Range use and food habits of the pronghorn antelope in Central Montana with special reference to alfalfa

by Glen F Cole

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

Abstract:
A study of the range use and food habits of the pronghorn antelope was conducted during 1953 and 1954 on an area in Central Montana where the principal land use was stockraising, integrated with alfalfa forage and seed production. Data indicating seasonal and inseason differences in the use of vegetative types were obtained by recording observations of antelope seen on agricultural croplands and rangeland types along routes. Food habits were determined by rumen analyses and the examination of antelope feeding sites. Various characteristics of the alfalfa fields used by antelope and those not used were described and compared. Seasonal differences in the intensities of field use by antelope and the numbers, sex and age classes involved were indicated by regular observations of alfalfa fields. Observations of fawns and yearlings, marked with plastic ear tags, and recognizable adults provided data on movements in relation to fields and some of the factors influencing field use. Measurements of alfalfa plants inside and outside exclosures and pellet group counts along transect lines on fields provided data on the effects and pattern of antelope use on fields.

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ABSTRACT

A study of the range use and food habits of the pronghorn antelope was conducted during 1953 and 1954 on an area in Central Montana where the principal land use was stockraising, integrated with alfalfa forage and seed production. Data indicating seasonal and inseason differences in the use of vegetative types were obtained by recording observations of antelope seen on agricultural croplands and rangeland types along routes. Food habits were determined by rumen analyses and the examination of antelope feeding sites. Various characteristics of the alfalfa fields used by antelope and those not used were described and compared. Seasonal differences in the intensities of field use by antelope and the numbers, sex and age classes involved were indicated by regular observations of alfalfa fields. Observations of fawns and yearlings, marked with plastic ear tags, and recognizable adults provided data on movements in relation to fields and some of the factors influencing field use. Measurements of alfalfa plants inside and outside exclosures and pellet group counts along transect lines on fields provided data on the effects and pattern of antelope use on fields.

INTRODUCTION

The plains area of Montana is included in the original range of the pronghorn antelope, Antilocarpa americana. Beer (1944) concluded from Seton's early estimates that the "original" population was about 2,500,000. The settling of the plains area by homesteaders in the early 1900s is generally believed to have resulted in conditions that were decidedly adverse to the pronghorn. By 1922-24 the population had dwindled to about 3,000 (Nelson, 1925). During this period of low populations some citizens became actively concerned. Certain ranchers protected small remnant herds. Other remnant herds survived in areas of less intense agriculture and superior escape habitats.

Human depopulation of the plains and the abandonment of dryland farms occurred during the droughts of 1918-21 and 1930-37 (Gieseker et al., 1953). Progressively more efficient law enforcement, predator control, and water developments, in the form of artificial stock reservoirs, probably served to further lessen the environmental resistance of pronghorn habitat. Numbers increased. Biological Survey estimates for 1937, 1938 and 1939 were 10,602, 6,740 and 7,142 respectively. A 1941 ground census estimated the population at 14,233 (Beer, op. cit.). Montana's first aerial census (1943-44) gave an estimated winter population of 14,225 (Bergeson and Thompson, 1946).

To give impetus to the restoration of antelope the Montana Fish and Game Department initiated a trapping and transplanting program in 1946. From 1946 to 1949, 2,383 were transplanted into formerly unoccupied

habitats or historical ranges where the animals were low in numbers. Estimated populations for 1947 and 1951 were 26,000 and 50,600 respectively (Montana Fish & Game Commission 1946-47 and 1950-52). The 1954 population was estimated at 67,600.

In recent years the antelope has become one of the principal huntable big game species in the state. Since 1943, when 750 permits were issued, antelope hunting seasons have occurred annually and have become progressively more liberal; e.g., 2,854, 9,272 and 23,677 antelope permits were issued to the public by the Fish and Game Department for the years 1947, 1951 and 1954 respectively.

Coincident with population buildups, reports of antelope depredation on alfalfa fields, reported as early as 1922-24 for the state by Nelson (op. cit.), increased. Since alfalfa raising is an important economy over much of the antelope range, this conflict has caused much concern. The utilization of alfalfa fields by antelope is well established. The extent of damage, segments of the population involved and other pertinent factors have not been thoroughly investigated. To determine some of these unknown factors an intensive field study was conducted April 6, to September 24, 1953 and May 23, to October 7, 1954. Fall and winter periods in 1952 and 1953 were devoted to the identification of plant collections, analyses of rumen samples and making antelope collections.

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J. C. Wright and W. E. Booth, for assistance in plant identifications; D. L. Brown for administrative direction and permission to use census and transplanting data; H. D. Picton for assistance in recording data from alfalfa fields; R. L. Eng, G. B. Chaffe and J. L. Egan for collecting antelope during the writer's absence from the area; Mr. and Mrs. Joe King of the King and Peterson Livestock Company for permission to use company property and for cooperation which made the study possible; the U. S. Forest Service, Soil Conservation Service, Production and Marketing Association and the Bureau of Land Management for various data on land acreages ownership and administration. Further thanks are extended to the Montana Fish and Game Department for financing the study.

THE STUDY AREA

A 62,160 acre study area in Petroleum County, approximately 45 miles east of the state's geographic center at Lewistown, was selected for study. This area was selected because its antelope populations, land use and vegetation were more or less typical of much of Montana's antelope range and because antelope depredations on alfalfa crops were frequently reported by landowners. Present antelope populations originated from native herds. Census figures of the Montana Fish and Game Department indicated about 4.0 and 4.5 antelope per square mile for 1953 and 1954 respectively. Currently six headquarter ranches are on the area. Abandoned homestead sites are common. The principal economy is stock raising, integrated with alfalfa seed and forage production. Privately owned lands constitute 60.4% (37,590 acres) of the area; publicly owned

39.6% (24,570). Public lands are administered by the U. S. Forest Service, Bureau of Land Management and the State of Montana. Land ownership is shown on Figure 1.

Gieseker et al (op. cit.) describes the climate for the area as semiarid, "... characterized by moderately low rainfall, great extremes in summer and winter temperature, many sunny days and relatively low humidity". The average annual precipitation at Flat Willow (U. S. Department of Commerce weather station) approximately five miles south, is 12.64 inches. The mean average annual temperature is 44.9° F. Temperature extremes in 1953 were 107° F. in July and -7° F. in January.

The characteristic physiographic features are sharply rolling upland plains, shale slopes and bottomlands (Fig. 2A). The latter two occur where erosion has dissected the upland plain. McDonald, Elk and Yellow Water Creeks flow through the area. The soils have developed over Cretaceous shales of the Colorado Formation (Andrews et al, 1944). Upland soils range from heavy clays to shaley clay loams. Shale slopes have soils ranging from fine shale loams to coarse shale gravels. Bottomlands range from silty clays to clay loams. Varying degrees of alkali are present.

Vegetative Types

Rangeland and cropland comprise approximately 95.0% (59,039 acres) and 5.0% (3,121 acres) of the area respectively. Seven rangeland types and two agricultural croplands were recognized as being available to antelope.

Fig. 1. Map showing the interspersion of private and public land on the study area (from U. S. Forest Service land ownership records).

Rangeland types

Sagebrush-grassland

This type occupied the major portion of the study area. Recognition was afforded by the dominant aspect of Big Sagebrush (Artemisia tridentata) (Fig. 2B). Western Wheatgrass (Apropyron smithii), Bluebunch Wheatgrass (Agropyron spicatum) and Blue Grama (Bouteloua gracilis) were the principal grasses. Among these grasses various degrees of association occurred, but the dominance of one species, or another, appeared to characterize important differences in the type. Erosion cuts and depressions in the upland plain favored a Big Sagebrush-Western Wheatgrass association (Fig. 2C). The Big Sagebrush-Bluebunch Wheatgrass association (Fig. 2D) was characteristic of the shaley clay loams on the uplands within the northwest two-thirds of the area. In this area the abundance of Blue Grama appeared to be influenced by livestock grazing; e.g., ridge tops (Fig. 3A) and areas around stock reservoirs had a dense Blue Grama turf. The upland clay loams on the southeastern third of the area favored the Big Sagebrush-Blue Grama association. Bluebunch Wheatgrass occurred as isolated plants within clumps of Big Sagebrush.

Grassland

This type had limited representation. Recognition was afforded by the absence of the Big Sagebrush aspect and the presence of certain grasses. Small patches of native grassland (Western Wheatgrass-Bluegrass, Poa sp.) occurred within swales which were never cultivated (Fig. 3B), but most of the type was confined to abandoned upland fields. Artificial-

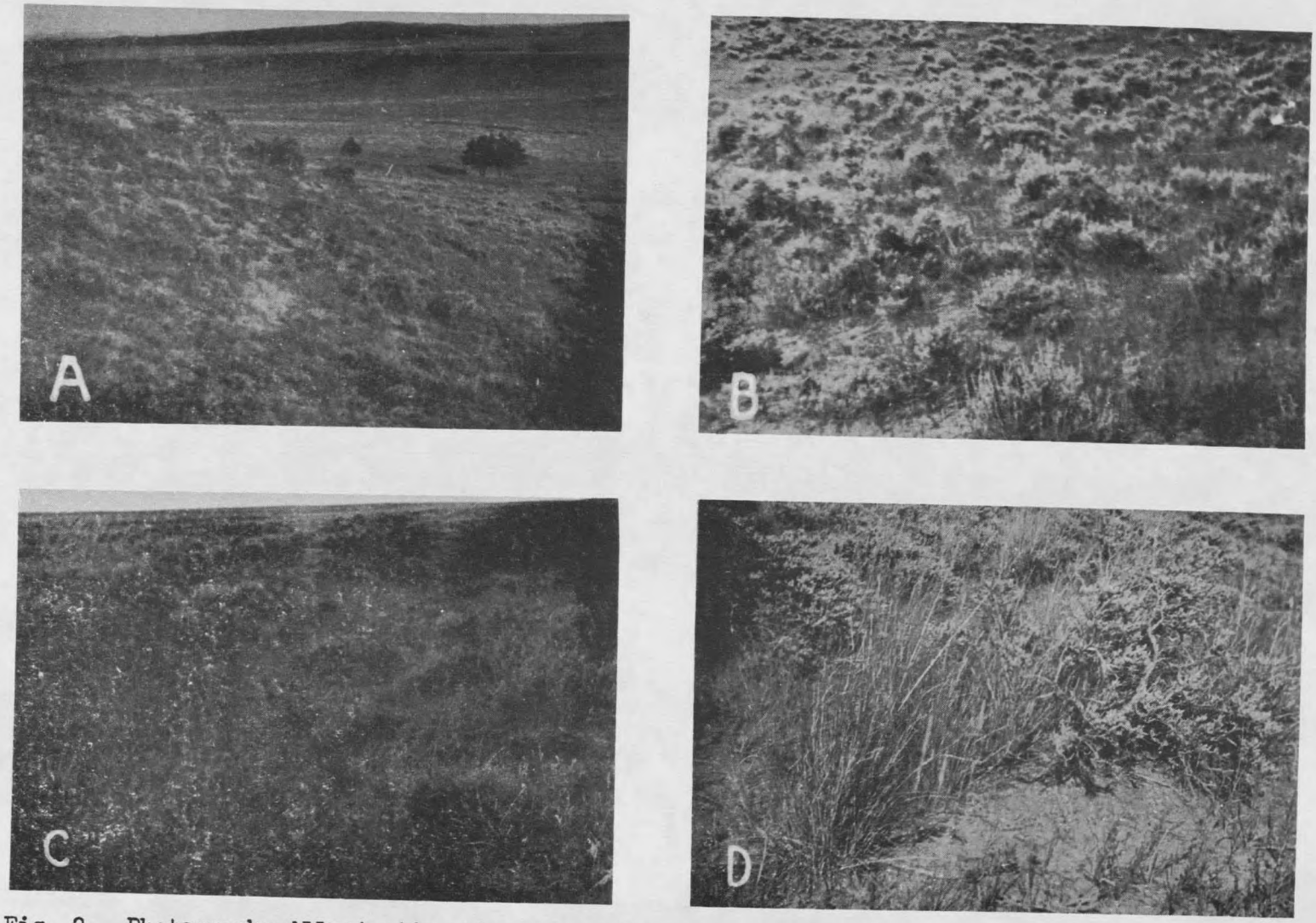

Fig. 2. Photographs illustrating characteristics of the study area. A. Characteristic physiography; upland slopes and bottomlands. B. Big Sagebrush aspect in Sagebrush-grassland type. C. Big Sagebrush-Western Wheatgrass association in an erosion cut. D. Big Sagebrush-Bluebunch Wheatgrass association.

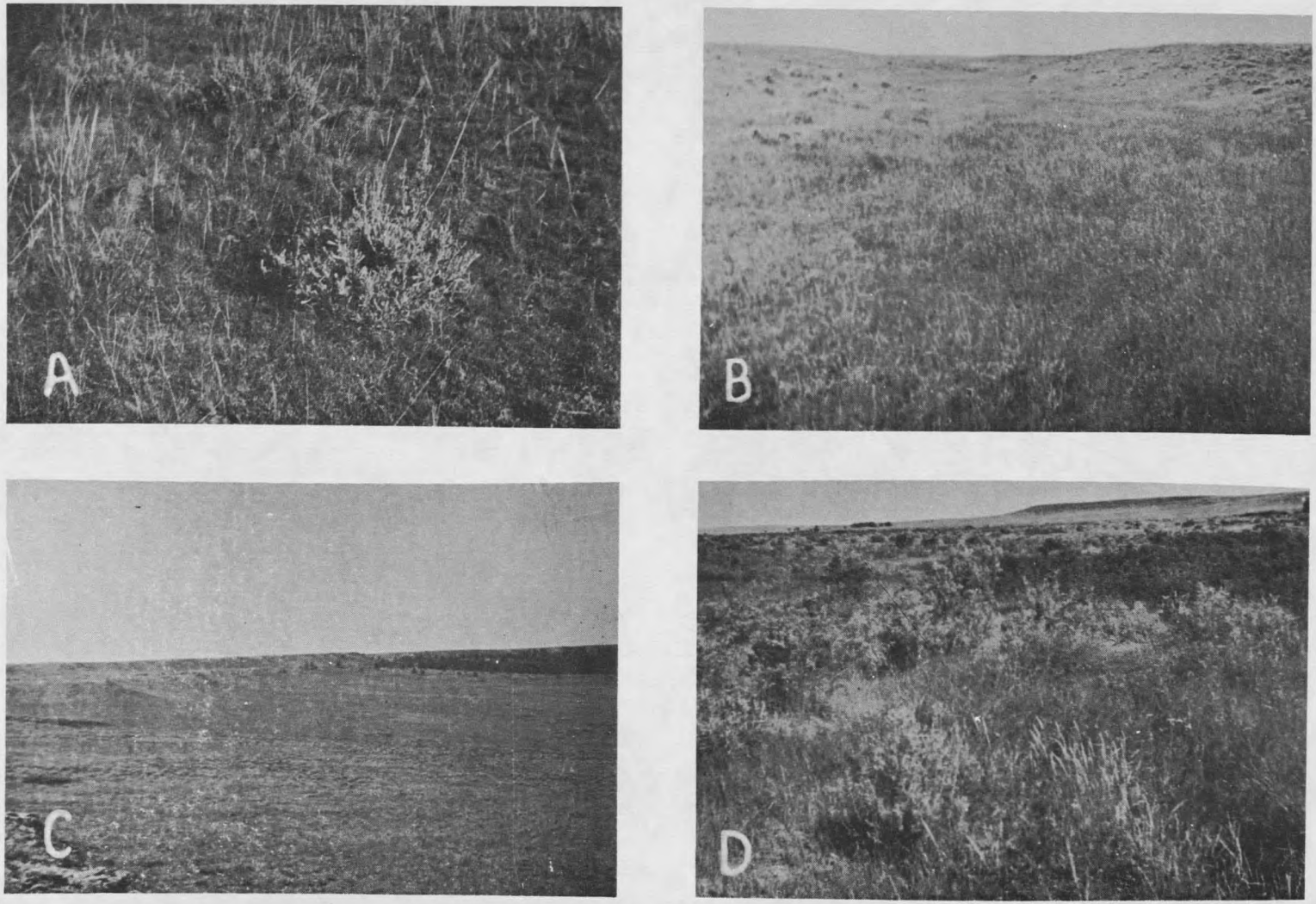

Fig. 3. Photographs illustrating characteristics of the study area. A. Big Sagebrush-Blue Grama association. B. Native grassland (Western Wheatgrass-Bluegrass) in a swale on the upland plain. C. Extensive Shale Slope type grading from a low shale ridge. D. Greasewood type showing luxuriant vegetative growth.

ly seeded Crested Wheatgrass (Agropyron cristatum) occupied the major portion of the abandoned sites. Other sites showed varying degrees of succession toward the Sagebrush-grassland type. On heavy clay soils invasions by Big Sagebrush appeared to be retarded. Here, Western Wheatgrass, Needle-and-thread (Stipa comata) and Green Needlegrass (Stipa viridula) were dominant.

