

FOOD PREFERENCE TESTING OF CAPTIVE BLACK BEARS

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Abstract: A method was developed to test food preferences of 2 young captive female black bears (*Ursus americanus*) under controlled conditions. Two sets of food items (5 native and 7 non-native) were tested biweekly for 1 year in a seminatural enclosure in Tennessee. The bears exhibited definite preferences among both sets of foods. The preferences were significantly correlated between the bears and were consistent throughout the year. In the native food test, acorns (*Quercus alba*) were the most preferred. In the non-native food test, fish (*Ictiobus* sp.) was the most preferred food. The foods most highly preferred were rich in either protein or carbohydrates.

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Seasonal variation of diet is well documented in black bears (Tisch 1961, Landers et al. 1979, Beeman and Pelton 1980). Availability of food to bears is considered the extrinsic mechanism regulating diet. However, food consumption may also be affected by physiological and nutritional needs that change with factors such as season, age, sex, and reproductive status. Learning may also play a role in food selection (Barker et al. 1977).

Bears have been found to vary their diet independent of availability. Couturier (1954) stated that in general bears prefer sweet plant material (bulbs, fruits, and berries) that contain large amounts of carbohydrates. Unfortunately, primary determinates of preference have not been documented under controlled conditions. This study was designed to quantify preferences for various foods and to study seasonal changes in relative preferences of 2 captive black bears maintained in seminatural biotic and climatic conditions. Equally important was the development of a method by which preferences could be studied under controlled conditions.

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METHODS

Test animals were 2 captive, female black bears (18 months old at start of study). The bears were obtained in eastern Tennessee when approximately 2 months old and raised in a 335-m²

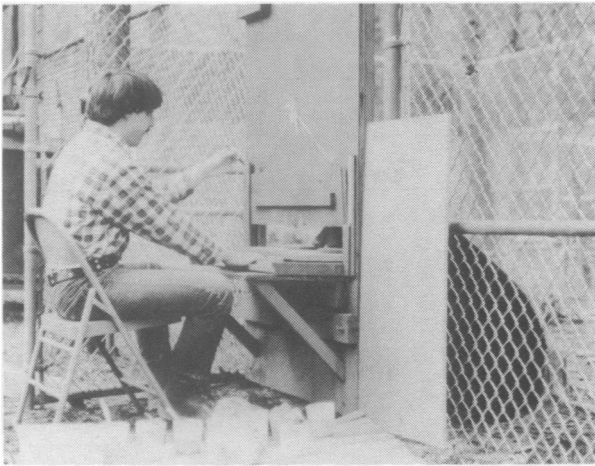
seminatural enclosure in Great Smoky Mountains National Park (Bacon 1973, Burghardt 1975).

The apparatus used was a modification of the Wisconsin General Testing Apparatus (Meyer et al. 1965). It consisted of 2 major parts: a wooden door equipped with an opening through which a tray could be introduced, and the tray in which the food items were placed (Fig. 1). The opening in the door could be closed to prevent the bear from viewing food preparation and reaching through. The tray was designed so that 2 glass bowls could be placed under movable screen covers. The bears could therefore see and smell each food item and choose the preferred food. The food tray rested on a platform attached to the door and could be completely withdrawn from the bears (Fig. 1b).

Each bear was trained to accept food from the tray by moving the screen covers with either nose or forepaw. Preliminary tests were done in which each bear was presented foods 30 times on 6 consecutive days. During the preliminary tests the bears could eat both food items from the tray. These tests acclimated the bears and the tester to the procedure (Bacon 1973). After the preliminary tests bears were allowed to consume only 1 food item.

Two tests (native foods and non-native foods) were done. A paired comparisons procedure was used. Each food item within a set was presented twice with every other item. In each 2nd pairing the positions were reversed. During each session for native foods 20 choices were presented; for each session for non-native foods there were 56 choices.

We presented 5 native foods (white oak acorns, *Quercus alba*; blackberries, *Rubus* spp.;



(a) Door through which tester could present and withdraw food tray.



(b) Food tray containing 2 glass bowls with screen covers that the bear could move aside to eat a test food.

Fig. 1. Apparatus for presenting pairs of test foods to captive black bears; bears were allowed to choose and eat 1 food of each pair presented.

hickory nuts, *Carya tomentosa*; beechnuts, *Fagus grandifolia*; and grass, *Gramineae* spp.) and 8 non-native foods (fish, *Iciobus* sp.; hamburger; red delicious apples; canned pears; whole-wheat bread; cucumber; lettuce; and Wayne dog chow). All native foods except grass were collected Au-

gust to October; grass was collected prior to each test. Non-native foods were obtained as needed. Foods in each test were equated by weight.

