SIZE INCREASE IN THE COMMON TOAD *BUFO BUFO* FROM CHESHIRE

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ABSTRACT

Toads were collected from two sites in Cheshire from March to November. Body length (snout to vent), jaw width, hind leg length and weight were measured. Three size ranges were observed and compared. Body length was found to be positively correlated to jaw width, hind leg length and weight and was used to calculate the growth rates over the year. It was determined that the percentage increase in size decreased with age.

INTRODUCTION

The size ranges of the common toad (*Bufo bufo*) have been examined by a number of workers (Mathias, 1971; Gittins *et al*, 1980; Frazer, 1983). However, little has been published on the growth rates during the year, and most of the information available is concerned with breeding adults rather than juveniles. The present study is an attempt to fill this gap and examines the increase in size over the year of recently emerged toads in comparison with second years and older.

METHODS

Toads were collected from two sites in Cheshire. These were Abbots Moss Hall (Grid Ref. SJ 593 681), a privately owned estate near Delamere and Tabley Hall (Grid Ref. SJ 727 769), owned by the University of Manchester and situated near Knutsford. In the former site captures were made from a marshy area. The trapping grid was situated 15 m away from a pond. The vegetation consisted mainly of Yorkshire fog (*Holcus lanatus*-50 per cent) and marsh horsetail (*Equisetum palustre*-30 per cent) with *Juncus* species (5 per cent) and small clumps of marsh thistle (*Cirsium palustre*-1 per cent). Small quantities of *Ranunculus* species were also present. The height of the vegetation was never below 0.5 m during the trapping season, which lasted from late March until mid-November. The ground was uneven, showing tussock-like formations.

At Tabley Hall the sampling site was situated on a mat of bulrushes effectively floating on the north east edge of Tabley Mere. The site was 25 m from the open water to the south west. The vegetation reached heights of up to 2 m and consisted of bulrushes (*Scirpus lacustris*-50 per cent) and great hairy willow-herb (*Epilobium hirsutum*-50 per cent). The ground cover consisted of nettles (*Urtica dioica*-10 per cent) and horsetails (10 per cent).

The animals were collected in large plastic pitfall traps (90 mm in diameter and 135 mm deep). These captures occurred whilst trapping for surface-active Coleoptera (Wheater, 1984). It was noticeable that larger adults were infrequent in the traps. This may have been a result of the trap size, preventing the entry of animals over a certain size (about 60 mm). Smaller specimens, however, were common and in total 1025 animals of all sizes were obtained over the trapping period.

A sample from each site was examined for each trapping occasion (the traps were examined at fortnightly intervals). In those catches where large numbers of very small toads were present, samples of 10 were taken. All large toads captured were examined.

Measurements of weight, body length (from snout to vent), jaw width (at the widest point) and hind limb length were taken for 188 specimens.

RESULTS

Weight is a measurement of particular ecological interest. This, however, tends to vary with the fulness of the gut. It was decided, therefore that the variability of this measurement negated its use as an estimate of annual growth rate. Since body length was found to be easy to measure and is of obvious value as an indicator of size, the rate of growth was calculated as the increase of body length with date. Three size groups are evident (I, II, III on Fig. 1). It can be seen from Table 1 that in all cases (except leg length) there is a decrease in the percentage increase of size with increased age. The data for the size ranges were separated and regression analyses performed on them. For the small size range (I), increase in size was positively related to time ($Y = 1.97X - 6.31$, significance of b: $p > 0.0001$). Similar results were obtained for size II animals ($Y = 1.699X + 16.221$, significance of b: $p > 0.0001$). These figures show an average size increase of 1.97 mm and 1.699 mm per fortnight respectively. This may also be expressed as 0.14 mm and 0.12 mm per day. Presumably size I animals are "this year's" animals and size II consists of "last year's" animals. Size range III showed no significant relationship between length and time and is more diverse in distribution. These animals are presumed to come from a range of ages over two years old and do not show a distinct pattern of growth. The regression lines calculated for the two smaller size

