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Pen Culture of Mud Crab (*Scylla serrata*) in Chilika Lagoon, Orissa, East Coast of India.

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Abstract:

Pen culture is a new technique applied in Chilika lagoon for crab farming. The pen cultured was carried out in an area of 1000m² during October 2007 to January 2008.Five hundred juveniles measuring 4.5cm to 4.9cm in carapace length and weighing 28gm to 33gm were released. Juvenile crabs were fed with fresh fish, fish head, fish skin, broken fish, fish entrails and squid heads. The mean specific growth rate was highest being 22.955% during January 2008 and the lowest mean specific growth rate was observed to be 19.078% during October 2007. The highest mean total weight gain was 0.665% during October 2007 and the lowest mean total weight gain was 0.171 during January 2008. The environmental parameter like temperature, salinity and dissolved oxygen ranged from 24°C to 31°C, 8.6‰ to 13.5‰ and 6.1 ml/I to 8.2 ml/l respectively during the culture period in pen constructed area inside the Chilika lagoon.

Introduction:

The crab, *Scylla serrata* is widely distributed in the Bay of Bengal and in the Chilika lagoon .The most commonly cultured crab species is *Scylla serrata* due to its preference to estuarine habitats, less aggressive behaviour and higher food value (Cowan, 1984). *Scylla serrata* is successfully cultivated in many Southeast Asian countries and Australia which fetches high prices in the local and international market. In Taiwan, *Scylla serrata* has been reared in both polyculture (together with shrimps, milkfish and rice) and monoculture pond (Chen, 1976; Cowan, 1984). Experimental culture of *Scylla serrata* in plastic cages, placed in large fishponds have been undertaken in Tuticorin, India, registering significant growth increment (Bensam, 1986). In Philippines, the species has been cultured in ponds (Catanaoan, 1972; Samanto and Agbayori, 1992; Trino et al. 1999) as well as in pens (Baliao et al. 1999). In East Malaysia, pen culture is a common practice where the mud crabs are allowed to grow in their natural habitat in enclosures in mangrove areas (Chang, 1997).

Compared to fishpond culture with its 4000 years tradition, fish pen culture is of more recent origin. It involves the rearing of fish within fixed net enclosures supported by frameworks made of bamboo, wood or metal, set in sheltered, shallow portions of lakes, bays, rivers and estuaries. Pen culture is said to have originated in the inland sea area of Japan in the early 1920s (Alferez, 1977) and adopted by the People's Republic of China in the 1950s for rearing of carps in freshwater lakes (Beveridge, 1984) and introduced to culture milkfish in the shallow, freshwater, eutrophic laguna de Bay in

the Philippines in the 1970s (Baguilat, 1979). Its development and adoption as a popular technology has not been widespread because of its specific requirements like its suitability mainly in shallow environments. At present, it is commercially practiced only in the Philippines, Indonesia and China (Beveridge, 1984).

Mud crabs of the genus *Scylla* are an ecologically and economically important group of protunids associated with the Indo-Pacific mangrove forests (Macnae, 1968). They are exploited in a number of ways by people living in the mangrove-fringed areas of the coastal zone (Macintosh et al. 1993). Small-scale fishermen capture mud crabs with baited traps and lift nets. The crabs are then sold live in local and exported to foreign markets. Large crabs and females with mature ovaries (berried females) are particularly valuable. Until recently, only one species of mud crab, *Scylla serrata* was recognised for food and culture. However, four species viz., *Scylla serrata, Scylla paramamosain, Scylla tranquebarica* and *Scylla olivacea*, have now been proposed for culture (Keenan et al. 1998).

