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FEEDING ECOLOGY OF BLACK BEARS IN NORTHWEST FLORIDA

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Abstract.—Food habits of black bears (*Ursus americanus floridanus*) was determined from the analysis of 259 scats collected on Eglin Air Force Base (Eglin AFB), Florida from 1994 to 1996. Spring diets were dominated by debris, insects, and the hearts of saw palmetto (*Serenoa repens*). Black bears consumed primarily blueberries (*Vaccinium* spp.) (44% by volume) in early summer and sweet gallberry (*Ilex coriacea*) (29%) and acorns (*Quercus* spp.) (25%) in late summer. In 1994, saw palmetto fruit was the primary fall food, but due to a palmetto mast failure in 1995, acorns were the primary fall food. The dominance of acorns and saw palmetto in the diet of black bears illustrates the importance of maintaining a variety of desirable bear foods.

The Florida black bear population has been reduced to eight relatively disjunct populations, largely due to land conversion for agriculture and urban development (Cox et al. 1994). Consequently, the black bear is listed as threatened by the State of Florida. Because the relative abundance and distribution of food can have a significant impact on bears in terms of natality, mortality, and movements (Pelton 1982, Rogers 1987), a detailed understanding of the feeding ecology of individual populations is necessary for proper management and future survival of these isolated populations.

In Florida, black bears use a wide variety of forest types, from temperate to subtropical plant communities (Maehr and Wooding 1992). Such distributional variation in Florida has resulted in regional differences in food habits. Food habits of Florida black bears have been studied in several areas of the state (Maehr and Brady 1982, 1984; Maehr and DeFazio 1985; Seibert 1993; Land 1994; Roof 1997; Maehr 1997), however, no information has been collected from the population at Eglin AFB in northwest Florida. Our objective was to determine the seasonal and annual diet of black bears at Eglin AFB.

STUDY AREA AND METHODS

Eglin AFB (1,875 km^2), is bounded by private land to the north and east and the Gulf of Mexico to the south and west. It is characterized by rolling sandhills with numerous seepage streams. Seventy-two percent of Eglin AFB is comprised of upland pine forests. Dominant tree species include longleaf pine (*Pinus palustris*), slash pine (*P. elliottii*), sand pine (*P. clausa*), turkey oak (*Quercus laevis*), laurel oak (*Q. hemisphaerica*), sand live oak (*Q. geminata*), and titi (*Cyrilla racemiflora*). Dominant understory species include saw palmetto, blueberry, gallberry (*Ilex* spp.), fetterbush (*Lyonia lucida*), and bri-

ars (*Smilax* spp.). Twelve percent of the land area has been cleared for military airfields, test ranges, right-of-ways, and administrative areas. The remaining areas are comprised of wetland and riparian habitats. Dominant overstory species in those habitats include titi (*Cyrilla racemiflora*) slash pine, redbay (*Persea borbonia*), magnolias (*Magnolia* spp.), and bald cypress (*Taxodium distichum*). Dominant understory species include wild grape (*Vitis rotundifolia*), gallberry, fetterbush, and briars.

Between November 1994 and October 1996, we collected scats at capture sites, daybeds, den sites, foraging areas, and while scouting for new trap sites. Radio telemetry was used to aid in locating scats from individual bears in foraging areas, bedding areas, and den sites. Scats were washed through a series of sieves with openings of 7, 2, and 0.15 mm to separate food particles of equal size. We identified individual food items to the lowest possible taxon using field guides and reference collections.

We determined frequency of occurrence and percent volume both seasonally and annually for each food item (Korschgen 1980). Percent volume was visually estimated for individual food items in each scat. Food items were grouped into five categories: tree fruit, shrub/vine fruit, animal matter, vegetation, and debris. Because invertebrate, mammal, and avian species are sources of high concentrations of protein, they were grouped into one category to show the collective seasonal and annual sources of protein in the diet of bears. We determined seasons by major shifts in bear food habits: winter - 1 February to 31 March; spring - 1 April to 31 May; early summer - 1 June to 31 July; late summer - 1 August to 30 September; and fall - 1 October to 31 January.

RESULTS

We identified 30 separate food items in 259 scats. Eighty percent (by volume) of the diet of bears was of plant origin. Spring diet was dominated by debris (unidentified material, soil, and wood particles) (Table 1); these were probably ingested while foraging for beetles (Coleoptera) and yellow jackets (Hymenoptera). Beetles and yellow jackets were the primary type of animal matter found in spring scats. The hearts of saw palmetto occurred in one-third of the spring scats and accounted for 23% of the volume. Vertebrate species identified in spring scats included armadillo (*Dasypus novemcinctus*), opossum (*Didelphis virginiana*), and white-tailed deer (*Odocoileus virginianus*).

The volume of early summer diet was dominated (60%) by shrub/vine fruit volumetrically. Blueberries and Florida anise (*Illicium floridanum*) accounted for 55% by volume. Saw palmetto hearts occurred in 18% of scats examined. Beetles occurred in 68% of the early summer scats.

