Published: May 31, 2021 | **Pages:** 140-147
Doi: https://doi.org/10.37547/tajas/Volume03Issue05-22

Assessment Of Hydrochemical Analysis And Phytoplankton Community Of Different Ponds Of A Fish Farm

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ABSTRACT

The article presents the results of the hydrochemical analysis and phytoplankton composition study of the "Namangan Balyk" fish farm's ponds. The species composition, biomass, and seasonal dynamics of phytoplankton in these ponds were calculated and analyzed for the first time.

KEYWORDS

Phytoplankton, zooplankton, biomass, hydrochemical index, pond fish farming, fish productivity, aquaculture, polyculture.

INTRODUCTION

In recent years, aquaculture has become the most important fish producer to meet the needs of the population. In Uzbekistan, fish production increased from 6-9 thousand tons per year in 1996-2009 to more than 100 thousand tons per year in 2020. The main technology is pond polyculture of Cyprinidae, the fish productivity of semi-intensive ponds reaches 2.3-2.5 t/ha/year. Water quality is the most important factor in aquaculture [17, 18, 16, 19]. In the used technology, the most important indicator is the development of phytoplankton. In such a rapid development of the pond polyculture of Cyprinidae, the hydrochemical parameters of water, as well as the species composition, biomass and dynamics of the growth of phytoplankton as a natural food base for fish in ponds of fish farms in the Fergana Valley have been little studied. At the confluence of the Naryn and Karadarya rivers, when leaving the mountains, the Syrdaryariver is born, which runs along this valley with a length of 300 km. Moreover, in recent years, in this specific large mountain valley, there are about 3 thousand hectares of earthen ponds for fish breeding, and they produce about 6 thousand tons of Cyprinidaefish per year.

The purpose of this work was to determine the hydrochemical indicators of water quality in ponds, qualitative and quantitative analysis of phytoplankton.

MATERIALS AND METHODS

Measurement of dissolved oxygen and water temperature was carried out with a portable thermooximeter "HANNA" HI 9147-04, pH measurement - with a portable pH meter pHscan 30S (using built-in methods). Portable conductometer ECscan-40 was used for determination of mineralization Otherhydrochemical parameters were measured according to standard hydrochemical methods [2].

Phytoplankton samples were taken with a one-liter Ruttnerbathometer; poured 250 ml into 500 ml dishes, mixed (i.e., integrated samples were taken).

For high-quality phytoplankton collection, a silk plankton net was used. For "soft" fixation of phytoplankton samples, Lugol's solution is used (to a slightly yellow color) followed by the addition of formalin (10 ml of 40% formalin is sufficient for 0.5 l of the sample). Phytoplankton samples were collected according to generally accepted algological methods [12, 4, 11, 9], and identification guides were used to identify the species composition of microalgae [1, 5, 10, 6, 7, 8, 13, 14, 15]. The sample taken in a polyethylene bottle was fixed with 40% formalin and Lugol's solution, supplied with a label (sample number, date, water body, station). Standard sampling horizons: 0 (surface); 0.5; 1.0 m.

In box conditions, the sedimentation method (sedimentation) was used for the concentration of samples, because Planktonic cells settle at a speed of 1 cm in 3 hours, then the samples were settled in a dark place for 5-10 days, and then the filtrate was very slowly sucked off by a siphon through a double layer of meshNo. 76 (this helps to preserve the fine structures of algae).

The compaction of the sample was carried out in two stages: from 0.5 l to 0.1 l (100 ml). Then, after secondary settling (no more than 5 days can be used), the solution was sucked off again. Further analysis of the samples was carried out under laboratory conditions using a microscope.

RESULTS

Table 1 shows the hydrochemical indicators in different ponds of the "Namangan Balyk" fish farm and generally accepted fishery technological standards for these indicators. The quality of water in spring samples (2021) differs in hydrochemical indicators from autumn (2019) by a decrease in mineralization, which is associated with the influx of a large amount of water (snowy winter and rainy spring). For the same reason, the overall stiffness has decreased. However, the content of ammonium nitrogenin the incoming water exceeded the permissible value in spring, even at low water temperatures and pH less than 7.0 led to the formation of ammonia both in the water of the supply channel and in fish ponds. All other investigated indicators of water quality were within the permissible limits.

Table 1. Hydrochemical indicators of rearing and feeding ponds of the fish farm "Namangan Balyk" (March 2021).