In Indonesia, various silvo-fishery models that combine integrated mangrove tree culture with brackish water aquaculture have emerged. The silvo-fishery ponds may combine mud crab *Scylla serrata*, seabass, milkfish and shrimp production on construction of several pens (8-12) of 10x10m spaced 1 metre apart on a platform area (Fitzgerald, 1997). Breeding and maturation of *Scylla serrata* was also undertaken at Karwar, India, when females attained sexual maturity at 80mm carapace length (Prasad and Neelakantha, 1989). The temperature of Chilika lagoon varies from 23.98^{o}C to 35.6^{o}C (Nayak & Mohanty, 2006). pH varies from 7.1 to 9.9 (Panda et al. 2008). Salinity shows a wide variation in different seasons of the year. The salinity value varies from 0.2 ppt to 22 ppt in the pre-mouth opening condition and from 0.4 to 33 ppt in the post mouth-opening condition during summer (Dube, 2007). The dissolved oxygen concentration varies from 3.9 ml/l to 13.9 ml/l in different sectors and different seasons of the year (Nayak & Behera, 2004).

In Chilika lagoon, the local community practise artisanal fishery, but as the bay is overfished, the fishermen have to go far, often beyond the need, in order to return with a satisfactory catch. No work has been carried out on the mud crab ranching in Orissa in general and Chilika lagoon in particular. Therefore, the objective of this study is to introduce a pen culture system of mud crabs to provide an alternative source of income, food and employment to local people and to obtain basic scientific data necessary for maintenance and management of the culture system in Chilika lagoon.

Materials and Methods:

Chilika lagoon stretches over three districts, namely, Puri, Khurda and Ganjam. The water spread area of Chilika lagoon varies from 1165 km^2 to 906 km^2 during the monsoon and summer seasons, respectively. Chilika is the largest brackish water lagoon located on the east coast of India, which is situated between 19^{o}28'-19^{o}54'N latitude and 85^{o}05'-85^{o}38'E longitude (Figure 1). It is the largest wintering ground for migratory waterfowl on the Indian Subcontinent. Chilika lagoon is influenced by three subsystems, the Mahanadi distributaries (Delta Rivers), 52 rivulets and streams draining into the lagoon from the Western catchment and the sea (Bay of Bengal). The Chilika drainage basin is estimated to contribute about 1.760 million cubic metres (mcm) water into the lagoon. There are 35 species of crabs available in this lagoon. Out of these *Scylla serrata* is the most commercially important crab, which has great demand in India and abroad. Two species of *Scylla* are available in Chilika lagoon i.e.,

Scylla serrata and *Scylla tranquebarica*. *Scylla serrata* is known as Red crab and is small in size whereas *Scylla tranquebarica* is generally known as Green crab and larger in size as compared to red crab. The study site was chosen in an important area of Chilika lagoon, viz., Mainsha village. The study site in Chilika lagoon is a naturally occurring area fenced by nylon net, supported by bamboo sticks. The nylon net fenced area was constructed with a length of 50m and 20m breadth having an area of 1000m^2. The substratum is generally muddy. The net used for catching the juvenile crabs were popularly known as Uzio (Crab traps) made up of finely net constructed by the local fishermen and other villagers.

500 juvenile crabs (*Scylla serrata*) were collected with the help of local fishermen from the surrounding area of Chilika lagoon and stocked at the density of two crablets in a bamboo enclosure having one square meter, each measuring 6'x3'x3' length, width and height. The targeted crab was weighed at 15 days interval. Growths estimated were evaluated by calculating Specific Growth Rate (SGR) and Total Weight Gain (TWG) for the 15 days interval period as follows:

$$SGR = \frac{Log_e (FBW - IBW)}{No.\ of\ culture\ days} \times 100$$

$$TWG = \frac{FBW - IBW}{IBW}$$

Where

FBW = Final body weight and

IBW = Initial body weight.

Each crablet was measured for carapace length and width, sexed and weighed. Before stocking in the pen, crabs were allowed to acclimatise in cool water for that stocking site or pen. Juvenile crabs were fed with fresh fish, fish heads, fish skin, broken fish, fish entrails and squid heads collected from local fishermen depending on the availability. Salinity, temperature, dissolved oxygen were measured at an interval of 15 days from the experimental site adopting the standard method (APHA, 2005). The experiment has been conducted for four months from October 2007 to January 2008.

