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TECHNOLOGY OF MARKETABLE CARP FARMING IN PONDS ON NATURAL FORAGE SUPPLY

Data of experiments regarding the study of influence of carp yearlings stocking density while farming on natural forage supply are provided. It was stated that with standard stocking of 750 individuals / hectare the marketable carp grows well and with increased density of stocking up to 1500 individuals / hectare the weight growth drops.

Keywords: *marketable carp, stocking density, food supply, feed consumption, feed ratio, physiological parameters.*

PROBLEM STATEMENT AND ITS RELEVANCE

Recently fish capacity has greatly reduced in pond fish farming mainly on the account of changes in density of carp stocking for one hectare of the area while farming carp up to a marketable weight without active feeding with artificial feeds. Many fish farms make a practice of farming marketable carp in polyculture with phytovorous fish (grass carp, bighead and silver carp) for the whole vegetation cycle using only natural forage supply. It is developed by applying organic and mineral fertilizers. They include decomposed manure; phosphorous, nitrogenous and calcium fertilizers and many others [1-5].

It is known that all the fertilizers are used mainly to develop in ponds natural forage and primary development of bacteria and phytoplankton on the base of which zooplankton and to some extent zoobenthos grow. The abovementioned natural animal forage contains a lot of nutrients including nonessential and essential amino acids and fats [6 - 8].

Numerous experiments stated that in farming of fish juveniles in the ponds zoo-plankton should be not less than 8 - 12 g/m^3, and zoobenthos – not less than 3 - 5g/m^3. Feed ratio of the raw natural forage makes up 6 units, and ratio of dry one – 1 - 2 units [9 - 12].

According to B. P. Luzhin [5], for normal growth and development of the carp larvae, starting since the 3rd -4th day when they begin to eat externally, till their stocking into nursery ponds it is necessary that zooplankton amount should be in the limits of 600 - 700 thousand individuals/m^3 . If its abundance does not exceed 300 - 400 thousand individuals/m^3, it results to starving of fish larvae [5]. Optimum small zooplankton amount in the water for phytovorous fish larvae feeding should be 1 000 - 2 500 individuals/ l [4].

While farming carp it is rather difficult to maintain the level of natural forage in the normative limits for the whole vegetation period, it requires great efforts.

In this connection it is necessary to know how density of fish stocking influences on the level of the natural feed supply, changes in hydrochemical regime in ponds and their fish capacity.

THE OBJECTIVE OF THE PAPER

The objective of the present paper is to demonstrate the influence of various densities

of stoking during the period of marketable carp farming on the natural forage supply on environmental, fish-farming and physiological parameters.

STATEMENT OF BASIC MATERIAL

The material for research under the specified subject was yearlings of scaly carp which were stocked into ponds (as calculated for 1 hectare) in the amount of:

- I control group (standard) - 750 individuals – control pond;

- II group (experimental) – 1 000 individuals – experimental pond;

- III group (experimental) – 1 250 individuals – experimental pond;

- IV group (experimental) -1 500 individuals – experimental pond.

In all the ponds carp was farmed only on natural forage without any artificial feeds. Daphnids and chironomids made up the natural forage of a pond. The nutritional value of daphnids and chironomids was compared with the nutritional value of Californian worm which is used while farming fish in pools especially in the winter [6 - 8].

The content of amino acids in feeds was determined by means of amino acid analyzer of trademark "Hitachi-83" (Japan).

Research in fish feeding, hydrobiology and hydrochemistry was carried out under standard practice [13 - 16].

The results obtained were processed biometrically [17].

The duration of the experiment was 120 days.

During the research depending on the density of stocking the dynamics of changes in chemical composition of water was studied.

The nutritional value of daphnids, chironomids and Californian worm is represented in Table 1.

The dynamics of salt, gas regimes, biogenic elements and organic substances in the control and experimental ponds are represented in Tables 2 and 3.

