

## A Population Explosion in a Tropical Tree Frog: *Hyla rufitela* on Barro Colorado Island, Panama

Tropical forests are not the stable environments they were once thought to be; populations of at least some tropical organisms change greatly over time, both among seasons and years. Most of the evidence for population fluctuations in tropical forest animals comes from invertebrates (Wolda 1978, Wolda and Foster 1978). Examples for vertebrates are largely from reductions in numbers that can be associated directly or indirectly with human influences (birds on BCI, Willis 1974) or disease (howler monkeys and yellow fever, Milton, in press). Populations of some species such as *Anolis limifrons* on Barro Colorado Island (BCI) have been shown to fluctuate from year to year (Sexton 1967, Andrews and Rand, in press). Scott and Starrett (1974) report an extraordinarily dense breeding aggregation of tree frogs (*Agalychnis spurrelli*), probably as the result of highly favorable breeding conditions provided by a man-made pond. In this paper, we report a dramatic expansion of another tree frog population in the apparent absence of human influence.

*Hyla rufitela* is a medium-sized frog (ca 45 mm) of the family Hylidae, occurring in wet forests from Nicaragua to Panama (Duellman 1970). Males call throughout most of the year from dense vegetation above standing or slowly flowing water. *Hyla rufitela* was first reported from BCI by Dunn in 1931 (as *H. albomarginata*). He described it as breeding only in one swampy area near the center of this island. We found no records of it from other locations on the island until the mid-1960s. In 1964, Duellman collected reptiles and amphibians extensively on BCI and found *H. rufitela* breeding in the same swamp and nowhere else (W. Duellman, pers. comm.). Rand, in 1965–67, extensively searched BCI and located a chorus at Dunn's locality and a second at the head of a deep estero on the south side of the island. No additional choruses had been reported until the rainy season of 1980, when we heard *H. rufitela* calling from Allee Creek, next to the laboratory clearing on the northeast side of BCI. At that time we surveyed the island walking all of the marked trails and traveling by small boat around the shore, pushing into creeks and esteros to listen for *H. rufitela* calling. Figure 1 shows the choruses located. This is certainly an underestimate, because choruses on streams far from the shore and from any trail were probably undetected.

Our findings show that in 1980 *H. rufitela* was calling in many places where it had not been calling in the early 1930s or mid-1960s. No systematic surveys of the frogs on BCI were conducted between about 1966 and 1980, but a number of biologists who worked at night in the forests on BCI report that they did not hear it (Clark, Heyer, Sexton, Toft, Wells, Zug, pers. comm.). Whatever the timing of the spread of *H. rufitela* across the island, we are sure that it did not begin to call at the laboratory clearing until 1980.

The density of calling male *Hyla rufitela* does not seem to have changed greatly at the older sites. The population has increased both in size and in distribution. What caused these changes? First, there does not seem to have been

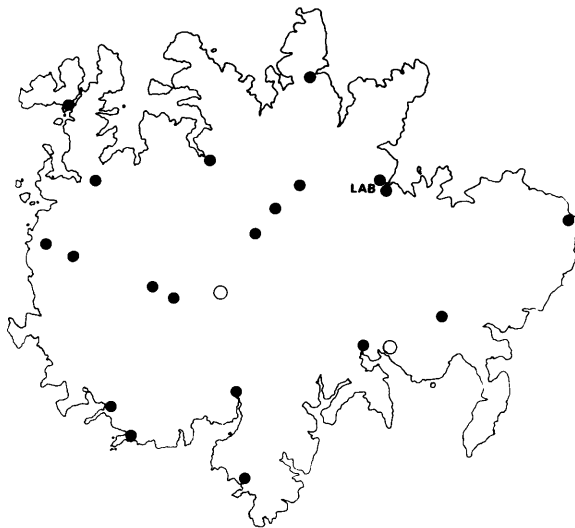


FIGURE 1. Breeding choruses of *Hyla rufitela* on Barro Colorado Island in 1980. Circles indicate sites also used in 1965–67.

an increase in the number of suitable breeding sites. The new sites with which we were familiar from earlier years did not seem to have changed since 1965, nor do the original breeding sites appear to have changed. Second, the change in *H. rufitela* does not seem to be related to either increases or decreases in other species of amphibians on BCI. Although other species fluctuate, and this is particularly noticeable in the forest-floor species such as *Bufo typhonius* and the *Eleutherodactylus* (Toft *et al.*, in press), none showed changes comparable to those in *H. rufitela*. This conclusion argues that there has not been a general increase in frog food nor a general decrease in frog predators. It also argues that there has been no change in the competitive relationships among the various frogs on BCI.

Possibly the increase in *H. rufitela* is the result of a fortuitous sequence of favorable years for breeding and survival of tadpoles and newly transformed frogs. In these stages, mortality is generally highest, and unusually favorable conditions could most easily result in large-scale increases in population size and subsequently in distribution. Because we do not know the precise timing of the population changes, we can neither support nor eliminate this possibility. However, an examination of the rainfall records for BCI (Rand and Rand, in press) shows that the 1979–80 dry season began very late and was therefore unusually short. Perhaps the longer availability of surface water lengthened the breeding season and increased tadpole survival.

Although we can only speculate as to the causes, *Hyla rufitela* on BCI presents one of the few documented instances of a radical population increase for a tropical vertebrate in the absence of a man-induced environmental change. It will be interesting to see if the change is a permanent one, or whether *Hyla rufitela* populations will shortly return to their original conditions.

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