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INFLUENCE OF FEEDING LEVEL ON THE GROWTH OF SIBERIAN STURGEON (*Acipenser baerii* B r a n d t, 1869) IN A RECIRCULATING AQUACULTURE SYSTEM

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Abstract. The paper is presenting aspects regarding the influence of feeding level on the breeding of Siberian sturgeon in a recirculating aquaculture system (RAS). The experiment took place over 30 days, in 4 pilot breeding units of type aquariums of 300 l in volume. Two kinds of feeding level variants were compared, with two repetitions: V1 with 5.5 g/kg metabolic weight (1.2% from total biomass) and V2 with 11 g/kg metabolic weight (2.4% from total biomass). The same stocking density of 20 fish/unit and the same pellets with 46% crude protein were used. The parameters of fish breeding showed that changing the quantity of fodder, the fish growing was positively influenced. This experiment showed that *Acipenser baerii* is a sturgeon with a rapid growth rate and it is possible to obtain an increase of fish biomass using different quantity of pellets with 46% crude protein.

Keywords: sturgeon, aquaria, pellets, feeding level.

AIMS AND BACKGROUND

For several decades, indigenous wild sturgeon populations have registered a continuous decline. The only alternative to still have them in our waters is to growth them in specially designed systems, including recirculating aquaculture systems (RAS)[1]. Sturgeon species most suitable for growing in artificial systems are those living in freshwater, non-migrating such as: sterlet, *Acipenser ruthenus* and especially siberian sturgeon, *Acipenser baerii,* recently brought in Romania[2].

The paper presents some aspects related to the influence of feeding level on the growth of *Acipenser baerii* species.

A. baerii is one of the most frequently captive-bred species of sturgeon. *A. baerii stenorrhynchus* have been successfully bred in several European countries[3]. The farming of this species began in the former USSR in the 1970 years. Since then, the dispersal of the species has accelerated and, in addition to the Russian Federation (its country of origin) it is known to be present in Europe (Belgium,

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France, Italy, Germany, Hungary, Poland, Spain and Romania), America (United States, Uruguay) and Asia (China). It is highly likely that it is also present in other countries, at least in an experimental capacity. Few companies cover the entire production cycle and market with all possible products. Some only produce eggs and/or juveniles; others specialise in producing the fish for meat; in many Western countries, caviar has become the main purpose of rearing sturgeon.

In Europe, the feed used is mainly based on commercially produced pellets which are often very similar to those used in trout farming. Extruded pellets with better water stability are more suited to the feeding behaviour of sturgeon. Feeding levels are rarely higher than 1–1.5% of the biomass, or even less for larger individuals. When feeding 2 to 4 times daily, the sturgeons will completely consume the feed within a few minutes. Frequent feeding with small amounts is ideal for sturgeon growth rates[4,5].

EXPERIMENTAL

The experiments were conducted in July–August 2009, in the pilot laboratory of the Aquaculture Department of the Faculty of Food Science and Engineering, Galati. The recirculating aquaculture system is represented by four aquaria-type units with a volume of 300 l and a size of 100×80×40 cm. The system is equipped with a mechanical and biological filtration unit, an UV sterilisation unit (equipment Quiet Tetra UV-C 35000, power 36 W) and an aeration equipment (compressor RESUN Quiet LP-100 100W, 0.045 MPa pressure and flow air 150 l/min.) (Fig. 1). The temperature and the dissolved oxygen which are the main physicochemical water parameters, were measured daily with equipment Hach-Lange Sc 1000.

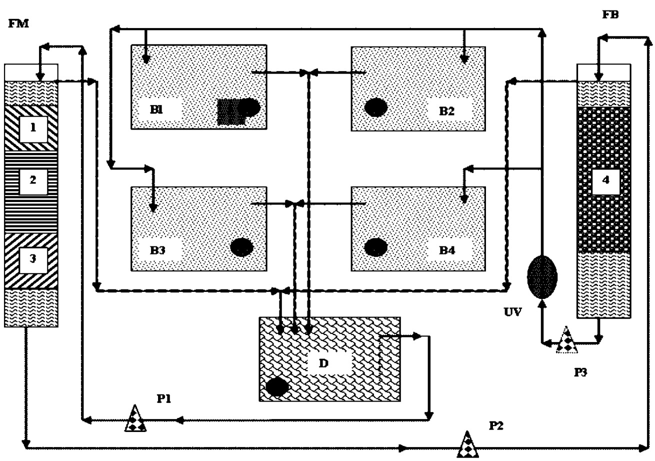


Fig. 1. Scheme of the recycling system
(B1–B4) – aquariums; D – settling; (P1–P3) – pumps; UV – lamp sterilisation; FM – mechanical filter; FB – biological filter; 1 – sponge; 2 – sand; 3 – gravel; 4 – bactobolt; 5 – nozzle aeration

