SOME ASPECTS OF PRONGHORN ECOLOGY AND MANAGEMENT IN NORTHEASTERN CALIFORNIA

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ABSTRACT.

Management goals and objectives must be revised for northeastern California's pronghorn. Recent population increases have caused depredation problems, and may be leading to higher levels of competition between pronghorn and other grazing animals. A simulation model of the population shows it will continue to increase at about 8% per year if recruitment stays at its current level. Harvest of 290 females per year can stabilize the population at about 6,000 while providing for an annual harvest of 500 males.

INTRODUCTION

This paper could well have been titled "It's time for a change in pronghorn management". California's wildlife resources are rarely static. This makes periodic assessment of management strategies necessary. We are at the point where such a review of pronghorn management is in order. From the standpoint of pronghorn harvest we have seen two basic strategies in the past three decades:

1) Protection from harvest, and

2) Conservative harvest of males.

Both of these strategies were appropriate at the time. In fact pronghorn management to date must be considered an unqualified success in northeastern California. Through the 1950's and early 1960's there was little argument that nearly total protection from hunting was the best course for population management. Pronghorn numbers were low and all agencies were concerned with rebuilding the herds.

During this period pronghorn ranges improved under better livestock grazing management. Fences were modified to present less of a hazard to pronghorn. Mule deer, potential competitors with pronghorn for spring forage, began to decline in numbers. The result was a gradual increase in pronghorn numbers. By the mid-1960's we were able to return to a limited harvest of males from a vigorous population.

Since 1964 the annual harvest of pronghorn bucks has risen from less than 200 to over 300. In the past eight years, the population has been growing faster than at any time during the past 50 years. Considering the abysmal performance of our deer herds during this period, one would have to be pleased with pronghorn management. But, there are some indications that we should not be content to rest on our laurels.

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Current conditions indicate the future holds some problems. In 1977 it was necessary to transplant over 70 pronghorn from agricultural lands in Modoc County. That sub-herd grew too large in relation to a local rancher's willingness to support pronghorn on his alfalfa. In 1977 and 1978, the summer fawn ration of one of the largest sub-herds in the state (the Devil's Garden sub-herd) dropped to 18 and 8 fawns per 100 does, respectively. It was not due just to the drought, as the average fawn ratio of all pronghorn in the area held at 38 fawns per 100 does during the period. Feral horse competition is suspected as a factor in the low sub-herd's performance. Now a local rancher is considering replacing his cattle permit on the winter range of both of these sub-herds with a sheep permit. Competition, both intraspecific and interspecific, and with local economic interests is a definite factor in the ecology and management of our pronghorn.

These signs are not being missed by managers. Bud Pyshora of the Redding office of the California Department of Fish and Game has acknowledged the need for a pronghorn management plan in his historical review of pronghorn (Pyshora 1977), and in his depredation contingency plan (Pyshora 1978). We no longer have the luxury of operating under a management goal that says, in essence, we want more pronghorn. Ranchers, land managers, and scientists are beginning to ask how much is enough. Management alternatives during an era of rapid population increase and high pronghorn densities will be controversial. If transplanting is used to control populations size it will be expensive; about $100 per animal. Besides, we do not have an unlimited supply of suitable unstocked pronghorn range. If harvest of both sexes is used for population regulation, it will be hotly debated.

Fundamental to any future management program is the establishment of reasonable and politically acceptable goals and objectives. When we get around to that task, and it must be soon, they should be based on sound ecological facts and principles as well as on political realities. In this paper we present some of the more relevant aspects of population ecology that should be considered.

RECENT HISTORY AND CURRENT STATUS OF PRONGHORN

Pronghorn wintering in northeastern California (Modoc, Siskiyou, Lassen, and eastern Shasta counties) currently number about 6,000. They occur in five major populations, our so-called herds (Figure 1). The Lassen herd is currently the largest at about 1,650 head (28% of the total population). The Likely Tables and Clear Lake herds are nearly as large at 1,500 animals (25% each). The Mount Dome and Big Valley herds are about half the size of the larger three at 650 and 600 respectively (11% each).

