SOME RESULTS OF THE STUDY ON REARING OF MANGROVE CRAB, *Scylla serrata*, JUVENILES IN THE BARACHOIS OF MAURITIUS

Hassea R.[1], Codabaccus B.[1], Rathacharen S [1]. Khadun S.[1], Iwamoto H.[2] and Shimizu T.[2]

[1] *Albion Fisheries Research Centre*

[2] *Japan International Cooperation Agency*

Abstract

The mangrove crab, *Scylla serrata* (Forskal) is a potential candidate for aquaculture development in Mauritius and experimental trials on its culture were carried out from 1997 to 2002. It has a fast growth rate and tolerates a wide range of physico-chemical parameters. The survival rate of *Scylla serrata*, both under the controlled/hatchery conditions and in the natural eco-habitat is low. In 1997, the Japan International Cooperation Agency (JICA) launched the "Coastal Fisheries Resources & Environment Conservation Project" to enhance the stock of crab in the lagoon waters. The quantity of crab juveniles for culture in barachois is dependent on the availability of seed in the lagoon. Hatchery-produced crab juveniles were reared for experimentation/study in pen enclosures in two barachois prior to release in the coastal areas. The bio-indicators, stocking density and feeding regime differed in the two experimental studies. These experiments indicated varying survival and growth rates using different feeding regimes and stocking densities.

Keywords: *Scylla serrata*, crab juveniles, hatchery-produced, pen enclosure, feeding regime, stocking density, barachois, growth, survival.

Introduction

The mangrove crab, *Scylla serrata*, is widely distributed in the Pacific and Indian Oceans, where it inhabits brackish coastal waters and estuaries and has a great potential for aquaculture. The most commonly cultured crab species is *Scylla serrata* due to its preference to estuarine habitats, less aggressive behaviour and higher value (Cowan, 1984). *Scylla serrata* is successfully cultivated in many Southeast Asian countries and Australia and 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 ponds (Chen, 1976; Cowan, 1984). Experimental culture of *Scylla serrata* in plastic cages, placed in large fishponds has been undertaken in Tucorin, India, registering significant growth increment (Bensam, 1986). In Philippines, the species has been cultured in ponds (Catanaoan, 1972; Samonto & Agbayni, 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 mangroves (Chang, 1997).

Compared to fishpond culture with its 4 000 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 1920's (Alferez, 1977) and adopted by the People's Republic of China in the 1950's 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 1970's (Baguilat, 1979). From there, it has been successfully extended for the culture of tilapia and carp (Rabanal, 1988 b). Its development and adoption as a popular technology has not been widespread because of its site- specific requirements like its suitability mainly in shallow environments. At present, it is commercially practiced only in the Philippines, Indonesia, and China (Beveridge, 1984).

The rearing of crab juveniles, *Scylla serrata* was undertaken in net pen at the Rouillard and Butte à l'Herbe barachois. As the catch of wild juveniles from the coastal waters is low, crab production through the extensive culture in barachois has declined from 4.1 tons in 1996 to 1.0 ton in 2002 (Annual report, Ministry of Fisheries, 1996-2002). This may be attributed to loss of mangrove habitats and over-fishing of wild stocks. Seed production of crab and release of hatchery-produced crablets in the natural environment could greatly contribute to enhance this lagoonal stock.

A Resource Propagation Programme was launched in 1997 in collaboration with the Japanese International Cooperation Agency (JICA) with a view to produce crab juveniles

under controlled/hatchery conditions for release in the barachois and other coastal sites around the island. Seed production of *Scylla serrata* was pursued from 1998 to 2002. A total of 10 841 crablets (C1) was produced during this period (Annual report, Ministry of Fisheries, 1998-2002). The survival rates ranged between 1.0 and 1.2%. This low survival was mainly due to high mortality prior to their reaching the megalopa stage as a result of fungal infection. The crab juveniles were reared in net pens at the Rouillard, Butte à l'Herbe, Nosaic, and Virginia barachois prior to release in the coastal waters. A small batch was also released at Choisy barachois and in the Albion estuary.

