Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 26(5): 841 – 850 (2022)
www.ejabf.journals.ekb.eg

Ichthyofauna of River Chirchik at Tashkent region, Uzbekistan

Kamilov B.G.[1], Sobirov J.J.[1], Yuldashov M.A.[2], Turayev L.G.[1], Rakhmatova S.K.[3]

1. Institute of zoology, Uzbekistan Academy of Sciences, Uzbekistan.
2. Tashkent state Agrarian university, Uzbekistan.
3. Tashkent branch of the Samarkand Institute of Veterinary Medicine

Corresponding Author: asqarquvatovxabb@mail.ru

ARTICLE INFO

Article History:
Received: July 28, 2022
Accepted: Aug. 9, 2022
Online: Oct. 11, 2022

Keywords:
Chirchik River,
Ichthyofauna,
Native species,
Invasive species,
Uzbekistan

ABSTRACT

Information on the modern state of fish fauna in the Chirchik River (the largest tributary of the River Syrdarya, Uzbekistan) is very limited; hence the current study was organized to analyze the qualitative state of the ichthyofauna. Fish sampling was monthly conducted from February 2021 to March 2022 at the upper, middle and down streams of the Chirchik River. The fish samples were taxonomically identified. The results revealed the addressed ichthyofauna included 39 fish species belonging to 12 families. Among them, 17 species are native, 22 species are invasive as a result of the acclimatization work in the second half of the 20th century.

INTRODUCTION

Uzbekistan is situated in the central part of the basin of landlocked drainless Aral Sea (Central Asia), which lies in the southern temperate zone; the eastern part is covered by the high Asian mountains (about 25% of the territory of the country), and the western part is covered by plain steppes and deserts. In the natural state, the ichthyofauna of the Aral Sea basin had some biodiversity: 44 - 49 freshwater fish species were recorded. There are only two main rivers that reach the Aral Sea, one of those is Syrdarya River. It originates at Tien Shan mountains and receives many tributaries in the upper and middle streams. The ichthyofauna of the Syrdarya in the natural state of the Aral Sea basin has been sufficiently studied. **(Nikolsky, 1940; Turdakov, 1963; Maksunov, 1968; Kamilov, 1973)**.

The middle stream of the Syrdarya River covers the section from the Farkhad dam (on the border of Tajikistan and Uzbekistan) to the Chardara reservoir (on the border of Kazakhstan and Uzbekistan). The river with a developed accessory system of channels and oxbow lakes flows through a wide valley. Within the middle stream, Syrdarya River receives several large tributary rivers including Chirchik River. The Chirchik River is the largest tributary of the Syrdarya; it irrigates the Tashkent oasis - the most densely populated and industrial region of Uzbekistan **(Salikhov & Kamilov, 1995)**.

In relation to large tributary rivers, information on the ichthyofauna is much less **(Salikhov, 1983)**. However, those studies were carried out mainly in the 20th century. In the

second half of the 20th century, a significant anthropogenic impact on the ichthyofauna occurred in the Aral Sea basin: large-scale irrigation construction, which completely regulated the flow of all local rivers (including the Syrdarya), and acclimatization activities to introduce new fish species into the basin **(Salikhov *et al.*, 2001; Yuldashov & Kamilov, 2018)**.

As a result of the lack of regular research in the last few decades, there is practically no information about the ichthyofauna of the Syrdarya River in the middle reaches, including the Chirchik River. The purpose of this study was to analyze the current state of the ichthyofauna of Chirchik River, Uzbekistan.

MATERIALS AND METHODS

The present study was carried out from February 2021 to March 2022 in Chirchik River. The fish sampling was conducted monthly at 7 locations along the river **(Fig. 1)** using various fishing gears such as gillnets (14 – 110 mm mesh), casting nets, hooks, and different traps. The Chirchik River was divided into three regions, namely Upstream, Middle Stream and Downstream. In Upstream fish were sampled in the Charvak reservoir and in the rivers flowing into it, as well as in the Chirchik channel to the Khodjikent hydroelectric complex. In the Middle stream, fish were caught in the channel and adnexal system of Chirchik River in the vicinity of the cities of Tashkent and Yangiyul; in the Downstream sampling was conducted in the vicinity of the city of Chinaz and in the mouth of Chirchik River at the confluence with the Syrdarya.

