p. 155). These same fawns showed considerable daily variation and had a mean temperature one degree higher than that of two mature does (100.9°F). Considering these average temperatures of other big game animals it does not

seem unreasonable to assume that the average of 102.2°F for young antelope is normal.

All of the young kids handled during the study showed every external appearance of being in a good state of health. Most of them were extremely vigorous for their age. No patchy pelage was observed and all were in good flesh as evidenced by their body weights. Only one abnormal condition was found in the 20 kids handled. On May 31, 1954, on Drake's Flat a female kid was sighted and chased for nearly one mile before being captured. Upon examination a quantity of feces, about 1½ inches in diameter, was found adhering to the under side of the tail. This fecal material was about the consistency of peanut butter. No similar situation was found in the other kids. Feces from one kid about three or four days old was stringy in appearance with some portions showing definite formed segments about 3 x 6 mm. in size. A specimen of the fecal material was analyzed by the Diagnostic Veterinary Laboratory at Oregon State College with no causative agent apparent. It was suggested that perhaps the long chase was responsible for the above condition.

Observations dealing with the reaction of does to tagged kids revealed that abandonment probably rarely occurs. On one occasion a kid which had just been tagged was seen following a doe. The kid attempted to nurse but the doe kept butting the young animal and running away from it. Finally after about 25 minutes the kid was allowed to nurse. Following nursing the doe licked the kid's body.

Apparently the reluctance exhibited was due to human scent on the young antelope's body but such a conclusion must be assumed. On another occasion two tagged kids were observed nursing a doe shortly after being handled. She reacted normally and did not shy away. Sight records of tagged young have been recorded several weeks after handling in both years to weaken any claim of abandonment through handling.

Antelope Kid Production

Observations were of sufficient length during the summer of 1953 to justify assigning kids to 49 does. Over one-half of the observations made on Drake's Flat with most of them in June and the first part of July. Since the proportion of singles to twins was nearly equal on both areas the data are grouped. Of the above does, 26 or 55 per cent nursed one kid, 21 or 43 per cent nursed twins, and one doe or 2 per cent nursed triplets. These figures represent production of a 145 per cent crop (145 kids to 100 does). Due to the fact that some mortality occurred while the above data were being collected the number of twins was undoubtedly greater than indicated.

As mentioned previously, production was determined in 1954 only during the period when kids were several days old. This method should have yielded data which was more reliable than obtained in 1953. Ten does on Drake's Flat produced 15 young which represents a 150 per cent crop. One-half of the does nursed twins and one-half single kids.

In 1954 on Hart Mountain observation indicated that 22 young were produced by 17 does which represents a 129 per cent crop. Single kids were assigned to 7 of the does and twins to 10. Thus, 41 per cent produced a single young and 59 per cent twins.

Einarsen indicated a considerable variation in kid drop from year to year (12, p.126). Table VII lists five years of sight records of known family groups in Oregon recorded by Einarsen. Percentage of

TABLE VII.

NUMBER OF KIDS PRODUCED BY BREEDING DOES IN OREGON FROM 1936 TO 1940 AS RECORDED BY EINARSEN

Year	Singles	Sets of twins	% Singles	% Twins
1936	62	97	39	61
1937	118	91	56	44
1938	99	128	44	56
1939	131	72	65	35
1940	111	66	63	37

singles and twins was added to his table. In three out of the five years more single kids were produced than twins. In contrast both McLean in California in 1944 (21, p.228) and Buechner in Texas in 1950 (5, p.289) indicate the usual number of kids per get to be two with an average of about 1.75. In Colorado in 1954, 19 sets of twins (70%) and 13 singles (30%) kids were recorded during tagging operations (1, p.356).

Data from the present study then, follows closely with that obtained by Einarsen in Oregon but is in marked contrast to that found in California, Texas, and Colorado. It appears that kid

production in Oregon, is as a rule, not as great as in some other states, at least in the years when data were available.

Growth of Kids

Observation during the years of the study have shown that the growth of the young antelope is quite rapid. Interest in this fast growth stemmed from the idea that beginning in September some kids may be mistaken for does. If this were true, herd composition counts would not give an accurate picture of herd increase.

Field observations revealed that when about a month old a majority of the kids are nearly one-half the height of the doe. By the middle of August or about 2½ months of age most of the young appear to be a little over three-quarters of the doe's height. At the age of 3 or 3½ months, attained in September, the kids are but several inches shorter than the does.

In 1954 measurements were estimated with the aid of milscale binoculars. A table was constructed for converting milscale readings to inches at various distances on the basis of one mil equaling one foot at 1,000 feet. Table VIII shows the estimated shoulder height of 14 does and 15 kids as calculated from milscale readings taken from June 16 through August 19, 1954. The estimated measurements show considerable variability. Height of does varied from 38 inches to 50½ inches with an average of 43.7 inches. Height of the young ranged from 18½ inches to 40 3/4 inches and average 20.9 inches. Kid height would be expected to vary more due to growth and variability between young individuals. These figures, even though quite

TABLE VIII.

ESTIMATED SHOULDER HEIGHT OF ADULT DOE AND KID ANTELOPE CALCULATED FROM MILSCALE READINGS TAKEN DURING THE SUMMER OF 1954 ON DRAKE'S FLAT

Date	Height in mils	Distance of Observations in feet	Calculated Height in inches
		ADULT DOES	
6/16	2.5	1,300	39 1/4
6/16	2.5	1,300	39 1/4
6/19	3.5	1,050	44
6/21	3.5	1,100	46 1/4
6/24	3.5	1,200*	50 1/4
6/24	3.5	1,200*	50 1/4
6/24	3.5	1,200*	50 1/4
6/24	3.5	1,200*	50 1/4
6/24	3.5	1,200*	50 1/4
6/24	3.0	1,200*	43 1/4
7/7	2.5	1,250	37 1/2
7/29	3.0	1,320	43 3/4
8/17	2.0	1,580	38
8/19	2.5	1,390	41 3/4
		Average	43.7
		KIDS	
6/24	2.5	1,200*	36
6/24	2.0	1,200*	28 3/4
6/24	2.5	1,200*	36
6/24	3.0	1,200*	40 3/4
6/24	2.0	1,200*	28 3/4
6/24	2.0	1,200*	28 3/4
7/7	2.0	1,250	30
7/14	3.0	580	18 1/2
7/14	4.5	400	22 1/2
7/14	3.0	700	25 3/4
8/23	3.0	950	34 1/4
8/23	2.5	1,210	36 1/4
7/29	2.0	1,320	31 1/2
8/17	1.5	1,580	28 1/2
8/19	2.0	1,390	33 1/4
		Average	29.9

*Distance measured but observations were taken on slope overlooking Twelve Mile Creek so compensated by estimating straight-line distance.

divergent, indicate that the young of the year are still shorter than adults in August by approximately one foot if the averages are used in comparison.

In order to evaluate these data, comparison should be made with actual measurements. Known shoulder heights are as follows: kids - 1-6 days old, 15 averaged 18.7 inches (table VI); 6/27, 27 inches; 8/30, 31½ inches; 8/30, 27 inches; adult does (17, p.389) - 12/11, 36 inches; 12/11, 36 inches. Even though the known measurements are few it appears that the milscale method tended to overestimate. The reason for this and for wide ranges in estimating height is believed to be due to the fact that the milscale etched on the binocular lens was divided into 5 mil rather than single mil divisions. This probably added another variability related to the observer's estimate of mils.

Number of Mortalities Found

The number of mortalities which were located on the two study areas during the summers of 1953 and 1954 are presented in table IX. Adults include animals over 6 months of age and kids include animals less than 6 months of age. It is of interest to note that if the total number of adult and kid losses found on each study area are considered, the adult losses were about one-half that of the kid losses. On both areas a larger number of mortalities were judged to have occurred in 1953 than in 1954. However, since the 1954 data does not include the period after September, the loss would tend to be somewhat higher than indicated although mortality was found to be greatest in spring and early summer.

Since the 1952 and older group includes mortalities for more than one year no actual comparison can be made with the 1954 and 1953 data. Nevertheless the number of deaths assigned to the 1952 and older class does indicate that a greater loss did not occur during this period. In all probability this latter group includes only animals dying after 1950 since bones disintegrate or at least widely scattered after two or three years of exposure. Einarsen (12, p. 72) reported that adult antelope bones disintegrate completely in less than three years while new-born kid skeletons will do so in less than a year, if unmolested by predators. A few limited observations made during this study point out that kid carcasses may remain almost wholly intact for at least one year.

TABLE IX.

ADULT AND KID MORTALITIES FOUND ON THE DRAKE'S FLAT AND HART MOUNTAIN STUDY AREAS DURING THE SUMMERS OF 1953 AND 1954

Year of Mortality	Drake's Flat			Hart Mountain		
	Adults	Kids	Total	Adults	Kids	Total
1954	5	19	24	2	2	4
1953	13	20	33	4	10	14
1952 & older	10	25	35	3	6	9
TOTALS	28	64	92	9	18	27

As mentioned previously, new-born kids were tagged in an attempt to determine more accurately the extent of loss since it was believed impossible to find all carcasses. However, since most of the dead kids had their ears removed by carrion-eating animals this was

impossible (see figure 10). No tags were recovered.

Calculated Loss Per Square Mile

From the number of mortalities found the calculated kid loss per square mile on the Drake's Flat tract was 1.05 kids for the summer of 1954 and 1.11 kids in 1953. Loss on the Hart Mountain study area was .15 kids per square mile in 1954 and .76 kids per square mile in 1953. Losses recorded by Einarsen (12, p.73) on observation plots in 1937, 1938, 1939, and 1940 were 1, 2, 1.5, and 1.6 kids per section (square mile) respectively. No mention was made of the number of antelope using these observation plots. From Einarsen's data the loss on the study areas then can not be considered high or excessive.

In dealing with loss per square mile the number of animals present or using the area must be considered. Areas with higher concentrations would be expected to have a greater loss per unit area. Since the antelope wandered back and forth in and out of both study areas the best estimation of total kids would be an average of the numbers counted through the summer. On Drake's Flat in 1954 an average of 73 kids was present compared to an average of 23 kids on the Hart Mountain area (see table A, Appendix). Consequently the kid population in 1954 on Hart Mountain was about one-third of that on Drake's Flat. In 1954 kid mortality per square mile on Hart Mountain was only about one-sixth of that on Drake's Flat. In 1953 the loss on Hart Mountain was greater than on Drake's

Flat judging from the number of kids present on each site. That is, Hart Mountain had only about 28 per cent of the kid population present on Drake's Flat but the loss per square mile on Hart Mountain was 69 per cent of that on Drake's Flat.

Adult loss per square mile on Drake's Flat and Hart Mountain in 1954 and 1953 was .28, .72, .15, and .31 respectively. Since the adult population on Hart Mountain in 1954 was about two-fifths of that on Drake's Flat the adult loss on Hart Mountain in 1954 was nearly one-fifth higher in relation to population size (see table A, Appendix). However, considering the number of animals involved (5 in Drake's Flat and 2 on Hart Mountain) the difference in loss has little significance. Hart Mountain had a little less than one-third of the number of adults that Drake's Flat had in 1953 and yet adult mortality per square mile on Hart Mountain was 43 per cent of that occurring on Drake's Flat. So in both years adult mortality was somewhat higher in relation to the average population size on Hart Mountain.

Percentage of Loss Based on Carcass Counts

Perhaps of more practical use in evaluating the extent of mortality in any one year is determing the percentage of herd loss. Since this loss is based upon two estimated figures, namely total antelope using the area and mortality as determined from carcasses found, the actual loss is undoubtedly greater. Due to the size of the study area, which is necessarily large due to the wide ranging

habit of antelope, it is not believed that all mortalities were found. Therefore, the loss as presented here may represent about 90 per cent of the actual loss.

