

## STUDY REGARDING THE MORPH-PRODUCTIVE PERFORMANCES OF *POLYODON SPATHULA* STURGEON BREED

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### Abstract

Rearing of *Polyodon spathula* sturgeons, which are the subject of the current study, was carried out in fisheries exploitation in which is applied a semi-intensive growing system. Rearing of *Polyodon spathula* sturgeons of first summer was realised in two stages: growing in channel basins type, and growing in a basin with large surface in poly-culture with carp and white amur. Having in view the fact that in the 10 ha basin were placed 18590 fishes with a total mass of 790.75 kg, we could appreciate that was realised a density at population of 1859 individuals/ha and a basin charge of 79.07 kg/ha. The total average of mass gain of the 1<sup>st</sup> summer paddlefishes was of 110.44 g, and daily average gain was of 3.68 g. Growing of *Polyodon spathula* sturgeons of second summer was carried out in dam, in this raising basin being introduced 125290 fishes (carp, silver carp, white amur, bighead and paddlefish) with a total mass of 11145 kg, so was realised a density at population of 3132.25 individuals/ha and a basin charge of 278.63 kg/ha. The recorded values for paddlefish with the age of two summers, shown a total average mass gain of 1620 g and a daily average gain of 12 g, gain which was with 126.08% better than those of the 1<sup>st</sup> summer paddlefish. The presented data are in according with the ones found in the literature, describing a very well rhythm of growing.

**Key words:** *Polyodon spathula*, grow, basin, poly-culture

### INTRODUCTION

*Polyodon spathula* is a breed with the natural spread area in North America, in the Mississippi river basin. Fish is plankton-eating, feeding especially with filtered zooplankton from water, growing rate being superior to many others fresh water breeds in conditions in which feed isn't a limitative factor. Growing rate of this fish is huge in fisheries and in poly-culture with other breeds. Meat and roe of this breed are quite similar with the ones gathered from other sturgeons [8].

Growing of sturgeons in fisheries is a way to cover the market demands, which is deficient at the moment, and could be realized through many technologies which varies a lot from extensive to super-intensive [2].

### MATERIAL AND METHOD

Research were carried out on a number of 1490 sturgeons from *Polyodon spathula*

breed with different ages (1200 individuals P.s.<sub>0+</sub>; 290 individuals P.s.<sub>1+</sub>), in a fish farm from Botoşani County. From the studied individuals were weighted almost 10%, for each age, at the end of growing period, to evaluate the growing mass increase.

Rearing of *Polyodon spathula* individuals of 1<sup>st</sup> summer, in the working unit, was realised in two stages: rearing in channel type basins, with small dimensions in mono-culture and rearing into a basin with a large area in poly-culture with carp (*Cyprinus carpio*) and grass carp (*Ctenopharyngodon idella*). Those 1200 larvae pre-developed were achieved from SCCDP Nucet.

Rearing in the first stage was realised in tow basins with equal areas, of around 3,000 m<sup>2</sup>, with depth of 2 meters, with plain platform and steep slopes. In the next stage rearing was made into a basin with an area of 10 ha.

Rearing basins for mono-culture were prepared as follows: were emptied during winter, disinfected with sodium hypochlorite and after that fertilized with cattle and bird manure in quantities of 5,000 kg/ha with

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around 10-14 days before population and with other 150 kg/ha/week during the whole growing period. Also were realised improvement works for the soil structure of platform, in the areas in which those works were suitable to be done, and was assured the tightness of evacuation installations to prevent loosing of juveniles fish.

To prevent the negative effect of higher water temperatures in July and August, on growing rhythm, juveniles of *Polyodon spathula* were gathered from channel type basins and transported into a growing basin with a larger surface. Transferring of paddlefishes in 10 ha basin was also realised to assure a higher quantity of natural food, a

better density (less individuals per hectare) but also for wintering of the breed in this basin.

