2001. Proceedings of the Indiana Academy of Science 110:123–125

FOOD OF *EPTESICUS FUSCUS*, THE BIG BROWN BAT, IN INDIANA IN THE ABSENCE OF CULTIVATED FIELDS AND AGRICULTURAL PESTS

John O. Whitaker, Jr.: Department of Life Sciences, Indiana State University, Terre Haute, Indiana 47809

Harmon P. Weeks, Jr.: Department of Forestry and Natural Resources, Purdue University, West Lafayette, Indiana 47907

ABSTRACT. Big brown bats (*Eptesicus fuscus*) in Indiana feed heavily on agricultural pest insects. Big brown bats at Crane Naval Surface Warfare Center, Martin County, Indiana, where agricultural fields were not present, had almost the same diet as in areas of central Indiana and neighboring Illinois with abundant cultivated fields. Scarabaeid beetles, spotted cucumber beetles (*Diabrotica undecimpunctata*), green stinkbugs, carabid beetles, other beetles, cicadellid bugs and lepidopterans were the most important foods in both cases, although the order varied somewhat.

Keywords: Bats, Chiroptera, food habits, *Eptesicus fuscus*, big brown bat

In Indiana, the big brown bat is assumed to feed over or near cultivated fields, since spotted cucumber beetles (*Diabrotica undecimpunctata*) and other agricultural pests form about 80% of its diet (Whitaker 1995). Therefore, it seemed of interest to determine the food of big brown bats in an area in which cultivated fields were not readily available. A maternity colony of big brown bats was located under a bridge (Bridge 1891) at Crane Naval Surface Warfare Center (CNSWC), Martin County, Indiana. The Crane facility is 250 km^2 and is 78% wooded, with the remainder in mowed grassy areas (e.g., roadsides, powerline rights-of-way) and industrial complexes. It includes no cultivated fields; the nearest agricultural field, which is relatively small, is about 5 km from the bridge and outside CNSWC's border. Thus, it appeared unlikely that the bats would be feeding over cultivated fields. The purpose of this project was to determine the food of big brown bats in central Indiana in a situation where agricultural pest species were likely not readily available, and insect foods would presumably reflect "natural" rather than agricultural conditions.

METHODS

Guano samples were gathered beneath clusters of big brown bats under the bridge on 13 different dates, 4 in 1994 (6, 11, 12, 14 June) and 9 in 1995 (6, 12, 21 July, 2, 8 August, 10, 19, 25 September, and 25 October). Fifty guano pellets were examined in most samples except that only 28 were available from 6 July, and only 34 from 12 July. A total of 612 pellets was included in the sample. Foods were identified, and their percentage volumes were estimated visually in each pellet. The percent volumes were calculated (sum of individual volumes for each food/sum of total volume × 100; see Whitaker 1988), indicating the relative amount of each type of food in a sample. These data were compared to data from 11 different maternity colonies of this species from agricultural areas of Indiana and Illinois (Whitaker 1995).

RESULTS

We were surprised to find that the foods of big brown bats at CNSWC, where there were no cultivated fields within 5 km, were strikingly similar to those in the 11 maternity colonies in agricultural areas in Indiana and Illinois (Table 1). The top two foods were the same, Scarabaeidae and the spotted cucumber beetle, *Diabrotica undecimpunctata*. These items constituted 32.4 and 22.3% (total of 54.7) of the food at Crane, and 29.6 and 28.2 (total of 57.8%) of the food in the Indiana/Illinois sample.

Table 1.—Foods (% volume) of the big brown bat at Crane Naval Surface Warfare Center (Martin County Indiana), as compared with food from fecal pellets from 11 colonies of big brown bats in Indiana and Illinois studied by Whitaker (1995). Items are listed from greatest to least percent volume at Crane.

	Crane	Indiana/ Illinois
Scarabaeidae	32.4	29.6
Diabrotica	22.3	28.2
Pentatomidae (green)	18.1	8.1
Unidentified Coleoptera	5.5	3.6
Cicadellidae	4.0	4.3
Lepidoptera	3.5	4.0
Carabidae	3.2	9.9
Formicidae	2.7	0.2
Ichneumonidae	2.7	2.2
Curculionidae	1.2	1.6
Hemerobiidae	1.0	1.6
Trichoptera	0.9	2.5
Pentatomidae (brown)	0.6	0.0
Tettigoniidae	0.5	0.0
Dytiscidae	0.3	0.3
Miridae	0.3	0.4
Calathus	0.2	0.6
Chironomidae	0.2	0.2
Dolichopodidae	0.2	0.0
Gryllidae	0.2	trace
Unidentified insect	0.2	0.1
Cynididae	0.1	1.0
Unidentified Diptera	0.1	1.1
Tipulidae	0.08	0.1
Delphacidae	0.08	0.0
Cercopidae	0.07	0.0
Coleopterous larvae	0.06	0.0
Lygaeidae	0.04	0.0
Cerambycidae	0.03	0.0
Unidentified Hymenoptera	0.03	0.0
Culicidae	0.01	0.0
Total	100.8	99.3

The next five foods were the same at the CNSWC and in the Indiana/Illinois samples, although the order differed. The third most important item at Crane was green stinkbugs, forming 18.1% of the volume. It was fourth in the Indiana/Illinois sample at 8.1%. Fourth at Crane was unidentified coleopterans (5.5%; seventh with 3.6% volume at Indiana/Illinois). Fifth at Crane was cicadellids with 4.0%; sixth at Crane were lepidopterans (sixth at Indiana/Illinois also with 4.0% of the volume), and seventh at Crane was carabids at 2.2% (3rd at Indiana/Illinois; 9.7% of the volume).

