

Research regarding the evolution of corporal masses and feed conversion on sterlet (*Acipenser ruthenus*) juvenile raised in recirculating system

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Abstract. The research was performed on 3375 specimens of sterlet juveniles (*Acipenser ruthenus*) maintained in five square pools (1.5 x 1.5 x 0.7 m; V=1.125 m³) and in a round pool (Ø=3 m; H=1 m; V=5.63 m³). Water temperature varied between 14-16°C. Sterlet juvenile was fed with Dana Feed forage granulation 1.5 mm (52% raw protein and 13% raw fat). Body weight and body length on 30 individuals from each tank were determined every two weeks. Based on weighings of body mass and quantity of feed given calculations, it had been established bioproductive indicators at juvenile sterlets aged between 135-178 days. At the age of 178 days, the sterlet juvenile reached an average body mass that ranged between 56.60±2.19 g and 78.50±2.07 g, and an average body length that ranged between 23.83±0.29 cm and 27.22±0.23 cm. Individual values of minimum and maximum body mass were located between 30 g and 104 g and body length between 19 and 30 cm. During the 43 experimental days, the 3375 juvenile sterlets have acquired a real weight gain of 142.91 kg, with a specific consumption of feed of 0.79 kg feed/kg spore and an index of feed conversion of 1.27 kg spore/kg feed consumed.

Keywords: *Acipenser ruthenus*, body weight, feed conversion, recirculating system.

Zusammenfassung. Die Untersuchungen wurden an 3357 Exemplare junger Störe (*Acipenser ruthenus*) vorgenommen, die in 5 quadratförmigen (1,5 x 1,5 x 0,7 m; V=1,125 m³) und einem runden Becken (Ø=3 m; H=1 m; V=5,63 m³) gehalten wurden. Die Wassertemperatur variierte zwischen 14-16°C. Die Störjungen wurden mit Dana Feed Granulat von 1,5 mm (52% Brutto-Protein und 13% Brutto-Fett) gefüttert. In einem Intervall von 2 Wochen, wurde die Körpermasse und Körperlänge von 30 Individuen aus jedem Becken gemessen. Auf die Messungen und die Menge des verwendeten Futters bezogen, wurden die bioproductiven Parameter bei den Störjungen im Alter von 135-178 Tagen festgelegt. Im Alter von 178 Tagen haben die Störjungen eine durchschnittliche Körpermasse von 56,60±2,19 g und 78,50±2,07 g, wie auch eine durchschnittliche Körperlänge die zwischen 23,83±0,29 cm und 27,22±0,23 cm variierte, erreicht. Die maximalen und minimalen Werte bei der Körpermasse befanden sich zwischen 30 und 104 g, während die der Körperlänge sich zwischen 19 und 30 cm befanden. In der Zeit der 43 Experimenttage, haben die 3357 Störjungen einen realen Wachstumswert von 142,91 kg, und einen Futterumwandlungskoeffizienten von 0,79 kg Futter/kg Wachstum und einem Futterumwandlungsparameter von 1,27 kg Wachstum/kg verwendetes Futter, angesammelt.

Schlüsselwörter: *Acipenser ruthenus*, Körpermasse, Futterumwandlung, wiederzirkulierendes System.

Rezumat. Cercetările au fost efectuate pe un număr de 3357 exemplare puiet de cegă (*Acipenser ruthenus*) întreținute în 5 bazine pătrate (1,5 x 1,5 x 0,7 m; V=1,125 m³) și un bazin rotund (Ø=3 m; H=1 m; V=5,63 m³). Temperatura apei a variat între 14-16°C. Hrănirea puietului de cegă s-a făcut cu granule Dana Feed de 1,5 mm (52% PB și 13% GB). La interval de 2 săptămâni, s-a determinat masa corporală și lungimea corpului la 30 de indivizi din fiecare bazin. Pe baza determinărilor de masă efectuate și a cantității de furaj administrate, s-au stabilit indicatorii bioproductivi la puietul de cegă cu vârsta cuprinsă între 135-178 zile. La vârsta de 178 zile, puietul de cegă a atins o masă corporală medie cuprinsă între 56,60±2,19 g și 78,50±2,07 g, precum și o lungime corporală medie ce a variat între 23,83±0,29 cm și 27,22±0,23 cm. Valorile individuale minime și maxime au fost cuprinse în cadrul masei corporale între 30 și 104 g, iar pentru lungimea corpului între 19 și 30 cm. Pe parcursul celor 43 de zile experimentale, cele 335 exemplare de puiet de cegă au acumulat un spor real de creștere de 142,91 kg, cu un coeficient de conversie a hranei de 0,79 kg furaj/kg spor și un indice de conversie a hranei de 1,27 kg spor/kg furaj consumat.

