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A Morphological and Taxonomical Study on the Subspecies of the Lycian Salamander, *Mertensiella luschani*, (Steindachner, 1891) (Urodela: Salamandridae)

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A Morphological and Taxonomical Study on the Subspecies of the Lycian Salamander, *Mertensiella luschani*, (Steindachner, 1891) (Urodela: Salamandridae)*

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Abstract: The morphometric measurements of 10 taxonomically important characters, and the coloration features of the 8 subspecies of *Mertensiella luschani* were investigated and statistical analyses were carried out. The importance of these characters in distinguishing the subspecies is discussed and some of them were found to be very reliable, although some did not show any statistical differences among the subspecies of *M. luschani*. The mean total body length, and the ratio of the width of the parotid to its length were the most important; the ratio of head length to head and body length, the ratio of head width to head length, the ratio of forelimb length to head and body length, and the ratio of nostril-eye distance to head length were important characters in the recognition of these subspecies. The ratios of tail length to head and body length, hind limb length to head and body length, length of parotid to the length of head and body and tail length to the total body length were not statistically significant in distinguishing subspecies of the Lycian salamander.

Key Words: *Mertensiella luschani*, Morphology, Taxonomy, Turkey

***Mertensiella luschani* (Steindachner, 1891) (Urodela: Salamandridae) Alttürleri Üzerine Morfolojik ve Taksonomik Bir Araştırma**

Özet: Bu çalışmada 8 *Mertensiella luschani* alttürünün renk-desen özellikleri ile 10 önemli taksonomik karaktere istatistiksel analiz uygulanarak, alttürlerin ayırımında bu karakterlerin önemi tartışılmıştır. Bu karakterlerden bazıları *M. l. luschani* alttürleri arasında güvenilir bulunurken bazıları da hiçbir istatistiksel farklılık göstermemiştir. Total Vücut uzunluğu, parotid genişliği-parotid boyu oranı, Baş uzunluğu-Vücut uzunluğu oranı, Baş genişliği- Baş uzunluğu, Ön ekstremite uzunluğu-Baş ve vücut uzunluğu oranı, Burun deliği Göz arası mesafe-Baş uzunluğu oranı bu alttürlerin tanımlanmasında önemli karakterlerdir. Kuyruk uzunluğu-Baş ve Vücut Uzunluğu, Arka ekstremite uzunluğu-Baş ve Vücut Uzunluğu, Parotid uzunluğu- Baş ve Vücut Uzunluğu, Kuyruk Uzunluğu-Total vücut uzunluğu oranları *M. luschani* alttürlerinin ayırımında istatistiksel olarak önemli bulunmamıştır.

Anahtar Sözcükler: *Mertensiella luschani*, Morfoloji, Taksonomi, Türkiye

Introduction

Nine subspecies of *Mertensiella luschani* were identified by 1987, 1 from Karpathos Island, Greece (*M. l. helverseni*) and 8 from the southern coast of Turkey (*M. l. luschani*, *M. l. atifi*, *M. l. fazilae*, *M. l. finikensis*, *M.*

l. antalyana, *M. l. basoglu*, *M. l. billae* and *M. l. flavimembris*) (Steindachner, 1891; Pieper, 1963; Başoğlu, 1967; Başoğlu and Atatür, 1974, 1975; Başoğlu and Baran, 1976; Baran and Atatür, 1980; Franzen and Klewen, 1987; Klewen et al., 1988; Mutz

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and Steinfartz, 1995). These subspecies have been described from an area of less than 400 km (between the cities of Alanya and Marmaris) on the Mediterranean coast of Turkey and some Greek islands. Although Baran and Atatür (1986) stated that the populations of Marmaris and Muğla belong to the same subspecies *M. l. helverseni*, which lives only on Karpathos Island, these populations were recognised as a new subspecies by Mutz and Steinfartz (1995). Veith et al. (2001) revised these populations and their geographic distribution as 9 subspecies from 46 localities. The morphometric measurements of some body parts, and the coloration and pattern features of the above-mentioned subspecies were given in previous studies without detailed statistical analyses. Therefore our first aim was an investigation of these subspecies with a statistical analysis of some taxonomically important measurements and ratios, since the identification of these subspecies is based on their typical coloration resulting from an interplay of 3 different epidermal chromatophore layers: an inner erythrophore layer, a melanophore layer and an outer iridophore layer (Klewen et al., 1988).

Materials and Methods

The localities where material was collected are shown in Figure 1. We surveyed the study area on different dates (given for each sample in the list of materials below). The coloration of live specimens was determined by eye, slides are taken, and then the specimens were fixed with the standard processes. These fixed specimens were kept in the Department of Biology at the Faculty of

Arts and Science of Akdeniz University. The list of material is given below from west to east with the total number of specimens, departmental identification code, sex and collection number of specimens, the locality, date, and the initials and surname of the collector per subspecies.

