Short note [Nota corta]

GROWTH OF *Dormitator latifrons* UNDER DIFFERENT DENSITIES IN CONCRETE TANKS†

[CRECIMIENTO DE *Dormitator latifrons* BAJO DIFERENTES DENSIDADES EN TANQUES DE CONCRETO]

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SUMMARY

Dormitator latifrons is an excellent candidate to be cultured in Mexico. In this research work four experimental treatments were carried out to evaluate the effect of stock density on growth: D3 (three organisms/m^3), D5 (five organisms/m^3), D6 (six organisms/m^3) and D7 (seven organisms/m^3), during 90 days. No significant differences were observed between the evaluated densities, although the highest increase in weight in percentage is observed with higher stock density (7 org/m^3). Density did not have a negative effect on survival.
Keywords: Growth; native fish; feed conversion rate; *Dormitator*.

RESUMEN

Dormitator latifrons es un excelente candidato para ser cultivado en México. En este trabajo de investigación, su desempeño productivo fue evaluado a cuatro densidades de siembra (3, 5, 6 y 7 org / m^3) durante 90 días. Los resultados obtenidos muestran que no hubo diferencias significativas en el rendimiento entre las diferentes densidades, aunque el mayor incremento en peso se registró a la mayor densidad evaluada (7 org/m^3).
Palabras clave: Crecimiento; peces nativos; tasa de conversión alimenticia; *Dormitator*.

INTRODUCTION

The production basis of farmed fish in inland waters is the culture of exotic species such as tilapia *(Oreochromis niloticus)* (Ferreira *et al*., 2015). However, the introduction (deliberated or naive) of exotic species to local ecosystems can have negative effects on the assemblages of native species and their habitats (Klotz *et al*., 2013).

One of the alternatives to avoid the invasions of exotic aquatic species is the study and technological development for the culture of native species. *Dormitator latifrons* (colloquially known as "fat sleeper", "chame", "popoyote", "chalaco", "puyeque", "chopopo") is distributed along the coastal areas and estuaries of the Pacific, from the State of California (USA) to the south of Peru. In Ecuador it is grown on a medium scale and represents a popular and demanded food (Rodríguez *et al.,* 2012)

The Food and Agriculture Organization of the Unites Nations (FAO) has cataloged it as a species of importance in aquaculture and reports that it can be cultured in areas of both shallow fresh and salt water, as well as in rustic earthen tanks at a stock density of 5 org/m^2. The culture period can last from five to eight months, reaching sizes of 25 to 32 cm (Vicuña, 2010). However, the scientific information on this fish is scarce especially in relation to its culture technology.

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Most research works published focus on describing their abundance, ecology, parasitology and physiological aspects (Hendrickx *et al*., 1996; Tomchik and Lu, 2005; Violante *et al*., 2008; Sandoval *et al*., 2014). In Mexico there are few culture experiences (Castro-Rivera *et al*., 2005), addressed aspects of growth and food conversion with inconclusive results. Under laboratory conditions were studied protein and lipid requirements of juveniles of the same species (Badillo-Zapata *et al*., 2018). Most of the works have been carried out in Ecuador, under the format of technical reports that evaluate the substitution of commercial foods for other alternatives. There are no reports or publications addressing other aspects of its culture, such as optimal stocking density under semi-intensive conditions. Therefore, the objective of this work is to evaluate the growth at different stocking densities of *D. latifrons* in concrete tanks.

MATERIAL AND METHODS

Eight hundred juveniles of *D. latifrons* were captured in the Quelele estuary, located at 20º43' 25.43" N and 105º18' 03.63" O, Nayarit, México. Fish were transported in a container (400 L) with constant aeration (O_2 concentration of 4 mg/L). Before confining in the culture facilities, an ectoparasite removal treatment was carried out (due to the presence of *Argulus* sp.) with trichlorfon (Neguvon ®) at a concentration of 0.3 ppm, for 10 to 12 min in a 200 L container (Vega-Villasante *et al*., 2017). Fish were subjected to a quarantine of seven days in a 500 L reservoirs.

The experimental culture was carried out at the facilities of the Instituto Tecnológico de Bahía de Banderas (20°45' 42.58"N and 105°22' 16.20" W), Nayarit, Mexico. Two 50 m^3 concrete tanks were used, divided in six sections of 8.3 m^2 each (for a total of 12 sections). Aeration was carried out with a 1 HP blower and a piping system connected in series to ensure adequate oxygenation in all treatments. The tanks were filled with running water from the municipal drinking water system. Two weekly replacements of 5% of the total volume were carried out. Debris and feces were removed twice a week with a siphon.

