

THE EFFECTS OF OVERPOPULATION AND HUNTING ON THE FORT KNOX DEER HERD

By JAMES A. DECHERT
Wildlife Biologist, Office of the Engineer
Fort Knox, Kentucky

ABSTRACTS

The Fort Knox Military Reservation began to show signs of overbrowsing eight years after stocking with white-tailed deer (*Odocoileus virginianus*).

Data collected annually on the reservation's deer herd during the deer hunting season indicated a rapid decline of the deer's physical condition as the wintering population increased from 5,500 to 9,000 over the period 1962-1965 and the deer range became overpopulated.

Average dressed weights of yearling bucks and fawns decreased 16-18% while those of yearling does decreased 11% from 1958-1965.

Average antler beam diameters of yearling bucks deteriorated 18% and "spiked" yearlings increased from 10% to 24% from 1960 to 1965.

The reproductive rate dropped 47% from 1960 to 1965.

Selective buck hunting during conservative "any deer" seasons reduced the buck:doe ratio among wintering deer from 106:100 in 1962 to 68:100 in 1966.

Data indicated a crippling rate of one deer for every four deer legally harvested in 1965 and 1966.

A thinning of the deer density in overpopulated areas in 1965 resulted in a partial recovery of antler development, body weight and productivity in 1966 in spite of the wintering population size remaining approximately the same as the previous year.

The present deer management policy is based on the population dynamics of the past six years.

I. INTRODUCTION AND PURPOSE

"Too many deer = Less food

Too many deer + Less food = Fewer fawns + Smaller Deer

Too many deer \times Time = Less deer + Starvation"

The equation above summarizes the story of many fine deer herds within the last half century. The deer herd on the Fort Knox Military Reservation (Kentucky) is less than twenty years old, yet it already was on the verge of entering the third line of the equation. During the summer of 1966 the herd reached an unprecedented peak of 14,800 deer! In the past two years (1965 and 1966) over 7,800 deer were taken by hunters as compared to a total of 6,300 during the nine years previous to 1965. The deer herd's fantastic rate of increase has far exceeded the expectations of those who originally restored the deer to the reservation's fauna. Concern over the deteriorating physical condition of the deer and the increasing damage to the habitat from overpopulation necessitates effective management of the deer population to provide excellent hunting in future years.

In order to develop a biologically sound deer management policy the population dynamics of the deer herd and the effects of overpopulation and deer hunting must be understood. Until recently sufficient data was lacking to accurately calculate annual herd increases, annual mortality losses other than legal harvest, and the size and sex ratio of the wintering (breeding) population. To provide the required data extensive cursory deer browse surveys, winter deer censuses, deer check station examinations, and deer hunter questionnaire surveys were conducted in 1965 and 1966. This information was combined with and applied to data

collected at Fort Knox by Kentucky biologists (Barber) during previous deer seasons in order to reconstruct the population dynamics of the deer herd from 1962-1967. The purpose of this paper is to show the complex inter relationships and effects of overpopulation and deer hunting on the population dynamics of the deer herd.

II. BACKGROUND

The Fort Knox deer are primarily descendents of fifty-some deer stocked in 1953-1956 and remnants of a few native Kentucky deer. Protection of the herd linked with an annual harvest equal to only a small fraction of the annual increase allowed the deer to multiply to 5,500 by the winter of 1962-'63. In 1961 signs of overbrowsing were noted in the isolated center of the reservation by Kentucky biologists and deer hunters (Barber). Failure to harvest a sufficient number of deer annually in this area and other overbrowsed areas as they developed allowed the deer herd to exceed the carrying capacity of the deer range. The result was an annually increasing deer population that reached a peak of 14,800 deer in the summer of 1966. Concurrently, the overbrowsed range increased to over half of the reservation's 96,000 acres of deer habitat, 25,000 acres being overbrowsed to the degree that browse damage will be evident for many years to come.

III. EFFECTS OF OVERPOPULATION

From 1962 to 1965 a rapid decline occurred in the physical condition of the deer in overbrowsed areas, resulting in stunted animals with poor antler development and low productivity. A comparison of deer from overbrowsed and underbrowsed areas is contained in Annex I.

It is noted that in 1966 the physical condition of the deer improved in all respects when compared to 1965 data except in the average dressed weight of buck fawns from underbrowsed areas. A bumper crop of acorns during the fall of 1965 caused the temporary improvement (Dechert—1966). Thinning of the deer density in overpopulated areas during the 1965 deer season resulted in greater improvement during 1966 of the deer in these areas as compared to deer from underbrowsed areas. However, in no case did the average for any of the criteria from the overbrowsed deer area in 1966 exceed the 1965 average of the same criterion from the underbrowsed deer area.

