

Data on morphology of Southern Crested Newt, *Triturus karelinii* (Strauch, 1870) (Caudata: Salamandridae) in Uludağ (Bursa, Turkey)

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Abstract. We examined Uludağ population of *Triturus karelinii*, which have not been investigated extensively, in terms of morphometrics measurements, ratios, features of coloration pattern. The study was carried out between April and May 2006 and a total of 43 individuals (2 juveniles, 16 ♂♂, 25 ♀♀) were measured. Mean total body size is 98.795 mm (87.78 - 109.81) for juveniles, 109.209 mm (89.07 - 125.12) for males, and 122.328 mm (90.35 - 156.50) for females. Sexual dimorphism was observed between sexes. Females were larger than males.

Key words: morphology, Caudata, Salamandridae, *Triturus karelinii*, Turkey.

Introduction

The genus *Triturus* compasses seven species of so called "large bodied" newts that are organized in two groups: the marbled newts with two species [*T. marmoratus* and *T. pygmaeus*] and the crested newts with five species [*T. cristatus*, *T. carnifex*, *T. dobrogicus*, *T. macedonicus* and *T. karelinii*]. Crested newts are characterized by orange and black spotted ventral coloration and a dark backside and occupy most parts of Europe (except southern part) and adjacent Asia (Arntzen et al. 2007).

Southern crested newt, *Triturus karelinii* ranges from the eastern part of the Balkan Peninsula, Crimea, Asia Minor, the Caucasus and northern Iran (AmphibiaWeb 2010, Arntzen 2003). The species is considered to be the largest within the genus *Triturus*. It can be found from sea level to elevations 2,134m (Terentjev & Chernov 1949). The few publications on *T. karelinii* populations in Turkey provide some morphological data (Olgun et al. 2001). The objective of the present study is to obtain information on morphology of *Triturus karelinii* in Uludağ.

Materials and Methods

The individuals were captured from Kirazlıyayla (40°07'210"N, 29°05'259"E, 1,476m a.s.l) and Sarialan (40°07'964"N, 29°06'753"E, 1,617m a.s.l) in Uludağ (Bursa/Turkey). Sampling was carried out with a net on April 15 and May 20. After being captured, the individuals were sexed and measured with a dial calipers the nearest with 0.01 mm. Afterwards they were released at the place from where they were captured. The following body measurements were taken: L = total length, Lsv = snout-vent length (measured from the snout to the posterior

edge of the base of the cloaca), Lcd = tail length, Lc = head length (measured from snout to the gular fold), Ltc = head width, Pa = forelimb length, Pp = hind limb length, D = distance between fore - and hind limbs, O = eye length, In = distance between nose holes. Ratios of body measurements were used to compare the populations. From these, the Wolterstorff Index (WI) is one of the most important characteristics for recognizing the species of the sub genus *Triturus* (Arntzen & Wallis 1994, 1999). This characteristic is provided by the ratio of the forelimb length (Pa) to the distance fore- and hind-limbs (D). The coloration and pattern were also evaluated. Comparing sexes and populations were analyzed by student t-test. Alpha set 0.05.

Results and Discussion

A total of 43 aquatic individuals (2 juv, 16 ♂♂, 25 ♀♀) were examined from Uludağ (Bursa, Turkey). Within the individuals, 14 (2 juv, 6 ♂♂, 6 ♀♀) collected in Kirazlıyayla, 29 (10 ♂♂, 19 ♀♀) in Sarialan. In the *T. karelinii* population, the average mean total lengths (L) are 98.795 mm (range= 87.78 - 109.81) for juveniles, 109.209 mm (89.07 - 125.12) for males, and 122.328 mm (90.35 - 156.50) for females. The average snout-vent length (Lsv) is 59.375 mm (51.35 - 67.40) for juveniles, 73.244 mm (59.15 - 85.61) for males, and 76.590 mm (55.78 - 91.34) for females (Table 1).

