

# POPULATION RESPONSE OF PENNSYLVANIA BLACK BEARS TO HUNTING

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*Abstract:* Annual legal harvests of black bears (*Ursus americanus*) in Pennsylvania during 61 hunting seasons from 1915 through 1979 ranged from 149 to 929 and averaged 424. Data for 1971–1977 showed high hunting pressure, with 95,000–250,000 hunters estimated active during 1-day bear seasons and success averaging 318–507 hunters per bear harvested. In 1971–1979 total known bear losses were 92–129 for years with no hunting and 297–1017 for years with bear seasons. In hunting years, legal kills accounted for 70–84% of all losses; other significant causes of loss were illegal kills (including cubs), road kills, and damage control. Increasing hunting pressure in 1976 and 1977 and a decline in the average age of harvested bears from 4.2 in 1967 to 2.8 in 1976 led to closed seasons in 1977 and 1978. In 1979, a 1-day season resulted in 736 legal kills and 120 cub kills; known losses totaled 1017. A high reproductive rate and good cub survival, probably related to good nutrition, have allowed the Pennsylvania black bear population to respond with sustained high productivity that has compensated for population losses in most years. Control of hunting pressure is the most important management need.

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This paper reviews Pennsylvania data on the hunting kill, hunting pressure, characteristics of the kill and related information useful in the development of management guidelines for black bears. Particular attention is given to the impact of hunting which since 1915 caused the greatest known losses to the population.

Bears have been exploited to varying degrees in many states as a result of recreational use and attempts to control damage and nuisance problems. Pennsylvania bears are no exception, but they have survived to constitute a sizable bear population, now approximately 4,000 animals in a populous (13 million people) industrialized eastern state. Bears were long considered a sporting trophy; Pennsylvania in 1905 was the first state to protect them (Pa. Game Comm. 1970).

Information on the annual hunting kill in Pennsylvania is available from 1915 (Pa. Game Comm. 1975) when 188 legal bears were taken in a 53-day season to 1979 when 736 legal bears were taken in a 1-day season (Table 1). As human pressures increased on the bear, various regulations were promulgated to increase its chances for survival. Pens, pitfalls, and traps for taking bears were prohibited by 1915; cubs were protected as early as 1925; hunting using dogs was prohibited by 1935 (Pa. Game Comm. 1970); and finally the hunting seasons have been progressively shortened from 2-month seasons to single-day hunts in 1972–76 and in 1979. Hunting seasons

were suspended when the single-day season did not provide adequate safeguards against heavy losses to the population from hunting.

## HABITAT

Approximately 2/3 of Pennsylvania is in forest and that provides about 6.9 million ha of potential bear range. The major bear range in Pennsylvania now coincides primarily with the large blocks of forested land in the less developed northern areas of the State. Bears occur also in the heavily forested southwestern areas of the State but in lower numbers. In areas considered well stocked with bears, including parts of the northeast and northcentral ranges, populations approximate 1 bear per 405 ha of forest land. Populations in the more southerly and southwestern ranges are far below these levels and are considered to be below carrying capacity.

Past habitat changes have probably had important influences on the bear population. For example, much of the major forested bear range had been heavily logged and often burned over by 1916. Thus, while low-growing fruit producers were available, the important oak acorns (*Quercus* spp.), beechnuts (*Fagus grandifolia*), wild black cherries (*Prunus serotina*), and chestnut (*Castanea dentata*), valuable as rich fall foods, were limited. White-tailed deer (*Odocoileus virginianus*), almost extirpated by 1900, were

Table 1. Legal bear kill in Pennsylvania, 1915–79 (Pa. Game Comm. 1975); cubs included in legal kill only in 1915–1924.

Year	Kill	Year	Kill	Year	Kill	Year	Kill	Year	Kill
1915	188	1928	427	1941	593	1954	403	1967	568
1916	435	1929	447	1942	149	1955	363	1968	218
1917	368	1930	707	1943	307	1956	335	1969	295
1918	387	1931	501	1944	295	1957	294	1970	Closed
1919	472	1932	216	1945	366	1958	439	1971	488
1920	420	1933	586	1946	325	1959	296	1972	370
1921	510	1934	Closed	1947	569	1960	392	1973	299
1922	563	1935	402	1948	388	1961	237	1974	223
1923	500	1936	356	1949	411	1962	554	1975	388
1924	929	1937	537	1950	354	1963	280	1976	605
1925	470	1938	384	1951	429	1964	526	1977	Closed
1926	660	1939	535	1952	261	1965	347	1978	Closed
1927	321	1940	524	1953	303	1966	605	1979	736

Total kill = 25,856  
 Mean for all 65 years, 1915–79 = 397.8  
 Mean for 61 years with open seasons = 423.8

restocked and protected. By the 1930's they were so numerous that they depleted the understory vegetation in much of the bear range.

