

A BLACK BEAR TAGGING STUDY IN VIRGINIA¹

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A black bear (*Euarctos americanus*) tagging study in Virginia was part of a research effort begun in 1957 to determine whether or not the bear population in the mountainous areas of the State was being reduced by harvest.

Erickson (1957) in Michigan demonstrated the feasibility of a large-scale trapping project by making 109 catches of 96 bears. He established the basic steel trapping technique which later trapping programs used. Black (1958) in New York refined Erickson's techniques while trapping 383 bears. West Virginia conducted a trapping program concurrently with the Virginia project in neighboring areas and information was exchanged between these projects.

PREVIOUS BEAR TRAPPING IN VIRGINIA

Prior to 1958 when I began this study, ten bears had been culvert-trapped during the preceding three years. Recovery records were obtained on five bears. One was killed three months after being tagged, 20 miles south of the trap location. Two other bears were trapped and moved 80 miles north of the trap site; one of these was killed five months later four miles from the trap location. The other was killed approximately 3½ years later 16 miles south of the trap site and 97 miles from the release site. Another bear, trapped in 1954, was retrapped in approximately the same location in 1958; and a bear, trapped in 1957 and moved 21 miles northwest of the trap location, was killed in 1961 twelve miles south of the release site and 28 miles from trap site.

GENERAL TECHNIQUES AND RESULTS

Bear trapping was initiated in 1958 and was continued for three summers on two areas each summer. Bears on the Big Levels Game Refuge in eastern Augusta County on the Blue Ridge Mountain Range were trapped all three summers. Bears were also trapped the first two years on the North River section of Western Augusta and western Rockingham Counties on the Allegheny Mountain Range. This area lies 36 miles northwest across the Shenandoah Valley from Big Levels. In 1960 bears were trapped in the North Mountain section, an area 33 miles south of North River in western Rockbridge and eastern Alleghany Counties on the Allegheny Range.

Trapping was done from the middle of June until the middle of September each year. In 1960, however, I began trapping on the North Mountain area the first of June. The first two summers a three-man crew worked each area; three men were needed to handle the culvert traps used those years. The third summer, when only steel traps were used, two-man crews were employed.

One-hundred catches were made during the three-summer period. Eighty-three individuals were caught and released; six of these were caught twice and two were captured three times. Seven additional bears died. Thirty-one catches were recorded the first summer, 42 the next and 27 the last. Ninety-nine³ catches were made in 6337 trap nights, an average of 64 trap nights per bear caught.

Thirty-six steel traps and four culvert traps were used in an average of 77 trap sites each of the last two summers.⁴ Trap sites were used an average of 34 nights. Initially, I relied upon bear hunters and game managers for trap locations. Later the crew leaders selected the trap sites. Usually the sites were located near roads.

Trapping was poor until July on North River both years and on Big Levels in 1960. However, in 1959 on Big Levels, 14 of 25 bears caught were captured in the first month of trapping. Thereafter, trapping success for the summer declined.

¹ A contribution from Federal Aid in Upland Game Research Project 40-R, Virginia.

² Now with U. S. Fish and Wildlife Service, Newark, Delaware.

³ A game manager trapped one bear before the project started.

⁴ Trap-night records for 1958 on Big Levels were lost and, wherever used, are estimated.

The most successful bait used was fresh beef bones obtained from slaughter houses. Initially bones were dragged 0.2 miles each side of the trap to create a bait trail; however, no increase in trapping success was noted, so the dragging was discontinued. Smoked hog jowl, anise oil, hot dogs, peanut butter and groundhog were used with little success. Five bears were caught with honey and one with bear lure.⁵

Bears were marked with a metal ear tag on the leading edge of each ear as described by Erickson (1957). Tag retention was variable; one bear tagged in 1954 was caught four years later with one tag remaining. Another bear caught 3½ years after initial tagging had both tags. Of six bears retrapped the summer after original trapping, three had lost one tag. Attempts to tattoo bears on the inside of the ear failed because of hair in this area.

CULVERT TRAP TECHNIQUES AND RESULTS

Culvert traps were basically the same types used by Erickson (1957) and Black (1958). One modification was a wooden bait rod used in 1959 to prevent trapped bears from mutilating their mouths on steel rods. A chain-hoist mounted on a pick-up truck bed was originally used to lift the traps but this rig proved cumbersome and, later, side handles were used to lift and move the traps.

The bear-handling technique was similar to that described by Erickson (1957) and Black (1958). Following initial anesthetization of a bear with ether, pentobarbital sodium⁶ was injected into the peritoneal cavity behind the diaphragm at the rate of 1 cc. (60 mg.) per 5.5 pounds of body weight. One bear died while undergoing this treatment. However, the bear was injured and emaciated before trapping, and it died even though an underdose of pentobarbital sodium was administered.

