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Morphometric characteristics of *Leuciscus cephalus albus* (Bonaparte, 1838) (Pisces, Cyprinidae) from Skadar Lake (Montenegro), in the new systematic recognized as *Squalius platyceps*

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Key words: *Leuciscus cephalus albus*, morphometric characteristics, Skadar Lake, Montenegro, *Squalius platyceps*.

Abstract

Analyses of the morphometric characteristics presented in this manuscript has been done prior *Leuciscus cephalus albus* change its systematic status to *Squalius platyceps*. Consequently, data obtained for this white chub population were compared with comparable data for chub populations in aquatic ecosystems in Macedonia, Serbia, Bosnia and Herzegovina and Italy. Out of 27 studied white chub morphometric characteristics, 23 ones are analyzed in percentages related to standard length of body, while 4 morphometric characteristics are studied in the relation to the head length. Morphometric characteristics of white chub are analyzed on high number of samples, i.e. 400 individuals classified in six length groups that provides more comprehensive and accurate data for this species, for the first time.

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Introduction

Interests of scientists, motivated by natural phenomena of the Skadar Lake and its surroundings, can be approached from various scientific aspects. There are many data in literature about ichthyofauna of the Skadar Lake, as well as, of its whole Basin (Karaman, 1933.; Drecun,1957., 1962.; Ivanovic, 1973.; Knezevic, 1981., Krivokapic, 1999., 2001., 2002, 2004., 2005., 2006., 2008., 2009., 2010.; Maric & Krivokapic, 1997., Maric & Milosevic, 2010.; Zupancic *et al*, 2010.etc).

White chub represents economically important cyprinid species but also very interesting sports fish. Due to size of its distribution area with reduced number of salmon species, spread of polluted waters, different methods of catch applied, white chub population may become dominant. Scientific research has been done as part of author´s doctoral thesis (Krivokapic, 2002) on large number of specimens (four hundred) during few years of comprehensive analysis, prior *Leuciscus cephalus albus* change its systematic status to *Squalius platyceps* (2010.).

In this paper is provided new contribution to the knowledge on morphometric characteristics of the population of white chub from Skadar Lake Basin (Western Balkans, Adriatic Sea watershed) that could be used for further comparing.

Materials and methods

Samples were collected on following localities in Skadar Lake:

- St. Nicola monastery (42°16.30' N, 19°08.40' E);
- Virstica mouth (42°15.05' N, 19°06.30' E);
- Vucko blato: Lesendro island (42°16.10' N, 19°07.20' E);
- Vucko blato: Gavrilovac bay (42°16.35' N, 19°06.05' E);
- Vucko blato: Cakovica island (42°17.25' N, 19°07.05' E);
- Ploce (42°19.05' N, 19°05.45' E);
- Kamenik island zone: west side (42°17.45' N, 19°06.10' E).

Linear measurement technique

All linear measurements of morphometric parameters have been done by metal calliper square that provide precise data. Measurement of body mass of the examined samples of fish has been done by lab scale "Sartorius" type accurate to 0.1 g.

Morphometric parameters analysis

27 morphometric parameters (see Figure 1.) were analyzed in this manuscript, as follows:

- *total mass (g);*
- *mass without organs (g);*
- *total length of body* (*a-b*) - distance from the top of proboscis to the longer ray of caudal fin;
- *length according to Smith* (*a- c*) - distance from the top of the proboscis to the middle of the base of caudal fin;
- *standard length* (length without c) (*a-d*), distance from the top of the proboscis to the base of caudal fin;
- *the biggest height of body* (*g-h*), the height measured in front of dorsal fin;
- *the smallest height of body* (*i-k*), the height measured near the caudal fin;
- *the height of head in the back of the head* (*l-m*), measured at the level of the back of the head i.e. the place of attaching of the first vertebra for the skull;
- *the length of head(a-o*), distance between the top of the proboscis and the back part of the gill cover, which sticks out the most at the back side, skin edges don't count;
- *preorbital distance of head*- the length of proboscis (a-n), distance from the front proboscis to the front edge of the yes;
- *diameter between eyes* (*n-n*$_1$) - distance between eyes;
- *diameter of eye* (*n-p*), measured horizontal diameter;
- *postorbital distance of head* (*p-o*), distance from the back edge of eye to the back edge of gill cover;

- *antedorsal distance* (*a-q*), distance from the top of the proboscis to the beginning of the base of dorsal fin, on the straight line;
- *postodorsal distance(r-d*), distance from the vertical of the back end of the base of the dorsal fin to the base of caudal fin, along the straight line;
- *anteventral distance* (*a-z*), distance from the top of the proboscis to the beginning of the base of ventral fin, on the straight line;
- *postventral distance* (*s-d*), distance from the end of the proboscis to the base of caudal fin, on the straight line;
- *anteanal distance* (*a-e*), distance from the top of the proboscis to the beginning of the base of the under-caudal fin, on the straight line;
- *length of the caudal peduncle- postanal distance* (*f-d*), distance from the back part of the base of the undercaudal fin, to the ray of the caudal fin along the straight line;
- *the length of the base of the dorsal (D) fin* (*q-r*), distance from the front part of the first, to the back part of the last ray in the fin;
- *height of dorsal (D) fin* (*q-n*), distance from the front part of the first to the last part of the last ray of the fin;
- *the length of the base of the anal fin (A)* (*y-f*), distance from the front part of the first, to the back part of the last ray in the fin;
- *height of the undercaudal (A) fin* (*a-j*), distance from the front part of the base of the undercaudal fin to its top;
- *length of pectoral (P) fin* (*v-x*), distance from the front part of the base of the pectoral fin to its top;
- *length of ventral (V) fin* (*z-z*$_1$), distance from the front part of the base of the ventral fin to its top;
- *distance P-V* (*v-z*), distance between the back end of the base of the pectoral to the front part of the base of the ventral fins;
- *distance V-A* (*z-j*), distance between from the back part of the base of ventral to the front parts of the base of undercaudal fin;

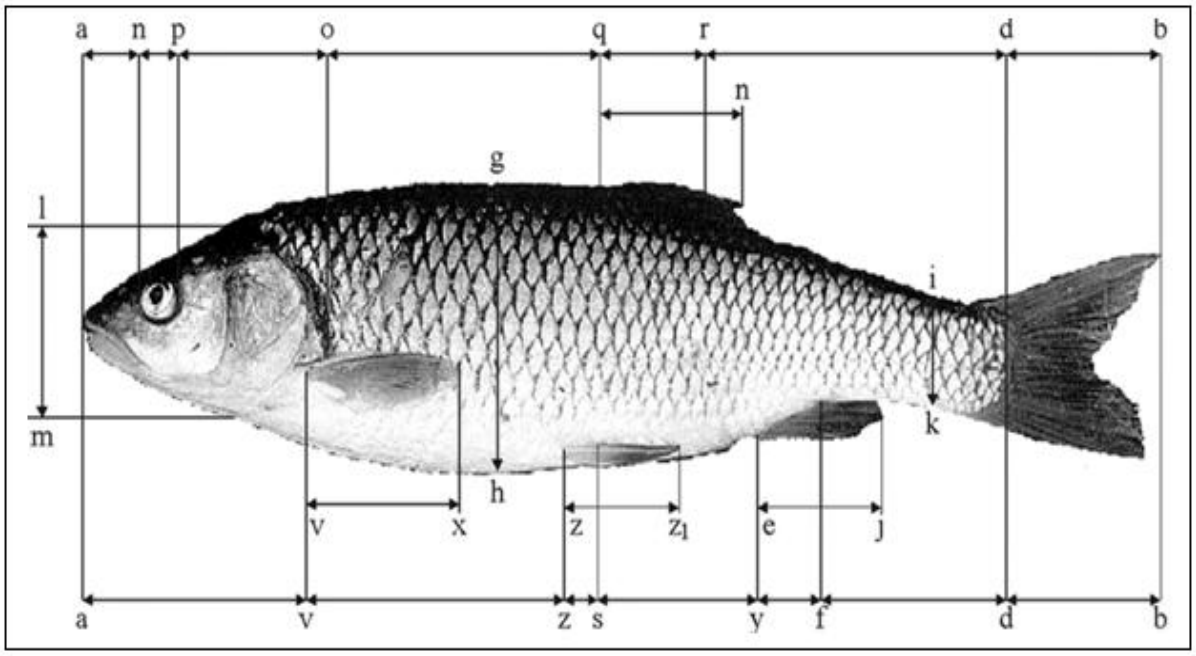

Fig. 1. Revised schedule for the measurement of morphometric characteristics - general review for *Cyprinidae* family (Pravdin, 1966.; Krivokapic, 1994.).

Data processing

In this work the following standard statistical methods were used in data processing:

1. Measures of central tendency: arithmetic mean $\bar{x}$ according to following formula:

$\bar{x} = \bar{X}/N$

presenting the sums of all results / number of results.

2. Testing of difference between the two arithmetic means: standard mistake of arithmetic means, according to formula:

$s = s/\sqrt{N}$

presenting the measures of variations of samples round the real arithmetic mean of population.

3. In data processing, standard deviation s in measures of variability was analysed according to the following formula:

$$s = \sqrt{\sum \left(\bar{x}_1 - \bar{x}_2\right)/(N-1)}$$

as a measure of varying of the individual results round their arithmetic mean.

4. Variability coefficient *(CV)* which was used to enable mutual comparison of variability of different features that defines what percentage of the arithmetic mean value is standard deviation value:

$CV = s\ 100 / x$

Variability coefficient is rather useful measure in all those cases to identify in which feature some groups varies more and in which less and also which group varies more and which less in the same feature. Variation width (Vw) is represented by difference between the maximal and minimal value of the sample.

5. For establishing the character of the connection of two variables, it was used the following coefficient correlation:

$$r = \frac{N\sum xy - \left(\sum x\right)\left(\sum y\right)}{\sqrt{\left[N\sum x^2 - \left(\sum x^2\right)\right]\left[N\sum y^2 - \left(\sum y^2\right)\right]}}$$

Calculating formula *(r)*:

$_{xy}$ - sum of multiplying of certain pairs results;

N - number of pairs;

x^2 and y^2 - sum of square results of variable x and variable y (Hadzivukovic, 1973; Petz, 1971;Snedecor, 1956.).