List of Materials:

A – *Mertensiella luschani flavimembris* 6 (3 ♂♂, 3 semi-adult ♀♀)

1- 16/96 1-3 ♀♀, 4-6 semi-adult ♀♀, Çiçekli village (Ula, Muğla), 9.3.1996, İ.BARAN.

B – *Mertensiella luschani fazilae* 12 (6 ♂♂, 6 ♀♀)

2- 3/99 1-6 ♂♂, 7-12 ♀♀, Kapıkargın village (Dalaman, Muğla), 14.2.1999, M.ÖZ- M.R.TUNÇ.

C – *Mertensiella luschani luschani* 16 (8 ♂♂, 8 ♀♀)

3- 4/99 1-3 ♂♂, 4-8 ♀♀, Dereboğazı (Fethiye, Muğla), 14.2.1999, M.ÖZ-M.R.TUNÇ.

4- 5/99 1-3 ♂♂, 4-5 ♀♀, Letoon (Fethiye, Muğla), 14.2.1999, M.ÖZ.

5- 6/99 1 ♂, 1 ♀, Dodurga village (Fethiye, Muğla), 14.2.1999, M.ÖZ; 172/96, 1 ♂ Dodurga village (Fethiye, Muğla), 23.12.1996, İ.BARAN.

D – *Mertensiella luschani basoglu* 13 (4 ♂♂, 9 ♀♀)

6- 1/98 2 ♀♀ Nadarlar village (Kaş, Antalya), 10.2.1998, M.ÖZ; 2/99 1-4 ♂♂, 5-11 ♀♀, Nadarlar village (Kaş, Antalya), 14.2.1999, M.ÖZ-M.R.TUNÇ.

E- *Mertensiella luschani finikensis* 8 (2 ♂♂, 3 ♀♀, 3 semi-adult ♀♀)

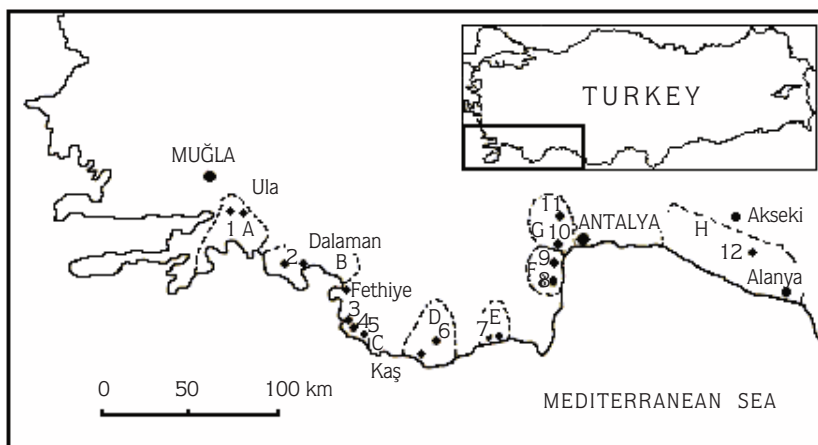


Figure 1. Collection localities. Refer to materials list for details.

7- 1/99 1-2 ♂♂, 3-5 ♀♀, 6-8 semi-adult ♀♀, Finike, Antalya 13.2.1999, M.ÖZ.

F - *Mertensiella luschani billae* 18 (10 ♂♂, 8 ♀♀)

8- 5/97 1-4 ♂♂, 5-9 ♀♀, Tünektepe (Antalya), 8.3.1997, M.ÖZ.

9- 5/98 1-6 ♂♂, 7-9 ♀♀, Büyükçaltıcak (Antalya) 09.3.1998, M.ÖZ-M. R.TUNÇ.

G - *Mertensiella luschani antalyana* 20 (6 ♂♂, 14 ♀♀)

10 - 2/95 1-2 ♂♂, 3-5 ♀♀, Hurma village (Antalya), 23.1.1995, M.ÖZ; 4/98 1 ♂, 2-9 ♀♀, Hurma village (Antalya), 30.3.1998, M.ÖZ-M.R.TUNÇ.

11- 9/97 1-3 ♂♂, 4-6 ♀♀, Yağca village (Antalya), 9.3.1997, M.ÖZ-M.R.TUNÇ.

H - *Mertensiella luschani atifi* 11 (1 ♂, 10 ♀♀)

12-1/96 1 ♂, 2-6 ♀♀, Fersin village (Akseki, Antalya), 25.1.1996, M.ÖZ; 16/96 1-2 ♀♀, Fersin village (Antalya) 29.3.1997, M.ÖZ; 9/98 1-3 ♀♀, Fersin village (Antalya), 4.4.1998, M.ÖZ.

