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Introduction of Alien Fish Species to Waterbodies of Uzbekistan

M. A. Yuldashov

Institute of Fish Culture, 2, Universitet St., Kibray district, Tashkent region, Uzbekistan

Abstract: ***Totally 47 alien fish species were introduced to Uzbekistan including 23 as target and 24 as accidental. One time introduction was carried out for health care; all other were done for fisheries purposes: (i) to the Aral Sea, (ii) to newly created irrigation water bodies, (iii) to aquaculture. Secondary settlement was marked for 27 species, for 20 species settlement was not found. Natural reproduction was marked for 31 species. At present 22 introduced species vanished in region; 7 species are not numerous, 20 species are numerous in water bodies. List of high value marketable fish includes 6 species, commercial – 18, trash fishes – 23 species. A number of introduced species did not find conditions for reproduction or could not survive and vanished. Several species survived and began to reproduce in the Aral Sea but vanished as salinity of water increased. Some species survived, but did not spread to another waterbodies. Several alien species have widely spread all over the Aral Sea basin; that's happened after introduction of far eastern fishes in early 1960s.***

Keywords: introduction of alien fishes to Uzbekistan

1. Introduction

Water bodies of Uzbekistan are part of inland basin of the Aral Sea, Central Asia. List of fish species of Uzbekistan includes 44-49 species [1; 2; 3]. In second part of 20th century, local ichthyofauna was undergone strong impact of two human activity factors:

- Hydrographical reconstruction of the Aral Sea basin for irrigation purposes. During 1950-1980s, about 40 reservoirs (total water volume 57 km^3), more than 250 thousands canals and 10 lakes for residual waters storage (area about 7000 km^2) were created, rivers were completely stocked for irrigation, receipt of water to the Aral dramatically decreased, since 1960s the Aral Sea began to dry and died as fisheries water body in the early 1980s due to water salinity increasing.
- Introduction of alien species. Long term research monitoring was carried out and many aspects of alien species biology in new environments and there relations with local fishes were studied [4; 5; etc.]. Nevertheless data are fragmentary.

Goal of this work was summarizing and systematization of alien fish species introductions to Uzbekistan water bodies.

2. Results

1) *Abbotina rivularis* (chinese false gudgeon) is native to Far Eastern Asia and was accidentally introduced with asian cultural cyprinids from River Amur (Russia) and rivers of China in early 1960th. It was first recorded in Uzbekistan by Kamilov and Borisova in 1966. It reproduces in plain water bodies in Uzbekistan and fully naturalized.
2) *Acipenser stellatus* (starry sturgeon) is native to Caspian Sea. It was target introduction to the Aral Sea for improving of commercial ichthyofauna two times. First introduction occurred in 1920s but *A. stellatus* did not survive. Second introduction of fertilized eggs was occurred in 1950s, fish survived, matured, many times were recorded in experimental catches [6; 7]. *A. stellatus* vanished in the Aral Sea because of increasing of water salinity.
3) *Acipenser baerii* (siberian sturgeon) is native to Siberian rivers, Russia. It was target introduction to Uzbekistan fish farms as a cultural species in early 1980s. It was not recorded in wild conditions of water bodies of Uzbekistan.
4) *Alosa caspia caspia* (caspian shad) is native to Caspian Sea. It has been introduced to the Aral Sea in 1920s for improving of local commercial fauna but did not survived. There were no catch of that species in the Aral Sea [6; 7].
5) *Atherina boyeri* (big-scale sand smelt) is native to Caspian Sea. It has been accidentally introduced with *A. stellatus* and *Liza aurata* in 1950s and was recorded by Bikov [6]. It began reproduction, spread in the Aral Sea and entered Delta of Amudarya River in the late 1950s. Later it vanished in the Aral Sea with water salinity increasing.
6) *Carassius gibelio* (prussian carp) is native to Europe and Northern Asia. It has been introduced as a cultural species from near Moscow fish farm 'Savino' and was first recorded by Kamilov [8]. At the same time there is native stock of *C. gibelio* habitats in lower and middle Syrdarya and Amudarya rivers. With great possibility, *C.gibelio* was occasionally introduced in early 1960s with cultured chinese cyprinids but did not recorded as a separate alien introduced object.
7) *Channa argus warpachowskii* (amur snakehead) is native to inland water bodies in Far Eastern Asia. It has been introduced as a commercial species to fish farm in Tashkent region and was first recorded from Uzbekistan by Kamilov and Borisova [9]. *C. argus warpachowskii* was accidentally spread to all plain fish farms and water bodies with cultured fingerlings. Recently it naturally reproduces and is fully naturalized in plain water bodies.
8) *Clupea harengus* (atlantic herring) is native to Baltic Sea. It was target introduction to the Aral Sea in 1950s in order to improve commercial ichthyofauna and species was recorded by Bikov [6]. It began

