

Rare and endangered populations of Fringebarbel sturgeon, *Acipenser nudiventris* Lovetsky, 1828, in Kapshagai Reservoir and Ili River on the territory of the Republic of Kazakhstan

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ABSTRACT

This article presents the analysis of literature data published from 1970 to 2020, data obtained in 2021-2023 as a result of research work, as well as data during conversations with fishermen and fishery inspectors on the current state of Fringebarbel sturgeon, *Acipenser nudiventris* Lovetsky, 1828. Fringebarbel sturgeon belongs to the sturgeon family, a rare and valuable fish species. Its natural habitat is the rivers of the Black, Azov, Caspian, and Aral Sea basins and their tributaries. Fringebarbel sturgeon is one of the most vulnerable and few sturgeons in the world, and its isolated specimens are still found in the Balkhash-Ili basin (Kazakhstan - China) due to its migration in 1933-1934. Notably, this is the only example of successful sturgeon acclimatization. In 2021-2023, research work in the Kapshagai reservoir and the Ili River was performed in May-August at 10 stations. Results of the research revealed that the Fringebarbel sturgeon population is extremely low, and only juvenile Fringebarbel sturgeon are occasionally caught in catches.

Keywords: Acclimatization, Basin, Reservoirs, Juveniles, Spawning, Sexual maturity, Population, River, Fringebarbel sturgeon.

Article type: Research Article.

INTRODUCTION

Fringebarbel sturgeon, *Acipenser nudiventris* Lovetsky, 1828, belongs to the sturgeon family (Acipenseridae Bonaparte, 1832). It is relict, rare, and valuable fish species, belonging to the Ponto-Caspian-Aral faunal complex. Its natural habitat is the rivers of the Black, Azov, and Caspian Sea basins, the Aral Sea, and its tributaries. It is acclimatized in the Balkhash basin (1933-1934). Currently, in Kazakhstan, it is widespread in the Ural-Caspian and Balkhash-Alakol basins. After constructing the Kapshagai hydroelectric power plant, the single Balkhash-Alakol population was divided into two parts (populations): Kapshagai and Balkhash. The third Ural-Caspian population is rapidly declining and is currently permitted for catching only for scientific and reproductive purposes (Mitrofanov 1986; Borzenko 1950; Gryunberg 1913; Erbulekov 2004; Pechnikova 1972; Vorobyova & Markov 1999; Avetisov 2008; Gershanovich *et al.* 1987; Konovalov 1961; Friedrich *et al.* 2019). However, even in this case, catching the required number of spawners for subsequent artificial reproduction is impossible. The Aral and

Balkhash populations are listed in the Red Book of the Republic of Kazakhstan as endangered populations under category I (2008) (Red Book of the Republic of Kazakhstan 2008). The Fringebarbel sturgeon is also included in the Red List of the International Union for Conservation of Wildlife (IUCN 1994) as a species in critical condition (CR): A2cdeIUCN Red Lists 2024; Dukravets *et al.* 2016).



Fig. 1. Fringebarbel sturgeon, *Acipenser nudiventris* Lovetsky, 1828, Kapshagai reservoir and the Ili River.

According to Serov N.P. (1963), the Fringebarbel sturgeon was brought into the Balkhash-Ili basin from the mouth of the Syrdarya River in six stages. A total of 291 specimens, 114-136 cm in length and 6.7-30.0 kg in weight, were brought in. The first three batches of 91 specimens were transported between November 1 and 29, 1933. The second three batches of 200 specimens were transported between November 10 and 23, 1934. Fringebarbel sturgeon were released into the Ili River near the Iliysk village (Serov 1963). By 1970, adult Fringebarbel sturgeon s and their juveniles were found in all lake areas. Adult Fringebarbel sturgeon s and juveniles were encountered in summer along the entire length of the Ili River to the border with China and Karatal River. After constructing the Kapshagai hydroelectric power plant, the single Ili population was divided into two parts: Kapshagai and Balkhash. By the mid-1980s, the Fringebarbel sturgeon population had significantly decreased, primarily due to a sharp deterioration in the conditions for the development of juveniles due to the reduction in the length of migration routes and the area of spawning grounds (Bekbergenova 2021).

