Conference Paper

New Data on the Anomalies of Tailless Amphibians of the Volga Basin

A.I. Fayzulin[1], I.V. Chikhlyaev[1], A.K. Mineev[1], A.E. Kuzovenko[1], R.A. Mihaylov[1], F.F. Zaripova[2], A.I. Popov[1], and O.A. Ermakov[3]

[1]Institute of Ecology of the Volga River Basin Russian Academy of Sciences, 10 Komzin Str., Togliatti 445003, Russia
[2]Saint-Petersburg Medical-Social Institute, Kondratievsky pr. 72 lit. A, Saint-Petersburg, 195271, Russia
[3]Penza State University, 40 Krasnaya Str., Penza, 440026, Russia

Abstract

This paper presents new findings on abnormal specimens of amphibians in the Volga basin. Some anomalies have been noted for the first time: macrophthalmia, eardrum anomalies in marsh frogs (P. ridibundus), the absence of a tympanic membrane in green toads and ectromelia in spadefoot Pallas samples (P. vespertinus).

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Corresponding Author:
A.I. Fayzulin
alexandr-faizulin@yandex.ru

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1. Introduction

In the Volga river basin, the registration of morphological abnormalities in amphibians began in the 19^{th} century with the collection of individual specimens with various disabilities in their internal and external structures: this increased in the second half of the 20^{th} century [1, 2]. Registration of deviations has been carried out in Kaluga [3], Moscow [4], Tambov [5, 6], Samara [7, 8], Penza [9], the Republic of Tatarstan [10] and Marie El [11]. Since 1996, comprehensive studies of anomalies have been conducted in the Volga region, including ones into the pathology and histology of the external structure of the lower vertebrate [7, 8]. Despite the long period during which anamolies have been studied, a number of aberrations in tailless amphibians are registered for the first time in this paper. The purpose of this paper is to supplement existing information on abnormal individual anurans from the Volga basin.

2. Methods

An analysis of amphibians with fixed anomalies was conducted among samples collected from 2011 to 2016. Collections were conducted in 82 localities in the Volga basin.

The total sample size was 1,938 individuals from 9 species of tailless amphibians: the European fire-bellied toad *Bombina bombina* (Linnaeus, 1761), the spadefoot Pallas *Pelobates vespertinus* (Pallas, 1771), the common toad *Bufo bufo* (Linnaeus, 1758), the green toad *Bufotes viridis* (Laurenti, 1768), the common frog *Rana temporaria* (Linnaeus, 1758), the moor frog *Rana arvalis* (Nilsson, 1842) the pool frog *Pelophylax lessonae* (Camerano, 1882), the marsh frog *Pelophylax ridibundus* (Pallas, 1771) and the edible frog *Pelophylax esculentus* (Linnaeus, 1758). Morphological identification of amphibian species was conducted. For hybrid and cryptic forms, molecular genetic typing was conducted, allowing us to determine the haplotypes, MT and nuclear DNA belonging to the "eastern" or "western" frog types. [12] We used two molecular genetic markers: mitochondrial DNA (mtDNA), inherited through the maternal line - a fragment of the first subunit gene cytochrome oxidase the COI, for nuclear DNA (nDNA), Mendelian inheritance the mode of inheritance - intron 1 of the gene serum albumin SA1 [13]. To classify anomalies, we used the work of V.L. Vershinin and colleagues [14, 15]. We took into account the structure of the aberrations in the stage after metamorphosis.

3. Results

In 19 localities, we discovered 10 types of morphological abnormalities in the 9 species of amphibians living in the Volga basin (Table 1). As a result, the study noted that the predominant abnormalities in the structure of the limbs were brachydactyly (Fig. 1, locality number 1), polydactyly (Fig. 2, locality number 2) and ectrodactyly. We can say that mass anomalies in the Volga basin are rare [1–12], being noted in only two species of amphibians: the common toad [1, 5] and the marsh frog [6, 8].

Figure 1: Brachydactyly *B.bufo*.

Figure 2: Asymmetric polydactyly *B.bufo*.

Figure 3: Abnormalities of pigmentation in eye and body color *P.vespertinus*.

