

OBSERVATIONS ON TWO SPECIES OF THE *HYLA RUBRA* GROUP IN PANAMA (ANURA: HYLIDAE)

While several species of the *Hyla rubra* group are widespread and well known in Panama, *Hyla rubra* itself has been recorded only from a few localities in the Canal Zone and eastward in the Pacific lowlands (Duellman, 1970; Leon, 1969). No ecological or behavioral data are available for *H. rubra* from anywhere in Central America. Leon (1969) had no ecological or natural history information to add and Duellman (1970) was forced to draw upon data from Ecuadorian populations in his discussion of the natural history of this species in Central America. We located a population of this species in sympatry with *Hyla Boulengeri*, another member of the *H. rubra* group, in the Caribbean drainage in the Canal Zone and made observations on their breeding activities over a two month period. Our observations differ in some respects from the previously published accounts of both species (Duellman, 1970; Fouquette, 1966) and indicate a degree of mating control breakdown between these species at this locality.

Our specimens were collected at the southern edge of the village of Achiote, Colon Province, Panama, approximately 10 miles west-north-west of Gatun, Canal Zone. The general habitat is tropical moist forest (Holdridge, 1967) modified to various degrees by slash and burn agricultural practice. The pond in which the frogs were found is located in a cleared pasture on the west bank of the Rio Providencia, which meanders through the village. The field is approximately 30 yards by 200 yards and is bordered on the west by a dirt road and rim of small trees 20-30 feet high; on the east, beyond the Rio Providencia, the habitat is advanced second growth grading into primary forest. Ridges rise immediately on either side of the area, either well forested with advanced second growth and remnants of primary forest, or recently cleared and in pasture or bananas.

The pond (Fig. 1) is permanent but less than 3 feet deep, heavily overgrown with emergent and submergent vegetation most of the year, and about 30 feet by 50 feet. The western edge of the pond is formed by the dirt road and associated trees; the other sides of the pond face on the pasture (Fig. 1). Along the south and east edge of the pond, and forming the posts of the fence surrounding the field, are small trees or bushes which have resprouted from stumps. Those at the edge of the pond were cut about 2 feet above ground while the fenceposts were cut at about 4 feet. *Acacia* shrubs are scattered about the pasture, but most of the area is close-cropped grass. Cattle are usually pastured within the field.



FIGURE 1. View of the pond at Achiote, Colon Prov., Panama, looking north. *Hyla rubra* and *H. Boulengeri* were taken in the three bushes at the edge of the pond.

Both species of frogs called from the fencepost trees bordering the pond and from shrubs near the pond on the night of 27 May 1968 during a light rain. At this time *Hyla rubra* was more abundant than *H. Boulengeri*; our sample included 14 *H. rubra* and 6 *H. Boulengeri*, a fair estimate of their relative abundance.

Although both species called from the same trees and bushes, their calling positions differed in height and orientation. *Hyla rubra* generally called from a head-down position on the lower portions of the trees, usually from within the matted grass and vines that covered the old stump portion 1 foot to 3 feet above the ground. In the bushes they were usually in the innermost parts of the vegetation, near the trunk. *Hyla Boulengeri*, on the other hand, called from branches higher in the trees and on the outermost, exposed, portions of the bushes 3 feet to 20 feet above ground. Individual orientation of the calling ♂ *H. Boulengeri* was irregular but was generally horizontal, either crosswise on the branch or on a leaf. Fouquette (1966) found *H. Boulengeri* in the Canal Zone usually calling from a head-down position in a variety of vegetational types from a few inches to 7 feet above ground.

The calls of the two species are quite distinct. Calls of *Hyla rubra* are in groups of 1-13 notes; in one recording the notes have a duration of 0.14 - 0.15 second, and a pulse rate of 66-72 pulses per second. The average dominant frequency lies about 1600 cycles per second (Fig. 2). The call is similar to that reported for this species in Ecuador by Duellman (1970), though the pulse rate is slightly higher than the 61-65 pulses per second in his recordings. *Hyla Boulengeri* utters a single call at irregular intervals (Fig. 3). It has a distinct cat-squall sound, as noted also by Fouquette (1966). Our recordings are in essential agreement with Fouquette's description of the call of this species.

