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RESOURCE CHARACTERISTICS OF EXPLOITED BIVALVES AND GASTROPODS OF KAKINADA BAY WITH A NOTE ON STOCK ASSESSMENT

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Introduction

Bivalves and gastropods are important molluscan resources of the Indian coasts. Kakinada Bay (81° 15' - 81° - 22' E and 16° 51' - 17 ° N) spreading about 130 sq.km is rich in molluscan resources. They are being exploited at varying maganitudes. However, in the recent times their exploitation has reached alarming proportions warranting remedial measures. Several workers have contributed to the knowledge on the molluscs of the bay. However, a detailed study covering the entire bay over a long period on the seasonal variations, size composition, exploitation pattern, utilization etc., is lacking, which is essential in view of the increased demand for these resources. An attempt has been made to collect the relevant data in a systematic way for six years and the results are presented here.

Craft and gear

At the Yetimoga village plank-built boat known as *Nava* and wooden planks are employed in collecting the bivalves and gastropods. There are about 10 *Navas* at Yetimoga that are regularly used. Large stretches of bay are exposed during low tides (Fig. 1). Wooden planks are used to skate over the mud flats to collect clams and important gastropods

Fig 1. Exposed mud flats of the Kakinada bay during low tide.

(Fig. 2). These used by children as their light weight will facilitate easy skating over the mud. *Shoe-Dhone* is a special type of craft operated from Chollangi. The entire family lives in the boat during a trip of 3 to 4 days and will be engaged in the fishing. If the clams or gastropods are found in good density, scoop nets are used to collect them.

Fig 2. Children using the wooden planks to skate over the mud flats for collecting clams.

Otherwise they are mostly hand-picked, as the depth of the water is about 50 to 70 cm during low tides. The fishermen that operate from Chollangi are migrants from neighbouring villages. They engage in the molluscan fishing throughout the year except bad weather days and important festival periods. In the recent times they are engaged in the collection of prawn seed during part of the year.

Landings and effort

The total landings of bivalves and gastropods during 1988 were 1,933 t and it gradually rose to a peak of 4,442 t in 1993. Similarly the effort also showed improvement from 32,458 man days in 1988 to 96,186 man days in 1992. However, there is a marginal decline in the effort during 1993 to 86,849 man days. The catch per man day's effort peaked at 60 kg during 1988 and gradually

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TABLE 1 *Catch (tonnes) effort (man days) and species composition of bivalves and gastropods, of the kakinada bay during 1988-'93*

Years	*A.granosa*	*A.rhombea*	*M.meretrix*	*P.malabarica*	*K.opima*	*Geloina* sp.	*P.placenta*	*C.madrasensis*	*P.viridis*	*Cerithidea* sp.	*Telescopium* sp.	*Hemifusus* sp.	*Umbonium* sp.	*Thais* sp.	Others	Total	Effort	C/E (kg)
1988	802	2	112	51	5	12	9	-	-	590	38	6	274	32	-	1,933	3,2458	60
1989	1,343	-	31	12	1	12	26	-	-	843	9	5	431	4	-	2,717	5,2777	51
1990	1,458	-	30	16	-	15	34	1	-	1,002	90	4	127	7	-	2,784	6,7045	42
1991	1,606	3	96	38	4	28	120	42	1	680	280	6	296	6	35	3,241	8,8869	36
1992	1,248	1	98	28	8	4	131	65	1	698	459	150	365	10	-	3,266	9,6186	34
1993	759	6	117	35	20	6	140	65	3	2,130	447	36	261	417	-	4,442	8,6849	51
Average	1,203	2	80	30	7	13	77	29	1	990	221	35	292	79	6	3,065	7,0697	43.4

decreased to 34 kg in 1992. However, the catch rate showed improvement during 1993 (Table 1).

Catch composition

The landings on an average comprised of 43% clams, 4% other bivalves and 53% gastropods (Fig. 3a). However, there were variations in the composition from year to year.