Materials and Methods

Experimental culture was conducted in net pens in intertidal areas at the Rouillard and Butte à l'Herbe barachois. Water exchange in these enclosed water bodies is effected by tidal fluctuation which is between 1.2 and 1.5 m respectively (Khadun and Samboo, 1998). At low tide, the depth of the water was between 0.75 m and 1.0 m. The Rouillard barachois is located at Anse La Raie, Cap Malheureux in the north and is shown in figure 1(A) and 1(B). The area of the barachois is 5 ha and is surrounded by dense mangrove vegetation (*Rhizophora mucronata*). The Butte à l'Herbe barachois is situated at Calodine, Grand Gaube, in the north and is shown in figure 1(A) and 1(C). The size of the barachois is 8.2 ha and consists of four water bodies.

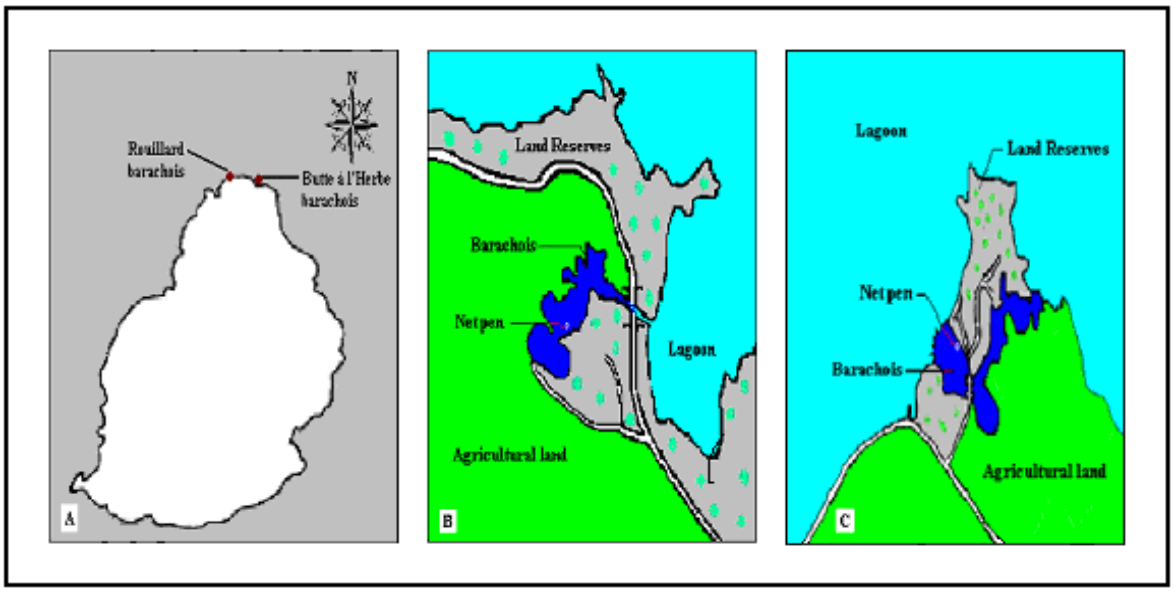

Figure: 1. The two study sites

A: Map of Mauritius showing the two barachois
B: Rouillard barachois
C: Butte à l'Herbe barachois

Net pen and stocking

Figure: 2. Net pen at the Rouillard barachois

The net pens (figure 2) at both the barachois were set in shallow areas at a water depth of 1.5 m with an adequate water exchange, good water quality, low turbidity, absence of pollutants, firm bottom condition and protection from high winds or cyclones. The size of the net pen was 25 m^2 and fenced with monofilament nets of mesh size 5 mm. The nets were fixed to the bottom of the barachois to a depth of 0.25 m to 0.50 m and supported with iron/wooden poles. The height of both the enclosures was maintained at 1 m which could be adjusted to a maximum height of 2 m during unfavourable climatic conditions. Hatchery-produced crab juveniles were transported in aerated tanks to the two rearing sites. Synthetic duckweed nets were used as attachment materials for the crabs to minimize stress during transportation. Prior to stocking, the net pens were cleared from any marine organisms.

The net pen at the Rouillard barachois was stocked with 325 juveniles of an average carapace width of 9.6 mm for a culture period of 71 days. The stocking density was 13 crablets/m^2. The culture animals were fed on trash fish, comprising mainly bonito and tuna, at the rate of 20% body weight once daily.

