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STATE OF NATURAL FEEDING BASE OF FISH-BREEDING PONDS BY BREEDING OF FINGERLINGSOF THE PIKEPERCH

Abstract. Thepurpose of this work was a determination of the level and the dynamic ofdevelopment the phytoplankton and zooplanktonin experimental ponds which were used for breeding the fingerlingsof pikeperch in polyculture with common carp and plant-eating carps. An importance of studying the level and the dynamic of development the phytoplankton and zooplankton in ponds which were used for breeding the fingerlingsof pikeperch in polyculture with common carp and plant-eating carps is substantiated. The methods of studying the level and the dynamic ofdevelopment the phytoplankton and zooplanktonin experimental ponds are presented. The level of phytoplankton and zooplanktonin experimental ponds in which was hold breeding the one-years of pikeperch from the fingerlings,is shown. The composition of species, the level of development of phytoplankton and zooplanktonin experimental ponds in different years of researchesis shown. The dynamics of the level of development of phyto-plankton and zooplanktonin some months of the determined year of holding the researchesis shown. The fact that holding of measures according to the stimulation of development the natural feeding base which are the using the fertilizers etc. is influencing for increasing the biomass of organisms of zooplankton especially in the end of fish-breeding season, is shown. The conclusions in which presented the dynamic of development of phytoplankton and zooplankton of experimental ponds in different months of the year are given. The importance of hydrobiological researches by breeding the one-years of pikeperch in fish-breeding ponds is shown. The recommendations according to the results of researches the dynamic and biomass of phytoplankton and zooplankton are given. The period of fish-breeding season in which holding the works according to the maintenance of biomass of phytoplankton and zooplankton in fish-breeding ponds which are using for the breeding of one-years of pikeperch is recommended.

Keywords: phytoplankton, zooplankton, dynamicof development, fish breeding in ponds, one-years, pike-perch.

Introduction. Currently, with the renovation of aquaculture as an industry in Kazakhstan, one of the ways to develop fish-breeding enterprises, in particular pond farms, is the development of fish seeds production for the needs of aquaculture with the aim of stocking natural reservoirs for the reproduction of commercial populations, and also for growing commodity fish production.

One of the technological parameters in pond fish farming is the biomass of phyto, zooplankton and macrozoobenthos by the cultivation of fish during the seasonof cultivation, on the basis of which it is possible to obtain indirect information on the pond's nutrition, which allows to optimally plan the measures to increase productivity, usually, up to a certain limit, with no additional expenses of feed. This increases the economic efficiency of pond farming.

One of the new objects of aquaculture of Kazakhstan is the pikeperch. The high taste qualities of this fish make it possible to export a significant part of the fillets to Europe. At the same time, the repro-duction of stocks of pikeperch in reservoirs of the country is particular urgency. Studies of LLP "Kazakh Science Research Institute of Fisheries" have shown the possibility of cultivation the pikeperch in carp ponds in polyculture with two-years of carp and the herbivorous fish.

The state of the natural forage of ponds during the cultivation of pike perch is the great scientific and practical interest.

Material and methods

According to materials obtained by the farmers of Hungary, phytoplankton and zooplankton are most great important for the fingerlings of pikeperch. The development of phytoplankton contributes to the increase of the biomass of the smallest zooplankton (Rotatoria), and then of largest forms of forage planktonic crustaceans (Cladocera, Copepoda) [1].

The materials for research were the compositionof species, abundance and biomass of phytoplankton and zooplankton in experimental ponds used for growing the pikeperch in a polyculture with two-years ofcommon carp, grass carp and silver carp.

The research of the state of phytoplankton and zooplankton of experimental ponds was carried out using standard methods adopted in hydrobiological researches [2-5].

The state of the natural food supply of experimental ponds was compared with the growth of pikeperch and the level of fish productivity [1, 6-20].

Results and discussion

Phytoplankton. According to the results of processing of samples taken in experimental ponds in the spring-and-summer period of 2013-2014, 52 species of algae belonging to 6 divisions, among them: Cyanophyta - 10, diatoms - 23, green - 12, pyrophytic - 3, euglenic - 3, golden - 1 species. The following species of algae were dominant: *N.gregaria, Achnanthes sp., C. vulgaris, P. achromaticum, C. meneghiniana, E. cordata, P. achromaticum, Trachelomonas sp.* The minimum amount of algae occurs in ponds was in May. In summer, in June and July phytoplankton in the ponds developed more intensively.

