THE DISTRIBUTION OF NEWTS, *TRITURUS* SPP., IN THE PEAK DISTRICT, ENGLAND

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ABSTRACT

1. Surveys of the distribution of newts, *Triturus* spp. in the Peak District show a distinct geographical separation between the species. *T. vulgaris* and *T. cristatus* occur principally on the Carboniferous Limestone, in ponds of pH >7.0. *T. helveticus* occurs on the Carboniferous Millstone Grit and Shales in more acid ponds of pH <7.0.
2. However, the altitudinal distribution of these species shows that *T. helveticus* is not a 'montane' species, as has been alleged, but occurs mostly in ponds below 1000 ft (305m), whereas *T. vulgaris* and *T. cristatus* occur mostly in ponds above that height.
3. Both field work and inspection of the 1:25,000 O.S. maps indicate an abundance of small field ponds suitable as breeding ponds for *T. vulgaris* and *T. cristatus*. Though population sizes in any one pond may be small, the overall density of ponds suggests that total population are high, and of no immediate conservation concern.

INTRODUCTION

The Palmate Newt, *Triturus helveticus*, is more numerous and widespread in northern and western Britain, leading Smith (1954) to suggest that it was a more montane species than the Common Newt *Triturus vulgaris*. Others have subsequently observed, however, that *T. helveticus* is not especially characteristics of high altitudes (Cooke and Ferguson, 1975) but that it is much more tolerant of acidity and lower ionic concentrations (Cooke and Frazer, 1976).

The Peak District provides an ideal area to examine further these opposing ideas. In the south, the dome of Carboniferous Limestone (the 'White Peak') produces a high plateau of base-rich rock dissected by lower dales. In the north and around the western and eastern flanks of the limestone area, the very acid rocks of the Millstone Grit (the 'Dark Peak') also produce high plateaux, interrupted by valleys of equally acidic Shales and Coal Measures. Thus both low and high altitude situations are available on both acidic and basic rocks.

In view of the concern which has been expressed for the survival of amphibian populations in southern Britain (e.g. Beebee, 1973; Cooke, 1972; Presst, Cooke and Corbett, 1974), a survey of the area for newts provided also an opportunity to consider the status and prospects for amphibians in this area.

METHODS

Information comes from three sources. In 1974-76, a preliminary survey was undertaken to establish the whereabouts of ponds with amphibian populations. Effort was principally directed at newts, and small ponds, which could be reasonably sampled with a pond net in 15 minutes netting, were preferred. In 1976, efforts were made to examine all the ponds shown on the First Series 1:25,000 Ordnance Survey maps in a few limited sampling area. This preliminary survey thus provides information on relative numbers of newts of the three species (*T. helveticus*, *T. vulgaris* and the Crested Newt *T. cristatus*) and also on the survival or otherwise of ponds marked on those maps (which date from surveying carried out in the period 1889-1935, but mostly from 1900-1920).

In 1984-85, and consequential upon the results obtained by Cooke and Frazer (1976), a sample of the ponds surveyed in 1974-76 was revisited. Newts were again sampled by 15-minute pond netting, and the pH of each pond ascertained with a portable Kent EIL 3055 digital pH meter. Three readings were obtained from each pond, and the mean of these three used in analysis. The approximate altitude of each pond (to the nearest 50 ft contour, from the 1" (1:63,600) Ordnance Survey map, the geology, physical characteristics (size, shape, depth) and other features (fauna and flora of the pond, nature of surrounding habitat) were also noted.

The third source of information is the Ordnance Survey maps of the area, especially the First Series 1:25,000 maps and, for the White Peak, the Second Series 1:25,000 tourist map. These give some information on the number of potential breeding sites available, and also, perhaps, on the level of change seen between the First Series (surveyed 1889-1935 but mostly 1900-1920) and the Second Series (surveyed 1950-1976). The availability of ponds was scored from the First Series maps for the whole of the 10 km squares SK05, 06, 07, 08, 09, 15, 16, 17, 18, 19, 25, 26, 27, 28, 29; SJ96, 97, 98; and SE00. Thus this availability relates to an area somewhat larger than,