Cuvinte cheie: *Acipenser ruthenus*, masa corporală, conversia hranei, sistem recirculant.

Introduction. In September 2008, a super intensive growing instalation of sturgeons in recirculating system was put into function at the Banat's University of Agricultural Sciences and Veterinary Medicine Timișoara. The system is new for Romania and the bibliographic information very poor (Bohl et al 1999; Oprea & Georgescu 2000; Bud et al 2001; Patriche 2001; Cristea et al 2002; Bura et al 2008; Lazu et al 2008). Moreover, as regards the culture of sterlet in recirculating system, only one international reference was found (Prokeš et al 1997). In order to help the holders of this kind of recirculating installation, we aimed to study the evolution of body weight and feed conversion in juvenile sterlet (*Acipenser ruthenus* Linnaeus, 1758).

Material and Method. The research was performed within the recirculated super intensive system resort of sturgeon growth from Didactical Station of Banat's University of Agricultural Sciences and Veterinary Medicine Timișoara, during the period 17.10.2008-29.11.2008.

The 3357 embryos of sterlet were hatched on the 4th of June 2008. Juveniles were maintained in 5 square tanks (1.5 x 1.5 x 0.7 m; V = 1.125 m³) and in a round pool (Ø=3 m; H=1 m; V=5.63 m³). Water temperature varied between 14-16°C. Juveniles were fed with granulated feed Dana Feed, 1.5 mm diameter, 52% raw protein, 13% raw fat, 10.34% raw ash, 1.25% crude fiber and 1.35% phosphorus.

On the 16th of October 2008, the resort was populated with juvenile sterlet. In order to not create an additional stress, on the 17th of October 2008, we appealed to weighing only 30 copies from pool III/1, whose body mass was used for the entire effective (3357 individuals). In the following week, all juveniles were sorted on two categories: big (III/1; II/6; II/3) and small (II/4; II/9; II/10). Every two weeks, we determined the body mass and body length of 30 individuals from two or three tanks. Based on the obtained body mass, it was established the amount of daily given feed to the population of juvenile sterlet from each tank.

Having in view both the performed mass calculations and administered fodder ration, bioproductive indicators in sterlet juvenile aged between 135-178 days were established.

Results and Discussion. At the first determination that was made (Table 1) on the 17th of October 2008 (135 days old), juvenile sterlets had an average body mass of 25.70±1.73 g and an average body length of 19.35±0.40 cm. Within the 30 studied specimens, it was shown a high variability of the body mass (CV = 36.92%) and an average variability of body length (CV = 11.32%). Safety index of the mean shows that this does not satisfy the precision (S_x% = 6.73%) for body mass, but pleases us as precision of the body length (S_x% = 2.07%).

After selecting the sterlet juveniles, two weight categories resulted. The 30 specimens weighed on the 31st of October 2008 (149 days old) from tank III/1 had an average body mass of 45.93±1.38 g. For this character variability was medium (CV=16.50%) and the mean satisfies us, as precision (S_x%=3%). The 30 weighted specimens, from tank II/9 (15 individuals) and II/10 (15 individuals) had an average body mass of 31.13±1.18 g. Within this lot a large variability of the body mass (CV=20.67%) was registered, and the mean was satisfying as accuracy (S_x%=3.79%). Sterlet juveniles from tank III/1 had an average body length of 24.20±0.29 cm while those from pools II/9+10 had an average of body length of 20.82±0.37 cm. For both lots, body length variability was low (CV<10%) and the mean satisfied us as precision (S_x%<5%).

On the 14th of November 2008 (163 days old), sterlet juveniles from tank III/1 reached an average body mass of 72.40±2.88 g and those from pools II/9+10 attained 45.17±1.73 g. Within both weighed groups, body weight variability was high (CV>20%), but the media was satisfying as accuracy. Fish from tank III/1 reached an average body length of 26.56±0.37 cm, and fish from tank II/9+10 an average body length of 23.38±0.23 cm. For this character, within both groups there was a small variability (CV=10%) and the mean pleased us as precision.

