Food Habits of Black Bears in Suburban versus Rural Alabama

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Abstract: Little is known about the food habits of black bears (*Ursus americanus*) in Alabama. A major concern is the amount of human influence in the diet of these bears as human and bear populations continue to expand in a finite landscape and bear-human interactions are increasing. To better understand dietary habits of bears, 135 scats were collected during late August to late November 2011–2014. Food items were classified into the categories of fruit, nuts/seeds, insects, anthropogenic, animal hairs, fawn bones, and other. Plant items were classified down to the lowest possible taxon via visual and DNA analysis as this category composed the majority of scat volumes. Frequency of occurrence was calculated for each food item. The most commonly occurring foods included: *Nyssa* spp. (black gum, 25.2%), Poaceae family (grass, 24.5%), *Quercus* spp. (acorn, 22.4%), and *Vitis* spp. (muscadine grape, 8.4%). Despite the proximity of these bear populations to suburban locations, during our sampling period we found that their diet primarily comprised vegetation, not anthropogenic food; while 100% of scat samples contained vegetation, only 19.6% of scat samples contained corn and no other anthropogenic food sources were detected. Based on a Fisher's exact test, dietary composition did not differ between bears living in suburban areas compared to bears occupying more rural areas ($P = 0.3891$). Thus, bears in Alabama do not appear to be relying on humans for food, although further research and monitoring is warranted.

Key words: Alabama, black bears, diet, food habits

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Understanding the dietary habits of mammalian species is an integral part of proper management of such species in the wild. Such knowledge is especially important when the species utilizes anthropogenic food sources as consumption of foods associated with humans by wildlife can increase human-wildlife conflict. For example, consumption of human food by black bears (*Ursus americanus*) is one of the most common and difficult problems for wildlife managers dealing with the species; as omnivores, bears will readily use human-associated foods as an easily attainable energy source, especially when natural food sources are scarce (Baruch-Mordo et al. 2014, Lewis et al. 2015). Plus, the black bear's large size makes human-wildlife encounters potentially dangerous.

Within the state of Alabama, the number of black bears is relatively low, estimated at less than 300 individuals split between two populations: one in the northeast portion of the state in and around Little River Canyon Preserve, and a population in the southwest, occupying Mobile and Washington counties (T. Steury, unpublished data). While the northeast population appears to be made of newly repatriated bears from north Georgia (T. Steury unpublished data), the southwestern population appears to have always been present historically (Edwards 2002). This southwestern population faces increased pressure from human activity, as the human population around the city of Mobile expands into what traditionally has been good bear habitat. The result of this human expansion is increased rates of encounters between humans and bears, particularly if bears are being forced to search farther and wider outside their home ranges for food. Yet, studies on the diet ecology of black bears in the state are sparse. While other aspects of black bear ecology, such as reproduction and social interactions, have been well-studied (Pelton 1982), their dietary habits in Alabama have yet to be thoroughly examined. Dietary selection is an important aspect of their ecology that should be understood in order for their management to be a success within the state.

Ecologists and wildlife managers generally understand that black bears are opportunistic feeders; their diets typically consist of various herbaceous material, fruits, the occasional small mammal, and even the remains of human food such as hamburger wrappers and other "trash" (Baldwin and Bender 2009). Studies in other states have suggested varying volumes of what type of food source makes up the majority of black bears' diets, but most agree that it is primarily a plant-based diet (MacHutchon 1989, Koike 2010, Hatch et al. 2011). However, variation among black bear diets can occur according to geographic region and abundance of food (Rode and Robbins 2000, Baruch-Mordo et al. 2014, Lewis et al. 2015).

The purpose of this study was to examine, down to the lowest possible taxon, the foods black bears in Alabama feed on during late August to late October. Our goal was to better understand their dietary makeup, but more importantly to evaluate if bears feed on a significant amount of anthropogenic food (either trash or food intentionally left out, such as corn from bait piles). An increase in anthropogenic food sources in their scats would be indicative of increasing human-bear interactions in the state which would potentially need to be addressed to ensure both human and black bear safety and well-being.

