Introduction of Fish and Other Aquatic Organisms in Water Bodies of the Republic Of Kazakhstan

Y. Kulikov

S. Assylbekova

K. Isbekov

Kazakh Research Institute of Fisheries
Suyunbaya Str. 89 A
Almaty, 050016
Republic of Kazakhstan

Abstract

This article describes the global and Kazakhstan experience of introduction of hydrobionts in fishery ponds. Conclusions about the main reasons for the success and failure of introductions are made. It is shown that for the success of acclimatization requires fodder for introduced species, repeated introductions. Also recommendations for follow-up work on the introduction and reintroduction of fish and aquatic invertebrates are made.

1 Introduction

Reservoirs of Central Asian countries inhabited diverse and unique fish fauna (150 species of fish and 15 species of amphibians). Maximum grade fish species diversity is observed in Kazakhstan (117 species). In XX century hydro fauna almost all fishing ponds Kazakhstan has fundamentally changed as a result of acclimatization. Practice shows, the introduction of fish and invertebrates is one of the most important measures to increase commercial productivity of ponds and qualitative improvement of their resource base. In many cases, acclimatization ended successfully. The introduction (acclimatization) of aquatic organisms contributes to: a) improve the formulation and stern fishing flora and fauna reservoirs; b) towards the formation and reconstruction of their populations; c) the conservation of species or the expansion of their range; d) fuller use of food reserves of the reservoir and the destruction of invaluable and harmful.

Implementing measures for the introduction of fish and other aquatic organisms will enable to increase the number of water bodies with valuable species of fish, increase commercial stocks of fish. Work on the reintroduction of rare and endangered species of fish to its native ponds in order to restore their strength – one of the main measures for the conservation of biodiversity. This ensures compliance with the requirements and obligations of Kazakhstan in the context of the requirements of the International «Convention on Biological Diversity», which has been ratified by the Republic of Kazakhstan [1]. In developing plans for acclimatization work on any body of water is necessary to very carefully analyze your goals and objectives, as well as the possibility of, and successful completion of these works. For different types of reservoirs, they can be different, and here it is necessary to take into account many parameters, and most importantly, the consequences not only for the body of water, but also for the whole basin, which owns the pond.

2 Literature review

The first substantiated the need for work on the acclimatization of fish Meisner [2]. However, he believed that acclimatization is an element of fish farming biological reclamation, greatly affects the ecological and fisheries management processes in the pond at installation of a new kind. Subsequently B.I. Cherfas classified acclimatization as indigenous ameliorative effect on the fauna of the pond. Biological process of acclimatization of aquatic organisms depends on the types of properties and acclimatized environment, which individuals and populations of invasive species are closely related. Theory and practice of acclimatization of fish in the waters of the former Soviet Union is reflected in the works of A.F. Karpevich, E.V. Burmakina [3, 4, 5, and 6].

Many of the issues discussed, including in the work of other scientists [7, 8, 9, and 10], so conclusive that is currently perceived as an axiom of acclimatization. At the same time in the waters of Kazakhstan revealed a specificity of acclimatization of fish [10, 11, and 12]. Selection of objects is the most important in the acclimatization. In it, there are three main tasks [4]:

- Select an object of acclimatization, and not primarily due to its economic value, and in terms of its relationship to a particular taxonomic group, and given the fact that the modern taxonomy of fish is built on a phylogenetic basis;
- Determination of the initial population of the selected object of acclimatization;
- Choice of the age of the implanting material and its quantity.

To determine how many individuals need to infuse to create a self-reproducing population is important determination of the effective population size to provide the necessary genetic diversity [13]. How many individuals is necessary in order to maintain the genetic diversity of the population? Franklin [14] showed that 50 individuals can be considered as the minimum amount required maintaining genetic diversity. This figure is based on the practical experience of breeders of animals, which shows that the group of selected animals should be increased after the loss of 2-3% of the variability of generation. According to the formula of Wright, a population of 50 individuals will lose only 1% of the generation of diversity, so that this figure could be starting in the selection. However, since the estimate is based on Franklin's work with pets, the possibility of its use for a wide range of wildlife species is not indisputable. Using data on the rate of mutations in the fruit fly Drosophila, Franklin [14] suggested that in a population of 500 individuals the rate of occurrence of new genetic variability through mutation can compensate for the loss volatility caused by the small size of the population. This range of values was formulated as the "50/500 rule": isolated populations to maintain genetic variability needed for at least 50 individuals, more preferably – 500 individuals. Since the rate of loss of genetic diversity depends on the effective size of the population, the loss of genetic diversity may be more rapid than that which can be assumed, based on the size of the actual population [15]. Review of a large number of research results in wild nature showed that the effective size of the population on average only 11% of its total population.

