Exploring the Aquaculture Potential of *Ayungin*, an Endemic Freshwater Fish in the Philippines

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In the early 1960s, silver therapon (*Leiopotherapon plumbeus*), locally known as *ayungin*, is regarded as one of the most abundant freshwater fishery resources in the largest lake in the Philippines, Laguna de Bay. Small-scale fishing communities around the lake are reliant on this fishery resource for subsistence consumption and livelihood. Recently, *ayungin* is touted as the most exploited commercial freshwater fish species in most regions of the country. The decline of this important food fish has led to a growing interest in its domestication for culture production and for possible replenishment of depleted stocks in the wild. Therefore, efforts to domesticate, manage, and conserve this native aquatic species have been given a high priority. Due to its readiness to spawn in captivity and successful hatchery production in outdoor tanks, *ayungin* is considered an emerging species with potential for inland freshwater aquaculture.

In the Philippines, fish is the chief source of dietary protein of rural households. According to the Bureau of Fisheries and Aquatic Resources (2021), Filipinos consume as much as 37 kg of fish per capita in 2015. Fish are mainly caught from the country's vast marine and inland waters.

In freshwater habitats, there are more than 180 native aquatic species widely distributed in the country (Froese & Pauly, 2021). For instance, a diversity of native food fish species are inhabitants of the three major lakes in south Luzon, Philippines, namely Laguna de Bay, Taal Lake, and Naujan Lake (**Figure 1**).

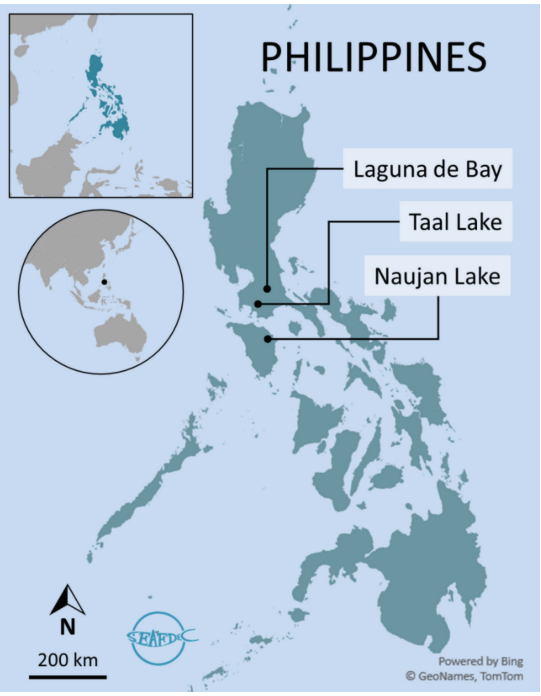

Figure 1. Location of three major lakes in south Luzon, Philippines

Indigenous fish species play an important role in ensuring food security especially among poor households in rural areas.

One of the Philippine native food fish species is the silver therapon, locally known as *ayungin* (**Figure 2**), which is targeted by the small-scale and commercial fisheries in lakeshore communities (Palma *et al*., 2002). *Ayungin* is a popular traditional fish to eat among the locals because of its tasty flesh. Eating *ayungin* is considered as part of the tradition of the consuming public, particularly for those who are 60 years old and above (Salayo *et al*., 2015). There is something in *ayungin* that it is a more sought-after fish than any other freshwater fishes such as tilapia or milkfish. Small-scale fishers catch this fish using gillnet (**Figure 3**), hook and line, and motorized push net for household consumption as well as livelihood.