The deer management units referred to in Annex I are shown in Annex II.

Body Weight

The trend of decreasing average body weight (field dressed) of deer in all age classes was noted as early as 1962 (Barber). By 1965 a 16-18% body weight loss had occurred in yearling bucks and all fawns. Yearling does lost 11% of their body weight over the same period. Yearling and fawn deer were chosen to illustrate body weight loss as there is little possibility of mis-aging. Together these two groups compose well over 60% of all deer in the herd.

Year-to-year changes in body weight of yearling deer are an indicator of food competition intensity during the previous year summer. Contained below in Table I are the average dressed weights in pounds of fawns and yearling deer taken at Fort Knox during the deer seasons of 1958, 1962, 1965 and 1966.

TABLE I — WEIGHT LOSSES

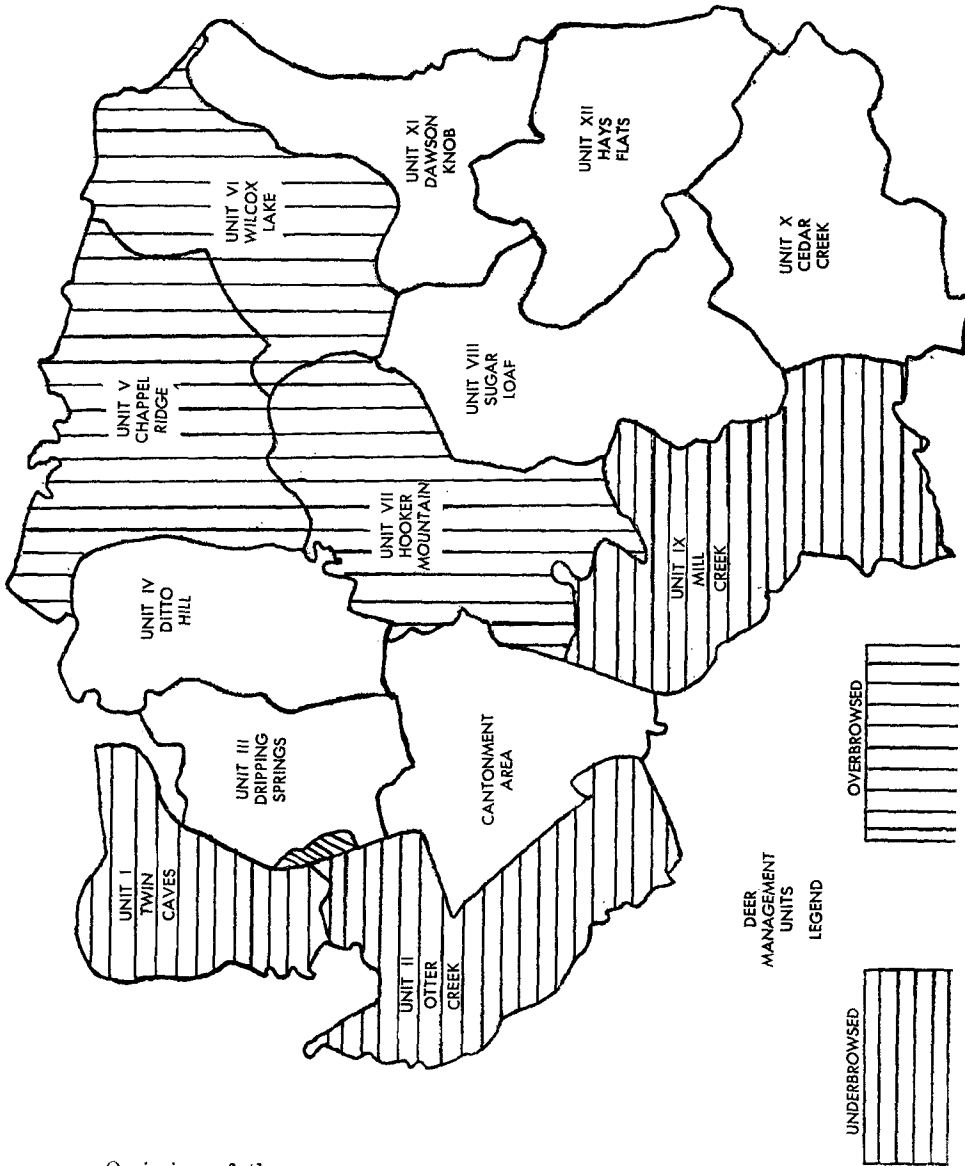
AGE GROUP	1958	1962	1965	1966
Fawn Buck	70.5	63.4	59.0	62.1
Yearling Buck	121.2	110.8	100.1	107.2
Fawn Doe	67.1	60.9	54.9	57.2
Yearling Doe	95.7	93.8	85.4	88.0