reproduction, widely spread in the Aral Sea but it totally vanished with water salinity increasing in the Aral Sea.

9) *Coregonus peled* (peled) is native to Siberian rivers, Russia. It has been introduced to mountain Charvak reservoir in middle 1980s from Kyrgyzstan (Lake Sonkul) where previously it was introduced from Russia. *C. peled* was first recorded by Salikhov [10]. It reproduces in Charvak reservoir but do not spread to other water bodies. There are a few data about modern condition of its population.
10) *Coregonus sardinella* (sardine cisco) is native to Siberian rivers, Russia. It has been occasionally introduced with eggs of peled and was first recorded by Salikhov [10]. There are a few data about modern condition of its population.
11) *Coregonus widegreni* (valaam whitefish) is native to Siberian rivers, Russia. It has been occasionally introduced with eggs of peled and was first recorded by Salikhov [10]. There are a few data about modern condition of its population.
12) *Ctenopharyngodon idella* (grass carp) is native to inland water bodies of Far Eastern Asia. It was introduced as cultured species to fish farms of Uzbekistan in 1961-1963 [7]. Commercially reproduced fingerlings were widely spread to all fish farms and plain water bodies since 1960s up to now days. Naturally reproduced fish populations were formed in middle streams of Syrdarya and Amudarya rivers.
13) *Elopichthys bambusa* (yellowcheek) is native to inland water bodies of Far Eastern Asia. It was accidentally introduced with chinese cyprinids to local fish farm in early 1960s and was first recorded Kamilov and Borisova [9]. It did not survived in Uzbekistan.
14) -15) *Gambusia affinis* and *Gambusia holbrooki* (gambusia, mosquitofish) are native to inland water bodies of America and were was introduced to Uzbekistan for malarial mosquito control from the Caucasus in 1920s. We could not found author of first record. Before local ichthyologists knew mosquitofish as one subspecies namely, *G. affinis holbrooki*. After species revision and dividing to two species at least, species is habitat in Uzbekistan has to be studied. Recently gambusia naturally reproduces, is widely spread all over plain water bodies in the country.
16) *Hemibarbus maculatus* (spotted steed) is native to Far Eastern Asia. It was accidentally introduced to fish farm in Tashkent region with cultural chinese cyprinids in early 1960s and was first recorded by Kamilov and Borisova [9] but did not survived.
17) *Hemiculter leucisculus* (sharpbelly) is native to Far Eastern Asia. It has been accidentally introduced with chinese cyprinids from River Amur (Russia) and rivers from northern China. It was first recorded in Uzbekistan by Kamilov and Borisova [9]. It reproduced in ponds and was accidentally spread to all plain water bodies with commercial fingerlings of cultured fishes. It fully naturalized in all plain regions in Uzbekistan.
18) *Hemiculter lucidus* (ussuri sharpbelly) is native to Far Eastern Asia. It has been accidentally introduced with chinese cultural cyprinids from River Amur (Russia). It was recorded in Uzbekistan by Salikhov in late 1980s. Modern status of this species is unknown.
19) *Hypophthalmichthys molitrix* (silver carp) is native to Far Eastern Asia. It was introduced targetly as cultured species to fish farms in Tashkent region in 1961-1963 from northern China and Amur river, Russia [7]. Commercially reproduced fingerlings were widely spread to all fish farms and plain water bodies since 1960s up to now days. Naturally reproduced fish populations were formed in middle streams of Syrdarya and Amudarya rivers. At present silver carp is the most important local cultured fish species.
20) *Hypophthalmichthys(=Aristichthys) nobilis* (bighead carp) is native to Far Eastern Asia. It was introduced accidentally with *H. molitrix* and *C. idella* to fish farms in Tashkent region [7]. Commercially reproduced fingerlings were widely spread to all fish farms and plain water bodies since 1960s up to now days. Naturally reproduced populations were formed in middle streams of Syrdarya and Amudarya rivers. At present *H. nobilis* is on the third place of local aquaculture production.
21) *Ictalurus punctatus* (channel catfish) is native to inland areas of North America. It was introduced as cultured species from USA to fish farms near Moscow from which it was introduced to fish farm in Tashkent region in the middle 1970s. In the middle of 1980s it was recorded in Syrdarya River by Salikhov [10]. Commercially reproduced fingerlings were spread to several fish farms but without success; farming stopped due to crashing of the ex-USSR. Modern status of *I. punctatus* in Uzbekistan is unknown.
22) *Ictiobus bubalus* (smallmouth buffalo) is native to inland areas of North America. It was introduced for aquaculture purposes from USA to Russia and then to fish farm in Tashkent region in the middle 1970s. Commercially reproduced fingerlings were spread to several fish farms. But farming of this species did not developed. In the early 1980s several fish were caught in Syrdarya River by Salikhov [10], but later was not noticed in the country.
23) *Ictiobus cyprinellus* (bigmouth buffalo) is native to inland areas of North America. It was introduced from USA to Russia and then to Uzbekistan fish farms in the middle 1970s. Commercially reproduced fingerlings were spread to several fish farms. But buffalo farming did not developed. In the early 1980s several buffalo were caught in Syrdarya River [10], but after that buffalo was not noticed in the country.
24) *Ictiobus niger* (black buffalo) is native to inland areas of North America. It was introduced from USA to Russia and then to Uzbekistan fish farms in the middle 1970s. Commercially reproduced fingerlings were spread to several fish farms. But buffalo farming did not developed. In the early 1980s several buffalo were caught in Syrdarya River [10], but after that buffalo was not noticed in the country.
25) *Knipowitschia caucasica* (caucasian dwarf goby) is native to the Caspian Sea. It has been accidentally introduced with starry sturgeon in 1950s and was recorded by Bikov [6]. It began reproduction, spread in the Aral Sea but vanished with water salinity increasing.
26) *Megalobrama terminalis* (black amur bream) is native to Far Eastern Asia. It was accidentally introduced with cultural asian cyprinids in early 1960s and was first