Dynamics of biomassof phytoplankton in experimental ponds in the 2013-2014 seasons is presented in table 1.

Table 1 – Dynamics of quantitative development (biomass, g/m^3) of phytoplankton in experimental ponds in 2013-2014

Algae	2013				2014			
	May	June	July	August	May	June	July	August
Green algae	–	0,040	0,250	0,020	0,085	0,015	0,020	0,030
Cyanophyta	0,020	0,155	0,225	0,001	0,008	0,045	0,039	0,055
Diatomaceous	0,065	0,955	2,00	0,855	0,050	0,900	0,645	0,400
Euglenic	–	0,150	0,105	0,075	0,040	0,950	0,040	0,200
Pyrophytic	0,015	0,215	0,475	0,100	0,200	0,050	0,070	0,400
Golden	–	–	–	–	0,010	–	–	–
Average	0,100	1,515	3,055	1,051	0,393	1,960	0,814	1,085

In spring the phytoplankton poorly developed in two seasons. According to the terms of the phytoplankton biomass in May the ponds were classified as low-grade nutrition β-oligotrophic type.

According to the terms of biomass of phytoplankton in June ponds can be considered as reservoirs of a moderate class of nutrition α-mesotrophic type.

In July 2013, the ponds in terms of the biomass of algae corresponded like the medium-grade nutrition β-mesotrophic type.In July 2014, the ponds to the reservoir of the moderate grade nutrition were likeβ-mesotrophic type. In August ponds by the size of phytoplankton biomass could be considered as reservoirs of a moderate class nutrition α-mesotrophic type [5].

According to the "scale of trophy" byKitaevS.P.ponds in June in terms of phytoplankton biomass corresponded like the middle class of nutritious, the β-mesotrophic type. In July and August nutrition began to correspond to the moderate, and the type of reservoir wasα-mesotrophic [5].

The basis of phytoplankton biomass in June was like euglene algae (54.8%), in July was mostlyof diatoms (56.9%), and in August pyrophyticalgae (55.5%). The taxonomic list of algae selected in experimental ponds in 2015 numbered 62 species of algae belonging to 5 divisions. Among them: Cyanophyta - 14, diatoms - 22, green - 20, pyrophytic - 4, euglenic - 2. The dominant phytoplankton complex is represented by the following species of algae: *N. gregaria, C. meneghiniana, A. ovalis, C. vulgaris,*

C. undulatum ,Trachelomona ssp., E. cordata. The smallest number of algal species was recorded in May-and-June and varied from 4 to 9 taxa. The taxonomic composition of algae varied from 13 to 21 taxa. In the spring the phytoplankton was developed poorly, the biomass was low and varied from 0.265 to 0.691 g/m^3.

The composition of dominant species varied during the summer period. So, in June pyrophyticalgae (56%) dominated in the reservoir, in July dominated the diatoms (34.4%), and in August – the blue-green algae (42%).

In June-July 2015, the biomass of phytoplankton (0.365-2.665 g/m^3) corresponded to a moderate class of nutritious, α-mesotrophic type. In June the basis of biomass was pyrophyte algae (71.4%), and in July - diatoms (35.7%). In August the level of water supply increased to the middle class, and the type of reservoir to β - mesotrophic type (when a number of biomass is 0.360-3.015 g/m^3). The fundament of phytoplankton at this time was diatoms (62%).

Zooplankton. According to the results of the hydrobiological survey in the period April-August of2013, the zooplankton of the experimental ponds is represented by 55 taxa from three main groups, where 26 taxa are rotifers, 16 cladoceraand 13 copepods. In addition to zooplankton organisms, a large number of facultative zooplankers have been found in the samples: ostracods, insect larvae, worms, hydra.

