

## PRESENT STATUS OF CLAM FISHERIES OF INDIA \*

K. A. NARASIMHAM \*\*

*Central Marine Fisheries Research Institute, Cochin-682 031*

### ABSTRACT

Among the exploited bivalve resources of India, clams are by far the most abundant. Several species belonging to a number of families constitute the clam resources and they are exploited all along the Indian Coast. In recent times a steady export market for the frozen clam meat is being developed. The distribution of clams, their biology, ecology, physiology, exploitation, resource potential, utilisation and marketing are reviewed in this paper. Based on this review, the lacunae in the present state of our knowledge for the development of clam fisheries and the constraints thereof are identified. In view of their sedentary habits and easy accessibility for exploitation, the clams are particularly vulnerable for overexploitation. The thrust areas where research input is required for the rational exploitation of clam resources are highlighted in this paper.

### INTRODUCTION

Among the exploited bivalve resources of India, clams are by far the most widely distributed and abundant. Several species belonging to a number of families constitute the clam resources and they are exploited all along the Indian Coast. A number of clam species, belonging to the families Arcidae, Veneridae, Tellinidae, Donacidae, Solenidae, Mesodesmatidae, Corbiculidae and Tridacnidae are exploited along the Indian Coast and considerable work was done on species of majority of these families. While some general accounts on the clams of India are available (Jones, 1970; Alagarwami and Narasimham, 1973; Nayar and Mahadevan, 1974; Silas *et al.*, 1982; Alagarwami and Meiyappan,

1989) a comprehensive review of the work done on this group is wanting. Further, due to the realisation about the high nutritive of clams and their importance in the economy of the coastal fishing villages coupled with the development of an export market for the frozen clam meat, stimulated research which resulted in a wealth of information on this important group during the last decade. In this article an attempt was made to review the work done on aspects of biology, ecology, physiology and fisheries of commercially important clams of India; based on this review the lacunae in the present state of knowledge and the constraints for the development of clam fisheries were identified. The thrust areas where research input is required for rational exploitation of clam resources are highlighted.

\* Presented at the 'Symposium on Tropical Marine Living Resources' held by the Marine Biological Association of India at Cochin from January 12-16, 1988.

\*\* Present address: Tuticorin Research Centre of Central Marine Fisheries Research Institute, Tuticorin-628 001.

The author is thankful to Dr. P. S. B. R. James, Director for encouragement and to Shri S. Mahadevan, Central Marine Fisheries Research Institute for suggesting improvements in the text.

## BIOLOGY AND ECOLOGY

## Family: Arcidae

*Anadara* spp. are popularly called as ribbed clams, ark shells, cockles, blood cockles and blood clams. Of the various species, considerable work was done only in *A. granosa*. In this species Patel and Patel (1964, 1974) worked on haemoglobin, dimensional relationships and pea-crab infestations, Patel *et al.* (1966) on the uptake of Manganese-54, Radhakrishna and Ganapathi (1968) on zonation, Narasimham (1969, 1983, 1985, 1988a, 1988b) on maturity, spawning, sex ratio, condition index, dimensional relationships, pea-crab infestation, age and growth and population dynamics, Krishnamurthy and Ramamurthy (1969) on the rate of feeding and Narasimham *et al.* (1984) on ecology.

In *A. rhombea*, Patel and Patel (1964, 1974) studied haemoglobin, dimensional relationships and pea-crab infestation, John (1977) on bioaccumulation of iron, Natarajan and John (1983) on maturity, spawning and sex ratio, Narasimham (1988c) on maturity, spawning, sex ratio, condition index, dimensional relationships, age and growth and Hameed and Paulpandian (1987) on feeding and digestive rhythms.

## Family: Veneridae

Venerid clams are the most soughtafter in the clam fisheries of India and three genera namely *Meretrix*, *Katylisia* and *Paphia* are important.

*Meretrix meretrix*, known as the giant clam was the object of study for spawning (Hornell, 1922; Rai, 1932), behaviour in waters of low salinity (Ranade and Kulkarni, 1973), effects of temperature and salinity on the oxygen consumption (Ranade, 1973), body component indices and chemical composition (Nagabhushanam and Deshmukh, 1976), growth on transplantation (Rao and Rao, 1983) and age and growth (Jayabal and Kalyani, 1986).