Results:

Growth of mud crab generally depends on the moulting of crab. Moult increments for male and female mud crabs were plotted against External Carapace Length (ECL).The highest mean carapace growth was observed to be 6.929% in the first 15 days period .The lowest mean carapace growth was observed to be 4.870% in last 15 days period (Figure 2).The highest mean body weight growth was observed to be 66.525% in the first 15 days culture period. The lowest mean body weight growth was observed to be 17.152% in seventh 15 days period (Figure 3).The highest mean specific growth rate (SGR) of body weight was observed to be 22.955gm in last 15 days period and the lowest mean SGR of body was observed to be 19.078 in second 15 days period (Figure 4). The highest total weight gain (TWG) was observed to be 0.665gm in first 15 days period. The lowest TWG was observed to be 0.171 gm in seventh 15 days period (Figure 5). The highest temperature inside the pen of Chilika lagoon was observed to be 31.5^oC in second 15 days period. The lowest temperature was observed to be 24^oC in sixth 15 days period (Figure 6).The highest salinity was to be 13.5‰ in eighth 15 days period .The lowest salinity was observed to be 8.6 ‰ in first 15 days period (Figure 7).The highest dissolved oxygen concentration was observed to be 8.2ml/l in first 15days period and the lowest dissolved oxygen concentration was observed to be 6.1 ml/l in last 15 days period (Figure 8).A total of 500 crablets were released in the pen culture area at the beginning

of the experiment, a total 457 adult crabs were obtained from the fenced pen culture area indicating a survival rate of 91.4%.

Discussion:

Growth rate of mud crab have been studied in individual of crabs considering weight gained during pen culture in Chilika lagoon at 15 days interval on 4 months culture period. The highest mean specific growth rate (SGR) of body weight was observed to be 22.955gm and the lowest mean SGR of body was observed to be 19.078. Similarly the highest total weight gain (TWG) was observed to be 0.665gm. The lowest TWG was observed to be 0.171 gm. at initially weighing 28gm to 33gm during the present pen culture period. Bensam (1986) has recorded average monthly increments of 8.0 to 16.2 gm for crabs of initially weighing 50 gm, 14.7 gm for crabs initially weighing between 51 to 100 gm and 19.6 gm for crabs initially weighing between 100-151 gm in Tuticorin. Whereas Kathirvel et al. (2004) have experimented on field culture of both *Scylla tranquebarica* and *Scylla serrata* in brackish water pond for six month culture period providing of different feeds. They have observed that larger species (*Scylla tranquebarica*) attained a maximum size of 220 mm / 2.4 kg and the smaller species (*Scylla serrata*) attained 140 mm / 0.7 kg. Further in experimental culture they have studied the growth rate of juvenile mud crab to be 4.5 cm to 5 cm in carapace length / 25 to 40 gm in total weight (TW) grew at a rate of 7 to 12 mm / 3 to 13 gm, whole juvenile crabs 61 to 80 mm / 40 to 80 gm in the sub adult and adult stages. The present study is inagreement with the work of Bensam (1986) and quite similar with the experimental studies made by Kathirvel et al. (2004). The growth rate of mud crab in body weight were coinciding with the result of Bensam (1986) and Khathirvel et al. (2004) which may be due to similar environmental condition and feeding mechanism. Temperature is the most critical environmental factor influencing metabolism, growth, reproduction, distribution and survival of animals (Kinne, 1963 & 1964). Temperature in the study side varied from 24^{o}C and 31.5^{o}C. Whereas Balio et al. (1999) suggested the suitable temperature for culture to be between 25^{o}C and 30^{o}C. However, Islam and Bhuiyan (1981), while working on the distribution of mud crabs in Karnafully River estuary found *Scylla serrata* to be extremely eurythermic and in aquaceous media, with a tolerance range of 3-45^{o}C. Bensam (1986) has observed that the temperature varied from 20^{0}C to 43^{0}C during the growth and production of *Scylla serata* from Tuticorin. The present result is inagreement with the result of Bensam (1986) which may be due to similar conditions in both the biotopes. Moreover the present result is also quite similar with the result of Bhuiyan and Islam (1981). Salinity is the most important factor influencing the life at an organism. It influences many functional responses like metabolism, growth, migration, osmotic behaviour, reproduction etc. The *scylla serrata* in an euryhaline organism .The salinity in the pen culture area varied from 8.6 ‰ to 13 ‰. Bhuiyan and Islam (1981) have observed that 10-50 ‰ of salinity is most favourable for *Scylla serrata* from Karnafully river estuary water. Chang (1997) have suggested that the salinity range from 20-35 ‰ with the lower value in the wet season is also favourable for culture of mud crab. Baliao et al. (1999) have recommended a salinity range of 10 ‰ to 35 ‰ for polyculture of crabs, prawns, milk fish and seaweeds (*Gracillaria* sp.). However, Cowan (1984) suggested a salinity range of 5.21 ‰ to 10.12 ‰ being the most appropriate for *Scylla serrata* culture. The present study on salinity distribution during the experimental period is coinciding with the above results of Bhuiyan and Islam (1981), Chang (1997) and Cowan (1984). In Chilika lagoon the growth of *Scylla serrata* is