There has been a considerable increase in the total population during the 1970's (Table 1). During the period 1956 through 1970, population size fluctuated around an average of 2,400 animals. There was a slight decline during 1959-1961, but the population gradually increased by 1,000 animals between 1961 and 1970. Since 1979 pronghorn have increased by nearly 3,000 animals, a 97% increase in numbers over the eight year period.

Interestingly, the population growth occurred during a period of declining summer fawn ratios (Table 2). Sex and age structure censuses are taken by the Department during late July and early August. Fawns are about 2½ months old at the time. During the 1960's, when the population grew by 33% over a 10 year period, post-natal fawn ratios averaged 56 fawns per 100 does. Since 1970, with the population growing at 10% per year, the average fawn ratios has been 44 fawns per 100 does, off by 21%. There are only two scenarios that can explain such a phenomenon:

1) Adult mortality has been much lower during the 1970's or

2) Fawn survival after the mid-summer census through recruitment into the population as yearlings is much higher than during the 1960's.

Unfortunately there is no data to indicate the more likely of the two scenarios.

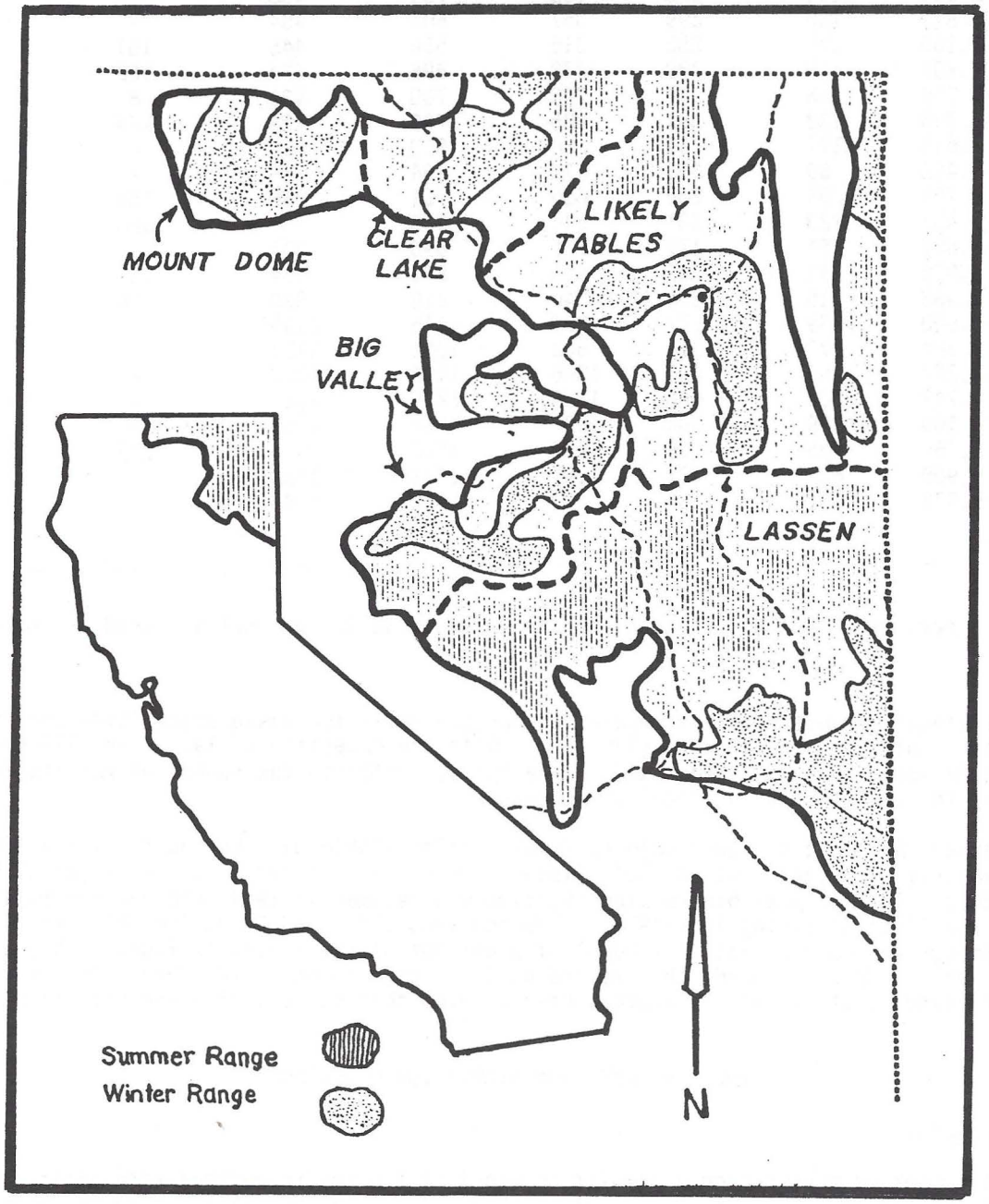

Figure 1. Seasonal distribution of pronghorn herds in northeastern California.

TABLE 1. January census of pronghorn wintering in northeastern California.

YEAR	TOTAL*	MOUNT DOME HERD	BIG VALLEY HERD	CLEAR LAKE HERD	LIKELY TABLES HERD	LASSEN HERD	SURPRISE VALLEY *	MISC.
1956	2,338	197	261	506	624	524	-	226
1957	1,973	197	286	392	508	590	107	-
1958	2,165	215	328	408	751	438	-	25
1959	1,917	180	299	357	605	464	-	12
1960	1,780	128	288	316	554	445	181	49
1961	1,909	110	279	378	696	424	162	22
1962	2,269	36	349	748	700	435	85	1
1963	2,375	132	387	685	709	424	123	38
1964	2,618	177	367	520	953	524	-	77
1965	2,468	59	358	518	734	757	-	42
1966	2,735	209	289	600	751	886	163	-
1967	2,537	223	281	544	563	881	128	45
1968	2,607	254	177	675	693	807	-	1
1969	2,870	244	292	619	861	854	101	-
1970	2,983	115	389	840	819	820	16	-
