

Preliminary Management Implications for Black Bears, *Ursus Americanus*, in the Catskill Region of New York State as the Result of an Ecological Study

EUGENE R. MCCAFFREY, GARY B. WILL and ANDREA S. BERGSTROM
New York State Department of Environmental Conservation, Delmar, New York

INTRODUCTION

New York State has three distinct black bear ranges (Fig. 1). The Adirondack range in northern New York is the largest containing 24,043 square kilometers (9,283 square miles) and an estimated population of 3,500 bears. The smallest is the Allegany range containing 1,168 square kilometers (451 square miles) and is a peripheral area of a major range centered in northwest Pennsylvania (Sauer and McCaffrey 1965). The Catskill bear range contains 3,280 square kilometers (1,270 square miles) and an estimated 200 bears. This range is located in southeastern New York between 95 and 160 kilometers (60 and 100 miles) from metropolitan New York City and is within easy access of its 16 million people.

A decline in the average hunter take in recent years prompted an assessment of the harvest statistics by town which revealed the possible existence of two sub-populations. The northern population centering in western Greene and Ulster Counties (Fig. 2) appeared isolated from the southern population by a series of towns where there was no take or a sporadic take. When the take was separated into two areas and examined, it appeared the majority of the decline occurred in the northern area. The southern area, while yielding a smaller take, appeared to maintain its population rather than to decline. This area is also contiguous with a larger area in Pennsylvania which has always supported bear populations.

A study was planned to determine the present status of the Catskill black bears and to prepare a policy for future management.

MATERIALS AND METHODS

Each hunter taking a bear during the regular big game hunting season (held during late November and early December) was required to report his bear to the New York State Department of Environmental Conservation via a toll free telephone answering service within 48 hours (Miller 1971). Upon notification of a Catskill kill, a Department employee interviewed the hunter and whenever possible examined the bear carcass for basic biological data. This included removing a premolar, normally a first upper premolar, for sectioning and aging by cementum layering (Sauer *et al.* 1966). These examined bears were considered the 'legal take' for 1970 through 1973. The 1969 'legal take' was by hunter reports only.

Aldrich foot snares and culvert box traps were used to trap, tag and release a substantial proportion of the Catskill bear population (Miller *et al.* 1973).



Figure 1—Location of New York State, Black Bear Ranges, and Catskill Study Area.

Etorphine (M99) and its antagonist Diprenorphine (M50-50) (Miller & Will 1973) were used for immobilization. Most bears were released at the trap site. A first upper premolar was extracted from each captured bear. Trapping was conducted from June to October in 1970 and from April through October in 1971 and 1973.

An appraisal of the economic effects of bears was determined by: (1) damage assessed by investigated nuisance bear complaints and (2) aesthetic qualities such as trophy value and non-hunter interest from interviews with sportsmen and others.

Determination of the current and future land use patterns, human population pressures and other socioeconomic factors that would influence a bear management policy were compiled from *The Land Use and Natural Resource Inventory of New York State, Manual for The Use of The Legislature of The State of New York 1971-72*, and *Deer Habitat Area in New York State* for comparisons.

