

A REVIEW OF THE MUD CRAB (*Scylla Serrata*) FISHERY ON THE EAST COAST OF INDIA AND IN KERALA STATE

by M Mahesh Raj

National Consultant, with the Bay of Bengal Programme,
91 St. Mars's Road, Ahhirarnapuram. Madras 600 018
INDIA.

ABSTRACT

Mud crab Scylla serrata are landed in all the east coast states of India. The craft and gear used for its fishing and the fishing season varies with the region.

Although the local market for mud crab is good, interest is being focussed on their exports, which started very recently. Export of live mud crab is a thriving activity today. Kerala, a state on the west coast of India, is a major supplier to the export trade. Madras is the focal point of live mud crab exports from India, which are mainly to the Singapore and Malaysian markets.

INTRODUCTION

The crab fishery in India is yet to be recognized as a major fishery despite the abundant occurrence of food crab all along the Indian coast. This could be attributed to the fishery being seasonal and confined to narrow coastal belts, and crab being generally considered cheap food in India.

Most of the commercially important edible crab belong to the family Portunidae, which includes such crab as *Scylla serrata* (Forsk.), *Portunus pelagicus* (L), *Portunus sanguinolentus* (Herbst) and *Charrhdia crusiata* (Herbst). Among the edible species, *Scylla serrata*, commonly called the mud crab or green crab, is important. It is popular because of its size, meat quality, high price and export potential. Mud crab are locally called *nandu* in Kerala and Tamil Nadu, *petha* in Andhra Pradesh, *kankada* in Orissa and *kankra* in West Bengal.

In recent years, the demand for seafood, especially shrimp, lobster and live crab, for export has been increasing quite considerably. There are also growing local requirements.

The ability of mud crab to grow fast and its suitability for culture in brackishwater and estuarine areas make it attractive to develop mud crab culture/fattening programmes in India to meet the increasing demand.

The objectives of this survey are to assess the state of the mud crab, *Scylla serrata*, fishery on the east coast of India and Kerala, with particular emphasis on the major landing centres, gear and craft used, the fishing communities involved and their socio-economic status, the fishing season, marketing structure (domestic and export), aspects of mud crab culture, and the current status of mud crab culture research.

THE MUD CRAB FISHERY GROUNDS

The mud crab fishing grounds along the east coast of India and Kerala state are highly dispersed and are often located in remote areas especially in West Bengal, with poor accessibility. However, many places which could be categorised as major mud crab landing centres were identified during the survey (See Figure 1, facing page).

Kerala: The major landing centres for the mud crab fishery are the Kochi (Cochin) areas, especially Vypeen island, Neendakara in Kollam (Quilon) and Kozhikode (Calicut),

Tamil Nadu: The important landing sites are Pulicat Lake, the Killai backwaters, Porto Novo, Muthupet (Thanjavur Dist.), Adiramapattinam, Pattukkotai, Nagapattinam, Mandapam, Tuticorin and Rameswaram.

Andhra Pradesh: The major landing areas are the villages around Kakinada. like Peddavalasala, Chinnavalasala and Gadimoga, and Dowleswaram and Rajahmundry near the Godavari estuary.

Orissa: Most of the landings are from the Chilika Lake. The major fishing grounds in the Lake are by Parikud, Nuapada, Mahisa, Berhampur, Garubai, Satapada, Arkhakuda, and areas between Kalupada and Nuapada. Mud crab are also landed in Paradwip.

West Bengal: The mud crab fishing grounds are scattered all along the Sundarbans and include several remote areas in the district of 24 Parganas. Important crab landing areas are Basirhat, Basanti, Sonakhali, Port Canning, Kakdwip, and Namkhana.

GEAR USED IN THE MUD CRAB FISHERY

The main gear used in the mud crab fishery are the longline, hook-and-line, gillnets, crab traps, dragnets and castnets. The kind of gear and the frequency of use varies from place to place. While longline, hook-and-line, crab traps and crab gillnets are used exclusively for crab fishing, other gear, like dragnets and castnets, are mainly used for shrimp and other fish. Crab are also landed as bycatch.

Longline: Longline with bait is the most widely used gear in the mud crab fishery along the east coast of India and Kerala. The construction of the gear and the way it is used varies slightly from place to place.

The longline essentially consists of a main line of coir rope (300 m.) and branch lines attached to it (See Figure 2, page 107) at intervals of 1-2 m (1 m intervals in Andhra Pradesh, 2 m intervals in the Killai estuary, where it is called *thamuni kavaru*). The bait are tied to the ends of the branch lines. In Kerala, bait is mainly fish head and gills, while in Tamil Nadu pieces of catfish, eel, shark, and ray are used. In Andhra Pradesh, dried bits of eel are used. The longline is operated at depths of 1-4 m.

Longlines (75-100 m) with hooks attached at intervals of 3-3.5 m are used in Chilika lake, with decaying shrimp and catfish (*Mystus* sp.) as bait. One end of the longline is tied to a pole which is planted at a point selected by the fisherfolk. The line is then gradually released as the craft moves away from the pole.

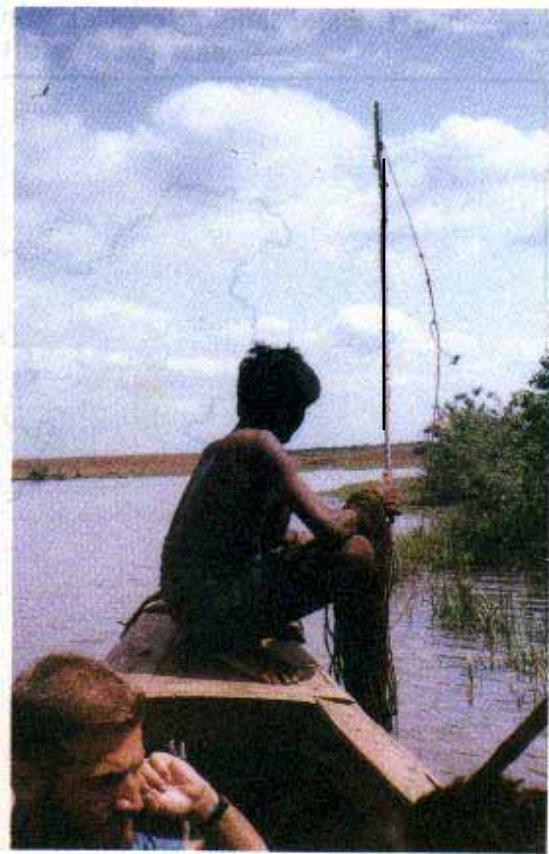
The line is allowed to rest undisturbed at the bottom of the water for 15-30 minutes before being slowly hauled in by moving the craft towards the pole. Crab can now be noticed just below the water surface, clinging to the bait, and they are collected using a scoopnet.