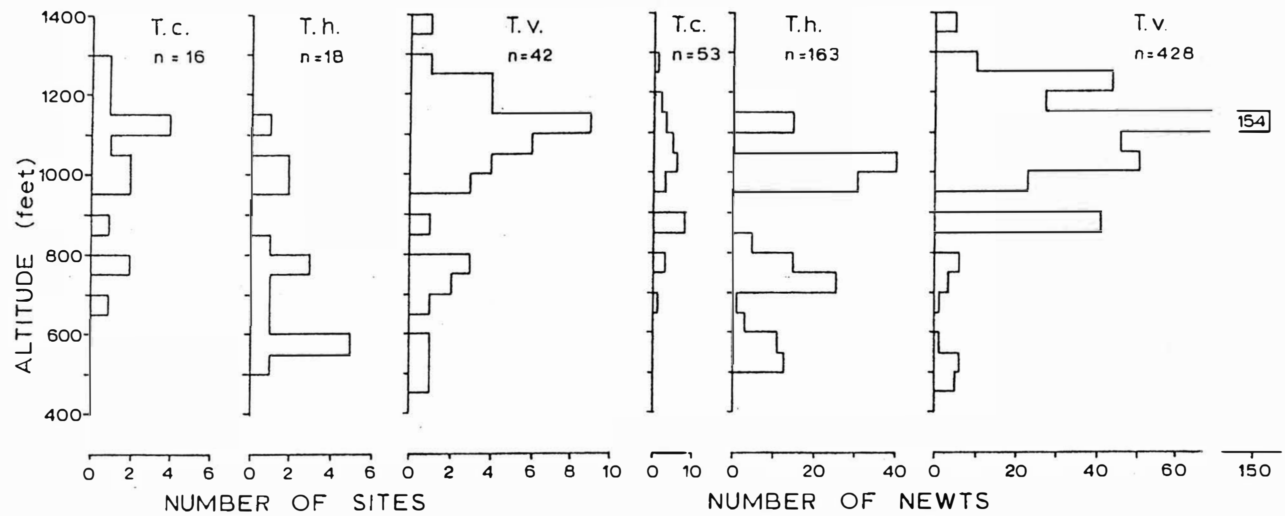

Fig. 1 Altitudinal distribution of newts *Triturus* spp. in the Peak District
(a) by the ponds in which they were found
(b) by numbers of individual newts handled.

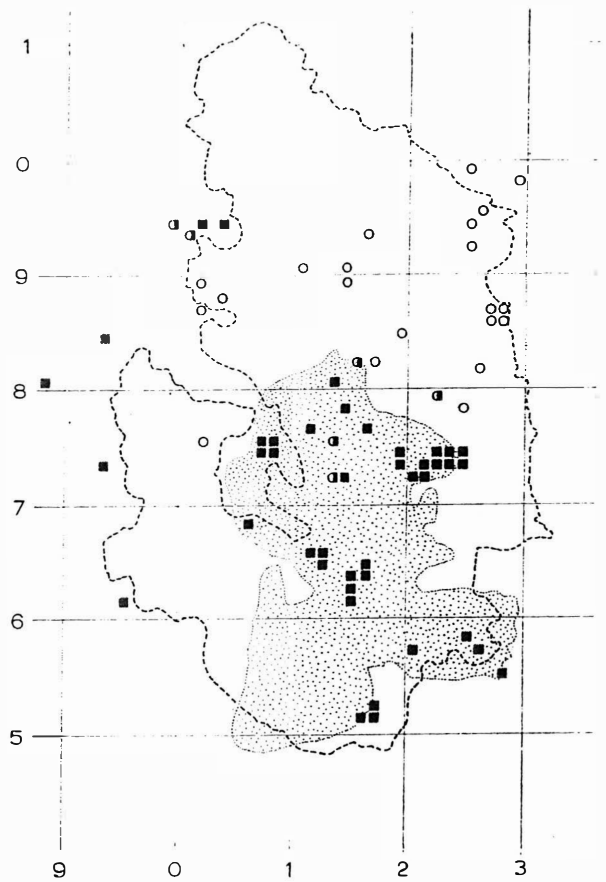

Fig. 2 Distribution of newts *Triturus* spp. in the Peak District. The grid squares represent the 10 km National Grid, and the dashed line is the outline of the Peak District National Park. The stipple indicates the extent of the Carboniferous Limestone o *T. helveticus* ■ *T. vulgaris*. (*T. cristatus* not mapped, for security).

though encompassing almost all of, the Peak District National Park. For examining changes between the First and Second Series maps, a more limited sample of 10 km squares, SK15, 16, 17, 25 and 26, was used; these contained the majority of the ponds in the Peak District. Ponds were scored as 'Field Ponds' — mostly in fact 'dew ponds' created for stock, but also other small ponds, and 'Reservoirs' — larger bodies of water, mostly reservoirs but also large ornamental lakes and similar ponds which could not be adequately sampled for newts but which were, in any case less likely to be used by them (because of the presence of large fish and other predators).