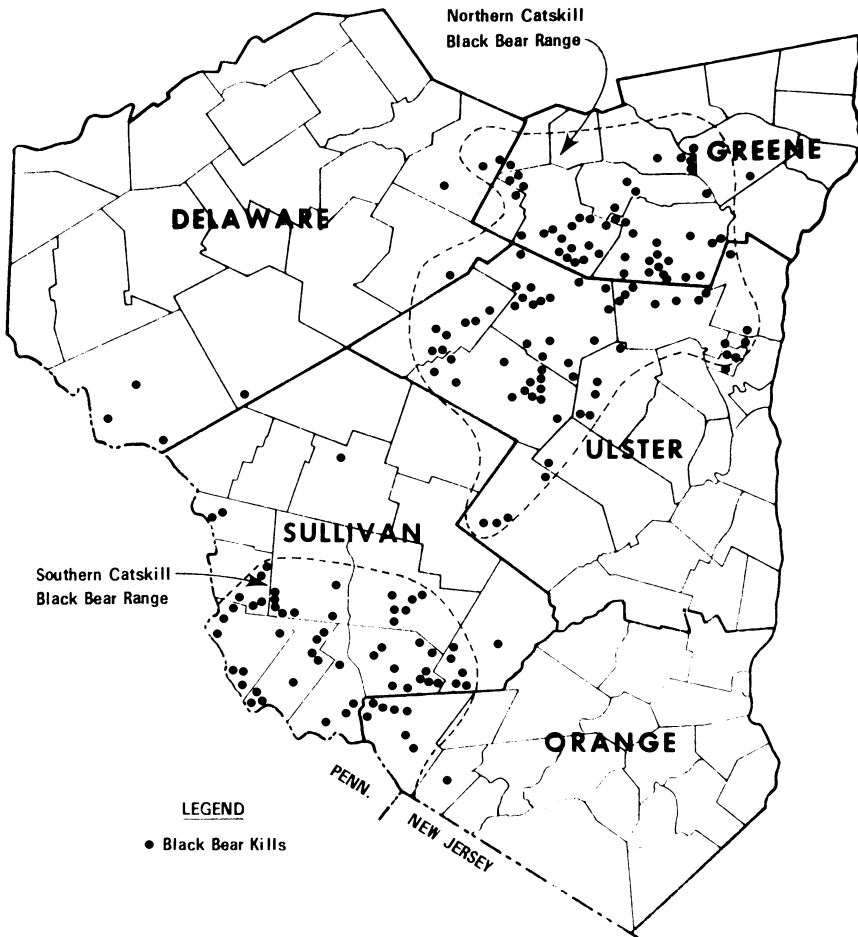


Figure 2 Black Bear Kills in the Catskill Region 1970-73, Inclusive; and Location of Northern and Southern Black Bear Ranges.

The initial study was planned to last from three to five years depending on the number of bears examined and/or captured. Funding difficulties prevented the study from reaching even half its planned expenditures and thus severely hampered the successful completion of the objectives.

Study Area

For the purpose of this study the Catskill Region is described as Delaware, Greene, Sullivan, Ulster and Orange Counties, an area of approximately 13,200 square kilometers (5,100 square miles) between 42°31' and 41°08' north latitude and 75°25' and 73°47' west longitude (Fig. 3). Elevations range from sea level in the Hudson Valley to 1,281 meters (4,004 feet) on Slide Mountain in the Town of Shandaken, Ulster County. Most of the land in the northern and western Catskills has elevations between 300 and 900 meters, while most of the land in

