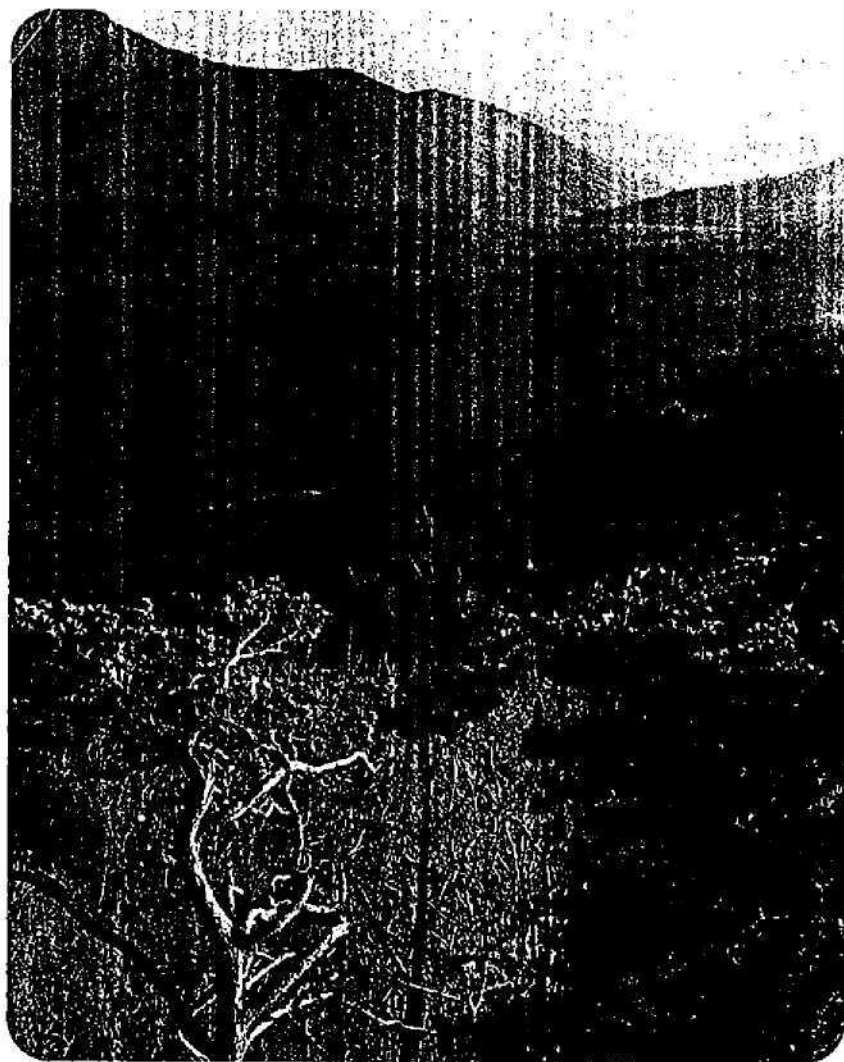




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Shenandoah Research Symposium
April 1976

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National Park Service
Mid-Atlantic Region
143 South Third Street
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BLACK BEARS

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I'd like to brief you, if I may, a little bit on the work we're conducting in Virginia on the black bear. It's an animal that is quite controversial, to say the least. It's an animal also that is very, very difficult to get much good information on. Our aim in the study is to establish biological bases on which to manage Virginia's bear population. There are different avenues of enjoyment for different individuals and we're going to try to come up with some ideas that will help not only the hunting public that I work for but also the visitor who enjoys seeing these animals, as all of us do.

Our study of the black bear is state-wide in scope and includes lands here on the Shenandoah National Park where we find about 25%, roughly, of the state-wide black bear population as we currently know it. Other prime study areas are the United States Forest Service lands, Virginia Game Commission lands and selected private lands in the Commonwealth. The Shenandoah National Park serves as the primary control area, if you will, for the studies that we are doing. It is the largest single block of "non-hunted" land that we have available in the state. It gives us a good "control" from the standpoint that it shows us what we should expect in terms of population phenomena: births, deaths, and movements which should occur in a non-hunted area. We do know that this area is illegally hunted, regardless of how we might want to think of it. The periphery, of course, can be legally hunted. It's a large area; manpower is limited and certain types of individuals will take advantage of the situation. Still, it serves as the best available control area for our study.

