



• Փորձարարական և տեսական հոդվածներ • Экспериментальные и теоретические статьи •
• Experimental and theoretical articles •

Biolog. Journal of Armenia, 4 (71), 2019

SPAWNING FEATURES OF KURA CHUB *ALBURNOIDES EICHWALDII* (DE FILIPPI, 1863) (CYPRINIDAE, ACTINOPTERYGII) IN THE BASIN OF DEBED AND AGHSTEV RIVERS (ARMENIA)

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Spawning features of Kura chub *Alburnoides eichwaldii* (De Filippi, 1863) distributed in the basin of Debed and Agstev Rivers have been studied. It has been revealed that the Kura chub in the basin of Debed and Agstev Rivers becomes mature at the beginning of the second year when it has no less than 60 mm body length. The spawning period starts from April and lasts until the end of July. During this period, the females spawn three times, laying from 1362 to 8245 eggs. Males are supposed to become mature earlier than female, and at first elder individuals with larger body length spawn.

Kura chub – Alburnoides eichwaldii – River Debed – River Agstev – spawning – absolute individual fertility

Ուսումնասիրվել են Դեբեդ և Աղստև գետերի ավազանում տարածված արևելյան տառեխիկի *Alburnoides eichwaldii* (De Filippi, 1863) բազմացման առանձնահատկությունները: Պարզվել է, որ Դեբեդ և Աղստև գետերի ավազաններում արևելյան տառեխիկի սեռահասունությունը վրա է հասնում մարմնի 60 մմ-ից ոչ պակաս երկարության և կյանքի երկրորդ տարվա սկզբում: Բազմացման շրջանը սկսվում է ապրիլից և կարող է շարունակվել մինչև հուլիսի վերջը, որի ընթացքում էգերը ընդմիջումներով ձվադրում են երեք անգամ՝ ընդհանուր առմամբ ղնելով 1362-ից մինչև 8245 ձկնկիթ: Բացահայտվել է, որ արուներն ավելի վաղ են հասունանում էգերից, իսկ առաջին հերթին բազմանում են առավել խոշոր և տարեց առանձնյակները:

Արևելյան տառեխիկ – Alburnoides eichwaldii – Դեբեդ գետ – Աղստև գետ – բազմացում – անհատական բացարձակ բեղունություն

Изучены особенности размножения восточной быстрянки *Alburnoides eichwaldii* (De Filippi, 1863) в бассейне рек Дебед и Агстев. Выяснено, что в изученных водоемах половозрелость быстрянки наступает при длине тела более 60 мм и в начале второго года жизни. Нерестовый период начинается с апреля и может продолжаться до конца июля. В этот период самки порционно размножаются до трех раз, откладывая от 1362 до 8245 икринок. Выявлено, что самцы созревают раньше самок и, в первую очередь, размножаются более крупные и зрелые особи.

Восточная быстрянка – Alburnoides eichwaldii – река Дебед – река Агстев – размножение – индивидуальная абсолютная плодовитость

Kura chub *Alburnoides eichwaldii* (De Filippi, 1863) is widely spread in Armenian freshwaters and is found on the height up to 2200 meters above the sea level [6, 12]. During the recent decades it has accidentally appeared in Lake Sevan [1, 10] and in the downstairs of Dzknaget [9], as well as Argichi, Vardenis, Tsakqar and Gavaraget rivers belonging to its basin and river Hrazdan source [2, 16]. Kura chub found here was formerly regarded as Armenian subspecies of Kura chub *Alburnoides bipunctatus* (Bloch, 1782) *Alburnoides bipunctatus armeniensis* Dadikyan, 1972 [5, 6]. Later, based on the comparative analysis of morphological characteristics of Kura chub spread in Southern Caucasus freshwaters by different authors, it was recommended to consider the *Alburnoides bipunctatus armeniensis* as junior synonym for Kura chub *Alburnoides eichwaldii* (De Filippi, 1863) [11, 15].

Currently, Kura chub is a widespread fish species also in the basin of Debed and Aghstev rivers. In spite of its widespreadness and numerous quantity, many biological features of this fish species haven't been fully described and studied so far. Thus, taking it into full account, we have set a goal to study spawning features of Kura chub in the basin of Debed and Aghstev rivers, the description of which is the aim of the current work.

