

The Taxonomic Status of *Triturus vulgaris* (Linnaeus, 1758) Populations in Western Anatolia, Turkey

Kurtuluş OLGUN

Adnan Menderes Üniversitesi, Fen–Edebiyat Fakültesi, Biyoloji Bölümü, 09010 Kepez, Aydın-TURKEY

İbrahim BARAN

Dokuz Eylül Üniversitesi, Buca Eğitim Fakültesi, Biyoloji Bölümü, 35150 Buca, İzmir-TURKEY

C. Varol TOK

Ege Üniversitesi, Fen Fakültesi, Biyoloji Bölümü, 35100 Bornova, İzmir-TURKEY

Received: 24.03.1998

Abstract: A total of 179 (97 males, 82 females) *Triturus vulgaris* specimens collected during the breeding season from Western Anatolia (Efes, Ayvacık, Lapseki, Karacabey, Gemlik) and European Turkey (Bölür) was examined. The morphological and the statistical evaluations showed that the Western Anatolian (except Efes) and the Thrace populations are similar. The West Anatolian populations, therefore, should be included in the nominate subspecies, *T.v. vulgaris*.

The Efes specimens were found to be different from specimens of Ayvacık, Lapseki and Gemlik especially in terms of body measurements. The explanation of the taxonomic status of the Efes population will be possible with the material which will be collected from the northern and southern regions of Bozdağ.

Key Words: *Triturus vulgaris*, taxonomy, morphology, distribution, Turkey.

Türkiye, Batı Anadolu *Triturus vulgaris* (Linnaeus, 1758) Populasyonlarının Taksonomik Durumu

Özet: Bu çalışmada, Batı Anadolu (Efes, Ayvacık, Kapseki, Karacabey, Gemlik) ile Trakya (Bölür)'de yayılış gösteren üreme dönemine ait 179 (97 erkek, 82 dişi) *Triturus vulgaris* örneği incelenmiştir. Morfolojik ve istatistiksel değerlendirmeler sonucu Batı Anadolu Populasyon örneklerinin (Efes hariç), Trakya'da yaşayanlarla benzer olması nedeniyle nominat alttür *Triturus vulgaris vulgaris*'e dahil edilmesi sonucuna varılmıştır.

Efes örneklerinin ise, özellikle vücut ölçüleri bakımından Ayvacık, Lapseki ve Gemlik'den farklı olduğu saptanmıştır. Adı geçen populasyonun taksonomik durumunun etraflıca açıklanabilmesi, Bozdağın kuzey ve güney bölgelerinden toplanacak yeni materyalin incelenmesi ile mümkün olacaktır.

Anahtar Sözcükler: *Triturus vulgaris*, taksonomi, morfoloji, dağılım, Türkiye.

Introduction

The genus *Triturus* from the Salamandridae family, which has a vast distribution in Europe and Asia, includes 9 species and a number of subspecies (1). Subsequent studies have determined that above-mentioned genus consists of 12 species (2, 3). This is also supported by the DNA sequence analysis made on the group (4). Macgregor et al. (5) included *Triturus vulgaris* in the *vulgaris* species group and in the subgenus *Palaeotriton*. The above-mentioned species are distributed in Central and Eastern Europe, Southern Scandinavia, Western Asia, Anatolia and the Iberian Peninsula. *T. vulgaris* which has a wide range is separated into 7 subspecies namely *vulgaris*, *meridionalis*, *graeus*, *lantzi*, *ampelensis*, *kosswigi* and *schmidtlerorum* (5–7).

According to studies (8-13) on *T. vulgaris*, the species is represented by 4 subspecies in Turkey. Of these, the nominate subspecies, *T.v. vulgaris*, is distributed in the Thrace Region. The dorsal crest of this subspecies starts from the posterior of the body and the free margin of the crest has either pointed or rounded projections. The tip of the tail is pointed and generally not ended with tail filament. On the other hand, it is observed that there is a gradual transition, in terms of above-mentioned characters, in the distribution area of the subspecies *vulgaris* from west to east and increasing in resemblance to the subspecies *kosswigi*. As a matter of fact, the same situation was noticed in the population east of the Istanbul Bosphorus (11, 12).

The distribution area of the second subspecies, *T.v. kosswigi*, extends from the east of the Istanbul Bosphorus to Ereğli (Zonguldak) through Izmit, Adapazarı and Abant. The dorsal crest of this subspecies starts from the posterior of the body and its free margin is smooth. The tip of the tail is stubby but has a long tail filament.

