

WHAT THE GIANT SURINAM TOAD, *BUFO MARINUS* L., IS EATING NOW IN PUERTO RICO

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In the history of man's attempts to control pests by the introduction of some other animal to attack and destroy them are numerous instances of the later development of less desirable or injurious habits by the introduced animal after the numbers of the pest on which it is normally supposed to feed have been greatly reduced, and its shrinking supply of food must be augmented by the substitution of other items, neutral or even beneficial to man, if it is to continue to exist in large numbers. Such an eventual result has been predicted in the case of the giant Surinam toad, *Bufo marinus* L., in Puerto Rico.

Originally introduced in 1920 and 1924 to control white grubs in cane fields, it proved so extraordinarily successful within the next ten years, because of its decided preference for the adults (May beetles, or "caculos") of the white grubs, that they have now ceased to be of appreciable economic importance in all the more level coastal regions where cane is most extensively grown (3). It might possibly be expected that the toads, deprived of their main source of food and forced to find new sources or perish, would have already begun to be a much less desirable permanent addition to the fauna of the Island than when engaged in the elimination of the white grub pest. Their present status indicates, however, that such fears were quite unfounded. Altho not susceptible to statistical proof, it is a matter of common observation that toads are much less abundant now than a few years ago.

One possible contributing cause to their present comparative scarcity is that some insects or other animals already present in Puerto Rico before the importation of the toad, and of course quite unaccustomed to feed upon it or affect it in any way, have gradually learned to attack it. One such striking instance is the large number of predaceous diving beetle larvae (Dytiscidae), *Megadytes giganteus* Castelnau, as determined by Dr. S. E. Danforth, which have been noted developing recently in a pool only a few weeks previously well stocked with tadpoles of *Bufo marinus*. Presumably the fundamental cause of the scarcity of the toads, however, is lack of food, which may either prevent normal reproduction, or cause actual star-

vation of toads unable to change their habits and develop a broader basis of nourishment.

For determining whether the Surinam toad has changed its food habits in the last few years, the investigations conducted by Mrs. Raquel R. Dexter (1) in 1931, when the toad had presumably attained its maximum abundance in Puerto Rico, are most useful. She collected three hundred toads from eighteen localities, all of them in the lowlands or cane-producing sections of the Island, where the toads were very abundant at that time. The data given by her are based on stomach contents examinations, and are expressed in percentage of the total bulk of the food there found. Scarabaeid beetles, the adults of white grubs (neutral and non-injurious species, as well as the economic pests) she found to constitute 43.3 per cent of the total food of the toad at that time; millipeds one-fourth of the total, Curculionid weevils one-sixth and mole-crickets or "changas" only one-fortieth. The Scoliid wasp, *Campsomeris dorsata* F., a parasite on the larvae of the rough black Scarabaeid beetle, *Ligyris tumulosus* Burmeister, was found to constitute 5.1 per cent of the food of the toad, while the host beetle adult was 12.0 per cent of the toad's food. Such intensive consumption of these two insects, host and parasite, could not fail to produce decisive results in lessening their numbers, an eventuality which was reported by the present writer (2) in 1934. The *Ligyris* grubs are strictly saprophytic, and neutral in their relations to the interests of man, but those of the yellow-brown May beetles are the white grubs which were such serious pests of sugar-cane and other crops. Their adults formed over one-quarter of the food of the toad, and the result soon became obvious to every cane-grower on the Island. Millipeds are most common in well-rotted manure or compost heaps, or in old malojillo grass, and are of so little direct importance to man that not even estimates of their abundance are available. One of their most annoying habits was to crawl over the concrete porch of a house at the Experiment Station in such numbers during wet weather that no sooner were they swept away at one end than an equal number had already appeared at the other. This no longer occurs, and while millipeds can still be found in abundance in suitable locations, they seem much less numerous generally. Of all the important items in the food of the toad as noted by Mrs. Dexter in 1931, only the common Otiorynchid weevils or "vaquitas", seem to have decreased slightly, if at all, since that time.

The toads themselves are so much less numerous than formerly that considerably numbers can be observed only in the most favorable locations. A small, sluggish brook runs thru the grounds of the Agricultural Experiment Station at Rio Piedras, and on one side a considerable expanse of well-kept lawn rises in gentle slope. Even one casually crossing the lawn in the daytime will often note pellets of toad excrement on it, especially after two or three rainy nights when the toads have been active. An examination of these pellets gives by no means as exact a record of the food habits of the toad as would stomach examinations, for some items may be so lightly chitinized as to be completely digested. But so many of the normal items of the toad's food are heavily chitinized that their undigested remains in the excrement pellets may be taken as a reasonably accurate indication of the bulk of the food. The results of the examinations can not be expressed as bulk percentages, but only as numbers of the insects found. The first collections, made over a year ago at Rio Piedras, were few in number, and at the time little regarded, but when compared with the much more numerous collections of this spring are seen to be surprisingly similar. It should be noted, however, that these observations were confined to a single restricted locality, and that a somewhat wider range of food might be expected if examinations were made from more localities, and at other times of year.

Table No. 1.