Results and discussion

Among 27 estimated morphometric characteristics, 23 characteristics have been analysed in percentages related to standard length of the body, while 4 characteristics were analysed in the relation to the length of head.

Consequently, data obtained for this population of white chub were compared with available comparable data for chub populations in aquatic ecosystems in Macedonia, Serbia, Bosnia & Herzegovina and Italy. In order to provide more precise data, 400 individuals have been analysed and statistically processed in the relation to chub size. These individuals were classified in six length groups for analysing morphometric characteristic.

The following morphometric characteristics were analysed:

- total mass (g);
- mass without organs (g);
- total length of body (mm);
- length according to Smith (mm);

percentage (%) in relation to total length (in longitudinis corporis)

- standard length

percentage (%) in relation to standard length of body (in longitudinis corporis)

- total length;
- the biggest height of body (*latitudo corporis maximum*);
- the lowest height of body (*latitudo corporis minimum*);
- the height of head (*latitudo capitis*);
- length of the head (*longitudo capitis*);
- length of the preorbital distance of head (*distantia praeorbitalis*);
- distance between eyes (*diameter oculi*);
- length of the postorbital distance of head (*distantia postorbitalis*);

- antedorsal distance (*distantia praedorsalis*);
- postdorsal distance (*distantia postdorsalis*);
- anteventral distance (*distantia anteventralis*);
- length of caudal peduncle (*longitudo ped. caude*);
- length of base D (*longitudo pinae D*);
- height D (*altitudo pinae D*);
- length of base A (*altitudo pinae A*);
- height A (*altitudo pinae A*);
- length P (*longitudo pinae P*);
- length V (*longitudo pinae V*);
- distance P-V (*distantia P-V*);
- distance V-A (*distantia V-A*);

in percentage in relation to the length of the head (in % longitudinis capitis)

- length of preorbital distance of head (*distantia praeorbitalis*);
- distance between the eyes (*distantia interoculis*);
- diameter of eye (*diameter oculi*);
- length of postorbital distance of head (*distantia postorbitalis*);

Results of variation-statistical processing are presented separately in compliance with length groups of the species. Since significant number of examined morphometric parameters had high variability in relation to the body length, their common characteristics for entire population of white chub in Skadar Lake were not provided.

Regarding the length, seven length groups were distinguished, and they are:

- the first group: from 60.0 to 120.0 mm;
- the second group: from 120.1 to 180.0 mm;
- the third group: from 180.1 to 240.0 mm;
- the fourth group: from 240.1 to 320.0 mm;
- the fifth group: from 320.1 to 380.0 mm;
- the sixth group: from 380.1 to 420.0 mm;
- seventh group: from 420.0 to 480.0 mm.

Values of morphometric characteristics are presented in section for Tables, as follows: (i) Tables 1-7 present data related to the standard length of body (24 morphometric characteristics) for 7 length groups, in percentages (%) (ii) Tables 8-14 present data related to the length of the head (4 morphometric characteristics) for 7 length groups in percentages (%); and 4 morphometric characteristics: total mass and mass without organs; total length, length according to Smith and standard length expressed in mm. In total, statistically 32 parameters are processed. Varieties of morphometric parameters are visually presented in Figures 2-6.

In the first length group (60.0-120.0 mm) by analysing the samples, the lowest value of the caught samples is 5.1 g (total mass), 3.6 g (mass without internal organs) while the weight of the biggest caught specimen of this length group is 23.7 g (total mass) or 33.1 g (mass without internal organs). In the sixth length group (420.0-480.0 mm) the mass of the smallest caught samples is 1484.0 g or almost 1.5 kg. According to data of the fisherman from Skadar Lake, it is not a rare case to catch specimen from 1.5 to 2.0 kg, and on the basis of the same data although more rarely, samples with mass of 3.0 kg were caught.

Total length of the biggest sample previously mentioned is 500.0 mm, or 450.0 mm of standard length. The smallest samples of the first length group are 75.0 mm long and the biggest 134.0 mm. The average value of the standard length, expressed in percentages in relation to a total length, in all six groups varies from 83.77% in the third length group, to 87.92 % in the sixth length group. Values of standard deviation (s) for the given parameter in all six groups are: 1.51; 0.99; 3.78; 1.49; 2.01; 0.18; 2.43. This parameters show that the calculated value of the arithmetic mean is relatively good presented results.

The maximum measured total body length (*longitudo total corporis*) for Chub from Skadar Lake is 353.0 mm; for Chub from Prespa Lake (Macedonia) 358.9 mm; for chub from Dojran Lake(Macedonia) 305.5 mm; for chub from Vardar river (Macedonia) 247.5 mm and for chub from Strumica river(Macedonia) 38.5 mm (Grupce and Dimovski, 1982). The total length of the chub from the thermal waters of the river Vrujci, Gornja Toplica (Serbia) is 121.51 mm (Lenhardt and Krpo, 1988). Ivanovic and Sekulovic (1971) gave variations of total length for Chub from

Skadar Lake from 194.5 to 372.5 mm ($\bar{x}$=279.83). The same authors gave variations from 164.0 to 313.1 mm ($\bar{x}$=237.81) for the standard length. Variations of the standard length of chub from Skadar lake, on the basis of the obtained data, are from 65.0 to 450.0 mm. Taking into account the above mentioned it is noticed quite higher values obtained on the basis of personal explorations.

Average value of parameter, the biggest body height, varies from 22.50 (the first length group) to 26.48 (the fifth length group) expressed in % in relation to body length.

The biggest height of the body for the chub from Ohrid Lake, varies from 21.3-27.8 ($\bar{x}$=23.64); for the chub of Prespa Lake, 21.0-27.2 ($\bar{x}$=24.13); Dojran Lake, 20.5-26.1 ($\bar{x}$=23.64); for the chub of River Vardar, 20.2-26.3 ($\bar{x}$=24.07); and for the chub of Strumica River 20.0-25.7 ($\bar{x}$=23.07), (Grupce and Dimovski, 1982).

Average value of biggest height for the chub live in thermal waters of river Vrujci is 20.68 (Lenhardt and Krpo, 1988) while for the chub from Zapadna Morava river (Serbia) counts 24.34 (Lenhardt, 1987). Variations of the parameters that are linked to the height of chub from Skadar Lake are defined in the range from 15.1 to 33.5 in respective length groups.

Comparing the above mentioned chub populations from the various localities, this parameter shows obviously higher values. However, this parameter varies in depending on season and the sex. Vukovic (1967.)pointed out the biggest height of the body 22.72% for the samples from the river Trebisnjica (Bosnia and Herzegovina) in relation to the body length without caudal fin.

The smallest body height (*latitudo corporis minimum*) is more stable parameter comparing to the biggest body height parameter. This is manifested by the lower value of standard deviation (s), which is from 0.41 (the second length group) to 0.74 (third length group).

The smallest height of the body in the scope of length groups varies from 8.3 (for 1st length group) to 13.3 (for the IV length group). Variations for chub from Ohrid Lake are from 9.5 to 11.5 ($\bar{x}$=10.49); for chub from Prespa Lake from 8.3-15.0 ($\bar{x}$=10.44); for chub from Dojran Lake from 8.9 -11.1 ($\bar{x}$=9.87); for chub from Vardar river from 10.0 to 12.4 ($\bar{x}$=10.83); for Chub from Strumica river from 9.35 to 11.2 ($\bar{x}$=10.32), (Grupce and Dimovski, 1982); for the chub from the river Vrujci $\bar{x}$=9.86, and for the chub from the river Zapadna Morava $\bar{x}$=9.85 (Lenhardt and Krpo, 1988; Lenhardt, 1987). Grupce and Dimovski (1982) gave variations of the parameter of the smallest body height for chub from Skadar Lake: 9.8 – 13.4 ($\bar{x}$=10.63). The given data point out the big similarity with the data of my personal research.

The smallest body height which was given by the author (Vukovic, 1967) for the samples from the river Trebisnica is 10.59% of the body length without caudal fin.

The head length (*longitudo capitis*) expressed in percentage (%) of the standard body length of chub from Ohrid Lake varies from 22.4 to 26.5 ($\bar{x}$=24.37); for chub from Prespa Lake varies from 23.9 to 28.4 ($\bar{x}$=26.31); for chub from Dojran Lake varies from 22.4 to 27.4 ($\bar{x}$=25.63); for chub from Vardar river varies from 22.2 to 26.7 ($\bar{x}$=24.37) and for chub from Strumica river varies from 21.7 to 26.6 ($\bar{x}$=24.42). Authors Grupce and Dimovski (1982) also gave data for chub from Skadar Lake and they pointed out variation from 24.2 to 28.2 ($\bar{x}$= 22.58). According to the personal data percentage variations of the head length in relation to body length are from 19.80 to 29.00% for all 7 analysed length groups with the average value $\bar{x}$=24.59. The scope of variations of the morphometric parameter head length is the biggest

for the population of chub from Skadar Lake, although the average values are bigger for the population of chub in Prespa and Dojran lakes. Chub populations in Ohrid Lake, Vardar river and Strumica river have smaller average values of this parameter than population of chub from Skadar lake. The average value of the head length for chub from river Zapadna Morava is 26.32 (Lenhardt, 1987), while for the chub from thermal waters of river Vrujci is 26.13 (Lenhardt and Krpo, 1988).

Ivanovic and Sekulovic (1971) gave data of the average value of 27.70 expressed in percentages in relation to body length without tail fin for Skadar chub. Oliva (1951) concluded that head length is 3.25 times of the body length without caudal fin.

Morphometric parameter, head length, at younger individuals, or younger age groups takes more than 1/4 of body length, or, the average values expressed in percentages in relation to standard length of the analysed length groups, are: I- 25.52; II- 25.02; III- 26.29; IV - 25.31; that present slightly less than 1/4 of body at the samples from older age groups: V - 24.88; VI - 23.00; VII - 22.50.

