

Gypsy Moths May Alter Black Bear Population Dynamics In Shenandoah National Park

By Michael R. Vaughan and John Karish

Shenandoah NP (SNP) is home to what likely is one of the densest black bear (*Ursus americanus*) populations in the conterminous United States (Carney 1985). However, recent invasion of the park by gypsy moths (*Lymantria dispar*) threatens the continued stability of the bear population.

When the 777 km² park (Fig. 1) was established in 1935 in the Blue Ridge Mountains of northern Virginia, it was largely deforested due to homesteading (Mazzeo 1979), and black bears reportedly were observed infrequently. But with protection from hunting and favorable habitat changes, the population apparently increased quickly. By the mid-1970s, it had reached a reported density of one bear per 2.6 km² (Raybourne 1976, Dubrock 1980). With construction of Skyline Drive and improvement of park visitor facilities, human visitation also increased, and bear/human interactions became an issue (Garner and Vaughan 1989). Bear damage to property adjoining the park also increased.

In response, the park implemented a bear management plan in 1976 with goals of (1) restoring and maintaining the natural integrity, distribution, and behavior of the bear population, (2) minimizing nuisance bear conflicts, and (3) providing visitors the opportunity to view bears in a natural setting. The plan called for a number of practices aimed at reducing front country use by bears, plus research on the bear population that would provide information essential for dealing effectively with this valuable resource.

In 1982 the NPS established an interagency agreement with the Virginia Cooperative Fish and Wildlife Research Unit at Virginia Polytechnic Institute and State University to study the black bear population at SNP. This long-term project, still in progress, had as its initial objective to determine demographic characteristics of the park's bear population and to describe movement, distribution, and habitat use patterns. More recently, research has focused on effects of gypsy moth induced defoliation on the bear population. Thus far, four graduate students, several technicians, and numerous volunteers have participated in the research.

Demographics

The bear research started with an intensive capture and marking program. From April 1982 through November 1983, 115 different bears were captured 149 times in the 298 km² Central District study area (Fig. 1), and 47 were equipped with radio transmitters. The overall sex ratio of first-time captures was 2.03 males per female. However, for adult bears (estimated by tooth sectioning to be >3 years old) and for subadults (1-3 years old) the ratios were 1.3 and 3.8 males per female, respectively.

While it is generally accepted that males are more vulnerable to trapping than females and may be captured 1.5 to 2.5 times as frequently as females, the greatly disproportionate ratios for subadults and the similarity of capture frequencies for adult males and females was an indication of an unusual age distribution for SNP bears. The average age of captured females was 5.1 (N=36) while for males it was 3.2 (N=76). Bears less than 1 year old (N=3) were excluded from sex and age ratio analyses.

In the first three years of study about 50 percent of marked bears denned on the ground. Ground dens

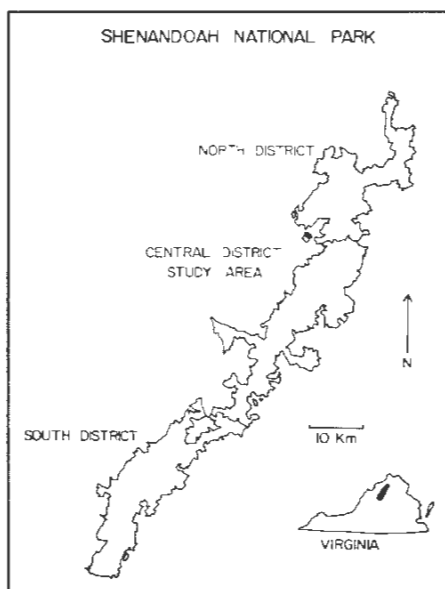


Figure 1.

and, where possible, tree dens were checked in late winter prior to emergence to determine reproductive effort. The average litter size of 21 reproductive females was 2.0. No females produced more than 3 cubs per litter during the initial study, although the first litter of 4 in SNP was recorded in 1990. All but 2 reproductive females were estimated to be at least 4 years old when they gave birth. The 2 exceptions were estimated to be 3 years old when they gave birth, meaning they had bred at 2 years of age. Generally, females gave birth every second year unless they lost their entire litters during the summer, in which case they gave birth in consecutive years.

Forty-four of the 47 radio equipped bears were adults and 28 of the 44 were alive at the end of the study. The remaining 16 were legally (7) or illegally (5) harvested, disappeared (3), or were removed (1) because of nuisance activity. The annual adult male mortality rate was 41 percent; the adult female mor-

talidity rate was only 7 percent.

The capture data were processed through programs CAPTURE and JOLLY to estimate bear density in the central district of SNP. The estimated density (an average of all estimators) ranged from 0.67 to 1.04 bears per square kilometer (1.7 to 2.7 bears/mi²). This extremely high bear density represents one of the highest density estimates reported in North America.

Contributory Factors

Why does SNP have such a high bear density? Probably several factors contribute. The area was a mosaic of homesteads prior to becoming a national park, and most of these old home sites had fruit trees (apple, cherry, pear) growing nearby. Our investigation of old home sites and bear movements (Garner 1986) indicated that these sites produced substantial amounts of fruit and were important to bears, particularly in late summer and early fall. In addition, natural food supplies were abundant. Although we made no quantitative measures of food availability, we noted good production of berries and forbs in summer months, and cherries, grapes and acorns in the fall.

The forest in SNP is over 70 percent oak and normally produces high quantities of acorns, which made up almost 50 percent of the bears' annual diet. (Fig. 2). Thus, the park appears capable of supporting a high number of bears. The discovery of a high degree of home range overlap among adult female bears (up to 90%) further strengthened the conclusion that food was abundant.