ANNEX I — DEER PHYSICAL CONDITIONS*

Deer Management Unit Condition		Overbrowsed					Underbrowsed		IX Underbrowsed	Average Difference
		V	VI	VII	I	II	Average	Difference		
Fawn Buck Weight	1965	56.4	57.6	56.0	56.7	66.1	66.9	61.1	64.7	12.4%
	1966	60.6	64.6	59.5	61.6	66.1	63.4	61.7	63.7	3.3%
Fawn Doe Weight	1965	54.1	53.9	50.9	53.0	62.7	57.5	55.6	58.6	9.6%
	1966	53.3	57.5	56.2	55.7	58.4	61.8	59.3	59.8	6.9%
Yearling Buck Weight	1965	95.9	95.8	97.3	96.3	108.9	119.5	105.9	111.4	13.6%
	1966	100.2	108.9	102.7	103.9	116.5	115.2	108.4	113.4	8.4%
Yearling Doe Weight	1965	80.4	82.7	84.0	83.6	94.6	86.8	85.0	88.8	5.9%
	1966	84.9	87.6	86.1	86.2	98.6	92.4	87.1	92.7	7.0%
Yearling Buck Antler Beam (64th)	1965	46.4	45.1	46.7	46.1	54.3	52.5	51.9	52.9	12.9%
	1966	48.7	51.0	45.3	48.3	53.7	55.1	52.6	53.8	10.3%
Yearling Buck "Spike" Percentage	1965	36.7	37.6	29.1	34.5	11.1	9.1	10.4	10.2	70.5%
	1966	17.6	11.8	17.0	15.5	12.9	0.0	8.0	7.0	54.8%
Fawn:Doe Ratio	1965	0.76	0.85	0.76	0.79	1.09	1.18	1.00	1.09	27.6%
	1966	1.06	1.14	0.89	1.03	1.42	1.39	1.24	1.35	23.8%

* Based upon data taken from 2,299 and 3,817 deer checked during the 1965 and 1966 Fort Knox deer seasons, respectively.

ANNEX II
FORT KNOX MILITARY RESERVATION



Omission of the average weights for the missing years was necessary as the deer seasons did not coincide calendarwise with those shown above. Analysis of the average weights taken during the six weekend deer seasons of 1965 and 1966 indicated weekly changes in weight due to the intensity of breeding and the acorn crop available to the deer (Dechert—1966).

Antler Development

Slight annual fluctuations in average antler beam diameters in yearling bucks occurred between 1956 and 1960, indicating annual variations in the quality and quantity of winter browse available to the deer. However, from 1960 to 1965 a continued and rapid 18% decrease in the average antler beam diameters of yearling bucks was

noted. During the same period the percentages of yearling bucks that could only produce "spikes" increased from 10% to almost 24%. Contained below in Table II are the average antler beam diameters and "spike" percentages for yearling bucks.

TABLE II
YEARLING BUCK ANTLER BEAM DIAMETER FLUCTUATIONS

1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
59.5	59.4	56.0	58.9	59.1	52.7	52.0	52.8	50.4	48.1	51.1
0.0%	0.0%	2.2%	9.5%	10.3%	17.5%	15.3%	10.8%	18.0%	23.9	10.0%

NOTE: All diameters are in the 64th of 1".

Productivity

Data from the deer check station examinations indicated a decline in the number of fawns per doe in deer harvested since 1960. The fawn:doe ratio dropped from 1.69 to 0.89 in 1965. This was a decrease of 47% since 1960, 35% since 1962. The ratio of fawns per doe in the harvest is considered approximately the true ratio in the herd at the time of the hunt. Selective cropping of the largest of a group of antlerless deer would tend to lower the fawn:doe ratio in the kill some degree so the ratio should be considered as the minimum reproductive rate for 1962-1964. The composition of the deer kill (50-60% adult buck) indicates high hunter selectivity during these years as compared to 1960-1961 and 1965-1966 (30-40% adult buck). Contained below in Table III are the fawn:doe ratios from 1960 to 1966.