Fig 1. Major landing centres of mud crab (*Scylla serrata*) along the east coast and in Kerala State, India

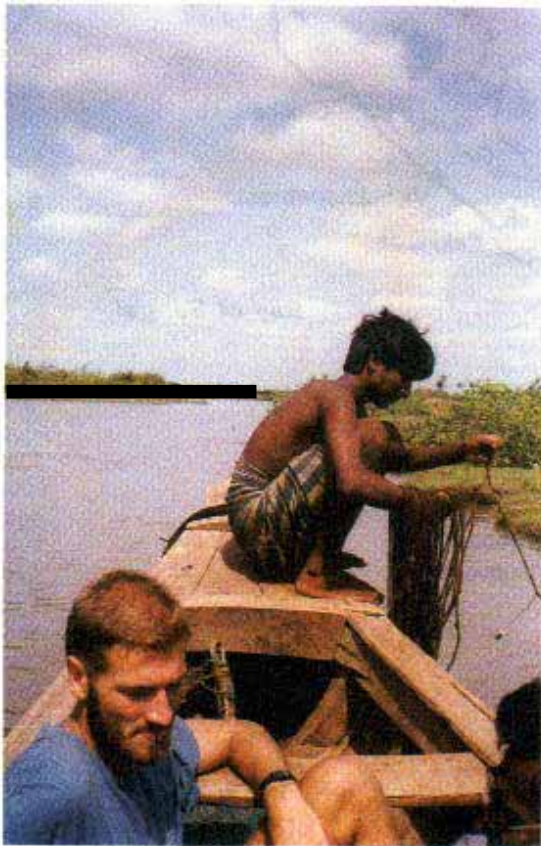




*Longline fishing for mud crab, *Scylla serrata*, at Peddavalasala (Andhra Pradesh), India*



Longline being readied before being set

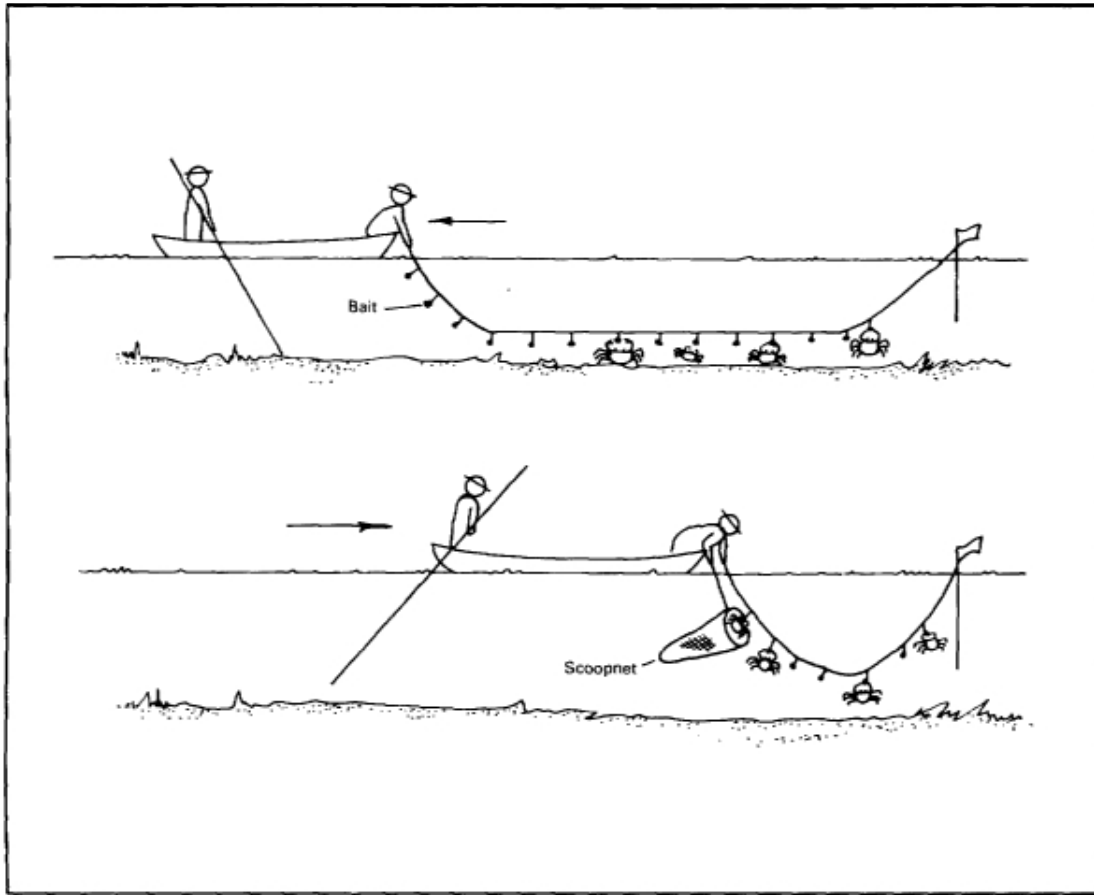


Longline being set



Collection of crab from the longline

Fig 2. Longline used in crab fishery



This gear is operated by two people. While one punts and manoeuvres the craft, the other lays the line, hauls it in and collects the crab. This gear is generally operated during the day.

The catch rate with longline varies with the season and the fishing grounds.

Longline fishing accounts for 47.3 per cent of the mud crab landed in Pulicat Lake (Srinivasagam, 1984).

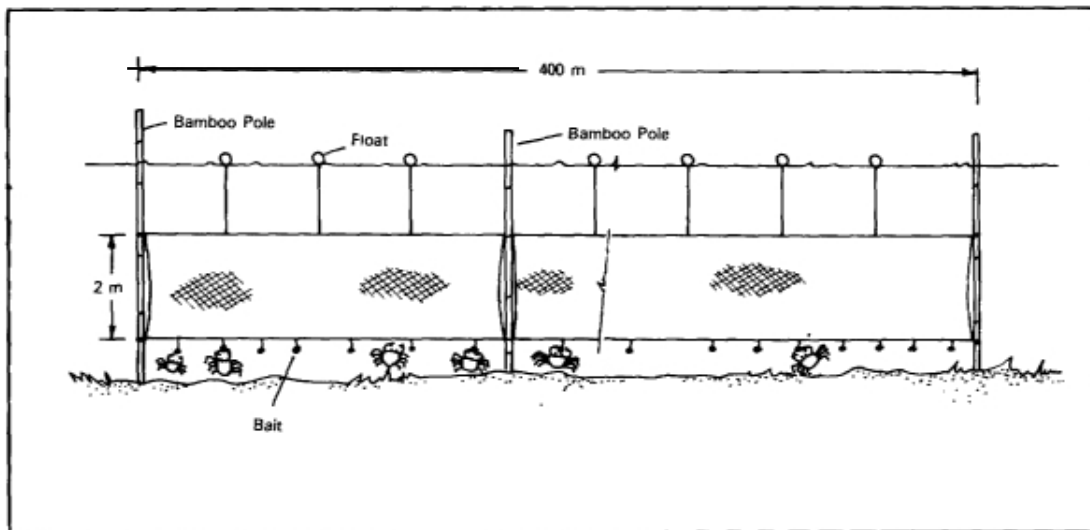
During a crab fishing demonstration at Vadalanal Creek, near Peddavalasala, 16 crab, weighing in all about 0.5kg and of carapace width (CW) 4.5-10 cm each, were removed from a 300 m longline after it had been left at the bottom of the creek for 20 minutes. Dried eel was used as bait.

Hook-and-line: This consists of a single line made of nylon filament with a hook attached at its end. The line, with bait is cast into the water (or dangled in front of crevices) to attract the crab. As soon as a crab grabs the bait, the line is slowly hauled in and the crab collected with a scoopnet. This gear is operated in intertidal areas exposed during low tide and at 3-4 m depths when operated in water.

The bait used varies from place to place. At Haldi in West Bengal, fishermen claim to land between 15 and 20 crab of varying sizes a day using chicken heads as bait. The catch rates vary with season. Each line can land, on an average, ten large crab/day, but this could go up to even 25-30/day during peak season.

Gillnets: Crab gillnets are mainly used in the Chilika Lake and the Killai estuary. In Chilika Lake, the gillnet (400m x 2m), locally called *noli jal* (see Figure 3), is made of sunhemp and has a mesh size of 10-15 cm. The nets are stretched between bamboo poles and kept without sinkers. The number of floats used depends on the water depth and the length of the net. Bait are hung at the bottom of the net. Crab attracted by the bait are caught by lifting the net at regular intervals.

