INFLUENCE OF STOCKING DENSITY AND WATER PARAMETERS ON GROWTH OF JUVENILE BELUGA STURGEON (*HUSO HUSO*, LINNAEUS, 1758)

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Abstract

The main purpose of the present experiment consist in evaluation of growth performances of beluga sturgeon juveniles (obtained from the artificial reproduction of mature sturgeons with origins in the Danube-Pontic basin) reared in different stocking densities in a recirculating aquaculture system .The influence of stocking density and water quality on the growth of beluga fingerlings was studied during 30 days. The two experimental variants (V1 and V2) were formed by two rearing units each with a different fish density: 30 exemplars (initial average weight -34g) in first two aquaria (V1) and 10 exemplars (initial average weight -25g) in the following two aquaria (V2). The fish were fed a 55% protein feed to a feeding rate of 3 % body weight/day. During experiment water quality parameters (pH, O_2, T, NH_3-N, NO_2-N, NO_3-N) were recorded an a daily basis and, every 2 weeks, the fish were weight individually, and weight gain was recorded. Beluga growth performances were evaluated through analysis of various technological indicators: W (weight gain), FCR (food conversion ratio), SGR (specific growth rate), PER (protein efficiency ratio). The body profile was evaluated through allometric factor.

Key words: recirculating system, sturgeons, artificial feed.

INTRODUCTION

In the last years, beluga in Danube registered an extreme depletion, in the number and size as well excepting the last two years when few exemplars were desultory cached. In this context the rearing in controlled environment problem is becoming an imperative issue from an economic and ecological point of view. Rearing of fingerlings beluga, obtained through artificial reproduction, in the specific conditions of a recirculating system represents an important technological opportunity (Vasilean and Cristea, 2005).

The main purpose of the present experiment consist in evaluation of growth performances of beluga sturgeon juveniles (obtained from the artificial reproduction of mature sturgeons with origins in the Danube-Pontic basin) reared in different stocking densities in a recirculating aquaculture system.

MATERIALS AND METHODS

The biological material proceeded from the artificial reproduction of wild sturgeons at Reproduction Station ISACCEA (S.C. Kaviar House S.R.L. Bucuresti), where the fry and fingerlings have been reared, now have been transferred in the „Recirculating aquaculture system engineering" laboratory from the „Aquaculture and Fisheries" Department, University Dunarea de Jos Galati.

The influence of stocking density and water quality on the growth of beluga fingerlings was studied during 30 days. The recirculating system has as experimental rearing units four glass aquaria with an individual volume of 300L.

The recirculating system where the experiment was realized is presented in figure 1.

Technical characteristics of the recirculating aquaculture system:

From a constructive point of view the recirculating system is compiled from:

A. Rearing modules unit - represented by 4 rectangle aquariums made from glass with 10 mm, with a volume of approximately 300 liters/tank, resulting in the total breeding 1.2 m^3 of water. The number of the rearing units assures a right flexibility regarding biotechnological indicators as well as the possibility of accomplishing the needed experimental variants in order to have conclusive results of technological approach.

Fig. 1. Recirculating system

B. Water conditioning units has the mission to control and maintain in optimal range the main water quality parameters (oxygen concentration, ammonia nitrogen concentration, total suspended solids concentration, pH and carbon dioxide formed), formed by:

- Mechanical filtration unit - has a foot plate with tronconic items of hard plastic material where a number of long gaps are realized; through those gaps the filtrated water is passing without involving the filtration material represented by the quartz sand;

- Biological filtration unit - use a trickling filter (the nitrification process realizable through a large surface area where the nitrifiers grows to form a bacterial film over which the water is flowing in sprinklings in order to make possible the ammonia oxidation), wos chosen a material with large specific surface (300m2/m3) with a spherical form called bactoballs;

- Water sterilization unit - is realized with a UV installation mounted on the principal supply flow of the rearing units (UV lamp, TERA POND, Type UV-C 35000 is the power -36Watt, that assures the right amount of gamma radiation with optimal length wave for the technological flow);

- Oxygenation unit - for oxygen concentration supply dictated by the stocking intensification degree, the recirculating system was provided with one compressor RESUN AIR-PUMP (model: ACO-018A with a flow of 260l/min), sharing in each aquarium.

C. Water distribution unit - consist in three pumps, GRUNDFOS, type UPBASIC 25-6 180, max.10 bar, which assures the technological flow necessary for each rearing unit.

The inflow for the aquariums: 4×12=48 l/min.

The main parameters (temperature, dissolved oxygen, and pH) from the recirculating system were determinate with oxy-meter - Oxi315i and pH-meter type pH - 315i, for nitrogen compounds measurements have been used the photometer PCMULTIDIRECT.