The above listed material was collected under stones during the day, since these are nocturnal animals. The morphometric measurements were taken with a digital calliper (Mitutoyo) with an accuracy of 0.02 mm. An ANOVA statistical test was used to compare measurements and ratios (Fowler and Cohen, 1996). Measurements of body parts and the ratios used in this study are as follows: total body length (TBL) (the length of the whole body including the tail), ratios of tail length (TL)/head and body length (H+BL) (excluding the tail), head length (HL)/head and body length (H+BL), head width (HW)/head length (HL), forelimb length (FL)/head and body length (H+BL), hind limb length (HLL)/head and body length (H+BL), tail length (TL)/total body length (TBL), parotid length (PL)/head and body length (HBL), width of parotid (PW)/length of parotid (PL), nostril-eye distance (NED) (from the nostril to the anterior edge of the eye)/head length (HL).

Results

I- **The Morphometric Measurements:** A total of 40 ♂♂, 58 ♀♀ and 6 semi-adult ♀♀ were collected from 12 different localities in 2 main provinces (Antalya and Muğla) in Turkey. The measurements of these specimens and the results of F statistics are given in the Table. The comparisons of each character for all the subspecies are

given below. The individual 95% confidence intervals (CIs) for mean based on pooled standard deviation of the 8 subspecies of *M. luschani* are also given in Figure 2.

a- **Total Body Length (TBL):** The mean body length is statistically different in *Mertensiella l. flavimembris* from those in *M. l. luschani*, *M. l. billae*, *M. l. antalyana* and *M. l. atifi*, but not statistically different from those in the other subspecies. The mean body lengths of *M. l. fazilae* and *M. l. basoglui* are only different from that of *M. l. atifi*, but are similar to those in the other subspecies. *M. l. luschani* is different from *M. l. flavimembris* and *M. l. atifi*, but is similar to other subspecies in terms of mean total body length. *M. l. finikensis* is different from *M. l. antalyana* and *M. l. atifi* in terms of mean total body length. Similarly, *M. l. billae* is statistically different from *M. l. flavimembris* and *M. l. atifi*. The subspecies *M. l. antalyana* is only different from *M. l. flavimembris*, *M. l. finikensis* and *M. l. atifi* in total body length, but is similar to other subspecies. The mean body length of *M. l. atifi* is longer than those of the other 7 subspecies (Table, Figure 2).

b- **Tail Length/Head and Body Length (TL/H+BL):** No statistical differences were found, due to the very close ratios, among these subspecies in terms of this character (Table, Figure 2).

c- **Head Length/Head and Body Length (HL/H+BL):** This ratio was similar among all the subspecies, except for *M. l. flavimembris*, which was statistically different from all the subspecies apart from *M. l. finikensis* (Table, Figure 2).

d- **Head Width/Head Length (HW/HL):** *M. l. flavimembris* is statistically different from *M. l. antalyana*, but similar to other subspecies in terms of this ratio. *M. l. antalyana* is similar to *M. l. billae* and *M. l. atifi*, but statistically different from the other subspecies. The HW/HL ratio is different in *M. l. finikensis*, *M. l. billae*, *M. l. antalyana* and *M. l. atifi*, but similar among the other subspecies (Table, Figure 2).

e- **Fore limb Length/Head and Body Length (FL/H+BL):** *M. l. antalyana* differs from *M. l. flavimembris* and *M. l. luschani* in terms of this ratio, but no statistical differences were found among the other subspecies. In *M. l. luschani* this ratio is only different from that in *M. l. antalyana*, but is similar to that in the other subspecies (Table, Figure 2).

Table. A comparison of the morphometric measurements taken from the subspecies of *M. luschani*. (N: Sample size, Ext.: Extreme values, M: Mean value, SD: Standard Deviation, see the text for other abbreviations). F statistics are also given in the bottom row for each morphometric comparison at a level of 0.05.