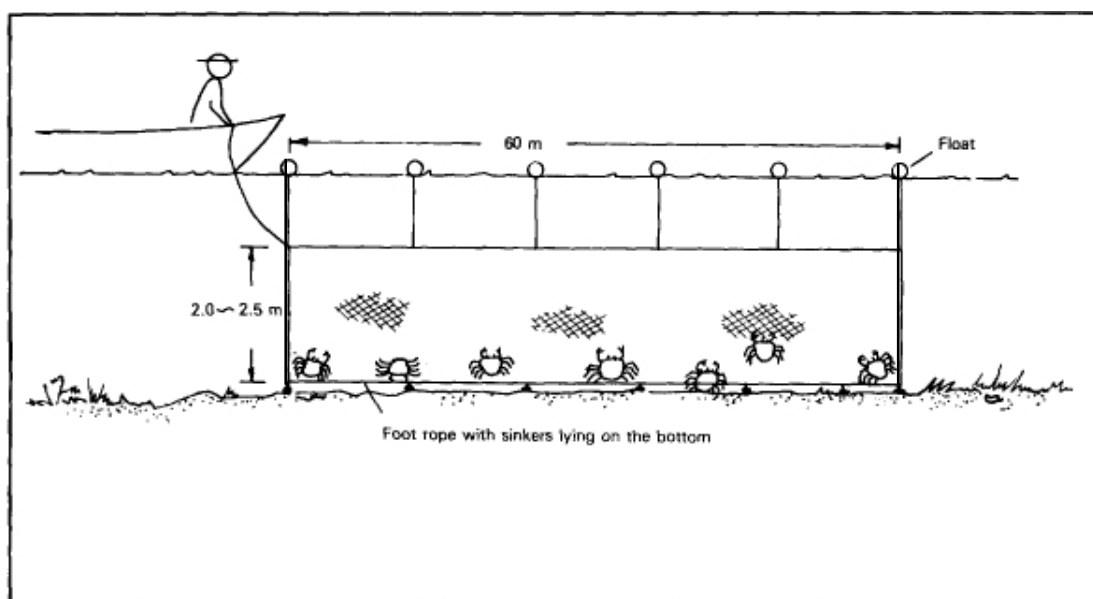
Fig 3. Crab net – *nail jal*



The gillnet used in the Killai backwaters is locally called *nandu valai* (see Figure 4). It is a small wallnet made of synthetic fibre (60 m x 2-2.5 m, with mesh size: 75 mm and head rope: 5 mm in dia.). Small wooden floats (25 x 7 x 3 cm) are attached at intervals of 1.5 m. The foot rope is 5 mm in diameter and has stone sinkers attached to it. These sinkers are tied opposite the floats and alternately. The foot rope rests on the bottom, while one end of the head rope is tied to the canoe. Fishing is conducted day and night by two fishermen. Every two hours, they collect the crab clinging to the mesh.

The gillnets are operated at depths of 2-4 m. The catches vary with seasons.

Fig 4. Crab net – *nandu valai*



Crab traps: *Kankada khadia*, as they are locally called, are widely used in Chilika Lake. The trap is a simple, box type one, rectangular in shape and with a single opening on one side. It measures 45 x 30 x 25 cm and is made of bamboo strips of about 0.6 cm width separated from each other by about 2.5 cm.

The 25 x 10 cm opening is enclosed by a conical structure made of bamboo splits which project inside the trap. Bait consisting of shrimp or small fish are put inside each trap. The traps are placed on the bottom and generally tied to a pole, for easy spotting.

Fishing goes on day and night and the traps are lifted every 2 to 3 hours. Each team, 2- or 3-strong, operate 50-100 trap every day. Each trap on an average snares 3 or 4 crab/day. The traps are operated at 1-3m depths.

Nandu katcha are traps mainly used in Pulicat Lake and the Killai backwaters in Tamil Nadu.

Each trap comprises a small bagnet made with a piece of nylon net of 70 mm mesh size attached to an iron ring of about 155-165 cm diameter (see Figure 5). The depth of the bag is about 20 cm. Bait, usually pieces of eel, skate or catfish are pierced with a wire, which is then placed across the ring. The ring has three bridles (60-80 cm long) and these are tied to a long rope, which is attached to a wooden float (25 x 7 x 3 cm). Line length varies from 4-6 m.

Each canoe carries 20-30 *katchas* and is operated by two fishermen. The traps are set at intervals of about 5m from one another and left in water for about an hour. They are then hauled up in quick succession.

Fishermen claim that each trap brings in 10-20 crab/day. This trap is operated only during the day and at depths of 2-4 m.

Dragnet: These rectangular (8-12 m in length, 1-1.5 m in width) are used with about 8-12 spreader sticks. The length of each spreader stick is usually two-thirds of the width of the net (see Figure 6).

The net is dragged along the bottom, to the shore, by two people. This is not a selective gear and, hence, mud crab is landed along with other fish and shrimp. In Pulicat Lake, dragnets account for about two per cent of the *S serrata* landed.

Fig 5. Crab trap – *katcha*

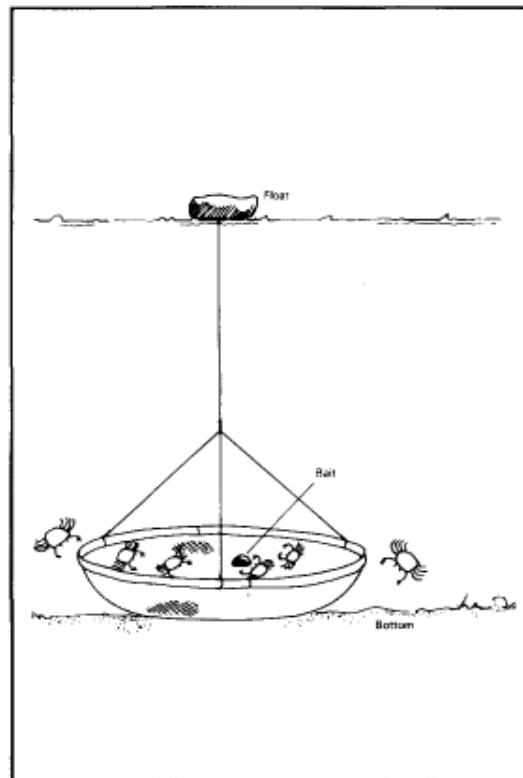
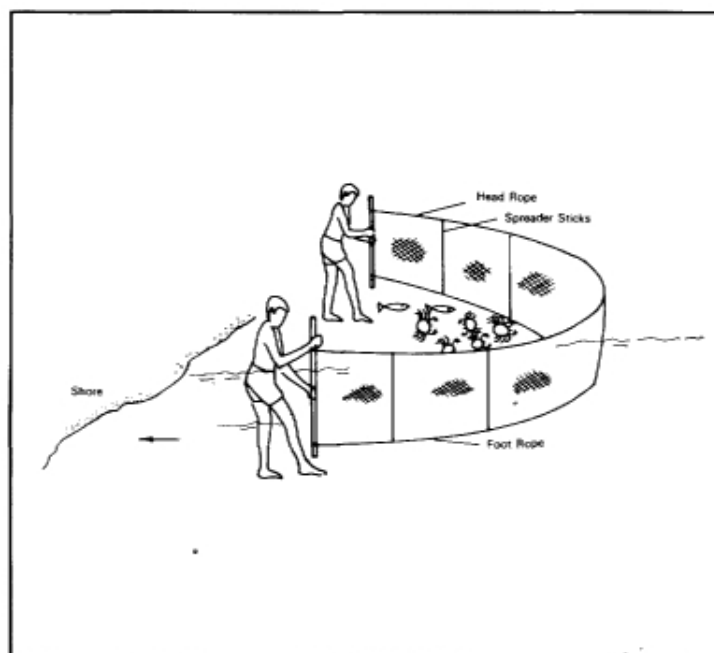


Fig 6. Dragnet



Castnets: These cone-shaped nets have mesh sizes varying from 15 mm at the apex to 5 mm at the bottom. The open end of the net has lead sinkers, enabling quick sinking. Mud crab are landed only as incidental catch by this gear, as it is generally used for shrimp and other bottom dwelling fish.