On the night of 27 May 1968 we were somewhat uncertain about the status of the specimens we were collecting; while two call types were clearly discernible, three of the 9 clasping pairs collected were mismatched (♂ *H. rubra*, ♀ *H. Boulengeri*), and in the collecting bags pairing was indiscriminate. In aquaria in the laboratory this indiscriminate pairing was continued and 3 mismatched pairs deposited eggs. These failed to develop beyond stage 4 or 5 (Gosner, 1960).

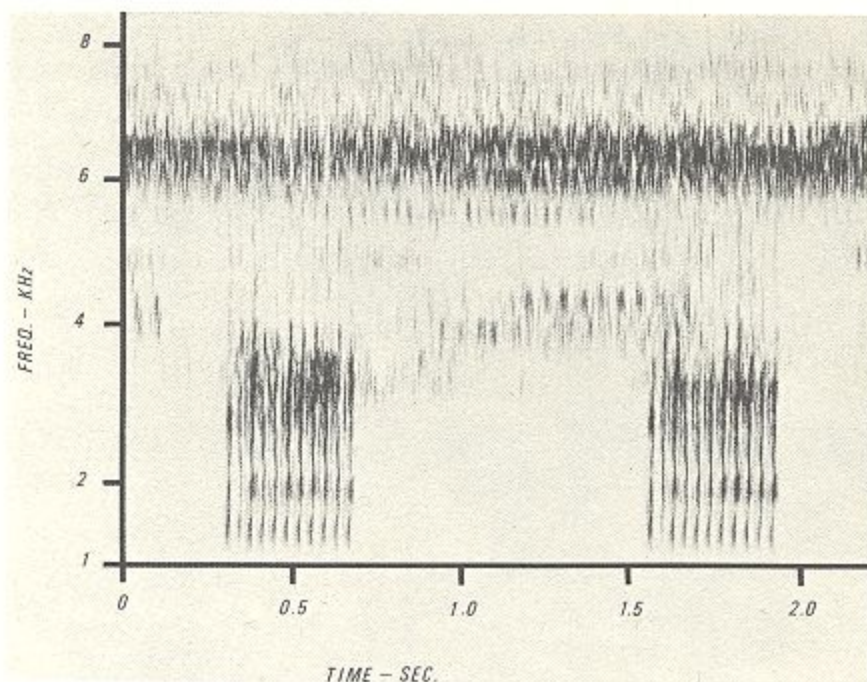


FIGURE 2. Sonograph of the call of *Hyla rubra*. Recorded with a Sony Model 500 recorder at $T_a = 26$ C. 17 June 1968.