A total of 125 juveniles of an average carapace width of 12 mm was stocked in the net pen at the Butte à l'Herbe barachois for a culture period of 68 days. The stocking density was 5 crablets/m^2. The juveniles were fed on artificial pellets at the rate of 20% body mass once a day. The pellets comprised 35% protein, 6.0% fat, 12.0% carbohydrate, 5% fibre, 1.6% calcium, 1.4% phosphorus and humidity, vitamins and minerals.

During the trial period, 9 and 7 random samplings were carried out at the Rouillard barachois and Butte à l'Herbe respectively for monitoring of the physico-chemical parameters and the growth of the crablets. A caliper was used to measure the carapace width. The sea water temperature, the pH values and the DO levels were recorded using the direct probe method.

Results

Rouillard barachois

At the time of stocking at the Rouillard barachois, the carapace width of the 325 crab juveniles ranged between 8.3 mm and 12.4 mm with an average carapace width of 9.6 mm. At the end of the experiment, a total of 51 crablets was obtained from the net pen, indicating a survival of 15.7%. The average carapace width of the crablets was 31.8 mm at day 71. The results of the sampling for the growth of the crab juveniles are summarized in table 1.

Table 1: Growth of crablets at Rouillard and Butte à l"Herbe barachois

Rouillard barachois		Butte à l"Herbe barachois	
Day	**Carapace width mm**	**Day**	**Carapace width mm**
1	9.60	1	12.03
8	14.90	8	13.57
16	17.40	16	15.65
23	17.80	22	19.63
31	22.47	29	20.47
37	23.63	36	20.49
44	25.90	68	28.30
51	26.90	-	-
71	31.82	-	-

The temperature recorded at the Rouillard barachois from May to July varied between 24 ^{o}C and 28.6 ^{o}C. The salinity fluctuated between 9 and 17 ppt due to mixing of underground water. The DO values ranged between 5.1 and 6.0 mg/l which was favourable for the growth of the cultured species. The pH values during the experimental culture at this barachois indicated slight variation from 7.0 to 8.8. The sea water was slightly turbid with detrital matter observed at low tide when the water depth was between 60 cm and 80 cm. The high nutrient levels at the culture site resulted in a high primary production increasing the pH values as presented in table 2. Feeding of the

crablets with trash fish and the good quality of water resulted in a good growth of 0.31 mm per day as shown in figure 3.

Table: 2. Physico-chemical parameters at the Rouillard barachois

Day	Temperature ^{o}C	Salinity ppt	Dissolve O_2 mg/l	pH
1	27.0	11	5.1	7.2
8	28.6	14	6.0	7.3
16	26.0	10	5.5	7.3
23	28.4	14	5.1	7.5
31	26.5	10	5.5	8.8
37	26.3	9	5.9	7.1
44	24.3	12	6.0	8.0
51	24.3	16	5.1	7.0
71	24.0	17	5.1	8.1