Study Area

We collected samples from two study areas: northeastern and southwestern Alabama. The northeastern study area included areas in and around Little River Canyon National Preserve, near Fort Payne, a rural part of Alabama with low human population density and only a few small towns. The southwestern study area included parts of Mobile and Washington counties and was divided into two different sections. The northern section was located in Washington County near the towns of Chatom and Wagarville, while the southern section was located in Mobile County in and around Saraland. The northern section was classified as "rural," as the region is characterized by very low human density and a lack of large cities (Chatom and Wagarville have populations <3500 each). Alternatively, the southern section was classified as "suburban" as human densities are much higher—Saraland is a suburb of Mobile and part of the Mobile metropolitan area. Radio-collared bears in the southern section occupy forests adjacent to residential areas and often visit the yards of homes in the area (T. Steury unpublished data).

Methods

Field Methods

In the northeastern study area, scats were collected opportunistically while conducting other field work on bears (setting up and maintaining hair snares, trapping bears, driving roads, etc.; T. Steury unpublished data). In the southwestern study area, scats were also collected opportunistically but were primarily found via the use of scat-detection dogs from the EcoDogs program at Auburn University, which is a part of Canine Performance Sciences Program in the College of Veterinary Medicine. The EcoDogs program trains dogs using standard scent-detection techniques (but are not certified) and pairs them with a professional handler to search for ecological samples. Dogs would walk 1.5 km triangular transects randomly chosen throughout the southwestern study area with their handlers and a biologist (who also served as orienteer; MacKay et al. 2008).

Once scats were found, a DNA sample (~0.4 ml) was taken from the driest part of the scat and stored in 1.5ml of >95% ethanol or DETS buffer (Murphy et al. 2002). Confirmation of the species' origin of scats in the field was based on the scat size and shape. Further confirmation was later sought using DNA amplification of the cytochrome b region of the mitochondria (T. Steury, unpublished data, modified from Bidlack et al. 2011). The rest of the scat was placed in a zip-lock bag and frozen at the earliest possible opportunity for later analysis of composition. Due to the nature by which scats were collected, nothing was done to minimize the effect of multiple scats coming from an individual or a family group of bears, except to only collect one scat if two or more were found within 5m of each other.

Laboratory Methods

All scat samples were placed in individual, 2-L plastic containers and soaked in warm water with laundry detergent overnight. The following day, the contents of the container were thoroughly homogenized and then filtered through two sieves with mesh sizes measuring 2.0 mm and 1.0 mm (MacHutchon 1989, Paralikidis et al. 2010). Each scat had three 10-mL samples taken from the 2.0-mm-sized sieve and one 10-mL sample taken from the 1.0-mm sieve. Only one sample was taken from the 1.0-mm sieve due to the extremely small size of the food items present, most of which could not be identified by visual examination. The sample taken from the 1.0-mm sieve was viewed through a dissecting microscope primarily to identify insect presence or absence in the scats. The four samples taken from each scat were placed into four separate Petri dishes measuring 100 × 15 mm and spread evenly over the entire surface in order to estimate the % volume for each food item (MacHutchon 1989, Koike 2010, Domenico et al. 2012).

We identified several of the food items visually, but for those we could not identify or were uncertain of, further confirmation was sought using DNA analysis. Because vegetation and seeds composed the vast majority of the food items found in the scats, we focused our efforts on identifying food items down to the lowest taxon via chloroplast barcode DNA analysis. DNA from the food items was extracted using a Qiagen DNeasy kit (Qiagen, Hilden, Germany), and amplified using polymerase chain reaction (PCR). We used matK primers for the amplification of our DNA samples. Our forward primer was matK-xf: TAATTTACGATCAATTCATTC; while our our reverse primer was matK-MALP: ACAAGAAAGTCGAAGTAT (Knapp 2009; Murphy et al. 2000, 2002). We followed a standard PCR recipe and thermocycling program for the matK marker (Knapp 2009; Murphy et al. 2000, 2002). Amplified samples were sent to the High Throughput Genomics Center at the University of Washington in Seattle for sequencing. Once the samples had been sequenced, we used the program Sequencher (Gene Codes Corporation, Ann Arbor, Michigan) to view the chromatographs of each food item. Sequences obtained from chromatographs were then identified down to the lowest taxon using the online BLAST database (National Center for Biotechnology Information, Bethesda, Maryland).