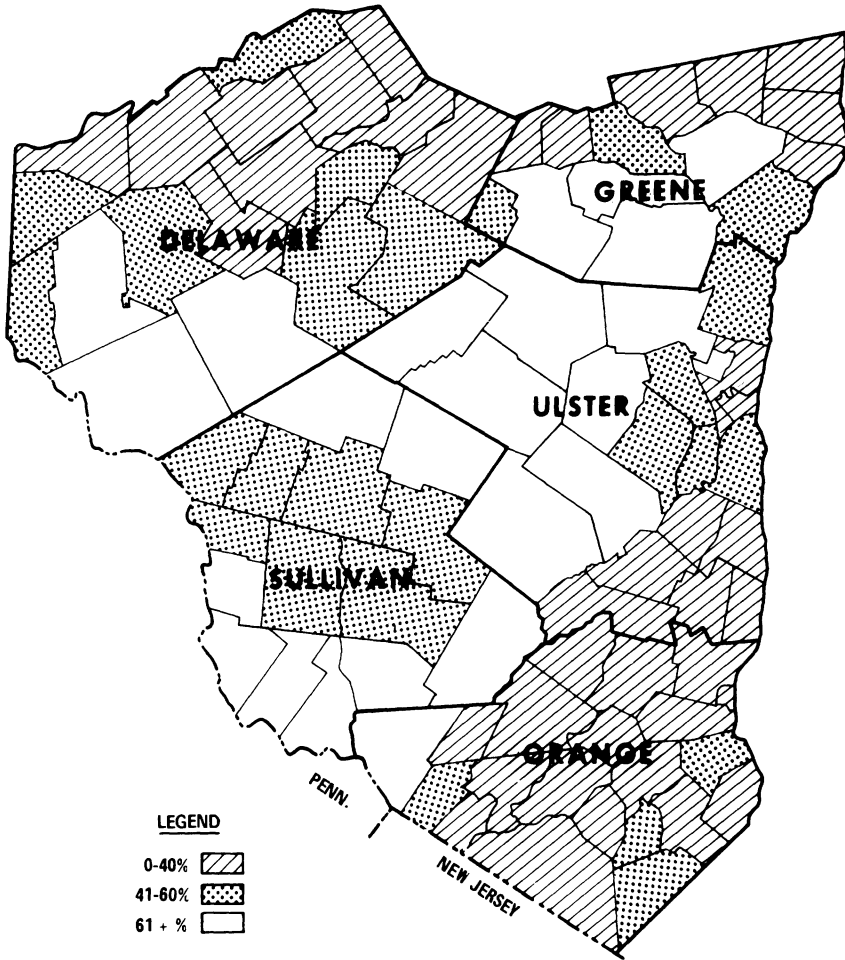


Figure 3—Per Cent Forest and Brush in Towns in the Catskill Region.

the southeast lies between sea level and 300 meters. The western portion of those lowlands is cut by the Shawangunk Ridge which rises between 600 and 900 meters throughout most of its range. Those areas above 900 meters are located in the north central Catskill Region.

Soil types in the Catskills are poor to moderately productive soils of glacial origin derived from sandstone and conglomerate (Howe 1935). The highlands support little or no agriculture. Lower elevations with slightly more fertile soils support numerous farms, most dairies. In the Hudson Valley, the alluvial clay soils support a large apple industry. The Delaware and Hudson River watersheds provide the major drainage for the Catskills. January mean temperatures range from -7°C to -4°C and July mean range from 18°C to 21°C . The minimum temperature ranges from -26°C to -29°C . Annual precipitation ranges from 100 to 125 centimeters with about half of this occurring during the 120-125 day growing season. Annual snowfall ranges from 100 to over 150 centimeters (Smith 1954).

Much of the land is in forest and brush. A large portion is in old field succession and second growth forest re-establishing itself since the extensive clearing for agriculture and lumbering throughout the nineteenth century. Changes in forest composition were effected by large cuttings of hemlock (*Tsuga canadensis*) for tanbark in the late 1800s, and almost total decimation of American chestnut (*Castanea dentata*) by the chestnut blight in the early twentieth century. Native vegetation of the lower elevations consists of various species of oaks (*Quercus* spp.) with some tulip 'poplar' (*Liriodendron tulipifera*).

Mountain laurel (*Kalmia latifolia*), great laurel (*Rhododendron maximum*), low-bush blueberry (*Vaccinium angustifolium*) and highbush blueberry (*Vaccinium corymbosum*) are also locally predominant in the understory. On the excessively well drained soils of the Shawangunk Ridge this flora grades into oak (*Quercus* sp.) and pitch pine (*Pinus rigida*) forest. Throughout the rest of the Catskills, white pine (*Pinus strobus*) and hemlock (*Tsuga canadensis*) combine with northern hardwoods, especially sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*) and yellow birch (*Betula alleghaniensis*).

At higher elevations, mountain maple (*Acer spicatum*) and striped maple (*Acer pensylvanicum*) and finally red spruce (*Picea rubra*), black spruce (*Picea mariana*) and balsam fir (*Abies balsamea*) appear. These last three species also occur sporadically throughout lower elevations of southern Sullivan County in swamps and bogs—remnants of Pleistocene glaciation (Smith 1954; Harlow and Harrar 1958).

