A preliminary study on potentiality of captive breeding of *Holothuria scabra*

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Abstract

Sea cucumbers are severely overfished in most countries of the world including Sri Lanka. During the last decade, the sea cucumber fishery in the shallow areas off Southern Sri Lanka rapidly declined and finally collapsed. At present the fishery is restricted to the Northwestern and Eastern coasts of the country. High demand for Sri Lankan processed sea cucumbers in the world market and easy to collect from their habitat due to sluggish movements are the root causes for overexploitation of wild sea cucumbers. Aquaculture is the solution to overcome wild stock overexploitation. Sea cucumber breeding and culture are not yet ventured in Sri Lanka. This preliminary study is aimed at prospecting potentiality of captive breeding of highly valued sea cucumber species in Sri Lanka. Brood stocks of the selected culture species, *Holothuria scabra* are collected from Jaffna and Mannar by divers. In this study brooders matured in wild and brooders conditioned and matured in hatchery were used to induce spawning. Pressurized water treatment technique was used to induce wild matured sea cucumbers, both males and females responded to it. Thermal shock was applied to brooders conditioned in the hatchery, only males responded to it. This is the first ever breeding trial succeeded in local conditions.

Keywords: Sea cucumber, Brood stock, Spawning

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Introduction

Ever increasing demand for processed sea cucumber, *beche-de-mer* provides valuable source of income for developing nations of the Indo- Pacific region. Sea cucumber fishery was introduced in Sri Lanka by the Chinese in late 19th century (Hornell, 1917). Since then the total sea cucumber production, derived from wild catch was subjected to export and the coastal community have earned significant income. Uncontrolled exploitation of wild stock lead to the decline of natural population, thus threatened the survival of the industry. Aquaculture, stock restoration and enhancement programs are desirable interventions to overcome overfishing of sea cucumbers. There are nearly 200 known species found in the waters around Sri Lanka. Dissanayake *et al*., (2010) reported that there are 24 sea cucumber species found in commercial catches around Sri Lanka. There is enough potential for sea cucumber aquaculture in Sri Lanka. The shallow Northern coastal waters are ideally suited for sea cucumber farming, while abandoned shrimp ponds and shrimp hatcheries on the Northwestern coast could be used for sea cucumber farming.

Studies on tropical sea cucumbers have been largely focused on the widespread commercial sea cucumber *Holothuria scabra* (Grisilda, 2006). It has a short larval phase, relatively high tolerance of changing environmental conditions, and can be processed to produce high-value *beche-de-mer* (FAO, 1990, Hamel *et al.,* 2001). There are few attempts by Chinese farmers to breed sea cucumbers in Sri Lanka; however, captive breeding remained unsuccessful. The study is aimed at assessing the potentiality of captive breeding of *H. scabra* under local conditions.

Materials and Methods

Brooders collection: For this preliminary study, *H. scabra*, a high value species is selected for breeding. Healthy brooders were collected from both lagoon and the sea in the Jaffna Peninsula during the period of January to March and July to September, which have been identified as two breeding seasons for the species. The brooders were collected at day time by divers at the depth of 10- 15 m. The collected brooders were placed in water filled containers for the purpose of minimizing their stress. At the end of the day they were brought to the landing site and stored in the sea cucumber pen which had been set up within the lagoon.

Brood stocks transportation to the breeding site: Individuals, which were stored in the pen, were brought to the packing site for further conditioning to make them fit for transportation. They were packed individually in separate oxygenated polythene bags with no water. Brooders were transported to the Regional Research Center of National Aquatic Resources Research and Development Agency at Kalpitiya, Northwestern Province, where the hatchery is located. The time taken for the transportation of brooders from packing point to the hatchery was approximately six hours.

Maintenance of brood stocks: Individuals which were brought to the hatchery were stocked in fiberglass tanks with a density of 18-20 specimens per of 2.5 m^2. Two third of the tank bottom area was covered with sand while the rest was left without sand. This bare bottom was used to place the feed. The thickness of the sand layer was always maintained at 15 cm, while water level was kept at 45 – 50 cm. Thirty percent of water in the holding tanks was daily replenished, while water was completely renewed once a week. Potassium permanganate ($KMnO_4$) was used to clean the tank when sand was exchanged at every fortnight.