Eye diameter (*diameter oculi*) in relation to head length (%), for the Ohrid chub, varies from15.0 to 21.0 ($\bar{x}$ =18.77); for Chub from Prespa Lake from 15.2 to 22.1 ($\bar{x}$ =17.30); for chub from Dojran Lake from 21.5 to 29.2 ($\bar{x}$ =25.88); for chub from Vardar river from 19.1 to 24.9 ($\bar{x}$ =21.95); for chub from Strumica river from 18.5 to 25.6 ($\bar{x}$ =22.40). The average value of the eye diameter of all length groups in relation to the head length is 17.62.

However, concerning the fact that there are big differences between younger age groups and mature samples, the given average value cannot be completely competent result, because the average value of the eye diameter for the first length group is 26.32 (as it was said, this morphometric parameter shows bigger value for younger age groups). These values decrease moving towards the older samples, i.e. older age groups, so that the average value for length group II are: 20.74; for III– 18.27; IV – 16.65; V – 15.34; VI –13.10 and for VII – 12,94. Regular fall of average values of morphometric parameters, eye diameter, is evident in relation to the standard length, too: I length group 6.71; II – 5.19; II- 4.80; IV – 4.21; V – 3.81; VI – 3.01; VII – 2.90 ($\bar{x}$ =4.37). Correlation also points out the regular fall of the average values, which for length group I amounts 0.7817, while the correlation for the length group VII is negative and incomplete because increase of variables, body length, correspond to linear decrease of the second variable – morphometric parameter – eye diameter.

Oliva (1951) established that eye diameter “fit” in the head length 3.8 times. Tortonese (1970) established eye diameter in relation of the head length for samples from the Lake Trasimeno (Province of Perugia, Italy) with the value of 5-5.5%, but also for samples from Lake Arsa (il lago d Arsa, Italy)that has value 4.5-5.5%. Ivanovic and Sekulovic (1971) established eye diameter of 16.71% of the head length.

Eye diameter, as a morphometric parameter is bigger at the individuals of the younger age groups. When calculated in percentages (%) in relation to standard length, the average value is the bigger at the first length group, 6.71%. When calculated in percentages in relation to head length, the biggest percentage is also at the first length group 26.31, that is, the eye takes almost 1/4 of the head length (3.79 to be more precise). At the older age groups, the size of eye is getting smaller, so at the seventh length group, in relation to head length, the eye takes something less than 1/8 of the head length, or to be precise 7.72.

When calculated in %, in relation to standard body length, arithmetic mean of morphometric parameters: antedorsal distance is from 46.08 (VII length group) to 55.61 (III length group); postdorsal distance from 34.18 (VII length group) to 40.64 (II length group); anteventral distance from 44.78 (VII length group) to 52.23 (II length group); anteanal distance from 64.81 (VII length group) to 71.92 (III

length group) and the length of tail branch from 19.68 (VII length group) to 25.17 (I length group). From the above mentioned facts, we can see that the values of the given parameters are lower at the older individuals, i.e. they are bigger at the older individuals.

Antedorsal distance (*distantia praedorsalis*) (in %) for chub from Ohrid Lake varies from 49.9 to 56.4 ($\bar{x}$ = 53.03); for chub from Prespa Lake 51.2 to 56.2 ($\bar{x}$ =53.57); for chub from Dojran Lake 43.6 to 54.1 ($\bar{x}$ = 51.92); for the chub from the thermal waters of the river Vrujci 54.16; for the chub from the river Zapadna Morava 54.66 (Grupce and Dimovski, 1982; Lenhardt and Krpo, 1988; Lenhardt, 1987). Grupce and Dimovski(1982) pointed out variations of chub from Skadar Lake from 51.7 to 55.6 ($\bar{x}$ = 53.84). Variation of antedorsal distance for all length groups of chub from Skadar Lake is 46.6 to 66.2, and the average value is $\bar{x}$ =52.67.

Anteventral distance (*distantia praeventralis*) (in %) for chub from Ohrid Lake varies from 44.5-53.4 ($\bar{x}$ = 49.46); for Chub from Prespa Lake 49.3-57.1 ($\bar{x}$ =51.76); for chub from Dojran Lake44.0-51.7 ($\bar{x}$ =49.36); for chub from Vardar river 47.2-53.1($\bar{x}$ =49.70); for chub from Strumica river 44.5-53.4 ($\bar{x}$ =49.46) (Grupce and Dimovski, 1982); for the thermal waters $\bar{x}$ =51.74; for chub from the river Zapadna Morava 50.98 (Lenhardt, 1987;Lenhardt and Krpo, 1988). Variation of anteventral distance for chub from Skadar Lake goes from 37.8 to 62.3 ($\bar{x}$ =50.07). Grupce and Dimovski gave data on variation of this morphometric parameter from 48.6 to 52.4 ($\bar{x}$ =50.38).

Anteanal distance (*distantia praeanalis*) (in %) for chub from the river Zapadna Morava is $\bar{x}$ =70.77, for chub from thermal waters of river Vrujci 70.37 (Lenhardt, 1987; Lenhardt and Krpo, 1988). On the basis of the obtained data on chub from Skadar Lake variation for all length groups is from 47.7 to 86.9 ($\bar{x}$ =70.79). The average value of the anteanal distance in chub from Skadar Lake is bigger than in chub from Ohrid Lake ($\bar{x}$ =69.92); Prespa Lake ($\bar{x}$ =70.30); the Dojran Lake ($\bar{x}$ =69.08); Vardar river ($\bar{x}$ = 69.99) and Strumica river ($\bar{x}$ =69.38). For chub from Skadar Lake anteventral distance in relation to antedorsal distance is, in average, more moved forward.

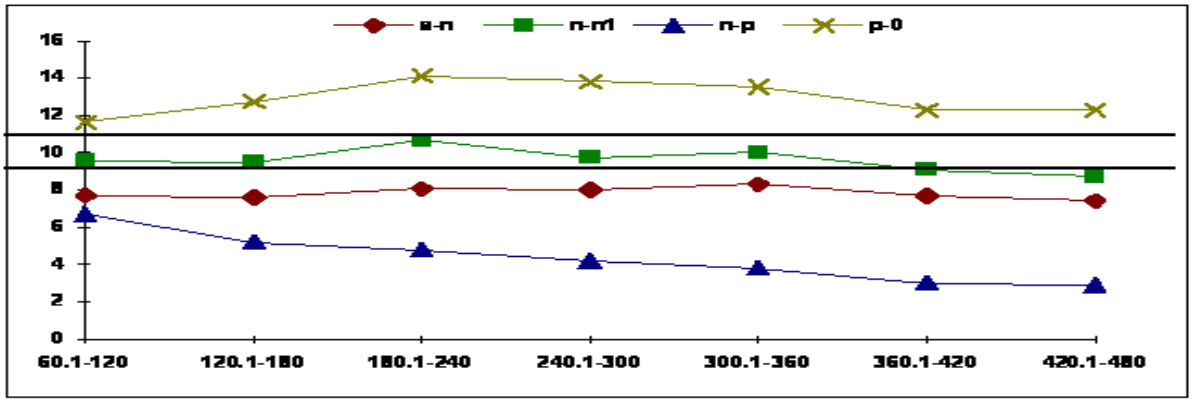

Fig. 2. Variability of morphometric parameters: a-n, n-n_1, n-p and p-o in relation to head length.

Legend:
a-n – preorbital distance of head
n-n – diameter between eyes
n-p – diameter of eye
p-o – postorbital distance of head.

The length of the dorsal branch (*longitudo peduncle caudalis*) varies from 17.8 to 31. 1 ($\bar{x}$=22.84). Concerning this parameter, authors Grupce and Dimovski (1982) established value of $\bar{x}$=22.58 which shows a very big similarity to the data presented in this work. Length of caudal peduncle, tail branch represents a stable parameter comparing to the other given morphometric parameters, which show season variation as well as variation between the sexes.

Preocular distance (*distantia praeorbitalis*) varies from 25.5 to 42.6 for all length groups. Variation of this parameter for chub from Skadar Lake are bigger than the variations of the same parameter for chub from Ohrid Lake (31.0-36.7); chub from Prespa Lake (30.0-36.7); chub from Dojran Lake (30.2-33.2); chub from Vardar river (31.0-37.5) and chub from Strumica river (30.2- 37.5). According to data, this has bigger interocular distance (*distantia interoculis*) than preocular distance, i.e., variation of interocular distance is from 29.6 to 47.5, with the average value, for all length groups, of 38.68. As for previous parameter, the values of variations are bigger in relation to the Ohrid lake's chub (37.9-44.5); the Prespa lake's chub (33.4-40.9); and Dojran lake's chub(33.6-42.5); as well as the Vardar river's chub (38.7-45.7); and Strumica river's chub (34.0-40.9), although the average values for the population of the Vardar (42.00) and Chub from Ohrid Lake (40.80) show higher values.

Ivanovic and Sekulovic (1971) established the data of 32.81% for this parameter for chub from Skadar Lake. Vukovic (1967) pointed out that the preocular distance takes 32.81% of the head length.

The average value of morphometric parameter, preorbital distance, expressed in % in relation to the head length, shows lower value at the first five length groups (30.32; 30.50; 30.68; 31.68;), that is higher value at the fifth (33.40) and seventh (33.43) length group. At the younger age groups, preorbital distance takes something more than 1/3 of head length, for example, at the individuals of the third length group- it takes 3.33 while at the seventh length group it takes 2.99.

Distance between the eyes, parameter whose average value of analysed length groups in relation to the head length is 36.08 (VII length group) to 40.59 (III length group).

