

**DATA REGARDING THE PHENOTIPICAL VARIATION OF SOME POPULATIONS OF
LACERTA AGILIS LINNAEUS 1758 FROM ROMANIA**

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ABSTRACT

We studied 60 samples of *Lacerta agilis* from four localities of Romania (20 samples from Borca – Bacau County, 19 samples from Ocloș – Bacau County, 5 samples from Greci – Tulcea County and 16 samples from Bordei Verde – Galati County). We analyzed characteristics of the pholidosis and biometric characteristics. After that, we calculated the ratio of each investigated character and the variation quotient. Besides the existences of a special inter-population variability, we noticed the existence of large intra-population variability. Almost all the investigated characters in the analyzed populations of *Lacerta agilis* are heterogeneous or little heterogeneous.

Key words - *Lacerta agilis agilis*, *Lacerta agilis chersonensis*, pholidosis, phenotypical variation, Romania

Introduction

We meet this species throughout central Europe to central Russia. In our country, *Lacerta agilis agilis* occupy Western Europe, the Transilvanian plateau and both sides of the Carpathians. It lives in open spaces, good sunshine, and grass or shrub vegetation on the banks of mountain streams, often in the same biocenosis with mountain lizard (*Zootoca vivipara*). In plain and in the outside hills we meet the subsp. *Lacerta agilis chersonensis*. We often meet on the cultivated fields, on the waves of roads and highways, and the forest edge (FUHN & VANCEA 1961, FUHN 1969).

In Romania, some studies have been conducted on some pholidosis and biometric characters of some populations of *Lacerta agilis* (FUHN & VANCEA 1961, ION ET AL. 2006, TÖRÖK 2008).

Material and method

We studied 60 samples of *Lacerta agilis* from four localities of Romania (20 samples from Borca –

Bacau County, 19 samples from Ocloș – Bacau County, 5 samples from Greci – Tulcea County and 16 samples from Bordei Verde – Galati County), all parts of herpetology collection from “Ion Borcea” Natural Sciences Museum, Bacau.

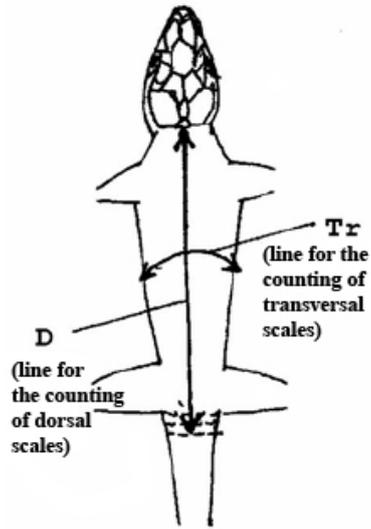
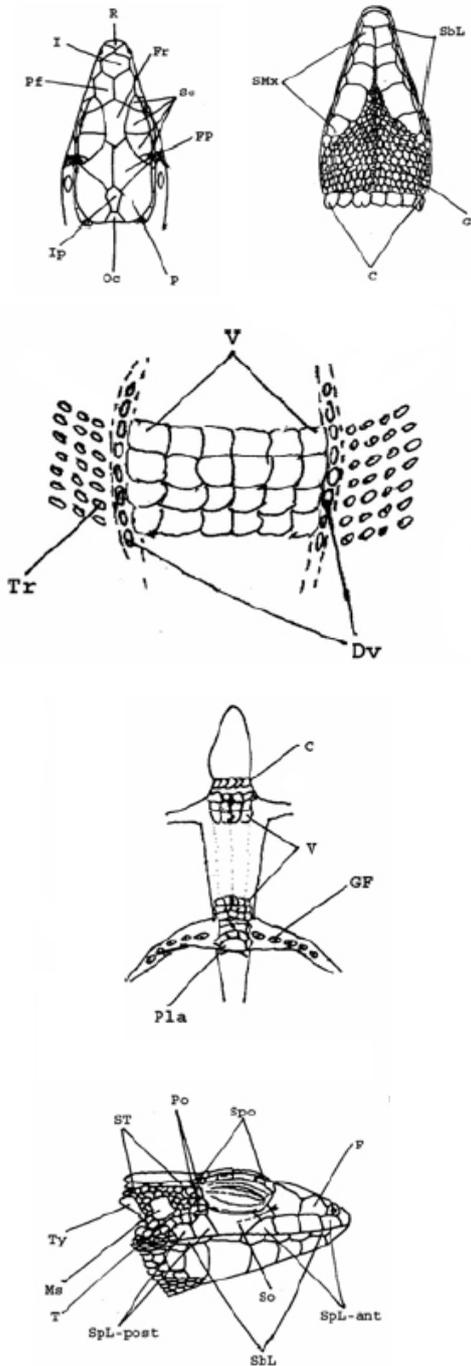
To study specimens of *Lacerta agilis*, we started with morphological indications of FUHN & VANCEA (1961), supplementing this data with our personal observations.

