



IRSTI 34.15.23

<https://doi.org/10.32523/2616-7034-2025-153-4-118-131>

Review Article

Morphological characteristics of the spotted thicklip loach *Triplophysa strauchii* (Nemacheilidae) from the Uba River (upper Irtysh basin)

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Abstract. The spotted thicklip loach is a Central Asian fish species native to many water bodies of Kazakhstan. This species belongs to a complex taxonomic group of fish, the genus *Triplophysa*. Three subspecies of the spotted thicklip loach are known for water bodies of Kazakhstan: *T. s. strauchii*, *T. s. ruzskyi*, and *T. s. zaisanicus*, but their taxonomic status and distribution require clarification. The modern distribution of the spotted thicklip loach is very wide; it inhabits the basins of Balkhash-Alakol, Tarim, the Chu and Syr Darya rivers, and is also known for the basin of Lake Zaysan. Currently, this species expands its range far to the north, where it has successfully acclimatized in the endorheic rivers and lakes of Central and Northern Kazakhstan. In 2016, the spotted thicklip loach was discovered in the Uba River of the upper Irtysh basin. Here we present a description of the external morphology, including coloration, plastic and meristic features, body proportions, fin shape, lip structure, features of the intestine, and swim bladder. Features of sexual dimorphism were also investigated. Characteristic features of *Triplophysa strauchii* have been revealed. In order to clarify the range of this species, further research is needed in the Irtysh basin.

Key words: spotted thicklip loach, *Nemacheilidae*, *Triplophysa strauchii*, morphology, upper Irtysh basin, Uba River

Introduction

The loaches of the genus *Triplophysa* are widely distributed in Central and East Asia. It is one of the largest genera of the family *Nemacheilidae*, currently comprising approximately 160 species [1]. Moreover, the number of described species of this genus is increasing every year [1-6]. The taxonomy and phylogeny of the genus *Triplophysa* are undergoing a period of revisions and descriptions of new species [7-12]. In this regard, the identified subspecies and morphs of loaches from the Kazakhstan water bodies also require more detailed research using modern approaches.

One of the most widespread species of the genus is the spotted thicklip loach *T. strauchii*, which inhabits both flowing and stagnant water bodies in Central Asia. This species is considered ecologically flexible, capable of inhabiting a variety of habitats, where it creates morphologically distinct forms [13]. The modern range of the spotted thicklip loach includes the basins of lakes

Received: 13.10.2025. Accepted: 12.12.2025. Available online: 25.12.2025.

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Balkhash, Alakol, Tarim, the Chu and Irtysh rivers (upper reaches), and the Syr Darya river [13, 14]. Moreover, along with seed from southern fish hatcheries, this species has spread beyond its natural range far to the north, and today is quite common in the endorheic rivers of Central Kazakhstan. There is some data about his presence in the lakes of the North Kazakhstan region – Shalkar, Katarkol, and Bolshoye Chebachye [15].

The following subspecies of *T. strauchii* are known:

- *T. s. strauchii*, inhabiting the basins of Lake Balkhash and Lake Alakol, the Chu River, and Lake Biylikol;
- *T. s. ruzskyi*, inhabiting the basin of the Alakol-Sasykkol lake system;
- *T. s. zaisanicus*), described for Lake Zaisan and the rivers of the northern slopes of the Tarbagatai Mountains.

Data on the last two subspecies are very scarce, and the systematic status of these forms requires verification.

Previous data on the distribution of *T. strauchii* in the upper Irtysh basin are known for the rivers of the northern slopes of the Tarbagatai Mountains. In 2016, a sample of the spotted thicklip loach was collected from a more northern location – the tributary of the Uba River [16], where it had not been previously mentioned.

The aim of the study was to investigate the external morphology of the spotted thicklip loach *T. strauchii* from the Uba River in the upper Irtysh basin. Here we confirm the new location for this species and provide new data on its morphology.

Material and methods

Fish were caught with net traps on July 20, 2016, in the tributary of the Uba River (the Poperechka River, near Shemonaikha, East Kazakhstan, 50.3751°/ 81.5228°). The fish were fixed in a 4% formaldehyde solution in horizontally placed plastic bottles, so the fish had straightened bodies and fins.

