Initiating Resource Enhancement of Seahorses:
A Case Study at Sagay Marine Reserve in Central Philippines

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Seahorses (*Hippocampus* spp.) are commonly found in tropical coral reefs as well as in lagoons and estuaries, and are highly exploited for their high price, resulting in the listing of these seahorses in the International Union for Conservation of Nature (IUCN). In fact, all seahorses are among the first marine fishes of commercial importance to be listed in both the IUCN and Appendix II of the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES) to ensure their sustainable utilization. In promoting the protection and sustainability of this resource, efforts have been made worldwide for their conservation through stock enhancement by releasing captive-bred or captive-held seahorses. The SEAFDEC Aquaculture Department (AQD) with support from the Japanese Trust Fund through the project "Resource Enhancement of Internationally Threatened and Over-exploited Species in Southeast Asia through Stock Release," has been working on the resource enhancement of seahorses primarily by developing appropriate release and monitoring strategies, and enhancing the involvement of concerned communities in the management of the natural as well as the restocked seahorses.

Seahorses are vulnerable species due to habitat degradation and pressure arising from illegal, unreported and unregulated collection of these resources for traditional Chinese medicine and to a lower extent, the marine aquarium and curio trade (Vincent *et al*., 2011; Foster *et al*., 2016). Recognizing that the release of captive-bred animals to augment the threatened wild populations needs to be managed carefully to circumvent damages to the wild seahorse populations as results of disease introductions and genetic contamination of the natural population, AQD initiated a baseline assessment of the natural stocks of seahorses in a pilot site in Molocaboc Island in Sagay Marine Reserve, Sagay City, Negros Occidental in central Philippines (**Fig. 1**). Taking into consideration the information compiled during the baseline assessment, AQD carried out the necessary preparatory activities (Vincent and Koldewey, 2006), for the development of long-term program on seahorse stock release and enhancement in the Philippines which could also be applicable in other countries in the region.

Fig. 1. The pilot site in Molocaboc Island, which is part of Sagay City, Negros Occidental, Philippines

Baseline assessment of seahorse natural stocks

In order to establish the baseline information on the wild seahorse population at Molocaboc Island in Sagay Marine Reserve (**Fig. 1**), monthly monitoring of wild seahorses was conducted from October 2012 to December 2017 on a 12,000 m^2 patch reef in Molocaboc Island. Collection of DNA samples was also carried out for the genetic analyses of the wild and hatchery-reared seahorses, to ensure the genetic integrity of the stock release and enhancement programs.

More specifically, the activity carried out by AQD in Molocaboc Island was aimed at developing the appropriate transport and acclimation strategies from seahorse hatcheries to release sites, determining the appropriate size-at-release of seahorses and time of release, developing the appropriate monitoring strategies of the released seahorses, and enhancing the involvement of concerned communities in the management of the natural as well re-stocked resources through their actual participation in the protection and conservation of the coral and sea grass areas which are the natural habitat of seahorses. Results of the baseline survey to determine the natural seahorse stocks density in the pilot site are shown in **Fig. 2**.

For monitoring of the population density, the seahorses were collected during night time by designated local divers at the onset of high tide. After an hour of diving, the collected seahorses were weighed, measured and classified based on the stages of their gonadal development. From the sampled seahorses, the data were recorded that include the average stretched heights measuring 12.3 ± 0.6 cm, and average body weight at 7.7±1.2 g. Analysis of the data indicated that the average number of seahorses (30 ± 6 ind/sampling) was the same in 2016 and 2017, but was higher than in 2015 (19 ± 6 ind/sampling) and October 2012 to December 2013 (5 ± 3 ind/sampling).

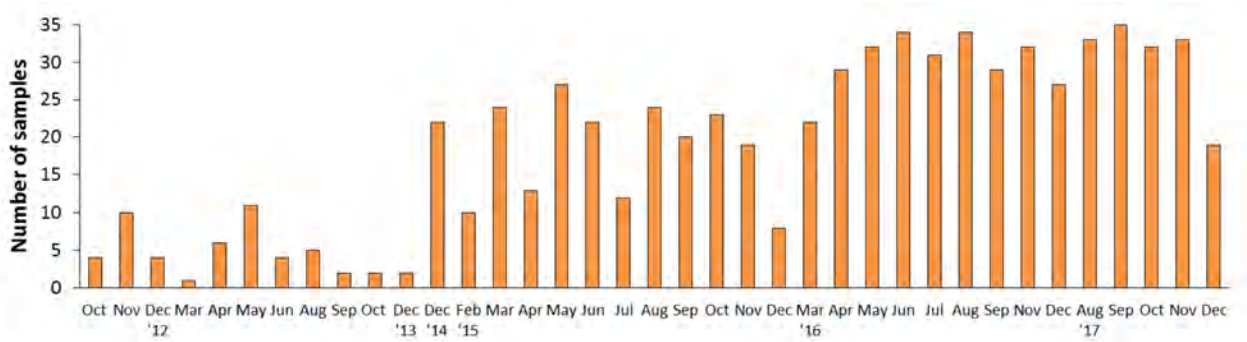

Fig. 2. Monthly data on the number of wild seahorses in Molocaboc Island, Sagay Marine Reserve, Philippines (2012-2017)