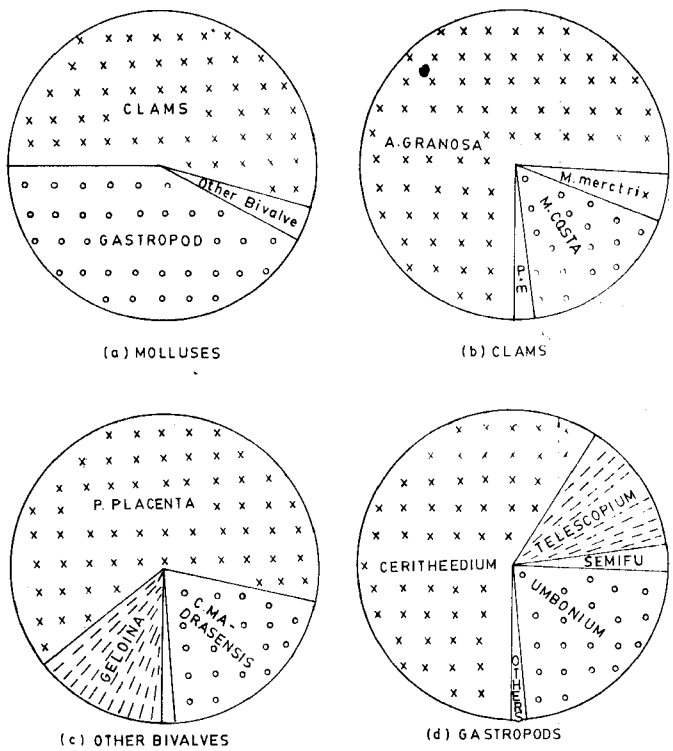

Fig 3. Composition of molluscs, clams, other bivalves and gastropod landings from Kakinada bay.

Clams

This group is the most important and economically valued component of molluscs, comprising five species (Fig. 3b).

Anadara granosa: This is the major clam resource and on an average it formed about 39% of the total molluscan landings of the Kakinada bay. The landings of *A. granosa* rose from 892 t in 1988 to 1,606 t in 1991 and thereafter showed a declining trend. The main season is January-April during which about 45% of the annual landings takes place. The length of the exploited *A. granosa* ranged from 10 to 78 mm (Fig. 4) with major mode at 33 mm. The important feature of the exploitation of the species is that about 29% of the clams are

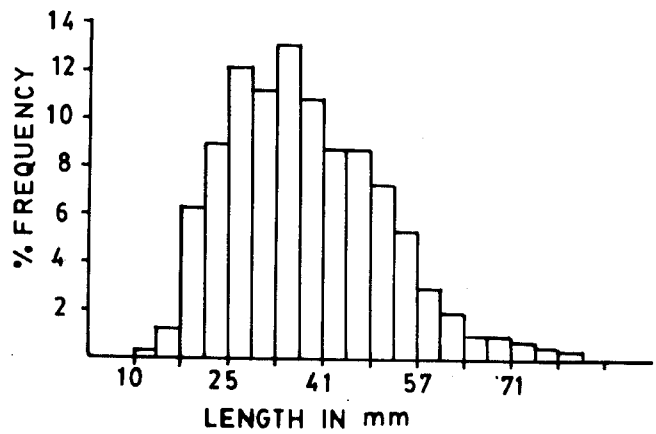

Fig 4. Length distribution of *A. granosa*.

below 30 mm which are selectively exploited for a particular purpose. However, the exploitation of these small sized clams reached a proportion of 43.4% during 1991. Narasimham *et al. (Mar. Fish. Infor. Serv., T & E Ser.*, 59 : 1-16, 1984) estimated the stock of *A. granosa* at 6,895 t. However, due to diversified utilization in recent times, the fishing pressure has increased on this clam. A recent study indicated that under the present pattern of fishing there is little scope to increasing the landings of this species beyond 1,500 t (Rao and Somayajulu) (MS).