The greatest taxonomic diversity was found in the pond #3 - 43 taxa, 21 - rotifers, 12 - cladocera and 10 - copepods. In the pond #4, 31-16-9-6 taxa, respectively, were identified. The main background of the zooplankton community in both ponds was (33-45% of the occurrence for the spring-summer period) *S. pectinata, A. sieboldi, L. ungulate, E. d. dilatata, C. laticaudata, S. mucronata, Ch. sphaericus and M.leuckarti.* In the pond No.3 they were supplemented with *E. pyriformis, Br. q. melheni, D. macro-phthalma, P. Trigonellus, in pond No. 4 - C. reticulate, N. incongruens.*

In pond #4, the basis of abundance and biomass were the cladocera - 75.4% according to thenumber of specimens and 84.3% according to the biomass. Production indicators per m^3 in the pond began to grow from June to mid August, did not fall below 65.0 thousand individuals and 1.5 gper 1 m^3, reaching its peak in early July - 263.7 individuals and more than 9.0 grams per 1 m3, due to the mass development of the cladocera crustaceans of the genus Ceriodaphnia, whose share in the total indices was from 30 to 94 %.

In the pond #3 the basis of abundance was copepods - 41.6%, biomass in the pond formed a Cladocera - 48.2%. During the season, the largest production indicators were revealed in May, due to the massive development of large representatives of the Cladocera crustaceans D. galeata, S. vetulus, S. mucronata, and in the mid-period July-August, due to the development of large predatory rotifers of the genus *Asplanchna*, C laticaudata and younger age stages of copepods (nauplii and copepods).

Hydrobiological analysis of the natural forage reserve of experimental ponds in the 2012-2014 seasons showed that zooplankton is represented by 55 taxa from three main groups, where 26 taxa are rotifers, 16 cladoceraand 13 copepods. In addition to zooplankton, a large number of facultative zooplankers - ostracods, insect larvae, worms, hydra, were found in the samples.

The determining role in the plankton of all the ponds during the vegetation seasons belonged to the Cladocera crustaceans. Their stable dominance in the total mass of zooplankton in the experimental ponds was noted.

Analyzing dynamics of development ofzooplankton during the season in 2012-2014, in experimental ponds it is clear that after flooding of experimental ponds, the quantitative indices of zooplankter abundance and biomass were identically low and were within 19.04-39.76 thousand individuals/m^3 and 0.355-0.827 g/m^3, respectively.

The dynamics of quantitative indicators of zooplankton in experimental ponds in 2012-2014 is presented in table 2.

For increasing the level of the natural food supply in ponds, intensification measures were carried out, which stimulated the development of hydrobionts. The organic fertilizers (manure of cattle) were brought at the rate of 2 t / ha; inorganic (ammonium nitrate at the rate of 20 kg/ha, superphosphate - 10 kg/ha); sheaves of the dried up aquatic plants (reed, cattail); culture of daphnia (1 l / ha); fodder yeast (1 kg/ha).

The results obtained after stimulation indicate a general tendency for the growth of quantitative parameters, which reach their maximum in 2012-2014 in the first decade of May (129.1-246.6 thousand individuals/m^3 and 3.817-5.46 g/m^3, respectively). These indicators characterize the experimental ponds during this period, as highly nutritious ponds [5].

Table 2 – Dynamics of number and biomass of zooplankton in experimental ponds in 2012-2014

Date	2012		2013		2014	
	thousand individuas / m^3	g/m^3	thousand individuas / m^3	g/m^3	thousand individuas / m^3	g/m^3
14.04.	25,7	0,827	39,760	0,640	19,04	0,355
28.04.	89,5	1,738	10,90	0,126	29,860	1,485
15.05.	129,1	3,817	246,60	4,441	136,70	5,460
31.05.	101,0	1,864	65,970	1,763	63,50	2,189
14.06.	112,1	4,367	93,450	2,579	55,040	2,009
29.06.	129,1	3,817	87,920	3,071	53,0	1,962
15.07	155,5	2,163	84,511	2,823	31,68	1,660
30.07.	165,0	2,792	98,176	2,740	10,87	0,10
15.08.	76,5	1,349	17,10	0,382	8,80	0,069

On the parameters of quantitative zooplankton development in 2012 and 2013 in general, the level ofnutritious of ponds washigh. In the season of 2014, the dynamics of zooplankters development characterizes the ponds as medium nutritious level [5]. Probably the decrease in the quantitative indicators of plankton is associated with the increase in the ponds of carp individuals. In 2014, the density of carp seeds in polyculture with pike perch was 1000 pcs / ha. As we know, the zooplankton in yearlings of carp is the main diet during the first half of fish-breeding season.

