THE FOOD OF *RANA CATESBEIANA* SHAW IN PUERTO RICO

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HISTORICAL NOTES[2]

The common bullfrog, *Rana catesbeiana* Shaw, of the Southeastern United States was introduced to Puerto Rico in 1935 by the Insular Department of Agriculture and Commerce. Mr. Adger C. Smyth, head of the Ornithology and Pisciculture Service, notes in its 1935 Annual Report that a total of 40 frogs from Florida were placed in a specially constructed pond at Río Piedras. In the 1936 Annual Report he stated that the introduction and breeding of the bullfrog in Puerto Rico had been very successful.

The present range of the bullfrog in the Island is not known exactly, but may be expanding rapidly in the more humid coastal areas. The frog is at present definitely known to be in the environs of Río Piedras and neighboring towns, and at Mayagüez and Humacao. Most recently it was reported from Barceloneta, where it caused a great deal of nervousness among the inhabitants who had never before heard the noise made by the male frog. So many stories and superstitions were current about these noises in the night that the Station had to explain the cause in the newspapers to bring peace to those people. The same thing happened some 10 years ago in the vicinity of Río Piedras, but this time a continental lady, Miss Asca Watson, who probably had heard the bullfrog's croak many times in the States, cleared up the mystery. She called a group of neighbors one night and with the aid of a flashlight and a home-made net caught the amphibian ghost and showed it to the astonished people.

REASONS FOR UNDERTAKING THIS WORK

The leading crop in the island of Puerto Rico is sugarcane, the cultivation and manufacture of which employs around 40 percent of the Island population. Other crops are pineapples in the coastal areas and coffee and tobacco in the mountains.

Together with the ravages caused by the sugarcane mosaic disease around 1915–1920, white grubs of the genus *Phyllophaga* have most seriously threatened the sugarcane industry. They attacked not only sugarcane but almost every other crop grown. Mr. Harold E. Box, Entomologist

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[2] Presented at the sixty-first Annual Meeting of the American Association of Economic Entomologists, at Tampa, Fla., Dec. 16, 1949.

of Central Aguirre (1925),[3] gave a good picture of the seriousness of the situation when he noted that "the administration of one of the largest concerns operating in the south coast of Puerto Rico spent approximately $15,000 upon six million grubs and 4 million adults of *Phyllophaga* during five years 1919–1923 inclusive, in hand collection control".

The situation had become so critical that, with the objective of finding a remedy for this pest, the Sugar Producers Association of Puerto Rico founded the Agricultural Experiment Station now at Río Piedras.

Mr. D. W. May, Director of the Federal Experiment Station at Mayagüez, introduced a few toads, *Bufo marinus* (L.), from Barbados; in 1920 and 1923, Mr. R. Menéndez Ramos, Director of the Insular Experiment Station, made an introduction from Jamaica of the same species of toads, which were released at Río Piedras.

The studies by Mrs. Raquel Dexter (1932), showed that no factor other than the toad had contributed more to the rescue of the main agricultural crop from destruction by white grubs.

However, the hero of such a wonderful performance was readily forgotten by many a farmer, as well as by the large sugarcane corporations, until recently the toad population began to decrease. Among the factors responsible are: (1) the prolonged periods of drought that dried up the most important breeding areas, especially the Cartagena and Guánica lagoons in southwestern Puerto Rico, (2) the abundance of the aquatic larvae of the Dystiscid beetle, *Megadytes giganteus* Castelnau, predaceous on the immature stages of the toad, (3) lack of food after most of the Maybeetle adults of the white grubs had been devoured by the toads and (4) ignorance of farmers who destroyed the toads because they thought that they ate chicks.

It was thought that one of the additional factors possibly affecting the reduction of the toad in Puerto Rico might be competition with the increasingly abundant bullfrog. The adult frog, living in the same environment as the toad's pollywogs, might also be eating them, for there was evidence that the frog in the States ate frog pollywogs (Frost, 1932). With the help of Dr. George N. Wolcott, and at his suggestion, the author started studying the stomach contents of the bullfrog in Puerto Rico.

METHODS OF COLLECTION AND STUDY

With the aid of a long-handled net the frogs were caught as early in the morning as possible in a nearby brook.

Mr. Harold C. Plank, Entomologist for the Federal Experiment Station in Puerto Rico, very kindly sent 12 alcoholic-preserved alimentary tracts from the Mayagüez area.

[3] For this and other references see Literature Cited, pp. 141–42.

A total of 50 frogs were examined during the year 1948–49, starting with the month of August.

Immediately after killing, the animal was dissected, the stomach contents placed in a petri-dish and examined with the aid of a binocular. The insects that were found were checked with the Station collection and the snails and undetermined insects were sent to the U. S. National Museum for determination. We are greatly indebted to Mr. C. F. W. Muesebeck for insect and snail identifications and to Miss Doris Cochran for confirming identification of the frogs.

FOOD ITEMS FOUND IN THE STOMACHS OF 50 BULLFROGS, *RANA CATESBEIANA* SHAW, IN PUERTO RICO

	Percent
Platyhelminthes	0.7
Trematode (free living species)	
Nematode	
Mollusca	3.7
Subulina octona Brugiere, determined by Div. of Mollusks,U. S. N. M.	
Australorbis glabratus (Say)	
Physa cubensis Pfeiffer	
Family Acteonidae	
Family Pupillidae	
Annelida	.3
Isopoda	.24
Sowbugs	
Arachnida	2.86
Cyrtopholis portoricae (Chamberlin)	
Family Marpissinae	
Red spider	
Myriapoda	5.52
Orthomorpha coarctata (Saussure), determined by H. F. Loomis	
Trigonulus lumbricinus (Gerstaecker), determined by Prof. Nathan Banks	
Unidentifiable Diplopod	
Dermaptera	.92
Doru albipes F.	
Anisolabis sp.	
Orthoptera	1.9
Periplaneta australasiae F.	
Supella supellictum Serville	
Pycnoscelus surinamensis L.	
Achetz assimilis F.	
Orocharis vaginalis Saussure	
Isoptera	.19
Nasusitermes costalis Holmgren, all soldiers	
Odonata	1.3
Enallagna sp.	