Meretrix meretrix is another large sized important clam exhibiting different colour variations (Fig. 5). In 1993 the quantity landed touched 117 t. During 1988 also this species contributed to the clam fishery in a significant way (112 t). However, decreased landings occurred during 1989 - 1990. On an average the landings of this species were estimated at 80 t forming 2.6% of the total molluscan landings of the bay and 6% of the clam landings. Narasimham *et al. (op.cit.)* estimated the stock at 1,082 t. The length range in the fishery was 25-86 mm with modes at 52 and 65 mm (Fig. 6). The major season for the landings of this species is April-August during which about 50% of the annual landings takes place. This species spawns almost throughout the year.

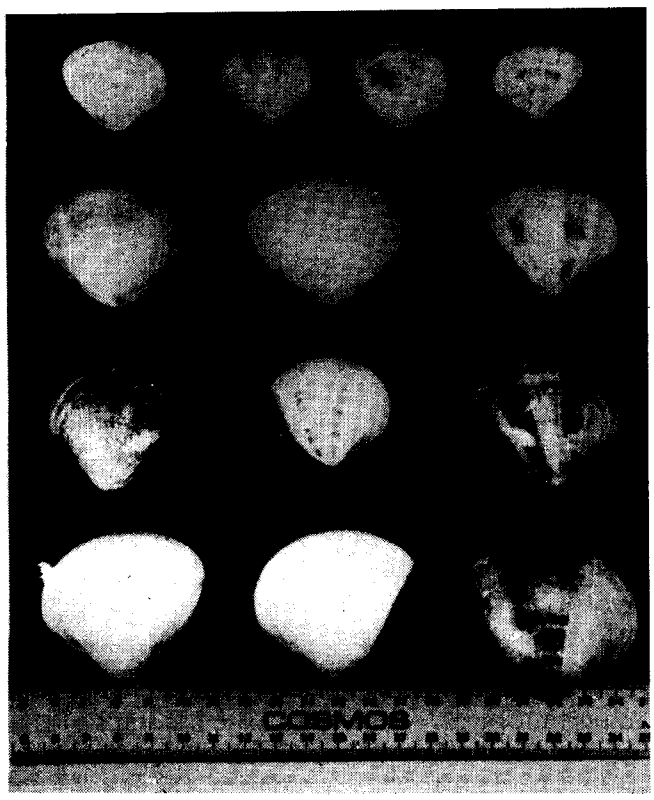

Fig 5. *Meretrix meretrix* exhibiting different colour variations found in the Kakinada Bay.

Paphia malabarica is another significant clam, contributing on an average about 30 t per annum. The catches of this species peaked at 51 t in 1988 and thereafter followed a declining trend. However,