In Kapshagai hydroelectric power station, the Fringebarbel sturgeon was rarely encountered in the first years of its filling. However, in June 1970, an 11-cm long yearling Fringebarbel sturgeon was already caught. In May-June 1971, 25 immature Fringebarbel sturgeon s 27-76 cm in length (39.7 cm on average) and 0.14-3.48 kg in weight (679 g on average) were caught at the age of 3-8 years (Dukravets & Mitrofanov 2009; Ablaysanova *et al.* 2017). In 1973, the Fringebarbel sturgeon juveniles in Kapshagai Reservoir were represented in small quantities in collections (0.4% of the total number of juveniles), most in the reservoir's upper reaches. In 1971-1974, different-aged Fringebarbel sturgeon specimens (1,125 specimens) were relocated from the downstream wall of the dam to the Kapshagai Reservoir in order to accelerate the formation of its population (Bekbergenova 2020). Further, the size of the Fringebarbel sturgeon population in the Kapshagai Reservoir increased. Thus, in the spring of 1974, up to 50 young Fringebarbel sturgeon specimens were caught in a fixed net per day in the Issyk River. In 1975-1976, up to 10-15 Fringebarbel sturgeon specimens were caught in commercial nets in the Salt Lakes area (Isbekov & Ismukhanov 2009). If in 1971-1973, specimens weighing up to 4-5 kg were rare, and larger specimens were singly encountered, then in 1975, the average weight of the Fringebarbel sturgeon was already 5.1 kg. In 1976, specimens weighing 7-9 kg predominated in commercial fishing gear, and in 1977-1978, they weighed. In 1980-1981, spawners weighing 18-25 kg were caught. In 1984, cases of catching large Fringebarbel sturgeon s weighing up to 43 kg were noted, but specimens weighing 20-30 kg predominated. Since 1988, Fringebarbel sturgeon catching has been prohibited in the Kapshagai Reservoir. In May 1994, immature Fringebarbel sturgeon s 6 kg in average weight were caught in the control fleet of the nets of scientific research fishing. In subsequent years, the number of Fringebarbel sturgeon s in net catches decreased. Thus, from March 25 to April 5, 1995, in the Ili River, in a section 10 km upstream of the Kapshagai Reservoir, yearling Fringebarbel sturgeon s 15 cm in average length were 17% of the total number of fish in experimental catches. The last case of a Fringebarbel sturgeon being caught in scientific fishing gear occurred on May 14, 2002, in the Kapshagai Reservoir near the mouth of the Turgen River; the caught specimen had a body length of 1080 mm and a total

weight of 10.6 kg (Ablaisanova & Makambetov 2021; Kucharczyk *et al.* 2022; Kucharczyk *et al.* 2022). In 2009, in the area of the Salty Lakes, fishermen caught several specimens of juvenile Fringebarbel sturgeon s. In November 2010, one specimen, 27 cm in body length and 0.142 kg in weight was caught in Ili River, and in 2014, it was 50 cm in body length and 1.2 kg in weight (Ayak-Kalkan area). According to fishermen from the Panfilov District (Almaty Region), the last females with gray caviar (gonad maturity stage III-IV) were caught in 2011-2012 weighing more than 20 kg, and in subsequent years (since 2015), females with small white caviar (stage II) were caught. According to fishermen, in April 2015, near the mouth of Kaskelen River, they caught two Fringebarbel sturgeon specimens with an approximate weight of 4 kg in a 55-mm mesh-sized net, which, according to them, were released alive since this fish is prohibited from catching. In April 2015, near “Salt Lakes,” the upper reaches of the reservoir, fishermen, while clearing the bed of fishing ground (No. 24), fished up an abandoned Chinese net - funicular web, in which, along with other species, about 10 kg of the half-decomposed Fringebarbel sturgeon were found. Over the past five years, juveniles caught in scientific and commercial fishing gear have mainly been Fringebarbel sturgeon ped. Thus, in 2016, at the beginning of October, one specimen (body length = 25 cm, weight = 158 g) was caught in the retaining zone of the reservoir. Later, on April 10, 2019, in the area of Karakol Bay, one Fringebarbel sturgeon specimen (body length = 73 cm, weight = 3.5 kg) was noted in scientific catches (“Scientific and Production Center of Fishery” LLP). In the spring of the following year, one other specimen (body length = 37 cm, weight = 0.35 kg) was recorded in the same reservoir area (Isbekov & Ismukhanov 2009). The last cases of catching a larger Fringebarbel sturgeon entering sexual maturity were noted in the autumn of 2019 when two Fringebarbel sturgeon specimens weighing 8 and 12 kg were caught, suggestively females, which were released alive.

