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Morphological Variability of Larval Mouthparts of the Marsh Frog *Pelophylax ridibundus* (Pallas, 1771) (Anura, Ranidae) in Natural Populations of Southeastern Kazakhstan

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Abstract

This report presents the results of the analysis of the morphological variability of the larval mouthparts of the marsh frog *Pelophylax ridibundus* from various natural populations in Southeastern Kazakhstan.

Keywords: larval mouthparts, morphological variability, marsh frog

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1. Introduction

Information on the morphological variability of amphibian larval mouthparts is scarce [1–4, 6]. We believe that a study of the variations of larval mouthparts, especially in natural populations, is highly useful. It is known that the condition of natural populations or habitats may be determined based on an analysis of the morphological variability of species. A study of anomalies and the preparation of a catalogue about them may serve as the basis for the further study of factors that may cause the variations. The objective of this research is to study the morphological variability of the larval mouthparts of the marsh frog *Pelophylax ridibundus* from natural populations in Southeastern Kazakhstan.

2. Methods

The habitats of tadpoles are listed in Figure 1: 1. low flow of River Aksu (14.08.2014) – 37 specimens; 2. medium flow of River Aksu, near Matai station (20.05.2014) – 31 specimens; 3. unnamed river to the west of River Aksu (21.06.2014) – 31 specimens; 4. low flow of River Tentek (3.07.2014) – 26 specimens; 5. Tentek River delta, upper

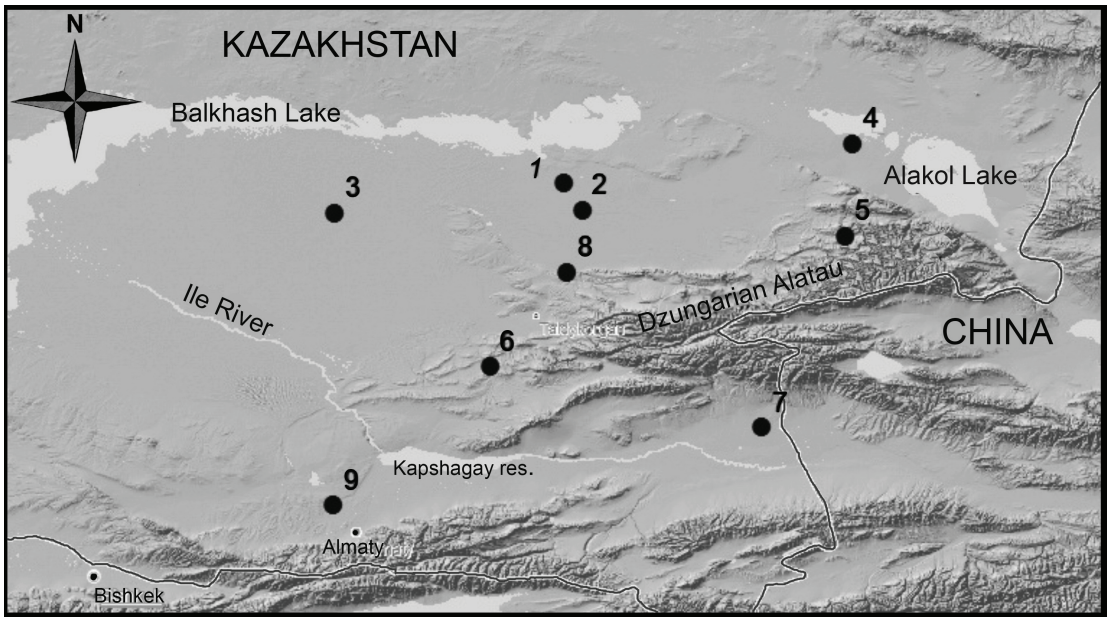

Figure 1: Locations of the studied groups.

flow of River Krasnaya Rechka (29.06.2014) – 41 specimens; 6. River Malaya Bizhe (End of April 2013 and May 2014) – 60 specimens; 7. Akeshke water reservoir (30.04.2013) – 41 specimens; 8. Lake Linkovoe (1-3.05.2013) – 32 specimens; 9. River Kaskelenka (25.06.2013) – 31 specimens. Tadpoles with well-developed mouth parts (stages 30-41) were selected for analysis.