T.v. lantzi, which is thought to occur in Turkey is the third subspecies. Although, this subspecies has been found in Georgia (14, 15), which is close to the Eastern Black Sea region of Turkey, there is no record from Turkey until now. The pointed or rounded projections of the free margin of the dorsal crest and the long tail filament (almost 7 mm.) are the diagnostic features of *lantzi*.

The fourth subspecies, *T.v. schmidtlerorum* (6), was originally described as *T.v. schmidtleri* by the same author (16). The range of this subspecies is the Marmara coast and Western Anatolia (5, 7). This subspecies can be distinguished by its smaller size, pointed projections of the dorsal crest on the free margin, indistinct foot webbing and the absence of a tail filament.

The researchers (8, 9, 17) who provided material from the distribution area of the last subspecies state that in spite of the specimens of this region exhibiting a few differences from *T.v. vulgaris*, the nominate subspecies occur in the region. Eiselt (10) noticed that the body

length of specimens he examined from İzmir was small and the tip of the tail was elongate. Subsequently, Schmidtler and Schmidtler (18) explained that the specimens from İzmir are similar to *T.v. lantzi*. Raxworthy (16) collected some material from Karacabey and he noticed the differences from *T.v. vulgaris* such as short body length, the indistinct foot webbing, the lack of a tail filament and the presence of a pointed projection of a dorsal crest on the free margin. In contrast, Baçoğlu et al., (13) explained that the population of this region should be included in *T.v. vulgaris* for the time being.

As understood from the studies on *T.v. vulgaris* in the Marmara and Western Anatolia regions, there is no agreement among the researchers about the subspecific status of *T. vulgaris* populations. Some researchers (9, 10, 13) accept the presence of only nominate subspecies in the region, whereas others (5, 7, 16) accept a different population from *T.v. vulgaris*.

We collected some new material from the different localities of Western Anatolia with the aims of describing the taxonomic relationships between them and with the Thrace populations.

Material and Method

A total of 179 adult specimens were examined. All were aquatic and consisted of 97 males and 82 females. The collecting localities are given in Figure 1. The material

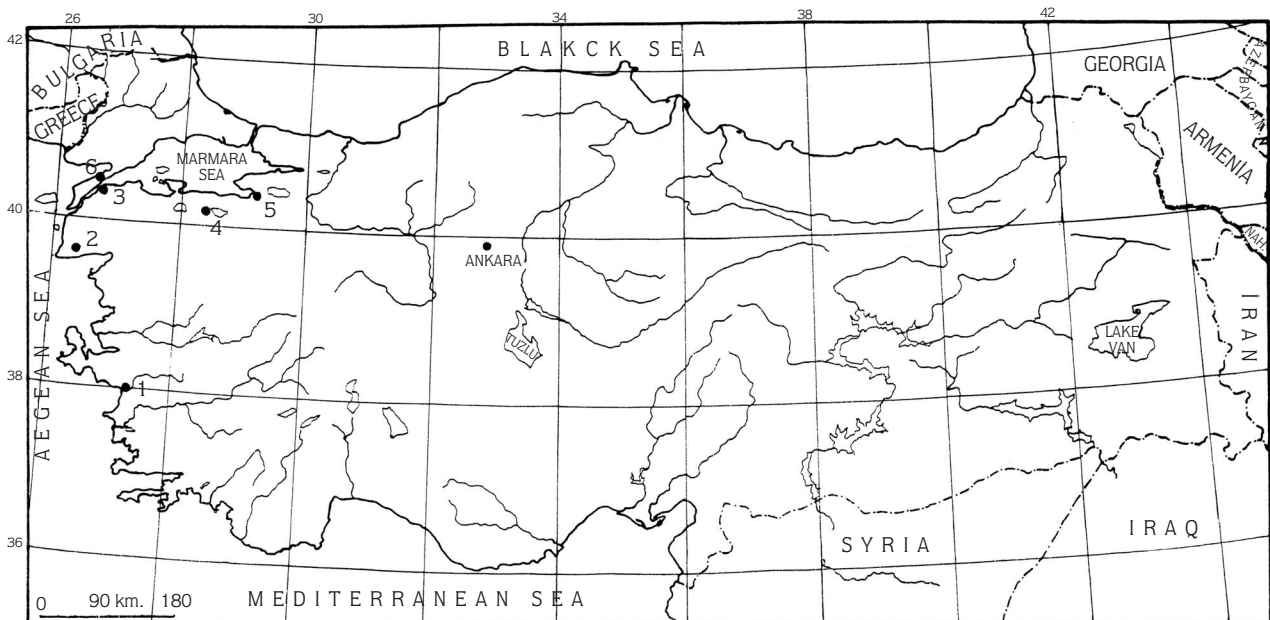


Figure 1. Localities in Western Anatolia and Thrace from which specimens of *Triturus vulgaris* were studied. 1- Efes, 2- Ayvacık, 3- Lapseki, 4- Karacabey, 5- Gemlik, 6- Bolayır.

