Physical and Behavioral Characteristics of Nuisance and Non-nuisance Black Bears in Southern West Virginia

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Abstract: Increased interactions among humans and black bears *(Ursus americanus)* are spurring increased concerns over property damage and human safety. These concerns become more apparent with habitat loss and fragmentation, particularly in relation to urban situations. To better understand the behavior and ecology of nuisance and non-nuisance black bears, the West Virginia Division of Natural Resources (WVDNR) captured 152 (127 males, 25 females) nuisance and 118 (61 males, 57 females) non-nuisance individuals from 1996 to 2002. Sample sizes for each analysis were lower due to missing or incomplete data. Initial age of capture was greater for nuisance ($N = 104$, $\bar{x} = 4.04$ yr, SD = 2.64) than non-nuisance ($N = 52$, $\bar{x} = 3.29$ yr, SD = 2.75) bears ($P = 0.003$). Mean litter size was similar for nuisance ($N = 15$, $\bar{x} = 3.0$ cubs, SD = 1.09) and non-nuisance ($N = 17$, $\bar{x} = 2.65$ cubs, SD = 0.88) female bears ($P = 0.309$). Nuisance males translocated $\geq$8 km (8–68 km) from point of capture were less likely to repeat nuisance behaviors ($N = 58$, 27.6%) than bears moved $<$5 km from their capture site ($N = 11$, 72.7%; $P = 0.005$). Nuisance males were 19% more likely to survive fall archery and rifle season ($N = 106$, 86.2%) compared to non-nuisance males ($N = 40$, 67.0%, $P = 0.014$). Removing nuisance bears from their point of capture appears to be relatively effective in reducing future nuisance problems. Innovative means of increasing hunting mortality of nuisance bears, while maintaining mortality rates of non-nuisance bears should be addressed in future studies.

Key words: black bear, nuisance, *Ursus americanus*, West Virginia.

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Interactions among black bears *(Ursus americanus)* and humans are manifesting themselves with increasing regularity. Land fragmentation and the associated loss of habitat is a clear and prominent contributing factor fueling such interactions (Saunders et al. 1991). Habitat loss and human disturbance through mountain top removal mining and valley fill, agricultural, residential, urban, and recreational devel-

opment promotes instances of negative exchanges between bears and humans (Hellgren and Maehr 1992, Balcerzak and Wood 2003). These incidents are resulting in damage to agricultural and personal properties, and pose a risk to human health and safety (Singer and Bratton 1980, Herrero and Fleck 1990, Calvert et al. 1992).

Generally, nuisance black bear activity can be attributed to seasonal variations in mast production where nutritional forage is limited, especially in early spring or in poor mast years (Eagle and Pelton 1983, McLean and Pelton 1989). However, bears are an opportunistic species that concentrate foraging efforts on high quality human-related foods throughout the year (Herrero 1983, McLean and Pelton 1989). Edible human refuse and agricultural crops are substantial items in the diets of some black bears (Mattson 1990).

As human developments continue to expand into forested regions regularly used by bears, the potential for conflicts increase (Martinka 1982, Herrero and Fleck 1990). National and state parks and forests harbor a significant number of black bears, of which some frequently come into direct contact with tourists (McLean and Pelton 1989). Residential conflicts result in damage to homes, storage facilities, and associated personal property (Calvert et al. 1992, Shull 1994, Virginia Department of Game and Inland Fisheries 2001). Many of these situations stem from food-conditioned animals feeding on human refuse or receiving handouts from local inhabitants (Calvert et al. 1992, Shull 1994). These interactions create habituated animals or "panhandler bears" that look to visitors for regular handouts (Tate 1985) and can result in human injury or death (Herrero and Higgins 1994). Often, garbage is the initial element that draws black bears to residential areas (Herrero 1983, Calvert et al. 1992). In southern West Virginia, nuisance bears are often drawn to open dumpsters on active mine sites as well as residential refuse.

