

NOTES ON THE MORPHOMETRICS AND SPOT PATTERNS OF FEMALE SMOOTH NEWTS (*TRITURUS VULGARIS*) AT A COASTAL SITE IN LINCOLNSHIRE

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ABSTRACT

Adult female *Triturus vulgaris* breeding at seven small ponds within a freshwater marsh at Saltfleetby-Theddlethorpe Dunes National Nature Reserve were measured, weighed and examined for throat and belly spotting.

When the data were combined it was found that 26.8 per cent \pm 4.2 per cent S.E. of the total population had immaculate throats. Immaculate-throated newts tended to have fewer, smaller and usually less distinct belly spots than the normal spotted-throated form. All the immaculate-throated newts in the sample were found to have dark-yellowish throat and lower mandible pigmentation.

There were no significant morphometric differences between immaculate-throated and spotted-throated newts at the study site although the immaculate-throated animals were found to have a significantly shorter head + body length than those recorded in mid-Wales by Harrison, Gittins and Slater (1981). Both immaculate-throated and spotted-throated newts at the study site were found to be significantly lighter than those recorded by Frazer (1983) and Harrison *et al.* (1981).

It is suggested that the high incidence of immaculate-throated female smooth newts at Saltfleetby-Theddlethorpe Dunes NNR is the result of the 'founder effect'.

INTRODUCTION

It is well known that the females of the two smaller British newt species, *Triturus helveticus* and *Triturus vulgaris*, are not easily distinguished from one another in the field. Frazer (1983) states that the females of both species have 'much the same range of brown and olive colouration with a whitish belly'. Although it is generally stated that they can be separated by the paler immaculate throat of the palmate female (Smith, 1964; Arnold, Burton and Ovenden, 1978; Frazer, 1983), Smith (1964) states that the spots or speckles on the throats of some smooth newts may be very indistinct and easily overlooked. A number of workers have reported female smooth newts which have been difficult to interpret (De Fonseca and Jocqué, 1982; Frazer, 1983) and low incidences of immaculate-throated females of this species have been recorded in some populations (Roberts, pers. comm.). However, as far as the writer is aware there is little reported work quantifying their frequency in natural populations. This short paper describes the occurrence of immaculate-throated female smooth newts at the Saltfleetby-Theddlethorpe Dunes National Nature Reserve in Lincolnshire and compares the morphometrics of these animals with those of the normal form.

THE SITE

The Saltfleetby-Theddlethorpe Dunes National Nature Reserve is situated on the north Lincolnshire

coast 20 miles south of Grimsby (Grid Ref. TF472915). A feature of the site is the extensive freshwater marsh, extending to approximately 12 hectares, which is dominated by a combination of fen/marsh and relict saltmarsh plant species. This marsh contains a number of small artificial ponds, most of which have been created over the past 10 years as part of a programme to improve the breeding habitat of the natterjack toad (*Bufo calamita*). The freshwater marsh has usually dried up by midsummer and these ponds provide areas of permanent fresh water which support large populations of common frog (*Rana temporaria*), common toad (*Bufo bufo*) and smooth newt (*Triturus vulgaris*) during the breeding season. The palmate newt (*Triturus helveticus*) has not so far been recorded at the site. The pH of the ponds ranges from 6.5 to 8.0 and each has an established emergent vegetation of spike-rush (*Eleocharis uniglumis*), blunt-flowered rush (*Juncus subnodulosus*) and reedmace (*Typha latifolia*).

It is not certain how long *Triturus vulgaris* has been present on the nature reserve but the reserve records show that the species was first recorded between 1965 and 1969 and a preliminary survey of the amphibia of the site in August 1973 (Hutton, 1973) found larvae of this species to be numerous in most of the ponds of the freshwater marsh. Casual observations since then have indicated that a relatively high proportion of the adult female newts in the population are immaculate-throated animals.

METHODS

To obtain quantitative information on the frequency of this morphological variant within the population, samples of adult female newts were taken from each of seven discrete ponds within the freshwater marsh at the peak of breeding activity between 26th and 30th March 1984. Care was taken to ensure that ponds geographically close to one another, and between which there may have been some movement of animals, were sampled on the same day and usually within the same hour, to minimise the possibility of any individual animal being captured more than once. Sampling was carried out during daylight using a long-handled, coarse-mesh pond net for sweeping emergent vegetation and catching newts in open water. Only female newts actually in the water were sampled as it was assumed that these would be adult animals. Each captured newt was weighed and measured; the length of tail, from the posterior edge of the cloaca to the tip, and the head + body length were measured to the nearest millimetre using a transparent plastic rule. The standard error (S.E.) was calculated for each measurement and 95 per cent confidence limits were attached using Student's 't' to allow for the small sample. After drying off excess moisture, the weight of each animal was recorded to the nearest 0.1 g, using a 'Pesola' spring balance and the throat and lower mandible were carefully examined to determine whether markings were present or not. Additionally, belly markings were noted and categorised as follows:

Category 1 without markings

Category 2 small spots or speckles \leq c.1.0mm diam.