was collected from 6 different localities by K. Olgun and is preserved in the collection of the Biology Department of Ege University (ZDEU). The material is listed below:

1. Efes Population: ZDEU 138/1997; 24 males, 8 females; Efes-Izmir; 11.03.1997.
2. Ayvacık Population: ZDEU 139/1997; 10 males, 13 females; Ayvacık-Çanakkale; 03.04.1997.
3. Lapseki Population: ZDEU 140/1997; 17 males, 17 females; Lapseki-Çanakkale; 04.04.1997.
4. Karacabey Population: ZDEU 141/1997; 16 males, 17 females; Karacabey-Bursa; 04.04.1997.
5. Gemlik Population: ZDEU 142/1997; 9 males, 9 females; Gemlik-Bursa; 05.04.1997.
6. Bolayır Population: ZDEU 143/1997; 21 males, 18 females; Bolayır-Çanakkale; 03.04.1997.

The material from Ayvacık and Gemlik was collected for the first time, whereas the materials from Efes, Lapseki, Karacabey and Bolayır were previously collected and examined (9,12, 16,18).

During field studies, 5 male and 4 female specimens were caught from Bursa. However, these specimens were not included in the study due to their insufficient number.

The fixation of the material was made by the method of Olgun and Baran (19) in the field. The examined features were in two groups.

1. Morphologic characters: The structure of the free margin, the height and starting point of the dorsal crest in males, the structure of the tail tip and the foot webbing. In order to determine the starting point of the dorsal crest, the distance from the snout to the starting point of the crest was measured. In order to explain the structure of the tail tip, the length of the tail filament was measured from the end of the tail and if the length of tail measured over 3 mm. the tail was accepted as filamented.

2. Body measurements and rates: The features were as follows:

Total length (L); Snout-vent length (Lsv) (from the tip of the snout to the posterior margin of the vent); Head length (Lc); Head width (Ltc); Tail length (Lcd); Tail width (Lw); Forelimb length (Pa); Hindlimb length (Pp); Inter-limb length (D); Body length (Lcp) (measured from the tip of the snout to the anterior margin of the vent); Head length/Total length (Lc/L), Head width/Total length (Ltc/L), Head length/Head width (Lc/Ltc), Body length/Total length (Lcp/L), Snout-vent length/Total length (Lsv/L), Body length/Head length (Lcp/Lc), Tail length/Body length (Lcd/Lcp), Forelimb length/Inter-limb

length (Pa/D), Hindlimb length/Inter-limb length (Pp/D). Of these values, only L, Lsv, Lcd and Lcp values are given (Table 1) and the rates were obtained during the analysis of the literature. A dial caliper with an accuracy range of 0.05 mm was used for the body measurements. In the comparison of the morphometric features Oneway Analysis of Variance (ANOVA) was performed with the software SPSS (20). The males and females were compared with Tukey's HSD (Tukey's Honestly Significant Difference). The groups showing differences from one another according to the results were reanalysed and the Coefficient of Difference (CD) (21) was calculated. The coefficient of difference is calculated with the formula $CD = (X_1 - X_2) / (SD_1 + SD_2)$, (X_1 = Mean of first group, X_2 = Mean of second group, SD_1 = Standard deviation of the first group, SD_2 = Standard deviation of the second group). If the numerical equivalent of the CD is found to be equal to 1.28 or larger, the two populations are considered taxonomically different in terms of the investigated character.

Results

Efes Population

Morphologic characters: The dorsal crest in males started from 2.3-(2.6)-2.9 mm of the posterior of the head tip and its height ranged from 1.1 to 2.3 mm with a mean 1.6 mm. The free margin of the dorsal crest, the tip of the tail and the structure of the foot webbing are given in Figures 2, 3 and 4. The rate of occurrence of the above-mentioned characters in the individuals of the populations are also given in the same figures.

Body measurements and ratios: The total length (L) ranged from 54.6-65.9 mm in males and 56.1-66.8 mm in females; the body length (Lcp) 27.7-33.4 mm in males and 29.2-34.4 mm in females, the snout-vent length (Lsv) 28.8-35.4 mm in males and 30.5-36.4 in females. The tail length (Lcd) 24.5-31.2 in males and 25.3-30.4 mm in females. The biometrical and mean values of the body measurements are given in Table 1.

