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PRELIMINARY NOTE ON THE MORPHOMETRIC DIFFERENCES BETWEEN TWO POPULATIONS OF *Podarcis muralis muralis* (LAURENTI, 1768) AND *Podarcis muralis maculiventris* (WERNER 1891) IN SLOVENIA

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The aim of this preliminary study is to evaluate some differences between two populations of *Podarcis muralis muralis* and *Podarcis muralis maculiventris* living in Slovenia using some biometric and meristic characters. Forty-eight specimens from Žovnek (Central Slovenia, 46°16' N, 15°10' E) and 24 specimens from Lucija (Slovenian Istria, 45°30' N, 13°36' E) were included in a statistical analysis. The values of body dimensions of both sexes differ significantly between the two localities. Specimens from Lucija are bigger with a longer pileus. According to the results of this preliminary study on some characters of the external morphology, the classification of Slovenian populations of wall lizard into two subspecies seems justified.

Key words: Squamata: Lacertidae, *Podarcis muralis muralis*, *P. muralis maculiventris*, morphological differences, Slovenia

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Cilj ove preliminarne studije bila je procjena nekih razlika među dvjema populacijama *Podarcis muralis muralis* i *Podarcis muralis maculiventris* u Sloveniji koristeći neke biometričke i numeričke značajke. U statističku analizu je uključeno 48 primjeraka iz Žovneka (središnja Slovenija, 46°16' N, 15°10' E) i 24 primjerka iz Lucije (slovenski dio Istre, 45°30' N, 13°36' E). Vrijednosti dimenzija tijela oba spola u ta dva lokaliteta značajno se razlikuju. Primjerci iz Lucije su veći i s dužim pileusom. Prema rezultatima ove preliminarne studije o nekim značajkama vanjske morfologije čini se opravdanom, klasifikacija slovenskih populacija krške gušterice u dvije podvrste.

Key words: Squamata: Lacertidae, *Podarcis muralis muralis*, *P. muralis maculiventris*, morfološke razlike, Slovenija

INTRODUCTION

Podarcis muralis (Laurenti, 1768) has a wide distribution in Europe, and is concentrated in the south and south-east of the continent (GUILLAUME, 1997). According to GRUSCHWITZ & BÖHME (1986) and GUILLAUME (1997) eight subspecies live in Europe. However data about morphological differences between subspecies are rather scarce (GRUSCHWITZ & BÖHME, 1986).

P. muralis is present with the nominal subspecies *P. muralis muralis* and subspecies *P. muralis maculiventris* (Werner 1891) in Slovenia. *P. m. maculiventris* is distributed in Slovenian Istria (BRELIH & DŽUKIĆ, 1974; GRUSCHWITZ & BÖHME, 1986), whereas the nominal subspecies lives in the other parts of the country. The subspecies *P. muralis maculiventris* is a bigger form with a well-pronounced ventral pattern (a large number of ventral dots), and it has a higher number of dorsalia in comparison with *P. m. muralis* (GRUSCHWITZ & BÖHME, 1986).

The aim of this study is to evaluate some differences between the above-mentioned subspecies in Slovenia using biometric and scalation traits of the *P. m. muralis* population from Central Slovenia and of the *P. m. maculiventris* population from Slovenian Istra.

STUDY AREA

Two populations of *P. muralis* came under study. The *P. muralis muralis* population lives in the ruins of the Žovnek castle (46°16' N, 15° 10' E, 400 m a.s.l.) in the Lower Savinja Valley (Central Slovenia). For a detailed description of the study area see VOGRIN (1998). According to MARINČEK (1987) the area belongs to the pre-alpine phytogeographical region. The population of *P. muralis maculiventris* is located in Lucija on the Slovenian coast (45°30' N, 13°36' E, up to 2 m a.s.l.). This area belongs to the sub-Mediterranean phytogeographical region (MARINČEK, 1987).

METHODS

Specimens were caught by hand or by noosing in 1996. The sex of each specimen was determined according to ARNOLD & BURTON (1983) and GRUSCHWITZ & BÖHME (1986). After the measurements, all specimens were released at the site of the capture. The following biometric traits were measured: SVL – snout-vent length, TL – tail length, PL – pileus length and HW – head width. All measurements were made with callipers to the nearest millimetre (SVL, TL) or to the nearest 0.1 mm (PL, HW). Also, the collar scales (C) and ventral scales (V) were counted. The number of dorsalia was excluded from analysis, because the counting was not reliable in live (non-anaesthetised) specimens. True lengths were also transformed into the non-dimensional ratios: PL/SVL, HW/SVL and PL/HW.

Statistical analyses performed in the study were based on the relative similarity or dissimilarity of populations. Descriptive statistics comprised arithmetic mean, standard deviation, maximum and minimum. Analysis of covariance (ANCOVA) was used to compare single body dimensions among sexes taking into account

SVL as the covariate. All statistical tests were performed with the SPSS 6.0 statistical package and according to SOKAL & ROHLF (1995). A P-value < 0.05 was considered significant. Broken or regenerated tails were excluded from the statistical comparison.