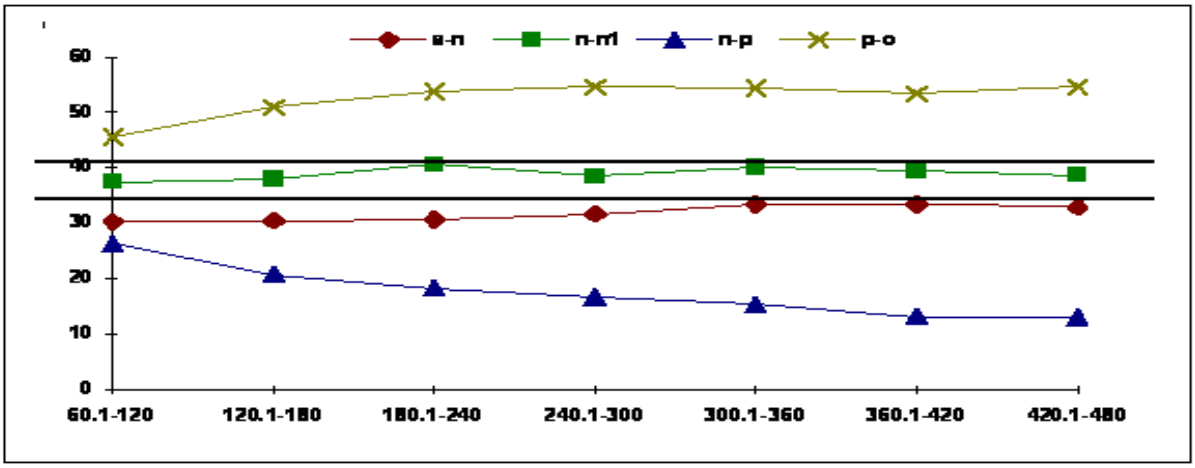

Fig. 3. Variability of morphometric parameters: a-n, n-n_1, n-p and p-o in relation to standard length.

Legend:
a-n = preorbital distance of head (*distantia praeorbitalis*)
n-n_1= distance between the eyes (*distantia interoculis*)
n-p= diameter of eye (*diameter oculi*)
p-o= postorbital distance (*distantia postorbitalis*).

Post ocular distance (*distantia postorbitalis*), expressed in %, according to data, and varies from 25.3 to 63.7 with the average value of 49.80. The obtained value is insignificantly higher in relation to chub from Dojran Lake (49.69), while the values of the following populations are: from Vardar river ($\bar{x}$=50.69), Strumica river ($\bar{x}$=54.08), Prespa lake ($\bar{x}$=54.08) and Ohrid lake ($\bar{x}$=52.40). Vukovic (1967) mentioned that morphometric parameter postocular distance takes 50.45% of the head length. Ivanovic and Sekulovic (1971) pointed out that postocular distance takes 55.03% of the head length. Comparing to previously mentioned morphometric parameters (preorbital distance, the distance between eyes, diameter of eye) postorbital distance takes the greatest percentage in relation to head-length and that is up to 54.65% (IV-length group).

Morphometric parameter P–V (*distantia P – V*) varies from 21.3 to 32.9%, while distance V–A, varies from 18.0 to 27.7 % for the samples of all length groups of the Skadar chub. The distance P –V is bigger than the distance V–A. The length of the basis of anal fin *(longitudo pinae A*) varies from 5.8 – 13.4 % and, on average, is bigger than the length of the basis of the dorsal fin (*longitudo pinae D*) which varies from 5.5-12%.

The height of D fin *(altitudo pinae D)* varies from10.8-20.5% and it is significantly higher than the height of anal fin (*altitudo pinae A*) which varies from 8.0-15.1%.

In order to compare variability of the different morphometric parameters, coefficient of variability was calculated and then it was established which parameter varies more and which one less in the same feature. Great variation of variability coefficient was noted with the following morphometric parameters: total length (expressed in mm) and mass (g), in all length groups, especially in the first length group, while the other parameters show pretty small variability coefficient.

The length of the basis of anal fin *(longitudo pinae A)* varies from 5.8 – 13.4% and, on average, is bigger than the length of the basis of the dorsal fin (*longitudo pinae D*) which varies from 5.5-12%.

The height of D fin *(altitudo pinae D)* varies from 10.8-20.5% and it is significantly higher than the height of anal fin (*altitudo pinae A*) which varies from 8.0-15.1.

According to the researches on the basis of meristic and morphometric characteristics of chub from Macedonia (from river Vardar: *Leuciscus cephalus vardarensis*, Karaman, 1929, and from river Strumica: *Leuciscus cephalus macedonicus*, Karaman, 1955, and from Ohrid, Prespa and Dojran lakes) and from the Skadar Lake, authors Grupce and Dimovski (1982) pointed out that there are no significant differences between them.

Authors pointed out that the analyses of morphometric parameters of the chub from Skadar Lake and Vardar river show that 10 parameters have no statistically justified significant differences (d<3.0). The difference varied from 3.1 to 5.0 for 8 parameters, for 11 parameters it varied from 5.1-10.0 and for 1 parameter it varied more than15.1. Authors also pointed out that the chub from lakes had significantly shorter dorsal and anal fin and that the biggest differences appeared for these morphometric parameters. They also supposed that the reasons for these differences were primarily different life conditions of the compared populations: some of them lived in stagnant and the some lived in running waters.

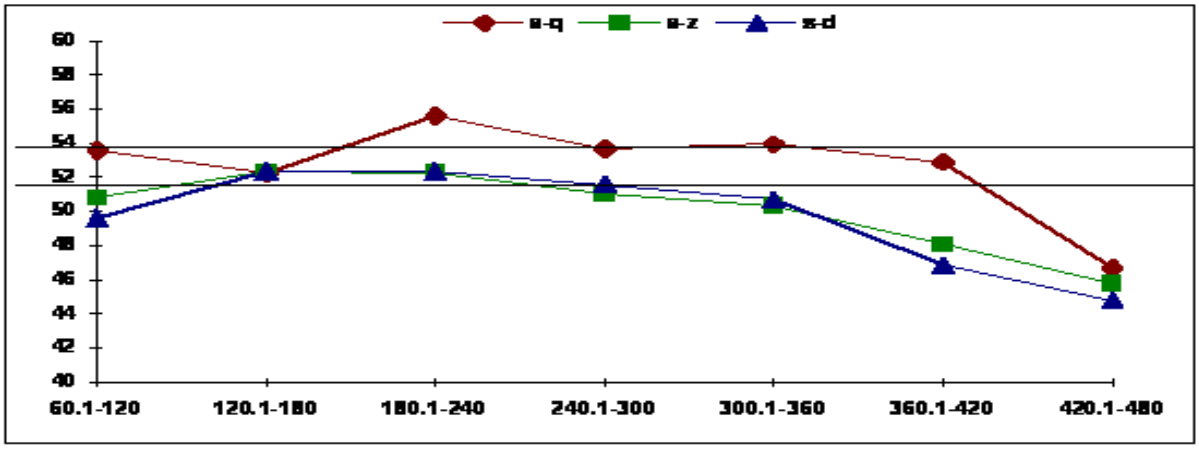

Fig. 4. Variability of morphometric parameters: a-q, a-z and s-d in relation to standard length.

Legend:
a-q= antedorsal distance (*distantia praedorsalis*)
a-z= anteventral distance (*distantia anteventralis*)
f-d= length of caudal peduncle (*longitudo ped. caude*).

During the comparison of the chub populations from the Skadar Lake and the river Strumica, authors point out that 7 parameters do not have statistically justified differences (d<3.0), for 9 parameters difference varies between 3.1 and 5.0, for 7 parameters from 5.1-10.0, for 9 parameters from 10.1-15.0 and for 1 parameters more than 15.1.

Concerning these two populations authors pointed out that compared parameters do not show (sub)species differentiation and if 5 morphometric parameters are close to the (sub)species differentiation *distantia praedorsalis*, *altitudo capitis* and *altitudo A* expressed in percentage (%) of the body length, as well as diameters: *diameter oculi* and *distantia interoculis* expressed in percentage of the body length.

Concerning population of the chub from Skadar Lake and its comparison to the population from Ohrid Lake, author provided analyses which undoubtedly indicate that morphologically, these two populations are identical (15 parameters do not have statistically justified differences, d<3.0; for 3 parameters the difference varies from 3.1-5.0 and for 13 parameters it varies from5.1-10.0).

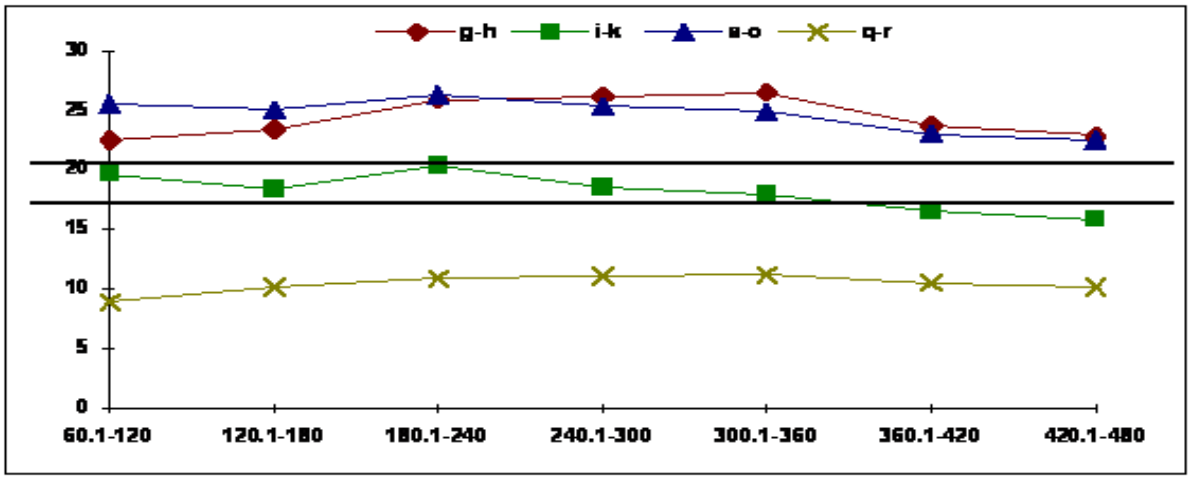

Fig. 5. Variability *of morphometric parameters: g-h, i-k, a-o and q-r in relation to standard length*.