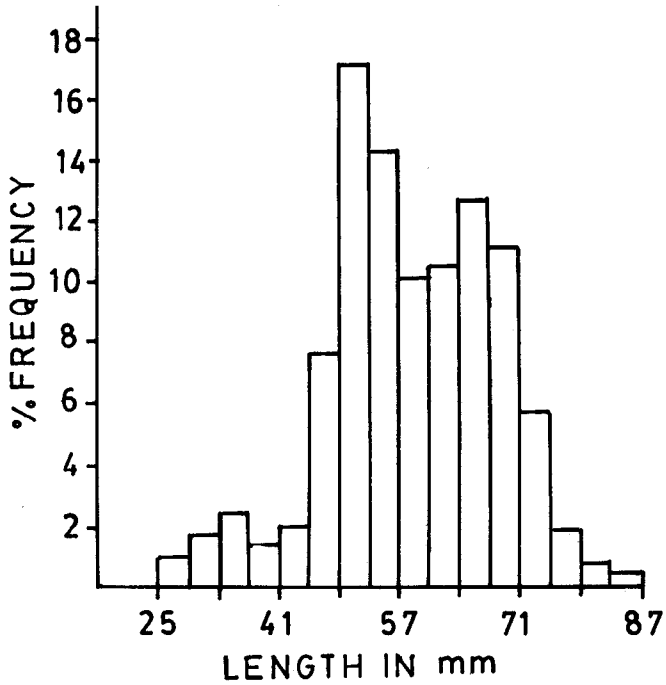

Fig 6. Length distribution of *M. meretrix*

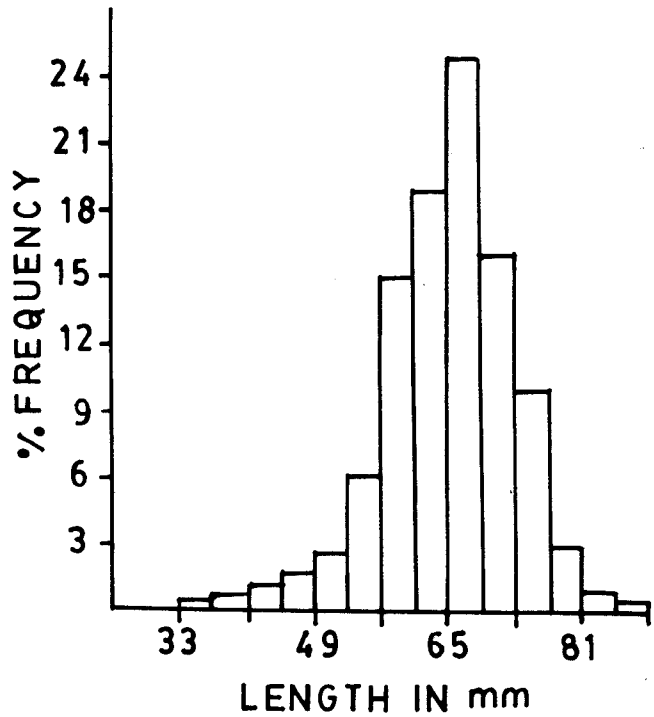

Fig 7. Length distribution of *P. malabarica*

during 1991-'93 period the catches improved considerably. This species forms about 2.2% of the total landings and constitutes about 1% of the total molluscan landings of the bay. The population of this species in the bay was estimated at 665 t by Narasimham *et al. (op.cit.)*. Most of the landings of this species occur during April-August period. The length of this species ranged from 33 to 86 mm (Fig. 7). This species also spawns almost throughout the year.

Katelysia opima landings have gradually increased from 5 t in 1988 to 20 t in 1993. On an average this species contributed 0.5% to the clam landings mostly during April-August. The length range of this species in the fishery is 34-56 mm with the mode at 48 mm (Fig. 8). It also spawns almost throughout the year.

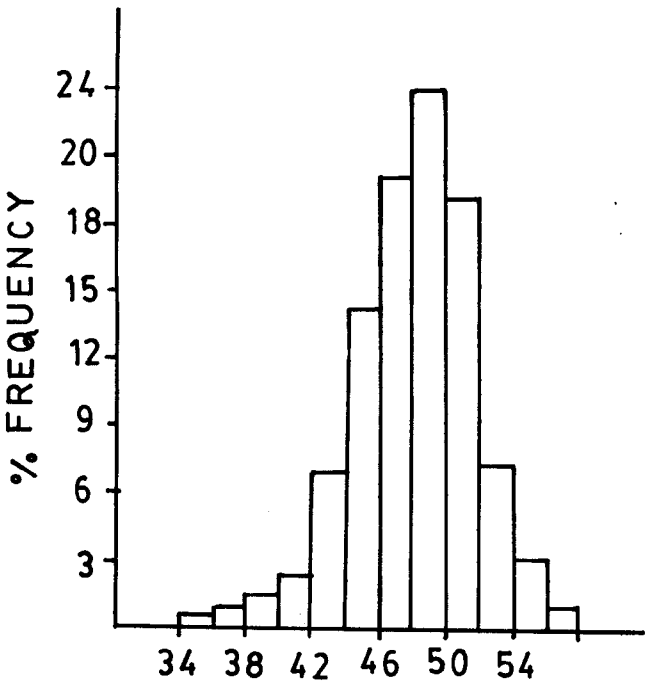

Fig 8. Length distribution of *K. opima*

Geloina bengalensis, popularly known as "big black clam" contributes about 1% to the total clam landings of the bay. They are mostly picked up when it is difficult to go for other resources due to floods etc. The landings ranged from 4 to 28 tonnes. There is a decline in their landings during 1992 and 1993 compared to the previous years 1988-'91). Their size ranged from 35 to 88 mm (Fig. 9) with the mode at 67 mm. Although they may not form an important clam resource, their presence