1971	3,800	239	327	894	1145	1195	-	-
1972	3,764	272	314	803	1251	1124	-	-
1973	4,357	361	411	1386	1196	1003	-	-
1974	4,747	365	656	1362	1236	1126	-	2
1975	4,109	329	364	1020	1312	1069	-	15
1976	4,869	435	758	1236	1526	913	118	1
1977	4,908	627	423	1195	1371	1285	-	7
1978	5,872	652	606	1493	1478	1643	-	-

* Erratic occurrences of Nevada pronghorn in Surprise Valley are not included in the total

The annual legal harvest from the population has generally increased since 1964, the first year of the continuing annual hunt (Table 3). With the exception of 1975, over 270 males have been harvested annually since 1971. The harvest reflects the number of permits issued, as well as the availability of legal class males.

Higher harvest has lead to lower male to female ratios (Table 3). During the years 1956-1963, when only one legal hunt was held (1959), the mid-summer buck ratio averaged 47 bucks per 100 does. In five year blocks since hunting was resumed in 1964, the average ratio has changed from 47 to 41 during 1964-1968, 38 during 1969-1973, and 28 during the last five years. At current harvest rates (removal of about 30% of the available legal bucks) 28 to 30 bucks per 100 does are needed before the hunt in order to maintain a breeding ratio census indicates that harvest management has achieved this ratio during the past five years.

IMPLICATIONS FROM SIMULATION MODELING

The Basic Model

This past summer we constructed a simulation model of the entire northeastern California pronghorn population. Program ONEPOP (Gross et al. 1973), as modified for annual adjustment of mortality rates (Salwasser 1978), was used in this work. The model is based on the data listed in Tables 1-3, with the following priorities as to validity: the mid-summer fawn to doe ratio had the highest priority, followed by the winter census, reported buck harvest plus 10% for unreported losses, and mid-summer buck to doe ratio. Reproductive potentials were estimated from literature sources at 1.80 and .50 fawns per adult and yearling doe, respectively.

TABLE 2. Mid-summer fawn to doe (FF:100DD) ratios of pronghorn herds in northeastern California.

