

The Food of *Rana catesbeiana* in Three Habitats in Owen County, Indiana

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Abstract

A total of 442 bullfrogs, *Rana catesbeiana*, was collected, of which 367 had food in the stomachs. Frogs were collected from the White River, strip-pit ponds and farm ponds by gigging. The most important foods in stomachs of frogs from the river were scarabaeid beetles, crayfish, lucanid beetles, terrestrial snails, earthworms, and carabid beetles. Corresponding foods of frogs from the strip-pit ponds were crayfish, Lepidoptera, spiders, vegetation, Dytiscidae and Libellulidae, and from farm ponds they were *Rana* tadpoles, crayfish, Libellulidae, Lepidoptera, young *Rana* sp., and Aeschnidae.

Introduction

Among the papers concerning bullfrog food habits are: Korschgen and Moyle (7) 455 bullfrog stomachs examined from Missouri; Korschgen and Baskett (6) 408 Missouri stomachs; Cohen and Howard (3) 300 California stomachs examined, Brooks (1) 138 Virginia stomachs examined, Perez (9) 50 Puerto Rico stomachs examined, Surface (10) and Frost (4) 29 and 25 Pennsylvania stomachs examined, and Bush (2) 18 Kentucky stomachs examined.

The present study was initiated to determine and compare the food habits of *Rana catesbeiana* in three different habitats, river, farm ponds and strip pit ponds, in central Indiana.

Materials and Methods

The study area was located in Owen County and consisted of approximately twenty miles of the White River from Gosport to Freedom, eleven strip pits and fourteen farm ponds. Bullfrogs were collected in June and July of 1966, 1967, and 1968, by using gigs and lights from a boat in the river, and from shore in the ponds.

Stomachs were removed soon after collection of the frogs and were examined in the laboratory using a dissecting microscope.

Description of Study Areas

Around the strip pit ponds were characteristic rows of spill piles in various seral stages of succession but much *Rubus* was present. The ponds were clear and contained *Typha latifolia* and algae. The immediate shore of most of the strip pits was essentially void of vegetation.

The farm ponds were in pasture situations usually with relatively little ground cover along the shore. *Typha latifolia* in the shallow end and algae were predominant forms of vegetation.

The White River meanders slowly through flat bottom land and rolling hill country characteristic of Owen County. Dominant plants

along its banks are *Populus deltoides* (cottonwood), *Betula nigra* (river birch), *Salix interior* (sandbar willow), and *Acer negundo* (box elder).

Some important reptiles and amphibians present in the study area were: *Rana pipiens* (leopard frog), *R. clamitans* (green frog), *Bufo woodhousei* (Fowler's toad), *Hyla crucifer* (spring peeper), and *Natrix sipedon* (common water snake).

Discussion

During the three years 442 frogs were taken. The stomachs of 367 contained food: 178 from the river, 111 from the strip pits, and 78 from farm ponds (Table 1.)

TABLE 1. *Stomach contents of 367 bullfrogs, Rana catesbeiana, from the White River, strip-pits, and farm ponds in Owen County, Indiana.*

