

ISSN 0260-5805

**THE BRITISH
HERPETOLOGICAL SOCIETY
BULLETIN**



**No. 50
Winter 1994**

HOW MANY CLUMPS ARE THERE IN A MASS OF FROG SPAWN?

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INTRODUCTION

The Common Frog is an explosive breeder with all spawn being laid within about ten days at any one site (Smith, 1969; Reading, 1984; Beebee, 1986; Ryser, 1989). A convenient and widely used method for estimating the size of a common frog population involves counting the number of spawn clumps laid, soon after breeding is over, as each female lays one clump of eggs, the number of clumps gives a reliable estimate of the number of female frogs in the breeding population. However, there are two problems with using this method. Firstly, after breeding has finished the spawn clumps tend to coalesce into a single spawn mass. This makes distinguishing individual clumps difficult. Secondly, what constitutes a 'single clump' in a spawn mass may depend upon prior knowledge of how large an individual clump actually is. Estimates of the number of clumps in a mass by inexperienced field workers may therefore be unreliable.

As part of a wider study to evaluate survey methods for the British amphibians, we have (1) compared the reliability of spawn clump estimates by 'trained' and 'untrained' observers; and (2) developed a simple method for estimating the number of clumps present based on the area covered by the spawn mass.

METHODS

Recorder Variability

In mid-March 1994 sixteen surveyors independently estimated the number of frog spawn clumps in a spawn mass at Beverly Farm Pond on the University of Kent campus. The surveyors were divided into two groups; one group (n=7) consisted of 'trained' surveyors, while the second group (n=9) comprised 'untrained' surveyors. The 'trained' surveyors were all given a two-minute explanation of how to conduct a spawn clump count at the pond. This consisted of a demonstration of how to separate clumps within the mass, and what a single clump looked like. The 'untrained' group were given no briefing, and consisted of individuals who had never attempted a spawn clump count before.

Estimating Spawn Clumps

The number of spawn clumps deposited at each of eighteen ponds in Kent was counted between 4 and 18 March 1994 by an experienced surveyor (one of the authors). For most sites the date of counting was between seven and ten days after spawn deposition. At the same time the area covered by the spawn clump mass was determined. This was done by measuring the dimensions of the mass with a tape measure or ruler, and estimating its area by equating it to the most appropriate shape (i.e. circle, oval, rectangle, triangle etc.). Regression analysis was used to determine the relationship between the number of clumps and the spawn mass area.

RESULTS

Recorder Variability

All of the trained individuals gave very precise estimates of the number of clumps in the mat, which had a mean of about 33 (Table 1). The untrained group, however, gave much more varied estimates of the number of clumps, with a lower overall mean.

Table 1

Comparison of estimates of the number of frog spawn clumps in a mat by 'untrained' and 'trained' surveyors. C.V.; coefficient of variation.

Untrained group	Trained group
37	33
32	34
8	33
38	33
10	34
9	31
48	33
31	
33	
n=9	n=7
mean=26.0	mean=32.8
SD=16.60	SD=1.09
C.V.=63.8%	C.V.=3.3%

Estimating Spawn Clumps

The number of clumps at the eighteen sites varied between 1 and 160, corresponding to areas of 0.12 m² and 2.26 m² respectively. There was a strong linear relationship between the two variables, which was highly significant (Fig. 1; $F_{1, 16} = 277.8$, $P = 0.001$, $R^2 = 94.6\%$). Thus the number of clumps laid, and thereby the number of breeding females, can be predicted with a high degree of accuracy from measurements of spawn mat area.

DISCUSSION

There is clearly a source of considerable error in determining spawn clump number, and hence the number of females in the population, if the surveyors are inexperienced. Providing even brief guidelines on how to estimate spawn clumps can result in a much more precise determination of the number present. If surveyors are inexperienced, or uncertain how to count clumps, the number present may be determined by measuring the area of the spawn mass and reading off the corresponding number of clumps using Fig. 1.

