



Advances in biology through agronomy, aquaculture, coastal and environmental sciences

— Volume II —

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**Advances in biology through
agronomy, aquaculture, coastal and
environmental sciences**
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Advances in Biology through Agronomy, Aquaculture, Coastal and Environmental Sciences, Volume II, is an e-book that continues the work of the first version (<https://editorapantanal.com.br/ebooks/2023/advances-in-biology-through-agronomy-aquaculture-coastal-and-environmental-sciences/ebook.pdf>), published in 2023 by Leandris Argente-Martínez and Ofelda Peñuelas-Rubio.

Our e-book compiles 25 manuscripts that present scientific results and reviews based on biological aspects. All of them contribute to explaining the responses of living organisms to agricultural, aquaculture, and coastal ecosystems, as well as those facing fragility or threat of climate change. This e-book was edited by Leandris Argente-Martínez, Ofelda Peñuelas-Rubio, and Joe Luis Arias-Moscote, members of the Consolidated Academic Group ITVAYA-CA-3.

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Growth of the wild juvenile common snook *Centropomus undecimalis* in captivity

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 10.46420/9786585756792cap19María de Jesús Contreras-García¹ Wilfrido Miguel Contreras Sánchez ^{1*} Alejandro Mcdonal Vera¹ 

ABSTRACT

Aquaculture can be a high-impact alternative for this species since wild populations are overexploited because of fishing. This study contributes to the incorporation of *Centropomus undecimalis* (common snook) into aquaculture, providing information on the growth of wild juveniles and the formation of a stock of breeders. The study was conducted in the Tropical Aquaculture Laboratory at the Biological Sciences Academic Division in Universidad Juárez Autónoma de Tabasco. Wild fish were captured at different sites in Mecoacán Lagoon and maintained in marine water for one week; after this, they were slowly transferred to fresh water. Samplings were conducted monthly to determine growth in weight and length. At the end of this experiment, we obtained a batch of 126 young adults to be used as broodstock measuring, on average, 26.92 cm in length and 136.81 g in weight.

Keywords: common snook, grow-out, culture.

INTRODUCCIÓN

The overexploitation of fishery resources has led to the decline of important fish populations that hold high ecological, cultural, and economic value for a large number of residents in southeastern Mexico. An example of this is the snooks of the genus *Centropomus*, which inhabit the basins of numerous rivers flowing into the Gulf of Mexico. This genus, represented mainly by *C. undecimalis*, constitutes a group of predatory fish (primarily ichthyophagous) with distinctive characteristics; they are protandric hermaphrodites that change sex, although the mechanism underlying this change is unknown. They are diadromous fish, as they are found in both marine and freshwater environments (Rivas, 1986). They spawn in the sea and spend extended periods in freshwater, brackish, or marine waters, depending on their feeding or reproductive needs (Greenwood, 1976). The described breeding season for *C. undecimalis* runs from May to October (Chávez, 1963; Rojas, 1975). As part of one of the highest links in the food

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chain, it acts as a regulator for a large number of fish. Its role in maintaining food webs is fundamental for both inland and marine waters.

From a social perspective, common snook are a resource of great cultural and commercial value; they have been part of the local population's diet since pre-Hispanic times and are currently the species of greatest commercial value in the national market, supporting a large number of families that depend on coastal fishing (Tucker; Campbell, 1985). This high demand, driven by the exquisite flavor, texture, and color of its flesh, has led to increased catch volumes and made the pursuit of larger specimens a priority, thereby reducing resource availability and necessitating the establishment of a fisheries management plan (DOF, 2014).

Considering its reproductive biology, this results in the capture of large females of incalculable population value, as they represent the guarantee of fishery stock renewal. Owing to fishing pressure, its wild populations have come to be considered at potential risk. Perera-García et al. (2009) evaluated indicators of the fishery for this species and concluded that the overfishing of adult organisms could alter the minimum size at sexual maturity. To address this situation, aquaculture can be used as a strategy to develop farming techniques and, where appropriate, produce juveniles that can be used to restore overexploited populations. In this context, common snook have been widely considered for inclusion in aquaculture since they can easily adapt to various types of culture (Álvarez-Lajonchere; Tsuzuki, 2008) as well as to artificial feed and variations in physicochemical parameters (Chapman et al., 1982).