Fishing from channel type basins was realised on 1<sup>st</sup> of July. Rearing of paddlefishes in 10 ha basin was made in poly-culture with 1<sup>st</sup> summer carp and grass carp. The weight at fishing from channel type basins, to populate the 10 ha basin was 200-250 g (tab. 1). Population formula of 10 ha basin with *Polyodon spathula* sturgeons of 1<sup>st</sup> summer is presented in table 2.

The 10 ha basin was prepared and flooded in May. The specific works for basin preparing were the same as channel type basins (fertilization with cattle manure, improvement of soil structure.

Table 1 Populating formula of channel type basins

Breed	Basins	Nr. of individuals at populating	Mean weight at populating (g)	Nr. of individuals at transfer	Mean weight at transfer (g)
<i>Polyodon spathula</i> (paddlefish)	B1	500	2-4	320	250
	B2	700	2-4	670	200

Table 2 Populating formula of 10 ha basin

Breed	Nr. of individuals	Mean weight at populating (g)
<i>Cyprinus carpio</i> (carp)	12,000	100
<i>Ctenopharyngodon idella</i> (grass carp)	5,600	80
<i>Polyodon spathula</i> (paddlefish)	990	225

Having in view the fact that in 10 ha basin, were introduced 18,590 fishes with a total weight of 790.75 kg, we could appreciate that was realised a populating density of 1,859 individuals/ha and a basin charge of 79.07 kg/ha.

Rearing of *Polyodon spathula* individuals of 2<sup>nd</sup> summer, in the working unit, was realised in poly-culture with carp, silver carp, bighead carp and grass carp. The

age of the fishes from other breeds was of one summer.

Before populating were realised disinfection works with lime chloride, 400 kg/ha, and with 10 days before flooding of basins was realised a fertilization with cattle and bird manure, in quantities of 5,000 kg/ha and another 5,000 kg/ha during growing period.

Populating was realised on 15<sup>th</sup> of May and the formula is presented in table 3.

Table 3 Populating formula of rearing basin in the 2<sup>nd</sup> summer

Breed	Nr. of individuals	Mean weight at populating (g)
<i>Cyprinus carpio</i> (carp)	50,000	100
<i>Hypophthalmichthys molitrix</i> (silver carp)	37,500	80
<i>Ctenopharyngodon idella</i> (grass carp)	22,500	80
<i>Aristichthys nobilis</i> (bighead carp)	15,000	80
<i>Polyodon spathula</i> (paddlefish)	290	500

Having in view that in the rearing basin in 2<sup>nd</sup> summer, with 40 ha, were introduced 125,290 individuals with a total weight of 11,145 kg, we

could appreciate that was realised a populating density of 3,132.25 individuals/ha and a basin charge of 278.63 kg/ha.

**RESULTS AND DISCUSSIONS****Particularities for feeding and maintenance**

For developing and sustaining of cladoceran population which represent the basic feed for *Polyodon spathula* breed, in 1<sup>st</sup> summer of breed rearing, a great importance was given to fertilization of basins. In addition to fertilization with cattle manure was applied an aqueous suspension of sunflower grist fine minced (5 kg grist added in 30 litres of water and allowed a period for initiating of fermentation processes). For the same aim was utilised a solution of beer yeast (500 g of yeast added in 30 l of water and allowed for some hours to initiate the fermentation processes). To sustain the phytoplankton populations were

distributed small quantities of ammonia nitrate of NPK mineral complex.

During whole growing period in channel type basins were administrated a mixture of concentrate fodders (tab. 4), in increasing quantities, from 2 kg/day till 10 kg/day, in 6 meals per day, distributed near banks. This mix of concentrate fodders was administrated to stimulate the development of zooplankton from rearing basins. The mix of concentrate fodders had the following rate: 40% soybean grist, 20% sunflower grist, 15% barley, 15% corn, 10% wheat. During the whole growing period in channel type basins was consumed 720 kg mix of concentrate fodders, 600 kg sunflower grist and 15 kg of yeast.

