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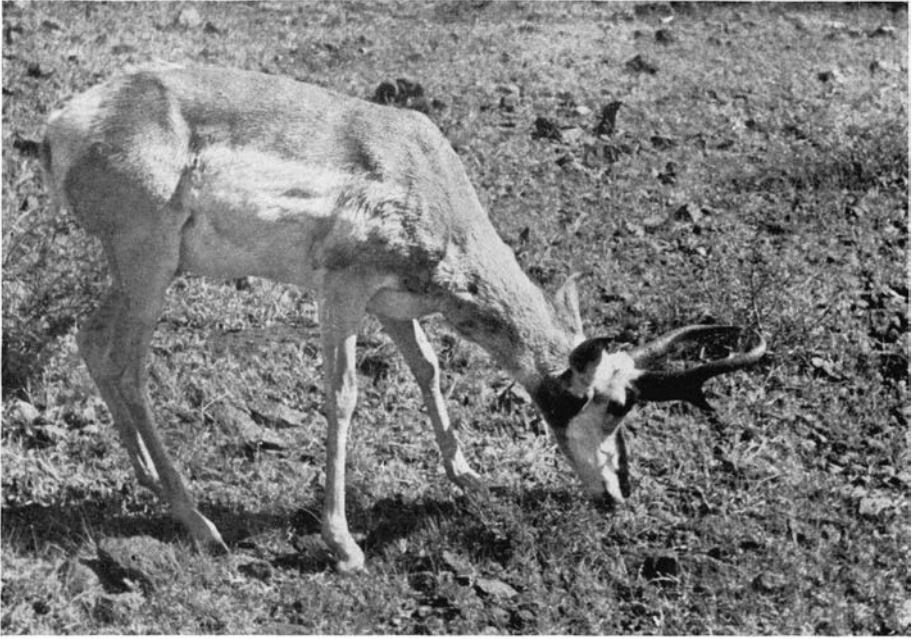
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REGULATION OF NUMBERS
OF PRONGHORN ANTELOPE
IN RELATION TO LAND USE

Helmut K. BUECHNER

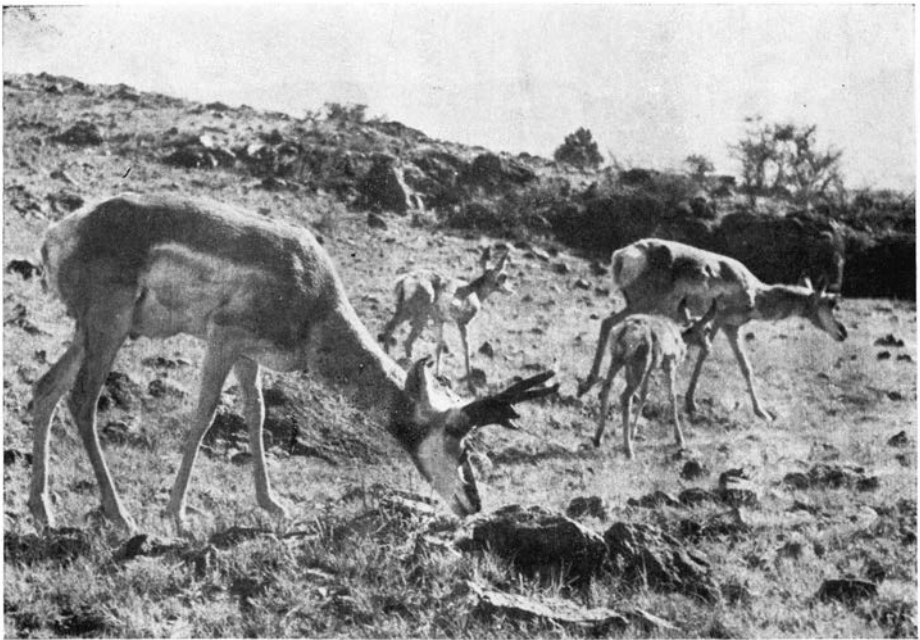
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As white man's influence swept through the ranges of pronghorn antelope (*Antilocapra americana* Ord) in the western half of the United States and in Canada and Mexico, indiscriminate, year-around hunting reduced the entire population in North America from an estimated pristine level of approximately forty million to about thirty thousand in 1924 (NELSON, 1925, pp. 1-2). A phenomenal recovery was made during the following 30 years as a result of protection through : Law enforcement, an increasingly conservation-minded public, the vigorous efforts of farsighted landowners and water developments. In 1955 the population in the United States was estimated at 375,000 (Anonymous, 1957), and additional numbers in Canada and Mexico brought the total well above four hundred thousand. Probably little change has taken place in the past five years, during which time no overall estimates have been compiled. The present distribution is much as shown by NELSON (*op. cit.*, map, p. 2) for 1924, the populations having increased from a large number of small, widely scattered remnant herds. Within the past decade most of the rising populations of pronghorn antelope appear to have reached stability either through annual harvests or in steady state with vegetation much modified from natural conditions. These contrasting types of population control place pronghorn antelope into two groups : (1) Those in which numbers are regulated by man in the region of dry-land agriculture and Short Grass plains (*cf.* SHANTZ and ZON, 1924) east of the Rocky Mountains from the Panhandle of Texas to southern Saskatchewan and (2) those in which numbers are regulated by natural phenomena in the more



H. K. Buechner

Adult male.