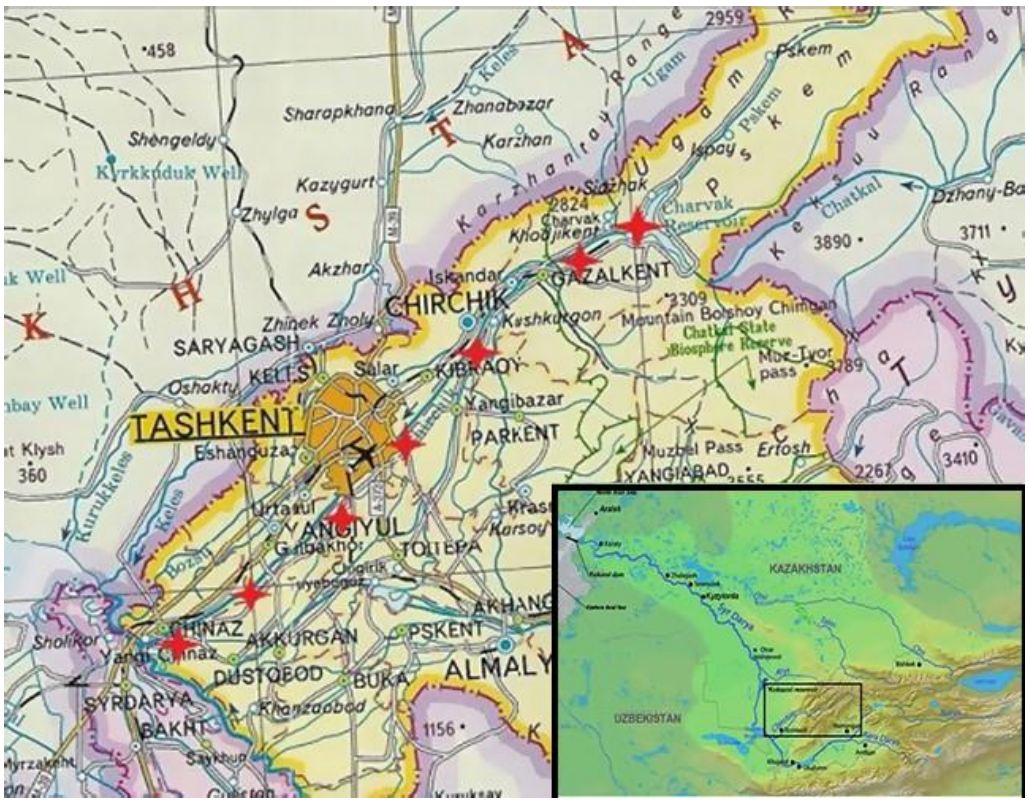

Fig. (1). Map of the Syrdarya River basin (in the lower right corner) and the Chirchik River (main sampling stations are shown)

The sampled fishes were divided into species using different keys for fish species identification **(Berg, 1948-1949; Veselov, 1977** and **Salikhov *et al*., 2001)**. The status of the species was documented by using the database of **Froese** and **Pauly (2019)**. Hydrochemical parameters of Syrdarya River during the study period were estimated. An analysis of the hydrochemical parameters of water were also carried out **(Alekin *et al*., 1973)**.

RESULTS

1. Site description

Chirchik River flows down from the slopes of the Talas Alatau mountains and its southwestern spurs. It is formed at the confluence of the Chatkal and Pskem rivers, while Chatkal is the main component. The Chirchik River in its course receives two relatively large tributaries namely the Ugam and Aksakata rivers, the remaining tributaries are small mountain rivers. Tthe totalarea of the Chirchik River basin is 18061 km^2, its length is 155 km, length from the sources of the Chatkal River is 328 km. In upper stream, the Chirchik River flows in the canyon; below the valley expands, and it flows on the flat part of the Tashkent oasis. The average water flow at the source is 221 m^3/sec. Ice phenomena passes from November to March.