Analysis of morphological traits was conducted according to Prokofiev (2010) [17]. Plastic features were measured on 10 specimens (TL – 121–133 mm – 6 males and 4 females) using a digital caliper with an accuracy of 0.1 mm. All measurements were made in a straight line directly between two points. To increase the accuracy of the analysis of meristic characters, fish were stained in potassium hydroxide solution (0.3%) with the addition of Alizarin Red. The last fin rays in the dorsal and anal fins, located on a single pterygiophore, were counted as 11/2. The intestine and gas bladder were also investigated in all the specimens.

Results and discussion

Meristic features

Number of lateral line pores – 70–94.

Dorsal fin with 4 unbranched and 7½–8 ½ branched rays; anal fin with 3 unbranched and 5½ branched rays; caudal fin with 16 branched rays (C I+8+8+I); pectoral fin with 1 unbranched and 13–14 branched rays; ventral fin with 1 unbranched and 7½–8½ branched rays. Scales absent.

Coloration

The body is light brown with clear brown spots of variable shape and size on the lateral and dorsal sides of the body (Figure 1). On the back, the spots are often small and unclear. The

lateral line is usually distinguished by a white stripe. The abdomen is whitish. On the lateral sides of the head, clusters of melanophores might form a marble pattern. In some specimens, the top of the head is uniformly brown, while in others it is spotted.



Figure 1. Examples of coloration of the spotted thicklip loach (*Triplophysa strauchii*) from the Uba River (upper Irtysh basin) – specimens fixed in formaldehyde. Female (A, TL – 121 mm) and male (B, TL – 128 mm)

Some specimens have vertically elongated spots of irregular shape on the dorsal fin. The caudal fin is mottled with rows of spots. The anal and pelvic fins are uniformly whitish or have a few small spots. The pectoral fins have small spots.

Plastic features

Results of measurements are presented in Table 1.

Table 1
Plastic features of males and females of *T. strauchii* from the Uba River (upper Irtysh basin)

Feature	Uba River, males, n=6		Uba River, females, n=4	
	Range	Mean $\pm$ m	Range	Mean $\pm$ m
Total length (mm)	121–133	128 $\pm$ 0,17	121–139	129 $\pm$ 0,47
Standard length (mm)	102–113	108 $\pm$ 0,15	100–116	107 $\pm$ 0,39
Percentage of standard length				
Predorsal length	53,1–56,86	54,44 $\pm$ 0,05	54,46–56,76	55,53 $\pm$ 0,22
Postdorsal length	34,8–37,27	36,51 $\pm$ 0,09	35,14–38	36,89 $\pm$ 0,15
Pre-anal length	69,44–70,91	70,12 $\pm$ 0,11	68,97–72	70,25 $\pm$ 0,24
Prepelvic length	51,87–54,72	53,34 $\pm$ 0,08	52,48–54	53,11 $\pm$ 0,19

