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FOUNDATION AND CALCULATION OF THE FISH SEEDING DENSITY FOR SPECIAL COMMODITY FISHERIES CREATION

The results of the complex reservoir research are presented, the proposals for the special commodity fisheries creation are developed. The state of the aquatic environment meets the requirements of the fishery regulations, and the natural feed base was at a relatively high productive level.

Non-industrial fish species dominated in the reservoir, the natural fish productivity is 3.0-3.5 centners per ha, industrial fish has 0.5 centners per ha.

It is suggested to use carp, silver carp, bighead carp, and grass carp for fish seeding.

We should use a two-year-old (this year) sander for the purpose of biological melioration of reservoirs.

Keywords: *aquatic environment, families and species of fish, feed base, reservoir, hydrobionts, fishery norms, hydrochemical indicators, phytoplankton, algae, zooplankton, fish farming, carp, white carp, crucian carp, sunbleak*

Tab. 1. Ref. 15.

Statement of the problem. In modern conditions, aquaculture is one of the crucial means of producing high-protein products and low production costs.

To obtain 1 kg of fish gain we use 1.0-1.5 kg of feed, at the same time but we use more feed for the production of other types of livestock products (chicken, pork, and beef). Therefore, an increase in the production of fish products is rather actual.

Water bodies and reservoirs are the most accessible for development in Ukraine. They provide about 70% of fish production and are the main reserve for the further development of domestic aquaculture [7].

There are 1103 reservoirs in Ukraine; their total volume is 55315.8 million cbm.

There are 92 reservoirs in Vinnytsia region with a total area of 9,658 hectares and a total volume of 293 million cbm. The hydrographic network of water objects of the region belongs to the basins of the three main rivers of Ukraine such as the Dniester, the Southern Bug and the Dnieper, with 28%, 62% and 10% respectively of the territory of the region [8].

A characteristic feature of the region rivers is the high degree of regulation of the flow of artificial reservoirs, i.e. small reservoirs and ponds. Most of reservoirs, 94% (49 units), are of a small volume, they have less than 10 million cbm; Ladyzhyn reservoir is a medium-sized one.

Small reservoirs are created as a result of economic activity that is related to the need to create stable water supplies to meet the needs of different water users. Requirements for such reservoirs are caused by the interests of departments and

organizations that determine the special hydrological, physico-chemical, hydrobiological regimes [1].

According to the intended purpose the reservoirs of the Vinnytsia region are used for the needs of water supply, energy, fish breeding, cultural and household purposes.

The peculiarity of small reservoirs is an objective sum of abiotic and biotic factors, which allow the directed formation of its ichthyofauna to produce commercial products [1].

According to the literary primary sources, the vast majority of small reservoirs have favorable conditions for feeding but they have not conditions for the effective reproduction of valuable fish species. This state allows us to use a catchy form of fish farming that requires the systematic accumulation of reservoirs by posterior material, i.e. carp, white and multicolored papillae [12, 15].

Fish productivity depends on such factors as the quality of water, the natural forage base, the set of fish polyculture, the degree of intensification of fish farming.

Literature Review. A lot of works are devoted to the research of small reservoirs as an object of fishing exploitation. [2, 3, 6, 7, 10, 13, 15].

The development of small reservoirs is one of the most promising lines of modern pasture aquaculture but their design and construction took place without taking into account the interests of fish farming [2, 5].

Breeding of fish in small reservoirs was considered as a secondary one.

The polyculture of small reservoirs includes both the main objects of fish farming and non-traditional representatives of aquaculture (pike, sheatfish and pike perch, etc.) is practiced, which contributes to a more complete development of the forage basin of reservoirs, increase their fish productivity and economic efficiency of fish-breeding enterprises [3].

To determine the fish density we take into account the feed base, i.e. phytoplankton, zooplankton, the water area, and the volume of the photonic layer [13].

The purpose of the work is to calculate the density of planting fish to create special commodity fisheries, research the quality of the water environment and the state of ichthyology fauna and the natural forage basin of the reservoir.

Material and methods of research. Laboratory and field methods, literature review were used in the process of research. The research was carried out at Sandrak Reservoir, located on the Southern Bug River.

The area of the reservoir is about 170 hectares, the total and useful volume is respectively 1.9 and 1.5 million cbm, average depth is 1.8 m.