On the 29th of November 2008 (178 days old), average body mass was 76.87 ± 1.59 g in tank number III/1, 56.60 ± 2.19 g in pools II/9+10 and 78.50 ± 2.07 g in tanks II/6+3. While in pools III/1 and II/6+3 the body mass variability is medium, in pools II/9+10 variability is large. For all three lots, the mean of the body mass satisfies us as precision. The studied sterlet juvenile presented an average body length of 27 ± 0.18 cm in pool III/1, 23.83 ± 0.29 cm in pools II/9+10 and 27.22 ± 0.23 cm in pools II/6+3. Within the three lots, the body length variability was low and the mean had satisfied us as precision.

Table 1

Mass and body length of sterlet (*Acipenser ruthenus*) juvenile

Tank	Body mass (g)						Body length (cm)									
	n*	X	Sx	S	CV	Sx%	Min.	Max.	n*	X	Sx	S	CV	Sx%	Min.	Max.
17.10.2008 (135 days old)																
III/1	30	25.70	1.73	9.49	36.92	6.73	10	47	30	19.35	0.40	2.19	11.32	2.07	13.5	23
31.10.2008 (149 days old)																
III/1	30	45.93	1.38	7.58	16.50	3.0	31	60	30	24.20	0.29	1.56	6.46	1.19	21	27
II/9+10	30	31.13	1.18	6.44	20.67	3.79	19	47	30	20.82	0.37	2.03	9.78	1.78	14.5	24
14.11.2008 (163 days old)																
III/1	30	72.40	2.88	15.77	21.78	3.98	47	119	30	26.56	0.37	1.99	7.52	1.39	23.5	33
II/9+10	30	45.17	1.73	9.47	20.97	3.83	25	74	30	23.38	0.23	1.24	5.29	0.98	21	25.5
29.11.2008 (178 days old)																
III/1	30	76.87	1.59	8.70	11.32	2.07	57	95	30	27.00	0.18	1.01	3.74	0.67	25	29
II/9+10	30	56.60	2.19	11.98	21.17	3.87	30	83	30	23.83	0.29	1.61	6.76	1.22	19	26.5
II/6+3	30	78.50	2.07	11.31	14.41	2.64	61	104	30	27.22	0.23	1.24	4.54	0.84	25	30

*n=3357 specimens

From the analysis of Table 1, it can be seen that there is a large and medium variability for body mass in the lots and a predominantly low variability for the body length of sterlet juvenile.

In Table 2, we presented the amount of feed given to sterlet juvenile in relation to the number of individuals and to their body mass.

At each of the 4 weighings, it was determined the total body mass by multiplying the average body weight with the number of individuals. By multiplying the total body mass with the percentage share of fodder from total body mass we obtained the calculated amount of feed.

From the analysis of Table 2, it is found that the total body mass of the 3357 copies of sterlet juvenile increased from 87.28 kg on the 17th of October 2008, at 230.19 kg on 29th of November 2008. In this period there was an accumulation of mass of 142.91 kg and food consumption of 11.466 kg.

In Table 3 are presented bioproductive indicators on sterlet juvenile between the age of 135 days and 178 days.

Table 2

The amount of feed given to sterlet (*Acipenser ruthenus*) juvenile in relation to the number of individuals and their body mass

Tank	Nr. individuals	Average body mass (kg)	Total body mass (kg)	Feed ponderosity (%)	Calculated amount of feed (kg)	The amount of feed given (kg)
17.10.2008						
TOTAL	3357	0.026	87.28	2.7	2.356	2.302
31.10.2008						
II/3	229	0.046	10.53	2	0.212	0.220
II/4	536	0.031	16.62	2	0.332	0.314
II/6	361	0.046	16.61	2	0.332	0.340
II/9	531	0.031	16.46	2	0.329	0.314
II/10	525	0.031	16.28	2	0.326	0.314
III/1	1175	0.046	54.05	2	1.081	1.100
TOTAL	3357	0.039	130.57	-	2.612	2.702
14.11.2008						
II/3	229	0.072	16.49	2	0.330	0.285
II/4	536	0.045	24.12	2	0.482	0.382
II/6	361	0.072	25.99	2	0.520	0.393
II/9	531	0.045	23.90	2	0.478	0.355
II/10	525	0.045	23.63	2	0.473	0.382
III/1	1175	0.072	84.60	2	1.692	1.433
TOTAL	3357	0.059	198.73	-	3.975	3.230
22.11.2008						
II/3	229	0.079	18.09	1.6	0.289	0.284
II/4	536	0.057	30.55	1.6	0.489	0.375
II/6	361	0.079	28.52	1.6	0.456	0.381
II/9	531	0.057	30.27	1.6	0.484	0.381
II/10	525	0.057	29.93	1.6	0.479	0.381
III/1	1175	0.079	92.83	1.6	1.379	1.430
TOTAL	3357	0.069	230.19	-	3.576	3.232

