



# MARINE FISHERIES INFORMATION SERVICE



No. 58

JUNE, JULY, AUGUST

1984

*Technical and Extension Series*

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

**THE MARINE FISHERIES INFORMATION SERVICE:** Technical and Extension Series envisages the rapid dissemination of information on marine and brackish water fishery resources and allied data available with the National Marine Living Resources Data Centre (NMLRDC) and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation - *Mar. Fish. Infor. Ser. T & E Ser.*, No. 58: 1984

## CONTENTS

1. Molluscan resources of Kali river estuarine system in Karnataka
2. Multidisciplinary marine fisheries resources management
3. Regulated mechanised and traditional fishing in Tamilnadu - An approach to end clashes
4. Culture of larvae of *Scylla serrata*
5. Two incidents of fire accident at Madras Fishing Harbour during the month of April '84

*Cover photo:* Clam deposits collected from the Kali river accumulated at Sadashivgad

# MOLLUSCAN RESOURCES OF KALI RIVER ESTUARINE SYSTEM IN KARNATAKA

K. NAGAPPAN NAIR, K. RAMADOSS AND C. T. RAJAN

(Central Marine Fisheries Research Institute)

AND N. SUNDARAM

(Central Avian Research Institute, I. V. R. I. Campus, Izat Nagar)

## Introduction

The Kali river in Karnataka is well known for edible molluscan resources but there have been no detailed studies on the resources of the river except for the works of Rai (*J. Bomb. nat. Hist. Soc.*, 35 (4): 826-47, 1932) and Alagarswami and Narasimham (*Proc. Symp. Living Resources of the seas around India*, CMFRI: 648-58, 1973) who have made some observations on the resources in the river and their exploitation. Available information on the clam and oyster resources of the Kali river is of a generalised nature and it has been felt that there is need for a detailed survey of the river which supports a regular molluscan fishery. A survey of the Kali river was considered by the Central Marine Fisheries Research Institute on account of a dispute arising between the clam fishermen of the Kali river and the industry exploiting shell deposits. It was felt that first hand assessment of the conditions would help to evaluate the status of the live clam resources from the river bed. During the survey conducted in November-December, 1978 observations were made on the environmental conditions, species composition of the molluscan resources, their distribution pattern, exploitation and marketing and the findings are presented in this paper.

## Physiography of Kali river

The Kali river is an important perennial river of Karnataka which joins the sea at the northern border of Karwar at lat. 14°48' N and long. 74°8' E (Fig. 1). Some islets are present in different parts of the river from a distance of 2 km from its mouth. There are also submerged rocks upstream beyond a distance of 7 km from the mouth. The water depth varied from less than 1 m to 7.75 m and at a number of places near the banks of the river it was ankle deep enabling fisher-

men to collect clams found there easily. Strong currents occur in the river especially at low tide.

## Method of survey

The river was surveyed from the river mouth upstream up to Mallapur, the limit up to which molluscan resources are available in the river bed. The survey was planned in such a way that a certain spot on the southern bank of the river was taken as the base and the river bed was extensively sampled breadthwise along a straight line towards the northern bank. Samples were collected at a distance of every 200 m between the banks. The width of the river varies much. It is 0.4 km at the mouth and a maximum of 1 km at other places, for example at Nandangadda. A quadrat frame of 0.5 x 0.5 m was made use of for sampling the river bed (Fig. 2). To prevent the frame from moving due to water current, it was provided with sharp, pointed wooden pegs at the four corners so that it could be placed over the sampling area by driving the wooden pegs into the sand. After fixing the quadrat repeated skin divers were made quickly to scoop out the sand and mud up to a depth of 25 cm from the sampling area. Later the molluscan species found in the samples were separated. At each sampling station particular attention was paid to observe the nature of bottom, depth of water in the sampling area, species composition, density of population per m<sup>2</sup>, size range of the species and percentage of live and dead shellfish.

From the river mouth to Mallapur, totally 12 bases viz., river mouth, Kodibag, Nandangadda, Sunkeri, Kadwad, Ambeju, Bhairebag, Kinnar, Botjug, Kerwad, Iripagae and Mallapur extending over a distance of 18 km were selected along the southern bank of the river for observations. The data collected from different parts

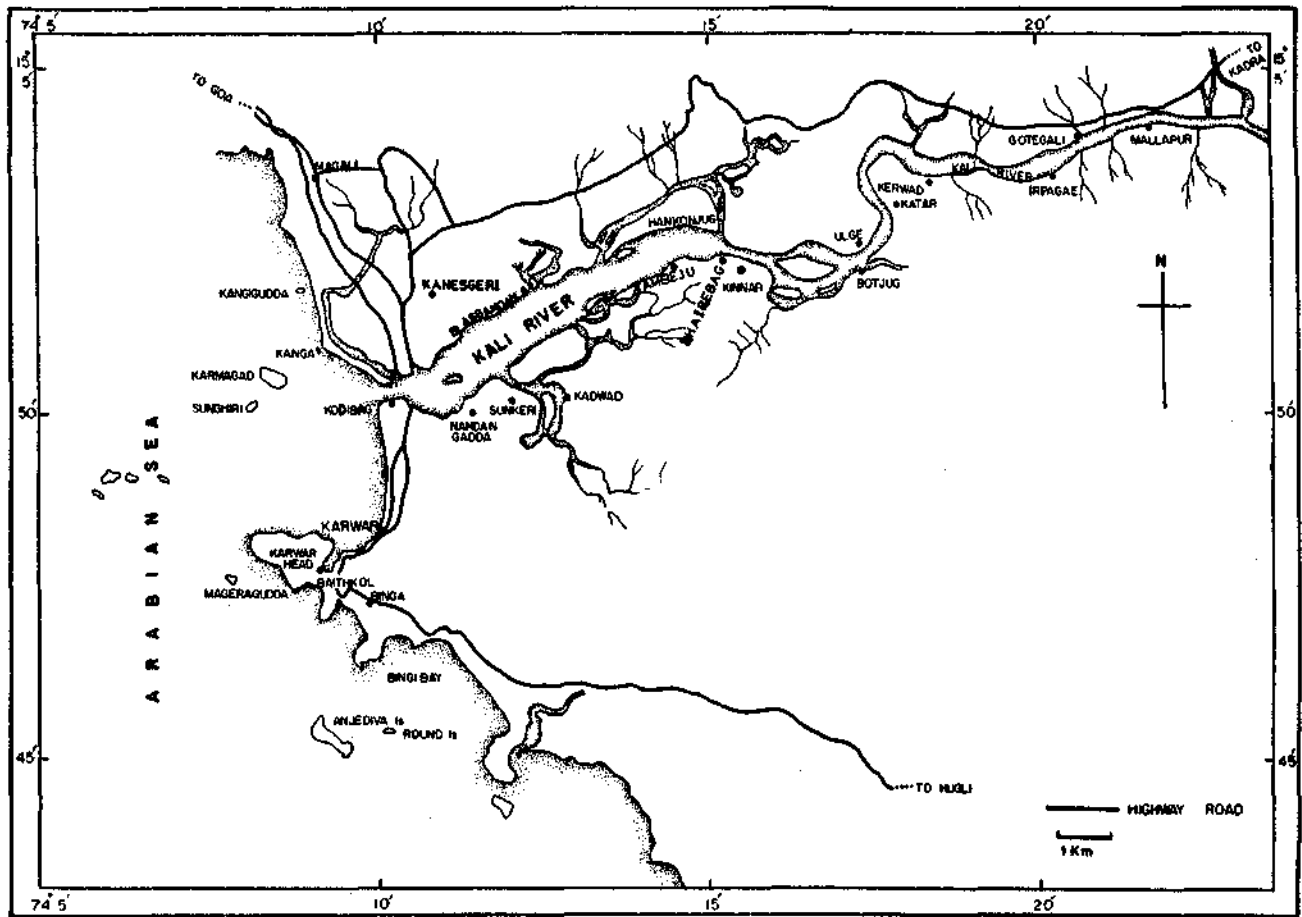


Fig. 1. Map showing important clam and oyster fishing villages along Kali river.

of each base were pooled together and the average was worked out for the density of population. The size range of individual species was also noted. The average depth was determined, water samples were collected and salinity, dissolved oxygen and pH were determined at each base.