The mountainous part of the Chirchik basin is represented by its constituent rivers Pskem and Chatkal. The Pskem River and all its tributaries are typically mountainous, turbulent ones of the snow-glacial type of nutrition, flowing through deep mountain valleys. The Chatkal River in the upper section also flows through a deep gorge, after the confluence of the Karateke tributary, the river valley expands, the flow is lower, but calm, although in some places there are gorges. Below the village of Brichmulla, Chatkal and Pskem merged, but now this place is flooded with the waters of the Charvak reservoir, the dam of which blocked the channel of the Chirchik just before the Ugam flows into it.

The Pskem and Chatkal rivers (sources of Chirchik) flow through the mountainous zone (altitudes of 1500 m above sea level and higher), only their confluence enters the foothill zone (about 890 m, just the level of the Charvak reservoir). The water in the Pskem and Chatkal rivers is fresh and cold (even in summer it warms up to a maximum of 8-10°C), the mineralization of water varied 105 - 230 mg/l in our studies in different seasons.

The Charvak reservoir was put into operation in 1978 for irrigation, hydropower and water supply to the cities of the Tashkent region. The total area of the reservoir with full filling (890 m) is 40.1 km^2, it's length is 22 km, maximum width - 10 km, maximum depth - 148 m, and average - 50 m. The reservoir water volume with full filling is 2006 million m^3, usable volume -1580 million m^3.

The water catchment in the reservoir occurs from a height of 900 - 4500 m. The inflow of surface water into the reservoir is carried out along 3 main rivers - Chatkal, Pskem and Koksu (96% of the annual water inflow). Additionally, there are about two dozen small rivers flowing into the reservoir, these rivers are fed by melting seasonal snow and drainage by groundwater channels.

The water in the reservoir is fresh, the mineralization varied by seasons 168 - 280 mg/l, pH 7.7 - 8.3. The water is rich in dissolved oxygen, in our observations there were indicators of 7.6 - 13.1 mg/l in different seasons.

In January-February, reservoir water can be covered with ice in some years (for example, in 2022). In the winter of 2022, the water temperature dropped to 2-3°C and stayed that way until mid-March. Further, the water warms up until the summer. In July, at a depth of 1.5 m, we noted a water temperature of 13-15^{o}, at depths of up to 4-5 m - 9-10°C, at the surface of the water in shallow bays it can warm up to 21°C. From the second half of August, the water begins to cool until December, when a temperature of 3-4 ° C is usual.

Below the Charvak reservoir dam, the Chirchik River flows through a deep canyon to the Khodjikent dam, which formed the reservoir of the same name. Further, the Chirchik River flows along wide floodplain to the Gazalkent dam. In both dams, distribution structures have been created to regulate the flow of the Chirchik and large canals (which are more water-bearing than the channel).

After the Gazalkent dam, the runoff of Chirchik River during the low water period consists to a large extent of groundwater and return wastewater. Below, the Yumalak dam was created, also with the function of distributing runoff along the river channel and canals. The discharge of Chirchik water into the Syrdarya is carried out along the river channel, the Bozsu and other canals. Conventionally, the Yumalak dam near the city of Chirchik can be considered the boundary of the foothill-plain and flat areas.

2. Ichthyofaunal composition

The Pskem and Chatkal rivers and their tributaries are inhabited by snow trout (*Schizothorax curvifrons*), naked osman (*Gymnodiptychus dybowskii*), tibetan stone loach (*Triplophysa stolickai*), turkestan catfish (*Glyptosternon reticulatum*). The turkestan sculpin (*Cottus spinulosus*) mainly adheres to the tributaries of the Pskem and Chatkal within the foothill zone.

In the rivers flowing into the Charvak reservoir and in the reservoir itself, snow trout, naked osman, kuschakewitsch loach (*Iskandaria kuschakewitschi*), tibetan stone loach (*Triplophysa stolickai*), turkestan sculpin inhabit. The snow trout is distributed throughout the reservoir and inflowing rivers, the rest of the native species (rheophils) remained only in the estuarine sections of the rivers and inflowing small mountain rivers and higher.

At present, we noted 12 species of fish, including 5 native species in the ichthyofauna in upper stream including the Charvak reservoir **(Tab. 1)**.

