

Fall Foods of Black Bears in Arkansas

Joseph D. Clark, Arkansas Game and Fish Commission,
2 Natural Resources Drive, Little Rock, AR 72205 and
Zoology Department, University of Arkansas,
Fayetteville, AR 72701

William R. Guthrie, Arkansas Game and Fish Commission,
P.O. Box 1087, Russellville, AR 72801

Wilbur B. Owen, Biology Department, University of
Central Arkansas, Conway, AR 72032

Abstract: Stomach contents of 59 black bears (*Ursus americanus*) killed by hunters in Arkansas from 1981 to 1986 were examined. Acorns (*Quercus* spp.) comprised 34.1% of the total volume examined and occurred in 66.1% of the stomachs. Fruits of pokeweed (*Phytolacca americana*), hickory (*Carya* spp.), persimmon (*Diospyros virginiana*), black gum (*Nyssa sylvatica*), Carolina buckthorn (*Rhamnus caroliniana*), devil's walkingstick (*Aralia spinosa*), and wild grapes (*Vitis* spp.) were commonly consumed by bears. Acorn and hickory nut consumption positively correlated with mast survey data collected in Arkansas from 1982 through 1986. The high volume and frequency of occurrence of pokeweed fruits suggest that clearcuts are used by bears in the Ozark and Ouachita mountains of Arkansas.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 41:432-437

Although extensive food habits and habitat use studies have been performed on black bears in the eastern United States, particularly the Southern Appalachian Mountain region (Beeman and Pelton 1977, Eagle and Pelton 1983, Carlock et al. 1983), little is known about the feeding ecology of bears in the Ozark and Ouachita mountains. Furthermore, black bear feeding ecology during fall has been shown to influence reproduction, movements, bear-human interactions, and harvest dynamics (Beeman and Pelton 1977, Rogers 1976, Willey 1978). To gain a greater understanding of those relationships, a study of foods found in stomachs of fall-killed bears in the Ozark and Ouachita mountain regions was initiated in 1981.

Appreciation is extended to the Arkansas Game and Fish Commission and U.S. Forest Service personnel for collecting bear stomachs. Gratitude is also extended to R. Fowler, T. Nelson and C. Van Horn for assisting in the stomach analy-

ses; to P. Gipson, K. Smith, and the 3 anonymous reviewers for commenting on the manuscript; and to K. McClellan for typing the manuscript. This study was funded under provisions of the Federal Aid in Wildlife Restoration Act (Pittman-Robertson Act), administered by the U.S. Fish and Wildlife Service.

Study Area and Methods

The Ozark Mountain region is located in northwestern and northcentral Arkansas, north of the Ouachita Mountain region and west of the Mississippi Delta region. It is characterized by flat-topped mountains and ridges, separated by narrow valleys and fast-flowing streams. Elevations rarely exceed 600 m. Dominant tree species include white oak (*Quercus alba*), northern red oak (*Q. rubra*), black oak (*Q. velutina*), and shagbark hickory (*Carya ovata*). Southern slopes support a mixture of upland hardwoods and shortleaf pine (*Pinus echinata*). American beech (*Fagus grandifolia*) and red maple (*Acer rubrum*) associations are found in moist, north-facing coves. Cedar (*Juniperus virginiana*) glades can be found on xeric exposures. All of these forest types are interspersed with numerous clearcuts and old fields.

The Ouachita Mountain region is located between the Gulf Coastal Plain and Ozark Mountain region in west central Arkansas. Elevations reach 760 m, and the topography is more rugged than in the Ozarks. The mountain slopes of the east-west ridges vary greatly in temperature and humidity. North-facing slopes support white oak, northern red oak, and shagbark hickory, whereas south-facing slopes typically consist of shortleaf pine, post oak (*Quercus stellata*), blackjack oak (*Q. marilandica*), and winged elm (*Ulmus alata*). In many areas large-scale conversions from hardwood to pine have taken place. Both regions receive 101 to 140 cm of annual rainfall.

Stomach samples are more reliable than scats for food habits studies because the representation of various food items is relatively unaffected by digestion (Graber and White 1983). Fifty-nine stomachs of hunter-harvested black bears were collected at mandatory check stations during bear hunting seasons from 1981 through 1986. Hunt dates were 26 October–1 November 1981, 16–22 October 1982, 5–8 November 1983, 3–6 November 1984, 2–5 November 1985, and 4–7 December 1986. Nine, 8, 10, 17, 7, and 2 usable stomachs were collected from 1981 through 1986, respectively, and collection dates of 6 stomachs were unknown. Some stomachs were frozen intact and others were emptied into plastic containers and preserved in 10% formalin. Each stomach sample was labeled with sex, date of kill, and location of kill.

Analytical procedures follow those outlined by Korschgen (1980). Stomach contents were washed into a 0.25-mm mesh sieve, drained, and emptied onto porcelain trays. When possible, individual food items were segregated and measured by water volume displacement. In some cases, individual food items could not easily be segregated (e.g. when both oak and hickory mast had been consumed). In such cases, relative percentage of each food item was ocularly estimated and total

volume of the stomach contents was determined by water displacement. The aggregate volume method was used to express volumes of each food item. Percentage frequency of a particular food item is defined as the percentage of stomachs in which that item occurred.