Agricultural damage from black bears include losses to field crops, apiaries, fruit trees, orchards, and livestock (Davenport 1953, Alt et al. 1977, Landers et al. 1979, Brady and Maehr 1982, Wooding et al. 1988, Elowe and Dodge 1989, Mattson 1990, Calvert et al. 1992, Maddrey and Pelton 1995). Nationwide, bears were responsible for the loss of 2,800 head of cattle in 2000, with damages estimated to be US$1.8 million (USDA 2001) while sheep losses totaled $555,000 in 1999 (USDA 2000). In 2002, black bear depredation costs totaled $102,636 throughout West Virginia, including damage to personal property, livestock, and agricultural goods (West Virginia Division of Natural Resources 2002).

A better understanding of nuisance black bear ecology and behavior is necessary to manage and reduce potential conflicts. Black bear management strategies may become more effective in relation to human encroachment and disturbances if characteristics of nuisance and non-nuisance black bears are evaluated. Therefore, our study objectives were to evaluate differences in litter size, age, girth, weight, cub sex ratios, and mortality between behavior types (nuisance and non-nuisance) and, where applicable, gender. Furthermore, we evaluated the effect of onsite release versus translocation for nuisance male bears. We defined nuisance bears as individuals who demonstrated unwanted destructive behavior resulting in property damage.

Study Area

Our study was conducted in four southern West Virginia counties (Kanawha, Fayette, Raleigh, and Boone) located between Charleston and Beckley, West Virginia. Topography was steep, with elevation ranging from 180 to 915 m. Major cover types on the study area included mixed-mesophytic hardwood forest, cove hardwood forest, and oak (*Quercus* spp.) dominated forest (USGS 2002). According to the 2000 census, 352,407 residents lived in the four counties, which was 19.5% of the total West Virginia population (West Virginia Health Statistics Center 2003). Kanawha County had the largest human population of the 55 counties in the state.

Methods

West Virginia Division of Natural Resources (WVDNR) personnel captured nuisance black bears using baited culvert traps near residential or commercial buildings after a nuisance complaint had been filed, and captured non-nuisance black bears using modified Aldrich type foot snares (Johnson and Pelton 1980) in forested habitats. Personnel with the WVDNR immobilized captured individuals with Telazol (1:1 mixture of tiletamine hydrochloride and zolazepam hydrochloride; Elkins-Sinn, Inc., Cherry Hill, New Jersey) and recorded: sex, weight, girth, and characteristic markings (scars, physical abnormalities). We classified black bears by sex, age, and behavior type (nuisance or non-nuisance).

Each black bear received a numbered and color-coded ear tag (orange for nuisance, black for non-nuisance), an upper lip tattoo corresponding to the ear tag number, and 100 individuals received a VHF radio transmitter. Biologists with the WVDNR removed one premolar tooth from each individual to estimate age via cementum annuli counts (Willey 1974). Non-nuisance bears and nuisance females were released on-site. Nuisance males were released on-site ($<$5 km) or translocated $\geq$8 km to a wildlife management area. We measured translocation distance using the straight-line distance from point of capture to releases site.

Annual den visits of females equipped with radio transmitters were conducted from mid-February through March. Females were immobilized while in the den and once removed, weight, girth, physical condition, litter size, cub sex, and nape hair length among cubs (to approximate birth date) were recorded (Bridges et al. 2002).

We used two-way analysis of variance (ANOVA, PROC GLM, SAS 2000) to compare initial age of capture, weight, and girth between sex and behavior (nuisance or non-nuisance) groups. We compared litter size and proportion of male cubs in the litter among female behavior types and ages using two-way ANOVA. We used a *G*-test of independence to evaluate repeat nuisance behavior between translocated (moved $\geq$8 km) and non-translocated ($<$5 km) black bears. A X^2 test was used to examine differences in mortality rates from hunter harvest between nuisance and non-nuisance black bears from mandatory check stations (PROC FREQ; SAS 2000). A significance level of $\alpha = 0.05$ was used for all statistical tests.

Table 1. Number of nuisance and non-nuisance bear captures by sex in southern West Virginia, 1996–2002.

	Nuisance		Non-nuisance	
Year	Male	Female	Male	Female
1996	3	1	0	0
1997	1	4	0	0
1998	1	0	0	0
1999	20	2	8	8
2000	29	5	13	14
2001	47	6	8	7
2002	26	7	32	28
Total	127	25	61	57

Results

The WVDNR captured 270 bears from 1996–2002 (Table 1). However, sample sizes for each analysis were lower due to missing or incomplete data. Sample size was lower in hunter harvest among nuisance ($N = 123$ males, $N = 23$ females) and non-nuisance ($N = 59$ males, $N = 56$ females) bears due to vehicle related deaths or from bears being destroyed due to repeat nuisance behavior.