Table 4 Nutritional parameters of concentrate fodders mix administrated in channel type basins

Fodder	%	EM kcal/kg	Crude protein (%)	Met.+Cist. (%)	Liz. (%)	Crude fibber (%)	Ca (%)	P (%)	Crude fat (%)
Corn	15	522	1.30	0.055	0.036	0.315	0.002	0.039	0.606
Barley	15	412	1.38	0.061	0.053	0.755	0.008	0.054	0.270
Wheat	10	312	1.11	0.046	0.031	0.223	0.006	0.032	0.189
Soybean grist	40	1320	16.12	0.480	1.024	1.968	0.104	0.240	0.704
Sunflower grist	20	490	6.66	0.284	0.242	3.800	0.070	0.180	0.520
TOTAL	100	3057	26.58	0.927	1.386	7.061	0.189	0.545	2.289

Trophic spectre is represented mainly by zooplankton, aquatic insects, then phytoplankton and organic detritus [3], [5]. After studying the feeding behaviour of 1<sup>st</sup> summer paddlefishes was observed the fact that those ones alternated feeding by filtration with individual capturing of zooplankton.

By studying the content of digestive tube of 1<sup>st</sup> summer paddlefishes was enlightened the fact that in their feed prevailed cladocerans

with large waist (*Daphnia sp.*), their rate in the content of digestive tube at the end of growing period (September) being 75%; also were founded larvae and adults of *Chironomidae*, that although numerically are represented in small percents, as biomass, have a significant rate. Copepods had a rate of 19% and aquatic insects were 2.8% (tab. 5).

Table 5 Rate of trophic spectre from digestive tube of the analysed *Polyodon spathula* sturgeons

Age (years)	Identified components	Rate in feed (%)	Observations
P.s. <sub>0+</sub>	Cladocerans	75	Cladocerans were represented by <i>Daphnia sp.</i> and <i>Moina micrura</i>
	Copepods	19	
	Insects	2.8	
	Vegetal	1.3	
	Rotifers	1.9	
P.s. <sub>1+</sub>	Cladocerans	77	Cladocerans were represented by <i>Daphnia sp.</i> and <i>Leptodora sp.</i>
	Copepods	21	
	Insects	1.4	
	Vegetal	0.4	
	Rotifers	0.2	

Having in view the above mentioned facts are confirmed the data from literature, [9], [4] according to which juveniles of paddlefish have an intensive feeding during night and dawn, highlight the presence in the content of digestive tube of an important number of cladocerans (*Leptodora kindti* and *Sida cristallina*) and aquatic insects which migrate during night to the surface, being mainly in the superior layers of water. So can be explained the presence during day, but especially during night, of the juveniles at the water surface.

At all studied fishes were founded in quite low rates, benthic forms belonging to ostracods and isopods, proving the feeding with organisms from the bottom of the

rearing basins. Vegetal elements from the digestive tube of analysed paddlefishes were represented by fragments of superior plants.

During growing of 2<sup>nd</sup> summer paddlefishes into rearing basin were introduced the quantities of fodders presented in table 6. Wasn't made a specific feeding for this breed but were administrated concentrate fodders for the rest of the breeds with which paddlefish was reared in poly-culture. The administrated feed had the secondary role to stimulate the development of zooplankton necessary for sturgeons' feeding. Maximum of administrated feed was in August (43.2 t), respectively 30.02% from the total of administrated fodders – 143.87 t.

