Bulletin UASVM Animal Science and Biotechnologies, 66 (1-2)/2009
Print ISSN 1843-5262; Electronic ISSN 1843-536X

The Breeding of Beluga Sturgeon (*Huso huso*, Linnaeus, 1758) in recirculating aquaculture systems

Lucian OPREA[1], Mihaela BARBULESCU[1], Gianina M. BACANU[2]

[1]"Dunarea de Jos" University, 47 Domneasca Street, 800008 Galati, Romania; lucian.oprea@ugal.ro
[2]Institute of Animal Diagnostic and Health, 63 Dr. Staicovici Street, Bucharest, Romania;

Abstract. Research was aimed at the breeding of beluga juveniles (Huso huso) in a pilot recirculating aquaculture system, aquarium-type, in conditions of low fish density and intense feeding. The factor that made the difference between the two experimental variants was the feeding level.

After a growth period of 30 days, as a result, fish biomass has doubled in the variant with 15g/kg metabolic weight (2.1% of biomass), from about 3 kg/m3 to 6 kg/m3. We demonstrated that the use of a feeding level of 30g/kg metabolic weight (4.2% of biomass) negatively affected the fish growth because the food quantity was too big, unprofitable and causing pollution to the system.

Keywords: beluga, feeding level, FCR, RAS

INTRODUCTION

Dating 200 million years ago, sturgeons are the most valuable fish in Earth's waters. They can be found only in Europe, North America and Asia. From a systematic point of view, sturgeons are part of the *Osteichthyes* class, subclass of *Actinopterygii* and order of *Acipenseriformes* spp. This order includes 27 species grouped into 2 families: *Acipenseridae* with 25 species and *Polyodontidae* with 2 species. Of the 27 species, 6 species are native in the Danube basin: Great sturgeon (beluga) (*Huso huso*), Russian sturgeon (*Acipenser gueldenstaedti*) Stelate sturgeon (*Acipenser stellatus*), Sterlet (*Acipenser ruthenus*), Ship sturgeon (*Acipenser nudiventris*), and Common sturgeon (*Acipenser sturio*).

If 50 years ago, one could frequently find all 6 species in the Danube, today we find only 4 species (*Huso huso, Acipenser gueldenstaedti, Acipenser stellatus, Acipenser ruthenus*). During the last 4-5 decades, no Common sturgeon (*Acipenser sturio*) was caught, while recent information shows that Ship sturgeon (*A. nudiventris*) was caught in 2003, at km 1390, on the Serbian sector of the Danube.

According to the red list of threatened species prepared by the IUCN (International Union of Conservation of Nature) in 2004, all sturgeon species worldwide are endangered and some are even critically endangered. Recent research conducted by specialists of the World Society for the Conservation of sturgeon (World Sturgeon Conservation Society) have highlighted that urgent measures must be taken to conserve populations of sturgeon in the Danube. Fortunately, on Earth, there are no extinct species of sturgeons yet, but the most valuable ones are very close to becoming extinct. Although measures were taken to conserve sturgeons, they are still insufficient. Over-fishing and poaching are very intense. This has become the main cause that leads to a decline in populations. But there are other causes that affect the substantial decrease of sturgeon stocks, such as destruction of habitats and areas of breeding, the construction of dams on the Danube, pollution, and introduction of exotic species that alter the genetic structure of populations.

MATERIALS AND METHODS

Experiments were conducted in early 2009 in the pilot recirculating aquaculture system of Aquaculture, Environmental Science and Cadastre Department of the Food Science and Engineering Faculty from Galati.

The aquaculture system is represented by 4 type-aquarium growth units with useful volume of 165 l and dimensions of 98x47x36 cm. The growth unit is equipped with mechanical and biological filters, sterilization unit (Quiet equipment Tetra 35000 UV-C, with 36 W power) and the aeration equipment (compressor Resun Quiet LP-100 with 100 w power, pressure 0.045 MPa and flow air 150 l/min.) (Fig.1).