Table 3

Bioproductive indicators on sterlet (*Acipenser ruthenus*) juvenile

Period	Tank	Real weight gain (S_r) (kg)	Apparent weight gain (S_a) (g)	Daily rhythm of growth (R_{gr}) (kg/day)	Specific growth rate (R_{sc}) (%/day)	Specific consumption of feed (Q_{ch}) (kg feed/kg spore)	Index of feed conversion (I_{ch}) (kg spore/kg feed)
17/30.10.2008	TOTAL	43.29	13	3.30	330	0.69	1.45
31.10/13.11.2008	II/3	5.69	26	0.46	46	0.48	2.08
	II/4	7.50	14	0.58	58	0.54	1.84
	II/6	9.38	26	0.72	72	0.47	2.12
	II/9	7.44	14	0.57	57	0.55	1.82
	II/10	7.35	14	0.57	57	0.56	1.80
	III/11	30.55	26	2.35	125	0.47	2.14
	TOTAL	68.16	20	5.24	524	0.50	2.02
14/29.11.2008	II/3	1.60	7	0.11	11	2.67	0.37
	II/4	6.43	12	0.43	43	0.89	1.12
	II/6	2.53	7	0.17	17	2.33	0.43
	II/9	6.37	12	0.42	42	0.84	1.20
	II/10	6.30	12	0.42	42	0.91	1.10
	III/11	8.23	7	0.55	55	2.61	0.38
	TOTAL	31.46	10	2.10	210	1.54	0.65
17.10/29.11.2008		142.91		10.64		0.79	1.27

n = 3357 specimens

$$S_r = B_f - B_i$$

$$S_a = M_t - M_i$$

$$R_{zc} = (B_f - B_i) : t$$

$$R_{cs} = [(B_f - B_i)] \times 100$$

$$Q_{ch} = C_{fa} : S_r$$

$$I_{ch} = S_r : C_{fa}$$

During the 43 experimental days, the population of 3357 sterlet juvenile cumulated a real weight gain of 142.91 kg, with a daily rhythm of growth of 10.64 kg/day, with a specific consumption of feed of 0.79 kg feed/kg spore and with an index of feed conversion of 1.27 kg spore/kg consumed feed.

Conclusions

A sterlet (*Acipenser ruthenus*) population, at the age of 135 days, the juveniles had an average body mass of 25.70 ± 1.73 g and an average body length of 19.35 ± 0.40 cm. At the age of 178 days, sterlet juveniles reached an average body mass that ranged between 56.60 ± 2.19 g and 78.50 ± 2.07 g, and an average body length that ranged from 23.83 ± 0.29 cm to 27.22 ± 0.23 cm. Registered individual values of minimum and maximum were between 30 and 104 g for the body mass and between 19 and 30 cm for the body length. From the analysis of the variability coefficient, it results that the population of sterlet juveniles recorded a middle and high variability of the body mass and a small variability of the body length of individuals. At certain time intervals, a sorting of the sterlet juveniles after body size is required, because of the mass differences that appear over time. During the 43 experimental days, the 3357 specimens of sterlet juvenile cumulated a real weight gain of 142.91 kg, with a specific consumption of feed of 0.79 kg feed/kg spore and an index of feed conversion of 1.27 kg spore/kg consumed feed.

Acknowledgements. The present studies were funded by NASR (National Authority for Scientific Research) through the CEEEX Program during 2006, 2007 and 2008. We thank NASR for their financial support.

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Received: 09 March 2009. Accepted: 20 April 2009. Published online: 21 April 2009.

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How to cite this article:

Bura M., Szelei Z.-T., 2009 Research regarding the evolution of corporal masses and feed conversion on sterlet (*Acipenser ruthenus*) juvenile raised in recirculating system. AACL Bioflux 2(2):223-228.

Printed version: ISSN 1844-8143

Online version: ISSN 1844-9166 available at: <http://www.bioflux.com.ro/docs/2009.2.223-228.pdf>

Submitted and accepted also in the official program of International Symposium ACVAPEDIA 2009.