Statistical Methods

All food items were categorized as fruit, nuts/seeds, insects, human grown (primarily corn), animal hairs, bones, or other. Because exact calculation of volume of each item would have been extremely tedious (if not impossible), the volume of each item found in a given 10 ml scat sample was classified into one of five categories: <1%, 1%–25%, 25%–50%, 50%–75%, and 75%–100%, based on visual estimation of volume (Koike 2010). If a food item was found in one of the four samples of a scat but not in another, the volume in the scat lacking the item was said to be <1%.

The frequency of occurrence of each food item was determined by the formula $F = (\frac{n}{N}) * 100$, where: F = frequency of occurrence, n = the number of scats the food item was found in, and N = the total number of scats examined (Paralikidis et al. 2010). Fisher's exact tests were used to compare the amount of anthropogenic food detected between scats from the north and south study areas and between scats from suburban and rural areas.

Results

A total of 135 scats were collected from 2011 to 2014. Sixty-five scats were collected in 2011, 19 scats in 2012, 21 in 2013, and 30 in 2014 (additional scats were collected 2011–2014, but were lost when a freezer failed). The majority of the food items sampled and detected in the scats were plant items (Table 1). When sorting through each sample, we observed that scats would often have ~100% volume of a single food item. Particularly high frequency species and families identified included *Nyssa* spp. (black gum; 25.2% of scats), Poaceae family (grasses; 24.5%), and *Quercus* spp. (acorns; 22.4%). Other plants identified included: *Vitis* spp. (muscadine grape; 8.4%), *Diospyros virginiana* (persimmon; 5.6%), *Callicarpa americana* (beautyberry ; 3.5%), and *Rubus* spp. (black/raspberry; 3.5%). Insects (ants, bees, beetles, and larvae) occurred in approximately 46.2% of scat samples; however, volumes were typically very low (<1%). The only anthropogenic food found in the scats was *Zea mays* (corn) at 19.6% frequency of occurrence. Animal hairs occurred in about 12.6% of scats, while bones occurred in 2.8% of scats. Bone size, density, and shape, were consistent with young members of the Cervid family (R. Wilhite, College of Veterinary Medicine, Auburn University, personal communication), of which only white-tailed deer exist in Alabama. Finally, approximately 7.7% scats contained items that we were unable to identify and which we categorized as "other."

Table 1. Major categories of food items found in the bear scats sampled. Items listed within each category represent the major food components that were identified either visually or by DNA analysis for that category.

Food items	Frequency of occurrence (%)
Fruit	86.01
Nyssa spp. (black gum)	25.2
Vitis spp. (muscadine grape)	8.4
Diospyros virginiana (persimmon)	5.6
Callicarpa americana (beautyberry)	3.5
Rubus spp. (black/raspberry)	3.5
Nuts/Seeds	79.7
Quercus spp. (acorn)	22.4
Insects	46.2
Poaceae family (grass)	24.5
Human grown (*Zea mays*—corn)	19.6
Animal hairs	12.6
Other	7.7
Fawn bones	2.8

In the northeastern study area, 7% of scats had corn (2 of 28), while in the southwestern study area, 23% of scats had corn (24 of 104; a few samples did not have location of origin recorded). A Fisher's exact test indicated that the two areas were not significantly different in terms of the frequency of corn use (P = 0.066); however, the results bordered on significant and may have been significant with greater sample sizes. Within the southwestern study area, 15% scats collected in rural areas had corn (3 of 20), while 26% of scats collected in suburban areas had corn (21 of 81; again, a few samples did not have a location recorded). A Fisher's exact test indicated that the areas were not significantly different in terms of the frequency of corn use (P = 0.3891).