YEAR	ALL HERDS	MOUNT DOME HERD	BIG VALLEY HERD	CLEAR LAKE HERD	LIKELY TABLES HERD	LASSEN HERD
1956	57	61	49	88	68	55
1957	66	43	66	63	80	62
1958	70	41	66	62	80	75
1959	53	57	66	70	53	44
1960	39	35	41	40	35	41
1961	64	-	66	74	55	66
1962	42	94	43	42	39	51
1963	62	70	46	84	57	58
1964	57	95	57	83	37	53
1965	53	70	45	65	45	49
1966	40	52	44	42	38	36
1967	58	78	44	92	60	48
1968	61	62	67	96	46	71
1969	69	55	49	100	57	73
1970	63	66	29	73	62	70
1971	40	50	39	68	34	28
1972	55	85	63	80	44	45
1973	42	40	72	69	52	25
1974	41	55	57	61	39	33
1975	51	86	49	66	46	46
1976	48	71	57	73	51	35
1977	38	60	44	75	29	35
1978	38	51	64	41	32	34

We used the model to evaluate the population processes leading to a population increase under declining mid-summer fawn ratios, to assess the relative validity of sex and age ratio and winter censuses, and to analyze future population management options.

Comparison of the end of winter model population size with the mid-winter census shows the model faithfully simulates population size trends (Figure 2). Because there is certainly some mortality occurring between the time the mid-winter census is taken and the end of the biological year, and the census probably misses some of the animals in the population, we have modeled population size at the end of winter at approximately the same magnitudes as the mid-winter census. This assumes that post-winter mortality is approximately equal to the number of animals missed in the winter census. A spring census would be necessary to verify this assumption.

In aligning the model we assumed the mid-summer fawn ratio was the most valid estimate of an actual population parameter. We thus matched the model fawn ratio with the population statistic exactly. The model cannot be used to check the validity of that ratio. In fitting the model size to the mid-winter census, while maintaining the fit of mid-summer fawn ratios, it was necessary to reduce fawn mortality during the fall and winter periods during the 1970's. It was not possible to achieve this fit by adjusting adult mortality alone. Thus it appears that the population increase during the period of declining mid-summer fawn ratios is more a function of increased fall and winter fawn survival than it is a function of reduced adult mortality.

The model buck ratio matches the mid-summer census only in general trend and magnitude (Figure 3). Recently the mid-summer census appears to be underestimating the true buck ratio. It is well known that the summer social structure of pronghorn populations, that is males occur as both territorial bucks and bachelor bands (Kitchen 1974), leads to a