The population of 300 animals, it would seem, is large enough to sustain the population, may have an effective size of only 33 individuals, indicating that hanging over her grave danger of losing genetic variation and extinction [16]. These results show that the storage of large populations cannot prevent the loss of genetic variability, if only the effective population size also will not be sufficiently large. Reintroduction envisages issue of born in captivity or captured in the nature individuals in the area of their historic range, where this species is no longer found. The main task of the reintroduction program – to create a new population in its natural habitat. Analysis of available data [17-20] suggests that the success of acclimatization to a certain extent depends on the systematic position of introduced species. The available literature data indicate that acclimatization sturgeon, herring, salmon and whitefish accompanied by a significant number of failures. At sturgeon gave positive results only spike [21, 22], in herring – herring, salmon – rainbow trout [23]. There is no reliable data on the formation where whatever self-reproducing populations of whitefish introduced. It is different with the family Cyprinidae. Of the more than 20 species recorded setback suffered only three [24]. In most cases, the introduction of carp fish was successful. Currently, states are taken unprecedented measures to conserve those species that reduce their numbers or are already under threat of extinction. In addition to creating special protected areas for their protection, one of the most important measures is the reintroduction of rare species in their native habitats.

In his seminal work Shaffer [25] identified the need for the survival of the species number of individuals as the minimum viable population «minimum viable population of the species in a given habitat – is the smallest isolated population having a 99% chance of surviving for 1000 years, in spite of the projected impacts demographic, environmental and random genetic accidents». In other words, the minimum viable population – the smallest population, suspected of having a chance to keep high in the foreseeable future. Shaffer emphasized this tentative definition, indicating that the probability of survival can be set, and 95 and 99%, or whatever, but the time frame may be, for example, 100 years or 500 years. Important in determining the minimum viable population is that it allows quantifying how many individuals is necessary for the preservation of the species. A detailed analysis of 198 rehabilitation programs for birds and mammals, executed between 1973 and 1986, led to a number of important generalizations [13].

It has been documented that the success of the establishment of new populations above: for commercial species (86%) than for other species threatened with extinction (44%); when issuing a habitat of high quality (84%) than low quality (38%); near historical range (78%) than in the periphery or outside (48%); for captured in nature (75%) than for the captive-bred animals (38%); herbivores (77%) than for predators (48%).

3 Results of introduction in Kazakhstan

Ural-Caspian basin

The natural fish fauna of the basin consisted of 33 species, most of which (63%) –fishing. From 1955 to 1966 there have been attempts of introduction of herbivorous fish – grass carp and silver carp. Introduction held of different ages fish (857 pieces of grass carp and silver carp 900 pieces) and larvae (5 million pieces of grass carp). The result of these introductions is unknown. There remains the probability of the existence of those not numerous spawning fish species in the Ural River. In 1958-1962 years it were attempts to resettlement in the lake Chelkar stellate sturgeon by larvae (65 thousand units) and Russian sturgeon (59 thousand units) in order to increase the survival of fry and increased replenishment of sturgeon. In recent years there has been a systematic stocking of the Ural River sturgeon fingerlings to enhance replenishment of fishery resources. Evaluating the effectiveness of stocking is not carried out, so the results of these activities are largely unknown.

