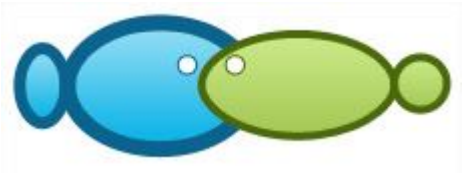

Evaluation of the survival and growth of the ornamental "Colombian shark catfish" A*riopsis seemanni* in water of different salinities

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Abstract. *Ariopsis seemanni* is one of the few marine catfish in the ornamental fish trade. In Colombia, its country of origin, this catfish is being overfished. The most immediate threat to their populations occurs during their collection and commercialization, in which they are treated as a freshwater fish. The fish are collected in water of varying salinities then immediately placed in freshwater that compromises their health and typically causes mass mortalities. In this study, we evaluated the growth and survival of small juveniles of this catfish raised in water of different salinities (0, 10, 20 ppt), over a period of 60 days. The average weight and length of the catfish at the beginning of the experiment were 2.6±0.1 g and 60.9±2.7 mm, respectively. At the end of the experiment, the catfish reared in salt water (10 and 20 ppt) grew significantly ($p < 0.05$) from their initial values and were significantly larger (e.g., 6.0±1.3 g and 82±7.4 mm; $p < 0.05$) than those maintained in freshwater; which did not gain significant weight (e.g., 2.6±0.5 g, $p > 0.05$). The average size of fish was similar ($p > 0.5$), within the two salinity treatments. We recommend that immediately after collection this catfish be placed in water with a salt concentration of about 10 ppt that would greatly improve survival and decrease morbidity.
Key Words: aquarium, acclimation, conservation, tete sea catfish.

Introduction. There are several hundred species of freshwater catfishes in the ornamental fish industry that are traded for display in aquariums. In contrast, only a few species of them are of marine origin, predominantly from the families Ariidae and Plotosidae. Although similar species appear in the trade, the "Colombian shark catfish" *Ariopsis seemanni* is probably the most widely traded catfish of marine origin in the hobby that is imported, at least into the USA and Europe (unpublished data, derived from Chapman et al 1997, and continuous independent interviews with importers and wholesalers). The common name for this species is derived, most likely, from where it was first exported. The species can be found along the Pacific coastline from México to Perú (Allen & Robertson 1994; Kailola & Bussing 1995; Ortega-Lara et al 2011), and Colombia has traditionally been the major supplier of wild-origin fish for ornamental purposes (Socolof 1996; Chapman 2000). *A. seemanni* is locally known in Colombia as "tiburoncito" which is a diminutive form for 'shark' in Spanish. Tiburoncitos are collected principally in the estuarine and nearshore coastal areas along the ports of Buenaventura and Tumaco on the Pacific coast of Colombia (Ortega-Lara et al 2011). These are rural regions, inhabited by predominantly dark-skinned people of African descent, living in economic poverty, that practice subsistence farming, and rely heavily on the use of the surrounding living aquatic resources and forest products to feed their families and for a source of income. There is a very high demand locally for the tiburoncito catfish because the larger ones (e.g., 24-30 cm) are eaten in traditional main course meals, and the small juveniles (e.g., 5-10 cm) are valued as an ornamental fish for the aquarium trade (Figure 1). Small juvenile tiburoncitos are collected by artisanal fishermen that sell them to a few local dealers, who in turn sell to middlemen for quick national distribution and exporting them to other countries, principally the USA and Europe. The tiburoncito *A. seemanni* and emperor tetra *Nematobrycon palmeri* are the principal species of

ornamental fish exported from the Pacific region of Colombia (Ajiaco-Martínez et al 2012).

Figure 1. *Ariopsis seemanni* are collected in the estuary and handled typically in plastic containers. Once in the consumers possession, the catfish are displayed in groups.

As expected, anecdotal evidence from local fishermen, buyers, industry observers, and our personal interviews with the same indicate that fish populations of tiburoncitos are being overexploited. Compounding this issue is a lack of biological data and fishery

statistics to provide guidance for the proper management of their fishery (Barreto et al 2015).

Another challenge that threatens the sustainability of the resource and has a detrimental effect directly on the fish is that although the tiburoncito fish are collected typically in brackish water of varying salinity, they are packaged, transported, and commercialized as a freshwater species. This erroneous belief of their freshwater origin is further reinforced since the ornamental fish export-import distribution centers in Colombia are in the mountain capital of Bogota or city of Leticia, a port on the Amazon river. However, if tiburoncitos of marine origin are commercialized to be in freshwater their health may be compromised, making them prone to disease and both acute and chronic mortalities. For example on separate and distinct occasions several of our students observed massive fish mortalities (over 90%) immediately after they were transferred by the fishermen to the local dealers. Therefore, the objective of this study was to assess the survival and growth of juvenile tiburoncitos *A. seemanni* in water with different salinities.