We followed the form and number of 24 scales categories (Fig. 1) and 13 biometric characters (Fig. 2). We modified the working key during our study, according to observations made on specimens examined. In case of the pholidosis we noted in short each scale (rostral = R, internasal = I, etc.). In case of scales that have bilateral arrangement, they've been studied separately in the right side and left side of the head. Given that asymmetric differences that might occur if these scales are small, irrelevant, in the end we used the arithmetic average of the number of scales on the right and left.

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**Figure no. 1 Pholidosis at *Lacertidae*
(according to FUHN & VANCEA 1961,
DÉLY 1978 b)**



Biometric measurements were made using a calliper with electronic display, watching the characters described in the literature (FUHN & VANCEA 1961):

LT - is the *total length* of the body including body length and tail length, measured from the tip of snout to tail tip;

Lb - body length is measured from the tip of the snout to the anal opening, and includes head length, trunk length and abdomen;

Lh - head length is measured between the tip of the snout and the distal end of occipital scales or distal end of colars scales;

Wh - head width is measured in temporal area;

Hh - head height is measured at the tympanum level;

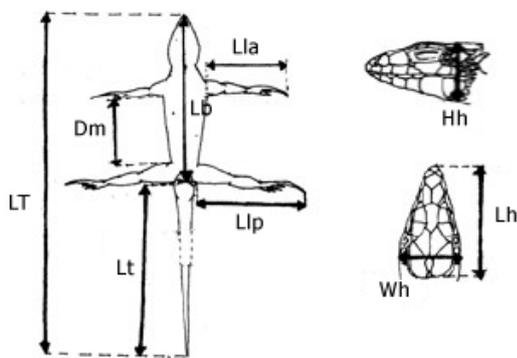
Lla - anterior leg length is measured from the anterior body joint to longest fingertip (4);

Llp - posterior leg length is measured from the posterior joint body to the longest fingertip (4);

Dm - the distance between members is measured between the joints of the front and rear legs;

Lt - tail length is calculated from total body length (**Lt**) and body length (**Lb**).

**Figure no. 2 Measurements at *Lacertidae*
(according to FUHN & VANCEA 1961,
DÉLY 1978 b)**



Results and Discussions

Pholidosis Study

R – *Rostral Scale* in most individuals of the four analyzed populations is separated from frontonasal, except three samples analyzed in population from Borca. Only in a few individuals of all four analyzed populations we found situations where rostral, internasal and supranasal (frontonasal) scales are joined at one point, and the edges of the scales are forming an X. In any cases, is not appearing a 3rd scale between rostral and frontonasal scales.

I – *Internasal Scale* (frontonasal) in most lizards studied of all populations, is separated from the frontal scale. In a number of two individuals in the population of Borca and two of Ocloş is joined with frontal scale and in an individual of Ocloş appears an 3rd scale linking frontonasal and frontal.

Pf – *Prefrontal scales (frontonasals)* are paired scales, which in most specimens may form a suture between them, can achieve a point or be completely separated (FUHN & VANCEA 1961). Prefrontal scales can be separated by the appearance of a rectangular or circular scale which is interposed between them or that frontal and internasal scales, which are normally distant one from another, come into contact.