Studies on the growth of juvenile fish in captivity are highly important, as they can generate essential information for evaluating the potential for captive management of a species, as well as the quality of a fishery's stock (Aliaume et al., 2000). These studies also allow for the establishment of culture conditions for a batch of organisms that can be used as broodstock, making the evaluation of an appropriate diet very important (Watanabe et al., 2003). It is also feasible to plan the timing, quantity, and type of feed to obtain high-quality spawn. In this study, the growth in captivity of a group of wild juvenile common snook was determined with the aim of assessing its suitability for establishing a broodstock of the species.

MATERIALS AND METHODS

Obtaining Juveniles

C. undecimalis juveniles were captured in Mecoacán Lagoon, Paraíso, Tabasco, using a trawl net made of 10 m long and 2 m high mosquito netting. Collection was carried out at shallow sites near mangrove areas, which are devoid of vegetation and mangrove roots. A total of 125 juveniles were collected on the basis of their size; they were considered to have been from the same reproductive season and were only a few months old (age 0). They were initially transferred to the Marine Aquaculture Station of the Universidad Juárez Autónoma de Tabasco (UJAT), located in Jalapita, municipality of Centla. The fish were kept for one week in 1,500-liter tanks with filtered seawater and constant aeration for a 24-h

period and subsequently transferred to the Tropical Aquaculture Laboratory of the Academic Division of Biological Sciences at UJAT, where they were acclimated to freshwater through gradual changes in salinity over the course of a week. The final arrangement of the fish in the laboratory was organized by size to prevent aggression by larger fish toward smaller ones, with the fish assigned to four 1,500-liter tanks as follows: 40 fish measuring 19.73 ± 3.14 cm (large); 25 fish measuring 16.09 ± 0.96 cm (medium); 35 fish measuring 12.08 ± 1.48 cm (small); and 25 fish measuring 8.66 ± 0.66 cm (very small). The initial biomass in each tank was 1.34 kg/m^3 (large), 0.47 kg/m^3 (medium), 0.30 kg/m^3 (small), and 0.09 kg/m^3 (very small).

Feeding

The common snook were subjected to a feeding regimen interspersed with fasting periods at each change in feed type: During the first 14 days, they were fed live feed consisting of juvenile *Castarrica* cichlids and tilapia (*Mayaberos urophthalmus* and *Oreochromis niloticus*) ad libitum; on days 15 and 16, the fish were fasted, and on days 17 and 18, they were fed ad libitum with whole fresh fish; from days 19 to 20, they were fasted again; and from days 21 to 22, they were fed ad libitum with pieces of fresh fish. From the 23rd to the 24th, they were fasted, and finally, from the 25th onward, they were fed a semimoist diet provided three times a day until apparent satiety. The diet was formulated using fish meal, ground fish fillet, shrimp meal, fish oil, soy lecithin, a vitamin and mineral premix, vitamin C, unflavored gelatin, soy milk, and sorghum flour. These ingredients have been used in similar studies with striped bass (Cerqueira and Tsuzuki, 2009). The fish were maintained in a recirculating system for 12 months, with monthly sampling of weight and length to determine growth, followed by prior anesthesia with tricaine methanesulfonate (MS-222).

Water Quality

The temperature and dissolved oxygen concentration were recorded daily using a YSI® Model 55 oximeter (Yellow Springs, OH, USA), and the pH was measured using an UltraBasic® UB-10 potentiometer (Denver Instruments, Denver, CO, USA). All the tanks were connected to a recirculation system equipped with a mechanical and biological filter. Water changes were performed monthly, and approximately 10% of the water lost to evaporation was replenished daily. The water quality throughout the study for the measured parameters was $6.83 (\pm 0.98)$ mg/L of dissolved oxygen, $28.09 (\pm 2.38)$ °C, and $7.04 (\pm 0.62)$ pH units.

Statistical analysis

One-way analysis of variance (ANOVA) was performed to determine significant differences in growth between the sampling months. In addition, a simple linear regression analysis was conducted. All

the statistical analyses were performed using STATGRAPHICS CENTURION® software, version 15.0 (Statgraphics Technologies, Inc., The Plains, VA, USA). Statistical significance was set at $p < 0.05$. Graphs were generated using SIGMAPLOT® software version 11.0 (Systat Software, Richmond, CA, USA).

RESULTS AND DISCUSSION

Wild juveniles of *C. undecimalis* adapted rapidly to captive conditions. Most of these organisms did not present significant problems in accepting the different foods provided, consuming live food, whole fish, fish pieces, or, finally, the semimoist food provided after short periods of forced fasting.

