Short communication

Sexual dimorphism of Baikalian amphipoda Gmelinoides fasciatus (Crustacea, Amphipoda)

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ABSTRACT. The degree of morphological variability in different groups of Baikal amphipods is different; sexual dimorphism among Baikal amphipods is described in approximately 30% of species by a limited number of morphological characters. There are very few works based on a large number of individuals and morphological characters. The latter is also true for the widespread species Gmelinoides fasciatus (Stebbing, 1899): it is known from the literature about its morphological heterogeneity, but no detailed studies have been carried out. This work is a study of sexual dimorphism of the species G. fasciatus based on an expanded number of quantitative characters. The purpose of this work is to investigate sexual dimorphism and identify the most significant signs. As a result of the study of the variability of the morphological characters of G. fasciatus from Lake Baikal, a pronounced sexual dimorphism of this species was revealed, and the features that characterize it were identified. Comparative analysis of the morphological variability of G. fasciatus increased the number of described species characteristics.

Keywords: Amphipods, Baikal, Gmelinoides fasciatus, morphological characters, sexual dimorphism

1. Introduction

The noted sexual dimorphism of Baikal amphipods (Takhteev, 2000; Kamaltynov, 2001) still remains poorly studied. For example, G. fasciatus is a widespread species of Baikal origin, morphologically very heterogeneous, but a complete morphological analysis based on a large number of individuals was not done. In the descriptions of the Baikal amphipods, mainly meristic and qualitative traits are used, and to a lesser extent quantitative ones. The set of the latter is in most cases limited to measurements of body length, antennae, and segments of the antenna shaft. More detailed measurement schemes are available in few works, however, the most complete set of quantitative morphological characters (21 in total) was used by E.N. Tikhonova (2011) in the study of the sexual dimorphism of the amphipod Pallasea cancellus (Pallas, 1772). In this regard, the aim of this study was to analyze the variability of G. fasciatus for the most complete set of quantitative characters, taking into account gender.

2. Materials and methods

Material for the study was collected evenly around the entire perimeter of Lake Baikal in June – July 2018. Samples were taken at the water’s edge using a hydrobiological net and from a depth of 3.5 m using divers. Amphipods were fixed in ethanol. Twenty males and females were randomly selected from each sample. Measurements were performed using an eyepiece ruler (scale for the WF10x eyepiece) of the MSP-1 V.2 stereoscopic microscope (OOO LOMO-Microanalysis) for 21 morphological characters according to the scheme adopted in E.N. Tikhonova’s work (2011). In order to exclude the influence of the age of individuals and environmental conditions, on the linear dimensions of the morphometric features, all the features of each individual were normalized (divided) by its body length. The overall similarity of the individuals according to the complex of morphometric features was examined using non-metric multidimensional scaling (NMDS). Before NMD analysis initial data were transformed by ranging from zero to 1. For NMDS, the distance matrix was calculated using the Euclidean dissimilarity metric.

Significant explanatory variables (Gender, coast of like Baikal east or west, basin of the lake - north, center or south) on the set of morphometric features G. fasciatus were identified using distance based AMOVA analysis. The analysis of the reliability of the influence of individual gender on the values of each morphometric feature was carried out using the ANOVA analysis with the Fisher test. The P-value of the Fisher test was adjusted for the false detection rate (FDR) in multiple comparisons using the Benjamini – Hochberg correction (Benjamini and Hochberg, 1995). Statistical analysis was performed in R, using the “vegan” package (Oksanen and Tulkki, 2010).

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3. Results

The results of AMOVA analysis show that the gender factor has the greatest influence on the set of morphometric features of G. fasciatus individuals (R² = 0.4700, P_value = 0.000999). The gender factor explains 47% of the variability in the totality of morphometric features of organisms (47% of the difference between individuals will depend on their gender). Two-dimensional NMDS plot that shows the similarities and differences between individuals G. fasciatus in complex of morphometric features are shown in Fig. The figure shows two partially overlapping point clouds. The first cloud in the lower right corner of the graph is from females, the second cloud in the upper left corner of the graph is from males. The small cloud overlap confirms the results of AMOVA analysis, showing that there are pronounced differences between females and males.

Analysis of the vectors of features gradients (see Fig.) that morphometric features that reliably distinguish females from males can be divided into two groups. The first group includes features p_8, p_10, p_7 and p_9. The relative values (normalized to body length) of these features were almost always higher in males than in females. The second group includes features p_13, p_11, p_20, p_21, p_19, p_6, p_15 and p_5. Most of the males are larger than females in terms of the relative values of these features. But at the same time, there were 11 males that had the meaning of these features as in females, and 4 females in these features were similar to males. It can be concluded that the features p_8, p_10, p_7 and p_9 contribute the most to the separation of females and males.

4. Discussion

The size of the body, its parts and appendages in crustaceans is an important component of sexual dimorphism. Sexual dimorphism of Baikal amphipods is expressed in the larger size of males (Gammarus pulex-group, Acantogammarus grewingkii, some species of coastal gammarids and some others), but the opposite also takes place, as, for example, described by V.P. Gariaev (1901). As a result of this study, it has been shown that males are significantly larger than females in a large number of measured parameters. This is due to the peculiarities of the division of functions between the sexes in this species and the purpose of body parts and its appendages in amphipods. Gnathopods are involved in capturing and holding food, transferring it to the mouth organs, grabbing the substrate, digging, defending and attacking, cleaning the antennae and mouth parts. In males, gnathopods can be noticeably more powerful, since they are used to capture and hold females during pre-copulation and copulation. Antennas II - chemo- and mechanoreceptor organs of aquatic crustaceans. They can serve to find and capture the female, as well as to repel rivals. Many amphipods willingly and quickly burrow into the ground. Usually they stick the antenna II into the ground and begin to rake it with their thoracic legs, discarding soil particles with their grasping front legs. The ability to burrow into the ground makes it easier for some species to spread up rivers, since the crustaceans can thus resist the current and not drift downstream. On sandy beaches where crustaceans hide, stronger antennas are required to prevent any injury. Males often have longer antennae with more numerous sensitive organs on them. This is possibly due to the greater activity of males, including in the search for females. The size of gnathopods and antennae in a male can be signals for both females and other males. Uropods are designed to jump, and the last of them still serve as a rudder. Periods are used to move across the substrate.

5. Conclusions

It can be concluded that the gender of individuals is the main factor determining the differences between individuals of G. fasciatus. The studied amphipod species in Lake Baikal has the pronounced sexual dimorphism.

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