As biological material, 3-months Siberian sturgeon juveniles were used, with a mean body weight of 20 g/fish, provided by the Institute of Research and Development for Aquatic Ecology, Fisheries and Aquaculture, Galati. In all 4 growth units the same stocking density was used, 20 fish/aquarium, respectively. Two kinds of feeding level variants were compared, with repetitions: V1 (B1, B2), with 5.5 g/kg metabolic weight (1.2% from total biomass) and V2 (B3, B4) with 11 g/kg metabolic weight (2.4% from total biomass). During 30 days, the same type of fodder was distributed in all 4 aquaria (Table 1).

Table 1. Chemical composition of the pellets

Nutrients	Quantity
Crude protein	46%
Fat	20%
Ash	6.8%
Crude fibre	2.8%
Phosphorus	0.9%
Vitamin A	9500 U.I./kg
Vitamin D3	1500 U.I./kg
Vitamin E	150 mg/kg
Copper	9 mg/ kg

Ingredients: products and sub-products from oilseeds, cereals and cereal subproducts, fish products, hemoglobin, oil, wheat gluten, BHT. Granulation – 2 mm.

RESULTS AND DISCUSSION

The super-intensive systems of growing fish (such as recalculating aquaculture systems) use the so-called distribution tables (feeding chart) for calculating daily food rations. Using a computer program, fodder intake has been calculated according to some pre-technological elements (initial number of fish, initial biomass, mean body weight of fish, feeding level, feed conversion ratio). Indicators of technological growth of young Siberian sturgeon are presented with their values in Table 2, Figs 2 and 3. Figure 4 presents the variation of water temperature and dissolved oxygen.

Both experimental variants, V1 (aquaria B1, B2) and V2 (aquaria B3, B4), achieved significant growth gains in terms of survival by 100% (Table 2). With variant V2, the feeding level was twice V1 so that the growth increase was higher, almost double. Analysing the mean values for each variant, we can see an increase of fish biomass from 0.62 kg/m^3 in V1 to 1.52 kg/m^3 in V2. Daily growth rate (GR), which is, in fact, the technological indicator showing linear growth of fish, ranged from 6.06–6.33 g/day (V1) and 13.80–16.50 g/day (V2).

Table 2. Technological indicators of Siberian sturgeon growth

Experimental variant		V1			V2		
indicators	UM	B1	B2	mean	B3	B4	mean
Initial biomass	(g)	400.00	400.00	400.00	400.00	400.00	400.00
Initial biomass	(kg/m^3)	1.33	1.33	1.33	1.33	1.33	1.33
Final biomass	(g)	590.00	582.00	586.00	815.00	895.00	855.00
Final biomass	(kg/ m^3)	1.96	1.93	1.95	2.71	2.98	2.85
Biomass gain	(g)	190.00	182.00	186.00	415.00	495.00	455.00
Biomass gain	(kg/ m^3)	0.63	0.60	0.62	1.38	1.65	1.52
Initial number of fish		20	20	20	20	20	20
Final number of fish		20	20	20	20	20	20
Survival	(%)	100.00	100.00	100.00	100.00	100.00	100.00
Initial fish weight	(g/fish)	20.00	20.00	20.00	20.00	20.00	20.00
Final fish weight	(g/fish)	29.50	29.10	29.30	40.75	44.75	42.75
Days of growth		30.00	30.00	30.00	30.00	30.00	30.00
GR (growth rate)	(g/day)	6.33	6.07	6.20	13.83	16.50	15.17
SGR (specific growth rate)	(g%/day)	1.30	1.25	1.28	2.37	2.68	2.53
Individual weight gain	(g)	9.50	9.10	9.30	20.75	24.75	22.75
Food given	(g)	166.00	166.00	166.00	380.00	380.00	380.00
FCR (feed conversion ratio)	(g /g)	0.87	0.91	0.89	0.92	0.77	0.84
Feeding level	(g/kg/met w.)	5.50	5.50	5.50	11.00	11.00	10.00
Feeding level	(%)	1.20	1.20	1.20	2.40	2.40	2.40
Crude protein	(%)	46.00	46.00	46.00	46.00	46.00	46.00

Figure 2 presents the evolution of the fish growth in all 4 aquaria. Very similar values of the repetition of the V1(aquaria B1 and B2) can be seen, meaning that the experiment went very well, having repeatable outcomes. With the V2 (B3 and B4 aquaria), the values were slightly different meaning that during the experiment one of the physicochemical indicators negatively influenced the growing of the specimens.

