

## OBSERVATIONS ON THE DISPERSAL OF COMMON FROG TADPOLES *RANA TEMPORARIA* FROM THE SPAWN SITE

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### INTRODUCTION

The common frog, *Rana temporaria*, is a typical 'explosive' breeder, and usually selects a single communal spawn site within a pond for mating and egg-laying activities. Such sites are often situated in warm, sunny areas of water (Smith, 1973; Frazer, 1983), which may provide optimum conditions for egg development. For the first few days after hatching the mouth is closed and tadpoles cling to the spawn jelly with an oral sucker and feed on yolk. Later, the tadpoles become free-swimming and are observed over a much wider area of the pond (Savage, 1935, 1961). Previous studies of the overall distribution of common frog tadpoles in Llysdynam pond, mid-Wales, suggest that even at their most widespread, tadpoles are not evenly distributed within the pond and tend to stay in the general vicinity of the spawning area (Harrison, 1985). This paper describes the progressive dispersal of tadpoles from the spawn site in 1986 and relates the pattern to the stage of development of the tadpoles.

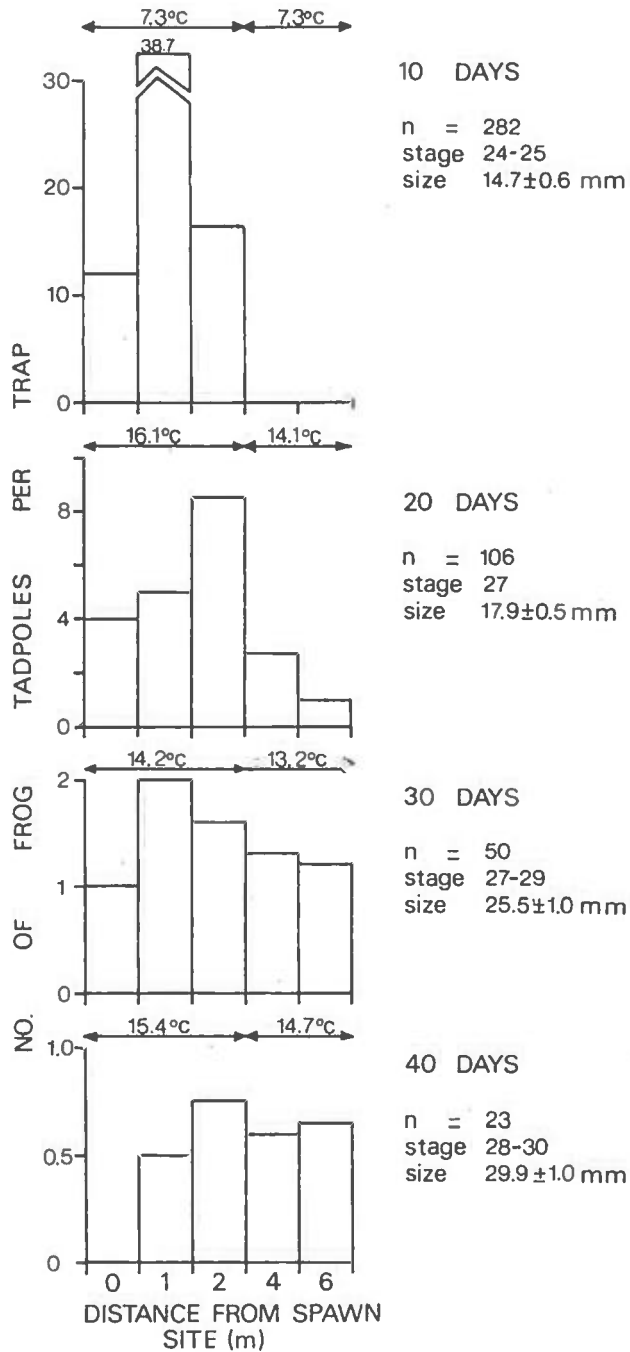
### MATERIALS AND METHODS

The main spawn site in Llysdynam pond is on the shoreline edge of a *Glyceria maxima* reed-swamp which occupies about two-thirds of the surface area of the pond. This shoreline faces south and is the warmest part of the pond (Harrison, 1985). In 1986 spawning was first observed on 19 March, and was completed by 31 March when about 50 clumps were counted at the spawn site. These clumps formed a dense mat approximately 3m<sup>2</sup> in area, the centre of which was marked using a cane driven through the spawn into the pond bottom. By 11 April hatching was almost complete, with large numbers of immobile tadpoles clinging to the remains of the jelly at the spawn site. Observations on tadpole distribution commenced 10 days after this date and were repeated at intervals of 10 days until 50 days after hatching.