Small farms in the forested areas diminished in number. In 1915 there were approximately 7.7 million ha in 210,000 farms which decreased to fewer than 4.5 million ha in less than 90,000 farms by 1965 (Struble 1967). However, this trend in land use has changed again as housing developments, homes in the woods, and commercial ventures such as swamp drainage for sphagnum, strip mining for coal, and industrial sites or parks are established in occupied bear range.

Finally, since the early part of this century, farm-to-market roads and major highspeed highways amounting to approximately 145,000 km (90,000 miles) (U.S. Dept. Transportation 1977) have usurped habitat and caused direct losses as bears are killed in roadways.

### ANNUAL BEAR KILL

The Pennsylvania bear population has yielded a legal harvest of nearly 26,000 animals in 61 hunting seasons during the 65 years, 1915–1979 (Table 1). The annual harvest has averaged 424 with a high of 929 in 1924 and low of 149 in 1942. Prior to 1966, the hunter take usually fluctuated between the 200's and 500's with kills of 400–500 followed by kills of 200–300 the following year and a return to a higher kill the next year. In 1966 and 1967, with heavy hunting pressure and favorable weather conditions for hunters, legal kills totaled 605 and 568, respectively. The following 2 years provided kills of only 218 and 295.

While cub bears were not legally taken by hunters after 1924, cub losses during hunting seasons occurred routinely. For example, cub losses amounted to 63 animals, or 10% of the to-

Table 2. Known losses, from all causes, to Pennsylvania's black bear population, 1971–79.<sup>a</sup>

Year	Hunting season losses				Losses other than legal hunting				Total known losses	% of known losses due to legal kills
	Legal kills	Cub kills	Total harvest		Illegal kills <sup>b</sup>	Road kills	Damage control	Other		
			No.	% cubs						
1971	488	45	533	8.4	45	40	3	4	580	84.1
1972	370	42	412	10.2	69	54	10	6	509	72.7
1973	299	19	318	6.0	19	81	9	7	415	72.0
1974	223	9	232	3.9	13	55	5	1	297	75.1
1975	388	46	434	10.6	62	69	23	10	552	70.3
1976	605	98	703	13.9	114	57	8	11	795	76.1
1977		Closed season			19	59	7	7	92	
1978		Closed season			27	84	13	5	129	
1979	736	120	854	14.1	120	88	21	52	1017	72.4

<sup>a</sup> Data from administrative reports of the Pennsylvania Game Commission.  
<sup>b</sup> Includes cub kills during hunting season.

Table 3. Average ages of hunter-killed black bears, excluding cubs, sampled during Pennsylvania hunting seasons, 1967–76.

Year	Sample size	Average age (years)		
		Males	Females	All
1967	30			4.18
1969	56			4.00
1971	120	2.69	3.30	3.00
1972	149	3.08	4.30	3.72
1973	246	2.21	2.96	2.59
1974	183	2.50	3.54	3.01
1975	329	2.26	3.69	3.33
1976	536	2.51	3.13	2.82

tal harvest, in 1967; 13 animals, or 5.6%, in 1968; and 25 animals or 7.8%, in 1969. Cub losses for 1971–79 are shown in Table 2.

Although data are limited, known natural mortality in natal dens or in denning 1st-year cubs was insignificant based on marked individuals and the percentages of yearlings occurring in the hunter harvest. Only 2 2nd-year animals were found dead in winter nests and only 1 case of natural mortality of cubs in the den was recorded in studies of over 50 denning females. Losses of adults have been rare except those related to hunting, illegal take, road kills, or damage control.

The number of bears killed by vehicles is shown in Table 2 along with other known losses. Known losses to vehicles reached a high of 88 in 1979. Road kill varied from approximately 65% of the total loss in years when bears were not hunted to 7–20% in years when hunting took place.

The ages of bears were determined by tooth sections taken from a sample of the legal kill (Sauer et al. 1966). Average ages of bears killed were determined in 1967, 1969, and annually from 1971 (Table 3). A decline in average age was shown for both sexes combined between 1967 and 1976.