Clay Slope

This was the smallest upland type. Recognition was afforded by the slope location, the absence of the Big Sagebrush aspect and the exposed clay soil. This type was confined to the southeastern third of the area and occurred on isolated west-facing slopes within Sagebrush-grassland. Forbs, especially vernal types, were relatively abundant. Stemless Goldenweed (Haploppapus acaulis), Nuttall Goldenweed (Haploppapus nuttalli) and Lewis' Wild Flax (Linum lewisi) were some of the characteristic forbs.

Shale Slope

This type had limited representation on the northwest two-thirds of the area. Here, it was confined to steep slopes below shale ridges which bordered bottomlands. On the southeastern third of the area the type was more extensive, occupying gentle slopes which graded towards bottomlands from low shale ridges (Fig. 3C). The Sagebrush-grassland type frequently occurred between the Shale Slope and other bottomland types here. Recognition of the type was afforded by the slope location, the absence of the

Big Sagebrush aspect and the coarse shale soils. The position below shale formations and a lower slope transition into other rangeland types suggested pioneer status. False Lupine (Thermopsis rhombifolia) and Big Sandgrass (Calamovilfa longifolia) were the characteristic plants.

Greasewood

In size this was a minor type, occurring only in bottomlands containing the larger streams. Recognition was afforded by the dominant aspect of Greasewood (Sarcobatus virmiculatus). Associations varied from Greasewood-Saltgrass (Distichlis stricta) on limited sites of alkali impregnated silty clays to Greasewood-Western Wheatgrass on clay loams. In close proximity to streams or on sub-irrigated sites the latter association acquired dense and luxuriant growth (Fig. 3D). A varied forb and deciduous shrub flora were present. The type was commonly adjacent to alfalfa fields.

Sagebrush-Greasewood

This type was slightly more extensive than the former. Recognition was afforded by the dominant aspect of the Big Sagebrush-Greasewood association. It was confined to bottomland flats and gentle slopes between the Sagebrush-grassland and Greasewood types. On heavy clay soils, marginal conditions for Big Sagebrush were suggested by its low stature and less vigorous appearance. Western Wheatgrass was the dominant grass. Sparse vegetation and frequent areas of bare soil were characteristic.

Abandoned Meadow

This type occurred on abandoned bottomland meadows. Only two sites were recognized; one within the Greasewood type, the other within the Sagebrush-Greasewood type. The former had more luxuriant vegetation and a greater variety of forbs and shrubs. In both, forbs appeared to be relatively more abundant than in the respective adjacent rangeland types. Western Wheatgrass was the principal grass.

Agricultural croplands

Alfalfa Fields

Alfalfa fields occupied about 4.3% (2,659 acres) of the area. They were confined to the less alkali impregnated soils along bottomlands. Field size varied from approximately 20 to 350 acres. Ditch systems intersected the fields for irrigation purposes. Alfalfa densities were variable between fields and within individual fields. Fields with sparse alfalfa were primarily one crop hay meadows with Western Wheatgrass and/or Timothy (Phleum pratense) supplying most of the forage. Other fields produced two crops annually. Either the first or second may be left for seed in years favoring production. All fields were within four to five strand barbed-wire and/or woven wire fences. The amounts of rangeland enclosed within these fences varied from narrow fence borders to more than the alfalfa acreage.

Grain Fields

Small grain fields occupied about 0.7% (462 acres) of the area. Al-

though the area is marginal for wheat, it comprised the major portion of the small grain acreage. Fields were confined to the more mature loams on upland sites and to the better drained soils along bottomlands. Bottomland fields were generally adjacent to alfalfa. Wheat and summer fallow were alternated.

USE OF VEGETATIVE TYPES

Antelope numbers, observed with the aid of a binocular and spotting scope, on the various rangeland types and croplands, were recorded along regularly established routes from April 6 to September 24, 1953 and May 23 to October 7, 1954. Routes were systematically covered in a vehicle after May 1, 1953. All portions of the area were visited at intervals of two weeks or less. The results are shown in Table 1.

Sagebrush-grassland received the greatest use for the entire period (about 49% of the total). Heavy use is indicated for spring and early summer, averaging 69.6%. Early July use sharply declined (57.3%). Further declines through late July, August and September occurred, with minimum use (22.4%) indicated for the last half of September. An increase occurred after October 1.

Grassland received minor use, about 5% of the total. A slight increase coincided with the July 1-15 decline for Sagebrush-grassland.

Only very minor use, all before the last half of July, was indicated for the Clay Slope (0.2% of the total).

Seasonally, only moderate use on Shale Slopes was indicated (about 12% of the total). A marked increase was noted after July 15. More or

Table 1. Total numbers of antelope observed along routes and the percentages of the total seen on the various rangeland types and croplands.

Periods	No. antelope observed	Percentages on rangeland types							Percentages on croplands	
		Sagebrush-grassland	Grassland	Clay Slope	Shale slope	Grease-wood	Sagebrush-greasewood	Abandoned meadow	Alfalfa fields	Grain fields
Spring										
4/6-15	571	73.4	5.9		2.8		17.7		0.2	
4/16-28	1068	60.6	4.5	0.2	4.5		30.2			
5/1-15	1117	66.2	4.2	1.3	5.5	1.0	20.9		0.8	
5/16-31	925	73.5	5.9	0.2	8.9	4.2	5.1		2.2	
Summer										
6/1-15	783	74.5	5.2		7.9	6.5	3.8		2.0	
6/16-30	1458	72.2	7.1	0.1	8.7	7.1	3.2		1.2	0.5
7/1-15	2007	57.3	10.4	0.9	8.0	18.0	1.8		2.7	0.8
7/16-31	1757	53.7	4.3		15.8	15.4	1.4	2.7	6.5	0.1
8/1-15	1778	39.7	5.6		20.2	22.9	0.4		10.0	1.2
8/16-31	2645	33.7	5.4		19.1	15.6	0.9	0.4	22.5	2.3
Fall										
9/1-15	2297	32.2	2.0		14.6	12.0	2.1		32.1	4.9
9/16-30	1688	22.4	3.9		8.7	11.7	0.1		50.3	2.9
10/1-7	339	38.1	8.8		17.7	10.9			23.9	0.6
Total	18,433	49.1	5.4	0.2	12.2	11.8	5.0	0.3	14.5	1.5

less comparable intensities of use continued to October 7, averaging 16.1%.

Seasonal use on Greasewood was also moderate (about 12%). Appreciable use after June 30 was indicated, with a relatively high peak (22.9%) in the first half of August. A gradual decline to October 7 occurred.

Overall use of Sagebrush-Greasewood was minor (about 5% of the total). Relatively high levels in spring coincided with the lower levels of heavy use on Sagebrush-grassland. A progressive decline occurred through summer.

Abandoned Meadows received very minor use (0.3% of the total). All was after July 15.

Alfalfa fields received moderate seasonal use (about 14% of the total). Early spring to midsummer use was negligible. After midsummer alfalfa field use progressively increased, reaching a maximum (50.3%) in the last half of September. A marked decline occurred after October 1.

Grain fields received minor use, 1.5% of the total. That which occurred was after June 15. Summer use increased through the first half of September and then declined. The fallow land portion of grain fields received the greatest use during the seasons when this study was conducted. Numbers of antelope seen on grain fields totaled 238 of which 229 (96%) were on fallow land.

Possible reasons for the apparent differences in the use of the various rangeland types and croplands are indicated in the following sections.

ANTELOPE FOOD HABITS

Two methods were used to determine food habits: instances of plant use at antelope feeding sites and rumen analysis. Eighty-one sites were

carefully examined during 1953 and 1954. New use on plants was recorded. An acquaintance with differences in the appearance of new and old use was obtained by clipping and examining tagged vegetation. Examinations were not made if livestock was known to have recently used the site. A rooted individual plant stem was considered the unit for recording one instance of use. A total of 5,616 instances of use on 12 browse species, 61 forbs and the grasses was recorded (Table 2). Various modifications of plant use observations to determine big game food habits have been employed by Rouse (1941), Buechner (1950), Brazda (1953), Saunders (1954) and others.

Collections of 26 antelope for rumen samples were made on or adjacent to the study area from March 3, 1953 to March 10, 1954. One was collected on September 28, 1952. Quart rumen samples were preserved in 10% formalin for laboratory examination. In the laboratory, samples were washed with water on consecutive 3 mm and 2 mm mesh screens. The fraction retained on the 3 mm screen was placed in a pan containing water. Various plants were segregated. Identifications to family, genus or species were accomplished by comparisons with reference plant collections. Volumes to the nearest 0.5 cc, by water displacement, and air-dried weights to 0.01 gram were obtained for the segregated plant items on the 3 mm screen and the unidentified material on the 2 mm screen. Items less than 0.5 cc were considered traces. After washing, the material on both screens totaled 5,044 cc. That on the 3 mm screen was approximately 24% of the total. About 88% was identifiable (Table 2).

Table 2. Antelope food habits as determined by the analyses of 27 rumen samples and 5,616 instances of plant use at antelope feeding sites. T = trace (less than 0.5 cc.).

Plants	Spring				Summer				Fall				Winter	
	Observed instances of use		Six rumen samples		Observed instances of use		Seven rumen samples		Observed instances of use		Eight rumen samples		Six rumen samples	
	No.	%	% Vol.	% Wt.	No.	%	% Vol.	% Wt.	No.	%	% Vol.	% Wt.	% Vol.	% Wt.
Artemisia tridentata	326	38.6	51.5	57.5	14	0.4	2.5	2.2	1	0.1	2.9	3.1	35.6	36.3
Artemisia frigida	24	2.8	13.4	12.1	54	1.5	0.7	0.6	17	1.4	11.5	11.6	34.4	30.9
Artemisia cana	31	3.7			26	0.7	0.4	0.3	3	0.3	12.9	14.2	23.1	25.6
Chrysothamnus nauseosus	2	0.2	3.7	2.5	56	1.6	10.2	9.1	6	0.5	4.3	5.4	3.0	3.0
Rosa arkansana	39	4.6	0.2	0.5	465	12.9	10.5	12.3	63	5.3	1.1	1.7		
Symphoricarpos occidentalis					60	1.7	8.2	8.8			17.7	16.9	0.6	0.8
Sarcobatus vermiculatus	14	1.7			23	0.6	0.1	0.1	1	0.1	T	T		
Atriplex confertifolia			1.4	1.9										
Juniperus horizontalis			0.6	1.2									0.6	0.7
Opuntia fragilis			T	T									0.9	0.6
Pinus ponderosa													T	T
Apocynum cannabium							T	T						
Eurotia lanata	15	1.8												
Salix sp.					1									
Rhus trilobata					18	0.5								
Chrysothamnus viscidiflorus					11	0.3								
Shepherdia argentea					2	0.1								
Gutierrezia sarothrae					1									
Browse totals		53.4	70.8	75.7		20.3	32.6	33.4		7.7	50.4	52.9	98.2	97.9
Medicago sativa							0.3	0.5			28.8	23.2	T	T
Tragopogon dubius					40	1.1	6.8	5.3					0.3	0.2
Artemisia ludoviciana			4.1	2.8	792	22.0	29.4	31.3	522	44.3	14.1	15.7		
Vicia sparsifolia	1	0.1	2.9	2.5	41	1.1	1.8	2.3	18	1.5				
Comandra pallida			0.4	0.4	34	0.9	0.1	0.2	3	0.3				
Lomatium foeniculaceum	43	5.1	10.7	6.5										
Allium textile	14	1.7	0.4	0.3										
Besseya cinerea			0.8	0.5										
Aster spp.	6	0.7			226	6.3	5.9	3.7	95	8.0	1.0	1.0	T	T

Table 2 (Continued)

Plants	Spring				Summer				Fall				Winter	
	Observed instances of use		Six rumen samples		Observed instances of use		Seven rumen samples		Observed instances of use		Eight rumen samples		Six rumen samples	
	No.	%	% Vol.	% Wt.	No.	%	% Vol.	% Wt.	No.	%	% Vol.	% Wt.	% Vol.	% Wt.
Solidago spp.	11	1.3			186	5.2	0.7	0.6	16	1.4	1.6	2.0		
Penstemon albidus					16	0.4	2.6	2.0						
Sphaeralcea coccinea	1	0.1			2	0.1	5.2	3.6	67	5.7	0.4	0.4		
Petalostemon spp.					247	6.9	2.9	3.6	4	0.3				
Bahia oppositifolia					1		1.3	1.2			T	T		
Psoralea tenuiflora					17	0.5	2.5	3.0	7	0.6	T	T		
Haplopappus nuttallii	19	2.3			7	0.2	2.0	2.5			0.6	0.8	T	T
Taraxacum sp.					2	0.1	0.1	0.1	57	4.8	T	T		
Linum rigidum							0.6	0.6						
Conringia orientalis							0.1	0.2						
Rumex sp.					50	1.4	1.5	1.3	1	0.1	T	T		
Polygonum spp.					3	0.1	1.0	1.4	11	0.9	0.8	1.2		
Potentila gracilis							0.4	0.6						
Astragalus agrestis					141	3.9	0.3	0.2						
Helianthus sp.					10	0.3	0.5	0.1	76	6.5			T	T
Astragalus gilviflorus	3	0.4					T	T			0.3	0.5		
Glycyrrhiza lepidota					247	6.8			2	0.2	0.8	0.8		
Trifolium sp.					10	0.3					T	T		
Hymenoxys acaulus	25	3.0	T	T	60	1.7	T	T			T	T	T	T
Achillea lanullosa			T	T	24	0.7	T	T	3	0.3	T	T		
Thelasperma gracile	9	1.1	T	T	1		T	T						
Gaura coccinea					7	0.2	T	T			T	T		
Liatris punctata					2	0.1	T	T	18	1.5				
Arenaria hookeri	1	0.1	T	T										
Astragalus missouriensis					1		T	T	4	0.3				
Verbena bracteata							T	T						
Ratibida columnaris					5	0.1			2	0.2	T	T		
Plantago spinulosa											T	T		
Melilotis alba					264	7.3			112	9.5	T	T		
Eriogonum multiceps	15	1.8			22	0.6					T	T		