| Subspecies | N | Total Body Length (TBL) | | | TL/H+BL | | | HL/H+BL | | | HW/HL | | |
|------------------------------|----|---|--------|--------|---|-------|-------|---|-------|-------|---|-------|-------|
| | | Ext | M | SD | Ext | M | SD | Ext | M | SD | Ext | M | SD |
| A- <i>M. l. flavimembris</i> | 6 | 80.46-124.48 | 102.03 | 16.345 | 0.83-0.92 | 0.871 | 0.037 | 0.28-0.30 | 0.288 | 0.009 | 0.67-0.73 | 0.706 | 0.020 |
| B- <i>M. l. fazilae</i> | 12 | 104.96-125.02 | 114.01 | 6.697 | 0.75-0.92 | 0.867 | 0.049 | 0.23-0.29 | 0.254 | 0.015 | 0.66-0.76 | 0.713 | 0.029 |
| C- <i>M. l. luschani</i> | 16 | 104.63-130.83 | 121.90 | 7.05 | 0.75-0.94 | 0.876 | 0.051 | 0.23-0.28 | 0.250 | 0.012 | 0.64-0.77 | 0.713 | 0.038 |
| D- <i>M. l. basoglui</i> | 13 | 90.40-133.35 | 113.35 | 15.549 | 0.80-0.94 | 0.868 | 0.042 | 0.23-0.29 | 0.258 | 0.020 | 0.68-0.82 | 0.719 | 0.038 |
| E- <i>M. l. finikensis</i> | 8 | 75.09-125.85 | 106.42 | 19.735 | 0.77-0.91 | 0.843 | 0.041 | 0.23-0.30 | 0.265 | 0.023 | 0.70-0.81 | 0.735 | 0.033 |
| F- <i>M. l. billae</i> | 18 | 102.46-139.93 | 119.40 | 9.900 | 0.80-1.00 | 0.892 | 0.050 | 0.23-0.29 | 0.263 | 0.018 | 0.63-0.77 | 0.686 | 0.030 |
| G- <i>M. l. antalyana</i> | 20 | 103.22-139.38 | 122.99 | 9.984 | 0.64-0.97 | 0.848 | 0.090 | 0.24-0.29 | 0.261 | 0.001 | 0.61-0.70 | 0.663 | 0.024 |
| H- <i>M. l. atifi</i> | 11 | 105.42-164.70 | 141.33 | 23.167 | 0.77-0.96 | 0.854 | 0.067 | 0.23-0.28 | 0.256 | 0.015 | 0.62-0.77 | 0.682 | 0.039 |
| F statistics | | F (7, 103): 2.11; F _{cal} : 7.75 | | | F (7, 103): 2.11; F _{cal} : 1.07 | | | F (7, 103): 2.11; F _{cal} : 3.72 | | | F (7, 103): 2.11; F _{cal} : 7.04 | | |

| FL/H+BL | | | HLL/H+BL | | | TL/TBL | | | PL/H+BL | | | PW/PL | | | NED/HL | | |
|-----------------|-------------------------|-------|------------------|------------------------|-------|-----------------|-------------------------|-------|------------------|-------------------------|-------|-------------------|-------------------------|-------|-------------------|-------------------------|-------|
| Ext | M | SD | Ext | M | SD | Ext | M | SD | Ext | M | SD | Ext | M | SD | Ext | M | SD |
| 0.31-0.38 | 0.341 | 0.026 | 0.34-0.39 | 0.361 | 0.021 | 0.45-0.48 | 0.463 | 0.012 | 0.11-0.17 | 0.143 | 0.019 | 0.32-0.50 | 0.405 | 0.066 | 0.14-0.20 | 0.161 | 0.023 |
| 0.28-0.33 | 0.319 | 0.013 | 0.32-0.37 | 0.345 | 0.015 | 0.43-0.48 | 0.460 | 0.014 | 0.9-0.11 | 0.190 | 0.223 | 0.36-0.54 | 0.440 | 0.050 | 0.15-0.23 | 0.181 | 0.022 |
| 0.30-0.35 | 0.328 | 0.015 | 0.32-0.39 | 0.347 | 0.019 | 0.43-0.48 | 0.463 | 0.014 | 0.10-0.14 | 0.125 | 0.010 | 0.30-0.44 | 0.357 | 0.041 | 0.14-0.20 | 0.171 | 0.018 |
| 0.29-0.36 | 0.328 | 0.018 | 0.33-0.39 | 0.359 | 0.020 | 0.44-0.48 | 0.460 | 0.014 | 0.10-0.17 | 0.138 | 0.019 | 0.30-0.45 | 0.358 | 0.036 | 0.15-0.22 | 0.181 | 0.020 |
| 0.28-0.34 | 0.313 | 0.019 | 0.32-0.36 | 0.340 | 0.016 | 0.43-0.47 | 0.452 | 0.012 | 0.13-0.15 | 0.130 | 0.015 | 0.33-0.43 | 0.387 | 0.034 | 0.13-0.22 | 0.182 | 0.029 |
| 0.29-0.35 | 0.323 | 0.019 | 0.32-0.38 | 0.356 | 0.018 | 0.44-0.50 | 0.468 | 0.012 | 0.10-0.16 | 0.136 | 0.020 | 0.27-0.39 | 0.338 | 0.036 | 0.13-0.21 | 0.161 | 0.024 |
| 0.28-0.35 | 0.310 | 0.018 | 0.29-0.38 | 0.340 | 0.022 | 0.39-0.53 | 0.456 | 0.030 | 0.11-0.15 | 0.127 | 0.010 | 0.31-0.48 | 0.392 | 0.052 | 0.11-0.20 | 0.149 | 0.021 |
| 0.30-0.34 | 0.320 | 0.014 | 0.33-0.36 | 0.342 | 0.011 | 0.43-0.49 | 0.456 | 0.020 | 0.11-0.14 | 0.128 | 0.009 | 0.28-0.48 | 0.363 | 0.057 | 0.14-0.21 | 0.167 | 0.019 |
| F (7,103): 2.11 | F _{cal} : 3.16 | | F (7, 103): 2.11 | F _{cal} : .38 | | F (7, 99): 2.12 | F _{cal} : 0.81 | | F (7,103): 2.11; | F _{cal} : 2.25 | | F (7, 103): 2.11; | F _{cal} : 6.44 | | F (7, 103): 2.11; | F _{cal} : 4.36 | |