### Observations and results

#### *Hydrographic conditions in Kali River*

Generally the salinity of the Kali river fluctuates in different areas with the tides. At Kodibag which is near the mouth of the river, the salinity was high, 33.44‰ at high tide and decreased to 21.65‰ at low tide (Table 1). The salinity values at Sunkeri and Kadwad further upstream in the river were comparatively less than at Kodibag being 30.82‰ and 28.85‰ respectively. At Sunkeri a decline in salinity to 18.15‰ was noticeable at low tide. At Kinnar which is 8 km from the river mouth salinity was very low, 8.76‰ and the values in the bases further up showed progressive reduction

and at Mallapur it was 0.24‰. In the bases in the upper reaches there was further fall in salinity at low tides.

The dissolved oxygen varied over a limited range of 3.18–3.73 ml/l at the various bases at high tide and the values were slightly higher at low tide. The pH fluctuated between 8.2 and 8.4 in Kodibag–Kadwad area at high tide and it was 7.0–7.4 in Kinnar–Mallapur area. A fall in pH was evident in the Kodibag–Nandangadda area at the time of low tide.

#### *Distribution of clams and oysters*

The survey has brought to light a vast clam bed which extends from the river mouth to a distance of 18 km upstream up to Mallapur. The clam resources comprise of three species *Meretrix meretrix*, *Paphia malabarica* and *Villoritta cyprinoides*. Locally the large clams *M. meretrix* and *P. malabarica* are called *Kube* and *Tisra* respectively. *V. cyprinoides* is also known as *Kube*. Two species of oysters *Crassostrea madrasen-*

**Table 1.** Hydrographic conditions during November-December 1978 at different bases of survey in Kali river, Karnataka

Area	Nature of bottom	Average depth in m	Salinity (‰)		Dissolved oxygen (ml/l)		pH		
			At high tide	At low tide	At high tide	At low tide	At high tide	At low tide	
River mouth		4.5							
Kodibag	N	Sandy							
	M	Muddy, rocky							
	S	Muddy							
Nandangadda	S	Coarse sand	3.0	33.44	21.65	3.18	3.73	8.4	7.2
	N	Hard substratum, sandy, rocky							
	M	Sandy	2.0						
Sunkeri	S	Muddy							
	N	Sand with mud, rocky							
	M	Sandy	2.0	30.82	18.15	3.18	3.73	8.2	7.4
Kadwad	S	Sandy, rocky							
	N	Muddy, rocky							
	M	Sandy	1.75	28.85		3.59		8.4	
Ambeju	S	Muddy, rocky							
	N	Sandy							
	M	Sandy, rocky	1.50						
Bhairebag	S	Sandy, muddy							
	N	Sandy, rocky							
	M	Coarse sand	1.50						
Kinnar	S	Sandy							
	M	Coarse sand	1.60	8.76	7.45	3.59	3.73	7.4	7.2
	S	Black clay, muddy							
Botjug	N	muddy							
	M	Sandy	1.50	5.70	4.83	3.73	4.01	7.2	7.2
	S	Sandy							
Kerwad	N	Sandy							
	M	Coarse sand	7.75	2.43		3.73		7.2	
	S	Muddy							
Irpaga	N	Sandy							
	M	Muddy	1.50	0.46		3.46		7.0	
	S	Muddy							
Mallapur	N	Sandy							
	M	Sandy	1.50	0.24	0.24	3.73	3.73	7.0	7.0
	S	Rocky							

N-North, M-middle and S-South portions of transects.

*sis* and *Saccostrea cucullata* have been recorded from the river. The oysters are known locally as *Kaloo*.

*M. meretrix* is the dominant species and occurs at a depth of 1 m or less from Nandangadda to Kinnar with clams in densities of 4-160/m<sup>2</sup> from Nandangadda to Kinnar (Table 2). In this area the substratum is

predominantly sandy with a little mud which appears to be most ideal for this species to settle and grow. The size range of the clams found at Bhairebag and Kinnar which are 7-8 km from the mouth of the river is 7-17 mm. On the other hand the size of clams in the downstream areas Nandangadda to Ambeju varied from 19 mm to 48 mm. This suggests that the clams of smaller

**Table 2.** Density and size range of bivalves occurring in different bases in Kali river

Area	<i>Meretrix meretrix</i>			<i>Paphia malabarica</i>			<i>Villorita cyprinoides</i>			Edible oysters		
	Average density per m <sup>2</sup>			Average density per m <sup>2</sup>			Average density per m <sup>2</sup>			Average density per m <sup>2</sup>		
	Live	Dead	Size range (mm)	Live	Dead	Size range (mm)	Live	Dead	Size range (mm)	Live	Dead	Size range (mm)
River mouth		10			4	20-31					20	80-120
Kodibag		20			10	22-33				2	15	80-120
Nandangadda	4	80	30-38	120	20	25-34				10	10	70-100
Sunkeri	130	2	33-36							15	20	80-150
Kadwad	140	16	31-48							3	25	80-150
Ambeju	150	15	19-27							4	42	90-120
Bhairebag	160	20	14-17							2	35	90-120
Kinnar	120	25	7-14							2	40	90-120
Botjug							120					22-36
Kerwad							80					16-34
Irpagae							52	8				18-35
Mallapur							4					20-28

sizes prefer the upstream areas. Dead shells of this species occurred in densities of 2-80/m<sup>2</sup> from river mouth up to Kinnar.

*P. malabarica* is found from river mouth up to Nandangadda only and it is common in the latter area with an average density of 120/m<sup>2</sup>. This species is distributed in the deeper parts of the river where the depth is 2-3 m and ranges in size from 20 to 34 mm.

From Kinnar onwards at different places like Botjug, Kerwad and Irpagae up to Mallapur the black clam *V. cyprinoides* is the only clam species met with. This species occurs over a wide depth range of less than 1 m to 7.5 m at Kerwad. The average density of this species is 120/m<sup>2</sup>, at Botjug and it progressively decreases in the upstream areas reaching a density of 4/m<sup>2</sup> at Mallapur. *V. cyprinoides* is distributed in the upper parts of the river only between Kinnar and Mallapur where the salinity is very low being 0.24‰-8.76‰ even at high tides. Beyond Mallapur upstream the river bed is predominantly rocky and no clams are encountered.