Table 2 (Continued)

Plants	Spring				Summer				Fall				Winter	
	Observed instances of use		Six rumen samples		Observed instances of use		Seven rumen samples		Observed instances of use		Eight rumen samples		Six rumen samples	
	No.	%	% Vol.	% Wt.	No.	%	% Vol.	% Wt.	No.	%	% Vol.	% Wt.	% Vol.	% Wt.
Descurainia sp.									6	0.5	T	T		
Astragalus striatus									4	0.3				
Phlox hoodi	8	0.9												
Musineon divaricatum	8	0.9												
Penstemon nitidus	7	0.8												
Microseris nutans	7	0.8												
Haplopappus acaulis	4	0.5												
Lactuca scariola					330	9.2			2	0.2				
Eriogonum flavum					17	0.5								
Artemisia canadensis					9	0.3								
Astagalus flexuosus					7	0.2								
Psoralea argophylla					7	0.2								
Erigeron pumilus					6	0.2								
Chrysopsis villosa					5	0.1								
Salsola kali					4	0.1								
Grindelia squarrosa					4	0.1								
Hymenopappus filifolius					4	0.1								
Erigeron caespitosus					3	0.1			4	0.3				
Astragalus bisulcatus					1				5	0.4				
Sonchus arvensis									33	2.8				
Haploppapus spinulosus									4	0.3				
Agroseris cuspidata									4	0.3				
Atriplex argentea					4	0.1								
Unidentified Forbs			1.4	1.0							T	T	T	T
Forb totals		21.6	20.7	14.0		79.5	66.0	64.3		91.5	48.4	45.6	0.3	0.2
Lichen			T	T										
Carex filifolia			T	T									T	T
Triticum aestivum									7	0.6				
Grass totals	211	25.0	8.3	10.4	4	0.1	1.4	2.1			1.2	1.4	1.5	1.9

Spring (March, April, May)

Six rumen samples (2 for each month) were analyzed. Three were from animals collected on Sagebrush-grassland; two from Sagebrush-Greasewood and the other from Grassland. Six browse species constituted 70.8% by volume and 75.7% by weight of the rumen samples. Big Sagebrush and Fringed Sage (Artemisia frigida) were the major items, amounting to 64.9% by volume and 69.6% by weight. Forbs made up 20.7% by volume and 14.0% by weight. Ten species were identified. Lomatium (L. foeniculaceum) was the most important (10.7% vol., 6.5% wt.). Grass constituted 8.3% by volume and 10.4% by weight.

Important monthly differences were obscured by seasonal analyses (Fig. 4). Although browse easily ranked first for the entire season, forbs were first in May 61.7% vol., 53.9% wt.). Only two forbs (one as a trace) were present in the four March and April samples. The samples for April contained the greatest amount of grass (11.7% vol., 13.8% wt.); for March the least (4.2, 4.3). Percentages for May were 6.9 and 12.0.

A total of 844 instances of plant use was recorded at 33 feeding sites as follows: Sagebrush-grassland—288 observed instances of use, 17 sites; Grassland—162, 2; Clay Slope—117, 5; Shale Slope—72, 5; Sagebrush-Greasewood—205, 4. Browse received the greatest use (53.4% of all observations). Seven species were represented, but Big Sagebrush was by far the most important (38.6%). Grass use was 25.0% and forbs 21.6%. The latter was represented by 17 species. Lomatium received about one-fourth of the forb use.

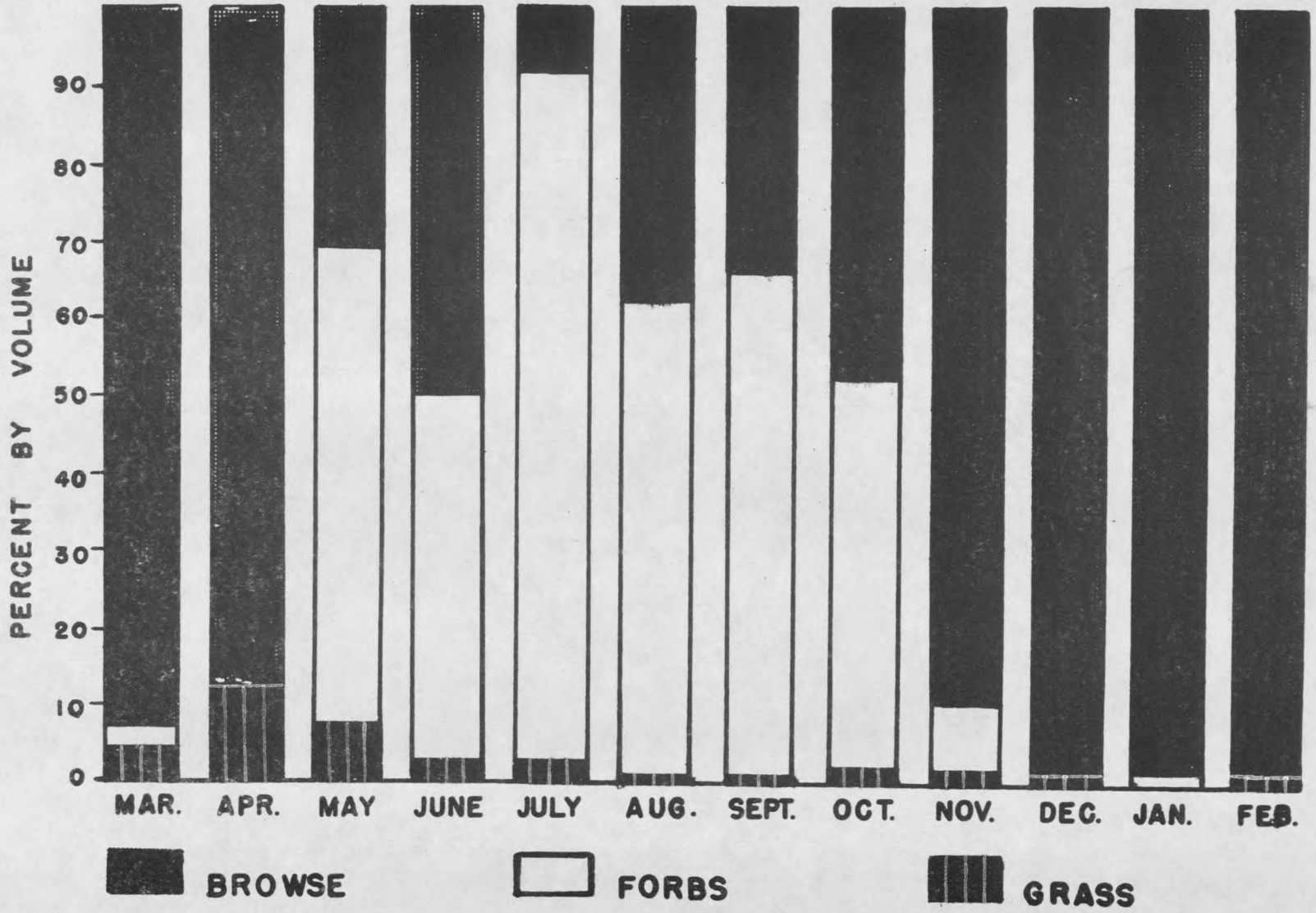

Fig. 4. Forage class use by months as indicated by volume percentages of antelope rumen samples.

Important differences in forage class use were noted for the different vegetative types. Browse was most important on the Sagebrush-grassland (94.6%), Shale Slope (69.4%) and Sagebrush-Greasewood (57.9%) Types. Big Sagebrush was the most important species on each type; 75.3%, 45.8% and 36.0% respectively. Rose (Rosa arkasana, 22.2%) was important on the Shale Slope; Silver Sagebrush (Artemisia cana, 15.1%) on Sagebrush-Greasewood. Browse use on Grassland was only 1.2%; on the Clay Slope 6.0%.

Grass ranked first only on the Grassland Type, 96.9%. Use on other types was: Sagebrush-grassland 2.4%, Clay Slope 6.0%, Shale Slope 15.3% and Sagebrush-Greasewood 14.1%.

Forbs received the greatest use on the Clay Slope 88.0%. Stemless Goldenweed, Nuttall Goldenweed and Eriogonum (E. multiceps) were important (combined usage 50.4%). Forb use on the other types was: Sagebrush-grassland 2.8% (Phlox hoodii); Grassland 1.8%; Shale Slope 15.3% (Missouri Goldenrod, Solidago missouriensis); and Sagebrush-Greasewood 27.8% (Lomatium 21.0%).

Summer (June, July, August)

Seven rumen samples (2 each for June and July, 3 for August) were analyzed. Five were from animals collected on Sagebrush-grassland; one from the Shale Slope and one from the Greasewood Type. One of the Sagebrush-grassland collections was made after the animal was observed to use the other two types. Seven browse species constituted 32.6% by volume and 33.4% by weight of the rumen samples. Rose, Rabbitbrush (Chryso-

thamnus nauseosus) and Snowberry (Symphoricarpos occidentalis) were important, amounting to 28.9% by volume and 30.2% by weight. Forbs represented 66.0% by volume and 64.3% by weight. Twenty-nine species were identified. Cudweed Sagewort (Artemisia ludoviciana) was important (29.4% vol., 31.3% wt.), exceeding all other food items. Grass constituted 1.4% by volume and 2.1% by weight.

Monthly differences obscured by seasonal analyses are shown in Figure 4. Although forbs ranked first for the season, June browse percentages (50.2% vol., 53.9% wt.) slightly exceeded those for forbs. Rose, Rabbitbrush and Big Sagebrush were important, amounting to 47.2% by volume and 49.6% by weight. The important forbs were Aster (Aster sp.) (23.3% vol., 15.4% wt.) and Cudweed Sagewort (16.0, 16.4). The July samples contained the greatest amount of forbs (90.1% vol., 85.4% wt.). Meadow Salsify (Tragopogon dubius, 21.5% vol., 17.3% wt.), Cudweed sagewort (19.4, 21.0) and Globemallow (Sphaeralcea coccinia, 17.9, 13.1) were important. Forbs also ranked first for the August samples, 60.8% by volume and 62.7% by weight. Cudweed Sagewort (40.9% vol., 41.7% wt.) was the predominant food item. Important browse species were Snowberry, Rabbitbrush and Rose, amounting to 36.5% by volume and 35.1% by weight.

A total of 3,594 instances of plant use was recorded at 38 feeding sites as follows: Sagebrush-grassland—1,380 observed instances of use, 21 sites; Grassland—92, 3; Shale Slope—853, 9; Greasewood—1,057, 4; Abandoned Meadow—212, 1. Forbs received the greatest use, 79.5% of all observations. Forty-one species were represented. Cudweed Sagewort was

the most important, 22.0%. Browse use was 20.3%; grass 0.1%. The former was represented by 12 species. Rose was the most important, receiving over half of the use for browse.

Similar forage class use was noted for the different vegetative types. Forbs were predominant for all types as follows: Sagebrush-grassland—81.8% of the use, Grassland—98.9%, Shale Slope—79.7%, Greasewood—75.3% and Abandoned Meadow—71.8%. Cudweed Sagewort was the major food item used on the Shale Slope (53.3%) and Abandoned Meadow (25.0%) and was important on all other types except Grassland. On Grassland Stemless Actinea (Hymenoxys acaulis, 50.5%) and Sweetclover (Melilotus alba, 45.6%) were the most frequently used. Important forbs, other than Cudweed Sagewort, on Sagebrush-grassland were Sweetclover (1954 only), Purple Milkvetch (Astragalus agrestis), and Prairieclover (Petalostemon purpureum); on the Shale Slope, Aster and Missouri Goldenrod; on Greasewood, Prickly Lettuce (Lactuca scariola) and Wild Licorice (Glycyrrhiza lepidota); on the Abandoned Meadow, Aster (A. commutatus). Rose was the principal browse on the Sagebrush-grassland, Shale Slope and Greasewood Types; 8.0%, 13.3% and 21.3% respectively. On the Abandoned Meadow, Rose use (7.5%) ranked second to Snowberry (17.4%).

Grass use was detected at only one site (Sagebrush-grassland) during the summer season.

Fall (September, October, November)

Eight rumen samples (3 each for September and October, 2 for November) were analyzed. Four were from animals collected on Sagebrush-

grassland; four from alfalfa fields. Six browse species constituted 50.4% by volume and 52.9% by weight of the samples. Snowberry, Fringed Sage and Silver Sagebrush were important, representing 42.1% by volume and 42.7% by weight. Forbs were 48.4% by volume and 45.6% by weight. Twenty-four species were represented. Alfalfa (Medicago sativa) (28.8% vol., 23.2% wt.) and Cudweed Sagewort (14.1% vol., 15.7% wt.) were by far the most important. Grass constituted 1.2% by volume and 1.4% by weight.

Seasonal analyses obscured important forage class differences with respect to months (Fig. 4). Browse ranked first for the season, but forbs were first (64.8% vol., 62.6% wt.) in September and about equal (50.1% vol., 49.1% wt.) to browse in October. In November, Browse ranked first by far (90.1% by volume and 90.6% by weight).

Individual rumen samples show important differences in the use of food items, especially alfalfa. This forb was the major food item for September 24 and 27 and October 8 and 26 rumen samples. Three were from animals collected on alfalfa fields; one from Sagebrush-grassland located about one quarter mile from an alfalfa field. Alfalfa volumes and air-dried weights for these samples were as follows: 62.1%, 52.2%; 62.5%, 57.5%; 56.1%, 56.2%; and 70.9%, 63.0%. Browse species, especially Fringed Sage, Snowberry and Rose, made up most of the remaining sample percentages.

September 11 and October 10 samples, from animals collected on Sage-brush-grassland, each had a browse species as a major food item. For the former, Fringed Sage (40.6% vol., 33.2% wt.) was the major item, but five

forbs represented 52.5% by volume and 57.1% by weight. Cudweed Sagewort and Missouri Goldenrod were most important. For October, Snowberry, a browse species, was the major food item (53.4% by volume and 48.0% by weight). All browse constituted 67.6% by volume and 64.6% by weight, but Cudweed Sagewort, a forb, ranked as the second most important item (30.7% vol., 33.2% wt.).

