



**MORPHOLOGICAL CHARACTERISTICS OF A POPULATION OF THE MOSOR ROCK LIZARD (*Dinarolacerta mosorensis* KOLOMBATOVIĆ, 1886) (SQUAMATA: LACERTIDAE) FROM LOVČEN MOUNTAIN (MONTENEGRO)**

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**Ključne riječi:**

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**Synopsis**

External morphological traits of the Mosor rock lizard, *Dinarolacerta mosorensis* (Kolombatović, 1886) from Lovćen mountain (Montenegro) were examined. The results of Descriptive statistics for 14 morphometric, 21 meristic and percentages of states for eight qualitative traits were presented. Results are discussed in comparison with the literature data for other populations.

**Sinopsis**

**MORFOLOŠKE KARAKTERISTIKE POPULACIJE MOSORSKOG GUŠTERA (*DINAROLACERTA MOSORENSIS* KOLOMBATOVIĆ, 1886) (SQUAMATA: LACERTIDAE) SA PLANINE LOVČEN, CRNA GORA**

U ovom radu analizirane su spoljašnje morfološke odlike populacije mosorskog guštera *Dinarolacerta mosorensis* (Kolombatović, 1886) sa planine Lovćen. Predstavljeni su rezultati deskriptivne statističke analize 14 morfometrijskih, 21 merističkog i procentualna zastupljenost stanja osam kvalitativnih karaktera. Rezultati su upoređeni sa postojećim literaturnim podacima za ostale populacije ove vrste.

## INTRODUCTION

The Mosor rock lizard *Dinarolacerta mosorensis* (Kolombatović, 1886), previously *Lacerta mosorensis* (see Arnold et al., 2007) represents both a relict and a steno-endemic species of the Balkan Peninsula (e.g. Crnobrnja – Isailović and Džukić, 1997). Its distribution is restricted to the south-western Dinaric mountain karst in Croatia, Bosnia & Herzegovina and Montenegro, exposed to the influence of the Mediterranean climate. There, it is patchily distributed, restricted to altitudes ranging between 450 and 1900 m (Džukić, 1989; Crnobrnja – Isailović and Džukić, 1997).

The Lovćen population of the Mosor rock lizard is located at the south-eastern boundary of the distribution range. Here it occupies altitudes from 1200 to 1350 m inhabiting the cliffs and blocks of rocks surrounded by subalpine beech forest (plant community *Fagetum montenegrinum subalpinum*) with whitebark pine (*Pinus heldreichii*) as the differential species (Tomić – Stančković, 1970; Ljubisavljević et al., in press).

Up until very recently *D. mosorensis* was one of the least studied representatives of the European herpetofauna (Džukić, 1989; Odierna and Arribas, 2005). However, the latest studies have revealed substantial morphological and genetic differences among populations of the Mosor rock lizard (Carranza et al., 2004; Ljubisavljević et al., 2007) and certain peculiarities in life-history traits (Ljubisavljević et al., in press).

Although specimens from the Lovćen population were included in some of these studies, complete descriptive data on morphological characters have not been published until now.



*Dinarolacerta mosorensis*-adult specimen

## MATERIAL AND METHODS

Analyses were carried out on the samples collected from localities Ivanova korita (42° 22' N, 18°50' E) and Međuvršje (42°24' N, 18°50' E) in the Lovćen mt. A total of 22 adult males, 23 females, 2 immature males and 5 immature females were examined. Specimens preserved in 70% ethanol were from Dr Georg Džukić's Herpetological Collection of the Institute for Biological Research, Belgrade (Međuvršje locality), and the Herpetological Collection of the Natural History Museum of Montenegro, Podgorica (Ivanova korita locality). Specimens were examined for the following characters:

*Morphometric characters:* Tot – total length, Lcor – snout-vent length, Lcap – head length, Ltcap – head width, Altcap – head height, Lfo – mouth length, Ltfo – mouth width, Lpa – forelimb length, Lpp – hindlimb length, Ldg – length of fourth toe on hindlimb, Lpil – pileus length, Ltpil – pileus width, Doa – orbit to ear distance, Pap – distance between fore and hind limbs.