*Meretrix casta* is one of the most extensively studied species. Hornell (1922) and Panikkar and Aiyar (1937) gave information on spawning, Venkataraman and Chari (1951) on biochemical composition, Abraham (1953) on the biology, Durve (1963, 1964, 1973, 1975) on the rate of filtration, spawning, growth on transplantation and change of form, Durve and Dharmaraja (1965, 1969, 1972) on the dimensional relationships, change of form and fatness, Silas and Alagarwami (1967) on pea-crab infestation, Seshappa (1971) on growth and spawning, Parulekar *et al.* (1973, 1984) on ecology and aspects of biology, Durve and George (1973) on condition index, Salih (1974, 1978 a, 1978 b) on growth, oxygen consumption and salinity tolerance, Wafer (1975) on biochemical composition, Harkantra (1975 a, 1975 b) on ecology and aspects of biology, Vijayaraghavan *et al.* (1975) on caloric value, Krishnakumari *et al.* (1977) on aspects of biology and biochemistry, Gopalakrishnan *et al.* (1977) on biochemical composition, Lakshmanan and Nambisan (1980, 1983) on biochemical composition and seasonal variations in trace metal content, Rao *et al.* (1980) on ecology, Mathew and Menon (1982) on oxygen consumption, Sreenivasan (1983 a, 1983 b, 1985) on ecology, spawning and growth on transplantation, Mohan *et al.* (1984) on allometric relationships, Balasubramanyam and Natarajan (1988 a, 1988 b) on biochemical composition and growth, Rao (1988) on spawning, growth and condition index and Joseph and Joseph (1988) on spawning and growth.

Desai (1971) and Kurian (1972) commented on the habitat preference of '*M. ovum*'.

On *Katylisia opima*, Rao (1952) reported on maturity, spawning and growth, Mane (1973, 1974, 1975, 1976, 1981) on early larval development, adaptations to low salinity, oxygen consumption, growth, spawning and biochemical composition, Ranade and Kulkarni (1973) on effects of temperature and salinity on oxygen consumption, Ranade (1973) on

behaviour and adaptations to low salinity, Nagabhushanam and Mane (1975, 1983) on reproduction and neurosecretion, Krishnamoorthy and Soman (1975) on uptake of Tritium, Mane *et al.* (1979) on effect of pesticides and narcotics, Kalyanasunderam and Kasinathan (1983) on age and growth, Sreenivasan (1985) and Joseph and Joseph (1988) on maturity, spawning and growth.

Joshi and Bal (1965) studied the chemical composition in *K. marmorata*.

In *Paphia malabarica*, Krishnakumari and Rao (1974) gave an account on pea-crab infestation and condition index, Vijayaraghavan *et al.* (1975) on caloric value, Parulekar *et al.* (1984) on ecology and Rao (1988) on maturity, spawning, age, growth and dimensional relationships.

In *P. laterisulca*, Nagabhushanam and Dhamne (1977 a, 1977 b) studied the spawning and neuroendocrinology, Mane and Nagabhushanam (1979) on maturity, spawning, dimensional relationships, age and growth and Mane and Dhamne (1980) on salinity tolerance.

Winckworth (1931) made observations on the growth of *P. undulata*.

#### Family : Donacidae

Among the members of this family, popularly called as wedge or bean clams, considerable information is available on *Donax cuneatus*. Maturity, spawning, age, growth and dimensional relationships were studied by Nayar (1955), reproduction by Rao (1967), respiration by Rao and Kutty (1968) and Mane and Talikhedkar (1976), neurosecretory cells, reproduction and biochemical composition by Nagabhushanam and Talikhedkar (1975, 1977 a, 1977 b), growth by Talikhedkar (1978), effect of pesticides and narcotics by Mane *et al.* (1979) and reproductive biology and population density by Victor and Subramoniam (1988 a, 1988 b).

Alagaraswami (1966) gave an account of maturity, spawning, age, growth and dimensional relationship in *D. faba* while Rao and Kutty (1968) studied respiration.

