

## A THERMAL PROPERTY OF THE *RANA CATESBEIANA* (AMPHIBIA, ANURA, RANIDAE) EGG MASS

The critical role of environmental temperature in the survival and developmental rate of anuran eggs is a classical concept (Moore, 1939). There are two general types of egg mass structure in temperate species of the genus *Rana*, the globular mass and the surface film mass. The globular mass, an irregular oval shape, is characteristic of those species with a more northern distribution and an early spring breeding season. It has been shown that this egg mass structure enables considerable heat retention and may aid in the avoidance of the possible harmful effects of low environmental temperatures (see review by Salthe and Mecham, 1974). The surface film egg mass is found in *Rana catesbeiana* and *R. clamitans*. These species typically breed later and in warmer waters than those species possessing the globular masses. One of the advantages of depositing eggs in a surface film is the utilization of the greatest available oxygen supply, often a critical resource in the warm stagnant waters in which the bullfrog and green frog may breed (Moore, 1940). It has also been noted that eggs in a surface film are rather dispersed and not likely to concentrate heat (Zweifel, 1968:56). The purpose of this note is to report a thermal property of the *Rana catesbeiana* egg mass, previously unknown among anurans, and to discuss its possible biological significance.

Temperatures within 39 *Rana catesbeiana* egg masses and the adjacent water, at the same level and within 3 cm of the egg mass, were recorded with a Schultheis quick-recording thermometer on 14 days between 6 May and 19 June 1976. Great care was taken to insure that the probe was entirely within the egg mass and sufficient time given for the thermometer to equilibrate before the reading was taken. Sixty-two temperature sequences (egg mass and adjacent water) were recorded during this period at various times between 0930 and 2130 h EST. All egg masses were located in Basking Pond, Great Swamp National Wildlife Refuge, Morris County, New Jersey. Basking Pond is a man-made permanent pond with no emergent vegetation and an open canopy. Sunlight reaches the surface water throughout most of the day.

In a significant number of cases the temperature of the egg mass was lower than that of the surrounding water (sign test,  $P < .01$ ). Of the 62 egg masses recorded, the temperature of 54 were lower than that of the surrounding water. Six masses were higher and two the same temperature as the surrounding water. Temperatures of the 62 egg masses (mean = 23.81°C, SE = 4.33) were on the average 0.84°C lower than those of the surrounding water (mean = 24.65°C, SE = 4.27). Most of the egg masses were exposed to sunlight during the data collection.

Savage (1961:4) reported that the mean temperature of 73 *Rana temporaria* egg masses

was 0.63°C higher than that of the surrounding water. The mean heat retention in *Rana sylvatica* egg masses in Alaska was 1.0°C (Herreid and Kinney, 1967:580) and 1.60°C in New Jersey (Hassinger, 1970). A similar phenomenon is exhibited in *Rana pipiens* (= *utricularia*). In 32 of 33 egg masses measured, the temperature within the mass was higher than that of the surrounding water, the mean difference being 0.63°C (Hassinger, 1970). All three species are spring breeders with a globular egg mass structure.

The surface film egg mass of *Rana catesbeiana* is adapted to the ecology of a warm water breeding anuran. Increase of respiratory exchange is the primary advantage of this type of egg mass structure (Moore, 1940), although Zweifel predicted that the spatial distribution of the ovum within the mass should cause a reduction in heat concentration; my data indicates another property of the surface film egg mass, its ability to remain at a temperature slightly lower than the surrounding water. This property may be of especial significance in any egg mass which floats fully exposed to the intense summer sun. It may have biological importance in avoidance of the harmful effects of high temperatures (Moore, 1940). The mechanism of this cooling process is unknown. The function of the anuran egg mass as an insulator from heat has also been suggested for the froth nests of some tropical anurans (Salthe and Mecham, 1974:410).

ACKNOWLEDGMENTS.—I thank Stanley N. Salthe for reviewing the manuscript. Douglas Morrison made some helpful comments and Clarke Keller assisted in the data collection. I especially acknowledge my indebtedness to the late James D. Anderson for his helpful discussion of these results as well as reviewing the manuscript. This research was completed during a study partially funded by the Theodore Roosevelt Memorial Fund, American Museum of Natural History.

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