MATERIALS AND METHODS

The collection, processing, and primary analysis of ichthyological material are based on generally accepted methods (Pravdin 1966; Bayimbet & Temirkhan 1999; Koblitskaya 1981; Froese 2024). A map of the sampling station was made using the QGIS 3.34.3 program (QGIS Development Team. 2021). Fish were caught using mandatory sets of fishing gear: fixed drift nets (for the Ili River) and fry drag nets.

Characteristics of standard fishing gear. Fixed nets: - length 25 m, each, height 2-3 m. The order of fixed nets consists of 10 nets with different mesh sizes: 16, 20, 24, 30, 40, 50, 60, 70, 80, 90 mm; Fused nets: length 100 m, mesh size 100 mm, 75 mm and 65 mm, height 3-4 m; fry drag net: length 6 m, mesh size in the wings 5 mm and bag - 3 mm. At each station, the catching time was at least 12 hours. If the catching time increased or decreased due to weather or other reasons, the catch amount was recalculated per unit of time: net/day. Fishing with fused nets was carried out on the river in areas where the width, current, depth, etc. allowed, with gill nets during the day and evening.

RESULTS

Only juvenile Fringebarbel sturgeon s are occasionally caught in scientific and commercial catches in the Kapshagai Reservoir and Ili River. In 2021-2023, as part of the project “Study of populations of rare and endangered fish species and alien aquatic organisms in order to develop recommendations for the artificial reproduction of rare species and prevention of the spread of alien fish species and other aquatic organisms”, research work was performed to remove live material of rare and endangered fish species in native reservoirs of the Balkhash-Alakol basin. In 2021, Fringebarbel sturgeon was not found in scientific catches. However, according to survey data, on May 25, 2021, in Karakol Bay, fishermen caught one specimen of the juvenile Fringebarbel sturgeon with a body length of 25 cm. During the test catch, employees of the Kapshagay fishery inspecting the area of the 18th fishing site recorded one Fringebarbel sturgeon weighing 1.5 kg and another specimen weighing 6 kg in the 20th fishing site. In the summer of 2021, amateur fishermen caught one specimen of the Fringebarbel sturgeon near the tributary of the Ili River (Sharyn River). On September 18 of this year, in the restricted area of the Kapshagai reservoir, fishery inspectors and hunting service seized 4 specimens of the juvenile Fringebarbel sturgeon, body length 25-30 cm, from illegal nets. They were released back into the reservoir alive after registering biological indicators (length and weight). The Fishery Committee of the Ministry of Ecology and Natural Resources of the Republic of Kazakhstan issued a Permit for the seizure of Fringebarbel sturgeon in the Kapshagai Reservoir and the Ili River (by the Permit of the Fishery Committee of the Ministry of Ecology and Natural Resources of the Republic of Kazakhstan for the fishing of Fringebarbel sturgeon dated 18.05.2022 No. KZ96VEP00124699, No. KZ26VEP00124698; dated 04.04.2023 No. KZ24VEP00146656 and

dated 10.04.2023 KZ21VEP00146904). During the research work, according to the permit for 2022-2023, 26 Fringebarbel sturgeon specimens were caught in the scientific catches in the Kapshagai Reservoir and the Ili River. The size and weight of the Fringebarbel sturgeon are presented in Table 1.

Table 1. Size and weight of the Fringebarbel sturgeon from the Kapshagai reservoir and the Ili River, 2022-2023.