The rock oyster *S. cucullata* is found in small numbers of 10-20/m<sup>2</sup>, on the surface of rocks in intertidal zone at Sunkeri (Fig. 3), Kadwad and Ambeju. In these areas *C. madrasensis* is also found in clusters in densities of 3-15/m<sup>2</sup>, attached to discarded oyster shells at a depth

of 1-2 m. Dead oysters were noticed from the river mouth up to Kinnar. In and around Kodibag which is about 2 km from the mouth of the river live oysters are very few, but further upstream they are comparatively more common as at Nandangadda and Sunkeri (Table 2). The oysters are found attached to rocks at Nandangadda while at Sunkeri they settle on oyster shells thrown into the river by fishermen after scooping out oyster meat. Beyond Sunkeri up to Kinnar, oysters occur in very low densities on rocky or firm sandy muddy substratum.

#### Clam and oyster fisheries

Both clam and oyster resources of the Kali river are exploited. The clam fishery of the river is a very important one and a large number of fisherfolk are engaged in the fishery while the oyster fishery is a localised one and restricted to Sunkeri. The fisherfolk of the villages on both the northern and southern banks of the river are engaged in clam fishing. The main clam fishing centres are Kodibag, Nandangadda, Sunkeri, Kinnar and Kadwad on the southern bank and Sadasivagad, and Kanegiri on the northern bank. The fisherfolk belong to Harkantra, Gabbit, Konkana-garvi, Ambitta, Dlathi, Bhovi and Bandari communities. Of these, persons of the Gabbit community are exclusively engaged in clam fishing. Although more than 25,000 fisherfolk in total are living in these villages

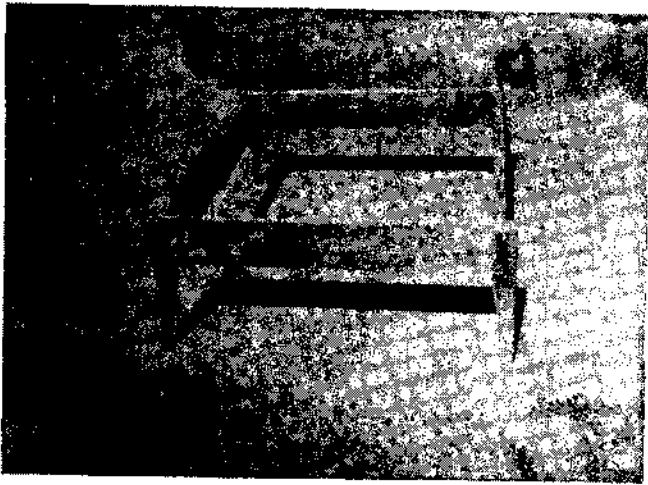


Fig. 2. Wooden quadrat used for sampling bivalves.

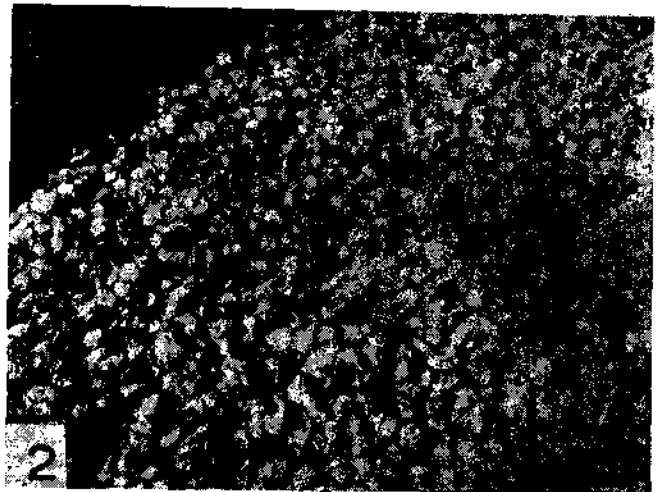
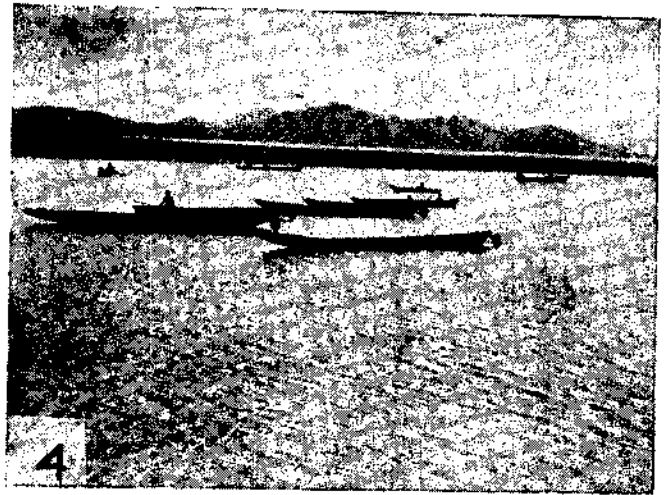
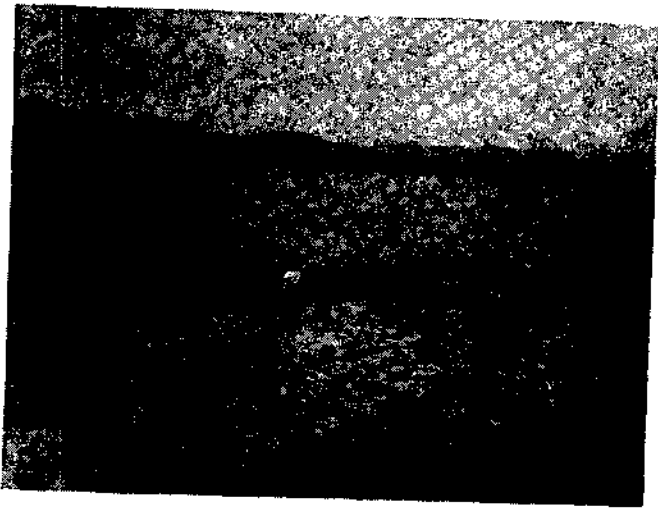


Fig. 3. Rock oysters, *Saccostrea cucullata* at Sunkeri.



Figs. 4 and 5. Clam fishing using boats and nets at Sunkeri.

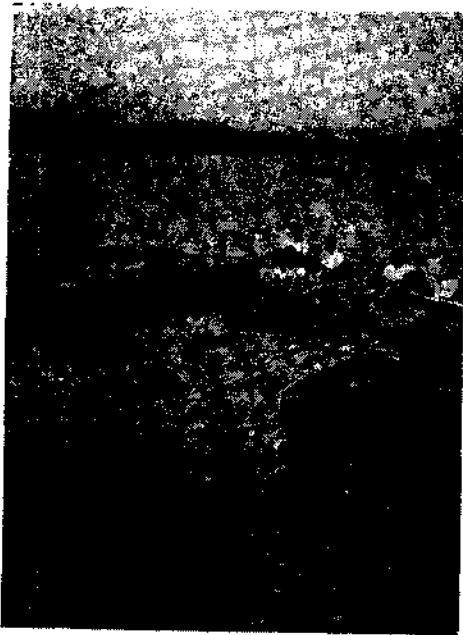


Fig. 6. Fisherwomen gathering clams by hand-picking at Sunkeri.



Fig. 7. Clam fishing net.