Within the Catskill Region, human population densities are highest along the Hudson River, the major branches and tributaries of the Delaware River, and along New York Route 17 and U.S. Route 209. Summer and early fall population densities increase substantially when transient populations move into summer cottages, resorts and hunting camps throughout the Region. Large tracts of land in the northern Catskills are under State ownership while virtually all the land in the southern portion of the Region is privately owned (NYSOPC, 1969; NYS DEC, 1957).

RESULTS

Mortality

Records were maintained on all recorded black bear mortality from April 1970 through March 1973 (Table 1). Hunters accounted for 189 out of 198 bears

TABLE 1. CATSKILL BLACK BEAR MORTALITY, 1970-73 INCLUSIVE.

	Northern Range			Southern Range		
	Hunter Killed	Other Deaths	Percent Killed by Hunters	Hunter Killed	Other Deaths	Percent Killed by Hunters
1970	27	2	93.1	14	2	87.5
1971	38	0	100.0	24	2	92.3
1972	9	1	90.0	12	1	92.3
1973	44	0	100.0	21	1	95.5
Total	118	3	97.5	71	6	92.2

known to have died during this period. There were five killed on highways, two trap mortalities, one found dead during the hunting season and one shot after it damaged an apiary. The distribution of mortality by area (Table 1) indicated a greater number recorded as 'other deaths' in the southern Catskills. This is probably due to a greater effort on the part of the summer trapping crew in making contacts and also a greater road network causing four of the five highway deaths. Both trap mortalities occurred in the northern Catskills and should not be considered as normal mortality since they would not have occurred without the study.

There is no doubt that other mortality has gone undetected. It is unlikely, however, that these deaths would exceed the hunting mortality. The legal hunting take is essentially complete although a few may have gone unreported.

Variable hunter harvests are due to availability rather than fluctuating bear populations. This is indicated by the extremely low take in the northern Catskills in 1972, which was accompanied by unusually early cold weather and deep snows just prior to the opening day of the season. The combination of possible early denning and restricted hunter access lessened hunter-bear contacts and reduced the legal take.

The age and sex composition of the hunter take 1970-73 inclusive (Table 2) reveals substantial differences between the northern and southern Catskill population structures. The northern Catskill sex ratio is about equal, and only about 25 percent of the take are yearlings. Females survive longer than males with 53.1 percent of the females being of the assumed breeding age of three years and older (Free and McCaffrey 1972). The southern Catskill bears on the other hand had a sex ratio of 1.48 males/females and between 60 and 70 percent of the take were yearlings. Older age (3+) males outnumbered females and only 14.8 percent of the take were breeding age females. Annual variation in the sex ratios of the hunter take is extreme. For instance, in the southern range in 1970 there were 12 males and only one female in the take. The other extreme occurred the next year when eight males and 15 females were taken.

TABLE 2. SEX AND AGE COMPOSITION OF CATSKILL BLACK BEARS LEGALLY TAKEN BY HUNTERS, 1970-73 INCLUSIVE.

		Age at Death						Total Bears Harvested
		Cub	1	2	3	4	5+	
Northern Range								
Male	number	5	13	20	7	3	3	51
	percent	9.8	25.5	39.2	13.7	5.9	5.9	100.0
Female	number	4	12	7	9	3	14	49
	percent	8.1	24.5	14.3	18.4	6.1	28.6	100.0
Southern Range								
Male	number	2	24	7	5	1	1	40
	percent	5.0	60.0	17.5	12.5	2.5	2.5	100.0
Female	number	1	19	3	0	0	4	27
	percent	3.7	70.4	11.1	0.0	0.0	14.8	100.0

TABLE 3. MINIMUM 1969 CATSKILL BLACK BEAR POPULATION AS DETERMINED FROM KNOWN EXISTING BEARS.