	Percent
Homoptera	.09
Agallia sp.	
Sibovia coffeaphila Dozier	
Undetermined fulgorids	
Undetermined aphids	
Hemiptera	7.00
Belostoma boscii Lep. & Serv.	
Limnogonus franciscanus Stål	
Undetermined coreid	
Undetermined lygaeid	
Coleoptera	3.94
Calosoma sp.	
Harpalus sp.	
Megadytes giganteus Castelnau	
Stetoxus intermedius Jacq. Duvál	
Dactylosternum sp.	
Parachalepus barbatus F.	
Selenophorus sp.	
Undeterminable Dytiscids	
Undeterminable Tenebrionids	
Anchonus suillus F.	
Metamasius hemipterus L.	
Cosmopolites sordidus Germar	
Diaprepes abbreviatus L.	
Diptera	.56
Asilid larvae	
Drosophilid fly	
Phorid fly	
Musca domestica L.	
Lepidoptera	.89
Prodenia sp. larva	
Pyralid caterpillar	
Acrolophus sp. larva	
Hymenoptera	2.14
Odontomachus haematoda L.	
Camponotus ustus Forel	
Solenopsis geminata F.	
Prenolepis longicornis Latreille	
Phleidole sp.	
Monomorium sp.	
Crassimicrodus sp.	
Apis mellifera L.	
Amphibia	3.90
Rana catesbeiana Shaw (pollywogs and small adults)	
Plant matter	10.58
Spathodea campanulata (seeds)	
St. Augustine grass leaves	

	Percent
Chilean willow leaves	
Clover leaves	
Cladophora moss	
Undetermined	3.36
Digested matter	45.10

DISCUSSION OF RESULTS

In none of the 50 frogs dissected during all seasons of the year in Puerto Rico was there any evidence that this Amphibian feeds on the toad's pollywogs. However, it ate pollywogs and small adults of its own species in Puerto Rico, as has previously been reported in the States (Frost, 1932).

Although the bullfrog is not as highly effective as the toad in devouring the most important economic pests of the island, it does eat them to a certain extent. Among the insects of economic importance found in the frog's stomach contents are the following:

Periplaneta australasiae—the Australian roach
Achetz assimilis—the common cricket, very destructive to foodstuffs, plants, and clothing.
Nasusitermis costalis—the "comején" termite
Metamasius hemipterus—the rotten cane-stalk borer
Cosmopolites sordidus—the banana corm borer, very injurious to bananas
Diaprepes abbreviatus—a common injurious leaf weevil which attacks almost every crop both as larva and adult
Megadytes giganteus—ferocious enemy of pollywogs
Prodenia caterpillars—cutworms
Pyralids (caterpillars)
Musca domestica—the common housefly
Solenopsis geminata—the fire ant, very injurious to many crops

It is rather interesting to note, comparing the food habits of the giant Surinam toad, *Bufo marinus*, with those of the bullfrog that the latter are considerably more diversified. According to Mrs. Raquel Dexter (1932) the highest total (43.3 percent) of the stomach contents of the toad was of Scarabaeid beetles, with very small percentages of other insects found. The bullfrog, on the other hand, shows more nearly equal percentages of the most important groups of insects and other small animals.

This difference in food eaten is most probably due to the fact that the bullfrog gets its food both from the water and from the ground, whereas the toad catches its food on the ground only.

The mollusk *Australorbis glabratus* (Say), the intermediate host of the common tropical disease known as Bilarhzia, has been found in a tenth of the frog's stomachs. Hoffman and Janer (1941), found that in a series of

analysis of feces of the toad *Bufo marinus* (L.), 26 had the parasite's ovum alive. Dr. Hoffman considered the toad as a potential menace acting as a mechanical vector of the disease. Having in mind that the frogs' habits are more restricted to water, we might expect the frog to be an even greater menace as a mechanical vector of the parasite.

The predacious larvae of *Megadytes giganteus* devours with insatiable appetite the pollywogs of both frog and toad, as well as other aquatic insects, including its own smaller larvae. However, the adult frog avenges this by eating the adults of the beetle.

Another instance of natural retribution is also shown in the food habits of the frog feeding frequently on the common Puerto Rican water bug, *Belostoma boscii* Lep & Serv. This aquatic hemipteran and other species of the group, have been reported as feeding on fish, as well as pollywogs and aquatic insects. They are strongly attracted to light in such great numbers that in many instances they are a great nuisance. L. O. Howard (1908) states that in Washington they fly to electric lights close to fish ponds, later falling to the water and devouring the fishes. Presumably, in Puerto Rico they feed on beneficial fishes like *Gambusia* spp. introduced for mosquito control.

In general, the bullfrog eats the same kinds of food in Puerto Rico as has been reported in continental United States (Frost, 1924), practically no items being beneficial to man, and although the majority are neutral, some are injurious species. The introduced bullfrog by no means eats as many injurious insects as does the introduced toad, and indeed, eats so few of them that it can hardly be considered a serious competitor with *Bufo marinus*.

The adult of each inhabits its own niche, and if the pollywogs of both live in the same pool, there is always an ample supply of ever-renewed algae to feed them. Nor is the bullfrog predaceous on either the pollywogs of the toad, or the very small adults, and any decrease in the abundance of the toad in Puerto Rico must be ascribed to other factors than the introduction of the bullfrog.

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