The reservoir is divided into the upper, middle and lower sections according to the depth, flow and characteristics of the coastline. The upper part has a lake-river character, the water mass extends beyond the channel, its average depth is 2 m, the river channel depth is 8 m [3-5].

The waters of the middle part of the reservoir cover large areas of the

floodplain. The maximum depth of the site reaches 11 m, the average depth is about 6 m. The lower part is the deepest. Near the dam the depth is 14 m, the average depth is 8 m.

The level regime of the reservoir is unstable, it is determined by the spring flood terms, water content and wind activity.

The collection of ichthyologic material was carried out with control and industrial fishing gear. The number of fish and industrial ichthyologic fauna were determined by combined representative methods [11, 14].

The hydrochemical regime, the water quality, the number and biomass of the main groups of fish organisms (phytoplankton, zooplankton, zoobenthos and visually higher aquatic vegetation) were studied [9].

To study of phytoplankton water samples were taken by Rotner's Bathometer, Einstein's zooplankton net according to generally accepted techniques.

The hydrochemical state of the water environment indicators was investigated in the laboratory, and the collection of samples, their fixation and treatment was carried out according to modern techniques. The obtained results were compared with the standards [11].

The water temperature during the research period was measured by a thermometer.

The Tretiak and Grytsyniak formula with zonal corrections on the forage base was used in calculations of fish densities [4].

The research results were processed using a personal computer and Microsoft Excel.

Experimental part and results discussion. As a result of research, it was found that the active reaction of water (pH) and the amount of dissolved oxygen are within the limits of norm, and its quantity is rather high.

The amount of calcium and magnesium ions is respectively 62-70 mg/l and 27-34 mg/l, these figures are slightly higher than the normative, but the excess is insignificant.

The amount of chlorides and sulfates is small, it is respectively 27 mg/l and 30-50 mg/l, water is dominated by hydrocarbons (330-347 mg/l).

The number of nitrogen and phosphorus basic nutrients (ammonium ion, nitrites, nitrates and phosphates), total iron and silicates (silicon) fully complies with the requirements of the fishery regulations. The hydrochemical parameters of reservoir water are in accordance with the fishery regulations, water is suitable for growing commercial fish.

As a result of the research it was established that phytoplankton reservoirs are represented by 54 species of algae; they belong to 6 freshwater phytoplankton groups, i.e. Cyanophyta (blue-green) has 3 species; Bacllariophyta (diatomaceous) has 25 species; Eugleno-phyta (eugenic) has 3 species ; Dinophyta (dinophytic) has 1 species; Chrysophyta (golden) has 2 species; Chlorophyta (green) has 21 species.

The basis species of phytoplankton are diatoms. The second place belongs to green algae, they are dominated by chlorococci (20), it is the most favorite feed for herbivorous fish.

The highest species diversity of algae is in the upper and lower part (41 and 37 species respectively). The basis of phytoplankton was diatoms and green algae. Their average number is 9,391 thousand cl/l and biomass is 4.12 g/m^3.

The dominant place in phytoplankton biomass is occupied by euglenic algae (1.6 g/m^3), they are represented predominantly by Trachlomonas species.

The next place in biomass is occupied by diatoms (1.409 g/m^3). The biomass of green algae, despite their greatest diversity, was only 0.862 g/m^3.

The analysis of the results shows that most algae are concentrated in the upper part of the reservoir. Biomass was dominated by euglenic algae (1,940 thousand cl/l at 3,069 g/m^3). In addition to them, alga flora was present in diatoms (2.4 g/m^3 at 4,200 thousand cl/l) and green algae (1.03 g/m^3 at 4.5 thousand cl/l).

The algae biomass of the reservoir middle part was 2 times lower than of the upper one; it amounted to 3.2 g/m^3 at 7,650 thousand cl/l. The diatoms had the greatest amount (1.164 g/m^3 at 1,700 thousand cl/l). There were euglenic, chlorococci and golden algae in the biomass.

Near the dam the algae population and their biomass were lower than in other parts, it was 2.63 g/m^3. However, the basis of biomass was eugenic algae (0.844 g/m^3 and 550 thousand cl/l) due to the development of Tgshelomonas volvocina. In addition, there were chlorococci and diatoms in phytoplankton; the percentage of other algae groups was negligible.