The November 16 sample was from an animal collected on an alfalfa field. Browse was the predominant food, 79.2% by volume and 80.6% by weight. Silver Sagebrush (41.5% vol., 40.4% wt.) and Big Sagebrush (20.7% vol., 21.7% wt.) ranked first and second as food items. Alfalfa (18.9% vol., 16.8% wt.) ranked as the third most important item. Two other forbs occurred as traces.

The November 30 sample was from an animal collected on Sagebrush-grassland. Silver Sagebrush (82.1% vol., 78.6% wt.) and Fringed Sage (16.4% vol., 19.5% wt.), both browse species, were the predominant foods. Grass constituted the remaining 1.5% by volume and 1.9% by weight.

The data from recorded plant use are limited to September and represent only the early fall season. A total of 1,178 instances of use was recorded at 14 sites as follows: Sagebrush-grassland—572 instances of use, 6 sites; Grassland—78, 1; Shale Slope—291, 5; Fallow land—237, 2. Forbs received the greatest use, 91.5% of the total. Twenty-six species were represented. Cudweed Sagewort (44.3%) was by far the most frequently used. Browse constituted 7.7%. Rose (5.3%) was the most important. Grass use was not detected.

Similar forage class use occurred on the different vegetative types. Forbs were used predominantly on all types as follows: Sagebrush-grassland—86.6%; Grassland—100.0%; Shale Slope—95.5%; Fallow land—99.6%. Cudweed Sagewort was major food item used on Sagebrush-grassland and the Shale Slope, 56.8% and 67.7% respectively. Sweetclover (71.8%) received the greatest use on Grassland and was important (23.6%) on Fallow land. On the latter type other important forbs were Sunflower (Helianthus sp., 32.1%), Dandelion (Taraxacum sp., 21.1%) and Sowthistle (Sonchus arvensis, 13.9%).

Winter (December, January, February)

Six rumen samples (2 for December, 1 for January and 3 for February) were analyzed. Five were from animals collected on Sagebrush-grassland; one from Sagebrush-Greasewood. Seven browse species constituted 98.2% by volume and 97.9% by weight of the samples. Big Sagebrush, Fringed Sage and Silver Sagebrush were the major food items, amounting to 93.1% by volume and 92.8% by weight. One forb (Meadow Salsify) made up 0.3% by volume and 0.2% by weight. Grass represented 1.5% by volume and 1.9% by weight.

Browse ranked first for all months (Fig. 4) as follows: December—91.8% by volume and 97.5% by weight; January—98.4%, 98.8%; February—98.2%, 97.6%. Big Sagebrush, Fringed Sage and Silver Sagebrush were the three major food items for the December and February samples. Either Fringed Sage or Big Sagebrush ranked as the major food item for the individual samples. The January sample, from Sagebrush-Greasewood, had

Silver Sagebrush (84.4% vol., 85.4% wt.), Fringed Sage (4.7, 5.3) and Rabbitbrush (3.1, 3.1) as the three major food items. Grass occurred as a trace.

Yearlong

The rumen samples from all seasons were averaged. Twelve browse species amounted to 56.6% by volume and 60.4% by weight. Forty-seven forb species made up 40.6% by volume and 36.1% by weight. The grasses constituted 2.8% by volume and 3.5% by weight.

These data suggest the following general food habits for antelope on the study area.

Through late fall, winter and the first two months of spring browse species, especially Big Sagebrush, Fringed Sage and Silver Sage, were the predominant food. Forbs were minor. Grass was a minor food at all times, but relatively greater utilization occurred during spring. Vernal forbs were important as food during late spring. They were obtained primarily from the Clay Slope, Shale Slope and Sagebrush-Greasewood Types.

During summer, forbs were the predominant food and the major class of forage utilized on the various vegetative types. Certain browse species, Rose, Rabbitbrush and Snowberry, were important. A variety of forb species were utilized, but few in any quantity. Cudweed Sagewort was one of the most important forbs.

Through the first two months of fall forbs, principally Cudweed Sagewort, were still the predominant food. Antelope using alfalfa fields utilized Alfalfa as their major food. The same browse species utilized

in summer were important as secondary items. Antelope using rangeland vegetation exclusively, utilized either browse or forbs as their predominant food. Fringed Sage or Snowberry were important as major food items. Cudweed Sagewort was an important secondary item.

Differences between the data from recorded plant use and rumen analyses are apparent. Two forbs, Sweetclover and Prickly Lettuce, were indicated important by the former technique, but not by the latter. This was attributed to differences in availability. About 75% of the total use on Sweetclover was recorded in 1954 when this forb was more abundant than in 1953. Prickly Lettuce had extremely limited distribution on the area. About 98% of the use on this plant was recorded from one site along an irrigation ditch.

Browse was indicated to have been of less importance by plant use data. Norris (1943) concluded, from his identifications of dry material in stomach samples, that coarse-textured plants were digested at a slower rate, causing this type of forage to be given undue weight as a food by the analysis technique. While the technique used in this study involved the identification of plant parts before drying, the possibility of differential digestion giving undue weight to browse species can not be discounted. More obviously, the differences between the results from the two methods used in this study were attributed to incomplete sampling of feeding sites and recording use on rooted stems. Sparsely vegetated sites favored detecting use by direct observations or following antelope tracks. The greater abundance of forbs on these sites may have resulted

in their being given undue weight as food. As compared to forbs, a more satisfactory measure of browse consumption would probably have been accomplished by recording use of leaders, since considerable numbers on a single rooted stem were invariably used.

The importance of browse as an antelope food has been reported by Couey (1946), Buck (1947), Einarson (1948), Ferrel and Leach (1952) and Mason (1952). Buechner (op. cit.) found that forbs were the most important food in Texas.

USE OF ALFALFA FIELDS

Fields Used

Thirteen alfalfa fields were within portions of the study area frequented by antelope. During 1953 and 1954 two fields were observed regularly, mornings and evenings, to determine antelope use. The others were observed as they were encountered along routes (discussed earlier). A total of 1,705 field observations was recorded.

Antelope were not observed (625 observations) on 5 of the 13 fields. All five were fenced. One, apart from inhabited ranch buildings, was within a fence composed of five strand barbed-wire or woven wire. Rangeland within the fenced area was about equal to the alfalfa acreage. The fences of the others were either four or five strand barbed-wire. These fields were immediately adjacent to inhabited ranch buildings. Enclosed rangeland was confined to the fence borders for all four fields.

On the eight fields observed to have been used, 2,937 antelope were recorded for 236 of 1,080 field observations. For both years relatively

greater use was indicated for the same four fields (Nos. 1-4). Numbers of observations and average numbers of antelope per observation follow: Field No. 1—309, 3.5; Field No. 2—283, 3.4; Field No. 3—74, 4.4; Field No. 4—79, 4.4. Field size ranged from 70.5 to 350 acres. A five strand barbed-wire fence enclosed Field No. 2. Antelope were observed to enter and leave this field by crawling under the bottom wire at a gate and/or where the fence passed over four erosion cuts. Measurements from the ground to the bottom wire at the gate gave a maximum height of 17 inches; at the erosion cuts 20, 21.5, 16 and 19 inches. Along the same fence 19 maximum height measurements (ground to bottom wire) between posts averaged 13 inches (11 to 16). Four strand barbed-wire fences enclosed the other three fields. Antelope experienced little difficulty in crawling under these fences. Upon entering or leaving the fields they habitually used the same places along the fence. Maximum ground to bottom wire measurements between 45 posts (Field No. 4) averaged 16 inches (12.5 to 22). Two places where well worn antelope trails went under the fence measured 17.5 and 18 inches. All four fields were apart from inhabited ranches. Amounts of rangeland included within the fences were approximately equal to or greater than the alfalfa acreages.

On the other four fields (Nos. 5-8) relatively less antelope use was indicated. Numbers of observations and average numbers of antelope per observation follow: Field No. 5—108, 0.4; Field No. 6—74, 0.2; Field No. 7—93, 0.2; Field No. 8—60, 2.4. These fields ranged from 165 to 233 acres. Only one (No. 5) was observed to have been used both years. It was enclosed within a four strand barbed-wire fence. The amount of

rangeland in the enclosure was greater than the alfalfa acreage. This field was adjacent to an inhabited ranch. Field Nos. 6 and 7 were used in 1953 only. The former had its alfalfa acreage enclosed within four and five strand barbed-wire fences and was apart from inhabited buildings. Enclosed rangeland was confined to fence borders. When not utilizing alfalfa, antelope inhabited an adjacent rangeland pasture. This pasture was alongside a well traveled road. In 1954 the pasture was used by sheep. Field No. 7 was enclosed within four strands of barbed-wire prior to mid-summer 1953. At this time a section of woven wire was placed around the western end of the field. The remainder of the fence was converted to five strands by the addition of a bottom wire. The rancher owning the field reported that antelope use during 1951 and 1952 had been heavy, with about 60 and 100 head involved for the two years respectively. Subsequent observations after the fence improvement in 1953 (12) and 38 observations in 1954 indicated that the field was no longer used. This field was apart from inhabited ranch buildings. The amount of enclosed rangeland was greater than the alfalfa acreage.

Field No. 8 was used during 1954 only. In 1953 access was apparently prevented by a woven wire fence along the west boundary. In 1954 antelope were observed to crawl under a four strand barbed-wire fence where it joined the woven wire on the southwest corner of the field. This field was apart from inhabited ranch buildings. Enclosed rangeland was confined to fence borders. After utilizing the field, antelope were observed to habitually return to rangeland outside the fence.

The data suggested that alfalfa fields located in the immediate proximity of inhabited ranches were less subject to antelope use. This could have been due to disturbances resulting from human activity. Fields apart from inhabited ranches, with considerable amounts of rangeland enclosed within the fence, were subjected to the greatest use. Fields similarly located, but having rangeland confined to fence borders, received relatively less use. This suggests that antelope preferred undisturbed situations where both alfalfa and appreciable amounts of rangeland were readily available within the same fence. Use of fields where rangeland within the fence was limited was possibly curtailed by the necessity of frequently crawling under a fence to have access to both alfalfa and rangeland. Apparently rangeland is essential to the pronghorn. This was suggested by the food habits study. Even antelope collected from alfalfa fields had consumed substantial amounts of rangeland plants. Furthermore, antelope using alfalfa fields were noted to habitually bed on adjacent rangeland. Exceptions to this were noted. An adult male was observed to prevent a group of females and fawns from leaving a field, forcing them to bed in the alfalfa. Other exceptions occurred only where adjacent fallow land or sparsely vegetated areas within the field were available. This suggests that antelope have an aversion to bedding in dense vegetation.

Fence characteristics in some instances undoubtedly determined whether an alfalfa field was used. Access to seven of the eight fields used was by crawling under the bottom wire of four strand barbed-wire fences. Access to the other was under the bottom wire of a five strand

barbed-wire fence either at a gate or at one of four erosion cuts. Fences composed of sections of woven wire and five strand barbed-wire were apparently responsible for the non-use of two fields. Both were apart from inhabited ranches and had large amounts of rangeland enclosed within the fence. The rancher who owned one of the fields reported that antelope had been excluded from the field since 1948 when the fence was constructed. Use on the other had been heavy prior to converting its four strand fence to five strands by adding a bottom wire (a section of woven wire was also added). Antelope ceased to use this field after fence modification.

Antelope were not observed to gain access to any field at a point protected by woven wire. Buechner (op. cit.) considered sheep-proof fences (woven wire) effective barriers to antelope in Texas. He also observed that antelope readily crawled under four or five strand fences on cattle range. On this study area five strand fences were apparently effective barriers except at points where unusual clearance was permitted; e.g., erosion cuts and gates. Seven ground to bottom wire measurements at places along five strand fences observed to "stop" antelope averaged 9.5 inches (7 to 11). Four strand fences were apparently ineffective barriers. Only one antelope, a large adult male, was observed to have been "stopped" along a four strand fence. Ground to bottom wire measurements at the two places were 16 and 15.5 inches. Fourteen measurements along four strand fences where antelope were observed to crawl under averaged 17 inches (14.5 to 23.5).

The chest depths (brisket to top of the shoulders) of 55 antelope

were measured in October 1954 at a checking station. Twenty fawns averaged 11 inches (9.5 to 12.75); 44 adults and yearlings 13 inches (11.75 to 14.5).

Only one antelope, an adult male, was observed to jump fences. Seven observations were recorded. Ground to top wire measurements at four points of jumping were 42, 44, 45 and 46 inches. Rouse (1954) reported that "many of the antelope in southern Carter County, Montana, have learned to jump fences up to 45 inches in height". He reported that adult antelope commonly jumped fences to utilize alfalfa fields. One of the alfalfa fields, reported as not being used by antelope in that area, had a 36 inch high woven wire fence topped with three strands of barbed-wire spaced 6 inches apart. Buechner (op. cit.) cited Fisher and others for records of antelope jumping fences in Texas. He concluded from his study that, "Most antelope seem unaware of their ability to jump for they often die of starvation on severely overgrazed sheep ranges rather than jump sheep-proof fences."

Numbers Using Fields

The maximum size of antelope groups observed on each of the alfalfa fields used suggested the numbers of animals involved in depredation. The maximum size of groups and the dates they were observed on the seven fields used in 1953 were as follows: Field No. 1—33, September 8, 13; Field No. 2—22, October 22, 23; Field No. 3—41, September 11; Field No. 4—22, August 30; Field No. 5—8, August 13; Field No. 6—14, August 28; Field No. 7—11, August 13. For the six fields used in 1954 similar data were

as follows: Field No. 1—35, September 30; Field No. 2—16, September 30, October 1, 4, 5; Field No. 3—35, September 7; Field No. 4—40, September 6; Field No. 5—9, August 9, September 30; Field No. 8—34, September 14, 17. Tagged animals (see section on movements) and composition counts indicated that Fields No. 3 and 8 were used by the same antelope. Other fields were observed to have been used by distinct antelope groups.

These data suggest that approximately 151 antelope were involved in alfalfa field depredation after midsummer 1953, 135 in 1954. These figures represent 39% and 31% of the 1953 and 1954 summer populations respectively.

Differences in Numbers Using Fields and Intensities of Field Use

Seasonal and inseason differences in the numbers of antelope utilizing alfalfa fields and the intensities of field use were illustrated by data from regular observations of Field Nos. 1 and 2 during 1953 and 1954 (Table 3). An indication of the numbers utilizing fields was the average group size. Different intensities of use were indicated by average numbers per observation.

Antelope were not observed on the fields during April. From May to August relatively few (average group size 4.0) utilized the fields. Intensities of use were low, averaging less than 0.5 antelope per observation. Low intensities (1.4) were still indicated for the first half of August, but numbers utilizing the fields had apparently increased (11.0). A slight increase in numbers (12.5) utilizing fields and a marked increase in the intensity of use (7.4) occurred during the last half of August.

Table 3. Seasonal differences in numbers of antelope utilizing alfalfa fields and intensities of field use as indicated by the size of antelope groups and numbers per observation.

