HERPETOLOGICAL JOURNAL, Vol. 7, pp. 37-41 (1997)

MONITORING A BREEDING POPULATION OF CRESTED NEWTS (*TRITURUS CRISTATUS*) IN A HOUSING DEVELOPMENT

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A housing estate was built immediately adjacent to two water bodies utilized by crested newts (*Triturus cristatus*). Conservation management, particularly pond deepening and fish removal, was undertaken during and after development. This paper describes a monitoring study to determine the success of the operation. Counting adults at night in the breeding season indicated that numbers were at least maintained over a ten year period. Larval counts were made in each of the seven years after the houses were constructed, and more than half of the larvae were netted in one year, 1991. In the autumn of 1990 both ponds were totally dry, and success in 1991 may have been associated with absence of fish and low numbers of invertebrate predators. The overall conclusion was that it is possible to conserve crested newts satisfactorily in such a situation.

INTRODUCTION

Many of the world's amphibian species are declining as a result of local or global factors (e.g. Blaustein & Wake, 1995). The crested newt (*Triturus cristatus*) ranges widely across Europe, but is under threat in many countries (Steward, 1969; Corbett, 1994). It is listed on Appendix II of the Berne Convention and Annexes II and IV of the European Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora. In Britain, it receives protection through listing on Schedule 5 of the Wildlife and Countryside Act, 1981 and on Schedule 2 of the Conservation (Natural Habitats & c.) Regulations, 1994. Important sites may be notified as Sites of Special Scientific Interest under Part II of the Wildlife and Countryside Act. It is again recognized as in need of protection by being on the short list of Annex F in the UK's Biodiversity Action Plan. Special Areas of Conservation (SACs) will be designated throughout the European Union as part of the *Natura 2000* series to assist the conservation of this species.

Conservation of the crested newt in Britain was reviewed by Gent & Bray (1994). Amongst the principal threats to British populations of this species is urban development for housing and other purposes (Cooke & Scorgie, 1983; Hilton-Brown & Oldham, 1991). One option, where a development is allowed to take place, is to attempt to conserve the species within the development. As with any novel form of management, there should be monitoring of its success. To date, however, no such event has been monitored over a number of years and the results published. This paper reports the monitoring of a crested newt population before, during and after construction of a housing development, both to determine whether such a solution may be a viable option in similar situations elsewhere and to provide information on monitoring methodology.

SITE AND ITS HISTORY

The site is located at TL 202961 in Stanground, near Peterborough. The history of newts at the site has not been documented, but it is well-known locally as a traditional breeding site and the ponds have existed since at least the last century.

In 1986, the Nature Conservancy Council (NCC, now English Nature) was consulted over a planning proposal by Persimmon Homes to convert horse pasture adjacent to East and West ponds into a housing estate (Fig. 1). The initial night count in 1986 (see below) revealed the presence of crested newts in both ponds and demonstrated the importance of the site. NCC confirmed that the ponds should be retained together with some surrounding land and, in view of the uncertain effects on the hydrology of the site, asked for a tap to be installed by East pond.

The area set aside for the ponds and their surroundings was about 1 ha. As this was considered unlikely to be sufficient to accommodate the newts totally (Cooke, 1985; Oldham & Nicholson, 1986; Oldham, 1994), access to adjacent gardens was facilitated by not erecting solid fences or walls (however, a few such fences have been erected in the intervening years). The Frank Perkins Parkway, which is a dual carriageway, probably represents a barrier to the north-west (e.g. see Oldham, 1994); but access to fragmented, suitable habitat within a few hundred metres to the north, east or south is relatively easy (Fig. 1). Crested newts are occasionally seen crushed on the lane to the south of West pond.

Construction of houses began in 1987, after the newt breeding season, and was completed by 1989. House density is about 16/ha over the estate as a whole. Since 1989 the site has been managed as a reserve with newt conservation as its primary aim.

