Hatchery Management Techniques for Tiger-tail Seahorse (*Hippocampus comes*)

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Abstract

Seahorse culture has been practiced throughout the world to meet the demand for global trade and reduce the pressure on wild stocks through overexploitation. Development of culture techniques for seed production of seahorses is one of the most effective measures to avoid such anthropological repercussions on the wild stocks, and is currently being conducted at SEAFDEC/AQD with the aim to produce seed for stock release to protect these internationally threatened and overexploited species in Southeast Asia. This paper describes the breakthroughs in seahorse breeding and nursery rearing. So far, we have developed water and feeding management schemes that resulted in improved reproductive performance of broodstock and higher survival and growth rates in newborn and juvenile seahorses.

We highlight the concern of providing desirable food organisms and maintenance of suitable water quality in order to maintain maximum efficiency in the management of the seahorse hatchery. Newborn seahorses fed with formalin-treated food organisms and reared in UV-treated seawater had significantly higher survival and daily growth rate based on stretched height and body weight than those fed with untreated food organisms and reared in both chlorinated and sand-filtered seawater. Broodstocks fed with mysid shrimps showed higher brood size and shorter parturition interval. Thus, improved reproductive performance as well as survival and growth of newborn seahorses were largely influenced by refinement of hatchery management techniques.

Keywords: *Hippocampus comes*, seahorse, breeding, nursery, hatchery management

Introduction

All seahorses are listed on Appendix II of the Convention on International Trade of Endangered Species Flora and Fauna (CITES) as of May 2004 with 160 signatory nations, where 'sustainable' trade was allowed, meaning, trade must be controlled in order to ensure that their use is compatible with their survival. An estimated 20 million seahorses were consumed every year for Traditional Chinese Medicine (TCM). In the Philippines, the Philippine Fisheries Code of 1998 or Republic Act (RA No. 8550) Section 97 completely bans seahorse trade. However, unmanaged fishing of seahorses still persists. Interest in seahorse aquaculture reflects concern over exploitation in the wild with consequent declines in populations, and in recognition that seahorses command high prices and thus may be highly marketable (Vincent, 1996; Lourie *et al.,* 1999).

Stock enhancement is the stocking of cultured organisms to replenish or increase abundance of wild stocks. Simply said, stock enhancement involves developing successful enhancement by producing and releasing hatchery animals that survive (Leber *et al.,* 2004). Two components of a hatchery-release program are the availability of the cultured organism and the release of these organisms to the natural environment. Breeding and seed production techniques must be developed in the hatchery, while release strategies such as selection of release sites, assessment of the release micro habitat, collection of baseline data on wild populations, magnitude of stocking and development of tagging techniques essential to evaluate survival and efficiency of stocking strategies must also be investigated.

Currently, culture techniques in the seed production of seahorses is being developed at SEAFDEC/AQD with the aim to produce seed for stock release to protect internationally threatened and overexploited species in Southeast Asia. The present study addresses the main breakthroughs in seahorse breeding and nursery rearing. So far, we have tested water and feeding management schemes (Figure 1) that resulted in improved reproductive performance and higher survival and growth rates in new-born and juvenile seahorse.

Broodstock management

The selection of pairs of seahorses for broodstock is done after a few days observation of adult seahorses (average size of 85±2 mm stretched height (SH), 2.3±0.3 g body weight (BW)) that exhibit some distinct swimming behavior and intertwining of tails. Sexual maturity in males can be recognized by the presence of brood pouch. Female seahorses transfer eggs to the pouch of males via the ovipositor tube. Eggs are fertilized in the male's pouch. Pregnancy lasts for two weeks, after which the males give birth to live seahorses.

The broodstock seahorses are maintained in 250 L circular fiberglass tanks (Figure 2) at a sex ratio of 1 female:1 male and a stocking density of 1 seahorse 5 L-1 seawater. Temperature of the rearing water is kept at 27-28°C, salinity at 30-33 ppt, and dissolved oxygen at 5.0-7.5 ppm under a LD12:12 photoperiod. Excess feeds and feces are siphoned out from the tank bottom and 30-50% of the rearing water is replaced daily at 0800 h. Sand-filtered seawater and mild aeration are provided in the rearing tanks. Nylon twines tied to lead sinkers serve as holdfasts where the seahorses can coil their tail around.