related to its body weight and heavier forms showing greater dependency on the oxygen content of the water. In present study, the dissolved oxygen content varied from 6.1 ml/l to 8.2 ml/l. Manjulata and Babu (2004) have suggested that, when the dissolved oxygen decreased to 1.5 ml/l, the feeding activity was very much reduced in this situation for mud crab. Mwaluma (2002) has observed that the dissolved oxygen content ranged between 2.65ml/l to 4.00ml/l is quite suitable for mud crab culture in pen culture system in mangrove area of Kenya. The present result is in agreement with the result of Manjulatha and Babu (2004) and Mwaluma (2002).

Conclusion:

The fish, shrimp and crab landing from Chilika lagoon is on a declining trend. Due to this, the fishermen of the Chilika lagoon are poor and most of them are below the poverty line. In order to increase their income and socio-economic status, pen culture should be introduced in Chilika lagoon on commercial basis. Pen culture of mud crab in Chilika lagoon is a new technique in the field of aquaculture. Pen culture of mud crab should be given priority for economic growth and to enhance the status of fishermen in and around the Chilika lagoon.

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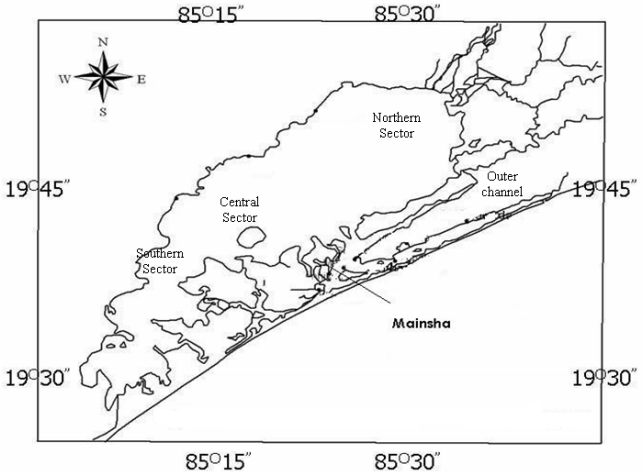

Fig. 1: Map showing the study site of Chilika lagoon

Fig. 2: Mean Carapace Growth Percentage of *Scylla serrata* from Chilika Lagoon during the experimental culture period (October 2007 to January 2008)

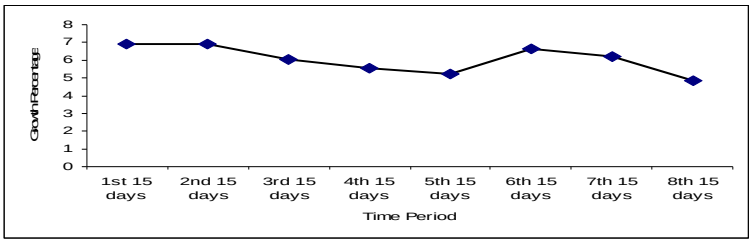

Fig. 3: Mean Body Weight Growth Percentage of *Scylla serrata* from Chilika Lagoon during the experimental culture period (October 2007 to January 2008)