recorded by Kamilov and Borisova [9]. It did not survived in Uzbekistan.

27) *Micropercops swinhonis* is native to Far Eastern Asia. It has been accidentally introduced with chinese cyprinids from River Amur (Russia) and rivers from northern China. It was first recorded by Kamilov and Borisova in 1966. With cultured fingerlings it was widely spread in all plain regions. It reproduces in many plain water bodies.
28) *Liza aurata* (golden gray mullet) is native to Caspian Sea. It has been introduced to the Aral Sea for improving of commercial ichthyofauna. Golden gray mullet did not survived in the Aral Sea [6].
29) *Mylopharyngodon piceus* (black carp) is native to Far Eastern Asia. It was introduced accidentally with silver carp and grass carp to Uzbekistan in 1961-1963 [7]. But commercial reproduction was not sustainable and black carp was losted as a cultural species in Uzbekistan. Fry Turkmenistan fish farms were spread in Amudarya River and at present black amur is recorded in the Middle stream of Amudarya in both countries.
30) *Neogobius fluviatilis* (monkey goby) is native to the Caspian Sea. It has been accidentally introduced with starry sturgeon in 1950s and was recorded by Bikov [6]. It begun reproduction in the Aral Sea but vanished with water salinity increasing.
31) *Neogobius melanostomus* (round goby) is native to the Caspian Sea. It has been accidentally introduced with starry sturgeon in 1950s and was recorded by Bikov [6]. It begun reproduction in the Aral Sea but vanished with water salinity increasing.
32) *Oncorhynchus mykiss* (rainbow trout) is native to North America. It has been introduced to trout farm in Tashkent region in 1970s and to mountain Charvak reservoir, Tashkent region [10] from Russia. New parties of rainbow trout eggs from USA are introduced since 2008 to aquaculture farms.
33) *Opsariichthys uncirostris* (three-lips) is native to Far Eastern Asia. It has been accidentally introduced with asian cyprinids from River Amur (Russia) and rivers from northern China. It was first recorded in Uzbekistan by Kamilov and Borisova in 1966. Amur three-lips reproduces in Uzbekistan and fully naturalized. It frequently inhabits in fish farms and is common in plain waters.
34) *Oryzias sinensis* is native to China. It origination in Uzbekistan is not clear. *O. sinensis* was recorded in Kazakhstan then through irrigation network it entered middle stream of Syrdarya River and lower stream of Amudarya River [11].
35) *Parabramis pekinensis* (white amur bream) is native to Far Eastern Asia. In early 1960s it was accidentally introduced to Turkmenistan, later bream enters Amudarya River and then irrigation network of Navoi and Bukhara regions (Uzbekistan) where it is found since 1990s. White amur bream in Uzbekistan was recorded for the first time by Salikhov in 1990s.
36) *Perca schrenkii* (balkhash perch) is native to Kazakhstan. It was accidentally introduced to Kattakurgan reservoir with fry of common carp in 1950s. We do not know exactly who was recorded balkhash perch for the first time. In 1980s reproduction and complete naturalization of perch in reservoir was noticed. Balkhash perch do not spread from that reservoir to other plain water bodies.