*Meristic characters* included the numbers of: SOC – supraocular scales, CIL – supraciliary scales, GRA – supraciliary granules, POC – postocular scales, TMP – temporal scales, STM – supratemporal scales, PNS – postnasal scales, 1LO – first loreal scales, 2LO – second loreal scales, PROC – praeocular scales, SLB – supralabial scales anterior to subocular, SUB – sublabial scales, SMX – submaxilar scales, GUL – gular scales along the throat midline, COL – large collar scales, VENT – inner ventral scales counted longitudinally, DOR – dorsal scales around mid-body, PAN – praeanal scales surrounding anteriorly the anal plate, FPO – femoral pores, FEM – femoral scales, SDG – lamellar scales under the fourth toe.

*Qualitative characters:* (I) masseteric plate: a—single, b—divided, c—indistinct. (II) row of supraciliary granules: a—complete; b—incomplete (included cases when only one granula was separated from the rest). (III) additional scale between the first postocular 1POC and the last supraocular 4SOC scale: a—present, b—absent. (IV) multiplication of supralabials anterior to subocular scale: a—by insertion of additional small scales, b—by vertical splitting of scales, c—state of four supralabials. (V) type of dorsal pattern: a—diffuse, scattered spots, b—diffuse, interconnected spots in more or less reticulate pattern, c—banded pattern, spots arranged in a single vertebral and/or two narrow juxtaposed paravertebral bands, d—banded pattern, broad vertebral band consisting of scattered spots, e—absent. (VI) spots of the dorsal pattern: a—large, b—medium, c—small, d—absent. (VII) areas of background color free of dark pattern: a—broad, b—narrow, c—absent. (VIII) lateral bands: a—distinct, b—indistinct. The band names of dorsal pattern were according to Arnold and Burton (1978).

Symmetrical characters were taken from both sides of the body. Data processing concerned the mean of the right and left values for quantitative traits, while for qualitative traits a combination of both sides was used.

The body and head dimensions were taken with digital callipers to the nearest 0.01 mm. Scale counts were taken under a stereoscopic microscope. For morphometric and qualitative characters, statistical analyses included only mature

individuals, while for analysis of the scalation, adults and immature individuals were pooled.

Descriptive statistics (mean, standard error, range) for quantitative traits, and percentages of states for each qualitative trait were calculated. Statistical analyses were carried out using the computer package Statistica (STATISTICA for Windows. StatSoft, Inc., Tulsa, OK, USA).

## RESULTS AND DISCUSSION

### *Quantitative traits*

Descriptive statistics of morphometric and meristic characters of adult males and females are presented in Tables 1 and 2. Maximum total length recorded was 205 mm and 197 mm for males and females, respectively. These values are smaller than those previously reported for the species as a whole (up to 220 mm, Bischoff, 1984), and Herzegovinian population (222 mm, Veith, 1991). However, it should be noted that due to the great number of regenerating individuals, we could analyse total length on a small sample. Our measures showed that snout-vent length (Lcor) values for females were between 56.3 – 70.7 mm ( $\bar{x} = 63.8 \text{ mm} \pm 0.8$ ), and for males were between 59.5 – 71.1 mm ( $\bar{x} = 65.5 \text{ mm} \pm 0.7$ ). While female data were mainly in accordance with literature data (57 - 64.4 - 68 mm, Bischoff, 1984), males showed greater mean Lcor than previously reported (51 – 62.3 - 68 mm Bischoff, 1984). No concrete literature data are available regarding the other morphometric characters here analysed.