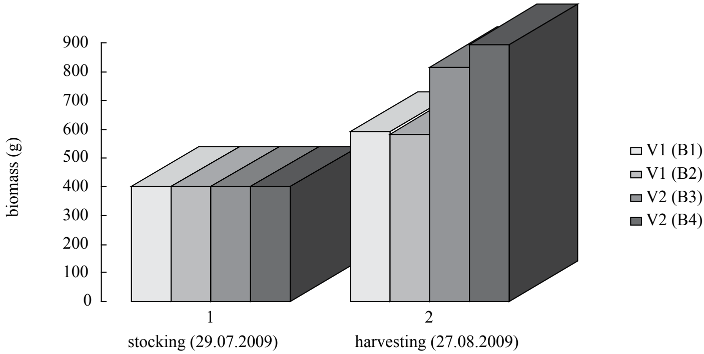
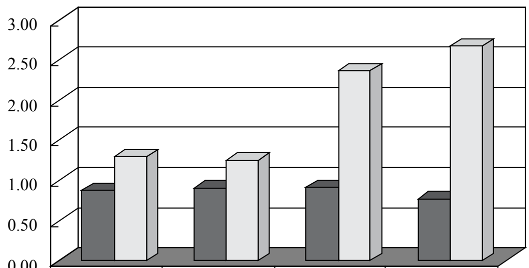


Fig. 2. Variation of fish growth

Among the most significant technological indicators there are the specific growth rate (SGR) and feed conversion ratio (FCR). Both indicators were best in the V2 version. Thus, the V2 has obtained an SGR value of 2.53 g%/day and an FCR of 0.84 g fodder/g weight gain, while in V1, SGR value of 1.27 g% SGR/day and a FCR of 0.89 g fodder/g weight gain. Figure 3 shows that there is an inverse correlation between SGR and FCR evolution; always a low FCR is achieved when SGR increases.



	B1	B2	B3	B4
	V1		V2	
FCR	0.87	0.91	0.92	0.77
SGR	1.30	1.25	2.37	2.68

Fig. 3. Variation of feed conversion ratio (FCR) and specific growth rate (SGR)

Regarding water quality, during the experiment the following parameters were daily monitored: water temperature and dissolved oxygen (Fig. 4). It is noted that during the experiment, temperature ranged within 18 to 22°C, optimum for the growth of the species, while oxygen varied within the range 6–9.8 mg/l values also optimum for the species studied.

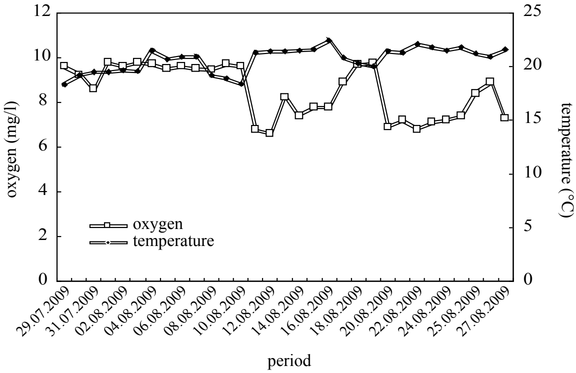


Fig. 4. Evolution of physicochemical parameters of water

CONCLUSIONS

An effective way to reduce pressure on wild populations of sturgeon is growing this species in alternative systems, either traditional (ponds, lakes) or modern systems (recirculating systems, net-cages, etc.). The research goal is growing young Siberian sturgeon *Acipenser baerii* in a pilot recirculating system represented by aquaria. The technological parameter that made the difference between the experimental variants was feeding level.

Technological indicators, calculated at the end of the experiment showed that doubling the daily feed ratio from a ratio of 5.5 g/kg metabolic weight (1.2 % of total biomass) to a ratio of 11 g/ kg metabolic weight (2.4 % of total biomass) led to obtaining specimens weghing almost double without a negative impact on the careing capacity of the system, making possible to easily obtain a fish biomass increase of over 1.5 kg/m^3/month.

Acipenser baerii, sturgeon recently introduced in Romania, has a very fast rate of growth, representing a definite promise for the aquaculture sector in Romania.

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