Paper 20

The Black Bear in Pennsylvania—Status, Movements, Values, and Management

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The black bear, *Ursus americanus*, in Pennsylvania is a trophy that is sought by as many as 130,000 hunters each year. The heavy hunting pressure and other factors are causing increased concern for the welfare and survival of huntable populations of bears in the state. Records of annual harvests since 1915, demonstrate the productivity of the range, the long-term value of the resource and the interest of the hunters in this animal. There have been only two closed hunting seasons, 1934 and 1970. The 1970 closure occurred when annual harvests were less than 300 animals (Table 1). The season was closed to allow the bear population to increase and maintain itself without the pressure of hunting losses.

With the bear on the endangered list in Maryland, nearly extirpated from New Jersey, and possibly over-harvested in the Catskill Mountain section of New York, any indications of a decline in the Pennsylvania bear population are cause for increased concern to hunters and the general public. Thus, when the legal harvest during a one-day season declined from 370 in 1972 to 299 in 1973, a decline in the population was suspected. In view of the heavy hunting pressure on the bear and the general interest in its welfare, a more sensitive management program for Pennsylvania's bear population is needed.

The bear population in Pennsylvania is widely distributed on good-quality range. Individual animals are healthy, the population is productive, and most

TABLE 1. AVERAGE AGE OF HUNTER-KILLED BEARS 1967-1973.

Year	Season Length (Days)	Legal Kill[1] for Season	Sample Size	Average Age[2] in Years
1967	6	568	30	4.18
1968	6	218	None	Unknown
1969	2	295	56	4.00
1970	Closed	None	None	—
1971	2	488	120	3.00
1972	1	370	149	3.72
1973	1	299	246	2.59

[1] Reports of Pennsylvania Game Commission.

[2] Includes both males and females. Excludes illegal cub kills.

bear range is occupied, although apparently below carrying capacity. Forest areas are composed largely of mixed-oak, *Quercus;* oak-hickory, *Carya*; beech-birch-maple, *Fagus-Betula-Acer;* and transition zones (Ferguson 1968). Spruce-hemlock, *Picea-Tsuga*; tamarack, *Larix*; and blueberry, *Vaccinium,* swamps are a small but important type in the north-east (Eveland 1973: Kordek 1973). Centers of bear populations (in the north-central and north-east portions of the state) coincide generally with commercial forest areas which have low human population.

Many important problems are associated with management of the bear population. In some localities, populations are low, and sex and age class imbalance may exist in parts of the range. Increasing recreational pressure from metropolitan areas is encroaching on much of the bear's range (Anon. 1969). It is obvious that both bears and humans must make adjustments if bear populations are to be maintained. The fact that more than one of every 12 people in Pennsylvania buys a hunting license indicates the potential support for intensified programs to manage the black bear.

The great variety of foods available throughout the year makes the Pennsylvania range potentially productive for bear. This range has supported average annual legal kills of 456 bears from 1915 to 1944 and 382 bears from 1944 to 1969. The productivity of the range is further enhanced by relatively mild winters during which food is available, thereby permitting some bears to stay active and feed for the entire winter (Matula 1974).

A wide variety of high-quality bear foods are produced on the range. Blueberry, juneberry *Amelanchier,* and blackberry *Rubus* fruits are important summer foods; fall mast and fruit allow further weight gains before denning and deer carrion is a regular supplement during winter and spring. The high quality of the range is demonstrated by cubs weighing 36 kg in the fall (Eveland 1973; Kordek 1973; Matula 1974) and by bears leaving dens in the spring in good to excellent condition.

Pennsylvania's 130,000 hunters can pursue bears on approximately 3.64 million hectares of range. Even though dogs are not legally used for bear hunting, the scores of hunters afield are very effective in moving the bears about. Thus, the large number of hunters results in heavy harvests of available animals. Experienced hunters familiar with bear retreats and trails are relatively few but highly successful. Even with the many hunters, some localities have a relatively low hunting pressure. The continued survival of huntable bear populations appears related to three factors: the presence of swamps and similar retreat areas in the primary range that is not penetrated by the hunter: private and public refuge areas closed to hunting; and peripheral bear range that regularly contains a few bears but which receive relatively light hunting pressure. These areas significantly increase the overall survival rate of the breeding-age stock.

The Pennsylvania Cooperative Wildlife Research Unit began studies in 1967 to obtain data for the development of a contemporary management plan. A series of studies by wildlife graduate students, assisted by Pennsylvania Game Commission biologists and game protectors, have played a major role in gathering field data. However, more data are needed to permit analyses to meet the following research objectives:

1. To characterize the black bear population in Pennsylvania by examining the age and sex of animals killed and by capturing, marking and releasing free-ranging animals.