Nine of the total 100 catches were made in culvert traps and these nine occurred the first summer. Trapping in 1958, primarily around a dump on Big Levels, resulted in a catch each 32 culvert trap nights. No bears were caught in culvert traps thereafter and total trapping success amounted to a bear every 129 trap nights.

STEEL TRAP TECHNIQUES AND RESULTS

No. 150 Newhouse steel traps were used. The trap jaws were toothless and offset ¾ inch so that a space existed between the jaws when closed. A six-foot chain connected a canted, double-hooked drag to the trap. A coil spring was fastened across slack in the chain to prevent bears from getting a firm pull and jerking free.

The trap was set as described by Erickson (1957) and Black (1958) except that trap jaws were perpendicular to the midline of the trap site. In this way I felt the jaws would strike the flat sides of the wrist and lessen escapes. Usually a bait hole was not dug; the bait was merely staked or wired down. Natural-appearing sets worked best; i.e., sets in a thicket edge which limited entry to one direction. Stepping sticks guided the bear's foot to the trap. Black and yellow cardboard signs were placed at trap sites, and, where discovery by humans was likely, a wire strung chest-high around the site.

The distance that steel-trapped bears pulled the trap before "hanging-up" depended on bear size and the density of trees and shrubs. A 28-pound cub pulled the trap four or five yards; a 350-pound bear pulled the trap over a mile. The average distance was approximately 100 yards. Four of the bears climbed trees with the trap on the foot. In these cases the tree was either cut down or the bear was anesthetized and then lowered to the ground.

Over the three summers, a bear was caught an average of every 60 trap nights in the steel traps. Trapping success amounted to a bear every 30 trap nights in 1958, a bear every 65 in 1959, and a bear every 75 in 1960. On Big Levels a bear was caught every 17 trap nights in 1958, a bear every 54 nights in 1959, and one every 95 in 1960. Trapping on North River resulted in a bear every 47 trap nights in 1958 and one every 80 in 1959. Efforts on the North Mountain area produced a catch every 60 trap nights. Seven bears escaped from traps in 1959 and 31 escaped in 1960.

⁵ S. Stanley Hawbaker & Sons, Ft. Loudon, Pa.

⁶ "Nembutal", produced by Abbott Laboratories, North Chicago, Ill.

Fifteen feral dogs and three turkey vultures (*Cathartes aura*) were also captured. Raccoons (*Procyon lotor*) and deer (*Odocoileus virginianus*) were caught several times, but were able to pull free. Bobcats (*Lynx rufus*) and gray foxes (*Urocyon cinereoargenteus*) never molested the sets although they inhabited the areas.

Of the 91 bears caught by steel-traps during the three summers, 6 were killed and 28 injured. The mortalities and injuries of steel-trapped bears are listed in Table 1.

TABLE 1.
MORTALITIES AND INJURIES OF STEEL-TRAPPED BEARS

Condition	No. of Catches
Dead	6
Broken leg	4
Foot with compound fractures	2
One or more toes broken or separated	22
Uninjured	57
Total	91

Two of the six deaths were caused by the traps. One of these two bears was found unconscious in a trap and later died; the other bear evidently suffered a compound fracture of the leg, chewed on the injured area, and died from shock or loss of blood or both. Other causes of death were probable overdose of drug (two deaths), puncture of blood vessel by automatic projectile syringe, and drowning.

Two bears with broken legs were harvested by hunters. In less than 3½ months, the legs of both bears were healed except for knots where the bones had mended. Both bears could travel and one had gained 25 pounds in 3½ months, the other 13 pounds in three months. Four of the bears that suffered broken toes were killed by hunters. The feet of these four were reported to be healthy. Two cubs were steel-trapped; one had a broken leg, the other was unharmed. The latter's "trap leg" fit between the offset jaws, but the large paw held the cub. Intramuscular shots of a veterinary penicillin⁷ were given to prevent infection of open wounds, and in 1960 the wounds also were sprayed with an anti-septic dusting powder.⁸

ANESTHETIZATION TECHNIQUES AND RESULTS

The "Cap-Chur" automatic projectile syringe rifle (Crockford, *et al.* 1957) was used to anesthetize steel-trapped bears. The 2-to-6-cc. projectiles containing the anesthetic were fired at the bear from a 25-foot distance. In 1958 and 1959 intraperitoneal shots were made into the area behind the diaphragm. In 1960 shots were fired intramuscularly into the hip. A 1½ inch syringe needle was used for both intraperitoneal and intramuscular shots, but a longer needle may have been better for obese bears. When the syringe struck, the bear often tried to pull it out, but probing the bear with a stick in the side opposite the dart distracted the animal. Syringe retention was insured by a small barb on the needle. The dart wound, usually negligible, was treated with penicillin and the antiseptic dusting powder. One intraperitoneal injection of a projectile syringe severed a femoral blood vessel and killed the bear.