TABLE III — FAWN:DOE RATIOS

1960	1961	1962	1963	1964	1965	1966
1.69	1.62	1.48	1.32	1.06	0.89	1.06

Selectivity of deer harvested during the 1965 and 1966 deer seasons is very low considering that more than 50% of the hunters were limited to one day of hunting in 1965 and two days in 1966.

Conclusions

The deterioration of the deer herd's physical condition appears to have started about 1958, prior to the noticeable overbrowsed condition of portions of the deer range. This is in agreement with Johnson's (1937) findings.

IV. EFFECTS OF HUNTING

The heavy selective harvest of male deer during the past five years at a much greater rate than the actual sex ratio in the herd was believed to have considerably reduced the percentage of male deer in the wintering herd. A tremendous amount of dead deer in the field after the hunt was reported by small game hunters and game wardens in 1965 and 1966. In view of the present management policy of sustaining the deer herd at the optimum population level, knowledge of the annual losses from crippling and the approximate sex ratio among wintering deer is necessary.

Crippling Rate

Prior to 1965 no accurate estimate had been made on deer herd losses as unrecovered cripples from the deer hunt. In 1965 and 1966 questionnaires were sent to Fort Knox deer hunters to determine the crippling rate along with other pertinent data. Hunters returned 450 questionnaires in 1965 and 1,920 questionnaires in 1966. Data indicated a crippling rate of one deer per 4.1 and 4.2 deer harvested in 1965 and 1966, respectively. This is a loss of 19% of all deer killed as a result of hunting. Mortality in cripples is 95%-100% as few deer with old

wounds from previous hunting seasons are harvested. A small percentage of these cripples (less than 5% in 1965 and 1966) are taken by other hunters as indicated by check station records. Since the crippling rate has remained the same for two years it seems safe to assume it was this high in the past and perhaps even higher during the conservative 1962-1964 deer seasons with their buck-heavy harvests.

Sex Ratio

Severinghaus and Cheatum (1956) calculated a sex ratio of 106 bucks per 100 does among 39,299 fawns killed in eleven states by "any deer" seasons and non-selective mortality causes. The removal of bucks at a greater rate than this sex ratio would tend to change the sex ratio among surviving deer and result in a doe-heavy deer herd. Knowledge of the approximate sex ratio among breeding deer is necessary to forecast the annual increase (fawn crop) on intensively managed deer areas.

The sex ratio among wintering deer was calculated from the yearling buck and doe percentages of the adult deer by using the equation below:

$$\frac{A(B)}{(C)} = 106$$

WHERE:

106 = Number of buck fawns per 100 doe fawns.

A = Number of adult bucks per 100 adult does.

B = Percentage of yearling bucks among adult bucks.

C = Percentage of yearling does among adult does.

Since "B" and "C" are known from the deer hunt kill data, the equation need be solved only for "A." The resulting sex ratio is that of the adult portion of the herd at the time of the deer hunt. This determination was based on the assumptions that the fawn sex ratio is 106 bucks per 100 does annually and that no significant change in the fawn sex ratio occurs prior to their first deer season as adults. The calculated adult sex ratios are contained in line "A" of Table IV.

TABLE IV — ADULT SEX RATIOS

	1957-'62	1963	1964	1965	1966
A	106:100	114:100	82:100	82:100	68:100
B	100:100	107:100	77:100	77:100	64:100

The removal of buck fawns at a greater rate than the sex ratio would decrease the number of bucks per 100 does in the surviving fawns and induce a slight error into the calculated adult sex ratios. In no case did the removal of buck fawns at a greater rate than the sex ratio reduce the sex ratio of surviving fawns below 100 bucks per 100 does. Adult sex ratios calculated from the 100:100 fawn sex ratio are contained in line "B" of Table IV.

Conclusions

The yearling buck and doe percentages over the last five years indicate a rapid decline of the adult sex ratio. Heavy harvest of bucks during the 1963, 1964, and 1965 deer seasons, combined with the extensive deer harvest of 1965, reduced the number of bucks among the adult portion of the herd from 100-106 bucks per 100 does in 1962 to 64-68 bucks per 100 does in 1966. The 1966 deer season resulted in a record kill and actually reduced the wintering herd for the first time. The removal of deer in the ratio of 102 bucks per 100 does (less than the fawn sex ratio) is believed to have resulted in a sex ratio of 60-70 bucks per 100 does among surviving deer.