2. To determine movements of black bears in relation to age, sex, season, food supplies, behavior, human disturbance and other factors. (Movements of black bears in and around northern Pennsylvania frequently take them into New York. Reseach is, therefore, coordinated between the two states to evaluate this interaction.)
3. To establish baseline data on blood parameters of black bear that may relate to changing disease or parasite loads or physiological or behavioral changes in the population.
4. To determine the productivity of the black bear population in Pennsylvania by records of cub production, examination of female reproductive tracts, and reconstruction of bear population data.
5. To develop or adapt a computer program to permit simulation of the population dynamics of bear in Pennsylvania and provide a basis for the utilization of data on kill, age and location, and other information to predict population trends and to guide management.

REPRODUCTIVE SYNCHRONY

In Pennsylvania, harvest and observational data indicate an apparent reproductive synchrony in which a majority of cubs are produced in alternate years. This synchrony is apparent from cub observations obtained in Pike County, Pennsylvania (Table 2) and is similar to the situation reported in New York (Free & McCaffrey 1972). Female black bears producing cubs that survive into the summer months do not mate until the following year. Thus, female black bears usually produce a cub or cubs every second year. The majority of females give birth for the first time in the same year that their mothers are producing another litter. If, by some as yet unexplained circumstance, an age class is severely depleted, the result will be that the majority of cub production will occur every other year with alternate high and low numbers of cubs produced in successive years.

Differential cub production in alternate years is also suggested by the number of hunter-killed cubs and yearlings (Table 2). Although the killing of cubs is illegal in Pennsylvania, it does occur, especially in years of high cub production such as 1972 when 52 were killed. The percentage of yearlings in the kill increased during years following high cub production, as in 1973 when 50 percent of the kill were yearlings. In contrast, only nine percent of the legal harvest had been yearlings in 1972.

In years following high cub production, the yearling age class is an important segment of the total kill as noted above. The total kill in this case usually exceeds the kill during the years when most cubs are produced (Table 2). Thus, larger legal kills have usually occurred in odd-numbered years than in the preceding even-numbered or cub-producing year. For example, in 1968, 218 bears were killed; in 1969, 295; in 1970, the season was closed; in 1971, 488; in 1972, 370; but in 1973, only 299. The decline in 1973 is believed to be the result of low population and the tendency of bears to move extensively and thereby elude hunters during years of natural food shortages.

The apparent synchrony that existed from 1958 until 1966, during which time the legal bear kill was higher in the even-numbered years than in the preceding odd-numbered years, was reversed during 1966 and 1967 with two years of exceptionally heavy kill (605 and 568, respectively). This reversal occurred in 1967 when many cubs were lost (138 bears illegally killed, mostly cubs);

TABLE 2. CUB OBSERVATIONS AND HUNTER HARVESTS, 1970-73.

Year	Cubs Observed[1] in Pike County, Pennsylvania	Cub Kill Statewide During Season	Percent Yearlings in Harvest Statewide	Statewide Harvest	Size of Sample of Kill for Age Determination
1970	28	None	Hunting Season Closed	0	0
1971	2	41	23	488	120
1972	37	52	9	370	149
1973	10	19	50[2]	299	246

[1] Cub observations reported for Pike County only because this was the one area where a worker was present to record observations.

[2] This percentage seems unusually high and may reflect an overharvested population with relatively fewer older bears present.

subsequently, more cubs have been produced in even years. It is unlikely that the complicated combination of factors that precipitated this reversal can be completely explained, but the combination of heavy loss to the 1967 age class, with high kill and consequent possible loss of pregnant females in 1966, was probably important.

AGE

Data have been collected on ages on harvested animals, bears killed in other ways, and live-trapped bears. The sample of bears examined has increased from 30 in 1967 to 246 in 1973. For harvested bears, a downward trend was found in the average age from 1967 to 1973, excluding 1968 when insufficient data were available and 1970 when the hunting season was closed (Table 1). As the sample size increased from 30 bears examined in 1967 to 246 in 1973, data became more meaningful. Although a general decline in average age is shown from 4.18 in 1967 to 2.59 in 1973, 1972 does not appear to follow the pattern (Table 1). This is believed to be the result of the hunting season closure in 1970 and the unusually high (34%) representation of $2\frac{3}{4}$-year-old animals in the 1972 harvest sample. These age data, information on the declining legal harvest (from 1915 to 1944, annual harvests averaged 456 bears; and from 1945 to 1969, the average was 382 bears), and the smaller proportion of adult bears in the kill (42% over $3\frac{3}{4}$ years of age in 1972 and 16% over $3\frac{3}{4}$ years in 1973) suggest that the Pennsylvania population is overexploited.