Character	males					females				
	N	Mean	Min	Max	SE	N	Mean	Min	Max	SE
Tot	5	192.00	179.00	205.00	4.54	6	176.17	160.00	197.00	5.63
Lcor	22	65.53	59.53	71.08	0.67	23	63.76	56.34	70.72	0.82
Lcap	22	16.85	15.67	17.62	0.14	23	14.41	13.46	15.71	0.12
Ltcap	22	10.37	9.03	11.68	0.15	23	8.79	7.80	9.74	0.10
Altcap	22	6.75	5.54	8.33	0.16	23	5.49	5.02	6.06	0.07
Lfo	22	12.77	11.62	13.59	0.12	23	11.07	10.35	12.05	0.10
Ltfo	22	9.82	8.67	10.90	0.15	23	8.30	7.30	9.33	0.09
Lpa	22	22.79	20.94	24.58	0.19	23	20.23	18.72	22.10	0.18
Lpp	22	36.06	32.70	40.57	0.39	23	31.39	29.73	34.37	0.25
Ldg	22	11.39	10.63	12.80	0.11	23	10.15	9.15	11.08	0.10
Lpil	22	15.66	14.37	16.43	0.14	23	13.41	12.60	14.58	0.11
Ltpil	22	6.85	6.30	7.30	0.06	23	6.01	5.50	6.60	0.06
Doa	22	5.12	4.60	5.65	0.07	23	3.96	3.50	4.60	0.05
Pap	22	29.01	25.85	31.96	0.36	23	32.16	25.82	38.24	0.63

**Table 1. Descriptive statistics of 14 morphometric characters of adult male and female *Dinarolacerta mosorensis* of the Lovćen population studied. Sample size (N), mean value (in mm), range, standard error (SE). Abbreviations of characters are given in "Material and Methods".**

Concerning meristic characters, the mean number of four supraocular scales and variation range of supraciliary scales were in agreement with literature data (CIL: 5 – 8, Bischoff, 1984), while the number of supraciliary granules varied (especially in females) in a broader range than it was previously described for this species (GRA: 8 – 12, Bischoff, 1984). The most frequently detected number of two postnasals (PNS) in our sample was in agreement with previous studies (M é h e l y, 1903; Radovanović, 1951; Bischoff, 1984; Arnold and O v e n d e n, 2002; A r n o l d et al., 2007). The number of loreal (1LO, 2LO) and praeocular scales (PROC) varied from 1 – 2, although individuals with single-scale state were the most frequent in our sample. Previous literature data (B i s c h o f f, 1984) also showed single state of these scales as characteristic for this species. The usual number of four or five supralabial scales (SLB) in front of the subocular (with possibility of an asymmetric condition), as well as usual number of six sublabial (SUB) and submaxilar scales (SMX) reported for *D. mosorensis* by other authors (e.g. R a d o v a n o v i ć, 1951; B i s c h o f f, 1984; A r n o l d et al., 2007) were in agreement with our results. However, the number of gular (GUL), dorsal (DOR) and subdigital scales (SDG) varied in broader range than previously recorded (GUL: 23 - 30; DOR: 36 - 40 - 45; SDG: 22 – 23,4 - 25 in B i s c h o f f, 1984). The mean values and/or variation range for other analysed meristic characters were mainly in agreement with those previously reported for this species (e.g. R a d o v a n o v i ć, 1951; B i s c h o f f, 1984).

Character	males					females				
	N	Mean	Min	Max	SE	N	Mean	Min	Max	SE
SOC	24	4.02	4.00	4.50	0.02	28	4.00	4.00	4.00	0.00
CIL	24	5.94	4.50	7.00	0.15	28	6.09	5.50	8.00	0.12
GRA	24	9.17	7.00	11.50	0.25	28	8.65	5.00	12.00	0.29
POC	24	3.81	2.50	4.00	0.08	28	3.52	3.00	4.50	0.10
TMP	24	42.23	24.50	73.00	2.07	28	39.09	25.00	54.00	1.69
STM	24	2.52	1.50	3.50	0.11	28	2.35	2.00	3.00	0.07
PNS	24	1.88	1.00	2.00	0.06	28	1.96	1.50	2.00	0.03
1LO	24	1.00	1.00	1.00	0.00	28	1.02	1.00	1.50	0.02
2LO	24	1.00	1.00	1.00	0.00	28	1.07	1.00	2.00	0.05
PROC	24	1.13	1.00	2.00	0.06	28	1.07	1.00	2.00	0.04
SLB	24	4.69	4.00	5.50	0.12	28	4.57	3.50	5.00	0.08
SUB	24	6.02	4.50	7.00	0.11	28	6.04	5.00	7.00	0.10
SMX	24	5.96	5.50	6.00	0.03	28	5.78	5.00	6.00	0.08
GUL	24	25.88	20.00	32.00	0.52	28	24.48	19.00	28.00	0.40
COL	24	8.83	6.00	10.00	0.21	28	8.67	7.00	11.00	0.22
VENT	24	25.25	23.50	27.50	0.23	28	26.72	25.00	29.00	0.21
DOR	24	39.06	33.00	44.00	0.66	28	38.46	30.50	43.00	0.59
PAN	24	7.71	6.00	9.00	0.13	28	7.30	6.90	9.00	0.18
FPO	24	18.35	16.50	21.00	0.23	28	17.19	12.00	20.50	0.32
FEM	24	4.00	3.00	5.00	0.11	28	3.67	3.00	4.50	0.10
SDG	24	22.29	20.00	24.50	0.24	28	21.96	20.00	25.50	0.26