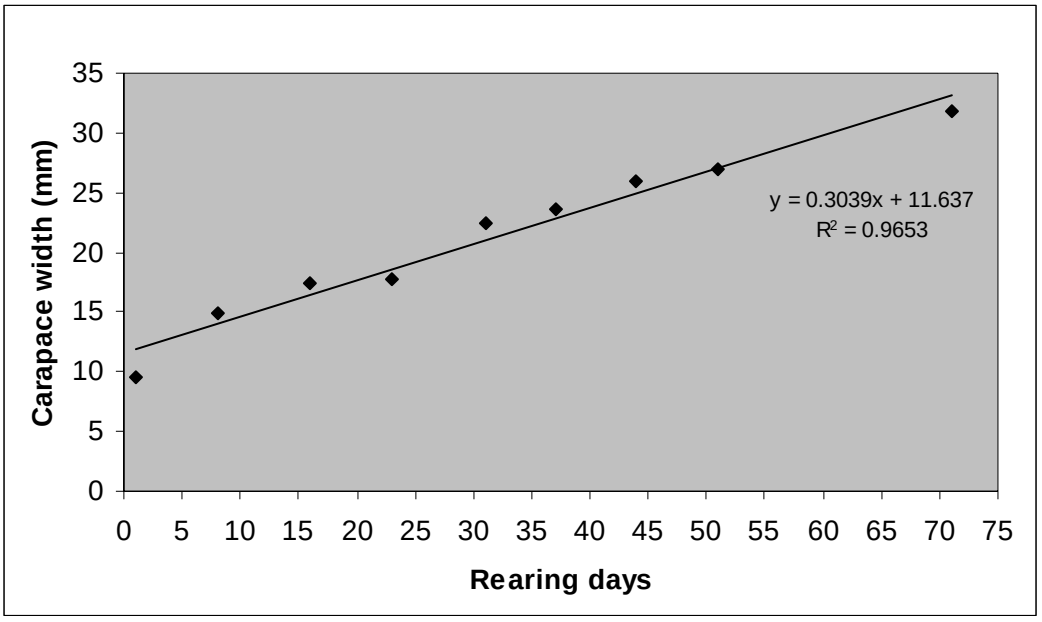

Figure 3: Increase in carapace width of *Scylla serrata* at the Rouillard barachois

Regression equation gave a linear line of good fit with the R^2 value 0.9653 with a growth of 0.31 mm per day and an intercept of 11.64 for crablets cultured at the Rouillard barachois.

Butte à l'Herbe barachois

At Butte à l'Herbe barachois, the carapace width of the crab juveniles at the time of stocking ranged between 8.2 mm and 16.1 mm with an average carapace width of 12.03

mm. After 68 days of experimental culture, a total of 41 crablets of an average carapace width of 27.34 mm was recorded, with a survival of 32.8% as presented in table 1.

The physico-chemical parameters in the net pen at the Butte à l'Herbe barachois are presented in table 3. The sea water temperature varied between 21.2°C and 28.2°C, the salinity ranged between 26 and 31 ppt and the DO values varied from 6.2 to 7.0 mg/l which were conducive for a favourable growth of the *Scylla serrata*. The pH values ranged from 7.5 to 8.2. A good plankton growth was observed during the culture period. A growth of 0.24 mm per day was obtained as shown in figure 4.

Table:3. Physico chemical parameters at the Butte à l'Herbe barachois

Day	Temperature ^{o}C	Salinity ppt	Dissolve O_2 mg/l	pH
1	26.3	28	6.7	7.9
8	28.2	31	6.5	8.1
16	25.0	25	6.7	8.2
22	26.0	27	7.0	7.7
29	23.9	26	6.5	7.5
36	25.1	30	6.9	7.7
68	21.2	30	6.2	7.6

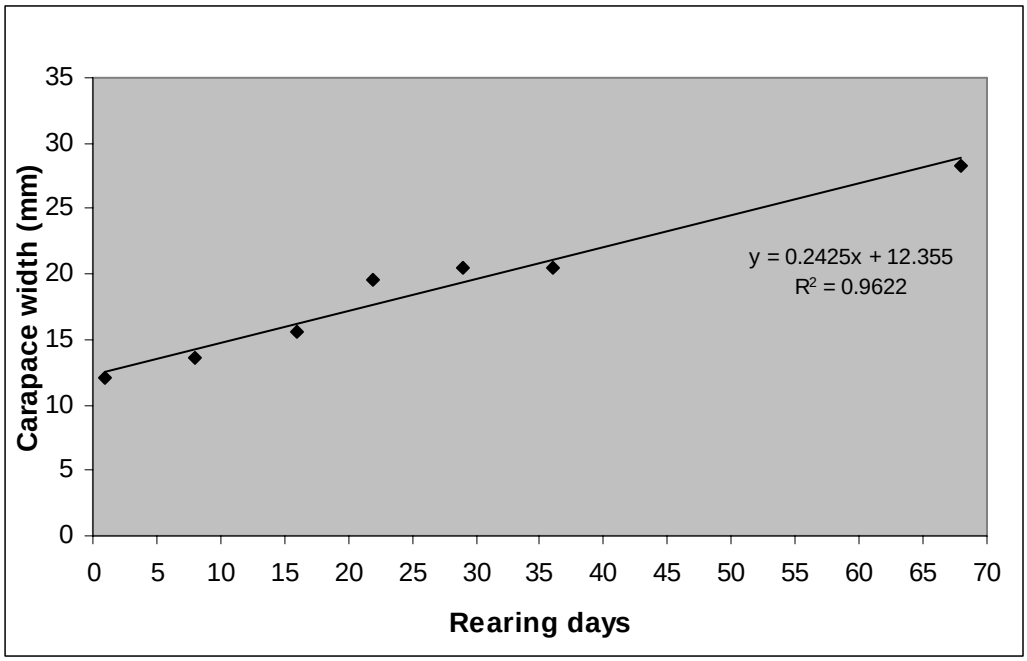

Figure 4: Increase in carapace width of *Scylla serrata* at the Butte à l"Herbe barachois

The goodness of fit measured by the R^2 value was 0.9622 with a growth of 0.24 mm per day and an intercept of 12.36.

