HERPETOLOGIA PETROPOLITANA

Proceedings of the 12th Ordinary General Meeting of the Societas Europaea Herpetologica

12 – 16 August 2003
Saint-Petersburg, Russia

Edited by
Natalia Ananjeva and Olga Tsinenko

Saint-Petersburg, 2005

TAXONOMICAL ANALYSIS OF MORPHOLOGICAL VARIETY OF THE SAND LIZARD (*Lacerta agilis*) IN UKRAINE

O. A. Tytov,[1] V. N. Peskov,[1,2] and A. U. Brovko[1]

Keywords: pholidosis, morphology, variety, *Lacerta agilis*, Ukraine.

INTRODUCTION

The four subspecies *L. agilis agilis*, *L. a. chersonensis*, *L. a. euxinica*, and *L. a. exigua* of the sand lizard occur in the Ukraine (Darevsky et al., 1976; Scherbak and Scherban, 1980; Kotenko and Taraschuk, 1982, Kalyabina-Hauf and Ananjeva, 2004). The age and sex composition of populations and questions in connection with taxonomic varieties of the sand lizard in Ukraine are still not clearly understood.

MATERIAL AND METHODS

232 lizards of pure subspecies populations were analyzed to resolve these questions. We have studied 57 lizards of *L. a. agilis* from Zakarpatskaya Oblast', 49 lizards of *L. a. chersonensis* from Zhytomir Oblast', 58 lizards of *L. a. euxinica* from Odessa Oblast', 68 lizards of *L. a. exigua* from Donetsk Oblast'. From each lizard 17 pholidoses, 3 pattern and 18 morphometry features were recorded. We used one- and multimeasured methods for statistical analysis of these data.

The differences were analyzed as integral indices by the Zarapkin Distances and Squared Mahalanobis Distances (The Mahalanobis distance is similar to the standard Euclidean distance measure, except that it takes into account the correlation between variables). The distance matrixes were analyzed by klaster, factor and discriminant analyses.

RESULTS AND DISCUSSION

Young males and females of the sand lizard clearly differ from matures by body proportions. Nevertheless, with age body proportions of lizards from subadultus to senex change gradually. This property is more typical for *L. a. chersonensis* and *euxinica* subspecies in comparison with *L. a. agilis* and *L. a. exigua*. Among these age groups there are few lizards with intermediate properties of the same linear dimensions and body proportions. Young lizards have relatively bigger head and eyes and more longer and wider muzzle in comparison with matures. In body proportions they almost have no reliable differences. The reliability to distinguish age groups could be confirmed by the discriminant analysis. It is known that the sex differences increase with the age. For example the Squared Mahalanobis Distances of *L. a. agilis* young males and females is 28.05, while the old males and females of this subspecies have much more Squared Mahalanobis Distances — 40.14. Taxonomical differences were registered in character and degree of sex dimorphism by all features and by some of them as well. For example the differences between the old males and females of *L. a. exigua* are two times as little as the same differences of *L. a. agilis* lizards.

According to the results of discriminant analysis of *L. agilis* males and females by pholidoses and pattern features the maximal differences were registered between *L. a. agilis* and *L. a. exigua* subspecies, and minimal between *L. a. chersonensis* and *L. a. euxinica* subspecies (Table 1).

The most similar by phenotype *L. a. chersonensis* and *L. a. euxinica* subspecies have reliable difference in ratio combinations of postnasalia and frenale scutums ($P < 0.001$) and bilateral combinations of postnasalia ($P < 0.001$) and frenale ($P < 0.01$) scutums. With reliable level 95% ($P < 0.05$) these subspecies have reliable difference by number of subciliaria scutums and scutums which adjoin the 4th submaxilaria scutum, by ratio of central white strip and lateral lines morphs. *L. a. agilis* and *L. a. exigua* have reliable difference by 16 (it is 80%) pholidoses features. For other comparison pairs 13 – 16 features registered the reliable difference.

The morphometry features have had the same result for males and females of all four subspecies. The maximal differences in body proportions were registered between *L. a. agilis* and *L. a. chersonensis*, *L. a. agilis* and *L. a. exigua* (Table 2).

[1] Biological Department, International Solomon University, Sholudenko str. 1-b, 01135 Kiev, Ukraine;
E-mail: oleks@walla.co.il, vladimir peskov@ukr.net, brovko@i.com.ua
[2] Zoological Institute, NASU, B. Khmelnitsky str. 15, 01601 Kiev, Ukraine.