Four experimental treatments were carried out to evaluate the effect of stocking density on growth: D3 (three organisms/m^3), D5 (five organisms/m^3), D6 (six organisms/m^3) and D7 (seven organisms/m^3). The distribution of the treatments (in triplicate) was based on a completely randomized design. The culture lasted 90 days, from July to October 2016. Fish were fed twice a day (08:00 and 19:00) with commercially balanced feed for tilapia (Purina®) (protein 35%, humidity 12%, fat 8%, crude fiber 3%, ash 8% and NFE 28%). At the beginning, feeding was provided with 8% of the total biomass per section and was adjusted to 4% at 30 days, keeping the same percentage until the end of the culture. Biological samples (biometrics) were made every month recording the total weight (g) with a digital scale (OHAUS ®) and total length (cm) with a ichthyometer, considering the length of the fish from the anterior region (head) to the posterior region (caudal fin). In order to evaluate the development of fish in the different treatments, the following zootechnic parameters were used: Weight increase (WI) $WI = Wf - Wi$, where Wf is final weight and Wi is initial weight. Specific Growth Rate (SGR) SGR = [(ln Wf - ln Wi) / t] x100, where Wf is final weight (g), Wi is initial weight and t is time in days. Protein Efficiency Rate (PER), PER = weight gained / weight of delivered protein* (* = amount of feed delivered per percentage of feed protein /100). Feed Conversion Rate, FCR = Feed consumed / weight gained. Survival (%) = (final number of organisms x 100) / Number of initial organisms).

Physicochemical parameters of the culture water were taken on a daily basis (08:00, 14:00 and 19:00); temperature and dissolved oxygen were recorded with an oximeter (YSI 51®), pH was measured with a manual potentiometer (Sper Scientific®), salinity with a manual refractometer (salinity range 0-100 ‰) and turbidity (cm) with a Secchi disk. The record of ammonium, nitrites, nitrates, phosphates and hardness of the water were taken with a photometer (YSI 9300®).

Fish growth performance data (initial and final average weight, increase in weight, percentage of increase in weight, initial and final biomass and survival) were analyzed by a one-way analysis of variance, followed by multiple comparison tests (Tukey), previously analyzed with normality tests (Kolmogorov-Smirnov) and homogeneity of variance (Bartlett).

RESULTS AND DISCUSSION

Table 1 shows the zootechnic performance results at 90 days of culture. No significant differences were observed between any of the densities evaluated, although the highest increase in weight in percentage is observed with higher stocking density (7 org/m^3). Density did not have a negative effect on survival, either.

Since this is the first study of the effect of culture densities on the growth of this fish, there are no previous records that may be taken as the basis for establishing the optimal conditions of water quality. Therefore, it was necessary to consider optimum for tilapia to analyze this culture. The average of the registered values of water quality parameters during the culture are in Table 2, and in general terms,

correspond to the appropriate for tilapia culture (Ibrahim and El Naggar, 2010; Makori *et al*., 2017**).**
Results obtained with the different stocking densities tested do not show significant differences (P> 0.05) in fish weight. Unfortunately, there are not enough previous works with this species that could be used to compare the results obtained in this study. The only work published on culture of this species address the food conversion of this species, evaluating the growth of male, females and mixed sex, with commercial feeds with 30% of protein and 5% of lipids (Castro *et al*., 2005). The evaluated density in all cases was 1org/m^3. The results of size and weight at 14 weeks, regardless of sex, show poor growth (maximum 45 g in males) despite the low density. Apparently, water temperature conditions had a negative influence on the growth, since the highest temperatures recorded were around 15 °C and those below 8 °C, while in present study, temperatures averaged almost 32 °C, obtaining in 12 weeks an average weight gain of 243 g with higher densities.

Other research studies carried out with different freshwater species have shown that different stocking densities can result in similar growth in culture. With the "piraucu" fish (*Arapaima gigas*) confined in cages at two stocking densities (10 and 12.5 org/m^3), fed with commercial feed, was reported the effect of stocking density on the performance with survival rates of 100 and 94.7%, specific growth rates of 2.25 ± 0.09 and 2.22 ± 0.06 and food conversion factors (FCF) of 1.2 for both densities. However, there were differences in the final average weight and weight gain between both treatments (Gonçalves *et al*., 2012). For "tambaqui" (*Colossoma macultureomum*) under different stocking densities (20, 30, 40 and 50 fish/m^3) in culture in cages (6 m^3) was evaluated both the performance in culture and economic feasibility. The authors report that the survival was not affected by the different densities (higher than 97% in all cases) and growth was not affected either, so they conclude that the maximum capacity of organisms per cage was not reached (Carvalho *et al*., 2006).