We are trying to establish an age and sex structure on the bear population similar to what a life insurance company

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does with humans. From this we can predict, based on the production rates, and the mortality factors (not only hunting but accidental causes of death, disease, and what have you) that occur in a population. Reproductive factors are highly important in black bears since they are so unusual in their biology. They are "induced ovulators" and "delayed implanters." The former "fifty-cent words" meaning they shed their ova during the physical act of mating, as do rabbits. They are also delayed implanters like the weasel and mink family. The fertilized ovum implants at some later point in the gestation period. In the case of bear, which normally breed June-August, the fertilized ovum divided into two, then four, eight, sixteen cells to a blastula stage. It then free floats in the uterus until about mid-December at which time light conditions are such that it implants into the wall of the uterus and begins a very rapid development. The young are born in late January or early February. The black bear has both of two conditions that are very unusual in the animal kingdom. In addition they only breed every other year and don't reach normal maturity until three years of age.

We have two studies in progress designed to improve our overall knowledge of this fine animal. I think about the best way to show you what we're doing is by way of photographs. I'll describe a bit of the work we're doing, what we hope to accomplish and some of what we've found out to date. We have one more year ahead of us of actual trapping, tagging-type work. The primary thing that we're after is a small premolar tooth with which we can establish a bear's age.

The Game Commission, National Park Service, and the U.S. Forest Service have collaborated in this study of the black bear. The problems associated with such an investigation, though great, have fortunately now been overcome to a large extent. The first problem primarily concerned terrain. Bears live in typically remote, inaccessible, very rugged terrain that creates problems for researchers in getting equipment into the study area. Additionally, because of their low production potential, bears simply do not provide as great numbers of animals to study as do deer, turkeys, squirrels, etc. Compounding these two problems has been a means of handling bears in a manner safe to the operator and the animal itself. We now have tools available to us that will allow us to do this.

There is a Southeastern Association of Game and Fish Commissioners which some of you may be familiar with. I am a member of the Black Bear Sub-Committee under this organization which is coordinating various research studies designed to maximize several phases of bear research simultaneously.

We have divided the "puzzle" so that each researcher is working on a separate "piece" of the unknown. It is planned that this knowledge be pooled so we can put the puzzle together as quickly as possible. Each state or set of states has a different problem such as reproduction, home range, habitat, determination of age and sex structures, etc. We're trying to gain as much as we can as quickly as we can on this animal now that we have the tools available.

Bears can do a considerable amount of damage. They are a very powerful animal. There's nothing quite like coming back and finding a convertible, with the top destroyed, "easy pickings" for a bear, in which someone has left food items. This becomes a real problem for the park and also for the visitor who is unfortunate enough to have left something in his car which is attractive to a bear.

I want to point out that of the many bears we've trapped in this park, only about 10% have been known to frequent campgrounds at all. The other 90% are free-roaming, free-ranging wild black bears that stay in back country areas. Fortunately, the Shenandoah has not had, to my knowledge, the "panhandling bear" evident in the Great Smoky Mountain National Park.

Bears cause some crop and property damage to adjacent land owners. This occurs primarily to corn from July to September when corn is in the tender milk stage. The natural fruits and berries are gone and, at this point, nuts, acorns, etc. have not yet fallen. Fresh corn is attractive, to say the least. It wouldn't be so bad if the bears' activities were confined to eating, but they destroy a lot while fighting, wrestling, etc., especially the young males. We've observed bears literally riding down a row of corn, allowing those big stalks to run across the chest. It evidently fells good! We caught fourteen bears in one farmer's corn field in a week's time. They can destroy a tenth of an acre in one night. If a farmer has a corn patch in a small open field that's rocky, mediocre farm land to begin with, it's all he's got; and if it's right next to "Bear Heaven," he's got a problem! Fortunately we've been able to take care of many of these landowner complaints. We trap and relocate problem animals to a new habitat in western areas of the state with the hope of "rehabilitating" them. A percentage of them do return.