Legend:
g-h= the biggest height of the body (*altitudo corporis maximum*)
i-k= the lowest height of body (*altitudo corporis minimum*)
a-o= the height of head (*longitudo capitis*)
q-r= length of base D (*longitudo pinae D*).

Comparison of morphometric parameters from the Skadar and the Prespa Lake shows that these two populations are close, although the two parameters have values close to the (sub)species differentiation. Bigger differences are for the following parameters: *diameter oculi* expressed in % of *distantia postorbitalis* and *distantia postorbitalis,* expressed in percentage of *longitudo capitis* (Grupce and Dimovski, 1982).

According to data of my own researches that include the number of morphometric parameters, it is evident that population of white chub from Skadar Lake can be differentiated from white chub populations in Ohrid Lake, Prespa Lake, Dojran Lake, Vardar river and Strumica river, as well as from white chub populations from river Vrujci and Zapadna Morava river for most of parameters with high values.
This can be explained by the distance of a certain freshwater ecosystems, in which the given populations exist, i.e. the variability of morphological parameters is also the result of the long geographical isolation.

Grupce and Dimovski (1982) according to their own researches of meristic and morphometric parameters have pointed out that there are no differences between chub population from lakes in Macedonia (Ohrid and Prespa Lake) and from Skadar Lake from Montenegro, as well as *Leuciscus cephalus vardarensis*, Karaman, 1929. (from Vardar river) and *Leuciscus cephalus macedonicus*, Karaman, 1955. (from Strumica river that is tributary to Struma river). If there are some differences they appear as a result of great variability of morphometric parameters concerning the geographical distance. As conclusion it should be taken into account that the comparison was done by the authors with three lake forms and two rivers forms.

The number of forms mentioned by Ivanovic and Sekulovic, 1971, Grupce and Dimovski, 1982, for chub from Skadar Lake population, show more differences in comparison to data obtained by this research.

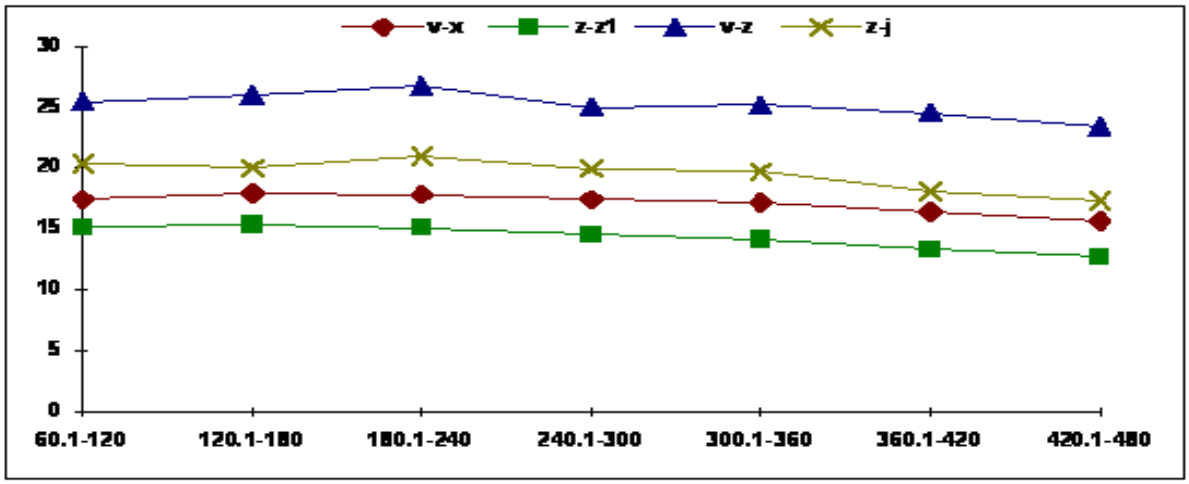

Fig. 6. Variability of v-x, z-z_1, v-z and z-j in relation to standard length.

Legend:
v-x= length P (*longitudo pinae P*)
z-z_1= length V (*longitudo pinae V*)
v-z= distance P-V (*distantia P-V*)
z-j= distance V-A (*distantia V-A*).

According to data from the literature white chub is very similar to *Leuciscus cephalus cabeda*. Tortonese (1970) comparing these two forms. Author pointed out the difference: *L. c. albus* has bigger eye diameter than *L. c. cabeda*. Bonaparte takes the cut of oral cavity as a very important parameter. He said that the oral cavity reaches almost to the middle of the eye what, as it was mentioned by Ivanovic and Sekulovic (1971.), completely applies to the samples from the Skadar Lake. Karaman (1928) and Tortonese (1970) concluded for the *chub*: the oral opening is deeper and it stretches to under the front part of the eye edge.

Authors Grupce and Dimovski (1982.) said that claims of Tortonese (1970.),Ivanovic and Sekulovic (1971) and other authors "that the angle of the oral cavity reaches to the middle of the eye and that it represents one of the characteristic traits of the *chub* (Bonaparte, 1838) is not truthful. Authors claims that for the analysed populations the angle of the oral cavity reaches not even close to the front edge of the eye (it ends a great deal in front of it). Further, authors claim that the situation is in a way different with the end of upper jaw, since upper jaw reaches to the front edge of the eye for 13 chub samples in Vardar river and 17 chub samples in Strumica river, while in 28 samples of chub from Vardar river and 23 samples of chub from Strumica river the upper jaw ends by the front part of the eye. Concerning population of white chub in Skadar Lake, there were identified 15 samples with upper jaw that is ended by front edge of eye and 29 samples with jaw that is ended in front of the front part of eye. For the other lake populations the upper
jaw ends in front of the front part of the eye.

The body length without caudal fin for chub from Skadar Lake reaches up to 450 mm. The head length reaches up to 26.29%. The average value of the antedorsal distance is 52.67, while the postdorsal distance varies from 34.18 to 40.64. The biggest body height values go from 22.50 to 26.48. The average value of the anteventral distance is 50.07%. The smallest body height varies from 8.3 to 13.3.

The length of the caudal branch varies from 17.8 to 31.1 ($\bar{x}$ =22.84). The distance P–V is bigger than the distance V–A. Parameter P–V varies from 21.3 to 32.9. V–A varies from 18.0 to 27.7% in relation to body length without caudal fin. The basis length of the anal fin varies from 5.8 to 13.4 and in average it is

bigger than the basis length of the dorsal fin which varies from 5.5 to 12.0. Preocular distance varies from 25.5 to 42.6%; the average value of postocular distance is $\bar{x}$=49.80 while the average value of the eye diameter in relation to the head length is 17.62%. Correlation (r) of morphometric characteristics in relation to standard length, according to seven length groups are given in the Table 15.

Chub has prolonged and cylindrical body, covered with large scales. The head of chub from Skadar Lake is relatively big. The mouths are wide and ended, somewhat bigger than the mouth of the related carp fish. Its back is of grayish silver color, and its sides are of silver – whitish color (with the gold – yellowish nuance). Its abdomen is of white color. Dorsal fin is grayish, and it begins behind the vertical middle of the abdominal fin basis. Pectoral fins are orange in color, while the abdominal and the anal fins are of pink-reddish nuance.

Tables

Table 1. Morphometric characteristics of the first length group (60.1 - 120.0 mm)

	Min-max	Vw	$\bar{x}$	s	$s_{\bar{x}}$	CV %
●	5.1 - 23.7	18.6	11.47	4.46	0.66	38.87
❍	3.6 - 33.1	29.5	11.14	6.78	0.94	60.86
■	75.0 - 134.4	59.4	102.81	16.23	2.34	15.79
◘	71.0 - 127.6	56.6	95.12	15.24	2.13	16.02
❒	65.0 - 119.2	54.2	86.58	14.14	1.96	16.33
		% in relation to total length				
a-d	82.1 - 89.2	7.1	84.85	1.51	0.22	1.78
		% in relation to standard length				
a-b	112.1 - 121.8	9.7	117.89	2.08	0.30	1.76
g-h	15.1 - 26.5	11.4	22.50	1.87	0.26	8.33
i-k	8.3 - 11.1	2.9	9.97	0.58	0.08	5.77
l-m	17.0 - 22.8	5.8	19.64	1.29	0.18	6.57
a-o	21.7 - 27.8	6.0	25.52	1.23	0.17	4.83
a-n	6.3 - 8.8	2.5	7.72	0.52	0.07	6.78
n-n_1	7.9 - 10.7	2.8	9.55	0.55	0.08	5.76
n-p	5.6 - 8.5	2.9	6.71	0.70	0.10	10.49
p-o	6.3 - 14.2	7.9	11.66	1.52	0.21	13.05
a-q	47.6 - 56.2	8.6	53.57	1.63	0.23	3.03
r-d	36.7 - 44.0	7.3	39.90	1.49	0.21	3.74
a-z	43.5 - 54.5	11.0	50.79	2.04	0.29	4.02
s-d	44.7 - 57.7	13.1	49.61	2.56	0.36	5.16
a-e	47.7 - 76.2	28.5	70.23	3.82	0.53	5.44
f-d	21.5 - 31.1	9.6	25.17	1.80	0.25	7.17
q-r	5.5 - 13.4	7.8	8.89	1.26	0.18	14.21
q-u	13.4 - 20.5	7.2	16.58	1.24	0.17	7.49
y-f	5.8 - 13.4	7.6	8.36	1.17	0.16	14.00
e-j	8.0 - 15.5	7.6	13.31	1.23	0.17	9.24
v-x	10.2-19.7	9.5	17.42	1.44	0.20	8.29
z-z_1	12.4 - 18.0	5.7	15.16	1.14	0.16	7.55
v-z	21.3-29.9	8.6	25.43	1.72	0.25	6.74
z-j	18.0-24.5	6.5	20.35	1.44	0.21	7.06

Legend:

● - total mass (g); ❍ - mass without internal organs (g); ■ - total length (mm); ◘ - length according to Smith(mm); ❒ - standard length (mm); min-max - minimal and maximal values; Vw - variation width; $\bar{x}$ - arithmetic mean; s - standard deviation; $s_{\bar{x}}$ error of standard deviation; CV – coefficient of variability; a-d – standard length of body; a-b - total length of body; g-h – the biggest height of body; i-k – the smallest height of body; l-m – the height of head in the back of head; a-o - the length of head; a-n – preorbital distance of head; n-n_1- diameter between eyes; n-p - diameter of eye; p-o – postorbital distance of head; a-q –antedorsal distance; r-d – postdorsal distance; a-z – anteventral distance; s-d postventral distance; a-e – anteanal distance; f-d - postanal distance; q-r – the length of the dorsal (D) fin; q-n – the height of the dorsal (D) fin; y-f – the length of the base of the anal (A) fin; e-j – height of the undercaudal fin (A) fin; v-x – length of pectoral (P) fin; z-z_1 - length of ventral (V) fin; v-z – distance P-V; z-j – distance V-A

Table 2. Morphometric characteristics of the second length group (120.1- 180.0 mm).