Late summer diet was predominantly sweet gallberry and acorns. Sweet gallberry occurred in 46% of the scats and accounted for approximately one-third of the diet by volume. Black bears switched to acorns in mid-September. Acorns represented 25% of late summer diet by volume. Animal matter was dominated by beetles.

Acorns and saw palmetto fruit accounting for 93% by volume during fall. Animal matter was dominated by beetles and occurred in 24% of fall scats. Other forms of animal matter found in fall scats included cottontail rabbit (*Sylvilagus floridanus*), wild turkey (*Meleagris gallopavo*), and unidentified mammalian and avian species.

Table 1. Percent of items by occurrence and volume identified in black bear scats collected on Eglin Air Force Base, Florida, 1994-1996.

Food Item	Spring (n = 27) O[1]/V[2]	Early Summer (n = 62) O/V	Late Summer (n = 26) O/V	Fall (n = 108) O/V	Winter (n = 36) O/V	Total (n = 259) O/V
TREE FRUIT	30/13	1/T[3]	50/37	73/70	1/T	37/33
Black Titi (*Cliftonia monophylla*)			4/T		3/T	1/T
Persimmon (*Diospyros virginiana*)			8/T			1/T
Blackgum (*Nyssa* spp.)			38/12	9/3		8/2
Acorn (*Quercus* spp.)	30/13	1/T	38/25	72/67	3/T	38/31
SHRUB AND VINE FRUIT	0/0	69/60	73/54	35/27	64/39	32/37
Huckleberry (*Galussacia* spp.)			8/4			1/T
Sweet gallberry (*Ilex coriacea*)		1 /T	46/29			5/3
Bitter gallberry (*Ilex glabra*)				2/T	3/T	1/T
Holly (*Ilex* spp.)		5/2			3/T	2/1
Florida anise (*Illicium floridanum*)		15/11				3/3
Oderless wax myrtle (*Myrica inodora*)		3/3	19/12			3/2
Blackberry (*Rubus* spp.)		3/T				1/T
Saw palmetto (*Serenoa repens*)				30/26	19/15	15/13
Greenbriar (*Smilax* spp.)		6/T	4/T	6/1	50/23	11/4
Blueberry (*Vaccinium* spp.)		64/44	15/1			17/11
Wild grape (*Vitis rotundifolia*)		5/T	19/8			3/1
ANIMAL MATTER	74/29	69/7	77/1	40/1	56 / 19	56 / 8
Spiders (*Araneae*)		1/T				T/T

[1]O = Percent occurrence
[2]V = Percent volume
[3]T = Trace amount (<1.0%)

Table 1. (Continued) Percent of items by occurrence and volume identified in black bear scats collected on Eglin Air Force Base, Florida, 1994-1996.

Food Item	Spring (n = 27) O[1]/V[2]	Early Summer (n = 62) O/V	Late Summer (n = 26) O/V	Fall (n = 108) O/V	Winter (n = 36) O/V	Total (n = 259) O/V
Beetles (*Coleoptera*)	48/7	68/6	65/1	24/1	58/18	46/5
Fly larvae (*Diptera*)			4/T[3]			T/T
Ants (*Formicidae*)		1/T				T/T
Bees, wasps, nests (*Hymenoptera*)	37/16	1/1		6/T		7/2
Grasshoppers (*Orthoptera*)		1/T			3/T	1/T
Walking sticks (*Phasmatodea*)		3/T				1/T
Armadillo (*Dasypus novemcinctus*)	4/4					T/T
Opossum (*Didelphis virginiana*)	4/T		4/T			1/T
Deer (*Odocoileus virginianus*)	4/T	3/T			3/1	2 /T
Rabbit (*Sylvilagus floridanus*)				1/T		T/T
Black bear hair (*Ursus americanus*)	4/T	11/T	11/T	6/T	11/T	8/T
Mammal - Unknown	4/2			1/T		1/T
Wild turkey (*Meleagris gallopavo*)				1/T		T/T
Avian - Unknown		3/T		1/T		1/T
VEGETATION	63/26	21/14	8/T	3/T	47/27	20/10
Saw palmetto (*Serenoa repens*)	33/23	18/11			19/9	11/6
Grass (*Graminae*)	19/3	3/T	4/T		3/T	3/T
Vegetation - Unknown		11/2	4/T	3/T	25/18	8/3
DEBRIS	67/32	50/19	23/8	11/2	39/15	31/12

[1]O = Percent occurrence
[2]V = Percent volume
[3]T = Trace amount (<1.0%)

Winter scats consisted primarily of saw palmetto and greenbriar fruit, which occurred in 69% of these scats. Although ingestion of debris is considered accidental, it represented 15% by volume of the winter diet. Vegetation, primarily the hearts of saw palmetto and gallberry leaves, accounted for 27% by volume.

The annual diet by volume was dominated by shrub/vine fruit (38%) and tree fruit (34%). Debris, vegetation, and animal matter accounted for 12%, 9%, and 7% by volume, respectively.

