# PRODUCTIVE PERFORMANCE OF SILVER CATFISH, *Rhamdia quelen*, JUVENILES STOCKED AT DIFFERENT DENSITIES

## DESEMPENHO PRODUTIVO DE JUVENIS DE JUNDIÁ (*Rhamdia quelen*) SUBMETIDOS A DIFERENTES DENSIDADES DE ESTOCAGEM

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**SUMMARY**

The objective of this study was to evaluate the productive performance of silver catfish (jundiá), *Rhamdia quelen*, juveniles stocked at different densities. In a completely randomized design, with three treatments and three replications, 450 silver catfish juveniles weighing an average 14.76 ± 1g were used. Nine polyethylene tanks with 100 liters capacity were stocked with jundiá juveniles at the following densities: 250, 500 and 750 juveniles/m$^3$ corresponding, respectively, to 25, 50 and 75 fish per tank. During a 30-day period, ration was supplied twice daily based on 5% of initial biomass. The following performance parameters were evaluated: average final weight and total length, specific growth rate and apparent food conversion. The lower stocking density (250 fish/m$^3$) yielded the highest growth rate; however, high densities (750 fish/m$^3$) did not increase mortality rates, which by its turn increased the biomass and the number of juveniles available for the next production step

**KEY-WORDS:** Pisciculture. Southern Brazil. Intensive cultivation. Native fish.

**RESUMO**

O objetivo deste trabalho foi avaliar o desempenho produtivo de juvenis de jundiá em diferentes densidades de estocagem. Foram utilizados 450 juvenis com peso médio de 14,76 ±1g, distribuídos em um delineamento completamente casualizado, com três tratamentos e três repetições. Em nove caixas de polietileno com 100 L de água cada, foram comparadas três densidades de estocagem: 250, 500 e 750 juvenis/m$^3$ correspondendo, respectivamente, a 25, 50 e 75 peixes por caixa durante 30 dias. Os peixes foram alimentados duas vezes ao dia, com base em 5% da biomassa inicial. Foram avaliados peso médio final, comprimento total médio, taxa de crescimento específico, uniformidade do lote e conversão alimentar aparente. A menor densidade de estocagem (250 peixes/m$^3$) proporcionou melhor crescimento, entretanto, densidades elevadas (750 peixes/m$^3$) não ocasionaram mortalidade, elevando a biomassa e número de juvenis para a próxima etapa da criação.

**PALAVRAS-CHAVE:** Piscicultura. Sul do Brasil. Cultivo intensivo. Peixe nativo.

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## INTRODUCTION

Due to well defined seasons, a characteristic of the climate in Rio Grande do Sul state, fish grow-out and harvesting steps are conducted primarily during spring and summer when water temperature remains above 20°C. In order to reach commercial weight during this period, the fish must have been born the previous summer and raised during the winter, so that they weigh between 30 and 50 grams when they are transferred to net-cages or ponds where they are intensively farmed.

The silver catfish, *Rhamdia quelen*, is a fish of great economic importance in southern Brazil. It is acclimated to different environments, widely used in fish ponds and well accepted by the consumer market (MARCHIORO et al., 1999; BALDISSEROTTO & RADÜNZ NETO, 2004; CARNEIRO & MIKOS, 2005; CANTON et al., 2007).

As fish farming develops, a greater number of fish species is farmed and very often in overcrowded conditions where they are subject to water quality changes, to stress and diseases (SHAMA et al., 2000). According to Brandão et al. (2004) the first step to develop a package for the farming production of a new fish species is to determine ideal stocking density, aiming to establish the optimal levels of productivity per area. Werner & Dorr (2006) stated that an appropriate stocking density decreases waste, regulates and improves feeding efficiency, and reduces the release of nutrients in the water. The majority of the studied species display an inverse relationship between stocking density and growth rate (EL-SAYED et al., 1995). Fish reared at high densities are subjected to stress and emerging social interactions that results in fish lots with heterogeneous size distribution (CAVERO et al., 2003).

The ideal stocking density changes with species, commercial size, farming system and fish stocking age. On the other hand, fish well being is getting increasing attention, and steps are being taken to regulate management practices, including stocking densities (TURNBULL et al., 2005; NIEUWEGIESSEN et al. 2008). Thus, the objective of this study was to evaluate the performance of juvenile catfish at different stocking densities.

## MATERIAL AND METHODS

Four hundred and fifty silver catfish weighing an average 14.76 ± 1g were distributed in 9 polyethylene tanks filled with 100 L water, a closed system equipped with biofilter, constant aeration and temperature set at 24°C. The tanks were stocked at three different densities: 250, 500 and 700 juveniles/$m^3$, which corresponded to 25, 50 and 75 fish per tank, respectively. The fish were fed a commercial extruded diet for juveniles that contained 42% crude protein at a rate of 5% biomass/day, twice daily at 9:00 am and 4:00 pm. The experimental design was completely randomized and consisted of three treatments and three repetitions.