Initial age (years) of capture was greater for nuisance ($N = 104$, $\bar{x} = 4.04$, SD = 2.64) than non-nuisance ($N = 52$, $\bar{x} = 3.29$, SD = 2.75) bears ($F_{1,152} = 8.96$, $P = 0.003$). Initial age of capture also was greater for female ($N = 38$, $\bar{x} = 4.97$, SD = 3.36) than male ($N = 118$, $\bar{x} = 3.41$, SD = 2.33) bears ($F_{1,152} = 18.60$, $P < 0.001$). Males involved in nuisance activity upon initial capture and following release were older at initial capture ($N = 24$, $\bar{x} = 4.13$, SD = 2.77, Range 1–12) than males ($N = 45$, $\bar{x} = 3.38$, SD = 2.16, Range 1–8) not demonstrating repeat nuisance activity ($F_{1,65} = 4.36$, $P = 0.041$).

Weight was greater for male ($N = 85$, $\bar{x} = 89.34$ kg, SD = 39.56) than for female ($N = 52$, $\bar{x} = 62.20$ kg, SD = 16.76) bears ($F_{1,129} = 15.26$, $P = 0.003$). Girth was greater for male ($N = 85$, $\bar{x} = 94.06$ cm, SD = 16.73) than for female ($N = 52$, $\bar{x} = 83.84$ cm, SD = 10.05) bears ($F_{1,129} = 417.15$, $P < 0.001$).

Nuisance males translocated <5 km from their capture site ($N = 11$) were more likely (72.7%) to repeat nuisance behaviors than nuisance males translocated ≥8 km ($N = 58$, 27.6 %) from initial capture sites ($G_1 = 7.84$, $P = 0.005$). Nuisance males were translocated 8 km to 68 km ($N = 69$, $\bar{x} = 40.1$, SD = 11.6). Only one nuisance female was translocated >8 km, and therefore females were not analyzed. Repeat nuisance activity was often, but not always documented during the same year as initial capture (Table 2). Nuisance males ($N = 123$) were 19% more likely to survive fall archery and rifle season (86.2%) compared to non-nuisance males ($N = 59$, 67.0%, $X^2_2 = 8.49$, $P = 0.014$). Archery season accounted for 58.8% of the known mortality in nuisance males and 57.9% of the mortality in non-nuisance males. Hunting mortality was similar for nuisance ($N = 25$, 16.0%) and non-nuisance ($N = 56$, 23.2%) females ($X^2_2 = 2.26$, $P = 0.323$).

Table 2. Nuisance black bear capture rate and repeat nuisance activity among both sexes by year, southern West Virginia, 1996–2002.

Initial capture year	*N*		Year of repeat nuisance activity[a]													
			1996		1997		1998		1999		2000		2001		2002	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1996	3	1	0	0	0	1	0	0	1	0	0	0	2	0	0	0
1997	1	4			0	0	0	1	1	0	0	0	0	0	0	0
1998	1	0					0	0	0	0	0	0	0	0	0	0
1999	20	2							4	0	9	0	0	0	1	0
2000	29	5									2	0	5	0	2	0
2001	47	7											3	0	8	0
2002	26	7													3	0

a. Repeat nuisance activity was counted once per individual per year, but any one individual may be represented across multiple years.

Mean litter size was similar for nuisance ($N = 15$, $\bar{x} = 3.00$, SD = 1.09) and non-nuisance ($N = 17$, $\bar{x} = 2.65$, SD = 0.88) female bears ($F_{1,33} = 1.06$, $P = 0.309$). There was an interaction for proportion of male cubs in the litter among age and behavior types ($F_{1,19} = 14.01$, $P = 0.001$). The proportion of male bear cubs for non-nuisance females decreased with age ($F_{1,10} = 10.84$, $P = 0.008$) and increased with age of nuisance females ($F_{1,9} = 4.90$, $P = 0.054$). The proportion of male bear cubs for nuisance females ($N = 11$, $\bar{x} = 0.49$, SD = 0.27) and non-nuisance females ($N = 12$, $\bar{x} = 0.41$, SD = 0.32) was similar.