Materials and methods. 480 individuals of Kura chub have been studied caught from Aghstev (n=109, Dilijan), Pambak (n=86, Nalband village surroundings) and Debed rivers (n=285, Sanahin station surroundings) between the periods of 2015 and 2017-2018. The fish were caught by a fishing hook, a fishing net with 70 cm diameter, a hand fishing net with 55 cm diameter, as well as a fishing rod. The fertility was determined among Kura chub of III-IV or IV stage of gonad sexual maturity. The determination of fish maturity coefficient, individual absolute fertility and relative fertility, as well as the calculation of spawning were guided by the recommendations of Pravdin [13] and Ivankov [7]. For determination of age, the number of annual rings on the scales between the ribs and the backbone was calculated according to the methods used in Ichthyology [13, 14].

The obtained data were processed using approved statistical methods [4, 8], and statistical calculations were performed using Stat soft statistics 12.5 analytical package and MS Excel 2019 computer software.

Results and Discussion. In Debed, Pambak, and Aghstev rivers, the Kura chub becomes mature at the end of the second year or at the beginning of the third year, which is also observed in the Kura chub of other freshwaters in the Armenia [3, 6]. So, in Pambak river, the Kura chub becomes mature at the beginning of the second year, when the length of the body (*l*) reaches 60 mm and its weight (*Q*) reaches 6 grams. The youngest mature female studied here had 62.10 mm length and 6.0 g weight. Similar indicators of body length to reach maturity are also indicated by Dadikyan [6], according to which the youngest mature female was 62 mm long.

Judging by the maturation status of the reproductive organs and the presence of fish egg of various stages of development, the spawning season in the areas of Debed and Aghstev rivers studied by us begins in May and may continue with intervals until August. During this time small, round, cream epithelial tubercles appear on the snout, operculum, scale and first ray of pectoral fin of males. Moreover, the beginning and the end of spawning are closely connected with the temperature of the place of residence and other conditions necessary for spawning, as evidenced by other authors [6]. So, 2 and 3 year old females of Kura chubs in river Pambak have been in the 4th stage of maturity at the end of May, when the maturity coefficient was 11.11-30.77 (tab. 1). They have three generations of eggs, each of which differs in size (tab. 2). It is known that Kura chub belongs to polycyclic spawning fish species and spawning fish eggs in its various populations may range from two to four [3, 6].

Table 1. Indicators of fertility and maturity coefficient of Kura chub in Pabak River by age, mass and body length (20.05.2018)

Age	<i>l</i> , mm	<i>Q</i> , g	MC	IAF	RF	n
	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	
2	$\frac{72.77 \pm 1.46}{62.10 - 80.00}$	$\frac{9.15 \pm 0.62}{6.00 - 13.00}$	$\frac{17.54 \pm 1.93}{11.11 - 30.77}$	$\frac{2722.17 \pm 327.99}{1362 - 5256}$	$\frac{297.91 \pm 25.10}{170 - 438}$	13
3	$\frac{81.86 \pm 0.85}{77.30 - 94.70}$	$\frac{13.24 \pm 0.47}{8.00 - 19.00}$	$\frac{17.88 \pm 1.09}{11.67 - 28.46}$	$\frac{3952.62 \pm 251.87}{2431 - 8245}$	$\frac{298.85 \pm 14.43}{174 - 469}$	25
Average	$\frac{78.75 \pm 1.02}{62.10 - 94.70}$	$\frac{11.84 \pm 0.94}{6.00 - 19.00}$	$\frac{17.76 \pm 0.94}{11.11 - 30.77}$	$\frac{3531.68 \pm 217.87}{1362 - 8245}$	$\frac{298.53 \pm 12.40}{170 - 469}$	38

Table 2. The fertility and fish egg sizes of Kura chub in Pambak river by fish egg generation (20.05.2018)

Age	1st generation of fish eggs		2nd generation of fish eggs		3rd generation of fish eggs		n
	Quantity (number)	Diameter, mm	Quantity (number)	Diameter, mm	Quantity (number)	Diameter, mm	
	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	
2	$\frac{851.09 \pm 117.95}{340 - 1760}$	$\frac{1.28 \pm 0.06}{0.93 - 1.61}$	$\frac{946.13 \pm 148.57}{364 - 2000}$	$\frac{0.86 \pm 0.02}{0.75 - 1.00}$	$\frac{924.94 \pm 145.40}{196 - 1885}$	$\frac{0.60 \pm 0.03}{0.45 - 0.84}$	13
3	$\frac{1236.60 \pm 127.65}{181 - 3520}$	$\frac{1.32 \pm 0.04}{0.96 - 1.75}$	$\frac{1529.67 \pm 198.42}{507 - 5480}$	$\frac{0.94 \pm 0.01}{0.87 - 1.10}$	$\frac{1186.35 \pm 107.83}{85 - 2280}$	$\frac{0.63 \pm 0.01}{0.50 - 0.80}$	25
Average	$\frac{1104.72 \pm 96.16}{181 - 3520}$	$\frac{1.30 \pm 0.04}{0.93 - 1.75}$	$\frac{1330.04 \pm 144.96}{364 - 5481}$	$\frac{0.91 \pm 0.01}{0.75 - 1.10}$	$\frac{1096.92 \pm 86.85}{85 - 2280}$	$\frac{0.62 \pm 0.01}{0.45 - 0.84}$	38