The biological material that was used consisted of juvenile beluga, aged 8 months, having a body weight of 178-196 grams/fish, delivered by the Fish Research Institute (ICDEAPA) Galati. Each unit was populated with 3 fish.

During the 30 days of the experiment, there were tested two research variants: V1, with feeding level of 15 g/kg metabolic weight (2.1% of total biomass) and V2, with feeding level of 30g/kg metabolic weight (4.2% of total biomass). To check the accuracy of the results, each experimental variant had a repetition. Trout pellets were used for fish feeding, with grain of 3 mm length and 2 mm wide range, the "Classic Extra 1P" produced by SKRETTING Italy (table 1). The calculation of feeding was made according to the feeding level (table 2).

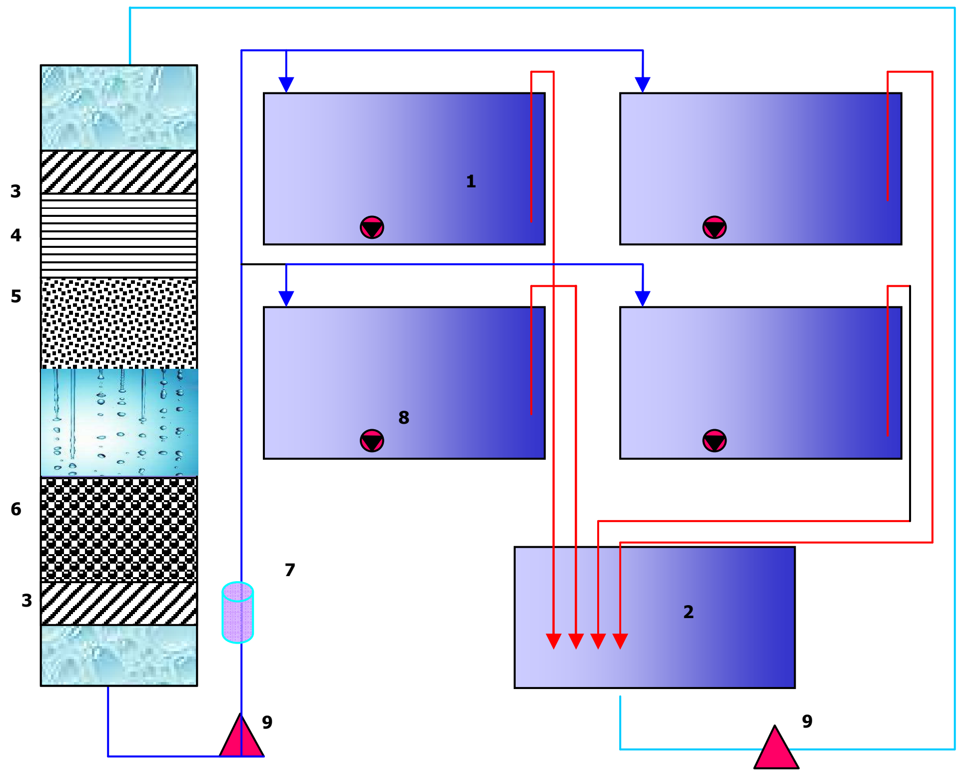


Fig. 1. The experimental growth units
(1.Aquarium 2.Collecting tank 3. Sponge 4. Sand 5. Gravel
6. Biological filter 7. UV Lamp 8. Aeration unit 9.Pump)

Tab. 1

Chemical composition of the pellets Classic Extra 1

Nutrients	Quantity
Gross protein	41 %
Lipids	12 %
Ash	7 %
Raw cellulose	2,5 %
Phosphorus	0,9 %
Vitamin A	10.000 U.I./kg
Vitamin D3	1250 U.I./kg
Vitamin E	150 mg/kg
With	6 mg/ kg
Ingredients: products extracted from oilseeds, cereals and cereal by-products, fish, haemoglobin, oils, BHT.	

