THE ASSESSMENT OF *POLYODON SPATHULA* GROWING TECHNOLOGY IN THEIR DIFFERENT AGES OF LIFE

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Abstract

The aim of this study was to investigate two of Polyodon spathula growing technology in their different ages of life. Our research was performed in two different fish farms, each of them with a semi-intensive growing system. The Polyodon spathula aged at 3rd summer was grown in BC 30 ha lake which has a production area of 30 hectares. There were placed 36500 fishes (carp - 15250; silver carp - 10500; white amur - 6300; bighead- 4200, and Polyodon spathula - 250) with a total weight of 12900 kg (average weights were: carp - 400 g, silver carp - 300 g, white amur - 300 g; bighead - 300 g, and Polyodon spathula - 2000 g), thus achieving a 1216.66 individuals/ha stocking density and a 430 kg/ha loading of tank. The Polyodon spathula aged at 4th summer was grown in "Cal Alb" water accumulation, which has a production area of 135 hectares. There were placed 127025 fishes (carp – 53375; silver carp - 36750; white amur - 22000; bighead - 14700, and Polyodon spathula - 200), with a total weight of 57829.8 kilograms (average weights were: carp - 500 g, silver carp - 400 g, white amur - 450 g; bighead - 400 g, and Polyodon spathula - 3700 g), thus achieving a 940.92 individuals/ha stocking density and a 428.94 kg/ha loading of tank. The obtained results suggest a well-yielded Polyodon spathula using semi-intensive fish-farming systems.

Keywords: *Polyodon spathula*, growing, polyculture

INTRODUCTION

Polyodon spathula is a large sized fish which in wild reach weights of about 50-70 kg and lengths of 1.5-2.0 m. Due to its exceptional biological characteristics such as fast-growing, planktonic feeding, high adaptability to captive breeding in different environmental conditions, to which the quality of meat and eggs could be added, *Polyodon spathula* draw the attention of worldwide aquaculture specialists. Its biological and ecological particularities permit ponds growing in different types of polyculture, without any consumption of feed concentrates.

These arguments and the total ban on sturgeon fishing, creates favorable conditions for aquaculture development, in particularly of *Polyodon spathula* [1], [2].

MATERIALS AND METHODS

This research was conducted in a fishery unit located in Botoşani County, using 450 sturgeon fish of *Polyodon spathula* specie in their summer III and IV age of life (250 fish and 200 fish, respectively).

Polyodon spathula growing was done in different ponds according to their age of life. Those aged at summer III were grown in a 30 ha area pond (*BC 30 ha*), in polyculture with carp, silver carp, white amur, and bighead, also aged at two or three summers. *BC 30 ha* is used in winter as an accommodation pond for fish which are delivered to customers, reason why no specific preparatory works such as platform disking, hypochlorite disinfection, auxiliary inventory repairing are made. This pond was especially chosen for summer III aged sturgeons because the amount of natural feed is well-appreciated, creating in this way favorable assumptions for *Polyodon spathula* growing. *BC 30 ha'* water supply is performed from Stăvilar lake and the water that drains from the nearby slopes when it rains. Water passes from the Stăvilar lake through the alimentation pipes and from there get into the pond through a canal dug in the excavation. The alimentation pipes is fitted with grates to reduce the access of other (wild) fish species and provided with vanet for water

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flow regulation. A spillway construction (a monk-type facility equipped with spillway) was needed for situations when flash floods occur. *BC 30 ha'* fertilization were manually made with manure and poultry manure in quantities of 7000 kg/ha.

BC 30 ha' populating was made according to the formula shown in *table 1*. If there is considered a total of 36500 introduced fish in *BC 30 ha* pond (12900 kg total weight), we could estimate a density of 1216.66 individuals/ha and a loading tank of 430 kg/ha.