Indices of oak and hickory mast production were determined for 14 Wildlife Management Areas throughout the Ozark and Ouachita Mountain regions from 1982 through 1986. The mast survey followed procedures described by Whitehead (1980). Indices derived from the survey can range from 0 to 10, with higher numbers being indicative of greater mast production. Areas surveyed represent typical bear habitat within the 2 physiographic regions.

Results and Discussion

Plant materials, particularly fruits, occurred most frequently and in greatest volume (Table 1). Acorns were the most common food, and bears in Arkansas used acorns in similar proportions to those reported elsewhere (Cottam et al. 1939, Bennett et al. 1943, Eagle and Pelton 1983, Graber and White 1983, Carlock et al. 1983).

Simple linear correlation indicated that the volume of acorns in bear stomachs was correlated with mast survey data from corresponding years ($r = 0.94$, $P < 0.05$). This suggests that acorn use is related to availability (Table 2). The majority of samples was collected during years when acorn production was low; therefore, overall acorn use by bears, expressed as aggregate volume, is conservative.

Pokeweed fruits ranked second to acorns in importance. Pokeweed fruits occurred in greater volumes in stomachs of bears killed in October than in November, suggesting that this food may become limited in November, or bears may begin using other more available or preferred foods at that time. Pokeweed is reported to be of relatively minor importance in other studies of bear food habits in the southeastern United States (Beeman and Pelton 1977, Carlock et al. 1983, Eagle and Pelton 1983), but it is clearly a major food in Arkansas.

Hickory nuts were an important food item in 1983 but did not occur in any 1981, 1982, 1985, or 1986 samples and occurred in only 2 samples in 1984. Mast survey indices from 1982 through 1986 positively correlated (simple linear correlation) with volume of hickory during those years ($r = 0.83$, $P < 0.10$) (Table 2). As with acorn use, bears apparently use hickory nuts in proportion to availability.

Other fruits consumed in large volumes were persimmons and grapes. Carolina buckthorn, black gum, and devil's walkingstick fruits did not occur in high volumes but occurred frequently. Various grasses and leaves occurred in a high proportion of stomachs.

Walkingsticks (Phasmatidae) were the most important insect food, and the highest volume and frequency occurred in 1981. Walkingstick populations are sometimes eruptive and, during peak years, may constitute an important protein source for Arkansas bears during summer and early fall. Insects are reported to be

Table 1. Contents of 59 black bear stomachs collected in Arkansas, fall 1981 to 1986.^a

Food item	Aggregate volume	Percentage frequency
Plant material		
Fruit		
Acorns	34.1	66.1
Pokeweed	18.6	28.8
Hickory	11.6	18.6
Persimmon	5.1	11.9
Black gum	1.7	18.6
Grape	2.5	23.7
American Beech	2.0	1.7
Devil's walkingstick	1.4	10.2
Blueberry (<i>Vaccinium</i> spp.)	1.2	1.7
Carolina buckthorn	0.7	22.0
Greenbriar (<i>Smilax</i> spp.)	0.5	6.7
Dogwood (<i>Cornus florida</i>)	0.2	5.1
Unidentified fruit	0.2	10.2
Total	79.8	96.6
Leaves		
Pokeweed	2.3	8.5
Unidentified leaves	0.5	37.3
Unidentified grasses	2.2	33.9
Total	5.0	69.5
Animal matter		
Insects		
Walkingstick	4.4	35.6
Bee	0.1	6.8
Honeycomb	0.1	1.7
Total	4.6	49.2
Other animal		
Domestic pig	9.5	1.7
White-tailed deer	0.2	3.3
Total	9.7	15.3
Non-natural foods		
Cooked fish	0.7	1.7
Total	0.7	1.7

^aTrace items are included in totals but are not individually listed.

Table 2. Mast survey data collected from 1982 through 1986 compared to percentage frequency and aggregate volumes of acorns and hickory from black bear stomachs collected during the same period.

Year	N	Acorns			Hickory nuts		
		Aggregate volume in stomachs	Percentage frequency	Mast survey index	Aggregate volume in stomachs	Percentage frequency	Mast survey index
1982	8	48.7	62.5	3.3	0.0	0.0	1.6
1983	10	26.7	60.0	2.9	39.1	80.0	2.4
1984	17	25.0	70.6	3.0	12.3	11.8	1.3
1985	7	82.7	100.0	4.3	0.0	0.0	1.3
1986	2	98.2	50.0	4.0	0.0	0.0	0.7

used frequently by bears in southeastern states (Landers et al. 1979, Eagle and Pelton 1983, Graber and White 1983, Carlock et al. 1983, Maehr and Brady 1984).

