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NATURE OF VARIABILITY OF *CANDAHARIA LEVANDERI* (SIMROTH, 1902) IN THE FERGHANA AND SURKHAN - SHERABAD VALLEYS, UZBEKISTAN

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ABSTRACT

The variability of *Candaharia levanderi* (Simroth, 1902)(Gastropoda, Stylommatophora, Parmacellidae) in two biotopes (southern and northern slopes, the Kampirtepa gorges, the Kugitang Tau ridge) has been investigated using polymerase chain reaction (PCR) with the implementation of primers, the 18S DNA of the region is amplified, the variability (sharply differing in color) of two populations of *C. levanderi* is studied .

The first population is in the suburbs of Namangan, (Namangan Region); the second population is in Kampirtepa gorges, Kugitang Tau ridge (Surkhandarya Region). It is established that, most often, the variability of morphological signs is observed on the coloration of mollusks. The development of body coloration is an adaptive feature that reflects the adaptability to certain biotopes on the one hand, and landscape and climatic conditions on the other .

Keywords: Biotope, *Candaharia levanderi*, Ferghana valley, Morphological feature, Surkhan-Sherabad valley.

INTRODUCTION

Like other terrestrial mollusks, slugs are characterized by a high level of intra-and inter-population variability. The nature and intensity of the color of slugs are often adaptive, reflecting their adaptability to certain biotopes on the one hand, and landscape and climatic conditions on the other (Likharev and Viktor, 1980).

It should be noted that the nature of the variability of shell-bearing mollusks living in Central Asia is discussed in a number of works (Schileyko, 1971; Uvalieva, 1990; Pazilov, 1991; Pazilov and Daminova, 2001; Pazilov and Gaibnazarova, 2012; Pazilov and Umarov, 2021). Similar studies were conducted in the far (Cain, 1977; Goodfriend, 1986; Pettitt, 1977;

Tissot, 1988a, 1988b, 1988c) and near abroad (Kramarenko, 1993; Kramarenko and Popov, 1994; Khokhutkin, 1997).

However, there is no data on the variability of slugs, including *Candaharia levanderi* (Simroth, 1902), until today. Therefore, the main goal of this work was the investigation of the inter-population variability of morphological features of *C. levanderi*, spread in various landscape and climatic conditions of the Ferghana and Surkhan-Sherabad valleys.

MATERIALS AND METHODS

Material for the study has been collected during two years (2019-2020) from spatially separated populations of *C. levanderi* inhabiting different habitat and climate and geographical conditions: Fergana valley (suburbs of Namangan, near Gavasay village, Gavasay gorges); the Northern slopes of Zarafshan range, Urgutsay; Surkhan-Sherabad valley (Kugitang Tau, Babatag, Baysun Tau ranges (Map 1).

Collected from different habitats, the habitats of the species are radically different from each other; in Surkhan–Sherabad district, winter is short and cold, summer is long and hot. Hot days in Surkhan-Sherabad valley come early and last for a long time. The average temperature of July in the flat part is 28-32 °C. The average temperature in January is +3 °C. Precipitation on the plains ranges from 130 mm to 360 mm per year, in the foothill areas from 440 mm to 620 mm. In Namangan region, the climate is sharply continental. The average temperature in January is +4 °C, in July +35 °C. Precipitation on the plains ranges from 135 mm to 370 mm per year, in the foothills - from 460 mm to 640 mm.

Collection of material was carried out in the plains in March and April and in the mountain in May and June. This is due to the fact that slugs are active during these months. The optimal temperature for succulents is 18-22 °C, and humidity is up to 20-30%. In lowland areas, the air temperature warms up earlier, and in mountainous areas-later (Likharev and Viktor, 1980). During the collection process, all living mollusks were seized within 5 pilot sites (size is 1 sq. meter).

During the analysis of morphological features, 30 sexually mature species were randomly selected from each sample and quantitative and qualitative variability were studied with the help of the MBS-9 binocular microscope. In the study, the DNA genome was taken from the heel part of the species *C. levanderi*. We use “DNeasy Blood & Tissue Kits” for DNA sequencing in genomic DNA sequencing (QIAGEN GmbH, Germany). The PZR is made with an automatic programmable amplifier (Touchgene Gradient, UK). During DNA sequencing ABI PRISM ® Bigdye ™ Terminator v. 3.1, performed using a set of reagents, special reaction parameters were recorded in the automatic sequencer ABI PRISM 3100-AVANT. The sequencing data were taken in the "ab1" format and analyzed using the Chromas version 1.45 program (McCartney, 1996 - 1998). Moreover, highly discriminating individuals by morphological characteristics have been studied in the nucleotide sequence using molecular genetic methods.