MOVEMENTS

The movements of bears are important to management programs because of the critical influence they have on harvests, nuisance and damage problems, losses on the highways, and utilization of available foods. In addition to the usual marking and recovery methods, radio telemetry techniques have been employed to obtain data needed for management. Detailed data on the extent of movements in north-eastern Pennsylvania were obtained by radio-tracking bears with the aid of fixed-wing aircraft (Matula 1974). One male bear, trapped and moved because he was raiding cabins, traveled 80.5 km north from his release point into New York and then returned almost to the original capture site approximately one month later. Another male was tracked for two winters and apparently remained active during both, although he utilized a winter nest in a swamp during part of the second winter. Two females equipped with radio collars were tracked to determine their home range and later to locate their winter dens.

Home range data obtained for seven instrumented bears (Table 3) suggest two items of management importance: (1) females are less mobile and can, once located, be given protection by refuge or closed areas; and (2) the more mobile males can be harvested outside of the female ranges or cub production areas.

On the average, nuisance animals ranged farther than non-nuisance animals, 19 km compared two 10.2 km, respectively (Table 4). The fact that nuisance bears were transplanted from the nuisance site undoubtedly affects these bears and may lead to the greater movements recorded. From the management standpoint, alternative techniques for nuisance animal management are needed because nuisance bears are capable of extensive moves and may return to the original site. As was also indicated in telemetry studies, males moved on the average farther than females, 15.2 km compared to 5.4 km, respectively.

TABLE 3. HOME RANGE CALCULATED FOR SEVEN BEARS IN NORTHEASTERN PENNSYLVANIA AS DETERMINED BY RADIOTRACKING AND TRAPPING.

	Bear Numbers						
	192-193	215-216	221-222	245-246	272-273	274-275	276-277
Sex	M	F	M	M	F	F	F
Age at Time of First Capture	2+	4+	3+	2+	5+	3+	3+
Time Period Observed	05/27/72—01/19/74	09/12/72-09/10/73	10/24/72-10/04/73	04/09/73-10/12/73	08/28/73-12/19/73	09/04/73-10/28/73	09/04/73-11/14/73
Number of Observations	90	12	12	17	49	25	37
Home Range Estimates* km^2 —1	108.68	9.81	41.49	571.98	44.39	77.75	26.62
—2	163.02	14.71	62.24	857.97	66.59	116.63	40.09
—3	113.38	10.81	93.75	880.48	50.01	338.55	27.17
—4	170.07	16.22	140.62	1320.73	75.02	507.82	40.75
—5	162.48	3.19	13.49	228.79	39.07	40.43	18.71
—6	38.91	1.98	8.38	121.26	12.25	17.73	6.73

*cf. Jennrich & Turner 1969.

1 and 2 — Based on the co-variance matrix of capture loci at the (1) 95% and (2) 99% confidence region.

3 and 4 — Based on the mean recapture radius at the (3) 95% and (4) 99% confidence region.

5 — Based on the estimated convex polygon method.

6 — Based on the estimated minimum polygon method.

TABLE 4. RECORDED MOVEMENTS OF BLACK BEARS FROM TRAPPING TO LAST RECAPTURE OR KILL, 1967-73.

Number & Category of Animals	Age in Years		Km Moved from Nuisance Site		Km from Original Capture to Final Location		Period of Observation (Months)	
	Ave.	Range	Ave.	Range	Ave.	Range	Ave.	Range
Nuisance								
10 Males	2.4	(.75-4+)	44.6	(0-130.4)	21.4	(0-40.2)	9.0	(1-48)
6 Females	4.3	(1-10)	44.4	(9.7-112.6)	14.6	(0-67.6)	4.5	(1-13)
16 Total Nuisance	3.2	(.75-10)	44.6	(0-130.4)	18.9	(0-67.6)	7.1	(1-48)
Non-Nuisance								
32 Males	2.1	(.75-4)		None	12.9	(0-104.6)	7.0	(.2-33)
16 Females	3.1	(.75-6)		None	4.0	(0-14.5)*	9.2	(.2-48)
48 Total Non-Nuisance	2.47	(.75-6)			10.1	(0-104.6)	6.2	(.2-48)
42 All Males	2.24	(.75-4)			15.2	(0-104.6)	7.5	(.2-48)
22 All Females	3.43	(.75-10)			7.0	(0-67.6)	8.3	(.2-48)
64 All Bears	2.65	(.75-10)			12.4	(0-104.6)	7.8	(.2-48)

*Six of these bears had no movements recorded.

Data collected in northeastern Pennsylvania indicate that Pike County is an important cub production area (37 cubs in 1972) for this part of the state (Table 2). Other data showing movements of Pennsylvania bears to the Catskill area of New York indicate the potential importance of the Pike County area to this New York population. Therefore, closure of bear hunting season in Pike County would be expected to benefit a large area of Pennsylvania and the southern Catskill area of New York.