f- Hind limb Length/Head and Body Length (HLL/H+BL): No statistical differences were found among the subspecies in terms of this ratio (Table, Figure 2).

g- Tail Length/Total Body Length (TL/TBL): No statistical differences occur among the subspecies (Table, Figure 2).

h- Parotid Length/Head and Body Length (PL/H+BL): There are no statistical differences among the subspecies in terms of this ratio (Table, Figure 2).

i- Parotid Width/Parotid Length (PW/PL): This ratio is statistically different in *M. l. flavimembris* from that in *M. l. billae*, but is not statistically different from those in the other subspecies. The width of the parotid to the length of the parotid of *M. l. fazilae* is different from those of *M. l. flavimembris*, *M. l. finikensis* and *M. l. antalyana*, but is similar to those of the other subspecies. Similarly, *M. l. billae* is statistically different from *M. l. flavimembris*, *M. l. fazilae* and *M. l. antalyana*, but no statistical differences were found among the other subspecies. The subspecies *M. l. luschani* and *M. l. basoglui* are only different from *M. l. fazilae*, and *M. l. atifi* is different from *M. l. fazilae* (Table, Figure 2).

j- Nostril-Eye Distance/Head Length (NED/HL): *M. l. antalyana* is statistically different from *M. l. fazilae*, *M.*

l. luschani, *M. l. basoglui* and *M. l. finikensis*, but similar to *M. l. flavimembris*, *M. l. billae* and *M. l. atifi* (Table, Figure 2).

II- Coloration and Pattern: The subspecies of the Lycian salamander (*M. luschani*) show different varieties in coloration and pattern. These are described as follows for each subspecies.

M. l. flavimembris: The dorsum is dark brown and shiny black, covered with orderly distributed yellowish-white spots. The parotid is pinkish-yellow and covered with small black dots, as is the back side of the eyelids. The lateral parts of the body are yellowish-grey. The extremities and tail are similar and look like red meat. There are small black spots on the dorsal part of the tail; the ventral part is light pink or meat-like coloured. There are no spots.

M. l. fazilae: The dorsum of the body is pinkish-red and covered with blackish-brown spots of different sizes. The parotids are pinkish red; the ventral of the tail and extremities are pinkish. The lateral parts of the body are grey and the spots on the tail are few and indistinct.