Yılmaz (1983) has determined that L ranges from 110-134mm for males, 115-158mm for females in Thracian population. Olgun & Baran (1993) reported that L of males ranges from 87 to 132mm, females ranges from 75 to 149mm in middle Black sea region. In western and central Turkey, the largest L 131.80 mm for males, 140.40 mm for females (Table 3). The largest size

(L) reported at *Triturus karelinii* is 145 mm for males and 160 mm for females (Buresch & Zonkov 1941). In the

Uludağ population, the largest male was 125.12 mm and the female measured 156.60mm.

Table 1. Body measurements (in mm) and ratios of *Triturus karelinii*. [n= number of specimens, x= mean, SE= standard error of mean, Min.-Max.= extreme values, SD= standard deviation]

Characters	juveniles					♂♂					♀♀				
	n	x	SE	Min. - Max.	SD	n	x	SE	Min. - Max.	SD	n	x	SE	Min. - Max.	SD
L	2	98.795	11.015	87.78 - 109.81	15.578	14	109.209	2.194	89.07 - 125.12	8.208	21	122.328	3.659	90.35 - 156.60	16.769
Lsv	2	59.375	8.025	51.35 - 67.40	11.349	104*	73.244	0.531	59.15 - 85.61	5.415	113*	76.590	0.702	55.78 - 91.34	7.466
Lcd	2	39.420	2.990	36.4 - 42.4	4.228	14	42.756	1.780	27.8 - 57.1	6.661	21	52.632	2.300	27.7 - 71.6	10.539
Lc	2	14.570	1.940	12.63 - 16.51	2.744	16	15.226	0.276	13.51 - 17.30	1.102	25	16.718	0.257	12.56 - 19.11	1.285
Ltc	2	11.645	1.285	10.36 - 12.93	1.817	16	12.624	0.247	10.73 - 14.49	0.990	25	13.711	0.227	11.42 - 15.92	1.137
Pa	2	21.660	3.710	17.95 - 25.37	5.247	16	22.859	0.551	19.43 - 26.20	2.202	25	22.618	0.480	17.18 - 25.77	2.401
Pp	2	22.385	4.015	18.37 - 26.40	5.678	16	24.034	0.600	19.80 - 28.79	2.399	25	22.714	0.514	17.53 - 27.50	2.572
D	2	28.560	3.960	24.60 - 32.52	5.600	16	31.759	0.636	26.60 - 35.46	2.543	25	35.002	0.964	26.80 - 46.76	4.820
O	2	3.670	0.080	3.59 - 3.75	0.113	16	3.685	0.143	2.50 - 4.65	0.574	25	3.797	0.084	2.97 - 4.55	0.419
In	2	2.580	0.090	2.49 - 2.67	0.127	16	2.465	0.129	1.81 - 3.67	0.517	25	2.655	0.093	1.37 - 3.53	0.464
Lc-L	2	0.147	0.003	0.14 - 0.15	0.005	14	0.142	0.003	0.13 - 0.17	0.012	21	0.138	0.003	0.11 - 0.17	0.014
Ltc-L	2	0.118	0.000	0.12 - 0.12	0.000	14	0.118	0.002	0.11 - 0.14	0.007	21	0.114	0.002	0.09 - 0.14	0.011
Lcd-L	2	0.401	0.014	0.39 - 0.42	0.020	14	0.390	0.010	0.31 - 0.46	0.038	21	0.427	0.009	0.31 - 0.48	0.041
Lc-Ltc	2	1.248	0.029	1.22 - 1.28	0.041	16	1.208	0.015	1.12 - 1.33	0.058	25	1.221	0.013	1.10 - 1.39	0.067
Pa-D	2	0.755	0.025	0.73 - 0.78	0.036	16	0.724	0.021	0.55 - 0.86	0.085	25	0.655	0.019	0.49 - 0.94	0.097
Pp-D	2	0.779	0.033	0.75 - 0.81	0.046	16	0.760	0.021	0.62 - 0.91	0.085	25	0.656	0.018	0.56 - 1.00	0.092
Lsv-L	2	0.599	0.014	0.58 - 0.61	0.020	14	0.610	0.010	0.54 - 0.69	0.038	21	0.573	0.009	0.52 - 0.69	0.041
Lsv-Lcd	2	1.499	0.090	1.41 - 1.59	0.127	14	1.591	0.073	1.19 - 2.21	0.272	21	1.368	0.062	1.10 - 2.26	0.282
In-Ltc	2	0.223	0.017	0.21 - 0.24	0.024	16	0.195	0.010	0.16 - 0.31	0.038	25	0.193	0.005	0.12 - 0.23	0.026
O-Ltc	2	0.318	0.028	0.29 - 0.35	0.040	16	0.291	0.009	0.22 - 0.35	0.034	25	0.277	0.005	0.23 - 0.33	0.024
Ltc-Lsv	2	0.197	0.005	0.19 - 0.20	0.007	16	0.192	0.002	0.18 - 0.21	0.009	25	0.199	0.003	0.16 - 0.24	0.015