Indicator	Technologic norm	Pond				
		№ 1	№ 2	№ 3	№ 4	№ 5
Mineralization mg/l	300-1000	280	280	360	690	470
pH	6.5-8.5	6.74	6.82	6.95	6.86	6.88
Color of water, nm		500	540	540	540	540
Oxygen,mg/l	5-6	4.8	5.6	5.6	5.2	4.8
Hydrocarbonate, mg/l	60-120	140.3	164.7	146.4	189.1	170.8
Alkalinity, mg ecv/l	1.5-3.0	2.3	2.7	2.4	3.1	3.2
Ammonia nitrogen mg/l	До 1.0	>4.0	>4.0	>4.0	2.0	>4.0
Nitrites, mg/l	0.2	0.02	0.002	0.002	0.002	0.07
Phosphates, mg/l	0.2-0.5	0.085	0.0	0.14	0.26	0.32
Ammonia, mg/l	0.000	0.0128	0.0128	0.0128	0.0064	0.0128
Fe (average), mg/l	< 2.0	0.1	<0.05	0.01	0.25	0.25
CO_2, mg/l	< 10	8.32	8.1	7.65	6.3	7.68

Hardness (average), mg-ecv/l	1.5-7.0	1.5	2.1	2.5	2.3	2.3
Sulfates, mg/l	<300	115	125	253	254	264
Chlorides, mg/l	25-30	27	35	35	38	38

Note: No. 1 - feed channel of the fish farm; No. 2 - feeding pond; No. 3 - feeding pond; No. 4 - nursery pond; No. 5 - nursery pond.

Pay special attention to the content of dissolved oxygen in water in spring, when the water temperature was + 11 ° C, the oxygen content was 4.8-5.6 mg / l. However, at such a low temperature, the oxygen content in the water should have been up to 11.03 mg / l. There are reasons for this:

- In ponds at a water temperature of + 11°C in spring, the development of phytoplankton involved in the production of oxygen has not yet begun;
- The incoming water contains a very large amount of organic matter, for the oxidation of which oxygen is consumed to a large extent.

In the studied spring (late March 2021) phytoplankton samples, 121 species, varieties and forms of algae were found, of which Cyanophyta - 11 species, Bacillariophyta - 68 species, Chlorophyta - 33 species, Euglenophyta - 4 species, Dinophyta - 3 species, Cryptophyta - 2 species (Table 2).

Table 2. Taxonomic structure of phytoplankton in nursery and feeding ponds of the fish farm "Namangan Balyk" for March 2021

TAXON	Pond				
	№ 1	№ 2	№ 3	№ 4	№ 5
CYANOPHYTA	4	5	3	6	8
BACILLARIOPHYTA	33	29	7	12	42
CRYPTOPHYTA	2	2	1	-	1
EUGLENOPHYTA	-	1	-	1	2
CHRYSOPHYTA	-	-	-	-	-
DINOPHYTA	2	1	3	-	-
CHLOROPHYTA	-	17	11	11	22
Average number of species	41	55	25	30	75

Published: May 31, 2021 | **Pages:** 140-147
Doi: https://doi.org/10.37547/tajas/Volume03Issue05-22
IMPACT FACTOR
2021: 5. 634
OCLC - 1121105553

Note: No. 1 - feed channel of the fish farm; No. 2 - feeding pond; Number 3 - feeding pond; No. 4 - nursery pond; No. 5 - nursery pond.

The dominant complex of phytoplankton communities was represented, first of all, by producers, among which Bacillariophyta, Chlorophyta and Cyanophyta species reach the greatest development and diversity. Microalgae from other departments in the samples were found with low indicators (1-4 species) of qualitative and quantitative development.

In spring samples of phytoplankton, a weak growth of Cyanophyta(from 3 to 8 species) forms and varieties was observed. In total, 11 species or 9.09% of the total amount of species were noted in spring samples. Mainly planktonic colonial and filamentous Cyanophyta species of the genera *Microcystis, Phormidium, Lyngbya*was presented. The number of Cyanophyta species in the samples ranges from 618.750 * 10^3 cells/l to 8693.750 * 10^3 cells/l. The biomass of the last ranged from 17.850 mg / l to 265.113 mg / l (table 3).

Bacillariophyta species in terms of taxonomic diversity (7-42 species) occupy one of the dominant positions in the phytoplankton of the studied areas. In total, 68 species were noted in 5 spring samples, which amounted to 56.20% and are represented both planktonic and mesosaprobicphytobenthos species from the genera *Melosira, Cyclotella, Fragilaria, Synedra, Achnanthes, Cocconeis, Cymbella, Caloneis, Gyrosigma, Navicula, Amphora ,Rhopalodia, Nitzschia. CyclotellaKuetzingianaThw., Asterionellaformosa (Hantz.) Heib.,SynedraacusKütz., AchnanthesaffinisGrun., Amphora ovalis, Naviculacryptocephala* with its variations, *BacillariaparadoxaGmelin.* The number of Bacillariophyta in the samples ranges from 300.00 * 10^3 cells / l to 2100.00 * 10^3 cells / l. The biomass of the last ranged from 774.319 mg / l to 4567.698 mg / l (table 3).

Table 3. Quantitative development and biomass of phytoplankton in rearing and feeding ponds of the fish farm "Namangan Balyk" for March 2021 (numerator - abundance (cells * 10^3) / denominator - biomass (mg / l).