37) *Perccottus glehni* (chinese sleeper) is native to Far Eastern Asia. It has been accidentally introduced with cultural asian cyprinids and was first recorded by Kamilov and Borisova [9]. It did not survived in Uzbekistan.
38) *Platichthys flesus* (european flounder) is native to Black Sea. It has been introduced to the Aral Sea in 1970s. It began reproduction, spread over the Aral Sea but vanished due to increasing of water salinity. It was caught in the Lower Amudarya up to 2000s.
39) *Proterorhinus marmoratus* (tubenose goby) is native to the Caspian Sea. It has been accidentally introduced with starry sturgeon in 1950s and was recorded by Bikov [6]. It began reproduction in the Aral Sea but vanished due to water salinity increasing.
40) *Pseudorasbora parva* (stone moroko) is native to Far Eastern Asia. It has been accidentally introduced with chinese cyprinids from River Amur (Russia) and rivers from northern China. It was first recorded in Uzbekistan by Kamilov and Borisova in 1966. It reproduces in Uzbekistan and fully naturalized in ponds and plain water bodies.
41) *Rhinogobius similiss* is native to Far Eastern Asia. It has been accidentally introduced with asian cultural cyprinids from River Amur (Russia) and rivers from northern China. It was first recorded in Uzbekistan by Kamilov and Borisova in 1966. It reproduces in Uzbekistan and fully naturalized in ponds and plain water bodies.
42) *Rhodeus ocellatus* (rosy bitterling) is native to Far Eastern Asia. It has been accidentally introduced with asian cyprinids from River Amur (Russia) and rivers from northern China. It was first recorded in Uzbekistan by Kamilov and Borisova in 1966. It reproduces and fully naturalized in ponds and in all plain water bodies.
43) *Salmo ischchan* (sevan trout) is native to the Lake Sevan, Caucasus. It has been introduced to Issik-kul Lake (Kirgizstan) and then, in 1970s, to mountain Charvak reservoir, Uzbekistan. It began reproduction [10]. It did not spread to other water bodies. Modern status of population is unknown.
44) *Siniperca chuatsi* (mandarin fish) is native to Far Eastern Asia. It has been accidentally introduced with asian cyprinids in early 1960s. It was first recorded in fish farm ponds by Kamilov and Borisova [9]. It did not survived in Uzbekistan.
45) *Tinca tinca* (tench) is native to northern part of Eurasia. It has been introduced to Uzbekistan fish farm from Kazakhstan in 1950s [7] but was lost as cultured species. It was not recorded since 1970s.
46) *Triplophysa labiata* (plain thicklip loach) is native to Kazakhstan. It has been accidentally introduced with common carp in 1950s from fish farm in Kazakhstan and was first recorded by Kamilov in 1965. It reproduces, but is rather rare and now can be found singularly near 'Damachy' fish farm (Tashkent region, Uzbekistan). It did not spread to other regions.
47) *Triplophysa strauchii* (spotted loach) is native to Kazakhstan. It has been accidentally introduced with common carp in 1950s from fish farm in Kazakhstan. It was first recorded by Kamilov in 1965. It began

reproduction, entered irrigation system and rivers in Tashkent region (tributaries of Syrdaya River in middle stream).