In *D. incarnatus*, Ansell *et al.* (1972, 1973) made observation on the population density, growth, length-weight relationship, condition index and biochemical composition Vijayaraghavan *et al.* (1975) on the caloric value, Nair *et al.* (1978) on growth, Balasubramanyan *et al.* (1979) on energy content, Parulekar *et al.* (1984) on aspects of biology and Mohan *et al.* (1986) on allometric relationships.

#### Family : Solenidae

Clams belonging to this family are known as razor clams. Rao *et al.* (1964) gave an account of maturity, spawning, age, growth and dimensional relationships in *Solen kempii* and Vijayaraghavan *et al.* (1975) worked on the caloric value.

#### Family : Corbiculidae

*Villorita cyprinoides*, popularly known as the black clam, was studied by Nair and Shynamma (1975 a, 1975 b) for biochemical composition and salinity tolerance, by Nair (1975) for growth, Vijayaraghavan *et al.* (1975) for caloric value, by Lakshmanan and Nambisan (1980, 1983) for biochemical composition and trace metal content, Ansari *et al.* (1981) for biochemical composition, Chatterji *et al.* (1984) for growth, Parulekar *et al.* (1984) for ecology, Achari (1988 a) for larval development and Joseph and Joseph (1988) for population density, spawning, age and growth.

### CLAM FISHERIES

In India, while the effort expended and catch of finfish and crustacean species are regularly monitored, such a system is not in vogue for clams mainly because the fishing is generally seasonal and is carried on, on a subsistence level at several small centres.

Nevertheless, surveys conducted by different authors at important production centres have yielded valuable information on clam fisheries. There are no regulations for the exploitation of live clams. The land is given on lease by Government for the exploitation of subsoil shell deposits.

#### Species-wise clam production

In Table 1 are given the species-wise estimated annual production of live clams at different centres along the Indian Coast. It may be noted that the production figures for various centres pertain to different years. Where more than one study was conducted from the same area, the latest information alone was given.

Of the estimated annual production of 45,412 t of clams, the black clam *Villorita cyprinoides* with a catch of 29,077 t forming 64%, is the mainstay of the clam fisheries. This species forms a fishery along the west coast in Goa, Karnataka and Kerala States in the saline and also in near freshwater habitat. Major production centres are the Vembanad and Ashtamudi Lakes (Table 1).

Next in importance are the venerid clams with an estimated annual production of 14,052 t forming 30.9%. These clams are widely distributed and form fishery in all the maritime States where clams are currently exploited. In this group, *Katelysia opima* is most important with 5552 t followed by *Meretrix casta* (4642 t), *Paphia malabarica* (1793 t) and *M. meretrix* (965 t).

The blood clam *Anadara granosa* accounts for 2,000 t/year and forms 4.4% of the clam landings (Table 1).

Other commercially important clam species, collected usually in small quantities at various places and for which catch statistics are not available are *P. laterisulca*, *K. marmorata*, *Gafrarium tumidum*, *Mesodesma glabratum*, *Tellina* sp., *A. rhombea*, *Donax cuneatus*, *D. faba*

and *D. incarnatus*. In the Nicobar group of islands, Ramadoss (1983) mentioned about the exploitation of the giant clams *Tridacna maxima*, *T. groceae* and *T. squamosa*.

#### Statewise production of clams

There is no information from Gujarat, Orissa and West Bengal. It may be due to the absence of exploitation rather than the non-availability of the resources. For the erstwhile Bombay Presidency (including parts of Karnataka), Rai (1932) estimated the production of clams at about 1,800 t/year. The only other study which gave an estimate of the clam production in Maharashtra State (1,100 t/year, Table 1) was by Ranade (1964). The production from Goa was 887/year (Table 1).

Of all the maritime States, clam production of Karnataka State was intensively studied. In the Kalinadi Estuary, earlier, Alagarwami and Narasimham (1973) estimated the annual production at 1 000 t, Nayar *et al.* (1984) at 2 000 t, Neelakantan *et al.* (1985) at 69 to 662 t and Rao *et al.* (1989) at 545 t. For the Mulky Estuary, Rao (1984) estimated the annual clam landings to vary between 271 to 951 t, Rao and Rao (1985) at 500 t and Rao *et al.* (1989) at 2,392 t (Table 1) indicating considerable fluctuations in the catches. In 7 estuaries in (Karnataka Table 1), Rao and Rao (1985) estimated the annual production of clams at 1,550 t. However, in a recent study Rao *et al.* (1989) indicated the annual catch of the Karnataka State, wherein 10 estuaries are productive at 6,592 t.

