RESEARCH ON ESTABLISHING THE OPTIMAL GROWTH DENSITY OF RAINBOW TROUT *(ONCORHYNCHUS MYKISS)* IN RECIRCULATED SYSTEMS IN ROMANIA

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Abstract

This study aimed to establish the optimum population density of the basins (with a useful volume of 45 m3 / basin), in order to increase the rainbow trout (Oncorhynchus Mykiss), in the recirculated system, in correlation with obtaining a higher technological efficiency. The study was carried out over a period of 90 days aimed at monitoring the technological performances, by performing period weighing, adjunsting the quantities of extruded combined feeds that were administred to the fishes, as the quantitative growth of the crop biomass.

The control fishing was carried out three times a month. In order to establish the optimum storage density, the three experimental pools from the recirculated system component were populated with a different number of specimens, to allow the possibility of testing three different storage densities.

Keywords: fish, trout, density, recirculating system

INTRODUCTION

With a modern fisheries management, streamlining it and manage stocks of each species of aquatic organisms that present economic interest, is currently seeking proximity to aquaculture, especially in closed aquatic environments (lagoons, fjords, lakes, bays, etc.) and in addition it is an increasingly important indicator in assessing the level of civilization of nations [5,6].

The most important step in the development of salmon farming at the international level was made when the granulated feed was created, thus easing the work of the trout breeder and completely eliminating the traditional feeding of salmonids, becoming known as a component. of the rather expensive and cumbersome technological process [1,2,6,7]. The growth performance of fish in a recirculating system in the case of stocking density and the influence of population density of different fish species, in practice studying these aspects on different species of culture and production systems, were highlighted by several authors [3,4,8].

MATERIAL AND METHOD

The biological material was represented by the 68-day-old rainbow trout (*Oncorhynchus mykiss*), hatched on Doaga fish farm in Vrancea county area and raised in small basins up to this age. This study aimed to create the conditions of overcapacity, respecting the carrying capacity of the recycling system, thus populating 3 basins (B1, B2, B3) with a single age class (68 days), sapling which was raised to reach the weight of marketing.

In the B1 basin a number of 12700 specimens of trout were populated with a total biomass weight of 152.4 kg and an average individual weight of 12 g / ex., In B2 there were 9700 specimens of saplings with a total weight of the biomass 112.52 kg and with the average individual weight of 11.6 g / ex., and in the last basin, B3 populated a number of 15000 specimens of rainbow trout with a total weight of 150 kg and an average weight individual of 10 g / ex. The control fishing was carried out three times a month. In order to establish the optimum poplar density, the 3 experimental basins in the composition of the

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recirculating system were populated with a different number of specimens, to allow the possibility of testing three different storage densities. In the first phase, the feeding began when the temperature of the water was about 12 ° C, with extruded combined feed Biomar Inicio 917, with the grain size of 1.1 mm, as a percentage of 1.2% of the total biomass. Table 1 shows the chemical composition of the combined feed extruder Biomar Inicio 917.

Table 1 The chemical composition of the combined feed extruder Biomar Inicio 917

Chemical composition	
Crude protein (%)	50
Crude fat (%)	16
NFE (%)	17
Ash (%)	8
Fiber (%)	1.4
P (%)	1.3
Energetic value	
Gross energy MJ / kg	21.7
Digestible energy MJ / kg	18.5

When the brood reached the weight of 50 gr / ex, the combined feed extruder Biomar Efico Enviro 920 Advance, with a granulation of 3 mm, was administered, also giving 1.2% of the total weight of fish estimated in the water at that time. The nutritional values of the Biomar Efico Enviro 920 Advance extruded combined feed in Table 2.

Table 2 The chemical composition of the combined feed extruder Biomar Efico Enviro 920 Advance

Chemical composition	
Crude protein (%)	44
Crude fat (%)	32
NFE (%)	14
Ash (%)	6
Fiber (%)	1.6
P (%)	0.9
Energetic value	
Gross energy MJ / kg	25
Digestible energy MJ / kg	21.7

The feed was divided into three daily portions, the administration of which was done manually and was spread all over the surface of the basin.

Throughout the research period, the quality parameters of the water were monitored, and were measured with the farm equipment; thermometer, oximeter, pH meter, spectrophotometer

RESULTS AND DISCUSSIONS

Throughout the experimental period, the physico-chemical parameters of the water were carefully monitored, by periodic sampling of water samples for chemical analysis.