*Additional Lsv data obtained from Mermer et al. 2008.

Table 2. t test results between sexes [t= t table value, df= degrees of freedom, P= significant level]

Characters	t	df	P
L	2.604	33	0.014
Lsv	1.668	39	0.103
Lcd	2.825	33	0.008
Lc	3.705	39	0.001
Ltc	3.136	39	0.003
Pa	0.352	39	0.727
Pp	1.629	39	0.111
D	2.413	39	0.021
O	0.845	39	0.403
In	1.218	39	0.231
Lc-L	0.847	33	0.403
Ltc-L	1.232	33	0.227
Lcd-L	2.643	33	0.012
Lc-Ltc	0.636	39	0.528
Pa-D	2.390	39	0.022
Pp-D	3.794	39	0.001
Lsv-L	2.740	33	0.010
Lsv-Lcd	2.740	33	0.010
In-Ltc	0.193	39	0.848

The Lsv in the Caucasian population (Georgia) of *T. karelinii* varies between 65-72 mm for males and 64-80 mm for females (Tarkhnishvili & Gokhelasvili 1999). Olgun et al. (2005) reported mean Lsv 72.0 mm (60-82) for males, 73.7mm (55-90) for females and did not differ significantly between sexes. The average Lsv of males was 63.50 mm (55.44-77.4) and 68.98 mm (56.78-83.18) in the case of the females in Adapazarı (Northwestern Turkey) (Üzüm & Olgun 2009).

The ground colour of the dorsum and flanks of our specimens are dark brown, almost black (Fig. 1a). In this ground, spots are more or less obvious. The dorsal crest is dark, with irregularly dispersed spots. Belly and throat bright orange, solidly covered with black spots of irregular shape (Fig. 1b). Spots on the throat are smaller than those on the belly. At some individuals the spots were merged. Generally the coloration of females is similar. The coloration of Uludağ population is in accordance with the literature (Başoğlu & Özeti 1973, Yılmaz, 1983, Olgun & Baran 1993, Tarkhnishvili & Gokhelasvili 1999, Olgun et al. 2001, Arntzen 2003).

With respect to L, Lcd, Lc, Ltc, D, Lcd-L, Pa-D, Pp-D, Lsv-L and Lsv-Lcd values, statistically significant differences were found between the sexes. The females were significantly larger than the males (Table 2). There

Table 3. Comparison of some measurements (in mm) and ratios of *Triturus karelinii* in Turkey.

