

## SEAFDEC/AQD Stock Enhancement Initiatives: Release Strategies

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### Abstract

The Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC/AQD) started its Stock Enhancement Program more than a decade ago with the first stock enhancement initiative on the mud crab *Scylla* spp. funded by the European Commission. This was followed by another stock enhancement program in 2005 supported by the Government of Japan Trust Fund. In preparation for its implementation, a Regional Technical Consultation on Stock Enhancement of Species Under International Concern was convened in Iloilo City, Philippines in July 2005 to identify species for stock enhancement. During the meeting, seahorses *Hippocampus* spp., giant clam *Tridacna gigas*, abalone *Haliotis asinina*, and sea cucumbers *Holothuria* spp. were among the priority species for stock enhancement work.

Stock enhancement, restocking and ranching are management approaches involving the release of wild or hatchery-bred organisms to enhance, conserve or restore fisheries. This paper reports SEAFDEC/AQD release activities and some of the release strategies that have been established for mud crabs, giant clams and abalone.

**Mud crab, *Scylla* spp.** – Studies on the mud crab, conducted from April 2002 to November 2005, evaluated the effectiveness of releasing wild and hatchery-reared (HR) crabs in the mangroves of Ibañay, Aklan, Philippines where preliminary studies demonstrated declining fishery yields, abundance and size of crabs (Lebata *et al.*, 2007). Comparison of survival and growth of wild-released and HR *Scylla olivacea* and HR *Scylla serrata* demonstrated the effect of nursery conditioning, size-at-release and species differences. Overall yield and catch per unit effort (CPUE) increased by 46% after stock enhancement trials. Recapture rates of released crabs were highest in wild-released *S. olivacea* and in crabs measuring 65.0–69.9mm carapace width (CW) and lowest in non-conditioned HR *S. serrata*. Growth rates were highest for conditioned HR *S. olivacea* and lowest for conditioned HR *S. serrata* (11.7 and 3.7 mm month<sup>-1</sup>, respectively). Fishing mortality was highest for *S. olivacea*, whereas natural mortality was greater for *S. serrata*. Conditioning hatchery-bred animals before release is also important in obtaining higher survival. *S. olivacea* was the more appropriate of the two species for release in mangrove habitats inundated with low-salinity water. However, there is a need for site-specific studies to evaluate the effectiveness of releases (Lebata *et al.*, 2009). It is important to consider the following factors when releasing mud crabs: 1) hatchery-

reared mud crabs should be conditioned in ponds prior to release to increase chances of surviving in the wild; and 2) bigger crabs have better chances of survival in the wild compared with smaller ones; in this case, crabs measuring 4.5 cm CW or bigger during release had the highest recapture rates.

**Giant clam, *Tridacna gigas*** – To restore the diminishing population of the giant clams *Tridacna gigas* in Sagay Marine Reserve (SMR), Negros Occidental, central Philippines, two size classes [8- and 10-cm shell length (SL)] of hatchery-bred *T. gigas* were reared in an adjacent ocean nursery for subsequent restocking to Carbin Reef upon reaching escape size of  $\geq 20$  cm SL. Average growth rates of  $0.67 \text{ cm month}^{-1}$  did not significantly differ for both sizes. However, survival after 382 days of rearing *T. gigas* was significantly higher in the 10-cm SL clams than the 8-cm SL clams (96 and 83%, respectively). For future restocking projects, the use of 8-cm SL clams is recommended because the lower survival of this size class is compensated by its cheaper price. While rearing the clams to attain grow-out size, the population of wild clams (Family Tridacnidae) in Carbin Reef was assessed using ten  $50 \times 2$ -m belt transects. Four species of tridacnid clams have been recorded: *Hippopus hippopus*, *Tridacna crocea*, *T. maxima*, and *T. squamosa*. *T. crocea* comprised 12.5–93.9% of all the clams observed in all ten transects. There was a significant difference in clam density between species (ANOVA,  $F = 6.94$ ,  $P < 0.001$ ), with *T. crocea* having the highest density. Living *T. gigas* were absent, but presence of dead shells was indicative of its presence in the reef in the past. It can be expected that the release of hatchery-bred *T. gigas* juveniles in Carbin Reef could provide future breeders that will repopulate this reef and the adjacent reef communities (Lebata-Ramos *et al.*, 2010). For the giant clam restocking activity, among the lessons learned were to: 1) first rear giant clams in ocean nurseries until escape size of 20 cm SL because they are less vulnerable to predators when they have attained this size; and 2) rear them in shallow reefs with 0.5-1.5 m deep water during low tide because better growth was observed in giant clams reared in shallow waters with warmer temperatures (mean  $\pm$  SE  $29.5 \pm 0.24^\circ\text{C}$ , range  $26\text{--}31^\circ\text{C}$ ).

