

PANEL 1: THE ECOLOGY, POPULATION CHARACTERISTICS, MOVEMENTS AND NATURAL HISTORY OF BEARS

Use of Foot Trail Travellers in the Great Smoky Mountains National Park to Estimate Black Bear (*Ursus americanus*) Activity¹

MICHAEL R. PELTON

Assistant Professor of Forestry, Department of Forestry, University of Tennessee, Knoxville.

SUMMARY

The Great Smoky Mountains National Park is a relatively inaccessible area. Only one highway dissects the center of the park, and most areas can be reached only by foot trail. Over 700 miles of trails are maintained in the park; of these, 310 miles are located on the Tennessee side. Beginning in April 1970, 10 routes (19 different trails covering 180 miles) on the Tennessee side were designated as 'Index Trails' and used to determine black bear activity. From April through October 1970, these routes were hiked for a total of 2,363 miles. The exact location of each bear scat and bear sighting was recorded. Bear survey forms were distributed to backpackers using the trails for extended periods. Over 400 scat-locations and 150 live-bear observations were recorded. Information gathered indicated the distribution, areas of high-bear use, and seasonal onset, peak, and cessation of activity of the black bear in the park. Potential use of the data for estimates of black bear density, food habits and movements, and solutions to some bear-person interactions are discussed.

INTRODUCTION

It is agreed by most wildlife biologists that perhaps the greatest challenge to the profession is that of being able to census with accuracy and precision a population of wild animals. This challenge is especially important at two points in the population dynamics of a species: (1) when the population is so high as to affect its surroundings adversely and (2) when the population is so low as to place the species in danger of extirpation by the untimely influence of various intrinsic and/or extrinsic factors. In many instances black bear populations fit the latter category.

Gilbert (1951) pointed out that apparently no state uses a census method of estimating black bear (*Ursus americanus*) population densities. Spencer (1955) reported that 'No wholly satisfactory method has been devised for censusing the black bear'. It is obvious from the more recent literature that little progress has been made in this direction. It appears that only Spencer (*op cit.*) has utilized bear scat for other than food habits studies. He made random

¹ This study was supported through funds made available from McIntire-Stennis Project No. 12 and the Agricultural Experiment Station, Institute of Agriculture, University of Tennessee, Knoxville.

cruises of known mileage by foot and canoe in Maine to count scat and other signs as a method for estimating black bear density. It is essential that wildlife biologists continue their quest for better census techniques especially populations of those species that fall into one or both of the categories mentioned above.

As a part of a long-term study of the natural history, ecology and behavior of the black bear in the Great Smoky Mountains National Park (hereafter referred to as GSMNP), an intensive effort is being undertaken to census this species using various techniques. Part of this effort involves recording the incidence (exact date and location) of bear scat (droppings) along established 'Index Trails' within the park boundary. Inaccessibility of most areas of the park by motorized vehicles, and an extensive and well-maintained trails system, provide a good opportunity to undertake such an endeavor. It is hoped that results from using this technique can be related to direct counts or other population estimation techniques and provide a more accurate and precise census of the black bear population in the park.

It was also recognized that these data could be used in delineating other aspects of this animal's life history. This paper includes the preliminary results from traversing these trails and an evaluation of the techniques involved. The usefulness of the data for delineating various parameters of the life history of the black bear is also discussed.

DESCRIPTION OF THE STUDY AREA

The GSMNP covers 800 square miles (512,000 acres) of the Southern Appalachian mountain region. The park is characterized by rugged terrain with 16 peaks rising above 6,000 feet in elevation (the highest section of mountains in the Appalachian chain). Within the park, altitude varies from 900 feet to over 6,600 feet. With respect to climate and plant life, a trip from the foothills of the park to its highest point is equivalent to a trip from the valley of East Tennessee to southern Canada. Temperature differences from 15 to 25°F are commonly reported between the extremes in altitude within the park. Annual rainfall varies from 45 to 55 inches at low elevations to 85-100 inches at high elevations. High rainfall provides the runoff for over 600 miles of clear mountain streams.