Rare anomalies, such as ectromelia (Fig 3, locality № 13), pigmentation disorders and eye color (Fig 4, locality № 14), were first observed in the spadefoot Pallas. Previously, this type of ectromelia, in which a part of the forelimb/forearm is hidden under the skin, was observed in the European fire-bellied toad [8], the *Litoria aurea* Lesson, 1827 and the *Bombina variegata* (Linnaeus, 1758) [16].

Macrophthalmia (Fig. 5, locality number 10) was recorded in the "Western" forms of the marsh frog and was identified by nuclear and mitochondrial DNA (mtR-nRR type) markers. Symmetrical polydactyly was observed in "Western" hybrids in the mitochondrial and nuclear DNA (mtB-nRB type). The population in locality № 19 was the only "Eastern" form of the marsh frog discovered to have duplicate fingers. There

Figure 4: Ectromelia *P.vespertinus*.

Figure 5: Macrophthalmia *P. ridibundus*.

was a deviation in the structure of the eardrum - green toads lacked it, while it took an irregular shape (triangle) in the marsh frog. We noted the incomplete development of the ear in the swimming marsh frog (Table 1).

Table 1: External anomalies in tailless amphibians by the study area.

Locality		year	N	E	species	n	Anomalies
Mordovia Republic:							
1	Settlement Lesnoy	2008	54.462	42.711	*B. bufo*	17	1 – brachydactyly (Sh)
2	Saransk city	2006	54.214	45.249	*R. temporaria*	13	1 – ectrodactyly (ARh)
3	Mordovia reserve, Pavlovsky cordon	2011	54.748	43.402	*R. temporaria*	22	1 – polydactyly (ALh)
Chuvash Republic:							
4	National Park "Chavash Varmene"	2009	55.012	47.189	*B. bufo*	16	1 – polydactyly (ARh)
Samara Region:							
5	Settlement Birinsk	2011	53.573	48.655	*P. ridibundus*	15	1 – syndactyly (ALh)
6	v. Klimovka	2010	53.487	49.018	*P. ridibundus*	16	1 – polydactyly (ARh)
7	v. Verchnii Suskan	2011	53.818	49.311	*P. esculentus*	17	1 – polydactyly (ALh)
8	Togliatti city, lake "Lesnoe"	2014	53.500	49.439	*P. ridibundus*	15	1 – the triangular shape of the eardrum (AL)
9	Togliatti city, Settlement. Fedorovka	2014	53.466	49.665	*P. ridibundus*	15	1 – ectrodactyly (ALh)
							1 – polydactyly (Sh)
10	Samara city, Lake Shishiga	2012	53.269	50.229	*P. ridibundus*	23	1 – macrophthalmia (AL)
11	Samara city, pond Botanical Garden	2012	53.215	50.179	*P. ridibundus*	19	1 – polydactyly (Sh)
12	Samara city, a park	2016	53.194	50.201	*B. viridis*	19	1 - hypoplasia of the eardrum (AL)
							1 – syndactyly (ARh)
13	near Settlement Kryazh	2012	53.151	50.177	*P. vespertinus*	37	2 – depigmentation eye (S), coloring anomalies
14	v. Kinel -Cherkassy	2015	53.467	51.503	*P. vespertinus*	20	1 – ectromelia (ARa)
15	v. Ekaterinovka	2012	52.668	48.430	*B. bombina*	15	1 – polydactyly (ALh)
16	Settlement Gornyi	1999, 2011	52.997	51.061	*P. lessonae*	10	1 – polydactyly (ARh)
					R. arvalis	15	1 – polydactyly (ALh)
Orenburg region:							
17	Settlement Koltubansky	2010	52.918	51.932	*P. ridibundus*	23	1 – hypoplasia swimming membranes (ARh)
Republic Bashkortostan:							
18	Ufa city, Zaton Park	2009	54.788	55.876	*P. ridibundus*	32	1- ectrodactyly (ARh)
19	Ufa city, p. Lokotki	2009	54.542	55.931	*P. ridibundus*	26	1 - duplication of fingers (ARh)

Note: "S" - symmetrical expression, "A" - asymmetrical, "R" - on the right side, "L" - on the left side, "a" - forelimbs; "H" - hindquarters.

4. Conclusion

Based on the data presented, the deviations in internal and external structures are present in areas with low levels of anthropogenic transformation (nature reserves and national parks) and areas with high anthropogenic influence, including urban areas.

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