Discussion

The physico-chemical parameters recorded in the net pens at the Rouillard and Butte à l'Herbe barachois were favourable for the growth and survival of the crabs. The salinity levels in the net pen at the Rouillard barachois was low due to the inflow of fresh water from underground sources. A low water exchange in the lagoonal waters resulted in sedimentation at the water inlet. The salinity at the Butte à l'Herbe barachois was relatively more stable; due to a good water exchange in the net pen during the culture period as the enclosure was located close to the seawater inlet. The favourable salinity range for *Scylla serrata* culture is from 10 to 50 ppt. Bhuiyan and Islam, (1981), reported that the lower and upper lethal salinities are 10 ppt and 50 ppt respectively. For that period, the sea water temperature at both the culture sites were conducive to the growth of the crablets. Baliao *et al* (1999) suggested that the suitable sea water temperature for culture of the *Scylla serrata* ranges between 25 ^{o}C and 30 ^{o}C. The pH and the dissolved oxygen values at both sites were favourable for the growth and survival of the crab juveniles.

The application of trash fish as feed, the presence of naturally occurring food, muddy nature and dense mangrove surrounding the Rouillard barachois favoured the growth of the culture species. Hence the growth of the crabs at the Butte à l'Herbe barachois fed on artificial pellets gave encouraging results. The mangrove crab is omnivorous and feeds on raw crushed fish, crustaceans, bivalves, molluscs, penaeids and detrital matter.

The stocking densities of the crabs at the Rouillard and Butte à l'Herbe barachois were 13 individuals/m^2 and 5 individuals/m^2 respectively; which were substantially higher compared to other trial cultures conducted in Taiwan by Chen, in 1990 where a stocking density of 2-3 individuals/m^2 was used. Cannibalism is common in mud crab culture when high stocking densities (Baliao *et al*. 1981) and mixed sex culture, (Cholik and Hanafi; 1992) are used.

The recapture of the crab juveniles during sampling at the Rouillard barachois was difficult as the floor was muddy and silted. The water level in the net pen ranged between 60 cm and 70 cm due to low water exchange and clogging of the net. In such conditions the crab juveniles either escaped the system or burrowed themselves in the mud. Trino *et al*, (1997) reported that the loss of young crabs grown in ponds for a period of 3 to 8 months can be relatively high, from 40% to 60%, if the stocking rates are high. The percentage survival of the crablets at the Rouillard and Butte à l'Herbe barachois was 15.7% and 32.8% respectively.

The net pen at the Butte à l'Herbe barachois had a sandy and rocky bottom with sparse sea grass. Sea grasses are nursery grounds and natural habitats for marine organisms and act as crab shelters, minimizing mortality and loss of stock due to cannibalism. Chen (1990) reported that a survival of 50% to 60% was obtained for crabs cultured in Taiwan with *Gracilaria* sp. at a stocking density of 2 to 3 individuals /m^2. Fielder *et al*, (1998) indicated that the application of crab shelters increased survival by minimizing antagonistic encounters.

A large number of fish, crustaceans and shrimps were encountered during sampling at both sites. The by-catch was dominated by *Papilogobins* sp. at the Rouillard barachois, whereas at Butte à l'Herbe the majority of the by-catch comprised *Scylla* sp. The occurrence of these species might have hindered the growth of the crabs as they competed for food. Mwaluma, (2001) proposed the possibility to explore the polyculture of milk fish (*Chanos chanos*), mullets (*Mugil mugil*) and prawns (*Ferropenaeus indicus* and *Peneaus monodon* with crabs.

Crab culture in net pens in barachois may be enhanced by covering the upper surface of the net pen with a small-sized mesh net, the application of plastic linings on the top of the net pen, the removal of unconsumed feed, the use of crab shelter, minimizing biofouling and using a lower stocking density of 0.5 to 3 crablets per metre square.

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