Table 1 Populating formula for „BC 30 ha"

Fishes	Individuals	The average weight at populating (g)
Cyprinus carpio (carp)	15250	400
Hypophtalmichthys molitrix (silver carp)	10500	300
Ctenopharingodon idella (white amur)	6300	300
Aristichthys nobilis (bighead)	4200	300
Polyodon spathula (paddlefish)	250	2000

The paddlefish aged at summer IV was also grown in polyculture with carp, silver carp, white amur, and bighead at two or three summer age of life. Their growing was done in *„Cal Alb"* water accumulation, which has a production area of 135 hectares. Its fertilization were manually made with manure and poultry manure in quantities of 5000 kg/ha before flooding and another's 5000 kg/ha during the growing season. Its populating was made according to the formula shown in *table 2*. If there is considered a total of 127025 introduced fish in *„Cal Alb"* water accumulation (57829.8 kg total weight), we could estimate a density of 940.92 individuals/ha and a loading tank of 428.94 kg/ha.

Table 2 Populating formula for „Cal Alb" water accumulation

Fishes	Individuals	The average weight at populating (g)
Cyprinus carpio (carp)	53.375	500
Hypophtalmichthys molitrix (silver carp)	36.750	400
Ctenopharingodon idella (white amur)	22.000	450
Aristichthys nobilis (novac/bighead)	14.700	400
Polyodon spathula (paddlefish)	200	3700

In order to found out the paddlefish eating behavior, the digestive content of each three individuals according to previous mentioned categories of age was analyzed. They were transported to laboratory, anesthetized with MS 222 (125 mg/l), measured and weighed, after which they were sacrificed by pithing. At each individual the content of digestive tract was extracted into 50 ml glass vials and stored in 4% formalin. All the samples were analyzed under MC 5A (IOR) microscope, being determined the main feeding components (zooplankton, insects, insect larvae). About 10% of individuals were weighed at the end of their growing period in order to estimate their gain in weight.

RESULTS AND DISCUSSIONS

Polyodon spathula feeding and maintenance

The paddlefish aged at summer III was fed according to the data given in *table 3*. Considering its' mainly filtration way of feeding (his food is mainly composed of cladocerans), it was not performed a specific feeding but there was administrated concentrated feed as for all of the included fish in *BC 30 ha* pond. We consider that the administrated feed also contributes to zooplankton development necessary for sturgeons feeding.

The concentrated feed was administrated after their prior soaking; therefore, it was facilitating a rapid dive and it was eliminated the risk of mortality in carp (carp is greedy, and by consuming a large amount of dry food will quickly increase in volume, which could cause its death).

Table 3 Fodder types administration in „BC 30 ha" pond

Fodder type / Months	Sunflower grist (t*)	Soybean grist (t)	Corn (t)	Barley (t)	Wheat (t)	Rye (t)	Total (t)
May	2.91	-	-	3.36	-	-	6.27
June	6.09	-	-	7.46	-	-	13.55
July	13.38	-	-	1.09	10.80	1.67	26.94
August	20.00	2.73	-	18.76	-	-	41.49
September	9.38	6.76	-	14.84	-	-	30.98
October	2.50	0.96	1.50	-	2.84	-	7.80

*tons

The total consumption of feed concentrates in *„BC 30 ha"* was calculated at 126.93 tons, and was represented by sunflower grist, soybean grist, corn, barley, wheat and rye.

Considering the already tabled data, the maximum food quantity was administered in August (41.49 t), i.e. 32.68% of the total given feed (126.93 t).

We consider that the administered feed did not achieve the optimum level of basic species (carp, for example) in terms of metabolizable energy (ME - kcal/kg), the calculated values for mixed feed concentrates administered in *BC 30 ha* pond (between 2611 kcal/kg in May and 2999 kcal/kg in October) being below the minimum accepted (ME - 3600 kcal/kg). The protein level varied between 20.68% GP (gross protein) in June (being below the minimum level of 22%) and 24.51% in September (being below the optimum level of 26%) (table 4).