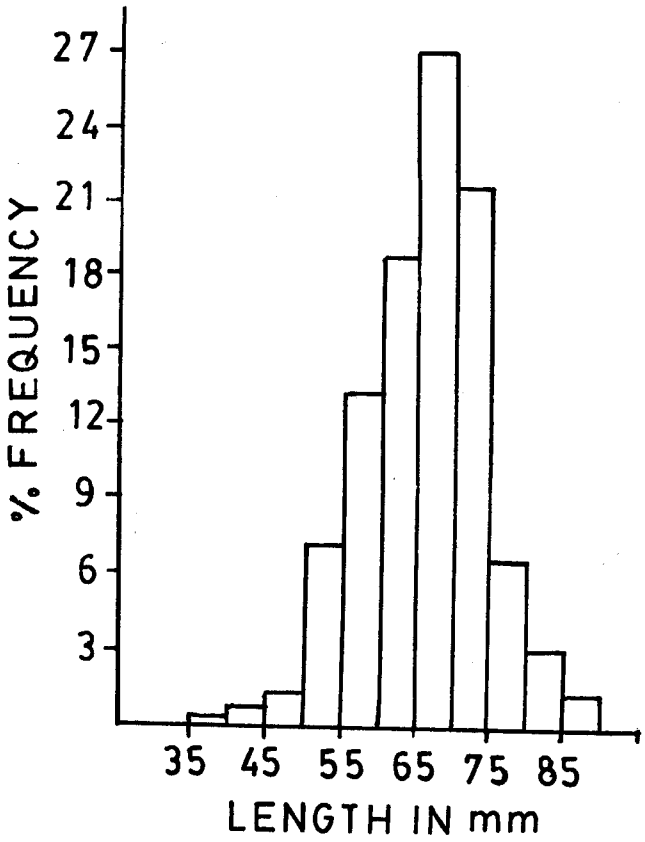

Fig 9. Length distribution of *G. bengalensis*

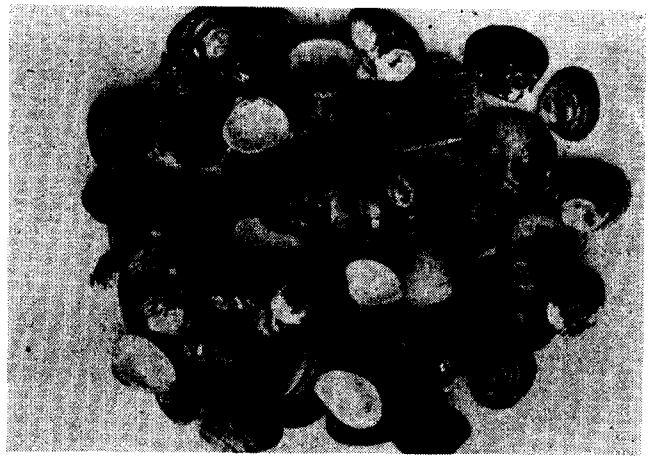

Fig 10. A view of *Geloina bengalensis* found in the Kakinada bay.

is ecologically very significant (Fig. 10). Other bivalves comprising windowpane oyster, edible oyster and green mussel form 3.5% of the molluscan landings (Fig. 3c).

Placenta placenta is one of the most important bivalve resources. The landings of this species gradually increased from 9 t in 1988 to 140 t in 1993. The length of the exploited windowpane oyster ranged from 30 to 160 mm. The stock of this species was estimated at about

Fig 11. Small heaps of window pane oyster shells and clams at Chollangi.

