STOMACH CONTENTS OF BULLFROGS (*RANA CATESBEIANA*) TAKEN FROM A MINNOW HATCHERY

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In the southern Illinois region, the bullfrog is one of the most abundant vertebrates in minnow hatcheries. It is therefore desirable to establish its status as a predator on minnows. This was the objective of the present study.

The study was done as a science project for the Illinois Junior Academy of Science.

Several studies have been made of the natural feeding habits of the bullfrog. Among the more exhaustive is that of Korschgen and Moyle (1955), who examined the contents of 455 stomachs from specimens collected from central Missouri farm ponds. The percent volume for the principal food items were as follows: insects, 32; crayfishes, 26; frogs, 11; tadpoles, 10; meadow mice, 3; fishes, 2; snails, 2; toads, 2; miscellaneous invertebrates, 2; and snapping turtles, 1.

Frost (1935) reported that insects comprised the greatest part of the diet of 25 smaller frogs. Ants were eaten in considerable numbers. Spiders and snails formed the largest part of the diet by volume. Upon examining the larger bullfrogs, Frost found crayfishes in 4, frogs in 2 and mice in 2.

Needham (1905) concluded that snails and insects were the main items of the diet. In 16 bullfrogs collected from New York, he found 18 snails, 3 spiders, 3 crustaceans and 2 vertebrates.

A study by Perez (1951) in Puerto Rico showed the following principal food items in terms of percent volume of total stomach content: insects, 19; plant matter, 11; and bullfrogs, 4.

Pope (1947) gives the combined results of five workers who tabulated the contents of about 200 stomachs and more casual information from others. The diet of young frogs was comprised of insects and other small invertebrates, at least half of which were non-aquatic. Larger frogs preyed upon numerous invertebrates and vertebrates such as fishes, frogs, salamanders, young turtles, snakes, moles, mice and birds. Frogs and crayfishes seemed to be the chief food items of larger frogs.

Other more casual observers add to the widely varied list of food items. Baker (1940) gave crayfishes as the chief food item of the bullfrog in eastern Texas. Dickerson (1906) lists fishes, small turtles, young water birds, and frogs as food items forming the greatest part of the diet. Breckenridge (1944) includes insects, fishes, crayfishes, birds, and other frogs as popular food items. Morris (1945) states that the bullfrog is cannibalistic to a marked degree. Other food items listed by Morris are mice, crayfishes, salamanders, snails, small fishes, worms, and various insects, both lar-

val and adult, that are found among the water weeds.

Dyche (1914) examined 30 stomachs from bullfrogs taken from a Kansas fish hatchery. He found 32 fishes in 14 of the 30 stomachs. Other items found included crayfishes, insects, spiders, and snails.

Study Area

The frogs utilized in this study were taken from a minnow hatchery located in the Mississippi River Bottoms of Jackson County, Illinois. The collecting area covered 6 acres. Within this area were 19 ponds ranging in size from 0.05 to 1.0 acre. Throughout the summer and fall, the levees of the ponds were covered with a dense growth of vegetation.

Method

The original plan of sampling called for collecting ten frogs per week. This plan was followed from spring to midsummer. However, after this time, the frogs became so scarce and vegetation cover so dense that it was not possible to obtain the desired number. It was also noted that the larger frogs became relatively more scarce. A total of 123 frogs were utilized in the study.

The specimens were collected primarily during the daylight hours by use of a .22 caliber rifle. They were all collected in the water or at the water's edge. As each frog was collected it was marked as to which pond it was taken from and stomach contents were determined by dissection. The size of frog was measured from the snout to the posterior end of the body. The abundance of various food items in the habitat was noted throughout the course of the study.

Results

Plant matter constituted only a minor portion of stomach contents and was considered to be accidentally ingested with food. For this reason it was not listed with stomach contents (Table 1).

Insects were found to be in 68 percent of the stomachs examined. Terrestrial beetles (32 percent), aquatic beetles (24 percent), and dragon flies (13 percent), were the most numerous food organisms in this group. Dragonflies constituted a large part of the diet in July, August, and September, probably because of availability. Twenty-five other kinds of insects were recognized but were relatively unimportant as food items.

Crayfishes (especially *Orconectes immunis*) found in 30 percent of the stomachs examined constituted the second most prevalent food item. A decrease in the number of crayfishes eaten in late summer was probably due to a poisoning program which reduced the number of crayfishes present in the ponds.

Frogs (especially *Rana pipiens*) were the third most prevalent food item and were found in 24 per cent of the stomachs examined. Although cricket frogs (*Acris gryllus* were known to be abundant in the study area at the time the bullfrogs were being collected they occurred in only 1.6 percent of the stomachs examined. Young Fowler's toads (*Bufo woodhousei*) were also abundant in May and June, but none were found in the stomachs of the bullfrogs examined.

TABLE 1.—Percent Occurrence of Food Items in Stomachs of 123 Bullfrogs Collected From Minnow Hatchery Ponds, Gorham, Illinois.

Food Item	Percent Occurrence		Food Item	Percent Occurrence	
Insects (Total)		68.3	Water Strider	0.8	
Terrestrial Beetles	31.7		Horsefly or Cranefly Larvae	0.8	
Aquatic Beetles	24.4		Cranefly Larvae	0.8	
Dragon Flies	13.0		Terrestrial Bug	0.8	
Unidentified Flies	8.1		Cricket	0.8	
Terrestrial Moth or Butterfly Larvae	6.5		Crayfishes		30.1
Dragon Fly Larvae	5.7		Frogs (Total)		24.3
Unidentified Insect Remains	5.7		Leopard Frogs	10.6	
Aquatic Beetle Larvae	5.7		Unidentified Frogs	8.9	
Damsel Flies	4.1		Cricket Frogs	1.6	
Aquatic Bugs	4.1		Bullfrog Tadpoles	1.6	
Grasshoppers	2.4		Frog Eggs	1.6	
Syrphid Flies	2.4		Fish (Total)		13.8
Aquatic Fly Larvae	1.6		Golden Shiners	8.9	
Honey Bees	1.6		Unidentified Fishes	4.1	
Bumble Bees	1.6		Fathead Minnows	0.8	
Water Boatmen	1.6		Snails		8.4
Leaf Hopper	0.8		Spiders		8.1
Damsel Fly Larvae	0.8		Empty		7.3
Moth	0.8		Millipedes		4.1
Unidentified Aquatic Insect Larvae	0.8		Painted Turtle		0.8
Firefly	0.8		Rabbit Hairs		0.8
Midge	0.8		Mice		0.8
Backswimmer	0.8		Unidentified Animal Remains		0.8
			Unidentified Hairs		0.8

Since the primary objective of this study was to determine the status of the bullfrog as a predator on fishes, the data collected for this study were analyzed with this purpose in mind. Fishes were the fourth most prevalent food item. Minnows (*Notemigonus crysoleucas* and *Pimephales promelas*) were known to be abundant in most ponds on the hatchery but were found in only 14 percent of the stomachs examined. On comparing size of frog with stomach contents, it was found that larger frogs fed more heavily on minnows. They occurred in 25 percent of the stomachs from frogs 6 inches or over, 15 percent in 5-inch to 6-inch frogs, 7 percent in 4-inch to 5-inch frogs, and 9 percent in frogs 3 inches or less in body length.

Conclusions

Under conditions existing in a bottomland minnow hatchery of the southern Illinois region, the bullfrog appears to utilize primarily insects, crayfish, frogs, and minnows as food. Of these principal items minnows are utilized the least. It is questionable if the bullfrog constitutes a very serious predator on minnows under hatchery conditions.

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