Major vegetation types are: cove hardwood, hemlock, northern hardwood, spruce-fir, closed oak, open oak, pine, and balds (heath and grass). The cove hardwood forest is located in coves and sheltered slope sites to 4,500 feet elevation. The hemlock forest is typically restricted to sheltered topography along streams up to about 3,000 feet but occurs on more exposed slopes and lead ridges from 3,000 to 4,500 feet. The northern hardwood forest occurs above 4,500 feet and is dominated by beech (*Fagus grandifolia*) and yellow birch (*Betula lutea*). The spruce-fir forest also occurs principally above 4,500 feet. The closed oak forest is found on intermediate to dry slopes and is dominated by oaks (originally by the American chestnut, *Castanea dentata*). The open oak, pine and bald vegetation types are characteristically found on more exposed slopes and ridges. This high diversity of plant life results in a great variety of vertebrate life as well.

One major highway dissects the park. However, many paved roads skirt its perimeter. Over 700 miles of hiking trails are maintained in the park of which 310 miles are located on the Tennessee side (excluding 70 miles on the Appalachian Trail). The Appalachian Trail traverses the Tennessee-North Carolina

border along the highest peaks. Twelve permanent stone shelters are located along this trail.

METHODS

On the Tennessee side a total of 19 different trails representing 10 circuitous routes were designated as 'Index Trails'. Most routes started at a low elevation, went to a high elevation, encompassed a section of the Appalachian Trail and an overnight trail shelter, and returned by way of a different trail. 180 miles out of the total of approximately 310 (plus 70 on the Appalachian Trail) on the Tennessee side were included in the Index trails. The length of the routes ranged from 13 to 27 miles. From 4 April to 31 October 1970, most of the 10 routes (19 trails) were hiked biweekly by bear project personnel, graduate students and undergraduate wildlife majors. No route was hiked less than 10 times or more than 15 times during the study. Miles hiked ranged from

TABLE 1. HIKE DATES AND NUMBERS OF BEAR SCAT LOCATED IN THE GSMNP.

Date	Number of Routes Taken	Number of Trails Taken	Miles Covered	Number of Scat Located	Scat/Mile	Miles/Scat
Apr. 4	4	8	75	0	0	0
Apr. 18	3	6	51	4	0.078	12.75
May 2	9	17	160	5	0.031	32.0
May 16	9	18	167	4	0.024	41.8
May 30	10	19	180	23	0.127	7.8
June 13	9	17	163	17	0.104	9.59
June 27	10	19	180	15	0.083	12.0
July 11	7	13	123	27	0.219	4.5
July 25	10	19	180	17	0.094	10.6
Aug. 8	7	14	126	11	0.087	11.45
Aug. 22	10	19	180	41	0.227	4.4
Sept. 5	9	17	166	29	0.174	5.7
Sept. 19	8	15	133	28	0.210	4.7
Oct. 3	10	19	180	40	0.220	4.5
Oct. 17	10	19	180	7	0.038	25.7
Oct. 31	7	14	119	4	0.033	29.8
Total or Average	132	263	2,363	272 ¹	0.115	8.69

¹ 155 additional scat were collected at a garbage dump at the half-way point of one index route.

156 miles on the Sugarlands route to 351 miles on the Elkmont-Bent Arm route (Table 2). The exact location of each bear scat was recorded and the scat collected. Pertinent data were recorded on actual bear sightings. Bear survey forms were distributed to backpackers using the trails for extended periods.

RESULTS

A total of 132 separate routes were hiked at two-week intervals in the period 4 April through 31 October 1970 (Table 1). A total of 2,363 miles were hiked and 272 bear scat located and collected. An additional 155 scat not used in tabulating results were obtained at a garbage dump near one route. An average of 147.6 miles was covered during each biweekly period. On six of the 16 periods all trails were hiked.

The number of scat per mile ranged from zero on 4 April to 0.227 scat on August 22 (Table 1). The number of miles per scat ranged from 41.8 miles on May 16 to 4.4 on August 22. The average miles per scat for all routes was 8.69. A dramatic increase in the incidence of scat was observed between May 16 and May 30. A distinct peak in numbers collected occurred between August 8 and October 3 followed by a rapid decline between October 3 and October 17. The most productive route for scat was Sugarlands with an average of 2.52 miles per scat and the least productive was Gregory Bald with an average of 238 miles per scat (Table 2).