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Prepectoral length	22,43–23,64	23,06±0,05	22,77–24,32	23,56±0,13
Pectoral-pelvic distance	29,09–32,35	30,68±0,03	30,17–33	31,28±0,09
Pelvic-anal distance	16,67–18,69	17,5±0,04	16,22–17,33	16,82±0,05
Pelvic-anus distance	10,19–12,15	11,1±0,04	9,9–11	10,52±0,05
Anus-anal distance	2,39–2,84	2,68±0,01	3,02–3,6	3,35±0,01
Body depth maximum	17,29–23,53	19,85±0,07	19,8–20	19,88±0,08
Body depth at dorsal-fin origin	16,36–17,94	17,24±0,02	17,33–18,1	17,73±0,09
Body depth minimum	6,02–6,94	6,49±0,01	6,03–6,44	6,26±0,02
Body width maximum	14,49–17,94	16,17±0,04	17,33–18,62	18,06±0,1
Body width at dorsal-fin origin	11,68–12,75	12,08±0,01	14–15,32	14,5±0,08
Caudal peduncle length	22,12–24,07	22,84±0,04	21–23,76	22,41±0,11
Caudal peduncle depth	8,14–9,26	8,66±0,02	7,84–9,01	8,47±0,03
Caudal peduncle width	7,01–8,33	7,59±0,02	7,76–9,01	8,24±0,05
Pectoral-fin length	15,93–18,18	17,23±0,04	15,95–17,33	16,46±0,05
Pelvic-fin length	14,16–16,67	15,41±0,04	15–17,12	16,17±0,09
Dorsal-fin depth	15,93–19,81	17,83±0,06	18,5–18,97	18,78±0,08
Dorsal-fin base length	11,95–12,75	12,31±0,01	11–12,87	11,93±0,06
Anal-fin depth	13,27–14,81	14,01±0,03	14–15,32	14,73±0,08
Anal-fin base length	6,64–7,73	7,04±0,02	6,63–7,66	7,03±0,05
Caudal-fin length	17,70–20,37	19,2±0,06	19,8–21,62	20,45±0,1
Caudal-fin longest branched ray length	18,14–20,94	19,45±0,06	19,8–22,07	20,6±0,11
Caudal-fin shortest branched ray length	14,95–16,7	15,85±0,05	16,81–17,57	17,1±0,07
Lateral head length	22,12–23,64	22,84±0,03	22,77–24,32	23,56±0,13
Percentage of lateral head length				
Head depth at nape	55,77–62,5	59,04±0,02	55,56–58,7	57,03±0,07
Head depth at the middle of eye	44–47,5	45,99±0,01	46,3–48,21	47,45±0,06
Interorbital width	32,5–36	33,77±0,02	29,63–33,48	31,65±0,03
Head width	65,38–71,43	68,16±0,02	66,67–69,57	68,02±0,08
Head width at the preopercle	57,69–63,27	60,73±0,02	61,11–65,22	62,77±0,07
Snout length	41,67–46,8	44,21±0,02	44,44–43,59	43,59±0,06
Postorbital head length	40–45,83	42,05±0,02	43,48–42,53	42,53±0,04
Eye diameter	18,75–20,8	19,73±0,01	21,3–19,91	19,91±0,01
Inner rostral barbel length	23,75–30,61	26,37±0,03	25,93–23,08	23,08±0,04
Outer rostral barbel length	25–40,82	34,49±0,05	35,56–33,35	33,35±0,04
Maxillary barbel length	28,85–44,90	34,01±0,06	30,43–29,71	29,71±0,04
Mouth length	22,92–29,17	26,18±0,02	26,09–25,77	25,77±0,04
Mouth width	36,8–40,82	38,67±0,01	39,57–37,95	37,95±0,04

Body shape and proportions

The body is elongated and only slightly laterally compressed. The origin of the dorsal fin starts closer to the end of the snout than to the end of the caudal fin. The dorsal profile of the back is nearly arch-like. The deepest body point is between the occiput and the dorsal fin. The maximum body depth is greater than its width at this point and smaller than the caudal peduncle length. The caudal peduncle is short, not compressed laterally; its length is much greater than its depth and width. The width of the caudal peduncle is equal to, or slightly smaller than, its depth. The depth of the caudal peduncle is 2.5-2.9 times its length. The minimum body depth is smaller than the caudal peduncle depth.

The dorsal fin is longer than the anal fin. The pectoral fins in males are slightly longer than the pelvic fins, and in some females, they are equal in length. The pectoral fins extend beyond half the distance between the bases of the pectoral and pelvic fins. The pelvic fins extend beyond the anus and do not reach the anal fin. The anus is closer to the bases of the anal fin than to the bases of the pelvic fins. The distal margin of the caudal fin is slightly concave.

The head is not compressed laterally and dorsally resembles a truncated cone with a rounded top (Figure 2).