Catching site	Date of catching	№	Fish length (L; cm)	Fish length (L; cm)	Fish weight (g)
2022					
96 km along navigable path	26.05.2022	1	127.0	108.0	8930.0
96 km along navigable path	15.06.2022	2	32.0	27.0	109.0
96 km along navigable path	15.06.2022	3	29.5	25.0	99.7
96 km along navigable path	15.06.2022	4	29.0	25.0	100.9
96 km along navigable path	15.06.2022	5	30.0	27.0	103.5
96 km along navigable path	15.06.2022	6	29.5	25.0	118.6
96 km along navigable path	16.06.2022	7	31.0	28.0	127.4
96 km along navigable path	16.06.2022	8	29.0	25.0	103.4
96 km along navigable path	16.06.2022	9	30.5	27.0	120.1
96 km along navigable path	16.06.2022	10	35.0	29.5	182.5
96 km along navigable path	18.06.2022	11	31.5	28.0	148.9
96 km along navigable path	18.06.2022	12	29.0	25.0	99.9
96 km along navigable path	18.06.2022	13	29.0	25.0	104.2
96 km along navigable path	18.06.2022	14	25.0	21.5	67.7
96 km along navigable path	19.06.2022	15	41.0	37.0	300.0
96 km along navigable path	04.07.2022	16	47.0	42.5	461.0
96 km along navigable path	10.09.2022	17	62.0	-	1150.0
96 km along navigable path	10.09.2022	18	55.0	-	630.0
96 km along navigable path	12.09.2022	19	55.0	-	866.0
96 km along navigable path	12.09.2022	20	60.0	-	1054.0
96 km along navigable path	13.09.2022	21	62.5	52.7	1134.0
96 km along navigable path	14.09.2022	22	63.2	53.4	1305.0
2023					
96 km along navigable path	30.05.2023	1	-	49.0	800
96 km along navigable path	19.07.2023	2	-	90.0	7900
Ili River	21.07.2023	3	-	60.0	1900
Station No. 1	03.08.2023	4	-	90.0	7000

The Fringebarbel sturgeon in the Balkhash-Ili basin reaches sexual maturity at 9-11, less often 8 years (males) and 12-14 years (females). Suggestively, the Fringebarbel sturgeon reproduces in the Ili and Karatal rivers every 2 years. Spawning occurs in April-May and can continue until mid-June. Spawning begins at a water temperature of 10-12 °C and ends at 21-24 °C. This species' most optimal spawning temperature is 14-18 °C. The Ili Fringebarbel sturgeon population fattens in the Balkhash Lake and the Kapshagai Reservoir, feeding on mollusks and fish. The growth rate of the juvenile is high in the Ili River (9.2-14.3 cm); in Balkhash at 7 years, it reaches an average weight of 7-9 kg, and at 17 years 18-20 kg [1, 19]. Spawning grounds are located on solid ground, rocky ridges, and pebbles. The main spawning grounds of Fringebarbel sturgeon were located in the middle, mainly in the upper reaches of Ili River. In Kapshagai Gorge, east of the Iliysk station, on the Chulak tract and above the Dubun pier, The upper spawning grounds are located in Ili River and its tributaries flowing beyond the state border of Kazakhstan. After spawning, spawners remain in the river for some time and later migrate to the fattening reservoir. The repeated ascent to the river and spawning of the Fringebarbel sturgeon occurs after 2-3 years. In the first years of life, juvenile Fringebarbel sturgeon s migrate down to the lake in small quantities; most of them stay in the river system for up to three years, rarely six years. Like many other sturgeon species, the Fringebarbel sturgeon in the Balkhash-Ili basin, along with the migratory form, has a small population of resident Fringebarbel sturgeon s. Unlike the migratory Fringebarbel sturgeon, the resident Fringebarbel sturgeon spends its entire life cycle in Ili River (Ablaysanova *et al.* 2017; Bekbergenova 2020; Isbekov & Ismukhanov 2009). By the time the Kapshagai hydroelectric power station dam blocked the river, the Fringebarbel sturgeon population in water bodies of flooding zones was relatively numerous. It was represented by fish of different ages, with the prevalence of young, immature specimens. The sexually mature part of the population could not migrate up through hydraulic structures during the construction years, while the reverse migration of spawners that had previously entered the river was observed but already into the waterways of the newly formed reservoir. After the construction of the Kapshagai hydroelectric power plant in 1970, the single Ili population of the Fringebarbel

sturgeon was divided into two Kapshagai and Balkhash. By the mid-1980s, the number of Fringebarbel sturgeons had significantly decreased, which was due, first of all, to a sharp deterioration in the conditions for the development of juveniles due to the reduction in the length of migration routes and the area of spawning grounds. Also, in 2023, in the spring and summer, we conducted an inventory of the Aral Fringebarbel sturgeon's spawning grounds. In the upper reaches of Ili River (from Kapshagai reservoir to the border of the PRC), the Fringebarbel sturgeon's modern spawning grounds are located on a section of 135 km along the navigable path at the mouths of the Sharyn, Borokhudzir, and Dubun rivers.