Table 4 Nutritional parameters of the administrated mixed fodders

Specification	ME kcal/kg	GP %	Lysine %	Methionine + Cystine %	GF %	GC %	Ca %	P %
May	2611	21.01	0.81	0.85	1.29	12.10	0.17	0.84
June	2615	20.68	0.79	0.84	1.32	11.94	0.16	0.83
July	2780	22.75	0.82	0.90	0.96	10.29	0.18	0.86
August	2642	23.84	0.99	0.93	1.18	12.30	0.18	0.88
September	2697	24.51	1.20	0.90	1.46	10.33	0.17	0.73
October	2999	22.37	0.95	0.85	1.54	7.95	0.15	0.70

ME - metabolizable energy, GP - gross protein, GF – gross fat, GC - gross cellulose

The paddlefish aged at summer IV was fed according to the data given in *table 5*. The concentrated feed was administrated according to previous protocol exposed for paddlefish aged at summer III.

The total consumption of feed concentrates in *„Cal Alb"* water accumulation was calculated at 381.08 tons, and was represented by sunflower grist, soybean grist, corn, barley, wheat and rye.

Table 5 Fodder types administration in „Cal Alb" water accumulation

Fodder type / Months	Sunflower grist (t*)	Soybean grist (t)	Corn (t)	Barley (t)	Wheat (t)	Rye (t)	Total (t)
May	8.73	-	-	10.08	-	-	18.81
June	18.27	-	-	22.38	-	-	40.65
July	40.14	-	-	3.27	32.4	5.00	80.81
August	60.00	8.19	-	56.28	-	-	124.47
September	28.14	20.28	-	44.52	-	-	92.94
October	7.50	2.88	4.50	-	8.52	-	23.40

*tons

Considering the already tabled data, the maximum food quantity was administered in August (124.47 t), i.e. 33.66% of the total given feed (381.08 t).

We consider that the administered feed did not achieve the optimum level of basic species (carp, for example) in terms of metabolizable energy (ME - kcal/kg), the calculated values for mixed feed concentrates administered in „Cal Alb" water accumulation (between 2611 kcal/kg in May and 2999 kcal/kg in October) being below the minimum accepted (ME - 3600 kcal/kg). The protein level varied between 20.69% GP (gross protein) in June (being below the minimum level of 22%) and 24.59% in September (being below the optimum level of 26%) (table 6).

Table 6 Nutritional parameters of the administrated mixed fodders

Specification	ME kcal/kg	GP %	Lysine %	Methionine + Cystine %	GF %	GC %	Ca %	P %
May	2611	21.07	0.81	0.85	1.29	12.11	0.17	0.84
June	2615	20.69	0.79	0.84	1.32	11.94	0.16	0.83
July	2780	22.75	0.83	0.90	0.96	10.29	0.18	0.86
August	2642	23.84	0.99	0.93	1.18	12.30	0.18	0.88
September	2779	24.59	1.20	0.90	1.46	10.33	0.17	0.73
October	2999	22.40	0.95	0.85	1.54	7.95	0.15	0.71

ME - metabolizable energy, GP - gross protein, GF – gross fat, GC - gross cellulose

We discovered an identical nutritional spectrum (zooplanctonofag) in the investigated Polyodon spathlula aged at summer III and IV, the dominance of one or another group of planktonic species in paddlefish's diet being dependent by their abundance in growth ponds. Feeding at this age is less selective, prevailing zooplankton organisms that correspond to their maximum development in growth ponds. At the end of investigated period (September), in digestive content of paddlefish aged at summer III prevailed cladocerans - 73%, followed by copepods - 24%, and then of insects - 2.2%; the share of these components in digestive content of paddlefish aged at summer IV was the following: cladocerans - 70%, copepods - 16%, insects - 1.5% (table 7).

Table 7 Identified components in digestive content of the studied *Polyodon spathula* sturgeons

Specification	Identified components in digestive content	Their share in feed (%)	Observations
Polyodon spathula aged at summer III	Cladocerans Copepods Insects Vegetables Rotifers	73 24 2.2 0.5 0.3	Cladocerans were represented by Daphnia sp., and copepods by Cyclops sp.
Polyodon spathula aged at summer IV	Cladocerans Copepods Insects Vegetables Rotifers	70 16 1.5 1.3 0.2	Cladocerans were represented by Leptodora sp. and Daphnia sp.