Black bears are such creatures of habit that instead of making evenly-depressed trails they form little pads or depressions that are rather obvious in heavily-used bear country. Where you don't have deer in the area you can see this fairly readily. Each bear travelling the trail steps in the footprints of its predecessor until obvious depressions

result. This habit is a "natural" for using a new type of trap known as the Aldrich Foot Snare. Previously, when anyone mentioned bear traps the listener thought of powerful steel traps that were extremely dangerous. The Aldrich Foot Snare is a very safe, humane trap. A small child can step into one of these and get out of it just by simply loosening the noose. It will hold the animal in place until we get there with a dart gun. We simply dig up one of the depressions on a bear trail and set the snare noose, made of 42 inch aircraft cable with 4,200 pounds of tensile strength. We also can use baited sets with this type trap. The simplest baited set consists of two small anchor trees, four to six inches in diameter, about two feet apart. Then we build a closed "horseshoe" out of small saplings about four feet deep, with the two small trees serving as the mouth of the horseshoe. The set is then baited. They'll come around the open end. Black bears have very soft, sensitive pads on the bottoms of their feet. They won't step on anything sharp, such as a stone or a stick, that they can avoid. By strategically placing stepping stones and sticks, we can direct his feet into the area of the snare trigger.

The culvert trap is used exclusively in the Shenandoah National Park since there is less danger to the public when the bear is in this type of trap. They are marked very clearly so that anyone knows that it is a bear trap. The culvert trap is potentially more dangerous to people than the snare, particularly if small children were to be playing around it. The door weighs about 50 pounds. We visit these traps daily. They weigh approximately 500 pounds empty. With a device that heavy, plus a bear that may weigh as much, handling of traps was formerly a problem. To solve this we strengthened the truck's tail gate, attached a cargo roller track, and added an electric boat winch. The winch has been absolutely indispensable to us. We use it for all loading of traps and weighing of animals.

The new drug which we have available to us now is known as M-99 Etorphine. It's a synthetic morphine compound and is extremely powerful and has an antagonist that works with it. It generally takes effect in 15 minutes, making the animal "high as a kite." The animal's respiration rate drops dramatically, but the heart rate remains essentially stable, about one beat per second. We don't attempt to handle the animals now until the respiration rate drops to about one inspiration per twenty seconds. Normally they pant very quickly, like a dog.

There are two different kinds of injecting devices, one for liquids and one for solids. The drugs currently in use come in liquid form. The drug formerly used was known

as Sucostrin (Succinylcholine Chloride). It is a skeletal muscle immobilizer which was pre-assembled in disposable darts with excellent shelf-life in the dry form. It can be kept almost indefinitely, pre-loaded. Unfortunately, in the case of an accidental human injection or bear overdose there is no antagonist for Sucostrin except oxygen. With the dosage required to immobilize a black bear, accidental injection would probably mean certain death for a human.

To my knowledge, the drug that we are now using has not been tested on humans. Injection is done at point blank range with a CO2 dart pistol. Within 15 minutes, normally, the bear is sufficiently anesthetized to handle. The first thing we do is to weigh each animal and affix a numbered metal tag in each ear. Each tag has a reward inscription to encourage individuals to report any dead bears to our agency. This gives us an opportunity to monitor bear mortality and survival on a sample basis by sex, age, time of year, etc. Tag data also provides information on weight gain and movements.

We collect a variety of measurements on these animals once we've got them in hand. Some information collected is not needed presently, but is collected with the possibility of future use. Various head measurements are taken along with total body length, shoulder height, heart girth and measurement of the front and rear pads. There appears to be a degree of correlation between heart girth and weight by sex.

Gerald Blank is a trapping specialist with our agency. He's been instrumental in developing a lot of the techniques that we utilize not only on black bears but for live trapping other species as well.

We take an extra step to permanently identify individual bears in addition to ear tagging. Some studies in other states have indicated that one or both ear tags may be lost the first year, particularly by the males, due to fighting, greater movement, etc. We tattoo the lowest ear tag number inside the upper lip as a permanent means of identification.

The primary thing that we're after is an age and sex structure on the population. Establishing an accurate age has been the biggest problem that has beset black bear researchers. Turkey, deer, and many other species can be aged very accurately. Age and sex data along with reproduction data has allowed us to manage deer populations to numbers far greater than the Pilgrims found when they came to this country. Current statewide deer harvests exceed 66,000 animals due largely to planned management on a sustained-yield basis. We've not been able to do this with black bear because of past diffi-

culties in aging. We formerly could call a bear a cub, possibly a yearling or an adult. "An adult" is a broad category. Age of adults is important because of its bearing on reproduction, particularly in the case of the female. Therefore, we need to have an age and sex structure.

