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### HABITAT VARIATION IN Rana arvalis OF NORTHEASTERN UKRAINE

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### INTRODUCTION

The moor frog, *Rana arvalis* Nilsson, 1842 is a widely distributed Eurasian species ranging from eastern France and the Netherlands in the west to Yakutia in the east, and from the Polar Circle, southern Yamal Peninsula and Putoran Plateau in the north to the southern part of the Pannonian Basin, Altai Mountains, and Transbaikalia in the south (Borkin, 1998).

Previously, the frogs of the Pannonian lowlands (including Transcarpathian Ukraine) were assigned to a separate subspecies R. a. wolterstorffi Fejérváry, 1919, while frogs from the northern area of the Pannonian Basin were recognized as R. a. arvalis Nilsson, 1842. The former subspecies is characterized by slender habitat with longer hind legs and larger body size (Fejérváry, 1919). According to Tarashchuk (1984), the long-legged form inhabits both Transcarpathia and some central and southern regions of Ukraine. Other authors, however, questioned the validity of R. a. wolterstorffi (Shcherbak and Shcherban, 1980; Babik and Rafiñski, 2000). They suggested that the body shape differences in this species may be resulted from the phenotypic plasticity and clinal variation correlating with local climatic factors. Moreover, genetic divergence between those groups proved to be relatively low (Rafiñski and Babik, 2000). Indeed, R. arvalis demonstrated obvious clinal variation in the leg length (Toporkova, 1965; Bannikov et al., 1977; Ishchenko, 1978): the southern frogs have longer legs in comparison with that of the northern latitudes.

In northeastern Ukraine, both forms of *R. arvalis* were found in the same territory but in different habitats.

### MATERIAL AND METHODS

The studies of *R. arvalis* populations were carried out in 2000 – 2003 in the Desnyansko-Starogutskii National Nature Park and adjacent territories (Sumy Oblast', northeastern Ukraine, the forest zone, Fig. 1), throughout an

area of about 42 × 16 km. Four kinds of habitats were recognized: the coniferous forest, the deciduous forest, bogs, and river meadows. 323 frogs were registered by the transect sampling method. Among them, 110 individuals, including males, females, and juveniles, were taken for morphometric measuring (33 from a pine forest, 35 from river meadows, 27 from oak-and-birch forests, 8 from a wooded river bank, and 7 from a marsh). After treatment, all animals were released to habitats, respectively. For each frog 24 external measurements (in mm) were taken with a calliper (with an accuracy of 0.1 mm): L., L.c., Lt.c., D.r.n., Sp.n., D.r.o., D.n.o., L.o., L.tym., D.tym.o., Sp.oc., Lt.p., Sp.p., L.m., D.p., Lt.m., F., T., C.s., D.p.4, Lt.c.s., D.p.1, C.int., H.int. Eventually, 15 indices were calculated: L./L.c., L.c./Lt.c., L.c./Sp.n., L.c./L.o., L.c./L.tym., L.c./D.r.o., Sp.oc./D.r.o., D.p.1/C.int., T./C.int., L./T., F./T., D.p.1/D.p.4, D.p.4/C.int., L./(F. + T.), C.int./H.int. 44 samples (817 specimens) from Ukraine and 2 samples (46 specimens) from Russia were analyzed with respect to the hind leg length. Standard statistical methods (factor and cluster analyses, t-test) used. Calculations were performed STATISTICA 5.0.



Fig. 1. Region of investigation.

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### **RESULTS AND DISCUSSION**

In northeastern Ukraine, two kinds of *R. arvalis* were identified: the short-legged form (ankle joint reaching the frog's eye) and the long-legged form (ankle joint reaching the nostril or the end of snout). In deciduous forests (birch, alder, and oak) and bogs, all 177 individuals were only short-legged (100%). The majority of 146 frogs from meadows and pine forests located along Desna River were long-legged (78% from meadows and 78.1% from pine forests), some of them had intermediate leg length (12.2 and 14.1%, respectively), and only few individuals were with short legs (9.8 and 7.8%). However, these frogs with short legs (9.8 and 7.8%) differed from short-legged frogs inhabiting deciduous forests by other proportions, and by these proportions they belonged to the long-legged form.

110 specimens taken from various habitats of the region were analyzed morphometrically by cluster and factor analyses. The analysis procedure has divided frogs into two groups: the first one included specimens from decidu-

ous forests and bogs (the short-legged form), whereas the second group contained specimens from pine forests and meadows along Desna River (the long-legged form; Figs. 2 and 3). Differentiation by sex and age did not affect the division. The first group statistically differed from the second one by shorter legs, shorter breadth of wrestle joint and shorter breadth of foot. However, the short-legged frogs had larger head, and eyes, larger distance between nostril and snout, as well as larger distance between eye and snout (Table 1).

Our examination of *R. arvalis* throughout Ukraine (44 samples, 817 specimens) revealed that almost all of Ukrainian territory is occupied by the long-legged form. Only in the northern part of Chernigov and Sumy Oblast's (northeastern Ukraine, the forest zone), all 10 samples studied (96 specimens) belonged to the short-legged form. By the way, 2 samples (46 specimens) from the Russia's forest zone, situated far away north-east from Ukraine, contained the short-legged frogs as well. It should be taken into account, that the most of Ukrainian territory belongs to the

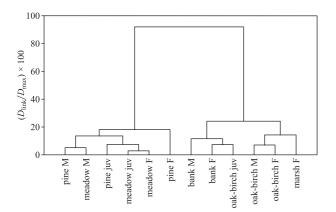


Fig. 2. Dendrogram of 12 samples (N = 110) of *Rana arvalis* from different biotops in the North-East of Ukraine obtained from cluster analysis.

