

Influence of basin shape on growth performance and development of North African catfish (*Clarias gariepinus*)

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Abstract. This paper presents the results of research that focused on the impact of basin type on growth performance and development in North African catfish (*Clarias gariepinus*). Therefore two types of ponds were tested, round and square in which subjects received the same type of quality forage and benefited by same water parameters so that the differences were caused exclusively by the basin configuration. Following investigations it was found that the best performance during the 213 day experimental period was achieved in circular basins 1623.904 ± 42.766 g versus rectangular basins where the total body mass accumulation was lower with 384.696 ± 10.131 g (1239.208 ± 46.608 g). The average daily gain was 7.624 ± 0.201 g for biological material grown in circular basins and 5.818 ± 0.219 g in rectangular basins.

Key Words: Basin shape, growth performance, North African catfish, *Clarias gariepinus*.

Introduction. Special qualities of the fish meat in general and especially the raptor species ones fully justify the growing demand of the market (Crisan & Bud 2013; Todoran & Bud 2013; Bud et al 2010). Besides fish farming can provide an efficient land capitalization/short period insuring large amounts of fish per unit area (Moldovan & Bud 2013). Among some predatory fish species that is gaining more familiarity stands the North African catfish (*Clarias gariepinus*), a new entry species in European countries, including Romania in the recent years (Pop & Bud 2013; Bud et al 2007). It is a predatory species formed and accommodated to harsh and extreme climatic conditions in Africa, at very high temperatures and long periods of drought, which benefit a complementary apparatus that allows him to withstand a long time in the air even in the absence of water, which favors the growth within high density and staying alive during long-distance transport (Baron et al 1994).

Recently entered our country, the North African catfish was raised in ponds of various types without sufficient information to provide reliable data on their influence on growth and development.

Based on these considerations, we considered that it is opportune for the prospective breeders of this species to provide reliable data on the effectiveness of choosing one or the other of the variants tested.

Given the peculiarities of the catfish species among which its plasticity which allows to easily adapt to different habitats, high fecundity, disease resistance, growth dynamics in our country especially in areas with hot springs and natural ponds waters during the warm season (Timmons et al 1998; Watten et al 2000), land itself for an economic fish farming.

Based on these arguments, and given to the poor information available, in this paper we allowed to test the growth of catfish in two types of ponds (round and square) and see if there are differences in this regard and to quantify their size.

Given to the fact that the exploitation of this species at the time of research was done in a single farm in our country, the research focused on two forms of research

basins and tried to answer the question "which ones are most profitable?" providing important information to potential breeders, scientifically verified to help in rearing this species.

Material and Method. The research was conducted according to the S.C. Clarias Com S.R.L fish farm conditions from Sântandrei, Bihor County, specialized in growth of North African catfish in super intensive system in circular and rectangular ponds, using thermal water and fresh water mixture as normal living environment.

The reared biological material originates from Hungary, Haki farm and from Fisheries Research Institute respectively.

The firm uses two types of ponds i.e. circular tanks (Figure 1) and rectangular ponds (Figure 2).



Figure 1. Circular basins for consumption fish.



Figure 2. Rectangular basins.

Circular tanks have a diameter of 6.6 m, a depth of 1.2 m and a volume of 40 m^3 , and the rectangular basins have a length of 5 m, 8 m width with an area of 40 m^2 and a volume of 46.80 m^3 water.

The main objective of this experiment was to highlight the growth and development of the North African catfish compared two types of ponds where operating parameters were identical except the form of ponds.

The administered feed structure comes from the Netherlands, the chemical composition is presented in Table 1.

The experiment was conducted during 2006, on a period of over seven months (213 days) from the age of 70 days when fish had an average body weight of $106.467 \pm 5.184 \text{ g}$ and up to 238 days of age when the biological material was capitalized for human consumption. During the experiment, body weight developments and the 9 major morphological features were followed, settling at the end of the experience the impact upon these features attributed to the ponds form.