Locality		L		Lsv		Lcd		Pa-D		Pp-D	
		♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀
Tokat-Center*	x	111.74	130.80								
	SD	8.68	11.13								
Tokat-Reşadiye*	x	101.09	115.45								
	SD	6.84	11.07								
Tokat-Şerefiye*	x	115.39	126.21								
	SD	7.27	9.35								
Tokat-Gökçekent*	x	121.97	133.72								
	SD	6.80	8.87								
İzmir-Bozdağ**	x	131.80	137.90	75.70	75.80	56.00	62.00	0.64	0.57	0.66	0.59
	SD	6.85	10.24	5.55	3.66	3.02	6.70	0.03	0.03	0.03	0.03
Sivas-Koyulhisar**	x	122.80	140.40	70.60	76.20	52.30	64.30	0.72	0.64	0.77	0.68
	SD	6.62	7.35	4.17	3.91	2.76	3.83	0.04	0.03	0.05	0.02
İstanbul**	x	123.00	133.20	70.70	72.60	52.30	60.60	0.72	0.60	0.75	0.62
	SD	5.27	8.99	3.08	4.31	2.84	5.95	0.04	0.03	0.04	0.03
Bursa-Uludağ	x	109.21	122.33	73.24	76.59	42.76	52.63	0.72	0.65	0.76	0.66
	SD	8.21	16.77	5.41	7.47	6.66	10.54	0.08	0.10	0.08	0.09

* Olgun and Baran (1993), ** Olgun et al. (2001)



Figure 1. The most common dorsal (a) and ventral (b) pattern of *Triturus karelinii* in Uludağ

Table 4. The Wolterstorff Index (Pa/D) of the various populations of *Triturus karelinii*

Locality	Pa/D ♂ (WI)	Pa/D ♀ (WI)	Source
Romania	0.69 - 0.82	0.67 - 0.72	Fuhn (1960)
Palearctic	0.69 - 0.82	0.67 - 0.72	Thorn (1968)
Thrace	0.62 - 0.83	0.57 - 0.77	Yılmaz (1983)
Yugoslavia		0.53 - 0.65	Wallis and Arntzen (1989)
Bulgaria		0.57 - 0.64	
Turkey		0.59 - 0.67	
Turkey	0.50 - 0.91	0.50 - 0.80	Olgun and Baran (1993)
General		0.57 - 0.67	Arntzen and Wallis (1994)
General		0.55 - 0.70	Griffths (1996)
Bozdağ	0.59 - 0.67	0.52 - 0.60	Olgun et al. (2001)
Koyulhisar	0.66 - 0.79	0.60 - 0.80	
İstanbul	0.66 - 0.81	0.56 - 0.64	
General	≥0.671	≥0.592	Arntzen 2003
Uludağ	0.55 - 0.86	0.49 - 0.94	Present Study

is a sexual dimorphism between the sexes, which is emphasized by previous studies (Olgun & Baran 1993, Olgun et al. 2001, Üzümlü & Olgun 2009). In terms of Lsv, there were differences (Üzümlü & Olgun 2009), some of which were not between the sexes (Olgun & Baran 1993, Olgun et al. 2001, Olgun et al. 2005, Mermer et al. 2008). Also we did not determine any statistical differences in terms of Lsv. Sexual dimorphism is generally lower in urodeles (61%) compared to anurans (90%) (Shine 1979). Ivanović et al (2008) state that key factors in the evolution of female size seem to be primarily correlated with strong selective pressures on female fecundity, as the relative size and shape of females' abdomen may be tightly associated with fecundity (e.g. Shine 1989).

As shown in Table 3, there were some differences in terms of Lcd, Pa-D and Pp-D values among populations. A possible reason for this is derived from the development of individuals. Uludağ populations have lower values regarding the aspect of L and some of the related ratios [Lsv and Lcd]. Besides, in terms of Pa-D and Pp-D ration, there were similarities among İstanbul, Sivas and İzmir (Olgun et al. 2001) (Table 3).

Destruction of forests and wetlands, agrochemical pollutants and other anthropogenic factors are threatening populations of *Triturus karelinii* (AmphibiaWeb 2010, Arntzen et al. 2008). In Uludağ, although there are suitable biotopes for amphibians, there are many pressure elements especially arising from anthropogenic factors (Çiçek 2009). Because of a wide distribution area, *Triturus karelinii* does not have any protecting status. According to our field observations, for the sustainability of the species' populations some protection measures should be taken.

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