The water temperature and oxygen content dissolved in water were determined 3 times during each month (Table 3)

Table 3 Temperature and dissolved oxygen content of the water in the breeding basins

The breeding basin	B1		B2		B3	
Density of population	12700 ex		9700 ex		15000 ex	
Analysed parameter	temperature °C	Dissolved oxygen mg O_2/l	temperature °C	Dissolved oxygen mg O_2/l	temperature °C	Dissolved oxygen mg O_2/l
22.12.2018	12.7	10.1	12.5	10.2	12.6	10.2
04.01.2019	12.6	9.6	12.7	10.1	12.1	9.93
16.01.2019	12.8	9.2	12.8	9.8	13.1	8.81
31.01.2019	13.1	8.91	13.0	9.01	13.2	8.62
09.02.2019	13.2	8.24	13.2	8.91	13.4	8.32
18.02.2019	12.9	8.04	12.9	8.76	12.8	7.93
26.02.2019	13.4	7.83	13.1	8.69	13.5	8.45
04.03.2019	13.5	8.4	13.5	9.02	13.7	9.31
11.03.2019	13.7	8.01	13.8	8.6	13.9	9.20
21.03.2019	13.3	7.6	13.3	8.35	12.9	9.16

Analyzing the data entered in table 3, we find normal values for the studied parameters, in all 3 experimental basins. So, the water temperature showed values between 12.6 ° C and 13.7 ° C in the case of basin B1, between 12.5 ° C and 13.8 ° C in the case of basin B2, respectively between 12.1 ° C and 13.9 ° C in the case of basin B3. During the researches, besides the water temperature and its content in dissolved oxygen, were monitored other very important parameters, such as the concentration of ammonia, and the technological water content in nitrogen and nitrogen.

The determination of these parameters was made carefully, throughout the experimental duration, by periodic water samples for chemical analysis. The samples were taken, processed and interpreted in an authorized analysis laboratory, according to the national and international standards in force. (Table 4)

Table 4 Water content in breeding basins in ammonia, nitrates and nitrates

The breeding basin	B1			B2			B3		
Density of population	12700 ex			9700 ex			15000 ex		
Analysed parameter	NH_3 mg/l	NO_2^- mg/l	NO_3^- mg/l	NH_3 mg/l	NO_2^- mg/l	NO_3^- mg/l	NH_3 mg/l	NO_2^- mg/l	NO_3^- mg/l
22.12.2018	0.25	0.16	18.3	0.20	0.12	17.4	0.21	0.14	15.3
04.01.2019	0.15	0.18	20.1	0.19	0.10	18.6	0.24	0.12	16.8
16.01.2019	0.20	0.11	23.2	0.15	0.16	21.3	0.14	0.18	14.3
31.01.2019	0.28	0.38	24.6	0.24	0.31	22.9	0.26	0.33	15.2
09.02.2019	0.4	0.36	27.1	0.31	0.26	24.8	0.39	0.36	19.7
18.02.2019	0.48	0.26	28.5	0.38	0.16	23.0	0.46	0.24	26.2
26.02.2019	0.57	0.46	42.7	0.46	0.28	27.1	0.56	0.29	30.4
04.03.2019	0.51	0.42	36.8	0.44	0.30	30.5	0.48	0.28	34.1
11.03.2019	0.49	0.32	38.9	0.41	0.28	26.4	0.44	0.21	32.8
21.03.2019	0.68	0.25	39.4	0.48	0.30	38.7	0.51	0.25	28.7

Analyzing the data entered in table 4, it can be observed that the three analyzed parameters showed a similar evolution in all the 3 growth basins. So, in the case of ammonia the values obtained in the three basins were in the range 0.14-0.68 mg / l, in the case of nitrites they were in the range 0.10-0.46 mg / l, and the values determined for the nitrate content were in the range 14.3-42.7 mg / l. The lowest values for the physico-chemical parameters were determined in the case of basin B3, basin in which were obtained the best values regarding the growth rate.

In order to establish the optimum population density, the 3 experimental basins in the composition of the recirculating system were monitored over a period of 90 days. (Table 5). Control fishing to determine the growth rate was carried out three times a month.

At the time of population, the average weight of the rainbow trout specimens was 12.0 g / ex in the case of B1, 11.6 g / ex, in the case of B2, respectively 10.0 g / ex in the case of the specimens populated in B3.

The first control fishery was conducted on 04.01.2019, at which time there was an average weight gain of between 4.3 g / ex and 5.2 g / ex. As of 16.01.2019, the specimens from groups B1 and B2 had an average weight of 16.3 g / ex g, and those of group B3, of only 15.2 g / ex.