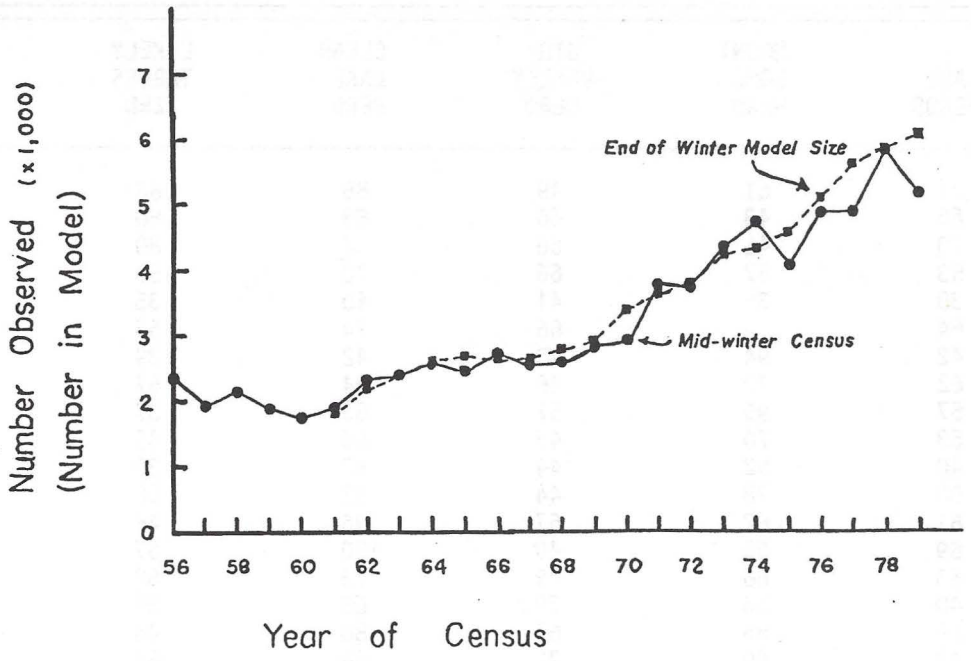

Figure 2. Comparison of the mid-winter pronghorn census with the simulation model size at the end of winter.

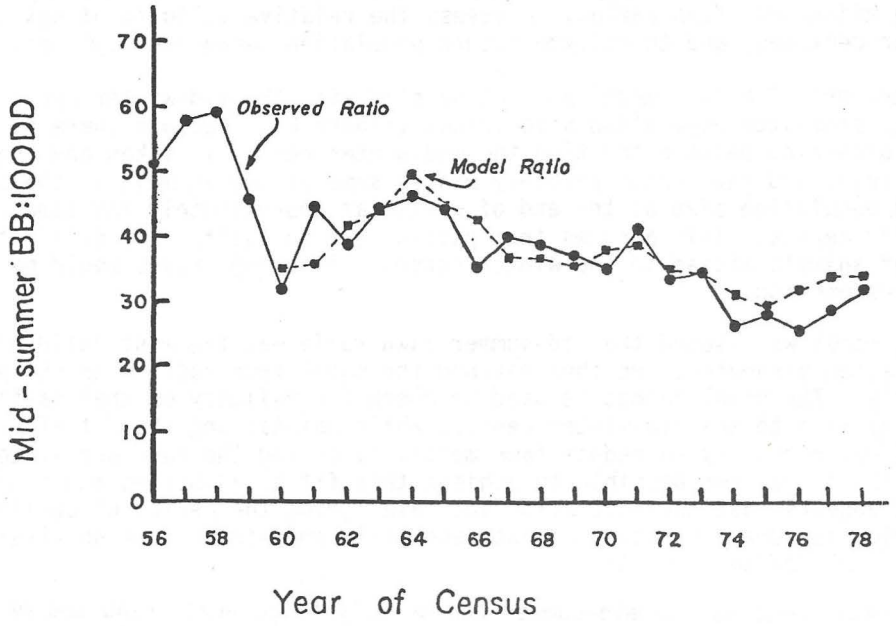

Figure 3. Comparison of observed and model buck to doe ratios (BB:100DD).

TABLE 3. Sex ratios (BB:100DD) and reported legal harvest of pronghorn in northeastern California.

YEAR	PRE-HUNT BB:100DD	LEGAL HARVEST REPORTED
1956	51	-
1957	58	-
1958	59	-
1959	46	120
1960	32	-
1961	44	-
1962	39	-
1963	44	-
1964	47	183
1965	44	141
1966	35	180
1967	40	159
1968	39	189
1969	37	204
1970	35	241
1971	41	303
1972	33	301
1973	34	305
1974	26	284
1975	28	170
1976	26	306
1977	29	271
1978	32	352

high variability in sex ratio counts. The confidence limits of the buck ratio statistics probably encompass the model ratios (though they were not evaluated in this study). The model ratios are probably a good approximation of the true ratios, and indicate that caution must be used in basing harvest strategies on the mid-summer buck ratio statistic.

Model harvest was allowed to exceed reported harvest to account for illegal kills and wounding losses (Figure 4). The high difference in 1973 and 1975 between the model and reported harvest was caused by our attempt to match the model buck ratio with the following year's statistic. It is obvious that either the buck ratio statistic is highly errant in those years, or the harvest was under-reported.

