Prey of the Introduced *Bufo marinus* on American Samoa

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The giant cane or marine toad, *Bufo marinus*, is native to Central and northern South America (Zug and Zug 1979) but has been widely introduced to islands in the West Indies, the Pacific, Australia, and New Guinea (reviewed by Zug et al. 1975). In many areas it was introduced primarily to control sugar cane insect pests and has apparently been fairly successful in some areas in reducing damage to this crop (Wolcott 1937).

Bufo marinus was introduced from Hawaii to Tutuila Island (14°20'S, 170°43'W), American Samoa, in 1953 and the population was estimated to be over 2 million by 1976 (Amerson et al. 1982). Toads occur island-wide on Tutuila, have colonized neighboring Aunu'u Island, but do not presently occur on the nearby islands of Tau, Ofu, and Olosega, nor on Savaii and Upolu of Western Samoa.

Marine toads have catholic tastes (Alexander 1965; Hinckley 1963; McCoid 1994; Zug et al. 1975). The purpose of this study was to examine the food habits of marine toads in two different habitats on Tutuila, American Samoa.

On Tutuila Island, 26 toads were collected in suburban and park areas in the village of Tafuna and 28 were collected in secondary forest and primary rainforest (forest) of Amalau and Olovalu Crater near Futiga. Toads were collected from 24 October 1992 to 13 July 1994 and always 2–4 h after sunset to allow some time for foraging by the toads. Collected toads were immediately placed in plastic bags and frozen until processing.

TABLE 1. Mean (standard deviation) snout-vent lengths (SVL), jaw width (JW), and body mass minus stomach contents (BM) for 54 *Bufo marinus* in two habitats on Tutuila, American Samoa. Probabilities based on unpaired t- test.

	Combined N = 54	Suburban/Park N = 26	Forest N = 28	P
SVL (mm)	97.2 (13.9)	88.5 (11.9)	105.4 (10.2)	0.000
JW (mm)	36.9 (5.5)	33.8 (4.9)	39.8 (4.3)	0.000
BM (g)	90.6 (41.8)	68.0 (29.9)	111.6 (37.0)	0.000

TABLE 2. Mean (standard deviation) weight of entire contents, animal contents, and plant/grit contents from stomachs of *Bufo marinus* from two habitats on Tutuila, American Samoa. Probabilities based on t- tests.

	Suburban/Park N = 26	Forest N = 28	P
Entire contents (g)	2.3 (1.8)	4.7 (3.2)	0.001
Animal contents (g)	1.3 (1.7)	2.9 (2.1)	0.004
Plant/grit contents (g)	1.0 (1.2)	1.8 (1.9)	0.058

Intact toads, entire stomach contents, animal content of stomachs, and plant/grit content of stomachs were weighed to the nearest 0.1 g on a triple-beam balance. Snout-vent length (SVL) and maximum width of the jaws was measured with dial calipers to the nearest 0.1 mm. Animal prey were identified to the lowest possible taxonomic level and quantified.

Forest toads were longer, had wider gapes, and weighed more than suburban/park toads (Table 1). In addition, the stomachs of forest toads contained twice as much food by mass as did those of suburban/park toads. Animal contents, but not plant/grit contents, of the stomachs were significantly greater in forest toads (Table 2).

Toads in both habitat types took a wide variety of prey (Table 3). Nearly one half of the prey taken by forest toads was millipedes, whereas suburban/park toads took more moths, caterpillars, and beetles. The largest centipede taken was 51 mm long. Termites, geckos, and dog food were also eaten by toads in suburban/park habitats (P. Craig, B. Grant, P. Trail, pers. comm.), but the latter two items were not found in the stomachs of this study. Nearly equal numbers of animal prey were found in suburban/park toads (227) as in forest toads (217). Because the animal con-

tents in stomachs weighed twice as much in forest toads, individual prey items taken were substantially larger, on average. Toads took substantial quantities of plant material. Eighteen (69.2%) of suburban/park toad stomachs and 20 (71.4%) of forest toad stomachs contained plant material. Many very small arthropods were found among the vegetation in some toad stomachs. Two pieces of plastic wrap measuring 4 cm x 2 cm and 3 cm x 2 cm were found in one forest toad.