The remainder of the identified taxa corresponded closely between Crane and the general Indiana/Illinois sample (Table 1). The top seven food items were compared using one-way ANOVA's with Student-Newman-Keuls multiple range tests performed on arcsine transformed data. None were significantly different ($\alpha = 0.05$). Big brown bats were clearly eating very similar foods at Crane where cultivated fields were lacking as they were in areas where numerous cultivated fields were available. However, a greater total number of foods was identified from Crane ($n = 31$) as opposed to Indiana/Illinois ($n = 20$). Eleven taxa (35.5%) were found at Crane, but were not identified in the Indiana/Illinois at-large samples. This suggests that big brown bats will diversify their diets when other taxa are available and/or that agricultural areas may have an impoverished insect community, which is a subset of that occurring in wooded habitats.

DISCUSSION

Based principally on heavy use of the spotted cucumber beetle, but also because other important pest species (e.g., scarabaeids, pentatomids and cicadellids) were included in the diet of big brown bats, Whitaker (1995) concluded that the species is a particularly valuable asset to agriculture. The spotted cucumber beetle is an important pest on vine plants (melons and cucumbers) but is of special interest since its larva is one of the corn rootworms. However, inconsistencies exist in the evaluations of the importance of the spotted cucumber beetle as an agricultural pest. The larva of this species is the southern corn rootworm, which Krysan & Miller (1986) class as an important agricultural pest, stating that "In North America, the three important species of corn rootworms, *Diabrotica virgifera virgifera* the western corn rootworm, *D. barberi* the northern corn rootworm, and *D. undecimpunctata howardi* the southern corn rootworm are probably the continent's most expensive insect pests."

Because of Krysan & Miller's (1986) proclamation and since this species is so abundant in big brown bat diets in Indiana, we assumed that this was a major agricultural pest in the state. However, other authors suggest that this may not be the case. Edwards et al. (1993) indicate that the most important corn root-

worm in Indiana and Illinois appears to be the western corn rootworm produced by the striped cucumber beetle (*Diabrotica virgifera virgifera*). Of less importance is the northern corn rootworm beetle (*Diabrotica barberi*), also a striped beetle. These authors indicate that the spotted cucumber beetle, *Diabrotica undecimpunctata howardi* (larva = the southern corn rootworm), the species that is heavily eaten by big brown bats in Indiana, is a generalist feeder and is of little or no economic importance to corn in Indiana. One might think that the big brown bat would eat *D. barberi* and *D. virgifera*; it does not, undoubtedly because both of these species are apparently primarily diurnal.

There are several questions about the big brown bat's foraging ecology and its relationship with the spotted cucumber beetle that remain unclear; of principal interest would be where the bats obtain beetles (i.e., very high while beetles are dispersing, at lights, only over agricultural fields). Lack of answers to these questions makes it difficult to assess the foraging strategies, dietary selection, and economic impact of big brown bats, especially relative to this beetle species. However, this study suggests at least two possibilities: 1) big brown bats regularly fly over 5 km to preferentially forage over agricultural fields, or 2) spotted cucumber beetles are generalist feeders, as suggested by Edwards et al. (1993), and are abundant and successful residents of more natural habitats, substantially independent of agricultural crops. The latter seems to offer the most parsimonious explanation, given the great distance to agricultural fields and the volume of spotted cucumber beetles in the diet of the whole colony. However, since the completion of this study, we have radiotagged a big brown bat at its foraging area at lower Prairie Creek, in the Wabash bottomlands in Vigo County, Indiana, and tracked it back to its maternity roost in a building in the town of Prairie Creek, 3.25 miles (5 km) away. While it would seem likely that most of the food of big brown bats at Crane is obtained near the colony, it appears that the bats are fully capable of traveling the 5 km or more to open areas to feed. The observation that Crane bats took 11 taxa that were not present in any of 11 other Indiana and Illinois colonies suggests a diet diversification associated with foraging in a forest-dominated ecosystem and rebuffs the idea that many colony members regularly travel to far-distant agricultural fields to forage.

Information is needed on big brown bat foods in an area of the southern United States where the spotted cucumber beetle is considered an important agricultural pest. Also, considerable information is needed about distances routinely traveled between roosting and foraging sites by big brown bats. Such information would greatly assist in defining the relative importance of each of these resources to the big brown bat and help us understand why this species seems to be prospering while most other members of the chiropteran community are in decline.

LITERATURE CITED

Edwards, C.R., L.W. Bledsoe & F.T. Turpin. 1993. Managing corn rootworms—1993. Field crop insects. Publication E-49. Purdue University Cooperative Extension Service, West Lafayette, Indiana.

Krysan, J.L. & T.A. Miller. 1986. Methods for the study of pest *Diabrotica*. Springer-Verlag, New York. 206 p.

Whitaker, J.O., Jr. 1988. Food habits analysis of insectivorous bats. Pp. 171–189, *In* Ecological And Behavioral Methods For The Study Of Bats. (T.H. Kunz, ed.). Smithsonian Institution Press, Washington, D.C.

Whitaker, J.O., Jr. 1995. Food of the big brown bat, *Eptesicus fuscus*, from maternity colonies in Indiana and Illinois. American Midland Naturalist 134:346–360.

Manuscript received 26 January 2000, revised 22 September 2000.