TABLE 1. Squared Mahalanobis Distances in Compare of Four Sand Lizard Subspecies by the 17 Pholidoses and 3 Pattern Features

Females	Males			
	agilis	*chersonensis*	*euxinica*	*exigua*
agilis	—	19.03	24.07	31.15
chersonensis	23.04	—	8.94	22.45
euxinica	19.63	10.77	—	16.96
exigua	31.81	16.53	16.25	—

TABLE 2. Squared Mahalanobis Distances in Compare of Four Sand Lizard Subspecies by the 18 Morphometry Features

Females	Males			
	agilis	*chersonensis*	*euxinica*	*exigua*
agilis	—	33.00	15.41	31.75
chersonensis	29.79	—	12.75	28.49
euxinica	23.36	8.22	—	17.89
exigua	24.19	29.73	26.93	—

The minimal differences were registered for *L. a. chersonensis* and *L. a. euxinica*. *L. a. chersonensis* occupies a middle part of all subspecies distribution and by body proportions this subspecies is intermediate form among other three subspecies. By the all of body proportions *L. a. euxinica* (which is synonymized with *L. a. chersonensis* in 1984 (Bischoff, 1984)), is a reduced copy of *L. a. chersonensis*, that can be explained by means of ecological peculiarity (living on the sand) of subspecies (Kotenko and Taraschuk, 1982). Although *L. a. euxinica* has shorter, lower and narrower head, it almost hasn't differences from *L. a. chersonensis* by such head features as width of brain part, eye and ear-drum diameter, that has shown on some of mutual pattern adaptations to arid conditions.

Each subspecies can be characterized by the following features: *L. a. euxinica* has the most narrow and low head, short extremities and narrow anal scutum. Females have a big ear opening. *L. a. exigua* has the longest extremities, short frontal and anal scutums, little eye and ear opening. Females have a wide anal scutum. *L. a. agilis* has the longest neck, narrow pileus, and wide distance between nostrils and the biggest height of head. Males have long and wide frontal and anal scutums. Females of *L. a. chersonensis* have the longest head and the biggest one in comparison with the other subspecies female length of frontal, anal and width of frontal scutums.

The discriminant analysis of young and mature *L. a. agilis* and *L. a. exigua* subspecies lizards has shown, that Squared Mahalanobis Distances value used to be determined by taxonomical lizard's attribute, then by sex of animals and their age. By the results of our work the following conclusions could be made.

1. The age differences of the sand lizard in body proportions can be divided into the two age groups: young (subadultus and adultus 1) and mature (adultus 2 and senex).

2. *L. a. euxinica* in comparison with *L. a. chersonensis* has the most variable age groups by morphology. The increasing of these subspecies differentiation level with the age has been registered.

3. The sex differences become evident both for the body proportions and individual morphometry features. The level of sex differences increases with the age.

4. In pholidoses and body proportions features *L. a. agilis* and *L. a. exigua* are the most variable subspecies and the least variable are *L. a. chersonensis* and *L. a. euxinica*.

5. We think that level and degree of *L. a. agilis*, *L. a. exigua*, and *L. a. chersonensis* divergence confirm their subspecies status by the all folidoses features and body proportions. *L. a. chersonensis* and *L. a. euxinica* have a less degree of difference, so we think that they should be considered as the biotopical forms, which are at the initial forming stage by morphology divergence level. The *L. a. chersonensis* subspecies by both the body proportions and pholidoses features will keep intermediate status for a long time yet.

Acknowledgments. Authors would like to thank the Director of Zoological museum of the National Museum of Natural History Prof. Eugen Pisanets and senior reserch scientist of the Institute of Zoology of National Academy of Science of Ukraine Dr. Tatjana Kotenko for offered an opportunity to work with scientific collections. Special sincere gratitude to International Solomon University rector, Professor Alexandr Rozenfeld for the sponsor assistance.

REFERENCES

Bischoff W. (1984), "*Lacerta agilis* Linnaeus 1758 — Zauneidechse," in: Böhme W. (ed.), *Handbuch der Amphibien und Reptilien Europas*, AULA Verlag, Wiesbaden, pp. 23 – 68.

Darevsky I. S. et al. (1976), "Systematic and intraspecific structure," in: A. V. Yablokov (ed.), *Sand Lizard*, Nauka, Moscow, pp. 53 – 96 [in Russian].

Kalyabina-Hauf S. A. and Ananjeva N. B. (2004), *Phylogeography and Intraspecies Structure of Wide Distributed Sand Lizard*, Lacerta agilis *L., 1758* (*Lacertidae*, *Sauria*, *Reptilia*). *Case Study of Mitochondrial Cytochrom b Gene*, St. Petersburg [in Russian].

Kotenko T. I. and Taraschuk C. V. (1982), "New subspecies of the sand lizard in USSR fauna *Lacerta agilis euxinica* Fuhn et Vancea, 1964 (Reptilia, Lacertidae)," *Vestnik Zool.*, **6**, 33 – 37 [in Russian].

Scherbak N. N. and Scherban M. I. (1980), *Amphibians and Reptiles of Ukrainian Carpathians*, Naukova Dumka, Kiev [in Russian].