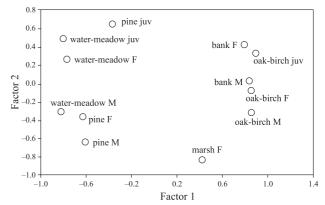


Fig. 3. The distribution of 12 samples (N = 110) of Rana arvalis from different biotops in the North-East of Ukraine obtained from factor analysis.

**TABLE 1.** Differentiation of Two Forms of Frogs (t-test p < 0.05)

Indices	"Short-legged" form $(N = 52)$ (deciduous forests, bogs)		"Long-legged" form $(N = 68)$ (pine forest, meadows)	
	$mean \pm standard error$	range	mean ± standard error	range
L.c./Lt.c.	$1.03 \pm 0.06$	0.95 - 1.22	$1.07 \pm 0.06$	0.93 - 1.2
L.c./L.o.	$2.41 \pm 0.17$	2.03 - 2.93	$2.59 \pm 0.19$	2.23 - 3.4
L./T.	$1.93 \pm 0.07$	1.77 - 2.14	$1.84 \pm 0.06$	1.66 - 1.98
L./(F. + T.)	$0.98 \pm 0.04$	0.91 - 1.08	$0.94 \pm 0.04$	0.85 - 1.05
Parameters (normalized)				
Dr.n.	$1.05\pm0.07$	0.96 - 1.2	$0.98 \pm 0.06$	0.76 - 1.09
Dr.o.	$1.03\pm0.05$	0.93 - 1.13	$0.99 \pm 0.07$	0.85 - 1.02
L.o.	$1.07 \pm 0.07$	0.88 - 1.25	$0.97 \pm 0.06$	0.76 - 1.02
Lt.p.	$1.045\pm0.07$	0.93 - 1.2	$0.98 \pm 0.06$	0.85 - 1.13
Lt.m.	$0.85\pm0.09$	0.65 - 1.03	$1.07\pm0.08$	0.93 - 1.34
Lt.cs.	$0.94 \pm 0.06$	0.79 - 1.08	$1.02 \pm 0.05$	0.86 - 1.15

steppe and forest-steppe zones, and the forest zone covers the northern and mountain regions only. Our results, therefore, can be regarded as an evidence that, as a rule, the long-legged form of *R. arvalis* inhabits the steppe and forest-steppe zones while the short-legged form occurs in the forest one.

Thus, in northeastern Ukraine, the both forms of the moor frog can be found, however, they inhabit different habitats. It seems likely that the southern long-legged form spreaded across steppe and disturbed areas (including pine forests) near large rivers, while the short-legged form invaded from Russia through native deciduous forests. In the territory under the study, the two forms of *Rana arvalis* are sympatric.

So far it is not possible to assert whether these forms of the moor frog have genetic differences or they are merely ecological races based on epigenetic phenomenon (like some fishes). Appropriate genetic studies are going to be arranged in the nearest future. However, the problem is that the draught of the last two years caused a significant decline in local populations of the moor frog. Further research will only be possible if its populations will renew.

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### REFERENCES

- **Babik W. and Rafiñski J.** (2000), "Morphometric differentiation of the moor frog (*Rana arvalis* Nilss.) in Central Europe," *J. Zool. Syst. Evol. Res.*, **38**, 239 247.
- Bannikov A. G., Darevsky I. S., Ishchenko V. G., Rustamov A. K., and Shcherbak N. N. (1977), Guide to Amphibians and Reptiles of the USSR [Opredelitel' Zemnovodnykh i Presmykayushchikhsya SSSR], Prosveshchenie, Moscow [in Russian].
- Borkin L. J. (1998), "Amphibians," in: Ananjeva N. B., Borkin L. J., Darevsky I. S., and Orlov N. L. (eds.), *Amphibians and Reptiles. Encyclopedia of the Nature of Russia [Zemnovodnye i Presmykayushchiesya. Éntsiklopediya Prirody Rossii*], ABF, Moscow, pp. 19 174 [in Russian].
- **Fejérváry G. J.** (1919), "On two south-eastern varieties of *Rana arvalis* Nilss.," *Ann. Mus. Nat. Hung.*, **17**, 178 183.
- **Ishchenko V. G.** (1978), Dynamic Polymorphism in Brown Frogs of the USSR Fauna [Dinamicheskii Polimorfizm Burykh Lyagushek fauny SSSR], Nauka, Moscow [in Russian].
- Rafiñski J. and Babik W. (2000), "Genetic differentiation among northern and southern populations of the moor frog *Rana arvalis* Nilsson in Central Europe," *Heredity*, **84**, 610 618.
- Shcherbak N. N. and Shcherban M. I. (1980), Amphibians and Reptiles of Ukrainian Carpathians [Zemnovodnye i Presmykayushchiesya Ukrainskikh Karpat], Naukova Dumka, Kiev [in Russian.
- **Tarashchuk S. V.** (1984), "On the variation in *Rana arvalis* in the territory of Ukraine," *Vestnik Zool. Kiev*, **5**, 80 82 [in Russian].
- **Toporkova L. J.** (1965), "On the geographic variation of amphibians," *Dokl. Vyssh. Shkoly. Biol. Nauki*, **1**, 31 36 [in Russian].