Management Implications

Fall foods are important for black bears because high-energy diets are necessary to enable bears to withstand the rigors of winter denning, production of young, and the negative foraging period of early spring (Poelker and Hartwell 1973, Eagle and Pelton 1983). Acorns appear to be the most important source of that energy during fall in Arkansas. The predominance of hard mast in the diets of Arkansas bears indicates that oak-hickory habitat types are used heavily. Timber management programs featuring bears should incorporate a mixture of red oak, white oak, hickory, and beech to help offset mast failures for 1 or more groups.

Mast survey data correlated well with both acorn and hickory use by bears. Hard mast production has been shown to affect a variety of bear population characteristics (Beeman and Pelton 1977, Rogers 1976, Willey 1978). Such surveys, therefore, can be used by wildlife managers to predict food availability and its future effect on bear population dynamics.

Pokeweed usually is found in open, disturbed habitats and along forest edges (Armesto et al. 1983). In the Ozark and Ouachita mountains, such sites commonly exist in the form of clearcuts. The high use of pokeweed berries suggests that bears in Arkansas use these areas for feeding in fall. Furthermore, pokeweed fruits begin to ripen in the summer and it is likely that they also are important at that time.

The practice of clearcutting, depending on its execution, may have both positive and negative effects on bear populations. Rotation length, size, shape, and distribution of clearcuts as well as timber harvest and site preparation methods can significantly affect pokeweed production and its use by bears. For example, if bears feed only near the edges of excessively large clearcuts, habitat in the center would be unavailable. Further study is needed to determine patterns of clearcut use by bears.

The long-term effects of clearcutting should also be considered. Although short rotation, large block clearcutting produces pokeweed, this practice may not result in a reliable annual supply of this food within bear home ranges compared to smaller clearcuts with longer rotation lengths. In addition, clearcuts may not provide significant quantities of bear foods following the short-term flush of pokeweed. Large scale clearcutting, therefore, may ultimately result in the displacement of, perhaps, more important habitats such as upland hardwood forest. Wildlife managers should carefully consider these factors when prescribing clearcutting as a forest management strategy to favor bears in the Ozark and Ouachita Mountains.

Literature Cited

- Armesto, J. J., G. P. Cheplick, and M. J. McDonnell. 1983. Observations on the reproductive biology of *Phytolacca americana* (Phytolaccaceae). *Bul. Torrey Bot. Club* 3:380-383.

- Beeman, L. E., and M. R. Pelton. 1977. Seasonal foods and feeding ecology of black bears in the Smoky Mountains. Pages 141–147 in C. J. Martinka and K. L. McArthur, eds. *Bears. Their biology and management*. Bear Biol. Assoc. Conf. Ser. 3. U.S. Gov. Print. Off., Washington, D.C.
- Bennett, L. J., P. F. English, and R. L. Watts. 1943. The food habits of the black bear in Pennsylvania. *J. Mammal.* 24:25–31.
- Carlock, D. M., R. H. Conley, J. M. Collins, P. E. Hale, K. G. Johnson, A. S. Johnson, and M. R. Pelton. 1983. Tri-state bear study. Tech. Rep. No. 83–9. Tenn. Wildl. Resour. Agency, Nashville. 286pp.
- Cottam, C., A. L. Nelson, and T. E. Clarke. 1939. Notes on early winter food habits of the black bear in George Washington National Forest. *J. Mammal.* 20:310–314.
- Eagle, T. C. and M. R. Pelton. 1983. Seasonal nutrition of black bears in the Great Smoky Mountains National Park. *Proc. Internat. Conf. Bear Res. and Manage.* 5:94–101.
- Graber, D. M. and M. White. 1983. Black bear food habits in Yosemite National Park. *Proc. Internat. Conf. Bear Res. and Manage.* 5:1–10.
- Korschgen, L. J. 1980. Procedures for food-habits analyses. Pages 113–127 in S. D. Schemnitz, ed. *Wildlife Management Techniques Manual*. The Wildl. Soc., Washington, D.C.
- Landers, J. L., R. J. Hamilton, A. S. Johnson, and R. L. Marchinton. 1979. Foods and habitat of black bears in southeastern North Carolina. *J. Wildl. Manage.* 43:143–153.
- Machr, D. S. and J. R. Brady. 1984. Food habits of Florida black bears. *J. Wildl. Manage.* 48:230–235.
- Poelker, R. J. and H. D. Hartwell. 1973. Black bear of Washington. Wash. State Game Dep. Biol. Bul. 14, Olympia. 180pp.
- Rogers, L. 1976. Effect of mast and berry crop failure on survival, growth, and reproductive success of black bears. *Trans. North Am. Wildl. and Nat. Resour. Conf.* 41:431–438.
- Whitehead, C. J. 1980. Wildlife research reports: a qualitative study of mast production in a Southern Appalachian region of North Carolina, Georgia, and Tennessee. *Tenn. Wildl. Resour. Agency Tech. Rep.* 80–2. 97pp.
- Willey, C. H. 1978. The Vermont black bear. Vt. Fish and Game Dep., Montpelier. 73pp.