Kerala State stands far ahead of all maritime States in clam production with a catch of 32,927 t which accounts for 72.5% of the total clam landings. The Vembanad and Ashtamudi Lakes account for the above production (Table 1). Rasalam and Sebastian (1980) estimated the production of *V. cyprinoides* in 1968 at 27,000 t while in recent times the catch has come down to 21,490 t (Table 1).

TABLE 1. Clam production at different centres

Place	Production (t/year)		Source
	*Species-wise	Total	
Thane to Ratnagiri	Mm & Ko 70% Pl, Km & Dc rest	1,100	Ranade (1964)
Gav-khadi	Sk	3	Rao <i>et al.</i> (1964)
Goa	Vc 500, Mc 315	887	Parulekar <i>et al.</i> (1973); Ansari <i>et al.</i> (1981)
Kalinadi	Vc 525, Mm 20	545	Rao <i>et al.</i> (1989)
Aghmashini	Mc 500, Mm 250, Vc 5	755	„
Uppunda	Mc 10, Ko 65, Pm 80	155	„
Coondapur	Mc 50, Mm 40, Ko 5, Pm 500, Vc 8	603	„
Sita	Mc 230, Mm 5, Ko 5, Vc 5	245	„
Swarna	Vc 15	15	„
Udyavara	Mc 215, Pm 5, Vc 5	225	„
Mulky	Mc 1814, Pm 578	2392	„
Gurpur	Mc 300, Pm 600, Vc 375	1275	„
Nethravathi	Mc 233, Vc 149	382	„
Vembanad Lake	Vc 21490	21490**	Achari (1988 b)
Ashthamudi	Ko 5552, Vc 6000	11437	Appukuttan <i>et al.</i> , (1988)
Vellar Estuary	Mc over 87%	985	Sreenivasan (1985)
Pulicat Lake	Mc 102	102	Thangavelu and Sanjeevaraj (1988)
Kakinada Bay	Ag 2000, Mm 400, Ko 40, Pm 30, Dc 30	2,500	Narasimham (1973) Silas <i>et al.</i> (1982)
Godavari Estuary	Mm 250	250	Narasimham (unpublished)
Bhimunipatnam Backwater	Mc 66	66	Rao <i>et al.</i> (1980)
	Total	45,412	

\* Mm = *Meretrix meretrix*, Mc = *M. casta*, Ko = *Katylsia opima*, Pm = *Paphia malabarica*,  
Pl = *P. laterisulca*, Dc = *Donax cuneatus*, Sk = *Solen kempfi*, Vc = *Villorita cyprinoides*,  
Ag = *Anadara granosa*

\*\* Average for 1974-85.

Along the east coast of India the clam resources are smaller. In Tamil Nadu, the Vellar Estuary and the Pulicat Lake together contribute to 1,087 t while in Andhra Pradesh the clam production, coming from the Kakinada Bay, the Godavari Estuary and Bheemuni-patnam Backwater was estimated at 2,816 t.

#### Stock assessment of clams

In India few studies were conducted to assess the stock position of the clam populations. In Karnataka, based on the surveys conducted during 1979-80, Rao and Rao (1985) estimated the standing stock of clams in 11 estuaries at 5345 t with *M. casta*, *V. cyprinoides* and *P. malabarica* accounting for about 88%, 7% and 4% respectively. In a recent study by Rao *et al.* (1989), also conducted in Karnataka during February-May, 1984 in 8 estuaries (Table 1), the standing stock of clams was estimated at 8,027 t comprising *M. casta* 70.3%, *V. cyprinoides* 12.8%, *P. malabarica* 11.3% and *M. meretrix* 5.5%. These studies showed wide variation in the abundance of clams in some estuaries over a period of 4-5 years. For example the standing stock of clams in Coondapur during April, 1979 was 1,167 t against 19 t in May, 1984, in Udyavara during December, 1980 it was 1,457 t against 34 t in May, 1984 and in Mulky the standing stock was 1,603 t in March, 1979 against 4,369 t in May, 1984. Also, considerable changes in the species composition are discernible such as the appearance of *P. malabarica* in the Gurpur Estuary (Rao *et al.*, 1989). Recently Joseph and Joseph (1988) estimated the Y max of *M. casta* in Netravathi - Gurpur at 661 t, in Mulky at 2,581 t, in Udyavara at 1592 t and in Coondapur at 8,110 t. The same authors gave the Y max of *K. opima* in Mulky as 1,035 t.