We introduced food with stainless steel forks and separate glass bowls. Bears were allowed to consume only 1 food item, but were required to notice both choices. If a bear did not orient its nose to each screen before eating, the tray was retracted. Several seconds later the tray was reintroduced. The procedure was repeated until we saw obvious head orientation toward both foods. Infrequently bears held the tray and ate both foods. To avoid reinforcement of this behavior, bears received sharp words and a rap on the knuckles with a stick. The foods within each test were ranked by preferences. Significance of choice between each pair of foods was determined by cumulative binomial probability ($P \leq 0.05$, Siegel 1956). Using the rankings obtained, an analysis of linearity (Lehner 1979) was performed to determine the extent to which the preferences formed a linear hierarchy. Seasonal variation was analyzed by dividing the testing period by season (winter—January, February, March; spring—April, May, June; summer—July, August, September; fall—October, November, December), ranking the foods by total times chosen, and applying Friedman 2-way analysis of variance (Siegel 1956).

RESULTS

In the native food test (Table 1), bears chose acorns over all food items and blackberry and hickory nut over beechnut and grass ($P \leq 0.05$, cumulative binomial probability, Siegel 1956). The bears differed in their preferences for beechnut vs. grass and hickory nut vs. blackberry. The only choice not significant ($P > 0.05$) was between blackberry and hickory nut for both bears. An analysis of linearity ($h = 0.90$ for both bears, Lehner 1979) also indicated a distinct hierarchy of preference. The preferences between the bears were also very similar ($r = 0.96$, $P < 0.01$, Pearson product moment correlation coefficient, Sokal and Rohlf 1973).

In both the native and non-native food test, seasonal variation (Table 1) was not found to be significant ($P > 0.01$ for each bear, Friedman 2-way analysis of variance, Siegel 1956).

Table 1. Food preferences of 2 captive black bears determined by paired preference tests conducted biweekly from 21 November 1971 to 25 November 1972 in a seminatural enclosure, Great Smoky Mountains National Park, Tennessee.

Food	Bear 1				Overall preference (percent) ^b	Bear 2				Overall preference (percent) ^b
	Preference ranking ^a by season					Preference ranking ^a by season				
	Oct–Dec	Jan–Mar	Apr–Jun	Jul–Sep		Oct–Dec	Jan–Mar	Apr–Jun	Jul–Sep	
Native foods										
Acorn	1	1	1	1	94	2	1	1	1	87
Hickory	2	2	2	3	64	3	2	3	3	64
Blackberry	3	3	3	2	62	1	2	2	2	70
Beechnut	5	4	4	4	18	5	5	5	5	6
Grass	4	5	5	5	12	4	4	4	4	23
Non-native foods										
Fish	1	3	2	1	85	2	1	1	1	85
Hamburger	2	1	1	5	79	1	2.5	3	4	73
Pear	3	2	3	2	72	3	2.5	2	2	76
Bread	4	4	5	3	55	4	4.5	4	3	61
Apple	5	5	4	4	55	5	4.5	5	5	52
Cucumber	8	6	6	6	24	7	7	6	6	24
Lettuce	6.5	7	7	7	21	6	6	7	7	23
Dog chow	6.5	8	8	8	9	8	8	8	8	7

^a Within seasons, most preferred = 1, 2nd preferred = 2, etc.

^b Total choices for test food as a percent of all possible choices for that food.

DISCUSSION

Both bears exhibited distinct preferences among foods presented to them. Variation among seasons was small and changes observed did not follow trends. Acorns were significantly preferred over other native food items, as seemed to be the case for wild bears in eastern Tennessee and western North Carolina (Beeman and Pelton 1980). Continued preference for acorns did not change seasonally. Berries, an important summer food item in this area, were also highly preferred. In the non-native test the most consistent result was the sharp preference for fish, hamburger, and pear over lettuce, cucumber, and dog chow.

The nutritional constituents of the food items appeared to be related to the relative preference. In the native food test, acorns contained the highest percentage of starches and sugars or carbohydrates (Morrison 1954, Heinz International Research Center 1964). In the non-native food test, the high-carbohydrate foods (pear, apple, bread) were preferred but not as much as the high-protein foods (fish, hamburger).

Although it is difficult to extrapolate these results to wild bears, it appears that consumption may be mediated by factors other than availability. The stability of preference of the captive

bears also points to the possibility of specific preferences exclusive of environmental or physiological factors.

The methodology developed may be modified for use with hand-raised or wild captive bears. Behavioral testing of individual bears in controlled conditions has been very limited and the literature generally unavailable to American researchers (Kuckuk 1937, Leyhausen 1948). General comments on experimental approach are therefore appropriate.

The apparatus must remain simple and very sturdy. The bears exhibited very rapid learning rates (3–10 trials to learn a 2-choice discrimination, 2–3 exposures to an apparatus to master its use); however, they were very easily frustrated. Frustration generally occurred when bears were blocked from obtaining an observed goal (normally food). This resulted in intense effort to get at the food by force. All experimental design was developed to minimize bears' need to detour from the goal (Bacon 1973).

Food rewards were consistently small (3–10 g). In other tests (Bacon and Burghardt, 1976), 2–3 raisins per trial kept bears' interest for over 2 hours. The bears' learning was very rapid. In fact, the 2 bears compared very favorably to chimpanzees tested for acquisition of hue discrimination (Grether 1940).

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