Material and Method. Small size juveniles of tiburoncitos *Ariopsis seemanni* were collected by fishermen in the estuary in the vicinity of the port of Buenaventura, in the Pacific coast of Colombia, and immediately transported to the local laboratory where the experiment was conducted (October 2015 to February 2016). One hundred-twenty fish were randomly distributed into 12 plastic tanks (31.5 liters, 30 x 30 x 35 cm) containing water with a salinity of 10 (parts per thousand, ppt), and acclimatized for two weeks until the experiments began. The catfish were divided into three experimental treatment groups: water with salinities of 0, 10, and 20 ppt. Each group had four replicates with 10 catfish each. The fish were acclimated to the experimental salinity levels by raising or lowering the salinity over a four-day period.

Catfish were fed a commercially prepared sinking trout pellets, *ad libitum,* three times per day. Water from the tank bottom was siphoned 30 min after feeding to remove debris; any water losses were replaced immediately. The water in each tank was continuously filtered and aerated using an air-driven mechanical and biological two-sponge filter; and about 20-30% of the water in each tank was exchanged weekly. Measurements of temperature, dissolved oxygen, total ammonia nitrogen, and salinity were recorded multiple times during the experiment. The tanks were exposed to natural day and night light cycles. The catfish were weighed (g) and measured (total length, mm) at the beginning, middle, and end of the experiment that lasted 60 days. General observations were made daily with special attention to the behavior and health condition of the fish; any mortalities were removed immediately and recorded. Means and standard deviations of measured weights and lengths were estimated for each treatment group and compared between the groups using simple one-way analysis of variance with a post-hoc Tukey HSD test, using a 0.05 level of significance. Statistical analyses were performed using the SPSS Statistics software package (Ver. 22). The percentages of survival were estimated by dividing the number of survivors by the total number of dead fish and multiplying by 100.

Results and Discussion. During the acclimation period of two weeks, all the tiburoncitos catfish survived direct transfer from the body of water where they were caught to the water in the experimental tanks, which had a salinity of 10 ppt. These fish appeared healthy and fed normally. However, during the experimental period, there were marked differences in the health condition and survivorship of the fish between those in freshwater and those in saltwater. Severe mortalities (50%) occurred in the tiburoncitos maintained in freshwater, and many of the live fish in this group showed external signs of disease on the skin, reduced avoidance reaction to external stimuli, sluggish swimming behavior, and a loss of appetite. In contrast, all the catfish survived in the tanks containing salt water, either with 10 or 20 ppt. The fish under these conditions swam actively throughout the tank, appeared in good health, and kept eating normally. Water quality parameters remained within the favorable ranges required for warmwater fishes

(Chapman 2000) e.g., dissolved oxygen levels at 5-6 mg L^{-1}, water temperature 26-27°C, and un-ionized ammonia levels were below detectable levels (0.01 mg L^{-1}).

The average weight and length of the tiburoncito catfish at the beginning of the experiment were 2.6±0.1 g and 60.9±2.7 mm, respectively. At the end of the experiment, the catfish reared in salt water (10 and 20 ppt) grew significantly ($p < 0.05$) from their initial values and were significantly larger (e.g., 6.0±1.3 g and 82±7.4 mm; $p < 0.05$) than those maintained in freshwater; which did not gain significant weight (e.g., 2.6±0.5 g, $p > 0.05$). The average size of fish was similar ($p > 0.5$), within the two salinity treatments.

Acclimating the fish to a concentration of salts of around 10 ppt is a physiologically valid approach. This works because maintaining a sufficient volume of fluid and salt concentration in cells is essential for the proper functioning of the body. The salt content of the blood and other body fluids in fishes and mammals is relatively similar and about one third the salt concentration of normal seawater (about 35 ppt).

Conclusions. There is wide consensus the tiburoncito catfish stocks are being fished to heavily. The proper management of the stocks will require programmatic and legislative approaches at the local and central governments, in combination with a participatory process involving communities, beneficiaries and other stakeholders (e.g., public, private, social, and economic). Such processes, however, require much planning and time. Based on this study, a conservation practice that can be implemented and evaluated quickly is to simply allow the live tiburoncitos, immediately after their capture, to stabilize to a new environment by placing them in water of an intermediate salinity of around 10 ppt. The adoption of this practice can substantially increase survival of individuals of the overall population, thus protecting the wild stocks and at the same time benefiting the entire commercialization chain, especially at the local level.

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