Ayvacık Population

Morphologic characters: The dorsal crest of males started from 1.4-(2.7)-3.3 mm posterior of the head tip and its height ranged from 1.4-5.4 mm with a mean of 3.2 mm. The processes of the dorsal crest on the free margins were pointed in 60% of specimens, and in the rest rounded (Fig 2). The structure of the tail filament and the foot webbing and their rate of occurrence in the population are given in Figures 3 and 4.

Table 1. The biometrical values belong to body measurements of *Triturus vulgaris* populations. N: Number of samples, X: Mean, Min. and Max.: Minimum and Maximum Values, SD: Standard Deviation, SE: Standard Error of the Mean.

Populations	♂♂					♀♀					L				
	N	X	Min.-Max.	SD	SE	N	X	Min.-Max.	SD	SE	N	X	Min.-Max.	SD	SE
Efes	24	60.3	54.6-65.9	3.188	0.651	8	60.3	56.1-66.8	3.891	1.376	32	60.3	54.6-66.8	3.310	0.585
Ayvaciık	10	70.0	59.8-81.4	5.789	1.831	13	70.6	62.5-77.2	4.230	1.173	23	70.4	59.8-81.4	4.855	1.012
Lapseki	17	75.2	66.4-79.7	3.823	0.927	17	70.2	59.9-78.1	5.693	1.381	34	72.7	59.9-79.7	5.416	0.929
Karacabey	16	65.4	56.2-77.8	5.675	1.419	17	62.9	56.2-76.5	5.329	1.293	33	64.1	56.2-77.8	5.566	0.969
Gemlik	9	72.0	64.7-79.5	3.914	1.305	9	71.4	65.6-77.1	3.897	1.299	18	71.7	64.7-79.5	3.802	0.896
Bolayır	21	65.4	57.5-72.7	4.393	0.959	18	63.3	52.6-67.9	3.873	0.913	39	64.4	52.6-72.7	4.242	0.679
Lsv															
Efes	24	32.0	28.8-35.4	1.871	0.382	8	33.0	30.5-36.4	1.890	0.668	32	32.2	28.8-36.4	1.899	0.336
Ayvaciık	10	36.1	31.1-40.0	2.346	0.742	13	37.3	33.2-40.1	2.050	0.568	23	36.8	31.1-40.1	2.213	0.462
Lapseki	17	38.8	36.6-40.8	1.518	0.368	17	37.3	31.0-41.6	3.112	0.755	34	38.0	31.0-41.6	2.530	0.434
Karacabey	16	32.7	29.4-39.6	2.604	0.651	17	32.7	29.7-39.8	2.694	0.653	33	32.7	29.4-39.8	2.609	0.454
Gemlik	9	37.1	33.0-40.5	1.953	0.651	9	38.4	34.5-41.6	2.189	0.730	18	37.7	33.0-41.6	2.115	0.499
Bolayır	21	33.0	30.0-36.1	1.833	0.400	18	33.5	28.7-36.2	1.835	0.433	39	33.2	28.7-36.2	1.825	0.299
Lcp															
Efes	24	30.2	27.7-33.4	1.646	0.336	8	31.7	29.2-34.4	1.843	0.652	32	30.5	27.7-34.4	1.790	0.316
Ayvaciık	10	34.3	30.4-38.4	2.144	0.678	13	36.0	32.9-37.7	1.839	0.510	23	35.3	30.4-38.4	2.116	0.441
Lapseki	17	37.2	35.0-40.0	1.594	0.387	17	36.3	30.5-41.0	2.533	0.614	34	36.7	30.5-41.0	2.130	0.365
Karacabey	16	31.1	27.3-37.0	2.563	0.641	17	31.6	28.5-38.5	2.648	0.642	33	31.3	27.3-38.5	2.579	0.449
Gemlik	9	35.2	31.2-38.3	1.966	0.655	9	37.5	33.1-41.3	2.376	0.792	18	36.4	31.2-41.3	2.410	0.568
Bolayır	21	31.8	28.1-34.4	1.793	0.391	18	32.3	28.0-34.7	1.678	0.396	39	32.0	28.0-34.7	1.736	0.278
Lcd															
Efes	24	28.2	24.5-31.2	1.739	0.355	8	27.2	25.3-30.4	2.063	0.729	32	28.0	24.5-31.2	1.844	0.326
Ayvaciık	10	33.9	28.8-41.4	3.755	1.187	13	33.3	28.2-37.1	2.396	0.665	23	33.6	28.2-41.4	2.996	0.625
Lapseki	17	36.5	30.1-39.4	2.552	0.619	17	32.9	28.1-37.9	2.908	0.705	34	34.7	28.1-39.4	3.250	0.557
Karacabey	16	32.8	26.8-40.7	3.339	0.835	17	30.2	26.5-36.7	2.954	0.716	33	31.5	26.5-40.7	3.361	0.585
Gemlik	9	34.9	31.7-39.0	2.156	0.719	9	33.0	28.9-36.0	2.361	0.787	18	34.0	28.9-39.0	2.397	0.565
Bolayır	21	32.4	26.6-36.6	2.714	0.592	18	29.8	23.9-33.4	2.244	0.529	39	31.2	23.9-36.6	2.794	0.447