Aral-Syrdarya basin

The natural fish fauna of the pool consisted of 34 species, most of which (65%) – fishing. The basis of the catch made up of three species: roach, carp and bream. In the period 1929-1953 in the Aral Sea basin is infused in order to introduce a new object of the North Caspian shad and sturgeon. Introduction carried by larvae (8,08 million pieces shad, 330 000 – stellate sturgeon), larvae and fry (12-20 million units stellate sturgeon), sexually matures (90 pieces stellate sturgeon). Events of this period failed. In the period 1953-1963 was slightly changed direction of acclimatization: along with the introduction of the new object (Baltic herring, mullet, golden mullet) task was to restore (Amudarya trout) or recharge (the spike) herds of native fish species. Introduction carried by caviar (32 million pieces of herring), the larvae (19, 44 million pieces of herring, 2,7 million of spike), young (961-1944 thousand pieces of mullet) and fish of different ages (2039 pieces of trout). Events of this period had a positive effect with regard to Baltic herring. In the period from 1962 to 1970 inspires grass carp, silver carp, sturgeon, thorn. The introduction of this period carried by caviar (5 195 000 pieces of tongue and stellate sturgeon), fingerlings (over 3 246 000 pieces of grass carp). Events of this period had a positive effect: grass carp and silver carp have formed a self-reproducing herd. A negative result of the period was entering in the pool a large number of new unplanned invasive (Hemiculter lucidus, Pseudorasbora parva, Pseudogobio rivularis, etc.). In the period 1979-1987 acclimatization in the pool was reduced to attempts to introduce a new kind of fish in the degrading Aral Sea (flounder). Events of this period had a positive effect: flounder formed a self-reproducing population in the Aral Sea, and currently has a commercial value in the North Aral Sea.

Balkhash-Alakol basin

In the Balkhash-Alakol basin main reservoirs are Lake Balkhash, the Ili River, Alakol system of lakes, Kapshagai reservoir. The most important in relation to the fishing pond – Lake Balkhash, giving at present about 15% of the total fish catch in the Republic. In the extremely poor (5-6 species) lake ecosystem in a relatively short period it was instilled 22 species of fish, thus significantly increase the commercial catch. Acclimatization feeding invertebrates was necessary in order to ensure that exotic species familiar to them nutritional conditions and facilities. Fish fauna of the lake now includes 29 species, of which 21 are acclimatized, 9 aboriginal. Alakol lakes (Alakol, Sasykkol, Koshkarkol) differed extreme poverty in species. Of economically valuable species are historically occurred only 6 species, of which the greatest significance for the development of the fishing had Schizothorax argentatus (Ili and Balkhash subspecies) and Balkhash perch. In the period 1930-1935 were carried out attempt to acclimatize in the Aral barbel, tongue and whitefish. These were one-off measures aimed at introducing a new kind of value species in water ponds. Introduction of mature individuals was carried out (290 pieces of the spike), fish of different ages (18 483 pieces of the Aral barbel) and eggs (27584-40534 thousand eggs whitefish and whitefish-ludogi). Aral barbel and tenon (Acipenser nudiventris) formed self-reproducing herds in the pool.

In the period of 1948-1961 years the pool inspires tench, bream, silver carp, and pike and Coregonus albula ladogensis. All the events of this period were aimed at the introduction of new species of economic value in the water.

Events of this period had a positive effect: tench, bream, goldfish and pike-perch have formed self-reproducing herds in the pool. Another positive point is the formation of a significant commercial stock of bream and pike-perch. The disadvantage in these activities was the failure to acclimatization whitefish. Another negative aspect to be considered from entering the pool unplanned invasive – asp, catfish and bersh. Despite the fact that these species have taken root in the pool and now form a significant fishery, their introduction into the ecosystem was not planned. In the period of 1963-1970 years the pool is infused rainbow trout, Coregonus peled, grass carp, silver carp and roach.