Altitudinal distribution of scat exhibited a remarkably linear relationship. Only four scat (1.5 percent) were found at less than 2,500 feet elevation with 155 (56 percent of the total) being found at elevations greater than 4,500 feet (Table 3).

TABLE 2. INDEX TRAILS AND NUMBERS OF BEAR SCAT LOCATED IN THE GSMNP.

Route	Number of Trips Made	Number of Miles Covered	Number of Scat Located	Scat/Mile	Miles/Scat
Mt. Cammerer	13	260	14	0.53	18.57
Snake Den	13	273	19	0.69	14.37
Greenbriar	10	200	8	0.040	25.0
Alum Cave	15	210	19	0.90	11.05
Trillium Gap-Bullhead	13	182	35	0.192	5.2
Sugarlands	12	156	62	0.397	2.52
Elkmont-Bent Arm	13	351	67	0.190	5.24
Tremont	15	255	36	0.141	7.08
Spence Field	14	238	11	0.046	21.64
Gregory Bald	14	238	1	0.004	238.0
Totals	132	2,363	272	0.115	8.69

TABLE 3. THE RELATIONSHIP BETWEEN MONTH, ALTITUDE AND NUMBERS OF BEAR SCAT LOCATED IN THE GSMNP.

	Less than 2,500 ft.	2,500- 3,500 ft.	3,500- 4,500 ft.	Greater than 4,500 ft.	Total
April	1	1	2	0	4
May	1	3	10	21	35
June	0	1	10	23	34
July	0	5	18	24	47
August	1	3	12	39	55
September	1	5	20	32	58
October	0	6	17	16	39
Totals	4 (1.5%)	24 (8.8%)	89 (32.7%)	155 (56.9%)	272

TABLE 4. A SUMMARY OF LIVE BEAR OBSERVATIONS BY INDEX TRAIL HIKERS AND SURVEY BACKPACKERS IN THE GSMNP.

Date	Index Hiker Count	Backpacker Survey Count	Total
April 4	—	—	—
April 18	—	—	—
May 2	1	—	1
May 16	4	—	4
May 30	5	—	5
June 13	5	8	13
June 27	6	17	23
July 11	4	16	20
July 25	7	6	13
Aug. 8	7	14	21
Aug. 22	12	21	33
Sept. 5	1	8	9
Sept. 19	3	0	3
Oct. 3	8	—	8
Oct. 17	6	—	6
Oct. 31	—	5	5
Totals	69	95	164

From a total of 92 survey forms distributed to backpackers, 68 (74 percent) were returned of which 48 (70 percent) reported one or more bear sightings. Table 4 summarizes live bear observations by index trail hikers and backpackers. Index trail hikers recorded a total of 69 live bear observations while backpackers recorded a total of 95 observations.

DISCUSSION

General black bear activity in the GSMNP is not appreciated by the park visitor who does not see this animal until after the first of June. The high influx of visitors to the park at this time and a concomitant movement of some bears to areas where they are readily observed (artificial and easy sources of food along roads, in picnic areas and in campgrounds) gives a false impression regarding the emergence of black bears. This apparent high degree of activity of the bear population continues until after the peak of fall leaf colors and the large reduction in numbers of park visitors. In fact, preliminary attempts at delineating black bear activity and density in the GSMNP and Yellowstone National Park have revealed that total numbers of bears counted on specific dates seem to be directly related to intensity of use of the park by visitors (e.g. easily observed bears were usually counted and these were typically panhandler roadside bears responding to visitor influx). Thus, an important question arises as to the degree to which people influence the general activity and local density of bear populations. It is apparent that direct counts indicate that number of bears are influenced by number of park visitors at any given time or place. However, this technique does not provide evidence as to the status of the total bear population within an area. Direct counts could present a very misleading picture of the activity and density of a bear population.