Questionnaires returned by deer hunters following the 1965 and 1966 deer seasons indicated a fall sex ratio (fawns and adults combined) of 85 bucks per 100 does in 1965 and 80 bucks per 100 does in 1966. These findings also indicate a decrease in the buck percentage of the deer herd during 1965 and 1966.

V. POPULATION DYNAMICS 1962-1967

The stringent control of organized deer hunts on the reservation leaves few deer that are harvested of which the military authorities did not have knowledge. Deer harvests as compiled by Kentucky biologists provided a check on the figures as calculated by the post personnel. (Kessler—1967).

Accurate records were kept on the highway deer mortalities from 1958 when the first was noted. During the period 1962-1967, known losses from this cause ranged from 40-60 deer annually with many other collisions reported but the deer never found. It is believed that the actual losses from this source presently constitute about one hundred deer annually.

In recent years deer have been frequently reported as killed on the firing ranges of the reservation. It is believed that present losses due to this cause annually equal the highway kill.

Deer poaching has been prevalent ever since the herd was established and has no doubt increased annually with the deer population. Any estimate of losses from poaching is an educated guess as data other than the existence of poaching activity is lacking. Poaching estimates were made as a result of the reconstruction of the population dynamics from 1962-1967 as contained in Annex III. Presently poaching is believed to be accounting for 10% of all deer removed from the herd.

The rapid increase in the deer population (from 5,500 after the 1962 deer hunt to 9,000 after the 1965 deer hunt) was due to conservative harvests during 1962-1965 and an increasing percentage of does in the breeding population. This increasing doe percentage compensated in part for the declining reproductive rate and allowed the annual increase to remain above 50% in spite of the deteriorating condition of the deer range.

The extensive harvest of 1966 reduced the winter deer population by almost one thousand deer, primarily resulting in a thinning of the deer herd in many overpopulated areas. Deer in underpopulated areas were lightly harvested resulting in increasing populations in these areas as verified by rapidly increasing deer mortalities on the highways.

Based upon the population dynamics of the past six years it is apparent that the Fort Knox deer herd was not providing the maximum recreational value to the sportsmen of Kentucky during 1963-1965. The annual increase has dropped considerably even in view of the present doe-heavy population. Overpopulation and a deteriorating deer range are the principal causative agents. It is therefore necessary to eliminate these causative agents in order to protect both the deer and the range for future generations. To accomplish this, the following deer management goals have been established and are being accomplished.