Statistical analysis revealed statistically significant differences between sampling months for both weight and length (ANOVA; $P < 0.01$) in the four grow-out tanks. In the large fish tank, the average final weight and length were 258 ± 65.64 g and 34.08 ± 3.14 cm, respectively; in the medium fish tank, 139.05 ± 29.93 g and 28.38 ± 1.79 cm, respectively; in the small fish tank, 112.43 ± 34.21 g and 26.13 ± 1.48 cm, respectively; and in the very small fish tank, 68.11 ± 21.79 g and 22.18 ± 2.33 cm, respectively (Figure 1). The weight gain was 207.91 g at the end of the sampling year (0.57 g/day) for large fish; the gain for medium-sized fish was 110.67 g at the end of the year (0.30 g/day); for small fish, the value was 99.58 g per year (0.27 g/day); and for very small fish, the gain was 62.95 g per year (0.17 g/day).

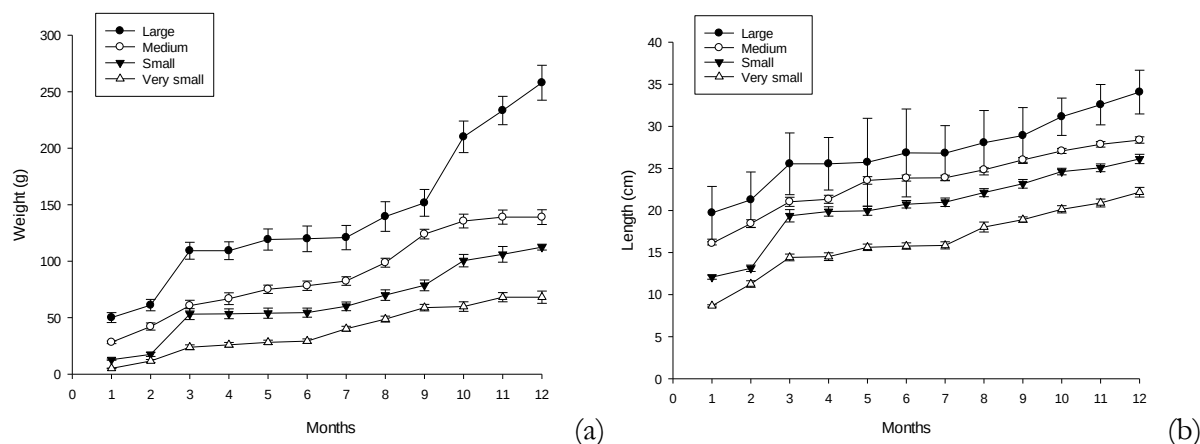


Figure 1. Average values ($\pm$ SE) for weight gain (a) and total length (b) for the four different sizes of captive juvenile common snook.

When the data were evaluated as a whole, the results also revealed statistically significant differences between the sampling months for both weight and length (ANOVA; $P < 0.01$). The average initial weight of all the organisms evaluated was 26.30 ± 24.05 g. The final weight was 145.37 ± 79.43 g (Figure 2), representing a gain of 119.07 g over the 12-month sampling period (0.33 g/day). The initial

average total length was 14.65 ± 4.66 cm, and the final average was 27.82 ± 4.72 cm (Figure 2).

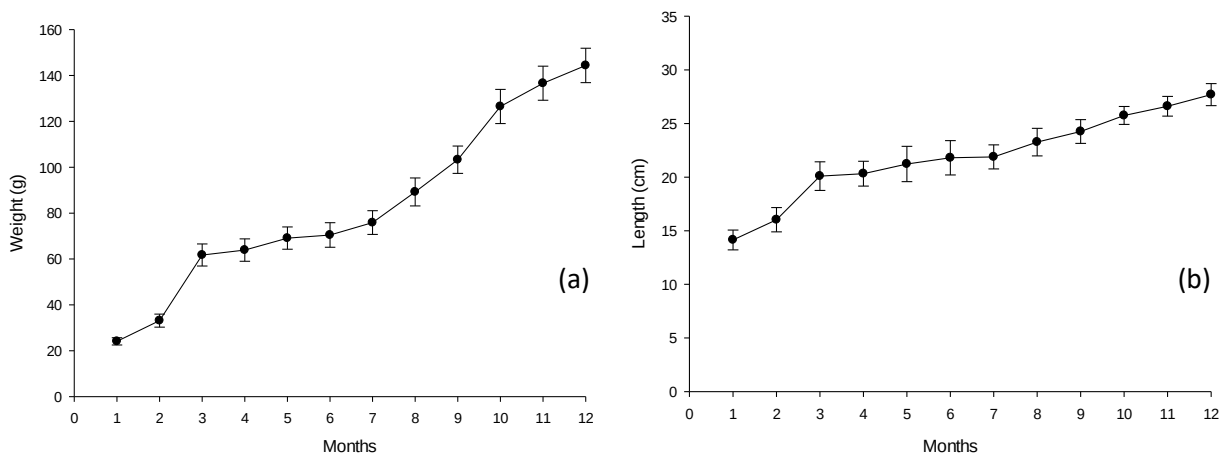


Figure 2. Average values ($\pm$ SE) for weight gain (a) and total length (b) for all the organisms included in the study.