Map (1): Map of proliferation of *C. levanderi* in the studied territories (Pazilov and Azimov, 2003). (○ - collection points of terrestrial mollusks).

RESULTS AND DISCUSSION

C. levanderi is considered as a Central Asian endemic species and it is found in almost all high-altitude zones: in the desert zone-among cultivated plants, in Adyr zone-among semi-shrubs, in mountainous zones under shrubs and among large rocks. In Uzbekistan, it is spread in the Ferghana and Surkhan-Sherabad valleys, as well as in the ridges, such as Zarafshan, Turkestan, Babatag, Baysun Tau and Kugitang tau.

Usually the coloration gray or grayish-yellow; mantle darker than the rest of body. Sometimes there are populations with a dark pattern on the upper side of the body of spots and stripes. When shortening, a clear but rounded corner appears on the posterior edge of the mantle. The sole is always lighter than the upper side of the body it is monochrome.

After studying all the available material, it can be noted that the limits of variability of morphological features of C. levanderi were much wider than those given in the monographs of Likharev and Viktor (1980), Schileyko and Rymzhanov (2013) when describing the species.

Most often, the variability of morphological features is observed in the coloration of mollusks, and such variability is clearly observed even in biotopes located not far from each other. For example, in mollusks living among the bushes of the Kampirtepa gorges (Kugitang tau ridge), on the northern slopes of the hills (Pl. 1A), the body color of the mollusks is yellowish, covered with elongated dark spots, and on the sides of the mollusk these spots combined with yellow formed a dark yellow color. The length of the body when moving is 80-90 mm, with a reduction of 55-60 mm.

Plate (1): *C. levanderi*; (A) Living on the northern slopes of hills, (B) In southern slopes, Kampirtepa gorges, Kugitang tau ridge (Surkhandarya region).

The color of mollusks living on the southern slopes of hills (Pl. 1B), among herbaceous plants in an open space, is most often yellow, or part of the neck is earthy (gray), the rest is yellow, when moving it is shiny yellow, on the sides of the legs are light gray. The length of the body when moving is 75-85 mm and when reducing is 50-55 mm.

The mollusks living in the suburbs of Namangan (Pl. 2) have the following variability: the body size is much larger than that of other populations, the body base is yellow, however, the black spots on it are well developed and merge, as a result of which the body color of the mollusks is dark yellow. On the neck there are two yellow stripes running from the mantle to the tentacles, the separator of the tail part of the body is also yellow. On the underside of the body there are dark spots located in a line. The length of the body when moving is 105-120 mm. when reduced; it is 70-75 mm.

Plate (2): *C. levanderi* living among thickets of grasses, in the suburbs of Namangan (Namangan Region).

Thus, the results of the study show that the variability of *C. levanderi* is mainly observed on the coloration of mollusks. For example, the body color (coloration) of mollusks living among shrubs is yellowish, covered with elongated dark spots (Pl. 1A), the color of the species of those living among herbaceous plants in an open space, is most often yellow (Pl. 1B), whereas mollusks living among thickets of grasses, have black spots on the body and they are well developed and merge, as a result of which the color of the body of mollusks becomes dark yellow (Pl. 2).

Apparently, the development of body coloration is an adaptive feature, reflecting, on the one hand, adaptability to certain biotopes on the other hand, and landscape and climatic conditions.

Using a polymerase chain reaction (Kuznetsov, 2002), with the use of primers, the 18S DNA of the region was amplified, the variability (sharply differing in color) of two populations of *C. levanderi* was studied. The first population is in the suburbs of Namangan, (Namangan Region); the second population is Kampirtepa gorges, Kugitang Tau ridge (Surkhandarya Region). The obtained data were compared with the international database (Genbank), and the following results were obtained (Diag. 1).