The summer kid loss in 1954 on Drake's Flat was 20.7 per cent. This figure was arrived at by using 92 (73 as the average kid use + 19 kid mortalities) as the total kid population and 19 as the total number of mortalities (see table A, Appendix, for average use data). Kid loss was lower in 1953 on the same area as indicated by a mortality of 14.6 per cent. Adult losses on Drake's Flat in 1954 and 1953 were, respectively, 4.6 and 6.7 per cent.

On the Hart Mountain area kid and adult loss was greater in 1953 than in 1954. Kid loss amounted to 8.0 per cent in 1954 and 23.3 per cent in 1953. Loss of adult animals was considerably lower than kid loss as evidenced by a 4.8 and 6.6 per cent mortality in 1954 and 1953 respectively. Again it should be mentioned that data for 1954 does not include the period from September to December.

A summary of the above calculated percentage herd loss and kid and adult loss per square mile on both study areas in 1953 and 1954 is presented in table X.

Age of Mortalities

Of the 19 kid mortalities found on Drake's Flat which occurred during the spring and summer of 1954, 8 (42%) were estimated to include premature, or kids less than one week old, 9 (47%) between two and four weeks of age, and 2 (11%) were between five and eight

weeks old (Table B, Appendix). This means that 89 per cent of the kid mortalities occurred in May and June while the remainder (11%) died in July or the first part of August.

TABLE X.

CALCULATED KID AND ADULT LOSS PER SQUARE MILE AND PER CENT LOSS ON THE DRAKE'S FLAT AND HART MOUNTAIN STUDY AREA IN 1953 AND 1954

Area	Year	ADULTS			KIDS		
		No. Loss	Loss/ Sq. mi.	% Loss	No. Loss	Loss/ Sq. mi.	% Loss
Drake's Flat	1953	13	.72	6.7	20	1.11	14.6
	1954	5	.28	4.6	19	1.05	20.7
Hart Mt.	1953	4	.31	6.6	10	.76	23.3
	1954	2	.15	4.8	2	.15	8.0

Kid loss on Drake's Flat in 1953 and 1952 and previous years by age classes is shown in figure 6. Age classes are in intervals of two months since the aging techniques are not considered to be accurate enough to warrant classes by weeks as was done in the 1954 data. Of the 42 deaths during this period for which age was estimated, 29 or 69 per cent died before reaching two months of age. This would include the period from the end of May through July. Seven or 17 per cent of the kid loss fell in the three to four month age class. These occurred during the months of August and September. Mortality in the 5-6 and 7-8 week age classes amounted to 4 or 10 per cent and 2 or 4 per cent of the total loss respectively. The former groups of mortalities occurred in October and November and the latter in December or January.

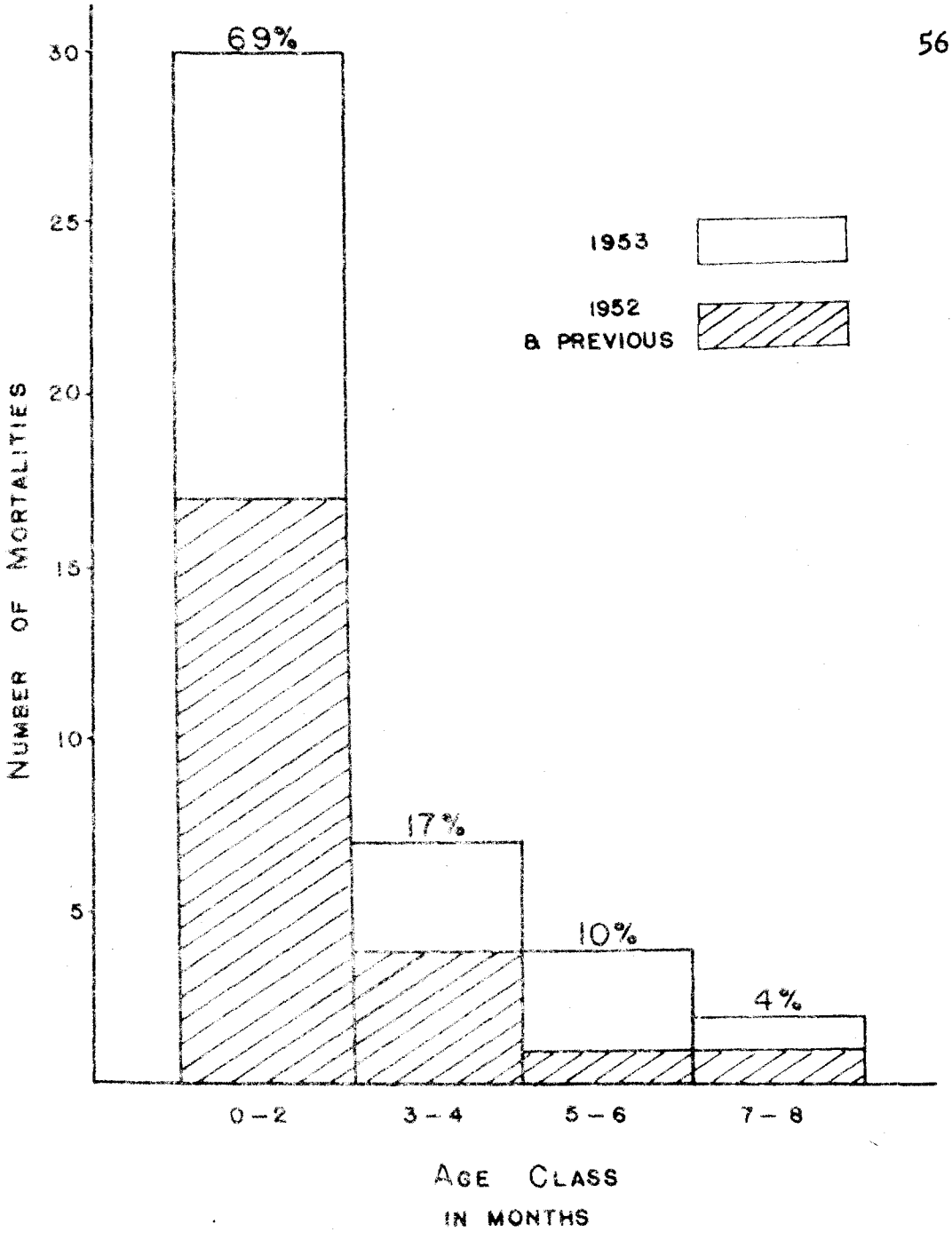

Figure 6. Estimated age of 42 kid mortalities found on the Drake's Flat study area estimated to have occurred in 1953 and 1952 and previous years.

Age of adult mortalities was difficult to determine since after about one year of age the skeleton attains its maximum growth (11, p.15). Also dental characteristics, which are the best criteria for aging, are not always easily recorded due to rapid deterioration and cracking of the teeth after death.

The oldest age recorded was a doe estimated to be 5½ year old. A special note should be made of the fact that of the 28 adults mortalities on Drake's Flat 7 were believed to be yearlings. Most of these animals were mortalities of 1952 or before and possibly hunter kills since hunting was allowed during the years prior to 1953. Little more can be said about age of adult mortalities since in most cases it was possible to only determine that the animal was an adult (over one year of age).

Of the 18 kid mortalities found on the Hart Mountain area, 59 per cent (10) were estimated to have been about one month old or less at the time of death. A majority of the mortalities then occurred in the month of June. The remainder of the deaths, 41 per cent (8), took place from July to November with four (20%) of these estimated to have died sometime between September and November.

It was impractical to place any of the adult mortalities on Hart Mountain into definite year classes due to weathering of the dentition. In most instances it was only possible to note that the dentition was complete.

Sex of Mortalities

Nineteen of the total number (64) of kid mortalities found on Drake's Flat were identified as to sex. Males made up 6 (32%) of these and females 13 (68%). The large number of unsexed mortalities make it impossible to positively state if this preponderance of females may be simply an unbalance due to the small sample or due to an actual differential mortality.

Females also predominated the adult mortalities on Drake's Flat, particularly in 1954 and 1953. The total mortalities found for these years were 18, with 14 recorded as does. Of the remaining four, two were bucks and two were unclassified as to sex. A different picture is presented in the data for 1952 and previous years. The 10 mortalities in this year class were sexed as follows: 3 females, 6 males, and 1 unsexed. All but three of these animals were yearlings. This may be explained on the basis that hunting occurred on Drake's Flat in 1952 and the years previous. It is likely then that some of the yearling bucks found were killed by hunters and left or were wounded and died later.

No statement can be made concerning sex of kid mortalities on the Hart Mountain area since only two out of the 18 were sexed. However, the adults found consisted of 5 females, 2 males, and 2 unsexed. Again we find a drift towards a larger number of female deaths.

A possible explanation for the finding of a greater number of female mortalities, other than on a differential basis, lies in the

habits of the bucks. As a rule males tend to remain apart from herds during the spring and summer months. Often only one or two bucks accompany the small groups of does and kids. Also adult males are inclined to move greater distances and move more. Due to these habits it would be expected that bucks, even if as numerous as does, would spend less time on any particular unit of ground.

Condition of Carcasses

Condition of carcass was recorded as a possible aid in interpretating causal factors. That is, carcasses found intact would most likely indicate death causes other than predation while carcasses scattered or found incomplete might indicate predation. As well older carcasses would in all probability be scattered more widely than relatively fresh remains as a result of exposure to weathering elements. Figures 7 to 16 show the condition of carcasses found during the study. Figures 7 and 8 picture kid remains which had weathered about one year but were still relatively intact. Such mortalities were often found at the base of shrubs. Kid mortalities found intact in the year that they occurred are shown in figure 9 and 10. Often the carcass had been worked on by carrion-eating animals (figure 9) or sometimes disturbed but little (figure 10). A majority of the kid mortalities found in the year they occurred had their ears removed(figure 10). This has important implications in any ear-tagging program since the number of tag recoveries would be greatly reduced.

In some instances only fragments of a carcass could be found. Figure 11 and 12 picture kid remains consisting of the head, feet,

and portions of the hide. In a few cases only the legs and a portion of the head was found (figures 13 and 14).

Figure 15 shows an adult doe about one week after death while figure 16 pictures a doe which was estimated to have died in 1953 (picture taken in 1954). Both of these were in a relatively undisturbed state.

Figure 17 graphically depicts the state of the carcasses found during the course of the study.

A majority of the kid mortalities occurring in 1954 were found in either an incomplete or intact state. Those found and estimated to have died in 1953 were about equally represented in each condition class. The mortalities which occurred in 1952 or previously were for the most part scattered. The fact that kid carcasses are small and thus more easily disturbed by external forces accounts for the increased number found scattered after remaining exposed for one or more years. The sample of adults was much smaller but there seemed to be a tendency in the 1954 carcasses towards an intact condition. Mortalities occurring in 1953 were for the most part intact but with quite a few represented in the scattered class. Those estimated to have died in 1952 or previously were nearly equally represented in the scattered and intact classes.

Herd Composition

Aerial and ground herd composition data for both study areas and a portion of the southern end of Hart Mountain refuge for 1953 and 1954 are shown in Table XI. Any downward trend in kid:doe ratios

Figure 7. A young kid, not more than one or two weeks old, found after being exposed for one year, and recorded as being intact.