Table I. Zootechnic performance of *Dormitator latifrons* cultured in concrete tanks under different stocking densities.

Parameters	D3	D5	D6	D7
Initial average weight (g)	15.0 ±1.0	13.1 ±1.0	14.5 ±1.5	13.7 ±2.9
Final average weight (g)	263.4 ± 28.1	257.5 ± 15.2	265.5 ± 2.8	264.1±15.09
Increase in weight (g)	248.4±28.8	244.3±15.9	241.9±1.3	250.4±18
Increase in weight (%)	1768.3 ± 280.3	1973.1 ± 240.1	1783.4 ± 208.5	2019.96 ± 611.5
Initial Biomass (g)	1,200.0 ± 32.5	1,668.4 ± 50.8	2,222.4 ± 95.1	2,632.6 ± 187.1
Final Biomass (g)	20,568.5 ± 732.4^a	32,484.1 ± 645.2^b	39,340.8 ± 110.9^c	50,831.9 ± 991.4^d
% increase in weight	1768.3 ± 280.3	1973.1 ± 240.1	1783.4 ± 208.5	2019.96 ± 611.5
FCR (Feed Conversion Rate)	1.37	1.39	1.41	1.39
PER (Protein Efficiency Rate)	2.1	2	2.0	2.1
SGR (Specific Growth Rate)	5.5 ± 0.11	5.5 ± 0.06	5.5 ± 0.01	5.5 ± 0.06
Survival (%)	100	100	99^a	99.5

$^{a-d}$ Different letters on each row (superscripts) show significant differences (P<0.05). Data ± SD are shown.

Table 2. Results of water quality parameters during the culture of *Dormitator latifrons.*

Parameters	July	August	September	October
Temperature (ºC)	31.2 ± 0.5	32.3 ± 0.7	31.9 ± 0.9	31.9 ± 0.5
Oxygen (mg/L)	6.4 ± 0.7	7.2 ± 0.9	7.3 ± 0.9	6.9 ± 0.10
pH	7.8 ± 0.1	8.0 ± 0.3	7.6 ± 0.4	7.4 ± 0.2
Ammoniacal Nitrogen (mg/L)	-	0.3 ± 0.1	0.3 ± 0.0	0.4 ± 0.0
Nitrates (mg/L)	-	0.4 ± 0.1	0.4 ± 0.1	0.4 ± 0.0
Nitrites (mg/L)	-	0.3 ± 0.1 ^{a}	0.3 ± 0.1 ^{a}	0.7 ± 0.1 ^{b}
Phosphates (mg/L)	-	1.3 ± 0.1 ^{a}	1.1 ± 0.1 ^{a}	3.6 ± 0.1 ^{b}
Hardness (mg/L)	-	391 ± 28.1 ^{a}	432 ± 56.7 ^{a}	400 ± 22.1 ^{b}
Turbidity (cm)	42.5 ± 1.4	39.3 ± 20	38 ± 2.3	39 ± 2.7

^{a,b} Different letters on each row (superscripts) show significant differences (P< 0.05). Data ± SD are shown.

On the other hand, Tilapia stocked at densities of 73 and 184 / m^3 in culture cages did not record any significant difference in survival, final weight, weight gain and daily growth rate. However, it was observed that FCF was better at a higher stock density, which suggests a better use of feed (Fraga *et al*., 2012). In that sense, it has been mentioned that high stocking densities can have positive effects on agonist behavior in certain species such as the African catfish (*Clarias gariepinus*), which would allow more adequate physiological states (stress reduction) and the subsequent optimum growth (Van de Nieuwegiessen *et al*., 2009). With *Scortum barcoo* (jade perch) were reported no differences in final weight, daily growth rate or in FCF (among others) in stocking densities of 100 and 260 fish/m^3 (Gang *et al.* 2010). Although the stocking densities of present study cannot be considered as high, the results suggest that there is no negative effect on the growth of the fish in relation to the established densities, since no differences were found in any of the evaluated indicators.

CONCLUSIONS

This is the first report on the effect of culture density on the development of this native species of commercial importance. Therefore, it is possible to conclude that this study was far from reaching the maximum optimum density. In fact, there is an apparent better growth at the highest density (although it was not statistically significant) which suggests the idea that *D. latifrons* could be developed in semi-intensive commercial cultures without any problem. More studies should be carried out to determine the maximum density of confinement of this native fish, which guarantees an adequate growth and an optimal state of health.

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