Body measurements and rates: The total length (L) was 59.8-81.4 in males, 62.5-77.2 in females. The body length (Lcp) 30.4-38.4 in males and 32.9-37.7 in females; the snout-vent length (Lsv) ranged from 31.4-40.0 in males, 33.2-40.1 in females; the tail length (Lcd) 28.8-41.4 in males and 28.2-37.1 mm in females. The mean and biometric values are given in Table 1.

Lapseki Population

Morphologic characters: The dorsal crest of males started from 1.6-(2.4)-3.1 mm posterior of the head tip and the height of the crest ranged from 2.6-5.1 mm with a mean of 3.9 mm. The processes of the dorsal on the free margin's crest were pointed in 82.4% of specimens and in the rest rounded (Fig 2). The structure of the tail filament and the foot webbing and the rate of occurrence of each form in the population are given in Figures 3 and 4.

Body measurements and rates: The total length (L) was 66.4-79.7 mm in males and 59.9-78.1 in females; the body length (Lcp) was 35.0-40.0 in males and 30.5-41.0 mm in females; the snout-vent length (Lsv) 36.3-40.8 mm in males and 31.0-41.6 mm in females; the tail length (Lcd) 30.1-39.4 mm in males and 28.1-37.9 mm in females. The mean and biometric values are given in Table 1.

Karacabey Population

Morphologic characters: The dorsal crest of the males started from 1.7-(2.5)-3.1 mm posterior of the head tip and the height of the crest ranged from 2.2-(3.7)-4.6 mm. The processes of the dorsal on the free margin's crest were pointed in 68.8% of specimens, and in the rest rounded (Fig 2). The structure of the tail filament and the foot webbing and the rate of occurrence of each form in the populations are shown in Figures 3 and 4.



Figure 2. The structure of the free margin of the dorsal crest and their rate of occurrence in the populations.

	A-Pointed	B-Round
Efes	17 (70.8)	7 (29.2%)
Ayvacic	6 (60.0%)	4 (40.0%)
Lapseki	14 (82.4%)	3 (17.6%)
Karacabey	11 (68.8%)	5 (31.2%)
Gemlik	7 (77.8%)	2 (22.2%)
Bolayir	11 (52.4%)	10 (47.6%)



Figure 3. The structure of the tail tip and the rate of occurrence in the populations.

	A-With Filament	The Length of Filament	B-Pointed	C-Blunt
Efes	3 (12.5%)	3.1-(3.5)-3.9	17 (70.8%)	4 (16.7%)
Ayvacic	3 (30.0%)	3.6-(4.2)-5.0	7 (70.0%)	-
Lapseki	11 (64.7%)	3.0-(3.7)-5.6	6 (35.3%)	-
Karacabey	12 (75.0%)	3.0-(4.2)-5.7	4 (25.0%)	-
Gemlik	8 (88.9%)	3.0-(3.8)-4.5	1 (11.1%)	-
Boyalir	11 (52.4%)	3.0-(3.7)-4.5	10 (47.6%)	-



Figure 4. The structure of the foot webbing the rate of occurrence in the populations.

	A-Narrow	B-Wide	C-Very Wide
Efes	19 (79.2%)	5 (20.8%)	-
Ayvacic	10 (100%)	-	-
Lapseki	-	10 (58.8%)	7 (41.2%)
Karacabey	-	9 (56.3%)	7 (43.7%)
Gemlik	-	7 (77.8%)	2 (22.2%)
Bolayir	-	21 (100%)	-

Body measurements and rates: The total length (L) was 56.2-77.8 mm in males and 56.2-76.5 mm in females; the body length (Lcp) was 27.3-37.0 mm in males and 28.5-38.5 mm in females; the snout-vent length (Lsv) was 29.4-39.6 mm in males, 29.7-39.8 mm in females; the tail length (Lcd) 26.8-40.7 mm in males and 26.5-36.7 mm in females. The mean and biometric values of the body measurements are given in Table 1.

Gemlik Population

Morphologic characters: The dorsal crest of the males started from 1.8-(2.4)-3.1 mm posterior of the head tip.