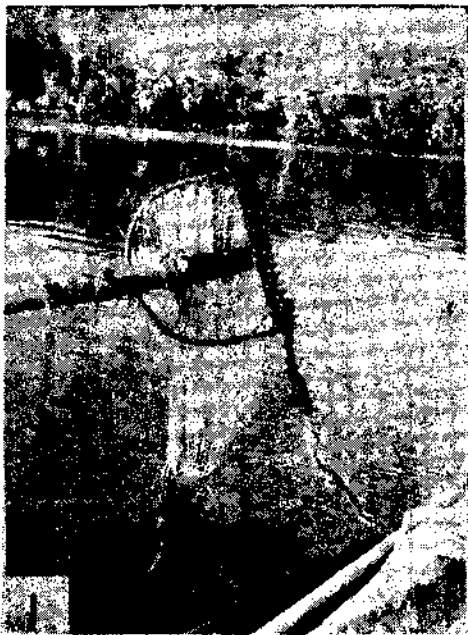


Fig. 8. Dredge used for collecting bivalve shells from the subfossil deposits of Kali river.



Fig. 9. A fisherwoman with clams ready for sale.

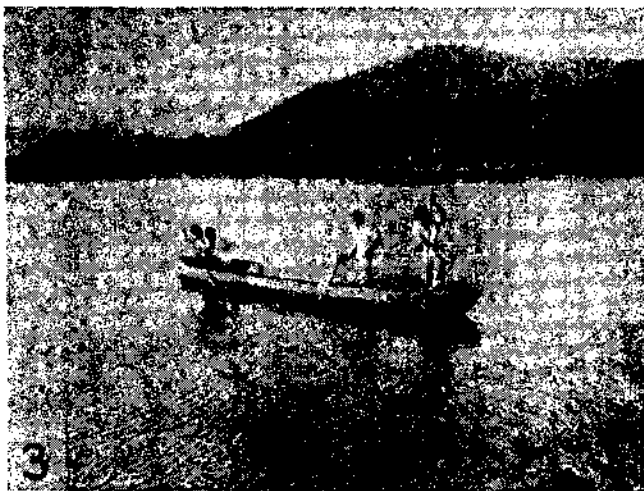


Fig. 10. Dredging operation for empty shells.

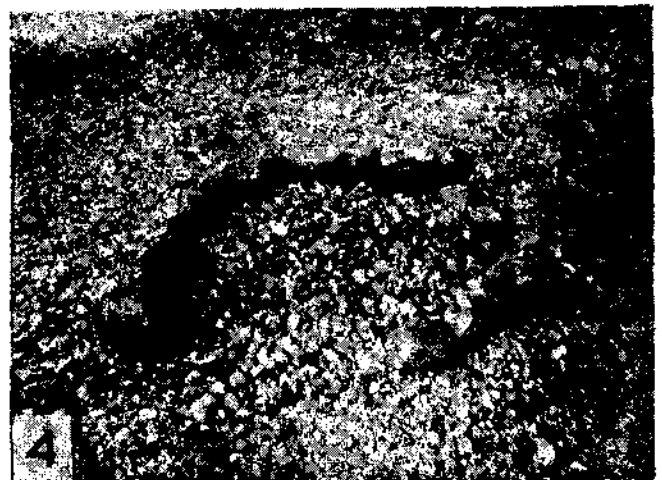


Fig. 11. Clams kept in sheltered tidal area.



Fig. 12. Heaps of shells with sieving device.

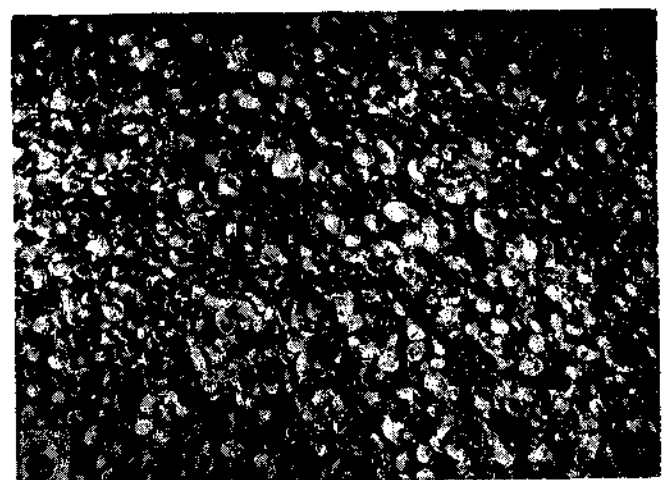


Fig. 13. A close-up view of shells gathered for industrial uses.

along Kali river, on an average only about 500 individuals including men, women and children fish for clams in the river every day. Fishing is carried out throughout the year unless there is a heavy flood in the river as during the southwest monsoon months.

Clam fishing is done during low tides irrespective of the time of the day. Hand-picking (Fig. 6) is the common method of fishing for the large clam *Meretrix meretrix* although nets are used sometimes in areas where the clams are found in large numbers. In deeper zones of the river the bottom is ploughed with leg and individual clams are collected as in Sunkeri area. When a large number of clams are encountered, a clam fishing net called *Kambalai* (Fig. 7) is used (Figs. 4 & 5). The net is held in position with one leg over the river bed while the clams along with sand and debris are pushed into the net with the other leg. After repeated operations for sometime, the net is lifted, the sand allowed to pass through the meshes and clams are collected and stored in boat. In some areas in and around Sunkeri and Kadwad during low tide, the bed is completely exposed and clams are handpicked from such areas. Intensive fishing for *Meretrix meretrix* is done in areas from Sunkeri to Kinnar.

In the case of fishing for *Paphia malabarica* the boat is kept in position with the help of a bamboo pole since the clams have to be collected from deeper areas with depths of 2-3 m. (Figs. 4 & 5) Due to the occurrence of clams together in large numbers, a net is frequently used. On an average about 75 boats are employed per day for *Paphia* fishing. Empty shells of *Paphia* are also collected in the net. When compared to other molluscan species, empty shells of *Paphia* are encountered in more numbers and form almost half of the quantity of the

live clams. Irrespective of the species, the empty shells are invariably left on the river bed.

Clams are kept in the intertidal areas in small enclosures made with stones (Fig. 11) and are thus safely stocked for two or even three days before marketing. Usually the clams collected are stocked for at least one day before they are marketed. Rough estimates made of clam landings of Kali river indicate an annual clam production of about 2,000 t. *Crassostrea madrasensis* occurring in the river bed at a depth of 1-2 m at Sunkeri are collected by fishermen by diving at low tides. The oysters gathered are either sold or consumed by the fishermen.

In addition to the fishing of live clams and oysters, sub-soil molluscan shell deposits mostly clams present in the river bed are exploited on a large scale by agents of companies manufacturing calcium carbonate, caustic soda and fertilizers. (Table 3). The State Department of Geology leases out the right of collection of empty shells from the Kali river bed on a long term basis. The particulars of the companies etc. who acquired the rights of lease are given in Table 3. The clam shells are collected by the lessees from the river bed by operating a kind of a dredge consisting of an iron frame, with a net and provided with a long iron handle. The dredge could be operated at a depth of 2-4 m (Figs. 8 & 10).

When it is dragged on the bottom of the river where shell deposits are present, the shells are collected along with sand and debris. After washing the shells in the water the dredge is lifted and shells taken into the boat. On making trial operations of the dredge to assess the effect of dredging on live clams, it was found that near the banks of the river clam shells alone were collected

Table 3. Details of leases for exploiting sub-fossil shell deposits in Kali river, Karnataka

Name of lessee	Area and extent sanctioned	Date of sanction	Period
M/s. Mineral Enterprises (P) Ltd., Karwar	Kodibag 403.23 ha	11-7-1972	21 years
-do-	Chittakula 110.50 ha	3-1-1976	-do-
Shri M. Mohammed Ismail	Kadwad & Kinnar 132.52 ha	28-6-1976	-do-
M/s. Mangala Minerals	-do- -do-	20-10-1976	-do-
M/s. West Coast Paper Mills Ltd.	Sunkeri 151.71 ha	14-12-1976	-do-
M/s. Mangala Minerals	Kali river creek	1-6-1978	10 years

in it whereas in deeper areas good numbers of live clams were got along with dead ones. The dredged shells are allowed to dry, sieved and accumulated in large quantities for the use of industries (Figs. 12 & 13.)