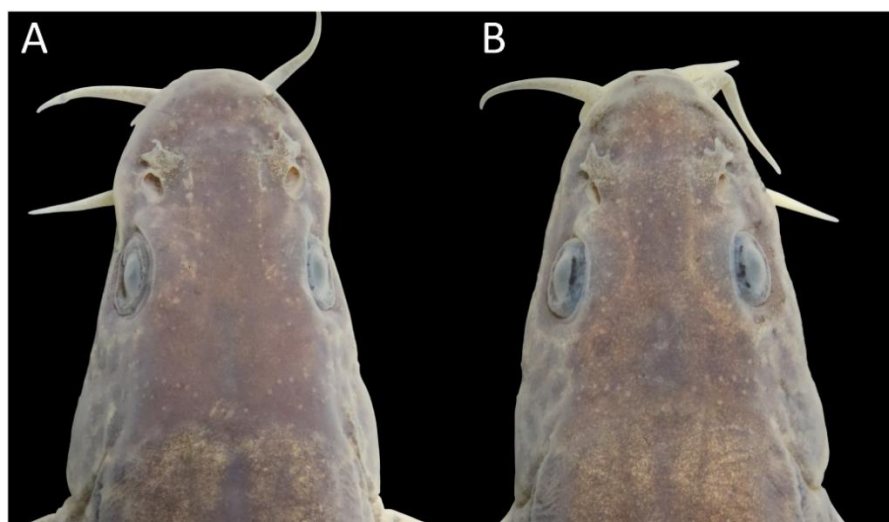


Figure 2. Head of the spotted thicklip loach (*T. strauchii*) from the Uba River (upper Irtysh basin), dorsal view. Male (A, TL – 126 mm) and female (B, TL – 121 mm)

The head length is more than 22% of SL, exceeds the greatest body depth, and is approximately equal to the caudal peduncle length. The head depth at the occiput is greater than half its length and smaller than the head width here. The interorbital space is flat and moderately wide; the eye diameter is less than 1.8 times its width. The dorsal profile of the head is straight to the nostrils, where it is slightly or noticeably convex (Figure 3). The snout is rounded and moderately elongated; it is usually shorter than the postorbital distance. In males, the anterolateral edges of the snout form small ridges - thus, dorsally, their snout is more rounded than in females. In addition, a well-formed swelling extends from the eye to the upper jaw in males (Figure 3A).

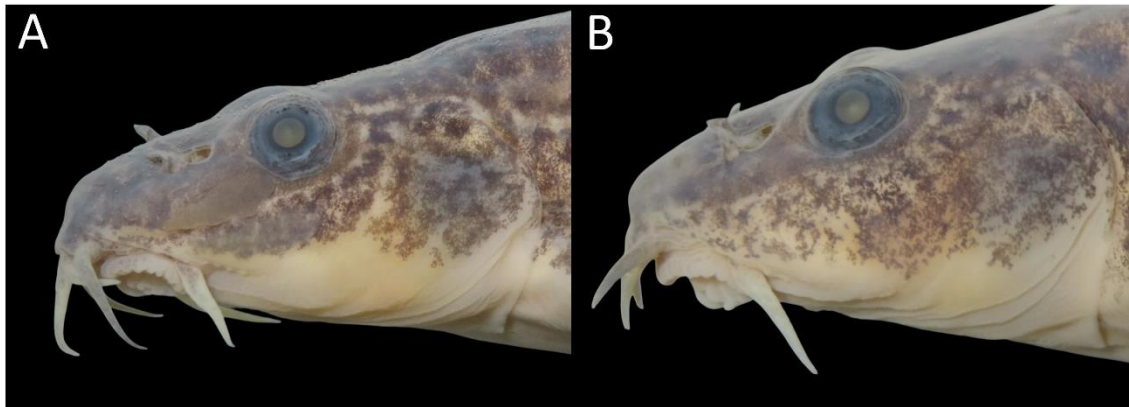


Figure 3. Head of the spotted thicklip loach (*T. strauchii*) from the Uba River (upper Irtysh basin). Male (**A**, TL – 131 mm) and female (**B**, TL – 139 mm)

The eyes are situated rather laterally and, when viewed from the side, are located above the forehead line. The horizontal diameter of the eye is 2.0-2.4 times the length of the snout. The barbels' length is greater than the eye diameter. The longest is the outer rostral one. The maxillary barbels extend beyond the middle of the eye, or further beyond the posterior edge of the eye.