RESULTS

Biometric and scalation traits were measured and counted on 72 adult specimens, 32 of which were females and 40 males. Forty-eight specimens belong to the population at Žovnek Castle and 24 to the population in Lucija.

Males and females from Žovnek differ significantly in pileus length (ANCOVA, $F = 32.85$, $P < 0.001$, $R^2 = 0.77$), head width (ANCOVA, $F = 20.48$, $P < 0.001$, $R^2 = 0.53$), and number of ventral scales (ANCOVA, $F = 57.17$, $P < 0.001$, $R^2 = 0.57$). However, there is no difference among the sexes in Lucija. The statistical analyses for tail length difference were not performed in the case of Lucija specimens because of the high incidence of regenerated tails.

Results of the statistical analyses using one-way ANOVA are summarised in Tab. 1 and Tab. 2. The values of body dimensions differ significantly between the two localities. Specimens from Lucija are bigger, with a longer pileus, and the males have narrower heads. The variability in the number of ventralia is greater in the specimens from Lucija.

DISCUSSION

Sexual dimorphism is usually well pronounced in wall lizards (e. g. GRUSCHWITZ & BÖHME, 1986). Sexual dimorphism in head dimensions is well pronounced in

Tab. 1. Descriptive statistic of biometric and scalation traits for males. For character abbreviations see »Materials and Methods«. (mean – arithmetic mean, std – standard deviation, min – minimum, max – maximum)

Character	Žovnek (n = 27)				Lucija (n = 13)				ANOVA	
	mean	std	min	max	mean	std	min	max	F	P
SVL (mm)	57.4	3.74	51.0	65.0	62.0	4.23	57.0	70.0	6.06	< 0.01
TL (mm)	108.1	7.34	90.0	116.0	119.1	8.59	104.0	131.0	36.82	< 0.001
PL (mm)	14.46	1.19	11.50	15.90	15.51	1.06	14.0	18.0	30.11	< 0.001
HW (mm)	8.52	0.69	6.60	9.60	8.37	0.83	7.0	9.70	9.17	< 0.01
C	9	0.68	8	10	8.5	0.67	7	9	1.78	> 0.05
V	25.1	0.92	23	27	24.5	1.81	22	29	30.24	< 0.01
PL/SVL	0.24	0.01	0.21	0.26	0.25	0.02	0.20	0.27	29.83	< 0.001
HW/SVL	0.15	0.01	0.11	0.17	0.13	0.01	0.11	0.15	18.80	< 0.001
PL/HW	1.66	0.07	1.53	1.78	1.86	0.18	1.56	2.30	14.52	< 0.001

Tab. 2. Descriptive statistic of biometric and scalation traits for females. For character abbreviations see »Materials and Methods«. (mean – arithmetic mean, std – standard deviation, min – minimum, max – maximum)

Character	Žovnek (n = 21)				Lucija (n = 11)				ANOVA	
	mean	std	min	max	mean	std	min	max	F	P
SVL (mm)	58.6	3.62	54.0	67.0	62.0	2.74	57.0	67.0	4.48	< 0.05
TL (mm)	85.7	12.70	62.0	100.0	–	–	–	–	–	–
PL (mm)	12.69	0.67	11.60	13.80	13.96	1.00	12.60	16.30	34.11	< 0.001
HW (mm)	7.67	0.64	6.60	9.10	8.18	0.99	6.80	9.90	3.47	< 0.05
C	8.8	0.94	7	11	8.9	0.60	8	10	0.66	> 0.05
V	27.3	1.06	26	29	27	1.94	25	30	13.98	< 0.001
PL/SVL	0.22	0.01	0.20	0.24	0.23	0.02	0.21	0.27	19.55	< 0.001
HW/SVL	0.13	0.01	0.12	0.14	0.13	0.02	0.11	0.16	0.32	> 0.05
PL/HW	1.63	0.08	1.52	1.77	1.72	0.18	1.42	1.97	8.19	< 0.01

the population of *P. m. muralis* from Žovnek. It is interesting that there is no difference in those characters among sexes in the population of *P. m. maculiventris* from Lucija; however, this could be explained by low sample size.

According to the results of the preliminary study of some morphological characters in the two populations of *P. m. muralis* and *P. m. maculiventris*, the classification of Slovenian populations of wall lizard into two subspecies seems justified. On the other hand, the differences in size are likely to have been caused ecologically (e.g. climatic factors), which can be considered as taxonomically unstable (e.g. DE LUCA 1989). Nevertheless, subspecies from southern Europe are bigger than those from Central Europe (see e.g. BEJAKOVIĆ *et al.*, 1996a; BEJAKOVIĆ *et al.*, 1996b). According to GRUSCHWITZ & BÖHME (1986) differences in the ecological demands of these two subspecies may exist. DE LUCA & GRBAC (1995) stated that *P. m. maculiventris* appears in climatically favourable habitats in the narrow coastal zone of the Istrian Peninsula, while *P. m. muralis* inhabits cooler habitats, mostly farther away from the coast. This is also the case in the present study areas.

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