	Min-max	Vw	$\bar{x}$	s	$s_{\bar{x}}$	CV%
●	50.0-120.0	70.0	64.61	18.24	4.87	28.23
❍	40.2-70.0	29.8	49.33	10.81	4.41	21.91
■	155.0-204.3	49.3	179.01	13.17	3.10	7.36
◘	142.3-188.6	46.3	162.62	11.00	2.59	6.77
❒	132.5-174.2	41.7	150.45	10.39	2.45	6.91
			% in relation to total length			
a-d	82.9-86.4	3.5	84.08	0.99	0.23	1.18
			% in relation to standard length			
a-b	115.7-120.6	4.9	118.95	1.38	0.33	1.16
g-h	22.5-24.9	2.4	23.38	0.60	0.14	2.57
i-k	9.5-11.0	1.5	10.32	0.41	0.10	3.94
l-m	16.7-22.5	5.8	18.36	2.11	0.50	11.47
a-o	23.5-27.6	4.0	25.02	0.79	0.19	3.16
a-n	6.7-11.4	4.7	7.62	1.03	0.24	13.47
n-n_1	8.9-10.6	1.7	9.49	0.43	0.10	4.56
n-p	4.7-5.9	1.2	5.19	0.38	0.09	7.30
p-o	10.6-14.2	3.6	12.74	1.07	0.25	8.37
a-q	50.6-55.7	5.1	52.22	1.52	0.36	2.91
r-d	38.0-43.5	5.6	40.64	1.33	0.31	3.28
a-z	49.2-56.0	6.8	52.31	1.60	0.38	3.07
s-d	46.4-55.0	8.6	52.33	2.74	0.65	5.24
a-e	66.2-73.2	6.9	70.75	1.54	0.36	2.18
f-d	22.1-27.4	5.3	24.37	1.04	0.24	4.25
q-r	8.8-11.1	2.4	10.17	0.69	0.16	6.81
q-u	13.7-18.7	5.0	16.71	1.35	0.32	8.07
y-f	7.7-10.5	2.8	9.66	0.76	0.18	7.86
e-j	11.3-15.1	3.7	13.75	1.09	0.26	7.92
v-x	16.0-18.7	2.7	17.92	0.74	0.17	4.11
z-z	14.1-16.1	2.0	15.33	0.55	0.13	3.59
v-z	24.1-26.8	2.6	25.98	0.73	0.17	2.82
z-j	18.7-20.8	2.1	20.03	0.56	0.13	2.79

Legend:

● - total mass (g); ❍ - mass without internal organs (g); ■ - total length (mm); ◘ - length according to Smith (mm); ❒ - standard length (mm); min-max - minimal and maximal values; Vw - variation width; $\bar{x}$ - arithmetic mean; s - standard deviation; $s_{\bar{x}}$ error of standard deviation; CV – coefficient of variability; a-d – standard length of body; a-b - total length of body; g-h – the biggest height of body; i-k – the smallest height of body; l-m – the height of head in the back of head; a-o - the length of head; a-n – preorbital distance of head; n-n_1- diameter between eyes; n-p -diameter of eye; p-o – postorbital distance of head; a-q –antedorsal distance; r-d – postdorsal distance; a-z – anteventral distance; s-d postventral distance; a-e – anteanal distance; f-d - postanal distance; q-r – the length of the dorsal (D) fin; q-n – the height of the dorsal (D) fin; y-f – the length of the base of the anal (A) fin; e-j – height of the undercaudal fin (A) fin; v-x – length of pectoral (P) fin; z-z_1 - length of ventral (V) fin; v-z – distance P-V; z-j – distance V-A.

Table 3. Morphometric characteristics of the third length group (180.1-240.0 mm).

	Min-max	Vw	$\bar{x}$	s	$s_{\bar{x}}$	CV%
●	95.0-480.0	385.0	272.30	81.59	8.65	29.96
❍	60.0-325.0	265.0	222.06	56.70	6.26	25.53
■	216.2-289.2	73.0	260.77	16.55	1.75	6.35
◘	202.0-264.7	62.7	241.71	14.94	1.58	6.18
❒	185.3-238.0	52.7	218.21	13.88	1.47	6.36
			% in relation to total length			
a-d	71.1-88.5	17.4	83.77	3.78	0.40	4.51
			% in relation to standard length			
a-b	113.0-140.7	27.6	119.65	6.10	0.65	5.10
g-h	20.9-31.3	10.4	25.87	2.32	0.25	8.96
i-k	9.4-12.9	3.5	10.95	0.74	0.08	6.77
l-m	15.6-24.4	8.9	20.33	2.21	0.23	10.89
a-o	24.1-29.1	5.0	26.29	1.23	0.13	4.68
a-n	6.8-11.0	4.2	8.06	0.76	0.08	9.41
n-n_1	7.6-12.4	4.8	10.66	0.80	0.08	7.51
n-p	3.8-5.5	1.7	4.80	0.37	0.04	7.69
p-o	11.9-15.8	3.9	14.12	0.87	0.09	6.13
a-q	49.8-66.2	16.5	55.61	3.30	0.35	5.94
r-d	35.8-47.4	11.6	40.36	2.47	0.26	6.13
a-z	47.3-62.3	14.9	52.24	3.25	0.34	6.23
s-d	45.0-61.6	16.6	52.33	3.61	0.38	6.89
a-e	65.8-85.1	19.2	71.92	4.49	0.48	6.24
f-d	21.0-29.0	8.0	24.41	1.70	0.18	6.95
q-r	9.8-12.8	3.1	10.91	0.70	0.07	6.41
q-u	14.3-18.6	4.3	16.40	0.94	0.10	5.76
y-f	8.4-12.3	3.9	10.11	0.80	0.08	7.90
e-j	11.0-15.0	4.0	13.05	0.81	0.09	6.22
v-x	15.3-20.1	4.8	17.82	1.08	0.11	6.04
z-z	13,4-16.4	3.0	15.06	0.73	0.08	4.83
v-z	21.5-32.9	11.4	26.78	2.55	0.27	9.52
z-j	16.7-27.7	11.0	20.96	2.18	0.23	10.39

Legend:
● - total mass (g); ❍ - mass without internal organs (g); ■ - total length (mm); ◘ - length according to Smith (mm); ❒ - standard length (mm); min-max - minimal and maximal values; Vw - variation width; $\bar{x}$ - arithmetic mean; s - standard deviation; $s_{\bar{x}}$ error of standard deviation; CV – coefficient of variability; a-d – standard length of body; a-b - total length of body; g-h – the biggest height of body; i-k – the smallest height of body; l-m – the height of head in the back of head; a-o - the length of head; a-n – preorbital distance of head; n-n_1- diameter between eyes; n-p - diameter of eye; p-o – postorbital distance of head; a-q –antedorsal distance; r-d – postdorsal distance; a-z – anteventral distance; s-d postventral distance; a-e – anteanal distance; f-d - postanal distance; q-r – the length of the dorsal (D) fin; q-n – the height of the dorsal (D) fin; y-f – the length of the base of the anal (A) fin; e-j – height of the undercaudal fin (A) fin; v-x – length of pectoral (P) fin; z-z_1 - length of ventral (V) fin; v-z – distance P-V; z-j – distance V-A.

Table 4. Morphometric characteristics of the fourth length group (240.1- 300.0 mm).

	Min-max	Vw	$\bar{x}$	s	$s_{\bar{x}}$	CV%
●	260.0-960.0	700.0	414.26	102.32	11.03	24.70
❍	220.0-810.0	590.0	395.50	115.98	21.18	29.33
■	280.8-392.0	111.2	322.00	20.79	2.24	6.46
◘	260.0-350.0	90.0	296.84	17.92	1.93	6.04
❒	240.4-300.0	59.6	271.86	16.17	1.74	5.95
			% in relation to total length			
a-d	76.0-87.6	11.5	84.47	1.49	0.16	1.76
			% in relation to standard length			
a-b	114.2-131.5	17.3	118.43	2.17	0.23	1.83
g-h	21.1-31.9	10.8	26.18	2.35	0.25	8.96
i-k	9.6-13.3	3.7	10.97	0.61	0.07	5.53
l-m	15.3-26.0	10.6	18.55	2.38	0.26	12.81
a-o	22.3-29.0	6.7	25.31	1.16	0.13	4.59
a-n	6.6-9.9	3.3	8.01	0.53	0.06	6.61
n-n_1	8.4-13.8	5.4	9.75	1.00	0.11	10.27
n-p	3.6-5.0	1.4	4.21	0.34	0.04	8.16
p-o	12.6-16.2	3.6	13.82	0.68	0.07	4.90
a-q	50.7-64.4	13.7	53.67	2.00	0.22	3.73
r-d	35.2-45.3	10.1	39.24	1.47	0.16	3.76
a-z	45.2-53.9	8.7	51.04	1.76	0.19	3.45
s-d	47.8-56.7	8.9	51.58	1.51	0.16	2.93
a-e	65.6-74.8	9.2	71.09	2.02	0.22	2.85
f-d	19.4-27.5	8.1	23.14	1.41	0.15	6.10
q-r	7.6-12.7	5.1	11.04	0.66	0.07	5.99
q-u	13.5-17.3	3.8	15.12	0.85	0.09	5.62
y-f	6.8-12.1	5.3	10.46	0.72	0.08	6.92
e-j	8.00-14.6	6.6	12.47	1.02	0.11	8.20
v-x	14.9-21.5	6.6	17.41	1.28	0.14	7.34
z-z	12.5-17.1	4.7	14.54	1.02	0.11	6.99
v-z	21.7-29.2	7.5	24.99	1.30	0.14	5.18
z-j	16.7-24.2	7.5	19.92	1.50	0.16	7.51