Data of Table 2 prove that parameters of the salt regime do not depend greatly on density of fish stocking. Although, certain increase of calcium in the water of ponds No. № II and III and of magnesium in the water of pond No. IV

Table 1. **The nutritional value of daphnids, chironomids and Californian worm**

Parameters	Type of feeds		
	Daphnids (various)	Chirono-mids	Californian worm
Quantity of energy, kCal./kg	5 034	4 589	4 257
Quantity of energy, MJ/kg	21,1	19,2	17,8
Fat, %	16,0	14,0	7,0
Protein, %	61,4	57,0	62,7
Amino acids, g/kg:			
Asparagine acid	52,5	58,3	65,5
Threonine	27,9	26,5	31,4
Serine	26,6	30,4	31,4
Glutamic acid	77,7	77,0	95,2
Proline	25,5	22,0	23,6
Glycine	27,4	24,5	32,6
Alanine	36,1	41,8	18,7
Cystine	5,1	5,2	10,9
Valine	29,3	26,4	29,0
Methionine	5,3	17,0	6,8
Isoleucine	23,2	22,5	26,6
Leucine	41,1	38,5	50,7
Tyrocine	26,4	18,5	21,5
Phenylalanine	26,6	33,0	25,4
Lysine	40,3	39,6	44,0
NH3	13,2	14,7	10,7
Histidine	12,0	14,0	15,2
Arginine	35,1	35,1	42,1
Total amino acids	581,4	544,9	581,5
Including essential ones	240,8	252,6	271,2

was recorded, parameters of sodium remained at the control level.The amount of chlorine and sulphur oxide in ponds varied slightly and concentrations of HCO_2 anions in the water of all experimental ponds were higher as compared with the water of the control pond on average for 2,5 - 14,6 %.

The experiment stated that with increased density of fish stocking the hardness and mineralization of water remained almost at the same level and no significant changes of the salt quantity of water took place.

The dynamics of gas regime, biogenic elements and organic substances in the waters of ponds may be judged by the data of Table 3.

Table 2. **Dynamics of the salt regime in experimental ponds of the fish farm "Nivka" (on average for the vegetation period)**

Pond No., ind./ha	Date of sampling	Basic ions, mg/l						Hardness	Mineralization
		Cathions			Anions				
		Ca^{2+}	Mg^{2+}	Na^{2+}	HCO_2	C1	$S0^2_4$		
I - 750	11.05-25.08.	54,7	20,9	35,1	166,6	67,3	47,6	4,8	392,2
II - 1000	11.05 -25.08.	62,1	19,1	39,2	191,0	66,0	44,0	4,7	428,0
III - 1250	11.05 -25.08.	57,6	20,9	35,1	170,7	64,3	43,6	4,6	423,1
IV- 1500	11.05 -25.08.	50,9	24,9	35,1	175,0	66,6	44,5	4,6	392,2

Table 3. **The dynamics of gas regime, biogenic elements and organic substances in the waters of ponds of the fish farm "Nivka" (on average for the vegetation period)**

Pond No., ind./ha	Number of samplings for the vegetation period	pH	Weighed substances, mg/l	CO, mg/l	NH_3, mg/l	Oxidability, mg N|l		NH_{4+}, mg/l	$N0_2$, mg N /l	$N0_3$, mg/l	$P0^3_4$, mg/l	Fe, mg Fe/l
						permanganate	dichromate					
I - 750	2	7,5	5,1	13,3	0,005	11,7	33,8	0,29	0,02	0,12	0,08	0,54
II - 1000	2	7,3	4,3	29,6	0,003	11,1	32,2	0,34	0,02	0,12	0,10	0,46
III - 1250	2	7,3	4,8	20,4	0,004	13,7	48,5	0,33	0,02	0,23	0,10	0,53
IV- 1500	2	7,4	5,4	22,3	0,006	11,4	37,2	0,44	0,03	0,31	0,11	0,54

Experimental material of Table 3 demonstrated that increased density of carp stocking while its farming had no great impact on changes in water. Thus, it is necessary to note that salt and gas regimes, biogenic elements and organic substances in all the ponds were in the controllable limits, i.e. the density of farmed carp stocking had no significant influence on the water medium. Therefore it is essential to make fish-farming evaluation of each pond taking into account carp yearlings density in respect of cultivation. Fish-farming indices were represented in Table 4.

