Preliminary Results Regarding the Growth of Catfish in Floating Cages on the Irrigation Canal

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Abstract

The selection of fish species that can be raised in floating cages took into account the physiological compatibility between them and the water supply to the irrigation canal, respectively of the Danube River. The European catfish is a predatory species with a positive growth rate and high-quality meat, which recommends it for use in aquaculture. This experiment aimed to adapt and evaluate the growth conditions of wels catfish (*Silurus glanis*, Linnaeus 1758) in floating cages located on the irrigation canal. The experimental period lasted 120 days. A number of 52 catfish specimens were distributed in two floating cages, the experimental variant V1 with 26 specimens and an average weight of 230 g, and the experimental variant V2 with 26 specimens and an average weight of 440 g. The fish were fed three meals per day with extruded feed containing 53% crude protein and 18% fat. The analysis of the experimental data on the growth of catfish in floating cages located in irrigation canals shows that both, the survival of the biological material and its growth rate, registered a positive evolution in the experimental variant V2, where survival was 92% and gained weight 19.66 kg/m^3, compared to 12.12 kg/m^3 in the experimental variant V1. In conclusion, catfish may be a species of interest for the culture in floating cages on irrigation canals, but the study recommends future research to elucidate several aspects of growing and assessing of the environmental conditions.

Keywords: catfish, floating cages, irrigation canal.

1. Introduction

Cage culture expanded rapidly in recent decades owing to its advantages including high unit production, efficient use of water resources, convenience for movement and management, and relatively lower input-output ratio, as well as providing alternative livelihood opportunities to people displaced from impoundment [1-3].

Cage aquaculture can be defined as the rearing of aquatic organisms in a volume of water enclosed on all sides with cage netting materials including the bottom while permitting free circulation of water through the mesh of cages.

The technology is suitable for almost all types of water bodies provided there is sufficient water depth so that the bottom cage net is about 2 m above the bottom of the waterbody to allow water current below the cages and reduce the probable impact of fecal matter and uneaten feed.

The European catfish is among the largest freshwater fish worldwide, reaching up to 4-5 m in total length and a body weight of more than 300 kg [4, 5]. This species has economic importance in aquaculture, due to its positive characteristics, such as its high growth rate and high tolerance to different hydro-chemical conditions [6] and its delicious meat with little bones. European catfish (*Silurus glanis* L., 1758; also called wels catfish or sheath fish) are commercially important

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freshwater fish originating from Eastern European countries [7]. European catfish have a high economic value due to their rapid growth and excellent flesh. They are cultivated in many European countries. In Romania, production can be high as the fish can be grown at high stock density, fed with pellets, and can live in warm waters [8]. The experiment proposed in the present study aimed to establish the technical conditions for the design and implementation of growth systems and the application of growth technologies, given the hydro-technical characteristics of irrigation canals, the eco-biology of crop species, and analysis of biological, chemical, and physical risks that may occur on the technological flow of fish species growth.

2. Materials and methods

The experimental period lasted 120 days in the first stage. A number of 52 catfish specimens were distributed in two floating cages, the experimental variant V1 with 26 specimens and an average weight of 230 g, and the experimental variant V2 with 26 specimens and an average weight of 440 g. The two floating cages are made within ICDEAPA Galati, with the aim of testing a rearing technology for *Silurus glanis* (european catfish) based on placing the nets on a square HDPE frame with Φ 120 mm and 120 cm sides located directly in the canal water, without additional structures to ensure buoyancy and direct access (Foto 1).

Foto 1. The layout of floating cages for growing European catfish (first stage)

In the second stage (50 days), the experimental module for the growth of the european catfish species (*Silurus glanis* Linnaeus, 1758) was represented by a cage of size 3×2×2 m made of galvanized panels (Foto 2). This cage had built at ICDEAPA Galati near the irrigation canal, and the usable volume was 9 m^3, with a safety guard of 0.45 m. The cage has been provided with floats to ensure its buoyancy. The location of the cage in the CM Lunca irrigation canal has been done using a motorboat and some ropes. The biological material for stocking the cage was european catfish species with an average mass of 1200 g/fish and a stocking density of 41 fish/cage, respectively 4 fish/m^3 (foto 2). The materials used to make the experimental cage in the second stage of european catfish rearing are described by Nistor et al., (2022) [9].