3. Discussion

One time introduction was carried out for health care purposes; in 1930th mosquitofish was introduced for malarial mosquito control. All other introductions were done for fisheries purposes and can be divided to three groups of activity: (a) to the Aral Sea for improving of commercial ichthyofauna; (b) to newly created irrigation water bodies for improving of commercial ichthyofauna; (c) to aquaculture (to fish culture ponds).

Fish introductions to the Aral Sea. As far back as 1920s caspian shad and starry sturgeon were delivered from Caspian Sea, but they did not survived. In 1950s starry sturgeon (fertilized eggs) and golden gray mullet (fry) from Caspian Sea and atlantic herring (fertilized eggs) from Baltic Sea were introduced. Starry sturgeon and atlantic herring survived, maturated and began reproduction. Golden gray mullet did not survived. Accidentally several species were introduced (big-scale sand smelt, tubenose goby, monkey goby, caucasian dwarf goby, round goby) [6; 7]. After 1960s, as water salinity increased, local species so as alien ones vanished in the Aral Sea. In 1980s (when salinity increased strongly), european flounder has been introduced, it began to reproduce but also vanished due to salinity increasing. Some fish got out to Amudarya delta and were found in catches time to time in 1990-early 2000s.

Introductions to newly created irrigation water bodies. In reservoirs and lakes for residual waters storage ichthyofauna formed from local river fauna. In order to improve ichthyofauna introductions of valuable fishes were carried out. In 1950s, fry of common carp from Alma-Ata fish farm (Kazakhstan) were introduced to Kattakurgan reservoir (river Zerafshan) and simultaneously to 'Damachy' fish farm (Tashkent region); accidentally fry of balkhash perch, plain thicklip loach, spotted loach were introduced. Loaches did not survived in the reservoir at the same time balkhash perch survived, began to reproduce and became mass fish in the reservoir [5].

Since 1960s, plain water bodies were stocked by commercial cyprinids (including chinese carps introduced from Far East) from aquaculture ponds regularly. So, it was secondary spreading of introduced fareastern fishes including several unplanned alien species. Such stocking is regular up to modern time.

A list of coldwater fishes were introduced to mountain Charvak reservoir (Tashkent region) from lakes of Kyrgyzstan (sevan trout and peled) in 1980s. Accidentally sardine cisco and valaam whitefish were introduced. Rainbow trout was taken from trout farms in Russia and introduced to Tavaksay trout farm (Tashkent region) and then to Charvak reservoir. All those species survived, matured and began reproduction [10]; they can be found in reservoir and tributary rivers. Due to physical barrier those species do not spread from mountain Charvak reservoir to other mountain regions. Rainbow trout from mountain lakes in Kyrgyzstan permanently come down by riverbed of River Narin in Namangan region (Uzbekistan, Fegana Valley).

Introductions to aquaculture. In 1950s, fry of prussian carp from Moscow region fish farm 'Savino' (Russia), common carp and tench from Alma-Ata fish farm (Kazakhstan) were introduced to 'Damachy' fish farm (Tashkent region); accidentally fry of balkhash perch, plain thicklip loach, spotted loach were introduced. Tench and perch did not survived but plain thicklip loach and spotted loach survived began reproduction, entered irrigation network of rivers Chirchik, Akhangaran (Tashkent region, tributaries of the River Syrdarya).