All the events of this period were aimed at the introduction of new species of economic value in the water. Stocking of fish of different ages was carried out (1871 thousand pieces of grass carp, 825 – silver carp, 120 thousand – roach), fry (15 thousand pieces of rainbow trout), larvae (310 thousand pieces of rainbow trout and 8, 7 million – peled). Events of this period had a positive effect: rainbow trout, roach and carp formed self-reproducing herds in the pool. Another positive point is the formation of a significant commercial stock of roach. In the period of 1970-1980 years ıntroduced into the pool: peled, gegharkuni trout and Parasalmo mykiss. Stocking conducted by larvae (1,6 million peled and 1,3 million gegharkuni trout) and fingerlings (5 thousand pieces of mykiss). The disadvantage in these activities was another setback to the stocking peled, failure to stocking rainbow trout and gegharkuni in Kapshagai reservoir. Another negative point is the inefficiency of stocking carp in terms of creating self-reproducing herd, and from the point of view of getting tangible commercial return. In the period of 1981-1990 years all work on stocking in the pool were focused on Kapshagai reservoir. During this period, it instills buffalo, carp, grass carp and silver carp (based on the commercial return), bream (to increase the number). Stocking conducted fingerlings (6,53 million pieces of carp, 250 thousand – buffalo, 329 000 – grass carp), two-year fishes (306 thousand pieces of carp, 10 000 grass carp), fry (1 387 000 pieces of carp) and fish of different ages (51 580 pieces of bream). Events of this period had a positive effect in terms of creating self-reproducing herds of carp.

Zaisan-Irtysh basin

The natural fish fauna of the area ponds consisted of 25 species, most of which (15 species) – fishing. In the history of acclimatization of the field is clearly distinguished 4 periods, which differ in the number and orientation of acclimatization. In the period 1934 - 1958 in the reservoirs in order to introduce a new economic value of the object inspires carp, bream and pike (zander), and introduction was carried out only by the mature (2273 pieces carp, 15868 bream, 1300-1500 zander). All works of this period had a positive effect: self-reproducing herd formed with great commercial importance. Bream, zander and carp gradually penetrated into downstream waters of the pool. In the period 1959-1985 introduced ripus (Coregonus albula ladogensis), Baikal omul, peled, whitefish, Schizothorax argentatus, rainbow trout, grass carp and silver carp; to accelerate the formation of stocks – bream and zander. Introduction carried by caviar (5 million units of ripus, 21 million units of Baikal omul), larvae (13,9 million pieces of Baikal omul, 13.1 million units of peled, 1,8 million pieces of grass carp), fingerlings (14,85 million pieces of grass carp), yearlings (10 thousand pieces of rainbow trout), young (7,1 million pieces of carp), fish of different ages (17 thousand pieces of zander, 11,395 thousand pieces of bream) and mature (38,3 thousand pieces of bream). Events of this period had a positive effect: self-perpetuating flock formed ripus having commercial value, bream and perch were the main commercial fish in the pool. The negative side of the work is a failure with acclimatization of Schizothorax argentatus and rainbow trout; low efficiency of stocking peled, grass carp and silver carp.

In the period of 1982-1991 years further attempts of invasion ripus and peled made. Introduction carried by larvae (177 million units). A positive effect was obtained by stocking ripus, there was virtually no effect from peled. Currently peled occurs sporadically in catches; ripus catch is 50-150 tons annually. In 1960-1970's commercial fish stocks in inland waters were formed in Kazakhstan, mainly influenced by two factors: the acclimatization of valuable fish species and the construction of hydroelectric power plants. As a result of acclimatization of species such as bream, carp, zander, chub, ripus significantly increased productivity of the poor starting in species reservoirs: Lake Balkhash, Alakol, Zaisan. Results for fisheries should recognize as positive. On the other hand, the construction of dams and changes in the hydrology of the rivers led to a decrease in spawning areas and an increase in salinity end reservoirs (Aral, Balkhash, Irtysh River floodplain), which has a negative impact on productivity and catch. It is believed that the acclimatization of invertebrates feed in natural waters increases their productivity of 30%. Especially important is the introduction of feed for fish organisms in the newly created water bodies (reservoirs) with a change in flow from reservoirs on the river with the type, as well as in the case of the introduction of the purpose of acclimatization of fish in those waters, where they have no natural fodder.