As shown in **Fig. 2**, the trend of the natural seahorse stocks in 2016-2017 was increasing, compared with that of the previous years (2012-2015). This suggests that the natural population of seahorse could recover through proper management of the natural resources, particularly by minimizing human disturbance on their habitats and preventing the collection of seahorses. Nevertheless, the average number of seahorses in December 2017 (30 ind or 0.0025 m^{-2}) was much lower than the reported (0.02 m^{-2}) average density of seahorses in Bohol Province, also in central Philippines (Martin-Smith *et al*., 2004). Perante *et al*. (2002) and Morgan and Lourie (2006) gathered that fishers in Bohol reported a decline in the population density of seahorses, especially the tiger tail seahorse *Hippocampus comes*. Specifically, the mean density of seahorse around Jandayan Island on the north-western edge of Bohol, was low at 0.019 m^{-2}, and in nearby islands (also under the jurisdiction of Bohol Province) the densities were even lower at 0.00143 m^{-2} (Perante *et al*., 2002; Morgan and Vincent, 2007). Moreover, Morgan and Lourie (2006) also reported a decline in the mean catch per unit effort (CPUE) throughout central Philippines, *i.e.* 24 seahorses per night per fisher in 1986-1990 to 2.9 seahorses per night per fisher in 1996-1999.

Natural food such as mysids and copepods are abundant in the pilot site area, which explains the all year round presence of sexually mature seahorses. Analysis of the stages of their gonad development also indicated that partially and fully mature development of the gonad of males and females could occur throughout the year (**Fig. 3**).

Population density monitoring strategies

For the density monitoring of seahorse population, the local divers had to undergo training on the proper handling of live seahorses, conducted by AQD researchers. More particularly, practical lectures were given to the divers for them to learn the skills and techniques of handling live seahorses during sampling to minimize stress on the animals, including the proper use of PVC pipes that temporarily hold the seahorse samples (**Fig. 4**).

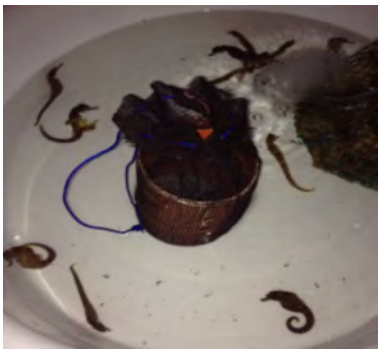

Fig. 4. PVC pipes used as temporary holding for seahorses

The informal lectures given to divers also included the biology of seahorses to enable them to efficiently collect the necessary measurements of the stretched height and body weight, as well as information on the stages of gonadal development of the sampled seahorses. Furthermore, hands-on training on monitoring of seahorses was also regularly conducted by AQD researchers for the fisherfolk organization members in

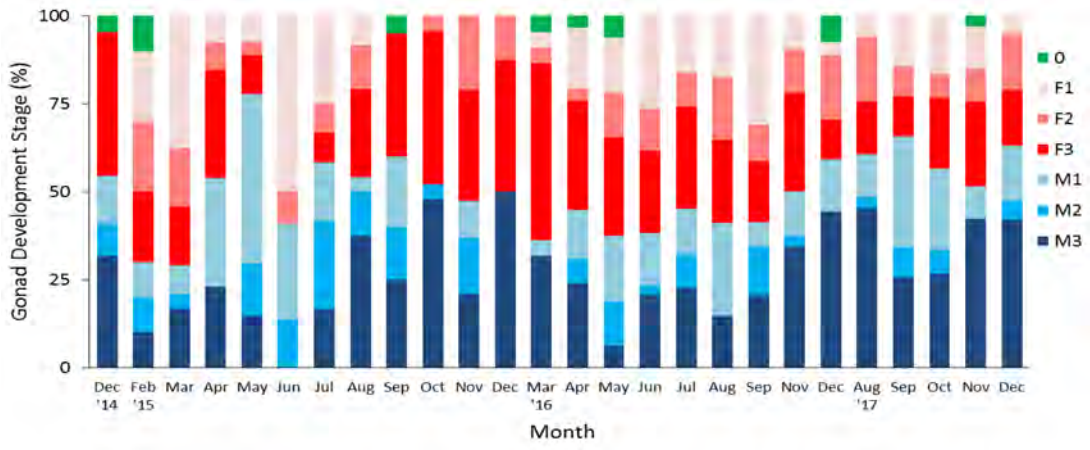

Fig. 3. Gonad development stage of wild seahorses observed from December 2014 to December 2017 Legend: **0** - juvenile, **F1** – immature female, **F2** - partially mature female, **F3** – fully mature female, **M1** – immature male, **M2** – partially mature male, **M3** – fully mature male.

the pilot site, for them to provide assistance in the monitoring of the seahorses when needed.

