

Food of the Marine Toad, *Bufo marinus*, and Six Species of Skink in a Cacao Plantation in New Britain, Papua New Guinea

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Abstract

Food items from the stomachs of the toad *Bufo marinus* comprised 88% snails and ants. The main single item of food of the skinks *Carlia fusca*, *Emoia baudinii*, *E. callisticta*, *E. mivarti*, *Lamprolepis smaragdina* and *Sphenomorphus jobiensis* was lepidopteran larvae.

Introduction

Cacao trees in plantations around Keravat (4° 21' S., 152° 2' E.; average annual rainfall 278 cm), on the Gazelle Peninsula of New Britain, are commonly grown beneath the canopy of the shade tree, *Leucaena leucocephala*. In these two types of tree, and in the thick and generally weedless leaf litter on the floor of the plantation, five species of skinks are commonly found; the toad *Bufo marinus* is also common. *B. marinus* was introduced to New Britain in 1939 to control the sweet potato hawk-moth, *Hippotion celerio* (Szent-Ivany 1972).

The abundance of these predators suggested that they may influence the numbers of arthropods of economic significance in cacao growing. The aim of this preliminary study was to observe the pattern of feeding of these predators, and the incidence of economic species in their diet.

Methods

Approximately 15 toads, and as many skinks as could be caught by hand in 30 min by three persons, were collected on one day of each month of 1972 between 0800 and 1500 h. The stomachs were dissected within 2 hours of capture, and the contents individually stored in alcohol.

The frequency of occurrence of items identifiable under a dissecting microscope was recorded.

Results

The species of skinks and where they were caught are shown in Table 1. No detailed habitat observations were made, but the two species caught on the trunks of *Leucaena* and cacao were rarely observed on the ground. The four species of skink caught on the ground were mostly found amongst leaf litter and around the bases of trees. However, some of the food found in their stomachs suggests that they may seek food in the trees. Toads were found almost exclusively on or beneath leaf litter, or around the bases of trees.

Ants composed 46% of the dietary items of toads. Two species predominated: the ground-dwelling *Odontomachus simillimus* (25% of food items), and *Oecophylla smaragdina* (15%), which nests in the foliage but may forage on the ground. Snails composed 42% of food items; these included the small snail, *Subulina octina* (37%),

and small individuals of the giant land snail, *Achatina fulica* (2%). Most of the remaining 12% of food items were from four insect orders (Fig. 1). Two beetles of economic importance were recorded: adults of the cacao weevil borer, *Pantorhytes plutus*, and adults of an unidentified species of dung beetle (Scarabaeinae). Amongst the trace items (frequency of <1%), two skinks and two small toads, respectively, were found in individual stomachs.

Table 1. Species of toad and skink caught

Species	Where caught	No. stomachs examined	No. of food items
Amphibia : Bufonidae			
<i>Bufo marinus</i> (Linnaeus)	Ground	162	2423
Reptilia : Scincidae			
<i>Carlia fusca</i> (Dumeril & Bibron)	Ground	99	408
<i>Emoia baudinii</i> (Dumeril & Bibron)	Ground	20	67
<i>E. callisticta</i> (Peters & Bibron)	Ground	35	149
<i>E. mivarti</i> (Boulenger)	Ground	17	101
<i>Lamprolepis smaragdinum</i> (Lesson)	Tree	37	110
<i>Sphenomorphus jobiensis</i> (Meyer)	Tree	20	88