The represented experimental material (*Table 4*) prove that in the control group of fish (I group, normative) with stocking density 750 ind./ha the largest average final weight of carp equal to 516,7±20 g was recorded and the absolute increase of body weight was equal to 492,2 g. With increased density of carp stocking in each group up to 1 500 ind./ha the average final weight was equal respectively to 328,2±15,2 g, 280,0±10,2 g and 225,1±8,3 g. As a result the average weight while farming marketable carp in IV experimental group (stocking 1 500 ind./ha) turned to be less 2,3 times than in control one.

Output of carp in the control group made 100 %, and in the experimental one - from 70,0 to 71,5 %. The fish capacity in the control pond made up 387 kg/ha, that almost as much as twice exceeded the standard parameter for this fish farming area in Kiev region [3, 4]. In the experimental groups fish capacity was in the limits of normative - 200 kg/ha.

The energy consumption of natural food in the control group and in all experimental ones of farmed carps was almost the same and varied in the limits of 2 - 6 %.

The results of blood examinations for experimental and control fishes are represented in Table 4. It was stated that the concentration of hemoglobin was the highest in the control group and made up 8,9 g %, and in the experimental, especially in III and IV, it was less – 7,5 g %. The amount of erythrocytes in the blood of fishes of all groups was at the level of 1,8 mln./ mm^3. At the same time, the amount of leucocytes in the blood of carps from the control group made up on average 72,5 thousand/ mm^3, that was more for 4,6 - 24,1% than in the experimental groups.

Table 4. Fish-farming indices of the undertaken research for farming of fish juveniles under various conditions of stocking

Indices	Stocking density, ind./ha			
	Normative control, I	Experimental		
		II	III	IV
	750	1 000	1 250	1 500
Volume of pond, m^3	400	400	400	400
Average initial weight, g	24,5±2,1	24,6±2,2	25,0±2,3	25,0±1,4
Average final weight, g	516,7±20,1	328,2±15,2	280,0±10,2	225,1±8,3
% of control	100	63,5	54,2	43,6
Average increase of weight, g	492,2	303,6	255	200,1
% of control	100	61,7	51,8	40,7
Output, %	100	70,0	70,0	71,5
Fish capacity, kg/ha	387	230	240	241
% of control (to normative)	100	59,4	63,3	62,2
Consumption of raw natural feed, kg/kg of raw (daphnids, chironomids)	6,0	-	-	-
Consumption of natural feed, kg/kg of dry (daphnids, chironomids)	1-2	-	-	-
Energy quantity, kCal./kg of food	5 995	6 133	6 321	5 586
Energy quantity, MJ/ kg of food	25,1	25,7	26,6	23,4
% of normative (control)	100	102,4	105,9	93,2
Haemoglobin concentration, g %	8,9	8,1	7,7	7,5
Amount of erythrocytes, mln./mm^3	1,8	1,8	1,8	1,8
Amount of leucocytes, thousand/mm^3	72,5	69,2	55,0	60,0
Total protein of blood serum, g %	4,0	3,6	3,6	3,6

As for the content of total protein in blood it was the highest in the control group (stocking density 750 ind./ha), exceeding similar parameter of blood for fishes in the experimental groups for 10 %.

CONCLUSIONS

The studies stated that while farming carp yearlings on natural food without artificial feeds depending on stocking density (from 750 to 1500 ind./ha) resulted in reduction of the average body weight more than twice and drop in fish output. At the same time fish capacity of the pond reduced as well.

Consequently, it is necessary to apply scientifically backgrounded values of stocking density depending on the fish-farming zones while farming marketable carp in ponds with natural forage supply.

It is recommended to control strictly and maintain the required level of natural forage supply from the first day after stocking in order to provide high rate of fish output.

Application of scientifically backgrounded stocking of ponds and rational exploitation of natural forage supply while farming of fish make possible to achieve high results in fish cultivation with consumption of artificial feeds.