On each observation day, funnel traps (Griffiths, 1985a) were positioned at distances of 1m, 2m, 4m and 6m from the centre of the original spawn mass. Traps were positioned at intervals of about 1.6m, such that they lay on the pond bottom facing towards the centre of the spawn site in a series of concentric arcs. The depth at which traps were placed varied between 10 and 50cm, according to the depth of the pond. The total number of traps used within each arc varied between observation days as some parts of the shoreline and swamp dried out during the course of the study. Maximum numbers used were 4 traps at 1m, 7 traps at 2m, 10 traps at 4m, and 13 traps at 6m. A single trap was placed at the centre of the original spawn mass. As *Rana temporaria* tadpoles are mainly day-active (Griffiths 1985b), traps were placed in position at 1000 hrs and emptied at 1700 hrs on the same day. Temperatures were taken at each trap site using a mercury thermometer graduated at 0.1°C intervals. Access to the traps was gained by wading in the swamp, using duckboard walk-ways in the deeper areas. On each observation day, trapped tadpoles were counted and a sample of 10 was taken to the nearby laboratory to be measured and staged. These animals were anaesthetized using benzocaine, measured (snout to tail-tip) to the nearest 0.1mm using a binocular microscope equipped with an eyepiece graticule, and staged using the table described by Gosner (1960).

### RESULTS AND DISCUSSION

The total number of tadpoles captured every 10 days declined rapidly over the study period, and the study was discontinued after 50 days as only 4 tadpoles were captured on this date. This decline may well be associated with dispersal from the spawn site, but predation of tadpoles by invertebrates in the pond is severe (Harrison, 1985), and the decline therefore almost certainly reflects mortality.



**Figure 1.** The progressive dispersal of frog tadpoles from the spawn site. Median temperatures 0-2m and 4-6m from the spawn site are shown at the top of each histogram. Stages are based on Gosner's (1960) table; sizes are means of 10 tadpoles  $\pm$  SE.

Ten days after hatching the tadpoles had become free-swimming and the external gills had largely disappeared. At this stage the tadpoles had yet to disperse beyond 2m from the spawn site, and most individuals were in fact still confined to the area originally occupied by the spawn mass (Fig. 1). By 20 days the hind limb buds had commenced development and some tadpoles had now dispersed to a distance of 6m, although the majority had still moved less than 2m. As the hind limbs continued to develop, the tadpoles moved out from the spawn site and were relatively evenly distributed across the trapping area by 30-40 days. Traps placed elsewhere in the pond (i.e. about 20m from the spawn site) succeeded in capturing tadpoles 30 days after hatching, suggesting that dispersal was almost complete by this time. Forty days after hatching tadpoles were twice the size observed at 10 days, but the toes on the developing hind limbs had yet to differentiate.

Direct comparisons between the present data and Savage's (1961) extensive field notes on frog tadpole life history are difficult due to differences in methodology. However, at most of Savage's ponds tadpoles were first captured away from the spawn site during the first two weeks of May, but the size of the tadpoles at this time varied between ponds and between years

The temperature of Llysdinam pond 4-6m from the spawn site was significantly lower than 0-2m from the spawn site, 20-40 days after hatching (Mann-Whitney *U*-tests, *P* 0.05). Tadpoles therefore appeared to be moving from warmer to cooler water during dispersal. This behaviour appears to be rather different from that observed in dispersed, free-swimming tadpoles which frequently orient towards warmer areas of water where they may form aggregations (e.g. Beiswenger, 1977; Griffiths, 1985b).

Although newly-hatched tadpoles are capable of swimming (Savage, 1935), dispersal from the spawn site clearly does not occur until the external gills are lost and a mouth is developed to facilitate independent feeding. Dispersal appears to be largely completed, however, before the hind-limbs are half-grown.

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#### REFERENCES

- Beiswenger, R.E. (1977). Diel patterns of aggregative behavior in tadpoles of *Bufo americanus*, in relation to light and temperature. *Ecology* **58**, 98-108.
- Frazer, D. (1983). *Reptiles and amphibians in Britain*. Collins, London.
- Gosner, K.L. (1960). A simplified table for staging anuran embryos and larvae with notes on identification. *Herpetologica* **16**, 183-190.
- Griffiths, R.A. (1985a). A simple funnel trap for studying newt populations and an evaluation of trap behaviour in smooth and palmate newts, *Triturus vulgaris* and *T. helveticus*. *Herpetological Journal* **1**, 5-10.
- Griffiths, R.A. (1985b). Diel pattern of movement and aggregation in tadpoles of the common frog, *Rana temporaria*. *Herpetological Journal* **1**, 10-13.
- Harrison, J.D. (1985). *Aspects of the ecology of amphibian larvae*. Ph.D. thesis, University of Wales.
- Savage, R.M. (1935). The ecology of young tadpoles, with special reference to some adaptations to the habit of mass-spawning in *Rana temporaria temporaria* Linn. *Proceedings of the Zoological Society of London*, 605-610.
- Savage, R.M. (1961). *The ecology and life history of the common frog (Rana temporaria temporaria)*. Pitman, London.
- Smith, M.A. (1973). *British amphibians and reptiles* (5th edition). Collins, London.