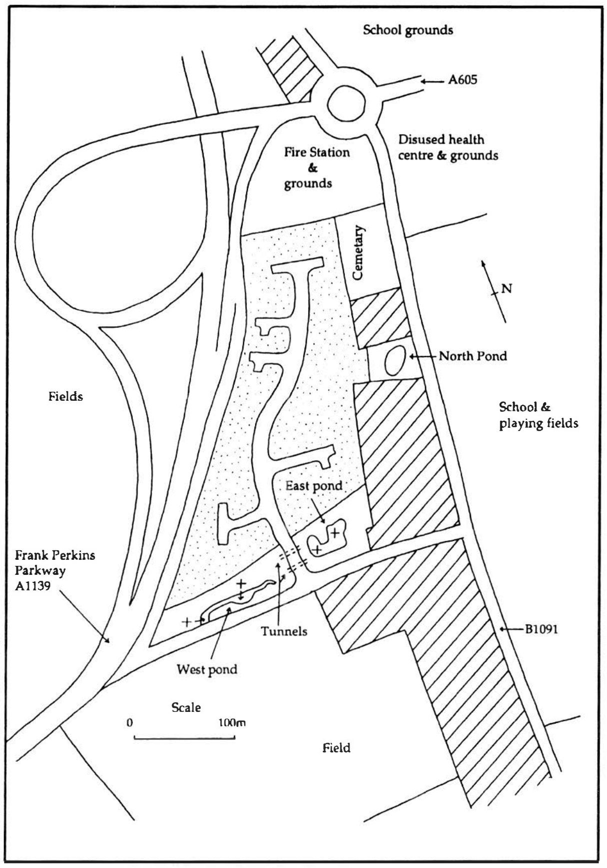

FIG. 1. A sketch map showing the ponds and their surroundings, as they were in 1995. Existing houses and gardens are cross-hatched; houses and gardens in the new development are stippled. Netting locations in East and West ponds are indicated by crosses.

East pond measures roughly 40 m x 20 m, while West pond is up to 80 m long and 10 m wide. North pond lies about 200 m to the north east of East pond (Fig. 1). Although North pond was not directly affected by the housing development, its hydrology has been modified (see later). Some amenity management has been done to its surrounds which extend to about 0.2 ha. The pond measures 30 m x 25 m. No other crested newt breeding site is known within 600 m (unpublished and T. Langton, pers. comm.).

METHODS

Both adult and larval phases of the newts were studied. Counting at night with a torch was used as a means of monitoring the comparative size of the breeding population (Griffiths & Raper, 1994; Langton *et al.*, 1994; Oldham, 1994; Cooke, 1995; Griffiths *et al.*, 1996). Water turbidity and amount of aquatic vegetation were recorded when counts were made. During the pre-development phase, one count was done for East and West ponds in 1986 and two in 1987. Thereafter three or four counts were undertaken during the main part of each breeding season (March-May). The principal objective of conserving newts at the site was to maintain and, if possible, enhance the crested newt population. The smooth newt (*Triturus vulgaris*) population was of secondary interest but was monitored at the same time. The aim of night counting was to be able to detect long term trends rather than short term variations between years. Regression analysis was performed on annual means to determine whether there was a significant change in newt numbers post-development or over the entire ten year period, 1986-1995. Means were used primarily because there was some

TABLE 1. Night counts of newts in East and West ponds, 1986-1995. Values given are mean counts±SE.

Year	No. of counts	Crested Newts			Smooth Newts		
		East pond	West pond	Total	East pond	West pond	Total
Pre-development							
1986	1	93	9	102	17	1	18
1987	2	28±0	1±1	29±1	8±4	2±2	10±6
During development							
1988	3	16±12	0	16±12	3±2	1±1	4±2
Post-development							
1989	4	51±4	17±6	67±15	24±7	18±2	42±8
1990	3	41±15	10±2	51±16	7±2	9±2	16±2
1991	3	93±30	13±6	106±36	41±24	18±4	59±27
1992	3	62±11	12±5	74±16	18±4	27±10	45±12
1993	3	102±17	20±6	123±17	68±32	57±10	125±35
1994	3	59±28	16±5	75±33	29±6	20±6	49±12
1995	3	44±23	10±4	55±26	23±17	10±4	33±19

TABLE 2. Night counts of newts in North pond, 1986-1995

Year	night counts	
	Crested newts	Smooth newts
1986	17	5
1987	16	6
1988	20, 2	5, 8
1989	31	13
1990	30	8
1991	39	20
1992	29	17
1993	19	25
1994	0	1
1995	4	15

variation in the number of counts per year. North pond was also counted at night once (or twice) each spring for comparison, being considered in 1986 to be far less vulnerable to impacts from the development.