The european catfish (*Silurus glanis* Linnaeus, 1758) came from the Brateș nursery near the CM Lunca irrigation canal. The fish were fed extruded feed containing 53% crude protein and 18% fat three times a day. The amount of feed fed varied between 3.5 and 10% of the biomass. The biochemical composition of the feed used is presented in table no. 1:

Foto 2. The layout of floating cages from galvanized panels for growing European catfish (second stage)

Table 1. The biochemical composition of *AQUA START*

Composition	Quantity
Crude protein %	53.0
Crude lipid %	18.0
Crude cellulose %	1.0
Phosphorus %	1.60
Vitamin A (UI)	15000
Vitamin D3 (UI)	3000
Vitamin E (mg)	300
Vitamin C (mg)	375
Digestible energy (MJ/kg)	19.3

Monitoring of water quality in the irrigation canal where the cages were located was carried out by daily determination of temperature, oxygen, and pH using a portable oxygen meter HACH HQD Field Case 58258-00, and once a week nitrogen compounds, chlorine, and dissolved organic matter were determined by colorimetric method using DR 2800 spectrophotometer.

3. Results and discussion

The European catfish (*Silurus glanis*, Linnaeus 1758) has long been reared in polyculture with other species in extensive systems, but nowadays there are clear trends towards intensive rearing. Its ability to adapt to environmental conditions and rapid growth rate are the most important references for growing this species in intensive systems. This species needs minimum growing conditions, which can be easily provided due to the range of allowable values. These include a dissolved oxygen content in water of 4-14 mg/l, a pH between 6.5-9.0, and a temperature of 18-28°C [10]. In the first experimental stage, results on water quality as reported by temperature, dissolved oxygen concentration, pH, ammonia nitrogen, chloride, nitrite, hardness, level, and others are described by Nistor et al., (2021) [11]. In the second experimental stage, specific to the autumn season, the water temperature varied between 21.7-10.6^{o}C, with low values at the end of the experimental period when the biological material stopped feeding (Figure 1).

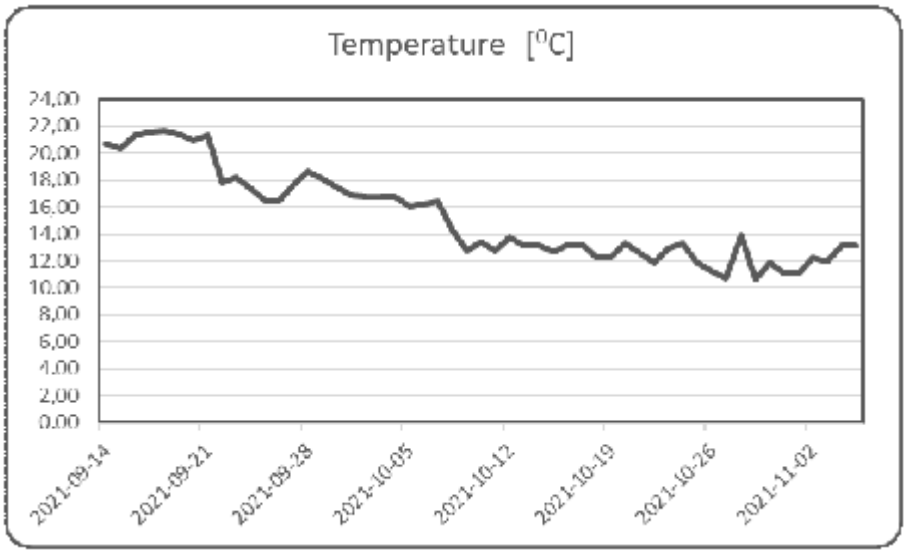

Figure 1. The temperature evolution during the second experimental stage

Dissolved oxygen concentrations in irrigation canal were often low in the early morning hours during season summer and autumn, which is an effect of the influence of other environmental factors. The values recorded during the second stage ranged quite widely, with minimum values of 4.95 mg/L and maximum values of 14.92 mg/L (Figure 2). Low dissolved oxygen concentrations can be lethal to crop biomass, even when the deficit is maintained for short periods (a few minutes). Such situations are likely to occur because the amount of dissolved oxygen in the water depends, in addition to temperature, on other factors such as culture species, average individual fish weight, and total biomass/unit volume of water. The harm caused to fish by high oxygen levels in the water is rare and is mainly due to over-saturation. Excess oxygen in the water can lead to paralysis of the fish or, at lower stages of development, to gas emboli in the gill epithelium affecting the normal respiration of the affected fish.