The height of the crest ranged from 3.5-4.5 mm with a mean of 3.9 mm. The processes of the dorsal on the free margin's crest were pointed in 77.8% of specimens and in the rest rounded (Fig 2). The structure of the tail filament and the foot webbing and the rate of occurrence of each form in the populations are shown in Figures 3 and 4.

Body measurements and rates: The total length (L) is was 64.7-79.5 mm in males, 65.6-77.1 mm in females. The body length (Lcp) was 31.2-38.3 in males, and 33.1-41.3 in females; the snout-vent length (Lsv) was 33.0-

40.5 mm in males, 34.5-41.6 mm in females. Tail length (Lcd) ranged from 31.7-39.0 mm in males and 28.9-36.0 mm in females. The mean and bimetric values of the body measurements are given in Table 1.

Bolayır Population

Morphologic characters: The dorsal crest of the males started from 1.7-(2.4)-2.9 mm posterior of the head tip. The height of the crest ranged from 1.6-5.6 mm with a mean of 3.0 mm. The processes of the dorsal crest on the free margins were pointed in 52.4% of specimens, and in the rest rounded (Fig 2). The structure of the tail filament and the foot webbing and the rate of occurrence of each form in the populations are shown in Figures 3 and 4.

Body measurements and ratios: The total length (L) was 57.5-72.7 in males and 52.6-67.9 mm in females. The body length (Lcp) was 28.1-34.4 mm in males and 28.0-34.7 mm females; the snout-vent length (Lsv) was 30.0-36.1 in males and 28.7-36.2 mm in females; the tail length (Lcd) was 26.6-36.6 mm in males and 23.9-33.4 mm in females. The mean and bimetric values of the body measurements are given in Table 1.

Comparison of the Populations

Morphologic characters: The dorsal crest of the specimens in the 6 different populations stated from just behind the eyes, with a mean of 2.5 mm posterior of the tip of the head. In other words, no difference was found

among the populations in terms of the starting point of the dorsal crest. However, the dorsal crest was higher than the others in the Gemlik and Karacabey populations. The proportion possessing a dorsal crest with a pointed free margin was higher than that of those with rounded (Fig 2). However, those possessing a dorsal crest with a either pointed or a rounded free margin was determined to be nearly equal in the Bolayır (Thrace) population (Fig 2). The proportion with a tail filament increased remarkably from the Efes population, from the most southerly locality to Gemlik the population (Fig 3). As can be seen from the values the proportion with a tail filament and without a tail filament were nearly the same in the Bolayır (Thrace) population. The structure of the foot webbing in the Efes and Ayvacık populations was clearly different from the others. The webbing was narrow in these two populations, and wide or very wide in the others (Fig 4).

Body measurements and proportions: According to Tukey's HSD test results, important differences were determined among the populations in terms of body measurements and rate's (Table 2).

In Table 2, most of the comparisons were done between the Efes and Lapseki (13 different character) populations in terms of body measurements. Furthermore, remarkable differences were established in terms of 12 body measurements between the Efes-Ayvacık, Efes-Karacabey and Lapseki-Bolayır populations

Table 2. The comparison of the body measurements and ratios of *Triturus vulgaris* populations according to Tukey's HSD test. The marked features are those which are considered different among the populations.

Populations	L	Lsv	Lc	Ltc	Lcd	Lw	Pa	Pp	D	Lcp	Lc/L	Ltc/L	Lc/Ltc	Lcp/L	Lsv/L	Lcp/Lc	Lcd/Lcp	Pa/D	Pp/D
Efes-Ayvacık	*	*	*	*	*	*	*	*	*	*	*					*			
Efes-Lapseki	*	*	*	*	*	*	*	*	*	*	*	*			*				
Efes-Karacabey	*				*	*	*	*			*	*		*	*		*	*	*
Efes-Gemlik	*	*	*	*	*	*			*	*		*						*	*
Efes-Bolayır	*				*					*					*		*		
Ayvacık-Lapseki			*			*							*						
Ayvacık-Karacabey	*	*	*	*			*	*	*	*		*							*
Ayvacık-Gemlik									*			*	*					*	*
Ayvacık-Bolayır	*	*	*	*	*	*			*	*			*						
Lapseki-Karacabey	*	*	*	*	*		*	*	*	*				*			*		
Lapseki-Gemlik																			
Lapseki-Bolayır	*	*	*	*	*	*		*	*	*			*					*	*
Karacabey-Gemlik	*	*	*	*	*		*	*	*	*					*		*		
Karacabey-Bolayır				*		*	*	*				*						*	*
Gemlik-Bolayır	*	*	*		*	*			*	*		*	*					*	*

(Table 2). No difference was found between Efes-Gemlik, Lapseki-Karacabey, Karacabey-Gemlik and Gemlik-Bolayır populations, whereas 3 different characters were determined between the Ayvacık-Lapseki populations.