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A family group.

The Pronghorn Antelope

TABLE 1
Population Estimates and Harvests of Pronghorn Antelope in the United States (1)

State	Range Area (Square Miles)	Population Estimate	Harvest	Per Cent Harvest	Year
Group I (Short Grass and Sagebrush — Short Grass)					
Colorado	33,560	10,000	3,302	33	1957
Montana	98,600	54,884	14,434	26	1957
Nebraska	9,475	3,500	783	22	1957
North Dakota	23,000	8,000	1,381	17	1957
South Dakota	30,847	18,000	3,800	21	1957
Wyoming	65,000	109,906	25,708	23	1957
Group II (Desert Shrub and Desert Grassland)					
Arizona	7,031	8,500	301	4	1958
California	3,125	2,040	No open saeson for past 7 years		1959
Idaho	6,200	8,000	821	10	1958
Nevada	4,686	3,500	126	4	1958
New Mexico	60,119	25,000	1,800	7	1958
Oregon	39,062	12,000	314	3	1958
Texas	3,750	11,000	926	8	1958
Utah	20,312	1,500	33	2	1958

(1) Modified from Longhurst (1957) with data from the 1957 and 1958 Big Game Inventories (U. S. Fish and Wildlife Service, Washington, D. C., Wildlife Leaflets 399 and 441).

arid grazing lands of desert shrub and desert grassland on intermontane flats, high plateaus, and rolling plains in and near the Rocky Mountains. The classification suggests that management of pronghorn antelope is largely determined by land use, although it is influenced also by productiveness of the land, the more moist eastern lands being more productive in vegetation, farm crops, and animal life than the more arid ranges farther west. In accordance with the theme of this program, the objectives of the present paper are (1) to compare population performances on the eastern plains grasslands with those on the desert ranges and (2) to relate the food habits of the pronghorn antelope to land use.

Population Performance in Relation to Land Use.

The practicality of making highly accurate midsummer counts and classifications to determine sex and age ratios from the air make it possible to study population performance and to regulate numbers much more precisely with pronghorn antelope than with most wild ungulates in North America. The tabulated data referred to in the discussions to follow have been selected to include only accurate counts made over the same area in the same manner for a period of years.

By way of introduction, first examine Table 1, from which it will be seen that the states in Group I (mostly eastern Short Grass vegetation) harvest from 17 to 33 per cent of the midsummer population annually, whereas the states in Group II (western Desert Shrub and Desert Grassland vegetation) harvest from 2 to 10 per cent of the population. Harvests in some states in Group II were skipped in certain years because of low production and high mortality resulting from drought conditions. The data suggest that in eastern areas, where pronghorn antelope seemed to interfere with production of livestock or agricultural crops as the populations increased, demands from landowners to regulate numbers were sufficient to elicit harvests under the direction of state departments of game. In Wyoming, which has the highest population of all of the states, the increases of pronghorn antelope on sagebrush ranges were so striking that livestock owners feared severe economic losses from competition for forage. In all of the other states, the demand for regulation of numbers stemmed from fear of economic loss through damage to crops as well as from competition on grasslands adjacent to cultivated lands. Thus, it appears that heavy annual harvests were imposed on these populations of pronghorn antelope while they were still in the exponential phase of population growth, with

the result that (a) high rates of annual population increase have been maintained, (b) most of the population mortality has been diverted to hunting, (c) landowners have been satisfied with the control of numbers, and (d) an important source of recreation has been provided. The contrasting low harvests in those states under Group II result in part from lack of demand for regulation of numbers, which can be attributed to (a) the lower density of pronghorn antelope on arid ranges and, therefore, less concern over forage competition and (b) fear on the part of the lay public that the herds of pronghorn antelope on desert ranges cannot withstand harvests even when carefully regulated by issuing permits. In part the low harvests also reflect the influence of recurring droughts on ranges of desert vegetation which have been abused for decades by overgrazing with livestock.