In early 1960s, two herbivorous chinese cyprinids namely silver carp and grass carp were introduced from fareastern rivers of Russia and China to ponds of Akkurgan fish farm (Tashkent region). Since 1960s and up to present, artificially reproduced fry and fingerlings of cyprinids regularly are sent to all fish farms and plain water bodies for restocking. Accidentally a list of alien species were introduced. There were as marketable fishes (bighead carp, black carp), so trash fishes. At first times after introductions such species as yellowcheek, spotted steed, black amur bream, mandarin fish, chinese sleeper were marked in ponds [9; 12] , but they did not survived in ponds and vanished in 1960s. At the same time such species as chinese false gudgeon, sharpbelly, micropercops, stone moroko, *Rhinogobius similis*, rosy bitterling, three-lips, prussian carp survived began reproduction. All those fishes were spread with fry of cultured species to all plain regions of Uzbekistan.

Separately amur snakehead can be marked; fingerlings were taken from Moscow zoo to Akkurgan fish farm in early 1960s. Snakehead began to reproduce. It was accidentally spread to all regions with fry of cultured cyprininds. Now this species is mass and commercial in all plain regions of the Aral Sea basin.

Such fareastern species as white amur bream and black carp was accidentally introduced to Turkmenistan in early 1960s and later enters Amudarya River including irrigation network of Navoi and Bukhara regions (Uzbekistan) where they has been found since 1990s. *Oryzias sinensis* was recorded in River Ili (Kazakhstan) and then it entered middle stream of Syrdarya River and lower stream of Amudarya River [11].

In 1970-80s, representatives of North America (three species of buffalo and channel catfish), Siberia (Siberian sturgeon) and South-Eastern Asia (hybrid mix of silver carp and harmandi bighead, *Hypophthalmichthys harmandi*, called as 'vietnamise' bighead [13] were introduced to fish farms of Tashkent region. Tilapia was introduced to fish farm of Syrdarya Electric Power Station. Rainbow trout from Russia was introduced to local trout farm. Management of those introductions was good, and at that time accidental alien species were not marked. Three species of buffalo and channel catfish were reproduced artificially and sent to other fish farms of Uzbekistan and entered rivers. But fish farms did not turn there technology to those new species. In wild conditions those exotic fishes could not to reproduce and did not survived. Tilapia could not winter and died. Project with

Vietnamese bighead also was stopped, fish was totally sale and did not reproduce.

Erroneous species identifications of alien fishes. Several fishes introduced to Uzbekistan were identified erroneously, for example corean sharpbelly, *Hemiculter eigenmanni (*instead of *H. leucisculus*), amur bitterling, *Rhodeus sericeus* (instead of rosy bitterling), *Hypseleotris swinhonis* (instead of *Micropercus sinctus*) [14; 15; 16; 17]. At first local ichthyologists considered that mosquitofish *Gambusia affinis holbrooki* was introduced; now those two species are divided namely *Gambusia affinis* and *Gambusia holbrooki*. Both species or one of them was introduced to Uzbekistan has to be studied.

Present situation with new species introductions. No introductions of fish species to the waterbodies of Uzbekistan were conducted since 1991. Uzbekistan has signed Convention of Biodiversity and enacted legislation which regulate introduction of new fishes to the country. Main tendency is not to introduce new species to wild conditions in order to protect biodiversity of fishes.

List of fish species introduced to Uzbekistan is showed in Table 1 except vietnamise bighead (as fish did not mature when project was closed and all fish were sale) and tilapia (all fish were sale, tilapia can not winter in local environments).

Totally 47 alien species were introduced to the waterbodies of Uzbekistan including 23 as target and 24 as accidental. Donor regions were Caspian Sea (8 species), Black Sea (1), Baltic Sea (1), Caucasus (2), European part of Russia (8), lakes of Kyrgyzstan (4), fish farm of Kazakhstan (3), Far Eastern part of Russia and China (20). At that, 7 species from Russia are representatives of North American ichthyofauna so as 2 species taken from Caucasus. Species taken from Kyrgyzstan are native to Siberia (3) and Caucasus (1).

Distribution of introductions between waterbodies-recipients was following: to the Aral Sea – 10 species, to mountain Charvak reservoir – 4, to aquaculture ponds – 31, and gambusia – to different types of plain waterbodies.

Secondary settlement of introduced species was marked for 27 species, for 20 species settlement was not found.