Figure 2. Silver therapon (*Leiopotherapon plumbeus*), locally known in the Philippines as *ayungin*

Declining stock of *ayungin*

About six decades ago, the production of *ayungin* was enormously abundant in the 90,000-hectare Laguna de Bay. Together with goby (*Glossogobius giurus*) and Manila sea catfish (*Arius manilensis*), this fish constituted 95 % (about 83,000 t) of the annual fish harvest (Manalang & Diaz, 2017). However, there are no regulations in catching this fish in the lake where everyone can catch anytime and anywhere. Intense fishing pressure (Palma *et al*., 2002) and more recently, the proliferation of the invasive alien species in Laguna de Bay (Guerrero III, 2014) contributed to the decline in the production of *ayungin*. There was a significant downward production trend of *ayungin* by as much as 75 % from 4,675 t in 2002 to 1,182 t in 2020 (Philippine Statistics Authority, 2021b), and this corresponds to more than 50 % decrease in value from USD 5,396 in 2002 to USD 2,387 in 2020 (Philippine Statistics Authority, 2021a) (**Figure 4**).

Figure 3. Small-scale fishers use gillnet to catch *ayungin* in Laguna de Bay, Philippines
(***Source:*** *C. Fernando-Aya)*

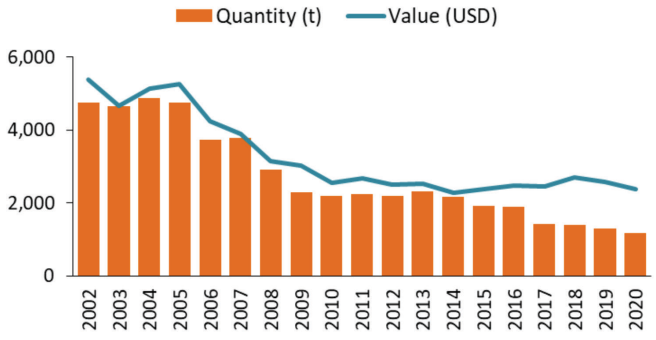

Figure 4. Production of *ayungin* in the Philippines in 2002-2020 by quantity (t) and value (USD)
(***Source:*** *Philippine Statistics Authority, 2021b, 2021a)*

A closer analysis of the rate in the volume of production showed fluctuation across years (**Figure 5**). There were four periods of positive growth (+4.62 % in 2003–2004, +1.30 % in 2006–2007, + 2.88 % in 2010–2011, and +5.47 % in 2012–2013) that were observed within the 18-year period. However, the periods of decline were noted for the years 2005–2006, 2007–2008, 2008–2009, and 2016–2017 at -21.42 %, -23.20 %, -21.45 %, and -23.82 %, respectively. Consequently, using this 18-year dataset, the average production rate of *ayungin* is estimated at -6.96 % per year. Using this value to make future prediction, the

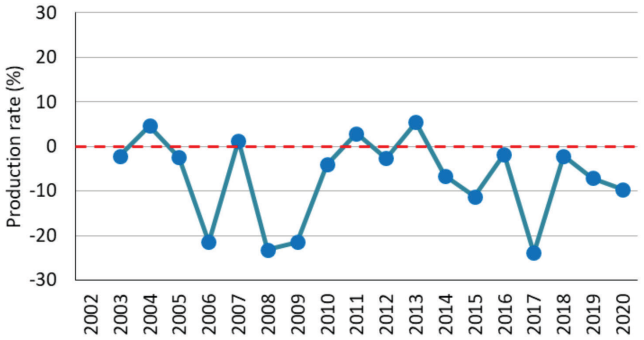

Figure 5. Production rate of *ayungin* in the Philippines in 2002-2020
(***Source:*** *Philippine Statistics Authority, 2021b)*

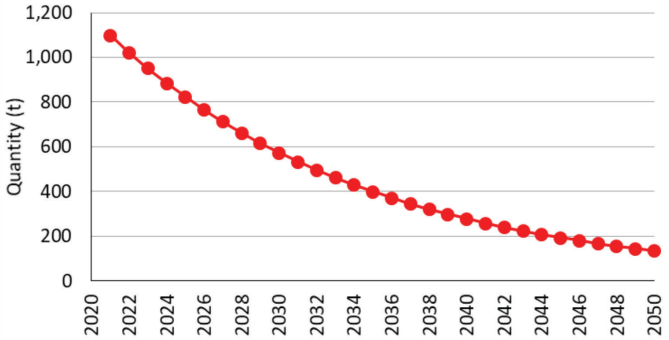

Figure 6. Predicted production of *ayungin* in the Philippines from 2021 to 2050 by quantity (t)

projected production is estimated at 575 t, 279 t, and 136 t in 2030, 2040, and 2050, respectively (**Figure 6**).