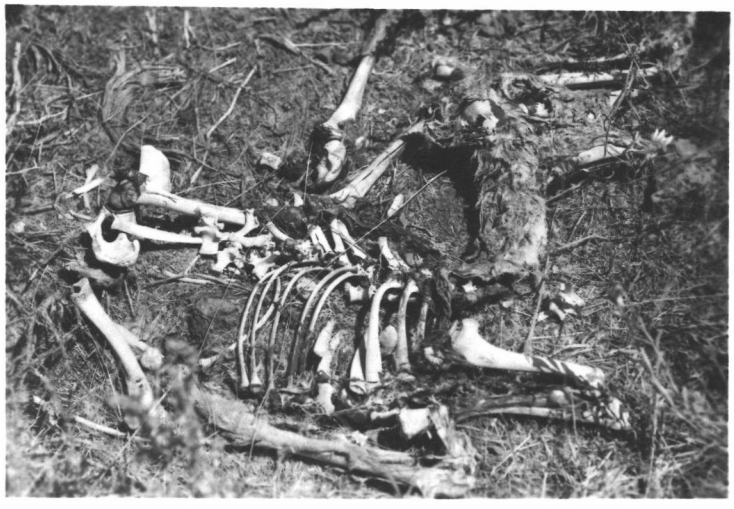

Figure 8. Another kid mortality which was found with the skeleton intact after one year weathering.

Figure 9. A kid, approximately two or three weeks old, found several days after death. Most of the bones were present and in their relative position but the carcass had been moved about by carrion-eating animals.

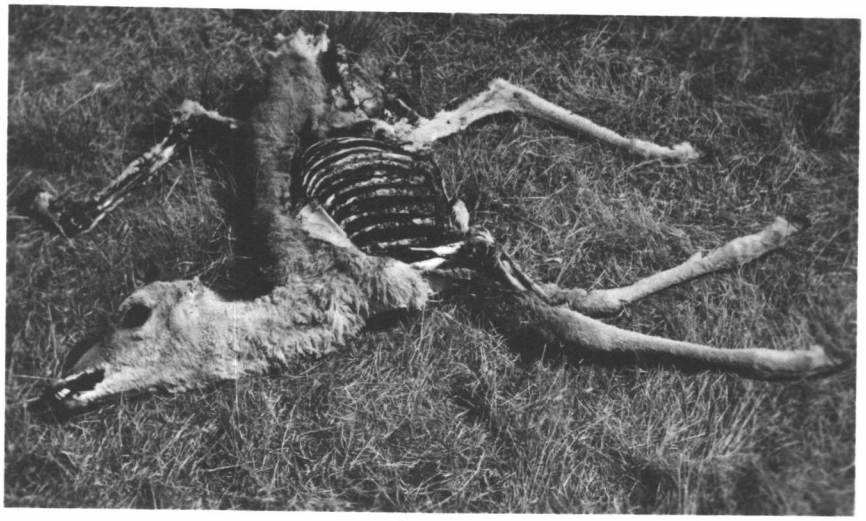

Figure 10. A female kid, about 1½ months old, found over one month after death showing a carcass which had been disturbed very little. Note the missing left ear.

Figure 11. Remains of a kid less than two weeks old found shortly after death. Only the head, portion of one leg, and fragments of the rib cage could be found.

Figure 12. Kid mortality located shortly after death. The entire head and four legs were attached to each other by a strip of the hide.

Figure 13. Pictured are the only remains that could be found of a young kid. Only the upper half of the skull and portions of the legs were present.

Figure 14. Another kid carcass which was incomplete. Note the coarse texture of the ground which made it very difficult to find animal tracks.

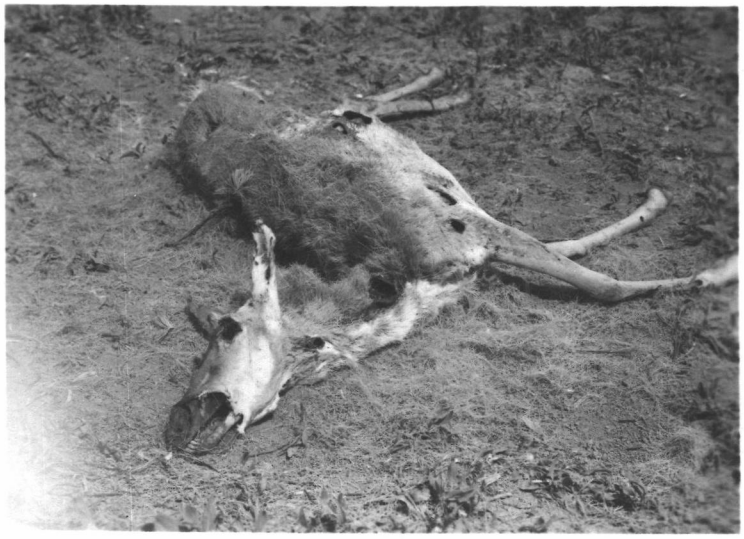

Figure 15. An adult doe carcass on a dry lake bed after being exposed for approximately one week. Carrion-eating animals had removed flesh around the nose, lower mandible, and abdomenal area.

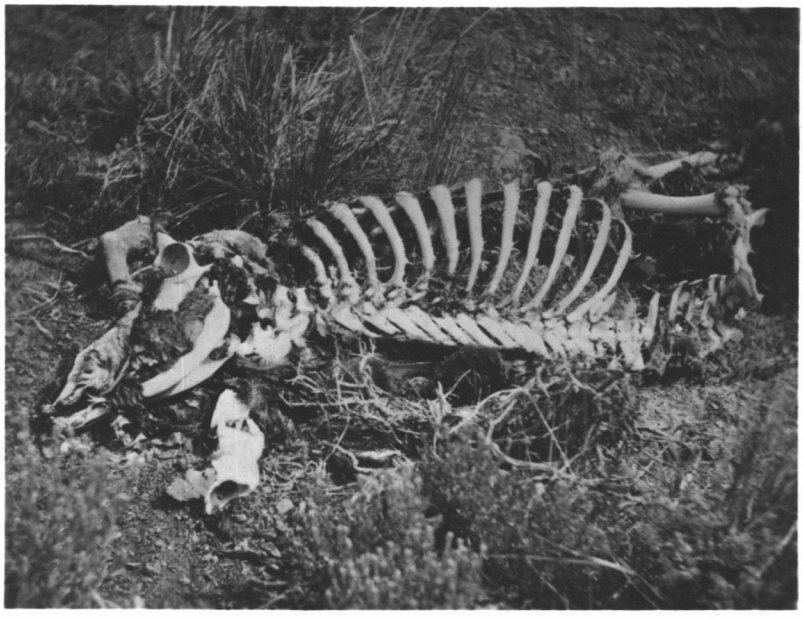

Figure 16. A mature doe found about one year after death. The carcass for the most part was intact and relatively undisturbed.

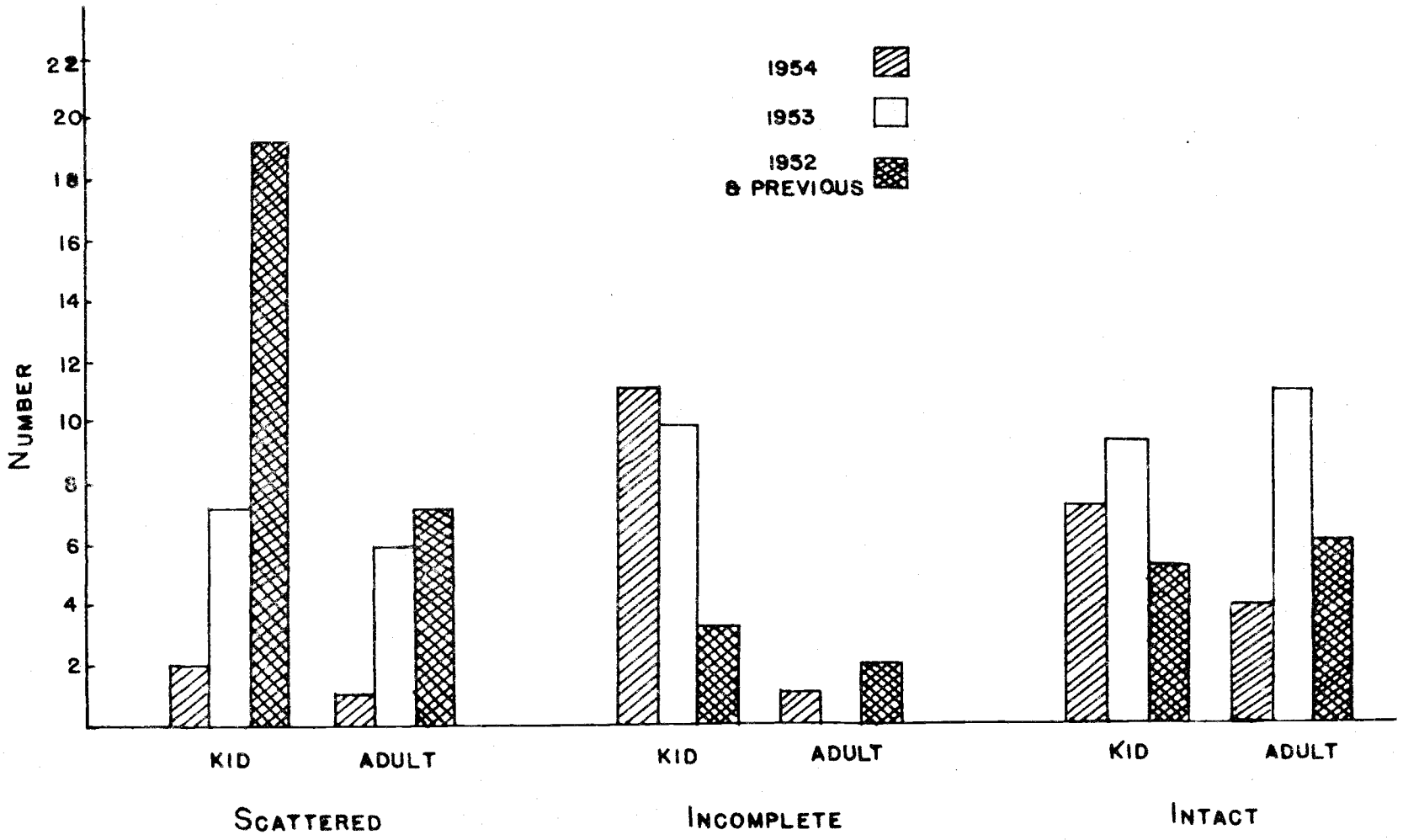

Figure 17. Condition of kid and adult carcasses found on the Drake's Flat and Hart Mountain study areas in 1953 and 1954.

during the summer was assumed to be due, in part, to some kid mortality. A high loss, if occurring, should be apparent by comparing the ratio of kids to does early in the summer to that obtained later in the summer. At times, however, ratios showed a larger portion of kids later in the season. Such errors are mainly due to a shifting of animals in and out of the study areas and missing some animals in the counting process which would tend to upset ratios one way or the other. For example a kid:doe ratio of 81:100 was obtained on July 20, 1953 on the Hart Mountain study area compared to a ratio of 89:100 obtained on September 10, 1953. This particular descrepancy was undoubtedly due to animals moving out of the study area which resulted in a change in proportion of kids and does. By discounting some of the wide fluctuations certain trends can be noted, however.

Variation in kid:doe ratios on Drake's Flat in 1953 was due partly to the fact that a much smaller area was censused by the ground reconnaissance method than by aerial survey. Thus more animals were tabulated by the latter method. If the figures from the aerial count are overlooked, the difference between the highest and lowest kid:doe ratio is 17 kids per 100 does. If the aerial survey is considered the maximum loss was 36 kids per 100 does. This latter figure seems quite high and not indicative of the situation since only 6 kids were found which apparently died in July and August, 1953. In contrast, herd composition figures for 1954 were consistent. The ground count on June 29 yielded the same kid:doe ratio as the aerial survey made on August 14. In September

a ground count gave a ratio of 92:100 which showed a loss of 11 kids per 100 does for the two months of July and August. Of the 19 kid carcasses found on Drake's Flat during the summer, only two were believed to have occurred during this period.