Period	Total No. obser-vations	No. observ. antelope seen	No. of antelope observed	Av. No. antelope per ob-servation	Av. group size
1st half Apr.	17	0			
2nd half Apr.	22	0			
1st half May	40	2	6	0.2	3.0(1-5)
2nd half May	34	3	19	0.6	6.3(4-10)
1st half June	38	10	16	0.4	1.6(1-5)
2nd half June	72	4	6	0.1	1.5(1-2)
1st half July	61	7	35	0.6	5.0(1-10)
2nd half July	55	9	59	1.1	6.5(1-10)
1st half Aug.	54	7	77	1.4	11.0(7-22)
2nd half Aug.	69	41	511	7.4	12.5(1-35)
1st half Sept.	66	30	529	8.0	17.6(13-33)
2nd half Sept.	53	35	706	13.3	20.2(15-32)
1st wk. Oct.	11	7	74	6.7	10.6(1-16)
Totals	592	155	2,038		

Intensities of use increased (8.0) and greater numbers (17.6) utilized the fields during the first half of September. The greatest numbers (20.2) and the highest intensities of use (13.3) were indicated for the last half of September. After October 1, both the numbers of antelope (10.6) and the intensities of field use (6.7) decreased.

Sex and Age Classes Using Fields

The sex and age classes involved in depredation were determined in 1953 and 1954. Adult male, yearling male, female and fawn classes were recognized. Relatively small and undeveloped horns distinguished yearling males from adult males. The absence of a dark throat patch and small horns separated females from males. Fawns were recognized by their small size. Classifications were made with a binocular or a spotting scope. Various associations of the different sex and age classes comprised groups. A total of 30 "singles" and 210 groups was observed.

The animals recorded as "singles" were as follows: females, 20; adult males, 9; yearling males, 1. The various associations comprising groups and the number of times each was observed were as follows; one adult male-female(s) with or without fawns—146, female(s)-fawn(s)—33, two or more male-female(s) with or without fawns—10; two or more females—8; two or more males—4; two or more fawns—3; one yearling male-female(s) with or without fawns—3; one or more males-fawn(s)—3.

Through April to September 26 "singles" (20 females, 6 adult males) and 100 groups were observed on alfalfa fields; through September to October 7, 4 singles (3 adult males, 1 yearling male) and 110 groups.

Prior to September, 65 of the groups seen on fields were one adult male-female(s) with or without fawns associations. Other group associations and the number of times each was seen were as follows: female(s)-fawn(s)—24; two or more females—8; two or more fawns—2; two or more males (1 adult, 1 yearling)-female(s) with or without fawns—1. During September and October, 81 of the groups seen on fields were the one adult male-female(s) with or without fawns association; 9, two or more females; 9, two or more males-female(s) with or without fawns; 4, two or more males; 3, one yearling male-female(s) with or without fawns; 3, one or more males-fawn(s); and 1, two or more fawns.

The data show that alfalfa fields were utilized by all sex and age classes. Females, fawns and adult males were the segment of the population most involved. The one adult male-female(s) with or without fawns association was the principal group. Prior to September only one instance of more than one male in a group using fields was recorded. During September and October various associations of males (adult or yearling) with males, females, females and fawns and fawns were observed.

The apparent increase in the number of males using alfalfa fields during September and October was indicated to coincide with the rut (see later section) and the breeding season. Five observations of adult males covering females were recorded. The dates were September 16, 20, 20, 21 and 22. An additional observation for October 1, was reported to the writer by R. L. Eng, Montana Fish and Game biologist.

Limited use of alfalfa fields by yearling males and more than one

adult male in the company of females and fawns was suggested. This was attributed to certain adult males apparently being intolerant of other males. Adult males associated with females or females and fawns were observed to actively pursue yearlings or other adult males attempting to associate with the group. This behavior was observed on 25 occasions from May 15 to October 6. All months except June were represented. One of the observations was of a yearling male attempting to expel three other yearling males. Twenty-four were of adult males chasing yearling or other adult males. Degrees of intolerance were observed. Two adult males, (each with female-fawn associates) utilizing the same field, appeared to tolerate each other. Both were observed to chase yearling males. One chased a lone adult male ignored by the other. In two cases, where more than one adult male habitually used the same field, different portions of the field were utilized. Two males in 1953 and one in 1954 were apparently successful in keeping all other males off the fields they and their respective female-fawn associates utilized. These data suggested that the behavior of certain adult males influenced field use by other males (either as individuals or as groups) and female-fawn groups associated with other adult males.

Movements in Relation to Alfalfa Fields

To obtain information on movements, observations of marked or otherwise recognizable individuals were recorded. In 1953 (May 17 to June 6), 26 fawns were located (Fig. 5) by systematically searching areas where adult females were seen. They were marked by attaching plastic markers,

Fig. 5. Antelope fawn in Sagebrush-grassland type.

as described by Johnson (1951), to either the right or left ear with a metal stock tag. A tag without a marker was placed in the opposite ear. Sixteen fawns were marked in 1954 (May 26 to May 31). The vegetative types and the number of fawns located on each were as follows: Sagebrush-grassland—33; Sagebrush-Greasewood—5; Greasewood—2; Grassland—1; Shale Slope—1. Certain adults were recognizable by horn peculiarities (9 males) or a physical deformity (1 female). A binocular or a spotting scope was employed to identify marked or recognizable individuals. The maximum distance a marked animal was identified in 1953 was 332 yards (paced). A 20-power spotting scope was used. In 1954 a marked fawn was identified at approximately 500 yards (map measure) with a 40-power scope.

Most identifications were made at less than 200 yards.

For both years 488 relocations (observations after the initial marking or recognition) were recorded. Only 449 of 31 individuals (21 marked, 10 recognizable), each relocated five or more times, were considered adequate for movement analyses. Fifteen of the 21 marked individuals (as fawns and/or yearlings) and seven of the ten recognizable adults were observed to use alfalfa fields. The maximum distance each was seen from the field used was plotted on aerial photos. For the others (six marked, three recognizable) not observed to use fields, the maximum and minimum distances each was seen from the nearest alfalfa field was plotted. The results are shown in Table 4.

The average maximum distance the 15 marked individuals (14 as fawns, 1 as a yearling) were indicated to have moved to or from the fields they used was 2.2 miles (1.3 to 3.8), the 7 recognizable adults 2.5 miles (0.4 to 4.6). For the animals not observed to use fields, the minimum distances the six marked individuals (five as fawns, one as a yearling) were seen from alfalfa fields averaged 1.0 miles (0.1 to 2.0), the maximum from these fields 3.0 miles (1.2 to 4.4). The minimum and maximum distances for the three recognizable adult males (not observed on fields) averaged 1.0 miles (0.5 to 1.7) and 2.1 miles (1.2 to 3.2) respectively.

The data suggest that on this area the distances that antelope had to travel was not the deciding factor in their use of an alfalfa field. All 15 of the marked individuals were indicated to have traveled greater distances to or from a field than No. 31 (not using a field) would have

Table 4. The maximum distances 22 antelope were seen from the alfalfa fields they used and the maximum and minimum distances 9 (not using alfalfa fields) were seen from the nearest field.

Marked indiv. No.	Date marked	No. of relocations 1953	No. of relocations 1954	Distances seen from fields (miles) Minimum	Distances seen from fields (miles) Maximum
2(M)**	5/17	24(6/21-9/23)		on No. 1	1.7
3(F)**	5/21	19(7/18-9/23)		on No. 1	1.4
4(F)	5/22	5(7/1-7/9)		0.6 of No. 2	2.4
5(F)	5/23	22(6/21-9/23)		on No. 1	1.4
6(F)	5/23	18(6/5-9/22)		on No. 2	3.0
7(F)	5/25	5(7/9-9/17)	12(5/23-10/7)	0.1* of No. 2	3.6*
8(M)	5/25	5(7/9-9/17)		2.0 of No. 2	3.2
9(F)	5/26	15(7/2-12/26)	13(6/13-10/7)	on No. 4	3.8*
11(M)	5/27	22(6/18-9/23)		on No. 1	1.4
15(M)	5/28	11(6/22-9/18)		on No. 4	1.5
16(M)	5/28	10(7/20-9/18)	3(6/15-9/16)	on No. 4	3.8*
18(F)	5/31	19(6/1-9/23)		on No. 1	1.5
19(F)	5/31	18(6/5-9/22)		on No. 2	3.0
22(M)	6/2	2(8/2-9/4)	5(6/15-9/2)	2.0 of No. 4	4.4*
26(M)	6/6	29(6/21-9/23)		on No. 1	1.7
31(F)	5/28		7(7/5-10/5)	0.5 of No. 2	1.2
32(F)	5/28		15(7/4-10/6)	on Nos. 3 & 8	2.2
35(M)	5/29		5(7/4-10/6)	1.1 of No. 4	3.3
38(M)	5/29		9(7/11-10/6)	on Nos. 3 & 8	2.5
41(M)	5/30		18(6/14-10/4)	on No. 1	2.7
42(F)	5/31		8(7/4-10/7)	on No. 4	1.3
Recog. adults No.	**Date first recog.**				
1(F)	8/8	5(8/9-9/19)	12(5/28-9/2)	on Nos. 3 & 6	3.7
2(M)	4/15	5(5/26-9/17)		on No. 4	4.6
3(M)	7/3	15(7/17-9/24)		on No. 3	0.9
4(M)	7/14	6(7/15-9/14)	13(6/25-10/5)	0.5 of No. 1	1.2
5(M)	7/21	12(7/21-9/23)		on No. 4	4.1
6(M)	7/23	16(7/26-9/22)		on No. 2	0.4
7(M)	7/26	2(7/27-8/2)	11(6/13-10/7)	1.7 of No. 4	3.2
8(M)	6/13		11(6/25-10/5)	on No. 1	2.1
9(M)	7/26		9(7/28-10/7)	on No. 4	1.8
10(M)	8/2		13(8/6-10/6)	0.7 of No. 4	2.0

* Movements as a yearling
** M - Male; F - Female

had to travel to reach a field. Six, using fields, traveled greater distances to or from a field than would have been necessary for No. 4 (this fawn may have died early), two greater distances than No. 8. Five of the recognizable adults traveled greater distances than would have been necessary for Male No. 4, four greater distances than No. 10 and three greater distances than No. 7.

More extensive movements for yearlings than for fawns was suggested by the data from the four marked individuals (2 males, 2 females) which were relocated during the two successive years. The wandering tendencies of yearling deer, especially males, has been reported by Leopold et al (1951).

Some of the factors influencing movements in relation to fields were indicated by the association habits and movements of the various sex and age classes. The following data illustrate these differences.

Female-fawn groups habitually using alfalfa fields

The 15 marked fawns, observed to use fields, were mostly associated with female-fawn groups. The numbers of individuals comprising groups varied from time to time. Fawn No. 18 was observed to have been associated with one group prior to mid-August and with another after that date. The movement behavior of these groups, characterized by marked fawns, was considered to represent the general pattern of movements for female-fawn groups. The extreme range of the movements (the greatest diameter of the area traveled over) for 13 fawns (2 were twins of other marked fawns), associated in female-fawn groups, averaged 2.7 miles (1.5 to 3.7). The

composition of female-fawn groups and the movements are illustrated by the complete history of Fawn No. 26 in Table 5. Figure 6A shows the movements graphically.

Female-fawn groups were characteristically attended by one adult male. This was reported for antelope in Texas by Buechner (op. cit.). Adult male No. 4 attended the group (characterized by Fawn No. 26) only at the western limit of their movements (relocations No. 5, 11, 13—Fig. 6A). Another adult male attended the group when they were using Field No. 1, or were in the area extending from the vicinity of the field to the eastern limit of their movements. The movement pattern suggested that the use of Field No. 1 constituted either a seasonal extension or intensified use on the northern edge of the summer home range. Data from other marked fawns involved in field use showed a similar pattern.

Adult males habitually using fields

Recognizable males No. 3, 6 and 9 were observed to habitually use alfalfa fields. The extreme movements for these were less extensive than those for female-fawn groups, averaging 1.3 miles (0.7 to 2.0). These males were characteristically associated with female-fawn groups or occurred alone on relatively small areas. Data for adult male No. 6 are given in Table 6. Figure 6B shows the movements graphically. Positive identifications indicated that this male occupied the area in the vicinity of Field No. 2 (the field he used) from July 23 to September 22. On the former date a distinguishing accessory "prong" was noted on his left horn providing a basis for subsequent identifications. It is believed that he

Table 5. The composition of groups associated with Fawn No. 26 and their movements as indicated by relocations of Fawn No. 26. *M - Male; ** Females and fawns; SB-GL - Sagebrush-grassland; GL - Grassland; GW - Greasewood; S.S. - Shale Slope.

Relocation No.	Dates relocated	Marked or recognizable associates		No. and classification of all associates					Vegetative type relocated on	Distance (miles) from previous site seen
		Fawns No.	Adults	Females	Fawns	Adult male	Yearling male			
1	6/21	2, 5, 11, 12		4	5				SB-GL	0.2
2	6/22								"	0.8
3	7/3	2, 5, 11, 12		17	21				G L	1.1
4	7/16	2, 3		8	8	1			SB-GL	1.0
5	7/18	3	*M No. 4	14	8	1			"	1.4
6	7/22	3		10	4	1			"	1.0
7	7/27	5, 11		4	6	1			"	0.5
8	7/31	2		7	3	1			"	0.6
9	8/2	2		5	4				G W	0.3
10	8/4	2, 5, 11		11	10	1			SB-GL	0.2
11	8/6	3, 2	M No. 4	13	11	1			S.S.	2.5
12	8/9	2, 5, 11		8	12	1			SB-GL	0.1
13	8/12		M No. 4	11	9	1			S.S.	0.1
14	8/14	2, 3		6	7	1			Alfalfa	1.4
15	8/17	2, 3, 5, 11, 18		12	14	1			SB-GL	0.4
16	8/21	2, 3, 18		11	10				"	1.0
17	8/24	3, 18		10	13	1			Alfalfa	1.3
18	8/28	2, 5, 11		13	10	1			SB-GL	0.1
19	8/29	2, 3, 5, 18		11	11	1			Alfalfa	0.1
20	8/31	2, 3, 5, 11, 18		11	6	1			SB-GL	1.2
21	9/4	2, 3, 5, 11, 18		28**		1			Alfalfa	1.2
22	9/5	2, 3, 5, 11, 18		14	14	1			SB-GL	1.2
23	9/17	2, 3, 5		15	14	1			Alfalfa	1.2
24	9/18	3, 18		28**		1			"	0.0
25	9/19	2, 3, 5, 18		30**		1			"	0.0
26	9/20	2, 3, 5, 11, 18		8	15	1			"	0.0
27	9/21	3, 5, 11, 18		16	13	1			"	0.0
28	9/22	3, 5, 11, 18		31**		1			"	0.0
29	9/23	2, 3, 5, 11, 18		15	15	1	2		SB-GL	0.5