Shape of the mouth and nostrils

The mouth is short, inferior, and surrounded by three pairs of barbels (Figure 4). The length of the oral opening is less than its width, and the oral slit is crescent-shaped. The lower lip covers the edge of the lower jaw; the edge is visible in the middle of the lip. The upper lip is without a medial notch; in some individuals, it covers the edge of the upper jaw, but in most fish, the edge is visible. The processus dentiformis is absent. The lower lip is interrupted in the middle and divided into three or four paired and more or less isolated lobes. The mental lobes are well-formed and disc-shaped. The lateral lobes are not formed. The lips with short thickened papillae. The upper lip is not interrupted, the folds on the lower lip are well expressed. The anterior and posterior nostrils adjacent, the posterior nostril is triangular in shape, the internasal septum is wide.

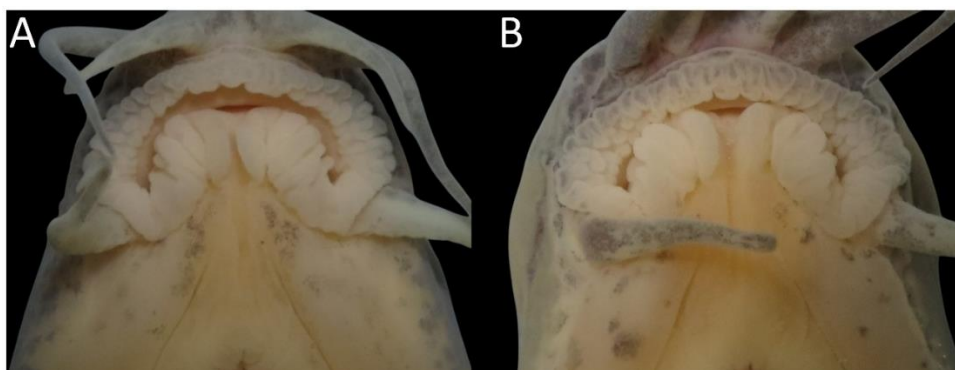


Figure 4. Lips of the spotted thicklip loach (*T. strauchii*) from the Uba River (upper Irtysh basin), ventral view. Female (**A**, TL – 135 mm) and male (**B**, TL – 128 mm)

Fins shape

The distal end of the dorsal fin is rounded, the posterior margin is straight, the longest ray is the second branched one. The distal end of the anal fin is rounded, its posterior margin is rather convex, the longest ray is the second branched one (Figure 5).

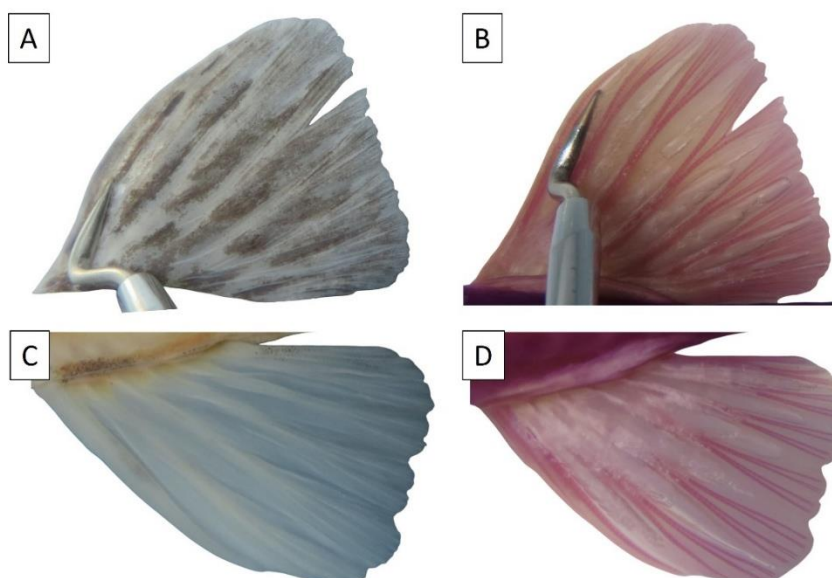


Figure 5. Dorsal (A-B) and anal (C-D) fins of the spotted thicklip loach (*T. strauchii*) from the Uba River (upper Irtysh basin). On the right are fins with stained rays

The lobes of the caudal fin are rounded, the upper lobe is slightly longer than the lower one, the fin is slightly notched, the longest upper lobe rays the second and third branched ones, the longest lower lobe rays are the third or the third and fourth branched ones (Figure 6).