As a result of the research, it was established that the zooplankton reservoir was characterized by sufficient qualitative quantity; it has 32 species and taxa, i.e. 18 species of rotifers (Rotatoria), 5 species of Cladocera and 8 species of copepods (Copepoda), and ostracods (Ostracoda).

The number of species on some plots varied from 27 to 30, and in each section almost all kinds of water basins in general are presented, which indicates a very large faunistic similarity of zooplankton in the reservoir.

Such species as Asplanchna sieboldi, Keratella guadrata dominated among rotifers. Speaking about Cladocera we should mention that such species as Bosmina longirostris + llyocryptus sordidus dominates at the upper part, Daphnia longispina + B.longirostris dominates at the middle part, Chydorus sphaericus + B.1longirostris dominates near the dam. Speaking about copepods we should mention that such species as Cuclops strenuus + Eurutemora velox dominates at the upper part, C.strenuus + Mesocuclops crasus dominates at the middle part and near the dam. The average number and biomass of zooplankton was 1,826 per m^3 and 1.5 g/m^3.

The smallest number of zooplankton was recorded in the upper part of the reservoir; in the middle and lower parts the number and biomass of the zooplankton group was larger by 1.6-1.2 and by 4.3-3.7 times the biomass than in the upper part.

Rotifers dominated among the main taxonomic groups in biomass, their percentage 59-65% of total biomass.

In spring the species of the reservoir bottom fauna consisted of 6 species and belonged to 4 systematic groups, i.e. oligochaetes (2 species), larvae of chironomids (2 species), and larvae of other two-winged (2 species).

Insect larvae prevailed quantitatively and qualitatively. The average number and biomass of zoobenthos in the reservoir was 280 per m^2 and 5.184 g/m^2.

At the same time, the maximum indicators for the development of the zoobenthos were on silty sand in the middle and near-dam areas of the reservoir of 5.840 g/m^2 and 9.072 g/m^2.

Despite the low water temperature in the spring benthic biomass indicators were quite high. The predominance of benthic high calorie fodder larvae of chironomids and other insects and oligochaetes indicates a highly developed feed base.

There was a high development of phytoplankton and macrozoobenthos in the reservoir in spring.

According to visual observations, the reservoir has significant reserves of higher aquatic vegetation, especially in the upper part of it.

The representatives of the surface higher vegetation such as phragmites, broadleaf cattail and others dominated among macrophytes. Falcaria, Myriophyllum spicatum, meadow cultures dominated among the swimming and underwater higher plants.

According to observations, the overgrowing area in the upper part is from 50 to 75%, and directly in the upper reaches of the reservoir, these figures are close to 100%.

In the middle part, the surface macrophytes are located along the coast line entirely or with intervals, the area of overgrowing is approximately 15-20% taking into account floating and underwater plants,

In the lower, the most deep-water section of the reservoir the vegetation occurs only in separate islands. Thus, the total area of overgrowing of the reservoir is 25-35% in total.

The research results showed that there are 17 species of fish and their young, belonging to 6 families.

The most numerous is the Cyprinidae family, it has 11 species (carp, prussian carp, silver carp, rutilus, grass carp, rudd, bleak, gobio, rhodeus, tench, stone moroko), Percidae family has 2 species (perch, gymnocephalus), Esocidae family has 1 species (pike), Siluridae family has 1 species (European catfish), Cobitidae family has 1 species (misgurnus) and Acipenseridae family has 1 species (sterlet).

It should be noted that grass carp, tench, pike, catfish, misgurnus, and sterlet are also listed as a result of a interviewing of fishermen who caught these fish.

According to the results of catching, the young perch had a length,

respectively, lim=3.9-10.5 cm, rutilus had 3.0-11.2 cm, rudd had 3.9-7.9 cm, prussian carp had 15.3-17.0 cm, and other non-industrial fish had 2.3-8.5 cm. 234 fish species were measured.

Non-industrial small species of fish, including bleak (98-99% of the total fish catch), gobio exceeded 23% at separate areas dominated by relative number.

In spring absolute number of bleak was above 12 per m^2, absolute number of gobio was above 1.2 per m^2

Taking into account that there is a significant amount of gymnocephalus but they are non-industrial and unwanted fish in the management of cultural fisheries. They negatively affect the feed base, reducing its potential productivity.

