IRSTI 69.09.41 https://doi.org/10.26577/eb.2021.v88.i3.12

**S. Berdiakhmetkyzy[1*], S.Zh. Assylbekova[2], A.M. Abdybekova[3], T.T. Barakbaev[2]**

[1]Al-Faraby Kazakh national university, Kazakhstan, Almaty
[2] LLP "Research and Production Center of Fisheries" MEGNR RK, Kazakhstan, Almaty
[3]LLP «Kazakh Research-Scientific Veterinary Institute», Kazakhstan, Almaty
*e-mail: camal-90.ok@mail.ru.

# CURRENT STATE OF POPULATIONS OF THE MAIN COMMERCIAL FISH SPECIES OF THE SMALL ARAL SEA

The Aral Sea was one of the main commercial basins until the 80s of the last century. However, intensive water management activities aimed at regulating the upper reaches of the Syrdarya and Amudarya rivers, which were the main sources of water supply in the Aral Sea, led to a decrease in the water level and the sea was initially divided into two reservoirs: Small and Large.

As a result, huge damage was caused to the fishing industry of the region. And only after more than 20 years, a decision was made to restore the Aral Sea, by building a dam, in order to block the channel connecting the Small Aral with the Big Sea. In 2005, the construction of the Kokaral separation dam was completed.

The basis of the fishery is: bream (Abramis brama), zander (Sander lucioperca), pike (Esox lucius), asp (Aspius aspius), carp (Cyprinus caspio), crucian carp (Carasius auratus), roach (Rutilus rutilus), sabrefish (Pelecus cultratus), rudd (Scardinius erythrophthalmus). The fewly presented species include silver carp (Hypopthalmichthyx molitrix), snakehead (Channa argus), ide (Leuciscus idus), white-eyed bream (Ballerus sapa), perch (Perca fluvatilis). Flounder glossa (Platichthys flesus), catfish (Silurus glanis), shemaya (Alburnus chalcoides) that are found in catches.

According to the research of the current year, the commercial fishes in Small Aral Sea was represented by 16 species of fish, of which 9 species (Abramis brama, Cyprinus caspio, Aspius aspius, Esox lucius, Silurus glanis, Sander lucioperca, Rutilus rutilus, Channa argus, Pelecus cultratus) form the basis of the fishery, 6 species (Ctenopharyngodon idella, Carasius auratus, Ballerus sapa, Chalcalburnus chalcoides, Leuciscus idus, Hypopthalmichthyx molitrix) are few and 1 species (Platichthys flesus) of fish are isolated in catches.

This article provides a brief assessment of the state of the populations of the main commercial fish in the Aral Sea based on research in 2019-2020.

**Key words:** Aral Sea, ichthyofauna, aboriginal, alien species, abundance, species composition.

С. Бердіахметқызы[1*], С.Ж. Асылбекова[2], А.М. Абдыбекова[3], Т.Т. Барақбаев[2]

[1]Әл-Фараби атындағы Қазақ ұлттық университеті, Қазақстан, Алматы қ.
[2]Балық шаруашылығы ғылыми-өндірістік орталығы» ЖШС, Қазақстан, Алматы қ.
[3]«Қазақ ғылыми-зерттеу ветеринария институты» ЖШС, Қазақстан, Алматы қ.
*camal-90.ok@mail.ru

## Кіші Арал теңізінің негізгі кәсіптік балық түрлерінің қазіргі жағдайы

Арал теңізі өткен ғасырдың 80-ші жылдарына дейін негізгі кәсіптік суалаптың бірі болған. Алайда Арал теңізін сумен қамтамасыз ететін негізгі көздері болып табылатын Сырдария мен Әмудария өзендерінің жоғарғы ағыстарын реттеу жөніндегі қарқынды су шаруашылығын жүргізу, су деңгейінің төмендеуіне алып келді және Кіші Арал мен Үлкен Арал болып екі бөлікке бөлінді. Кейіннен Кіші Арал теңізі тез құрғап, балық шаруашылықтық маңызын жоғалтты. Тұщы су ағыны жоқ Үлкен теңіздің тұздылығы артты.

Нәтижесінде аймақтың балық шаруашылығына үлкен залал келді. Тек 20 жылдан астам уақыттан кейін, Кіші Аралды Үлкен теңізбен жалғайтын каналды бөгеу мақсатында бөгет салу арқылы Арал теңізін қалпына келтіру туралы шешім қабылданды. 2005 жылы Көкарал бөгетінің құрылысы аяқталды. Бөгеттің құрылысының арқасында 2006 жылдың сәуір айында Арал (Кіші)

 

теңізінің су деңгейі тұщы суы бар БС 42,0 М белгісіне жетті, 2002-2005 жылдары Сырдария өзенінің сулылығының артуына ықпал етті. Осының есебінен тұщы аймақтың ауданы едәуір ұлғайды.

Балық аулаудың негізін келесі балық түрлері құрайды: табан (Abramis brama), көксерке (Sander lucioperca), шортан (Esox lucius), ақмарқа (Aspius aspius), сазан (Cyprinus caspio), мөңке (Carasius auratus), торта (Rutilus rutilus), қылышбалық (Pelecus cultratus), қызылқанат (Scardinius erythropthalmus). Аз кездесетін түрлерге ақ дөңмаңдай (Hypopthalmichthyx molitrix), жыланбас (Channa argus), аққайраң (Leuciscus idus), айнакөз (Ballerus sapa), алабұға (Perca fluvatilis) жатады. Камбала глосса (Platichthys flesus), жайын (Silurus glanis), шимай (Alburnus chalcoides) сирек кездеседі.

Ағымдағы жылдың зерттеулері бойынша Кіші Арал теңізінің кәсіптік ихтиофаунасы 16 түрді құрады, оның 9 түрі (Abramis brama, Cyprinus caspio, Aspius aspius, Esox lucius, Silurus glanis, Sander lucioperca, Rutilus rutilus, Channa argus, Pelecus cultratus) кәсіптік ихтиофаунаның негізін құрайды. Сонымен қатар, 6 түр (Ctenopharyngodon idella, Carasius auratus, Ballerus sapa, Chalcalburnus chalcoides, Leuciscus idus, Hypopthalmichthyx molitrix) аз кездесетін және 1 түр (Platichthys flesus) сирек кездесетіндігі анықталды. Алайда, пілмай және Арал қаязы секілді құнды түрлердің популяциясы әлі қалпына келтірілген жоқ.

