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Correspondence

Observations on a breeding population of *Neurergus strauchii barani* Öz, 1994 (Caudata: Salamandridae) on Kubbe Mountain, Turkey

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The Anatolian newt, *Neurergus strauchii* (Steindachner, 1887), is a poorly studied stream-breeding species (Bogaerts et al. 2006, Pasmans et al. 2006). In order to contribute to the knowledge of this species, we visited the type locality of the subspecies *N. strauchii barani* Öz, 1994 on Kubbe Mountain (38°15 N, 38°37 E), Malatya Province, Turkey. Observations were made on two occasions during the breeding season, i.e., on 7 April 2007 from about 10:00 to 12:00 h and 13 April 2007 from about 21:00 to 23:00 h. Data obtained were compared with previous information, either by ourselves and unpublished, or from the literature (see below). All adults found (opportunistic sampling) in or migrating towards the breeding stream over a stretch of 100 m were sexed and their dorsal and ventral sides photographed for individual recognition with the goal to estimate the breeding population size. Also, some apparently large specimens were measured to obtain information on the subspecies' maximum adult size. Water temperature was measured to the nearest 0.1 °C. Water samples were examined for pH, GH and KH values using standard colorimetric tests (Tetra). In addition, notes on breeding behaviour were taken.

The breeding stream is fed by melting snow. It was 1–3 m wide and in most parts 10–40 cm and in some up to 100 cm deep. The stream edges were covered with grass and low vegetation. The newts could be spotted easily. Both sampling dates, i.e., day and night observations, had comparable weather conditions, with dry weather, but overcast sky. In the agricultural land surrounding the stream, some early spring flowers were found (e.g., *Gagea* sp., *Colchicum* sp.); specimens of the *Rana macrocnemis* complex (Veith et al. 2003, Franzen et al. 2008) were found breeding in quiet sections of the stream and in small temporary puddles along the stream shore.

To collect information on the breeding population size of *N. strauchii barani* at this location, we compared the number of specimens found on the two occasions. Adult individuals can be identified by a combination of the patterns of dorsal spots and red-orange belly colouration. It turned out to be easier to identify individuals on the basis of belly pattern than of the dorsal spotted pattern. In case of doubt photographs of the dorsal pattern were used in addition to those of the ventral pattern. The two surveys are difficult to compare, however, since one was conducted during the day and the other at night. After sunset, more animals are expected to be found active. We found 18 animals during the day and 50 during the night sampling (Table 1). In the day sample, we only found animals in the water and none migrating towards the water. At night, approximately 10 animals were found wandering actively towards the stream, even over stretches of melting snow (Fig. 1). At night, the animals in the water clearly showed more activity and were therefore easier to detect than during the day. Although animals can be observed at daytime, the main activity takes place after sunset. On 30 April 2001, we found seven animals at daytime and twenty in the evening in a stretch of roughly 50 m of the stream, at the same location (Bogaerts et al. 2006).

We assume that during the first visit we witnessed the start of the breeding season and cannot rule out that more animals migrated towards the stream in the days between 7 and 13 April. This means that during the second capture session the number of animals in the streams was certainly higher than during the first, besides that they were more active and therefore easier to detect than at daytime. The chance of capturing a large part of the population was therefore higher. Only two males and one female were recaptured, which is relatively low taking into account that

Figure 1. Female *Neurergus strauchii barani* migrating towards the breeding stream along melting snow. Photo: F. Pasmans.

Figure 2. Two males of *Neurergus strauchii barani* sniffing at each other, picking up cues about each others' sexual identity. Photo: S. Bogaerts.

capturing probability was higher. The female was carrying eggs on both occasions.

We made an estimate of the total breeding population by using two different approaches. We considered the breeding population as being a 'closed' part of the total population, although we know that within a week probably more animals would migrate to the water. However, if immigration is the main factor, which is the case here, the Lincoln-Petersen's test is biased for population size in the second period (see Kendall 1999). Animals have roughly the same probability of being caught in the second and the first sample. We did not have to mark the animals, so that marking did not affect captures or behaviour. Chapman's (1951) adaptation for low recaptures of the Lincoln-

Table 1. Numbers of males (m) and females (f) of *Neurergus strauchii barani* counted and their sex ratios (m:f) during different visits at the same site on Kubbe mountain.

Date	m	f	m:f
30 April 2001	10	10	1:1
13 April 2005	0	6	0:6
7 April 2007	10	8	5:4
13 April 2007	33	17	2:1

Table 2. Water parameters taken on two occasions at the breeding stream of *Neurergus strauchii barani* at Kubbe mountain (T = temperature; GH = general hardness; KH = carbonate hardness; pH = acidity; NO_3 = nitrate; NO_2 = nitrogen dioxide).

Date	T (°C)	GH (dH)	KH (dH)	pH	NO_3/NO_2 (mg/l)
7 April 2007	8.3	3	3	7.2	10 / < 0.5
13 April 2007	5.8	3	4	7.0	0 / 0

Petersen's test (N = (n1 + 1 x n2 +1/ R + 1) – 1) gives a total estimate of 241 breeding individuals. The standard error provided by Seber (1982) for Chapman's test leads to a total population size of 241 ± 102 (minimum 139 and maximum 343 adults). A Bayesian approach, as presented by Pellet & Pellet (2003), may be more adequate, yielding a more precise outcome than the classical Lincoln-Petersen's test. We performed it in the manner of Pellet & Pellet (2003), resulting in the breeding population to comprise 305 individuals. Multiplying the standard error with 2, the confidence interval shows indeed that the error is wide. The actual breeding population size is somewhere between 41 and 445. Here, the confidence interval is already large as a consequence of the fact that we had only two sampling dates.