FOOD ITEMS	WHITE RIVER		STRIP-PITS		FARM PONDS	
	178 stomachs		111 stomachs		78 stomachs	
	% vol.	% freq.	% vol.	% freq.	% vol.	% freq.
Scarabaeidae	14.2	23.6	2.3	4.5	3.5	5.1
Crayfish	12.3	18.0	21.3	31.5	14.8	16.7
Lucanidae	9.6	11.2	—	—	1.3	1.3
Snails (terrestrial)	8.2	13.5	1.3	6.3	0.4	1.3
Earthworms	7.1	14.6	0.1	0.9	—	—
Carabidae	6.8	14.5	1.5	9.0	0.7	2.6
Snails (aquatic)	6.5	11.8	—	—	—	—
Spiders	5.3	12.4	7.7	21.6	2.5	5.1
Unidentified minnows	4.8	11.2	0.7	0.9	1.3	1.3
Diplopoda	3.6	8.4	4.9	7.0	—	—
Elateridae	2.0	3.9	—	—	1.5	2.6
Vegetation	1.8	11.0	7.0	33.0	2.3	10.3
<i>Lepomis machrochirus</i>	1.5	1.7	0.8	0.9	—	—
<i>Notropis atherinoides</i>	1.3	1.7	—	—	—	—
<i>N. chrysocephalus</i>	1.2	1.1	—	—	—	—
Sialid larvae	1.1	1.7	—	—	—	—
<i>Rana</i> sp.	1.1	1.1	3.9	6.3	3.9	3.8
Blattidae	1.1	1.1	—	—	—	—
Libellulidae	1.0	1.7	5.4	10.9	10.4	11.5
Formicidae	0.9	3.9	0.2	2.7	3.3	5.1
Chilopoda	0.8	2.8	—	—	—	—
<i>Hyla versicolor</i>	0.6	0.6	—	—	2.6	2.6
<i>Ambystoma texanum</i>	0.6	1.1	—	—	—	—
Hydrophilidae	0.6	0.6	0.6	1.8	1.3	1.3
Omophronidae	0.6	0.6	—	—	—	—
<i>Natrix sipedon</i>	0.5	1.1	—	—	—	—
<i>Graptemys pseudo-geographica</i>	0.4	0.6	—	—	—	—

TABLE 1 (Continued)

FOOD ITEMS	WHITE RIVER		STRIP-PITS		FARM PONDS	
	178 stomachs		111 stomachs		78 stomachs	
	% vol.	% freq.	% vol.	% freq.	% vol.	% freq.
Unidentified insects	0.4	2.2	0.4	3.6	—	—
Tenebrionidae	0.4	1.1	0.2	1.8	—	—
Bombidae	0.4	0.6	0.2	0.9	0.8	1.3
Plecoptera naiads	0.4	0.6	—	—	—	—
Oniscidae (sowbugs)	0.3	2.2	0.9	1.8	—	—
Silphidae	0.3	0.6	—	—	—	—
Chrysomelidae	0.3	0.6	0.2	1.8	—	—
Unidentified Coleoptera	0.3	1.1	0.7	4.5	1.3	1.3
Gryllidae	0.3	1.7	0.7	2.7	—	—
Phalangida						
(Harvestmen)	0.2	1.7	—	—	—	—
<i>Notropis spilopterus</i>	0.2	0.6	—	—	—	—
Lampyridae	0.2	1.1	—	—	0.8	1.3
Vespidae	0.2	0.6	1.5	3.6	—	—
Lepidopterous larvae	0.2	0.6	3.6	9.9	1.5	2.6
Cantharidae	0.1	1.1	—	—	1.7	3.8
Pentatomidae	0.1	1.1	0.1	0.9	—	—
Apidae	trace	0.6	0.1	0.9	1.9	3.8
Notonectidae	trace	0.6	—	—	—	—
Agrionidae	trace	0.6	0.4	0.9	0.4	1.3
Adult Lepidoptera	—	—	10.5	21.6	4.7	5.1
Dytiscidae	—	—	5.8	14.4	—	—
Aeschnidae	—	—	2.7	6.3	3.9	3.8
Odonata naiads	—	—	1.9	5.4	2.6	2.6
Trichoptera	—	—	1.8	2.7	—	—
Acrididae	—	—	1.6	3.6	—	—
Tipulidae	—	—	1.3	2.7	—	—
Stratiomyidae	—	—	1.3	4.5	—	—
Ephemerida	—	—	1.3	2.7	—	—
Gryllotalpidae	—	—	0.9	0.9	—	—
Curculionidae	—	—	0.8	7.0	1.4	2.6
Buprestidae	—	—	0.4	0.9	—	—
Phalacridae	—	—	0.4	0.9	—	—
Reduviidae	—	—	0.4	1.8	—	—
Coreidae	—	—	0.3	0.9	1.3	1.3
Belostomatidae	—	—	0.2	0.9	0.7	1.3
Cicadellidae	—	—	0.2	0.6	—	—
Mantidae	—	—	0.2	0.9	—	—
Mussels	—	—	0.1	0.9	—	—
Haliplidae	—	—	0.1	0.9	—	—
Anobiidae	—	—	0.1	0.9	—	—
Rhysodidae	—	—	0.1	0.9	—	—
Cerambycidae	—	—	0.1	0.9	—	—
Coleopterous larvae	—	—	0.1	0.9	—	—

