FOOD AND FEEDING RELATIONS OF COMMON FROG AND COMMON TOAD TADPOLES (*RANA TEMPORARIA* AND *BUFO BUFO*) AT A POND IN MID-WALES

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ABSTRACT

The guts of frog tadpoles in Llysdinam Pond, 1983, frequently contained detritus (partially decomposed macrophyte tissue) and other items associated with the pond's sediment (the tests of rhizopod protozoa, pollen grains, fungi), suggesting that the frog tadpoles fed directly on the sediment. The guts of toad tadpoles from Llysdinam, 1984, however, contained high frequencies of rotifers (*Keratella*) and motile algae (Dinophyceae) and little detritus, suggesting that the toad tadpoles fed mainly in mid-water. Evidence of both mid-water and sediment feeding was observed in samples of toad tadpoles from other ponds. Samples of frog tadpoles from other ponds, however, showed only the sediment feeding mode.

INTRODUCTION

As Altig and Kelly (1974) point out, feeding mechanisms in anuran tadpoles have been studied in considerable detail (e.g., Dodd, 1950; Savage, 1952; Kenny, 1969; Wassersug, 1972; Seale and Wassersug, 1979) but there is less detailed information concerning the food ingested either by common frog (*Rana temporaria*) or common toad (*Bufo bufo*) tadpoles. Data on the food taken by these tadpoles is confined mainly to the observations of Savage (1952) and Scorgie (1980). Although such studies give useful insights into the food taken by tadpoles, they are mainly qualitative and yield little information on the importance of the various items in the diet.

The aim of the present study, therefore, was to describe in a semi-quantitative way the food taken by frog and toad tadpoles in Llysdinam Pond, mid-Wales. The gut contents of tadpoles collected from several other localities in mid-Wales were also described. Together, these investigations give an insight into both the food of the tadpoles and also their modes of feeding, and suggest possible differences in feeding behaviour between frog and toad tadpoles.

METHODS

Samples of tadpoles were netted from Llysdinam Pond, Newbridge-on-Wye, mid-Wales (described in detail by Harrison, Gittins and Slater, 1983). Frog tadpoles were collected from 30.3.83 to 7.6.83 and toad tadpoles from 4.5.84 to 7.6.84 for examination of their gut contents. Direct yearly comparisons could not be made because toad tadpoles were not present in the pond in 1983 (due to high spawn mortality) and the frog tadpoles were present for a short period only in 1984 (due to habitat desiccation — Harrison, 1985).

Immediately following collection from the pond, tadpoles were preserved in 70 per cent alcohol. At a later date, 5mm of foregut from each tadpole was removed, mounted in a drop of water on a glass slide and examined microscopically. Inspection of the slides showed that many guts contained items which did not occur in discrete categories, such as filamentous green algae (which were present in filaments of just a few cells to very large colonies), and detritus, such as fragments of partially decomposed macrophyte tissue, which varied greatly in size. The usual numerical methods of analysis, therefore, were unsuitable (Hyslop, 1980). As an alternative the occurrence method was used. Here the number of guts containing a particular food category is expressed as a proportion of the total number of guts containing food. This method does not relate information concerning the numerical importance of items in the diet, nor on the contribution of each item to the bulk of the diet. It does, however, yield a crude quantitative picture of the most frequent types of food ingested by tadpoles.

In addition to the samples taken from Llysdinam Pond, the gut contents of small samples of frog and toad tadpoles from a number of other mid-Wales localities, collected during 1983 and 1984, were examined.

RESULTS

DIET OF FROG AND TOAD TADPOLES IN LLYSDINAM

In total, 67 frog tadpoles and 80 toad tadpoles were taken from Llysdinam Pond. Many were very young tadpoles, at or just following the external gill stage (Gosner, 1960 stages 21-25) and showed little evidence of any ingested food material. The following analysis, therefore, is based on the guts of 34 frog tadpoles and 38 toad tadpoles which contained food. The range of

size (total length) in the samples was 14-43mm (frogs) and 12-18mm (toads).