The individual absolute fertility (IAF) of Kura chub in Pambak river ranges from (IAF) from 1362 to 8245 fish egg. Here, the second generation of fish eggs dominates somehow, making up about 36% of total fish egg, and the first and third generations are 32%, respectively (tab. 2). At the same time, IAF indicators increase with age, while maturity coefficient and relative fertility indicators do not differ significantly among separate age groups (tab. 1). However, it is observed that different generations of two-year-old fish eggs have on average smaller diameter than three-year-old eggs (tab. 2).

The changes of IAF indicators of Kura chub in river Pambak are more closely related to fish body mass ($r=0.70$), than to the body length ($r=0.64$), and the correlation coefficient with age is quite low ($r=0.46$) (fig. 1). Other indicators of such a correlation were observed in Sevan basin, where Kura chub IAF in Dzknaget was more closely related to fish body mass ($r=0.77$) and age ($r=0.72$), than body length changes ($r=0.68$) [3].

At the end of June, 2017 Kura chubs in Pambak river were in IV-V and VI-III stages of maturity, when the maturity coefficient of 2-4 year old fish was 2.33-26.36 (tab. 3), and in the ovaries 2 generations of fish eggs with trophoplasmic growth were observed (tab. 4). The presence of different stages of maturation of gonad (IV-V and VI-III) and the large differences of maturation coefficient indicated by us (2.33-26.36) witness, that Kura chub in Pambak river start spawning at the end of May and at the beginning of June, which with intervals continues until July.

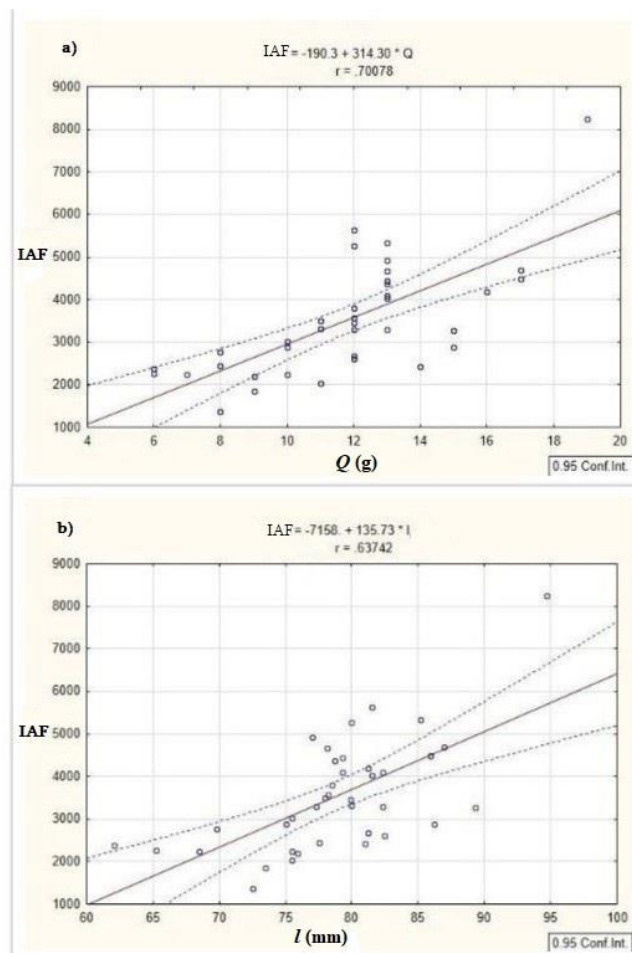


Fig. 1. Kura chub in Pambak river a) Correlation relation between IAF and mass changes, b) Correlation relation between IAF and body length changes.