Population performances, as indicated by annual variation in total counts and age ratios, are shown in Table 2 for parts of Montana and Wyoming (Group I) and California and Arizona (Group II). The number of individuals removed by harvest and trapping from all of the census areas was not available, and reference should be made to Tables 1, 3, and 4 for an approximation of the percentage harvested. The data were obtained during midsummer after the period of initial heavy juvenile mortality and before the fawns became too large to be distinguished readily from the air. As it is impossible to segregate yearling females from adult females during aerial counts, the fawn : ♀ ♀ ratios are based partly on a varying proportion of nonbreeding females. A high survival of yearlings in one year may result in an apparent low production of young on the basis of the fawn : ♀ ♀ ratios determined by aerial counts. However, all yearlings are not necessarily nonbreeders. One clear-cut case of breeding in a female fawn was recorded on the National Bison Range by WRIGHT (1960). Interpretation of the tabulated age ratios also requires some knowledge of natality. In California, 18 of 20 adult females that died during trapping operations in December, 1949, and January, 1950, were pregnant; of the 18 pregnant females, 1 contained a single embryo and 17 contained twin embryos (CHATTIN and LASSEN, 1950). In Colorado 39 of 42 females contained twin embryos and the remaining 3 contained single embryos; 81 embryos from 42 females produced a ratio of 193 : 100 (fawns : ♀ ♀) (HOOVER, TILL, and OGILVIE, 1959, p. 25). The highest ratio of fawns : ♀ ♀ in Table 2 is 113 : 100 and most of the high ratios lie between

TABLE 2

Population Performance of Pronghorn Antelope (1)

Year	Total Count	Classified Animals			Midsummer Sex and Age Ratios	
		♂ ♂	♀ ♀	Fawns	♂ ♂ : ♀ ♀ : Fawns	Fawns : Adults
Montana-Musselshell Unit (Group I)						
1948	8,651	1,693	3,749	3,209	45 : 100 : 86	59 : 100
1950	11,010	2,388	4,470	4,152	53 : 100 : 93	61 : 100
1952	10,538	1,455	2,150	2,181	67 : 100 : 101	60 : 100
1953	10,068	1,929	3,624	3,178	53 : 100 : 88	57 : 100
1954	7,817	1,269	1,457	1,426	87 : 100 : 98	52 : 100
1955	9,347	1,738	3,085	2,907	56 : 100 : 94	60 : 100
Montana-Yellowstone Unit (Group I)						
1949	10,073	1,444	2,516	1,976	57 : 100 : 79	50 : 100
1951	11,832	1,504	2,552	2,316	59 : 100 : 91	57 : 100
1953	11,022	2,199	3,507	3,344	63 : 100 : 95	59 : 100
1954	9,998	1,573	2,720	2,629	58 : 100 : 97	61 : 100
1955	9,295	1,869	3,721	3,096	50 : 100 : 83	55 : 100
Wyoming-Northeast Unit (Group I)						
1953	34,420	596	1,045	921	57 : 100 : 88	56 : 100
1954	»	455	662	602	69 : 100 : 91	54 : 100
1955	»	480	646	528	63 : 100 : 81	50 : 100
1956	33,113	450	826	790	54 : 100 : 96	62 : 100
1957	»	334	857	667	39 : 100 : 78	56 : 100
1958	42,934	611	1,050	1,188	58 : 100 : 113	71 : 100
1959	»	1,269	1,883	1,888	67 : 100 : 100	60 : 100

TABLE 2 (Continued)
Population Performance of Pronghorn Antelope (1)

Year	Total Count	Classified Animals			Midsummer Sex and Age Ratios	
		♂ ♂	♀ ♀	Fawns	♂ ♂ : ♀ ♀ : Fawns	Fawns : Adults
California (Group II)						
1953	2,247	192	371	148	52 : 100 : 40	26 : 100
1954	2,022	165	285	239	58 : 100 : 84	53 : 100
1955	2,137	232	445	343	52 : 100 : 77	51 : 100
1956	2,338	228	444	255	51 : 100 : 57	38 : 100
1957	2,080	222	384	255	58 : 100 : 66	42 : 100
1958	2,165	357	608	425	59 : 100 : 70	44 : 100
1959	2,040	347	750	399	46 : 100 : 53	36 : 100
Arizona (Group II)						
1951	2,900	826	1,355	719	61 : 100 : 53	33 : 100
1952	5,068	1,066	2,166	1,836	49 : 100 : 85	57 : 100
1953	3,931	1,009	1,835	975	55 : 100 : 53	34 : 100
1954	4,513	1,095	2,075	1,343	53 : 100 : 65	39 : 100
1955	4,406	1,139	2,283	969	50 : 100 : 42	28 : 100
1956	3,726	845	2,023	858	42 : 100 : 42	30 : 100
1957	3,619	756	2,090	773	36 : 100 : 40	27 : 100
1958	4,114	775	2,307	1,032	34 : 100 : 45	33 : 100

(1) Data for Montana-Musselshell Unit from Brown (1953) and Ellig (1956); for Montana-Yellowstone Unit from Brown (1954 a) and Ellig (1956).
 Data for Wyoming from June (1959).
 Data for California from Gilman (1959).
 Data for Arizona from Welsh (1958).