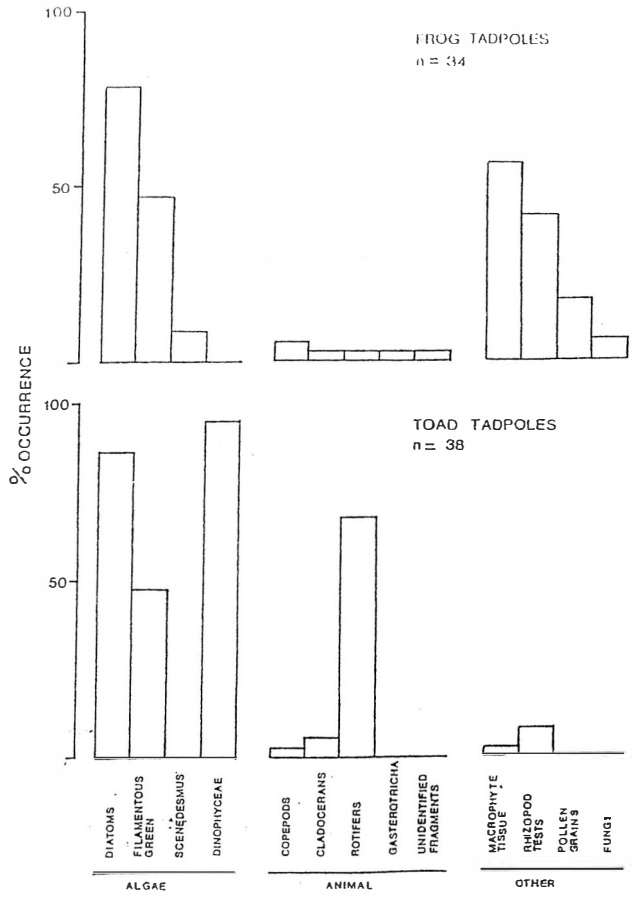

Fig. 1 Items recorded from the guts of frog tadpoles (from Llysdinam Pond in 1983) and toad tadpoles (from Llysdinam Pond in 1984).

Diatoms and filamentous green algae were observed frequently in the guts of both frog and toad tadpoles collected from Llysdinam Pond (Fig. 1). Additionally, the frog tadpole guts frequently contained items associated with the pond's sediment (partially decomposed macrophyte tissue, tests of rhizopod protozoa, pollen grains, fungi) but rarely contained items usually present in mid-water (motile algae — Dinophyceae, planktonic rotifers — *Keratella*). However, the reverse trend was apparent in the sample of toad tadpole guts (Fig. 1). This difference in gut contents suggests that the frog tadpoles may have been feeding predominantly on the pond's sediment whereas the toad tadpoles fed mainly in mid-water.

Diets of Tadpoles from Other Mid-Wales Localities

The gut contents of frog tadpoles from Royal Welsh Show Pond and Buftons Pond (Table 1) contained large amounts of detritus suggesting that the tadpoles were feeding mainly on sediment. This manner of feeding was also apparent in samples of toad tadpoles from Dyfnant and Llandrindod Quarry (Table 1). The toad tadpoles from Builth Quarry, however, contained little detritus and were dominated by microscopic algae, indicating that they fed mainly in mid-water (Table 1).

DISCUSSION

Although the present study is based on small sample sizes and utilises only a semi-quantitative analysis of gut contents, the results indicated the presence of two modes of feeding in populations of frog and toad tadpoles: (1) feeding on the pond's sediment; (2) feeding on planktonic organisms in mid-water. Moreover, the data indicated that the mid-water feeding mode was more prevalent in populations of toad tadpoles (recorded in two of four populations sampled) than in frog tadpoles (not recorded). Further research is necessary to determine whether this trend is indicative of possible interspecific differences in feeding habits between frog and toad tadpoles, or merely reflects conditions in the study ponds at the time of sampling (high concentrations of micro-organisms, for example).

In common with most families of anuran tadpoles, Ranidae and Bufonidae possess the filter feeding apparatus which enables them to remove small particles from suspension, and also the keratinized mouth-parts allowing them to bite and scrape at surfaces (Savage, 1952; Kenny, 1969). Thus both species have the necessary morphology to perform both modes of feeding. Any possible interspecific differences in feeding habits, therefore, are likely to result from differences in behaviour rather than morphology.