There is a new technique that now enables us to get within one year of a black bear's age. The technique involves examination of cross-sections of tooth samples. We pull a small premolar, just alongside the large canine in the upper jaw, from animals that we trap. Additionally, the hunters in the state who are successful in harvesting a black bear return to us voluntarily a front portion of the lower jaw from which we extract the large canines and do a cross-section on that to see the cementum annuli that lie within. The principle is almost exactly the same as involved in tree growth. During the spring and summer, when vegetation is lush and nutrition is at its highest, there is active depositing of bone and tooth cells. This depositing slows off during the winter months, resulting in alternate layers annuli which can be observed and counted under the microscope. The first upper premolars lie immediately behind the large canines. Dental forceps were used for initial premolar extractions, but were discontinued in favor of a standard 8-inch screwdriver. Professionally, this may sound crude, but it's the best tool we've found yet. The matchhead size tooth lies immediately adjacent to the large canine. By inserting the blade of the screwdriver between the two and twisting, the tiny tooth will roll out of its socket with little resulting gum damage. Removal of an upper premolar provides good drainage and we have found that an oral antiseptic is not necessary.

This photograph of an unprocessed canine tooth cross-section (see Figure 1, page 34) will give you a rough idea of what we are looking for. This is just a very rough cross-section, polished just a little bit. The area on the extreme left, the white band, is the enamel portion of the tooth. The next layer containing the cementum layers that we're after. The innermost region is the root canal, which closes in with age.

The tooth samples are put in a formic acid solution for about a week. This de-calcifies or removes all the enamel on the tooth leaving it soft and pliable, almost rubbery. It is then placed in a paraffin bed and a freezing microtome is used to section it to about 5 microns which is then mounted on a slide to go through a stain, alcohol and washing procedure. You end up with something like this (see Figure 2, page 34). This particular photograph is not a photomicrograph, but does show the presence of the annuli. The enamel has been removed by the acid. The area on the extreme left

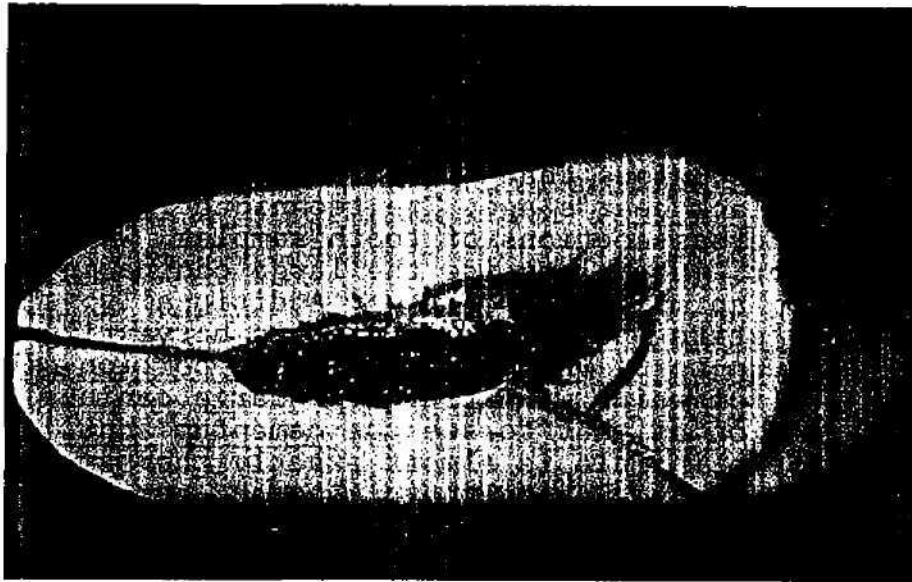


FIGURE 1. Unprocessed canine tooth cross-section.