At the present time, formulated artificial diet for seahorses are not commercially available, thus, seahorses are solely fed with live or frozen food. Seahorses are ambush predators that feed on a variety of mobile preys consisting mostly of planktonic crustaceans such as mysid shrimps, amphipods, copepods, or any tiny larvae that fits into their elongated snouts (Woods, 2002; Kendrick and Hyndes, 2005; Kitsos *et al.,* 2008). One factor to consider in prey selectivity would be the simple digestive physiology of seahorses, which enable them to prefer mysid to *Artemia*. When feeding within the water column, seahorses wait until preys come close to the mouth, whereupon, the preys are drawn up into the long snout with a rapid intake of water (Foster and Vincent, 2004). Thus the snout opening would limit the size of the prey that the seahorse can

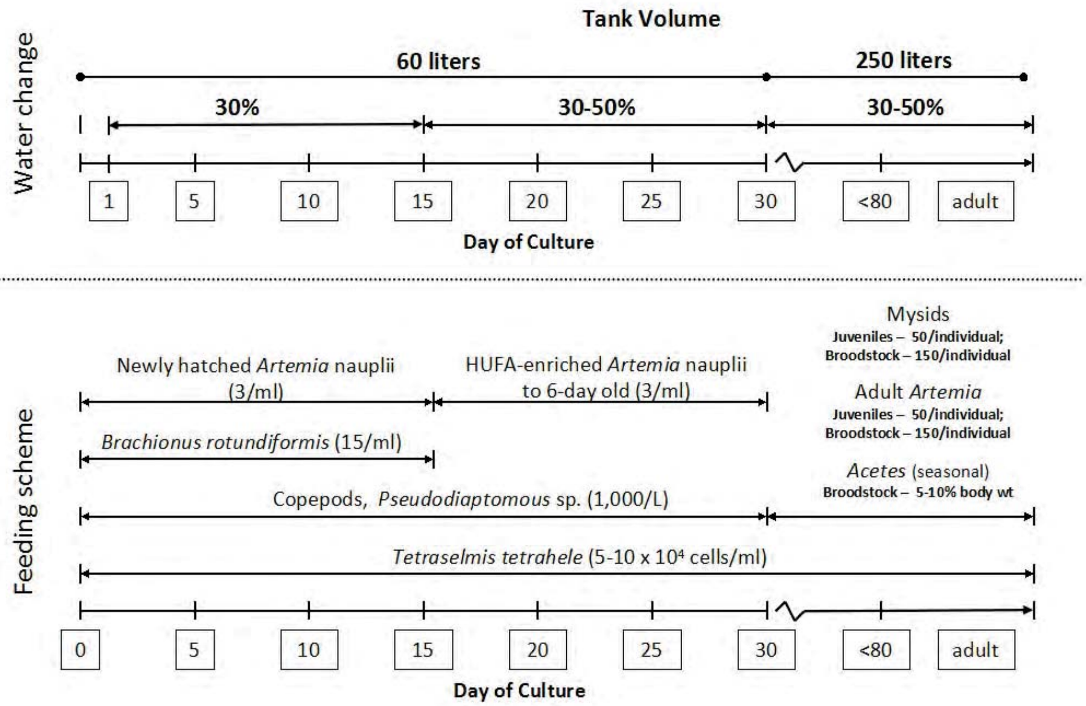

Figure 1. Feeding and water management scheme for seahorse.