Composition data for the Hart Mountain study area in 1953 shows the highest kid:doe ratio of 113:100 on July 10 and the lowest of 55:100 on August 17. However, by inspecting the other ratios it appears that the loss was probably not over about 30 kids per 100 does. Only 6 kid carcasses were found which were estimated to have died during the intervals of the composition counts. In 1954 the highest ratio was 133:100 and the lowest 66:100. By considering the other ratios a loss of about 20 or 30 kids per 100 does is reflected. Two kid mortalities were found which were estimated to have died during the period between counts.

In the main, ratios obtained on a portion of the southern end of the refuge were much lower in contrast to the two study areas. The highest ratio obtained in 1953 was 101:100 and the lowest 36:100. It is difficult to say whether this highest ratio obtained was simply a matter of chance or not. The other ratios obtained show that possibly this first figure is higher than would be expected. Nevertheless it may be a reflection of a high loss. In 1954, data show very little change in the relationship of kids and does. Again this may be the result of errors in sampling or to the actual situation. Since the latter kid:doe ratios were low throughout the summer compared to the two study areas it may be possible that either the production was lower or else a larger number of yearling does were

present. Note should be made that more yearling bucks were observed in 1954 than in 1953. This would tend to indicate a higher survival or greater production, or both, in 1953 than in 1952. In other words, fewer kids born in 1953 matured as yearlings in 1953 than matured as yearlings in 1954. Thus more yearling does would be expected in the 1954 doe population than in the 1953 population. Since the kid:doe ratios are based on all does counted it would naturally be expected to have on the average fewer kids per doe in 1954, when a higher number of yearlings were present, than in 1953. By examining the data for each area for each year it appears that on the average a higher ratio prevailed in 1954 than in 1953. This, then, reflects a presence of more kids in 1954 and thus higher productivity.

Table XI also lists the ratio of bucks to does. In most cases a higher proportion of bucks were counted toward the end of the summer. This may be attributed to the approach of the rutting season which attracts bucks from areas surrounding the main herds. The low buck:doe ratios of about 15:100 on Drake's Flat in 1953 may be explained on the basis that hunting took place on the area in 1952. Since no hunting was allowed in 1953, the number of bucks increased in 1954. The Hart Mountain study area had an average buck:doe ratio of 46:100 in 1953 and 64:100 in 1954. An average ratio of 44/100 and 59/100 prevailed on the southern end of the refuge in 1953 and 1954 respectively. In every instance more bucks were observed in 1954 than in 1953.

To appreciate more fully the herd composition data obtained, figures compiled by personnel of the Oregon State Game Commission

TABLE XI.

AERIAL AND GROUND HERD COMPOSITION DATA FOR THE DRAKE'S FLAT AND HART MOUNTAIN STUDY AREAS AND A PORTION OF THE SOUTHERN END OF HART MOUNTAIN REFUGE TAKEN DURING 1953 AND 1954

Date	Method	Does	Kids	Bucks	Unclass.	Kid:Doe	Buck:Doe
				DRAKE'S FLAT			
1953							
7/6	Ground	30	33	4	-	110:100	13:100
8/12	Ground	28	26	14(7)	-	93:100	50:100
8/17	Aerial	156	116	25(4)	3	74:100	16:100
9/9	Ground	41	42	6	12	102:100	15:100
		255	217	49		85:100	19:100
1954							
6/29	Ground	73	75	28	13	103:100	38:100
8/14	Aerial	74	76	21	-	103:100	28:100
9/1	Ground	74	68	45(20)	15	92:100	61:100
		221	219	94		99:100	43:100
				HART MOUNTAIN			
1953							
7/10	Aerial+	31	35	8	-	113:100	26:100
7/20	Ground	43	35	9	-	81:100	21:100
8/6	Ground	65	48	23	2	74:100	35:100
8/17	Aerial	40	22	23(1)	-	55:100	58:100
8/20	Ground	32	26	13	-	81:100	41:100
9/10	Ground	18	16	30(3)	-	89:100	167:100
		229	182	106		75:100	46:100
1954							
6/27	Ground	29	34	15(9)	6	117:100	52:100
7/12	Aerial+	9	12	9	29	133:100	100:100
7/13	Aerial	53	46	26	-	87:100	49:100
7/19	Ground	19	23	12(5)	3	121:100	63:100
8/11	Ground	27	16	19(7)	1	60:100	70:100
9/9	Ground	9	9	12(4)	-	100:100	144:100
		146	140	93		96:100	64:100

(continued on page 71)

TABLE XI. (Continued)

Date	Method	Does	Kids	Bucks	Unclass.	Kid:Doe	Buck:Doe
		SOUTHERN END HART MOUNTAIN REFUGE					
1953							
7/16	Ground	75	76	25	-	101:100	33:100
8/10	Ground	95	43	42(12)	115	45:100	40:100
8/17	Aerial	88	32	48?	-	36:100	54:100
9/11	Ground	36	22	13(2)	68	61:100	36:100
		294	173	128		59:100	44:100
1954							
6/28	Ground	15	10	29(9)	22	67:100	193:100
7/13	Aerial	135	40	49	-	30:100	36:100
7/15	Aerial+		122	247 adults++			
7/19	Ground	87	57	39	-	66:100	45:100
9/9	Ground	42	29	47(24)	40	69:100	112:100
		279	136	164		49:100	59:100

\+ U. S. Fish and Wildlife Service plane with Unit personnel observers.

++ No break-down made between does and bucks.

from 1945 through 1954 are presented in table XII. These figures were taken in August and represent a sample of between 1,500 and 2,000 animals each year since about 1948. Considering the average for each year there had been a noticeable increase in kids per 100 does from 1945 up to 1950. A sharp drop occurred in 1951 followed by a further decrease in 1952 but with a steady rise in 1953 and 1954. There has been considerable variation among the counties. Each county has been both above and below the average for the state at various intevals over the 10 year period. The increase of kids per 100 does from 1953 to 1954 for the entire state was mirrored in the data from both study areas. In both years the average number

of kids per 100 does was greater on the study areas than averages for the entire state.

Bucks per 100 does the entire state fluctuated up and down from 1945 to 1950 and then remained relatively stable. The hunting season was closed in 1946, 1947, and 1948. The effect of this closure was shown by a build-up in buck numbers to an average of 77:100 in 1949 before the hunting season. Thereafter a decline and leveling off was evident. Average figures for the Drake's Flat study area were 25 bucks per 100 does lower than the state's average in 1953 and 8 bucks higher in 1954. The absence of hunting on Drake's Flat allowed a quick increase in the number of bucks. The lack of harrassment was probably an important factor since more bucks would probably use this area. Both the Hart Mountain study area and the southern end of the refuge had average ratios equal or above the state average in both years. All three areas showed an increase in the number of bucks while the average for the state showed a slight decline.

Kid:doe ratios obtained in other states also present interesting comparisons. Montana, where the antelope population has been increasing, arrived at kid:doe ratios of 86:100, 93:100, and 101:100 in 1948, 1950, and 1952 respectively (36, p.391). These were taken in July and August. On the average these ratios are somewhat higher than those prevailing on either study area. Table XIII presents herd composition figures from California, Nevada, and Idaho in 1954 as reported at the Tri-state Antelope Meeting in 1954 (31, pp.3-5).

TABLE XII.

SUMMARY OF HERD COMPOSITION TAKEN BY PERSONNEL OF THE OREGON STATE GAME COMMISSION FROM 1945 THROUGH 1954 IN THE SOUTHEAST REGION

County	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954+
					BUCKS PER 100 DOES					
Crook-Deschutes	42	27	59	48	83	111	69	32	58	?
Lake		32	83	50	37	59	40	44	45	40
Harney	87	33	59	91	100	63	56	45	38	38
Malheur	—	—	—	33	71	43	35	52	50	27
AVERAGES	64	31	67	50	77	63	48	44	44	35
					KID PER 100 DOES					
Crook-Deschutes	9	8	18	26	100	25	60	69	68	?
Lake		46	125	63	59	77	71	60	70	74
Harney	21	42	112	91	83	111	53	38	57	82
Malheur	—	—	—	67	100	63	47	69	62	83
AVERAGES	13	31	40	50	83	91	60	49	62	79

+ Data for 1954 calculated from compiled by the Southeast Regional Office of the Oregon State Game Commission.

California and Nevada ratios compare closely with those on Drake's Flat and Hart Mountain. In contrast, Idaho's ratio of kids to does was considerably higher. The apparently higher proportion of kids was attributed, by Idaho, to a heavy winter loss during 1953-54, which probably resulted in a larger percentage of breeding does in 1954. This is assuming a high loss of young which would have reached yearling age during the summer. Note should be made that California,

TABLE XIII.

HERD COMPOSITION IN CALIFORNIA, NEVADA, AND IDAHO AS REPORTED AT THE TRI-STATE ANTELOPE MEETING ON SEPTEMBER 21, 1954

State	Date	Number Classified	Kid:Doe Ratio
California	July 7, 8, 9	689	84:100
	July 26	409	89:100
	August 6	458	89:100
	August 20	401	77:100
	September 3	402	96:100
Nevada	June 15-20	72	129:100
	July 10-24+	952	81:100
	August 13-14	126	73:100
Idaho	June 22+	-	120:100
	June 24	-	144:100
	July 27+	-	126:100
	August 3	-	142:100

+ Aerial Count

Nevada, and Idaho have low, and for all practical purposes, a static antelope population.

Kid loss as indicated by herd composition in Utah during the period of 1948 to 1951 varied from 26 to 44 kids per 100 does (32, p.44). These figures are based on kid and doe counts made in the summer, fall, and winter on areas with intensive predator control. Thus the highest possible loss, as indicated by composition counts, on the two study areas of 36 kids per 100 does not seem to be excessive.

Cause of Mortalities

Perhaps the most important and yet one of the most difficult tasks in this study was determining the cause of death. In the case

of most factors it was impossible to attach definite importance since in many instances a definition of cause of death could not be determined by carcass examination. Thus little more than list type of presentation of the various factors found on the study areas and other portions of the antelope's range in Oregon can be made.

Predation

No attempt was made during the study to measure predator populations. Some idea of abundance was obtained, however, since a considerable amount of time was spent in the field. The potential predators of young antelope present on the study areas were the coyote, bobcat, golden eagle, and raven.

The coyote population on Drake's Flat was very low since none were observed and few fresh scats found. On Hart Mountain the coyotes were more plentiful. Five adults and two pups were seen in the close vicinity of refuge headquarters during 1954 and six adults and four pups in 1953. It is possible that some of the adult observations were duplicated. Normally a few relatively fresh scats could be found during each day of intensive field work. Several dens were examined on the refuge area but only one showed signs of recent use. This particular den contained the leg of a very young antelope. Only one fresh mortality was definitely attributed to the coyote. On June 24, 1953, a positive coyote kill was found just a few hours after it occurred. A kid's head, which had been neatly severed from the body at about the mid-point of the neck, was lying on bare ground. Teeth marks, appearing in a pattern similar to that

possessed by a coyote, were in evidence on the throat. A few patches of skin and hair were scattered about and a small portion of the rib cage and one leg five feet away. Three feet from the head in a clump of sage lay the stomach partially covered by dirt. Some fresh coyote tracks were in evidence near by but due to the character of the ground they were hard to find except in the dust in well-worn paths of travel. Surprisingly little evidence of a struggle was found. Blood and hair trails could not be located to indicate the direction in which the remainder of the body was taken. Portions of three days were spent searching the surrounding area for sign of the kid's remains but to no avail. However, on July 26 a foreleg which possibly could have belonged to this kid was found about one-half mile south of the kill site. It is probable that this kid was killed by a female coyote with pups and that the remains were carried off by the entire group.