Pentobarbital sodium was the drug used in the projectile syringe. This usage required a more concentrated solution than that employed with a hand syringe. Jenkins (1958)⁹ reported use of this drug on a black bear at a concentration of 400 mg./cc., and I increased this to 600 mg./cc. This enabled a 1200-mg. dose of pentobarbital sodium to be placed in a 2-cc. dart. I initially used this amount on bears weighing 100 pounds or less, but increased the dose to 3-cc. when I found 2-cc. doses usually were slow-acting or did not act at all. The average intraperitoneal dose delivered by the projectile syringe was 21.4 mg./lb. of body

⁷ Veticillin Suspension (Penicillin G Procaïn in Aqueous Suspension) produced by Cynamid.

⁸ "Suloptic" and "Sulcop", both produced by Pittman-Moore Co., Richmond, Va.

⁹ Personal letter, May, 1958.

weight, and bears were rendered helpless in an average of 47 minutes after injection (Table 2 and Appendix Table I & II). (The term "rendered helpless" is used instead of "anesthetized" since in seven cases additional dosage had to be administered by hand syringe to achieve anesthetization.) This average dose of 21.4 mg./lb. caused no mortalities in 64 cases.

The average intramuscular dose was 13 mg./lb. and bears were rendered helpless in an average of 97 minutes (Table 2 and Appendix Table III). Six of the 20 bears subjected to this technique were not completely anesthetized. In three other instances additional pentobarbital sodium (administered by hand syringe), or ether had to be given. Most of the bears put to sleep were lightly anesthetized and four awoke while still being examined.

TABLE 2.
EFFECTIVENESS OF DRUG AND DELIVERY ON BEARS
RENDERED HELPLESS BY AUTOMATIC PROJECTILE
SYRINGE¹⁰

<i>Drug</i>	<i>Delivery</i>	<i>No. of Bears</i>	<i>Average No. Mg./lb.</i>	<i>Average Min. Until Helpless¹¹</i>	<i>Effectiveness of Drug¹²</i>
Pentobarbital Sodium	Intraperitoneal . . .	46	21	47	987
Pentobarbital Sodium	Intramuscular	10	13	96	1248
Capchur-Barb	Intramuscular	6	11	102	1122

"Capchur-Barb"¹³ was used intramuscularly on seven bears in 1960 at an average rate of 11 mg./lb. of body weight (Table 2 and Appendix Table III). Bears were rendered helpless in an average of 102 minutes after injection. Five of six bears processed successfully had to be given additional hand syringe injections to achieve or continue anesthetization. One bear died, probably of an overdose due to a weight miscalculation.

Two central nervous system stimulants were used to counteract pentobarbital sodium. In 1958 and 1959, an average dose of 15-cc. of "Mike-demide 3%"¹⁴ at 50 mg./cc. was used when a bear appeared too deeply anesthetized, as determined by respiration rate. No observable results were obtained with this drug. In 1960 amphetamine solution¹⁵ was used on bears still anesthetized when left by trapping crews. The average dose was 3.5-cc./bear (50 mg./cc.) and in two cases noticeable effects were seen within 20 minutes.

I did not record the length of time bears remained under anesthesia. When recovery was assured, trapping crews left before bears revived. The anesthetization period for bears administered pentobarbital sodium by intraperitoneal injection probably ranged from three to eight hours. Those receiving intramuscular injection remained anesthetized for a shorter time.

TRAPPED BEARS

Sex Ratio. The sex ratio of trapped bears was 129 males for every 100 females (54 males to 42 females) as compared with the 1958-60 harvest ratio of unmarked bears in the area of 113:100.¹⁶ The trapped-bear sex ratio for all areas was 21 males to 10 females in 1958, 23 males to 19 females in 1959, and 14 males to 13 females in 1960. The trend towards a lesser preponderance of males trapped over the three-year period also was indicated by the Big Levels data. Slightly more males than females were trapped on both the Big Levels and North Mountain

¹⁰ Includes only bears for which all information in table was known.

¹¹ Bears occasionally had to be given additional doses by hand syringe to become anesthetized.

¹² Average no. mg./lb. (column 4) times average minutes until helpless (column 5).