RESULTS

Status of the Amphibians

T. vulgaris is much the most common newt, with 439 handled at 42 sites in all. *T. helveticus* is numerous (148 handled at 15 sites), while *T. cristatus* is apparently much scarcer, though fairly widespread (52 handled at 16 sites) (Table 1). The relative abundance in the two surveys was similar; although the proportion of sites which had newts was higher in the second survey, this was simply because this was a resurvey of sites found in the first survey, and therefore concentrated on better sites.

All the sites at which *T. cristatus* was found also contained *T. vulgaris*; none of them contained *T. helveticus* as well, though one pond containing all three species is known near Calver (D. Whiteley, pers. comm.). Three sites contained both *T. helveticus* and *T. vulgaris*.

Of the other two amphibians, the Common Frog *Rana temporaria* is also abundant in this area and occurs nearly twice as commonly as *T. vulgaris*. Since most records are of spawn or tadpoles, it is not possible to present numbers of individual frogs for comparison with the newts. The Common Toad *Bufo bufo* appears to be relatively scarce, being recorded from only eight sites. However, it generally favours larger water bodies than the small ponds which were the primary target of this survey, and is likely to be more numerous locally than this suggests. In his report of amphibians in the Sheffield area, which includes much of the Peak District, Whiteley (1977) had 655 sites for *Rana* and 338 for *Bufo*.

ALTITUDE

The 18 sites where *T. helveticus* occurred ranged from 500-1,100ft in altitude, but only three sites were above 1,000ft (305m), and the median height was only 700ft (213m) (Table 2); thus, most sites were in the shale valleys, at fairly low altitudes. The 42 sites with *T. vulgaris* occurred in a similar range, 450-1,250ft, but because most of them were up on the limestone plateau, the median height was 1,050ft (320m); the difference was statistically highly significant (Mann-Whitney U-test, $p<0.0001$). Since all the *T. cristatus* sites were also *T. vulgaris* sites, it is not surprising that these two species occupied a similar altitudinal range (Fig. 1).

GEOLOGY AND pH

The distribution of the two species differed markedly; 15 out of 18 ponds with *T. helveticus* were on gritstone, whereas only nine of the ponds with *T. vulgaris* were on the gritstone (Table 2). The three ponds which had both species included two of those where *T. helveticus* occurred on limestone. Since *T. cristatus* invariably shared its pond with *T. vulgaris*, it is not surprising to find that it, too, occurred principally on the limestone (Fig. 2). The different preferences, of *T. helveticus* for the gritstone and *T. vulgaris* for the limestone, were statistically highly significant (X^2 test, $p<0.00006$).

Since pH is largely a reflection of this geological difference, it is not surprising that, in the smaller sample of ponds checked for pH, there was also a clear bias of *T. helveticus* toward more acid ponds and *T. vulgaris* (and *T. cristatus*) toward more basic ponds. Both of the smaller species occurred over a wide range of pH, and with a considerable overlap, but only three of the ponds with *T. helveticus* had a pH of 7.0 or more; two of these were ponds with *T. vulgaris* also present. Conversely, only three of the ponds with *T. vulgaris* had a pH below 7.0; the other 'shared' pond was one of these. Again, *T. cristatus* occurred in ponds of high pH, with a suggestion, not statistically significant, that it might prefer ponds which were on average more base-rich than those frequented by *T. vulgaris*. The difference in observed pH between *T. helveticus* and *T. vulgaris* was highly significant (Mann-Whitney U-test, $p<0.002$).