***Spawning induction methods*:** Sea cucumber is a dioecious species, which may not show external sexual dimorphism. Microscopic examination of ratified gonads can only prove the sex of *H. scabra* specimens. However there is a possibility to identify them at spawning with the aid of their different spawning behaviors. Two techniques were used to induce the spawning of *H. scabra*, namely pressurized water treatment immediately after transportation and thermal shock treatment for stocked brooders in the hatchery.

***Pressurized water treatment*:**Transported brooders were placed in the empty spawning induction tank and pressurized water was sprayed for about 10 minutes. The tank was filled with water at 18:00 hrs, and allowed the brooders to be settled without any disturbances. When the signs of spawning were observed, males and females were segregated and placed in separate tanks.

Thermal shock spawning induction: technique is applied to the brooders, conditioned at the hatchery in May, 2011. In this method, water temperature of the breeding tank was reduced to 3 -5^{0}C by adding adequate amount of ice. Brooders were kept in low temperature for about 60 minutes. After the thermal shock they were introduced in to the spawning tank and observed for their spawning behaviors. The males have shown signs

of spawning but female remained unresponsive. However, males and females were segregated and placed in separate tanks.

Fig.1. Sea cucumber showing spawning behavior

Fig. 2.Male releasing milt on thermal shock stimulation

Fig. 3.Female sea cucumber laying eggs

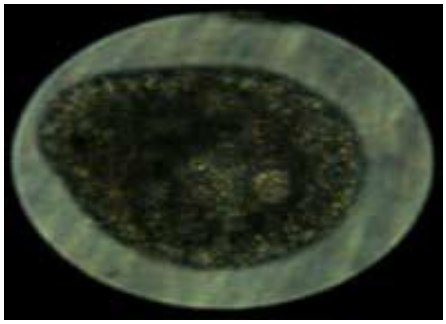

Fig. 4. Microscopic view of a fertilized egg obtained from the breeding trial

***Fertilization*:** Once the female had released oocytes, the fertilization takes place in the water column. After completion of the spawning process, the parent sea cucumbers are removed from the tank. The fertilized eggs were transferred to the larval rearing tank.

Results and Discussion

A sea cucumber, induced by pressurized water treatment has shown spawning behavior, after 90 minutes of inducing by raising its anterior end, twisting and showing swaying movements and the behavior was followed by few other individuals too (Fig.1). In total of 26 *H. scabra* individuals, only five individuals, four males and one female showed spawning behavior. The point of the genital opening at the anterior end became bulged out due to the pressure created inside the gonopore in the mid-dorsal position.

Males released sperms as continuous creamy white stream (Fig. 2) for about 90 to 120 minutes. Male gametes formed sperm clouds which were suspended in the water within a few seconds. Induced females ejected oocytes in batches (Fig. 3). According to Baskar

(2004), the number of batches released is usually depends on the size of the individual. The deposited oocytes at the bottom were easily identifiable by its reddish orange colour. In order to prevent polyspermy, the fertilized eggs were rinsed with freshly collected sea water to remove excess sperms (Battaglene, 1999). The fertilized eggs floated in water and were white in colour and visible to the naked eye. Developing eggs were transferred into larval rearing tanks for further development. The density of eggs in the larval rearing tank was measured as 6 eggs/ml.

In total 32 brooders were subjected to thermal shock treatment for inducing. Only one male released sperms, none of the females responded. This may be due to the fact that the artificial environment created inside the hatchery, where brooders were stored is not favorable to mature female gonads or lack of duration of thermal shock treatment given to induce spawning or the month of May not being a breeding season of *H. scabra*. In India, Baskar (2004) obtained best results of thermal stimulation during breeding peaks of the sea cucumbers.

Conclusions

H. scabra is commercially important high value species for the production of *beche-de-mer*. Depletion of wild stocks, potentials for aquaculture of this species and passion for developing breeding technology served as the motivation for current investigation of captive breeding of *H.scabra*. Healthy brood stock is essential for the successful operation of hatchery. In this trial study, brooders are collected from wild population. However, rearing of brooders at captivity would further advance the successful operation of hatchery. The animal shrinks and the gonad is reabsorbed, when it is not fed with proper nourishment. Furthermore, it eviscerates in poor water quality and becomes useless for spawning. Thus, future studies shall focus on identifying appropriate feed and water quality, including photoperiod, light intensity and temperature.

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