It was established that the number of young industrial fishes was only 1-1.5% (rutilus, perch, crucian, rudd).

Thus, the species and number of fish populations are represented by non-industrial and garbage species of fish.

An analysis of the industrial ichthyologic fauna shows that carp (3 years), prussian carp (3-4 years old), silver carp (3 years), perch (4 years), rudd (4 years) and gymnocephalus (5 years) live in a reservoir.

The carp was 0.49-0.5 kg, silver carp was 0.72-1.2 kg, prussian carp was 0.14-0.38 kg, perch was 50-80 g.

There are listed types of fish of larger sizes in the reservoir; they are typical species naturally reproduced.

The analysis of the length of the fish body shows that the intensity of their growth is low.

According to the results of control fishing, industrial catch was 20 fish species (6.41 kg) by net for night in the Sandrak Reservoir on an area of 830 square meters. They were prussian carp (35%), carp (25%), perch (20%) and silver carp (10%).

Carp (38.8%), silver carp (30.0%), and prussian carp (24.3%) were dominant in the weight.

As a result of the conducted research it was established that the reservoir actual fish productivity is 76.7 kg/ha. At the same time, the weight of the carp per hectare was 29.8 kg/ha, silver carp was 23.0 kg/ha and prussian carp was 18.6 kg/ha.

The calculations show that, with a bleak absolute number of 12.38 per m^2, its actual catch could be at 371.4 kg/ha.

It was established that actual fish productivity of the reservoir is 300-350 kg/ha. Industrial species have above 50 kg/ha of and non-industrial species have above 250-300 kg/ha.

Taking into account the obtained results on the natural forage base, water environment and ichthyologic fauna, we will calculate the density of fish planting.

The calculation of the fish seeding is carried out for the period 2019-2022. The ratio for fish seeding is the following: silver carp (40%), bighead carp (10%), grass carp (5%), carp (10%) and sander (35%).

Table 1

Total annual fish seeding

No	Species	Years							
		2019		2020		2021		2022	
		per ha	total	per ha	total	per ha	total	per ha	total
1.	Silver carp	140	23,520	130	21,840	110	18,480	100	16,800
2.	Bighead carp	50	8,400	40	6,720	30	5,040	20	3,360
3.	Grass carp	30	5,040	30	5,040	20	3,360	10	1,680
4.	Carp	50	8,400	50	8,400	40	6,720	30	5,040
5.	Sander	80	13,440	50	8,400	30	5,040	20	3,360
Total		350	58,800	300	50,400	230	38,640	180	30,240

The table analysis shows that the total number of seeding fish in 2019 is 58,800, i.e. silver carp is 23,520, bighead carp is 8,400, and grass carp is 5,040.

The number of sander as a biological ameliorant is 13,440, as the amount of garbage is reduced, its amount will be reduced from 80 to 20 per ha

Conclusions. The natural forage base of the reservoir was at a high productive level. The state of the aquatic environment meets the regulatory requirements and is suitable for the introduction and cultivation of commercial fish.

Non-industrial small species of fish dominated in the reservoir, fish productivity is 3.0-3.5 centers per ha (0.5 centers per ha was industrial fish and 2.5-3.0 centers per ha was non-industrial fish).

The ratio for fish seeding is the following: silver carp (40%), bighead carp (10%), grass carp (5%), carp (10%) and sander (35%).

The total number of seeding fish in 2019 is 58,800, i.e. silver carp is 23,520, bighead carp is 8,400, and grass carp is 5,040.

In order to improve the species composition and conduct biological melioration of the reservoir we shall install two-year-old (this year) sander (80 per ha). Their total number will be 13.44 thousand. As the amount of garbage is reduced, its amount will be reduced from 80 to 20 per ha.

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АННОТАЦІЯ
ОБГРУНТУВАННЯ ТА РОЗРАХУНОК ЩІЛЬНОСТІ ПОСАДКИ РИБ ДЛЯ СТВОРЕННЯ СПЕЦІАЛЬНОГО ТОВАРНОГО РИБНОГО ГОСПОДАРСТВА

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Викладено результати комплексного дослідження водосховища на основі яких розроблено пропозиції по створенню спеціального товарного рибного господарства.