The basic mortality schedule that allowed us to fit the model to reported data follows the general shape of ungulate mortality schedules (Figure 5). High juvenile mortality is followed by relatively low adult natural mortality, less than 10% per year, through age five. Beyond five years of age adult mortality sharply increases such that few pronghorn survive their eighth year of life. It was necessary to allow for a sex differential of 15% higher mortality on male fawns than on female fawns, and a sex differential on adults of 2.5% higher on males in order to achieve a buck ratio of 50BB:100DD when the population is not hunted legally. The sex differential in the model probably reflects a true population characteristic.

To summarize the basic model; it shows the winter census is a reasonably good estimator of true population trend and size, it indicates the mid-summer sex ratio census is a less sensitive indicator of the true population parameter, and it indicates that higher fall and winter fawn survival is responsible for the population increase under declining mid-summer fawn ratios.

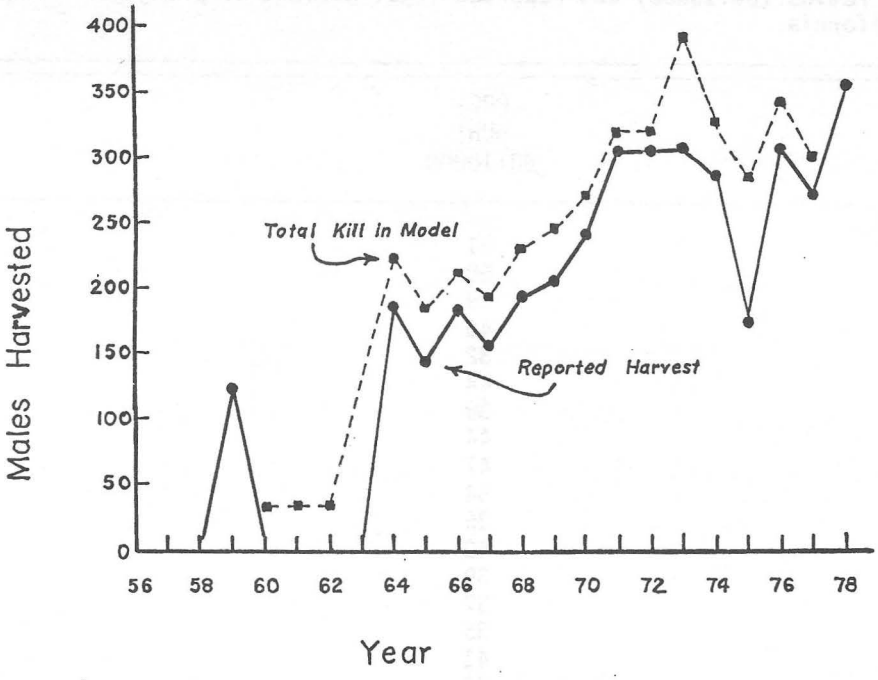

Figure 4. Comparison of reported and modeled harvest of males. Difference is an estimate of unreported losses.