#### Marketing of clams

Clams are regularly sold in the local markets. They are taken to the markets by womenfolk in head-loads and sold throughout the day. The clams are marketed with shells intact (Fig. 9) while the oysters are shucked and meat sold. The market price of the large clam *M. meretrix* depending on the size varies from 30 paise to 65 paise per 100 numbers whereas *Paphia malabarica* is sold at the rate of 30 paise per 100 numbers. The prices of shucked oysters is higher and they are sold at Rs. 4-6 per 100 numbers. Normally the marketable size of *M. meretrix* varies from 30 to 48 mm, that of *P. malabarica* from 20 to 34 mm and oysters from 90 to 120 mm in size. Both clams and oysters are packed in wet gunny bags and sent in vans to distant places like Goa and Bombay where they find a ready market. People living in and around the villages situated on the banks of the river in upper reaches, who are mainly agriculturists barter clams for paddy. One measure of clams irrespective of size fetches equal quantity of paddy. At times, clam and oyster meat is also sun-dried and marketed.

#### Discussion

The present work has shown that there is an organised clam fishery for *Meretrix meretrix*, *Paphia malabarica* and *Villorita cyprinoides* in Kali river. The three species of clams show differential distribution. *Paphia malabarica* is confined to lower reaches of river from the river mouth to Nandangadda where salinity is 33.44‰, suggesting that this species has distinct preference for areas where salinity is high. In a study of benthos of Kali river, Harkantra (*Mahasagar* 8 (1 & 2): 53-58, 1975) has also made similar observations on this species. *Meretrix meretrix* occurs over a distance of 6.25 km from Nandangadda where the salinity is 30.82‰ to Kinnar where the salinity is 8.76‰. *Villorita cyprinoides* is distributed only in low salinity areas in the upper parts of the river from Botjug to Mallapur where salinity is uniformly low fluctuating between 5.7‰ and 0.24‰, indicating that this species thrives well in low salinity conditions.

Although large quantities of clams are caught from the river, there is no information on the annual production, seasonal variations in landings and biological characteristics of the species exploited. Studies on these aspects will be helpful for proper management of the fishery. There are many large shallow stretches in the Kali river where it may be possible to transplant seed clams and carry out clam farming. The possibilities for conducting clam farming in the river could be explored as production from clam farming operations could augment that from capture fishery in the river. There is a very large demand for clam meat in several countries. India has exported as much as 510 t of clam meat during 1982-83. By stepping up clam production from Kali river, there are very good possibilities to meet the demands of export industry.

In the exploitation of the subfossil shell deposits in the Kali river, there appears to have been indiscriminate capture of live clams, belonging to the species *Meretrix meretrix* and *Paphia malabarica* in large numbers, which is detrimental to the resources. According to the local clam fishermen, dredging operations have been carried out by the agents of industries over wide areas in the river bed.

Due to the intensive quarrying carried out in these areas the topography of the river bed has changed much rendering survival of clam populations difficult. Therefore it is suggested that areas where subfossil deposits are distributed should be clearly demarcated through detailed geological investigations and the State Government has to prevent indiscriminate capture of the live clams by regular inspection of the quarrying of shell deposits.

We wish to express our gratitude to Dr. E. G. Silas, Director, Central Marine Fisheries Research Institute, for the kind encouragement received from him. We are thankful to Dr. K. Alagarwami, Head of Molluscan Fisheries Division, CMFR Institute for critically reading the paper and giving helpful suggestions and to Dr. M. V. Pai, the then Officer-in-charge, Karwar Research Centre of CMFR Institute, for extending all facilities and help to us during the course of this investigation. Our thanks are also due to Shri Shankar, Supporting Staff, for assisting in the field work.



# MULTIDISCIPLINARY MARINE FISHERIES RESOURCES MANAGEMENT\*

World fisheries have been beset by problems such as the over exploitation of resources, a restricted approach to fisheries problems, marine pollution and the establishment of exclusive economic zones. The purpose of this paper is to present a summary of a modern, logical and systematic multidisciplinary approach to fisheries management for administrators, the details of which are available elsewhere (Bakus, in press).

The major objectives of a fisheries resources management programme are to: 1) summarize existing information of fisheries; 2) emphasize data gaps for priority species; 3) assess socioeconomic problems and user conflicts, 4) develop a comprehensive management programme. How these objectives can be reached is accomplished by carrying out a seven phase programme.

Phase I (Initial Contact and Information Gathering) begins by the formation of a working group of experts, comprising at least a programme manager, fishery biologist, fishing industry specialist, economist, sociologist and in some cases a pollution or public health specialist. These individuals compile, with the help of students, preliminary data and information in their respective

**Table 1. Species Information Sheet†**

- 
- Species:
  - Distribution:
  - Habitat Preference:
  - Abundance:
  - Reproduction:
  - Production:
  - Ecology:
  - Feeding Habits:
  - Predators:
  - Disease:
  - Other Related Data: (e. g., physiology)
  - Commercial Harvesting:
  - Sport and Recreational Harvesting:
  - Subsistence-Artisanal Harvesting:
  - Legal Aspects:
  - Alternative Species for Exploitation:
  - Fishing Regulations:
  - Methods of Processing:
  - Economics of Processing:
  - Marketing of Fish:
  - Sociology-Anthropology:
  - Additional Information:
- 

†Detailed descriptions are presented in Bakus (in press)

**Table 2. Fisheries Resource Management Programme Methodology**

Preliminary investigation	Intensive field study	Laboratory studies and data analysis	Group analysis	Results
Initial Contact-Information Gathering	Ecology	Ecology	Progress Meetings	Summary of Information on Priority Economic Species
Formation of Working Groups	Fisheries Biology and Management	Fisheries Biology and Management	Modelling	Data Gaps
Information Compilation	Economics	Economics	Feedback and Evaluation	Recommended Research Programmes
Information Synthesis	Sociology	Sociology	Decision Analysis	Alternative Management Plans
General Meetings	Pollution and Health	Pollution and Health	...	Preferred Management Plans including Cost-benefits, Tradeoffs & Management Priorities in Rank Order of Importance

\*Prepared by Gerald J. Bakus, Department of Biological Sciences, University of Southern California, Los Angeles, California 90089-0371, U. S. A.

disciplines from a variety of sources. Phase II (Information Compilation) is a more intensive compilation of published and unpublished materials, including the use of computer searches of the literature if feasible. Information obtained in Phase II is synthesized in Phase III (Information Synthesis). These synthesized data are entered into data sheets, a separate set for each priority species (Table 1). Data gaps are ranked into three categories: essential, important, and minor importance, providing the government and others with suggested priority research programmes.

Phase IV (Preliminary Research) is an attempt to fill serious data gaps prior to the development of alternative management plans. Phase V (Modelling) consists of the development of visual or compartmental models, both general and specific, in order to help the working group understand more clearly the inter-relationships between the various parts of the management framework. Models for stock assessment are also considered at this time. A series of alternative

management scenarios are developed in Phase VI (Management Scenarios) that reflect a variety of interests.