Table 1

Chemical composition of the fodder administered to North African catfish

<i>Feed structure</i>	<i>Unit</i>	<i>Values</i>
CP - Crude protein		45.0
CF - Crude fat		12.0
CC - Crude cellulose		1.5
Ash	%	9.5
Ca (Calcium)		1.8
P (Phosphorus)		1.2
Lysine		3.0
Methionine		1.0
Vitamins	A	IU/kg
	D ₃	IU/kg
	E	mg/kg
	C	mg/kg
	Cu (CuSO ₄)	mg/kg
	Selenium (Na ₂ SeO ₄)	mg/kg
		15000
		2000
		200
		150
		5.0
		0.3

Results and Discussion. At the end of the experiment according to the data from Table 2 we see that from the first control at the age of 135 days weight differences of the two groups are significant, biological material growth in circular basins achieving a higher weight (573.621 ± 21.526 g) comparative with individuals from rectangular basins which weight was only 429.325 ± 18.377 g, a difference of 144.29 g which we consider particularly eloquent and merely reveals circular selection over those rectangular basins.

The differences from the first stage are still maintained further so at the age of 183 days to reach 258.098 g, being very significant and insured for the biological material growth in circular basins.

At the end of the experimental period when the biological material is 283 days old the average final weight is circular basins is 1756.376 ± 42.8470 g, while catfish specimens growth in rectangular tanks reaches 1345.674 ± 49.643 g, being lower with 410.70 g which confirms that regardless of the interval the North African catfish feel more comfortable in growth in circular basins compared to rectangular basins (Figure 3).

Comparing the data in the study carried out on the range and establishing differences and significance of the differences we find that in all cases these are very significant (Table 3).

The same trend is recorded for body measurements in accordance with body development (Table 4).

In Figure 4, evolution of body mass and average daily gain per stages and the total period is very suggestive, which shows the suitability of growth of North African catfish in circular tanks compared to growth in rectangular basins.

Based on this experiment it is demonstrated that in round basins is achieved a higher degree of homogeneity of the water volume which leads to a more uniform distribution of biological material in the tank, and consequently optimizes the use of water and space and insuring a higher comfort for growth and superior performance of body mass compared to rectangular basins.

Table 2

The average weight and weight dispersion indices (Gg) in the studied populations of North African catfish (*Clarias gariepinus*)

Specification	Body weight (G) - g			
	Population I. - Rectangular ponds			
	70	135	183	283
Age (days)				
N			75	
Mean - \bar{X}	106.467	429.325	967.432	1345.674
Std. error of mean - $s_{\bar{X}}$	5.184	18.377	46.885	49.643
Median	104.304	410.304	932.920	1340.266
Std. deviation - s	44.896	159.147	406.035	429.920
Variance - s^2	2015.671	25327.792	164864.778	184831.507
Minimum	27.760	132.170	175.750	369.860
Maximum	224.020	806.120	2009.320	2298.700
Sum - ΣX	7984.980	32199.410	72557.400	100925.570
Coefficient of variation - V %	42.169	37.069	41.970	31.948
		Population II. - Circular ponds		
N			75	
Mean - \bar{X}	106.467	573.621	1225.530	1756.376
Std. error of mean - $s_{\bar{X}}$	5.184	21.526	48.974	42.847
Median	104.304	531.993	1128.980	1757.195
Std. deviation - s	44.896	186.421	424.126	371.067
Variance - s^2	2015.671	34752.864	179882.744	137690.584
Minimum	27.760	255.710	481.770	966.540
Maximum	224.020	1219.250	2525.760	2657.400
Sum - ΣX	7984.980	43021.550	91914.710	131728.200
Coefficient of variation - V %	42.169	32.499	34.608	21.127

N – no. of considered individuals.