Natural reproduction in new conditions was marked for 31 species.
At present 22 introduced species vanished in region; 7 species are not numerous in waterbodies, 20 species are common and numerous in waterbodies were they habitat.
A number of introduced species did not find conditions for reproduction or could not survive and vanished (golden gray mullet, spotted steed, chinese sleeper, 3 species of buffalo, channel catfish, etc.). Several species survived and even began to reproduce in the Aral Sea at first years but died as salinity of water increased dramatically (atlantic herring, starry sturgeon, gobies from Caspian Sea, european flounder) the same as aborigine species.

Table 1: List of species introduced to Uzbekistan

Species / English name	Years of intro-duction[#] / Region – donor	Target	Waterbody – recipient	Secondary spread	Reproduction	Quantity in new waterbodies	Quantity of populations
Acipenser stellatus Starry sturgeon	1920, 1940 Caspian Sea	Target	Aral Sea	No	Yes	No	No
Abbotina rivularis Chinese false gudgeon	1960 Far East	Accidental	Aquaculture	Yes	Yes	Common	Many
Acipenser baerii Siberian sturgeon	1980 Russia[##]	Target	aquaculture	No	No	No	-
Alosa caspia caspia Caspian shad	1920 Caspian Sea	Target	Aral Sea	No	No	No	No
Atherina boyeri Big-scale sand smelt	1950 Caspian Sea	Accidental	Aral Sea	Yes	Yes	Rare	One
Carassius gibelio Prussian carp	1960 Russia	Target	aquaculture	Yes	Yes	Common	Many
Channa argus warpachowskii Amur snakehead	1960 Russia	Target	Aquaculture	Yes	Yes	Common	Many
Clupea harengus Atlantic herring	1950 Baltic Sea	Target	Aral Sea	No	No	No	No
Coregonus widegreni Valaam whitefish	1980 Kyrgyzstan	Accidental	Reservoir	No	Yes	Rare	One
Coregonus peled Peled	1980 Kyrgyzstan	Target	reservoir	No	Yes	Rare	No
Coregonus sardinella Sardine cisco	1980 Kyrgyzstan	Accidental	Reservoir	No	Yes	Rare	One
Ctenopharyngodon idella Grass carp	1960 Far East	Target	Aquaculture	Yes	Yes	Common	Many
Elopichthys bambusa Yellowcheek	1960 Far East	Accidental	Aquaculture	No	No	No	No
Gambusia affinis Mosquitofish	1930 Caucas	Target	Different	Yes	Yes	Common	Many
Gambusia holbrooki Eastern mosquitofish	1930 Caucas	Target	Different	Yes	Yes	Common	Many