Each year post-development, East and West ponds were netted for larvae in a standard fashion: for each pond, the sumps and the western ends (Fig. 1) were each swept with a pond net for five minutes on a total of four dates during July and August. Whenever possible, visits were on fine, dry days. Catches should give a comparative indication of numbers during the late larval period (see Cooke & Cooke, 1993; Cooke, 1995). There was no systematic netting of North pond.

RESULTS AND OBSERVATIONS

Night counts are given in Tables 1 and 2 with larval catches in Table 3. In general, all three ponds had conditions suitable for torch counting (Griffiths *et al.*, 1996). During the night counts, <1% of crested newts recorded were believed to be immatures, based on small size (<10 cm total length); in view of this low number of immatures, they are not differentiated in Tables 1 and 2.

Pre-development counts were variable, but the local importance of the site was confirmed by the combined count for East and West ponds in 1986 of 102 crested newts (Table 1). The main drain for the housing estate was installed in April 1988 and by June this appeared to have had a marked effect on the hydrology of the site, with the water table being 40-50 cm below the bed of West pond. Both ponds were therefore re-excavated with a mechanical digger in December 1988. Although reasonable numbers of adult crested and smooth newts returned to breed in 1989 and 1990 (Table 1), production of metamorphs failed in 1990 (Table 3). This failure was associated with an increase in three-spined sticklebacks (*Gasterosteus aculeatus*) caught in East pond (a mean $\pm$ SE of 3 $\pm$ 1 were netted in 1989, with 26 $\pm$ 2 in 1990) and total desiccation of West pond. (A means of piping the water to west pond was not devised until 1991). In October 1990, East pond was pumped dry and the fish removed. No fish have been seen or caught there since then.

Larval catches in 1991 were high for smooth newts and exceptional for crested newts; indeed, more than 50% of the entire larval catch for crested newts, 1989-1995, occurred in 1991 (Table 3). The summers of 1991-1993 were marked by stable, high water conditions in East and West ponds, with the tap being used when necessary. Larval production for crested newts declined in both ponds over this period (Table 3). In contrast, numbers of smooth newt larvae remained high throughout the period. Numbers of larvae of both species were very low in 1995; the tap was little used and West pond was reduced to a few puddles by late summer and East pond was confined to the sump.

Regression analysis was done on mean night count data for both species in East pond, West pond and both ponds over the periods 1986-1995 and 1989-1995. Of the 12 analyses, 11 gave positive slopes, although there were no significant relationships between newt numbers and time. Thus populations in the ponds in the reserve were at least maintained. Numbers of the two species were correlated in East pond (1985-1995, r_s = 0.77, P<0.01; 1989-1995, r_s = 0.79, P<0.05) and West pond (1985-1995, r_s = 0.88, P<0.01; 1989-1995, r_s = 0.71, P = 0.05).

TABLE 3. Catches of larval newts in East and West ponds, July-August, 1989-1995. * indicates a total of 1-3 larvae caught during the year. Values represent mean catch$\pm$SE.

year	no. of netting occasions	crested newt larvae			smooth newt larvae		
		East pond	West pond	Total	East pond	West pond	Total
1989	4	16$\pm$5	13$\pm$4	29$\pm$8	3$\pm$2	4$\pm$1	6$\pm$2
1990	4	0	0	0	<1*	0	<1*
1991	4	37$\pm$3	62$\pm$7	99$\pm$9	13$\pm$4	22$\pm$2	35$\pm$3
1992	4	14$\pm$5	15$\pm$2	29$\pm$7	22$\pm$1	27$\pm$7	49$\pm$7
1993	4	1$\pm$1	<1*	2$\pm$1	12$\pm$4	15$\pm$6	26$\pm$8
1994	4	10$\pm$3	2$\pm$2	13$\pm$3	19$\pm$9	6$\pm$5	24$\pm$15
1995	4	<1*	0	<1*	<1*	2$\pm$2	2$\pm$1

In contrast, in North pond there was a significant decline in crested newts counted at night over the period 1989-1995 (Table 2, slope of line significantly different from zero, $t_5 = 3.52$, $P<0.05$). By the mid 1990s, counts of crested newts in North pond were low following unsympathetic amenity management. In 1993, overhanging branches were removed, thereby reducing shaded, open areas in which breeding newts were frequently recorded. In 1994, the hydrology of the pond was changed and the water level lowered. Since 1994, the shallow edges have been increasingly invaded by *Typha latifolia*. North pond was totally dry by August 1995, the first time I had seen it in this condition (i.e. it did not desiccate during the drought of 1991-92).