Table 3. Indicators of fertility and maturity coefficient of Kura chub in river Pambak by age, mass and body length (22.06.2017)

Age	l, mm	Q, g	MC	IAF	RF	n
	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	
2	$\frac{81.68 \pm 1.00}{77.00 - 86.40}$	$\frac{12.00 \pm 0.53}{9.00 - 15.00}$	$\frac{13.02 \pm 2.12}{2.33 - 26.36}$	$\frac{2445.81 \pm 303.76}{316 - 3640}$	$\frac{202.04 \pm 21.21}{26 - 268}$	11
3	$\frac{89.35 \pm 1.08}{86.50 - 98.00}$	$\frac{16.40 \pm 0.80}{13.00 - 20.00}$	$\frac{20.64 \pm 1.41}{13.33 - 25.94}$	$\frac{3812.95 \pm 244.31}{2844 - 4939}$	$\frac{232.33 \pm 9.40}{196 - 282}$	10
4	$\frac{105.2}{-}$	$\frac{28.0}{-}$	$\frac{24.11}{-}$	$\frac{5738}{-}$	$\frac{204.91}{-}$	1
Average	$\frac{86.24 \pm 1.41}{77.00 - 105.20}$	$\frac{14.73 \pm 0.91}{9.00 - 28.00}$	$\frac{16.99 \pm 1.48}{2.33 - 26.36}$	$\frac{3216.86 \pm 263.02}{316 - 5738}$	$\frac{215.94 \pm 11.38}{26 - 282}$	22

Table 4. The fertility and fish egg sizes of Kura chub in Pambak river according to the fish egg generations (22.06.2017)

Age	1st generations of fish eggs		2nd generations of fish eggs		n
	Quantity (number)	Diameter, mm	Quantity (number)	Diameter, mm	
	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	
2	$\frac{739.06 \pm 97.17}{95 - 1260}$	$\frac{1.27 \pm 0.06}{0.98 - 1.57}$	$\frac{1706.75 \pm 225.26}{221 - 2451}$	$\frac{0.76 \pm 0.03}{0.55 - 0.95}$	11
3	$\frac{1328.65 \pm 107.49}{912 - 1825}$	$\frac{1.46 \pm 0.04}{1.25 - 1.59}$	$\frac{2484.30 \pm 176.69}{1824 - 3115}$	$\frac{0.85 \pm 0.03}{0.70 - 0.95}$	10
4	$\frac{3510}{-}$	$\frac{1.4}{-}$	$\frac{2228}{-}$	$\frac{1.02}{-}$	1
Average	$\frac{1133.01 \pm 147.70}{95 - 3510}$	$\frac{1.36 \pm 0.04}{0.98 - 1.59}$	$\frac{2083.85 \pm 156.37}{221 - 3115}$	$\frac{0.81 \pm 0.03}{0.55 - 1.02}$	22

For comparison it is worth mentioning that the IAF of Kura chub of other Armenian rivers on average can reach up to 3400, forming 990 fish eggs among the smallest (body length 62 mm), and 5990 among the largest female (body length 95 mm). It should be noted that relative fertility of Kura chub in terms of 1 g of body weight varies from 150-380 fish egg, however, in large individuals, this ratio decreases slightly [6]. It is of utmost importance that Kura chub IAF in Dzknaget river belonging to the basin of Lake Sevan has bigger indicators and varies among 1160-12000 fish egg [3], which witnesses the great potential for further distribution of this fish species in the basin of Sevan and favorable conditions for it.

We have also calculated maturity coefficients of gonad of males in river Pambak for June, 2017 and May 2018 (tab. 5). According to our data indicators of male maturity coefficient in May exceed the corresponding indicators of June, which in its turn confirms our assumption of their spawning for the first time in late May and early June. It should be noted that male maturity coefficient indicators grow along the age (tab. 5), which may indirectly indicate that first of all the larger and older fish species with higher maturity coefficients spawn.