Бұл жұмыста Кіші Арал теңізі ихтиофаунасының заманауи құрамы талданады. Негізгі кәсіптік балық түрлері популяцияларының жай-күйіне қысқаша баға берілді.

**Түйін сөздер**: Арал теңізі, ихтиофауна, абориген, жерсінген түрлер, балық саны, түрлік құрам.

С. Бердіахметқызы[1*], С.Ж. Асылбекова[2],
А.М. Абдыбекова [3], Т.Т. Барақбаев[2]

[1]Казахский национальный университет им. аль-Фараби, Казахстан, г. Алматы
[2]ТОО «Научно-производственный центр рыбного хозяйства», Казахстан, г. Алматы
[3]ТОО «Казахский научно-исследовательский ветеринарный институт», Казахстан, г. Алматы
*e-mail: camal-90.ok@mail.ru

## Современное состояние популяций основных видов промысловых рыб Малого Аральского моря

Аральское море до 80-х годов прошлого столетия являлось одним из главных промысловых бассейнов. Однако интенсивная водохозяйственная деятельность по зарегулированию верховьев рек Сырдарьи и Амударьи, которые являлись основными источниками водоснабжения Аральского моря, привела к уменьшению уровня воды и море разделилось вначале на два водоема – Малое и Большое. Впоследствии Малое Аральское море быстро осушилось и потеряло рыбохозяйственное значение. Большое море без притока пресной воды осолонилось. В результате чего рыбному хозяйству региона был нанесен огромный ущерб. И только через 20 с лишним лет было принято решение по восстановлению Аральского моря путем строительства плотины с целью перекрытия протока, соединяющего Малый Арал с Большим морем. В 2005 г. было закончено строительство Кокаральской разделительной плотины. Благодаря строительству плотины уже в апреле 2006 г. уровень воды Аральского (Малого) моря достиг отметки 42,0 м БС с распресненной водой, этому способствовало еще и увеличение водности р. Сырдарьи в 2002-2005 гг., за счет чего значительно увеличилась площадь опресненной зоны.

Основу промысла составляют: лещ (Abramis brama), судак (Sander lucioperca), щука (Esox lucius), жерех (Aspius aspius), сазан (Cyprinus caspio), карась (Carasius auratus), плотва (Rutilus rutilus), чехонь (Pelecus cultratus), красноперка (Scardinius erythropthalmus). К немногочисленным видам относятся белый толстолобик (Hypopthalmichthyx molitrix), змееголов (Channa argus), язь (Leuciscus idus), белоглазка (Ballerus sapa), окунь (Perca fluvatilis). Единично в уловах присутствуют камбала глосса (Platichthys flesus), сом (Silurus glanis), шемая (Alburnus chalcoides).

По исследованиям текущего года промысловая ихтиофауна Малого Аральского моря была представлена 14 видами рыб, из которых 9 видов (Abramis brama, Cyprinus caspio, Aspius aspius, Esox lucius, Silurus glanis, Sander lucioperca, Rutilus rutilus, Channa argus, Pelecus cultratus) составляют основу промысла. К немногочисленным относятся 6 видов (Ctenopharyngodon idella, Carasius auratus, Ballerus sapa, Chalcalburnus chalcoides, Leuciscus idus, Hypopthalmichthyx molitrix) и единичны в уловах 1 вид (Platichthys flesus) рыб.

В данной работе анализируется современный состав ихтиофауны Малого Аральского моря. Дана краткая оценка состояния популяций основных промысловых видов рыб.

**Ключевые слова:** Аральское море, ихтиофауна, аборигенные, чужеродные виды, численность, видовой состав.

## Introduction

The Aral Sea is a terminal drainless salt lake lying among the vast deserts of Central Asia. According to F. Miklin et al., its drainage basin occupies more than 2 million km$^2$ [21].

Commercial fishing in Kazakhstan developed well in the first half of the 20th century (44,000 tons). The basin is mainly a low-lying desert [17].

Back in the middle of the last century, the Aral Sea was the fourth largest lake in the world, which filled a gigantic 426 kilometers long bowl until the 60s of the last century. The reservoir on the border of Kazakhstan and Uzbekistan was so large that it is still called the «sea», although it does not have access to the ocean, therefore it is formally a lake. There were legends about the fishwealth of the Aral Sea, it provided all of Central Asia and exported it to the socialist countries of Europe: Hungary, Czechoslovakia, the German Democratic Republic. The diversion of the Amu Darya and Syr Darya rivers is considered the main cause of the death of the sea. Today, almost 30 species of fish live in its waters [7].

However, intensive water management activities aimed at regulating the upper reaches of the Syr Darya and Amu Darya rivers, which were the main sources of water supply for the Aral Sea, led to a decrease in the water level and the sea was initially divided into two reservoirs, the Maloye shallow part and the deeper Big part. Subsequently, the Small Aral Sea quickly dried up and lost its fishery value. The Big Sea, without an influx of fresh water, became saline [8].

The Small (North) Aral Sea received a common name – in its short form «Kazaral Sea» or «Kazakhstan Aral Sea». While the correct scientific name is the North Aral Sea, derived from a regulated reservoir with brackish water [1].

The current level state of the water volume of the Aral Small Sea and the area of the water area favorably affect the reproduction of many fish species (phytophilous, lithophilic). With further water freshening, the distribution of aboriginal freshwater forms of ichthyofauna and forage invertebrates is expected in the direction of the central and western parts of the sea, where favorable conditions for reproduction and feeding will be created [11].

Until the 80s of the last century, the Aral Sea was one of the main fishing basins in which valuable commercial fish species were found, such as thorn sturgeon, Aral barbel, bream, carp, Aral roach, shemaya, pike perch, asp, etc. [2].

In a relatively short period of time, the Aral roach, carp, bream, pike perch, asp, sabrefish, rudd and pike have reached commercial numbers in the Small Aral Sea [9].