Figure 6. Caudal fin of the spotted thicklip loach (*T. strauchii*) from the Uba River (upper Irtysh basin). On the right is fin with stained rays

The distal end of the pectoral fin is rounded, the posterior margin is convex, and the longest rays are usually the third and fourth branched ones. The distal end of the pelvic fin is rounded, the posterior margin is convex, the longest rays are the second branched, or the second and third branched ones (Figure 7).

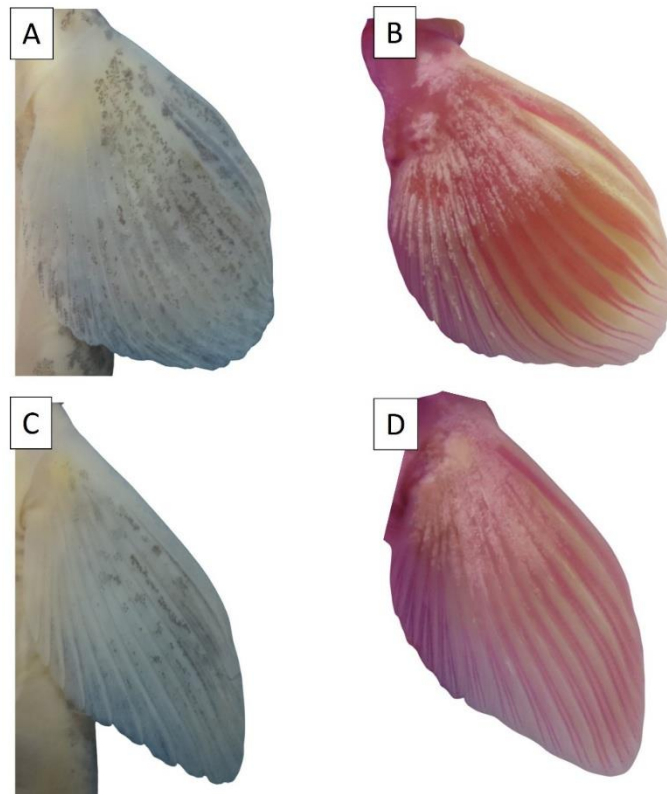


Figure 7. Left pectoral fin of the spotted thicklip loach (*T. strauchii*) from the Uba River (upper Irtysh basin). Male (**A-B**), TL – 128 mm) and female (**C-D**, TL – 121 mm). On the right are fins with stained rays

Internal organs

The posterior part of the swim bladder is well developed. The swim bladder is widened in the back part of the abdominal cavity and has a round or oval shape. It is connected to the bone capsule by a thin canal. The intestine is of medium length, usually forming two main loops – ascending and descending (Figure 8). Sometimes there are one to three additional loops.

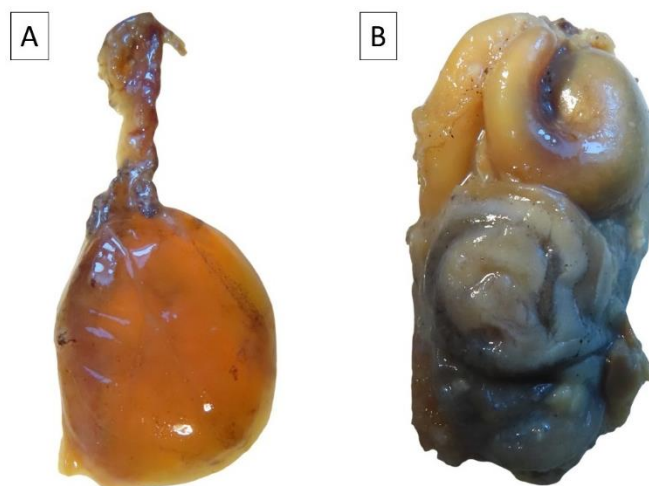


Figure 8. Swim bladder (**A**) and intestine (**B**) of the spotted thicklip loach (*T. strauchii*) from the Uba River (upper Irtysh basin)