Table 5. Maturity coefficient of male Kura chub in Pambak river by age group

Age	22.06.2017				13.05.2018			
	l, mm	Q, g	MC	n	l, mm	Q, g	MC	n
	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$		$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	$\frac{M \pm m}{lim}$	
1	-	-	-	-	$\frac{62.93 \pm 3.55}{59.60 - 68.70}$	$\frac{5.33 \pm 1.08}{4.00 - 7.00}$	$\frac{8.50 \pm 3.82}{2.50 - 13.00}$	3
2	$\frac{79.34 \pm 1.23}{73.50 - 83.30}$	$\frac{10.75 \pm 0.48}{9.00 - 13.00}$	$\frac{9.01 \pm 1.18}{6.50 - 15.91}$	8	$\frac{72.76 \pm 2.50}{61.50 - 81.50}$	$\frac{8.43 \pm 0.97}{4.00 - 11.00}$	$\frac{10.55 \pm 1.11}{7.50 - 15.00}$	7
3	$\frac{84.97 \pm 0.68}{83.20 - 86.70}$	$\frac{12.67 \pm 0.37}{12.00 - 14.00}$	$\frac{7.27 \pm 0.79}{3.85 - 8.33}$	6	$\frac{85.35 \pm 5.16}{81.70 - 89.00}$	$\frac{15.50 \pm 3.54}{13.00 - 18.00}$	$\frac{10.81 \pm 0.76}{10.28 - 11.35}$	2
Average	$\frac{81.75 \pm 1.07}{73.50 - 86.70}$	$\frac{11.57 \pm 0.40}{9.00 - 14.00}$	$\frac{8.27 \pm 0.75}{3.85 - 15.91}$	14	$\frac{72.40 \pm 2.74}{59.60 - 89.00}$	$\frac{8.83 \pm 1.21}{4.00 - 18.00}$	$\frac{10.08 \pm 0.97}{2.50 - 15.00}$	12

We have also studied the dynamics of maturity coefficient changes of gonads of females and males in Debed river for April-July, 2018. As shown in the graph (fig. 2), the maturity coefficient of females in April and May doesn't change significantly and on average is 10.99 ± 0.63 ($n=16$) and 11.08 ± 0.41 ($n=12$) respectively. It reduced sharply in June, forming on average 5.86 ± 0.74 ($n=64$), and rose again in July, reaching indicators of May, on average forming 10.44 ± 0.67 ($n=79$). Such a regularity is indicated in males, when the maturity coefficient was on average 4.50 ± 0.80 ($n=12$) in April, 3.32 ± 0.48 ($n=6$) and 3.02 ± 0.86 ($n=23$) in May and June, and 3.94 ± 0.30 ($n=73$) in July.

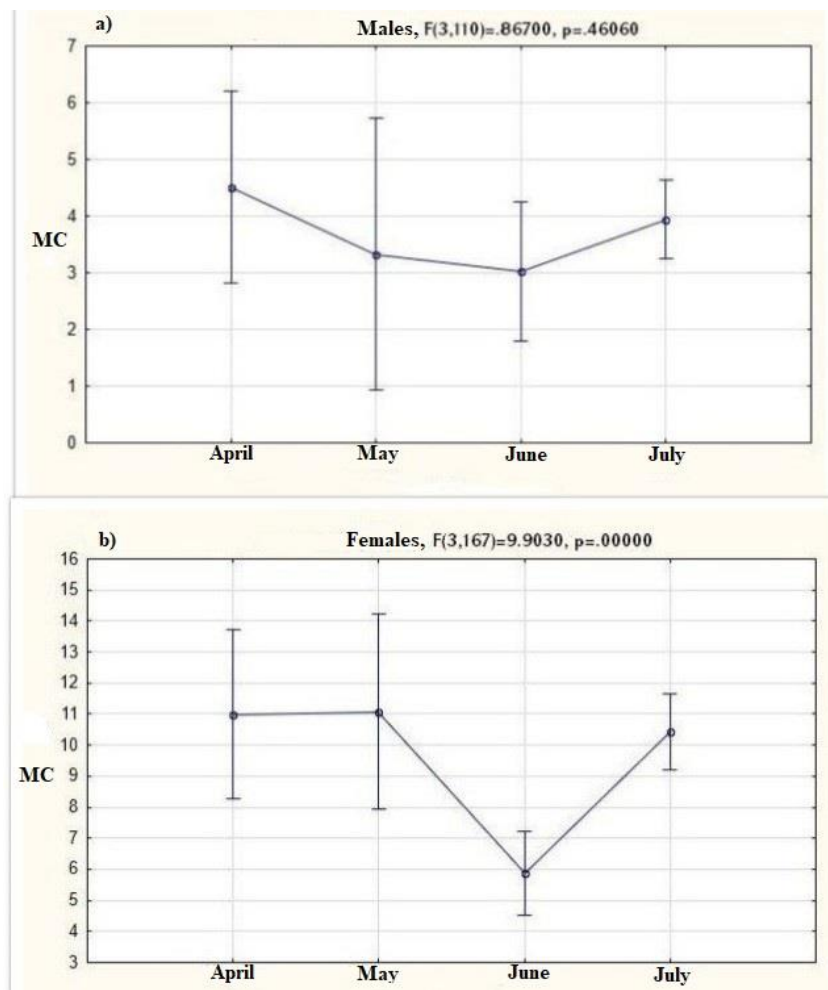


Fig. 2. The dynamics of maturity coefficient of a) male and b) female Kura chub in river Debed by months

The regular change in the above figures indicates that Kura chubs in Debed River begin spawning in late April and may continue with some intervals until July. At the same time, our observations indicate that both in Pambak and Debed rivers larger and older individuals of Kura chubs spawn earlier in April and June, and smaller and younger fish begin spawning later and can continue until the end of July.