M. l. luschani: The dorsum is shiny dark brown, it is covered with irregularly distributed yellowish spots. The

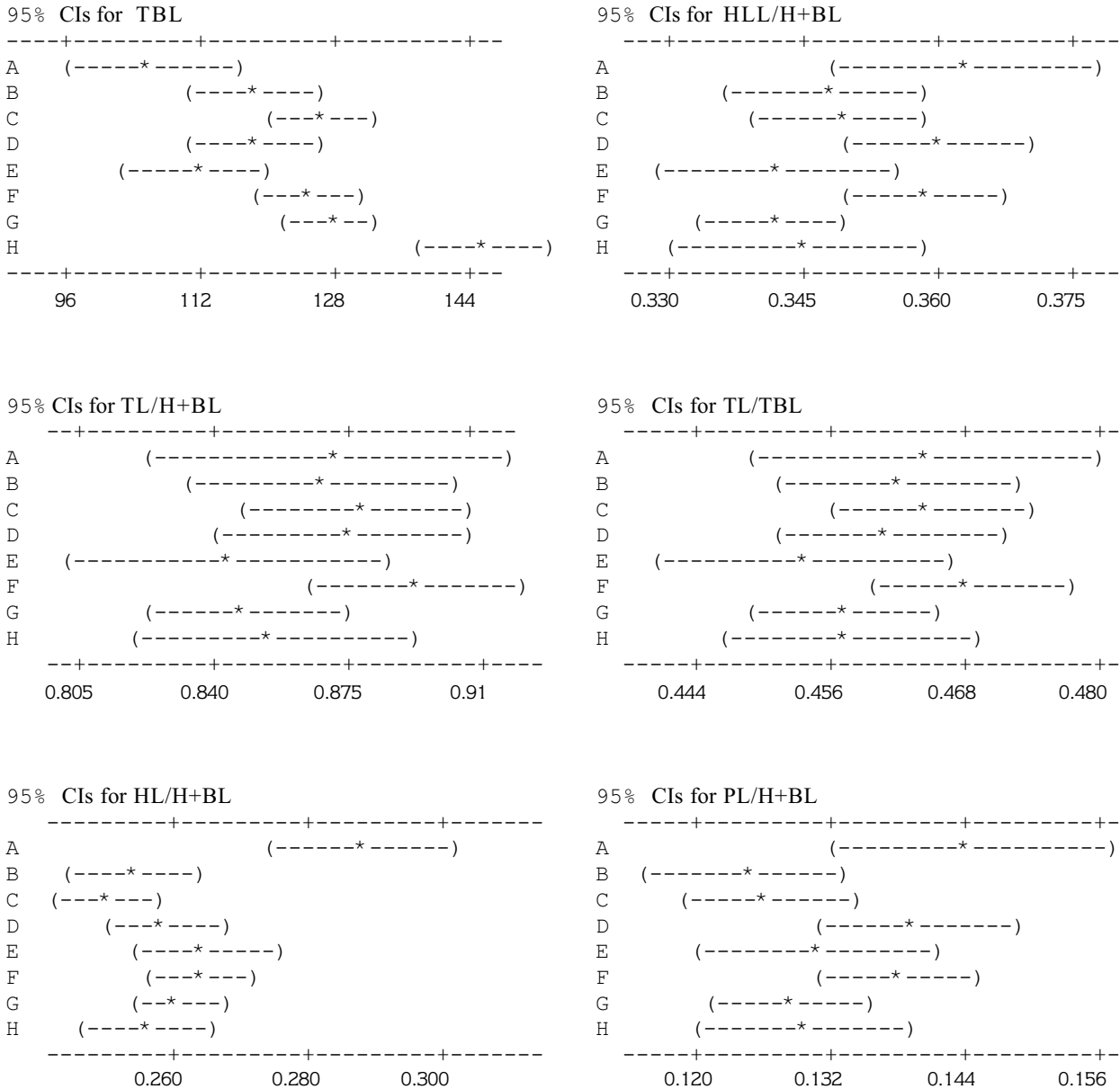


Figure 2. Individual 95% confidence intervals (CIs) for mean based on pooled standard deviation of the 8 subspecies of *M. Luschni*. A-H refer to each subspecies used in the Table and in the material list. See the text for other abbreviations.

parotid glands are light yellow with small black dots. The lateral parts of the body are whitish-grey. Both extremities and tail are light yellow with dark brown spots. There are also dark spots on the dorsal of the tail.

***M. l. basoglui*:** The dorsal part of the body is light yellowish-pink, covered with randomly distributed brown spots of different sizes and brightnesses. The parotids are

lighter than the dorsal part of the body. The lateral parts of the body are greyish-white. Both the extremities and tail are reddish with very small black spots.

***M. l. finikensis*:** The dorsal body is blackish dark brown, covered with irregularly distributed small greyish-white spots. The same type of colour and pattern continues on the dorsal part of the tail. Both the dorsal