F – *Frenals* in 70% of the population of Borca and Ocloş appear in number 2; this figure contradicts the determining key of *Lacerta agilis* according to FUHN & VANCEA 1961, who believe that the difference between the standard species *Lacerta agilis agilis* and *Lacerta agilis chersonensis* is the difference between the number of postnasal scales (2 and 1) and not of frenals. In the other two populations (Greci, Bordei Verde) most specimens, except three, showed only one frenal. There was also

a case in which these scales were missing in a sample of the Ocloş population.

Fr – *Frontal scale* appears elongated anterior-posterior and is unique in all cases. In one case, we observed the presence of a 3rd scale between frontonasal and frontal. We noticed only four samples in which observed contact between these two scales.

Ip – *Interparietal* is a small scale, with a large heterogeneity within each studied population. Thus may be rhomb, triangular, pointing back, rectangular, elongated and thin (needle form), round or oval, or sometimes difficult to define forms.

Oc – *Occipital scale* has the same shape heterogeneity as we noted in the case above. Has usually trapezoid shape. Occipital scales appears in the following forms: trapeze with wide or narrow base; the trapezoid with rounded or pointed base; rectangle with sides equal to the transverse or longitudinal side; elongated round or oval, being elongated transverse or longitudinal; transverse elongated, hexagonal form; as octagonal, elongated longitudinally. In most analyzed samples, occipital scale is in contact with interparietal scale. Exceptions are five samples, in which there is contact between these two scales, and in two studied specimens we observed a 3rd scale between occipital and interparietal.

T – *Temporal scales*, in most studied individuals are numerous, small, but sometimes can be larger sizes (FUHN & VANCEA 1961). Specimens may occur, in which the size of the temporal scales is not identical to the right and left side of the body.

Ms – *Masseteric scale* is present in most studied specimens, except the five who did not have this scale. Communicate with about 30% of cases with supratemporal scales. In most cases consists of one piece, rarely is composed of two pieces (1 specimen).

Spo – *Supraocularia*, occurs in studied animals by us in number of 4 (FUHN & VANCEA 1961), finding situations in which rarely occur in numbers of 2, 3 or 5.

Grs – *Supraciliary granules* are rarely present in studied specimens of *Lacerta agilis chersonensis*. Should that occur, may be in the number 1-4, 0-12 in some subspecies (FUHN & VANCEA 1961). In case of standard species *Lacerta agilis agilis* these granules always appeared at analyzed lizards in the number which may varies (1-7).

ST – *Supratemporal scales* are in the majority in number of two. Only in the three cases of the analyzed specimens we found 1 or 3 supratemporal scales.

Po – *Postocular scales* in most individuals are in the number of 3. More rarely appear individuals with two or four scales.

Sc – *Supraciliary scales* at most of the specimens studied are in number of five, but four supraciliary scales appear quite frequently. Situations rarely occur in which the number of these scales is 3, 6 or 7 (FUHN & VANCEA 1961).

SpL - *Supralabials*, in about 60% of animals studied are the number of 5. At approximately 30% of studied individuals appear in numbers of 6. We've rarely encountered situations with three or seven scales.

SpLa – *Anterior Supralabials* presents a numerical variation, but only in rare cases, their number being in the majority of four. In rare cases we encountered situations of individuals with three or five anterior supralabials (FUHN & VANCEA 1961).

SbL – *Sublabials*, in the vast majority of examined lizards are in number of six. We have rarely encountered situations with five, seven and even eight scales.

SMx – *Submaxillary Scales*, at most majority of samples appears in number of 5. Rarely appears individuals with four or six submaxillary scales.

C – *Collar Scales* compose a neck collar and according to our observations the number is between 8-13, in the most frequent cases 9 and 11. After FUHN & VANCEA 1961 the number of collar scales is 8-13 (average 10).

G – *Gular Scales* can vary from 14 to 24, in most cases being 16 to 21. According to the

specialty literature the number of gular scales is 14-20 (17) (FUHN & VANCEA 1961).

D - *Dorsal Scales*. We followed in the dorsal scales the number of transverse scales. After our observations they are present in numbers of 31-56 in most cases with values between 35 and 42. According the literature, number of these scales is between 33 and 44 (38) (FUHN & VANCEA 1961). Many scales we met in the Greci population, with the numbers between 50 and 56.