Apart from these gear, mud crab are also hand picked during low tide, especially in the mangrove areas. In West Bengal and Andhra Pradesh, iron rods, curved at one end are used to pull mud crab out from crevices and burrows along the shores of estuaries and mangrove areas.



Iron rods, curved at one end, are used in Andhra Pradesh, india, to pull out mud crab (Above, right and hellow)



CRAFT USED IN THE MUD CRAB FISHERY

Wooden canoes are the most commonly used craft in the mud crab fishery. They are either planked or dugouts scooped from a single log of wood. In Kerala, small canoes of 4-6 m are used. They are either punted, using bamboo poles, or sculled with wooden oars. Use of outboard motors is slowly becoming popular.

The main fishing craft used in Pulicat Lake, is known as the *padagu*. It is built with teak or sal wood planks nailed to wooden ribs. The craft's length varies between 5 and 6.5 m and the boat is punted using a bamboo pole or sculled with wooden oars when there is no wind. Sail is used if the wind is favourable.

In the Killai backwaters, dugout canoes, locally called *kanna*, are used. Usually 6 m long and 0.5 m wide, they are punted using a bamboo pole or sculled with an oar.

In Andhra Pradesh, wooden canoes called *nava* are used. They are plank-built and are 4-6 m in length. The mode of propulsion is punting with a bamboo pole.

In Chilika Lake, the main craft used is a plank-built wooden boat (6-8 m in length). Many of these craft are fitted with outboard motors.

In West Bengal, wooden canoes (4-6 m) are used in the mud crab fishery. Propulsion is generally by punting or sculling.

OTHER FISHERY ACTIVITIES OF THOSE INVOLVED IN MUD CRAB (S. serrata) FISHING

Owing to wide seasonal variations in the mud crab fishery, the majority of those involved in it, generally do not depend on this fishery alone. They claim that income from mud crab fishing alone would not be sufficient for their sustenance. During peak seasons, however, their maximum effort is directed towards mud crab fishing.

Most of these fisherfolk, operate in the estuaries and backwaters, depend on castnets, dragnets, gillnets, and shore seines so that they can land shrimp and other varieties of fish. In the Cochin backwaters, mullet (*Mugil* sp), shrimp, like *Penaeus indicus*, *P. semisulcatus* and *P. monodon*, and other varieties of fish and crustaceans are landed. Similarly, in the Killai backwaters and in the Ennore and Pulicat Lakes in Tamil Nadu, several fish species and crustaceans, including juveniles of *S. serrata* and *Portunus* sp. and shrimp are landed.

In Chilika Lake, substantial quantities of pearl spot, *Eetroplus* sp, is landed along with other fish, such as mullet, catfish and smaller species.

However, a few villages near Kakinada, Andhra Pradesh, appear to depend on mud crab fishing throughout the year. At Peddavalasala, a village about 25 km from Kakinada, the entire population depends mainly on this fishery. This village is surrounded by mangrove swamps and creeks, which are good crabbing grounds. About 100 craft (*nava*) are involved in crab fishing and the main gear used is longline. Hand picking is also to be widely seen in the swamps.

On an average, about 300-400 kg of *S. serrata* are landed here every day, mostly comprising small crab of CW 4-12 cm and weighing 50-300 g. Medium and large crab of above 15 cm in CW form only about 10- 15 per cent of the catch.

Other villages which depend on mud crab fishing to a large extent are Chinnavalasala, Gadimoga and Lakshmi pathipuram.

ECONOMIC AND SOCIAL CONDITIONS

An in-depth study over a considerable period of time would be necessary to assess accurately the economic and social conditions of mud crab fishermen, as this fishery is highly dispersed and often located in remote areas. To get a representative idea, a large number of mud crab fishermen would have to be interviewed. Moreover, it would be necessary to visit the mud crab landing centres during peak seasons to get a reliable estimate of the general economic and social conditions of the fishermen, for this is when the majority of the mud crab fishermen are available.

However, cursory observations made during this study indicate that the mud crab fishing communities of Andhra Pradesh and West Bengal are economically and socially backward, whereas those in Kerala enjoy satisfactory economic conditions.

The reason for the latter faring better than their counterparts on the east coast is perhaps because of their better literacy and, consequent, greater awareness. Another reason is that the mud crab is considered a delicacy in Kerala and fetches a very good price locally compared with prices



A craft used for mud crab fishing in Andhra Pradesh, India...



and one used in Chilika Lake, Orissa, India.

prevailing in other states. The recent spurt in demand for large mud crab for export has definitely increased daily earnings in Kerala. where these fishermen own different fishing gear which they could conveniently switch to for other fishery activities, depending on the season.

In contrast, in Andhra Pradesh. especially in mud crab fishing villages like Peddavalasala, it was observed that most of the mud crab, which are of small size, are sold locally. Large crab fetch good prices from agents who send them to Madras for export. It was also learnt that the number of large crab have diminished during the past few years and that the size of crab currently being landed is much smaller than what used to be previously caught. This is a possible indication of over-exploitation of the resource.

Literacy in the mud crab fishing communities of Peddavalasala village is extremely poor. compared to that of their counterparts in Kerala. Children are generally engaged in punting the canoes, while the womenfolk market the catch in the local market and nearby villages, often travelling distances up to 30 km.

The socio-economic status of the mud crab fishing communities of West Bengal is even lower than that of Andhra Pradesh. In West Bengal. crab are not popular, most people preferring freshwater fish to crustaceans and seafood. Mud crab fetch a very low price in the local market.

The crab fishermen here have to travel great distances, as the crab is found only in remote places in the difficult-to-access Sundarbans.

The literacy rate here is very poor. Almost all the members of a family engage in crab fishing. with the young children often hand-picking the mud crab from crevices and burrows in the Sundarbans, especially during low tide.

Table I: Estimated monthly household income of crab fishermen in various states

State	<i>Estimated monthly household income (in / Rupees*)</i>
Kerala	2000-2500
Tamil Nadu	1500-2000
Andhra Pradesh	1000- 1500
Orissa	1500-2000
West Bengal	750-1000

*US\$ 1 = I Rs. 27 appx (1991)

The estimated monthly household incomes of crab fishermen in the main fishing stages are presented alongside in Table I. The data are based on information provided by the mud crab fishermen themselves and includes income from other sources such as participation in agricultural activities, casual labour etc.

ANNUAL LANDINGS OF Scylla serrata AND SEASONAL VARIATIONS

An estimate of the total annual landings of mud crab along the east coast of India and in Kerala is rather difficult, owing to the fact that statistics from all sources are incomplete. This is because it is a highly dispersed fishery of an artisanal nature, making data-collection virtually impossible. The only dependable annual

landing statistics available is from Chilika Lake. Table 2 presents the annual landings of *S serrata* from 1972-1990.

Other available statistics for *S.serrata* are from Pulicat Lake, hut they are only for 1968-72 (Table 3). Table 4 presents the size and sex composition of *S serrata* in the southern sector of Pulicat Lake from April 1968 to March 1969 (Srinivasagam and Raman 1985).

