

Observations on the Influence of Frogs on the Ecology of Coffee Plantations in the Western Highlands of New Guinea.

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Introduction.

IN the course of a field survey of the frog fauna inhabiting the Wahgi Valley in the Western Highlands of New Guinea in 1960, many specimens were found to occur in coffee plantations. As it is well known that frogs are insectivorous animals, an attempt was made to establish the role played by these creatures in controlling insect pests of coffee.

Diet of Frogs and Toads.

There is a certain amount of controversy as to whether frogs and toads are selective feeders, accepting certain kinds of potential food items and rejecting others, or indiscriminate, accepting any small moving object. A frog in the latter category will ingest insects which are likely to be injurious to it (e.g., stinging bees), and have even been known to accept inanimate material such as stones.

The range of prey ingested by frogs and toads has been determined by direct observations in the field and examination of their stomach contents, supplemented by palatability trials conducted under artificial conditions in the laboratory, revealing that almost all orders of insects are eaten. There is an indication that availability of prey is the all important criterion in some species, so that their diet indicates the relative abundance of insects sharing the same environment.

Frogs and toads have long been regarded as beneficial to the horticulturalist, and in 1936 the American toad *Bufo marinus* was introduced into Queensland in an attempt to control insect pests of sugar cane. The introduction was opposed by local apiarists on the grounds that the toads would be just as likely to consume their bees. The value of this attempt at biological control is not easily assessed, and the population of the predators has now reached almost plague proportions in some areas.

New Guinea Frog Fauna.

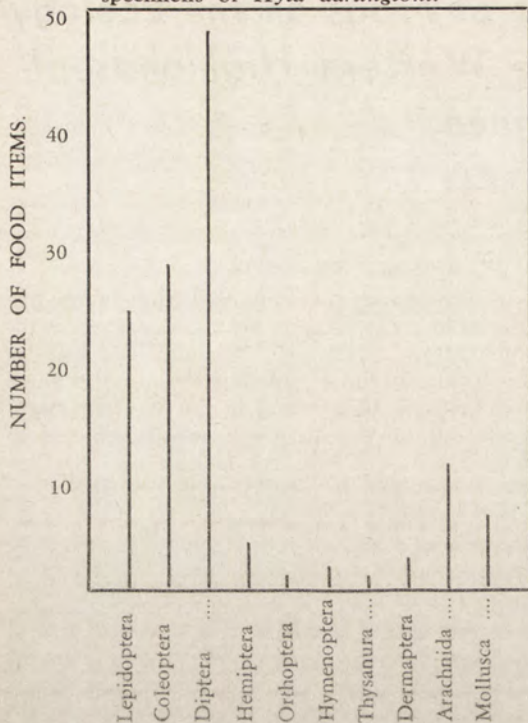
Approximately one hundred and twenty-five species of frogs occur in New Guinea, representing the families Hylidae, Microhylidae, Ranidae and Leptodactylidae. Members of the first three families have been found in the Western Highlands but, as the Microhylidae are confined to moss forest, it is only the Hylidae and Ranidae which are likely to inhabit coffee plantations.

The Hylidae are commonly known as tree frogs. The majority are well adapted to an arboreal life by possessing large circular discs at the tips of their fingers and toes, which enable them to gain a purchase upon smooth vertical surfaces.

The only hylid reported to inhabit coffee plantations is *Hyla darlingtoni* (Tyler, in press). This species has a maximum length of approximately two inches, and may be distinguished from other members of the same genus found in this region by its colour in life: upper surface brown with a thin mid-dorsal stripe situated on the skin covering the vertebrae, and black patches on the back of the thighs which are spotted with bright orange.

The Ranidae are known as grass frogs, and are commonly found in damp situations such as beneath long grass on the banks of streams and ditches. *Rana grisea* is the only ranid found in the Western Highlands (Forcart, 1953). It shares with the majority of the members of this genus a pointed head, strong muscular limbs and extensively webbed toes. The back is a golden brown colour and there are several black bands across the thighs. The undersurface of the body is white or cream in adults (yellow in juveniles) mottled with dark chocolate brown. Specimens were found in two plantations beneath decomposing vegetation used for mulching.

Figure 1.—Stomach contents of fifty-three specimens of *Hyla darlingtoni*.



The totals of the Lepidoptera, Coleoptera and Diptera include 19, 2 and 36 larvae respectively. The frogs upon which this point frequency diagram is based were collected in the Wahgi Valley during the period 22.1.60-28.3.60.

The native vernacular names used in the Wahgi Valley are "Wasip" and "Nagungar" for *H. darlingtoni* and "Gemboogal" for *R. grisea*. Although very little is known of their breeding habits, they both appear to select either static or slowly moving water for the deposition of spawn. The form of their spawn masses is unknown, but ova dissected from gravid females of the two species have been found to have a black upper hemisphere, and an unpigmented lower hemisphere.

Diet.

(a) *Hyla darlingtoni*.

The stomach contents of 53 specimens were examined, and 132 food items recovered (see Figure 1).

Approximately 10 per cent. of this total can be regarded as pests of coffee, 10 per cent. (mosquitoes, etc.) as harmful to man, and 5 per cent. (spiders and insect parasites) creatures which could be beneficial.

(b) *Rana grisea*.

This species, being of larger size, showed a marked tendency to ingest food items of greater bulk than those selected by *H. darlingtoni*. Amongst the few stomach contents examined, large grasshoppers and snails were frequently included, but there were also lepidopterous larvae, weevils and other beetles of the families Carabidae and Elateridae.

Discussion.

In a discussion of the pests and diseases of Highlands coffee Barrie (1956) states that two genera of weevils (*Cryptorrhynchus** and *Oribius*) are amongst the most important insect pests. It is therefore of interest to find that five of the Coleoptera ingested were members of the latter genus. *Oribius destructor* and *O. hostis* are defoliating weevils, the adults causing severe damage to coffee leaves.

Hyla darlingtoni is however likely to devour the Coccinellidae which are reported by Barrie to be predators of harmful scale insects and, in such a case, the presence of the tree frog could be regarded as disadvantageous if it failed to control the scale insects as effectively as the Coccinellids had done. Since there is an indication that *H. darlingtoni* may undertake the destruction of some of the more important pests of growing coffee, the possibility that this frog could be introduced into well established plantations for this purpose needs further investigation.

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* This weevil has been described by the late Sir Guy A. K. Marshall in 1959 as *Meroleptus cinctor*. *Papua and New Guinea Agric. J.* 12: 45-46.