DISCUSSION

Seasonal shifts in feeding ecology of black bears on Eglin AFB were similar to other studies (Maehr and Brady 1984, Land 1994, Brandenburg 1996, Roof 1997). Bears shifted from mostly herbaceous matter in spring, to soft mast in summer, then to hard mast in fall. A spring diet dominated by herbaceous vegetation is common in many parts of the Southeast (Beeman and Pelton 1980, Maehr and Brady 1984, Roof 1997). The consumption of saw palmetto hearts by bears in spring was also found in other regions of Florida (Maehr and Brady 1982, 1984; Maehr and Layne 1996; Roof 1997).

Saw palmetto is rich in carbohydrates (Hough 1968). Bear use of saw palmetto hearts appears to correspond with the seasonal changes in starch and sugar content in the plants. With the onset of the growing season in early spring, starches are converted to sugars, which are used for frond growth and fruit production (Hough 1968). While starch content decreases through the summer, sugar production increases. This reduction in starch content during spring and summer corresponded with the time when bears consumed the largest amounts of saw palmetto hearts.

Also, in plants with high moisture content, sugar content is nearly twice that of starch (Hough 1968). Signs of bears feeding on saw palmetto were frequently found in areas near den sites, along rivers, streams and wetlands during the spring and early summer. Because spring is generally a time of food shortage for bears, the increase in sugars in saw palmetto and high consumption of invertebrates likely provided the nutrients necessary to sustain general metabolic requirements until fruit production began in early summer.

On Eglin AFB, summer is a period of high soft mast production. Fruits of blueberry, sweet gallberry, blackgum (*Nyssa biflora*), and wild grape were the most important plant foods available during this period. These and other soft mast species provide the protein needed for growth and rebuilding of muscle mass, especially for sub-adults and females with cubs. This need for protein is reflected in the high consumption of blueberries by bears (Inman and Pelton *in press*). Blueberries

rank among the highest in caloric production for soft mast shrub/vine species (Inman and Pelton *in press*). Because some soft mast species maintain an abundant fruit supply throughout most of the summer, bears are able to take advantage of a variety food items to meet their nutritional requirements.

Although the relative abundance and distribution of oak mast can have a significant impact on bears in terms of natality, mortality, and movements (Pelton 1989), this may not be the case for black bears in some areas in Florida (Maehr and Brady 1982, Maehr and Wooding 1992). Maehr and Brady (1982) reported that saw palmetto fruit was the dominant fall food and found only traces of acorns in black bear stomachs collected in Baker and Columbia Counties, Florida.

The importance of the fruit and hearts of saw palmetto was recognized in other areas of Florida (Maehr and Brady 1982, 1984; Maehr and DeFazio 1985; Roof 1997; Maehr 1997). Saw palmetto, like some oak species, is subject to periodic local mast failures (Maehr and Brady 1982, Seibert 1993). In 1994, many areas were examined for bear sign, including numerous oak stands and palmetto thickets. Although many oak stands had abundant acorns, the fall diet in 1994 was dominated (94%) by saw palmetto fruit. In 1995, saw palmetto apparently suffered a mast failure; no fruit was found on saw palmetto plants. Subsequently, acorns dominated the 1995 fall diet of bears. In 1996, the production of saw palmetto fruit was fair compared to 1994. However, the sample size in 1996 (n = 6 scats) was too small to make reliable comparisons with previous years. The 1994 fall diet indicated that bears on Eglin AFB may be selecting saw palmetto over acorns as their primary source of fall food; similar results were found in other areas of the state (Maehr and Brady 1982).

The dominance of acorns in the 1995 fall diet demonstrates their importance as an alternative source of fall food for bears on Eglin AFB. Acorns and saw palmetto fruit likely serve as replacements for each other during years of mast failures or low food availability. Similar results were found from a population in the lower Wekiva River Basin in central Florida (Roof 1997). In contrast, bears in Apalachicola National Forest used blackgum fruit as an alternative source of food during a year of saw palmetto mast failure (Seibert 1993). Also, the 1-5 year burning regime on Eglin AFB (McWhite et al. 1993) may inhibit fruit production of saw palmetto. Because saw palmetto is subject to mast failures and frequent fires, hardwood stands on Eglin AFB should be managed to promote production of oak mast while providing a diversity of successional stages.

Human uses of the landscape will inevitably cause bear populations to become more fragmented and isolated. Differences in habitat composition and the isolation of black bear populations in Florida rein-

forces the need to understand the ecology of individual populations. If these remnant bear populations are to be preserved, then it is necessary to determine their life requisites and develop and implement management strategies. Because food is the key element to the survival of all wildlife species, a detailed understanding of the local feeding ecology of a species is necessary. Long-term effects of large-scale land use practices in areas occupied by black bears should be thoroughly evaluated to determine their impacts on the distribution and availability of important foods and ultimately on the survival of the species.

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