The foothill zone of the Chirchik River (from the Charvak dam to the Gazalkent hydroelectric complex) includes inhabitants of the foothills of the basin (snow trout, kuschakewitsch loach and turkestan sculpin). In recent years, due to the development of trout farming in the Tashkent region, rainbow trout (*Oncorhynchus mykiss*) individuals escaped from aquaculture cages and tanks and observed in this zone of the river.

In the middle stream of the Chirchik River, such native fish as gudgeon (*Gobio gobio*), striped bystrianka (*Alburnoides taeniatus*), tashkent riffle bleak (*Alburnoides oblongus*) and others inhabit (**Tab. 1**). Snow trout inhabits in river in vicinities of Tashkent city (including in the canals of the city). Beginning from Tashkent and below, fish that enter river from pond fish farms (cultivated cyprinids and other invasive fishes of the Chinese complex, snakehead, as well as two species of mosquito fish) begin to be found.

The lower stream of the Chirchik River (the plain zone of Chirchik River including the mouth) has the highest species diversity. Of the 25 species of fish in this area, 12 species are invasive.

Table 1: The ichthyofaunal composition in different zones of Chirchik River, Uzbekistan

№	Species	Local name	River zones			
			Mountain	Charvak reservoir	Foothill	Plain
	Family: 1. Salmonidae					
1	*Oncorhynchus mykiss* Walbaum	Rainbow trout	+	+	+	-
2	*Salmo ischchan* Kessler	Sevan trout, gegarkuni	-	+	-	-
	Family: 2. Coregonidae					
3	*Coregonus peled* (Gmelin)	Peled	-	+	-	-
4	*Coregonus sardinella* Valenciennes	Sardine cisco	-	+	-	-
5	*Coregonus lavaretus* (L.)	European whitefish	-	+	-	-
	Family: 3. Cyprinidae					
6	*Rutilus rutilus* L.	Roach	-	-	-	+
7	*Ctenopharyngodon idella* (Valenciennes)	Grass carp	-	-	-	+
8	*Aspius aspius* L.	Asp	-	-	-	+
9	*Opsariichthys uncirostris* (Temminck et Schlegel)	Three lips	-	-	-	+
10	*Pseudorasbora parva* (Schlegel)	Stone moroko	-	+	-	+
11	*Gobio gobio (*L.)	Gudgeon	-	-	+	-
12	*Abbotina rivularis* (Basilewsky)	Chinese false gudgeon	-	+	-	+
13	*Luciobarbus capito* (Güldenstädt)	Barbell	-	-	-	+
14	*Schizothorax curvifrons* Heckel	Snow trout	+	+	-	-
15	*Gymnodiptychus dybowskii* (Kessler, 1874)	Naked Osman	+	+	-	-
16	*Alburnoides taeniatus (Kessler,* 1874*)*	Striped bystrianka	-	-	+	-
17	*Alburnoides oblongus* Bulgakov	Tashkent riffle bleak	-	-	+	+
18	*Abramis brama* L.	European bream	-	-	-	+
19	*Ballerus sapa* (Pallas)	White-eye bream	-	-	-	+
20	*Hemiculter leucisculus* (Basilewsky)	Sharpbelly	-	+	-	+
21	*Pelecus cultratus* (L.)	Sichel	-	-	-	+
22	*Rhodeus ocellatus* (Kner)	Rosy bitterling	-	-	-	+
23	*Carassius gibelio* (Blochin)	Prussian carp	-	-	-	+
24	*Cyprinus carpio* L.	Common carp	-	+	+	+
25	*Hypophthalmichthys molitrix* (Valenciennes)	Silver carp	-	-	-	+
26	*Hypophthalmichthys nobilis* (Richardson)	Bighead carp	-	-	-	+
	Family: 4. Cobitidae					
27	*Triplophysa stolickai* (Steindachner, 1866)	Tibetan stone loach	+	+	-	-
28	*Iskandaria kuschakewitschi* (Herzenstein)	Kuschakewitsch loach	-	+	-	-
29	*Triplophysa strauchii* (Kessler)	Spotted thicklip loach	-	-	+	-
30	*Sabanejewia aurata* (De Filippi)	Golden spined loach	-	-	+	+
	Family: 5. Siluridae					
31	*Silurus glanis* L.	Wels catfish	-	-	-	+
	Family: 6. Sisoridae					
32	*Glyptosternon reticulatum* McClelland	Turkestan catfish	+	-	-	-
	Family: 7. Poecilidae					
33	*Gambusia affinis* (Baird & Girard)	Mosquitofish	-	-	-	+
34	*Gambusia holbrooki* (Girard)	Eastern mosquitofish	-	-	-	+
	Family: 8. Percidae					
35	*Sander lucioperca* (L.)	Pike-perch	-	-	-	+
	Family: 9. Eleotridae					
36	*Micropercops swinhonis* (Günther)		-	-	-	+
	Family: 10. Channidae					
37	*Channa argus* (Cantor)	Snakehead	-	-	-	+
	Family: 11. Gobiidae					
38	*Rhinogobius similis* Gill		-	+	-	+
	Family: 12. Cotiidae					
39	*Cottus spinulosus* Kessler	Turkestan sculpin	+	+	+	-
Totals			**6**	**15**	**8**	**25**