In the Caspian Sea successfully acclimatized worm Nereis, sindesmiya and shellfish, which are food for bottom-dwelling fish and especially sturgeon. To improve forage fish, increasing the productivity of the Caspian Sea for the first time in 1939 from the Azov Sea to the Caspian Sea has been delivered 50 thousand pieces of annelids Hediste diversicolor. In 1944, the species was found in the stomachs of sturgeon. Acclimatized views spread widely across the Caspian Sea and is one of the few examples where instills acclimatized occupied a free niche and become the object of high-calorie food available all benthic fishes. Shellfish Abra ovata acclimatized in the Caspian Sea at the second attempt in 1947. In 1955, it had reached a biomass of 300 g / m2, with the number of 7000 copies per m2. Successful acclimatization of Abra ovata significantly enriched food base benthic fishes of the Caspian Sea.

Due to the thin shell, high nutritional value, availability, abundance and biomass of large clam took a leading role in the diet of fish. However, along with a large number of published studies that confirms the usefulness of these species, by means of which increase the productivity of the Caspian Sea, there was a contrary view, proves the negative impact of invasive species on the development of aboriginal benthic fauna. Significantly increased food capacity of the Buhtarma reservoir after the invasion of mysids and Baikal gammarids. For mysids in the deep part of the reservoir gradually dominant in numbers and biomass. They constitute a significant share of power whitefish species, pike-perch fingerlings. The diet of bream from the mountainous part of the reservoir acclimatized up to 20%. Earliest feeding invertebrates did not cause damage to native benthic fauna and allowed to some extent increase the biological productivity of the reservoir. In the early 1960s, in the Aral Sea from Azov sea inspired nereid worms and sindesmy molluscs.

All of these invertebrates are now the main targets of forage fish. To improve forage Lake Balkhash in 1958 mysid shrimp caught in the delta of the Don River, and released them to the West Lake Balkhash. Then, in 1962, also from the delta of the Don, brought korofiidy. By 1964 mysid spread over the eastern half of Lake Balkhash. At the same time, experiments were conducted on the acclimatization of the clam Monodacna colorata, which resulted in the introduction of the mollusk from the delta of the Don River into Lake Balkhash. By the 1970s, the mollusk has become a leading body in the bottom biocenosis Lake Balkhash. Keep in mind that the introduction is not only planned. Together with planned invasive species into waters inhabit unplanned. Most unplanned invasive species are undesirable in ponds. Creating a significant number, they tend not mastered craft and create competition for the consumption of food resources of the reservoir fishery species.

4 Discussions

Currently, the need for a radical revision of approaches to acclimatization and stocking is dictated by the following main points: all the major reservoirs of Kazakhstan become cross-border; Kazakhstan signed the Convention on Biological Diversity; there have been dramatic changes in the economy, requiring the rejection of the extensive use of intensive technologies; exacerbated environmental problems, in particular, with the tension of water resources in Zaisan-Irtysh, Balkhash-Alakol basin, pollution. It is proposed to focus on the introduction of the activities on the following main areas: stabilization of the number of fish species to manage their inventory in large reservoirs; providing valuable fish species forage resources through the introduction of food organisms; an increase in the number of rare and endangered species to the economic importance for the conservation of the gene pool in accordance with the principles of the Convention on Biological Diversity. Table 1 discussed the number and success of planned introductions of fish species in the major fishery water bodies of Kazakhstan. Table 2 provides the same for invertebrates – food organisms for fish.

Table 1: The number and success of planned introductions of fish species in the major fishery water bodies of Kazakhstan

Basin	Zaisan-Irtysh	Aral-Syrdarya	Balkhash-Alakol
Number of fish introductions	21	21	37
Successful	7	9	14
Successful from the total number,%	33	43	38

Table 2: The number and success of planned introductions invertebrates in major fishery water bodies of Kazakhstan

Basin	Zaisan-Irtysh	Aral-Syrdarya	Ural-Caspian	Balkhash-Alakol
Number of invertebrates introductions	3	3	4	7
Successful	3	3	5	13
Successful from the total number,%	100	100	80	54

As can be seen from the tables, successful introductions of fish (which led to the naturalization in the reservoirs) were 30-40%, while the success of the introduction of invertebrates ranged from 50 to 100%. This shows a high degree of survival of invertebrates and their adaptation to the hydrochemical conditions of the recipient water bodies. The experience of the introduction of fish in the ponds of Kazakhstan showed that the success of the introduction depends on whether there is to instal species of fish suitable food base.

