COSTA RICAN NATURAL HISTORY

EDITED BY

Daniel H. Janzen

WITH

174 CONTRIBUTORS

THE UNIVERSITY OF CHICAGO PRESS
CHICAGO AND LONDON
1983

Centrolenella fleischmanni (Ranita de Vidrio, Glass Frog)

R. W. McDiarmid

Frogs of the genus *Centrolenella* include about sixty-five species found in tropical moist forests of the New World from southern Mexico southward to Bolivia, Paraguay, and northern Argentina. They, together with *Centrolene geckoideum,* constitute the family Centrolenidae. Centrolenid frogs are Neotropical endemics and, like dendrobatids, are important components of most wet-forest assemblages. The family relationships are not well understood, but most herpetologists would ally them either with the Hylidae or the Leptodactylidae.

There are thirteen species of *Centrolenella* in Costa Rica. Their systematic relationships and distributions are discussed by Starrett and Savage (1973), who also present a key to Costa Rican species.

Centrolenid frogs are generally small (less than 50 mm) green arboreal species that are found along vegetated streams from sea level to nearly 3,800 m elevation. In many species the viscera and heart are visible through the skin, giving rise to the name "glass frog." All species for which data are available deposit their eggs on or beneath leaves overhanging streams (McDiarmid 1975, but there are errors in the figure captions). A few species occasionally attach their eggs to moss on branches. The eggs are enclosed in a gelatinous mass and may be deposited on the upper leaf surface, near the tip, or beneath the leaf. Those on the upper surface are usually dark (black or brown), are laid in a single layer, and have little protective jelly. Those put near the leaf tip may be dark or light and usually swell with water, increasing their total volume two to four times. As a result they become pendant and form a drip tip from the leaf. Eggs placed beneath the leaf are white or light green and have less jelly than the drip-tip types. Nonpigmented eggs that are exposed to direct sunlight suffer high mortality (McDiarmid, unpublished), which helps explain the pigmented nature of most of the clutches placed on the upper leaf surface. Also, the large jelly volume associated with the light-colored drip-tip types probably serves as a protective layer to prevent developmental abnormalities.

The eggs develop on the overhanging leaves for varying periods, from 8 to 20 or more days. The length of egg development on the leaf is more a reflection of local weather conditions than of variance in developmental times. Often clutches develop up to a point and then hatch during heavy rains. This facultative hatch serves to increase the probability that the tadpoles will reach the water when they drop off the leaf. This timing may also make the small tadpoles less visible to fish in the stream, since water is often turbid during a heavy rain. Tadpoles dropped into a stream without the associated disturbance of raindrops on the water surface are quickly eaten by fish that respond to surface disturbance.

After a while the tadpoles become bright red and bury themselves in the decaying leaf litter and detritus that accumulates in slower parts of the stream. The bright color apparently is the result of an extensive network of surface capillaries and probably is associated with cutaneous respiration in this low-oxygen environment. Since the tadpoles are rarely seen, their bright colors apparently are not disadvantageous in terms of visibility to predators. The duration of larval life is unknown, but laboratory-reared tadpoles take several months to reach a size appropriate for metamorphosis (McDiarmid, unpublished). As they approach metamorphosis they begin to take on the characteristic adult coloration.

Adult males show varying degrees of territoriality depending on species and local densities. For most species, vocalization functions to space males and to attract females. The note-repetition rates are known to increase three to four times during male-male interactions (McDiarmid, unpublished). When vocal interactions fail to disperse potential male intruders, resident males frequently resort to physical defense. This male contact and defense has been described for *C. fleischmanni* and *C. valerioi* (McDiarmid and Adler 1974). Individual males may breed several times in a short period; nothing is known about female reproductive periodicity.

Parental care is another interesting aspect of the reproductive behavior of some species of *Centrolenella*. An ethocline from species lacking parental care to those with parental care exists in the *C. fleischmanni* group. In species with parental care the males are involved in egg attendance and guarding. In a comparison of two species, *C. colymbiphyllum* and *C. valerioi,* McDiarmid (1978) attributed the relatively higher survivorship of individual male *C. valerioi* offspring to the increased investment of males of *C. valerioi,* who spend 24 hr with their clutches, compared with male *C. colymbiphyllum,* who leave their clutches unattended during daylight. Predation by visual hunting predators, particularly wasps, accounted for most of the differences in survivorship of eggs and unhatched larvae between these two species.

The dorsal coloration of these two species also underscores the differences in parental behavior. *C. colymbiphyllum* is essentially a uniform green with small yellow dots. *C. valerioi* has a reticulate green pattern on a yellowish background. During the day an attending male *C. valerioi* is strikingly similar in appearance to his egg clutches. McDiarmid (1978) suggested that the dorsal coloration of *C. valerioi* evolved in response to its diurnal attendance at the egg clutch(es) in response to

visually hunting diurnal predators. *C. colymbiphyllum* does not resemble its egg clutches, has the more typical diurnal behavior of frogs, and "sleeps" in the surrounding vegetation. As it gets dark, the male *C. colymbiphyllum* returns to the egg site and resumes calling.

Males of *Centrolenella fleischmanni* show varying degrees of fidelity to their call sites and in certain instances have been seen on or near their clutches several nights after they were laid. An interesting association between *C. fleischmanni* and a predaceous *Drosophila* has been studied by Villa (1977). In some situations predation by fly larvae may result in very high mortality for *C. fleischmanni* eggs. Considerably more work needs to be done on the behavioral and evolutionary responses of male *C. fleischmanni* to egg predators, especially to predation by flies.

*

McDiarmid, R. W. 1975. Glass frog romance along a tropical stream. *Terra Los Angeles County Mus.* 13:14–18.

———. 1978. Evolution of parental care in frogs. In *The development of behavior: Comparative and evolutionary aspects*, ed. G. M. Burghardt and M. Bekof, pp. 127–47. New York: Garland STPM Press.

McDiarmid, R. W., and Adler, K. 1974. Notes on territorial and vocal behavior of Neotropical frogs of the genus *Centrolenella*. *Herpetologica* 30:75–78.

Starrett, P. H., and Savage, J. M. 1973. The systematic status and distribution of Costa Rican glass-frogs, genus *Centrolenella* (family Centrolenidae), with description of a new species. *Bull. Southern California Acad. Sci.* 72:57–78.

Villa, J. 1977. A symbiotic relationship between frog (Amphibia, Anura, Centrolenidae) and fly larvae (Drosophilidae). *J. Herp.* 11:317–22.