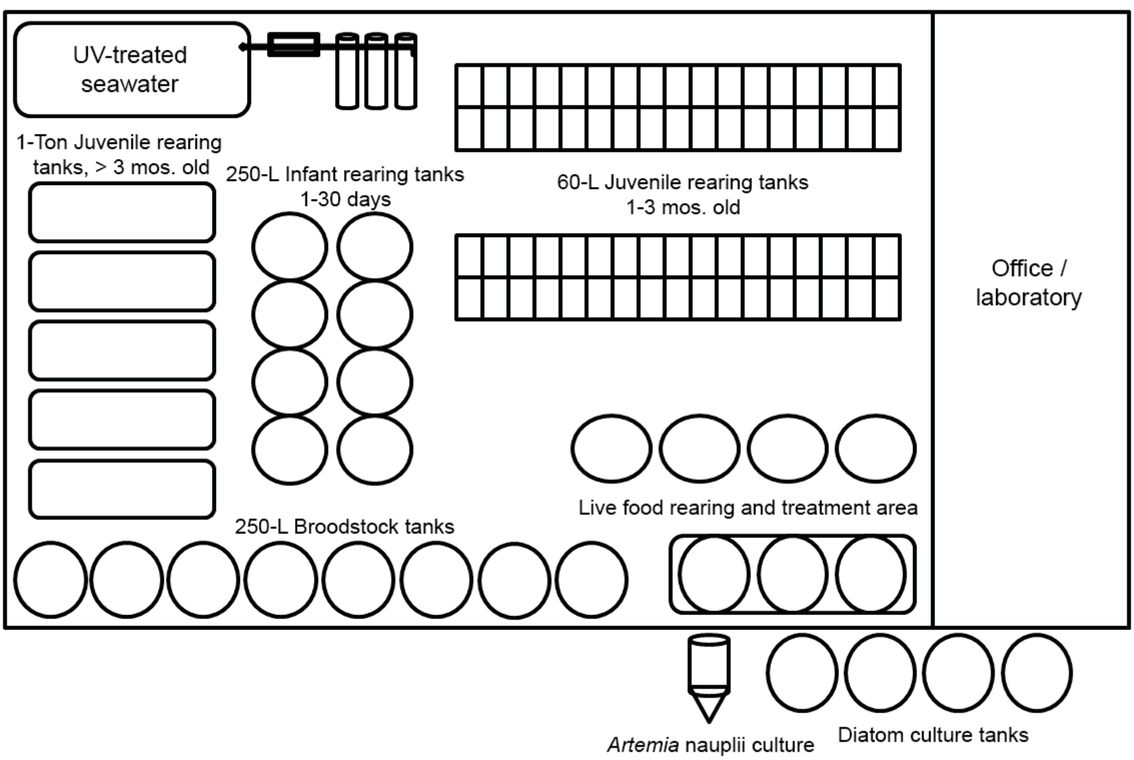

Figure 2. Layout of seahorse hatchery at SEAFDEC/AQD Tigbauan, Iloilo, Philippines.

ingest. Mysid shrimps (18-20 mm) may be longer in length compared to *Artemia* (7.8 mm), but the whole body is slender and the pleopods and pereiopods are found only on the ventral part, while the swimming appendages of *Artemia* are spread on both sides of the body.

The reproductive performance markedly improved when seahorses were fed with mysid shrimp alone or in combination with *Artemia* and *Acetes* (Buen-Ursua *et al.,* 2015). A food preference study where adult seahorses were offered a combination of mysid, *Artemia* and *Acetes* twice daily (0800h and 1400h) showed that mysid was the preferred food as a single diet or combined with *Artemia* and *Acetes*. Significantly higher brood sizes (223-292 newborn seahorses) were obtained from seahorses fed with mysid shrimps as a single diet or combined with the other natural food than diet treatments comprised of *Artemia* only, *Acetes* only and *Artemia+Acetes* which resulted in 107-152 broods. Longer parturition interval was observed in seahorses fed with single diet of *Artemia* (60 days) than those fed solely with mysid, or mysid in combination with other natural food (13-26 days). Parturition occurrence was highest when seahorses were fed mysid alone (13.3±1.5). Thus, better reproductive performance was obtained when seahorses were fed mysids alone or in combination with other natural food.