Category 3 Blotches $>$ c.1.0mm diam.

In general newts fell easily into one of the three belly marking categories. Only three newts intermediate between categories 2 and 3 were captured and in each case it was possible to allot each animal to a category once belly markings had been counted and measured.

Statistics derived from the binomial distribution were used to estimate the proportion of the population with immaculate throats, with the standard error (S.E.) being calculated as $\sqrt{(pq/n)}$, where p is the proportion of animals with immaculate throats, $q = 1 - p$ and n is the sample size. The relationship between belly markings and the presence or absence of throat spots was examined using a Chi-square (χ^2) test for association.

RESULTS

In total, 112 randomly selected adult female *Triturus vulgaris* were captured from the seven ponds and examined for the presence or absence of throat spotting. Due to the small samples from each pond the data were combined and statistical analysis showed that 26.8 per cent \pm 4.2 per cent S.E. of the total population of adult female newts had immaculate throats.

The belly markings of a sample of 100 newts were recorded and categorised as detailed above. The results of this investigation are given in Table 1. As only three

Belly markings	Numbers of newts	
	Throats spots	Immaculate throats
Immaculate	2	3
Small spots/speckles \leq c.1.0mm diam.	43	21
Blotches $>$ c.1.0mm diam.	29	2

TABLE 1: Belly and throat markings of adult female *Triturus vulgaris* at Saltfleetby-Theddlethorpe NNR, Lincolnshire.

completely immaculate newts (with both immaculate belly and throat) and only two immaculate-bellied animals with throat spots were captured it was not possible to use the Chi-square test to examine the relationship between the presence or absence of throat spotting and belly spotting. However, when the Chi-square statistic was used to examine the relationship between the relative size of belly spots and the presence or absence of throat spotting it was found that newts with immaculate throats tended to have category 2 belly markings, i.e. small spots ($\chi^2 = 7.91$; $p < 0.05$). Although no actual counts of belly spots were made, other than for newts which were intermediate between classes 2 and 3, 81 per cent of the sample of immaculate-throated newts were classified as having 'small spots or speckles'.

Table 2 shows the average lengths and weights of both immaculate-throated and normal spotted-throated newts. There was not a significant difference in overall length, head + body length, tail length or weight. The ratio of tail length to head + body length was 0.89 for immaculate-throated newts and 0.85 for those with spotted throats.

DISCUSSION

Although immaculate-throated female smooth newts appear to be quite well known to workers on the genus *Triturus* in Britain (Halliday, pers. comm.) their frequency in natural populations has not been well documented. The little data available suggest that only small numbers of adult female smooth newts within any one population are likely to have immaculate throats (Roberts, pers. comm.). The frequency within the Saltfleetby-Theddlethorpe population is therefore surprisingly high.

Frazer (1983) states that there is no significant difference in size between adult females of *Triturus vulgaris* and *Triturus helveticus* and this is supported by the work of Bell (1966) in Leicestershire. Casual observations at Saltfleetby-Theddlethorpe NNR between 1979 and 1983, later supported by the quantitative data collected in 1984, suggested that there was not a noticeable difference in overall size between spotted-throated and immaculate-throated female newts and it was at first thought that the latter might be *Triturus helveticus*. Closer examination of these animals during the 1984 field work showed that they had two layers of pigmentation on the throats, a dark yellowish background pigmentation, usually with

Throat markings	Total length (mm)			Head + body length (mm)			Tail length (mm)			Weight (g)		
	mean	<i>n</i>	95% limits	mean	<i>n</i>	95% limits	mean	<i>n</i>	95% limits	mean	<i>n</i>	95% limits
Spotted throat	78.5	82	1.3	42.3	82	0.7	36.2	82	0.8	1.7	74	0.1
Immaculate throat	77.9	30	2.4	41.3	30	1.1	36.6	30	1.5	1.7	25	0.2

TABLE 2: Comparative size data for adult female *Triturus vulgaris* with spotted and immaculate throats at Saltfleetby-Theddlethorpe NNR, Lincolnshire.