Legend:
● - total mass (g); ❍ - mass without internal organs (g); ■ - total length (mm); ◘ - length according to Smith (mm); ❒ - standard length (mm); min-max - minimal and maximal values; Vw - variation width; $\bar{x}$ - arithmetic mean; s - standard deviation; $s_{\bar{x}}$ error of standard deviation; CV – coefficient of variability; a-d – standard length of body; a-b - total length of body; g-h – the biggest height of body; i-k – the smallest height of body; l-m – the height of head in the back of head; a-o - the length of head; a-n – preorbital distance of head; n-n_1- diameter between eyes; n-p - diameter of eye; p-o – postorbital distance of head; a-q –antedorsal distance; r-d – postdorsal distance; a-z – anteventral distance; s-d postventral distance; a-e – anteanal distance; f-d - postanal distance; q-r – the length of the dorsal (D) fin; q-n – the height of the dorsal (D) fin; y-f – the length of the base of the anal (A) fin; e-j – height of the undercaudal fin (A) fin; v-x – length of pectoral (P) fin; z-z_1 - length of ventral (V) fin; v-z – distance P-V; z-j – distance V-A.

Table 5. Morphometric characteristics of the fifth length group (300.1-360.0 mm).

	Min-max	Vw	$\bar{x}$	s	$s_{\bar{x}}$	CV%
●	100.0-1200.0	1100.0	696.73	208.40	21.97	29.91
❍	460.0-1020.0	560.0	781.67	139.83	28.54	17.89
■	357.0-446.5	89.5	382.35	16.25	1.71	4.25
◘	318.0-383.0	65.0	352.38	15.47	1.63	4.39
❒	303.5-352.0	48.5	325.15	12.22	1.29	3.76
		% in relation to total length				
a-d	77.5-91.1	13.7	85.08	2.01	0.21	2.37
		% in relation to standard length				
a-b	109.7-129.0	19.3	117.61	2.89	0.30	2.45
g-h	22.7-33.5	10.8	26.48	2.34	0.25	8.85
i-k	9.6-12.1	2.6	10.80	0.61	0.06	5.65
l-m	9.5-24.0	14.5	17.91	2.67	0.28	14.90
a-o	22.0-27.4	5.3	24.88	0.97	0.10	3.88
a-n	6.9-9.9	3.0	8.31	0.51	0.05	6.20
n-n_1	9.0-13.1	4.1	10.00	0.80	0.08	8.04
n-p	3.2-4.6	1.4	3.81	0.31	0.03	8.16
p-o	11.8-15.9	4.1	13.53	0.68	0.07	5.03
a-q	50.3-60.3	10.0	53.94	1.75	0.18	3.25
r-d	33.2-44.9	11.7	38.45	1.46	0.15	3.80
a-z	44.7-55.8	11.1	50.32	1.86	0.20	3.69
s-d	44.3-55.2	10.9	50.70	1.78	0.19	3.50
a-e	62.6-96.9	34.4	70.73	3.57	0.38	5.05
f-d	17.8-26.7	8.9	22.98	1.24	0.13	5.41
q-r	9.8-12.4	2.6	11.16	0.58	0.06	5.23
q-u	13.2-18.3	5.00	14.65	0.83	0.09	5.65
y-f	8.8-13.1	4.2	10.34	0.86	0.09	8.34
e-j	11.0-15.5	4.5	12.12	0.77	0.08	6.34
v-x	14.2-20.1	5.9	17.19	0.94	0.10	5.44
z-z	12.4-17.2	4.8	14.11	0.95	0.10	6.73
v-z	20.0-28.0	8.0	25.19	1.36	0.14	5.40
z-j	15.3-24.6	9.3	19.68	1.44	0.15	7.30

Legend:

●- total mass (g); ❍ - mass without internal organs (g); ■ - total length (mm); ◘ - length according to Smith (mm); ❒ - standard length (mm); min-max - minimal and maximal values; Vw - variation width; $\bar{x}$ - arithmetic mean; s - standard deviation; $s_{\bar{x}}$ error of standard deviation; CV – coefficient of variability; a-d – standard length of body; a-b - total length of body; g-h – the biggest height of body; i-k – the smallest height of body; l-m – the height of head in the back of head; a-o - the length of head; a-n – preorbital distance of head; n-n_1- diameter between eyes; n-p - diameter of eye; p-o – postorbital distance of head; a-q –antedorsal distance; r-d – postdorsal distance; a-z – anteventral distance; s-d postventral distance; a-e – anteanal distance; f-d - postanal distance; q-r – the length of the dorsal (D) fin; q-n – the height of the dorsal (D) fin; y-f – the length of the base of the anal (A) fin; e-j – height of the undercaudal fin (A) fin; v-x – length of pectoral (P) fin; z-z_1 - length of ventral (V) fin; v-z – distance P-V; z-j – distance V-A.

Table 6. Morphometric characteristics of the sixth length group (360.1-420.0. mm).

	Min-max	Vw	$\bar{x}$	s	$s_{\bar{x}}$	CV %
●	147.8-160.0	145.2	1160.13	416.83	111.40	35.93 %
❍	135.0-135.0	0.0	1350.00	-	-	-
■	475.0-490.0	15.0	483.81	5.35	1.43	1.11 %
◘	440.0-453.0	13.0	449.07	3.41	0.91	0.76 %
❒	406.0-420.0	14.0	413.82	4.95	1.32	1..20 %
			% in relation to total length			
a-d	85.0-85.7	0.7	85.53	0.18	0.05	0.21 %
			% in relation to standard length			
a-b	116.7-117.7	1.0	116.92	0.24	0.07	0.21 %
g-h	22.5-29.2	6.8	23.74	1.63	0.44	6.87 %
i-k	8.8-10.5	1.6	9.58	0.50	0.13	5.26 %
l-m	13.8-21.4	7.6	16.54	2.00	0.53	12.10 %
a-o	19.8-25.4	5.8	23.00	1.29	0.34	5.60 %
a-n	7.0-8.3	1.3	7.69	0.48	0.13	6.25 %
n-n_1	8.2-10.3	2.1	9.10	0.66	0.18	7.27 %
n-p	2.8-3.9	1.1	3.01	0.28	0.07	9.19
a-o	4.7-13.4	8.7	12.29	2.26	0.60	18.36 %
a-q	46.6-56.8	10.2	52.90	4.67	1.25	8.83 %
r-d	32.8-37.0	4.2	35.21	1.76	0.47	5.01 %
a-z	41.1-52.0	10.9	48.05	5.03	1.34	10.47 %
s-d	44.0-51.0	7.9	46.85	2.21	0.59	4.72 %
a-e	60.6-72.3	11.7	68.06	5.56	1.49	8.18 %
f-d	19.3-23.3	4.0	20.15	0.99	0.26	4.89 %
q-r	10.0-11.3	1.3	10.53	0.42	0.11	3.97 %
q-u	12.0-15.8	3.8	13.74	1.30	0.35	9.44 %
y-f	9.2-10.9	1.7	10.19	0.70	0.19	6.86 %
e-j	10.2-13.3	3.1	11.00	0.80	0.21	7.29 %
v-x	14.5-17.6	3.1	16.39	1.44	0.38	8.76 %
z-z	11.9-14.2	2.3	13.33	1.08	0.29	8.12 %
v-z	20.2-28.3	8.1	24.51	2.95	0.79	12.04 %
z-j	16.0-21.1	5.1	18.06	1.34	0.36	7.45 %

Legend:
● - total mass (g); ❍ - mass without internal organs (g); ■ - total length (mm); ◘ - length according to Smith (mm); ❒ - standard length (mm); min-max - minimal and maximal values; Vw - variation width; $\bar{x}$ - arithmetic mean; s - standard deviation; $s_{\bar{x}}$ error of standard deviation; CV – coefficient of variability; a-d – standard length of body; a-b - total length of body; g-h – the biggest height of body; i-k – the smallest height of body; l-m – the height of head in the back of head; a-o - the length of head; a-n – preorbital distance of head; n-n_1- diameter between eyes; n-p - diameter of eye; p-o – postorbital distance of head; a-q –antedorsal distance; r-d – postdorsal distance; a-z – anteventral distance; s-d postventral distance; a-e – anteanal distance; f-d - postanal distance; q-r – the length of the dorsal (D) fin; q-n – the height of the dorsal (D) fin; y-f – the length of the base of the anal (A) fin; e-j – height of the undercaudal fin (A) fin; v-x – length of pectoral (P) fin; z-z_1 - length of ventral (V) fin; v-z – distance P-V; z-j – distance V-A.

Table 7. Morphometric characteristics of the seventh length group (420.1-480.0mm).