Table 2: Estimated annual landings of *scylla serrata* from Chilika Lake, Orissa, from 1972-90 (t)

Year	Total landings
1972-73	8362
1973-74	52.00
1974-75	70.00
1975-76	66.00
1976-77	63.00
1977-78	57.10
1978-79	59.20
1979-80	121.51
1981-82	79.93
1982-83	87.90
1983-84	141.44
1984-85	89.91
1985-86	78.66
1986-87	53.97
1987-88	39.06
1988-89	43.51
1989-90	23.57

Source: Directorate of Fisheries. Government of Orissa

Table 3: Estimated average monthly landings of *Scylla serrata* from Pulicat Lake from April 1968 to March 1972

Month	Total landings
April	1.189
May	2.947
June	0.850
July	1.995
August	1.876
September	1.777
October	.427
November	0.435
December	0.871
January	1.052
February	0.983
March	.309

Source: Srinivasagam and Ranian (1985)

Table 4: Size and sex composition of *Scylla serrata* in the southern sector of Pulicat Lake during April 1968 - March 1969

Sex		Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Male	Range (mm)	55.175	65.169	64.140	70.175	74.178	71.198	64.160	60.161	65.171	68.165	70.152	62.150
	Mean (mm)	100.2	104.8	90.9	108.8	115.9	101.3	99.1	83.5	110.2	106.5	103.1	93.3
Female	Range (mm)	61.172	64.175	68.141	62.152	74.170	68.171	62.183	60.158	60.160	66.182	70.185	69.152
	Mean (mm)	103.4	105.3	93.4	109.9	112.8	107.7	106.5	103.9	108.8	98.7	97.5	98.3
Sex	Male to Female	1:0.95	1:1.10	1:1.05	1:1.04	1:0.70	1:1.14	1:1.14	1:0.82	1:0.86	1:0.86	1:0.84	1:1.11

Source : Srinivasagam and Raman (1985)

Table 5 presents annual crab landings of different regions along the east coast of India. This data, excepting that pertaining to Chilika Lake, include other crab — *Porrinus pelagicus* (Linnaeus) and *Portunus sanguinolentus* (Herbst) — as well. The peak fishing season for *S. serrata* in the various regions is presented in Table 6.

Table 5: Annual crab landings of different regions along the east coast of India and in Kerala

<i>Region (Author)</i>	<i>Area (Sq. km)</i>	<i>Production (t)</i>
The Sundarbans Area (Anon. 1960)		33.60
Chilika Lake (Mohanty. 1975)	906.00	64.53
Godavari estuary (Vedavyasa Rao <i>et al</i> 1975)	211.00	337.46
Pulicat Lake (Anon. 1960)	461.00	907.18
Ennore river estuary (Chacko and Rajagopal. 1964)	6.00	5.86
Vembanad Lake (Anon, 1964-65, 1966-67 avg)	300.00	24.53
Killai backwaters	6.68	12.05

Source : Srinivasagam (1974-75)

Table 6: Peak seasons for *Scylla serrata* fishing along the east coast of India and Kerala

<i>Region</i>	<i>Peak season</i>
West Bengal	September - March
Orissa	August - November
Andhra Pradesh	August - January
Tamil Nadu	May - September
Kerala	July - September

DOMESTIC MARKETING AND EXPORT OF *S. serrata*

Domestic marketing

S. serrata is much in demand in the domestic market and fetches a good price, compared to other species of crab. During this survey it was observed that *S. serrata* can be successfully marketed, but only in live condition, as there is a prejudice against purchasing dead crab. Medium and large crab of more than 14 cm CW and weighing more than 400 g are collected exclusively for export in Kerala, Tamil Nadu and Andhra Pradesh.

As crab stay alive out of water only for a maximum of about 72 hours, they are generally sent to major cities by train. The crab are packed in bamboo baskets, each basket accommodating about 25-30 kg. Middlemen who collect the crab from the fishermen often mark up the price by about 50-100 per cent, depending on the size, when reselling them to the retailer at the market. There is again a mark-up ranging from 50-100 per cent by the retailer in the local markets. For example, on Vypeen island near Kochi, in Kerala, mud crab, of 8-12 cm CW could be bought directly from the fishermen at 2-6 I Rs*/piece. The same were sold at the Ernakulam fish market not far away for 6-12 Rs/piece. At the same market market, a large crab weighing 1.5 kg and of 21 cm CW was priced at Rs. 80, whereas a middlemen would pay about 20-25 rupees for the same crab to a fisherman.

In Andhra Pradesh, especially in Peddavalasala village, where several people were interviewed, it was learnt that about 300 kg of mud crab were being landed every, day in the village at that time. During the peak seasons, the catch could be as high as 500-600 kg.

The crab, varying in size from about 4 to 12 cm CW and weighing between 50-200 g, were taken by women to markets in Ramachandrapuram, Dowleswaram and Kakinada and sold in groups at Rs. 2-8 for five. Bigger crab fetched Rs. 8-10 for five at these markets.

They claimed that they earned 60-80 I Rs/day and that this could go upto 100-140 Rs/day during peak season.



Claws being secured before packing at a fishing site in Andhra Pradesh, India.



Mud crab from Peddavalasala village (Andhra Pradesh) on their way to the market.

*US \$ 1 = 1 Rs 27/- appx. (May 1991)

The fishermen normally go out on 2-day fishing trips and earn Rs 200-250 during the peak seasons and Rs 100-150 at other times.

Large crab of more than 17 cm CW and weighing more than 1 kg were sold to middlemen at Rs 15-30. These in turn were sold to crab exporting agents in Kakinada at 45 - 50 Rs/pc. It was learnt that, on an average, 50-100 crab of exportable size, *i.e.*, above 15 cm CW, were being collected from this village every day by agents supplying exporters.

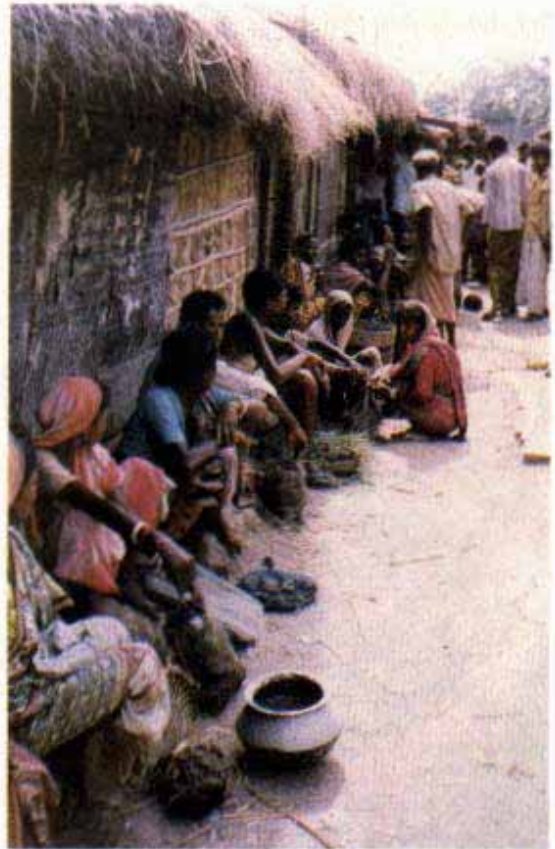
At the Kakinada fish market, crab of 9-10 cm CW were being sold at 2 Rs/pc, and those of 12-15 cm CW at 5 Rs/pc, while large crabs of 17.5 cm CW (weighing between 1100-1200 g) fetched 80 ₹ Rs/pair.

At Balugaon, on the hank of Chilika Lake, crab of 10 - 15 cm CW (weighing between 200 to 500 g) were being sold at 4-10 Rs/pc. Large crab of more than 16 cm CW and weighing more than 900 g fetched between 20-30 ₹ Rs/pc.

In West Bengal, prices were much lower. A visit to Taldi fish market, about 45 kms from Calcutta, revealed that, on an average, 50 - 60 baskets of live mud crab arrived every day. Each basket weighed 15-20 kg and each basket fetched, on an average, Rs. 50-60. A large crab of 17 cm CW and weighing 1000 g was quoted at Rs. 10.