90 : 100 and 100 : 100, indicating rather high juvenile mortality prior to midsummer. That high mortality of fawns may be completed by midsummer is supported by the data from Montana, and this point will be borne out in the discussion to follow.

The data in Table 2 show the following ranges in age ratios :

	Fawn : ♀ ♀	Fawn : Adult
Group I	78 : 100 — 113 : 100	50 : 100 — 71 : 100
Group II	40 : 100 — 85 : 100	26 : 100 — 57 : 100

The combination of more productive lands and greater demand for control of numbers in the states under Group I appears to be responsible for the higher ratios. Without further well-directed research it is impossible to determine the relative importance of the two contributing factors. However, it seems likely that the populations of pronghorn antelope in Group I are being maintained through hunting in that portion of a sigmoid growth curve immediately below the upper asymptote. In a few intensively managed areas of Group I the population seems to be held in an exponential phase of growth. This is best shown in the Musselshell and Yellowstone Units in Montana (Tables 3 and 4). Aerial counts in the late 1940's showed that the herds were developing with unanticipated explosive force and that landowners were justified in their demands for control of numbers.

The percentage of increase in the spring herd was based on the fawn : adult ratio obtained during the midsummer aerial count, on the assumption that the period of heavy juvenile mortality was at an end and the population had acquired a relatively uniform mortality rate. On the productive vegetation in Montana under the condition of heavy annual harvest, the assumption appears to be valid, for the calculations in Tables 3 and 4 are supported remarkably well by carefully made aerial counts. As a guide to judging what constitutes an adequate percentage of annual harvest, it is apparent from Tables 3 and 4 that about one-third of the midsummer populations was harvested to maintain stability in populations that increase with an annual recruitment of approximately 60 per cent. Under these conditions about 85 per cent of the annual recruitment was harvested. Note that the percentage of annual harvest is based on the midsummer population and the percentage of annual increase is based on the prefawning season spring population. The important conclusion is that a very large proportion of the annual increase may be harvested under

TABLE 3
Musselshell Unit, Population Determination

	1948	1949	1950	1951	1952	1953
Spring Herd	(4,603)	5,835	6,817 (6,854)	6,504	5,807 (5,629)	5,462 (6,403)
Fawns 61 % Increase	+ (2,808)	+ 3,559	+ 4,158 (4,156)	+ 3,967	+ 3,542 (3,368)	+ 3,332 (3,665)
Summer Herd	(7,411)	9,394	10,975 (11,010)	10,471	9,349 (8,997)	8,794 (10,068) (1)
Hunting Losses	— 705	— 1,558	— 3,500	— 2,596	— 3,071	
	6,706	7,836	7,475	7,875	6,278	
				— 1,200 (1)		
				6,675		
Post Hunting Season Loss 13 %	— 871	— 1,019	— 971	— 868	— 816	
Spring Herd	5,835	6,817	6,504	5,807	5,462	
Per Cent of Summer Herd Harvested	10	17	32	25	33	

Figures in parentheses from census.

(1) Emigrant antelope from Musselshell Unit to Yellowstone Unit.
Data from Brown (1954 b).

TABLE 4
Yellowstone Unit, Population Determination

	1949	1950	1951	1952	1953
Spring Herd	(6,720)	7,218	7,314 (7,512)	8,501	6,375 (6,948)
Per Cent Increase	(49.9 %)	53.7 % (1)	(57.5 %)	58.0 % (2)	(58.6 %)
Fawns	+ (3,353)	+ 3,876	+ 4,206 (4,320)	+ 4,931	+ 3,736 (4,074)
Summer Herd	(10,073)	11,094	11,520 (11,830)	13,432	10,111 (11,022)
Hunting Losses	-1,776	-2,687	-2,949	-6,104	
	8,297	8,407	8,571	7,328	
			+1,200 (3)		
			9,771		
Post Huntng Season Loss 13 %	-1,079	-1,093	-1,270	-953	
Spring Herd	7,218	7,314	8,501	6,375	
Per Cent of Summer Herd Harvested	18	24	26	45	

Figures in parentheses from census.

(1) Average of per cent of annual increase for 1949 and 1951.

(2) Average of per cent of annual increase for 1951 and 1953.

(3) Immigrant antelope from Musselshell Unit.