Table 6 Situation of fodders' administration in rearing basin in 2<sup>nd</sup> summer

Fodders Months	Sunflower grist (t)	Soybean grist (t)	Corn (t)	Barley (t)	Wheat (t)	Total (t)
May	0.84	-	-	1.57	-	2.41
June	9.15	-	-	11.48	-	20.63
July	17.88	-	-	18.60	-	36.48
August	21.60	-	-	21.60	-	43.20
September	13.68	1.12	-	-	15.80	30.60
October	4.62	1.61	1.12	-	3.20	10.55

From nutritional point of view, administrated feed didn't assured an optimal level for the basic breed (carp) regarding the metabolised energy (ME – kcal/kg), calculated values for the administrated mix of concentrate fodders being under the minimum level (ME - 3600 kcal/kg), ME

being between 2600 kcal/kg in August and 2893 kcal/kg October; protein level being between 18.06% CP in May, value lower than minimum value (CP – 22%) and 26.34% CP in October, value a little bit higher than the optimal value (CP - 26%), (tab. 7).

Table 7 Nutritional parameters of concentrate fodders mix administrated in rearing basin in 2<sup>nd</sup> summer

Specification	ME kcal/kg	CP %	Lysine %	Met.+Cyst. %	Crude fat %	Crude fiber %	Ca %	P %
May	2645	18.06	0.69	0.74	1.56	10.83	0.14	0.72
June	2617	20.53	0.76	0.83	1.33	11.88	0.16	0.82
July	2603	21.74	0.83	0.86	1.22	12.39	0.17	0.87
August	2600	22.00	0.84	0.89	1.20	12.50	0.18	0.88
September	2831	22.94	0.87	0.90	1.03	9.49	1.17	0.82
October	2893	26.34	1.15	0.99	1.16	9.92	0.19	0.84

The study of feeding behaviour for 2<sup>nd</sup> summer paddlefishes show the fact that those ones capitalized efficiently the natural feed from the studied basins, fishes preponderantly feeding themselves by filtration, filtrating apparatus being sufficiently developed at this

age, selectivity for zooplankton species being much lower in comparison with 1<sup>st</sup> summer paddlefishes. Was remarked a predominant preference for aquatic insects, which as biomass dominate all other components.

The content of digestive tube of 2<sup>nd</sup> summer *Polyodon spathula* individuals, analysed at the end of growing period (September) revealed the presence of cladocerans with the highest rate in fishes digestive tube – 77%, followed by copepods - 21% and insects – 1.4% (tab. 5). Vegetal elements trend to have a more significant rate at the end of hot season based on the reduced density of zooplankton at the beginning of cold season. Observing the feeding behaviour could be mentioned that paddlefishes carry out migration to water surface during night for capturing insects and alternate this behaviour with migrations specific to filtration.

**Dynamics of weight increase**

In the literature is shown the fact that *Polyodon spathula* sturgeon breed have a rapid growing rhythm in the first three years of life, followed by a diminishing of it starting with 4<sup>th</sup> summer [1]. Weight increase could be influenced by the quality and quantity of feed, making possible the achievement of very good increases in conditions of feed abundance [6], [7].

Weight increase was appreciated based on the data from populating (15<sup>th</sup> of May) and fishing (30<sup>th</sup> of September). Total mean weight increase of 1<sup>st</sup> summer paddlefishes (P.s.<sub>0+</sub>) was 497 g, and daily mean increase was 3.68 g (tab. 8).

Table 8 Weight increase at the studied fishes

Specification	Total mean weight increase (g)	Monthly weight increase (g)	DMI	
			g	%
Polyodon spathula of 1 <sup>st</sup> summer - P.s. <sub>0+</sub>	497	110.44	3.68	100.00
Polyodon spathula of 2 <sup>nd</sup> summer - P.s. <sub>1+</sub>	1620	360.00	12.00	226.08

The recorded values for 2<sup>nd</sup> summer paddlefishes (P.s.<sub>1+</sub>), show a total mean weight increase of 1620 g and a daily mean increase of 12 g, increase which was with 226.08% better than the 1<sup>st</sup> summer paddlefishes.