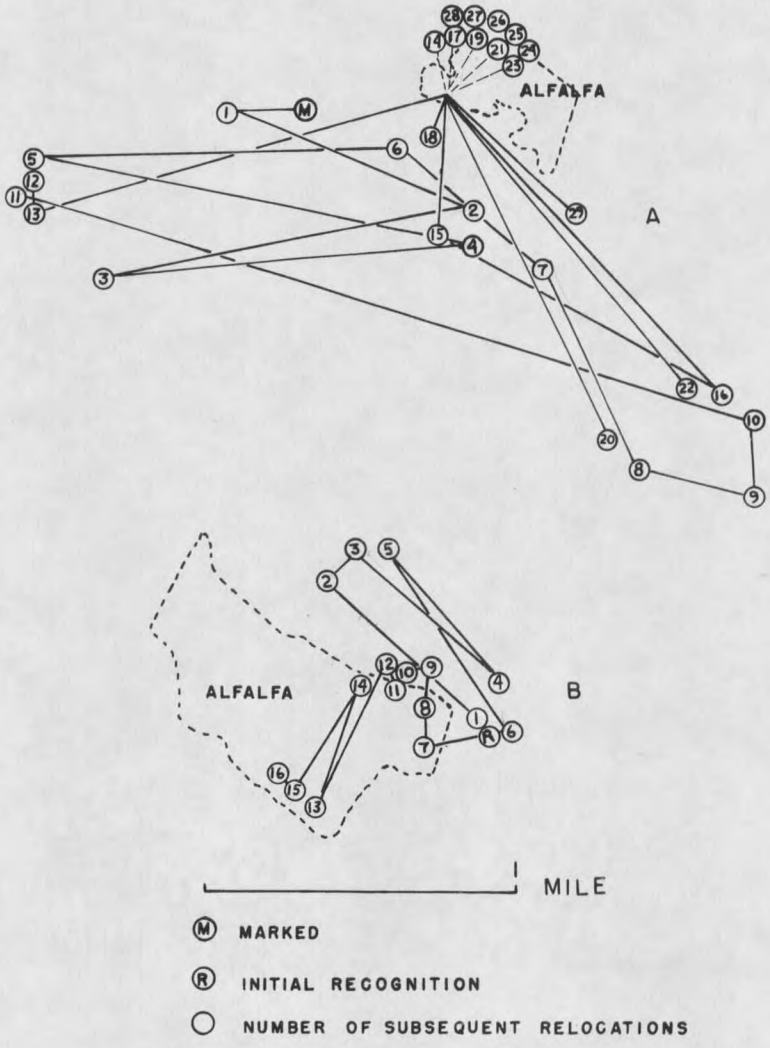

Fig. 6. Diagrams showing movement patterns of antelope as indicated by sight records. A. Fawn No. 26 and associates. B. Adult male No. 6.

Table 6. The composition of groups associated with Adult Male No. 6 and his movements.

Relocation No.	Dates relocated	Marked associates	No. and classification of all associates		Vegetative type re-located on	Distance (miles) from previous site seen
		Fawns No.	Females	Fawns		
	7/23	6, 19	7	2	G W	Recognized
1	7/26	6, 19	9	8	G W	0.0
2	7/27		1	1	SB-GL	0.6
3	7/31				"	0.1
4	8/1				G L	0.6
5	8/3				SB-GL	0.5
6	8/8		6	4	G W	0.7
7	8/16		3	6	Alfalfa	0.3
8	8/17		1	2	"	0.1
9	8/19		5	4	G W	0.1
10	8/24		2	4	F.L.	0.1
11	8/28		5	6	Alfalfa	0.0
12	8/31	19	8	6	F.L.	0.0
13	9/4	6, 19	7	8	Alfalfa	0.4
14	9/7	6, 19	9	8	"	0.3
15	9/16	6, 19	11	8	"	0.3
16	9/22	6, 19	12	9	"	0.0

G W - Greasewood type; SB-GL - Sagebrush-grassland; F.L. - fallow land.

had occupied the same area as early as April 6. An adult male was seen to jump a fence in this area on April 6, May 12, and July 1. Subsequent observations of male No. 6 revealed that he jumped fences.

The data from all three of these recognizable males suggested that certain adult males were apparently attached to a definite "territory". Einarson (op. cit) and Mc Lean (1944) noted this behavior. Further evidence (see previous section) that female-fawn groups were not "permanently" attached to the "territory" of a given male was provided by Fawns No. 6 and 19. These fawns were observed in groups associated with Male No. 6 during late July, late August and September (Table 6). They were not observed with Male No. 6 from July 27 to August 28. During this period they were seen in female-fawn groups, attended by another male, 2.8 miles from the field on August 3; 3.4 miles from the field on August 21.

Males not using fields until the onset of the rut (September)

Groups of yearling and adult males were frequently seen in bachelor herds on rangeland throughout the summer. Similar bachelor herds have been described by Buechner (op. cit.). Recognizable males No. 2, 5 and 8 were each observed in different bachelor herds. In September Males No. 2 and 8 were observed either alone on rangeland or in the company of females and/or fawns on rangeland or alfalfa fields. Male No. 5 was also indicated to have deserted the male group with which he was associated. On August 27 he was observed in the company of females and fawns adjacent to Field No. 4. Subsequent observations of him using this field and attending female-fawn groups suggested that he had successfully established a

"territory". Two marked fawns in the group attended by this male indicated that he had acquired individuals from a larger group previously attended by a different adult male. (A marked fawn in a group attended by Male No. 8 when he used Field No. 1 had also been previously associated with a larger group and a different adult male). The movements of bachelor herd males was indicated to have been greater than those of any other segment of the population. Extremes for the three recognizable males, associating with other males in herds during the summer, averaged 4.1 miles (3.0 to 4.7). The summer association with other males, culminating in the attending of female-fawn groups using alfalfa fields, is illustrated by the data from Male No. 5 (Table 7). His more extensive movements while with a bachelor herd than with a female-fawn group using a field are shown by Table 7 and Figure 7B.

The reasons for the apparent segregation of yearling and certain adult males into herds apart from female-fawn groups were suggested by the following observations. Males in bachelor herds were observed attempting to associate with females throughout the late spring and summer. When a resident adult male was present they were driven off. Male No. 6 was seen in male groups chased by a resident adult male attending a female-fawn group on two occasions. When female-fawn groups were out of the "territory" of a resident adult male (see earlier section) they were frequently molested by bachelor herd males. The aggressive sexual behavior of these males (both yearlings and adults) in bachelor herds was noted to cause females to leave their presence. Male antelope appear-

Table 7. The composition of groups associated with Adult Male No. 5 and his movements.

Relocation No.	Dates relocated	Marked fawn Associates	No. and classification of all associates				Vegetative types relocated on	Distances (miles) from previous site
			Females	Fawns	Adult males	Yearling males		
-	7/21				1	9	SB-GL	Recognized
1	7/21				1	7	"	1.5
2	7/27				1	6	"	1.6
3	8/7				1		S.S.	4.7
4	8/27		2	2			G W	3.2
5	8/28		20*				Alfalfa	0.9
6	8/29	No. 16	4	4			G W	0.8
7	8/31	No. 16	7	6			S.S.	0.8
8	9/6	No. 15	12	8			Alfalfa	1.5
9	9/11		6	5			G W	0.8
10	9/18		1				Alfalfa	0.7
11	9/20		3	4			"	0.1
12	9/23		7*				SB-GL	1.5

* Females and fawns not classified further; SB-GL - Sagebrush-grassland type; S.S. - Shale Slope type; G W - Greasewood type.

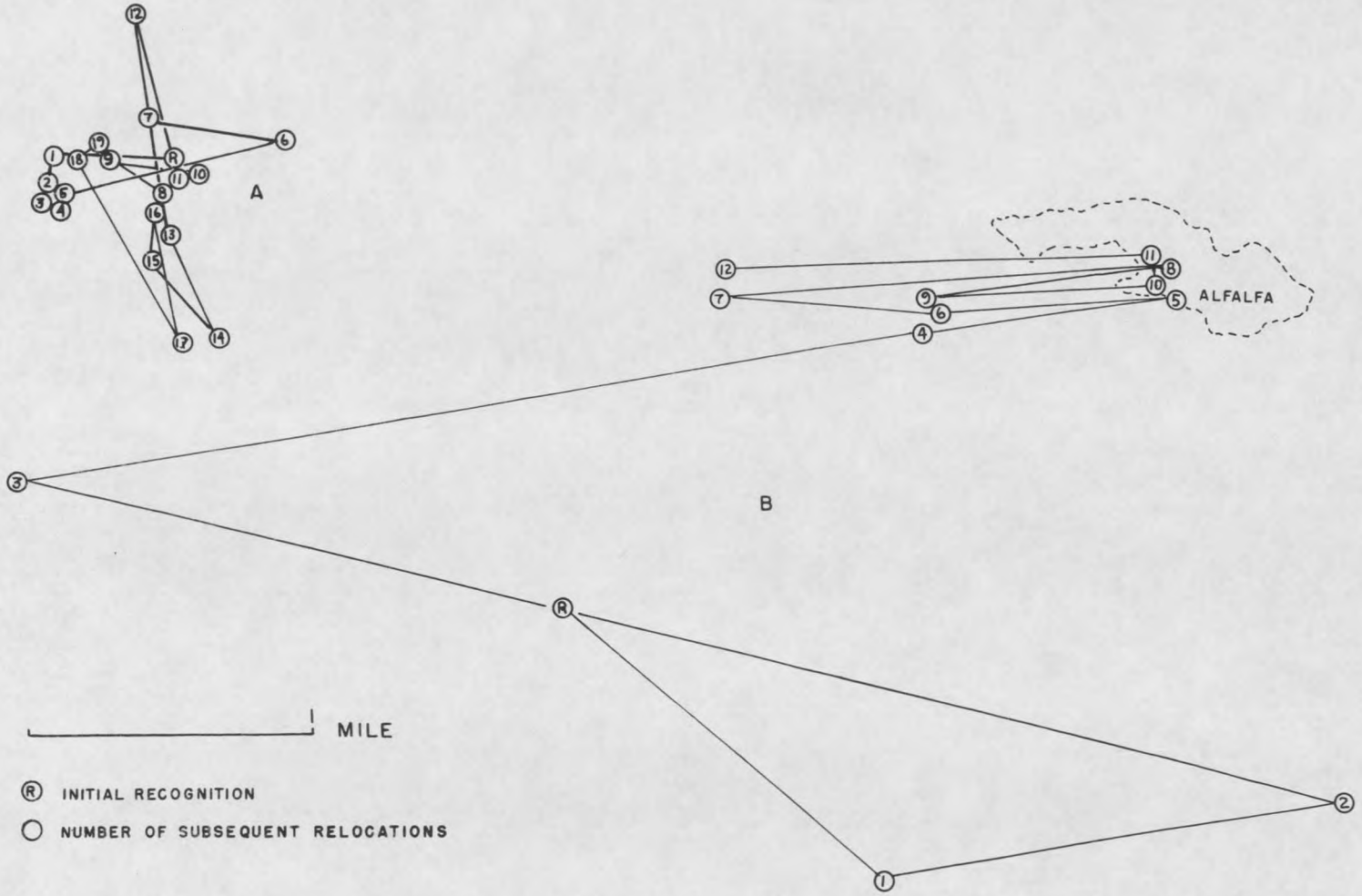

Fig. 7. Diagrams showing movement patterns of antelope as indicated by sight records. A. Adult male No. 4. B. Adult male No. 5 and associates.

ed to be sexually inclined in all but the winter season in Texas (Buechner, op. cit.). In the present study males in bachelor herds appeared to be sexually inclined at an earlier date than males habitually attending the females. The former were observed to display toward females as early as June 18 and throughout the summer. This behavior was first recorded for the adult males habitually attending female-fawn groups on August 28. Heightened sexual behavior for all males was noted during September, suggesting that this month marks the onset of the rut. The males from bachelor herds, moving onto fields at this time, were undoubtedly motivated by the presence of the females habitually using these fields. During September the persistent aggressiveness of males from bachelor herds appeared to impose limits on the ability of resident males to keep their female-fawn groups intact.

Adult males not using fields

Recognizable males No. 4, 7 and 10 were not observed to use alfalfa fields even though their respective "territories" were within 0.5 mile, 0.7 mile and 1.7 miles of fields (Nos. 1 and 4) habitually used by other antelope. Relocations of males No. 4 and 7 indicated that they occupied the same territories during the two successive years. When first seen in 1954 (June 25) male No. 4 was 0.1 mile from where he was initially recognized in 1953 (July 14). The first relocation of male No. 7 in 1954 (June 13) was 0.3 mile from where he was first seen in 1953 (July 26). The unusual 1953 horn characteristics of these males was retained in 1954. Evidence that these two males and male No. 10 were resident to relatively

Table 8. The composition of groups associated with Adult Male No. 4 and his movements.

Relocation No.	Dates relocated	Marked fawns No.	Associates No. and classification of all associates			Vegetative type re-located on	Distance (miles) from previous site
			Females	Fawns	Yearling Male		
	7/14/53		1	1		SB-GL	Recognized
1	7/15	11	25*			"	0.4
2	7/18	3, 26	14	9		S.S.	0.1
3	7/22					"	0.0
4	8/6	2, 3, 26	13	12		"	0.0
5	8/12	26	11	10		"	0.0
6	9/14					SB-GL	0.8
7	6/25/54		4			"	0.4
8	6/30		3			"	0.2
9	7/4		5			"	0.2
10	7/14		1			"	0.3
11	7/28		5	4		"	0.1
12	8/2	41	6	8		"	0.6
13	8/11					G L	0.7
14	8/14	41	12	14		SB-GL	0.4
15	8/21		1			G L	0.3
16	8/24					"	0.1
17	9/17				1	SB-GL	0.4
18	9/17					"	0.7
19	10/5		6	5		"	0.1

* Females and fawns not classified further; SB-GL - Sagebrush-grassland type; S.S. - Shale Slope type; GL - Grassland type.

small areas ("territories") was provided by their movements. Extremes averaged 1.3 miles (1.1 to 1.6). On their respective "territories" these males were characteristically associated with female-fawn groups or occurred alone. This is illustrated by relocations of male No. 4 (Table 8) Figure 7A. In the respective female-fawn groups attended by the three males, eight marked individuals (6 fawns, 2 yearling females) were observed. Relocations of these individuals in female-fawn groups attended by different adult males provided further evidence that these groups moved between the "territories" of resident males. Observations indicated that the movements from a "territory" often required considerable effort on the part of females or female-fawn groups. Resident males attempted to prevent desertion by actively pursuing and turning back the individuals involved. Movements into a "territory" were actively aided or even instigated by herding on the part of a resident adult male. This herding or turning back behavior, where adult males actively influenced the movements of females or female-fawn groups, was observed on 26 occasions ranging from June 30 to October 5. All months were represented.

Effects of Antelope Use on Fields

To determine the effects of intense use by appreciable numbers of antelope (maximum number 33 in 1953, 35 in 1954), data were obtained from the second crops of alfalfa on Field No. 1 (70.5 acres) during 1953 and 1954. Two-thirds of the alfalfa acreage was on the north side of a creek which intersected the field. The southern one-third (23.5 acres) was bounded on the north, east and west by this stream. Only this portion of

the field was habitually used by antelope. The entrance route was along the south boundary. Non-use of the northern portion of the field was apparently due to antelope being unwilling to cross the creek (even when dry) which was bordered by shrubs and trees.