*Mud crab on arrival at Taldi Market
(West Bengal), India.*



Mud crab being sold at Taldi Market.

Export of mud crab Scylla serrata

Export of live mud crab, *S. serrata*, from India started in 1982. Madras is the focal point of live crab exports from India. About 20 t of live mud crab are at present being exported to Malaysia and Singapore every week. There are five major exporters based in Madras (See Appendix I).

About 3 t of live mud crab of exportable size arrive in Madras every day, out of which about 2 t arrive from the Cochin backwaters, 100-200 kg from Neendakara in Kollam (Kerala), about 500-750 kg from Kakinada, about 300 kg from the Nellore, Yelluru and Repally area, in Andhra Pradesh, about 100kg from Tuticorin in Tamil Nadu and 50-100 kg from iladuthurai near Thanjavur, and Adiramapattinam. The crab arrive in bamboo baskets. The mortality during transit is from 5 - 10 per cent.

Grading is done as follows:

Extra large	- 1 kg upwards	- Constitutes about 20 per cent of the daily arrival.
Large	- 500 g - 1 kg	- Constitutes about 30 per cent of the daily arrival.
Medium	- 300 - 500 g	- Constitutes about 25-30 per cent of the daily arrival.
Small	- 200 - 300 g	
Water crab	- 200 - 300 g	- Very low meat content, but suitable for fattening
Red crab	- 200 - 400 g	- (about 25-30 per cent)

Singapore's daily requirement is about 10 t of live crab/day and Malaysia's requirement is about the same. About half this requirement comes from Indonesia, but though these crab weigh only 200-300 g, Malaysia and Singapore continue to buy from Indonesia because of the low airfreight and the short distances. Sri Lankan mud crab are comparable to those from India, but supplies are said to be not regular.

Importers consider Tuticorin crab the best, followed by crab from Kakinada and Cochin. Exporters say that June to September is the best season for procuring large crab; more than 5 t arrive every day during this period.



Mud crab basket on arrival at a Madras, India, exporter's premises.



The crab are graded before export.

The crab, while being packed for shipment, are moistened with diluted sea water. Each bamboo basket accommodates 25 - 30 kg of crab. They survive easily, it is reported, for 72 hours and even up to four days. Mortality up to 5 per cent is borne by the buyers; more than that has to be borne by the shipper.

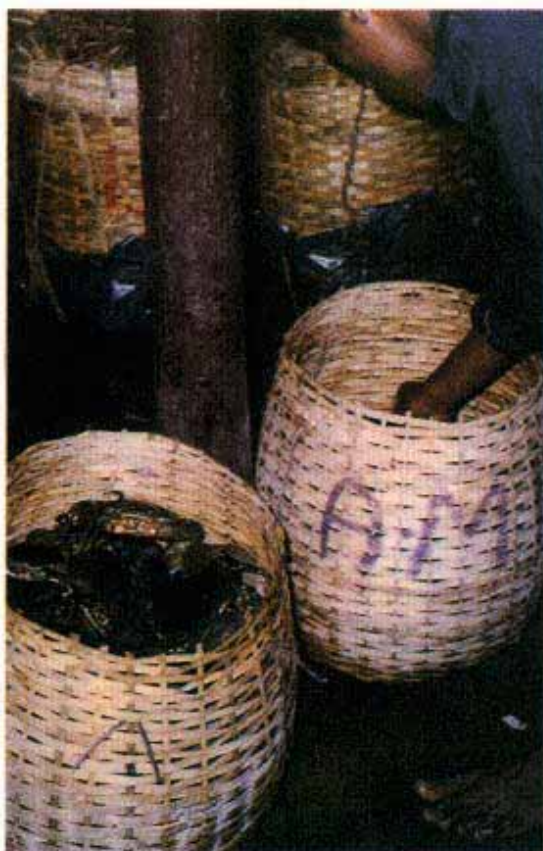
The costing is as follows:

	<i>Landed price for fishermen</i>	<i>Cost price for exporter</i>	<i>Cost of landing, freight and packing</i>	<i>Export market price</i>
	←	I Rs/kg	→	
EL	30-40	75	2-5	100-110 **
L	30-35	70	Do	95-100
M	10-15	40	Do	65-70
S	5-10	15-16	Do	45
Red	5-10	Do	Do	45
Water	5-10	Do	Do	45

** C.I.F. Singapore

Exporters state that shipments to Singapore pose very few problems as Singapore is a free port and the consignment is cleared within an hour. But in Malaysia it takes about three hours for clearance and 5 per cent customs duty is levied, which has to be borne by the buyer.

Exporters say that the major constraint are the exorbitant airfreight rates. Three airlines carry live crab to Malaysia and Singapore, namely Indian Airlines, Air India and Malaysian Airlines. The cargo is containerised by all these airlines.



The crab are packed in baskets for export.



Crab-filled baskets are ready for shipment from Madras.

Indian Airlines has the lowest freight rates, *i.e.* 18.85 Rs/kg and adheres to IATA rates for perishables. It operates flights on Wednesdays and on Sunday nights. As the Sunday flight is a night flight, exporters have to spend an additional 1 Re/kg as Customs overtime and the consignment has to reach the airport by 3.00 p.m. About 10 t of live crab are sent by Indian Airlines every week. Indian Airlines operates only to Singapore.

Air India charges 21.85 Rs/kg and all its flight operate during the day. Malaysian Airlines, which accommodates about 40 baskets (1000 kg) in a container, charges Rs. 26,000/ container. Of the five major exporters, two export about 5 t each per week. The rest export about 10 t and this is shared by the other three exporters.

Crab meant for export are collected by agents who buy them from middlemen who, in turn, get them from the crab fishermen. In Vypeen Island (Kerala), middlemen advance money to crab fishermen well in advance, so that all their catches are committed to them. They also advance money to the crab fishermen during lean seasons and during the Monsoons, when sustenance becomes difficult. Therefore, the crab fishermen are generally found to be 'commercially tied' to the middlemen.

There are crab collection agents at Vypeen Island who directly represent exporters based in Madras. These exporters supply bamboo baskets to the agents for use in shipment. The agents at Cochin buy adult mud crab of more than 14 cm CW and weighing above 300g. Crab of 500-750 g weight are bought for 40 - 45 Rs/kg and large crab weighing more than 1 kg are bought for 60-65Rs/kg. The agents claim that they are paid a commission of only 1Re/kg by the exporters for their services.



Samples of extra-large specimens of Scylla serrata.

According to agents on Vypeen Island, they are able to ship only 50-100 kg during the lean season. This can go up to 200-300 kg/day during the peak season (February-March). The crab packed in baskets are sent to Ernakulam from where they are freighted to Madras by train. Agents based on Kollam and Kozhikode send their consignments by bus or train to Ernakulam to join the bulk consignment destined for Madras. On May 7 and 8, 1991, 34 and 28 baskets of live crab respectively were seen at Ernakulam railway station awaiting despatch to Madras.

Kakinada is another major collection centre of live crab for export. There are four agents who collect and send these crab to Madras. On an average, 5 or 6 baskets are shipped from Kakinada to Madras during May-June, but during the peak season, November-January, up to 15 baskets (each weighing about 23 kg) are sent to Madras. On a visit to the Kakinada port railway station on May 17, 1991, seven baskets were seen be awaiting shipment to Madras.

In November 1990, a ban was imposed by the Ministry of Environment, Government of India, on the export of live mud crab from India. It was notified that mud crab were an endangered species. This caused panic and confusion in the live crab export industry and large quantity of crab were held up in Madras. Eventually the exporters managed to get temporary approval from the government.