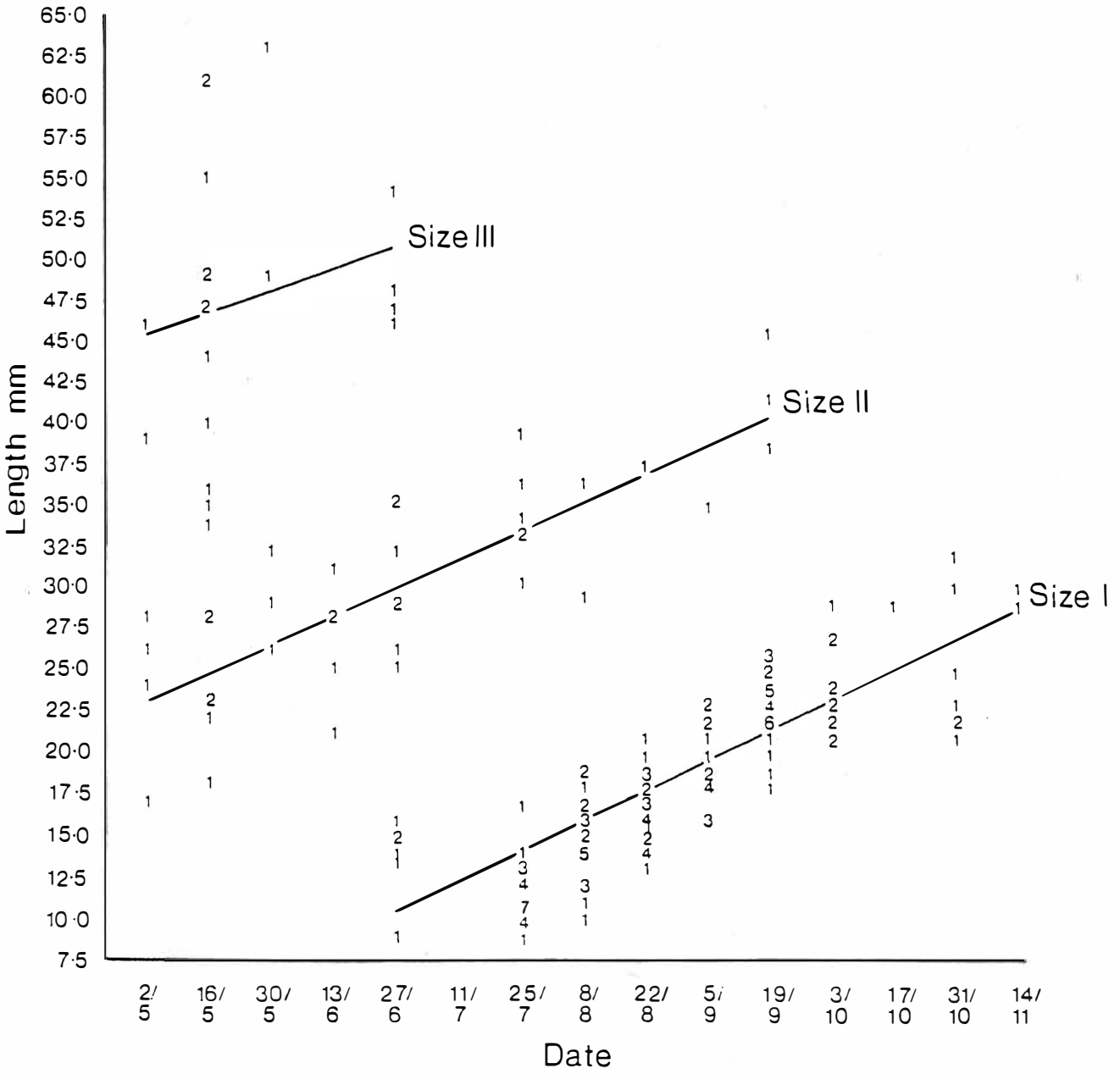

Fig. 1. Graph of body length plotted against date showing the regression lines calculated for each size range. The numbers indicate the number of points plotted. The equations and regressions of the lines are listed below.

Size I R = 0.844 Y = 1.97 X - 6.31 $p < 0.001$
Size II R = 0.81 Y = 1.699 X + 16.22 $p < 0.0001$
Size III R = 0.201 Y = 1.28 X + 40.33 $p = 0.395$

ranges were compared using a t-test and were found to have significantly different slopes ($t = 3.189$, degrees of freedom = 164, $p > 0.01$). The increase in size in group I is, therefore, more rapid than in group II and is presumably a result of the animals emerging in late June and early July and requiring to build up food reserves prior to hibernation in the Autumn. Peak emergence (peak numbers of small specimens caught) was from 27th June to 25th July at both sites.

Size, as measured by snout to vent length, was found to be significantly correlated with jaw width ($R = 0.986$, $p > 0.001$), leg length ($R = 0.980$, $p > 0.001$) and weight ($R = 0.871$, $p > 0.001$). The mean measurements of size range III animals are comparable to (if slightly lower than) those found by Collier (1970) and Mathias (1971). Both authors were primarily examining adult toads and this seems to confirm that animals in this size range are breeding adults.

	Size I (n = 130)			Size II (n = 38)			Size III (n = 20)		
	$\bar{x}$	S^2	increase during the year	$\bar{x}$	S^2	increase during the year	$\bar{x}$	S^2	increase during the year
Snout/vent length mm	18.2	5.28	110%	29.8	6.14	74%	47.5	8.36	15%
Jaw width mm	6.1	2.08	120%	10.3	2.16	47%	17.7	3.17	14%
Leg length mm	21.5	5.08	40%	34.0	6.83	72%	56.8	10.87	21%
Weight g	0.75	0.68	742%	3.2	2.01	399%	14.3	8.14	106%

TABLE 1

The means ($\bar{x}$) and variances (S^2) of each measurement were calculated for each size range over the capture period. The percentage increase in size during the year was calculated as the difference between the mean size at the beginning of the year ($\bar{x}_0$) and the mean at the end ($\bar{x}_n$), expressed as a percentage of the mean at the beginning, i.e. $\frac{(\bar{x}_n - \bar{x}_0) \times 100}{\bar{x}_0}$

DISCUSSION

It appears from this study that growth in first year toads is rapid (an average of 0.14 mm per day) and that this is followed by a smaller rate of increase (0.12 mm per day) in the second year of life. Gittins *et al.* (1982) found no significant relationship between length and age for either male or female toads; however his specimens were all breeding adults, collected during their breeding migration. Similar animals examined during this study also showed no significant relationship of length with time. This confirms Gittins' suggestion that "linear growth is insufficient after a toad has reached sexual maturity". Breeding adults are commonly judged to be those over two years old. During this study these showed a wide range of sizes and were only captured until the end of June after which the breeding migration had presumably ceased. It is interesting to note that first year animals were caught later in the year than were the other two size ranges. This probably reflects a difference in the behaviour of the age groups. It seems likely that more young toads stay close to the breeding ponds in their first year than do older animals, and, in view of the captures of group I animals in October and November, they may hibernate here. Haapanen (1974) found no marked differences in site tenacity between young and older toads, but he did not study first year animals.

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