Tab. 2

The daily quantity of food distributed

Calculation items	Water temp	V1		V2	
	(°C)	B1	B2	B3	B4
Initial no. of fish		3	3	3	3
Initial total biomass (g)		533	588	534	596
The average mass (g/fish)		178.0	196.0	178.0	199
Feeding level (% biomass)		2.1	2.1	4.2	4.2
Feeding level (g/kg met w)		15	15	30	30
FCR		1	1	1	1
31-Jan	20	11.3	12.2	22.6	24.7
01-Feb	20	11.5	12.4	23.4	25.5
02-Feb	20	11.7	12.6	24.2	26.4
03-Feb	20	11.9	12.8	25.0	27.2
04-Feb	20	12.1	13.0	25.8	28.1
05-Feb	20	12.3	13.3	26.6	29.0
06-Feb	21	12.5	13.5	27.5	29.9
07-Feb	21	12.7	13.7	28.4	30.8
08-Feb	22	12.9	13.9	29.3	31.8
09-Feb	22	13.1	14.1	30.2	32.8
10-Feb	22	13.3	14.4	31.2	33.8
11-Feb	21	13.6	14.6	32.1	34.8
12-Feb	21	13.8	14.8	33.1	35.9
13-Feb	20	14.0	15.1	34.2	37.0
14-Feb	19	14.2	15.3	35.2	38.1
15-Feb	19	14.4	15.5	36.3	39.2
16-Feb	20	14.7	15.8	37.3	40.4
17-Feb	20	14.9	16.0	38.5	41.5
18-Feb	20	15.1	16.3	39.6	42.7
19-Feb	19	15.4	16.5	40.8	44.0
20-Feb	18	15.6	16.8	41.9	45.2
21-Feb	18	15.9	17.0	43.2	46.5
22-Feb	19	16.1	17.3	44.4	47.8
23-Feb	20	16.4	17.6	45.7	49.2
24-Feb	20	16.6	17.8	47.0	50.5
25-Feb	20	16.9	18.1	48.3	51.9
26-Feb	20	17.1	18.4	49.6	53.4
27-Feb	19	17.4	18.6	51.0	54.8
28-Feb	19	17.7	18.9	52.4	56.3
01-Mar	19	17.9	19.2	53.8	57.8
Total food distributed		433	466	1098	1187
Note: On 20.02.2009, in B3 aquarium, one fish died (w = 190 g)					

RESULTS AND DISCUSSION

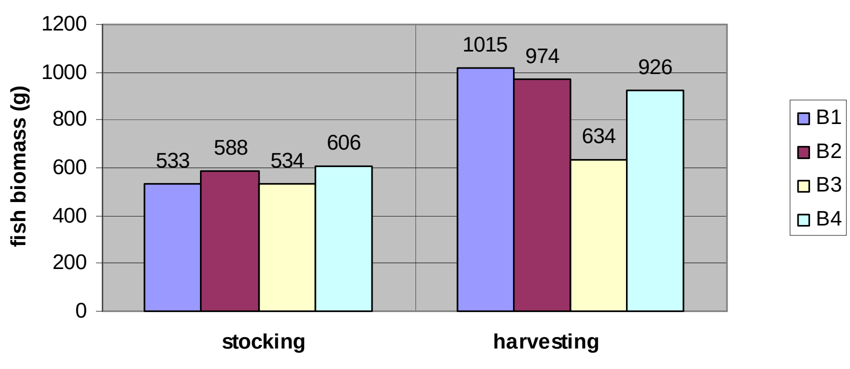
An overview of the performance of growth indicators and of the growth dynamics during the culture period is presented in table 3 and fig.2.