Phase VII (Final Management Plan) incorporates a powerful decision making procedure (multi-attribute utility measurement) to select the best management alternative. This process consists of first rating each attribute (e.g., fishermen's net income) on a scale of 0 to 100 against each alternative management plan, followed by the ranking of the attributes (e.g., fishermen's net income vs. fish stock assessment vs. coliform counts in fish, etc.), to give a final composite score that ranges from 0 (worst) to 100 (best) (Bakus, 1983, *Ocean Mgmt.* 8: 305-316). The management plan with the highest score is recommended along with alternative plans, in rank order of importance. The management plan summarizes all probable costs and benefits, tradeoffs, and recommended major research, development, and management priorities in rank order of importance. This methodology is summarized in Table 2.



## REGULATED MECHANISED AND TRADITIONAL FISHING IN TAMILNADU — AN APPROACH TO END CLASHES\*

### Introduction

Marine fishing in India is generally confined to narrow regions of nearshore areas. Till fifties marine fishing mostly by indigenous craft was in vogue throughout the Indian coast. In spite of successful experimental fishing of small mechanised boats introduced by Indo-Norwegian Project, mechanised fishing could not take strong roots till the end of sixties. Entering into prawn export trade was the turning point in the annals of fishing history of India and the enticing returns from exportable varieties encouraged introduction of mechanised boats on a large scale. This has brought in a new set of man power generally not drawn from traditional fishing communities. The presence of mechanised boats operated by those who were not involved in fishing earlier and the encroaching of the inshore fishing grounds by these boats created conflicts between the traditional and mechanised sectors, resulting in clashes between these two sectors leading to large scale damages to both

men and material. In order to save marine fishery from such a set back, different schemes are being introduced in different areas. One such novel scheme introduced in Tamil Nadu is described in the following.

The coast from Jagathapattinam (south) in Pudukkottai District to Mallipattinam (north) in Thanjavur District (Fig. 1) consists of 26 marine fish landing centres, 10 in the district of Pudukkottai and the rest in Thanjavur. Unlike the other regions in the east coast, the sea-front here is shallow and most of the time in the year this area is very calm and accessible for fishing by all types of gears. The operation of catamarans is significantly low in this stretch. This coastal region is a rich ground for important fisheries such as prawns, silverbellies otherwise locally called "KAARAL", sciaenids, pomfrets, seer fish and crabs. To exploit good grounds of prawns, mechanised fishing has been intensified in this area since past five years. The important mechanised fishing centres are Jagathapattinam, Kottapattinam, Sethubavachatram and Mallipattinam.

---

\*Prepared by G. Balakrishnan and K. Alagaraja

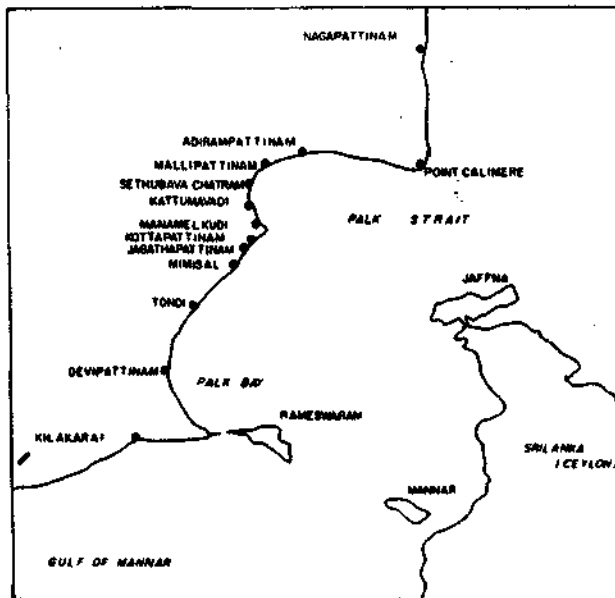


Fig. 1. Map showing the important fish landing centres in Palk Strait.

The mechanised boats in these areas are mainly owned by local fishermen only. In spite of the local ownership of the mechanised boats, clashes between local mechanised boat operators and indigenous boat operators from the neighbouring areas started in the year 1978 resulting in heavy losses.

#### Crafts and gears

Apart from mechanised trawlers numbering about 500, there are about 1000 plank built boats and dug out canoes, numbering about 10. As mentioned earlier, only a small number of catamarans, not more than 20, is available in this stretch. The major gears are 'Thallu Valai' (trawl net) 'Sippi Valai', 'Koi Valai', 'Nandu Valai' (all gill nets), 'Adi Valai' (drag net) and 'Thoondi' (hooks & lines).

#### Catch composition

The annual estimates of marine fish landings in this region from mechanised units were about 50,000 tonnes during 1981 and 1982 forming about 80% of total landings. Out of this, prawn catches accounted for about 3500 tonnes. Major contribution to the prawn came from *Penaeus semisulcatus*, *P. indicus* and *Metapenaeus affinis*. Among others, *Leiognathus*, sciaenids and other crustaceans including the crab *Portunus pelagicus* were the major components.

#### Reasons for the clashes

Due to the presence of good fishing grounds, particularly for prawns, combined with favourable fishing

conditions almost throughout the year in this region, the local fishermen have intensified mechanised fishing. The number of mechanised trawling boats owned by local fishermen at Jagathapattinam, Kottapattinam, Sethubavachatram and Mallipattinam are 120, 180, 80 and 100 respectively. In addition, mechanised trawling boats from other regions such as Colachel, Mandapam, Nagapattinam, Kaveripattinam, Cuddalore and Pondicherry also converge to this area for seasonal exploitation, the major fishing season for prawns being October to March. Increased tempo of mechanised fishing in these centres was not received well by indigenous craft owners of the fishing villages. This culminated in the major clashes between the two sectors in the year 1978, leading to heavy damages.

#### Regulated fishing

In order to avoid such clashes a Peace Council was formed with the local R.D.O. as Chairman and representatives from State Fisheries Department, mechanised boat owners and indigenous craft owners as members. The Peace Council has drawn up a programme to regulate fishing activities.

Since prawns are caught in good quantities during night time, intensity of fishing at night by both indigenous and mechanised crafts is high, resulting in clashes between these two sectors in the night. It is complained by indigenous craft owners that their gears are damaged by the mechanised crafts during night time and the culprits normally escape in dark. Hence the Peace Council suggested on a quota basis, 3 days night fishing to mechanised crafts in a week, fixing the days in advance and allotted the rest of the four days for non-mechanised crafts. However, during day time between 6.00 hrs and 18.00 hrs there is no such restriction and all crafts are allowed to fish, since during day time there is lesser chances of indigenous gears getting damaged by mechanised crafts. In case indigenous gears get damaged during night by mechanised boats on these four days allotted for indigenous crafts, then due compensation should be given by the mechanised crafts to the affected indigenous craft owners. On the other days since mechanised boats have the right to fish, if the indigenous boats also operate and their gears get damaged, then no compensation would be paid.

#### Mechanised boat owners associations and their function

In order to safeguard their interests, mechanised boat owners have formed Associations in each centre and it appears that they strictly adhere to the 3 day



Fig. 2. Boat owners queuing up for receiving tokens at Jagathapattinam.