RANGE AND KILL

Our studies, which showed that a high percentage of young bears were being killed, suggest that bears in part of the north-central range were over-harvested by 1968 (Wakefield 1969). In a 6,883 ha study area, previously the site of much hunting activity and good harvests, only two young males were located and tagged during extensive snaring efforts in 1967. During the 1967 hunting season, eight legal bears and three cubs were killed. Although four of the 1967 legal bears were females, 64 to 69 kg dressed weight, there was only one small female among the nine bears killed in 1968. Since 1968, annual kills in the area have been limited to a few young male bears.

On a state-wide basis during 1973, the average age of male bears killed was only 2.19 years, and one-half of all bears harvested were yearlings. When considered with other data from trapping records and previous hunting seasons, this suggests that the young, inexperienced males are more mobile and, therefore, more susceptible to harvesting. It also suggests, because the total 1973 harvest was only 299 bears, that there were few older bears available to the hunters.

PROBLEMS

Bear population losses from all causes except legal kill are high, ranging from 21 to 38 percent of the legal kill between 1969 and 1973 (Table 5). The apparent increasing trend in road kills from 19 in 1969 to 77 in 1973 reflects the increased highways and higher traffic speed in bear country and is of great concern because there seems to be no ready solution by management. The high total of 'other' losses in 1972 reflects the high illegal cub kill (52) in a year of high cub production.

TABLE 5. TOTAL BEAR LOSSES OTHER THAN HUNTING.

Year	Road Kill	Total all Losses Other than Legal Hunting	Percent of Legal Kill
1969	19	65	22
1970[1]	42	59	—
1971	40	102	21
1972	54	139	38
1973	77	110	37

[1] No legal hunting season.

The movement of bears appears to be at least partially related to food availability as demonstrated by the influx of animals into areas of high acorn (Wakefield 1969), berry and apple production. It suggests that bears, particularly males occupying large ranges, visit these areas with some regularity and will remain there for undetermined periods if food is available. During years of extreme natural food shortages, males may concentrate in cornfields and even females may cause considerable damage within their more limited ranges.

The general mobility of the bear population presents a difficult problem for management. Occasionally, this mobility results in heavy legal kills because hunters learn where bears concentrate to feed, and they, in turn, concentrate their efforts there. In years of food shortage, bears may not be concentrated where hunters traditionally seek them and consequently the kill may be low. However, in 1973, a year of bear food scarcity, a reduced legal kill was offset when increased numbers of bears were killed on the highways and shot because of crop damage.

Major changes are occurring in much of the Pennsylvania range, but the changes and the problems they create are particularly critical in the prime bear range in the glaciated northeast. Here, entire towns are developing around the swamps and lakes which are important retreats for bears. The net result of this disturbance and loss of habitat has yet to be measured, but carrying capacity is being reduced. Conflict between suburbanites and bears who raid garbage cans, frighten children and enter cabins, required further reductions in the populations. The problem is further heightened by individuals who feed bears, thereby setting the stage for damage in other areas and adding to the bear-people problem.

SOME MANAGEMENT ALTERNATIVES

With the broad interest in bears by hunters and non-hunters, the implications of a decline in the bear population of Pennsylvania and the increasing problems with them, a perceptive, flexible management program is necessary. It has been demonstrated that the bear, although extremely powerful and potentially dangerous, is basically timid and can live in reasonable proximity to man if the proper food and cover situations are maintained and if people have some understanding of bear behavior and requirements. Obviously all the data are not yet at hand to develop a contemporary management program, but some actions based on present knowledge appear desirable: (1) a broad public and hunter information program is required; (2) the needs of the bear in a developing Pennsylvania must be understood and accepted by the public and hunters; and (3) artificial feeding by the public, which creates problems of bear-people contact, should be eliminated.

A further important management opportunity exists in the recognition of high cub production areas such as Pike County. Closure of such cub producing areas during bear season may be a feasible means of helping to assure a viable population of bears. Where it is demonstrated that larger numbers of cubs are born in certain years, as in Pike County, it is possible to close these areas during 'cub years' and reduce the high loss of cubs.

With over 100, 000 hunters seeking to bag a bear annually and the other pressures that are being placed on the population, a permit system to limit the number of bear hunters may be needed.

The ultimate management tool available for protecting and increasing the population is season closure until it is determined that the population is reproducing at a rate equal to its losses. The practical problem arising under this system is the potential for high nuisance and agricultural damage before the desired equilibrium is obtained. It would seem more desirable, therefore, to use a hunting system that would permit controlled numbers of hunters to harvest animals in specified areas to minimize crop damage while assuring the protection of female bears and cubs in other areas.

The success of any system will be closely tied to the public relations program noted earlier and to the availability of adequate data on which to base management decisions.

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