Larval rearing of newborn seahorses (0-30 days)

Parturition events or giving birth of male seahorses usually occur at night time or in the early morning. The male seahorse goes into labor, pumping and thrusting to release his brood. The young are miniature seahorses, also called infants, with average size of 9 mm SH and 0.004 g BW. The newborn seahorses immediately swim up to the water surface to gulp air to inflate their swim bladders. They are collected from the broodstock tanks using a scoop net and transferred to the larval rearing tank (Figure 2).

Newborn seahorses are reared in 250L tanks at a stocking density of 3 seahorses L^{-1} seawater. Newborn seahorses are fed a mixture of newly-hatched *Artemia nauplii* at 3 ml^{-1} and copepod *Pseudodiaptomous* sp. at 10 ml^{-1} per (Figure 1). The copepods are collected using 40 µm plankton net from ponds in Trapiche, Oton, Iloilo, Philippines. Due to high infestation with the parasitic protozoans *Zoothamnium* sp. and *Vorticella* sp., in preliminary studies, copepods were washed several times with UV-treated seawater, subjected to 30 ppm formalin bath for 1 h and rinsed again in UV-treated seawater before feeding to seahorse. Feeding is done twice daily at 0800h and 1300h. The tank bottom water is siphoned out daily to remove uneaten feed and fecal matter. Around 30% of total water volume is replaced with fresh seawater. Mild aeration is continuously provided. On Day 15, nylon twines tied to a lead sinker are provided inside the tanks to serve as holdfasts for the seahorses.

Buen-Ursua *et al.,* (2011) showed that on Day 30, seahorses reared in UV-treated seawater had significantly higher growth in SH and BW (41.4 ± 0.5 mm and 0.23 ± 0.00 g) than those reared in both chlorinated (33.8 ± 1.4 mm, 0.16 ± 0.00 g) and sand-filtered seawater (32.8 ± 0.1 mm, 0.16 ± 0.00 g). Survival was higher in UV-treated seawater (65.6 ± 1.1%) and chlorinated seawater (62.2 ± 4.0%) than in sand-filtered seawater (41.1 ± 1.9%). Survival of seahorses fed with 30 ppm formalin-treated copepod and untreated copepod on Day 8 were 95 ± 2% and 79 ± 6%, respectively. On Day 15, survival was 79 ± 10% in seahorse fed formalin-treated copepod and none (0%) survived among those fed untreated copepod. Survival of seahorse with formalin-treated copepod was 65 ± 10% on Day 30.

Larval rearing of seahorses (1-6 months)

After 30 days of feeding with copepods, the juvenile seahorses are collected from the 250L tanks and transferred to the 60L tank (Figure 2) for nursery rearing at a stocking density of 1 seahorse L^{-1} seawater. A mixture of *Artemia* (up to 6 days old) at 3 ml^{-1} and copepod *Pseudodiaptomous* sp. at 10 ml^{-1} per day are fed to the juvenile seahorses until they are 2 months old. Methods of feeding and maintenance of seawater are the same as previously described for newborn seahorse. Nylon twines tied to a lead sinker are provided inside the tanks to serve as holdfasts for the seahorses.

Seahorse juveniles at 2 to 6 months old are maintained in sand-filtered seawater. They are fed with a mixture of mysids (50/individual), *Artemia* (50/individual) and frozen *Acetes* (5-10% BW). Juveniles that are less than 2 months old are sensitive to fluctuation in water temperature and availability of copepods. At this stage, the juveniles can be weaned to mysid. However, they are not able to feed on frozen *Acetes*. Survival of 2-6 months old juveniles is more stable mainly due to their ability to feed on mysid shrimps and *Acetes*. It was observed that mortalities of juvenile seahorses occur when seawater temperature decreases to 24 or 25°C.

Conclusions

UV sterilization of water and formalin treatment of natural feed resulted to higher survival of the newborn seahorses, which is crucial for stable mass production of seahorse juveniles. Timely and sufficient supply of the necessary food organisms is another key factor to ensure success of seahorse seed production. The development of techniques for the mass production of mysids and copepods as natural food to support seahorse seed production needs to be further pursued to ensure available supply for seahorse hatchery maintenance. Furthermore, an efficient and reliable water supply system is important in maintaining maximum efficiency in the management of the seahorse hatchery.

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