Data from Brown (1954 b).

the environmental conditions that pertain in Montana. If the resource is to be utilized wisely and conflicts with domestic interests are to be averted, adequate annual harvests are essential.

Not only was about 85 per cent of the annual population mortality diverted to harvest, but possibly the regulation of numbers through heavy harvesting also resulted in an increase in natality, as in white-tailed deer (*Dama virginiana* Zimmermann) in New York (MORTON and CHEATUM, 1946) and elk or wapiti (*Cervus canadensis* Erxleben) in Washington (BUECHNER and SWANSON, 1955).

In California, where only two hunting seasons (1949 and 1951) have been open since 1946, the fawn : ♀ ♀ ratio varied from 40 : 100 to 84 : 100 and the fawn : adult ratio varied from 26 : 100 to 53 : 100 from 1953 through 1959 (Table 2). Although the population is only about 2,000 and the ranges are subject to recurring drought conditions, it is probable that carefully controlled harvests would result in (a) diversion of a large percentage of annual adult mortality to harvests, (b) improved nutritional conditions, (c) increases in natality and survival of fawns, and (d) greater security in the preservation of this population. It is evident from aerial counts that the population of pronghorn antelope in California remained stable from 1953 through 1959. Apparently the population has reached stability through nutritional relationships with the vegetation and through social interrelationships within the various herds. Seemingly, an excellent opportunity is afforded in California to study the causes for stability and to determine the influence of harvesting on natality and survival.

The rough, rocky deserts of northeastern California extend also into southeastern Oregon, southwestern Idaho, and northern Nevada. The animals in this region migrate somewhat from one state to another; and the state departments of game, together with the U. S. Fish and Wildlife Service (representing Hart Mountain and Charles Sheldon National Wildlife Refuges), have formed an annual interstate conference to integrate efforts in research and management of the animal. In 1924 this region constituted one of the greatest centers of surviving pronghorn antelope in the entire West, according to NELSON (*op. cit.*, p. 46). The population in southeastern Oregon, the largest in this region, increased from a minimum of two thousand in 1924 to about nineteen thousand by 1939 (*cf.* EINARSEN, 1948, p. 11); decreased to about ten thousand by 1944; and remained at approx-

ximately this level to the present. Harvests never exceeded 8 per cent (1942) and usually remained under 5 per cent annually, indicating that stabilization of the population resulted from factors other than hunting. NELSON (*loc. cit.*) reported that climatic conditions were especially favorable in Oregon during the winter and spring of 1923-1924 and that an unusually large number of young were born, but that the ensuing summer was so dry that the cattle owners removed all of their stock from the range. A number of fawns were found dead, and presumably fawn mortality was exceptionally high during the summer. Because such recurring droughts are inevitable and since poor range conditions are prevalent as a result of overgrazing, these populations of pronghorn antelope must be harvested with great care and with greater allowance than in Montana for mortality other than hunting. Within this region there has been much concern over the possible causes for the low recruitment of fawns and the static nature of the herds. No increase in fawn survival resulted from effective control of coyotes through the use of 1080 poison (sodium fluoroacetate) in southeastern Oregon. No epizootics have occurred and no endemic diseases have been discovered that might control numbers. In an analysis of the causes of death of 370 pronghorn antelope in Oregon, YOAKUM (1956) concluded that no single factor was primarily responsible for population mortality, and he suggested that the stability of the population was related to the vegetation. Drought conditions and limitations of forage on overgrazed lands are probably the principal causes for the population performance, but no research has been accomplished to determine these relationships.

The effect of recurring drought conditions on vegetation impoverished by heavy livestock grazing is amplified in ranges of the Southwest where the climate is more arid than in the region described above. The fawn : ♀ ♀ and fawn : adult ratios are lower in Arizona than in California (Table 2). Populations in New Mexico and Texas show ratios similar to those in Arizona. The influence of severe drought is well illustrated by data from the Trans-Pecos Region in Texas. Here the population was approximately seven thousand three hundred in 1946 (BUECHNER, *op. cit.*, p. 263) following three or four years of favorable moisture and improved range conditions. The population remained relatively unchanged until the winter of 1951-1952 when heavy mortality resulted from severe drought conditions. The animals died in large numbers from January through May; for