The obtained values for 1<sup>st</sup> summer rearing were superior to the ones cited in literature in the rearing conditions from Romania (mean increase 320 g) and very close for 2<sup>nd</sup> summer rearing (mean increase 1636 g) [1].

**Losses from effective**

Larvae of *Polyodon spathula* are extremely vulnerable at attacks from birds, frogs and otters because have slow moves and circulate

at water surface for finding food, especially during night. This situation imposed some protection methods of channel type rearing basins by enclosure of the premises with metallic net and covering with rayon wires perpendicularly place on the big side of those.

The greatest losses were recorded in the case of rearing of 1<sup>st</sup> summer sturgeons – 235 individuals, fact which made that survival rate to be of only 77.91%. Losses from effective were due to predators and also due the sensitivity at manipulation (losses at transfer – 60 individuals and at fishing – 75 individuals) (tab. 9).

Table 9 Losses from effective

Specification	Nr. of individuals at populating (heads)	Nr. of individuals at fishing (heads)	Losses (heads)	Survival rate (%)
Polyodon spathula of 1 <sup>st</sup> summer - P.s. <sub>0+</sub>	1200	935	265	77.91
Polyodon spathula of 2 <sup>nd</sup> summer - P.s. <sub>1+</sub>	290	236	54	81.37

In effective of 1<sup>st</sup> summer sturgeons weren't recorded cases of illness of dead fishes due to pathologic causes.

At 2<sup>nd</sup> summer sturgeons losses were of 54 individuals which show a survival percent of 81.37% for this age.

The main cause for losses for this age was stress caused by repeated manipulations (populating, control fishing, harvest fishing). Also was observed that this fish is a weak swimmer because were founded dead individuals tangled in vegetation.

The feeding way at water surface with insects makes that paddlefish to be vulnerable at the attack of ichthyophagus birds, the recorded losses being of 9 individuals and otters attack caused the losses of minimum 7 individuals.

In the effective of P.s.<sub>1+</sub> weren't recorded illnesses or dead fishes due to some diseases.

## CONCLUSIONS

### Particularities of feeding and maintenance

After studying the feeding behavior of 1<sup>st</sup> summer paddlefishes was observed the fact that those ones alternate feeding by filtration with individual capturing of zooplankton.

By studying the content of digestive tube of 1<sup>st</sup> summer paddlefishes was highlighted the fact that in their feed predominated cladocerans with big waist (*Daphnia sp.*), (75%), copepods had a rate of 19% and aquatic insects 2.8%.

The study of feeding behavior of the 2<sup>nd</sup> summer paddlefishes show that fishes feed mainly by filtration. The content of digestive tube of the 2<sup>nd</sup> summer *Polyodon spathula* individuals revealed the presence of cladocerans with the highest rate in fishes' digestive tube – 77%, followed by copepods – 21% and insects – 1.4%.

Having in view the trophic spectre of the breed, represented mostly by zooplankton, aquatic insects, phytoplankton and organic detritus we could appreciate that *Polyodon spathula* breed capitalize efficiently the natural feed of the aquatic basins from the studied area.

### Dynamics of weight increase

Total mean weight increase of 1<sup>st</sup> summer paddlefishes (P.s.<sub>0+</sub>) was 497 g, and daily mean increase was 3.68 g.

The recorded values for 2<sup>nd</sup> summer paddlefishes (P.s.<sub>1+</sub>), show a total mean weight increase of 1620 g and a daily mean increase of 12 g, increase which was with

226.08% better than the 1<sup>st</sup> summer paddlefishes. The obtained values for 1<sup>st</sup> summer and also for 2<sup>nd</sup> summer are close to the values cited in literature in the rearing conditions of the breed in Romania.

### Losses from effective

The highest losses were recorded for 1<sup>st</sup> summer sturgeons – 235 individuals, so the survival percent was 77.91%. At 2<sup>nd</sup> summer sturgeons losses were of 54 individuals which show a survival rate of 81.37% for this age.

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