The following water physico-chemical parameters were determined daily: dissolved oxygen and temperature using the oxymeter YSI–55, pH using the pHmeter F-1002 (Bernauer Aquaculture), ammonia was determined colorimetrically by the Nesslerization method and alkalinity according to the method proposed by Apha (1998).

On the $15^{th}$ and $30^{th}$ days of the experiment, the fish underwent an individual biometrics after fasting for 24 hours, which consisted of weighing using a digital scale (0.1 g) and measuring total and standard length using an ictiometer. The performance variables evaluated were: mean final weight (g), total (TL) and standard length (SL) (cm) and specific growth rate (%) according to Legendre & Kerdchuen (1995), using the following equation: SGR = 100 (ln Pm final – ln Pm initial) $(t)^{-1}$, where ln = natural logarithm; Wm = mean weight; and t = time in days.

Lot uniformity was assessed by adapting the equation proposed by Furuya et al. (1998), considering a 20% variation above or below the mean weight given by: $U = n_{\pm 20\%}/N \times 100$ where: U = uniformity; $n_{\pm 20\%}$ = number of individuals within the ±20% mean weight range; N = total number of fish in the lot. Apparent feed conversion rate was determined by the following equation: AFCR = (feed weight supplied in the period)(final weight – initial $\text{weight})^{-1}$. The data underwent variance analysis and polynomial regression using the software Statistica 5.0®.

## RESULTS AND DISCUSSION

Mean values of water physico-chemical parameters during the experimental period were: dissolved oxygen (4.53 ± 0.84 mgL-1), temperature (24.16 ± 1.63°C), alkalinity (48 ± 5 mg/L), ammonia (0.2 ± 0.1 mg/L), pH (6.98 ± 0.64). These results were within the standards recommended for silver catfish farming (BALDISSEROTTO & RADÜNZ NETO, 2004).

The mean values of growth performance are shown in Table 1. The mean final weight of catfish juvenile decreased with increasing stocking density (Y = 47.32 – 0.0123X, $R^2$ = 0.62). Different results were reported by Piaia & Baldisserotto (2000) who tested three stocking densities for silver catfish fingerlings: 114; 227 and 454 fingerling/$m^3$ and observed increasing growth rate with increasing stocking density. The authors suggested that group behavior to capture food favored this result. Probably, growth rate and stocking density relationship is different during each growth stage, as stated by Souza-Filho & Cerqueira (2003). Frascá-Scorvo et al. (2008) found no difference in the mean weight of barred catfish (surubim pintado), *Pseudoplatystoma corruscans,* raised in net-cages at two different densities: 67 and 133 fish/$m^3$. The other performance variables displayed similar behavior, that is, they decreased as stocking density increased and are represented by the linear equations, SL (Y = 0.0009X – 13.71, $R^2$ = 0.57) and TL (Y = 0.0012X – 16.69, $R^2$ =

**Table 1 -** Effect of different stocking densities (fish/m$^3$) on the performance parameters of silver catfish juveniles.

| Variables | Treatments | | | |
|---|---|---|---|---|
| | 250 | 500 | 750 | p |
| IW(g) | 14.68 ± 0.37 | 14.84 ± 0.53 | 14.68 ± 0.36 | - |
| FW(g) | 44.49 ± 9.9 | 40.66 ± 10.8 | 38.33 ± 11.6 | 0.001 |
| SL (cm) | 13.52 ± 0.94 | 13.25 ± 1.05 | 13.08 ± 1.14 | 0.009 |
| TL (cm) | 16.44 ± 1.12 | 15.95 ± 1.27 | 15.84 ± 1.36 | 0.002 |
| SGR (%) | 3.61 ± 0.76 | 3.27 ± 0.90 | 3.01 ± 1.01 | 0.001 |
| AFCR | 1.12 ± 0.47 | 1.36 ± 0.73 | 1.74 ± 1.30 | 0.001 |
| Unif (%) | 60 ± 16 | 58.83 ± 3.32 | 52 ± 3.46 | 0.57 |
| Surv (%) | 100 | 100 | 100 | - |

IW = initial weight, FW = final weight, SL = standard length, TL = total length, SGR = specific growth rate, AFCR = apparent feed conversion rate, Unif = uniformity and Surv = survival, means followed by standard deviation.