Taxon	Pond				
	№ 1	№ 2	№ 3	№ 4	№ 5
CYANOPHYTA	112,500 29.60	1775,00 39.988	618,750 17.850	25,00 93.00	93,750 5.113
BACILLARIOPHYTA	2100,00 54.198	1825,00 67.698	300,00 774.319	6,250 14.844	12,500 67.809
CRYPTOPHYTA	43,750 43.450	75,00 74.438	6,250 6.175	-	12,500 12.350

EUGLENOPHYTA	-	6,250 7.650	-	12,500 14.825	12,500 9.713
CHRYSOPHYTA	-	-	-	-	-
DINOPHYTA	18,750 19.988	12,500 11.950	31,250 42.175	-	-
CHLOROPHYTA	231,250 63.506	12,500 412.863	856,250 444.375	625,00)6.325	62,500)9.788
Average ımber/biomass	;06,250 410.740	)06,250 14.587	12,500 84,894	518,750 1718,994	193,750 4654.773

Note: No. 1 - feed channel of the fish farm; No. 2 - feeding pond; No. 3 - feeding pond; No. 4 - nursery pond; No. 5 - nursery pond.

In almost all ponds in spring samples, a moderate growth of Chlorophyta(up to 22 species, forms and varieties)was observed. Less than 9 species were presented in the feed channel. In total, 33 species were noted in 5 samples, which amounted to 27.27% of the total number of algae species. The massive growth of Chlorophytais represented by the genera *Ankistrodesmus, Chlamidomomas, Chlorella, Carteria, Dictyosphaerium, Oocystis, Scenedesmus, Tetraedron, Cosmarium, Coelastrum*, etc. There is also a significant species diversity and quantitative development of Chlorophytain the samples, of which halophils are pronounced *Oocystisborgii, Chlamidomonas sp., Ch.ovate, Ch.airosum, Chlorocococcusturgida, Scenedesmusguadricauda, Sc.acuminatus, Cosmariumgranatum*, etc.).

The smallest number of green algae is observed in the supply channel 231.250 * 10^3 cells/l, the largest was 1762.500 * 10^3 cells/l. The biomass was 63.506 mg/l and 499.788 mg/l (table 3).

Euglenophyta, Dinophyta and Cryptophyta found in the studied samples are mainly represented by the genera *Euglena, Phacus, Glenodinium, Peridinium, Chryptomonas*. The number ofDinophytaranges from 12,500 * 10^3 cells/l to 31,250 * 10^3 cells/l, and the biomass, respectively, from 11.950 mg/l to 42.175 mg/l..Euglenophyta - 6,250 * 10^3 cells/l to 12,500 * 10^3 cells/l and biomass, respectively - from 7.650 mg/l to 14.825 mg/l;Cryptophyta - 6,250 * 10^3 cells/l to 75.00 * 10^3 cells/l, and biomass, respectively, from 6.175 mg/l to 74.438 mg/l (table 3).

DISCUSSION

In Uzbekistan, pond fish farming is the main fish producer, production has reached more than 100 thousand tons per year, the total number of fish ponds has reached more than 39 thousand hectares[3]. At the same time, the quality of water and the growth of plankton in ponds in recent years in the densely populated Fergana Valley (population of about 10 million people on an area of 1 million 550 thousand hectares) has practically not been studied. At the same time, the Fergana Valley is distinguished not only by the highest population density, but also by the great development of agriculture on irrigated lands. These activities have an impact on the quality of the water flowing into the ponds. The spring hydrochemical indicators of 2021 studied by us in the ponds. differed from the autumn 2019. a decrease in mineralization, and at each sampling point. For this reason, the total hardness of the water has decreased. However, the content of ammonium nitrogen in the incoming water is much higher than the permissible value and the pH is less than 7.0. This led to the formation of ammonia both in the water of the incoming channel and in the fish ponds. As the temperature rises, special attention should be paid to prevent nitrogen contamination from entering the water. All other tested indicators turned out to be normal. Also, before the start of the growing season, the content of such an important element as phosphorus, which is necessary for the synthesis of primary production, was checked. Only in ponds No. 4 and No. 5 the phosphorus content corresponds to the technological norm, in other sampling points its amount is much lower (in pond No. 2 it is completely absent, in pond No. 3 - 0.14 mg / l).

Based on the results obtained on the development of phytoplankton in ponds, it can be noted that the dominant complex is represented mainly by Bacillariophyta, ChlorophytaandCyanophyta. Dinophyta, Cryptophyta, and Euglenophytawere noted with a low abundance. In terms of quantitative development, the leading place is occupied by Bacillariophyta in channel No. 1 and ponds No. 2 for feeding, No. 5 for rearing; mass development of Chlorophyta from the genera Ankistrodesmus, Chlamidomomas and Scenedesmus was observed in ponds 2, 3, 4, 5. In spring samples of phytoplankton, weak development of Cyanophyta was observed everywhere. In the surveyed ponds, both freshwater and brackish-water forms of algae were approximately equally represented in the composition of phytoplankton. This indirectly indicates a moderate level of salinity of the water mass, especially in the flowing zone of ponds, where favorable conditions are formed for the development of phytoplankton and other groups of aquatic organisms, including ichthyofauna.

From the above data, it can be seen that the hydrochemical indicators in the ponds of this fish farm are not greatly disturbed, and many of them are favorable for fish feeding. The phytoplankton biomass in the spring period lags behind the autumn one by an average of 5-8 times, since the rapid development of phytoplankton in local climatic conditions has not yet begun in March.

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