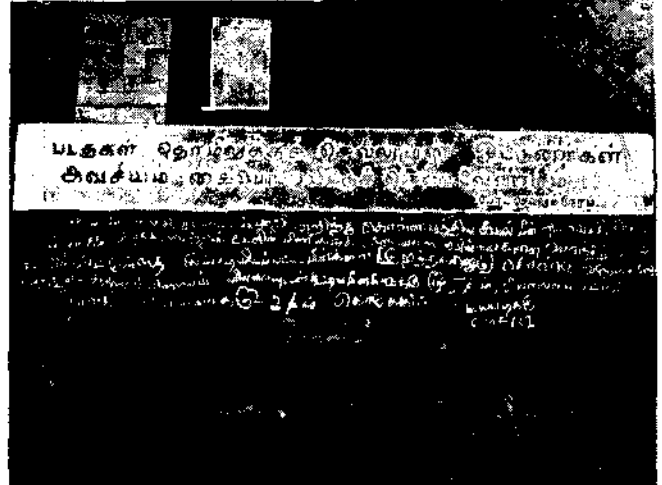


Fig. 3. Display of information to fishermen in front of the Mechanised Boat Owners Association office at Kottapattinam.



Fig. 4. Crabs from the catch for disposal at Kottapattinam.



Fig. 5. Resting mechanised boats and crowd awaiting the catches landed by carrier boats at Kottapattinam.



Fig. 6. Sun drying Silver bellies 'kaaral', part of the catches.



Fig. 7. Calm and quiet.



night fishing in a week. For this purpose they issue tokens on the allotted days of fishing for those mechanised boats after collecting a nominal fee of Rs. 3/- to Rs. 5/- depending on the centre. Apart from this token money, each mechanised boat operator deposits one good sized prawn from the catch to the Association. The sale proceeds adds up to the Association's general fund. The amount thus collected is used for the payment of compensation towards the damages caused to the gears of the indigenous craft owners. This is also utilised for social purposes such as health, education and religious festivals. The unity among mechanised boat owners belonging to different regions, communities and centres, works so nicely that the interest of this sector is well protected.

The orderliness in which the mechanised boat owners come and stand in queue to receive the tokens from 3.00 P.M. onwards on the allotted day for the ensuing night fishing is commendable. The systematic way of collection of token money and prawns and utilisation

of the proceeds to various needs of the association members indicates that the programme drawn up by the Peace Council is working satisfactorily.

### Conclusion

It is interesting to note that the schedule of restricted night fishing for mechanised boats for 3 days in a week and traditional boats for 4 days is strictly kept up by the respective boat owners without any violation, while all the types of boats operate during day time. It is equally interesting to see that the mechanised boat owners are eager to operate their boats on these three days, strictly adhering to the schedule as evidenced by the way in which they wait for getting the token for night fishing. This implies the economic viability of their operations under these constraints. Therefore, it is suggested that this system of regulated fishing may be extended to other regions where the clashes between these two sectors exist, especially concerning night fishing.



## CULTURE OF LARVAE OF *SCYLLA SERRATA*\*

### Introduction

A system has been designed and evaluated for mass rearing of the mud crab *Scylla serrata* (Forsk.) in the coastal ponds developed in intertidal mud flats at Tuticorin bay. Declining fisheries of this group throughout most of its range have stimulated a number of aquaculture ventures particularly in few Southeast Asian countries. It is a compatible species and reared profitably with milkfish. Stocking of ponds is dependent on the collection of small crabs from wild for fattening. The success of largescale culture depends upon the various management techniques including the development of hatcheries for the production of seed of this desirable species. A series of experiments were carried out during March-September 1983 and the larvae of the mud crab were successfully reared to crab stage under laboratory conditions for the first time in this Institute. The rearing techniques are simple and relevant for establishment of a hatchery.

### Rearing of broods

Ovigerous crabs were obtained from commercial catches and reared in aquarium having suitable facilities with salinity of  $32 \pm 2\%$  and temperature in the range of 26–30°C. Mother crabs were fed with meat of bivalves and shrimp during incubation period. Excess food and at least half the volume of water were removed from rearing tanks every day. The incubation period varied from 8–13 days. At the time of collection, the egg mass appeared completely yellow and compact and the eggs measured 280–380  $\mu$  in diameter. As development proceeded with the formation of the chromatophore and the eyes, the egg mass changed the colour to a greyish-yellow, brown, brownish-black and finally complete dark. An increase in the size of egg mass was also evident and the abdomen which was slightly curved became almost straight, continuous with the cephalothorax, and the telson was slightly tilted upwards at the end of incubation (Fig. 1). Later the egg mass became loosened and the abdomen made jerking movements

---

\*Prepared by R. Marichamy and S. Rajapackiam



Fig. 1. Berried female in last phase of incubation.



Fig. 2. Newly hatched zoea larva.

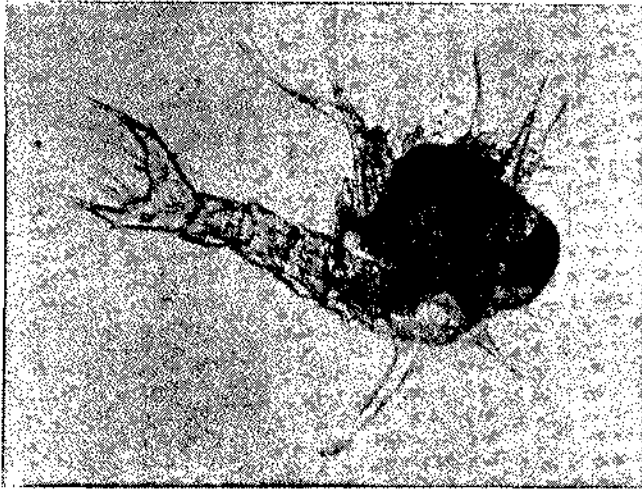


Fig. 3. Zoea V.



Fig. 4. Megalopa.

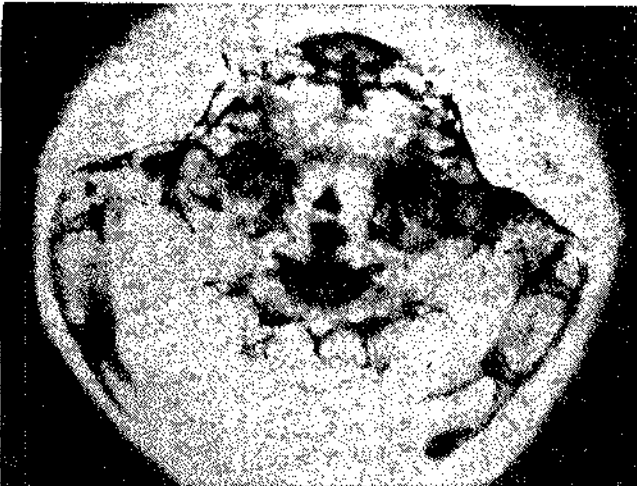


Fig. 5. Moulting of first crab instar.



Fig. 6. Young crabs.

in quick succession while the second and fourth walking legs lightly jabbed at the egg mass. The mother crab was restless and by the frequent contraction of the abdomen, the larvae were released from the eggs. Most of the eggs hatched from the berry directly into zoea and a few as prezoa. The larvae were liberated normally around 6 A. M. and the process extended over a period of 2 hours. A maximum of 2 million zoea were hatched out on 18-4-1983 from a crab which measured 140 mm cw.