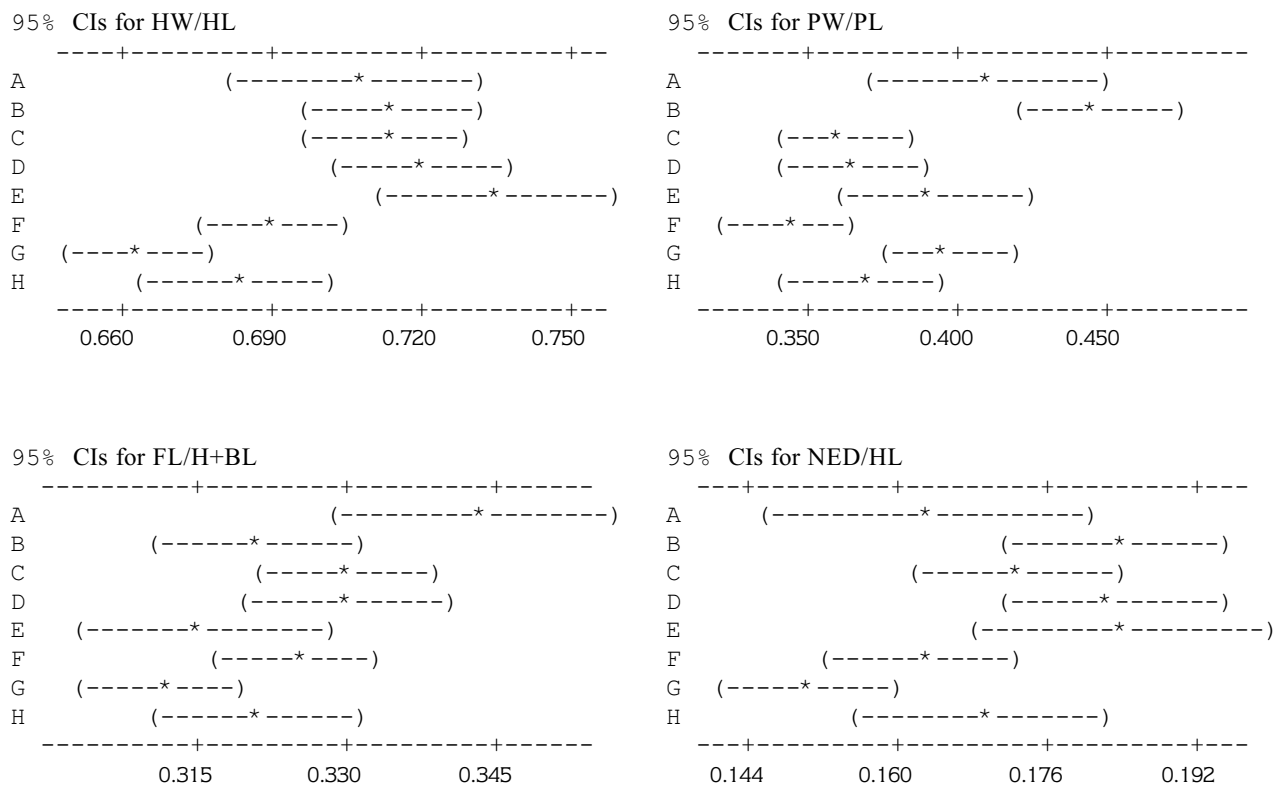


Figure 2. (Continue)

parts of the extremities and the lateral part of the tail are a meat-like red, covered with light brown spots.

***M. l. billae*:** The dorsal part of the body ranges from reddish-rust to dark brown, and is covered with brighter and whitish spots. The parotids can be differentiated from their surroundings by having a light yellow colour. The front parts of the eyes are black.

***M. l. antalyana*:** The dominant colour of the dorsal body and the median part of the dorsal head is red, covered with small blackish spots or speckle-like marks. The parotids and the upper sides of the eyes are always yellowish, and are covered with small black dots. The dorsal parts of the humerus and femur are yellow, while the rest of the extremities are similar in colour to the main body. There are also black spots on the tail.

***M. l. atifi*:** The dorsal part is uniformly dark brown. There are irregularly distributed small white spots. The lateral parts of the body are light grey, the extremities and the tail are slightly yellowish.

III- Comparison of Subspecies:

Some of the characters be statistically discriminative for the subspecies of *M. luschani* (Table and Figure 2). For example, the mean total body length of *M. l. atifi* is greater than those of the other 7 subspecies. The mean total body length of *M. l. flavimembris* is smaller than those of *M. l. luschani*, *M. l. billae*, *M. l. antalyana* and *M. l. atifi*. The mean total body lengths of *M. l. fazilae* and *M. l. basoglui* are less than that of *M. l. atifi*. The mean total body lengths of *M. l. luschani*, *M. l. billae* and *M. l. antalyana* are greater than that of *M. l. flavimembris*, but less than that of *M. l. atifi*. The mean total body lengths of *M. l. finikensis*, and *M. l. antalyana* are less than that of *M. l. atifi*. The mean total body length of *M. l. billae* is greater than that of *M. l. flavimembris* but less than those of *M. l. atifi*. The mean total body length of *M. l. antalyana* is greater than those of *M. l. flavimembris* and *M. l. finikensis*, but less than that of *M. l. atifi*.

The ratio of the head length to the head and body length was less discriminative than the mean body length.

This ratio in *M. l. flavimembris* is similar to that in *M. l. finikensis* but higher than those in the other subspecies.

The ratio of head width to head length was slightly different, the head being wider, in the subspecies *M. l. flavimembris* than in *M. l. antalyana*, but this ratio in *M. l. antalyana* is similar to those in *M. l. billae* and *M. l. atifi* but the head is narrower than in the others. The ratio of head width to head length of *M. l. finikensis* is greater than those of *M. l. billae*, *M. l. antalyana* and *M. l. atifi*.

The ratios of forelimb length to the head and body length were very close to each other; but those ratios in *M. l. flavimembris* and *M. l. luschani* are slightly higher than that in *M. l. antalyana*.

The ratio of parotid width to its length was also discriminative for most of the subspecies. This ratio in *M. l. flavimembris* is higher than that in *M. l. billae*. This ratio in *M. l. fazilae* is higher than those in *M. l. luschani*, *M. l. basoglu*, *M. l. billae* and *M. l. atifi*. The ratio of parotid width to its length in *M. l. billae* is smaller than those in *M. l. flavimembris*, *M. l. fazilae* and *M. l. antalyana*.