¹³ A bacteriostatic stabilized glycol-aqueous solution of 500 mg. of pentobarbital sodium and 1 mg. of scopolamine hydrobromide per cc.; Palmer Chemical Co., Atlanta, Georgia.

¹⁴ A product of Parlam Corp., Englewood, N. J.

¹⁵ A product of Norden Laboratories, Lincoln, Nebraska.

¹⁶ Total sex ratio of bears killed in Alleghany, Amherst, Augusta, Nelson, Rockbridge and Rockingham Counties.

areas. The only sexual disparity existed on the North River area where 17 males and 9 females were trapped.

Age. The age of each bear trapped was estimated by evaluating tooth wear and determining body weight. To estimate tooth wear, the unworn teeth of a cub skull were used for comparison. Tooth wear for each bear was recorded on a printed diagram of the dental areas. Where time allowed, clay impressions of the molar teeth (Flyger, 1958) were made and positive plaster-of-paris casts taken from the clay. These did not show tooth wear detail and, later, professional dental impression materials were used with better results.

Yearling bears could be identified with some accuracy. Bears with little molar wear were considered yearlings if they weighed under 90 pounds (females) and under 100 pounds (males). Length of the baculum was a consideration. A baculum length of less than 125 mm. (5 inches) generally put the male in the yearling category. The age of bears older than yearlings was judged roughly to the nearest year by weight and tooth wear. Cubs were identified by juvenile canines. Sixty-five adults, 27 yearlings and two cubs were trapped. Yearlings made up 29 percent of the trapped bears. Aging data indicate that bears on Big Levels were younger than those on the North Mountain and North River areas. Also, bears trapped on each area the first year appeared to be older.

Weights. Trapped adult males weighed an average of 157 pounds and females 119 pounds. Yearling males and yearling females weighed an average of 76 pounds. Adult male bears on Big Levels averaged 181 pounds; adult males on North River averaged 124. The difference in adult females in the two areas was not as great, but Big Levels females weighed more; 124 pounds to 113 pounds. North Mountain adult males weighed an average of 149 pounds, females 97. Average weights of yearlings and adult females did not change greatly from year to year, however, adult males did. In 1958 adult males averaged 191; and 1959, 122; and in 1960, 148.

Breeding Condition. Whether or not trapped female bears were in breeding condition was determined by noting if the vulva was inflamed and swollen. Of 31 females checked, eight appeared to be in heat. One of the 23 not in heat had cubs and was lactating. No other females were lactating. Of the eight females in heat, three were judged to be 1½ years old. Three of the eight in heat were trapped in June, three in July, and two in August.

RETRAPPED BEARS

Of 83 bears tagged and released, eight were retrapped and two of these were caught three times. These eight consisted of five adult males, one adult female, and two yearling males. One bear caught three times was an adult male that was moved 27 miles when first culvert-trapped as a nuisance animal. Two months later it was steel-trapped near the original trap site at the Big Levels dump and released. A month later it was trapped at the second site and in the same culvert trap in which it was first trapped. The other thrice-trapped bear was a yearling that was steel-trapped twice in 1959 and once in 1960. It was caught at the same site the first and last times trapped.

RESULTS OF TAG RETURNS

To obtain accurate mortality information from tagged bears harvested during the hunting season, a \$15.00 reward was offered for return of tags. This amount was felt sufficient to insure tag returns and yet not enough to encourage excessive hunting pressure on the tagged bears.

Distances Moved. Three tagged bears retrapped the summer of tagging were caught an average of 1.3 miles from the original trap site. Thirty bears harvested the fall after tagging were killed an average of 7.6 miles from the trapping location. Four bears retrapped the summer following tagging were caught an average of 1.6 miles from the first trap site, and three bears harvested fall a year after trapping were killed 7.5 miles from the original trap site.

The movement of a 2½-year male from Big Levels 90 miles to a point 25 miles southwest of Richmond considerably increased the average distance moved of bears harvested the fall after tagging. Without this record the average for this group would have been 4.6 miles.

Twenty-one male bears harvested the fall after tagging had moved an average of 10 miles, and seven females an average of 1.8 miles. Fourteen adult males harvested the fall after tagging had moved an average of 7.9 miles, while seven yearling males had moved 7.1 miles. One yearling female had moved 2 miles. The 90-mile record augmented the adult male average. Without it, adult males would have averaged less movement than yearling males, but still more than adult females.

Tagged bears were killed an average of 4.0 miles from tagging location in 1958, 10.0 in 1959, and 7.0 in 1960. However, if the 90-mile movement record is not included, the 1959 average stands at 3.4.