In the Kakinada Bay, during March-April, 1983, the standing stock of the blood clam, *A. granosa* was estimated at 6,895 t and that

of *M. meretrix* at 1,082 t (Narasimham *et al.* 1984). In a detailed investigation on the population dynamics of *A. granosa* in the Kakinada Bay Narasimham (1988 a) estimated the instantaneous rates of total (Z), natural (M) and fishing mortality (F) at 3.9, 1.3 and 2.6 respectively. The age at recruitment ( $t_r$ ) = 0.29 yr. and age at first capture ( $t_c$ ) = 1.0 yr. This study suggested that at the present level of F, maximum YW/R value of 10.42 g is possible if  $t_c$  is reduced to 0.6 yr.

#### Exploitation of shell deposits

As in the case of five clams, the production of shells from subsoil deposits pertain to different years (Table 2). An estimated 1,76,610 t of subsoil shell deposits, also called lime shell, are exploited annually. The shells of the black clam dominate in the Vembanad Lake; *Meretrix*, *Cardium*, *Tellina*, *Arca*, *Pitar*, etc. in the Pulicat Lake and Venerid clams in other places. The production of lime shell in 1968 from the Vembanad Lake was estimated at 2,00,000 t (Rasalam and Sebastian, 1980), but it has come down to 41,000 t to 70,000 t during 1979-84 (Achari, 1988 b); however, the production of lime shell was higher by 17,000 t in the Pulicat Lake compared to 40,000 t in 1914-15 estimated by Hornell (1916).

The estimated reserve of the lime shell in Karnataka estuaries is 21,35,700 t (Gopal *et al.*, 1976; Venkataraman and Bahat, 1978) suggesting vast scope to step up production.

#### Fishing methods

The live clams are collected by men, women and children at low tides in shallow waters as well as in the intertidal region. They are taken either by hand-picking or by using hand-operated scoop or rake nets (Alagarwami and Narasimham, 1973). In the shallow waters, collection of clams is made without using any diving aids. A spade or a knife is used in sandy substratum to remove the clams. The shells from the subsoil deposits are exploited

TABLE 2. *Exploitation of subsoil shell deposits (mostly clams)*

Place	Annual production (t)	Source	Remarks
Kalinadi	24,500	Rao <i>et al.</i> (1989)	
Aghnashini	7,600	"	
Sharavathi	100	"	
Venkatapur	100	"	
Coondapur	20,436	Rao (1983)	Average for 1975-76 to 1981-82
Swarna	9,000	Rao <i>et al.</i> (1989)	
Vembanad Lake	52,764	Achari (1988 b)	Average for 1979-84
Athankarai	3,995	James (1978)	
Pulicat Lake	57,215	Thangavelu and Selvaraj (1988)	Production in 1980
Bahundi	500	Alagarawami & Narasimham (1973)	
Chilka Lake channel	400	"	
Total	1,76,610		

by hand-operated shell dredge (Rao, 1983) or by suction type mechanical dredge (Rasalam and Sebastian, 1980). Non-powered wooden country craft are used for transport. In mud flats, wooden planks may be used for propulsion.

#### Utilisation

Along the west coast, the clams are consumed mostly by the poorer sections of the coastal population, particularly during the monsoon when there is a general cessation of fishing activity in the sea. Along the east coast they are eaten to a limited extent only. Of late, the clam meat is used as a feed in aquaculture of prawns. The shell is used in the manufacture of cement, calcium carbide, sand-lime bricks and lime. The lime-shell is used for manuring coffee plantations, as a mortar in building construction, in the treatment of effluents, as a pesticide by mixing with copper sulphate and in the glass, rayon, polyfibre, paper and sugar industries (Hornell, 1916, Alagarawami and

Narasimham, 1973; Rasalam and Sebastian, 1980; Rao, 1984). In recent times frozen clam meat is exported to Japan. In 1984, 1.072 t of frozen clam meat (mostly *K. opima*) valued at Rs. 1.51 crore was exported.