Marsh frog tadpoles were fixed in a 10% formalin solution. The description of the tadpoles' external morphology and staging were conducted using MBS-9 binocular microscop. The stages tadpole development were determined according to the normal development table for *P. ridibundus* (earlier *Rana ridibunda*) [7].

Anomalies (or deviations) in larval mouthparts were understood to be any deviations from the mouthparts described in the normal development table at the relevant stage. The occurence of specimens frequency with morphological anomalies was calculated according to the formula Pas=Nas/N*100% [5]. Designation of tooth row is presented according to McDiarmid, Altig (1999): A – anterior, P – posterior.

3. Results

P. ridibundus larval mouthparts are presented in Figure 2 (I-A, II-B) in line with the development stage as it is denoted in the normal development table [7]. It is worth noting that the normal development table of *P. ridibundus* shows the first lower tooth row P-1 as consisting of two sections of similar length located along one line. We have

discovered that a lack of break in P-1 (Figure 2-II-A, II-B) is most characteristic for the tadpoles in the target groups, as this pattern was discovered in most cases (51.6%-96.9% cases). Bibik (2010) also noted both types of the labial teeth row formula (LTRF) for marsh frog tadpoles in two target groups (96 species) from natural populations in the Donetsk region (Ukraine). Taking this data into account, a break in tooth row P-1 and an unbroken P-1 are considered to be variants of the norm. Thereby, tadpoles in stages 31-33 have an LTRF of 1/3(1) or 1/3, while tadpoles in stages 34-41 have an LTRF of 2(2)/3(1) or 2(2)/3.

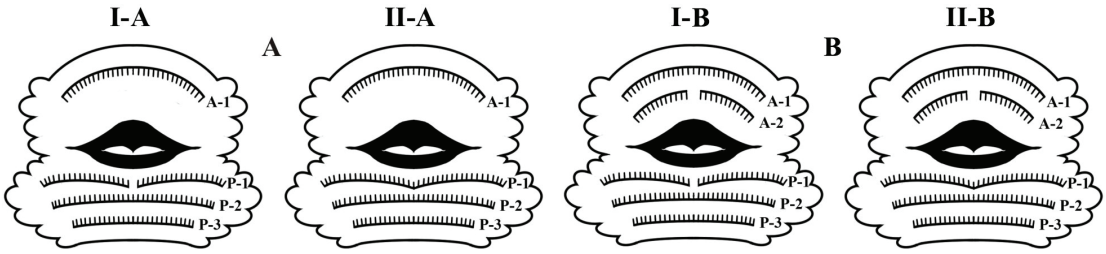

Figure 2: Normal larval mouthparts of *P. ridibundus*. A – stages 31-33; B – stages 34-41; I – tooth row P-1 with break; II – tooth row P-1 without break, unbroken.

The analysis of the studied materials demonstrates that the mouthpart structure of *P. ridibundus* tadpoles does not always correspond to norm. As a rule, the variations concern tooth rows; however, in some cases, deformation of other mouth parts was observed, for example, the beak (Figure 3).