The present study showed that detritus was a frequent component of the diet of the frog tadpoles in Llysdinam Pond in 1983. Fragments of partially decomposed macrophyte tissue found in guts were typically large (mean length = 1.3mm, SD = 0.73, n = 21; maximum = 3.5mm) suggesting that such organic detritus formed an important constituent of the diet. The growth rate of the frog tadpoles in 1983 was 72.7mg per week (Harrison, 1985). The frog tadpoles diet, therefore, was evidently capable of supporting growth. Berrie (1976) suggested that animals which consume detritus are utilising the microorganisms attached to the detritus, which are an easily digestible high grade food, rather than the detritus itself.

The habit of ingesting large amounts of detritus was apparent in all three frog tadpole populations and in two of the four toad tadpole populations which were sampled by this study. Similarly, detritus was recorded in the guts of frog and toad tadpoles by both Savage (1952) and Scorgie (1980). It may be better, therefore, to describe sediment feeding tadpoles as opportunistic detritivores rather than herbivores.

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	Site	Size mean total length ± SE	Items Associated with Sediment	Algae	Animal	Possible Mode of Feeding
FROG TADPOLES	Royal Welsh Show Pond	33.0 ± 1.7 (n = 5)	Many inorganic particles	Diatoms Desmids *Scenedesmus*	None	On sediment
	Buftons Pond	39.6 ± 2.7 (n = 3)	Decomposed macrophyte tissue. Inorganic particles	Diatoms Chrysophyceae	Cladoceran	On sediment
TOAD TADPOLES	Dyfnant	19.2 ±1.1 (n ± 4)	Many inorganic particles	Diatoms	None	On sediment
	Llandrindod Quarry	27.2 ± 0.6 (n = 5)	Many inorganic particles	Diatoms *Dinobryon*	None	On sediment
	Builth Quarry	22.2 ± 1.2 (n = 5)	Little detritus	Many algae Diatoms Chrysophyceae Dinophyceae *Scenedesmus* *Dinobryon*	None	In mid-water

TABLE 1: The gut contents, and possible modes of feeding, of frog and toad tadpoles from a number of sites in mid-Wales, collected in 1983 and 1984.

REFERENCES

Altig, R. and Kelly, J. P. (1974). Indices of feeding in anuran tadpoles as indicated by gut characteristics. *Herpetologica* **30,** 200-203.

Berrie, A. D. (1976). Detritus, micro-organisms and animals in fresh water. In *The role of terrestrial and aquatic organisms in decomposition processes.* Anderson, J. M. and Macfadyen, A. (Eds). Oxford, Blackwell.

Dodd, J. M. (1950). Ciliary feeding mechanisms in anuran larvae. *Nature, London* **165,** 283.

Gosner, K. L. (1960). A simplified table for staging anuran embryos and larvae with notes on identification. *Herpetologica* **16,** 183-190.

Harrison, J. D. (1985). Aspects of the Ecology of Amphibian Larvae. Ph.D. Thesis, University of Wales.

Harrison, J. D., Gittins, S. P. and Slater, F. M. (1983). The breeding migrations of Smooth and Palmate newts (*Triturus vulgaris* and *T. helveticus*) at a pond in mid-Wales. *Journal of Zoology, London* **199,** 249-258.

Hyslop, E. J. (1980). Stomach contents analysis —a review of methods and their application. *Journal of Fish Biology* **17,** 411-429.

Kenny, J. S. (1969). Feeding mechanisms in anuran larvae. *Journal of Zoology, London* **157,** 225-246.

Savage, R. M. (1952). Ecological, physiological and anatomical observations on some species of anuran tadpoles. *Proceedings of the Zoological Society of London* **122,** 467-514.

Scorgie, H. R. A. (1980). Growth and development of tadpoles of the common toad *Bufo bufo* Linnaeus on different foods. *British Journal of Herpetology* **6,** 41-43.

Seale, D. B. and Wassesrug, R. J. (1979). Suspension feeding dynamics of anuran larvae related to their functional morphology. *Oecologia (Berlin)* **39,** 259-272.

Wassersug, R. (1972). The mechanism of ultraplanktonic entrapment in anuran larvae. *Journal of Morphology* **137,** 279-288.