TABLE 1 (Continued)

FOOD ITEMS	WHITE RIVER		STRIP-PITS		FARM PONDS	
	178 stomachs		111 stomachs		78 stomachs	
	% vol.	% freq.	% vol.	% freq.	% vol.	% freq.
Unidentified Diptera	—	—	0.1	1.8	1.6	3.8
Nepidae	—	—	0.1	0.9	—	—
Aradidae	—	—	0.1	0.9	—	—
Gerridae	—	—	0.1	1.8	1.3	1.3
Unidentified Hemiptera	—	—	0.1	0.9	—	—
Membracidae	—	—	0.1	0.9	—	—
Cercopidae	—	—	0.1	0.9	—	—
<i>Rana</i> tadpoles	—	—	—	—	20.0	21.8
Plecoptera	—	—	—	—	1.3	1.3
Culicidae	—	—	—	—	1.3	1.3
Corixidae	—	—	—	—	0.8	1.3
Chrysopidae	—	—	—	—	0.3	2.6
Staphylinidae	—	—	—	—	0.2	1.3
Coccinelidae	—	—	—	—	0.1	1.3
Bombyliidae	—	—	—	—	0.1	1.3
Chrysididae	—	—	—	—	0.1	1.3

A large variety of animal foods was represented, undoubtedly because the diet of *Rana catesbeiana* is greatly influenced by availability. Almost anything that moves and is of appropriate size is probably taken.

Forty-four food items were recorded from stomachs from the river frogs, 38 from the farm ponds, and 57 from the strip ponds.

The six most important foods of bullfrogs in the river listed in order of decreasing utilization were Scarabaeid beetles, crayfish, lucanid beetles, terrestrial snails, earthworms, and carabid beetles. In the strip-pit ponds corresponding foods were crayfish, adult Lepidoptera, spiders, vegetation, Dytiscidae and Libellulidae. In the farm ponds the most important foods were *Rana* tadpoles, crayfish, Libellulidae, adult Lepidoptera, young *Rana* sp., and Aeschnidae.

Of the six most important foods in each of the habitats, only one, crayfish, was listed in all three. In the river habitat, various beetles were important, comprising a total of 35.5% of the total volume of food, and with three families of beetles included among the top six. Crayfish was the top food in strip-pits, and second in importance in the other two habitats. It would appear that crayfish are often a major food of the bullfrog. Crayfish was the only food in the top six in the river which was also in the top six in the other habitats. The similarity between stripped ponds and farm ponds was greater, with three major shared foods, crayfish, adult Lepidoptera, and Libellulidae. The top food in the farm ponds, however, was tadpoles, forming 20% of the food by volume. Tad-

TABLE 2. Ten most important foods (highest volumes) of bullfrogs from three Indiana habitats.

RIVER % vol.		STRIP-PITS % vol.		FARM PONDS % vol.	
1. Scarabaeids	14.2	Crayfish	21.3	Rana tadpoles	20.0
2. Crayfish	12.3	Lepidoptera	10.5	Crayfish	14.8
3. Lucanids	9.6	Spiders	7.7	Libellulidae	10.4
4. Terrestrial snails	8.2	Vegetation	7.0	Lepidoptera	4.7
5. Earthworms	7.1	Dytiscidae	5.8	Yg. Rana sp.	3.9
6. Carabids	6.8	Libellulidae	5.4	Aeschuidae	3.9
7. Aquatic snails	6.5	Diplopoda	4.9	Scarabaeidae	3.5
8. Spiders	5.3	<i>Rana</i> sp.	3.9	Formicidae	3.3
9. Unidentified minnows	4.8	Lepid larvae	3.6	<i>Hyla versicolor</i>	2.6
10. Diplopoda	3.6	Aeschnidae	2.7	Odonata naiads	2.6

poles were very abundant in the farmponds, but not in the river or stripped ponds.

It would appear that the bullfrog feeds both underwater and on land. Several of the important foods, the tadpoles, fish, aquatic snails, and presumably many of the crayfish, are probably or definitely gotten from the water. However, it is possible that the frogs catch the aquatic prey while sitting on the shore or in shallow water. Much of the food must be taken on land, where the frogs would appear to wait on the shore for prey to appear, probably at night, as indicated by the Scarabaeids, Lucanids, and the numbers of moths in stomachs.