**Abalone, *Haliotis asinina*** – The lucrative returns brought by abalone fisheries caused overexploitation and decline of the wild population. In the Philippines, SEAFDEC/AQD has successfully produced *Haliotis asinina* seeds in the hatchery. Aside from utilizing these seeds in aquaculture, they are also being considered for future stock enhancement endeavors of the department. This study aimed to evaluate post release behavior, recapture and growth rates of hatchery-reared abalone juveniles released in the Sagay Marine Reserve. From the two release trials conducted, results showed that abalone of shell length  $> 3.0$  cm had lower mortality during onsite acclimation and utilized transport modules as temporary shelter for a shorter period after release. Both wild and hatchery-reared abalone preferred dead branching corals with encrusting algae as their habitat. Recapture rates were comparable between the wild (7.97%) and hatchery-reared (HR2) abalone (6.47%). Monthly growth rates were almost the same between wild (0.25 cm, 4.0 g) and hatchery-reared (HR1: 0.27 cm, 4.6 g; HR2: 0.35 cm, 3.8 g) abalone. Moreover, hatchery-reared abalones were recaptured up to 513 days post-release, indicating viability of released stocks in the wild. Results of releases revealed that hatchery-reared abalone can grow and survive with their wild conspecifics (Lebata-Ramos *et al.*, 2013). Through this study, it was noted that: 1) abalone should be released at a minimum size of 3 cm SL; 2) they should be transported from the hatchery in PVC transport modules; 3) they should be acclimated on site prior to release to eliminate mortalities caused by transport stress; and 4) transport modules should be placed on the release site, letting the abalone move freely out of the modules into their natural habitat.

In all releases, it is important to tag the released stocks to separate them from their wild conspecifics. Numbered dymotapes were used for giant clams, diet tagging for the abalone, and

coded microwire tags in mud crabs. In stock enhancement, it is also important to consider security of the release area. Releases should be done in more secured habitats such as marine protected areas rather than in open access areas where fishing is uncontrolled.

**Keywords:** stock enhancement program, seahorse, giant clam, abalone, sea cucumber

## **References**

- Lebata MJHL, Le Vay L, Primavera JH, Walton ME and Binas JB, 2007. Baseline assessment of fisheries for three species of mud crabs (*Scylla* spp.) in the mangroves of Ibajay, Aklan, Philippines. *Bulletin of Marine Science* 80: 891-904.
- Lebata MJHL, Le Vay L, Walton ME, Biñas JB, Quintio ET, Rodriguez EM and Primavera JH. 2009. Evaluation of hatchery-based enhancement of the mud crab, *Scylla* spp., fisheries in mangroves: comparison of species and release strategies. *Marine and Freshwater Research* 60: 58-69.
- Lebata-Ramos MJHL, Okuzawa K, Maliao RJ, Abroguena JBR, Doyola-Solis EFC, Dimzon MDN and Dacles TU. 2010. Growth and survival of hatchery-bred giant clams (*Tridacna gigas*) in an ocean nursery in Sagay Marine Reserve, Philippines. *Aquaculture International* 18: 19-33.
- Lebata-Ramos MJH, Doyola-Solis EFC, Abroguena JBR, Ogata H, Sumbing JG and Sibonga RC. 2013. Evaluation of post-release behavior, recapture, and growth rates of hatchery-reared abalone *Haliotis asinina* released in Sagay Marine Reserve, Philippines. *Reviews in Fisheries Science* 21: 433-440.