Bobcats were perhaps more abundant than indicated through sight records or presence of scats. None were observed on Drake's Flat and only a few scats were found. Several old carcasses were present on the study area. On the Hart Mountain area reports of several sight records were received in 1953 and four were actually observed in 1954. Only a few scats were believed to be those of the bobcat. It is not possible to ascribe bobcat predation to any of the mortalities examined.

The golden eagle and raven were quite common and one or more of these species would usually be observed during the every-day course of field work. However, no observations were made which indicated that either were a menace to the young antelope. An eagle's nest

on a rocky cliff overlooking Rock Creek near refuge headquarters was examined by O. C. Nelson on August 8, 1954. No antelope remains were found in or surrounding the nest. Several interesting observations were made relating to the reaction of antelope to eagles which should be recorded. On one occassion in June of 1953 a single eagle was seen flying low over the ground and soon approached very close to a small herd of antelope causing those lying down to jump up. All of the herd appeared to be very alert and stood more or less motionless as if watching the eagle. After the eagle was considerable distance away the herd resumed their former activities. Another instance took place on Drake's Flat during early morning kid tagging operations in the spring of 1954 when an eagle was observed harrassing a group of 8 doe antelope. One of the does was racing along underneath the eagle as the other antelope moved up and along the opposite hillside. Finally the doe stood still and shortly thereafter the eagle landed on the ground. Immediately the doe commenced to run at the eagle causing it to become air-borne again. The eagle circled a bit and then flew out of sight. These observations at least indicate the the presence of the golden eagle, particularly during the kidding season, causes definite reaction which possibly indicates the eagle may form an important part of the predation factor.

In 1954 an unusual situation was encountered on Drake's Flat. Nine of the kid mortalities occurring in this year were found in approximately the same condition. Characteristically the legs

had been broken-off above the second joint but were usually attached to each other by a portion of the hide. In some cases the head was found separate and in others was attached by a strip of hide to the other remains. One or both ears had usually been removed close to the skull and the nasal cavity opened. In most cases the vertebrae, ribs, pelvic girdle, and viscera could not be located (figures 11, 12, 13, 14). The nature of the ground prevented a clear distinction of animal tracks (figure 14). Thus, the only evidence collected to indicate the animal responsible for killing or consuming the young antelope other than presence of occasional teeth marks was the finding of patches of hair adhering to nearby bushes. These hairs have been identified by the Fish and Wildlife Service Denver Research Laboratory as those of the fox, Vulpes macrotis Goldman. No fox were positively identified on Drake's Flat. However, on August 18, 1954 while driving toward Plush, on the road which formed the east boundary of the study area, in company with Francis Schneider, an animal at first thought to be a young coyote crossed the road. Only a brief glimpse was possible. Upon discussing the matter it was thought that the animal was perhaps too squatty and long-bodied to have been a coyote. So an occurrence record can be suggested with question.

Concerning the above situation a remark seems appropriate at this time concerning the possibility of predation by domestic dogs, Canis familiaris Linnaeus. Beginning the latterpart of the kidding season and through June two dogs, kept by a sheepherder grazing sheep

on the study area, were within one mile of all kids found in the condition noted above. No concrete evidence can be presented at this time but the possibility exists that these dogs were responsible for at least consuming the young antelope carcasses.

In order to obtain some idea of the possible extent of predation the condition of each carcass found was noted. This data was presented in figure 17. A re-examination will reveal that if just the kid mortalities for 1954 and 1953 are considered approximately 63 per cent were found in an incomplete or scattered condition in each year. It is believed that at least a good portion of these can be considered as being consumed or killed by carnivorous animals. In fact the 11 carcasses classed as incomplete in 1954 contained the 9 kids which were found in fragments and possibly attributed to the fox. Caution, however, should be used in interpretating this data since there is no conceivable way of knowing which animals were actually killed by predators rather than being fed upon after death by other causes. Approximately 33 per cent and 35 per cent of the adult mortalities were listed as scattered or incomplete in 1954 and 1953 respectively. The 1952 and previous mortalities should not be considered due to the longer time they were exposed to the elements. Some kids estimated to have died in 1953 may have been incomplete or scattered due to weathering also.

Some mention should be made of predator - antelope relations as found in the literature. Most investigators in previous years have shown that the coyote is the most important predator and at

times can have a significant influence on antelope population levels (28, p.102; 12, p.75, 79; 5, p.313; 32, p.44). Udy states that, "predators, chiefly coyotes appear to have been an important factor in Utah in retarding increase in small antelope herds". Attacks on antelope by bobcats and golden eagle s have been reported occasionally but they have never been considered as an important decimating factor, (12, p.76, 80; 5, p.310-315; 2, p.15-18). Einarsen concludes that ". . . under normal conditions predation perhaps is rarely a factor in determining survival (12, p.81).

Even though predation did not appreciably affect herd increase on either study area, it was interesting to note the correlation between percentage of kid loss on Hart Mountain and the rabbit population. Rabbits were much more abundant in 1954 than in 1953 and the percentage of kid loss was 8.0 and 23.3 respectively. Thus, it might well be that the buffering effect of the jackrabbit was important in decreasing kid loss.

Diseases and Parasites

On June 30, 1953 an occurrence of several scoured (dysentery) kids was reported by Boyd Claggett on Drake's Flat. Claggett collected one of these kids and another was collected by Norman Minnick on July 2 in about the same area. Both of these animals were examined by Dr. Victor Hill, Lakeview veterinarian, several hours after being collected. An intestinal inflamation was present in both cases. From the evidence at hand, Dr. Hill stated that he strongly suspected that these kids had enterotoxemia.

Enterotoxemia is commonly referred to as "over-eating disease" or "pulpy kidney disease". It is an acute toxemia caused by the Type D toxin of Clostridium perfringens (23, 1944). This bacteria is frequently found in soils and sequentially in the lower bowel of normal sheep (9, p. 1). An intake of rich feed apparently produces an environment in which the organism can multipy at a rapid rate and invade the small intestine. Consequently a lethal toxin is formed and absorbed causing death in most cases. Highest loss occurs in range lambs a few days to several months old. Symptoms are rarely observed in lambs under field conditions since death is so rapid. Muth (23, p.144) reports that there is considerable variation in symptoms in individual animals. Listlessness, incoordination, salivation, difficulty in breathing, convulsions, and coma are outstanding visible symptoms. As a prodromal symptom or any time during the course of the disease diarrhea may occur. The disease usually extends only over a period of from 4 to 8 hours. Losses are severe in some places and mortality of affected animals may approach 100 per cent. The Corn States Serum Company points out that enterotoximia has been mistakenly diagnosed as hemorrhagic septicemia, coccidiosis, and plant or chemical poisoning (9, p.1-2).

Scouring has been noted in antelope kids for several years by field workers of the Oregon State Game Commission. However, scours is also a symptom of other diseases and parasites, or may be caused by a change in diet. It does seem important, however, to report on the incidence of scours. Besides the above kids, one other

on Drake's Flat and two on the Hart Mountain area were observed in 1953. In 1954 this condition was observed in only two kids on Drake's Flat. In both years scouring was recorded during the latter part of June to the month of August.

A yearling buck was seen on Drake's Flat in 1953 which was believed to have pink eye or Keratitis. This buck was approached to within about 30 feet before he jumped to his feet and sped away. The left eye was definitely swollen and the lower edge moist with exudation. The animal appeared to be in good flesh and ran with a stable gait.

Pink eye is sometimes common in domesitc stock. It has been reported to occur in antelope throughout some of its range (12, p.74; 5, p.317). It is caused by a bacteria and depending upon the kind may or may not cause permanent blindness. Animals afflicted would undoubtedly be more susceptible to predation as indicated, for instance, by the close approach which was made to the above mentioned yearling buck.

The presence of lump jaw, also referred to as Actinomycosis, was indicated on some of the skeletal remains found on Drake's Flat. Only adult animals were found to be affected. One animal with this condition was placed in the 1952 and previous years mortalities class, five in the 1953 mortalities, and one in the 1954 year class. These animals with lump jaw composed 10, 39, and 20 per cent of the total mortalities found on Drake's Flat in the above respective years.

Skinner reports that antelope are particularly susceptibe to lump jaw (28, p.101-102). No mention of this condition in Oregon

antelope was made by Einarsen (12, pp.72-75). Lump jaw is the result of an infection of the jaw bone. The bacteria usually gains entrance through an abrasion in the gum caused by impaction of grass seed awns or similar coarse food. In most cases a thickening of the mandible occurs. Perhaps the real harm is that the infected animals eat with difficulty and the food is therefore poorly masticated. It seems logical to assume that the presence of lump jaw on Drake's Flat was due to the more abundant areas of grass.

While conducting a routine herd composition count on the southern end of Hart Mountain refuge on September 7, 1954 in company of Norman Mimnick, a female antelope of the year was seen standing alone on a dry lake bed. Upon examination through binoculars at about 200 feet it was obvious that the kid's head and eyes were swollen. Saliva was dripping from the mouth. As the kid began to walk it was obvious that it was in a weakened condition. The abdominal area seemed to be in a cramped condition as the animal moved about. Since the kid was in such poor shape an attempt was made to capture it. However, the young antelope was able to elude the pursuer who was on foot. While being chased the kid ran towards a group of eight other animals but was unable to maintain their pace. Finally, after circling a portion of the lake bed, the kid returned to about the same spot and stood still for awhile. A period of about one-half hour was spent, following the chase, observing actions before the animal was shot for examination. Other notable characteristics observed were occasional shaking of the head and standing with the head in a lowered position. The hind legs were spread further apart

than normal. After being left alone for a short while the kid layed down with apparently much labor. When it was thought that no more could be learned from watching the animal it was shot from a distance of about 50 yeards. Immediately thereafter a sample of blood was collected for later analysis. The carcass was then rushed to Corvallis and examined 11 hours after being collected by Dr. Allen. Dr. Allen's autopsy report follows: "A non-purulent subcutaneous lesion existed in which the entire head and anterior one-third of the neck was involved. The lesion was characterised by a great deal of edema and proliferation of connective tissue. No focal point nor point of entry was observed, but entire right side was thicker - condition ½" thick. Buccal cavity normal, no scars present to indicate point of entry. Muscles of face did not appear involved. The lungs were normal. The abomasum contained a good amount of food material and the mucous membrane was intact and no lesions were present. No parasites present. Rumen normal. Small and large intestines normal. They contained food material and were free of parasites. Live - good color and no lesions present. Kidney - appeared normal in size, but I have posted only one other antelope. Color - grey throughout the medulla. Appeared to be an increase in connective tissue."

"Miss Marjorie LaSalle, Bacteriologist, Department of Veterinary Medicine, isolated an organism from the facial lesion; this was classified as a Pasteurella-like organism. We are unable to state if the organism was the primary cause of the lesion, or if it was a secondary invader. The diagnosis is diffuse subcutaneous necrosis." Figure 18 shows a picture of the kid's swollen head.

Figure 18. A female kid, about 3 months old, collected on Long Lake, Hart Mountain Refuge, on September 7, 1954. The entire head of the kid was swollen causing the eyes to be nearly closed. A pasteurella-like organism was isolated but it was not possible to determine if it was a primary or secondary invader.

During 1954 a blood sample from 16 bucks and 3 kids was examined at the Oregon State College Veterinary Diagnostic Laboratory for brucellosis and leptospirosis. Most of these samples were collected during the hunting season just south of the Hart Mountain refuge. All results were considered negative.

Abomasums and intestines from six bucks and three kids, most of them being from the same animals from which blood was obtained, were examined for internal parasites. Specimens from two of the above bucks were from Harney County, one from Lake county near Sycan Marsh, and the rest from the area south of Hart Mountain. One of the bucks from Harney County was found to be infested with round worms. A portion of Dr. Allen's report follows: "Dr. Norman Baker of the University of California indentified the round worms as "probable Nemotodirus Helvetianus". If further work proves this to be the case it will be a new host record. It was observed that these parasites were quite numerous and the majority of those examined were immature, indicating a recent infestation."

