Northern crested newt (*Triturus cristatus*) migration in a nature reserve: multiple incidents of breeding season displacements exceeding 1km

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ABSTRACT - The northern crested newt *Triturus cristatus* is a model organism for the study of amphibian migrations but is in decline and is prioritised for conservation efforts. We monitored 15 adults in the Dönche Nature Reserve. During the breeding season five of these individuals migrated from one pond to a group of subjacent ponds. Surprisingly, in four cases their displacements were 1,520 m and in one case 1,610 m.

INTRODUCTION

Although the northern crested newt *Triturus cristatus* is widely distributed across Europe and present in parts of western Asia, populations have been declining (Griffiths et al., 2010). In Germany, *T. cristatus* can be found nationwide. In the Dönche Nature Reserve (Kassel, Central Germany), suitable habitats are steadily decreasing with little prospect of amelioration. The species was present in around 400 ponds after WWII, now only five ponds remain of which only three or four ponds hold enough water throughout the breeding and larval development period to support *T. cristatus* (Haubrock & Altrichter, 2016). The largest of the ponds is at a higher elevation and lies 1,430 m to the north-west of the others, and hence the newts in these ponds appear to be too far apart to be included within the same metapopulation. In previous monitoring studies, potential movements between ponds during the breeding season have received little attention (e.g. Kupfer & Kneitz, 2000; Griffiths et al., 2010), although it is known that certain species of newt are capable of travelling in excess of 1 km when returning to their breeding pond (reviewed in Jehle & Sinsch, 2007); indeed displacements of a much as 1,290 m have been recorded in the case of northern crested newts (Kupfer, 1998). Herein we describe migration displacements during the breeding season of a population of *T. cristatus* based on mark-release-recapture.

MATERIALS AND METHODS

Newts were sampled from March until the end of June 2015, using weekly scoop-netting and bottle trapping (volume 5 L) in four ponds. Ponds 1-3 were old bomb craters, which are now water filled. Pond 4 is an artificial open air laboratory used as part of the "Forschen und Lernen durch Offenes Experimentieren" (FLOX) project (Wulff et al., 2015). It is associated with a set of much younger and smaller to medium sized ponds with artificial foliage. All bottle traps were secured to prevent sinking. To forestall the possibility of overheating or drowning of newts we examined all bottle traps every 24 - 48 hours. Captured newts were collected in a 0.5 m × 0.3 m × 0.15 m sized plastic container and were then placed in a transparent box for belly-pattern photography. To facilitate individual recognition, these belly patterns were analysed using the open source programs "extract/compare" (http://www.conservationresearch.org.uk; (Hiby, 2013) and "Wild-ID" (Bolger et al., 2012).

RESULTS

From all ponds there were a total of 33 records of *T. cristatus* and following belly pattern analysis it appears that these records were obtained from fifteen different individuals, eight of which were females. In the more distant Pond 4, *T. cristatus* were only observed and caught until April 14th. Newts were observed in the three lower ponds and travelled between them (Table 1). Recapture data (Fig. 1) indicated significant movements of two females and three males from Pond 4 towards the subjacent ponds achieving four displacements of at least around 1,520 m and one of 1,610 m, in a mean period (± standard deviation) of 55±19.4 days (Table 1).

DISCUSSION

The majority of *T. cristatus* adults and metamorphs would be expected to stay in the vicinity of the ponds after leaving the water in the summer and autumn (Arntzen & Teunis, 1993; Jehle & Arntzen, 2000), but they are also known to migrate between ponds during the breeding season (Jehle et al., 2011). Furthermore, Latham et al., (1996) reported that 13% of *T. cristatus* were captured within the breeding season while moving between a pond and terrestrial habitat and that immigration is affected by temperature and emigration by rainfall. Our observations

Table 1. Individual inter-pond migrations of *T. cristatus*.

Encounter	ID	Gender	Location	Date (2015)	Days	Distance [m]
1	1	M	Pond 4	09.04	54	1,520
2			Pond 3	02.06		
3	2	M	Pond 1	29.05	7	100
4			Pond 3	05.06		
5	3	M	Pond 1	26.05	10	100
6			Pond 3	05.06		
7	4	M	Pond 4	10.03	72	1,610
8			Pond 1	21.05		
9			Pond 3	27.05	6	100
12	6	M	Pond 4	24.03	35	1,520
13			Pond 3	28.04		
29	14	M	Pond 1	27.05	6	100
30			Pond 3	02.06		
31	15	M	Pond 2	05.06	4	60
32			Pond 3	09.06		
33			Pond 3	12.06	3	-
10	5	F	Pond 4	19.04	37	1,520
11			Pond 3	26.05		
14	7	F	Pond 4	10.03	77	1,520
15			Pond 3	26.05		
16	8	F	Pond 1	21.05	12	100
17			Pond 3	02.06		
18	9	F	Pond 1	28.04	35	100
19			Pond 3	02.06		
20	10	F	Pond 1	21.04	7	50
21			Pond 2	28.04		
22			Pond 3	05.0	38	60
23	11	F	Pond 3	05.05	21	100
24			Pond 1	26.05		
25	12	F	Pond 2	05.05	-	-
26	13	F	Pond 1	28.04	35	-
27			Pond 1	02.06		
28			Pond 3	09.06	7	100

of the early appearance of *T. cristatus* in Pond 4 (the open-air laboratory) may be explained by higher than average temperatures and lower precipitation at the beginning of 2015 (Imbery et al., 2015). During the breeding season, we recorded five long distance migrations from Pond 4 to the other ponds, which resulted in displacements of 1,520 m and 1,610 m. These were potentially directed movements for mating purposes. However, it is possible that the five specimens observed had previously migrated into the Dönche Reserve from the north-west adjoining Habichtswald nature reserve and were continuing their migration in 2015 because Pond 4 has been, or has recently become, unsuitable for breeding purposes. It is uncertain whether the stream (Krebsbach) that connects the ponds may have assisted in the unusually long migration.

Our study clearly highlights the extraordinary migratory abilities of *T. cristatus* in the Dönche nature reserve. This should be investigated in more detail, perhaps employing radio telemetry (e.g., Schabetsberger et al., 2004). The displacement of 1,610 m is a new maximum for the species, which has relevance for conservation biology.

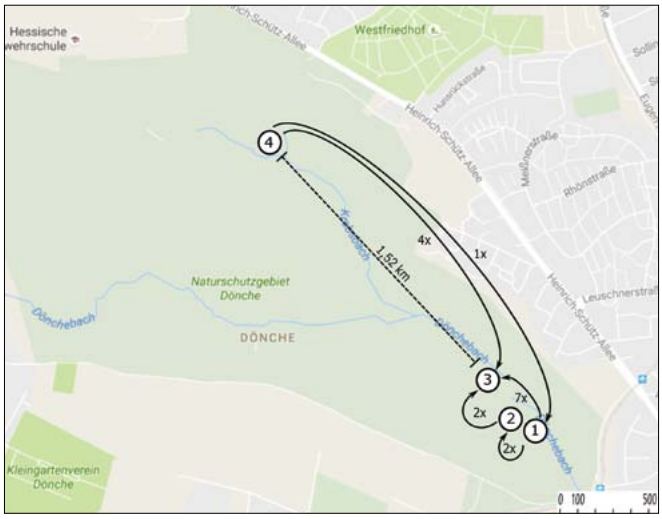

Figure 1. Recorded inter-pond movements of northern crested newts. Distance between subjacent and higher situated ponds is indicated by a dashed line. Numbers denote observed migrations.

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