The Contents of the Pellets of Excrement of the Giant Surinam Toad, *Bufo marinus* L., at Rio Piedras, Puerto Rico, 1935-36.

14 pellets, May 9, 1935, contained:

- 36 black Scarabeid beetles, *Parachalepus (Dyscinetus) barbatus* F.
- 3 large brown May beetles, *Phyllophaga (Lachnosterna) portoricensis* Smyth
- 2 cucubanos, *Pyropnorus lumnosus* Illiger
- 1 cockroach, *Periphaneta americana* L.
- 1 stone

5 pellets, Sept.-Oct., 1935, contained:

- 21 black Scarabeid beetles, *Parachalepus (Dyscinetus) barbatus* F.
- 4 common Otiiorhynchid weevils, or "vaquitas", *Diapreps abbreviatus* L.
- 1 large brown May beetle, *Phyllophaga (Lachnosterna) portoricensis* Smyth
- 1 blade of grass

58 pellets, April 23-28, 1936, contained:

- 118 black Scarabaeid beetles, *Parachalepsus (Dyscinetus) barbatus* F.
- 195 large brown May beetles, *Phyllophaga (Lachnosterna) portoricensis* Smyth
- 6 small brown May beetles, *Phyllophaga (Lachnosterna) citri* Smyth
- 1 rough black Scarabaeid beetle, *Ligyris tumulosus* Burmeister
- 1 common Otiorynchid weevil, or "vaquita", *Diaprepes abbreviatus* L.
- 4 leaves
- 2 stones
- 1 seed

12 pellets, collected September 14, 1936, contained:

- 54 black Scarabaeid beetles, *Parachalepsus (Dyscinetus) barbatus* F.
- 2 large brown May beetles, *Phyllophaga (Lachnosterna) portoricensis* Smyth
- 3 common large Otiorynchid weevils, *Diaprepes abbreviatus* L.
- 1 large bee ??
- 1 cockroach, near *Pycnoscelus*
- 1 large Pentatomid bug, *Nezara viridula* L.
- 1 large scorpion
- 1 milliped
- grass
- vegetable fiber
- mud

1 pellet, collected September 20, 1936, at Loíza Aldea, in field of young plant cane where changa tunnels were abundant, contained:

- 2 large brown May beetles, *Phyllophaga (Lachnosterna) portoricensis* Smyth
- 4 common large Otiorynchid beetles, *Diaprepes abbreviatus* L.

1 pellet, collected October 20, 1936, at Central San Vicente, Vega Baja, in field of young ratoon cane, "poyal" land, contained:

- 5 rotten cane stalk weevils, *Metamasius hemipterus* L.
- 2 common large Otiorynchid beetles, *Diaprepes abbreviatus* L.
- 1 large dark green Cicindelid beetle, *Tetracha sobrina infuscata* Mann.
- 2 millipeds

For instance, the rough black Scarabaeid, *Ligyris tumulosus* Burmeister, occurs normally in sandy land, and in sandy localities doubtless still forms an important item in the food of the toad, together with its wasp parasite, *Campsomeris dorsata* F. On the other

hand, it is quite inexplicable that of the two common small black Scarabaeid beetles; *Parachalepus (Dyscinetus) barbatus* F. and *Dyscinetus picipes* Burmeister (= *D. trachypygus* Burmeister), only one of the latter should be found eaten by the toads in Río Piedras in 1935-36, for in past years collections (by entomologists) of both species in abundance have been made there as well as in other parts of the Island.

The inclusion of stones and vegetable matter in the excrement of the toads was probably accidental, and incidental in obtaining the living items in their food. The absence of millipeds is possibly due to local scarcity on the lawn, for a single pellet examined in August 1936, picked up from beside a compost heap containing millipeds, was found to contain nothing else but their remains and earth. Of the insects other than the Scarabaeid beetles, it is a matter of common observation, and great regret, that the cucubano, *Pyrophorus luminosus* Illiger, is so much less common now at Río Piedras than it was before the introduction of the toad. In the mountains of Puerto Rico, where toads are noticeably scarce, the cucubano seems to be quite as abundant as it ever was. Thus it would appear that the cucubano continues to occur in normal abundance in the mountains because of the permanent scarcity of the toad there, while in the moist lowlands it barely manages to survive. The scarcity of the common Otorhynchid weevil, or "vaquita", *Diaprepes abbreviatus* L., in the pellets of toad excrement examined is accidental, and possibly due to a temporary scarcity of the adults at the time the pellets were collected, for the insect still seems very abundant, and despite its normally aerial and diurnal habits, in previous years was an important item in the food of the toad.

It would thus appear that, while no decided change in the food habits of the toad has occurred in recent years due to the increasing scarcity of May beetles, the even greater scarcity of some of the other insects and other animals previously eaten makes the trend towards an even more exclusive selection of the adults of white grubs for its food. Such a statement seems hardly logical, yet the data point to no other conclusion. It indicates that the introduction of *Bufo marinus* into Puerto Rico for the control of white grubs was not only an immediate and temporary success, but tends, at least so far as the food habits of the toad determine its trend, continually to become more effective and more permanent.

LITERATURE CITED:

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