Transport of seahorses from hatcheries to release site

Trials on transport and acclimation were conducted with three replicates for each of the three size groups of juvenile seahorses (**Fig. 5**): **size A** – 5 cm stretched height, **size B** – 6 cm SH and **size C** – 7 cm SH. A styrobox was filled with seawater and oxygenated. Nylon twines tied to lead sinkers were provided as holdfast for seahorses. Stocking densities of 1, 2, 3, 4 and 5 ind/L and transport durations of 10 and 12 hours were tested on the juvenile seahorses. The 7-day post-transport survival of seahorses was observed using intermediate enclosures made of black nets (1x1x1 m^3) and plastic cylindrical screen cages (30 cm long, 25 cm diameter) hanged on a 5 x 5 m^2 floating bamboo raft.

Fig. 5. Measuring of seahorse to determine size-at-release

Using such information for transporting the seahorses, there was 100% survival of the seahorses upon arrival in Molocaboc Island, for all size groups at all stocking densities for the 10 and 12-h transport duration. However, after 7 days of observation, only those with stocking densities of 1, 2 and 3 ind/L for all three size groups showed 100% survival. As a result, the survival for all size groups ranged at 70-85% and 50-60% for the transport stocking densities of 4 and 5 ind/L, respectively. The result also suggested that the optimum stocking density for transport should be 3 ind/L for 5-7 cm SH seahorse juveniles for a 12-h transport duration.

Community-based hatchery for seahorses

A community-based hatchery facility in Molocaboc Island was constructed to establish a technique for seahorse hatchery using the available natural food for seahorses in the area. Pregnant male seahorse breeders were collected from the patch coral reef and transferred to 10-L plastic pails at stocking density of 1 ind/5 L (**Fig. 6**). Mild aeration was provided using solar-powered aerators. Pail bottom was siphoned daily at 30-50% water change.

Fig. 6. Juvenile seahorses reared in 10L plastic pail

The breeders were released again in coral reef area after parturition (giving birth). Natural food was collected during night time at the sampling site using plankton net. Mysids and copepods were separated using a sieve with 40 µm plankton net. Mysid shrimps were fed to the adult seahorses, while copepods were fed to newborn seahorses. Stocking density for the newborn seahorses was ~100/10 L plastic pail. Feeding was *ad libitum*.

Information, education and communication

Using the information compiled through the baseline assessment and the resource enhancement activity, information, education and communication (IEC) has been promoted through the conduct of lectures on the biology, resource management and baseline data of wild seahorse population in Molocaboc Island. IEC campaign on the management of natural resources highlighting on the seahorse biology and conservation has been conducted yearly in Molocaboc Island since 2015.

Attended by students, school teachers, fishermen organization members, and local government officials, the event on 22 November 2017 also included a Draw and Tell Contest with the theme "My role in the promotion of seahorse as a natural resource in my community" (**Fig. 7**). A total of twenty (20) students, 10 from the elementary and 10 from the secondary level of Molocaboc Integrated School, participated in the said

contest. Their art works which showed seahorse in corals and sea grasses, also exhibited the importance of protecting the natural habitat of seahorses to safeguard the dwindling population of seahorses in the wild (**Fig. 8**).

Fig. 7. Two of the students of Molocaboc Island creating their entries to the "Draw and Tell Contest" which aimed to promote seahorse as a natural resource in the community

Fig. 8. Finished art works of the students joining the "Draw and Tell Contest"

Way Forward

Future activities on stock release and resource enhancement of seahorses require not only the results of baseline assessment of the natural stocks including genetic characterization of the wild stocks, but also the established appropriate size-at-release of the animals appropriate for the monitoring strategies. It is expected that the appropriate release strategies for hatchery-reared juveniles could enhance the recovery of the seahorse population and density, as well as the participatory involvement of the concerned communities. Promotion of IEC is also crucial to assess the perception of the communities towards seahorse stock release and resource enhancement. At the national and regional levels, and for the long-term sustainability of the seahorse resources, the relevant information derived from the activities at the pilot site in Molocaboc Island, Sagay City, Negros Occidental could be used to promote the resource enhancement of seahorses not only in other potential sites of the Philippines but also in other countries of the Southeast Asian region.

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