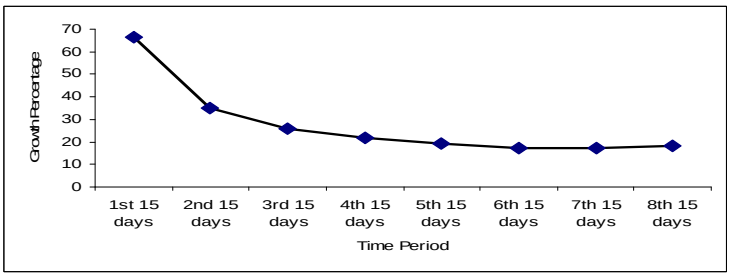

Fig. 4: Specific Growth Rate (SGR) of *Scylla serrata* from Chilika Lagoon during the experimental culture period (October 2007 to January 2008)

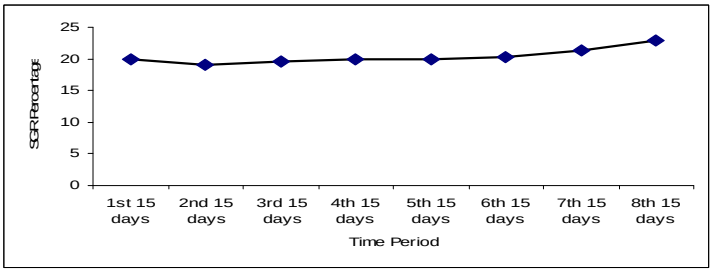

Fig. 5: Total Weight Gain (TWG) of *Scylla serrata* from Chilika Lagoon during the experimental culture period (October 2007 to January 2008).

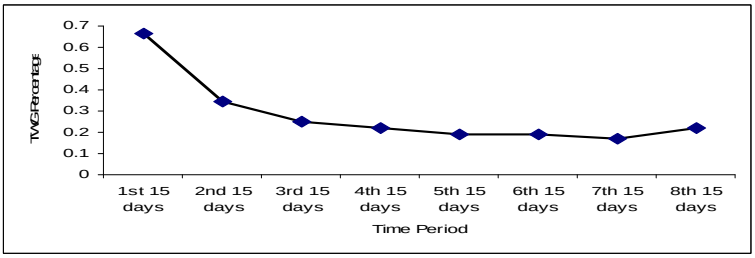

Fig. 6: Temperature (^{0}C) of the Study Site in Chilika Lagoon during the experimental culture period (October 2007 to January 2008).

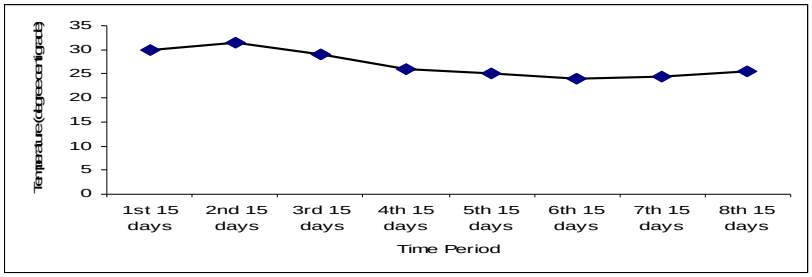

Fig. 7: Salinity (‰) of the Study Site in Chilika Lagoon during the experimental culture period (October 2007 to January 2008).

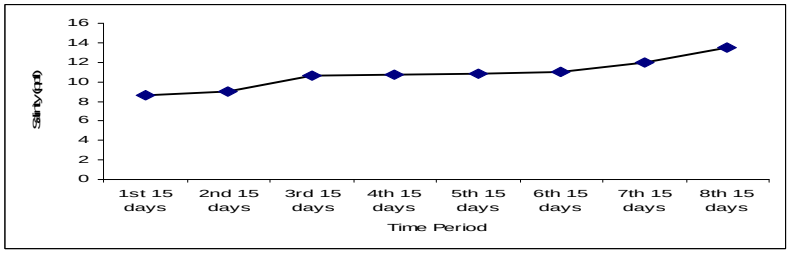

Fig. 8: Dissolved Oxygen (ml/l) of the Study Site in Chilika Lagoon during the experimental culture period (October 2007 to January 2008).