Zug et al. (1975) reported that *B. marinus* in rainforest habitats of New Guinea were both longer and heavier than savannah toads, a finding similar to that reported here. The body size differences reported in savannah and rainforest toads was attributed to the greater quantity and quality of food taken by rainforest toads (Zug et al. 1975). The size differences observed in American Samoan toads may be attributed to prey quality and quantity, sex ratio differences in the populations, or increased mortality rates in the suburban/park population. Unfortunately, I did not sex toads collected in this study. Zug and Zug (1979) showed that in neotropical populations females attained larger body size than males and that sex ratios varied in different populations. Some populations had twice as many males as females; others had twice as many females as males. Increased mortality rates were likely in the Samoan suburban/park habitat due to the presence of street lights and roads. Surface water for breeding was available in both Samoan habitats. Thus, the size differences are probably not due to differential recruitment rates.

Samoan forest toads consumed twice the quantity and animal content as did the suburban/park toads. Prey diversity was much greater in New Guinea toads (Zug et al. 1975) than Samoan toads, probably due to decreased prey diversity on small, distant islands. *Bufo marinus* is known to consume a wide variety of prey, including geckos, other toads, arthropods, vegetable matter, dog and cat food, and discarded pork spare ribs (Alexander 1965; Hinckley 1963; McCoid 1994; Zug et al. 1975; this study).

Many small arthropods (especially beetles and true bugs, Table 3) were found among some of the plant material in toad stomachs. Perhaps these arthropods were taken incidental to feeding on plant material, or conversely, the taking of plant material was

TABLE 3. Animal prey of 54 *Bufo marinus* in two habitats on Tutuila, American Samoa (N = sample size, NS = number of individuals with a particular prey item; NP = number of prey eaten).

	Suburban/Park (N = 26)				Forest (N = 28)			
Prey Types	NS	%	NP	%	NS	%	NP	%
Mollusca								
Snails*	7	9.0	16	7.0	5	7.0	6	2.8
Slugs	0	0	0	0	4	5.6	4	1.8
Arthropoda								
Scorpionida	1	1.3	1	0.4	0	0	0	0
Araneida	1	1.3	1	0.4	1	1.4	1	0.5
Isopoda	1	1.3	1	0.4	0	0	0	0
Diplopoda	9	11.5	24	10.6	17	23.9	96	44.2
Chilopoda	2	2.6	2	0.9	2	2.8	5	2.3
Orthoptera	6	7.7	11	4.8	0	0	0	0
Dermaptera	11	14.1	19	8.4	5	7.0	5	2.3
Hemiptera	3	3.8	6	2.6	2	2.8	2	0.9
Coleoptera	17	21.8	54	23.8	11	15.5	31	14.3
Lepidoptera	11	14.1	77	33.9	12	16.9	36	16.6
Diptera	1	1.3	1	0.4	1	1.4	1	0.5
Hymenoptera	6	7.7	12	5.3	11	15.5	30	13.8
Miscellaneous**	2	2.6	2	0.9	0	0	0	0

* includes 2 *Ostodes strigatus* and 20 *Subulina octona.*
** includes a fish scale 12 mm long and the tibia of *Rattus* sp.

incidental to the taking of small arthropods. The presence of a *Rattus* sp. tibia and a fish scale in toad stomachs is probably best attributed to incidental take while feeding on arthropods associated with carrion. Prey taken by neotropical populations of toads varied from one locality to the next and probably reflects the seasonal and habitat abundance of prey (Zug and Zug 1979).

Zug et al. (1975) reported toad densities 10 times greater in savannah habitats. I made no attempt to quantify densities. However, on Tutuila, American Samoa, population densities of *B. marinus* are highest in lowland areas with mowed lawns and villages and lowest in upland villages and forests (Amerson et al. 1982).

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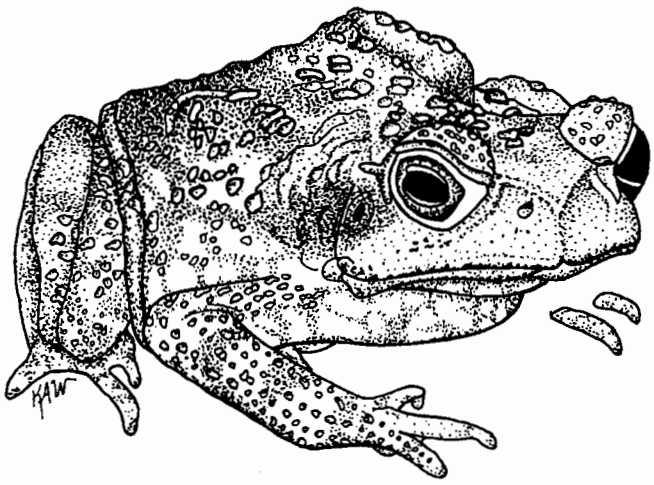

Bufo marinus (Cane or Marine Toad). USA: Puerto Rico: Caribbean National Forest. Illustration by Karen A. Wilson.