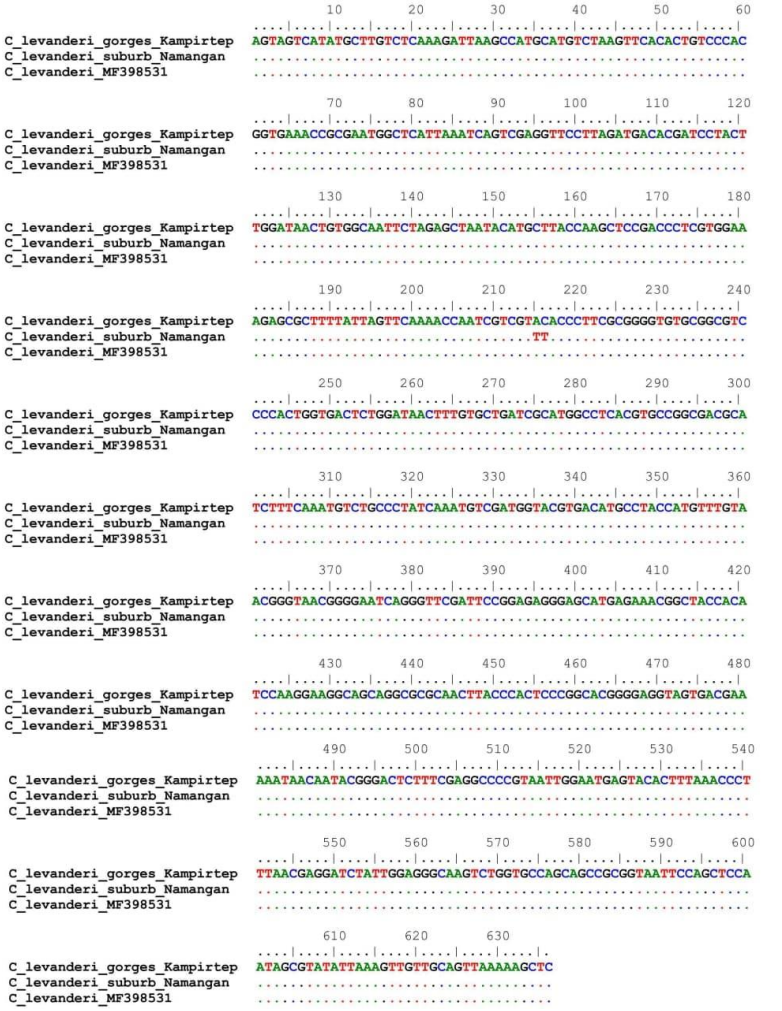

Diagram (1): Comparison of the nucleotide sequences of *C. levanderi* of two populations (direction from 5' to 3' – end, the dot indicates the nucleotide bases).

When comparing the nucleotide sequences of these sites (18S DNA of the region) between the population: the suburbs of Namangan and the Kampirtepa gorges (Kugitang tau), 2 nucleotide positions are noted, which are represented by the transition between pyrimidines (thymine instead of adenine on 205 nucleotides, thymine instead of cytosine on 206 nucleotides). The obtained results show that the nucleotide sequences of partial sections of 18S rDNA in two populations differ in morphological character (color), there were no significant differences between their nucleotides and these individuals were one species of *C. levanderi* living in different landscape and climatic conditions.

We can conclude, the snails change their color depending on the conditions of the habitat, the composition of nutrition and the pigment contained in the mantle. Also, we have not studied environmental factors, light intensity, pH, salinity of the studied species. Thus, having studied the variability of *C. levanderi* in two populations, it was found that this species differs in an extremely wide range of variability both biotopically and geographically (populationally), which, living in two biotopes not far from each other, differ extremely sharply in color and body structure.

The study of the variability of morphological features of *C. levanderi* revealed a certain pattern in shape and color. For example, light brown or yellow color is characteristic of mollusks living on the southern slopes in more open areas, while reddish-brown or dark brown color is characteristic of biotopes with mesophytic and moisture-loving plant associations.

CONFLICT OF INTEREST

We declare that there is no conflict of interest between the authors. We confirm that all the pictures in the manuscript belong to us. We note in this study that there is no conflict of interest regarding the use of the Gulistan State University laboratory.

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طبيعة التباين (Simroth, 1902) *Candaharia levanderi*
في فرغانا وسورخان - وديان شراباد، أوزبكستان

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الخلاصة

تم التحقيق في تباين النوع *Candaharia levanderi* (Simroth, 1902) (Gastropoda, Stylommatophora, Parmacellidae) في اثنين من البيئات الحيوية (المنحدرات الجنوبية والشمالية، وديان Kampirtepa، و Kugitang Tau ridge) باستخدام تفاعل البوليميراز المتسلسل (PCR) بتطبيق البادئات المناسبة مع تضخيم المنطقة 18S DNA للحمض النووي ، و درس التباين (الاختلاف الحاد في اللون) لمجموعتين سكانيتين من النوع اعلاه.

المجموعة السكانية الاولى من ضواحي نامانجان (منطقة نامانجان)؛ المجموعة الثانية من Kampirtepa gorges, Kugitang Tau ridge (Surkhandarya Region). ثبت أنه ، في أغلب الأحيان، لوحظ تغايرا في العلامات المظهرية لتلوين هذا النوع من الرخويات. يعد تطور لون الجسم ميزة تكيفية تعكس القدرة على التكيف مع بيئات حيوية معينة من جهة، والمناظر الطبيعية والظروف المناخية من جهة أخرى.