At the end of the season, the nutrition of all the ponds in 2012-2014 decreased. According to the classification of feed, all the ponds during this period corresponded to low nutritious level [5].

According to the results of hydrobiological researches in the spring-and-summer period of 2015, zooplankton in ponds of the Chilik farm was represented by 66 taxa from three main groups, where 32 taxa are rotifers, 16 cladoceraand 18 copepods. The main population of the zooplankton in both ponds were*A. girodi, A. sieboldi, A. brightwelli, L. bulabula, Br. c. amphiceros, D. macrophthalma, C. reticulata, C. quadrangula, M. brachiata, S. mucronata, D. crassa, Ch. sphaericus, A. americanus* and *M. leuckarti* (57-100% of the occurrence in the spring-summer period).

If we consider by months, the largest number of species in the ponds was found in June-July, 46-44 taxa, respectively, the smallest in August - 22 species. Quantitative development of zooplankton in ponds is presented in table 3.

The basis of abundance and biomass in pond #3 generally were Cladocera crustaceans - 74.5 and 87.0% respectively. Throughout the growing season they prevailed in the community, but in the beginning of June rotifers became the dominant group, where predatory rotifers of the genus Asplanchna (42.7% abundance and 72.9% in biomass). During the season the highest production indicators were revealed in the period from mid of June to mid of July, with a peak in mid of July (14,929-12,369-21,369 g/m^3), when the biological productivity of the pond reached a very high great eutrophic-hypertrophic type due to a massive development of the cladocera crustaceans of the genus *Ceriodaphnia* (81.3-92.5-95% of the total biomass). In May, a large number of facultative plankton organisms were noted in the samples, where ostracods were most important, their share in the total biomass was about 26.0%.

The basis of abundance and biomass in the pond #4 was Cladocera crustaceans - 92.1 and 96.8% respectively. The highest biomass indicators were detected in June - 22,121-22,627 g/m^3 and in the middle of July (32,528 g/m^3), where the basis was composed by Cladocera of the genus *Ceriodaphnia* (97.4-98.0-97.1% of the total biomass).

The basis of abundance and biomass in the pond #1 were Cladocera crustaceans - 74.5 and 87.0%, respectively. During the vegetation period the maximum production parameters were revealed during the period - the end of June to the end of July, with a peak in the middle of July (3.156-5.830-3.220 g/m^3), due to the mass development of the Cladocera crustaceans of the genus *Ceriodaphnia* and *Moina* (46.4-53, 9-51.8% of the total biomass).

Table 3 – Quantitative development of zooplankton in experimental ponds in 2015,
N – number, thousand specimens / m^3, B – biomass, g/m^3