DISCUSSION

The fish fauna is an essential part of inland waters and has an important socio-economic value especially in landlocked countries. Uzbekistan, in this respect, belongs to the countries with very poor natural fish resources. Rivers originate in the highest mountains in the form of numerous small rivers, gather into the main rivers, which go out onto the plain and flow through the steppes and deserts at high speed. Only small flood-plain lakes could be considered as lentic water bodies, in which ichthyofauna could develop noticeable for local fishing. In the natural state, the fish productivity of lakes in the Aral Sea basin was estimated at 1-5 kg/ha, and even less in rivers (**Lozanskaya, 1963**). In the natural state, 44 - 49 freshwater fish species were recorded in the Aral Sea basin **(Nikolsky, 1940; Turdakov, 1963; Maksunov, 1968; Kamilov, 1973)**.

The urbanization and industrial development (irrigation construction, appearing of new water bodies, dams and channels engineering, establishment of introduced alien species, etc.) have impacted to fish biodiversity **(Dudgeon *et al*., 2006)**. In Chirchik river basin those factors also could be noticed.

First factor is river stock reconstruction for irrigation purpose (**Kamilov, 2003; Petr *et al*., 2004**). The water of the Chirchik basin is intensively dissipated for irrigation in the Tashkent oasis, for which a network of canals has been built; some of the canals are more abundant than the Chirchik River (canals Zakh, Bozsu, Karasu). Through the irrigation network, the basins of the Chirchik and Akhangaran rivers (another major tributary of the Syrdarya, also flowing within the Tashkent region) have been intertwined in the 20th century in their middle and lower streams. A large Charvak reservoir and two smaller ones were created in river course. New irrigation water bodies increased area of fish species habitat; fish species were captured in all canals. But this factor did not impact qualitative composition of fauna (list of species).

Much more noticeable impact was from second factor - acclimatization of new fish species (**Tab. 2**). Reservoirs were newly created lentic water bodies that could be used for fisheries. However, there were not even local fish species that could create massive stocks for fish capturing. Therefore, in 1950 – 1980s, fisheries specialists focused on the artificial formation of commercial ichthyofauna through acclimatization of new species.

In 1930s, two species of gambusia (captured in the water bodies of the Caucasus) were imported to combat a malaria mosquito; they widely had spread in all plain regions of the country, including plain water bodies in Chirchik river basin.

In the plain part of the basin such species as european bream (*Abramis brama*), pike-perch (*Sander lucioperca*) were introduced in the middle Syrdarya, they formed populations and recently are important commercial species (**Kamilov & Urchinov, 1995**). They habitat in lower stream of the Chirchik river. Pike-perch is additional fish in fish culture ponds and constantly penetrates from ponds into rivers and channels in recent decades in miidle and low streams.