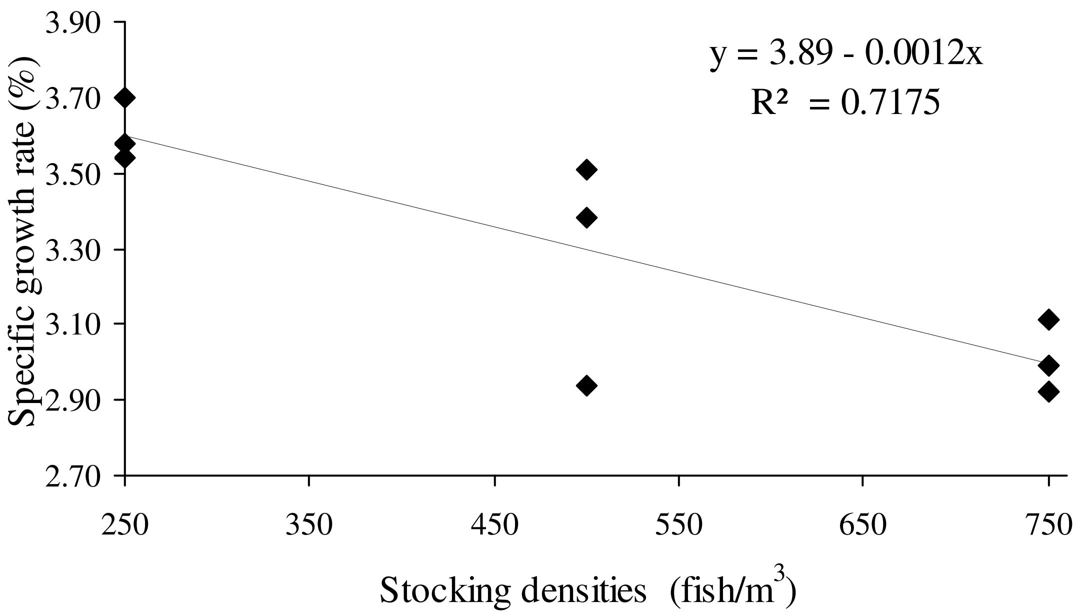


**Figure 1 -** Specific growth rate of silver catfish in relation to different stocking densities.

0.61) and SGR (Y = 0.0012X -3.89, $R^2$ = 0.71). Nevertheless, the specific growth rates of all treatments in this study were higher than those reported by Piedras et al. (2004), which evaluated the impact of different temperatures on juvenile catfish stocked at density of 5 fish/m$^3$, and obtained the highest SGR of 3.05%. Apparent feed conversion rate increased with density (Y = 0.0012X + 0.78, $R^2$ = 0.98). Barcellos et al. (2004) evaluated the performance of juvenile catfish raised in net-cages at three different stocking densities: 100, 200 and 300 fish/m$^3$, and concluded that the lower density yielded the best growth rate for juvenile production with mean final weight of 60 g. According to Hengsawat et al. (1997), the African catfish (*Clarias gariepinus*) displays the highest mean weight gain at lower stocking densities (50, 100, 150 and 200 fish/net-cage); however, higher stocking densities increase the overall productivity of the system.

According to Iguchi et al. (2003), the stress caused by high stocking densities favors the onset of diseases and increases mortality rate. These factors are evident by increasing serum cortisol levels and suppressing immunity (IgM). Like the other variables, apparent feed conversion rate was highest at stocking density of 250 fish/m$^3$, where AFCR of 1.12 was lower than the values reported by Losekann et al. (2008) for silver catfish juveniles with initial mean weight of 71 g (AFCR between 1.3 - 1.5) that were fed diets containing 32% crude protein during 90 days at density of 55 fish/m$^3$.

Even with the AFCR increase from 1.12 to 1.36 at density of 500 fish/m$^3$, the latter value is still better than the results reported by Canton et al. (2007), who while working with silver catfish at density of 2 fish/m$^2$ in earthen nursery ponds obtained mean AFCR of 1.48, which demonstrates the feasibility of rearing catfish at higher densities in controlled environments. For the African catfish (*Clarias gariepinus*), the AFCR was better when stocking density was higher. The authors reported that the fish ingest the food quicker due to the feeding behavior of the species (TOKO et al., 2007).

The uniformity coefficient of the lot (%) was not significantly different for the studied stocking densities (P>0.05), the mean for the three treatments was 56.94%, that is, these fish displayed mean weight variation lower than 20%, a value higher than those reported by Piedras et al. 2005 who worked with a density of 1 fish per gallon, whose highest uniformity coefficient was 43.40% for the same species. Survival rates were 100% for all treatments, similar results were reported by Nieuwegiessen et al. (2009), who studied the effect of stress on the African catfish *Clarias gariepinus* and reported that increasing stocking density from 67 to 1067 fish/m$^3$ did not affect mortality rates.

## CONCLUSION

These results show that it is feasible to farm silver catfish at high densities, since despite having lower average weight, it resulted in greater biomass and larger number of available juveniles to the next step of the farming process.

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