DISCUSSION

In this exercise, East and West ponds were allowed to remain, but the terrestrial habitat to the north was considerably altered by the construction of the housing estate. The original terrestrial environment was mainly closely-grazed pasture and, apart from use for foraging, was likely to be of relatively little value to newts which prefer structurally diverse habitats (Oldham & Nicholson, 1986; Oldham, 1994). The land in the reserve immediately surrounding the ponds has been left unmanaged except for some seasonal mowing. The newts also have access to gardens, both those of the new estate houses and those of the older houses. The amount of accessible terrestrial habitat of a newt-friendly type (Oldham, 1994) is therefore unlikely to be less than existed in the mid 1980s.

Pond conditions were generally suitable for torch counting, so this convenient and relatively non-intrusive technique was employed throughout. Night counting and larval netting enabled problems to be identified and subsequently corrected. The two principal problems encountered were desiccation in 1988 and fish predation in 1990. The significance of the latter factor in particular would not have been appreciated without focused monitoring.

The success of fish removal from East pond in autumn 1990 might be judged by the good production of crested and smooth newt larvae in the pond in 1991 following failure in 1990. However, poor production in non-desiccation years could not simply be blamed on fish, as crested newt larval numbers declined in East pond in 1992 and 1993 in the absence of fish. Similar changes in larval numbers occurred in West pond 1991 to 1993 following natural desiccation in 1990 (fish have never been recorded in this pond). These changes may have been due to populations of aquatic invertebrate predators recovering after both ponds were dry in 1990. For instance, dragonfly larvae may be important predators, but those species with a long period of larval development will be more affected by pond dessication (Smith, 1983; Arntzen & Teunis, 1993). Although dragonfly larvae were not counted during netting in East and West ponds, they were noted as being particularly numerous in 1992 and 1993. If predation by invertebrates is serious at a site, then management might aim to allow the ponds to desiccate in autumn. The temptation is always to maintain plenty of water to allow larval development and metamorphosis in all parts of a pond. But the magnitude of larval numbers of crested newts at this site in 1991 indicates that this may not lead to the best results in the longer term. The highest night counts of adults occurred in 1993, perhaps because of high numbers of two-year-old newts returning to breed for the first time (see Francillon-Vieillot *et al.*, 1990; Arntzen & Teunis, 1993; Oldham, 1994). Natural desiccation contributed to, or caused total (or near total), breeding failure in 1990 and 1995. But the benefits of the tap were demonstrated during the national drought which led to desiccation and breeding failure in other local sites in 1991 and 1992 (Cooke, 1995).

One problem with monitoring the success of a venture such as this is that often there are few baseline observations made before development takes place. For this reason, regression analysis of annual mean counts was used to test trends. Dodd & Seigel (1991) reviewed whether documented examples of relocation, repatriation and translocation (RRT) of amphibians and reptiles have succeeded; they contended that most experiments are monitored for an insufficient time to judge their success. Although the Stanground project is not an example of RRT, it nevertheless requires comparable monitoring to determine its success. Crested newts are capable of living for 10 years or more (Oldham & Nicholson, 1986; Francillon-Vieillot *et al.*, 1990), so individuals might have survived from the pre-development period until 1995. However, fluctuations in counts (Table 1) indicated appreciable recruitment of adults in 1991 and 1993 at least. The conclusion to date is that populations of both species of newt have been at least maintained, but it should be appreciated that without detailed monitoring and subsequent corrective management, the exercise may have failed. Monitoring will continue, at least in the short term to check that good reproduction of crested newts is recorded again.

ACKNOWLEDGEMENTS

I am grateful to Roy Bradley, Steven Cooke and Tony Gent for help with the night counts. Tony Gent, Tom Langton, Rob Oldham, Charron Pugsley, Ian Smith and George Young kindly supplied information and/or commented on drafts of the manuscript. I also acknowledge the advice of Richard Griffiths, Trevor Beebee and three other referees. The reserve is managed by the Wildlife Trust for Bedfordshire, Cambridgeshire, Northamptonshire and Peterborough; the security of the site and the newts owes a great deal to the efforts of George Young, who was warden until 1995. Larval catching was done under licence from English Nature.

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Accepted: 13.9.96