In the Charvak reservoir in the second half of the 20th century, a number of introductions of valuable fish species were carried out. In 1973 - 1984 juveniles of the Sevan trout gegharkuni were introduced into the reservoir from Lake Issyk-Kul (Kyrgyzstan). The Sevan trout reproduces in the reservoir, because we caught juveniles. However, the number

of gegharkuni and its juveniles is small. In the 1980s, for several years, peled fry from mountain reservoirs of the Syrdarya basin (Toktogul reservoir and Lake Sonkul, both in Kyrgyzstan) were systematically introduced into the reservoir. At the same time, two other species of whitefishes were also accidentally introduced. In our catches, there were both sexually mature fish of these species and juveniles, but their numbers are small. We attribute this to the not-large area of spawning grounds in shallow waters. In 1984, common carp fingerlings from regional hatchery were also introduced into the reservoir. The common carp keeps shallow zones of reservoir; their natural spawning is noted in the reservoir. Also in the 1980s, fingerlings of rainbow trout from the Tavaksay trout farm (Tashkent region) were introduced into the reservoir.

However, fish capturing did not develop in the Chirchik River, as it could not compete with aquaculture economically.

In 1950s, cultured common carp fingerlings were introduced from Kazakhstan fish farm, accidentally *Triplophysa strauchii* was introduced also. Fish found favorable environments and penetrated into Chirchik river and canals network in plain part of the basin.

Since the early 1960s, pond fish farming began to develop in Uzbekistan, starting precisely in the Chirchik river basin. For this, common carp (*Cyprinus carpio*) cultured strains from Ukraine (Europe), wild silver carp (*Hypophthalmichthys molitrix*) and grass carp (*Ctenopharyngodon idella*) from China were introduced to the pond fish farm in the lower stream of Chirchik. During introduction, many other fishes were introduced accidentally, including as commercial ones (bighead carp, *Hypophthalmichthys nobilis*, snakehead, *Channa argus*) so small trash fishes. Some of those species found favorable environments in ponds, began natural reproduction and penetrated from ponds into the Chirchik River, where they spread widely in the plains (**Borisova, 1972**). Gibel carp (*Carassius gibelio*) is widely spread in plain part of the basin: in fish farm ponds it is trash fish, in lakes and reservoirs – rather important commercial fish. By 1980, this fish farm had become one of the largest in the world, reaching total ponds area of more than 3,000 hectares ("Balykchi"). Recently, a huge number of small pond farms have been created in the plain part of the Chirchik River and large canals. Every year, fish farms harvest cultured fishes, and trash fishes are discharged into the external water bodies, which enhances the representation of invasive species in the plain part of the basin. Recently total aquaculture production in Chirchik river basin is more than 10 000 tons/year. In middle and lower stream fishes from Chinese ichthyological complex are widely represent in rivers, channels, lakes.

Thus, at present, representatives of 12 families of freshwater fishes inhabit in the Chirchik River basin. Representatives of the cyprinid family (*Cyprinidae*) dominate - 21 species, followed by representatives of the families Cobitidae (4 species), Coregonidae (3 species), Salmonidae (2 species) and Poecilidae (2 species). All other families are represented with 1 species **(Fig. 2)**. At the same time, 17 species can be considered as native; a total of 22 fish species are invasive.

Table 2. Assessment of the state of the introductions of fish species to the water bodies of Chirchik river basin, Uzbekistan

Fish species	Time of introduction, Donor region	Secondary settlement	Natural reproduction in local environments	Abundance in local water bodies*
1. Salmo ischchan	1970s, Kyrgyzstan	No	Yes	Rare
2. Oncorhynchus mykiss	1970s, Russia	No	Yes	Usual
3. Coregonus peled	1980s, Kyrgyzstan	No	Yes	Usual
4. Coregonus sardinella	1980s, Kyrgyzstan	No	Yes	Usual
5. Coregonus lavaretus	1980s Kyrgyzstan	No	Yes	Rare
6. Ctenopharyngodon idella	1960s, China	Yes	No	Usual
7. Opsariichthys uncirostris	1960s, China	Yes	Yes	Usual
8. Pseudorasbora parva	1960s, China	Yes	Yes	Usual
9. Abbotina rivularis	1960s, China	Yes	Yes	Usual
10. Abramis brama	1950s	Russia	Yes	Usual
11. Hemiculter leucisculus	1960s, China	Yes	Yes	Usual
12. Rhodeus ocellatus	1960s, China	Yes	Yes	Usual
13. Carassius gibelio	1950s, Russia	Yes	Yes	Usual
14. Hypophthalmichthys molitrix	1960s, China	Yes	No	Usual
15. Hypophthalmichthys nobilis	1960s, China	Yes	No	Usual
16. Triplophysa strauchii	1950s Kazakhstan	Yes	Yes	Usual
17. Gambusia affinis	1930s Russia	Yes	Yes	Usual
18. Gambusia holbrooki	1930s Russia	Yes	Yes	Usual
19. Sander lucioperca	1950s Russia	Yes	Yes	Usual
20. Micropercops swinhonis	1960s, China	Yes	Yes	Usual
21. Channa argus	1960s Russia	Yes	Yes	Usual
22. Rhinogobius similis	1960s, China	Yes	Yes	Usual