#### Marketing

The clams are marketed near the production centres either by numbers or by volume. At the production centres in Karnataka, *P. malabaricus* fetches the maximum price of shell-on weight while *M. casta* and Rs. 1,000 per tonne *V. cyprinoides* are priced at Rs. 200-400/t; the lime-shell is sold at Rs. 50-100/t (Rao *et al.*, 1989). The price realised by *A. granosa* is Rs. 500/t at Kakinada.

#### GENERAL CONSIDERATIONS

The above review of work shows that the available data on clam resources are mostly based on sporadic surveys or collected by enquiry except for a few production centres such as some estuaries of Karnataka, the

Vembanad Lake and the Kakinada Bay from where we have a sound data base. From Gujarat, Orissa and West Bengal there is no information. Even in those States where some information was available, it is outdated such as for Maharashtra or incomplete in the sense that a good number of estuaries and backwaters were not surveyed as is the case in Kerala, Tamil Nadu and Andhra Pradesh. For undertaking any developmental programmes it is imperative to have information on the availability of resources. Regular monitoring of the catch and effort data of clams should be undertaken and to start with at least some of the major production centres should be covered. It is high time that priority is given to undertake comprehensive surveys to estimate the resource potential. The clam atlas of Karnataka prepared by Rao *et al.* (1989) is a beginning in this direction and similar studies are needed for other states.

While some work was done on ecology and aspects of biology such as size at first maturity, spawning, sex ratio, condition index, growth and biochemical composition of the commercially important clam species, information pertaining to life history, age composition of the commercial catches, recruitment pattern to the fishery, age at first capture and the mortality rates of the exploited stocks is meagre. Such information is vital to study the population dynamics of the clams which in turn will help to evolve suitable management measures for rational exploitation.

It may be mentioned that small sized clams are collected in considerable quantities both in the Vembanad and Ashtamudi Lakes (Achari, 1988 b; Appukuttan *et al.*, 1988). Such a practice would have adverse effect on the stock and a minimum size limit should be fixed for exploitation, by taking into account the length at first maturity.

Rao and Rao (1985) observed that *M. casta* occurs in high density of 110 t/ha in the Mulky

Estuary and Sreenivasan (1983 a) mentioned that seed clams (< 13 mm) occur at a density of 1,08,355 numbers per sq.m in the Vellar Estuary. By adopting a simple technique of transplantation to suitable areas production can be augmented as revealed by the studies of Rao and Rao (1983) and Narasimham (1983, 1986, 1988 b).

It is known that dredging for subsoil deposits in the Kakinadi and Vembanad Lake has damaged the habitat (Nayar *et al.*, 1984; Narasimham *et al.*, 1986; Achari, 1988 b). Similar habitat destruction occurs when civil engineering works are taken up. It is desirable to demarcate the area for dredging the subsoil shells and for fishing the live clams. To replenish the clam stocks 'clam sanctuaries' can be created.

There is limited demand for clams as food as they continue to remain as non-conventional item of food. There is need to develop acceptable products out of clam meat and a vigorous extension drive should be launched to expand the consumer market and explore the foreign markets. Such a step would result in increased production and also better market price.

Clams are known to accumulate heavy metals, marine toxins, sewage and pesticide pollutants. From India two instances of the outbreak of PSP due to consumption of *M. casta* were reported (Silas *et al.*, 1982; Karunasagar, 1984). A consignment of frozen clam meat sent to Japan was rejected as it was polluted by Kerosene (Appukuttan *et al.*, 1988). In view of the hazards of consuming clam meat contaminated by enteric pathogens and toxins, Ray and Rao (1984) stated that '... we recommended that monitoring for sanitary quality of shellfish growing waters and shellfish meats be undertaken immediately in areas of shellfish production and utilisation.' Apart from monitoring there is need to set up deputation facilities at major production centres.