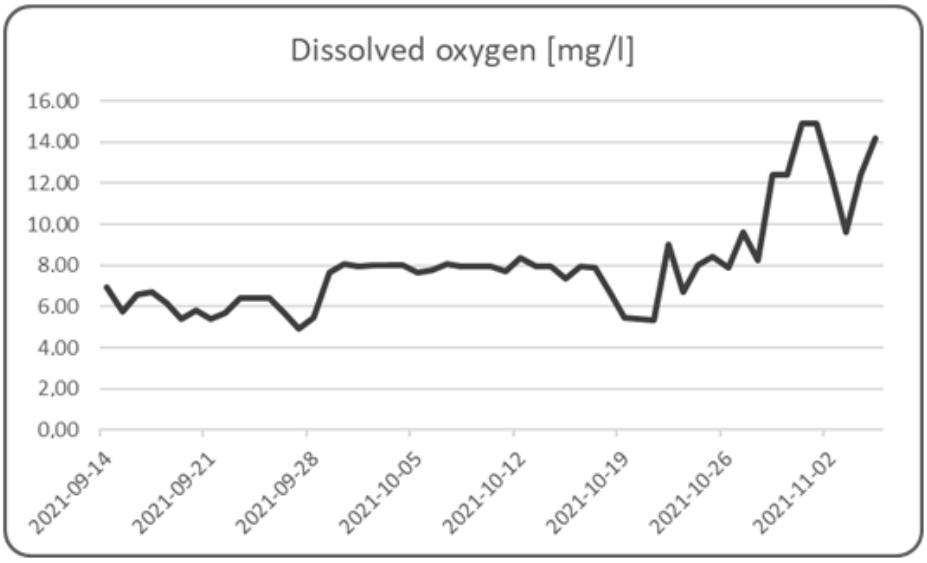

Figure 2. The dissolved oxygen evolution during the second experimental stage

The water level in the irrigation canal at the end of the experimental period recorded similar values due to the cessation of the irrigation regime. The level difference in the second stage was 0.50 m, with an average of 1.57 m (Figure 3).

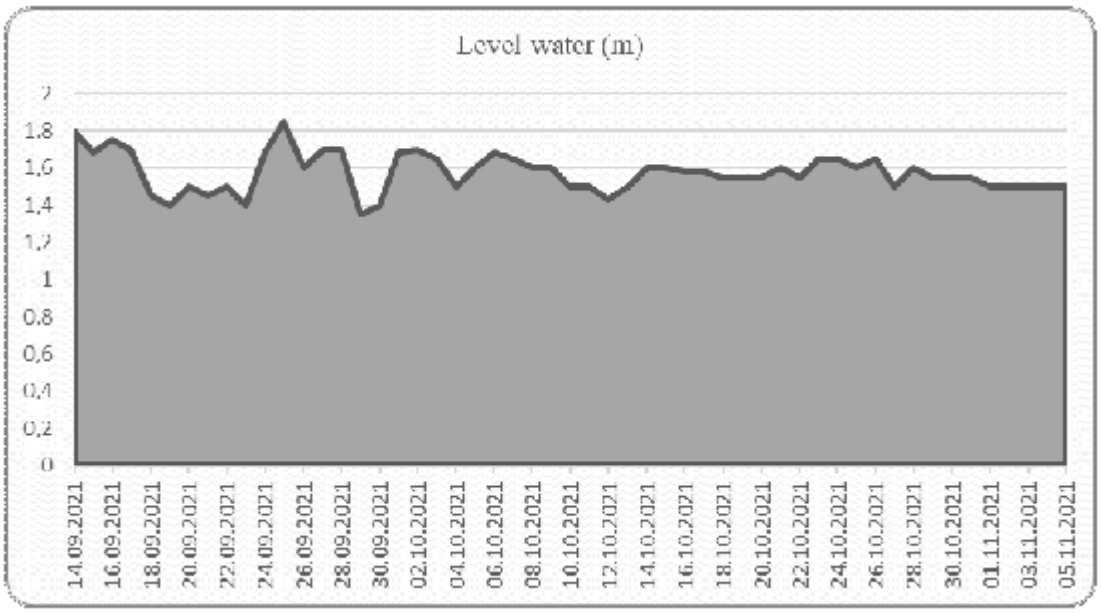

Figure 3. The variation in water level during the second experimental stage

The achievement of the proposed goal of adaptation and evaluation of growth conditions, mainly reflected in the growth rate of the biological material, involved dividing it into two size classes at the beginning of the experimental period, according to the average individual mass of the specimens (230 g and 440 g) which were subsequently stocked in the floating cages, thus eliminating competition for food and the phenomenon of cannibalism which is specific to predatory species.