The feed conversion ratios were 1.24 for large fish, 1.11 for medium-sized fish, 1.29 for small fish, and 6.1 for very small fish. Survival varied considerably among the batches, at 45%, 84%, 57%, and 64%, respectively.

The study of captive growth of a batch of wild juveniles of *C. undecimalis* to establish a broodstock suggests that this species adapts easily to captive conditions. Although mortality was recorded throughout the experimental phase, the overall survival rate exceeded 60%. Acceptance of artificial feed was achieved by applying a protocol that begins with live fish, moves to fish pieces, and culminates with wet balanced feed. Compared with that in other studies, the growth obtained in this study is slow, which may be due to the stocking densities in this study, resulting from the limited space available in the tanks used. Sánchez-Zamora et al. (2003) reported in a study with the same species that the daily growth rate of the fish was 2.7 g, which is considerably higher than that obtained in our study, with growth rates ranging from 0.17 to 0.57 g/day. It is important to note the significant differences between the two studies, as they used seawater, whereas this study used freshwater.

In the aforementioned study, the fish were kept in 20 m³ tanks, whereas in our study, the fish were housed in plastic tanks with a capacity of 1.5 m³ at a density of between 25 and 40 fish/m², with space being a limiting factor for good growth performance. With respect to 20-g juveniles, Tucker (1987) reported that this species of common snook can reach 450 g in just 8 months (1.8 g/day) and 2 kg in two years. Additionally, Reyes et al. (2006) reported that 280.1-g samples in earthen ponds can reach a weight of up to 761.9 g (5.0 g/day) in just 150 days of culture. These same authors compared the previous results with the growth of juveniles in fiberglass tanks in a marine environment, with an average initial weight of 371.5 ± 82.4 g, and over 162 days, they reached a final average weight of 716.7 ± 56.1 g (4.42 g/day). Polonía et al. (2017) reported a specific growth rate of 0.6 g/day, a condition factor of 0.8, and a feed

conversion ratio of 3.8 in juveniles. However, the survival rate was 50%. This variability could be related to differences in the salinity of the water used, the feed provided, and/or the stocking densities used in the studies. Recent studies have indicated that the combination of appropriate temperature and salinity improves growth and feed conversion in juvenile common snook (Mello, 2024).

In other common snook species, such as chucumite (*C. parallelus*), which are reared in an extensive system, good results have been observed when freshwater forage fish were used, with the fish reaching 500 g in two years (0.69 g/day; Cerqueira 2005), and in terms of growth length, capture–recapture studies by Aliaume et al. (2000) reported a daily growth rate of 0.06 cm in fish collected during the rainy season and 0.04 cm in those collected during the dry season. Studies by Zarza-Mesa et al. (2006a) report similar results, with daily growth rates of 0.04 cm in freshwater concrete ponds for both white common snook and chucumite common snook. Absolute daily growth was also determined for white common snook and chucumite common snook in earthen ponds, with growth rates of 0.06 and 0.02 cm, respectively (Zarza et al., 2006b). These results are consistent with those obtained in our study, which revealed 0.03 cm of daily growth.

It is possible to adapt wild juvenile white common snook to captive conditions using a balanced diet. Adaptation to artificial feed is relatively rapid, as the fish accept it after two days of fasting, with all the fish consuming it by the fifth day. However, more information is needed regarding the growth of this species under brackish and marine conditions, in addition to evaluating different stocking densities and feed types. The aquaculture and commercial potential of this species justifies these studies and requires research aimed at developing a technological package for its commercial cultivation.

CONCLUSIONS

The adaptation of the common snook to captive conditions is relatively easy and accessible, allowing for the establishment of a broodstock with reproductive potential in captivity using practical diets, which is highly beneficial for contributing to the development of marine aquaculture, as well as for strengthening wild populations by exerting less pressure on them by relying on this resource rather than on what is produced by aquaculture. Furthermore, obtaining a broodstock from wild conditions supports the release of larvae or juveniles to facilitate the reestablishment of populations through the reintroduction of organisms capable of natural reproduction *in situ*.

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