* Rare – were found less than in 4 monthly research catches during a year
** Usual – were found more than in 7 monthly research catches during a year

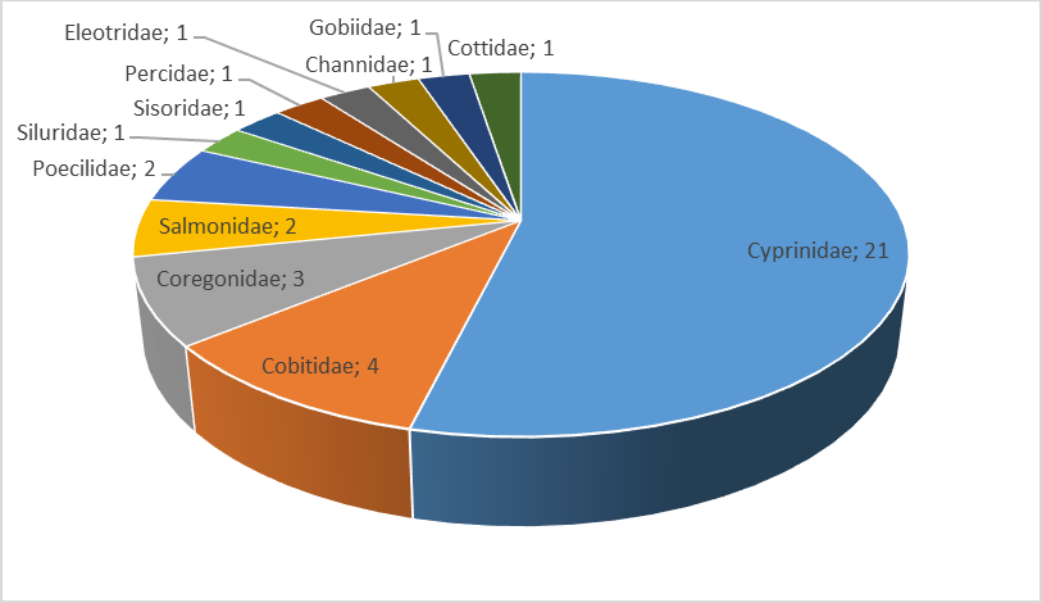

Figure 2. Ichthyofaunal composition of the Chirchik River by representatives of families (diversity)

The basin of the Syrdarya River and all large tributary rivers has undergone such an especially strong influence. Tashkent region (basin of the Chirchik River) has become the center of introducing new fish species since the second half of the 20th century (**Yuldashov & Kamilov, 2018).** Thus, there is no fish capturing in river, channels and reservoirs of the Chirchik river, but in the basin, pond fish farming is greatly developed. Fish farming continues to influence the composition of ichthyofauna in the basin.

ACKNOWLEDGEMENTS

The studies were carried out within the framework of the project "Study of the population phenotypic diversity and adaptive potential of aquatic organisms for the theoretical substantiation of the development of fisheries in Uzbekistan", which is carried out by the Institute of Zoology of Uzbekistan Academy of Sciences. The authors are grateful to the Institute for providing all facilities and funding for this research.

REFERENCES

Alekin, O.A.; Semenov, A.D. and **Skopinsev, B.A. (1973).** Rukovodstvo po khimicheskomu analizu vod sushi (Guidelines for the chemical analysis of land waters), 3rd edition. Leningrad, Gidrometeoizdat, 270pp.

Berg, L.S. (1948-1989). Ribi presnikh vod SSSR I sopredelnikh stran (Fresh water fish of the USSR and neighboring countries). Books 1–3, Moscow.