Somewhat surprising were the numbers of dragonflies since it would appear difficult for bullfrogs to catch them. The frogs might get them during the day or at dusk by remaining motionless and capturing them as they light, or else they might capture them from among the vegetation at night. The former would appear to be the case. Bullfrogs were seen on several occasions among cattails in the ponds during the day, apparently waiting for prey items.

Frost (4) stated that crayfish, frogs, and mice were principal foods of larger specimens. Percent volumes of crayfish from the White River were 12%, with 21.3% from strip pits and 14.8% in the farm ponds. Crayfish formed the highest volume of food from the pits and ponds, but ranked second to Scarabaeidae, at 14.2% in the river.

Kirn (5) reports a young bullfrog catching and eating another frog, presumed to be a bullfrog. In California, Cohen and Howard (3) found 17 frogs present in 300 stomachs examined. Young frogs, *Rana*, were found to be a relatively minor food item in all three habitats during the present study. *Hyla versicolor* specimens were taken from stomachs from farm ponds and from the White River.

Tadpoles of *Rana* (probably *R. catesbeiana*, *R. clamitans* and *R. pipiens*) were an important item in the diet of the farm pond frogs.

Minton (8) found a 17-inch coral snake in a bullfrog stomach. Two frogs from the White River had eaten 10- and 11-inch snakes, *Natrix sipedon*.

Minnows were found in stomachs in all three areas. Three species of *Notropis* were taken from frogs from the river. *Lepomis macrochirus* was taken in both river and strip-pit areas. A turtle, *Graptemys pseudogeographica*, was found in a stomach from the river.

Among the insects, beetles were the most important order in stomachs from all three habitats.

Vegetable matter from the three areas occurred frequently, but presumably was ingested accidentally.

The average length of strip-pit frogs was 103.5 mm; farm pond frogs averaged 107.2 mm; and the White River frogs averaged 174.8 mm. Average weights were 158.8 for the strip-pit frogs; 153.2 for the farm pond frogs and 373.7 for the river frogs. Thus the river frogs were much larger, but part of the weight difference could be attributed to the heavy volume of eggs since 78% of females taken in June contained eggs, contrasting to 31.3% in July and 14.3% in August. All frogs from the river were taken in June.

It is likely that the river frogs are larger because of the relative lack of fishing pressure in the more remote parts of the river. The strip-pits and farm ponds are heavily fished, thus the larger frogs are probably rapidly removed by fishermen.

Literature Cited

1. BROOKS, G. R., JR. 1964. An analysis of the food habits of the bullfrog, *Rana catesbeiana*, by body size, sex, month, and habitat. Virginia J. Science (New series) 15:173-186
2. BUSH, F. M. 1959. Foods of some Kentucky herptiles. Herpetologica 15:73-77.
3. COHEN, M. W., and W. E. HOWARD. 1958. Bullfrog Food and Growth at the San Joaquin Experimental Range, California. Copeia 1958:223-225.
4. FROST, S. W. 1935. The food of *Rana catesbeiana*. Copeia 1935:15-18.
5. KIRN, A. J. 1949. Cannibalism among *Rana pipiens* Berlandieri and possibly by *Rana catesbeiana*, near Somerset, Texas. Herpetologica 5:84.
6. KORSCHGEN, L. J., and T. S. BASKETT. 1963. Foods of impoundment and stream-dwelling bullfrogs in Missouri. Herpetologica 19:89-99.
7. KORSCHGEN, L. J. and D. L. MOYLE. 1955. Food habits of the bullfrogs in central Missouri farm ponds. Amer. Midl. Natur. 54:332-341.
8. MINTON, J. E. 1949. Coral Snake Preyed upon by Bullfrogs. Copeia 1949: 288.
9. PEREZ, M. E. 1951. The Food of *Rana catesbeiana* in Puerto Rico. Herpetologica 7:102-104.
10. SURFACE, H. A. 1913. First report on the economic feature of the amphibia of Pennsylvania. Zool. Bull. Pa. Dept. Agric.