Fifteen of the 16 bears tagged on Big Levels were harvested in a south or southeasterly direction from the trapping area (this includes the 90-mile movement). Tagged bears had moved in scattered directions in the North River and North Mountain areas.

Weight Changes. Three tagged bears retrapped the summer of tagging had lost an average of 73 pounds. Thirteen harvested the fall after tagging had gained an average of 42 pounds, or 2.4 lb./week. Six bears retrapped the following summer had gained an average of 18 pounds and two bears harvested the fall of the following year had gained an average of 65.6 pounds.

Accurate weight data for two adult females indicated an average gain of 56 pounds, or 3.9 lb./week, between trapping and harvest the following fall. Nine adult males had gained an average of 36 pounds or 2.1 lb./week. Two yearling males had gained an average of 37 pounds or 2.3 lb./week. No accurate weight data were available on yearling females. One male was culvert-trapped at 234 pounds and harvested 20 weeks later at 387, a gain of 7.6 lb./week. One male had lost 109 pounds in three weeks after being culvert-trapped, and still another lost 115 pounds in four weeks after being steel-trapped.

Mortality. Twenty-nine of 87 bears tagged and released were harvested the fall after being trapped. This is a 33 percent mortality for the total tagged bear sample. Tagged bear harvest data indicate a higher mortality of males than females (Table 3). Consistent mortality sex ratios were recorded on all three areas: Big Levels, 2.2 males to one female; North River, 2.4 males to one female; and North Mountain 2.2 males to one female. A preponderance of males were killed in two of the three areas.

TABLE 3.
TAGGED BEAR MORTALITY BY SEX

Sex	Area	Year	No. ¹⁷ & ¹⁸ Trapped		Percent Harvested	
			Released	No. ¹⁷ Harvested		
Female	Big Levels	1958	7	2	29	
		1959	12	2	17	
		1960	5	0	0	
		Total		24	4	17
	North River	1958	2	2	100	
		1959	6	0	0	
		Total		8	2	25
	North Mt. Total	1960	6	1	17	
	Grand Total		38	7	18	
Male	Big Levels	1958	8	2	25	
		1959	11	6	55	
		1960	5	1	20	
		Total		24	9	38
	North River	1958	7	4	56	
		1959	10	6	60	
		Total		17	10	59
		North Mt. Total	1960	8	3	37
		Grand Total		49	22	45

In 1959, 57 percent of the males and 11 percent of the females were harvested; in 1960, 31 percent of the males and 9 percent of the females

¹⁷ Includes only bears tagged and harvested in specified year.

¹⁸ Number includes bears trapped or retrapped once during specified year.

were harvested. In 1958, however, 40 percent of the males and 44 percent of the females were harvested.

Mortality data by section and year are shown in Table 4. Data for each year include only the mortality for bears trapped that year. (Thus far, three bears have been killed two hunting seasons after they were tagged.) The highest harvest rate was recorded in the North River area (Table 4); the rates on the North Mountain and Big Levels areas were lower. A high mortality rate was registered in Big Levels in 1959 but a low one in 1960. The percent of tagged bears killed each year declined; 42 percent in 1958, 36 percent in 1959 and 21 percent in 1960. The mortality of adults and yearlings was identical. A 33 percent mortality was observed in both age groups.

DISCUSSION

Trapping Results. Steel traps were more effective than culvert traps. Shyness toward culvert traps was evident, whereas shyness of bears to steel traps was not as noticeable because the traps could be hidden and used in a variety of sets. For these reasons, I discontinued using culverts at the end of the 1959 season. However, the continued decline in bears caught per steel trap night throughout the three years indicates that shyness to steel traps also developed when areas were trapped for long periods. Progressive weakening of the steel trap springs exaggerated this decline, as evidenced by the increased number of bear escapes from 1959 to 1960.

TABLE 4.
TAGGED BEAR MORTALITY BY AREA

Area	Year	No. ¹⁹ & ²⁰ Trapped & Released			Percent Harvested
		No. ¹⁹ Harvested			
Big Levels	1958	15	4	27	
	1959	23	8	35	
	1960	10	1	10	
	Total	48	13	26	
North River	1958	9	6	67	
	1959	16	6	38	
	Total	25	12	48	
North Mt.	Total	14	4	29	
	Grand Total	87	29	33	

Trapping Injuries. In spite of the offset jaws, the steel traps injured a large percentage of the bears caught. But the recuperative power of bears is great and most of the injuries were broken toes which apparently healed rapidly. The trapping experience, whether by steel or culvert trap, had a temporary debilitating effect on the bears. This is indicated by the loss of weight recorded on two bears that were trapped twice in one summer. Bears that were killed in the fall or trapped thereafter were gaining weight.