On 31.01.2019, the rainbow trout brood reached an average body weight of between 24.1 g / ex and 25.7 g / ex.

The following control fishing was carried out on 09.02.2019, at which time the specimens of rainbow trout analyzed weighed between 28.8 - 34.7 g / ex.

At the fishing control of 18.02.2019 the best values were obtained for the trout from the B3 group, they recorded an average weight of 38.2 g / ex.

At the following 3 controls, the same trend was maintained, so the trout brood from

group B3, presented the best values. The last control fishing was carried out on 21.03.2019, when the last weighings were made and average weights of 63.7 g / ex were obtained in the case of batch B2, of 67.3 in the case of batch B1, respectively 76.2 in the case of lot B3. (Table 5)

Table 5 Weight gain of the species Oncorhynchus mykiss

Specification	Rainbow trout	Rainbow trout	Rainbow trout
The breeding basin	B1	B2	B3
Density of population	12700 ex	9700 ex	15000 ex
22.12.2018	12.0 g/ex	11.6 g/ex	10.0 g/ex
04.01.2019	16.3 g/ex	16.3 g/ex	15.2 g/ex
16.01.2019	19.8 g/ex	19.3 g/ex	19.4 g/ex
31.01.2019	25.7 g/ex	24.3 g/ex	24.1 g/ex
09.02.2019	34.7 g/ex	29.3 g/ex	28.8 g/ex
18.02.2019	35.7 g/ex	34.8 g/ex	38.2 g/ex
26.02.2019	44.6 g/ex	40.2 g/ex	50.1 g/ex
04.03.2019	52.5 g/ex	43.9 g/ex	52.7 g/ex
11.03.2019	57.3 g/ex	49.6 g/ex	58.5 g/ex
21.03.2019	67.3 g/ex	63.7 g/ex	76.2 g/ex

Throughout the researches, the total losses, both numerically and as a percentage, were monitored for each of the three basins separately (Table 6).

Table 6 Total losses recorded during the research period

Specification	Rainbow trout		Rainbow trout		Rainbow trout	
The breeding basin	B1		B2		B3	
Density of population	12700 ex		9700 ex		15000 ex	
Losses	exemplary	%	exemplary	%	exemplary	%
04.01.2019	37	0.29	46	0.47	205	1.37
16.01.2019	44	0.35	149	1.54	159	1.06
31.01.2019	72	0.57	102	1.05	178	1.19
09.02.2019	26	0.20	46	0.47	83	0.55
18.02.2019	40	0.31	37	0.38	85	0.57
26.02.2019	11	0.09	31	0.32	39	0.26
04.03.2019	16	0.13	27	0.28	46	0.31
11.03.2019	27	0.21	29	0.30	32	0.21
21.03.2019	255	2.01	35	0.36	82	0.55
Total	528	4.16	502	5.18	909	6.06

Table 6 shows the mortalities recorded during the 90 days of experiment. According to the data from this table it can be observed that the highest mortality was registered in the case of the trout kept in the B3 basin, in which there were 909 non-surviving specimens, representing a percentage of 6.06%.

CONCLUSIONS

Throughout the researches, the physico-chemical parameters of the water presented optimal values for the normal growth and development of the rainbow trout brood. Thus, the water temperature in the breeding basins ranged between 12.1 ° C and 13.9 ° C, the water content in dissolved oxygen had values between 7.6 mg O2 / l and 10.2 mg O2 / l, and the ammonia content did not exceed 0.68 mg / l in all 3 basins.

Nitrates were in the range 0.10-0.46 mg / l, and the nitrate content was in the range 14.3-42.7 mg / l. Regarding the growth rate, the best values were obtained in the case of trout brood from basin B3, which presented the lowest average weight, at only 10.0 g / ex

and the most popular density. large, 15,000 ex, however, which at the end of the research reached the average weight of 76.2 g / ex. Also in the B3 basin were the largest losses, 909 non-surviving specimens of rainbow trout, representing 6.06% of the total populated trout. Analyzing all the data obtained, the growth rate of the trout brood from B3, superior to the other two experimental basins, was accounted for by the lower weight in the population, so that they settled much faster and easier after moving from the basin where they were raised to the age of 68 days and as a result of the higher storage density that led to the emergence of competition phenomenon in feeding. For these reasons, the administered food was used more efficiently, the feed having a better conversion thus the quantity of feed consumed being minimal.

According to the data obtained from this study, I recommend the popularity of trout brood at the age of 68 days, monitoring it permanently and feeding it with extruded granulated feed of the highest quality.

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