In addition an adult doe found on Drake's Flat on June 13, 1954 and examined by the California Mobile Laboratory contained two species of coddidia and a few nematode ova both unidentified.

So far, investigations dealing with antelope have produced no evidence of any serious epizootic situations (12, p.75; 5, p. 318). In North Dakota a study revealed, "Ninety-seven per cent of 95 southwest North Dakota antelope were parasitized with helmiths as determined by examination of 95 intestines and 59 abomasums". (13, p.641)

Einarsen mentions that pronghorns in Oregon have been particularly free from parasites (12, p.75).

Accidents

While patrolling hunting areas during the 1953 antelope hunting season near Sagehen Flat, which is southeast of Hart Mountain, Mr. W. C. Lightfoot and Mr. L. F. Schneider spotted a doe kid which was dragging its hind quarters. It was thought that the kid was partially paralyzed. By driving next to the young distressed antelope in a jeep they were able to capture it. The animal was taken to Corvallis for examination as quickly as possible and arrived very much alive. An autopsy by Dr. Allen revealed that the left knee joint had been damaged with all ligaments torn loose. All the muscles in the upper hind limbs were hemorrhagic and edematous with a complete rupture and separation of some of them. It was possible that the kid was running with a herd and lost footing. During the hunting season wherever hunters concentrate, herds are often kept moving for long periods. Also the possibility remains that the kid may have been struck by an automobile.

An adult doe was found on Drake's Flat on June 13, 1954 a few hours after death. The doe was lying about 40 feet or so from a sheep-proof fence. Examination revealed an open wound at about the mid-point of the right lower jaw. Blood and mucous were evident in the nostrils and the two middle incisors were missing. Approximately seven feet away a portion of the ground was scuffed up as if the

animal had dragged itself along. Hair was scattered about from this point to the carcass. On the right side of the doe were several shallow flesh wounds which were very narrow and from three-quarters to two inches long and an area about three inches in diameter bared of pelage. The right leg and top of the nose had a few scratch-like wounds. Also the right horn was missing. From the condition and position of the carcass it appeared that the doe had, for some reason, jumped over the nearby fence and tripped while doing so. This animal was kept in a cooler for one day and then taken to the California Fish and Game Mobile Disease Laboratory where it was examined by Dr. Oscar Brunetti and Dr. John Biscoff. The only thing revealed by the sutopsy was a fractured middle cervisl vertebrae, a congestion of blood in the lungs, and a lobe of the liver bruised. These findings suggest that the animal received quite a jolt probably from striking the fence. Figure 19 shows the condition of the doe when found.

A female kid was brought to refuge headquarters on June 27, 1954. The kid was found by Mr. M. Murphy, a local rancher, next to an electric fence which he had constructed around a rye field on Flook Lake which is 8 miles east of refuge headquarters. This young animal was completely intact. A small amount of flesh had been removed from the kid's rump. According to Mr. Murphy some hair lay near the body as if it had been moved, perhaps by coyotes. No teeth marks could be found that would indicate death by predators. The kid was taken to Lakeview where it was frozen forlater examination.

Figure 19. An adult doe found on Drake'f Flat on June 13, 1954, a few hours after death. Autopsy revealed a fractured middle cervical vertebrae. From the condition and position of the carcass it appeared that the doe had, for some reason, jumped over the nearby sheep-proof fence and tripped while doing so. Note the open wound on the right jaw and the active condition of the udder. (Photograph by James D. Yoakum)

Unfortunately, this animal was disposed of by the deep-freeze establishment where it was frozen. Therefore nothing definite can be said concerning the cause of death. It may have been due to contact with the electric fence or to other causes. The former suggestion seems likely.

Another mortality factor which should perhaps be classed as accidental is the so-called "accidental" shooting of kids and does by hunters. While patrolling the area just south of the Hart Mountain refuge during the 1954 hunting season two kids and one adult doe was located which had been shot. Both of the kids were reported by the hunters which shot them. The hunters claimed that they were shooting at a buck running with a herd. The location of the doe was described by several different persons and upon a search was readily found. It was located in the midst of several hunters' camps.

In addition, if hunting occurs in an area there are undoubtedly some bucks crippled. At least 7 cripples were seen or reported during the 1954 hunting season in the same area where the kids and doe were found. One of the cripples was a doe. Of the six crippled bucks at least two were later taken by hunters. In most cases the bucks were observed limping along or trotting with one of the legs dangling. It is most likely that some of these cripples with slight wounds recover. Some evidence which might indicate this to be true was the finding of a leg bone on a carcass near Jack's Lake which apparently had been broken at one time but had completely mended. The knitted area was greatly enlarged and the bone had a

slight curve. Thus, except for increased chance of infection or predation, losses from crippling are probably not too great compared with other factors.

Miscellaneous

Although rather obvious in nature, mention should be made that death of nursing does in June and July will probably result in the loss of the doe's kid through lack of nutrition. For example, the death of two adult does the first part of June on Drake's Flat may have resulted in the loss of up to four kids. One of the does was known to be nursing as indicated by an abundant supply of milk in the mammary glands. It was unknown whether the other doe had been nursing since carrion eaters had completely devoured the abdominal area and udder. Another instance which presented more concrete evidence was the finding of a doe on Drake's Flat which was completely intact. About 150 feet from this doe was a kid, perhaps one month old, whose body was also intact. The doe was thought to have died the last part of June or the first of July. Examination of the dried stomach of the kid revealed a fairly large content of grass, mainly cheat grass. Some sage browse was present. Possibly then, the doe died and the young kid stayed in the close proximity eating solid food in an attempt to stay alive.

There is still the possibility, however, that other does may adopt such "orphan" kids. Dow (11, p. 50) tells of a marked kid being adopted by a doe with two kids. Since these kids had been marked the identification was positive.

Still another factor of unknown importance, or in fact definite cause, is the matter of the occurrence of several premature kid carcasses on Drake's Flat. The fact that such a situation exists suggests that at least some prenatal mortality occurs. Six kid mortalities, were definitely classed as premature based upon size. All of these were found on Drake's Flat. Two of the kids were found as skeletons within the skeleton of the doe. The head of one kid was between the two sides of the pelvic girdle. Possibly complications developed just as the kids were ready to be born. Although, the size of the kids was such that they did not appear to be fully developed and ready for birth. In another instance two kids were found close to the carcass of a doe. This appeared to be a case in which the doe died and the kids being pulled out of the doe by carrion birds or mammals. The remaining two premature animals were found separately with only several legs of each in evidence. The above observations are limited and fragmentary but they are certainly enough to cause some speculation and point out a line of pursuit in increasing knowledge about kid production.

Discussion

There has been much speculation as to why the antelope population in Oregon has remained at an unchanging and apparently low level during the past several years. The task assigned to the Oregon Cooperative Wildlife Research Unit was that of determining the kid losses in the first months of their lives and the causes.

The investigation that has taken place during the past two summers has not revealed what may be considered as a high or significant kid mortality rate. That is to say, the loss of young and adult animals at the level found on both study areas in 1953 and 1954 was not sufficiently great to indicate why the antelope population has been in an unchanging state. A better understanding of the situation can be gained by considering herd increase on one hand and herd loss on the other. Table XIV shows the percentage gross increas, percentage loss, and percentage net increase for theherds occupying both study areas in 1953 and 1954. The gross increase was calculated from the average number of adults and young using the study areas throughout the summer (table A, Appendix) plus the total mortalities found. It was necessary to use this average figure since the number of animals within the study area boundaries was not constant. Percentage loss was taken from table 8. The percentage net increase was the difference between gross increase and percentage loss. Percentage loss would be somewhat higher for 1954 since it includes mortalities only up to September. On both areas a significantly greater net herd increase occurred in 1954 over that of 1953. Without higher measurable mortality the percentage increase which prevailed should result in a slight increase in population. This is particularly true in the case of the increase of nearly 40 per cent in 1954 on Drake's Flat.

So the evidence gained indicates that the two study areas are possibly not identical of conditions prevailing in the whole

TABLE XIV.

PERCENTAGE GROSS HERD INCREASE, PERCENTAGE LOSS, AND PERCENTAGE NET HERD INCREASE ON THE DRAKE'S FLAT AND HART MOUNTAIN STUDY AREAS DURING 1953 AND 1954

Area	Year	% gross increase	% loss	% net increase
Drake's Flat	1953	41	21.3	19.7
	1954	65	25.3	39.7
Hart Mountain	1953	41	29.9	11.1
	1954	37	12.8	24.2

state. Variabilities which may have influenced the data collected, however, include missing animals during herd counts, movement in and out of the study area boundaries, incomplete tally of carcasses in the areas, and assigning of mortalities to the wrong year. These inaccuracies could have resulted in tabulating a somewhat higher net herd increase than actually existed. Most likely, though, the two areas covered have above average production with correspondingly lower rate of mortality than some other areas in the state. Support of this idea is shown by the fact that the kid:doe ratio for Drake's Flat in 1954, as recorded by the Oregon State Game Commission, was higher than any count made throughout the pronghorn range. It is probably that a portion of the herds in Oregon are increasing each year while other areas have dwindling numbers.

Some attention needs to be directed towards herd composition data. Often too much emphasis has been placed on such information.

Granted, kid:doe and buck:doe ratios are useful in a management program but certain drawbacks must be recognized. For instance, since yearling does are difficult to distinguish from adults they are included in the doe population. Thus, the proportion of kids to does varies inversely with the number of yearling does. That is, a higher than normal kid loss one year may result in more kids per 100 does the following year since less yearlings, or non-breeding does, would be present in the herd. It appears impractical now to identify all those mature does capable of reproduction and those does which will be unproductive due to immaturity. Also, since good kid:doe ratios cannot be made before the last part of June or first of July, the loss of kids in May and June is not taken into account when a comparison of ratios is made in August or September. Another factor to consider is that of mistaking kids for does in September. Since the growth of the young was found to be rapid they at times, if opportunity to study the animals is lacking, may be classified as does if only stature is considered. Classifying kids as does, of course, results in a smaller proportion of kids than actually exists.

More food for thought is offered in the matter of kid production. Evidence has been presented showing that kid production varies from year to year. Various reasons can be suggested from fragments of evidence. The presence of a few premature animals and possibly an unbalanced secondary sex ratio may be indicated by the occurrence of some prenatal mortality and abortion. Chattin and

Lassen (7, p.328-329) in California reported that of 18 pregnant female antelope examined in December 1949 and January 1950, 17 contained twin embryos and one contained a single embryo. This is at least indicative of a high reproductive potential. However, most counts just after birth do not show as high a number of twins as is apparently possible. A loss then, may be taking place some time near the end of the fetal development at the time of birth. This can not be proved from data collected but is merely suggested on the basis of incomplete findings.

Such factors as kid production, mortality, and herd movement may be quite variable from year to year and thus result in maintaining a stable population, at least make it appear so. When production is high and mortality low, slight increases occur. Likewise low production followed by high mortality would result in no increase. Several decimating factors have been presented which may be important. It has been shown that production varied from year to year and that mortality also varied. As well, the number of antelope found on either study area changed, at times considerably. Thus, with all these variables interacting it may be easily seen how an erroneous idea of how the population is faring or how the level may change without the important factors being obvious on the surface. This tends to point out the importance of keeping tabs of trends.

As well, there are probably many minute forces which are difficult to detect but nevertheless have an influence upon population dynamics. An interesting example is afforded by Shelford

(27, p.533-537) who suggests that optimal solar ultraviolet radiation intensity is a reproductive stimulus for a short critical period and may be an effective factor influencing fecundity and perhaps milk production in antelope.