The local fish fauna of the Aral Sea Basin changed dramatically in the second half of the 20th century after the mismanagement of water resources and the introduction of alien fish. The Amur snakehead Channa argus (Cantor, 1842) was unintentionally introduced into the Aral Sea basin in early 1960-1963. This species is considered one of the most dangerous invaders. In addition, the abundance and state of alien species can serve as indicators of the reservoirs' state and sources of their ill-being [18]. The aim of this work was to study the morphological variability and biological characteristics of the snakehead in comparison with the early period of naturalization in the Syrdariya river[10].

For example, in order to increase the catches of commercial fish species, in particular the valuable species (carp) in the lake systems of the lower reaches of the Syrdariya river, it is necessary to carry out a number of measures. This is an increase in the commercial load on bream, reclamation catches of predatory and low-value fish species. Carp catches have changed significantly since the recovery period of the Small Aral Sea. In 2007, carp catches reached 260 tons, which is explained by a massive outbreak of numbers during the formation of the reservoir [24].

According to N. V. Aladin, I. S. Plotnikov and V. P. Mitrofanov modern ichthyofauna of the Aral Sea is represented by 17 species of fish: pike (*Esox lucius*), bream (*Abramis brama*), asp (*Aspius aspius*), carp (*Cyprinus caspio*), silver carp (*Hypopthalmichthyx molitrix*), sabrefish (*Pelecus cultratus*), roach (*Rutilus rutilus*), rudd (*Scardinius erythropthalmus*), catfish (*Silurus glanis*), pike perch (*Sander lucioperca*), snakehead (*Channa argus*), shemaya (*Alburnus chalcoides*), crucian carp (*Carasius auratus*), ide (*Leuciscus idus*), perch (*Perca fluvatilis*), white-eyed bream (*Ballerus sapa*) and flounder (*Platichthys flesus*) [3,19].

## Importance of research

Today, the Small Aral Sea plays an important role in the development of the region's economy. There are 8 fish processing plants in the Aral region, which process up to 20 thousand tons of fish per year. One of the largest fish processing plants in Aralsk has been exporting zander fillets to China, Poland, and Germany for the second year. Frozen vobla, bream, and asp are sent to the domestic market and the CIS countries. According to E.O. Kozhabaeva [16] 22 species live in the

sea, the population of 14 previously missing fish species has been restored. Taking into account the scale of the problems of the Small Aral, the studies of domestic scientists are carried out in order to preserve the fish resources of the sea.

**Materials and methods**

Determination of the species composition of the studied fish was conducted using the taxonomic description in the determinants of freshwater fish parasites of the USSR fauna [13,15,22] a complete biological analysis of fish with the determination of the length, weight, sex, stages of maturity of the gonads and the age of fish was also carried out [25]. Calculations of the total mass of the fish and the mass without entrails have been made. Fatness was considered as an indirect indicator characterizing fish nutrition. The exterior indicator was calculated using the Fulton formula [14]. According to many scientists, more indicative results are given by the Clarke fatness coefficient [5,23]. We used both methods in our work. Sex and the stage of maturity of the reproductive products were determined visually using 6 scales in accordance with the method of I.F. Pravdin.

**Study results**

According to the research of the current year, the commercial ichthyofauna of the Small Aral Sea was represented by 16 species of fish, of which 9 species (*Abramis brama, Cyprinus caspio, Aspius aspius, Esox lucius, Silurus glanis, Sander lucioperca, Rutilus rutilus, Channa argus, Pelecus cultratus*) form the basis of the fishery, 6 species (*Ctenopharyngodon idella, Carasius auratus, Ballerus sapa, Chalcalburnus chalcoides, Leuciscus idus, Hypopthalmichthyx molitrix*) are few and 1 species (*Platichthys flesus*) of fish are isolated in catches.

This paper analyzes the current composition of the ichthyofauna of the Small Aral Sea. A brief assessment of the state of populations of the main commercial fish species is given.

Bream (*Abramis brama*) – mass commercial species, dominates both net and non-aquatic catches.

**Table 1** – The quantitative ratio of the main commercial fish in fishing gear in 2020

| Fishing gear | Fish species | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | bream | pike | asp | carp | goldfish | sabrefish | roach | zander | rudd | |
| Fixed nets | 523 | 69 | 28 | 13 | 209 | 232 | 845 | 93 | 69 | 3181 |
| Seine, 50 m | 429 | 9 | 4 | 40 | 76 | 129 | 700 | 02 | 04 | 2113 |

The quantitative ratio of the Gate nets and Seine of the main commercial fish on the fishing gear is indicated. Bream 523 (429), pike 69 (9), asp 28 (4), carp 13 (40), goldfish 209 (129), roach 845(700), zander 93(2), rudd 69(4) (Table 1).

According to recent studies, bream becomes sexually mature at a length of 16-21 cm, at the age of 4-6 years. The maximum length of juvenile fish in 2019 is 21 cm [12]. The mass onset of sexual maturity in bream occurs at the age of 5-6 years. During this period, 84.5-94.5% of bream were sexually mature, by the age of 7 the fish reach full (100%) maturity.

Observations show that in the bream population there was a reduction in the size-age range of the first maturing individuals (in 2020, these were fish of 4-6 years old). This can be explained by some improvement in habitat conditions, namely, by the rarefaction of the population under the influence of fishing (Table 2).

The sex ratio in the sexually mature part of the bream population during the spawning period of the current year was characterized by the prevalence of females 1.0:1.18. A shift in the sex structure of bream in favor of females can also result from changes in population density, i.e. seizures, it's older than the age part.

The average size and weight indicators of bream in 2020 are equal to 24.9 cm (length) and 376.3 g (weight) and exceed the data for 2019 – respectively 24.1 cm and 368 g. At the same time, there are no visible changes in the growth rate of bream, the average indicators of the linear sizes of individuals for all age groups remained within the last year (Table 2). The limiting age of bream in the catches of recent years has somewhat decreased and is 9 years with a length of 340 mm and a mass of 910 g. In the weight ratio, 60-70% of fish weigh up to 500 g, and specimens of more than 900 g were absent in the catches of 2020.