the first time recorded, pronghorn antelope foraged on ornamental shrubs within the city limits of Marfa and Alpine. Counts on 12 of the major ranches producing pronghorn antelope showed a decrease of 36 per cent of the adult population from after the harvest in the fall of 1951 (2,111) to the spring of 1952 (1,353). Counts on nine ranches showed little change from 1952 (1,177) to 1953 (1,239), but counts on 26 ranches showed a decrease of 24 per cent from the fall of 1953 to the spring of 1954. In 1955, the population for the entire region was estimated at 4,600 (3,400 counted and 1,200 estimated from previous counts). The counts showed 53 per cent increase in yearlings and adults from 1953 to 1955. In 1956, the population was estimated at 5,500 (3,370 counted and 2,130 estimated from previous counts), indicating 16 per cent increase from 1955 to 1956. In 1957, 4,561 adults were counted and 906 adults were estimated from previous counts; 1,835 fawns were computed from a midsummer ratio of 60 : 100 (fawns : adults), except on the extremely dry ranges in Hudspeth County where the ratio was 18 : 100, making a total of 7,302. In 1958 the population was 8,963, and in 1959 it was 9,186. These data illustrate that drought can cause fluctuations of 50 to 60 per cent in numbers of pronghorn antelope in the Trans-Pecos Region. Within this Region of 31,392 square miles, local variations in drought were obvious during the period 1950-1955; in addition, each ranch showed a difference in production and survival of pronghorn antelope, depending upon the degree of utilization of the vegetation by livestock. No harvests were taken in the years 1949, 1952, and 1954. Thus, it seems possible to manage populations of pronghorn antelope that fluctuate violently with drought conditions. In fact, larger harvests, integrated with the best practices for managing livestock on desert grasslands, would improve the basic resources of soil and vegetation and result in greater benefits to society over the years.

It seems reasonable to conclude that in all ranges populations of pronghorn antelope are likely to improve in production and survival through heavy harvesting; and by controlling numbers through hunting, pronghorn antelope do not conflict seriously with domestic uses of the land.

In some states, especially in the southwest, practically all of the pronghorn antelope are on private lands. Remuneration is provided to the landowner in some states, under direction of the state departments of game, for economic losses that might be encountered

from competition for forage, damage to crops, or damage to roads, fences, and other property caused by the activities of hunters. In Wyoming the landowner receives \$ 3.00 from resident hunters and \$ 5.00 from nonresident hunters for each pronghorn antelope killed on his land. In Texas the landowner is permitted to charge without limit for the privilege of hunting pronghorn antelope on his land, and in 1959 landowners received \$ 50.00 to \$ 100.00 per male and \$ 30.00 to \$ 40.00 per female. The return to the landowner in Wyoming seems too low, and that in Texas seems too high. However, reasonable charges appear to be essential in obtaining adequate harvests in some states. In New Mexico, for example, the low percentage of harvest results from inaccessibility of hunters to private lands, a situation that adequate remuneration may correct. Although the idea of charging for hunting privileges is accepted readily in Texas, this philosophy meets with objection in other states, particularly where much hunting is done on public lands.

It is worthy of note that the success of hunters is low (50 to 75 per cent) where populations are harvested lightly and high (80 to 95 per cent) where populations are harvested intensively (cf. Table 9 in LONGHURST, 1957).

Food Habits in Relation to Land Use. Comparison of the food habits in grasslands and sagebrush vegetation shows that forbs provide the principal part of the forage consumed in the former and browse provides the principal part in the latter (Table 5). On all ranges, grasses are insignificant in the diet of pronghorn antelope. The number of kinds of plants constituting 75 per cent or more of the annual forage consumption is reduced from 10 or more in the Desert Grasslands of Texas to merely 3 or 4 in the Sagebrush (Northern Desert Shrub) areas of California, Oregon, and Wyoming. No single species of plant is outstanding in the diet of the pronghorn antelope in Texas and a continuum of important plants is apparent through about 25 species. Probably a similar continuum, though less extensive, existed in the natural vegetation of the northern deserts; but through the impoverishment of the vegetation and the increase of sagebrush with overgrazing by livestock (PICKFORD, 1932, pp. 165-166; CLEMENTS, 1934, pp. 59-60; ROBERTSON, 1947, p. 1), pronghorn antelope are now foraging on an extremely limited number of plants, of which sagebrush (*Artemisia tridentata*) may constitute 95 per cent. Sagebrush undoubtedly was the most preferred forage on many ranges prior to modification of vegetation. Fortu-