In the present study onset of black bear activity, as evidenced by the incidence of scat, begins before the first of June and the high visitor influx into the park. Peak activity occurs later than peak visitor-use (July and early August) and coincides with bear's time of intensive feeding and fattening before Fall. Based on the incidence of scat, cessation of bear activity apparently occurs before the peak of leaf colors and major reduction in numbers of park visitors. These data therefore indicate some degree of independence between seasonal black bear activity and intensity of visitor-use of the park.

However, areas of high and low use by bears as revealed by the incidence of scat on index trails support other data being collected on live bear observations. The least productive areas for scat (Gregory Bald, Greenbriar and Mt. Cammerer) are subjected to heavy pressures by poachers and dogs. Few live-bear observations have been made in these areas by park personnel, visitors or bear study personnel.

Some conjectures and observations about data on index trails, incidence of scat and bear populations for Spence Field (an area of low incidence of scat but excellent bear habitat) follow. If the incidence of scat is a true reflection of relative population density and activity of the black bear, then one would postulate that the Spence Field area contains a sparse population of bears compared to other areas in the park. Below Spence Field (at low elevations) is one of the largest campgrounds in the park and a picnic area as well. Here also is found the highest concentration of panhandler bears within the park. The attraction of the picnic and camping areas as a source of food likely causes a large influx of bears from the Spence Field area (and perhaps other areas) to concentrate at these low elevations.

While visitor-use on a park-wide scale seemed to be independent of seasonal bear activity, these data indicate that density of black bears in local areas can likely be affected by people quite dramatically. In fact, visitors and poachers are probably the greatest factors influencing the areas of high and low concentrations of bears within the park.

Further evidence of the role of people in influencing bear populations was obtained from the two most productive index trails for scat (Sugarlands and Bullhead). Both of these trails are located close to Highway 441, the only major highway crossing the park and over which millions of visitors pass each year. The Bullhead trail also traverses Mt. LeConte where a number of bears are attracted by a lodge and its garbage dump. Also, the above two areas (Sugarlands and Bullhead) are relatively well protected from poachers and dogs as compared to other areas within the park. Areas along the Elkmont and Tremont trails are also relatively well protected and revealed a higher incidence of scat.

Several possibilities may account for the higher numbers of scat at high elevations within the park. However, data are inconclusive at this time. Because of the greater rainfall, steeper grades and more exposed trails at higher elevations, one would expect scat to disappear much more quickly than at low elevations. However, preliminary data indicate that bear scat are highly resistant to weathering. Observational data indicate that scat at high or low elevations remains identifiable for at least two weeks.

Through the use of survey forms distributed by index-trail hikers to backpackers, much data can be obtained concerning observations of bears and bear activity. As more and more bears are individually marked in the population, and index-trail hikes are continued, the increasing amount of data will lend itself to various indirect population estimation techniques, analyses of movement of bears in relation to altitude and location, and the influence of people on the bear population.

Thus far, index trails have provided enough scat to analyze the food habits of black bears as influenced by season, altitude and location in the park. Also, preliminary information from the incidence of scat of other mammalian populations (bobcat, fox and European wild boar) indicates that these animals could be evaluated in the same way and in conjunction with bear index trail hikes.

Index trails and scat collections also lend themselves to possible 'feces-tagging' techniques such as radioactive isotopes, dyes, or the use of inert rare earths through Activation Analysis. Thus, captured bears (or other large vertebrates) could be injected with an identifiable 'feces-tag'. Then, when scat is later picked up on index trails, it could reveal movement information as well as population estimates through a ratio of tagged to untagged feces.

Alone, the index trails have provided an invaluable tool for evaluating black bear populations in the GSMNP. In combination with other data (live bear observations) and other techniques (telemetry and/or 'feces tags'), much new knowledge will be revealed about the ecology and natural history of the black bear in the Great Smoky Mountains National Park.

REFERENCES

- GILBERT, D. L. 1951. Economics and related biology of the black bear in Colorado. M. S. Thesis. Colorado A. & M. Coll., Fort Collins. 164 pp.
- SPENCER, H. E., Jr. 1955. The black bear and its status in Maine. Maine Dept. Inland Fisheries and Game, Div. Bull. 4. 55 pp.