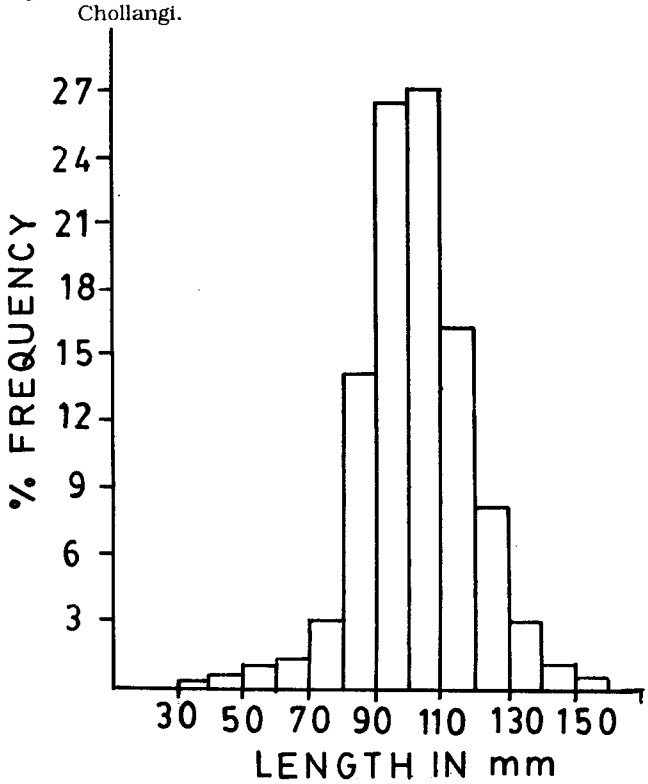

Fig 12. Length distribution of *P. placenta*

12,000 t, ranking first among the molluscan resources of the bay. This resource is not exploited to the full extent due to lack of sufficient demand (Fig. 11). The dominant length group in the fishery is 90-120 mm (Fig. 12) (one year age group). The major season is April-August, during which about 75% of the landings occurs.

Crassostrea madrasensis The edible oyster contributed on a minor scale to the fishery during 1991-'93. The green mussel *Perna viridis* is nominally represented in the landings (Table 1).

Gastropods

The landings of gastropods ranged from 940 t in 1988 to the maximum of 3,291 t in 1993. Their contribution to the molluscan landings varied from about 40% in 1991 to 74% in 1993. Five species contribute substantially to the gastropod fishery (Fig. 3d).

Cerithidea fluviatilis is quantitatively the most exploited gastropod species contributing about 990 t and forms 32% of the total molluscan landings of the bay. Their landings varied from 590 t in 1988 to 2,130 t in 1993. The major season for the landings is from November to April, during which about 66% of the annual landings takes place.

Umbonium vestiarium is the next important gastropod contributing 9.5% to the molluscan landings of the bay. The landings varied from 43 t in 1987 to 127 t in 1990 with an average of 2,92 t. The important season for the landings of this species is October-March, during which about 70% of the annual landings takes place.

Telescopium telescopium: on an average contributed about 221 t forming 7.2% of the total molluscan landings of the bay. The landings showed a progressive increase from 38 t in 1988 to about 450 t in 1992 and 1993. They are mostly collected during October-April and about 69% of the annual landings takes place during the above period (Fig. 13).

Fig 13. Heaps of gastropod shells like *Telescopium* and clams at Chollangi

Thais rugosa landings mainly (about 70%) take place during October-February. On an average about 79 t are landed annually, constituting 2.6% of the molluscan catches. Their landings were chiefly observed during 1988 and 1993.

Hemifusus pugilinus are landed on an average of about 35 t per annum, forming 1% of the total landings. They are chiefly collected during October-March and about 73% of the annual landings occur in the above period. Their landings reached considerable magnitude during 1992 and 1993.

The other species of gastropods that occur in the landings are *Neritina depressa*, *Murex trapa* and *Turritella acutangula*. In general it is observed that gastropod landings mostly take place during October-March/April period during which bivalve landings are relatively low (Fig. 14).