V - *Ventral Scales* in the four studied populations by us are in numbers between 25 and 33. Their average is about 29 in case of all studied populations. After literature data the number of line ventral scales is between 26 and 29 (27 in average) (FUHN & VANCEA 1961).

GF – *Femoral Glands (femoral pores)*. The number of openings of femoral glands at studied populations by us is between 9 and 20. Only in the population of *Lacerta agilis agilis* from the Greci we met 18 to 20 femoral glands. In most cases the number is between 11 and 15. After literature data the number of these glands is between 12/11-14/15 (FUHN & VANCEA 1961).

Study of the biometric parameters

Differences arising among biometric relations between the two studied populations are not significant, except only standard population of *Lacerta agilis agilis* from the Greci.

Table no. 1 Data and reports obtained from biometric study

Borca													
	Lt	Lc	Lcp	Ltcp	Îcp	Pa	Pp	Dm	Cd	Cd/Lc	Pp/Lc	Pa/Dm	Pp/Dm
Minimum	134,3	60,05	14,11	9,37	7,62	20	28,79	29,63	69,3	0,9631	0,3920	0,4613	0,6810
Average	177,06	72,6771	16,1128	11,5135	10,0728	22,3507	32,1471	38,8814	104,3829	1,4347	0,4432	0,5835	0,8359
Maximum	205,07	81,88	19,88	18,82	17,82	28,44	40,64	45,71	123,89	1,6963	0,5006	0,7502	1,0182
Ocloş													
	Lt	Lc	Lcp	Ltcp	Îcp	Pa	Pp	Dm	Cd	Cd/Lc	Pp/Lc	Pa/Dm	Pp/Dm
Minimum	143,02	53,06	12,24	8,53	7,46	17,61	25,9	25,11	77,73	1,0032	0,3713	0,4846	0,6638
Average	174,33	69,9910	16,6710	11,7305	10,8352	21,1689	30,7594	36,1384	104,3389	1,5008	0,4412	0,5947	0,8629
Maximum	214,15	80,36	20,03	15,54	14,29	23,92	35,3	47,42	134,92	1,8878	0,5248	0,7805	1,1091
Bordei Verde													
	Lt	Lc	Lcp	Ltcp	Îcp	Pa	Pp	Dm	Cd	Cd/Lc	Pp/Lc	Pa/Dm	Pp/Dm
Minimum	160,86	66,46	14,48	9,1	7,98	19,13	28,67	32,96	87,48	1,0725	0,4034	0,4613	0,7130
Average	188,69	76,561	16,834	11,351	9,925	22,751	34,505	39,876	112,13	1,4709	0,4516	0,5767	0,8734
Maximum	220,68	86,71	19,24	13,99	12,21	24,79	37,53	48,18	138,55	1,8397	0,5048	0,7046	1,0318
Greci													
	Lt	Lc	Lcp	Ltcp	Îcp	Pa	Pp	Dm	Cd	Cd/Lc	Pp/Lc	Pa/Dm	Pp/Dm
Minimum	219,91	65,1	16,97	10,2	8,43	26,71	44,98	29,97	149,3	2,0477	0,6454	0,6815	1,1592
Average	239,17	72,8	18,714	11,286	9,366	29,07	50,942	37,862	166,37	2,2838	0,6989	0,7735	1,3534
Maximum	278,38	77,97	21,91	12,85	11,71	33,97	59,44	42,02	200,41	2,5703	0,7623	0,8912	1,5008

Conclusions

The purpose of our study was not only to bring new data on phenotypic variation of sandlizard from Romania, but also to compare differences between the four analyzed populations, based on the idea that standard population of *Lacerta agilis agilis* from Greci (Tulcea County) is isolated of the Danube from Galati and Bacau populations.

We found that intra- and inter- population variability is high. In order to establish intra-population variability we calculated the coefficient of variation, indicating the degree of homogeneity of populations.