	1974-76 Survey		1984-85 Survey		Total	
	No. of Ponds	No. of Newts	No. of Ponds	No. of Newts	No. of Ponds	No. of Newts
T. helveticus	11	89	12	59	15	148
T. vulgaris	34	210	24	229	42	439
T. cristatus	11	33	7	19	16	49
Ponds surveyed	142	—	45	—	163	—
Ponds with newts	36	—	33	—	51	—
Ponds with no newts	106	—	12	—	112	—
Ponds with *Rana*	59	—	23	—	70	—
Ponds with *Bufo*	7	—	3	—	8	—

TABLE 1: Abundance of Newts, *Triturus* spp., during two surveys of the Peak District. Number of newts determined by 15 min. pondnet sampling at each site. Because many sites found in 1974-76 were revisited in 1984-85, the total number of ponds known to hold each species is less than the total of the two columns.

	Altitude (ft)		pH		Geology (No. of ponds)	
	Median	Range	Median	Range	Limestone	Grit/Shale
T. helveticus	700	500-1100	6.7	4.7-8.1	3	15
T. vulgaris	1050	450-1250	7.6	5.7-9.7	33	9
T. cristatus	1000	650-1150	7.9	7.3-9.7	14	2

TABLE 2: Altitude, pH and underlying geology for breeding ponds of newts *Triturus* spp. in the Peak District.

T.h. v T.v.	U = 138; z = 3.899; p = 0.0001	U = 53; z = 3.063; p = 0.002	$\chi^2_1 = 20.12$; $p = 6 \times 10^5$
T.h. v T.c.	U = 46; z = 3.420; p = 0.0006	U = 8; z = 3.095; p = 0.002	$\chi^2_1 = 17$; $p = 6 \times 10^4$
T.v. v T.c.	U = 324; z = 0.219; p = 0.826	U = 66; z = 1.333; p = 0.182	$\chi^2_1 = 0.6$; $p = 0.56$

It should, perhaps, be added that measurement of pH in the field was an unpredictable or erratic procedure. The comparison in the preceding paragraph was based on the mean, for each pond, of three or four readings. In 23 ponds, out of the 37 newt-ponds measured, the three readings were all within 0.5 pH units, giving some confidence in the value of the mean for this comparison (given that the species' preferences were 0.9 pH units apart). The other 14 ponds produced readings more variable than this, however, with in the extreme case 2.08 pH units discrepancy. These larger discrepancies presumably reflect local photosynthetic or respiratory activity, with bicarbonate forming or dissociating, perhaps only in the neighbourhood of the probe, but they could equally indicate genuine differences in the environment experienced by the newts. In other words, though the difference in average pH favoured by the species is real, all species must be tolerant of a range of ionic concentrations.

Availability of Ponds

Study of the 1:25,000 maps reveals several paradoxes. Because the Carboniferous Limestone is so porous, and liable to dry out in summer, large numbers of field ponds (dew ponds) have been dug. Some of these still have the traditional lining of clay with limestone blocks embedded in it for protection, but many are now lined with concrete. Conversely, the Gritstone region, because it is impervious, rarely dries out completely, even in the most severe drought, so livestock always has access to water; there has, therefore, been little or no need to dig artificial ponds. There is, therefore, the paradox that, in the dry Limestone area, newts have a wealth of suitable breeding ponds available, whereas in the wet Gritstone such ponds are apparently in short supply (Table 3). It was certainly difficult to find enough ponds on the Gritstone to sample for *T. helveticus*, and the sample size of ponds with that species is small, whereas the ponds sampled for *T. vulgaris* are only a small selection of those that could have been examined. It is probable that the surveyors were more punctilious about recording the clearly artificial dew ponds, on the limestone, than they were about recording the sites (ditches, natural oxbow lakes, etc.) that newts tend to use in the Gritstone areas; in other words, the real availability of breeding sites for *T. helveticus* is probably greater than the figures in Table 3 imply.

A second paradox is that the Gritstone has conversely, a much higher number of large ornamental lakes and water-supply reservoirs; obviously these would not be constructed over the porous limestone. Though these large water bodies are likely to be unsuitable for newts (and certainly impossible to sample properly for newts), they tend to have associated with them settling pools, water channels and similar smaller water bodies which may well be suitable for newts (but may not be shown separately on the maps).

The even higher density of newt ponds on the Cheshire Plain is the result of excavating marl ponds. However, this area was not examined for newts, and is not considered further.