TABLE 5

Principal Mean Annual Forage Consumption of Pronghorn Antelope

	SAGEBRUSH		GRASSLANDS		
	Texas	Colorado	California	Oregon	Wyoming
General Composition (Per cent) (1)					
Browse	30	40	65	66	85
Forbs	66	54	35	33	13
Grasses	4	6	1	1	2
Principal Species					
Browse :					
<i>Artemisia tridentata</i> Nutt. .		×	1	1	1
<i>Chrysothamnus</i> sp.		×			
<i>Chrysothamnus viscidiflorus</i> (Hook.) Nutt.....				×	
<i>Dalea frutescens</i> A. Gray —	8 (2)				
<i>Eriogonum</i> sp.		×			
<i>Gutierrezia sarothrae</i> (Pursh) Britt. & Rusby ..		×			
<i>Purshia tridentata</i> (Pursh) DC.			2	3	
Forbs :					
<i>Aplopappus spinulosus</i> (Pursh) DC.	1				
<i>Astragalus</i> spp.		×		×	
<i>Balsamorhiza</i> sp.			×		
<i>Carum</i> sp.			×		
<i>Dalea wrightii</i> A. Gray	5				
<i>Erigeron austinae</i> (Greene) Cronquist				×	
<i>Eriogonum tenellum</i> Torr.	7				
<i>Eryngium heterophyllum</i> Engelm.	9				

(1) Percentages based as follows : Texas — antelope-minutes method and verified by analyses of 89 rumen samples (Buechner, 1950, pp. 324-336); Colorado — 192 rumen samples (Hoover, Till, and Ogilvie, 1959, pp. 51-71); California — 139 rumen samples (Ferrel and Leach, 1950 and 1952); Oregon — 226 rumen samples (Mason, 1952); Wyoming — 133 rumen samples (June, 1959).

(2) Numbers indicate order of importance of plants that constitute approximately 75 per cent of the year-long forage consumption; volume by species not determined for Colorado; x indicates presence in analyses.

TABLE 5 (Continued)

Principal Mean Annual Forage Consumption of Pronghorn Antelope

	GRASSLANDS		SAGEBRUSH		
	Texas	Colorado	California	Oregon	Wyoming
Principal Species					
Forbs :					
<i>Gaura coccinea</i> Nutt. ex Pursh	4				
<i>Helianthus</i> sp.		×	×		
<i>Hymenoxys scaposa</i> (DC.) Parker var. <i>linearis</i> (Nutt.) Parker (3)	6				
<i>Iva axillaris</i> Pursh			3	4	
<i>Lomatium</i> sp.			×		
<i>Lotus oroboides</i> (H.B.K.) Otley	10				
<i>Oenothera</i> sp.		×			
<i>Opuntia polyacantha</i> Haw..	×				
<i>Oxytropis</i> sp.	×				
<i>Phlox caespitosa</i> Nutt. (<i>P. douglasii</i> Hook) + <i>P.</i> sp. .			4	2	
<i>Plantago lanceolata</i> L.				×	
<i>Polygonum aviculare</i> L. + <i>P.</i> sp.			×		
<i>Psilostrophe tagetinae</i> (Nutt.) Greene	2				
<i>Senecio longilobus</i> Benth. . .	3				
<i>Sisymbrium altissimum</i> L..			×		
<i>Trifolium</i> sp.				×	

(3) *Actinea linearis* var. *scaposa* in Buechner (1950); cf. Harrington (1954, p. 593).

nately, this plant is relatively high in nutritive value (SMITH, 1950) and is abundant on many ranges. However, should this species, because of its low palatability to livestock, be destroyed to improve the vegetation for livestock, pronghorn antelope undoubtedly would become much reduced in number. It seems, therefore, that variety in species composition of vegetation may be an important factor in the future survival of pronghorn antelope. In the Trans-Pecos Region of Texas, 228 species of plants were found utilized by pronghorn antelope (BUECHNER, *op. cit.*, p. 324), a far larger number than reported from any other region. Unless the economic value of pronghorn antelope remains sufficiently high to include these animals as an important product of the land in the states under Group I, the pronghorn antelope ultimately may be more secure in the more varied vegetation of the southwest despite the recurring droughts.

An evaluation of the relationships of pronghorn antelope to cultivated crops, especially wheat, is important in the Short Grass plains. Three points need to be considered : (1) The average percentage of wheat consumed per animal over the period of heavy use, (2) the intensity of use of the wheat fields throughout the year, and (3) an evaluation of the damage to the yields of wheat. In Colorado, analysis of 98 rumen samples collected from pronghorn antelope in the immediate vicinity of wheat fields showed a composition as follows (in percentages) : Browse, 13; forbs, 13; native grasses, trace; and wheat, 74 (HOOVER, TILL and OGILVIE, 1959, pp. 61-65). The period of intensive use was from November through April. No data were presented to indicate the intensity of use of fields in Colorado. No experimental studies were conducted to determine the influence of grazing on the yield of wheat; but HOOVER, TILL, and OGILVIE (*loc. cit.*) suggest that the effect may be, as with grazing by livestock, to produce denser stands and higher yields of wheat. In Montana, the intensity of field use was related to the proximity of large tracts of rangeland, 89 per cent (6,385 observations) of the animals observed on wheat fields being less than $\frac{1}{2}$ mile from rangeland and 11 per cent (712 observations) from $\frac{1}{2}$ to 1 mile from rangeland (COLE and WILKINS, 1958, p. 20). In 28,245 observations made over a two-year period COLE (*op. cit.*, p. 7) found pronghorn antelope on grain fields by seasons as follows (in percentages) : Spring, 15; summer, 11; autumn, 30; winter, 28, indicating that the animals use rangeland more than cropland at all times of the year. In contrast to the composition of rumen samples in Colo-