Anethetization Methods. The "Cap-Chur" automatic projectile syringe rifle was a satisfactory anesthetizing vehicle. Intraperitoneal injection with the projectile syringe in 1958 and 1959 also was satisfactory—except for the one death, previously described, due to improper placement of the syringe. Nevertheless, I felt that intramuscular shots would be safer and in 1960 delivered shots in this way with a reduced dosage to assure safety. In retrospect this was not an improved procedure. Anethetization took twice as long to achieve and was not as complete as that achieved by intraperitoneal injection with the higher dose.

I considered "Cap-Chur-Sol", a nicotine alkaloid ²¹ (Crockford, *et al.* 1957), and succinylcholine chloride, a muscular relaxant, along with pentobarbital sodium for use with the automatic projectile syringe. However, work with caged bears at the West Virginia State Game Farm indicated that nicotine would be ineffective on excited animals and that

¹⁹ Includes only bears tagged and harvested during specified year.

²⁰ Numbers include bears trapped or retrapped once during specified year.

²¹ Produced by Palmer Chemical Company, Atlanta, Georgia.

succinylcholine chloride would inactivate bears for only short periods. Since processing a trapped bear took approximately one hour, I felt that the long anesthetization period of pentobarbital sodium suited my needs. Black (1959), however, successfully inactivated black bears with succinylcholine chloride prior to dosing them with pentobarbital sodium, and Craighead, (1960) has used succinylcholine chloride on grizzlies (*Ursus horribilis*).

"Cap-Chur-Barb" was used only intramuscularly and had the same general effect as did intramuscular use of pentobarbital sodium. It was slightly more potent (Table 2).

Craighead (1960) found that age and amount of body fat apparently affected the anesthetic dosage required for individual bears. Dosage was not varied for age or body fat in this project and there were no marked differences in reaction toward anesthetic between thin young bears and old obese bears.

In retrospect, mikedemide did not work as a central nervous system stimulant because underdoses were given. Bears were not given the proper dosage because of fear of overdose in injecting the large volume (approximately 80 + cc.) needed to counteract barbituate poisoning. This fear was groundless. The smaller dose of amphetamine needed to achieve the desired effect was given and better results were obtained. Black (1959) recommended artificial respiration as the best antidote for barbituate poisoning. It was used in several cases with no success.

Weights. There was little correlation between bear weights and mast conditions in the trapping areas. Good mast crops from 1957 through 1959 followed several years of poor mast crops. Consequently, bear weights would be expected to increase throughout the trapping period or be uniformly high as mast continued to be good. Instead the weights decreased after the first year probably because large old bears were caught in each area the first year of trapping and after that were not caught.

Movements. Males moved much more than females, and yearling males moved nearly as far as adult males. Tagged bear movements could be correlated with mast abundance if the 90-mile movement record is not included. Thus the year of greatest movement would be 1960, which was the poor mast year. The 90-mile movement was unusual, not only for the distance traveled, but for the kill location. This was the first recorded bear kill for Amelia County, in the eastern Virginia piedmont region well beyond bear range.

The harvest of the majority of Big Levels bears in areas lying in a south or southeasterly direction from the trapping area occurred because most of the neighboring bear range is in that direction. To the east and west are farming areas, and to the north lies the Shenandoah National Park.

Breeding. The record of three, presumably yearling, females apparently in breeding condition is unusual.²² Seton (1929) refers to the female black bear breeding at age 3½, Leopold (1948) suggests this might be 2½ and I (1957) reported a captive bear which presumably was bred at age 2½ and bore a cub. That the eight females in breeding condition were caught in June, July and August indicates that the breeding season may be summer-long²³ instead of in the spring and early summer as given by most authorities.

Productivity. To interpret mortality figures, knowledge of bear productivity was essential. Information on productivity was obtained from 39 female bears. Thirty-eight of these were hunter-killed adult females taken between December 10 and January 5 (before December 10 most embryos had not developed enough to be seen), and one was a female which was observed with a litter in February. Nineteen, or 48 percent, of these females had embryos or cubs numbering 50 individuals, or an average of 2.6 per female.

²² Three captive yearling bears, a male and two females, were observed mating at the West Virginia State Game Farm in 1958. Whether the females would have borne cubs or not is unknown; they were transferred from the farm and died, presumably before the cubbing period.

²³ The three captive yearling bears that were observed mating did so repeatedly throughout June, July and August until the male was killed on August 28. Further indication of a long breeding season is supplied by the large size variation in bear embryos I collected during the month of December (1957). This variation was likely due to conception dates spaced throughout the summer.