Sexual dimorphism

Males are distinguished by the following characteristics: the first four-five branched pectoral fin rays are thickened in males, the anterolateral edges of the snout with ridges, a swelling extends from the eye to the snout, some males have the brush-like agglomerations of spawning tubercles on sides of the head, characteristic for *T. strauchii* [17] (Figure 9).

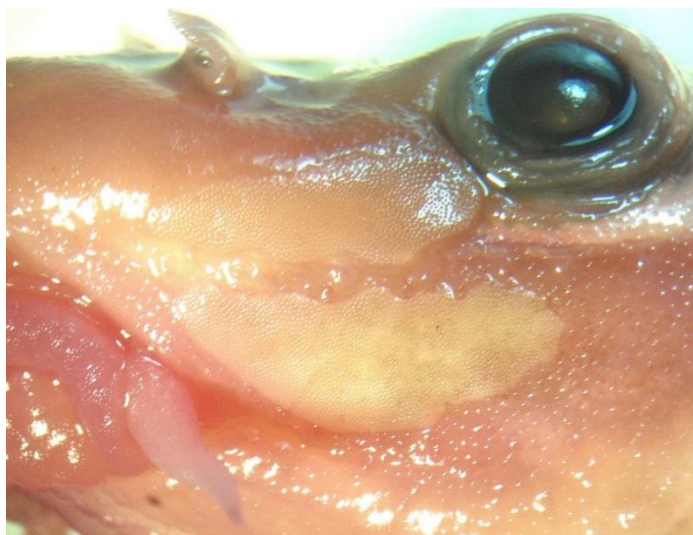


Figure 9. The brush-like agglomerations of spawning tubercles on sides of the head of the spotted thicklip loach (*T. strauchii*) from the Uba River (upper Irtysh basin). Male, TL – 131 mm)

The results of the morphological analysis showed that the studied fish from the Uba River have features characteristic of the spotted thicklip loach [13,17,18]: rounded black spots on the body, a caudal peduncle not compressed at the base, caudal peduncle width exceeds the minimum body depth, the minimum body depth more than 3 times in the caudal peduncle, the dorsal fin depth does not exceed the maximum body depth, the pectoral fins are longer than the pelvic fins, the anterior and posterior nostrils adjacent, the upper lobe of the caudal fin is slightly longer than the lower one. The structure of the swim bladder and intestine, the structure of the mouth and lips, as well as the location of the brush-like agglomerations of spawning tubercles on the head [17] are also characteristic of *T. strauchii*.

The spotted thicklip loach is subject to increased morphological variability, and individual populations differ significantly in many plastic features [13]. According to Prokofiev [17], most plastic features are of secondary importance in diagnosing the loach species, therefore, when describing new forms, it is necessary to study in more detail the qualitative features related to body shape, mouth structure, nuptial elements on the body of males, internal organ structure and, if possible, osteological features.

Conclusion

The spotted thicklip loach (*T. strauchii*) is a widespread Central Asian species, for which many populations have been poorly studied in the water bodies of Kazakhstan, and the distribution requires clarification. The range of this species is moving further north. In the upper Irtysh basin, *T. strauchii* was mentioned only for the rivers of the northern slopes of the Tarbagatai

Mountains. This study confirms its presence in the Uba River. The plastic and meristic features, body proportions, qualitative features related to color, shape of fins, head, lips, as well as the structure of the intestine and swim bladder were studied. Characteristic features of males were revealed. Most of the analyzed features are characteristic of *Triplophysa strauchii*. To clarify the range of this species, further studies are needed, including in the basin of the middle and lower Irtysh, and possible places for its penetration.

Authors' contributions

T.D.A. – idea and structure of the study, implementation of the experimental part of the study, writing and editing the text of the article; **S.M.B.** – implementation of the experimental part of the study, writing the text.