According to sources at the Marine Products Export Development Authority (MPEDA) office a Calcutta, they have received no intimation of the lifting of the ban and have been discouraging would-be exporters of live crab from Calcutta. Crab exporters are still uncertain about the future of live crab exports and are, consequently, rather hesitant to give information about the quantities of live crab exported, the source of the crab etc.

The exporters, however, have welcomed the idea of crab culture/fattening and have committed themselves to participating in such activities if they were provided information about the technology involved.

The data alongside clearly indicate the trend in live crab exports in recent years and its potential for the future.

Table 9: Export of live mud crab *Scylla serrata* from India

Year	Quantity (tonnes)	Value in Rs.(laks)
1987-88	36	6.45
1988-89	412	73.8!
1989-90	619	33.63
1990-91	654	60.37

Source: MPEDA. Export Review 1959-90.

CULTURE OF MUD CRAB *S. serrata*

S. serrata is not being cultured on a commercial scale in India at the moment.

Literature on aspects of *S. serrata* culture and related topics is rather scarce in India. Some literature is available, especially on the spawning and mass rearing of *Sserrata* (Forsk.) on experimental scales.

Very few scientists are, or have been, involved in *S.serrata* research in India. A list of some of the institutes and scientists who have worked on aspects of *S.serrata* is given in Appendix II. Among them, S. Srinivasagam and K. Raman have done many studies on various aspects of *S. serrata* (Forsk.). Some of their findings are:

- Successful spawning of *S. serrata* under laboratory conditions was achieved and the eggs could be reared upto first zoea stage. The zoea were fed with *Artemia* nauplii, but they survived only for 21 hours after hatching. Salinity of 37-41 ppt and temperatures of 25-29°C were recorded. (Study conducted in 1980).

Juveniles of *S. serrata* 12-56 mm CW (avg. 30.3 mm and 6.2 g) reared in small ponds with trash fish meat as supplementary feed showed a monthly growth of 29.4 mm and 17.0 g. It was also noted that the crab could be transported in open containers over distances of 20-56 km with 55-100 per cent survival. (Study conducted between 1978- 1980 in Madras).

Eggs from an ovigerous specimen of *S. serrata* (93.6 mm CW) kept in plastic pools with well-aerated seawater, hatched into pre-zoeal and post-zoeal stages after an incubation period of eight days. They were reared in glass jars and plastic trays with provision of freeze-dried diatoms *Coscinodiscus*, *Navicula* and *Nitzschia* as food. At second zoeal stage, when they were fed with slightly larger diatoms *Amphipleura*, there was no further moulting and the larvae perished due to ciliate attack. The eye stalk ablated specimens of *S. serrata* (100 mm and 105 mm CW) maintained in plastic pools released their eggs prematurely. (Study conducted in 1982).

Four short-term, 35-55 day experiments on rearing *S. serrata* (25-74 mm CW) were conducted in nylon huppas of 6m fixed in the lake, with varying stocking densities (16,666-23,333/ha) and trash fish meat as feed, showed varying monthly growth increments of 7.37-8.67 mm CW and 9.82-21.2 g weight, with 50-60 per cent survival. (Study conducted in 1982).

During a 4-year study (1982- 1985) at Pulicat Lake and in Madras, they found that eye stalk ablated females of *S. serrata* reared in a tide-flushed pond at Pulicat became berried and the eggs hatched into pre- and first zoeal stages in plastic pools. The eye stalk ablated females of 85 -125 mm CW (avg 99 mm and 176 g) recorded an average monthly growth of 8 mm and 63 g against 6.1 mm and 48 g in unablated ones (90-115 mm CW — avg 99 mm and 161 g weight).

- Brood stock of *S. serrata* collected from nature were reared in plastic pools with aeration and feeding. Unilateral eye stalk ablation was done on 39 crab. After 21 days, one specimen became berried and, after an incubation period of two weeks, released its larvae. The larvae died soon after hatching. In another case, an eye stalk ablated specimen moulted after 16 days. On introduction of a male specimen, it mated with it for about 36 hours, including pre-mating embrace. However, it did not become berried. Ovigerous *S. serrata* collected from nature released their larvae in four cases. the incubation period ranging between 5 and 13 days. The larvae could be reared to the second zoeal stage in two instances and the third zoeal stage in one case (4-6 days). Different stocking densities (1-42 pcs/litre) and feed materials, such as egg custard, green suspension etc., were tried. Ciliate infection preceded the mortality in all cases. (Study conducted at Madras between 1982-84).

Other significant work on aspects of *S. serrata* culture has been done by R. Marichamy, Manickaraja and S. Rajapackiam in Tuticorin Bay. They took up experimental culture of *S. serrata* in different types of cages in the shallow waters of the bay in 1978-79. Seed were collected from estuarine areas along creeks within the mangrove swamps, impoundments and intertidal flats in and around Tuticorin.

The young crab were first reared for 2-3 months in basket-type cages made of cane splits. Box-type cages made of soft, wooden planks, each comprising 8-10 compartments, and metal-framed synthetic twine mesh cages with compartments were preferred for culturing grown-up crab. The crab were fed with trash fish, clam meat and gutted wastes from the fish market. The growth rate appeared to be good, as a large number of the stock moulted frequently, at intervals of 25-30 days. They were observed to attain marketable size through four to five moults in a period of 9-10 months.

They found that eye stalk ablation accelerated the growth rate in young crab and promoted gonadal maturation in adult crab.

Seed could be collected with hoopnets baited with gill rakers and other gutted wastes. The cages were cleaned regularly to avoid algal growth and fouling. Crab were cultured singly in different types of cages to prevent cannibalism. Basket-type cages were used to rear young ones. Grown-up crab measuring above 10 mm CW were shifted to box-type wooden cages or metal-framed, synthetic twine mesh cages.

The basket-type cages were suspended with coir rope tied to poles and kept submerged in seawater. The other cages were placed on racks erected in the creek. The dimensions of the cages were 2 x 1 x 0.3 m and 1 x 1 x 0.3 m respectively, with compartments of 0.03 m³ each. The creek had good tidal flow and the cages were partially exposed during low tide. However, heavy mortalities occurred as a result of the water flow into the creek being cut off by salt pan operators.

P. Bensam too has worked on aspects of culture of *S. set-rata* in Tuticorin Bay. Between 1975 and 1977 he assessed growth and production and presented his observations at the Symposium on Coastal Aquaculture- 1984 in Kochi.

There has been some controversy recently over the possible presence of two different species of mud crab in Indian waters. To avoid confusion, mud crab has been referred to as *Scylla serrata* (Forsk.) in this study.

DISCUSSION, OBSERVATIONS AND CONCLUSIONS

This survey provides a basic idea about the present status of the mud crab *S. serrata* fishery along India's east coast and in Kerala State. Constraints in assessing the status of this fishery are:

Lack of statistics on the landings of this species.

The fishery is highly scattered and often involves remote places with very poor accessibility, as for example the Sundarbans area in West Bengal.

- There are wide variations in the peak mud crab fishing seasons between the different regions.

Visits to landing centres/fishing grounds during peak seasons would have given more accurate information as many fishermen could have been interviewed and a more representative situation assessed.

- The study has revealed that the mud crab catches, especially in Chilika Lake (Ref. Table 2) and Pulicat Lake (S. Srinivasagam, personal commn.), have declined in recent years. The size of crab landed in villages around Kakinada are also reported to have declined over the past few years. This is a probable indication of over-fishing and suggests the need for proper management of the mud crab fishery.

Once the technology of mass rearing of *S. serrata* from larval stage to juvenile stage is perfected, areas showing depletion in stocks of *S. serrata* could be restocked with juveniles so that a sustained *S. serrata* fishery could be developed.

Culture of *S. serrata* in India would be readily accepted, as a lot of enthusiasm was noted amongst live crab exporters and fisheries departmental officials, during this survey.