These data were used to construct a breeding potential table similar to that used by Leopold (1948). On the theory that female black bears first breed at age 2½, the annual cub (or embryo) crop amounts to approximately 25 percent of the population.

Mortality. If the black bear is polygamous, which is likely,²⁴ the female production and harvest has a greater effect on population changes than does the male production and harvest. (This assumes that there are enough males for breeding.) A comparison of the average 18 percent mortality of the female tagged bear population on the three areas (Table 3) with the annual female cub crop (25 percent of the female population) indicates that the tagged bears, and presumably the untagged bears, are not being overharvested.

Female bears on the North River area were harvested to the fullest extent without being overshot (Table 3). (This assumes complete tag returns and no crippling loss of female tagged bears.) The heaviest harvest occurred in this area because sportsmen hunt there more often with bear dogs. The area consists of terrain that is rugged enough for good bear country, yet not so rough that men and dogs cannot traverse it. A good dirt road encircles the major part of it, allowing for access and insuring the finding of lost dogs that eventually turn up on the road.

Neither the female bears on the North Mountain area nor those on the Big Levels area were overharvested. The North Mountain area, like the North River section, is good bear country, yet it does not sustain as much hunting pressure as North River does. The Big Levels area is not as well suited for hunting because certain sections are rough and inaccessible. The Blue Ridge Parkway, a National Park where no hunting is permitted, borders Big Levels on the east and increases the inaccessibility. Nevertheless, the Big Levels area is regularly hunted.

There was no difference in mortality to hunting between tagged yearlings and adults. However, the tagged bear data show a disparity between male and female vulnerability to hunting (Table 3); tagged males were approximately 2½ times more vulnerable than females. But the hunting-season sex ratio of unmarked bears for these areas from 1958 to 1960 was only slightly in favor of males. I cannot explain this lack of agreement. Unless the birth rate is highly in favor of females, the preponderance of harvested tagged males must be considered exaggerated. Perhaps males are more vulnerable to hunters because they travel farther than females and are more likely to be tracked by dogs.

SUMMARY

A black bear tagging study was conducted in the mountainous areas of Virginia from 1958 through 1960. One-hundred catches, involving 83 tagged and released bears, were made.

Most of the bears were captured in No. 150 Newhouse steel traps and were anesthetized with pentobarbital sodium delivered by means of "Cap-Chur" automatic projectile syringes. Intraperitoneal injections gave quicker and more complete anesthetization than intramuscular injections. Steel traps caused mostly minor injuries. Seven bears died of anesthetizing accidents or steel trap injuries.

Three bears classed as yearling females were judged to be in breeding condition. Females in breeding condition were trapped in June, July and August, indicating a summer-long breeding season.

Tag returns show that males travel farther than females. One tagged bear moved 90 miles southeastward. Tagged bears lost weight initially after being trapped but then regained it.

Productivity information collected from females and used in a breeding-potential table indicate that the annual cub crop is 25 percent of the population.

If the bear is polygamous, which is likely, the female production and harvest has a greater effect on population changes than does the male production and harvest. On this basis, none of the three study areas was overharvested, although the North River area approached it.

²⁴ Trippensee (1948) says that bears will gather in groups and then pair off for mating in seclusion, and that it is not known if males mate with more than one female. However, the captive male yearling, mentioned previously, was seen mating with both captive females. Polygamy in black bears, as opposed to monogamy, also is suggested by the indicated long breeding season.

Tagged males were much more vulnerable to hunting than tagged females, but a like condition in untagged bears is not indicated by the hunting season sex ratio. There was no difference in mortality to hunting between tagged yearlings and adults.

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APPENDIX TABLE I.

Steel-Trapped Male Bears Rendered Helpless By Pentobarbital Sodium Administered By Intraperitoneal Injection²⁵

<i>Weight</i>	<i>Age</i> ²⁶	<i>No. of Shots</i>	<i>Dose (mg.)</i>	<i>Length of Time Until Helpless (min.)</i>	<i>Mg./lb. of Body Weight</i>
87	2½	1	1800	5	21
113	2½	2	3600	55	32
184	3½	2	6000	65	33
123	5½	1	2400	7	20
211	3½	2	4200	52	20
76	1½	2	2750	85	36
205	3½	28	4200	70	20
64	2½	1	1200	5	19
87	1½	1	1200	68	14
55	1½	1	1200	9	22
115	2½	1	1800	9	18
76	1½	1	1800	7	24
95	2½	1	1800	45	19
112 ²⁷	2½	1	1200	45	11
91	2½	1	1800	10	20
77	1½	1	1800	185	20
148	4½	1	2400	13	16
86	1½	1	1200	45	14
182	4½	2	3600	70	20
94	1½	1	2400	60	26
80	1½	1	2400	60	30
100	2½	1	1500	90	15
84	1½	1	1200	30	14
78	1½	1	1800	50	23
250	9½	1	3600	60	14
68	1½	1	1800	90	27

²⁵ Only bears for which accurate weight records were known which were successfully handled are listed.²⁶ Estimated.²⁷ Second time caught.²⁸ Unknown.