Table no. 2 The Arithmetic Average (A), Standard Deviation (S) and Coefficient of Variation (CV) for pholidosis

	ST - average		
	A	S	CV
Borca	2,05	0,2179	10,629
Ocloș	2	0	0
Greci	2	0	0
Bordei Verde	2	0	0

	PO - average		
	A	S	CV
Borca	2,25	0,5361	23,826
Ocloș	2,63	0,5813	22,102
Greci	3	0	0
Bordei Verde	2,375	0,4841	20,383

	Sc - average		
	A	S	CV
Borca	4,35	0,7262	16,694
Ocloș	4,9	0,6244	12,742
Greci	5,6	0,7999	14,283
Bordei Verde	5,0625	0,5555	10,972

	SbL - average		
	A	S	CV
Borca	6,0526	0,6046	9,989
Ocloș	5,8888	0,3142	5,3355
Greci	6,4	0,7999	12,489
Bordei Verde	6	0,3535	5,8916

	SpLa - average		
	A	S	CV
Borca	4,05	0,2179	5,380
Ocloș	3,9	0,3	7,692
Greci	4	0	0
Bordei Verde	4,125	0,3307	8,016

	SMx - average		
	A	S	CV
Borca	5	0	0
Ocloș	5	0	0
Greci	5	0	0
Bordei Verde	5,06	0,2420	4,782

	GF - average		
	A	S	CV
Borca	11,85	1,3883	11,715
Ocloș	12,70	1,4525	11,437
Greci	16,40	2,5768	15,712
Bordei Verde	14,62	1,0532	7,203

Values of the coefficients of variation for most characters show that the two populations are heterogeneous, possibly less homogeneous. The only character of pholidosis after all studied populations are homogeneous is the sumaxillary scales. But sumaxillary scales is characteristic at both species and genus level, so that uniformity is not surprising.

Considering that most of the characters of analyzed populations are less heterogeneous highlights the special variability of this species. Probably during the glacial relict inhabiting this territory of our country was only enough to show some intra-population homogeneity.

High coefficient of variation recorded for the species *Lacerta agilis* characters seems to highlight how the sandlizard after postglacial colonized Romania in several directions, respectively meeting in Romania of immigrants from at least two glacial refuges, east and west Carpathians.

Regarding subspecies of *Lacerta agilis* in Romania, key determination of FUHN & VANCEA 1961, shows that *Lacerta agilis chersonensis* usually have a postnasal and a frenal scales, while *Lacerta agilis agilis* has two postnasal and a frenal scales, arranged in a triangle. Thus, the two populations of Bacau (Borca and Ocloș) had mostly subspecies *L. a. chersonensis* characters. The population of Bordei Verde (Galati County) has characters both of standard population and of subspecies *chersonensis*, perhaps because it is closer to the territory it occupies standard species (Dobrogea). This population is separated from the Greci standard population (Tulcea County) of the Danube.

Rezumat

Am studiat 60 de probe de *Lacerta agilis* din patru localități din România (20 probe de la Borca - județul Bacău, 19 probe de la Ocloș - județul Bacău, 5 probe de la Greci - județul Tulcea și 16 probe de la Bordei Verde - județul Galați). Am analizat caracteristici legate de folidoză și caracteristici biometrice. După aceea, am calculat raportul dintre fiecare caracter investigat și coeficientul de variație.

Pe lângă existența unei variabilități interpopulaționale, am observat existența unei mari intra-variabilități în cadrul populațiilor. Aproape toate caracterele investigate la populațiile analizate de *Lacerta agilis* sunt eterogene sau puțin eterogene.