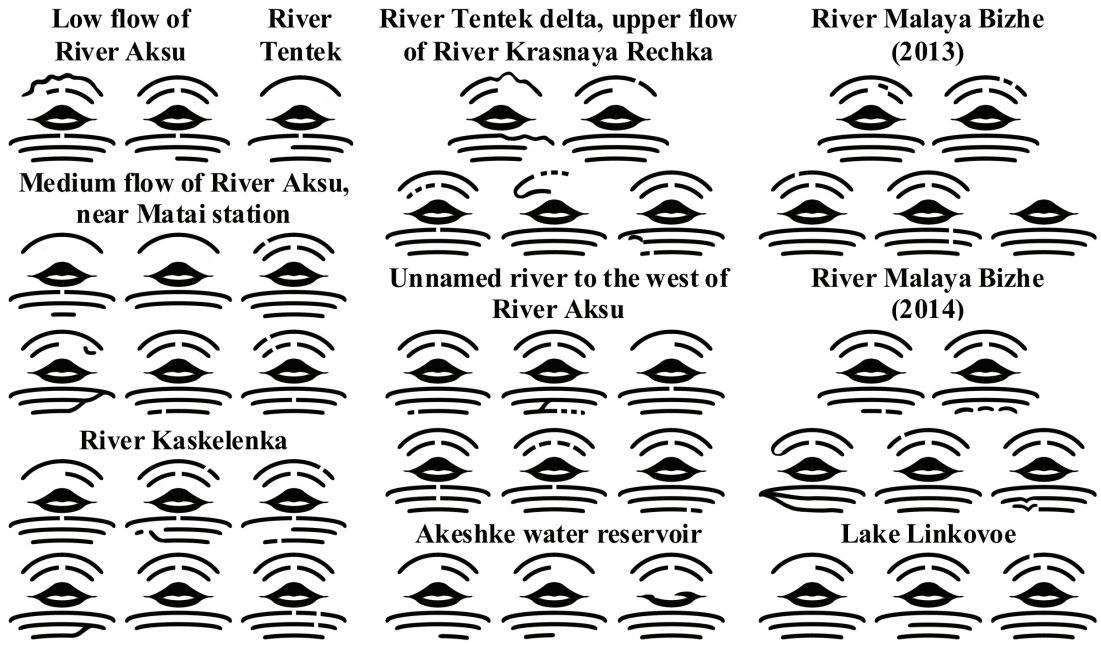

Figure 3: Variations of the mouthparts of marsh frog tadpoles from the studied groups.

The occurrence of specimens with anomalies in the mouthpart structure varied in various water ponds (Figure 3): 1. low flow of River Aksu – 5.4%; 2. near Matai station – 25.8%; 3. unnamed river to the west of River Aksu– 19.4 %; 4. low flow of River Tentek – 3.8%; 5. upper flow of River Krasnaya Rechka – 14.6%; 6. River Malaya Bizhe – 16.7%; 7. Akeshke water reservoir – 7.3%; 8. Lake Linkovoye – 12,5%; 9. River Kaskelenka– 22.6%.

However, Borkin et al. (2012) suggested a level of 5% anomaly occurrence for the target group, which accounts for no less than 100 specimens. As the volume of our materials is inadequate, to ensure easy evaluation of the differences between target groups we propose to accept a level of variability as low as less than 10% of specimens, an average of 10% to 20% and a high of over 20%. As such, a high level of variability is observed in tadpoles near River Kaskelenka and Matai station in the medium flow of River Aksu. As the most significant anthropogenic impact is observed in these regions, we assume that this factor could have had an impact on the morphology of tadpoles and tadpole mouth parts. However, this assumption requires additional study.

In the course of analysing larval LTRF of the marsh frog at various stages of development, we discovered four types of deviations from the LTRF as described in the normal development tables for this species [7]: 1. Breaks (sometimes with partial displacement) of tooth rows (39, 1% of total number of anomalies); 2. full or partial reduction of tooth rows (26.1%); 3. joining of tooth rows (4.3%); 4. deviation and deformation of tooth rows (2.2%).

Single or multiple breaks of tooth rows were discovered most often. The reduction of tooth rows, joining and deformation were rare events. In our opinion, the least significant is the first type of anomaly, as breaks of tooth rows may take place as a result of mechanical injuries. The other three types certify breaches in the formation of these structures. On several occasions (28.3%), the LTRF included a combination of two or more deviations. When observing several anomalies of the LTRF in one species, they were single-sided in 50% of the cases, symmetrical in 23% and unsystematic in 27%.

4. Conclusion

As such, the analysis of the LTRF of marsh frog tadpoles from natural populations in Southeastern Kazakhstan demonstrated a high degree of variability. Four types of deviations were singled out in the normal LTRF. It was observed that while one species had LTRF several anomalies, most of them were one-sided. Differences were detected

in the occurrence of species with anomalies between the target groups. It was proved that variability in the first lower tooth row P-1, expressed in the lack or presence of a break in the central part, was typical for the normal LTRF of marsh frog tadpoles.

Based on the above, an external morphological indicator like the structure of tadpoles' mouth parts may serve as a convenient indicator of the condition of marsh frog populations. In similar future experiments, it would be better to use tadpoles with well-developed mouth parts (up to stage 39 of their development).

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