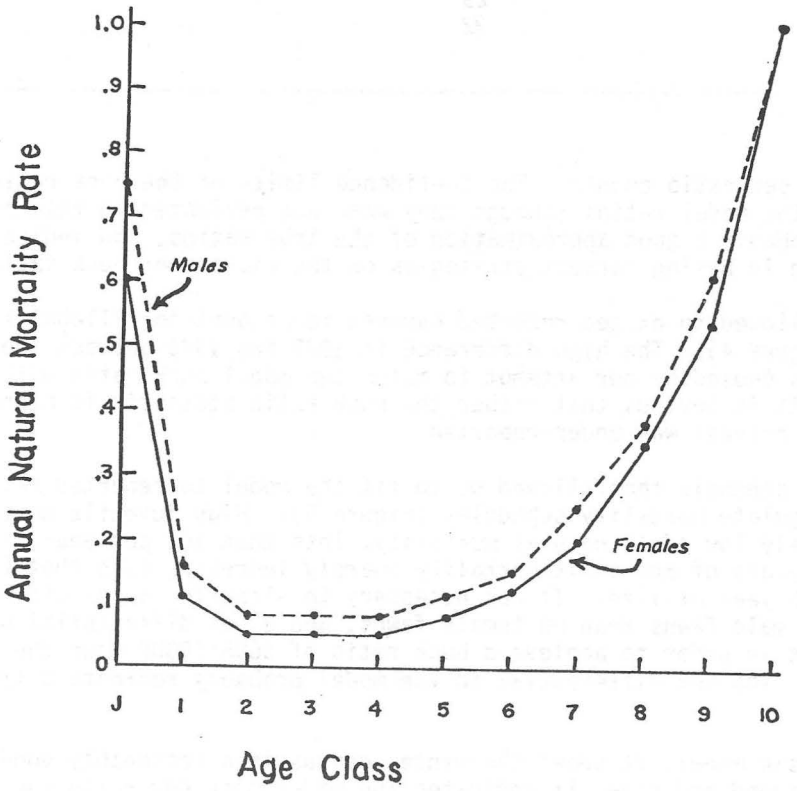

Figure 5. Basic mortality schedule used in the simulation model.

Future Management Options

In using the model to assess future management options we developed five combinations of environmental and management scenarios. In the first three we assumed that the environment would affect reproduction and mortality as it has during the past five through 1983. Each of the three options has a different harvest strategy. Under no legal harvest, and a continuation of existing average recruitment, the population will continue to increase at 8-10% per year, reaching 9,500 pronghorn by 1983. The mid-summer buck ratio would return to its unhunted equilibrium of 50BB:100DD by 1981.

If buck hunting continues at the current strategy of harvesting all surpluses over what is needed to maintain a 20BB:100DD ratio post-harvest, the population will increase to 7,500 animals by 1983. By 1980 we could be harvesting 550 bucks per year on a sustained basis as compared with the harvest of 352 bucks in 1978.

Again assuming that environmental conditions remain similar through 1983, and that the management objective of 20BB:100DD post-harvest guides the harvest, we would need to harvest 500 bucks and 290 does annually to stabilize the population at 6,000. Thus harvest of both sexes can be used to half the population increase, reduce intraspecific competition and depredation problems, and provide an additional recreational use of 480 pronghorn above what is currently harvested. This would more than double the number of permits that could be issued, while not causing a population decline.

In the forth scenario we attempted to simulate a population responding to competition through gradually declinging recruitment. We assumed that the mid-summer fawn ratio would immediately return to its pre-drought ratio of 48FF:100DD in 1979, then drop 3-4FF:100DD each year thereafter. With a continuation of the existing buck harvest, the population would peak at 6,753 in 1982 (growing at only 2-6% until 1982), then begin declining at 2-4% per year after 1983. The buck harvest would exceed 500 until 1983, when it would still be at 486. The pre-hunt fawn ratio in 1983 would be 31FF:100DD, and recruitment would be less than 20% of the population.

In the final scenario we mimicked a drastic environmental change that would result in stability at 6,000 animals post-winter. Fawn survival would have to drop to 36FF:100DD immediately and hold at that level at the mid-summer count through 1983 in order to stabilize the population. This is approximately the fawn ratio that occurred during the 1977-78 drought years. Buck harvest could be maintained at 400 through the period 1979-1983.

SUMMARY AND RECOMMENDATIONS

1. Pronghorn will probably continue to increase in northeastern California, causing a higher level of intra- and interspecific competition, and increasing depredation problems.

2. Management agencies must formulate specific population and habitat management goals and objectives for the five major herds.

3. Simulation models should be used to formulate population management strategies and to assess future population performance.

4. Buck harvest can exceed 400 annually, and reach 550 by 1981, if the population can be stabilized at 6,000 animals by annually harvesting 500 bucks and 290 does.

5. Assuming recruitment continues at 1970's rates, the population can be stabilized at 6,000 animals by annually harvesting 500 bucks and 290 does.

6. Recruitment must drop from the current 48FF:100DD at mid-summer to 36FF:100DD to naturally stabilize the population at 6,000 while sustaining an annual buck harvest of 400.

7. A research program should be instituted to evaluate reproductive potentials, age structures, fawn mortality patterns, dispersal between sub-herds, and the optimum time for herd census in order to improve model validity and management sensitivity.

ACKNOWLEDGMENTS

We were generously assisted in this work by Doug Thayer and Leo Pyshora of the California Department of Fish and Game.

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