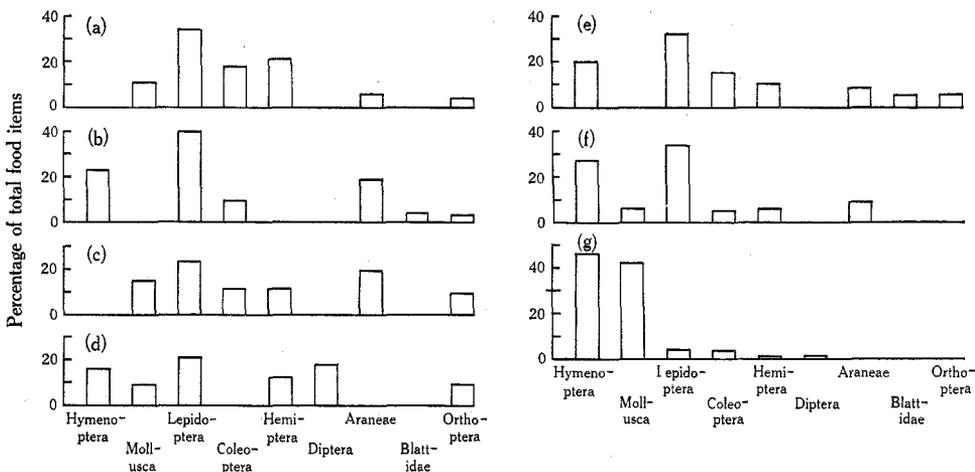


Fig. 1. Percentage frequency of food items eaten by the toad *Bufo marinus* and six species of skink in New Britain. (a) *Sphenomorphus jobenesis*. (b) *Emoia mivarti*. (c) *E. callisticta*. (d) *E. baudinii*. (e) *Lamprolepis smaragdinum*. (f) *Carlia fusca*. (g) *Bufo marinus*.

The most common food item in the diet of all six species of skink was lepidopteran larvae. These larvae were often very common in the canopy, feeding on leaves; they were rarely observed on the ground. The cacao webworm, *Panseptia teleturga*, represented 6% of the food items of *Emoia baudinii* and was found in *E. callisticta* (1%) and *E. mivarti* (1%). The cacao webworm channels into cacao branches and the entrance to the channel is covered by frass; its larvae would thus have to be actively sought by skinks. Other items of skink diet included representatives of a variety of taxa, most of which were found on the trees, rather than on the floor of the plantation.

Discussion

The diversity of taxa found in the stomachs of *B. marinus* is consistent with observations (reviewed by Clarke 1974) that toads of the genus *Bufo* are indiscriminate feeders. In the present study, the food items in toads' stomachs appeared to be in rough proportion to their accessibility to toads in the cacao plantation. The abundance of ants, particularly *Odontomachus simillimus* and *Oecophylla smaragdina*, in New Guinea cacao plantings is reflected in their predominance in toads' diet. Similarly, the prominence of ants in the diets of toads in Trinidad and British Guiana was noted by Weber (1938). Snails were also abundant in the study area, and formed the second most frequent food item. Beetles, which form a consistently large part of the diet of toads elsewhere (Krakauer 1968; Clarke 1974; Pippet 1975), were not abundant on the floor of the cacao plantation, and were infrequently eaten by toads.

The variety of food items in all six species of skink suggests that they were general predators. However, there was some evidence of selective feeding behaviour; all six species had caterpillars as the first-ranking food item. The presence of arboreal prey in the stomachs of skinks which were observed to be ground dwellers during the day suggests that these skinks may, in fact, have fed in the canopy unobserved. Every few years there is an outbreak of defoliating caterpillars which cause considerable damage to cacao trees; it is possible that skinks are among the natural controlling factors of these caterpillars in normal years.

Ants and snails appear less frequently than in toads' stomachs, and it is possible that skinks tended to avoid them.

The presence of an abundance of generalized vertebrate predators in the cacao plantation, and the presence of pest species in their stomachs, suggest the possibility that toads and skinks may exert some control over pests of cacao. There have been reports of control of pest species by *B. marinus*. In Puerto Rico the sugar cane rhinoceros beetle, *Strategus barbigerus*, disappeared after the introduction of *B. marinus*, but remained a pest on a nearby island where toads were not introduced (Wolcott 1950). Also in Puerto Rico, the increase in a number of other pests has been associated with the disappearance of the toad in some areas (Wolcott 1948). In Barbados, *B. marinus* is regarded as an important predator of some sugar cane pests (Tucker 1940). Pippet (1975) lists a number of cacao pests eaten by *Bufo marinus* at Popondetta, on the main island of New Guinea.

There have also been reports of toads eating beneficial species. *B. marinus* was thought to have prevented the establishment of introduced predators of *Oryctes rhinoceros* in Fiji (Simmonds 1953). *B. marinus* has been found to eat dung beetles in Fiji (Hinckley 1963), New Guinea (Pippet 1975) and New Britain (present study). The presence of toads, then, should be considered before any attempt is made to introduce exotic dung beetles into Papua New Guinea.

The ant *Oecophylla smaragdina* is thought to control a number of cacao insect pests, and plans for management of this species have been suggested (Room 1973). The presence of numbers of *O. smaragdina* in toads' guts suggests that toads may limit the spread of this beneficial ant.

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