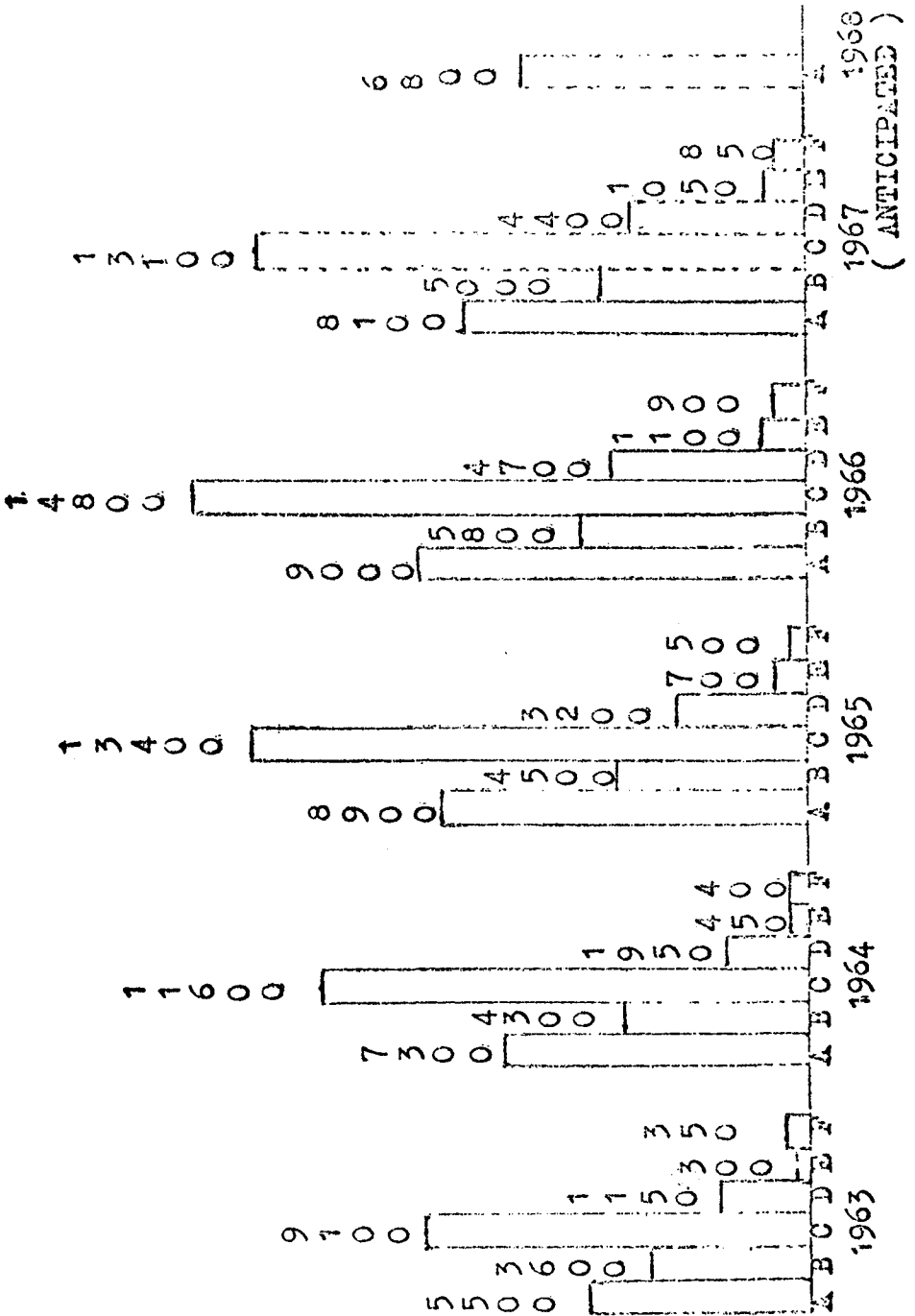
1. Reduce the winter (breeding) deer herd to 6,500-7,000 deer (one per fifteen acres of deer habitat) and retain the herd at this level.
2. Distribute the deer density evenly throughout the reservation by controlled hunting.
3. Conduct a summer deer reproduction census annually to estimate the annual population increase.
4. Harvest a number of deer equal to 70% of the estimated annual increase. The remaining 30% will be lost to crippling (17%), poaching (10%) and accidents (3%).
5. Conduct an annual winter deer census to estimate the breeding population.
6. Conduct annual cursory browse surveys to check the condition of the deer browse.

With this management policy a well-nourished deer herd with a high productivity can be anticipated to provide an annual harvest of 3,000-4,000 deer in the future.

ANNEX III — FORT KNOX DEER POPULATION DYNAMICS
1963-1967

Legend

- A = Winter population D = Harvest
B = Fawn crop E = Crippling losses
C = Summer population F = Poaching, accidental losses



VI. SUMMARY

Overbrowsing on portions of Fort Knox's deer range became noticeable eight years after stocking with white-tailed deer. Deterioration of the physical condition of the deer actually started two years prior to the noticeable overbrowsing of the range. The physical condition of the deer continued to decline annually as the acreage of noticeably overbrowsed range increased.

Average dressed weights of fawn and yearling deer decreased 11-18% during the period 1958-1965. Antler development in yearling bucks deteriorated 18% over the period 1960-1965 while productivity of does dropped 47% concurrently. Population inventories revealed the winter deer herd increased from 5,500 to 9,000 during the period December 1962-December 1965.

A comparison of deer from overbrowsed and underbrowsed areas in 1965 and 1966 revealed significant differences in the average weights, antler development, and productivity. A thinning of the winter deer density in overbrowsed areas during the 1965 deer hunt reduced the degree to which physical conditions of the deer differed between the two areas in 1966.

Deer hunters' preference for adult bucks during conservative deer seasons reduced the number of bucks per 100 does from 106 in 1962 to 68 in 1966. The increasing percentage of does in the herd compensated in part for the declining productivity and allowed the annual increase to remain above 50%.

A survey of deer hunters after the 1965 and 1966 deer seasons indicated roughly 19% of all deer killed as a result of hunting were lost as unrecovered cripples. Deer hunters took home 70% of all deer removed from the herd during the last two years. Poaching is presently accounting for 10% of all deer losses.

The Fort Knox deer management policy is based upon the population dynamics of the past six years. Goals are annual census of the winter population, reproduction, and deer browse conditions while reducing the winter deer population to 6,500-7,000 deer evenly distributed over the deer range. Seventy percent of the annual increase is to be harvested by deer hunting in order to maintain the deer herd at the optimum level.

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