In 1954, data were obtained from alfalfa plants within three fenced exclosures and on portions of the field utilized by antelope. The exclosures were 10 by 20 feet and were located in representative densities of alfalfa. Three transect lines (100 feet apart) were run from the south boundary north through the long axis of the field. Each line was divided into 100-foot sections to facilitate the evaluation of data at different distances from the field edge. As an index to levels of utilization, the maximum heights and numbers of stems used on the plants intersected by transect lines were recorded. Numbers of blossoms and seed pods were recorded as an indication of "potential" seed production. The results are shown in Table 9.

Relatively few blossoms and seed pods were recorded for plants intersected by the first four 100-foot sections of the transect lines. Plant heights were relatively low (Table 9). Greater average heights and numbers of blossoms and seed pods were recorded for sections No. 5, 6 and 7. Still greater average heights and numbers of blossoms and seed pods were recorded for sections No. 8, 9 and 10.

Differences in levels of utilization, as indicated by plant heights, were visually apparent. The heights of plants outside an exclosure, located 50 feet from the south edge of the field, were obviously lower than plants within (Fig. 8). Differences were less apparent between

Table 9. Maximum heights and numbers of blossoms and seed pods for alfalfa plants within three exclosures and along transect lines on the 23.5 acre portion of Field No. 1 used by antelope.

100 ft. transect section	No. plants intersected	No. stems	% of stems used	Av. maximum plant heights	No. of blossoms & seed pods	
					Total	Av. No. per plant
1(0 - 100)*	36	1004	86.8	8.0	124	3.4
2(100-200)	38	1120	95.5	6.0	8	0.2
3(200-300)	35	1119	96.1	7.0	15	0.4
4(300-400)	29	1113	93.5	9.0	41	1.4
5(400-500)	26	1461	92.0	12.5	218	8.4
6(500-600)	22	1046	87.9	12.5	278	12.6
7(600-700)	35	892	88.8	11.0	375	10.7
8(700-800)	25	773	87.3	14.5	456	18.2
9(800-900)	7	153	78.4	13.0	246	35.1
10(900-971)	5	77	80.5	13.5	98	19.6
Totals	258	8,758	90.7	9.8	1,859	7.2
Three exclosures	150			17.9	10,480	69.9

* Distance from field border.

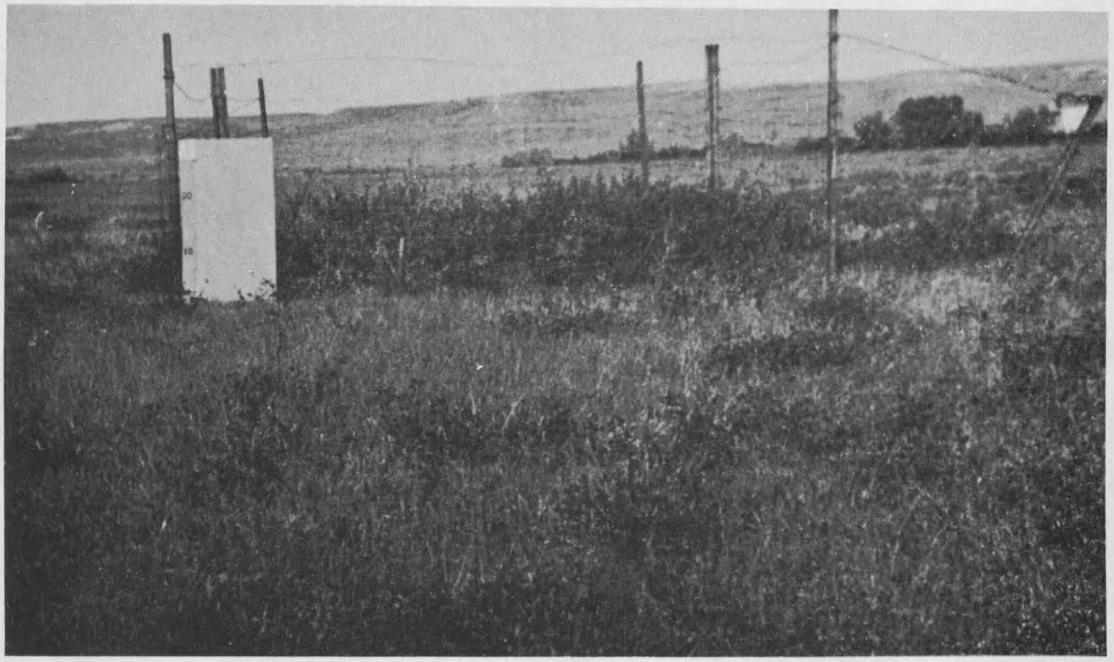

Fig. 8. Differences in alfalfa plant heights inside and outside an exclosure 50 feet from the south boundary of Field No. 1.

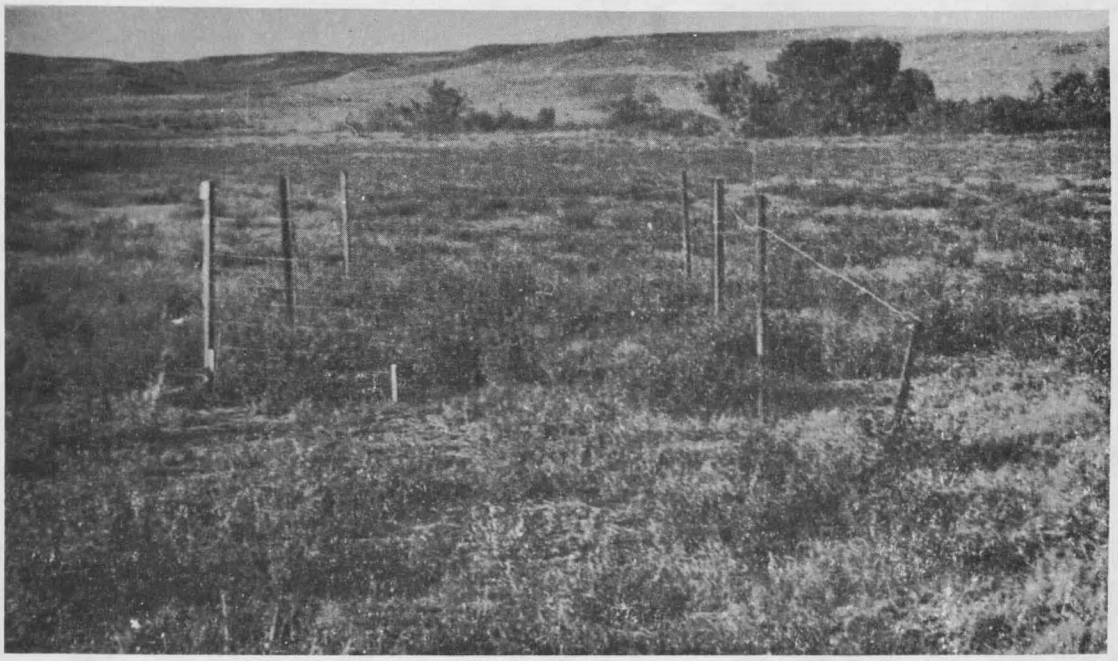

Fig. 9. Differences in alfalfa plant heights inside and outside an exclosure 430 feet from the south boundary of Field No. 1.

plants inside and outside an exclosure located 430 feet within the field (Fig. 9), but close examination revealed that the terminal parts of plants outside the exclosure had been taken (Fig. 10). Similar terminal utilization, but to a lesser degree, occurred in the vicinity of an exclosure located 650 feet within the field.

The data suggested that appreciable plant utilization and severe reductions in "seed potential" occurred throughout the southern one-third (23.5 acres) of this field. Only two plants, intersected along transect lines, had non-use recorded for all stems. For all of the intersected plants, 90.7% (7,943) of the stems showed evidence of utilization. Plants protected by exclosures averaged 8.1 inches (82.6%) higher and had an average of 62.7 more blossoms and/or seed pods per plant than those on portions of the field used by antelope. Exclosure plants averaged 10.5 inches (141.9%) higher and had an average of 68.6 more blossoms and/or seed pods per plant than those along transect lines within the first 400 feet of the field's south boundary. Within a 200 foot area, beginning 100 feet from the south edge, maximum levels of utilization and reductions in "seed potential" were found. Exclosure plants averaged 11.4 inches (175.4%) higher and had an average of 69.6 more blossoms and/or seed pods per plant than those intersected within this area. Progressively, from 400 feet (from the south edge) north to 971 feet, less severe levels of utilization and reductions in "seed potential" were suggested. Exclosure plants averaged 5.4 inches (43.2%) higher and had an average of 61.5 more blossoms and/or seed pods per plant than those within the 400 to 500 foot section; 3.4 inches (23.4%) higher and 51.7 more blossoms and/or seed pods

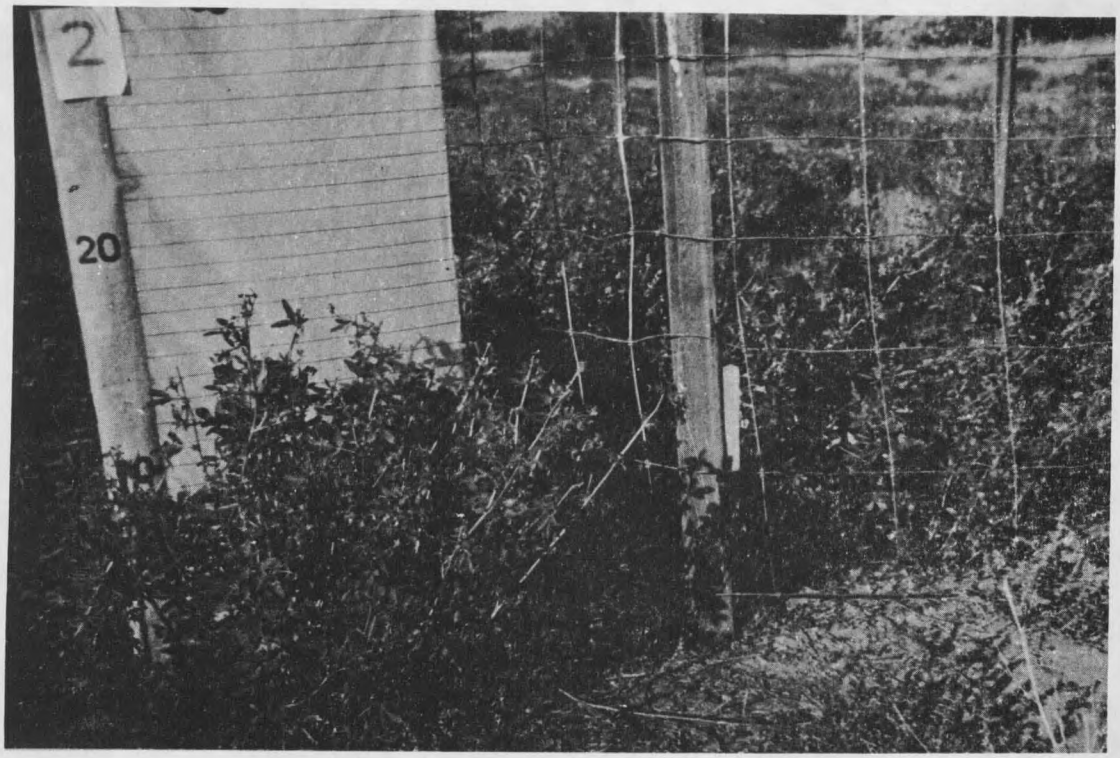

Fig. 10. Terminal utilization on an alfalfa plant in the vicinity of an exclosure 430 feet from the south boundary of Field No. 1.

per plant than those within the 700 to 800 foot section.

In 1953 heights and numbers of blossoms and seed pods were recorded from alfalfa plants intersected along transect lines (50 feet apart) run east and west through the entire 23.5 acre portion of Field No. 1. A total of 855 plants was intersected. Only two had non-use of all stems. The average maximum height of all intersected plants was 5.8 inches (4.0 inches shorter than 1954). Blossoms and/or seed pods averaged 3.4 per plant.

Differences in plant heights and numbers of blossoms and seed pods within the field were apparent. Within the first 300 feet from the south boundary 439 intersected plants had the lowest maximum heights (average 4.0 inches) and the fewest numbers of blossoms and/or seed pods (0.5 per plant). Relatively greater heights (average 7.0 inches) and numbers of blossoms and/or seed pods (4.7 per plant) were recorded for 332 plants intersected along lines 300 to 800 feet from the field's south boundary. The greatest heights (average 10.7) and numbers of blossoms and/or seed pods (13.4 per plant) were recorded from 84 plants intersected along transect lines within 800 to 971 feet (the north boundary).

The same general pattern as shown by the 1954 data was suggested, i.e., more severe utilization and reductions in "seed potential" in the portion of the field along the boundary where antelope first entered and progressively less toward the opposite side of the field. More intense utilization was suggested for 1953 than 1954, but the differences in heights for the two years were largely attributed to plant growth. In 1953 the first crop was mowed six days earlier (July 21) than in 1954, but

the regrowth of plants was retarded by dry weather. Records from the U. S. Department of Commerce Station, six miles south of the study area, showed August 1953 precipitation was 0.9 inches, in 1954, 3.18 inches. Plants had relatively greater heights in 1954 than in 1953 when appreciable numbers of antelope first used the field (the last half of August for both years).

Pellet group counts were used by Bennett et al (1940) and others as an index to the relative use of vegetational types by deer. On the 23.5 acre portion of Field No. 1 and on the eastern 400 foot wide by 1700 foot long (15.6 acres) portion of Field No. 3, antelope pellet groups were counted three feet on either side of successive 100 foot transect line sections. The pellet groups counted represented the aggregate use on the first and second crops. The results are shown on Figure 11. Pellet group counts on Field No. 1 corroborated the results from plant measurements in showing the sections of the field receiving the greatest use and provided further evidence that antelope were responsible for the differences in plant heights. Pellet group counts on Field No. 3 suggested that only a relatively small portion of this 204 acre field received appreciable use. A comparison of the number of pellet groups with the average maximum plant heights along transect lines on Field No. 1 indicated an inverse relationship (Fig. 12).

