Conference Paper

Comparative Analysis of Moor Frog Anomalies (*Rana arvalis* Nils., 1842) in Different Areas of Surgut City

D.V. Ibragimova and N.V. Nakonechnyi

Surgut State University, Surgut city, Energetikov street, house 22, cabinet 611

Abstract

In the local populations of moor frogs in Surgut city, 30 types of morphological anomalies were discovered. The quantity and frequency of anomalies were high in industrial and multistoried areas of the city. Individual subjects could have 1 to 4 different anomalies. The paper reveals that major variations in anomalies occurs in industrial and multistoried areas of the city.

Keywords: Moor frog, urbanization, morphological anomaly.

Corresponding Author:
D.V. Ibragimova
DV_Ibragimova@mail.ru

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1. Introduction

Morphological anomalies in amphibians are more frequent in comparison with other terrestrial vertebrate groups. This difference may be caused by the recoverability of lost limbs and the high sensitivity of adult amphibians and their larva to the chemical background of the environment [1]. However, traumas and anomalies in the frequency range of 3-5% are typical for a natural amphibian population [2, 3] because the process of development may be influenced by different factors different factors that caused possible deviance. Therefore, an anomaly rate higher than 5% could signify changes in the animal's morphology. Many authors have described different anomalies in amphibian populations on urban territories more so among brown frogs than among moor frogs [4, 5].

2. Methods

The research was conducted in Surgut city, Khanty-Mansyiskiy autonomous district, from May to September 2009-2011 and from May to June 2016. The city is situated on the right bank of the river Ob in the middle taiga subzone. We divided the territory of the city into 4 zones according to economic development: I – multistoried, II – industrial,

III – floodplain, IV – green. Trapping was performed with a catch cylinder (in 2009-2011) and the path method (in 2016). Data were obtained from 855 frogs. Developmental anomalies were recorded during the external examination of animals and after dissection. Evaluation of the quantity characteristics and anomaly classification was carried out according to recommendations from V.L. Vershinin [6].

3. Results

Thirty of known morphological anomalies were discovered in the moor frog population in Surgut city. A wide range and frequency of anomaly were observed in zones with high anthropological density (tables 1 and 2). Generally, ectrodactyly was found in 5.38% of moor frog subjects in the city, which could be referred to as divergence from an anomalous norm [2]. All other forms of deviation were sporadic. However, zone I of the city was distinct in terms of the norms for gonad asymmetry, phalangeal bone deformation, untypical pigmentation and ectrodactyly (the same in zone II). This could be determined by the influence of a host of factors. V. L.Vershinin called ectrodactyly of this amphibian species a specific anomaly for an urban environment. The fluctuations met only in zone I were kidney asymmetry, under-development of the liver, brachymely and taumely, while those only met in zone II were hypertrophy of the heart, liver deformation, the majority of skin and muscle anomalies and syndactyly. In zone III, two anomalies were discovered to be typical to this area. This circumstance was not surprising. The industrial and multistoried habitats of amphibia have a great impact that involves changes in the population structure [7]. It is conceivable that some isolated groups of moor frog in the industrial zone are close to an inbreeding depression. For the first time in this area anomalies such as swelling of the abdominal wall, reduction of eyelids, outgrowth on bones (tarsus), deformation of the femoral muscles and abdominal muscle tears were discovered. The proportion of combined anomalies is 14.22%. Generally, double combinations were found, like anomalies in the reproductive system and anomalies in the limbs. One subject could have from one to four anomalies. The number of anomalies for one subject is 0.25.

Comparing these results with those of populations from other cities (for instance, Yekaterinburg [5] and Kazan [8]), the occurrence rate was smaller in Surgut but the range of anomalies was higher. There is probably a connection with the relative youth of the city: intensive building started only at the end of the 1970s, so the amphibian population has not adapted to urbanization.

Table 1: Classification of anomalous moor frog subjects by zones in Surgut city.

Zone	n	Individuals with an anomaly	S_{ap}	$P_{as,}$%
I	80	25	14	31.25
II	551	117	21	21.23
III	198	32	13	16.16
IV	26	3	3	11.54

Remarks: S – quantity of anomalies; P_{as} – frequency of anomalous subjects; n – sample size.

The overlap grade of two anomaly spectra (by Morisita's overlap index CM) by double comparison groups of moor frog from different zones of Surgut city is: I – II CM = 84%; I – III CM = 63%; I – IV CM = 47%; II – III CM = 78%; II – IV CM = 58%; III – IV CM = 40%. Zones I and II were closer in terms of the diversity and frequency of revealed anomalies: this could be connected with the high anthropogenic impact on frog habitats in these zones. Only in these areas of the city did we record the quite unusual occurrence of partial albinism (in two yearlings and a three-year-old male). The overlap grade of anomaly spectra in these zones was lower than in the green zone because moor frog diversity and habitat destruction was minimal in the green zone.

4. Conclusion

The anomaly spectrum of moor frog in Surgut is higher than this characteristic from big cities in the Ural. However, the percentage of anomaly combinations and the quantity of anomalies for one subject was significantly lower. In these Ural cities, increases in the spectra are occurring more in green belts than heavily urbanized zones, while in Surgut the reverse is the case. This illustrates the start of species urbanization here.

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Table 2: Frequency of anomaly occurrence (P_{as} %) in moor frog populations in Surgut city.

Type of anomaly	Zone			
	I (n=80)	II (n=551)	III (n=198)	IV (n=26)
Internal organs				
Asymmetry of the gonads	5	3.81	3.03	-
Asymmetry of the kidneys	1.25	-	-	-
Hypertrophy of the heart	-	0.18	-	-
Curvature of the liver	-	0.18	-	-
Under-development of the liver	1.25	-	-	-
Unequal auricles	-	-	0.51	-
Unpaired gonads	1.25	0.36	1.01	3.85
Skin and muscles				
Deformation of the muscles	-	0.36	-	-
Growth on the skin	-	0.18	-	-
Untypical pigmentation	6.25	3.27	1.52	3.85
Tumours	-	0.18	0.51	-
Oedema of the abdominal wall	-	0.54	-	-
Damages of the skin	1.25	-	-	-
Break of the abdominal muscles	-	0.18	-	-
Reduction of the eyelid	-	0.18	-	-
Partial albinism	1.25	0.36	-	-
Axial skeleton				
Deformation of the pelvic bones	3.75	1.45	1.01	-
Curvature of the rostrum	-	0.18	0.51	-
Extremity				
Phalangeal bone deformation	-	0.18	-	-
Brachydactyly	1.25	0.54	-	-
Brahimely	1.25	-	-	-
Curvature of the falange	6.25	2.9	4.55	-
Outrowth on the bone	1.25	-	-	-
Oligodaktiliy	3.75	3.27	2.02	-
Polydactyly	1.25	-	0.51	-
Bifurcation of the foot	-	-	0.51	-
Syndactyly	-	0.73	-	-
Taumely	1.25		-	-
Ectrodactyly	8.75	6.17	2.02	3.85
Ectromely	-	0.54	0.51	-

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