Sampling day	Rotifers		Cladocera		Copepoda		Total	
	N	B	N	B	N	B	N	B
Pond #3								
20.05	11,90	0,116	76,0	5,027	30,0	0,663	117,90	5,806
05.06	235,90	5,337	54,80	1,268	32,20	0,638	322,90	7,243
20.06	10,30	0,128	430,0	14,401	59,50	0,413	499,80	14,942
05.07	15,0	0,082	331,0	11,915	44,30	0,249	390,30	12,246
20.07	20,60	0,091	500,0	20,757	38,0	0,511	558,60	21,369
05.08	1,20	0,021	96,0	3,407	10,30	0,263	107,50	3,691
Average index	49,150	0,963	247,967	9,463	35,717	0,456	332,834	10,882
Pond #4								
20.05	1,80	0,002	95,0	7,416	21,20	0,105	118,0	7,523
05.06	24,0	0,045	875,20	21,899	33,60	0,177	932,80	22,121
20.06	8,0	0,027	644,0	22,290	48,30	0,310	700,30	22,627
05.07	6,0	0,126	128,90	4,959	9,30	0,053	144,20	5,138
20.07	3,0	0,007	879,80	32,133	32,60	0,388	915,40	32,528
05.08	20,0	0,10	195,0	5,672	33,80	1,825	248,80	7,597
Average index	10,467	0,051	469,650	15,728	29,80	0,476	509,917	16,255
Pond # 1								
12.06	15,20	0,070	23,50	0,711	6,20	0,030	44,90	0,811
27.06	22,60	1,052	39,80	1,545	25,20	0,559	87,60	3,156
12.07	59,0	1,619	80,40	3,301	45,20	0,910	184,60	5,830
27.07	23,30	0,388	56,30	1,856	22,0	0,976	101,60	3,220
12.08	9,20	0,216	33,0	1,257	32,60	0,197	74,80	1,670
Average index	25,860	0,669	46,60	1,734	26,240	0,534	98,70	2,937
Pond # 5								
12.06	2,40	0,005	213,60	5,306	30,60	0,350	246,60	5,661
27.06	42,60	1,514	48,40	1,80	14,40	0,609	105,40	3,923
12.07	34,0	0,649	69,60	2,548	39,90	1,190	143,50	4,387
27.07	64,0	2,325	122,0	4,769	52,0	0,995	238,0	8,089
12.08	12,0	0,245	87,0	3,726	52,0	1,139	151,0	5,110
Average index	31,0	0,947	108,12	3,630	37,780	0,857	176,90	5,434

The basis of quantitative parameters in the pond #5 during the study period were Cladocera crustaceans - 61.1% by the number of specimens and 66.8% by biomass. The biomass of zooplankton during the season varied from 3.923 g/m^3 in late June to 8.089 g/m^3 at the end of July, which corresponds to high class of food level with the eutrophic type. Among the species dominated were the genus *Ceriodaphnia* - 42,8%, rotifers of the genus *Asplanchna* - 16,2%, *M.brachiata* - 10,9%.

During the researchingperiod,Cladocera crustaceans dominated in all the ponds, among them the crustaceans of the genus *Ceriodaphnia*, whose proportion in the total mass reached 98%.

Among studied ponds, #3 and #4 were the most productive in terms of zooplankton, where the parameters ranged from a medium-class mesotrophic class to a very high-class hypertrophic. The

productivity of zooplankton in ponds No. 1 and #5 was somewhat lower, the parameters varied from a low-great oligotrophic class to a highly eutrophic type [5].

The need for increasing the level of zooplankton development in ponds, where pikeperch is grown, is also indicated by Russian and Belarusian scientists [6-9].

Usually, an increase in the level of development of zooplankton in the first half of the hatchery season is the key to improving the fish productivity of perch pike. In the second half of the hatchery season, the zooplankton plays a secondary role as food. The main prey in this period of time is fish juveniles [10-13].

As can be seen from the presented data, the greatest growth of phytoplankton biomass is observed in the period "May-June", the greatest level of zooplankton development occurs in July, then, in August the biomass of phytoplankton goes down.

Conclusions.

1) In general, based on the results of hydrobiological studies of natural forage base of experimental ponds it is clear that the level of biomass of phytoplankton and zooplankton was optimal for pike perch cultivation.

2) At the beginning of the fish-breeding season, immediately after filling the ponds, the level of phyto- and zooplankton development is usually low. Taking into account the early stocking of pikeperch in ponds, which grows in the conditions of pond farms in the South Kazakhstan at the beginning of May,it is necessary to organize earlier filling of the ponds and carry out a set of measures to increase the level of phyto- and zooplankton development.

3) It is necessary to support the development of phyto- and zooplankton in the first half of the hatchery season. Further, the level of development of the natural forage of ponds is quite high.