Hunting pressure as measured by the number of individuals who hunted bears was determined on a sampling basis from field counts and from a game take survey operated by the Pennsylvania Game Commission (Table 4). Although the actual number of hunters was estimated, cross checks using 2 sampling methods confirmed that the pressure placed on the bear population exceeded 200,000 hunters in 1976 and 1979. During this same period the number of hunters in Pennsylvania holding general hunting licenses

Table 4. Hunting pressure and success during Pennsylvania black bear hunting seasons, 1971–79.

Year	Season length (days)	No. bears harvested	Est. No. hunters <sup>a</sup>	
			Total	Per bear harvested
1971	2	488	197,612 <sup>b</sup>	405
1972	1	370	132,080	357
1973	1	299	95,189	318
1974	1	223	113,000	507
1975	1	388	149,000	384
1976	1	605	203,921	337
1979	1	736	250,000 <sup>c</sup>	340

<sup>a</sup> Data from road counts (Pa. Game Comm., Game Take Survey, Admin. Rep., W.K. Shope, 1977) and estimates based on field reports.

<sup>b</sup> Total hunters over 2-day season.

<sup>c</sup> Sampling not complete; hunter numbers estimated on field reports.

that permitted them to hunt bears as well as other animals exceeded 1 million.

## DISCUSSION

Available data indicate the importance of the hunting take as a major factor influencing the bear population in Pennsylvania (Table 2). It is more difficult to evaluate the many changes that have taken place in the habitat. Certainly heavy logging and burning during the early 20th century reduced the availability of foods from oaks, beech, black cherry, and other mast producers. The large deer herd has competed for low-growing foods as well as mast crops since the late 1920 era.

Changes that occurred as small farms reverted to brush and woodlands were probably beneficial to the bear as bears appear to have been poorly tolerated by early farmers. Today, the best bear ranges are still characteristically the areas of the lowest human population such as large commercial forest areas. However, as bears have been forced to accept more human disturbance in portions of their range, they are making adjustments. Included among these adjustments are the living and denning in close proximity to occupied dwellings and the utilization of corn fields and apiaries as food sources. During poor mast years corn damage is particularly high. Feeding stations privately maintained for the bears are common in some sections and these as well as dumps are frequently visited by bears. Bears appear to be adjusting well to humans but not without creating some nuisance and at the sacrifice of some bears destroyed for causing damage (Table 2). These

bear–human conflicts have required constant effort to develop management systems that will reduce damage and help to maintain the popular support needed to encourage human tolerance and understanding for the bear.

Bears have not become adjusted to highspeed highways and the high rate of travel by trucks and cars as is indicated by heavy bear losses due to vehicles (Table 2). There have been indications that mesh-type fencing along rights-of-way discouraged but did not entirely prevent bears from crossing express highways. Deaths of bears due to vehicles appear related to bear population levels and appear to increase during years when natural foods are scarce.

Legal hunting has been considered the major factor affecting the Pennsylvania bear population since licensed bear hunting started. Only during 1967–1979 were data collected which reflected the characteristics of the bear population as it was subjected to hunting pressure.

The level of population exploitation which occurred in 1966 and 1967 when legal kills of 605 and 563 were recorded was sufficient to lead to reduced legal kills of only 218 and 295 in the next 2 years of hunting (Table 1). During these seasons, the illegal cub kill was only 13 and 25, respectively also suggesting that the decline in legal kill reflected fewer bears in the population. Hunting season length had been 6 days from 1956 through the 1968 season, but because of the low 1968 kill, it was reduced to 2 days in 1969. The continued low kill, even with the reduced season length, led to closure of the hunting season in 1970.

The 1971 season remained at 2 days and resulted in an appreciable increase in the kill to 488 legal bears and 45 cubs (Table 2). There was concern, however, because the average age of bears killed had declined from 4.18 years in 1967 and 4.00 years in 1969 to 3.00 years in 1971 (Table 3), and hunting pressure was heavy: 197,612 total hunter days over the 2-day season (Table 4).

The following 3 seasons, even though reduced to single-day hunting, showed a decline in kill from 370 in 1972 to 299 in 1973 and 223 in 1974. The average age of harvested bears was 3.72 years in 1972 but declined to 2.59 and then rose to 3.01 years in 1974 (Table 3). During this

period kills of cubs declined from 42 to 9 (Table 2) and hunting pressure continued high: approximately 113,000 hunters in 1974 (Table 4).