Spawning grounds of Fringebarbel sturgeon in the Balkhash-Alakol basin

Ili River

In July 2023, a survey of the spawning grounds of the Aral Fringebarbel sturgeon was conducted in the upper and lower reaches of the Ili River within the Almaty region from the border with China to the head of the Ili River Delta. A survey of the spawning grounds of the Aral Fringebarbel sturgeon was conducted in the main sections of the river according to literary and survey data from local residents. As a result, it was revealed that before the regulation of the river bed, the main spawning grounds were the areas between Iliysk and Bakanas villages in the lower reaches of the Ili River and from the Dubun pier to the confluence with the Kapshagai reservoir. In the upper reaches of Ili River (from Kapshagai reservoir to the PRC border), modern spawning grounds of the Fringebarbel sturgeon are located on a section of 135 km along the navigable path, on the section of the mouth of the Sharyn, Borokhudzir rivers and to Dubun Station (Fig. 2).



Fig. 2. Pike perch spawning grounds in the Ili River.

Spawning ground 135 km along the navigable path

Spawning ground 135 km along the navigable path is located on the right bank of Ili River; there are rocky ledges in this section of the river. The total area of the spawning ground is 25.4 hectares (the channel part 18.9 hectares, and the flooded part 6.5 hectares). Coordinates of the spawning ground: N 43°51'6.77", E 78°28'27.96". The bottom is uneven, soil composition is rocky pebbles, with a pebble diameter of up to 10 cm (Fig. 2). The underwater part of the river is completely covered with rocky-sandy soil. There is no above-water or underwater vegetation in this section. A schematic map of the spawning ground is shown in Fig. 3.

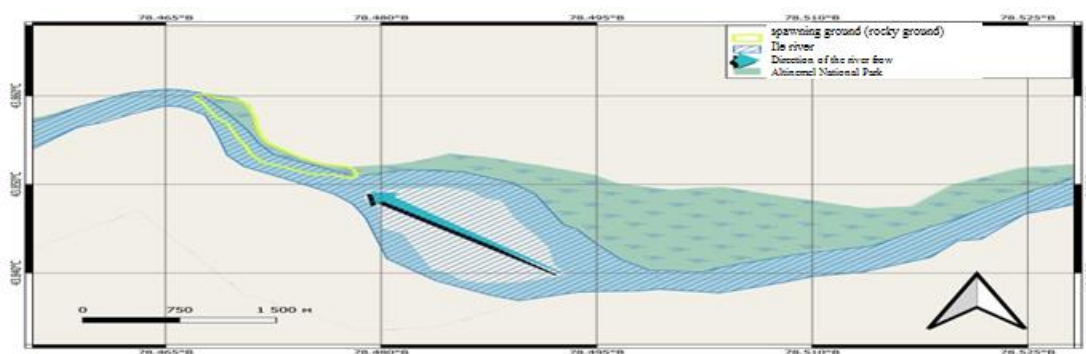


Fig. 3. Spawning grounds of the Ili River.

he spawning ground's soil quality can be classified as medium-effective. Given the soil, sturgeon spawning is possible.

Spawning ground Mouth of Sharyn River

The spawning ground, Mouth of Sharyn River is located 22 km north of Sharyn village. The total area of the spawning ground is 19.8 hectares (channel 14.4 hectares, flooded 5.4 hectares). The surface of the spawning ground is even, and the soil of the spawning ground is represented by sand and sludge deposits. There is no overgrowth in the coastal part. Coordinates of the spawning ground: N 43°55'51.68", E 79°25'35.74". A schematic map of the spawning ground is shown in Fig. 4.