Discussion

Captured nuisance bears were older than bears not demonstrating nuisance activity. Among both behavior types, female mean age was greater than males. Nuisance male bears also were less likely to be harvested during the fall archery and rifle seasons. These two parameters are probably related. It appears at least for males that older age structures occur in urban populations compared to rural populations. The preponderance of males in most harvest samples can be a reflection of a larger home range making the individual more susceptible to hunting while higher harvest rates can signify reduced age structure if harvest regulations remain constant (Bunnel and Tait 1977). An older age structure would be supported by smaller home ranges observed in females (Alt et al. 1977, Garshelis and Pelton 1981, Pacas and Paquet 1992). Nuisance bears of both sexes may have smaller home ranges in response to meeting their nutritional requirements from refuse. Beckmann and Berger (2003) reported a significant decrease in black bear home range, both male (90%) and female (70%), at the urban-wildland interface than wildland areas. Therefore, non-nuisance males inhabiting wildland areas would likely have a lower mean age compared to nuisance males due to increased harvest rates. The findings of Beckmann and Berger (2003) lend support to our analysis and conclusions among male behavior types.

Removing nuisance bears from sites where they caused damage appears to be an

effective means of reducing short-term repeat nuisance behavior. Wildlife managers may find releasing younger individuals onsite or translocating them a short distance may be more advantageous compared to older individuals who are more likely to repeat nuisance behavior. Relocated bears may become less dependent on garbage or other food sources that initially attracted them (Tate 1985, Mattson 1990). Alternatively, repeat nuisance behavior may be due to where bears were relocated. Relocating a nuisance bear into another developed area likely will not reduce repeat nuisance behavior as a variety of factors affect bear response (Clark et al. 2002). For example, bears do not necessarily avoid areas with roads and are probably driven more by natural than artificial food supplies (Carr and Pelton 1984). Moving bears away from urban areas and into remote areas should decrease the likelihood of repeat nuisance behavior. However, a decrease in documented repeat nuisance activity could be explained by a roaming individual reestablishing a home range and not persisting in one localized area where it would create a noticeable problem. Massopust and Anderson (1984) reported that 43% of nuisance males relocated an average of 62.4 km repeated nuisance behavior. In our study, nuisance males were relocated a mean distance of 40.1 km, but only 27.6% repeated nuisance behavior. Repeat nuisance male behavior from on site release was significantly greater than for apiary-raiding males (19.5%) indicated by Wooding et al. (1988). However, our data and data from Wooding et al. (1988) should be interpreted with some caution, because relocated bears may not be as likely to be reported as bears that were not relocated.

The mean litter size of 3.0 in nuisance bears was similar to bears in northeastern Pennsylvania, where the largest average litter size in the United States was thought to exist (Alt 1989). Alt (1989) believed their large litter size was due to favorable growing conditions in the region. The large litter size of our bears may be due to equally high availability of food resources in southern West Virginia.

Alt (1989) concluded that cub sex ratios do not differ significantly from 50:50 in Pennsylvania. Our results were comparable with some potential variation due to age. Our findings suggest that older nuisance females tend to have a higher proportion of males cubs, whereas younger nuisance females tend to have litters with a higher proportion of females. The opposite trend is shown for non-nuisance females who tend to have a higher proportion of males when younger and a lower proportion of males as they get older. Nonetheless, overall cub sex ratios do not vary significantly from 50:50.

In light of increasing black bear-human interactions, increased knowledge of black bear ecology and behavior is necessary to manage potential conflicts. These data contribute to our understanding of both nuisance and non-nuisance bear ecology in the Central Appalachians. It is clear that traditional hunting methods are not as effective in harvesting nuisance males compared to non-nuisance males. Wildlife managers may consider a special urban archery hunt when dealing with nuisance black bears that frequent developed areas. However, the modification of human behavior may have the greatest impact. Black bear nuisance behavior in urban areas will likely persist unless access to human refuse is effectively eliminated. Further research addressing home-range size and response to aversive conditioning techniques is required to fully understand how to manage nuisance black bears.

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