The sex and age ratios, average ages of male vs female bears, and differences in mortality rates of male vs female bears, all suggested that the male segment of the population was exploited while the female segment appeared not to be exploited. When we examined bear movements we found that females rarely left the park (15% of location out of the park) while males were twice as likely (32%) to be out of the park. When adult males were outside the park they suffered high mortality from poaching and legal harvest (we did not radio tag sub-adult males and do not know how frequently they left the park or their mortality rate).

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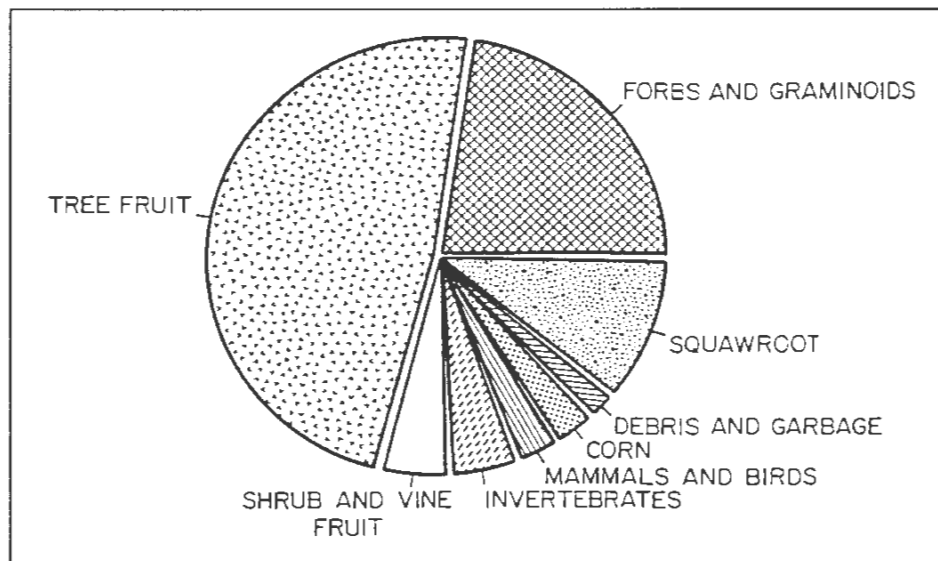


Figure 2.

This discovery helped explain why the average age of male bears on the park was so low and why adult males showed up in the trapped sample in lower proportion than expected. It also suggested why so many juvenile males were trapped in the park. Kemp (1976) earlier showed that by selectively removing adult males from a population of bears in Alberta, Canada, population size increased as several young males moved into the territory vacated by each larger adult male. Adult males are believed to be important in regulating bear populations by killing excess cubs and yearlings and by forcing young males to leave the population (forced egress).

Thus, we believe that the high density bear population in SNP is due to (1) an abundant food supply which enhances reproduction and survival and allows bears to tolerate extensive home range overlap; and (2) exploitation of the adult male segment of the population, which lessens their regulatory influence.

Enter the Gypsy Moth

As we concluded the demographic and habitat relations portions of our study in 1985, gypsy moths began to appear in the park. These insects can defoliate large areas of oak (and other) trees, resulting in loss of acorn production (McConnel 1988). Since bears in SNP depend heavily on acorns (Fig. 2), the NPS decided to continue bear research to determine how environmental perturbations caused by gypsy moths impacted the bear population. Likely short term impacts included changes in food habitats, changes in movement and distribution patterns, increased depredations by bears in areas adjacent to the park, and increased harvest of bears as they moved off the park in search of food. Predicted long-term impacts included reduced reproduction and survival because of poor nutrition,

and thus a reduced population level.

Defoliation in 1985 was light, but in 1986, 1987, 1988, 1989, and 1990, 551 ha, 2,633 ha, 6,500 ha, 17,400 ha, and 15,891 ha respectively, were defoliated within the park. Acorn production in defoliated stands from 1987-1990 was essentially nonexistent (McConnel 1988, Ksbohm and Vaughan 1990) and bears in those stands had to use alternative food sources or move during the fall hyperphagic (over-eating) stage.

Because defoliation opens up the forest canopy, some soft mast crops, grape in particular, were abundant in defoliated stands and bears fed heavily on them. Some long-range movements (>10 km) were recorded, but without complete data analysis it is not clear at this time if all movements were related to defoliation. Reproduction has remained good, but there are preliminary indications that cub survival may be down. Data from the initial four years of defoliation related research is being analyzed and data collection for the final year of field study soon will begin.

Nine years of research on the SNP bear population has provided valuable information to the NPS and to the Virginia Department of Game and Inland Fisheries (VDGIF). For the NPS, the research has provided demographic and bear/habitat relationship information, identified areas of SNP important to bears, and allowed SNP Resource Management personnel to develop a management strategy for park bears. The VDGIF has benefited from the research because SNP serves as a reservoir of bear reproduction, and those that spill out of the park are available for harvest. More than 50 percent of the bears harvested in Virginia (614 in 1990) were harvested from the eight counties in which SNP lies.

The current gypsy moth/bear interaction study will be useful not only to the NPS but to other agencies

trying to predict how loss of acorn crops will impact wildlife populations dependent on this valuable resource. SNP has provided a unique opportunity to study (1) the potential of a bear population under natural conditions, (2) the effects of a natural disaster (gypsy moth) on the bear population, and (3) the interactions that occur at the interface between a national park and the adjacent private land.

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