Discussion

Despite the proximity of black bear populations to developed areas within the state, our results do not support the concern that black bears are consuming a significant amount of human food. Although corn had a relatively high frequency of occurrence (19.6%), other individual food items, such as black gum (25.2%), were much greater. We hypothesize that corn may have been consumed from bait piles or feeders set out by hunters to attract game species. If this is the case, then although these bears are consuming food associated with humans, they are not traveling into the cities or neighborhoods to do so, although further research is necessary to confirm this hypothesis.

Our findings of corn intake contrast with those of another study done in the Okefenokee-Osceola ecosystem of Southeast Georgia (Dobey et al. 2005). Based on scat analysis, Dobey et al. (2005) found that black bears relied heavily on saw palmetto (*Serenoa repens*) fruit when it was available, but would rely on corn from white-tailed deer feeders when palmetto was not available. Our findings suggest that black bears in Alabama do not rely on corn from feeders as much as black bears in Georgia, despite these feeders being present. However, we only examined the diet of bears during a specific time of year (fall). Our results might have been different if we examined diet during periods when natural foods are more scarce, although the fall is a period when bears are hyperphagic and natural food is not necessarily abundant. Alternatively, bears in Alabama may simply have a more stable food source in the wild and/or a greater variety of food sources to rely on versus bears that ranage further north and may have a more restrictive diet due to colder temperatures that limit food item growth.

We found a high frequency of insects or insect parts in the scats. However, it was unclear if these insects were intentionally consumed by the bears or were accidentally consumed along with other food items. A third possibility is that these insects were picked up with the scats when they were collected and were not consumed at all. Therefore, it is possible that insects are not as frequently consumed by black bears as our data would suggest, due to the alternative scenarios by which insects may have been integrated into the identification process.

Our data provide additional support for the opportunistic feeding habits of black bears. Often times, we observed that scats would have 100% volume of a single food item, supporting the idea that they consume as much of an available food item at once in order to satisfy their dietary intake (Nelson et al. 1983). Such behavior is especially pertinent during the fall when black bears enter a hyperphagic period of foraging in order to gain fat for the winter. However, when weather conditions (i.e., drought) result in a masting failure of many plant species, bears may turn to anthropogenic food sources in order to satisfy their daily caloric needs (Lewis et al. 2015). This change in bear behavior based on season and food availability is something to consider for future research or management of the species in Alabama.

An important caveat to note in this study is the inherent bias associated with calculating the frequency of occurrence of food items. Although one of the goals of this study was to determine if black bear populations were consuming human food, digestibility becomes an issue when identifying food items. Due to the highly processed nature of most human foods, they are more easily digested than organic plant matter and are therefore more difficult to detect in scat. Thus, when calculating the frequency of occurrence of food items, foods that are more difficult to digest will be more easily detected in the scats, resulting in an over-representation of their importance in the diet. However, other obvious signs of consumption of human-associated foods (e.g., trash, paper, plastic, wrappers, etc.) were completely absent from the 135 scats we sampled. This lack of evidence of human food in our samples supports the conclusion that bears in Alabama continue to avoid humans, despite the proximity of human and bear population ranges within the state.

We suggest that additional research be done to more thoroughly understand the diet composition of black bears in Alabama. Isotopic analysis, broader DNA analysis, or other non-visual methods to identify food items may provide greater detail of the dietary habits of black bears in Alabama. Such information will allow the state to make more informed management decisions and understand the habitats that an apparently expanding black bear population might occupy. Understanding what black bears in Alabama are consuming provides valuable insight to black bear ecology, thus making it easier to manage for stable populations.

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