The experiment regarding beluga rearing in diferent conditions of stocking density was conducted over 30 days and was structured in two experimental stages splited by an

intermediary weight evaluation followed by a recalculated feedin rate.

The two experimental variants (V1 and V2) were formed by two rearing units each with a different fish density: 30 exemplars (initial average weight -34g) in first two aquaria (V1) and 10 exemplars (initial average weight -25g) in the following two aquaria (V2). The fish were fed a 55% protein feed to a feeding rate of 3 % body weight/.day. During experiment water quality parameters (pH, O2, T, NH3-N, NO2-N, NO3-N) were recorded an a daily basis and, every 2 weeks, the fish were weight individually, and weight gain was recorded. Beluga growth performances were evaluated through analysis of various technological indicators: W (weight gain), FCR (food conversion ratio), SGR (specific growth rate), PER (protein efficiency ratio).

The food conversion ratio was calculated with formula:

$$FCR = F / (Bf-Bi)$$

where: F – the amount of given food;
(Bf-Bi) – the gain biomass;
Bf, Bi – final and initial biomass.

The specific growth rate was calculated with the following formula:

$$SGR = [(\ln Mf – \ln Mi)/ T]*100$$

where: Mf – final biomass;
Mi – initial biomass;
T – time interval (day).

Protein efficiency ratio was calculated with:

$$PER = Wf\text{-}Wi/F \cdot Pb$$

where: Wf – final biomass, g;
Wi – initial biomass, g;
F - quantity of feed ingested, g;
Pb - brute protein feed, %,
(Oprea and Georgescu 2000).

The body profile was evaluated through allometric factor.

RESULTS AND DISCUSSIONS

In table 1 are presented the initial technological parameters.

Table 1
Weight and length average of beluga

	B1	B2	B3	B4
Weight (g)	35,46	32,84	24,4	22,4
Length (cm)	20,62	20,02	18,26	16,85

The fish had permanently an active behavior and consumed integrally the amount of administrated feed. Regarding the feeding behavior we have observed that the beluga fingerlings rather prefer taking granules from the bottom of the tank then from the water body mass, with onw the survival rate 100%.

Table two is painting on synthetic indicators of technological performance of beluga in different conditions intensivitate.

In figure 2 is observed that specific growth rate shows a trend similar to that of FCR, in that aquarium with the stocking density has higher values compared to smaller ponds where the stocking density was lower, this being more pronounced in stage II of growth.

Table 2
Growth performance of the biological material

Growth performance of fish	Stage I (1.08.07-15.08.07)						
Experimental variant	B1	B2	B3	B4	Total	Average	Dev.Std.
Total feed/ aquarium(g)	510,75	487,80	109,80	100,80	1209,15	302,29	197,18
Initial biomass (g)	1135,00	1084,00	244,00	224,00	2687,00	671,75	438,18
Exemplar number	32,00	33,00	10,00	10,00	85,00	21,25	11,26
Average initial weight (g/ex)	35,40	32,80	24,40	22,40		28,75	5,47
Final biomass(g)	2157,00	2176,00	510,00	457,00	5300,00	1325,00	841,74
Average final weight (g/ex)	67,40	65,90	51,00	45,70		57,50	9,35
Individual biomass gained (g/fex)	32,00	33,10	26,60	23,30		28,75	3,99
Total biomass gained (g)	1022,00	1092,00	266,00	233,00		653,25	404,68
Relative feeding rate - R (g/kg/zi)	0,23	0,23	0,06	0,06		0,15	0,08
Specific growth rate SGR (% BW/day)	4,29	4,65	4,91	4,75		4,65	0,23
Daily growth rate - (g/kg/day)	2,13	2,21	1,77	1,55		1,92	0,27
FCR (g/g)	0,50	0,45	0,41	0,43		0,45	0,03
Protein / aquarium	234,95	224,39	50,51	46,37	556,21	139,05	90,70
Protein efficiency ratio - PER (g)	4,35	4,87	5,27	5,03		4,88	0,34
Growth performance of fish	Stage II (15.08.07 – 2.09.07)						
Experimental variant	B1	B2	B3	B4	Total	Average	Dev.Std.
Total feed/ aquarium(g)	970,65	979,20	229,50	205,65	2385	596,25	378,78
Initial biomass (g)	2157,00	2176,00	510,00	457,00	5300	1325	841,73
Exemplar number	32,00	33,00	10,00	10,00	85	21,25	11,25
Average initial weight (g/ex)	67,40	65,90	51,00	45,70		57,5	9,35
Final biomass(g)	3920,00	3881,79	1020,0	926,00	9747,79	2436,94	1464,38
Average final weight (g/ex)	122,50	117,63	102,00	92,60		108,68	11,98
Individual biomass gained (g/fex)	55,10	51,73	51,00	46,90		51,18	2,09
Total biomass gained (g)	1763,00	1705,79	510,00	469,00		1111,94	622,94
Relative feeding rate - R (g/kg/zi)	0,26	0,27	0,07	0,07		0,17	0,09
Specific growth rate SGR (% BW/day)	3,98	3,86	4,62	4,71		4,29	0,37
Daily growth rate - (g/kg/day)	3,67	3,45	3,40	3,13		3,41	0,19
FCR (g/g)	0,55	0,57	0,45	0,44		0,50	0,05
Protein / aquarium	446,50	450,43	105,57	94,60	1097,1	274,27	174,23
Protein efficiency ratio - PER (g)	3,95	3,79	4,83	4,96		4,38	0,51