Thus, in Zaisan-Irtysh basin in 1959 was introduced ripus and in 1963-1974 years peled, but it's did not take root in water bodies due to lack of the necessary forage for them. Only once in Bukhtarma reservoir were successfully acclimatized mysids, repeated introduction of ripus in 1982-1991 yielded results in the form of the creation of a self-reproducing herd fishing. The success of acclimatization pikeperch (zander) in many reservoirs is also linked to the fact that he had a suitable forage base – stocks of small pelagic fish (roach, perch). Therefore, when planning the introduction of valuable species of fish, it is necessary for them to find out the specific demands of their food base. In her absence, you must create it by pre-invasion of suitable prey. The experience of the introduction of fish in the ponds of Kazakhstan also revealed that almost no cases where the introduced species survive in the pond in case of a single predicted. In the vast majority of cases it required an annual introduction for 3 to 10 years. Plan for the future introduction, consider this fact. In 2012, in the Black Irtysh rivers were released Siberian sturgeon fingerlings. In August 2012 in the scientific netting catches recorded Siberian sturgeon, body length was 35 cm and weight of 624 g, and in 2013 on the river Black Irtysh was marked Siberian sturgeon with a body length of 59 cm, weight 860 g. This suggests that sturgeon in a pond can be reintroduced.

However, the practice of introductions indicates that the only introduction is almost always doomed to failure. We need to continue work on the reintroduction of the Siberian sturgeon by planned introductions for several contiguous calendar years. Currently alarming upcoming low water period in the basin of Lake Balkhash in the background of a possible water intake from the river on the territory of China expected substantial reduction in surface flow of the rivers. As a result, there will a gradual lowering of the water body and the inevitable increase in water salinity. This focus has led to the need to continue work on the enrichment of forage fish East Lake Balkhash forms more resistant to higher salinity than the local freshwater species. In 2012, the Balkhash branch of the Kazakh Research Institute of Fisheries (KazNIIRH) for the purpose of replenishing the species composition of zoobenthos was designed themes and program of experimental research works on acclimatization (introduction) into the pond euryhaline invertebrates of the Aral Sea: polychaete Nereis diversicolor and bivalve Abra ovata. On the basis of experimental work in 2012-2014, we can say that the polychaete showed a very good survival in the water East Balkhash. Their survival in the water of East Balkhash was 80% [26]. The increase in commercial fish fauna in the Small Aral Sea enhances food competition. Changes in environmental conditions with an increase in runoff of the Syrdarya violated established over a period of heightened salinity stable structure of benthic fauna of the sea, provided mainly euryhaline species of marine origin. To enrich the forage fish of the North Aral Sea, which are mainly benthophages, it is advisable to recommend the following measures:

- Introduction of two species of crustaceans and mollusks one species from lakes, where the level of salinity of the water does not exceed the optimum: Dikerogammarus aralensis and molluscs Dreissena polymorpha.
- When carrying out preliminary development work on survival in the Aral Sea water of different salinity, later, with the stabilization of the level of the North Sea, possible universes hooded crustaceans from Lake Balkhash.

Preservation of the gene pool of valuable species such as the Aral thorn (Acipenser nudiventris) is exceptional necessity, require urgent measures to preserve and increase their numbers. In this case, a practical solution to this problem is possible only by removing the minimum number of producers from natural habitat, followed by artificial reproduction of fish farms and the reintroduction of juveniles produced in the reducing environment of the North Aral Sea and other waters of the Aral-Syrdarya and the Balkhash basin. Artificial reproduction in the conditions of fish farms can be a real opportunity for biodiversity conservation and to increase the stocks of this species in the Aral-Syrdarya basin.

The lake Zaisan existing stocks of benthic invertebrates do not fully meet the nutritional needs of the fish. Thus, large bream occasionally feed on zooplankton, which suggests a lack of benthic food. In this regard, in order to enrich forage fish and increase biodiversity, it is suggested to acclimatise in the lake mollusc Monodacna colorata.