The relation between the populations was examined in terms of coefficient of difference values (CD) as well as Tukey's HSD test. The results of the comparison are given in Table 3. Only the Efes population differed from the Ayvacık, Lapseki and Gemlik populations in terms of 2 or more characters. Furthermore, the populations situated both sides of the Çanakkale Bosphorus (Lapseki and Bolayır) showed remarkable differences from one another in terms of body length (Table 3).

Taxonomic Evaluation

As mentioned in the introduction, the presence of *T.v. vulgaris* had been accepted in the Western Anatolia until the study of Raxworthy in 1988 (9, 10, 13). Raxworthy collected material from Karacabey and described them as *T.v. schmidtleri*, a new subspecies, due to the small body size, the lack of tail filament, dorsal crest with pointed free margin and according to the courtship behaviour (16). According to Raxworthy, this new subspecies is distributed in the whole of Western Anatolia as well as Karacabey.

In our study, only the Efes material showed remarkable differences from the 3 northern populations (Ayvacık, Lapseki, Gemlik and Karacabey), whereas the northern populations did not show any differences among them or from Bolayır population (Thrace) (Table 3). In conclusion, all populations in Western Anatolia, excluding the Efes population, resemble one another. No difference was found between Bolayır and Karacabey material in terms of body length (Table 2). Furthermore, the body length of Karacabey material were not as small as mentioned by Raxworthy (16). On the other hand, it is remarkable that the body length of the southern Efes population was respectively smaller than the northern Ayvacık, Lapseki, Karacabey and Gemlik populations.

Thus, only the Efes material showed remarkable differences from the northern Ayvacık, Lapseki and Gemlik populations in terms of diagnostic characters for the identification of the subspecies of *T. vulgaris* and the rest of the populations did not show any remarkable difference. *T.v. schmidtlerorum*, therefore, should be taken as the synonym *T.v. vulgaris* for the time being.

A satisfactory explanation of the taxonomic status of the Efes population will be possible with the material which must be collected from the northern and southern part of Bozdağ.

Table 3. The comparison of the body measurements and rates of *Triturus vulgaris* populations according to CD (coefficient of difference) values.

Populations	L	Lsv	Lc	Ltc	Lcd	Lw	Pa	Pp	D	Lcp	Lc/L	Ltc/L	Lc/Ltc	Lcp/L	Lsv/L	Lcp/Lc	Lcd/Lcp	Pa/D	Pp/D
Efes-Ayvacık	1.24	1.12	0.59	1.06	1.16	0.41	0.55	0.67	0.73	1.23	0.56	-	-	-	-	0.47	-	-	-
Efes-Lapseki	1.21	1.22	0.95	0.96	1.32	0.73	0.61	0.71	1.03	1.58	0.53	0.83	-	-	0.63	-	-	-	-
Efes-Karacabey	-	-	-	-	0.67	0.57	0.41	0.48	-	-	0.56	0.91	-	-	0.88	0.51	0.60	0.51	0.56
Efes-Gemlik	1.60	1.37	0.94	0.68	1.41	0.65	-	-	1.33	1.40	-	0.91	0.43	-	-	-	-	0.71	0.59
Efes-Bolayır	-	-	-	-	0.69	-	-	-	-	0.43	-	-	-	-	0.63	-	0.48	-	-
Ayvacık-Lapseki	0.22	-	0.48	-	-	0.39	-	-	-	-	-	-	0.66	-	-	-	-	-	-
Ayvacık-Karacabey	0.60	0.85	0.45	1.07	-	-	0.91	1.05	0.47	0.85	-	0.10	-	-	-	-	-	-	0.45
Ayvacık-Gemlik	-	-	-	-	-	-	-	-	0.46	-	-	0.10	0.77	-	-	-	-	0.45	0.48
Ayvacık-Bolayır	0.66	0.89	0.56	0.73	0.41	0.41	-	-	0.59	0.86	-	-	-	-	-	-	-	-	-
Lapseki-Karacabey	0.78	1.03	0.80	0.98	0.48	-	0.95	1.08	0.75	1.15	-	-	-	0.43	-	-	0.35	-	-
Lapseki-Gemlik	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lapseki-Bolayır	0.86	-	1.02	0.66	0.58	0.87	-	0.33	0.91	1.22	-	-	-	-	-	-	-	0.43	0.36
Karacabey-Gemlik	0.81	1.06	0.78	0.73	0.43	-	0.72	0.89	0.99	1.02	-	-	-	-	0.56	-	0.39	-	-
Karacabey-Bolayır	-	-	-	0.41	-	0.69	0.66	0.80	-	-	-	0.10	-	-	-	-	-	0.60	0.67
Gemlik-Bolayır	0.91	1.14	1.00	-	0.54	0.78	-	-	1.23	1.06	-	0.10	0.57	-	-	-	-	0.83	0.71