In these experiments, the adaptability and growth rate of the European catfish had investigated, taking into account its ecophysiological characteristics, intensive rearing system, and the specific environmental conditions of CM Lunca - irrigation canals, which may argue for the development of aquaculture of this species in cages. In the first experimental stage, the data analysis on European catfish growth in floating tanks placed in irrigation canals showed that both the survival and the growth rate of the biological material showed a positive evolution in the experimental variant V2, where survival of 92% and a growth rate of 19.66 kg/m^3 was obtained compared to 12.12 kg/m^3 in the experimental variant V1 (Table 2).

Table 2. The table regarding the biotechnological indicators of farmed European catfish in a floating cage

Indicators	Stage I		Stage II
	V1	V2	C1
The initial number of fish	26	26	41
The final number of fish	17	24	39
Survival rate [%]	65	92	95
Initial biomass [kg]	5.98	11.44	49.2
Initial biomass [kg/m^3]	5.9	11.4	5.47
Final biomass [kg]	18.1	31.1	58.5
Final biomass [kg/m^3]	18.1	31.1	6.5
Biomass gain [kg]	12.12	19.66	9.3
Biomass gain [kg/m^3]	12.12	19.66	1.03
Mean initial weight [g/fish]	230	440	1200
Mean final weight [g/fish]	1000	1296	1500
Individual weight gain [g]	770	856	300
Days of stage growth [day]	120	120	30

From the analysis of biotechnological indicators of European catfish grown in the second experimental stage was observed that the biomass growth gain was 1.03 kg/m^3, and the individual growth gain was 300 g/fish (Table 2), given that this species is a carnivorous, voracious fish, it also consumes very well the forage administered in addition. In the first growth stage, the medial conditions in the irrigation canal were more favorable compared to the autumn season when the water temperature dropped significantly, along with the other physicochemical factors. From the analysis of the data on the initial and final biomass (biomass gain) of *Silurus glanis* (Linnaeus, 1758) has been seen that the best results were obtained in the experimental variant V2 in the first stage, but also in the second stage a favorable biomass gain was obtained under the given conditions (Figure 4)

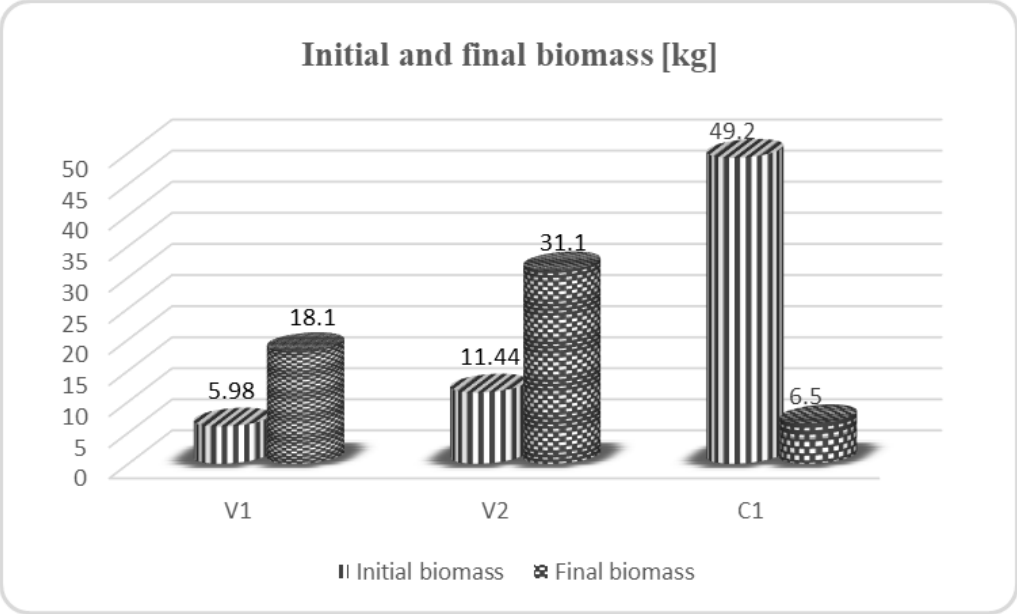

Figure 4. The initial and final biomass during the experimental period

4. Conclusions

The conclusion of the analysis of the preliminary experimental results is that European catfish grown intensively in the conditions of floating cage systems located on the CM Lunca irrigation canal is that the biological material showed a remarkable adaptation, demonstrated by the growth rate that recorded positive values, under the favorable conditions offered by the rearing environment and the applied technology. In conclusion, the European catfish may be a species of interest for the culture in floating cages on irrigation canals, but the study recommends future research to elucidate several aspects of growing and assessing the environmental conditions.

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