**Table 2** – Age composition of bream (as a whole for the reservoir), 2020

| Age range | Length, cm (min-max) | Average length, cm | Weight, g (min-max) | Average weight, g | Qty,pcs | % |
|---|---|---|---|---|---|---|
| 1+ | 10,0-13,0 | 11,4 | 18-44 | 27,5 | 7 | 1,3 |
| 2+ | 12,0-17,0 | 14,5 | 29-99 | 61,6 | 29 | 5,6 |
| 3+ | 16,0-22,0 | 19,0 | 72-203 | 145,2 | 45 | 8,6 |
| 4+ | 19,0-27,0 | 22,2 | 141-456 | 226,9 | 84 | 16,1 |
| 5+ | 22,0-29,0 | 25,5 | 197-568 | 374,8 | 159 | 30,4 |
| 6+ | 23,0-31,0 | 28,6 | 326-798 | 516 | 156 | 29,8 |
| 7+ | 29,0-33,0 | 30,6 | 536-867 | 643,6 | 33 | 6,3 |
| 8+ | 31,0-33,0 | 31,8 | 693-899 | 776,2 | 9 | 1,7 |
| 9+ | 34,0 | 34,0 | 910 | 910 | 1 | 0,2 |
| Total | 10,0-34,0 | 24,9 | 18-910 | 376,3 | 523 | 100 |

The fatness indicators of bream remained at the level of the last year and averaged 2.05 for Fulton versus 2.06 in 2019. The incidence of ligulosis in bream remains at the level of the average perennial and averaged 6.8% for the reservoir.

The indicators of individual fertility of bream in the current year remained within the limits of 2019, a slight increase in the average absolute fertility from 92.44 thousand eggs in 2019 to 115.88 in 2020 was due to the presence of older fish in the sample. AIF – absolute individual fertility, RIF – relative individual fertility (Table 3).

**The zander** (*Sander lucioperca*) is a valuable commercial species and is characterized by a high degree of stock utilization, which determines the variability of a number of its biological population indicators.

**Table 3** – Fertility of bream by age group, thousand eggs

| Years | Age groups | | | | | | Average AIF | RIF(L) | RIF(M) |
|---|---|---|---|---|---|---|---|---|---|
| | 4+ | 5+ | 6+ | 7+ | 8+ | 9+ | | | |
| 2019 | - | 39,310 | 50,630 | 85,560 | 175,270 | - | 92,44 | 3214 | 178 |
| 2020 | 35,652 | 39,420 | 62,780 | 95,810 | 210,540 | 251,122 | 115,88 | 4653 | 0,307 |

Significant changes in the timing of maturity perch is not observed in recent years. The age of the first maturing individuals is 3 years with a length of 32 cm. The onset of mass maturity occurs at the age of 4-5 years. The maximum size of immature fish is 42 cm [4,6,20]. The zander is a predator playing the role of a biological meliorator in the Small Aral Sea. Due to the intense desalination of the Small Sea, its habitat has expanded significantly, and it began to be found almost throughout its water area.

In the last years of research, zander began to enter Butakov Bay. Zander producers begin their prespawning migrations to the Syr Darya River from the end of September. The mass move was noted in late October and in the spring in March-April. The beginning of spawning is usually at the beginning of the second decade of April at a water temperature of 7-8 ºC, the height of spawning took place at the end of the third decade of April and in early May at a temperature of 14-15ºC. The end of spawning occurs in the second decade of May at a water temperature of 18-20ºC. The pike-perch, like other aboriginal freshwater species, began to inhabit the entire water area of the Small Aral Sea.

If in 2001-2003 zander lived only in the estuarine zone – in the Taur and Shagala regions, then in 2004, it began to occur in the northeastern and eastern regions, and in 2005 – almost throughout the entire water area of the Small Sea, with the exception of Bay of Butakov.

In scientific research catches of 2020, the length of the zander varied from 15 to 71 cm, the mass – from 44 to 4915 g, with an average body length of 30.9 cm and a mass of 456.4 g, respectively. The age

composition of zander in 2020 was represented by nine generations with predominance of young age groups (2 – 4+) 95%, which indicates its stable reproduction and the presence of self-regulation of the population under conditions of intensive harvesting by the fishery.

By the nature of spawning, zander belongs to the phytophilic group of fish. Zander breeders were found in lengths from 30.2 to 48.3 cm and weighing from 450.4 to 3425 g. Females and males differ sharply in length, as well as in weight. Fertility of zander according to observations of recent years ranged from 33.320 to 154.32 thousand units (Table 4).

An increase in the fertility of zander should be regarded as a response of the population to its intensive harvest.

**Table 4 –** Fertility of pike perch by age groups, thousand eggs

| Years | Age groups | | | | | Avarage AIF | RIF(L) | RIF(M) |
|---|---|---|---|---|---|---|---|---|
| | 3+ | 4+ | 5+ | 6+ | 7+ | | - | - |
| 2019 | 34,222 | 33,320 | 76,100 | 130,50 | - | 64,120 | - | - |
| 2020 | 33,414 | 40,286 | 79,563 | 131,25 | 154,32 | 87,766 | 2840 | 192,3 |

**The pike** (*Esox lucius*) is a valuable aboriginal predator, it is subjected to intensive fishing, which affects the structure of the population and biological indicators. In recent years, there has been a uniform preservation of the average size and weight parameters of pike in the Small Aral Sea, which indicates an improvement in feeding conditions.

The age structure during the study period is presented from two to eight years. Dominated by four-year-olds (34.9% of the total population). The average length of pike individuals in the current year was 39.7 cm with a weight of 648.6 g (Table 5). As the population responds to excessive withdrawal, the timing of puberty changes.