Hemibarbus maculatus Spotted steed	1960 Far East	Accidental	Aquaculture	No	No	No	No
Hemiculter leucisculus Sharpbelly	1960 Far East	Accidental	Aquaculture	Yes	Yes	Common	Many
Hemiculter lucidus Ussuri sharpbelly	1960 Far East	Accidental	aquaculture	Yes	Yes	Rare	unknown
Hypophthalmichthys molitrix Silver carp	1960 Far East	Target	Aquaculture	Yes	Yes	Common	Many
Hypophthalmichthys nobilis Bighead carp	1960 Far East	Target	Aquaculture	Yes	Yes	Common	Many
Ictalurus punctatus Channel catfish	1970 Russia	Target	Aquaculture	Yes	No	No	No
Ictiobus bubalus Smallmouth buffalo	1970 Russia	Target	aquaculture	Yes	No	No	No
Ictiobus cyprinellus Bigmouth buffalo	1970 Russia	Target	aquaculture	Yes	No	No	No
Ictiobus niger Black buffalo	1970 Russia	Target	aquaculture	Yes	No	No	No
Knipowitschia caucasica Caucasian dwarf goby	1950 Caspian Sea	Accidental	Aral Sea	No	Yes	No	No
Megalobrama terminalis Black amur bream	1960 Far East	Accidental	Aquaculture	No	No	No	No
Micropercops swinhonis	1960 Far East	Accidental	aquaculture	Yes	Yes	Common	many
Liza aurata Golden golden gray mullet	1950 Caspian Sea	Target	Aral Sea	No	No	No	No
Mylopharyngodon piceus Black carp	1960 Far East	Accidental	Aquaculture	Yes	Yes	Rare	One
Neogobius fluviatilis Monkey goby	1950 Caspian Sea	Accidental	Aral Sea	No	Yes	No	No
Neogobius melanostomus Round goby	1950 Caspian Sea	Accidental	Aral Sea	No	Yes	No	No
Oncorhynchus mykiss Rainbow trout	1970 Russia	Target	Aquaculture	Yes	Yes	Common	Two
Opsariichthys uncirostris Three-lips	1960 Far East	Accidental	Aquaculture	Yes	Yes	Common	No
Oryzias sinensis	1990 Kazakhstan	Accidental	aquaculture	Yes	Yes	Common	many
Parabramis pekinensis White amur bream	1980 Far East	Accidental	aquaculture	Yes	Yes	Rare	One
Perca schrenkii Balkhash perch	1950 Kazakhstan	Accidental	aquaculture	Yes	Yes	Common	One
Perccottus glehni Chinese sleeper	1960 Far East	Accidental	Aquaculture	No	No	No	No
Platichthys flesus European flounder	1970 Black Sea	Target	Aral Sea	No	Yes	Rare	one
Proterorhinus marmoratus Tubenose goby	1950 Caspian Sea	Accidental	Aral Sea	No	Yes	No	No
Pseudorasbora parva Stone moroko	1960 Far East	Accidental	Aquaculture	Yes	Yes	Common	Many
Rhinogobius similis	1960 Far East	Accidental	aquaculture	Yes	Yes	Common	many
Rhodeus ocellatus Rosy bitterling	1960 Far East	Accidental	aquaculture	Yes	Yes	Common	many
Salmo ischchan Sevan trout	1970 Kyrgyzstan	Target	reservoir	No	Yes	Rare	one
Siniperca chuatsi Mandarin fish	1960 Far East	Accidental	aquaculture	No	No	No	No
Tinca tinca Tench	1950 Kazakhstan	Target	aquaculture	No	No	No	No
Triplophysa labiate Plain thicklip loach	1950 Kazakhstan	Accidental	aquaculture	No	No	No	One
Triplophysa strauchii Spotted loach	1950 Kazakhstan	Accidental	Aquaculture	Yes	Yes	Common	Many
# - data are given for decades (for example – 1950s, 1960s, etc.) ## - fish farms of European part of Russia							

A numerous species survived and reproduce in recipient water body but do not spread to another waterbodies because of physical or ecological barrier (whitefishes and trout in Charvak reservoir, spotted loach in Chirchik river).

Several alien species have widely spread all over the Aral Sea basin but it happened one time – after introduction of far eastern fishes in early 1960s. Fishes were introduced to new waterbody (first to aquaculture pond, secondary to newly created reservoirs, channels, lakes for residual waters storage) without established local ichthyofauna. Conditions of those water bodies were new as for aborigine so for alien fishes. Alien species had preference in their biology. Several species occupied free ecological niche (grass carp – herbivorous, prussian carp – detrivorous, silver carp and bighead carp – planktonvorous fishes). Several species have preferences in reproduction biology: early maturation, offspring protection, high fecundity, multiple spawning (snakehead, three-lips, stone moroko, rosy bitterling, *Rhinogobius similis*, sharpbelly, *Micropercops swinhonis*). Besides, fareastern fishes live in conditions of much stronger press of carnivorous fishes and higher competition of large quantity of species in motherland. As a result, in new conditions alien species found themselves more competitive then local fishes and they negatively impacted to stocks of local small fishes. This way local zeravshan dace, *Leuciscus lehmanni*, gudgeon, *Gobio gobio*, tashkent riffle bleak, *Alburnoides oblongus* vanished from middle streams of rivers and such species as syrdarya dace, *Squalius squaliusculus*, golden spined loach, *Sabanejewia aurata*, striped bystranka, *Alburnoides taeniatus*, kuschakewitsch loach, *Iskandaria kuschakewitschi* strongly reduced area and quantity and now habitat only in premountain waterbodies.

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