It is alarming to note that indeed, *ayungin* has been reported to have the highest decline rate among the freshwater fish species in the country (Guerrero III, 2021). The declining production of *ayungin* has severely affected the livelihood of approximately more than 24,000 fishers (Israel, 2007) around Laguna de Bay, particularly the small-scale fishing communities who depend on *ayungin* fishery as main source of food and income. Fishers now earn lesser income as compared before (Gervacio, 2012). However, despite the declining wild populations of *ayungin* in most regions of the country, the demand for this fish remained high. The market price of this fish ranges from USD 6.2 to as high as USD 16.5, which is about 2–5 times more expensive than the selling prices of tilapia and milkfish (Tacio, 2013).

Aquaculture potential of *ayungin*

The popularity of *ayungin* as food fish and its importance in the lake's subsistence fishery have, therefore, led the Binangonan Freshwater Station of SEAFDEC Aquaculture Department, in partnership with the University of the Philippines Diliman, to develop hatchery rearing techniques for domesticating this Philippine native fish species. In 2010, hormone-induced spawning of captive broodstock has been developed (L. M. B. Garcia, personal communication, 2010) using human chorionic gonadotropin (hCG) hormone. Spawning of *ayungin* was

also induced through the application of salmon gonadotropin releasing hormone (sGnRH) (Javier *et al*., 2015). More recently, Aya and Garcia (2020) induced spawning in *ayungin* using the combination of hCG and ovaprim®.

Larval rearing techniques for *ayungin* in outdoor tanks have been established in 2015 but still require further refinements. Larvae of *ayungin* feed on natural food organisms such as copepod nauplii, rotifers, copepods, insect larvae, and ostracods during its early feeding stages (Aya *et al*., 2015, 2019). A stocking density of 0.4 larvae per liter in 4 m^3 outdoor tank is recommended (Aya & Garcia, 2016), with survival rates as high as 48 % (Aya *et al*., 2019).

Early-stage juveniles that weigh 0.17–0.18 g were harvested from outdoor concrete tanks after 30–40 days, followed by another four weeks in indoor plastic tanks before stocking in nursery cages (F.A. Aya, unpublished data) (**Figure 7**). In addition, Aya *et al*., (2021) evaluated different feeding regimes and stocking densities for rearing early-stage *ayungin* larvae under laboratory conditions. It was found that the larvae survived very well with the 69–81 % survival rate, demonstrating that *Artemia* nauplii were more suitable than the combined rotifers and formulated microdiet, and that larvae should be stocked at densities of 5–15 larvae per liter.

Recently, the aquaculture extension manual on the biology and hatchery rearing of *ayungin* (Aya & Garcia, 2020) has been published and is now available for download at the SEAFDEC/AQD Institutional Repository (https://repository.seafdec.org.ph/handle/10862/5898). The manual contains the detailed information on the patented hatchery rearing technology of *ayungin*.

Way Forward

The domestication, management, and conservation of native aquatic species would likely have positive socioeconomic and ecological consequences. Unfortunately, research efforts on the culture production of *ayungin* in the country are limited. Therefore, further refinements on the technology for seed production and rearing of *ayungin* are still being continued. Meanwhile, nursery and grow-out rearing techniques, including the development of artificial diets for this species, are currently in progress. It is hoped that through these interventions, the production of sufficient number of viable seeds of this native fish species may help secure food fish supply and provide the small-scale fishers with sustainable livelihood.

Figure 7. Early-stage *ayungin* juveniles reared in polyethylene tanks *(above)* before stocking in hapa net cages for nursery culture *(below)* at the Binangonan Freshwater Station of SEAFDEC/AQD in Binangonan, Rizal, Philippines

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