Borisova, A.T. (1972). Sluchainie vselenci v vodoemakh Uzbekistana (Accidental invasive fishes in Uzbekistan water bodies): Voprosi ikhtiologii, 12 (1): 49-53.

Dudgeon, D.; Arthington, A.H.; Gessner, M.O.; Kawabata, Z.I.; Knowler, D.J.; Lévêque, C.; Naiman, R.J.; Prieur Richard, A.H.; Soto, D.; Stissny, M.L.J. and

Sullivan C.A. (2006). Freshwater biodiversity: importance, threats, status and conservation challenges. Biological Reviews, **81**: 163–182.

Kamilov, B.G. (2003). The use of irrigation systems for sustainable fish production: Uzbekistan: Fisheries in irrigation systems of arid Asia. FAO Fisheries Technical Paper, 430, Rome, FAO: pp.115- 124.

Kamilov, G.K. (1973) Ribi I biologicheskie osnovi ribokhozyaistvennogo osvoeniya vodokhranisch Uzbekistana (Fishes and biological basis of fisheries using of Uzbekistan reservoirs). Tashkent, Fan, 220pp.

Kamilov G. and Urchinov Zh.U. (1995). Fish and fisheries in Uzbekistan under the impact of irrigated agriculture: T. Petr. Inland fisheries under the impact ofirrigated agriculture: Central Asia, FAO Fisheries circular. N 894, Rome, FAO: pp.10–41.

Luzanskaya, D.I. (1963). Ribokhozyaystvennoe ispolzovanie vnutrennikh vodoemov SSSR (ozer, rek i vodokhranilish). Spravochnik (Fisheries using of the USSR inland water bodies (rivers, lakes and reservoirs). Directory). Moscow, Pischevaya promishlennost, 379pp.

Maksunov, V.A. (1968). Promislovie ribi Tadjikistana (Commercial fishes of Tajikistan). Dushanbe, Donish, 99pp.

Nikolsky, G.V. (1940). Ribi Aralskogo morya (Fishes of the Aral Sea). Moscow, Izvestiya Moskovskogo obschestva ispitateley prirodi, Otdelenie biologii, 216pp.

Petr T.; Ismukhanov K.; Kamilov B.; Pulatkhon D. and Umarov P.D. (2004). Irrigation systems and their fisheries in the Aral Sea basin, Central Asia: Proceeding of the second interna-tional symposium on the management of large rivers for fisheries. Sustaining livelihoods and biodiversity in the new milleneum, 11th-14th February 2003 in Phnom Penh, Kingdom of Cambodia//Editors: R.L. Welcomme and T.Petr. Volume 2. FAO and the Mekkong River Commission: pp.223 – 242.

Salikhov, T.V. (1983). Raspredelenie ihtiofauni v basseine r. Chirchik (Fish fauna distribution in the basin of the Chirchik River). – In.: Biologicheskie osnovi ribnogo khozyaistva respublik Srednei Azii I Kazakhstana. Tashkent, Fan: pp.216-218.

Salikhov, T.V.; Kamilov, B.G. and Atadjanov, A.K. (2001). Ribi Uzbekistana (opredelitel) (Fishes of Uzbekistan (Keys)). Tashkent, Chinor ENK, 152pp

Salikhov, T.V. and Kamilov, B.G. (1995). Ichthyofauna of the Mid-Syrdarya River Basin. Journal of Ichthyology, 35: 61-71.

Turdakov, F.A. (1963). Ribi Kirgizii (Fishes of Kyrgyzstan). Frunze, Izdatelstvo ANKirgSSR, 283pp.

Froese, R. and Pauly, D. (2019). FishBase. World Wide Web electronic publication. Version 02/2019 accessed 15/03/2019. (www.fihbase.org).

Veselov, E.A. (1977). Opredelitel presnovodnikh rib fauni SSSR (Key of freshwater fishes of the USSR). Moscow, Prosveschenie, 140pp..

Yuldashov, M.A. and Kamilov, B.G. (2018). Rezultati introdukcii chujerodnikh vidov rib v vodoemi Uzbekistana (Results of introductions of alien fish species into water bodies of Uzbekistan): Nauchnie trudi Dalribvtuza, 44 (1): 40-48.