References

1. Thorn, R., Les salamandres d'Europe, Asie et d'Afrique du Nord, Paris: Lechevalier, 1968.
2. Bucci-Innocenti, S., Raghianti, M., Mancino, G., Investigation of karyology and hybrids in *Triturus boscai* and *T. vittatus*, with a reinterpretation of the species groups within *Triturus* (Caudata: Salamandridae). *Copeia* 1983, 662-672, 1983.
3. Frost, D. R., (ed) *Amphibian Species of the World: A Taxonomic and Geographical Reference*. Allen Press and the Association of Systematics Collections, Lawrence, KS, 1985.
4. Wallis, G. P., Arntzen, J. W., Mitochondrial-DNA variation in the crested newt superspecies: limited cytoplasmic gene flow among species. *Evolution* 43: 88-104, 1989.
5. Macgregor, H. C., Sessions, S. K., Arntzen, J. W., An integrative analysis of phylogenetic relationships among newts of the genus *Triturus* (family Salamandridae), using comparative biochemistry, cytogenetics and reproductive interactions. *J. Evol. Biol.* 3: 329-373, 1990.
6. Raxworthy, C. J., A review of the smooth newt (*Triturus vulgaris*) subspecies, including an identification key. *Herpetol. J.* 1: 481-492, 1990.
7. Griffiths, R. A., *Newts and Salamanders of Europe*. London: Poyser Natural History, 1996.
8. Freytag, G. E., Über *Triturus vulgaris* aus dem Gebiet von Istanbul. *Zool. Anz.* 158: 49- 53, 1957.
9. Özeti, N., Studies on the Morphology, Taxonomic Position, Seasonal Activity and Thermotaxic Behaviour of *Triturus vulgaris* (Linnaeus) in Aegean Region. *Scien. Reports of the Faculty of Science, Ege University.* 15, Izmir, 1964.
10. Eiselt, J., Einige Amphibien und Reptilien aus der nordöstlichen Türkei. gesammelt von Herrn H. Steiner. *Ann. Naturhist. Mus. Wien.* 67: 387-389, 1965.
11. Huşengi, F. T., On some new material of *Triturus vulgaris* (L.) from the area between Abant (Bolu) and Bosphorus in NW Anatolia. *Ege Univ. Fen Fak. Der. Ser. B.* 4: 115-140, 1980.
12. Yılmaz, I., Morphological and Taxonomical Investigation of Thracian Urodeles (Urodela: Salamandridae). *Doğa Bilim Dergisi, Temel Bilm.:*7: 119-130, 1983.
13. Başoğlu, M., Özeti, N., Yılmaz, I., The Amphibians of Turkey. *Ege Univ. Fen Fak. Kitaplar Serisi* 151, Izmir, 1996.
14. Kessler, K., *Zoologische Reise durch Transkaukasien im Jahre 1875.-Trudy Sankt- Petersburgskago Obscestva Estestvoispytatelej* 8, 1877 (Supplementum) 200 pp, 1878.
15. Tarkhnishvili, D. N., The Distribution and Ecology of the Amphibians of Georgia and the Caucasus: a biogeographical analysis. *Zeitschrift für Feldherpetologie* 3: 167-196, 1996.
16. Raxworthy, C. J., A description and study of a new dwarf subspecies of smooth newt, *Triturus vulgaris*, from western Anatolia, Turkey. *J. Zool. (Lond.)* 215: 753-763, 1988.
17. Boettger, O., Verzeichniss der von Hrn. E. von Oertzen aus Greichenland Kleinasien mit gebrachten Batrachier und Reptilien. *SB. Ak. Berl.* 5: 139-186, 1888.
18. Schmidtler, J. J., Schmidtler, J. F., Über die Verbreitung der Molchgattung *Triturus* in Kleinasien. *Salamandra* 3: 15-36, 1967.
19. Olgun, K., Baran, I., A systematic research on the *Triturus vittatus* (Gray, 1835) (Urodela: Amphibia) populations in the inner part of the Middle Black Sea Region. *Tr. J. of Zoology.* 17: 445-456, 1993.
20. SPSS for Windows., Academic Computing Services. 708722. Release 6.0 Jun 17, 1993.
21. Mayr, E., *Principles of Systematic Zoology*, McGraw-Hill, Inc., New York, 428 pp, 1969.