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СОСТОЯНИЕ ЕСТЕСТВЕННОЙ КОРМОВОЙ БАЗЫ ПРУДОВ ПРИ ВЫРАЩИВАНИИ СЕГОЛЕТОК СУДАКА

Аннотация. Целью работы было определение уровня и динамики развития фитопланктона и зоопланктона в экспериментальных прудах, занятых под выращивание сеголеток судака в поликультуре с карпом и растительноядными рыбами. Обоснована важность изучения уровня развития фито- и зоопланктона в прудах, занятых под выращивание сеголеток судака в поликультуре с карпом и растительноядными рыбами. Представлены методики изучения уровня и динамики развития фитопланктона и зоопланктона в экспериментальных прудах. Показан уровень развития фито- и зоопланктона в экспериментальных прудах, в которых проводилось выращивание сеголеток судака от подрощенной молоди. Показаны видовой состав, уровень развития организмов фито- и зоопланктона экспериментальных прудов в разные года проведения исследований. Показана динамика уровня развития фито- и зоопланктона в отдельные месяцы определенного года проведения исследований. Показано, что проведение мероприятий по стимуляции развития естественной кормовой базы (внесение удобрений и др.) оказывает непосредственное влияние на увеличение биомассы организмов зоопланктона, особенно к концу сезона эксплуатации рыбоводных прудов. Даны выводы, в которых представлена динамика развития фито- и зоопланктона экспериментальных прудов по месяцам года, показано значение гидробиологических исследований при выращивании сеголеток судака в прудах. По результатам исследований динамики и биомассы фито- и зоопланктона даны рекомендации, в какой период рыбоводного сезона наиболее целесообразно проводить работы по поддержанию биомассы фито- и зоопланктона в рыбоводных прудах, занятых под выращивание сеголеток судака.

Ключевые слова: фитопланктон, зоопланктон, динамика развития, прудовое рыбоводство, сеголетки, судак.

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ОСЫ ЖАДЫҚ КӨКСЕРКЕ БАЛЫҒЫН ӨСІРУДЕГІ ТОҒАНДАРДЫҢ ҚОРЕКТІК БАЗАСЫНЫҢ ТАБИҒИ КҮЙІ

Аннотация. Жұмыстың мақсаты тұқы мен шөппен қоректенетін балықтармен поликультура жағдайында осы жаздық көксерке балықтары өсірілген тәжірибелік тоғандардағы фитопланктон мен зоопланктонның даму динамикасы мен деңгейін анықтау болды. Мақалада осы жаздық көксерке балықтарын тұқы мен шөппен қоректенетін балықтармен бірге өсірген кездегі тоғандардың фито- және зоопланктон даму деңгейін зерттеу маңыдылығы көрсетілген. Тәжірибелік тоғандардағы фитопланктон мен зоопланктон даму динамикасы мен деңгейін зерттеудің әдістемелері келтірілген. Фито- және зоопланктон даму динамикасы зерттелген тәжірибелік тоғандарда осы жадық көксерке балықтары өскелең шабақ кезеңінен бастап өсірілген. Тәжірибелік тоғандардағы бірнеше жылдық зерттеу жұмыстарын жүргізу барысындағы фито- және зоопланктон ағзаларының даму деңгейі мен түрлік құрамы көрсетілген. Белгілі бір жылдарда зерттеу жұмыстарын жүргізген кезеңдердегі, жекелеген айлардағы фито- және зоопланктон даму деңгейінің динамикасы көрсетілген. Табиғи қоректік базаны қолдан арттыру үшін жасалатын іш шаралар (тыңайтқыштарды салу және т.б.) тікелей зоопланктон биомассасын арттыруға оң әсер ететіндіктері анықталған, әсіресе балық өсіретін тоғандарды пайдалану маусымының соңына қарай. Қортындыда тәжірибелік тоғандардағы фито- және зоопланктон даму динамикасы айма-ай көрсетілген, тоғандарда осы жаздық көксерке балығын өсірудегі гидробиологиялық зерттеу жұмыстарының маңыздылығы баяндалған. Фито- және зоопланктон динамикасы мен биомассасын зерттеу нәтижелері бойынша балықты қолдан өсіру маусымында осы жаздық көксерке балығын өсіру барысында фито- және зоопланктон биомассасын біркелкі әрі тұрақты етіп ұстап отыру үшін қажетті ұсыныстар берілген.

Түйін сөздер: фитопланктон, зоопланктон, даму динамикасы, тоған балық шаруашылығы, осы жадық балықтар, көксерке.