This mollusc has a relatively middle-sized dimensions, a "soft" shell and eaten by fish-benthophagous such as carp and bream. In Bukhtarma reservoir almost 100% of the biomass of mollusks produce types with a very hard shell: Lithoglyphus naticoides, Unio pictorum, Anodonta piscinalis and Viviparus viviparus, which are virtually consumed fish (except for large carp). In this regard, it is proposed to establish in lakes and rivers of the mollusc Monodacna colorata. At the present time to increase the food capacity zoobenthos proposed immigration into the lake Alakol Sasykkol and Koshkarkol previously studied polychaete H. invalida, H. kowalewskii and N. diversicolor, which has recently been settled in different regions of the reservoirs. In contrast, chironomids and oligochaetes, polychaetes live in the surface layer of mud, which makes them more accessible to fish-benthophagous.

With regard to the zooplankton, the level of which is low in Alakol lakes are invited to fill it up, it is necessary to dwell in all the lakes of copepod Calanipeda aquaedulcis, amphipod *Dikerogammarus haemobaphes*. In Kapshagay reservoir proposed to increase forage for benthos worms, polychaetes or amfaretid possible and crustaceans korofiid. It is possible and enriching plankton fauna of reservoirs by crustaceans kalyaniped. Thus, the period of large-scale introductions of new species of fish in the ponds is over. Currently being developed for the introduction of food invertebrates, as well as the reintroduction of rare native species of fish (Siberian sturgeon, Aral barbel, Aral thorn) in their native habitats.

5 Conclusions

A) In the XX century fauna almost all fishing waters in Kazakhstan has been radically altered as a result of acclimatization. In many cases, acclimatization ended successfully.

B) The period of large-scale introductions of new species of fish in the ponds was over. Currently being developed for the introduction of feed invertebrates to fishing ponds, and reintroduction of rare native species of fish (Siberian sturgeon, Aral barbel, Aral thorn) in their native habitats.

C) Developing plans for acclimatization on any body of water should be very carefully analyze your goals and objectives, as well as the feasibility and the successful completion of these works. For different types of reservoirs, they can be different, and here it is necessary to take into account many parameters, and most importantly, the consequences not only for the body of water, but also for the whole basin, which owns the pond.

D) The success of introductions of fish (which led to the naturalization in the reservoirs) in Kazakhstan amounted to 30-40%, while the success of the introduction of invertebrates ranged from 50 to 100%. This shows a high degree of survival of invertebrates and their adaptation to the hydrochemical conditions of the recipient water bodies.

E) The experience of the introduction of fish in the ponds of Kazakhstan showed that the success of the introduction depends on whether there is to instal species of fish suitable food base. Therefore, when planning the introduction of valuable species of fish, it is necessary for them to find out the specific demands of their food base. In her absence, you must create it by pre-invasion of suitable prey.

F) The experience of the introduction of fish in the ponds of Kazakhstan also revealed that almost no cases where the introduced species survive in the pond in case of a single predicted. In the vast majority of cases it required an annual introduction for 3 to 10 years. Plan for the future introduction, consider this fact.

6 References

Convention on Biological Diversity, Text and annexes. 1994. UNEP/CBD/94/1, Switzerland. UNEP International Technical Guidelines for Safety in Biotechnology. circa 1996. Nairobi, Kenya, UNEP.

Мейснер В.И. Основы рыбного хозяйства: Введение в изучение рыбоведения и в постановку рационального рыболовства. – М.: Науч. ин-т рыбного хоз-ва. – 1925. – Вып. 1. – 106 с.

Карпевич А.Ф. Итоги и перспективы работ по акклиматизации рыб и беспозвоночных в южных морях СССР // Акклиматизация рыб и беспозвоночных в водоемах СССР. – М.: Наука, 1968. – С. 50-68.

Карпевич А.Ф. Теория и практика акклиматизации водных организмов. – М.: Пищевая промышленность, 1975. – 432 с.

Карпевич А.Ф. Формирование популяций рыб-акклиматизантов // Динамика численности промысловых рыб. – М., 1986. – С. 42-54.

Бурмакин Е.В. Акклиматизация пресноводных рыб в СССР // Изв. ГосНИОРХ, – 1963. – Т.53. – 318 с.

Горюнова А.Н., Серов Н.П. Акклиматизация рыб в Казахстане // Труды совещания по акклиматизации рыб и кормовых беспозвоночных. – Алма-Ата, 1954. – С. 109-114.