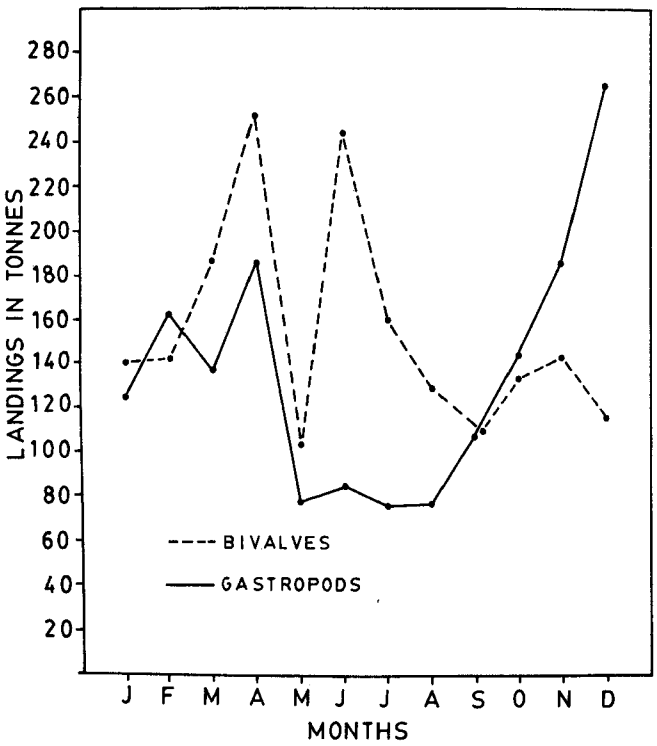

Fig 14. Seasonal variations in the landings of bivalves and gastropods.

Utilization

Traditionally all molluscan shells are used for making lime. However, in the recent years there has been considerable diversification in their utilization. Among the clam shells, *A. granosa* is mostly used for ornamental purpose. Other shells that are used in ornamental industry are *H. pugilinus* and *U. vestiarium*. Clam meat is being increasingly used as feed for prawns. However, the utilization of clam meat is seasonal. All other shells are used in lime, carbide industry and poultry feed. The opercula of *Neritina depressa* and few other gastropods are in great demand for their use in unani medicine. Similarly pearls from *Placenta placenta* (Windowpane oyster) are in good demand for use in unani medicine.

Generally live bivalves and gastropods are brought to the shore and allowed to decay for about a fortnight, before they are marketed. In case of any demand for clam meat, it is extracted by boiling the live clam. Similar is the case with windowpane oyster. The opercula are extracted, dried and sold in bulk quantities after accumulating sufficient quantities.

Price structure

The price of *A. granosa* shells ranged from Rs. 348/t in 1988 to 2,900/t in 1992. The small sized shells fetch better price. The price of other clam shells ranged from Rs. 500/t in 1989 to about Rs.1,200/t in 1993. The shells of *G. bengalensis* commanded better price and ranged between Rs.1,500 in 1989 to Rs.2,000/t in 1992. On an average the price of gastropod shells ranged between Rs. 300 in 1989 and about Rs. 700/t in 1993. The price of clam meat ranged from Rs. 4,000/t in 1990 to Rs. 4,800/t in 1992 (Fig. 15). The price of opercula of gastropods is about Rs. 450/kg and that of windowpane oyster pearls Rs. 90,000/kg. Totally about 3 to 4 kg of pearls were harvested during April 1993 and about 5 to 6 kg of opercula every month during 1992 and 1993.