Other considerations should be taken into account. Range condition, for instance, varies considerably particularly in areas of low rainfall. Thus forage production may be related to kid production. Also it can not be overlooked that the range of the antelope is being encroached upon more and more every year. Increased human activities such as land tilling, increased grazing, land clearing, fencing, etc., are detrimental to antelope. The question arises whether or not the pronghorn has reached the highest population possible under the condition which now exist.

There is little doubt that more research need be undertaken. Too much emphasis can not be placed upon a more careful approach to studying wild animals. There are too many vaiabilities to be haphazard in methodology. In many cases too much time and emphasis have been placed upon the animal itself rather than the environment in which it lives. The wildlife worker could, to good advantage, use more of the knowledge gained in other fields. Recognizing the need for further intense and accurate research, the following questions are posed. They need to be answered before a clear and adequate understanding of antelope population dynamics can be grasped. (1) What is the average number of embryos per adult doe in April or May and what is the per cent of twins and single kids

just after birth in these same years; (2) Does abortion occur and if so what are the causes; (3) What is the relationship of yearling does to the herd, i.e. do they bunch up together in winter herds and stay together in groups even after migration to summer ranges; (4) Can yearling does be distinguished from adult does through observation; (5) Does kid production vary directly with range condition; (6) What is the total amount of range which is suitable for the pronghorn at the present time; (7) What are the true relationships between antelope and diseases and parasites; between antelope and predators; (8) Do herds tend to spread out when slight increases occur and thus appear to be stable?

SUMMARY AND CONCLUSIONS

A field investigation concerned with the survival of young pronghorn antelope was conducted during the spring and summer of 1953 and 1954. The investigation was designed to determine important facts relative to the generally voiced theory that high kid losses have been the cause for a static antelope population in Oregon in recent years. Other data were collected and included for the sake of adding to the knowledge of antelope.

Each year on two study areas the condition of new-born kids was noted, a search was made for carcasses, her composition counts were made throughout the summer months to detect any high losses, and all possible mortality factors recorded. The following data were obtained.

Seven kids were captured and tagged in 1953 on the Hart Mountain refuge. The sex ratio was 40:100 (males:females). In 1954, 20 kids were tagged on the Drake's Flat and Hart Mountain study areas. The proportion of males to females was 150:100. By including an additional 19 kids caught by Federal and State personnel on Hart Mountain the ratio was 117:100. Most sex ratios in other states and in earlier investigations in Oregon have shown a greater number of females than males. These findings were reversed in this study. A suggestion was made that abortion may have caused the unbalanced sex ratio at birth, although this was not substantiated.

The average weight of 20 kids, between 1 and 6 days old, was 9.65 pounds with a range of 7 to 12 3/4 pounds. These weights compare favorably with those obtained in other portions of the antelope range. Average temperature of the 20 kids captured in 1954 was 102.2°F. No normal temperature records for antelope were found in the literature reviewed.

All of the young kids handled during the study showed every external appearance of being in good state of health. Criteria used for judging health were weight, temperature, appearance of pelage, flesh condition, and apparent vigor.

Observations dealing with the reaction of does to tagged kids revealed that abandonment probably rarely occurs.

In 1953 observations were of sufficient length to assign kids to 49 does. Of these 49 does, 55 per cent (26) nursed one kid, 43 per cent (21) nursed twins, and 2 per cent (1) nursed triplets. This was a production of 145 per cent. Ten does on Drake's Flat produced

15 young in 1954. This represents a 150 per cent kid drop. One-half of the does nursed twins and one-half single kids. On Hart Mountain in 1954, 22 young were produced by 17 does which represents a 129 per cent crop. Seven of these does (41%) produced single kids and 10 produced twins (59%). From the data collected it appears that kid production in Oregon is not as great as in other states at least in the years for which data were available.

Loss per square mile as calculated from number of carcasses found was 1.05 kids and 1.11 kids on Drake's Flat in 1954 and 1953 respectively. On Hart Mountain the kid loss was .15 per square mile in 1954 and .76 per square mile in 1953. Compared to loss per square mile obtained by Einarsen in earlier years in Oregon, the loss on the study areas can not be considered abnormal, or excessive. Considering the number of animals using the areas, losses based on carcasses per square mile was greatest on Drake's Flat in 1954 and less than the loss on Hart Mountain in 1953. Individual adult loss per square mile on Drake's Flat and Hart Mountain in 1954 and 1953 was .28, .72, .15, and .31 animals respectively. Considering the average population, adult loss was greater both years on Hart Mountain.

Percentage loss based on number of carcasses found and estimated total animals using each area was thought to be the most practical means of evaluating extent of mortality in any one year. The summer kid loss on Drake's Flat in 1954 and 1953 was 20.7 per cent and 14.6 per cent respectively. Adult loss for the same years were, respectively 4.6 and 6.7 per cent. On the Hart Mountain area kid and

and adult losses were greater in 1953 than in 1954. Kid losses amounted to 8.0 per cent in 1954 and 23.2 per cent in 1953. Losses of adults were considerably lower than kid losses as evidenced by a 4.8 and 6.6 per cent mortality in 1954 and 1953 respectively.

Data indicate that loss of kids was highest in May and June. Of 19 kid mortalities found on Drake's Flat which occurred during the spring and summer of 1954, 42 per cent (8) were estimated to include premature or kids less than one week old, 47 per cent (9) between two and four weeks of age, and 11 per cent (2) were between 5 and 8 weeks old. Thus 89 per cent of the kid loss occurred in May and June. Of 42 mortalities found on Drake's Flat and estimated to have occurred in 1953 and 1952 and previous years, 69 per cent (29) died before reaching two months of age. This includes the months of May, June and July. Seven or 17 per cent, in these same years, fell in the three to four month age class. Mortalities in the 5 to 6 and 7 to 8 month age class amounted to 10 per cent (4) and four per cent (2) of the total loss respectively. Of the 18 kid mortalities found on the Hart Mountain area, 59 per cent (10) were estimated to have been about one month old or less at the time of death and 41 per cent (8) were from one to five months old.

On Drake's Flat only 19 of the total (64) kid mortalities were identified as to sex. Females made up 68 per cent (13) and males 32 per cent (6) of these. Adult mortalities consisted of 14 does, 2 bucks, and 2 unidentified as to sex. The higher number of females was probably due to the small sample size. The wide-ranging habits

of the bucks and isolation from the main herds except during the rutting season were presented as a possible explanation of the greater number of female mortalities. Differential mortality should not be accepted as an explanation until more data is collected.

Herd composition data revealed that kid loss was not excessive compared to similar data collected in other states. On Drake's Flat in 1953 kid:doe ratios showed a maximum loss of 36 kids per 100 does while in 1954 the maximum loss was 11 kids per 100 does. Maximum kid loss per 100 does on the Hart Mountain area was about 30 kids and 20-30 kids for 1953 and 1954 respectively. Since there was such great variability in kid:doe ratios it is not believed that they can be considered sensitive enough to reflect anything but very high losses.

Proportion of kids to does on the two study areas also compared favorably with those reported for other states. Montana ratios, where the antelope are increasing, were on the average somewhat higher than those found on either study area. High kid:doe ratios prevailed in 1954 more than in 1953. This indicated higher productivity in 1954 on the study areas.

More yearling bucks were observed in 1954 than in 1953. This indicated a higher survival or greater production, or both, in 1953 than in 1952. The yearling bucks present in a herd would seem to be a useful indicator of survival and productivity.

Herd composition data for the state were compared to that obtained on the study areas. In both years the average number of

kids per 100 does was greater on the study areas than averages for the entire state. Both areas showed an increase in the number of bucks per 100 does while the average for the state showed a slight decline.

Causes and probable causes of mortalities as found on the two study areas or in surrounding country were listed. In some cases bacteria and parasites were found but it was not known if these would have been a direct or indirect contributor to death. The actual importance of the various causative agents needs to be determined in future studies.

Only one recent mortality was definitely attributed to predation by the coyote. In 1954 nine kid mortalities were found on Drake's Flat in approximately the same condition. Only small portions of the carcasses could be found. The only evidence collected to indicate the animal responsible for killing or consuming these kids was the finding of patches of hair adhering to nearby bushes. These hairs were identified by the U. S. Fish and Wildlife Service as those of the fox. No foxes were observed on Drake's Flat and were, therefore, probably rare in occurence.

It was believed that at least a good portion of the carcasses found in an incomplete or scattered condition could be considered as being consumed or killed by carnivorous animals. Of the total kid mortalities found for the years 1953 and 1954, 63 per cent were in an incomplete or scattered condition. Approximately 33 per cent and 35 per cent of the adult mortalities were listed as scattered

or incomplete in 1954 and 1953 respectively. There was no conceivable way, however, of knowing which animals were actually killed by predators rather than being fed upon as carrion after death by other causes.

Two kids collected the latter part of June on Drake's Flat which were suspected of having enterotoxemia. A yearling buck on Drake's Flat in 1953 was observed which was believed to have pink eye. On the southern end of the Hart Mountain refuge in September of 1954 a kid of the year was collected. This kid was quite thin and the entire head was swollen. A pasteurella-like organism was isolated from the facial lesion but it could not be determined if this organism was the primary cause of the lesion. Such a condition has not been previously reported in antelope in the literature reviewed.

Blood samples from 16 yearling and adult bucks and 3 kids were tested for brucellosis and leptospirosis with all results negative.

Abomasums and intestines from six bucks and three kids were examined for internal parasites. One of the bucks, collected from Harney County, was found to be infected with round worms. These were identified as probably Nematordirus helvetianus. In addition an adult doe found on Drake's Flat in 1954 contained two species of coccidia and a few nematode ova, both unidentified.

The presence of lump jaw was indicated in 10, 39, and 20 per cent of the total skeletal remains of adults found on Drake's Flat for the years 1952 and previous, 1953, and 1954 respectively.

Accidents accounted for an adult doe on Drake's Flat in 1954 with a fractured cervical vertebrae and a young kid with ruptured muscles in the upper hind limbs. Also classed with accidents were two kids and one adult doe shot by hunters during the 1954 season.

Miscellaneous causes of death included death of kids through lack of nutrition as result of death of the doe in June and July.

Finding of several apparently premature kid carcasses on Drake's Flat suggests that at least some prenatal mortality occurs.

A review of the data collected reveals that the loss of young and adult animals on the level found on both study areas in 1953 and 1954 was not sufficiently great to indicate why the antelope population has been in an unchanging state in Oregon. This was emphasized by calculating the percentage of net increase for each study area. Percentage of net increase amounted to 19.7 and 39.7 per cent on Drake's Flat in 1953 and 1954 respectively. Increase for these same years was 11.1 and 24.2 per cent on the Hart Mountain area. Increases such as these should result in a slight increase in population.

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A P P E N D I X

TABLE A.

AVERAGE NUMBER OF ANTELOPE PRESENT ON THE DRAKE'S FLAT AND HART MOUNTAIN STUDY AREAS AS DETERMINED FROM GROUND AND AERIAL COMPOSITION COUNTS IN 1953 AND 1954

Date	Count	Does	Kids	Bucks	Unclassified	Total
				DRAKE'S FLAT		
1954						
6/29	Ground	73	75	28	13	189
8/14	Aerial	74	76	21	-	171
9/	Ground	74	68	45 (25-20)+++	15	202
		221	219	94	28	562
AVERAGE		73	73	31	9	187
1953	Note:	Only one count was made on an area of comparative size to that used in 1954.				
		156	116	25 (21-4)	3	300
				HART MOUNTAIN		
1954						
6/27	Ground	29	34	15 (6-9)	6	84
7/19	Ground	19	23	12 (7-5)	-	54
8/11	Ground	27	16	19 (12-7)	1	63
7/12	Aerial	9	12	9	29	59
9/9	Ground	9	9	16	-	34
7/13	Aerial	53	46	26	-	125
		146	140	97	36	419
AVERAGE		24	23	16	6	70

(continued on page 109)

TABLE A. (continued)

Date	Count	Does	Kids	Bucks	Unclassified	Total
1953						
7/10	Ground	31	35	8	-	74
8/17	Aerial	40	22	23 (22-1)	-	85
7/20	Ground	43	35	9	-	87
8/5-6	Ground	65	48	23	-	136
8/19	Ground	32	26	13	-	71
		211	166	76		453
AVERAGE		42	33	15		91

+++First number designates adults and the second yearlings.