Митрофанов В.Л. Взаимоотношения хищных рыб и их влияние на виды мирных рыб // Биологические основы рыбного хозяйства Средней Азии и Казахстана. Алма-Ата. – 1970, - С. 81-85.

Диканский В. Я., Пивнев И. А. Результаты акклиматизации судака в оз. Балхаш. - В кн.: Биологические процессы в морских и континентальных водоемахмах, Кишинев. – 1970, - С. 145-154.

Рыбы Казахстана. В 5-ти т. Т. 5: Акклиматизация, промысел / АН Респ. Казахстан. Ин-т зоологии. - Алма-Ата: Гылым, - 1992, - 464 с.

Попова С.А. Динамика линейного и весового роста балхашской маринки // Рыбные ресурсы водоемов Казахстана и их использование. - Алма-Ата, 1974. Вып. 8. – С. 135-136.

Попова С.А., Тленбеков О.К., Цой Л.С., Смирнова К.В. Мероприятия по повышению рыбопродуктивности оз. Балхаш в период зарегулирования стока р. Или // Рыбные ресурсы водоемов Казахстана и их использование. - Алма-Ата, 1974. Вып. 8. – С. 137-142.

Primack, R. B. A Primer of Conservation Biology, Second Edition. Sinauer Associates. Sunderland, MA. 2000 – 319 p.

Franklin, I. R. Evolutionary change in small populations. In Conservation biology: an evolutionary-ecological perspective//Soulé, M. E. & Wilcox, B. A. (Eds). Sunderland, MA: Sinauer, 1980. – P. 135-150.

Nunney L., and D. R. Elam. Estimating the effective size of conserved populations// Conser. Biol. 8, 1994. – P. 175–184.

Frankham, R. Do island populations have less genetic variation than mainland populations// Heredity 78, 1996. – P. 311–327.

Асылбекова С.Ж. Изменение ихтиоценозов озера Балхаш в результате акклиматизации хищных видов рыб//Автореферат дисс. на соиск. уч. ст. канд. биол. наук. – Балхаш, 2006. – 21 с.

Городилов Ю.Н. К вопросу о стратегии работ по интродукции тихоокеанских лососей в морях европейской части России // Вопросы рыболовства. - 2002. - 2,№4(8). - С. 604-619.

Пашков А. Н., Плотников Г.К., Шутов И.В. Новые данные о составе и распространении видов-акклиматизантов в ихтиоценозах континентальных водоемов Северо-Западного Кавказа // Известия высших учебных заведений. Северо- Кавказский регион. Естественные науки. Приложение.-2004. - № 1. - С. 46-52.

Воробьева Н.Б., Фролова Л.И. Акклиматизация сиговых в озерах Северного Казахстана // Рыбное хозяйство, - 1976, - № 9, - С. 17–20.

Печникова Н.В. Изменение морфологии шипа (Acipenser nudiventris) Аральского моря и озера Балхаш в связи с акклиматизацией рыб и кормовых животных // Зоологический журнал, - 1970, - 49, №1, - С. 96-105.

Печникова Н.В. Результаты акклиматизации аральского шипа (Acipenser nudiventris lov.) в озере Балхаш // Вопросы ихтиологии, - 1964, - 4, №1(30), - С. 142-151.

Строганова Н.З. Результаты и проблемы акклиматизации гидробионтов // Рыбоводство и рыболовство. - 1994. - №3. - С.10-12.

Болтачев А.Р., Г.В. Зуев. Состав и экологическая структура ихтиофауны лимана Донузлав (северо-западный Крым) // Вопросы ихтиологии. - 1999. - №1. - С. 57-64.

Shaffer M.L. Minimum Population Sizes for Species Conservation/ BioScience, 1981. - Vol. 31, No. 2. – pp. 131-134.

Анурьева А.Н., Цой В.Н. Обогащение кормовой базы рыб необходимое условие повышения рыбопродуктивности озера Балхаш//Вестник Астраханского государственного технического университета. Серия: Рыбное хозяйство. – Выпуск № 3, 2014. С. 7-18.