FIGURE 2. Processed canine tooth cross-section, annular rings visible on the extreme left hand margin

hand margin of this photograph of the tooth section is the dentine. Within it you can see the annuli. On this photograph you can count most, but not all of the annuli which tend to be compacted in older animals. Under the microscope the annuli can be separated. This particular animal was a 19-3/4 year-old male that was killed in Rockbridge County in 1973. It was killed on the Game Commission's Goshen-Little North Mountain Wildlife Management Area. The oldest specimen we've had, a 20-3/4 year-old female, was also obtained from one of our hunting areas. She had been tagged originally on the Big Levels area of Augusta County in 1958 and was estimated to be 2-1/2 years-old when captured. Interestingly, she was killed within 1/4 mile of the original trap site. The oldest animal that we have trapped to date was a 16-3/4 year-old male weighing 360 lbs. trapped here in the park in 1975. It was not the largest animal trapped. Weights of bears handled have varied from 8 pounds to a known 580. We've had two males exceed our earlier 600-lb. scale capacity. Drug dosages indicated weights for these two animals of 705 lbs. and 750 lbs. for the 7-1/4 year-old and 10-1/4 year-old bears respectively. We have since acquired a friction tensiometer with capabilities of + 1% accuracy up to 1,000 lbs. Unfortunately, we've not been able to recapture either of those two animals to document their true weights.

Following processing, the antagonist for the original drug (M50-50 Diprenorphine) is injected directly into the femoral artery. The animals are normally "up and running" within 1-3 minutes. Subcutaneous or intra-muscular injections may require 20-45 minutes for recovery. We have a number of visitors along occasionally. The recovery phase is always a bit dramatic for them. We have a standard "three-minute rule" now. If the bear hasn't recovered within three minutes, our guest gets to walk up to the bear and shake him with his foot!

One of the first signs of initial recovery is the rapid return of the respiration rate to normal "panting." This is followed by twitching movements of the ears while the animal lies quietly. Once this stage is reached, any sudden noise will generally bring them up at a run. We have yet to have the first aggressive response following recovery from any of the nearly 500 animals handled. Their natural reaction is to instinctively retreat to the nearest cover available.

I'd like to introduce some of the data we've compiled thus far. For bears trapped and harvested from 1972 to 1974, the average age for the harvest sample was 4.2 years for males, 5.83 years for females and 4.83 years for combined sexes. The harvest sample doesn't differ greatly from the trapping sample. The average age for the trapping sample was 3.54

years for males, 6.19 years for females and 4.62 years for combined sexes. Female survival appears greater in both samples, especially the trapping sample.

A comparison of age and sex structures of both samples indicates certain similarities. Both harvest and trapping samples are composed primarily of younger age (1-3 year-old) male bears. Females predominate in the older age classes in both samples.

We get a striking contrast when we examine the population structure of the bears that have been tagged and subsequently harvested, poached or accidentally killed by vehicles. No females appear in this sample beyond 6 years of age. The great majority of these bears were trapped in the park and subsequently harvested in close association with the park. The data imply that the female segment of the population receives a large degree of protection by virtue of the size and security of preserved lands. Females appear to be "home bodies," occupying a relatively small home range of 1-10 square miles; whereas males may use from 10-100 square miles. The greater range of the male frequently carries him away from the protection of the park to areas where he may be harvested.

We examined the proportion of the tagged bears harvested annually as a means of estimating the proportion of the total population harvested annually. We have tagged 231 bears from 1972 to 1975. Eighty-four (84) tagged bears are known to have been removed from the population to date (36.4%). Fifty-six (56) of the 231 tagged bears were recovered the first fall following tagging (avg. 24%). Mortality figures are minimum known reported kills. Unreported illegal hunting no doubt has removed additional tagged animals from the populations.

In four years, 9 of the 12 animals trapped and tagged in 1972 are gone from the population (75%). In 1973, we trapped and tagged 97 bears in the Shenandoah National Park. Thirty-two and nine tenths percent (32.9%) were harvested the first year. Not all this was legal. In 1974, an additional 9% were removed. An additional 5% was removed in 1975. The total to date removed from the population in a three-year period is almost 50%. Average mortality for the three trapping periods provide at least two years recovery data indicating that 43.9% of the tagged population is gone within a two-year period. Since the majority of the tagged bear mortality is closely associated with the park, the observed mortality should be considered a minimum when applied to hunting lands.

We have added tremendously to our knowledge of the black bear in a very short time. In addition to age and sex structure data, we are obtaining new knowledge on the handling of nuisance bears, movements, home ranges, reproduction and mortality. We wish to extend our thanks to the personnel of the Shenandoah National Park for their kind assistance and for allowing us to use this area for intensive study of this fine animal.