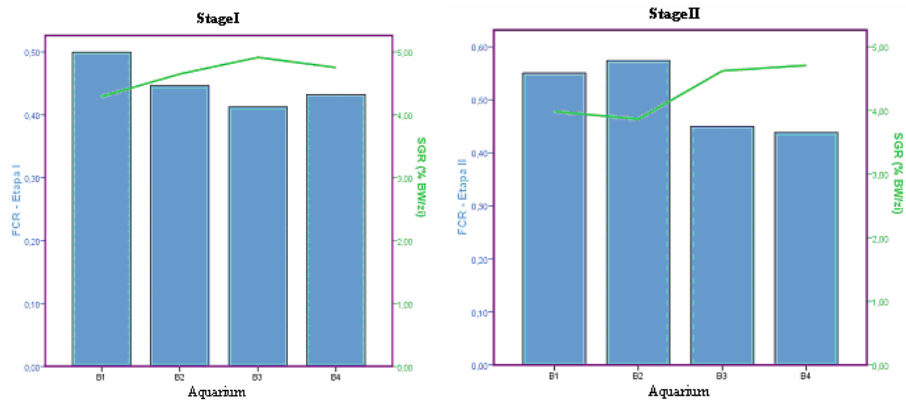

Fig. 2 Food conversion ratio (FCR) and specific growth rate (SGR) for experimental variants experimented in RAS

The stocking density in V1 variated from 3,75 kg/m2 to 12,75 kg/m2 in the first aquarium (B1) and from the 3,64 kg/m2 to 12,89 kg/m2 in the second aquarium (B2). In the second variant V2 the stocking density was 0,81 kg/m2 (B3), respectively 0,76 kg/m2 (B4) in the beginning and 3,4 kg/m2 (B3), respectively 3,86 kg/m2(B4) in the end of experiment.

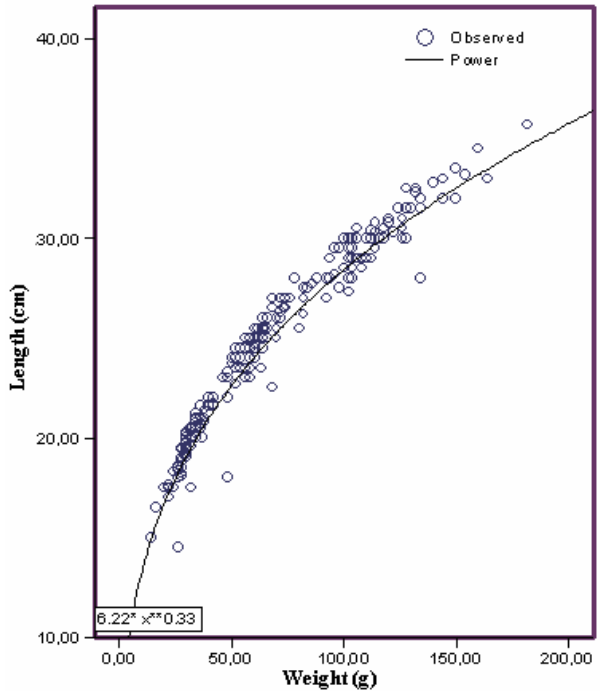

Fig. 3. The growth curve and growth equation for Huso huso specie in conditions of a recirculating aquaculture system

Growth curve estimation was realized with power model, the fish growth beeing defined by equation W=aLb. The model was checked with ANOVA test, the result corroborated with high confidence level against regression curve (R2=0.96), confirming the estimation prediction.

CONCLUSION

- Specific growth rate proved to be independent of initial weight of exemplars studied, a result of increasing the dynamic contrast to most species of fish at the rate of growth is in negative correlation with size and age of specimens.
- Conversion factor of food sub unitary recorded values for all variants and experimental phases, which confirms the potential of the species studied for intensive systems recirculante.
- State of condition of exemplars studied was not influenced by stocking density.
- Protein efficiency (PER) recorded values slightly higher (statistically insignificant) for density variations of small folk, this may be due to lower energy consumption in fish maintained at low density, active swimming is more obvious in the case of specimens maintained in density high.

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