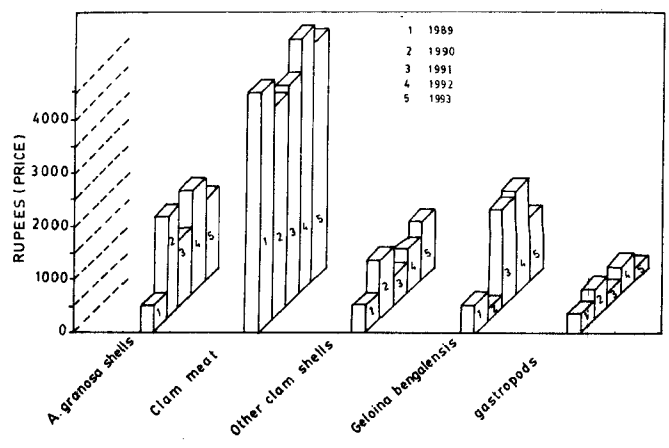

Fig 15. Price structure Rs./t of important groups of molluscs from the Kakinada bay during different years.

Stock assessment

The catch and effort data of 1988-'93 were used for assessing the stock by Schaefer and Fox models. The detailed yield curves are presented in Fig. 16. Schaefer model gave an MSY of 3,603 t of total bivalve and gastropod catch at an effort of 1,04,281 man-days. However, Fox model gave an MSY of 3,796 t with an effort of 1,38,313 man-days.

Remarks

The clams available in the Kakinada bay have the distinction of being the largest in size reported from India. The size of *M. meretrix* is 84 mm, *P. malabarica* 86 mm, *A. granosa* 85 mm, *K. opima* 56 mm found in the bay when compared to the sizes reported from both the coasts of India. This possibly indicates the stability of the ecosystem and the favourable interaction of species with the environment. Considering the availability of a variety of molluscan species and other fauna and the age of the bay (about 125 years) this unique bay requires protection from possible over-exploitation of biota and pollution.

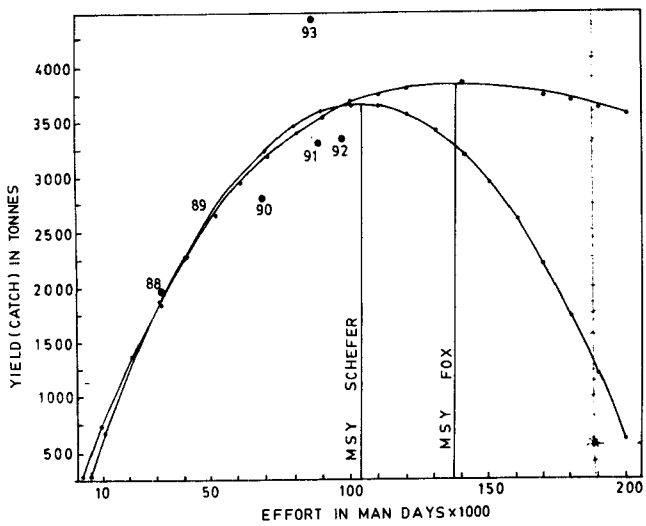

Fig 16. Yield curves of bivalves and gastropods from the Kakinada bay based on surplus production models.

The Kakinada bay is surrounded by thousands of acres of shrimp farms which discharge enormous quantities of pond waste water containing utilised putrified food into the bay. Hence regular monitoring of the effects of this qualitatively unknown shrimp pond waste water on the ecosystem and faunal elements is required for critical evaluation and implementing suitable management measures.

The meat of most of the molluscs goes unutilised during a good part of the year. It is well known that meat of molluscs is nutritious and therefore should be popularised.

The resource position of *P. placenta* is good compared to other molluscs. Its utilization in shell craft industry needs to be promoted.

Narasimham *et al.* (1984, *op.cit.*) estimated the molluscan resources of the Kakinada bay at about 22,000t. Among them *Placenta placenta* formed about 56%. The average landings during 1988-'93 were estimated at 3,100 t of which *P. placenta* formed only negligible quantity. Stock assessment by Schaefer and Fox models indicates the MSY at 3,600 and 3,880 t respectively which shows that the current level of exploitation is slightly on a lower side. Among these two, Schaefer model appears to be more appropriate as it is giving better catch rate. However, exploitation of small sized clams or concentration on a particular species like *A. granosa* may lead to overexploitation and species imbalance. Although no restrictions on the fishery are required under the current exploitation levels, judicious exploitation of the resources should receive adequate attention.