The survival of ponds through to recent times is indicated in two ways — from the survey in 1976 of a sample of ponds marked on the First Series maps, and from comparing the First Series with the Second Series. Of 101 ponds visited in 1976, 20 had dried up or been filled in and were therefore 'lost' as newt ponds; however, only 85 of this 101 were shown on the First Series maps, the remaining 16 were 'new' ponds and almost balanced the losses. Comparing the two series of maps also suggests a modest loss (Table 3b), with 71 per cent of the ponds shown on the older maps still extant according to the newer maps. Here too there are suggestions that the situation is actually better than the new maps indicate. Firstly, the revising surveyors seem to have been more restrictive in what they mapped; of 50 ponds shown on the First Series maps, and still evident in 1976, 13 were omitted from the Second Series. If this level of under-representation applies throughout the newer maps, the 'corrected' number of ponds actually available for newts now may be no less than when the First Series maps were drafted.

(3a)	Area Covered	No. of Field Ponds	Density of Field Ponds	No. of Lakes & Reservoirs	Density of Lakes & Reservoirs
Limestone	560 km^2	1006	1.80/km^2	44	0.08/km^2
Gritstone	1245 km^2	449	0.36/km^2	208	0.17/km^2
Cheshire Plain	95 km^2	649	6.83/km^2	20	0.21/km^2

(3b)	No. of Field Ponds First Series	No. of Reservoirs First Series	No. of Field Ponds Second Series	No. of Reservoirs Second Series
Limestone	893	36	628	11
Gritstone	19	13	16	15

TABLE 3: The availability of ponds in the Peak District:
(a) as shown on the First Series 1:25,000 maps, for twenty 10 km squares;
(b) as shown, for a sub-sample of five 10 km squares, on the First and Second Series 1:25,000 maps.

Secondly, there were 10 ponds in this sample that were not shown on either series of maps, (and another two ponds, not shown on the First Series, that had correctly been added to the Second Series maps). In other words, there are more ponds available for newts than the maps suggest.

DISCUSSION

The ditribution of the three *Triturus* species in the Peak District shows very clearly that while *T. vulgaris* and *T. cristatus* inhabit the base-rich Carboniferous Limestone area, with ponds of high pH, *T. helveticus* is not a montane species in any sense of that adjective; on average, it occurs at lower altitude than the other two species. Though he did not analyse the altitudinal records to emphasise the point, Whiteley (1977) pointed out these same distinctions in distribution.

Cooke and Ferguson (1975) examined the national distribution records for an altitudinal difference in range between *T. helveticus* and *T. vulgaris*, and could find, at most, only a hint that *T. helveticus* might be more numerous at higher altitudes. For this, they used the 400ft contour as the dividing line between lowland and highland, but they only had five records of newts above 1,000ft. They concluded that altitudinal preferences were, at most, only a marginal factor in explaining the tendency to a northwestern/southeastern division between *T. helveticus* and *T. vulgaris*, and felt that underlying substrate was more important. This suggestion was strongly supported by the more detailed study of pH preference undertaken by Cooke and Frazer (1976), and by this study.

In the absence of earlier surveys of the Peak District, it is difficult to be certain that there have been no major declines in amphibian populations. However, this survey suggests that the two smaller newts are still common and widespread. The Crested Newt *T. cristatus* is of concern to conservationists, in particular because of declines in S.E. England (e.g. Beebee 1973, 1975, 1977). Though the numbers handled in this study were small, the ponds were small and unlikely to hold large populations; the largest was 29 x 37m, but most were dew ponds 7m in diameter. There were, however, enough of these ponds, scattered widely throughout the limestone region, to suggest that the total population is large and not endangered. Though the 1976 survey of sites shown on the 1:25,000 map found that there had been some losses of ponds, perhaps 25 per cent of those marked on the maps, it also found a similar number of 'new' ponds. Given that the predominant land use on the limestone is for grazing cattle or sheep, and that much of the soil is too shallow for ploughing, the ponds are likely to remain in existence (though there is a trend towards piped water supplies and drinking troughs). Although much of the limestone plateau is intensively farmed and neat, the dale sides are generally covered in rougher vegetation, providing ample terrestrial habitat for newts. In the gritstone areas, rough grazings and heather (grouse) moorland are the main land uses, so that there is, again, no shortage of suitable habitat.

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