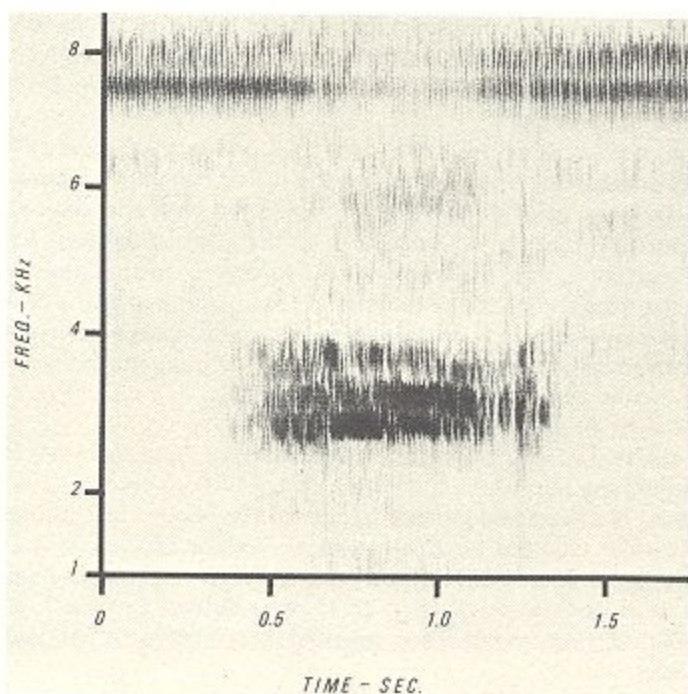


FIGURE 3. Sonograph of the call of *Hyla boulengeri*, recorded 17 June 1968 with a Sony Model 500 tape recorder. $T_a = 26$ C.

Eggs deposited by properly matched pairs on the same night also failed to develop, though they developed to stages 8 and 9 before death. These data are insufficient to allow evaluation of genetic compatibility; however, Duellman (in litt.) suggested to us that an adult specimen from this general area may be a hybrid. UK 125026, collected 3 mi S. Achiote, is not referable with certainty to any of the described species of *Hyla* from this area and possesses certain characteristics of both *H. rubra* and *H. boulengeri*.

In an effort to obtain additional data on these species, we returned to the area on 17 June 1968. Heavy rain fell during the afternoon but the night was dry and clear. *Hyla boulengeri* was calling in fair numbers, but only one *H. rubra* was heard. The relative calling positions of the two species were identical to the observations made on 27 May. This appeared to be the end of the breeding season for *Hyla rubra* in this area. Newly transforming *H. rubra* were abundant in the vegetation at the edge of the pond and the species was not heard calling on any subsequent monthly visits to the area throughout the remainder of the year.

This partial breakdown in premating reproductive isolation between these two species with such distinctive calls suggests that some unusual ecological factors are involved. The fact that all natural crossmating we observed involved a ♂ *H. rubra* and ♀ *boulengeri* suggests that choice of calling site by the male is the factor involved. The ♀ *Hyla boulengeri* must move past the calling ♂ *H. rubra* as she moves toward the higher ♂ *H. boulengeri*. Thus she may be seized by the ♂ *H. rubra*. The frequency of crossmating in this population is unknown. Such a source of potential gametic wastage is presumably selected against in species with long enduring contact. The present situation may result from recent contact on the periphery of the range of *H. rubra*. *Hyla rubra* is generally considered a Pacific lowland species (Duellman, 1970; Leon, 1969). Another species, *Phrynohyas venulosus*, also considered to be a Pacific form (Zweifel, 1964; McDiarmid, 1968), has been found in the same locality at Achiote. Whether these records indicate a recent expansion of Pacific forms into this area or merely reflect the superficial state of our knowledge of this complex faunal assemblage is, at present, a moot point.

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LITERATURE CITED

- Duellman, W. E. 1968. Letter dated November 15.
 ———. 1970. The hylid frogs of Middle America. Monograph Mus. Nat. Hist., Univ. Kansas, no. 1, pp. 1-427.
 Fouquette, M. J. 1966. Some hylid frogs of the Canal Zone, with special reference to call structure. *Carib. J. Sci.* 6(3-4): 167-172.
 Gosner, K. L. 1960. A simplified table for staging anuran embryos and larvae with notes on identification. *Herpetologica*, 16: 183-90.
 Holdridge, L. R. 1967. Life zone ecology. Tropical Science Center, San Jose, Costa Rica.
 Leon, J. R. 1969. The systematics of the frogs of the *Hyla rubra* group in Middle America. *U. Kansas Publs., Mus. Nat. Hist.* 18(6): 505-45.
 McDiarmid, R. W. 1968. Population variation in the frog genus *Phrynohyas* Fitzinger in Middle America. *L. A. Co. Mus. Cont. Sci.* no. 134: 25 pp.
 Zweifel, R. G. 1964. Life history of *Phrynohyas venulosa* (Salientia: Hylidae) in Panama. *Copeia*, no. 1: 201-208.

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