**Table 2. Descriptive statistics of 21 meristic characters of adult male and female *Dinarolacerta mosorensis* of the Lovćen population studied. Sample size (N), mean value (in mm), range, standard error (SE). Abbreviations of characters are given in “Material and Methods”.**

	males (N = 22)	females (N = 23)		males (N = 22)	females (N = 23)
character	%	%	character	%	%
laa	68	65	Vla	73	83
lab	5	4	Vlb	9	13
lac	9	22	Vlc	9	4
lbb	0	0	Vld	9	0
lbc	0	0	VIIa	5	4
lcc	18	9	VIIb	0	9
IIaa	68	57	VIIc	95	87
IIab	14	13	VIIIa	5	35
IIbb	18	30	VIIIb	95	65
IIIaa	0	0			
IIIab	5	4			
IIIbb	95	96			
IVaa	0	0			
IVab	5	4			
IVac	5	9			
IVbb	41	35			
IVbc	23	26			
IVcc	27	26			
Va	23	46			
Vb	64	46			
Vc	5	13			
Vd	0	0			
Ve	9	0			

**Table 3. Percentages of states of qualitative traits (in %) in *Dinarolacerta mosorensis* of the Lovćen population. For symmetrical traits combination of states for both body sides were given. Abbreviations of characters are given in "Material and Methods".**

### Qualitative traits

Percentages of states for qualitative traits of adult males and females are presented in Table 3. In general, analysed individuals are characterised by the presence of single masseteric plate (Ia), complete row of supraciliary granules (IIa), absence of additional scale between the first postocular and the last supraocular scale (IIIb), and symmetrical multiplication of supralabials by vertical partition of scales (IVbb). Concerning the type of dorsal pattern, they are distinguished by predominance of diffuse type consisting of large size spots coupled with indistinct lateral bands (Va,b; VIa; VIIIb) and the absence of areas of background color free of dark pattern (VIIc). The diffuse pattern with interconnected spots in more or less reticulate pattern was predominant in males (Vb), while in females reticulate pattern (Vb) and scattered spots (Va) were present in the same percentage. A certain percentage of individuals of both sexes with symmetrical presence of an indistinct masseteric plate (Icc), and complete absence of dorsal pattern (males) (Ve, Vld) were also recorded from Lovćen population.

Concerning the qualitative traits, the prevalence of specimens with distinct masseteric plate, complete row of supraciliary granules and diffuse reticulate pattern found in this study were also considered characteristic for the Mosor rock lizard (Radovanović, 1951; Bischoff, 1984; Arnold et al., 2007). On the other hand, we rarely found unmarked (uniform) specimens, the feature frequently referred to *D. mosorensis* by other authors (Tomassini, 1889; Bischoff, 1984; Veith, 1991; Arnold and Ovendén, 2002).

## CONCLUSION

Most of the values or percentages of occurrences obtained from the present analysis of external morphology of the Mosor rock lizard are in accordance (or within the variation range) with previous studies of the species. However, the number of supraciliary granules, supralabial, gular, dorsal and subdigital scales varied in somewhat broader range than it was previously reported for a species as a whole.

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