#### Larval development

Active newly hatched zoea (Fig. 2) were highly photopositive. These when congregated along water interfaces were transferred into different rearing tanks at a stocking density of 10-50/l. There were five zoea stages and one megalopa in the complete larval development of *S. serrata*. Each zoea took 3-4 days and the megalopa stage was attained on 18-20th day. Further metamorphosis was noticed after an interval of 8-11 days and thus the larval developments continued to 28-30 days to attain first crab instar. Heavy mortality was noticed during first, second and fifth zoea stages. The morphological changes of each stage were observed and recorded. Zoea I measured 1.2 mm while Zoea V measured 3.5 mm (Fig. 3). The cephalothorax of zoea has 4 spines, one dorsal, one rostral and two short lateral spines. All zoea stages except for the first have stalked compound eyes. The abdomen in all stages has lateral knobs on the second and third abdominal segments. Moulting in the zoea and megalopa took place by a split at the dorsal boundary between the cephalothorax and the abdomen. Megalopa resembled like a crab and swam by means of five pairs of pleopods which were functional for the first time. Prominent chelipeds were developed to catch prey (Fig. 4). Cannibalistic tendency was clearly indicated from this stage onwards. Carapace length including rostral spine measured 2.5 mm. A heavy mortality was noticed again when they turned into crab stage. The carapace length of first crab measured 3.2 mm while the width was 3.7 mm with slight variation. The length of the first crab instar in relation to the width was longer than in all later stages. Nine antero-lateral spines in carapace were formed and the abdomen was curved beneath the cephalothorax as in adult stage. The carapace, eye stalks and the periopods were marked with chromatophores which were able to change colour. The first crab instar moulted to second crab in 5 days period

(Fig. 5) and the moulting of second to the third instar took 4 days. A constant greenish-grey colour of carapace was noticed after the 7th moult. First instar crab although capable of sustained swimming, adopted an almost exclusive benthic habit.

#### Water quality and feeding

The preliminary study concerns the effects of water quality, antibiotics, phytoplankton and food on larval survival and development. It revealed several potential areas for more detailed research in larval biology. Several sea water treatments were conducted to determine their effect on larval survival and development. Filtered sea water was used directly or sterilized by passing water through a unit containing ultraviolet germicidal lamps. A commercial preparation of penicillin and streptomycin in powder form were used to minimize bacterial infection of crab larvae. Zoea and megalopa stages were maintained at salinity of  $32 \pm 2\text{‰}$  at temperature varying from 25 to 30.5°C. Water was changed daily. The excess food settled at the bottom, as well as the moulted shell and dead larvae were siphoned out. Continuous aeration was provided in all tanks. Once in four days, samples were taken from the rearing tank and zoea were counted to provide estimates of the number of surviving larvae. The larvae were fed with different types of food. *Chlorella* sp. was added during first three days. Second and third zoea were supplied with rotifers as well as frozen *Artemia* nauplii. The later stages were fed exclusively with newly hatched nauplii of *Artemia salina*. Attempts were made to rear megalopa in diluted sea water and with food consisting of live copepods and macerated prawn meat. Loss of larval stock was controlled when megalopa were reared in small compartments or at lower stocking density with intensive feeding. After reaching crab stage (Fig. 6) the mortality was negligible at lower stocking density.

#### Remarks

Experiments conducted so far, in rearing the larvae were unfortunately of little commercial value and labour intensive. It calls for further investigation if laboratory production of the early crab stages as seed stock for culture in ponds is to be achieved. Efforts are in progress to culture the larvae of this valuable species. The present findings envisage the scope to develop the hatchery for the large scale production of crab seeds. An improved system is designed for a direct scale-up potential at Tuticorin Research Centre of Central Marine Fisheries Research Institute.



## TWO INCIDENTS OF FIRE ACCIDENT AT MADRAS FISHING HARBOUR DURING THE MONTH OF APRIL '84\*

On the early hours of 5-4-84 at about 4 A.M. the first fire accident took place. On the southern side of the fish landing centre at Kasimode, one of the thatched sheds, used mainly for prawn peeling and handling caught fire first. The fire quickly spread in the northern direction causing complete damage to 42 sheds, six trawlers, 22 sets of *catamarans*, one fibre glass boat and six trawl nets. At the adjoining site the fire devastated all the equipments and tools used in the dry docking of mechanised boats. Sheds belonging to the Madras Fishermen Co-operative Federation and Tamil Nadu Fisheries Corporation were also affected by the fire. Ten fire fighting units battled for more than four hours and brought the fire under control. The estimated loss was over six lakhs. Fortunately there was no loss of life. The breakup figures for the material loss is as follows:

Cost of trawlers: Rs. 5,20,000.00

Cost of carrier boat (fibre glass): Rs. 35,000.00

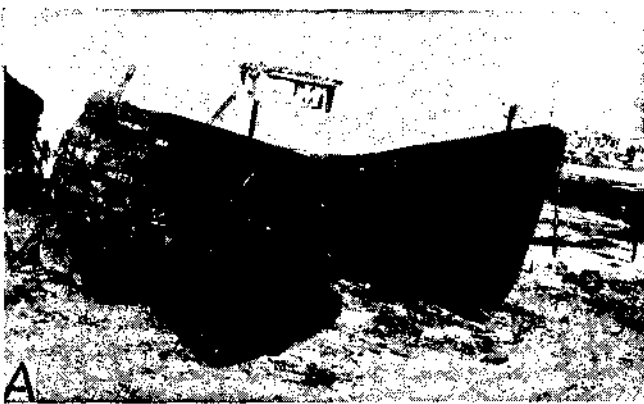
Cost of catamarans: Rs. 20,000.00

Cost of equipment used in dry docking the boats:  
Rs. 20,000.00

Cost of fishing nets: Rs. 21,000.00

Total loss: Rs. 6,16,000.00

Within a fortnight, another instance of fire outbreak took place on 16-4-84 in the vicinity of the first fire disaster. The second fire accident according to press reports and personal enquiry, took place in the early morning. The fire broke out on the northern side, well beyond the existing compound wall away from the shore. A total number of 204 sheds including five tea stalls were destroyed in the fire accident. Again there was no loss to life. No fishing boats were affected. Only 15 nets were damaged by the fire. The total loss was estimated to be around seven lakhs.



Two old boats kept for repair burnt out.



Partly burnt fibreglass boat.

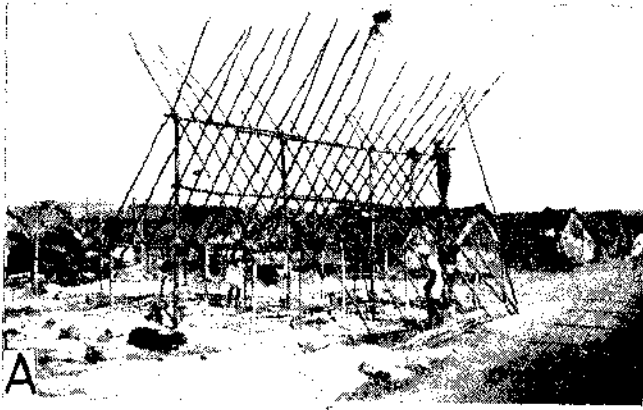


Engine of a boat destroyed by fire.



Location of prawn peeling shed - totally gutted.

\* Prepared by D. B. James, R. Sarvesan and S. Chandrasekar.



Burnt shed being reconstructed.



Area showing burnt sheds.



Burnt planks of *catamaran*.



Area showing place where prawn peeling sheds were completely gutted.



Planks of *catamaran* damaged by fire.



Burnt peeling sheds showing the partly burntout poles.