Tab. 3

Growth indicators of beluga juveniles

The experimental variant	V1		V2	
Indicator / basin	B1	B2	B3	B4
Initial biomass (g)	533	588	534	596
Final biomass (g)	1015	974	634	926
Biomass gain (g)	482	386	100	330
Initial fish number	3	3	3	3
Final fish number	3	3	2	3
Survival rate (%)	100	100	66.67	100
Initial mean body weight (g/ex)	178.00	196.00	178.00	202.00
Final mean body weight (g/ex)	338.33	324.67	317.00	308.67
Days of growth	30	30	30	30
Individual growth gain (g)	160.33	128.67	139.00	106.67
Total food distributed (g)	432	466	1098	1187
FCR (g feed/g biomass gain)	0.90	1.21	10.98	3.60
Feeding level (g/kg met. weight)	15	15	30	30
Feeding level (% biomass)	2.1	2.1	4.2	4.2

Fig. 2 - Fish growth dynamic during the culture period



The findings of the results are analysed below:

All four aquaria achieved growth of fish biomass after a period of 30 days. The largest growth was recorded in V1 variant, B1 aquarium (482 g), followed by B2 aquarium (386 g). The lowest growth was recorded in V2 variant, B3 aquarium, with only 100 g compared to 330 g in B4. This result was due to the loss of one fish.

Paradoxically, the best growth of fish was recorded in V1 (in aquaria B1, B2) which was distributed in a lower intake, 15 g/kg metabolic weight (2.1% of total biomass). Feed conversion ratios (FCR) obtained in B1 (0.9) and B2 (1.21) are very good, close to the amount proposed at the beginning of the experiment (FCR=1). These values demonstrate that the experiment was conducted in optimal conditions, without altering the environment.

In contrast, results in V2 (aquaria B3, B4) were weak, despite the fact that a larger amount of food was distributed. An FCR result of 10.98 in B3 and 3.6 in B4, demonstrates that the feeding level of 30 g/kg metabolic weight (4.2% of total biomass) proved to be exaggerated. The large amount of food in B3 was intentionally kept, despite the loss of one fish, too see the influence on FCR. Normally, when a fish dies, the daily food ratio needs to be recalculated according to the remaining fish biomass.

CONCLUSIONS

An effective way to reduce pressure on sturgeon populations in natural environments is to use different culture systems for breeding, such as traditional systems (ponds) or modern systems (RAS-recirculating aquaculture systems).

Research was aimed at breeding the beluga juveniles in a pilot recirculating aquaculture system (aquarium-type). The indicator that made the difference between the two experimental variants was the feeding level. After a growth period of 30 days, the fish biomass gain doubled in the variant with 15 g/kg metabolic weight (2.1% of biomass), from about 3 kg/m^3 to 6 kg/m^3.

We demonstrated that using a feeding level of 30g/kg metabolic weight (4.2% of biomass) negatively affects the fish growth because the amount of food is too big, unprofitable and causing pollution to the system.

Acknowledgments. All thanks are due to the project POSDRU-6/1.5/S/15-Management System for PhD Scholarships-6583 SIMBAD, financed by the European Union and the Romanian Government.

REFERENCES

1. Birstein, V, (2002). Sturgeon Biodiversity and Conservation, Ed. Kluwer Academic, Olanda, p. 157-163.
2. Bloesch, J, (2006). Action Plan for the conservation of sturgeons (Acipenseridae) in the Danube River Basin, Council of Europe, p. 5-15.
3. Cristea, V, (2002). Ingineria sistemelor recirculante din acvacultura, Ed. Didactica si Pedagogica, p. 14-60.
4. Dettlaf, T, (1993). Sturgeon Fishes, Ed. Springer Verlag Berlin, p. 5-22.
5. Holcik, J, (1997). The Freshwater Fishes of Europe/General introduction to Fishes, Acipenseridae, vol 1/II.
6. Manea, Ghe, (1980). Sturionii, Editura Ceres, Bucureşti, 1980.
7. Oprea, L, (2000). Nutriția şi alimentația peştilor, Editura Tehnică, Bucureşti.
8. Patriche, N, (2005). Pastruga/Biologie si reproducerea artificiala, Edit. Ceres, Bucuresti.