## REFERENCES

- ABRAHAM, K. C. 1953. Observations on the biology of *Meretrix casta* (Chemnitz). *J. Zool. Soc. India*, 5 (2) : 163-190.
- ACHARI, G. P. K. 1988 a. Induced breeding and early development of *Villorita cyprinoides* var. *cochinensis* with comments on hatchery system. Proceedings of the National Seminar on Shellfish Resources and Farming, Tuticorin, India. *Bull. Cent. Mar. Fish. Res. Inst.*, 42 : 344-348.
- 1988 b. Characteristics of clam resources of Vembanad Lake — A case study. *Ibid.*, 42 : 10-13.
- ALAGARSWAMI, K. 1966. Studies on some aspects of biology of the wedge-clam *Donax faba* Gmelin from Mandapam Coast in the Gulf of Mannar. *J. mar. biol. Ass. India*, 8 (1) : 56-75.
- AND M. M. MEIYAPPAN 1989. Prospects and problems of management and development of marine molluscan (other than Cephalopods) in India. *Bull. Cent. Mar. Fish. Res. Inst.*, 44 : 250-261.
- AND K. A. NARASIMHAM 1973. Clam, Cockle and Oyster resources of the Indian Coasts. In: *Proc. Symp. Living Res. seas around India*. Central Marine Fisheries Research Institute Special Publication, Cochin, India, pp. 648-658.
- ANSARI, Z. A., A. H. PARULEKAR AND S. G. P. MATONDKAR 1981. Seasonal changes in meat weight and biochemical composition in the black clam *Villorita cyprinoides* (Gray). *Indian J. mar. Sci.*, 10 (2) : 128-131.
- ANSELL, A. D., P. SIVADAS AND B. NARAYANAN 1973. The ecology of two sandy beaches in Southwest India. Part IV. The biochemical composition of four common invertebrates. MBAI Special publication dedicated to Dr. N. K. Panikkar, pp. 333-348.
- , —————, ————— AND A. TREVALLION 1972. The ecology of two sandy beaches in southwest India. III. Observations on the population of *Donax incarnatus* and *D. spiculum*. *Mar. Biol.*, 17 : 318-332.
- APPUKUTTAN, K. K., K. PRABHAKARAN NAIR AND K. T. THOMAS 1987. Clam resources of the Ashtamudi Lake, with special reference to *Katetylia optima* fishery. Proceedings of the National Seminar on Shellfish Resources and Farming, Tuticorin, India. *Bull. Cent. Mar. Fish. Res. Inst.*, 42 : 14-20.
- BALASUBRAMANYAN, K. AND R. NATARAJAN 1988 a. Seasonal variation in the biochemical composition of *Meretrix casta* (Chemnitz) occurring in Vellar Estuary. *Ibid.*, 42 : 184-188.
- AND ————— 1987 b. Age and growth of *Meretrix casta* (Gmelin) in Vellar Estuary at Parangipettai. *Ibid.*, 42 : 145-147.
- BALASUBRAMANIAN, T., SUMITRA VIJAYARAGHAVAN AND L. KRISHNA KUMARI 1979. Energy content of the wedge clam *Donax incarnatus* Gmelin. *Indian J. Mar. Sci.*, 8 (3) : 193-195.
- CHATTERJI, A., Z. A. ANSARI AND A. H. PARULEKAR 1984. Growth of the black clam *Villorita cyprinoides* (Gray) from Calvale River (Goa). *Ibid.*, 13 (13) : 119-120.
- DESAI, V. N. 1971. Dominance of mollusca in the benthic population off Cochin. *J. Bombay nat. Hist. Soc.*, 68 : 355-362.
- DURVE, V. S. 1963. A study of the rate of filtration in the clam *Meretrix casta*. *J. mar. biol. Ass. India*, 5 (2) : 221-231.
- 1964. Preliminary observations on the seasonal gonadal changes and the spawning in the clam *Meretrix casta* (Chemnitz) from the marine fish farm. *Ibid.*, 6 (2) : 241-248.
- 1973. Experimental transplantation of the clam *Meretrix casta* (Chemnitz) in the marine fish farm. *Indian J. Fish.*, 20 (1) : 56-60.
- 1975. Change of form in the clam *Meretrix casta* (Chemnitz) during its growth. *Indian J. mar. Sci.*, 4 (2) : 207-208.
- AND S. K. DHARMARAJA 1965. A study on the dimensional relationship in the clam *Meretrix casta* (Chemnitz) collected from two localities. *J. mar. biol. Ass. India*, 7 (1) : 69-79.
- AND ————— 1969. On the probable change of form in the clam *Meretrix casta* (Chemnitz) during its growth. *Proc. Symp. Mollusca*, MBAI, pp. 387-395.
- AND ————— 1972. On the fatness of the clam *Meretrix casta*. *Indian J. Fish.*, 16 (1 & 2) : (1969) 170-173.
- AND K. V. GEORGE 1973. Some observations on the index of condition of the clam *Meretrix casta* (Chemnitz) in relation to mud and water qualities. *Ibid.*, 20 (2) : 326-332.
- GOPAL, B., M. MUNISWAMIAH AND B. M. K. REDDY 1976. Lime shell deposits of Mangalore Taluq, South Kanara Dt. Geological Studies, No. 114. *Dept. of Mines and Geology, Govt. of Karnataka*.
- GOPALAKRISHNAN, T. C., K. K. C. NAIR, M. G. PETER, V. N. SANKARANARAYANAN AND T. S. S. RAO 1977. Major biochemical constituents of some faunal components of the Cochin Backwater. *Indian J. Mar. Sci.*, 6 : 151-153.