TABLE B.

DATA FOR ANTELOPE ADULT AND KID MORTALITIES OCCURRING ON DRAKE'S FLAT AND HART MOUNTAIN IN 1954 AND THOSE ESTIMATED TO HAVE OCCURRED IN 1953 AND 1952 AND PREVIOUS YEARS

No.	Date Found	Estimated Age - Months Cannon Bone[1] 0-1 0-179mm	2-6 180-189mm	Diastema[2] 0-2 0-39mm	3-6 40-54mm.	Dentition[3]	Est. Age Mon.	Sex	Carcass Condition[4] Sca.	Inc.	Int.
				KIDS							
				Drake's Flat - 1954							
	1954										
1	6/5	160		29		1M-1	½	M		x	
2	6/5	-	-	29		1M-1	½	?		x	
3	6/7	-	-	30		1M-1	½	F		x	
4	6/7	-	-	-	-	1M-1	½	?		x	
5	6/12	165		-	-	-	½	?		x	
6	6/17	120		18		3PM-D	P	?	x		
7	6/17	135		-	-	3PM-D	P	?	x		
8	6/17	130		-	-	1M-1	½	?		x	
9	6/22	140		20		-	¼	?		x	
10	6/22	-	-	-	-	-	1	F			x
11	6/24	104		-	-	-	P	?		x	
12	7/13	160		26		1M-1	1	?		x	
13	8/10	160		28		1M-1	1	?			x
14	8/10	146		-	-	-	½	?		x	
15	8/11	160		29		1M-1	½	?			x
16	8/11		186	39		1M-2	1½	?			x
17	8/18	175		34		1M-1	1	F			x
18	9/11		193		48	1M-2	2	F			x
19	9/11	-	-	-	-	-	P	?		x	

(continued on page 111)

TABLE B. (continued)

No.	Date Found	Estimated Age - Months: Cannon Bone 0-1 0-179mm	Cannon Bone 2-6 180-189mm	Diastema 0-2 0-39mm	Diastema 3-6 40-54mm	Dentition	Est. Age Mon.	Sex	Carcass Condition: Sca.	Inc.	Int.
					Drake's Flat - 1953						
	1953										
1	7/13	152		-	-	-	1	F			x
2	8/12		183	-	-	-	2	?			x
	1954										
3	5/28	162		24		3PM	1-	M			x
4	6/6	152		18		3PM	1-	?		x	
5	5/26	145		-	-	-	1-	?		x	
6	6/1	165		-	-	-	1-	?		x	
7	6/12		187		44	1M-2	3-3½	?			x
8	6/16	-	-		48	1M-2	3-3½	M			x
9	6/18		208		52	2M-2	6+	?	x		
10	6/18		190		49	1M-2	3-3½	?		x	
11	6/22	146		22		3PM	1-	?	x		
12	6/22	161		26		1M-1	1	?	x		
13	6/22		194		44	1M-2	6	F			x
14	6/22	160		32		1M-2	2-3	F	x		
15	6/24		184	39		1M-2	2-3	F		x	
16	7/21		200		51	1M-2	6	?			x
17	8/13	-	-	-	-	-	?	?		x	
18	8/13	162		37		1M-1	1	F			x
19	8/24	151		-	-	-	1-	?		x	
20	4/12		212		51	1M-2	6	M			x

(continued on page 112)

TABLE B. (continued)

No.	Date Found	Estimated Age - Months: Cannon Bone 0-1 (0-179mm)	Cannon Bone 2-6 (180-189mm)	Diastema 0-2 (0-39mm)	Diastema 3-6 (40-54mm)	Dentition	Est. Age Mon.	Sex	Carcass Condition: Sca.	Inc.	Int.
				Drake's Flat - 1952 and previous years							
	1953										
1	7/3	163		-	-	-	1	?			x
2	7/12	-	-	-	-	-	1	?		x	
	1954										
3	5/30		182	-	-	2M-2	6-8	F	x		
4	6/7	157		-	-	-	1-	?	x		
5	6/7		188	-	-	-	6	?		x	
6	6/7	136		-	-	-	1-	?	X		
7	6/9	175			45	1M-2?	3-6	M			x
8	6/12	145		23		3PM	1-	?	x		
9	6/12	122		-	-	3PM	1-	?	x		
10	6/12	139		22		3PM	1-	F	x		
11	6/12	146		-	-	1M-1	1-2	?	x		
12	6/22	120		21		3PM	1-	F	x		
13	6/22	140		-	-	3PM	1-	?		x	
14	6/22	148		36		1M-1	1-2	?	x		
15	6/24	154		26		1M-1?	1-2	?	x		
16	6/24	-	-	-	-	3PM	P	?			x
17	6/24	-	-	-	-	-	P	?			x
18	7/13	130+		27		-	1-2	?	x		
19	7/21		177+	-	-	-	2-6	?			x
20	7/22	153+		32		1M-1	1-2	?			x
21	7/22	170+			44	1M-2	3-6	M	x		

(continued on page 113)

TABLE B. (continued)

No.	Date Found	Estimated Age - Months Cannon Bone 0-1 0-179mm	Cannon Bone 2-6 180-189mm	Diastema 0-2 0-39mm	Diastema 3-6 40-54mm.	Dentition	Est. Age Mon.	Sex	Carcass Condition Sca.	Inc.	Int.
22	7/26	127+		27		3PM	1-	F	x		
23	8/10		173+	-	-	-	2-6	?	x		
24	8/13	-	-	-	-	-	?	?	x		
25	6/12	171		29		3PM	1-	?	x		
				Hart Mountain - 1954							
1	6/27	-	-	-	-	-	1	F			x
2	7/9		187	-	-	-	1-2	F			x
				Hart Mountain - 1953							
1	6/24/53	-	-	-	-	-	0-½	?		x	
2	6/24	-	-	-	-	-	1	?		x	
3	8/20	-	-	-	-	-	2½	?			x
4	9/8	-	-	-	-	-	3½	?			x
5	5/21/54	137		-	-	-	0-1	?	x		
6	5/23	-	-	35		1M-2?	3-6	?	x		
7	6/13		194		-	1M-2	3-6	?	x		
8	6/16		200		44	1M-2	3-6	?	x		
9	6/16		193	38		1M-1	1-2	?		x	
10	7/10		206		56	2M-1	6-8	?	x		

(continued on page 114)

TABLE B. (continued)

No.	Date Found	Estimated Age - Months Cannon Bone 0-1 0-179mm	2-6 180-189mm	Diastema 1-2 0-39mm	3-6 40-54mm.	Dentition	Est. Age Mon.	Sex	Carcass Condition Sca.	Inc.	Int.
				Hart Mountain - 1952 and previous years							
1	7/28/53	177		-	-	-	0-1	?	x		
2	5/19/54	-	-	-	-	-	0-1	?	x		
3	5/23		182	-	-	-	2-6	?	x		
4	5/19	-	-	34		-	0-2	?	x		
5	5/22	127		22		-	0-2	?	x		
6	5/22	-	-	-	-	-	?	?	x		

No.	Date Found	Estimated Age - Months Cannon Bone 7-11 190-198mm	12+ 200+	Diastema 7-9 55-59mm	10+ 60+	Dentition	Est. Age Years	Sex	Carcass Condition Sca.	Inc.	Int.
				ADULTS Drake's Flat - 1954							
1	6/12	-	-	-	-	-	Ad.	F			x
2	6/13	-	-	-	-	-	Ad.	F			x
3	6/17	214			67	9 inf.	4½	F	x		
4	7/21	214			69	DI-3	1½-2½	F			x
5	6/18	204		57		2M-2	2/3-1	F			x

(continued on page 115)

TABLE B. (continued)

No.	Date Found	Estimated Age - Months				Dentition	Est. Age Years	Sex	Carcass Condition		
		Cannon Bone		Diastema					Sca.	Inc.	Int.
		7-11 190-198mm	12+ 200+	7-9 55-59mm	10+ 60+						
						Drake's Flat - 1953					
1	4/12	-	-		63	8 inf.	5½	F			x
2	4/12		226		72	Full Dent.	?	F	x		
3	6/5		210		77	Full Dent.	?	F			x
4	6/6		224		73	?	?	F			x
5	6/6	-	-	-	-	-	?	F			x
6	6/9	-	-	-	-	-	?	F			x
7	6/9	-	-		73	Full Dent.	?	F			x
8	6/21	-	-	-	-	-	?	?			x
9	6/29		214	-	-	-	?	?			x
10	6/30		210	59		3M-1	1-1 1/3	F			x
11	7/13		216		71	Full Dent.	?	M			x
12	7/13		215		62	Full Dent.	?	F	x		
13	8/13		215		68	3M-1	1-1 1/3	M	x		
						Drake's Flat - 1952 and previous years					
1	7/13/53	-	-	-	-	-	1	M			x
2	6/5/54		209		63	3M-2	1-1 1/3	M			x
3	6/6		232	-	-	-	?	M	x		
4	6/7	193			62	2M-1	½-1	M			x
5	6/7		202		61	3M-1	1- 1 1/3	F			x

(continued on page 116)

TABLE B. (continued)

No.	Date Found	Estimated Age - Months: Cannon Bone 7-11 190-198mm	Cannon Bone 12+ 200+	Diastema 7-9 55-59mm	Diastema 10+ 60+	Dentition	Est. Age Years	Sex	Carcass Condition: Sca.	Inc.	Int.
6	6/24		214		61	Full Dent.	?	F			x
7	7/9	198+			65	3M-2	1-1½	F	x		
8	7/22		216		60	3M-2	1-1½	M			x
9	7/26		211		61	3M-2	1-1½	M	x	x	
10	8/10		224	-	-	-	?	?	x	x	
				Hart Mountain - 1954							
1	7/10/54		220	-	-	-	?	M			x
2	7/12	-	-	-	-	-	?	?		x	
				Hart Mountain - 1953							
1	6/18/54		215		60	Full Dent.	?	F	x		
2	6/23		220		82	Full Dent.	?	M	x		
3	6/23		215		76	Full Dent.	?	F	x		
4	7/20	-	-		69	Full Dent.	?	F			x
				Hart Mountain - 1952 and previous years							
1	6/15/53	-	-	-	-	-	?	?	x		
2	9/2	-	-	-	-	-	?	F	x		
3	7/10/54	-	-	-	-	-	?	F	x		

EXPLANATION OF TABLE B

1. Placed into month-age classes by length of cannon bone (metacarpal).
2. Placed into month-age classes by length of diastema (interdentary space).
3. 3PM-D: All three deciduous premolars erupted; 1M not yet erupted.

   3M-1: Third Molar erupted with only first cusp above gum.

   3M-2: Third molar erupted with both cusps above gum.

   2M-1: Second molar erupted with only first cusp above gum.

   2M-2: Second molar erupted with both cusps above gum.

   1M-1: First molar erupted with only first cusp above gum.

   1M-2: First molar erupted with both cusps above gum.

   DI-3: Third incisor deciduous.

   inf.: Infundibula.
4. Scattered, incomplete, intact.