	Min-max	Vw	$\bar{x}$	S	$s_{\bar{x}}$	CV %
●	840.0-1484.0	644.0	1175.15	306.32	84.96	26.07
❍	-	-	-	-	-	-
■	479.1-500.0	20.9	491.82	4.75	1.32	0.97
◘	450.3-479.0	28.7	462.92	11.02	3.06	2.38
❒	421.0-450.0	29.0	432.37	12.17	3.38	2.81
		% in relation to total length				
a-d	85.7-91.6	5.9	87.92	2.43	0.67	2.76
		% in relation to standard length				
a-b	109.1-116.6	7.5	113.82	3.12	0.87	2.74
g-h	20.9-24.5	3.7	22.87	1.63	0.45	7.12
i-k	8.8-10.6	1.8	9.71	0.64	0.18	6.59
l-m	12.9-18.4	5.5	15.84	2.50	0.69	15.80
a-o	20.1-24.5	4.4	22.50	1.97	0.55	8.75
a-n	6.1-8.4	2.3	7.44	0.91	0.25	12.21
n-n_1	7.2-9.8	2.5	8.73	1.05	0.29	12.08
n-p	2.7-3.1	0.4	2.90	0.14	0.04	4.78
p-o	10.6-13.5	2.9	12.31	1.27	0.35	10.29
a-q	6.1-57.1	51.0	46.68	13.96	3.87	29.91
r-d	30.3-37.5	7.2	34.18	3.43	0.95	10.03
a-z	37.8-52.4	14.6	45.74	7.19	1.99	15.72
s-d	40.4-48.5	8.1	44.78	3.87	1.07	8.64
a-e	55.6-72.5	17.0	64.81	8.48	2.35	13.08
f-d	18.3-20.9	2.6	19.68	1.01	0.28	5.12
q-r	9.0-11.0	2.0	10.15	0.86	0.24	8.47
q-u	10.8-14.7	3.9	12.96	1.83	0.51	14.09
y-f	8.3-10.9	2.6	9.77	1.17	0.32	11.98
e-j	9.2-11.5	2.3	10.45	0.99	0.27	9.44
v-x	13.0-17.6	4.6	15.61	2.18	0.60	13.95
z-z	10.6-14.3	3.8	12.72	1.69	0.47	13 .30
v-z	18.8-27.4	8.5	23.40	4.08	1.13	17.43
z-j	15.0-19.7	4.7	17.29	2.05	0.57	11.87

Legend:

●- total mass (g); ❍ - mass without internal organs (g); ■ - total length (mm); ◘ - length according to Smith (mm); ❒ - standard length (mm); min-max - minimal and maximal values; Vw - variation width; $\bar{x}$ - arithmetic mean; s - standard deviation; $s_{\bar{x}}$ error of standard deviation; CV – coefficient of variability; a-d – standard length of body; a-b - total length of body; g-h – the biggest height of body; i-k – the smallest height of body; l-m – the height of head in the back of head; a-o - the length of head; a-n – preorbital distance of head; n-n_1- diameter between eyes; n-p - diameter of eye; p-o – postorbital distance of head; a-q –antedorsal distance; r-d – postdorsal distance; a-z – anteventral distance; s-d postventral distance; a-e – anteanal distance; f-d - postanal distance; q-r – the length of the dorsal (D) fin; q-n – the height of the dorsal (D) fin; y-f – the length of the base of the anal (A) fin; e-j – height of the undercaudal fin (A) fin; v-x – length of pectoral (P) fin; z-z_1 - length of ventral (V) fin; v-z – distance P-V; z-j – distance V-A.

Table 8. Morphometric characteristics of the first length group (60.0 -120.0 mm) % in relation to length of head.

	Min-max	Vw	$\bar{x}$	s	$s_{\bar{x}}$	CV %
a-n	25.5-35.6	10.1	30.32	2.54	0.35	8.37
n-n$_1$	32.1-42.6	10.6	37.46	2.23	0.31	5.95
n-p	20.8-34.1	13.3	26.32	2.78	0.39	10.55
p-o	25.3-28.3	28.3	45.62	5.15	0.71	11.29

Legend:
a-n – preorbital distance of head;
n-n$_1$– diameter between eyes;
n-p – diameter of eye;
p-o – postorbital distance of head;

Table 9. Morphometric characteristics of the second length group (120.1-180.0 mm) % in relation to length of head.

	Min-max	Vw	$\bar{x}$	s	$s_{\bar{x}}$	CV %
a-n	26.9-46.4	19.5	30.50	4.30	1.01	14.09
n-n$_1$	36.3-42.4	6.1	37.93	1.48	0.35	3.90
n-p	19.2-23.3	4.2	20.74	1.47	0.35	7.09
p-o	41.3-54.9	13.6	50.95	4.36	1.03	8.55

Legend:
a-n – preorbital distance of head;
n-n$_1$– diameter between eyes;
n-p – diameter of eye;
p-o – postorbital distance of head;

Table 10. Morphometric characteristics of the third length group (180.1-240.0 mm) % in relation to length of head.

	Min-max	Vw	$\bar{x}$	s	$s_{\bar{x}}$	CV %
a-n	25.6-42.6	17.0	30.68	2.44	0.26	7.95
n-n$_1$	29.6-47.2	17.6	40.59	2.77	0.29	6.82
n-p	15.4-21.7	6.3	18.27	1.44	0.15	7.86
p-o	47.8-59.6	11.8	53.73	2.35	0.25	4.38

Legend:
a-n – preorbital distance of head;
n-n$_1$– diameter between eyes;
n-p– diameter of eye;
p-o – postorbital distance of head;

Table 11. Morphometric characteristics of the fourth length group (240.1-300.0 mm) % in relation to length of head.

	Min-max	Vw	$\bar{x}$	s	$s_{\bar{x}}$	CV %
a-n	26.4-36.0	9.6	31.68	2.02	0.22	6.36
n-n$_1$	34.4-47.5	13.1	38.48	2.84	0.31	7.38
n-p	14.3-20.2	5.8	16.65	1.15	0.12	6.88
p-o	49.6-59.3	9.8	54.65	2.13	0.23	3.89

Legend:
a-n – preorbital distance of head;
n-n$_1$– diameter between eyes;
n-p – diameter of eye;
p-o – postorbital distance of head;

Table 12. Morphometric characteristics of the fifth length group (300.1-360.0 mm) % in relation to length of head.

	Min-max	Vw	$\bar{x}$	s	$s_{\bar{x}}$	CV %
a-n	28.9-39.7	10.9	33.40	1.79	0.19	5.36
n-n$_1$	36.7-47.9	11.2	40.17	2.42	0.25	6.02
n-p	13.2-18.3	5.1	15.34	1.24	0.13	8.08
p-o	50.3-63.7	13.3	54.41	2.05	0.22	3.76

Legend:
a-n – preorbital distance of head;
n-n$_1$– diameter between eyes;
n-p – diameter of eye;
p-o – postorbital distance of head;

Table 13. Morphometric characteristics of the sixth length group (360.1-420.0 mm) % in relation to length of head.

	Min-max	Vw	$\bar{x}$	s	$s_{\bar{x}}$	CV %
a-n	31.2-35.8	4.6	33.43	1.36	0.36	4.07
n-n$_1$	36.5-42.0	5.5	39.55	1.66	0.44	4.20
n-p	12.1-15.5	3.3	13.10	1.10	0.29	8.37
p-o	21.0-60.5	39.5	53.43	9.58	2.56	17.93

Legend:
a-n – preorbital distance of head;
n-n$_1$ – diameter between eyes;
n-p – diameter of eye;
p-o – postorbital distance of head;

Table 14. Morphometric characteristics of the seventh length group (420.1-480.0 mm) % in relation to length of head.

	Min-max	Vw	$\bar{x}$	s	$s_{\bar{x}}$	CV %
a-n	30.3-35.2	4.9	32.97	1.38	0.38	4.17
n-n_1	36.0-41.1	5.1	36.68	1.53	0.43	3.97
n-p	12.1-13.7	1.6	12.94	0.57	0.16	4.39
p-o	52.8-56.8	4.0	54.65	1.15	0.32	2.11

Legend:
a-n – preorbital distance of head;
n-n_1 – diameter between eyes;
n-p – diameter of eye;
p-o – postorbital distance of head;

Table 15. Correlation (r) of morphometric characteristics in relation to standard length, according to seven length groups.

Morphometric characteristics	Length group						
	I	II	III	IV	V	VI	VII
a-b	0.9943	0.9893	0.7359	0.9555	0.8261	0.9884	0.2286
g-h	0.8971	0.9454	0.5852	0.4201	0.6306	-0.5008	-0.8785
i-k	0.9530	0.9317	0.6785	0.7275	0.6496	-0.8380	-0.7385
l-m	0.9368	0.3011	0.6820	0.2547	0.4029	-0.3664	-0.9043
a-o	0.9592	0.9251	0.8382	0.7609	0.7344	-0.0402	-0.8976
a-n	0.9624	0.5370	0.4982	0.7864	0.5982	0.3536	-0.8942
n-n_1	0.9496	0.8851	0.7386	0.4213	0.6186	-0.0785	-0.8998
n-p	0.7817	0.5375	0.7031	0.3034	0.0540	-0.6056	-0.7205
p-o	0.5485	0.9695	0.7586	0.7251	0.6876	0.0941	-0.9052
a-q	0.9850	0.9087	0.7239	0.8519	0.8053	0.3544	-0.1322
r-d	0.9744	0.9062	0.7241	0.8602	0.6565	0.7212	-0.9097
a-z	0.9693	0.9627	0.6030	0.8474	0.6719	0.4131	-0.9158
s-d	0.9622	0.9158	0.6431	0.8589	0.6889	0.0016	-0.9123
a-j	0.9451	0.9672	0.6273	0.8886	0.5702	0.2444	-0.9154
x-d	0.9187	0.8428	0.6079	0.6917	0.3637	-0.6970	-0.7347
q-r	0.8381	0.9726	0.6451	0.7144	0.4052	0.9070	-0.9069
t-u	0.9022	0.8987	0.7494	0.6503	0.3796	0.2392	-0.9146
y-f	0.8469	0.8976	0.5607	0.7473	0.3841	0.6061	-0.9189
e-j	0.8457	0.8252	0.7612	0.6825	0.4589	-0.3480	-0.9141
v-x	0.9071	0.9719	0.7812	0.5975	0.6651	0.2004	-0.9165
z-z_1	0.8910	0.9721	0.8108	0.5372	0.5423	-0.0160	-0.9166
v-z	0.9256	0.9747	0.4691	0.6372	0.4715	0.0312	-0.9151
z-j	0.9102	0.9212	0.6158	0.4059	0.6026	-0.2455	-0.8396

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