Year	Age	Male			Female			Total
		Dead	Tagged	Total	Dead	Tagged	Total	
Northern Range								
1969	0+	28	0	28	16	0	16	44
1970	1+	19	2	21	9	1	10	31
1971	2+	11	0	11	13	0	13	24
1972	3+	1	0	1	3	0	3	4
1973	4+	6	0	6	11	0	11	17
Minimum 1969 Population		65	2	67	52	1	53	120
Southern Range								
1969	0+	14	0	14	6	0	6	20
1970	1+	13	1	14	1	0	1	15
1971	2+	4	1	5	1	1	2	7
1972	3+	1	0	1	1	0	1	2
1973	4+	1	3	4	4	4	8	12
Minimum 1969 Population		33	5	38	13	5	18	56

TABLE 4. 1969 CATSKILL BLACK BEAR POPULATIONS CALCULATED FROM KNOWN MORTALITY AND AGE COMPOSITION.

	Bears Alive in 1969 But Killed from 1969 to 1973	Percent Population Four Years or Younger	Calculated Population	Minimum Population
Northern Range				
Male	65	.941	69	67
Female	52	.741	73	53
Total	117		142	120
Southern Range				
Male	33	.975	34	38
Female	13	.852	15	18
Total	46		49	56

Sex ratio variations occurred in the Northern Zone also, but not in such extreme proportions. Cubs are represented in the legal take despite the fact that they were technically illegal. This subject will be discussed later.

The high recovery rate of Catskill bears is indicated by the recovery rate of tagged bears. In the southern Catskills where the most tagging took place, 10 out of 27 bears died during the first fall following tagging (37.0 percent). Of those that were yearlings when tagged, seven out of nine died during the first fall (77.7 percent). Decreased mortality among older bears was also apparent. Three of nine bears aged two and three years old died (33.3 percent) and all nine bears five years old and older survived the first fall after tagging. Only six bears were tagged in the northern Catskills and one of these died during the first fall (16.7 percent). Hunters killed 91 percent of the tagged bears. These mortality rates depend on the assumption that all bears not recovered survived the first fall.

Population Size

Table 3 presents the minimum 1969 bear population. All known mortality regardless of age in 1969 was used as the base. Bears in appropriate age categories killed since 1969 were added to the table. Finally, tagged bears at least four years old in 1973 and not recovered by then were added to the table. Minimum 1969 figures for the Southern Range were 38 males and 18 females for a total of 56 bears. The Northern Range contained at least 67 males and 53 females for a total of 120 bears in 1969.

Realistic populations were calculated (Table 4) by assuming that the dead bears in the minimum 1969 population were in proportion to the frequency of bears 4½ years and younger in the observed age composition (Table 2). The realistic population should then account for bears alive in 1969 and yet to be recovered. Some, but not all, would be the tagged bears used in the minimum population calculation (Table 3). Calculated population for the southern Catskills of 49 actually fell below the known 1969 minimum population of 56. Observed hunter take frequency of five-year old and older bears was not sufficiently high to account for those bears actually known to be alive. The actual 1969 population was undoubtedly larger than the 56 bears determined as the minimum 1969 population. The occurrence of older bears which did not show up in the hunter harvest is difficult to explain. Perhaps insufficient observations of hunter killed bears invalidate the observed age composition, or these older bears have survived because they have home ranges which coincide with areas of low hunting pressure or where bear hunting is prohibited. The majority of trapping effort was on private lands with these restrictions.

The calculated 1969 population for the northern Catskills of 142 exceeded the minimum population of 120. For this area, the calculated population is undoubtedly closer to the actual 1969 population.