**Table 5 –** Main biological indicators of pike in the Small Aral Sea, 2020

| Age range | Length, cm (min-max) | Average length, cm | Weight, g (min-max) | Average weight, g | Qty,pcs | % |
|---|---|---|---|---|---|---|
| 2+ | 28,0-31,0 | 29,3 | 193-270 | 227,7 | 7 | 4,2 |
| 3+ | 25,0-38,0 | 32,8 | 153-544 | 322,4 | 39 | 23,1 |
| 4+ | 30,0-41,0 | 59,0 | 255-642 | 483,1 | 59 | 34,9 |
| 5+ | 39,5-50,0 | 42,9 | 506-1080 | 726,7 | 31 | 18,3 |
| 6+ | 45,0-54,0 | 48,9 | 758-1750 | 1148,5 | 22 | 13,0 |
| 7+ | 49,0-58,0 | 54,4 | 960-2115 | 1701 | 9 | 5,3 |
| 8+ | 56,5-61,0 | 58,7 | 1695-2145 | 1920 | 2 | 1,2 |
| Total | 25,0-61,0 | 39,7 | 153-2145 | 648,6 | 169 | 100 |

According to the data of the current year, the onset of pike's sexual maturity occurred at the age of 3-4 years with a size of 32.8 cm and a mass of 322.4 g. The beginning of spawning in pike in the Syr Darya River usually occurs in mid-April and depends on the climatic features of the year. It spawns immediately after opening the river from ice (sometimes still under ice) at a water temperature of 3 – 6ºC. The eggs are laid on last year's vegetation. The individual absolute fecundity of pike in the current year ranged from 12.14 to 41.32 thousand eggs (Table 6).

According to the research results, the fertility of pike is low, but it is impossible to draw conclusions due to the small size of the sample. The table shows that with an increase in the age and size of females, the individual absolute fertility increases.

**Table 6** – Fertility of pike by age groups, thousand eggs

| Years | AIF by age group | | | | | | AIF average | RIF (L) | RIF (M) |
|---|---|---|---|---|---|---|---|---|---|
| | 3+ | 4+ | 5+ | 6+ | 7+ | 8+ | | | |
| 2019 | 6,52 | 9,56 | 15,23 | - | - | - | 16,23 | 0,215 | 0,014 |
| 2020 | - | 12,14 | 17,68 | 22,78 | 27,42 | 41,32 | 30,33 | 0,764 | 0,046 |

**Aral asp** (*Aspius aspius*) is a valuable native species of the Aral Sea and rivers flowing into it. Aral asp spawns in early spring for 8-10 days at a water temperature of 5-7 $^0$C and continues up to 10-11 $^0$C. Semi-anadromous asp begins spawning in rivers in late autumn, at a water temperature of 4-5 $^0$C. Entering the river in autumn, asp hibernates in deep holes and goes to spawning grounds immediately after the drift of ice. In the catches of the current year, the age range of asp was represented by individuals up to 8+ years old, from 21.0 to 57.0 cm in length, weight – from 130 to 3155 g, with an average body length of 38.6 cm and a weight of 1060.5 g, six years old.

In the population of asp, the sex ratio in the current year was in favor of females and was 1:1.37. The individual absolute fecundity of the asp in 2020 ranged from 61.314 in four-year-olds to 183.514 thousand eggs in eight-year-old females (Table 7).

In recent years, there has been an increase in the size and weight indicators in the population of asp, which is associated with an increase in its number and a favorable food supply.

**Table 7** – Fertility of asp by age groups, thousand eggs

| Years | Age groups | | | | | | AIF average | RIF(L) | RIF(M) |
|---|---|---|---|---|---|---|---|---|---|
| | 4+ | 5+ | 6+ | 7+ | 8+ | 9+ | | | |
| 2019 | 58,352 | 75,246 | 80,522 | 94,284 | - | - | 78,190 | - | - |
| 2020 | 61,314 | 89,354 | 87,446 | 112,325 | 183,514 | - | 106,790 | 2766 | 1006 |

**The Aral roach** (*Rutilus rutilus*) is the dominant species in abundance throughout the Small sea area. In the early 90s, the flow of the river. The Syr Darya began to flow into the Small sea, which contributed to the formation of a freshened zone and the appearance of commercial fish fauna, including roach. Already in 2004, roach was found in the eastern and northeastern regions, in the central region and in the bay. Shevchenko, and since 2008 it also enters Butakov Bay, where a relatively high salinity is still preserved.

During the research period in 2020, roach was the leader in both net and non-aquatic catches. In net catches, the length of the Aral roach ranged from 10.0 to 24.0 cm, averaging 16.5 cm, and the weight varied from 21 to 392 g, on average -104.5 g. The age structure of the Aral roach is represented by seven generations, which are predominant are three years old (42.5%).

Sexually mature roach becomes in the second year of life, the period of mass puberty falls on fish 2-3 years old with a length of 11-16 cm. The sex ratio of roach in a commercial herd dominated by females is 3.58: 1. The individual absolute fecundity of females ranges from 42.256 in 2-year-olds to 325.452 thousand eggs in females aged 6+ (Table 8).

**Table 8** – Fertility of roach by age groups, thousand eggs, 2020

| Years | Age groups | | | | | | AIF average | RIF (L) | RIF (M) |
|---|---|---|---|---|---|---|---|---|---|
| | 2+ | 3+ | 4+ | 5+ | 6+ | 7+ | | | |
| 2019 | 42,256 | 80,308 | 95,640 | 245,098 | 98,325 | 42,256 | 112,325 | 6171 | 1123 |
| 2020 | 54,331 | 61,964 | 57,419 | 114,256 | 325,452 | - | 122,684 | 6457 | 613,4 |

**Carp** (*Cyprinus caspio*) is one of the most valuable fish species in inland water bodies of Kazakhstan. In the Small Aral Sea it is one of the main fishing objects. Reaches sexual maturity in the third and fourth year of life, spawns annually. In choosing a spawning substrate, it is unpretentious, it lays eggs both on the stalks of reed, water milfoil, and ыфпщ pondweed, and on various underwater vegetation, except for chara algae and najas. In research catches in 2020, the length of the carp ranged from 13.0 to 74.0 cm, averaging 32.9 cm. The mass of the carp varied from 145 to 9000 g, with an average of 1014.3 g. by nine generations, the main catch is carp at the age of 3+ to 5+ years**.** The carp reaches sexual maturity in the third and fourth year of life, spawns annually. In choosing a spawning substrate, it is unpretentious, it lays eggs both on the stems of reed, uruti, comb pondweed, and on various underwater vegetation, except for chara algae and sea rock cress.

The absolute fertility of the carp in the Small Aral Sea for the period 2019-2020 ranges from 153.165 to 559.455 thousand (Table 9).