The paddlefish feeding behavior revealed an intense activity at night and at early morning. They normally migrate for feeding to the surface of water. *Polyodon spathula* growing in polyculture with *Hypophtalmichthys molitrix* fish bodes well because paddlefish consume large zooplankton, therefore phytoplankton being in abundance for silver carp. The manure from *Hypophtalmichthys molitrix* fish support bacterio-plankton development which represent the feed for zooplankton [1].

***Polyodon spathula* growing rate**

The literature consulted by us revealed that *Polyodon spathula* has a rapid growing rate in its first three years of life, followed by a decrease at the beginning of summer IV [1], [8], [5]. Their growing rate may be influenced by the quality and quantity of food, very good gains in conditions of feed

abundance being achieved [6], [7], [3], [4], [9].

We appreciate that a monthly growing rate investigation was difficult to be realized in our study due to the paddlefish growing in polyculture with carp, silver carp, white amur, and bighead, our *Polyodon spathula* individuals being in small populations and we can not catch enough sturgeons to do an accurate assessment. Therefore, the growing rate of the investigated paddlefish was assessed based on data from populating time (on the 15th of May), from two control catches and from the harvesting catch (on the 30th of September). The average growing rate for the investigated individuals was 1700 g for sturgeons aged at summer III, and 1090 g for sturgeons aged at summer IV. The estimated monthly growing rate was 377.77 g for sturgeons aged at summer III, and 242.22 g for sturgeons aged at summer IV (table 8).

Table 8 The paddlefish growing rate in the investigated populations

Specification	No. of individuals	The average growing rate for the investigated individuals (g)	The estimated average of monthly growing rate (g)	The estimated average of daily growing rate	
				g	%
Polyodon spathula aged at summer III	10	1700	377.77	12.59	100
Polyodon spathula aged at summer IV	10	1090	242.22	8.07	-35.90

All the presented data are consistent to those provided in consulted references, describing a very good growing rate for the investigated paddlefish in their summer III age of life, and a slightly decrease with fish age increasing [1], [6].

Mortalities and their causes

Considering the assumed hypothesis that the survival rate of fishes is directly influenced by their ages of life, it is eloquent to separately present the obtained values for each age (table 9).

Table 9 Mortality rate in *Polyodon spathula* investigated populations

Specification	No. of individuals at populating time	No. of individuals at harvesting catch	No. of mortalities	Survivors (%)
Polyodon spathula aged at summer III	250	238	22	95.20
Polyodon spathula aged at summer IV	200	200	-	100.00

In *Polyodon spathula* aged at summer III population were fewer mortalities (22 individuals), the survivor percent being of 95.20. There were three individuals with scars of birds' aggressions, and at least three individuals killed and eaten by otters. But the main cause of mortalities could remain the stress caused by repeated manipulations (popular control fishing, harvesting catches). In *Polyodon spathula* aged at summer III population was no individual affected by any disease.

In *Polyodon spathula* aged at summer IV population was not recorded any mortality due to its growing in a larger pond (*„Cal Alb"* water accumulation with 135 ha) where poaching and catching by predators are occasional. The largeness of *„Cal Alb"* water accumulation made also difficult the fish catching control, thus reducing the handling stress.

CONCLUSIONS

Polyodon spathula uses very efficient the natural feed found in the studied ponds water, considering its mainly feeding with zooplankton, aquatic insects and phytoplankton. The main digestive content in the investigated fish was represented by cladocerans, followed by copepods, and then of insects.

In our investigated fish populations, the growing rate was increased in their summer III age of life, followed by a slightly decrease with fish age increasing.

In *Polyodon spathula* aged at summer III population were fewer 22 mortalities; there were three individuals with scars of birds' aggressions, and at least three individuals killed and eaten by otters, but no individual affected by any disease. In *Polyodon spathula* aged at summer IV population was not recorded any mortality. We consider that the largeness of pond is positively correlated with decreasing of poaching and catching by predators, and made difficult the fish catching control, thus reducing the handling stress.

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