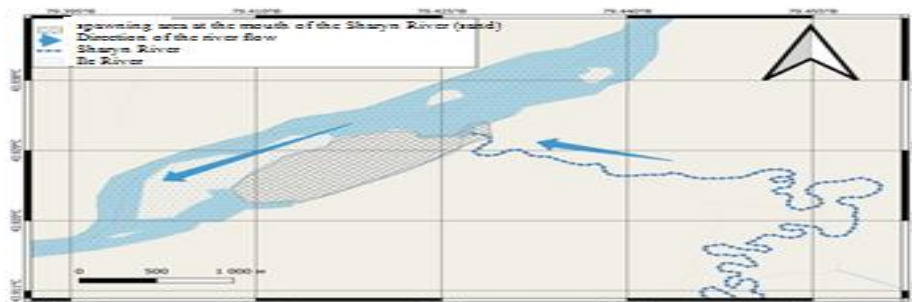


Fig. 4. Spawning grounds of the Sharyn River.

The spawning ground can be classified as ineffective in terms of the soil quality (fine sand with silt). Spawning of the Fringebarbel sturgeon is unlikely given the nature of the soil.

Spawning ground Mouth of Borokhudzir River

The spawning ground Mouth of Borokhudzir River is located on the right bank 5 km south of the Darbazakum village. During the study period, total area was 11.9 hectares, of which the channel area was 9.8 hectares and flooded area 2.1 hectares. Bottom of the channel section is uneven, there is no overgrowth, soil is sandy and rocky with silt, and diameter of the stones is up to 4-5 cm. Spawning ground coordinates: N 43°57'43.41", E 79°37'33.11". Schematic map of the spawning grounds is shown in Fig. 5.

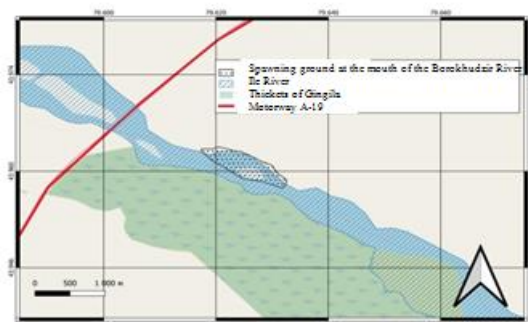


Fig. 5. Schematic map of the Spawning ground Mouth of the Borokhudzir River.

The spawning ground can be classified as medium-effective in terms of soil quality. Spawning of Fringebarbel sturgeon is possible, given the nature of the soil.

Spawning ground Dubun Pier

The spawning ground Dubun Pier is located on the left bank 6-7 km east of the Dubun village. The total area during the study period was 10.2 hectares (channel 8.8 hectares, flooded 1.4 hectares). The surface of the spawning ground is even; the soil consists of stone, rounded pebbles, and sand. No above-water or underwater vegetation; the coastline is partially overgrown with grass. Coordinates of the spawning ground: N 43°45'40.75", E 80°13'35.53". A schematic map of the spawning ground is shown in Fig. 6. The spawning ground can be classified as highly effective in terms of soil quality. Considering the nature of the soil, Fringebarbel sturgeon spawning quite realistically occurs in this area.

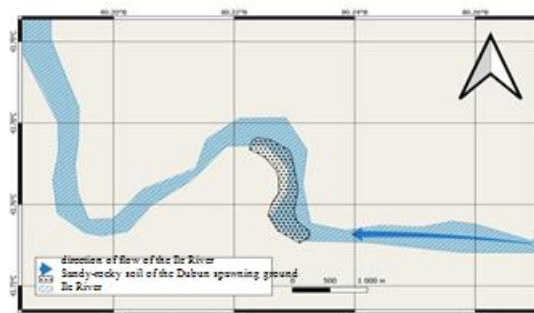


Fig. 6. Schematic map of the spawning ground Dubun Pier.

CONCLUSION

The Fringebarbel sturgeon is a rare and valuable species and a unique representative of sturgeon, the only one able to acclimatize to new conditions and then adapt to the conditions of hydraulic construction. According to the results of our research (2021-2023) and other authors, the Upper Ili population is currently extremely low. Only juvenile sturgeon are occasionally caught in scientific and commercial catches. One of the main ways to preserve the “Red Book” species remains artificial reproduction and stocking of reservoirs with fish. Thus, in the Kapshagai Reservoir and Ili River (upper reaches), to restore the number of Fringebarbel sturgeon s, it is necessary to artificially reproduce it and create conditions under which the mortality of juveniles in the nets will be reduced.

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