**Table 9** – Fertility of carp by age groups, thousand seeds

| Years | Age groups | | | | | | AIF average | RIF (L) | RIF (M) |
|---|---|---|---|---|---|---|---|---|---|
| | 4+ | 5+ | 6+ | 7+ | 8+ | 9+ | | | |
| 2019 | - | 135,312 | 241,465 | 429,523 | 422,109 | - | 331,324 | - | - |
| 2020 | 163,124 | 151,415 | 310,214 | 620,410 | 549,445 | 153,165 | 324,628 | 9867 | 0,320 |

**Sabrefish** (*Pelecus cultratus*) is a semi-anadromous fish that enters rivers for spawning. In the Small Aral Sea, the bulk of sabrefish spawns along the sea coast at depths of 2-6 m. The caviar of sabrefish is bathypelagic. The bulk of the sabrefish becomes sexually mature upon reaching the age of three. Spawning begins at a temperature of 12 ° C. and occurs in the second half of May – early June, sometimes stretching to mid-July. Sabrefish is a plastic euryphage. It feeds on plants and planktonic crustaceans, as well as on larvae and adults of Diptera, mysids, amphipods, beetles and juvenile fish. In recent years, sabrefish in the Small Aral Sea has reached a commercial size. In the catches of 2020, the length of sabrefish ranged from 20.0 to 33.0 cm, averaging 26.7 cm. The mass of sabrefish varied from 67 to 333 g, averaging 171.6 g. The age structure of sabrefish was represented by seven generations, individuals from 4 to 6+ years old are predominant (89.3%).

The sex ratio in the sabrefish population this year was 1:1.3 in favor of males.

The individual absolute fecundity of sabrefish varied from 14.26 thousand pcs in four-year-olds up to 98.563 thousand pieces in seven-year-old individuals (Table 10).

**Table 10** – Fertility of sabrefish by age groups, thousand eggs

| Years | Age groups | | | | | | AIF average | RIF (L) | RIF (M) |
|---|---|---|---|---|---|---|---|---|---|
| | 4+ | 5+ | 6+ | 7+ | 8+ | 9+ | | | |
| 2019 | 14,26 | 22,363 | 62,363 | - | - | - | 58,321 | 1854 | 294 |
| 2020 | 15,36 | 34,323 | 69,863 | 98,563 | - | - | 54,527 | 2042 | 317 |

**Crucian carp** (*Carasius auratus*) – makes a significant share in the catches of the Small Aral Sea inhabited by many species of fish. During the period of salinization of the Aral Sea, crucian carp lived in the estuary of the Syrdarya river. With the beginning of the filling of the sea and its freshening, the crucian carp mastered the previously lost niche.

In scientific research catches in 2020 in the Small Aral Sea, the length of the crucian carp varied from 13 to 29 cm, the mass – from 73 to 735 g, with an average body length of 22.1 cm and a mass of 393.4 g, respectively.

The age composition of crucian carp in the catches was noted up to 7+ years, middle-aged

groups dominate (65.5%), which indicates stable reproduction and the presence of self-regulation in the population under conditions of intensive harvesting by the fishery. The sex ratio in a female-dominated population is 3.5:1. The fertility of crucian carp, according to observations of recent years, ranged from 12.356 in three-year-old individuals to 91438 thousand pieces in seven-year-old carp (Table 11).

**Table 11** – Fertility of crucian carp by age groups, thousand eggs

| Years | Age groups | | | | | | AIF average | RIF (L) | RIF (M) |
|---|---|---|---|---|---|---|---|---|---|
| | 3+ | 4+ | 5+ | 6+ | 7+ | 8+ | | | |
| 2019 | 12,356 | 24,235 | 65,232 | - | - | - | 33,941 | 1593 | 2,00 |
| 2020 | 19,458 | 32,546 | 71,421 | 84144 | 91438 | - | 35,541 | 1608 | 90,3 |

## Conclusion

The modern ichthyofauna of the Small Aral Sea was represented by 17 species of fish: Esox lucius, Abramis brama orientalis, Aspius aspius, Cyprinus carpio, Pelecus cultratus, Rutilus rutilus aralensis, Sander lucioperca, Alburnus chalcoides, Carasius auratus, Hypophthalmichthys molitrix, Scardinius erythrophthalmus, Silurus glanis, Channa argus, Leuciscus idus, Perca fluviatilis, Ballerus sapa and Platichthys flesus.

The basis of the fishery is: Abramis brama orientalis, Sander lucioperca, Esox lucius, Aspius aspius, Cyprinus carpio, Carasius auratus, Rutilus rutilus aralensis, Pelecus cultratus, Scardinius erythrophthalmus. Rarely met species include Hypophthalmichthys molitrix, Channa argus, Leuciscus idus, Ballerus sapa, Perca fluviatilis. Occasionally, Platichthys flesus, Silurus glanis and Alburnus chalcoides are present in the catches.

The current state of fish populations in the Small Aral Sea can be characterized by the following provisions in 2020:

- a relatively high degree of biodiversity of the ichthyofauna of the Aral Sea in comparison with other water bodies of the basin;
- an increase in the variability of structural and biological indicators in fish populations intensively exploited by the fishery (pike perch, pike, carp, asp);
- relative stability of indicators of crucian carp, roach, sabrefish;
- numerical dominance of bream with weak variability of structural and biological indicators of the population.

**Acknowledgements.** The work was conducted within the framework of grant financing of the Ministry of Education and Science of the Republic of Kazakhstan № AP08955829 “Development of epidemiological methods for the prevention of parasitoses of commercial fish from the small Aral Sea”.

**Литература**

1 Aladin N. V., Micklin Ph., Plotnikov I. S. The partial restoration of the Aral Sea and the biological, socio-economic and health conditions in the region // HUMAN CAPITAL AND PROFESSIONAL EDUCATION. – No. 3 (19) 2016. – pp. 62-68.

2 Асылбекова С.Ж. Акклиматизация рыб и водных беспозвоночных в водоемах Казахстана: результаты и перспективы: диссертация на соискание ученой степени доктора биологических наук: 06.04.01. – Астрахань, 2017. – С. 52-58.

3 Aladin N.V., Gontar V.I., Zhakova L.V., Plotnikov I.S., Smurov A.O., Rzymski P., Klimaszyk P. 2019. The zoocenosis of the Aral Sea: six decades of fast-paced change // Environmental Science and Pollution Research, 26(3): 2228–2237. https://doi.org/10.1007/s11356-018-3807-z.