References

- ARDELEAN G., BÉRES I., 2000. *Fauna de Vertebrate a Maramureşului*. Ed. Dacia, Cluj-Napoca, Col. Universitară;
- COVACIU – MARCOV S. D., GHIRA I., SAS I., 2002 a. *Contribuţii la studiul Herpetofaunei zonei Oaşului (Judeţul SM, România)*. Mediul cercetare, protecţie şi gestiune 2, Cluj –Napoca, 107 – 112;
- COVACIU – MARCOV S. D., TELCEAN I., CUPŞA D., CADLEŢ D., ZSURKA R., 2002 b. *Contribuţii la studiul herpetofaunei din regiunea Marghiita (jud. Bihor, România)*. Analele Universităţii din Oradea, Fasc Biologie, Tom IX;
- COVACIU – MARCOV S. – D., SAS I., CICORT A. 2003. *Note asupra herpetofaunei zonei de nord a judeţului Botoşani (România)*. Studii şi Cercetări, Biologie, 8, Bacău, 201-205;
- DÉLY O. GY., 1978 a. *Angaben zur morphologischen Variation der Eidechsenarten Ungarns I. Bergeidechse (Lacerta vivipara Jacquin)*. Vertebrata Hungarica, XVIII, 7 – 53;
- DÉLY O. GY., 1978 b. *Hüllök – Reptilia*, Fauna Hungariae, 130, 20 (4), Akadémiai Kiadó, Budapest;
- FUHN I. 1969. *Broaşte, şerpi, şopârle*. Ed. Ştiinţifică, Bucureşti;
- FUHN I., VANCEA ŞT., 1961. “*Fauna R.P.R.*”, vol. XIV, Fascicola II, *Reptilia*. Editura Academiei R.P.R., Bucureşti;
- GHIRA I., VENCZEL M., COVACIU–MARCOV S.–D., MARA GY., GHILE P., HARTEL T., TÖRÖK ZS., FARKAS L., RÁCZ T., FARKAS Z., BRAD T., 2002. *Mapping of Transylvanian Herpetofauna*. Nymphaea, Folia Naturae Bihariae, Oradea, XXIX, 145 – 203;
- ION I., ZAMFIRESCU ŞT., ZAMFIRESCU OANA, GĂUCAN DIANA, 2006. *Observations on reptile populations from the zone Probota-Perieni (Iaşi County)*. Analele Ştiinţifice ale Univ. “Al. I. Cuza”, Iaşi, s. Biologie animală, Tom LII:197-204;
- KALIONTZOPOULOU A., CARRETERO M.A., LLORENTE G.A., 2005. *Differences in the pholidotic patterns of Podarcis bocagei and P. carbonelli and their implications for species determination*. Rev. Esp. Herp. 19: 71-86;
- LJUBISAVLJEVIC KATARINA, JOVIC D., DYUKIC G., 2010. *Morphological variation of the lizard (Zootoca vivipara Jacquin 1787) in the Central Balkans*. Arch. Biol. Sci. Belgrade, 62 (3): 789-797;
- MIAUD C. & G. GUYETANT (eds): *Current Studies in Herpetology*, Le Bourget du Lac (SHE);
- GUILLAUME C. – P., HUELIN B., BESHKOV V., 1997. *Biogeography of Lacerta (Zootoca) vivipara: reproductive mode and enzyme phenotypes in Bulgaria*. Ecography, 20, Copenhagen, 240 – 246;
- SAS I., COVACIU-MARCOV S. D., CICORT-LUCACIU A., KOVACS EVA H., PETER VIOLETA, 2004. *Studiul variaţiilor fenotipice a unor populaţii de Zootoca vivipara Jacquin 1787 din Munţii Apuseni*. Muzeul Olteniei Craiova, Studii şi Comunicări, Ştiinţele Naturii, vol. XX: 273-279;
- STUGREN B., 1957. *Noi contribuţii la problema originii faunei herpetologice din R. P. R. în lumina glaciaţiunilor*. Bul. Şt. Secţia de Biologie şi Ştiinţe Agricole, Seria Zool. 9, 1, 35 – 47;
- STUGREN B., 1968. *Systematics of Lizards of the Section Zootoca Wagler. Travaux du Museum D’Histoire Naturelle “Grigore Antipa”*. Vol VIII, Pars II, 1037 – 1044;
- STUGREN B., VANCEA ŞT., 1961. *Über die Variabilität der Bergeidechse (Lacerta vivipara – Jacquin) in Romanien*;
- SURGET–GROBA Y., HUELIN B., GHIELMI S., GUILLAUME C.-P., VOGRIN N., 2002. *Phylogeography and conservation of the populations of Zootoca vivipara carniolica*. Biological Conservation, 106, 365 – 372;
- TERHIVUO J., 1993. *Provisional atlas and status of populations for the herpetofauna of Finland in 1980-92*. Ann. Zool. Fennici. 30, Helsinki, 55 – 69;
- TÖRÖK Z., 2008. *Taxonomia şi ecologia populaţiilor de şopârle (Reptilia: Lacertidae) din Dobrogea de Nord*. Univ. Bucureşti, teză de doctorat.