The ratio of eye-nostril distance to head length in *M. l. antalyana* is only slightly smaller than those in *M. l. fazilae*, *M. l. luschani*, *M. l. basoglu* and *M. l. finikensis*.

The ratios of tail length to head and body length, hind limb length to head and body length, length of parotid to the length of head and body, tail length to the length of total body were not statistically important in distinguishing subspecies of the Lycian salamander, *Mertensiella luschani* (Table and Figure 2).

Discussion and Conclusions

Nine subspecies of *Mertensiella luschani* were identified, 1 from Karpathos Island, Greece (*M. l. helverseni*) and 8 from the southern coast of Turkey (Steindachner, 1891; Pieper, 1963; Başoğlu, 1967; Başoğlu and Atatür, 1974, 1975; Başoğlu and Baran, 1976; Baran and Atatür, 1980; Franzen and Klewen, 1987; Klewen et al., 1988; Mutz and Steinfartz, 1995). These identifications are largely based on coloration and pattern. We used both characters as well as morphometric measurements with statistical analyses.

Because the mean body length and the parotid measurements are informative in comparison of these characters was performed with the published studies.

Baran and Atatür (1986) provided measurements and ratios of a population of *M. l. helverseni* (later named *M. l. flavimembris* by Mutz and Steinfartz (1995) without any statistical interpretation. In their work for example, they gave the ratio of the tail length to the head and body length as 0.75-0.88, the ratio of the head width to head length as 0.64-0.75 and the ratio of the parotid width to its length as 0.35 and 0.46. Our results for the tail length to the head and body length range between 0.83 and 0.92, with a mean of 0.87; the ratio of head width to head length is 0.67-0.73, with a mean of 0.71 and the ratio of parotid width to its length is 0.32 and 0.50 with a mean of 0.41. Baran and Üçüncü (1994) gave the mean total body length for the same subspecies as 100.00-150.00 mm with a mean of 121.67 mm. This measurement was 80.46-124.45mm with a mean of 102.03 mm, in our study.

The mean total body length of *M. l. fazilae* was given as 126.86 mm (range; 119.65 to 137.30) by Baran and Üçüncü (1994). Our measurements for this subspecies resulted in a mean of 114.01 mm with a range between 104.96 and 125.02 mm.

A higher total body length was reported for *M. l. luschani*. According to Baran and Üçüncü (1994) this was 121.67 mm (102.65-130.35) Baran and Üçüncü (1994) also reported the same measurements for *M. l. basoglu* with a mean of 125.38 mm (109.00-142.00). This was also higher (our mean value was 113.35 mm) than our measurements for the same subspecies (Table).

The mean total body length for *M. l. finikensis* was given as 117.75 mm with a range of 100.55 to 131.40 mm, by Baran and Üçüncü (1994). Similar results were reported by Yılmaz and Öz (1984). These results were also higher than our data for the same subspecies; 106.42 mm as a mean, with a range of 75.09 to 125.85 mm.

The mean total body length for *M. l. billae* was given as 119.40 mm (107.70-132.00 mm) by Baran and Üçüncü (1994). The head and body length for the same subspecies were reported as 11.25 mm for males and 11.15 mm for females by Franzen and Klewen (1987), both of which were similar to our results.

Başoğlu and Baran (1976), in a study of *M. l. antalyana*, gave some morphometric measurements without any mean values or ratios of the characters. Baran and Üçüncü (1994) reported the mean body length

for this subspecies as 119.50 mm (108.00-134.00 mm). Our results were slightly higher, with a mean of 122.99 mm (103.22-139.38 mm).

Baçoğlu (1967) gave the mean body length of *M. l. atifi* ranged as 134.00 and 176.00 mm for adults. Baran and Üçüncü (1994) reported a figure of 61.00 mm (134.00-181.00 mm) for adults. The results these studies were higher than our results which were 141.33 mm as the mean with a range of 105.42 to 164.70 mm.

The coloration and pattern for these subspecies were very similar to those in the previous reports (Baçoğlu and Atatür, 1974, 1975; Baçoğlu and Baran, 1976; Baran and Atatür, 1980; Franzen and Klewen, 1987; Klewen et al., 1988; Baran and Üçüncü, 1994; Baçoğlu et al. 1994; Baran and Atatür, 1998).

As can be seen from these studies, morphometric variation among the populations of reptiles and amphibia in Turkey has been quantified extensively using

morphological characters. Some of the measurements used were statistically different in our study, but different and similar observations were reported by others. Therefore, a comparison of morphometric measurements may yield a new subspecies for a researcher. Unfortunately, genetic diversity at the intraspecific level is not available for any species in Turkey. Sequencing DNA, and particularly mtDNA may help to solve the taxonomic problems present in the herpetofauna of Turkey, as has been done for other amphibian species (Garcia-Paris et al 1988).

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