Характерною рисою річок Вінницької області є висока ступінь зарегульованості стоку малими водосховищами і ставками. У переважній більшості малих водойм сприятливі умови для нагулу і практично повна відсутність умов для ефективного природного відтворення цінних видів риби. При цьому сума абіотичних і біотичних факторів малих водосховищ дозволяє здійснити спрямоване формування іхтіофауни та одержувати товарну продукцію.

Гідрохімічні показники води відповідають рибогосподарським нормативним вимогам, а вона придатна для вирощування товарної риби.

Природна кормова база знаходилась на відносно високому продуктивному рівні. Зоопланктон водосховища характеризувався достатнім якісним багатством – у його складі зареєстровано 32 види.

Водосховище має значні запаси вищої водної рослинності, загальна площа заростання складає 25-35%. Площа заростання у верхній частині становить в середньому 60%, при чому безпосередньо у верхів'ї водосховища ці показники є близькими до 100%.

Вивчення іхтіофауни водосховища показує, що у ньому мешкають 17 видів риб та їх молоді, які належать до 6 родин. При цьому домінують непромислові види риб, а природна рибопродуктивності становить 3,0-3,5 ц/га, з яких 0,5 ц/га промислові риби.

Для зариблення пропонується використовувати коропа, товстолоба білого і строкатого та білого амура. З метою проведення біологічної меліорації водойми використовувати двохліток (цьоголіток) судака. Співвідношення при посадці риб на вирощування буде становити: товстолобик білий – 40%, товстолобик строкатий – 10%, амур білий – 5%, короп – 10% та судак – 35%.

Ключові слова: *водне середовище, родини та види риб, кормова база, водосховище, гідробіонти, рибогосподарські нормативи, гідрохімічні показники, фітопланктон, водорості, зоопланктон, рибництво, короп, білий товстолобик, карась, вівсянка*

Табл. 1. Літ. 15.

АННОТАЦИЯ
ОБОСНОВАНИЕ И РАСЧЕТ ПЛОТНОСТИ ПОСАДКИ РЫБ ДЛЯ СОЗДАНИЯ СПЕЦИАЛЬНОГО ТОВАРНОГО РЫБНОГО ХОЗЯЙСТВА

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Изложены результаты комплексного исследования водохранилища на основании которых разработаны предложения по созданию специального товарного рыбного хозяйства.

Характерной осебенностью рек Винницкой области является высокая степень регулирования стока малыми водохранилищами и прудами. В подавляющем большинстве

малых водоемов благоприятные условия для нагула и практически полное отсутствие условий для эффективного естественного воспроизводства ценных видов рыбы. При этом сумма абиотических и биотических факторов малых водохранилищ позволяет осуществить направленное формирование ихтиофауны и получать товарную продукцию.

Гидрохимические показатели воды соответствуют рыбохозяйственным нормативным требованиям, а она пригодна для выращивания товарной рыбы.

Естественная кормовая база находилась на относительно высоком продуктивном уровне. Зоопланктон водохранилища характеризовался достаточным качественным количеством – в его составе зарегистрировано 32 вида.

Водохранилище имеет значительные запасы высшей водной растительности, общая площадь зарастания составляет 25-35%. Площадь зарастания в верхней части составляет от 50 до 75%, причем непосредственно в верховье водохранилища эти показатели близки к 100%.

Изучение ихтиофауны водохранилища показывает, что в нем обитают 17 видов рыб и их молодежи, относящихся к 6 семьям. При этом доминируют непромышленные виды рыб, а естественная рыбопродуктивность составляет 3,0-3,5 ц/га, из которых 0,5 ц/га промышленные рыбы.

Для зарыблевания предлагается использовать карпа, толстолобика белого и пестрого и белого амура. С целью проведения биологической мелиорации водоема использовать двухлеток (сеголеток) судака. Соотношение при посадке рыб на выращивание будет составлять: белый толстолобик – 40%, толстолобик пестрый – 10%, белый амур – 5%, карп – 10% и судак – 35%.

***Ключевые слова**: водная среда, семьи и виды рыб, кормовая база, водохранилище, гидробионты, рыбохозяйственные нормативы, гидрохимические показатели, фитопланктон, водоросли, зоопланктон, рыбоводство, карп, карась, овсянка*

Табл. 1. Лит. 15.

Інформація про автора

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