There seems to be great potential for *S. serrata* culture in Chilika Lake in Orissa and the Sundarbans area, Kakdwip and Namakhana areas in West Bengal. Pulicat Lake and the Killai backwaters in Tamil Nadu also have great potential for crab culture (S. Srinivasagam, personal communication).

The export market chain at the moment seems to be well organized. The only constraints expressed by the exporters are the high airfreight charges and the fear of a ban on mud crab exports being imposed again.

From this study, it is evident that the mud crab *S. serrata* fishery along the east coast of India and in Kerala is an important fishery, making a significant contribution to both the domestic and export markets. Its importance and great potential calls for due attention to be focussed on the further development of this fishery. Although culture and fattening of mud crab are not practised on a commercial scale in India at present, significant studies at research level have been conducted on such aspects as larval rearing and culture.

REFERENCES

- ANON 1983. Breakthrough in rearing green crab. *Scylla serrata* (Forsk.). **CMFRI Newsletter**. (20) : 1-6.
- BENSAM, P. 1980. Culture experiment on crab *Scylla serrata* (Forsk.) at Tuticorin to assess growth and production. IN: Symp. on Coastal **Aqua.** Cochin. Ind., 12-18 Jan. 1980. Abs. Mar. Biol. Assn. of Ind. - p. 97.
- CHACKO, P.I. 1956. Studies on the green crab *Scylla serrata* (Forsk.). Dept. of Fish. (Madras) **Ann. Rep.** Mar. Biol. Stn., Ennore, 1955-56. **Fish. Stn. Rep. and Year Book** P. 18
- CHACKO, P.I. 1957. Crab landing at Pulicat Lake (April 1956 March 1957). **Fish. Stn. Rep. and Year Book** P. 86.
- CIFRI, Barrackpore. **Ann. Rep. 1970 - 1985.**
- ESTAMPADOR, E.P. 1949. *Scylla* (Crustacea: Portunidae). II Comparative studies on Spermatogenesis and Oogenesis. **Phil J. Sci.** 78 (3). 301-353.
- GEORGE, C. and GOPAKUMAR, K. Spoilage changes in the muscle of Crab *Scylla serrata* stored at three different temperatures. IN: **Proc. The 1st Ind. Fish. Forum.** (Ed.) M. Mohan Joseph. Asian Fish. Ind. Br., Mangalore p. 347-349.
- JAMESON, J.D., MURUGAN, A. and NATARAJAN, P. 1982. Studies on the distribution pattern and morphometry of *Scylla serrata* (Forsk.) along Tuticorin Coast. **Seafood Export J.** 14(4): 17-20.
- JOEL, D.R. and SANJEEVA RAJ, P.J. 1983. Taxonomic remarks on two species of the genus *Scylla* de Haan (Portunidae: Brachyura) from Pulicat Lake. Ind. **J. Fish.** Vol.30. No. 1. 1983. p. 13-26.
- JONES, S. and SUJANSINGANI, K.H. 1952. Notes on the crab fishery of Chilka Lake. **J. Bombay Nat. Hist. Soc.** 51(1)128-134.
- MARICHAMY, R., MANICKARAJA, and RAJAPACKIAM, S. 1980. Culture of the mud crab *Scylla serrata* (Forsk.) in Tuticorin Bay. IN: **Proc. of the Symp. on Coastal Aqua.** Cochin, Ind., Jan. 12-18. 1980.
- _____, and RAJAPACKIAM, S. 1985. Culture of Larvae of *Scylla serrata* **Mar. Fish. Inf. Ser.** CMFRI Pub. No. 58, June, July, Aug. 1984 p. 13-15.
- MOHANTY, S.K. 1973. Observations on the crab landings on the Chilka Lake during 1972. 3rd All Ind. Symp. on Estuarine Biol. Abs. Cent. Inst. **Fish. Educat. Sour.** 1. 13
- NAIDU, K.G.B. 1955. The early development of *Scylla serrata* (Forsk.) and *Neptunus Sanguinolentus* (Herbst). Ind. **J. Fish.** (2) : 67-76.
- PRASAD, F.N. and NEELAKANTAN, B. 1988. Morphometry of mud crab *Scylla serrata* (Forsk.). **Seafood Export J. Vol.** 88. No. 7.
- RADHAKRISHNAN, C.K. 1979. **Studies on the Portunid crabs Of Porto Novo (crustacea - Decapoda : Brachyura)** Ph.D. Thesis, Annamalai Univ.
- _____, and SAMUEL, C.T. 1980. Prospects of Fishery, Utilisation and Culture of Crabs in India. **Fish. Tech.** (1980) Vol. 17, 67-69.
- _____, and SAMUEL, C.T. 1982. Report on the occurrence of one subspecies of *Scylla serrata* (Forsk.) in Cochin backwaters. **Fish. Tech.** Vol. 19. PP. 5-7.
- _____, 1985. Crab meat and its utilization. IN: **Harvest and Post Harvest Tech. of Fish.** pp. 545-547.
- REKHA, D.D. 1968. **Some aspects Of biology Of the marine crab. Scylla serrata (Forsk.)** Ph.D. Thesis, Univ. of Bombay.
- SRINIVASAGAM, S. 1975. **Studies on the edible crabs Of Porto Novo waters** M.Sc. Thesis, Annamalai Univ.
- _____, 1979. On the nutritive values of the meat of Portunid crabs. **J. Inland Fish. Soc. Ind.** 11(2) 128-131.
- THOMAS, J. 1971. Crab fishery of Pulicat Lake. **J.M.B.A.** Vol.13(2)
- VEDAVYASA RAO, P., THOMAS, M.M. and SUDHAKAR RAO, G. 1973. The crab fishery resources of the seas around India. IN: **Proc. Symp. on Living Res. Of the Seas Around Ind.** Mar. Biol. Assn., Ind., pp. 581-591.

APPENDIX - I

List of major exporters of live mud crab, *Scylla serrata*, from Madras

1.	M/s. Maxwin Exports	31, West Coovam Road. Chintadripet, Madras 600 002.
2.	M/S. L.G. Seafoods	142, Wall Tax Road, Madras 600 003.
3.	M/s. Alagappa Exports	No. 24, Saraswathi Street, Mahalingapuram. Madras 600 034.
4.	M/s. Unimax Exports	No. 3-C. 3rd Floor, P.C. Road, Egmore, Madras 600 008.
5.	M/s. Susi Foods/ Rani Exports	26-32, G.A. Road, Madras 600 021.

APPENDIX - II

List of some of the scientists and institutes involved in *Scylla serrata* research

<u>NAME OF SCIENTIST</u>	<u>INSTITUTE</u>	<u>ADDRESS</u>
Dr C K Radhakrishnan	School of Marine Sciences, University of Cochin.	Fine Arts Lane., Ernakulam - Kochi 682 016.
Dr Joel Dr Santhanam Mr Jegatheesan Dr K Venkataramanujam Dr V Sundararaj	College of Fisheries, Tuticorin.	Fisheries College. Tamil Nadu Veterinary & Animal Sciences University, Tuticorin 628 008.
Mr S Srinivasagam Mr M Kathirvel	Central Institute of Brackishwater Aquaculture (CIBA).	12 Leith Castle Street, San Thome, Madras 600 028.
Mr R Marichamy Mr Manickaraja Mr Rajapackiam	CMFRI ' '	CMFRI, P.B. No. 2704 Kochi 682 031.
Dr P Sanjeeva Raj	Centre for Research on New International Economic Order (CRenIEO)	No I First Street Haddows Road Madras 600 006.
Dr D E Babu Dr P Chandramohan Ms C Manjulatha	Department of Zoology, Andhra University	Waltair, Vishakhapatnam 530 003.