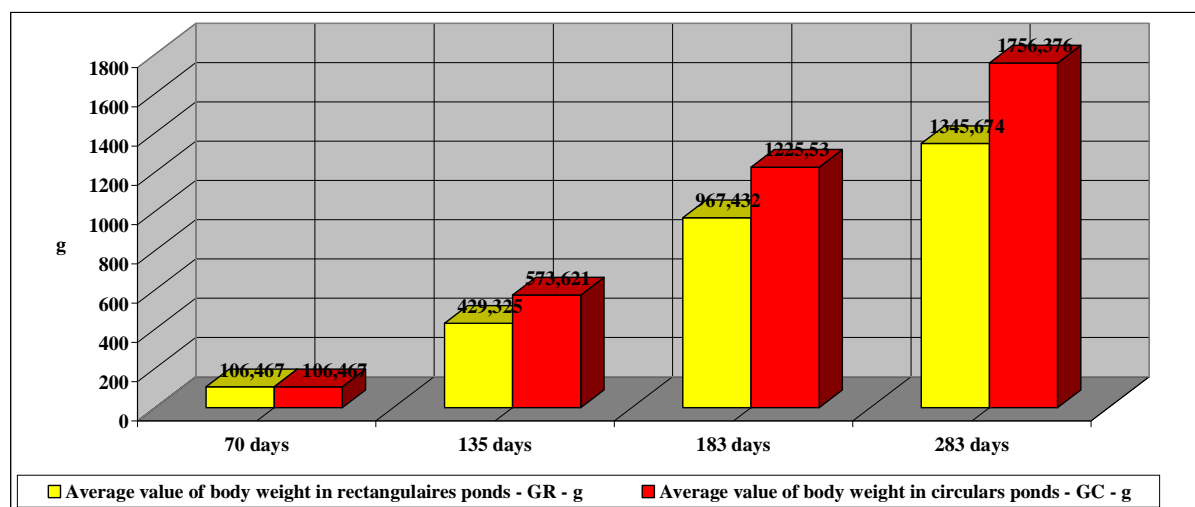


Figure 3. Average body weight (G) in North African catfish (*Clarias gariepinus*) growth in rectangular and circular basins.

Measurements performed at the ages of 135 days, 183 days and 283 days, shows a very significant differences between the mean body weight of the biological material of *C. gariepinus* reared in the two type of basins, which proves once again that the biological material of this species, growth in circular basins respond significantly better in terms of weight gain, feeding the feed of Dutch origin.

Table 3

Comparing samples and determining the significance of differences between environments - "t" test

Specification	N	Mean	Std. deviation	Std. error of mean	"t"	Significance of differences
GC* 70 - GC 135 days		467.154	188.483	21.764	21.464	***
GC 135 - GC 183 days		651.909	453.782	52.398	12.441	***
GC 183 - GC 283 days		530.847	557.462	64.370	8.247	***
GR** 70 - GR 135 days		322.859	143.679	16.591	19.460	***
GR 135 - GR 183 days	148	538.107	355.219	41.017	13.119	***
GR 183 - GR 283 days		378.242	428.856	49.520	7.638	***
GC 135 - GR 135 days		144.295	226.663	26.173	5.513	***
GC 183 - GR 183 days		258.097	630.907	72.851	3.543	***
GC 283 - GR 283 days		410.702	458.676	52.963	7.754	***