Bear Density and Range

Positions of hunter killed bears were plotted on United States Geological Survey Quadrangle maps and superimposed on maps of the Catskill Study Area with human population densities and land use patterns plotted (NYSOPC, 1969). As expected most of the bear kill locations were in those towns with greater than 60 percent forest and brush and less than 3.9 people per square kilometer (10 people per square mile) (Fig. 2 and Fig. 3). For unknown reasons several towns in southeastern Delaware County which fell into this high forest density-

low human population category showed few bear kills indicating little or no resident black bear population.

Occupied bear range was considered to be those areas with a high density of hunter kills. Outlines of the Northern Range and Southern Range were made using plots of the kills and excluding areas with high human populations or intensive farming (Fig. 2). Bears killed outside the range thus defined were considered occupying marginal range or as transient animals. Within these broad ranges there may be areas without resident bear populations, but the extent of these areas cannot be determined without data on where forested land exists within each town.

To determine the actual size of the occupied bear ranges an estimate was made of the percentage of each town within that range. Thus determined, the Northern Range constitutes about 2,250 square kilometers (870 square miles) with calculated 1969 population (Table 3) of 142 bears. This is 15.8 square kilometers (6.1 square miles) per bear or 0.06 bears per square kilometer (0.16 per square mile). The Southern Range constitutes about 1,030 square kilometers (400 square miles) with a minimum 1969 population (Table 3) of 56 bears. This is 18.4 square kilometers (7.1 square miles) per bear or 0.05 bears per kilometer (0.14 per square mile).

Besides the primary ecological constraints the bear ranges are maintained by the secondary effects of land ownership. In the Northern Range an estimated 40 percent of the land is owned by New York State as part of the Catskill Forest Preserve. Land in the Southern Range is in private holdings, but an estimated 30 percent is in the hands of only 15 owners. Both these ownership patterns have effectively reduced human development and encouraged forest succession.

The Cub Law

In the course of the Catskill Bear Study, it was discovered that 7.0 percent of the hunter harvest were cub bears despite a 1938 law which prohibits the shooting of 'bears less than one year old'. This figure is considered low because of documented claims that hunters shoot cubs or small bears and leave them in the woods for fear of prosecution.

Interviews with hunters revealed a problem with field application of this law. Most hunters attempted to identify cubs on a weight basis, usually considering all bears less than 45 kilograms (100 pounds) to be cubs. Field dressed weights taken of bears killed during the study showed this kind of estimate to be unreliable. The weights of the six cubs weighed, three males and three females, ranged from 20 to 34 kilograms (44 to 76 pounds). Both the lightest and heaviest cubs were females. The heaviest cub was 25 kilograms (55 pounds) less than the mean weight of yearling males, but heavier than three yearling females and only 1.7 kilograms (4 pounds) less than the lightest two-year old examined. Because of this overlap in weights among the various age classes it is understandable that hunters found it difficult to identify cubs in the field.

Mortality rates of the Catskill bear population show the futility of attempting to protect cubs. Mortality in young bears is high, despite the law. As stated, cubs make up 7.0 percent of the harvest which, compared to 11.0 percent of the Adirondack harvest where the cub law was repealed in 1956, proves the inadequacy of this provision. Once breeding age (3 years and up) is reached, mortality drops substantially. If the aim of the law is to increase the bear population, a more reasonable approach would be to protect the breeding age females, perhaps protecting sows with cubs. The cub law which casts doubt on the legality of possessing dead animals should be eliminated.

DISCUSSION

This paper has presented the interim findings of the Catskill Bear Study and has attempted to draw some tentative conclusions about population dynamics, population size and geographic extent. The future of the Catskill black bear populations will depend upon future management action. There appear to be two major courses of action which may be used for effective management: (1) promotion of land use patterns which perpetuate wild land and minimize disturbance by man; and (2) promulgation of hunting regulations which will reduce the effect of hunting on bears if it is established that a higher population is desirable. The negative socioeconomic qualities of bears are not currently a major problem in the Catskills, probably because of the relatively low bear population densities and restricted human development in bear range. If bear populations are allowed to increase without suitable wild land available, bear-human conflicts are bound to increase.

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