APPENDIX TABLE II.

Steel-Trapped Female Bears Rendered Helpless By Pentobarbital Sodium Administered By Intraperitoneal Injection²⁹

<i>Weight</i>	<i>Age</i> ³⁰	<i>No. of Shots</i>	<i>Dose (mg.)</i>	<i>Length of Time Until Helpless (min.)</i>	<i>Mg./lb. of Body Weight</i>
119	5½	2	3600	55	30
118	7½	1	2400	18	20
130	2½	2	3600	70	28
100	2½	1	3000	25	30
150	4½	1	2400	7	16
124	5½	1	2400	10	19
132	6½	1	2400	12	18
85	2½	1	1800	5	21
100	2½	1	1800	23	18
122 ³¹	3½	2	3600	105	30
170	2½	1	2400	60	14
114	2½	1	2400	30	21
122	2½	2	3600	75	30
142	3½	1	2400	45	24
84	1½	1	1800	20	21
112	2½	2	3600	150	32
70	1½	1	1800	45	26
68	1½	1	1800	30	26
118	4½	1	2400	105	20
75	1½	1	1800	20	24

²⁹ Only bears for which accurate weight records were known which were successfully handled are listed.³⁰ Estimated.³¹ Second time caught.

APPENDIX TABLE III.
Steel-Trapped Bears Rendered Helpless by Intramuscular Injection ³²

<i>Weight</i>	<i>Sex</i>	<i>Age</i> ³³	<i>No. of Shots</i>	<i>Dose (mg.)</i>	<i>Length of Time Until Helpless (min.)</i>	<i>Mg./lb. of Body Weight</i>
<i>Capchur-Barb</i>						
78	F	1½	2	1500	240	19
117	M	2½	1	1000	20	9
122	M	2½	1	1000	140	8
71	M	1½	1	1000	35	14
92	F	2½	1	1000	75	11
<i>Pentobarbital Sodium</i>						
65	F	1½	1	1200	30	18
100	F	2½	2	1800	105	18
132	F	4½	1	1200	120	9
61	F	1½	1	900	45	15
162	M	4½	2	2400	144	15
92	M	2½	2	2400	270	26
140	M	2½	1	1200	85	9
264 ³⁴	M	10½	1	1800	60	7
74	M	2½	1	1200	60	16
140 ³⁴	M	3½	1	2100	45	15

³² Only bears for which accurate weight records were known which were successfully handled are listed.

³³ Estimated.

³⁴ Second time caught.

MUTUAL BENEFITS IN COOPERATION BETWEEN FOREST AND GAME FISH MANAGEMENT

By RAY SHIRLEY
Georgia Forestry Commission

Cooperation between Forest and Game and Fish Agencies, organizations, companies and individuals should be a natural and mutual undertaking.

Forest and game go together. Any area where trees will grow game and fish can also abound. The success of a joint endeavor depends on the basic understanding of forest values and the need of game food and protective cover for wildlife. The landowner's primary purpose for his forestland will depend upon maximum game population or maximum tree growth. However both can live together in reasonable harmony if they desire and work toward it.

State and federal agencies, we believe, should be the leaders in any cooperative forest and wildlife program where land areas and facilities make cooperation possible.

In fact, enemies of the forest are also natural enemies of games, such as wild fire, insect and tree diseases and others. We must, therefore, work together on these natural enemies. The first requirement, therefore, of any state or federal forest organization is the prevention and control of forest fires and insects and diseases.

The Forestry Commission has, therefore, made its state forest available for a game refuge area for the Georgia Game and Fish Commission to stock, protect, plant food areas and other uses for game and fish conservation.

We find this to mutually benefit us in a number of ways.

1. It insures maximum game and fish population for local and area residents.
2. Wildlife and game population is well balanced by restocking depleted game species.
3. It permits multiple use of the forest area.
4. A well stocked forest with game provides for a better control of insects, which plays a part in the spread of many tree diseases.
5. Unauthorized people are less likely to use an area, such as poachers, timber thieves and others.