The legal kill rose to 388 in 1975 and then to 605 in 1976. Average age increased slightly to 3.33 in 1975 as the harvest apparently reduced the breeding population. The age then declined to an average of 2.82 years in 1976 when a heavy kill of 605 legal bears and 98 illegal cubs was recorded. Increasing hunting pressure, the declining age of bears harvested, and evidence that excessive harvests were occurring in certain parts of the range resulted in a season closure in 1977 and 1978 while a management solution was sought. Hunting pressure continued to increase and reached an estimated 250,000 hunters by the 1-day mid-December season in 1979.

The effects of hunting take on the population are further evidenced by past records. In evaluating the harvests over the years, it was noted that there was a decrease in average harvest of 110 bears in 8 years following the heavy 1939–41 kills when compared to the 8 years prior to 1939. An average decrease of 23 bears occurred in 8 seasons after the heavy 1966–67 harvests when compared to the 8 years prior to 1966. The 1976 mortality rate on tagged bears from hunting alone amounted to 35% in the important northeastern range. During 1979, when poor food conditions in this area resulted in consistent early denning by females, this kill rate declined to 11%.

The relatively high 1979 kill of 736 legal bears on a 1-day hunt following 2 years with closed seasons reflected the protection provided by the hunting season closure during 1977 and 1978. The fact that this population of bears has withstood heavy hunting pressure and shown an ability to recover quickly indicated its capacity to replace population losses through reproduction. We believe that the resiliency of this population results as a response or compensation to the heavy rate of exploitation to which it has been subjected. Data have shown 38% of 2-year-old females breeding, high ovulation rates, low intra-uterine mortality, and low incidence of non-breeders. Potential recruitment from 1st breeding averaged 2.39 animals and from later breedings 3.23 animals (Kordek and Lindzey 1980). It is important that there was usually a wealth of

high-quality food available that would help account for this high productivity. Nonetheless, heavy regular harvesting of the population reduced competition for food and tended to assure the nutritional plane usually considered important for high productivity.

In addition to a high breeding potential, cubs survival is good as indicated by recruitment to the population and studies of marked cubs. An important reason for the good cub survival may be related to nutrition and their body size when denning the winter following birth. Pennsylvania animals usually range from 27 to 57 kg, in contrast to the situation in Minnesota (Rogers 1976), where young bears may be succumbing as a result of poor nutrition even as yearlings. There is only one case of cannibalism known to us and this occurred when a snared yearling female was eaten and probably killed by another bear. There is no evidence that the presence of large male bears (over 180 kg) has had any effect in dampening the population as was indicated in the Alberta population (Kemp 1976). Approximately 2% of the legal kill in Pennsylvania may be large male bears.

Further evidence of a population that has responded to exploitation is provided by the behavior of Pennsylvania bears as indicated by their movements and home ranges described by Alt et al. (1976).

## CONCLUSIONS AND RECOMMENDATIONS

Our data indicate that Pennsylvania's black bear population has been subject to exploitation but that it has demonstrated a strong response of sustained high productivity. This productivity was maintained on a range which provided a high level of nutrition from natural sources, private feeding stations, dumps, and cultivated crops. The result was an unusually high reproductive potential which compensated for losses to the population in most years.

Habitat has been altered by human incursions into bear range as highways, homes, and commercial plants have been constructed. However, losses of space have been somewhat compensated

for by adjustments in bear behavior that have led to greater tolerance of human disturbance.

The major limiting factor has been the number of bears killed by hunters, but other losses including illegal and road kills have also removed an important portion of the population. The number of bears killed during hunting seasons has been related to the number of bears in the population, length of season, time of hunt, availability of natural foods, and number of hunters.

In recognition of the importance of hunting as a factor affecting the bear population, it is quite clear that the numbers of hunters must be controlled to avoid overharvests, particularly in heavily hunted portions of the range. It will also be necessary to control hunting pressure by areas through the control of bear hunting permits issued for specific areas of the bear range.

As the public is increasingly coming in contact with bears, careful public relations programs are needed to assure a sympathetic public response when damage and nuisance complaints occur. Efforts are needed to reduce the tendency of bears to become dependent on and too friendly with people because such animals often must be destroyed.

Continued data collection using tagged and radio-instrumented bears as well as records for all bears killed will be required to monitor the status of the population. Data obtained can be used to determine the level of hunter kill that will provide the maximum in hunting recreation but that will also assure the welfare of the resource for future esthetic and sporting uses.

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