REFERENCES

1. Sukhoverkhov F. M. Pond Fish Farming. - Moscow: Selkhozizdat, 1963, - 423 p. (In Russian)

2. Martyshev F. G. Pond Fish Farming. - Moscow.: Vysshaya Shkola, 1973.- 423 p. (In Russian)

3. Fedorchenko et al. Fish Farming and Biological Standards for Exploitation of Pond Farms. - Moscow: VNIPRKh, the 2nd Ed., 1985. - P.38. (In Russian)

4. Collected standard-technical documents for marketable fish farming.- Moscow: Agropromizdat,1986. - Vol.1, 2.- P.260, 317. (In Russian)

5. Luzhin B. P. Stages of carp larvae growth. // Fish Farming and Fishing.- 1976.-No. 3.- P.10-12. (In Russian)

6. Shpet G. I. Ecology of carp feeding in connection with development of rational methods of feeding. // Collected papers of Scientific Research Institute of Pond and Lake River Fish Farming.- Kiev, 1953.- No. 8.- P. 40 - 68. (In Russian)

7. Shpet G. I. On impact of environmental conditions on

carp feeding. // Collected papers of Scientific Research Institute of Pond and Lake River Fish Farming.- Kiev,1952.- No. 8.- P. 66 - 107. (In Russian)

8. Kharitonova N. N. Biological basics of intensive pond fish farming. - Kiev: Naukova dumka, 1984. - 195 p. (In Russian)

9. Zheltov Yu. Yu. Guidelines for experiments in fish feeding. // Fsiheries.- 2003, Vol. 62. - P.23-28. (In Ukrainian).

10. Sherman I. M. et al. Fish Feeding: Manual / I. M. Sherman, M. V. Grinzhevsky, Yu. O. Zheltov et al. - Kiev: Vishcha Osvita, 2001. - P. 121-136. (In Ukrainian).

11. Zheltov Yu. O. Recipes of combined feeds for farming of fishes of various species and ages in commercial cultivation. - Kiev: Firm "INKOS", 2006.- 154 p. (In Russian)

12. Zheltov Yu. O. Arrangement of feeding of carp of various ages in farmers' fish farms.- Kiev: Firm "INKOS", 2006. – 282 p. (In Russian)

13. Guidelines for sampling and processing of materials during hydrobiological studies in freshwater ponds: Zoobenthos and its products. - Leningrad,1982. - 33 p. (In Russian)

14. Alekin O. A. Guidelines for chemical composition of inland waters / O. A. Alekin, A. D. Semenov, B. A. Skopintsev. - Leningrad: Gidrometeoizdat, 1973. – 262 p. (In Russian)

15. Syara Ya.I . Guidelines for hydrochemical research in pond fish farms. - Lvov: Vilna Ukraina, 1978. – 17 p. (In Russian)

16. Shcherbina M. A. Guidelines for physiological assessment of nutritivity of fish feeds. - Moscow: VASKhNIL, 1983. – 83 p. (In Russian)

17. Plokhinsky N. A. Biometry. - Novosibirsk: the Siberian Branch of the USSR Academy of Science, 1961.- 364 p. (In Russian)

СТАТЬЯ ПОСТУПИЛА В РЕДАКЦИЮ 01.10.2013 г.

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ТЕХНОЛОГІЯ ВИРОЩУВАННЯ ТОВАРНОГО КОРОПА В СТАВАХ НА ПРИРОДНІЙ КОРМОВІЙ БАЗІ

Надані матеріали проведених досліджень впливу щільності посадки річняків коропа при вирощуванні його на природній їжі. Встановлено, що при нормативній посадці 750 экз./га товарний короп добре росте, а з підвищенням щільності до 1 500 экз./га приріст маси риби без додаткової годівлі знижується.

Ключові слова: *товарний короп, щільність посадки, кормова база, витрати корму, кормовий коефіцієнт, фізіологічні показники.*

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ТЕХНОЛОГИЯ ВЫРАЩИВАНИЯ ТОВАРНОГО КАРПА В ПРУДАХ НА ЕСТЕСТВЕННОЙ КОРМОВОЙ БАЗЕ

Представлены материалы экспериментов по изучению влияния плотности посадки годовиков карпа при выращивании его на естественной кормовой базе. Установлено, что при нормативной посадке 750 экз./га товарный карп хорошо растет, а с увеличением плотности посадки до 1 500 экз./га прирост массы снижается.

Ключевые слова: *товарный карп, плотность посадки, кормовая база, затраты корма, кормовой коэффициент, физиологические показатели.*