rado, COLE (*op. cit.*, p. 10) found wheat to be a minor item in 41 rumen samples collected throughout the year. Growing wheat and barley made up 10 per cent of the volume in summer, 9 per cent in autumn, 5 per cent in winter, and 0 per cent in spring. In comparing plots protected from pronghorn antelope with plots subjected to grazing by the animals, no differences in the yields could be demonstrated in statistical testing. Because of the wide distribution of grazing over large areas of the grain fields, the effect of grazing by pronghorn antelope on growing or dormant wheat could not be considered severe (COLE, *op. cit.*, p. 33). During the critical period from culm elongation to harvest, when pronghorn antelope could have a detrimental effect on wheat yields, few animals used the fields.

In a study of pronghorn antelope in relation to alfalfa production, COLE (1956) found serious damage to the crop under certain conditions. However, as pronghorn antelope rarely jump fences, the problem can be solved easily by the construction of fences (36 inches of woven wire topped with 3 strands of barbed wire 6 inches apart) close to field borders.

Although no specific studies of competition between livestock and pronghorn antelope have been conducted, the inference from information that has been accumulating over the past decade on the food habits of pronghorn antelope is that when populations of both classes of ungulates are in adjustment with the forage capacity of the range, competition between cattle and pronghorn antelope is negligible and competition between sheep and pronghorn antelope is about one-third (BUECHNER, *op. cit.*, pp. 337-342). However, proper adjustment of livestock to the capacity of the vegetation rarely obtains; and the more severe the destruction to the vegetation, the more the ungulates on the range compete for forage. Where cattle are grazed without sheep, forbs and shrubs usually increase with overutilization of grasses and the forage supply for the pronghorn antelope is improved. By foraging on forbs and shrubs that are unpalatable to cattle, and by consuming plants poisonous to livestock, pronghorn antelope actually do a service to the cattle industry; rarely, if ever, do they compete seriously for forage utilized by cattle. The compatibility between cattle and pronghorn antelope is similar to that which must have existed in the past between bison and pronghorn antelope, and it is tempting to suggest that the two species evolved as in different ecologic niches (or ways of life) within the same community.

In contrast, competition between domestic sheep and pronghorn antelope can be so severe under conditions of overgrazing that the latter become extirpated. This has happened on ranches in the Trans-Pecos Region of Texas where pronghorn antelope are trapped as former cattle ranches are fenced in to provide pastures for sheep. Comparison of three ranches that differed principally in treatment with livestock showed that the weight of forage production was reduced from 49 grams (dry weight) per square meter on land grazed properly only by cattle and pronghorn antelope, to 32 grams on land grazed moderately by cattle, sheep, and pronghorn antelope, to 14 grams on land grazed by excessive numbers of sheep and cattle and a remnant herd of pronghorn antelope (BUECHNER, *op. cit.*, p. 341). These data suggest that sheep, which can be kept alive with supplemental feeding, can overgraze the vegetation to a point where it is unable to support pronghorn antelope.

Summary and Conclusions. Management of pronghorn antelope in the United States is determined largely by the degree of presumed conflict with cultivation of crops and grazing of livestock. As much as 85 per cent of the mean annual population mortality can be diverted to harvesting by hunters on the more productive eastern ranges, and under these conditions the midsummer population shows annual recruitment of 60 per cent. Populations on more arid desert ranges farther west have reached stability through natural phenomena rather than through harvesting. Although the harvestable percentage of the mean annual adult mortality rate may be less than 85 per cent, populations on desert ranges are likely to improve in natality and survival under heavier harvests than currently imposed on them. Unless numbers of pronghorn antelope are regulated by carefully controlled harvests and the animal becomes established as an important economic byproduct of land use, populations will ultimately become much reduced as the sagebrush vegetation on northern ranges is modified for livestock. Fortunately, when populations of pronghorn antelope are properly controlled, the animals do not conflict seriously with cultivation of crops, nor do they compete seriously for forage used by livestock on ranges that are grazed properly. Furthermore, the animals lend themselves exceptionally well to determination of numbers and ratios of sex and age, making it possible to achieve excellent management through research. It is conceivable, therefore, that the pronghorn antelope can be perpetuated as

an economic asset in excellent harmony with other land-use objectives.

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