4 Аладин Н.В. и Плотников И.С. Современная фауна остаточных водоемов, образовавшихся на месте бывшего Аральского моря. // Труды Зоологического института РАН Том 312, № 1/2, 2008. – С. 145–154.

5 Бауер О.Н. Определитель паразитов пресноводных рыб фауны СССР. – Ленинград, Наука, 1987. – Т. III. – 582 с.

6 Clark F. The Weight Length Relationship of the California Sardine (Sardine caerulea) et San. Pedro //Fish Bulletin, 1928. – № 12.

7 Определение рыбопродуктивности водоемов и/или их участков, разработка биологических обоснований прогноза допустимых уловов и выдача рекомендаций по режиму и регулированию рыболовства на водоемах международного и республиканского значения Арало-Сырдарьинского бассейна. Раздел: Аральское (Малое) море и р. Сырдарья часть: Отчет о НИР – Аральск, 2016-2017.

8 Дәуітбаева К.Ә., Сатыбалдиева А.С. Кіші Арал теңізінің балықтарында желбезектерінде кездесетін паразиттер // ҚазҰУ хабаршысы, Экология сериясы. – Алматы, 2012. – №1(33). – 50-52 б.

9 Dukravets G.M., Machulin A.I. «The morphology and ecology of the Amur snakehead, Ophiocephalus argus warpachowskii, acclimatized in the Syr Dar'ya Basin». Journal of Ichthyology. 16 (1978):203–208.

10 Ermakhanov Z. K., Plotnikov I. S., Aladin N. V., Micklin P. Changes in the Aral Sea Ichthyofauna and Fishery During the Pe- riod of Ecological Crisis.// Lakes & Reservoirs: Research and Management. 17 (2012):3–9. DOI: 10.1111// j.1440-1770.2012.00492.x

11 Ермаханов З.К., Жубанов К.У., Калымбетова М.Т, Самбаев Н.С., Ермаханова Ж.З. Современное состояния экосистемы Малого Аральского моря // 62-й Международной научной конференции Астраханского государственного технического университета. Астрахань, апрель 23-28, 2018.

12 Fulton T. Rate of growth of sea fishes. Sc.Sci. Invest.Rept., 1902. – 20 p.

13 Gascho Landis A.M., Lapointe N.W.R., Angermeier P.L. «Individual growth and reproductive behavior in a newly established population of northern snakehead (Channa argus), Potomac River, USA». Hydrobiologia. 661 (2011):123–131. DOI 10.1007/s10750-010-0509-z.

14 Гусев А.В. Определитель паразитов пресноводных рыб фауны СССР. – Ленинград, 1985. – Т. II. – 424 с.

15 https://24.kz/ru/news/social/item/338855-рыбаки-обеспокоены-судьбой-Малого-Арала.

16 Кожабаева Э.Б. Современное состояние фоновых видов рыб Арало-Сырдарьинского бассейн: автореферат диссертации на соискание ученой степени кандидата биологических наук: 03.00.08. – Алматы, 2010. – 21 с.

17 Micklin P., Aladin N., Plotnikov I. Introduction to the Aral Sea and its Region. The Aral Sea: the Devastation and Partial Rehabilitation of a Great Lake // Springer Earth System Sciences. Springer, Heidelberg,2014.- pp 15–40.

18 Mamilov N.Sh., Amirbekova F.T., Khabibullin F.Kh., Adilbaev Zh.A., Bekkozhaeva D.K., Kozhabaeva E.B. New data on morphometry and biology of Alien snakehead Channa Argus in the Syrdarya river// Series Biological and Medical (№1). – Almaty, 2018. – 67 p.

19 Митрофанов, В. П. Рыба Казахстана. Т. 5 / под ред. Митрофанова В. П. – Алма-Ата: Гылым, 1992. – 464 с.

20 Определение рыбопродуктивности рыбохозяйственных водоемов и/или их участков, разработка биологических обоснований предельно допустимых уловов рыбы и других водных животных, режиму и регулированию рыболовства на рыбохозяйственных водоемах международного, республиканского значений и водоемах ООПТ Арало-Сырдаринского бассейна, а также оценка состояния рыбных ресурсов на резервных водоемах местного значения. Разд. Аральское море и р. Сырдарья //Отчет о НИР НПЦРХ. – Кызылорда, 2019. – 175 с.

21 Philip Micklin, Nikolai V. Aladin, Tetsuro Chida, Nikolaus Boroffka, Igor S. Plotnikov, Sergey Krivonogov and Kristopher White The Aral Sea: A Story of Devastation and Partial Recovery of a Large Lake// Springer Water. – Russia. 2020. – 109-112 pp.

22 Perez-Rodriguez A., Morgan J., Koen-Alonso M., Saborido-Rey F Disentangling genetic change from phenotypic response in reproductive parameters of Flemish Cap cod Gadus morhua. Fisheries Research.Volume.138 (2013):62-70. https://doi.org/10.1016/j.fishres.2012.09.004.

23 Правдин И.Ф. Руководство по изучению рыб (преимущественно пресноводных). – 4-е изд. – М.: Пищевая промышленность, 1966. – 374 с.

24 Самбаев Н. С. Приемная емкость Аральского Малого моря и потенциальные объемы искусственного воспроизводства карповыми видами рыб // Вектор ГеоНаук. – 2019 2(4). – С. 29. DOI: 10.24411/2619-0761-2019-10043.

25 Шульман С.С. Определитель паразитов пресноводных рыб фауны СССР. – Ленинград, 1984. – Т. I. – 428 с.

**References**

1 Aladin N. V., Micklin Ph., Plotnikov I. S. The partial restoration of the Aral Sea and the biological, socio-economic and health conditions in the region.// HUMAN CAPITAL AND PROFESSIONAL EDUCATION No. 3 (19) 2016. №. – pp. 62-68.

2 Asylbekova S. Zh. Acclimatization of fish and aquatic invertebrates in the reservoirs of Kazakhstan: results and prospects: dissertation for the degree of Doctor of Biological Sciences: 06.04.01. – Astrakhan, 2017. – pp.52-58.