Ratio Location	Total length (mm)			Head + body length (mm)			Weight (g)			tail length: body length
	mean	<i>n</i>	95% limits	mean	<i>n</i>	95% limits	mean	<i>n</i>	95% limits	
Llysdinam — 1981 (Harrison <i>et al.</i> 1981)	80.1	175	0.8	43.4	175	0.5	2.3	41	0.16*	0.85
Llysdinam — 1981-83 (Harrison <i>et al.</i> 1984)	79.8	266	0.63	—	—	—	—	—	—	0.83
Leicestershire (Bell, 1966)	75.9	—	—	—	—	—	3.4	81	—	—
Ham Street (Frazer, 1983)	—	—	—	—	—	—	2.25	20	0.23*	—
Other sites in mid-Wales (Harrison <i>et al.</i> 1984)	82.2	13	3.27*	—	—	—	—	—	—	—

TABLE 3: Size data for adult female *Triturus vulgaris* at a number of other sites in Britain. 95% confidence limits have been calculated for the data of Harrison *et al.* (1981 and 1984) and Frazer (1983). The figures marked with an asterisk have been calculated using Student's 't' to allow for the small samples.

a layer of spots or speckles on top of this. In agreement with the work of Roberts (pers. comm.) all the immaculate-throated newts in the sample from Saltfleetby-Theddlethorpe NNR were found to have this yellowish background pigmentation. As *Triturus helveticus* has a pale pink throat due to lack of pigmentation, it was concluded that the Saltfleetby-Theddlethorpe animals were not this species.

The possibility that these immaculate-throated female newts might be hybrids between *Triturus vulgaris* and *Triturus helveticus* was also considered. However, although partially viable hybrids between the two species have been produced in the laboratory (Spurway, 1953), only one natural hybrid has been recorded in the wild as far as is known (Griffiths, Roberts and Sim, In prep.) and other investigations of presumed hybrids have been shown to be morphological variants of *Triturus vulgaris* (Freytag, 1970; Roberts, pers. comm.). The fact that not a single specimen of *Triturus helveticus* was found during the intensive sampling at Saltfleetby-Theddlethorpe and the knowledge that there is not, as far as is known, a colony of this species in reasonable proximity to the Reserve supports the conclusion that the immaculate-throated animals at this site are also a morphological variant of *Triturus vulgaris*.

Data are available from Bell (1966), Frazer (1983) and Harrison, Gittins and Slater (1981, 1984) on the morphometrics of adult female smooth newts and these are summarised in Table 3. Harrison *et al.* (1981) give mean lengths and weights together with standard deviations, as do Harrison *et al.* (1984) for overall lengths only and Frazer (1983) for weights only. For the purposes of direct comparison 95 per cent confidence limits have been calculated for these data. A comparison of Tables 2 and 3 shows that there is no significant difference in the average overall lengths of either spotted-throated or immaculate-throated newts at Saltfleetby-Theddlethorpe and those measured by Harrison *et al.* (1981) and Harrison *et al.* (1984). Similarly, spotted throated newts at Saltfleetby-Theddlethorpe NNR were not found to be significantly different from the smooth newts measured by Harrison *et al.* (1981) with regard to weight and head + body length. However, immaculate-throated newts at Saltfleetby-Theddlethorpe were found to have significantly shorter head + body length, at the 95 per cent level of confidence, than those recorded by Harrison *et al.* (1981) and both immaculate-throated and spotted-throated newts at Saltfleetby-Theddlethorpe were found to be significantly lighter at the same level of confidence, than those recorded by Frazer (1983) and Harrison *et al.* (1981). Bell (1966) gives only mean overall length and mean weight data for female smooth

newts from his Leicestershire site but it seems likely that both immaculate-throated and spotted-throated newts at Saltfleetby-Theddlethorpe are significantly lighter than those measured in Leicestershire. Weight comparisons should however be treated with extreme caution due to the problems of female newts carrying differing numbers of eggs at the time of weighing. In agreement with the work of Bell (1966) all the newts measured at Saltfleetby-Theddlethorpe NNR were found to have head + body length greater than tail length.

Roberts (unpublished data) suggests that spot size, number and colour can be highly variable both within and between populations. At Saltfleetby-Theddlethorpe immaculate-throated female smooth newts were found to have fewer, smaller and usually less distinct belly spots than those with normal spotted throats, suggesting that they are generally less melanic than the normal form, in agreement with the trends found in Roberts's data.

When a site is relatively isolated it is usually the case that the colonisation of an empty habitat involves only small numbers of individuals. Under such circumstances the colonising event will give rise to a marked change in allele frequencies and in alleles present in the descendent population. This is unlikely to be significantly affected by fresh variation introduced by later immigration (Berry, 1977). The comparative isolation of the freshwater marsh at Saltfleetby-Theddlethorpe NNR from other suitable smooth newt habitat suggests that the high incidence of immaculate-throated adult female smooth newts may perhaps be the result of this 'founder effect', with the initial colonisers carrying genes which favoured immaculate throats.

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