Conflicts of Interest

Authors declare no conflicts of interest.

Compliance with ethical standards

All animal procedures complied with the ethical standards of the institution where the studies were conducted and the approved legal acts of the Republic of Kazakhstan and international organizations. (No. 25/2).

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Үбі өзені (Жоғарғы Ертіс бассейні) теңбіл талма балығының *Triplophysa strauchii* (Nemacheilidae) морфологиялық сипаттамасы

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Аңдатпа. Теңбіл талма балығы – Қазақстанның көптеген су қоймаларында мекендейтін Орталық Азиялық балықтардың аборигенді түрі. Бұл түр балықтардың күрделі таксономиялық тобына жатады – *Triplophysa* туысы. Қазақстанның су қоймаларындағы теңбіл талма балығының үш түршесі белгілі: теңбіл талма балығы (*T. s. strauchii*), көл талма балығы (*T. s. ruzskyi*) және Зайсан талма балығы (*T. s. zaisanicus*), бірақ олардың таксономиялық орны мен таралуы нақтылауды қажет етеді. Теңбіл талма балығының қазіргі таралу аумағы өте кең, ол Балқаш-Алакөл, Тарим, Шу және Сырдария өзендерінің бассейндерін мекендейді, сонымен қатар Зайсан көлінің бассейнінде де кездеседі. Қазіргі уақытта бұл түр өзінің таралу аймағын солтүстікке қарай кеңейтуде, ол Орталық және Солтүстік Қазақстанның ағынсыз өзендері мен көлдеріне сәтті бейімделген. 2016 жылы Жоғарғы Ертіс бассейнінің Үбі өзенінен теңбіл талма балығы табылды. Сыртқы морфологиялық сипаттамасы, оның ішінде түсі, пластикалық және меристикалық белгілері, дене пропорциялары, жүзбеқанаттарының пішіні, еріннің құрылымы, ішек пен жүзу торсылдағының

ерекшеліктері берілген. Жыныстық диморфизмге қатысты белгілер зерттелді. *Triplophysa strauchii* балығына тән белгілер анықталды. Осы түрдің ареалын нақтылау мақсатында Ертіс бассейнінде одан әрі зерттеу жүргізуді қажет етеді.

Түйін сөздер: теңбіл талма балығы, *Nemacheilidae*, *Triplophysa strauchii*, морфология, Жоғарғы Ертіс бассейні, Үбі өзені

Морфологическая характеристика пятнистого губача *Triplophysa strauchii* (Nemacheilidae) из реки Уба (верхне-иртышский бассейн)

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Аннотация. Пятнистый губач – аборигенный центральноазиатский вид рыб, обитающий во многих водоемах Казахстана. Этот вид относится к сложной таксономической группе рыб – роду *Triplophysa*. Для водоемов Казахстана известно три подвида пятнистого губача: пятнистый губач (*T. s. strauchii*), озерный губач (*T. s. ruzskyi*) и зайсанский губач (*T. s. zaisanicus*), однако их таксономический статус и распространение требуют уточнения. Современное распространение пятнистого губача очень широкое, он обитает в бассейнах Балхаш-Алаколя, Тарима, рек Чу и Сырдарья, также известен для бассейна озера Зайсан. В настоящее время этот вид расширяет свой ареал далеко на север, где успешно акклиматизировался в бессточных реках и озерах Центрального и Северного Казахстана. В 2016 году пятнистый губач был обнаружен в реке Уба бассейна верхнего Иртыша. Приведено описание внешней морфологии, включающее окраску, пластические и меристические признаки, пропорции тела, форму плавников, строение губ, особенности кишечника и плавательного пузыря. Изучены признаки, касающиеся полового диморфизма. Выявлены характерные черты *Triplophysa strauchii*. С целью уточнения ареала данного вида, необходимы дальнейшие исследования в бассейне Иртыша.

Ключевые слова: пятнистый губач, *Nemacheilidae*, *Triplophysa strauchii*, морфология, верхне-иртышский бассейн, река Уба

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