3 Aladin N.V., Gontar V.I., Zhakova L.V., Plotnikov I.S., Smurov A.O., Rzymski P., Klimaszyk P. 2019. The zoocenosis of the Aral Sea: six decades of fast-paced change // Environmental Science and Pollution Research, 26(3): 2228–2237. https://doi.org/10.1007/s11356-018-3807-z.

4 Aladin N.V. i Plotnikov I.S. Covremennaya fauna ostatochnykh vodoyemov, obrazovavshikhsya na meste byvshego Aral'skogo morya. // Trudy Zoologicheskogo instituta RAN Tom 312, № 1/2, 2008, c. 145–154.

5 Bauyer O.N. Opredelitel' parazitov presnovodnykh ryb fauny SSSR. – Leningrad, Nauka, 1987. – T. III. – 582 s.

6 Clark F. The Weight Length Relationship of the California Sardine (Sardine caerulea) et San. Pedro //Fish Bulletin, 1928. – № 12.

7 Determination of fish productivity of water bodies and / or their areas, development of biological justifications for the forecast of allowable catches and issuing recommendations on the regime and regulation of fishing in water bodies of international and national significance of the Aral-Syrdarya basin. Section: The Aral (Small) Sea and the Syrdarya River part: Research Report-Aralsk, 2016-2017.

8 Dautbayeva K. A., Satybaldieva A. S. Gill parasites found in Fish of the Small Aral Sea / / Bulletin of kaznu. – Ecology Series. – No. 1(33) 2012. – pp. 50-52.

9 Dukravets G.M., Machulin A.I. «The morphology and ecology of the Amur snakehead, Ophiocephalus argus warpachowskii, acclimatized in the Syr Dar'ya Basin». Journal of Ichthyology. 16 (1978):203–208.

10 Ermakhanov Z. K., Plotnikov I. S., Aladin N. V., Micklin P. Changes in the Aral Sea Ichthyofauna and Fishery Dur-ing the Pe- riod of Ecological Crisis.// Lakes & Reservoirs: Research and Management. 17 (2012):3–9. DOI: 10.1111// j.1440-1770.2012.00492.x.

11 Ermakhanov Z. K., Zhubanov K. U., Kalymbetova M. T., Sambaev N. S., Ermakhanova Zh. Z. Current state of the ecosys-tem of the Small Aral Sea.// 62nd International scientific conference of Astrakhan state technical university. Astrakhan, April 23-27, 2018.

12 Fulton T. Rate of growth of sea fishes. Sc.Sci. Invest.Rept., 1902. – 20 p.

13 Gascho Landis A.M., Lapointe N.W.R., Angermeier P.L. «Individual growth and reproductive behavior in a newly estab-lished population of northern snakehead (Channa argus), Potomac River, USA». Hydrobiologia. 661 (2011):123–131. DOI 10.1007/ s10750-010-0509-z.

14 Gusev A.V. Opredelitel' parazitov presnovodnykh ryb fauny SSSR. – Leningrad, 1985. – T. II. – 424 s.

15 https://24.kz/ru/news/social/item/338855-rybaki-obespokoyeny-sud'boy-malogo-arala.

16 Kozhabayeva E.B. Sovremennoye sostoyaniye fonovykh vidov ryb Aralo-Syrdar'inskogo basseyn: avtoreferat dissertatsii na soiskaniye uchenoy stepeni kandidata biologicheskikh nauk: 03.00.08. – Almaty, 2010. – 21 s.

17 Micklin P., Aladin N., Plotnikov I. Introduction to the Aral Sea and its Region. The Aral Sea: the Devastation and Partial Rehabilitation of a Great Lake.// Springer Earth System Sciences. Springer, Heidelberg, 2014.- pp 15–40.

18 Mamilov N.Sh., Amirbekova F.T., Khabibullin F.Kh., Adilbaev Zh.A., Bekkozhaeva D.K., Kozhabaeva E.B. New data on morphometry and biology of Alien snakehead Channa Argus in the Syrdarya river// Series Biological and Medical (№1).-Almaty, 2018.- 67 p.

19 Mitrofanov, V. P. Ryba Kazakhstana. T. 5 / pod red. Mitrofanova V. P.-Alma-Ata: Gylym, 1992. – 464 s.

20 Opredeleniye ryboproduktivnosti rybokhozyaystvennykh vodoyemov i/ili ikh uchastkov, razrabotka biologicheskikh obos-novaniy predel'no dopustimykh ulovov ryby i drugikh vodnykh zhivotnykh, rezhimu i regulirovaniyu rybolovstva na rybokhozy-aystvennykh vodoyemakh mezhdunarodnogo, respublikanskogo znacheniy i vodoyemakh OOPT Aralo-Syrdarinskogo basseyna, a takzhe otsenka sostoyaniya rybnykh resursov na rezervnykh vo-doyemakh mestnogo znacheniya. Razd. Aral'skoye more i r. Syrdar'ya //Otchet o NIR NPTSRKH. – Kyzylorda, 2019. – 175 s.

21 Philip Micklin, Nikolai V. Aladin, Tetsuro Chida, Nikolaus Boroffka, Igor S. Plotnikov, Sergey Krivonogov and Kristopher White The Aral Sea: A Story of Devastation and Partial Recovery of a Large Lake// Springer Water. – Russia.2020.-109-112pp.

22 Perez-Rodriguez A., Morgan J., Koen-Alonso M., Saborido-Rey F Disentangling genetic change from phenotypic re-sponse in reproductive parameters of Flemish Cap cod Gadus morhua. Fisheries Research.Volume.138 (2013):62-70. https://doi.org/10.1016/j.fishres.2012.09.004.

23 Ppavdin I.F. Pukovodctvo po izucheniyu pyb (preimushchestvenno presnovodnykh). – 4-ye izd. – M.: Pishchevaya pro-myshlennost', 1966. – 374 c.

24 Sambayev N. S. Priyemnaya yemkost' Aral'skogo Malogo morya i potentsial'nyye ob"yemy iskusstvennogo vosproizvod-stva karpovymi vidami ryb // Vektor GeoNauk.2019 2(4).-s.29. DOI: 10.24411/2619-0761-2019-10043.

25 Shul'man S.S. Opredelitel' parazitov presnovodnykh ryb fauny SSSR. – Leningrad, 1984. – T. I. – 428 s.