The estimate solely concerns the breeding population over a small straight stretch of stream, so that it only gives a partial estimate of the total population of *N. strauchii barani* at this location, which of course also includes juveniles and subadults not found in the breeding water. We also cannot exclude the possibility that animals have drifted off with the stream outside the research area. Because of the low numbers of recapture and the fact that our capture-recapture method does not fulfill all requirements for closed-population estimates, the range of error is large. In our case these limitations probably have a limited effect, as shown in comparable estimates (see Kendall 1999). However, in light of the limitations and uncertainties our calculations can only be very provisional.

Sex ratios differed slightly between 7 and 13 April (Table 1). Males outnumbered females on both occasions. On the basis of the few data we have, we assume that males enter the breeding site earlier than females. On other occasions in previous years we had found an equal sex ratio or a clearly female-biased number, but in 2005 and 2007 there was less snow cover, and breeding probably started earlier (Table 1). We conclude that apparently the aquatic period of breeding *N. strauchii,* at least in the population of the subspecies studied by us, is restricted to roughly three months, starting just after thaw and lasting until the beginning of summer. In more eastern locations where *N. s. strauchii* occurs, breeding can be delayed, depending on the onset of thaw; Schmidtler (1994) on 5 June 1976 found freshly laid eggs near Bitlis, Bitlis Province, Turkey, roughly 330 km east of Kubbe Mountain. Stream width and water temperatures had changed enormously between the two visits (Table 2), changing from slow-moving and about 1 m wide to about twice as wide and running much faster.

The water temperature had dropped to 2.5° C, but this did not result in a noticeable change of activity pattern of the newts. Notwithstanding the low temperature males and females were very active and showed reproductive behaviour. We could observe both male-female and male-male interactions. Movements were slow. Males approached one another, taking up positions more or less face-to-face and sniffing at each other (Fig. 2), checking sexual identity. Then, having identified the other animal as male, they would move away, or remain standing still opposite and facing each other with their tails bent (Fig. 3). We did not observe physical contact between males or other forms of interaction, which could be interpreted as aggressive behaviour. Two males were seen approaching a female near the stream's edge and fan their tails in the direction of the female, a form of courtship common to *Neurergus* and other newt species (see Sparreboom et al. 2000). Eggs were not found and egg-laying was not observed.

Previous authors reported 9–10 °C and 10.9 °C, respectively, as the lowest temperatures recorded for breeding *N. s. strauchii* (Schmidtler & Schmidtler 1970, Pasmans et al. 2006). Our data show that water temperatures can be much lower in breeding *N. s. barani*. However, water temperature likely increases in the weeks after thaw, as supported by data taken by us on an earlier occasion but later in the year (see Pasmans et al. 2006), and will then be more favourable for larval development.

The water quality parameters (Table 2) did not differ much from previously recorded values (see also Pasmans et al. 2006), only the levels of GH (general hardness) and KH (carbonate hardness) were lower in 2007, which was perhaps the result of melting snow.

Figure 3. Two males of *Neurergus strauchii barani* facing each other with their tails bent. Photo: M. Sparreboom.

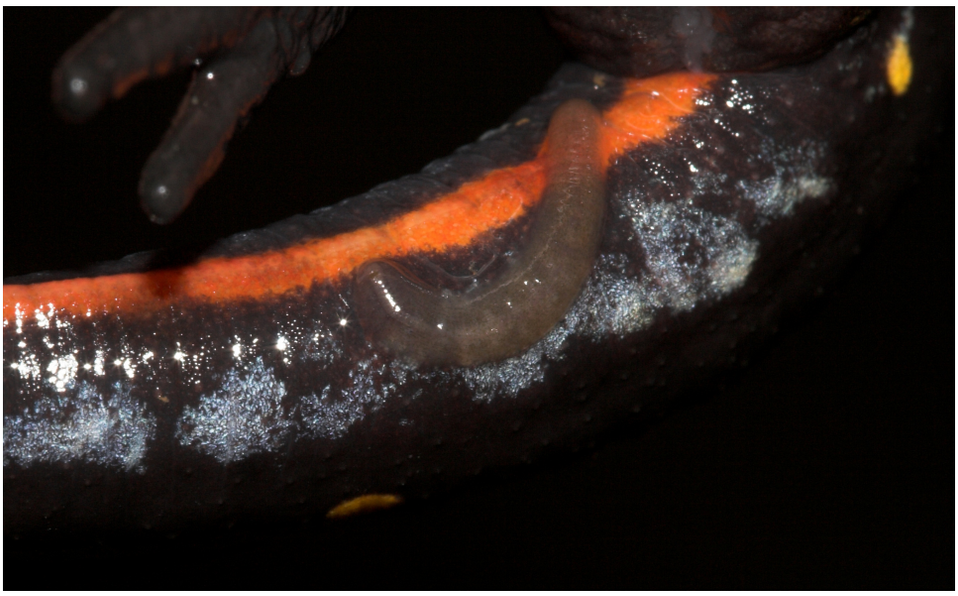

Figure 4. Unidentified leech on the tail of a male *Neurergus strauchii barani.* Photo: F. Pasmans.

The previously reported maximum length of *N. s. barani*, a female, was 174 mm (87 mm snout-vent length (SVL); unpublished data, 2001). We found two larger specimens, two females of 179 mm total length (88 mm SVL) and 181 mm (85 mm SVL), respectively.

During the photographing session on 13 April we found a small parasitic aquatic leech attached near the cloaca of one newt. Unfortunately, family or species cannot be determined from the pictures (Eike Neubert, pers. comm.). From then on all animals were checked for leeches: three out of 36 specimens had one or more leeches (Fig. 4).

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