It is important to realise that spawn clump counts can only yield estimates of the number of breeding females. In some populations female frogs may not breed every year (Ryser, 1989), so the total female population may be larger. Estimating the number of males in a population may also be a problematical. Although some observers have found a sex ratio near to unity (Smith, 1969; Cooke, 1975; Griffiths *et al.*, 1986), others have observed a male-biased sex ratio (Oldham, 1963; Hazlewood, 1969; Ryser, 1989). Extrapolating spawn clump counts to actual population size therefore requires knowledge of the adult sex ratio.

If spawn clumps are to give a reliable estimate of the number of females in a population they must be counted after all females have spawned but before eggs have hatched. The map provided by Cooke (1976), and reproduced in the BHS leaflet *Surveying for Amphibians*, gives a useful guide to spawning times across the country. Peak spawning activity usually occurs about four or five days after the first clump has been laid (Reading, 1984; Beebee, 1986). However, the spawning period may be interrupted or prolonged by flooding or cold weather (Cooke, 1982), and this should be taken into account when deciding the best time to conduct a count.

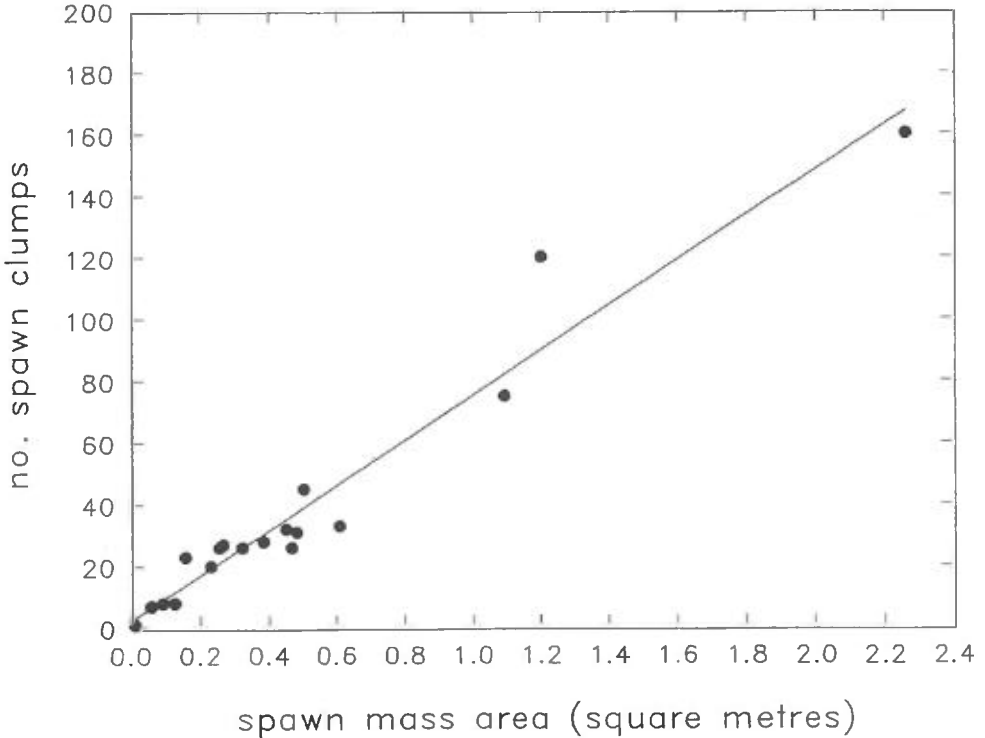


Fig. 1. Linear regression of the number of clumps in a spawn clump mass on the surface area of the mass. Regression line has been fitted using the equation: $y=2.27+73x$.

Clumps of eggs which are a few days old often have a covering of algae, and are readily distinguished from fresh clumps, which have an unswollen, 'cleaner' appearance. fresh clumps will absorb water and swell within a few days, and time should be allowed for this to occur before performing a spawn count.

ACKNOWLEDGEMENTS

We are indebted to the DICE students who acted as 'guinea pigs' for this project; to Leigh Gillet for suggesting suitable field sites; and to Lee Brady for assistance with the field work. This work was funded by the JNCC for whom S. D. Gibson was the nominated officer.



Plate 1. How many clumps?

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