It is worth mentioning that in the period preceding the spawning season, the maturity coefficients for males are higher than that for females. Thus, the maturity coefficient for females in Aghstev river in March was lower than that for males, on average, respectively forming 6.74 ± 1.07 ($n=13$) and 10.20 ± 3.07 ($n=6$) (fig. 3). Such a situation may indicate that males become mature earlier than females and are ready for mating earlier. As in Pambak and Debed rivers, in Aghstev river as well Kura chub stop spawning in August, when the maturity coefficient for females is on average 3.00 ± 0.32 ($n=56$), and for males 1.37 ± 0.12 ($n=34$).

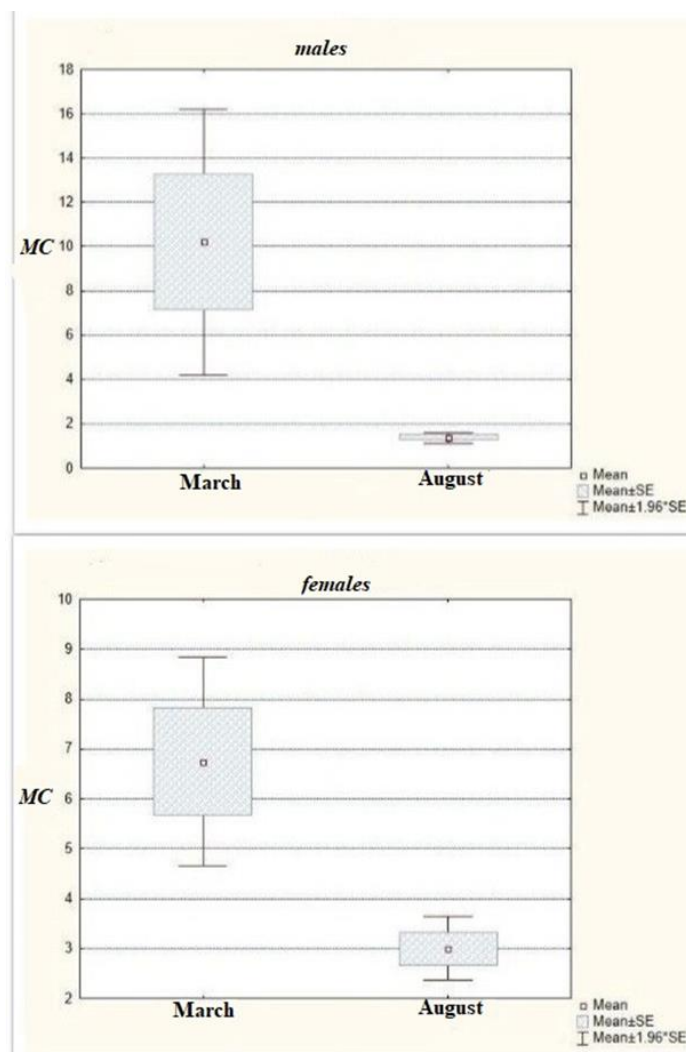


Fig. 3. Comparison of the maturity coefficients of male (a) and female (b) Kura chub in Aghstev River by months

Summing up the above mentioned, we can conclude that Kura chub in the basins of Debed and Aghstev rivers becomes mature in case of not less than 60 mm body length and at the age of two. The spawning season begins in April and can continue until July, when higher maturity coefficients are observed.

Being a polycyclic spawning species, Kura chub typically lay three times in the studied rivers, generally laying from 1362 to 8245 fish eggs having a diameter of 0.55-1.02 mm at the stages of III-IV and IV. Moreover, males become mature earlier than females, and first of all larger and older individuals spawn. Spawning of the latter occurs in April-June, and egg laying of smaller and younger fish begins later and may continue until the end of July. At the end of summer, in August the spawning season for Kura chub is over.

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Received on 01.08.2019