SUMMARY

1. The range use and food habits of the pronghorn antelope, Antilocarpa americana, were investigated on a 62,160 acre study area in Central

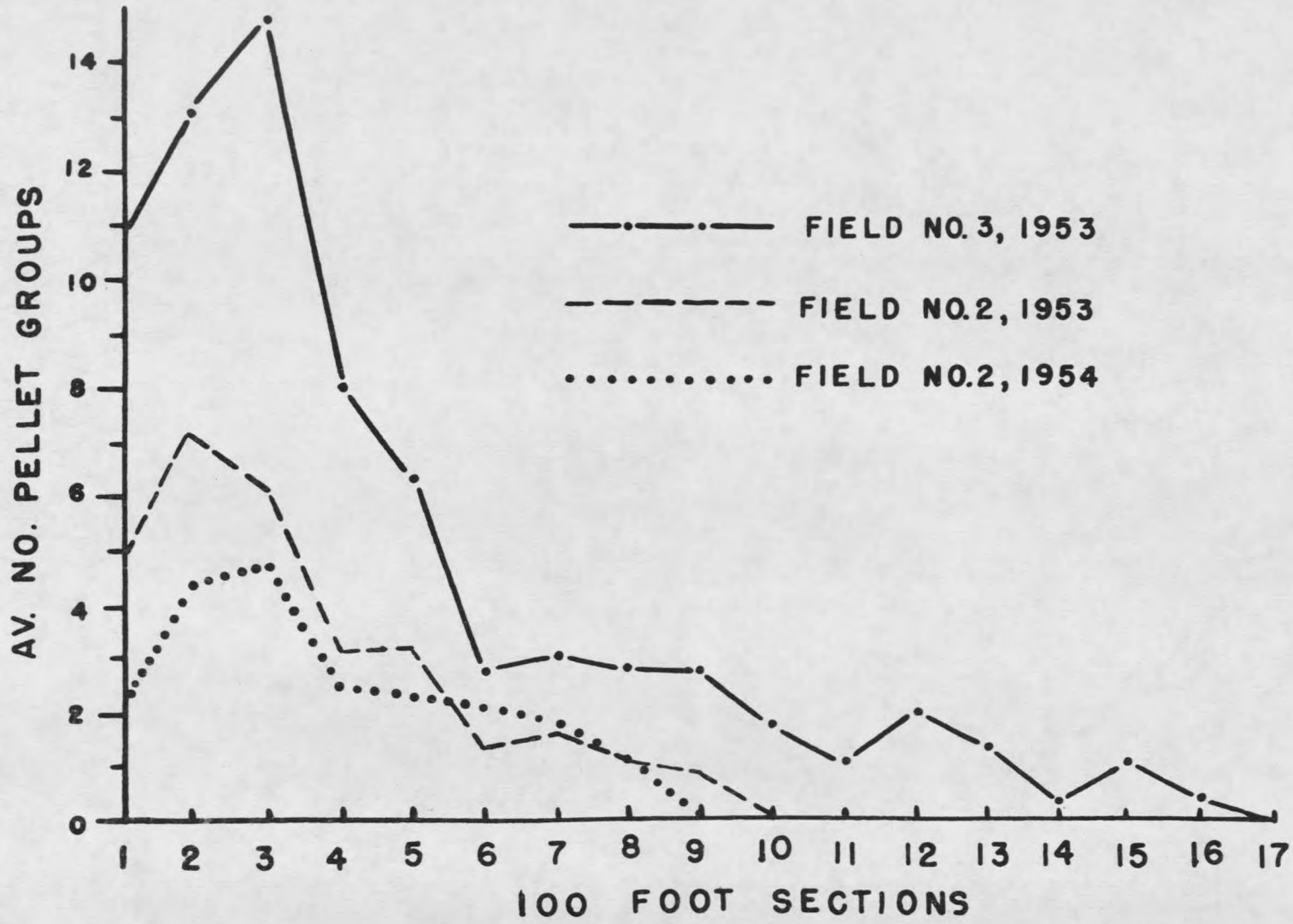

Fig. 11. Numbers of antelope pellet groups along successive 100 foot sections of transect lines beginning at the boundary where antelope entered alfalfa fields.

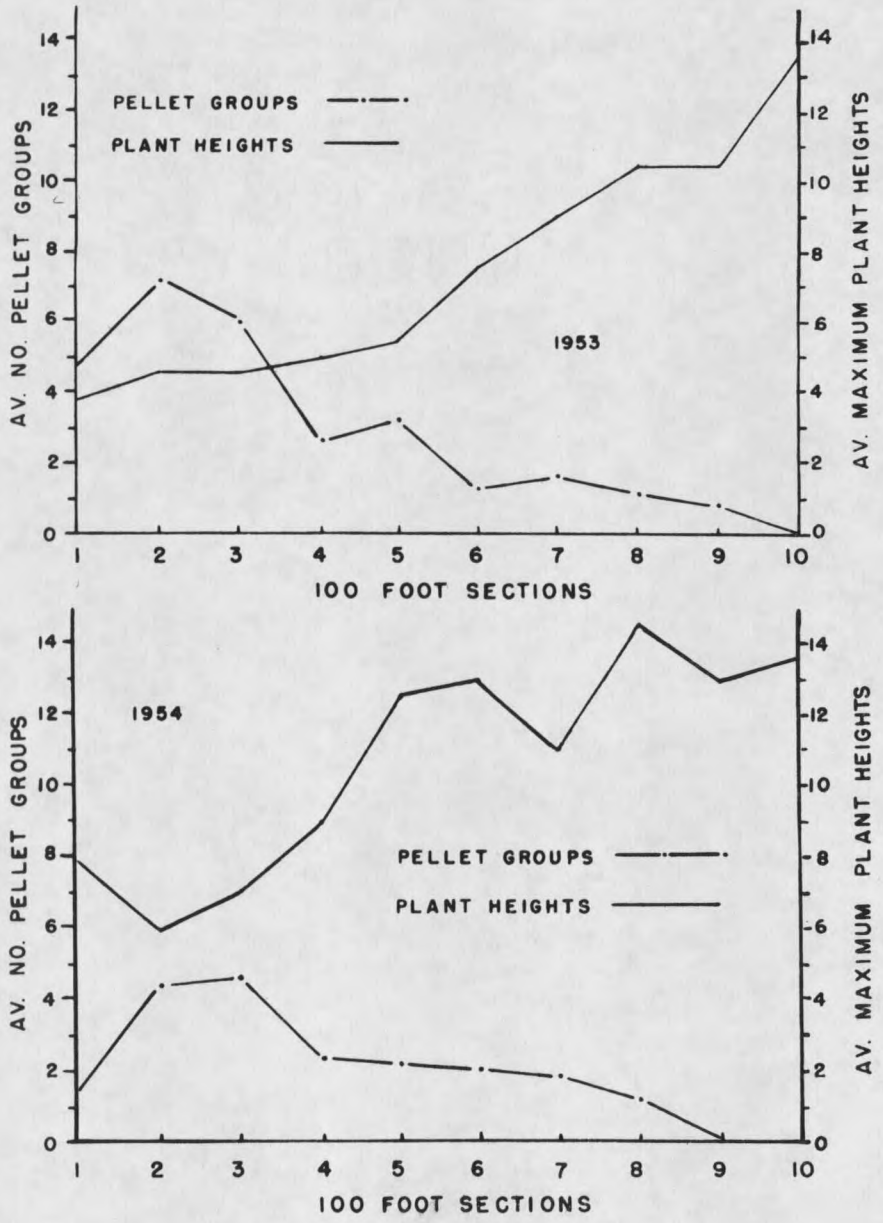

Fig. 12. The relationship of pellet group numbers to average maximum alfalfa plant heights along successive 100 foot transect lines beginning at the boundary where antelope entered Field No. 1.

Montana where the principal land use was stock raising integrated with alfalfa forage and seed production. Antelope depredations on alfalfa fields in the area were frequently reported by land owners. Field investigations extended through spring, summer and early fall during 1953 and 1954. Laboratory work was conducted during the two winters.

2. The agricultural croplands and the rangeland types available to antelope on the study area are described. Alfalfa fields occupied 4.3% (2,659 acres) of the area, other croplands 0.7%, the various rangeland types (Sagebrush-grassland, Grassland, Clay Slope, Shale Slope, Greasewood, Sagebrush-Greasewood, Abandoned Meadow) 95.0%. Privately owned lands represented 60.4% of the total acreage; publicly owned 39.6%.

3. Recorded observations of antelope seen on the various rangeland types and croplands along regularly traveled routes indicated seasonal and in season differences in the use of these vegetative types. Prior to midsummer (July) Sagebrush-grassland was used predominantly. After midsummer, decreased use on this type coincided with increased use on the Greasewood and Shale Slope types. Use on alfalfa fields sharply increased after mid-August, reaching a maximum in late September. Corresponding decreases for the use of rangeland types were shown. After October 1, decreased use on alfalfa fields was indicated to have resulted in corresponding increases for rangeland types.

4. Food habits were determined by rumen analyses and recorded instances of plant use at antelope feeding sites on the various vegetative types. Data showing food habits by seasons and differences within seasons are presented. Browse was indicated to have been the predominant food

through late fall, winter and the first two months of spring. The principal browse species were Big Sagebrush, Fringed Sage and Silver Sagebrush. During late spring certain vernal forbs were important. Grass was a minor food at all times, but relatively greater utilization was indicated during spring. In summer, forbs were indicated to have been the predominant food. Browse remained important, but the species were different from those used earlier. Through the first two months of fall, alfalfa was the predominant food of antelope using fields. Antelope using rangeland types exclusively at this time utilized either browse or forbs as their principal food. Yearlong, browse amounted to 56.6% by volume and 60.4% by weight of 27 rumen samples, forbs 40.6% by volume and 36.1% by weight and grass 2.8% by volume and 3.5% by weight.

5. Observations of 13 alfalfa fields indicated that 8 were used by antelope. Numbers of antelope seen for 1,080 observations of the 8 fields indicated that the same four fields received the greatest use during both years. Comparisons of fence characteristics, amounts of enclosed rangeland and the proximities to inhabited ranches for all fields, suggested that where antelope were able to gain access they preferred undisturbed situations where both alfalfa and large amounts of rangeland were available within the same fence.

6. Measurements and descriptions of fences apparently preventing access and those permitting access to alfalfa fields are given. At 14 observed places of access where antelope crawled under 4 strand barbed-wire fences the distances from the ground to the bottom wire averaged 17

inches (14.5 to 23.5). Seven ground to bottom wire measurements at places along five strand fences observed to "stop" antelope averaged 9.5 inches (7 to 11). The chest measurements of 55 antelope are given. Seven ground to top wire measurements at places where fences were jumped by an adult male were recorded.

7. The maximum size of antelope groups observed on each of the alfalfa fields used suggested the numbers of animals involved in depredation. Comparisons with summer aerial census data indicated that approximately 39% (151) of the population used alfalfa fields in 1953; 31% (135) in 1954.

8. Regular observations of two fields during 1953 and 1954 indicated seasonal and in season differences in the numbers of antelope utilizing alfalfa fields and the intensity of field use. Prior to mid-August few antelope were indicated to use these fields. Intensities of use (antelope per observation) were low. After mid-August both the numbers of antelope utilizing these fields and the intensities of use increased, reaching a maximum by late September. Intensities of use and numbers using fields decreased after October 1.

9. Observations indicated that all sex and age classes used fields, but females, fawns and certain adult males were the segment of the population most involved. Characteristically one adult male was associated with females and fawns. Data indicating that the behavior of adult males influenced field use is presented. An apparent increase in the numbers of males using fields after mid-September coincided with indications that

this period marks the beginning of the breeding season.

10. Data from relocations of 21 marked individuals (as fawns or yearlings) and 10 recognizable adults (9 adult males, 1 female) suggested that the distances antelope had to travel was not the deciding factor in their use of an alfalfa field on this area. Certain individuals traveled greater distances to or from a field they used than others would have had to travel in order to use a field.

11. Factors influencing movements in relation to alfalfa fields were indicated by data from relocations of marked fawns observed to use fields and recognizable adult males. Certain adult males habitually occupied relatively small areas ("territories"). The "territories" of some males included alfalfa fields. Those of others were confined to rangeland. On their respective "territories" these males were associated with female-fawn groups or occurred alone. Female-fawn groups moved between the "territories" of different resident males. Movements out of a "territory" were frequently hindered by the resident adult male. Yearling males and certain adult males were associated in bachelor herds during the summer. The movements of these bachelor herd males were indicated to have been greater than those for any other segment of the population. During the summer attempts by these males to associate with female-fawn groups within an alfalfa field or rangeland "territory" were prevented by the resident adult male. With the onset of the rut (September) males deserted bachelor herds. Certain adults from these herds were observed on rangeland or on alfalfa fields in the company of females and fawns. Marked fawns indicated that they had acquired individuals from groups previously attended

by resident adult males.

12. To evaluate the effects of antelope on alfalfa forage and seed production data were obtained from measurements of alfalfa plants and counts of blossoms and seed pods. The 1954 data from alfalfa plants within three exclosures and along transect lines on the 23.5 acre portion of Field No. 1 (70.5 acres) used by appreciable numbers of antelope suggested the following. Antelope caused appreciable reductions in plant heights and severe reductions in the numbers of blossoms and seed pods ("seed potential") throughout the 23.5 acres. Alfalfa plants protected by exclosures averaged 8.1 inches (82%) higher and had 62.7 more blossoms and/or seed pods per plant than those outside of exclosures intersected by transect lines. Relatively greater reductions in plant heights and "seed potential" occurred within the first 400 feet of the south boundary where antelope entered the field. From 400 feet toward the north boundary, reductions were progressively less severe. A similar relationship to the south boundary (point of entry) was shown by the 1953 data from this field.

13. Data from pellet group counts along transect lines on Field No. 1 corroborated that from plant height measurements in indicating the sections of the field receiving the greatest antelope use. Pellet group counts on Field No. 3 in 1953 indicated that only a relatively small portion of this 204 acre field received appreciable use.

14. A comparison of the numbers of pellet groups and the maximum plant heights along transect lines on Field No. 1 indicated an inverse relationship.

MANAGEMENT SUGGESTIONS

1. The interspersion of public and private land, the amount of public land (about 40% of the area) and the value of the antelope resource make it mandatory that the pronghorn antelope be given consideration in the land use of this area. Other land uses should be carefully considered in the general antelope management program. This study revealed a serious conflict under certain conditions between antelope and alfalfa production. The results of the study permit the following suggestions.

2. Either sex hunting seasons, beginning on or about September 1, would probably result in a reduction of the antelope population prior to the time that maximum numbers intensively use fields.

3. Reductions in the numbers of antelope habitually using alfalfa fields should be facilitated by hunting areas in the vicinity of fields.

4. Where unusually severe damage to alfalfa crops is sustained as a result of antelope depredations, "out of season" removals of the animals habitually using fields might be necessary.

5. Properly constructed and maintained fences will exclude antelope from alfalfa fields. On the area studied, antelope gained access to fields by crawling under fences. Five strand barbed-wire fences in some instances apparently prevented access to fields. Distances between the ground and bottom wire was the critical feature determining whether antelope were excluded. This distance should not exceed 11 inches at any place along the fence. Similar spacing between the first, second and third wires would be advisable. Maintenance, to keep all wires tightly

stretched is necessary. The use of woven wire fences, topped with strands of barbed-wire, would probably result in more effective long term protection and a lessened need for maintenance.

6. Although fence jumping by antelope in the area studied was very uncommon, there is evidence that they do learn to negotiate fences in this manner. In Carter County, Montana, where antelope commonly jumped fences, a 36 inch high woven wire fence topped with 3 strands of barbed-wire 6 inches apart appeared to prevent the use of a field.

7. Alfalfa fields with little or no rangeland within the enclosing fence were indicated to be less attractive to antelope than those with large amounts of rangeland within the fence. Fences should be placed as close to the field borders as practicable.

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