N - no. of considered individuals,

*GC – Weight - for population growth in circular basins,

**GR – Weight - for population growth in rectangular basins.

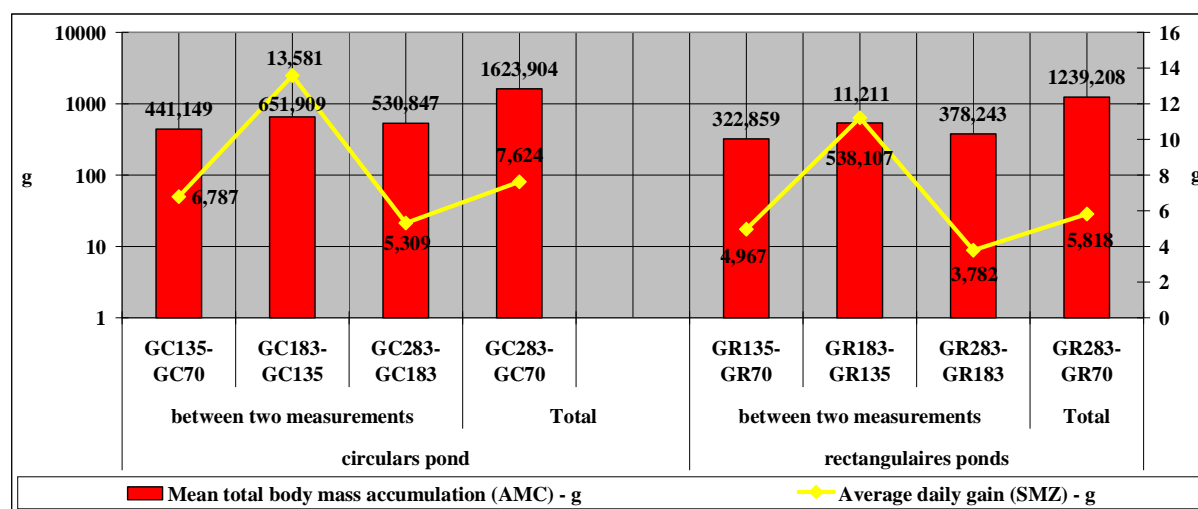


Figure 4. Mean of total body mass accumulation (AMC) and average daily gain (SMZ), achieved by the North African catfish (*Clarias gariepinus*) in circular and rectangular tanks, fed with feed imported from the Netherlands.

Table 4

The average (\bar{X}) of characters in the two studied populations of North African catfish (*Clarias gariepinus*)

Specification		Average - \bar{X} -							
Ponds type	Unit	Rectangular ponds				Circular ponds			
Age	days	70	135	183	283	70	135	183	283
N	no.	75	75	75	75	75	75	75	75
G	g	106.467±5.18	429.325±18.37	967.432±46.88	345.674±49.6	106.467±5.184	573.621±21.52	225.530±48.9	756.376±42.8
TL	cm	24.379±0.791	36.122±1.105	48.519±1.591	54.604±1.633	24.379±0.791	46.476±0.855	61.714±1.188	70.840±1.093
SL	cm	20.973±0.695	31.074±0.953	42.138±1.392	47.472±1.432	20.973±0.695	40.481±0.741	53.801±1.030	61.796±0.973
Lh	cm	6.086±0.204	9.470±0.298	14.962±0.456	15.024±0.275	6.086±0.204	12.270±0.224	15.875±0.318	17.725±0.271
pdL	cm	7.172±0.235	11.270±0.351	14.765±0.493	16.907±0.505	7.172±0.235	14.396±0.249	18.808±0.358	21.709±0.340
paL	cm	12.085±0.382	17.780±0.546	23.564±0.764	27.764±0.785	12.085±0.382	22.869±0.421	30.223±0.576	35.995±0.526
Lpc	cm	3.198±0.108	4.711±0.164	6.114±0.214	6.401±0.223	3.198±0.108	5.995±0.139	7.913±0.182	9.154±0.190
H	cm	3.109±0.100	4.333±0.144	6.161±0.212	6.260±0.183	3.109±0.100	5.503±0.113	7.879±0.178	8.036±0.133
h	cm	2.631±0.085	3.267±0.058	4.761±0.099	5.977±0.103	2.631±0.085	3.745±0.075	6.161±0.212	6.260±0.183
Tp	cm	9.670±0.322	18.444±0.589	22.923±0.766	24.477±0.685	9.670±0.322	23.231±0.427	29.150±0.611	31.639±0.476

G - body weight, TL - total length, SL - standard length, Lh - length of head, pdL - predorsal length, paL - preanal length, Lpc - length of caudal peduncle, H - the maximum height, h - minimum height, Tp - thoracic perimeter.

Conclusions. Considering the present research and results some most significant conclusions can be drawn.

The water supply positioned tangential to the circular wall of the pond produces a generally uniform flow pattern and at a constant rate of flow of water, properties that result in a lower rate of exchange of the water volume as compared with the rectangular basin.

Circular tanks provide better uniformity of water quality which allows easier optimization of health and growth performance, solid residues can be easily removed through the central evacuation pipe. For all these considerations are preferred the circular basins.

One of the disadvantages is the rectangular basins is the less self-cleaning ability compared with circular basins and waste disposal is deficient performed.

If case of *C. gariepinus* growth in the two types of ponds was found that growth performance are superior for individuals exploited in circular basins compared with those obtained by individuals exploited in rectangular basins, differences being significant and insured.

Following the results of the stages of growth was found that on the one hand records from biological material differences depending on the type of used ponds, and these differences increase in accordance of age, making the biggest differences by age of 6 - 7 months.

Following our results, we recommend circular basins at the expense of rectangular ones for those interested in the rearing of *C. gariepinus*, and pledge for large diameter circular tanks to reduce manufacturing costs and achieve economic productions.

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