- HAMRED, P. S. AND AL. PAULPANDIAN 1987. Feeding and digestive rhythms in intertidal bivalve molluscs, *Anadara rhombea* (Born) and *Crassostrea madrasensis*. *Indian J. Mar. Sci.*, 16 (3) : 151-154.
- HARKANTRA, S. N. 1975 a. Benthos of the Kali Estuary, Karwar. *Mahasagar—Bull. Natl. Inst. Oceanogr.*, 8 (1 & 2) : 53-58.
- 1975 b. Some observations on the clam beds of Kali Estuary, Karwar. *Ibid.*, 8 (1 & 2) : 101-108.
- HORNELL, J. 1916. The utilization of coral and shells for lime burning in the Madras Presidency. *Madras Fish. Bull.*, 11 : 1-51.
- 1922. The common Molluscs of South India. *Ibid.*, 14 : 97-215.
- JAMES, P. S. B. R. 1978. Subsoil shell deposit found at Añankarai. *CMFRI News letter*, 8 : 3.
- JAYABAL, R. AND M. KALYANI 1986. Age and growth of the estuarine clam *Meretrix meretrix* (L) inhabiting the Vellar Estuary. *Mahasagar—Bull. Natl. Inst. Oceanogr.*, 19 (2) : 141-146.
- JOHN, C. 1977. Bioaccumulation of iron in *Anadara rhombea* (Born) (Bivalvia : Arcidae). *Indian J. Mar. Sci.*, 6 (2) : 184-185.
- JONES, S. 1970. The molluscan fishery resources of India. *Proc. Symp. Mollusca*, MBAL, 906-918.
- JOSEPH, M. M. AND P. S. JOSEPH 1987. Biotic potential and environmental resistance of bivalves of Mangalore Coast. *Proceedings of the National Seminar on Shellfish Resources and Farming, Tuticorin, India. Bull. Cent. Mar. Fish. Res. Inst.*, 42 : 205-209.
- JOSHI, M. C. AND D. V. BAL 1965. Observations on the chemical composition of the clam *Katelysia marmorata*. *J. Zool. Soc. India*, 17 (1 & 2) : 108-113.
- KALYANASUNDERAM, M. AND R. KASINATHAN 1983. Age and growth in the estuarine clam *Katelysia optima* from the Vellar Estuary. *Indian J. Mar. Sci.*, 12 (4) : 247-248.
- KARUNASAGAR, I. 1984. Outbreak of paralytic shellfish poisoning in Mangalore, West coast of India. *Curr. Sci.*, 53 (5) : 247-249.
- KRISHNA KUMARI, L., M. D. RAJAGOPAL AND SUMITRA VJAYARAGHAVAN 1977. Some aspects of biology and biochemistry of the backwater clam *Meretrix casta* (Chemnitz). *Mahasagar—Bull. Natl. Inst. Oceanogr.*, 10 : 157-163.
- AND K. V. RAO 1974. Life history of the pea-grab *Pinnotherea vicatii* Chapgar infesting the clam *Paphia malabarica*. *Indian J. Mar. Sci.*, 3 (2) : 165-172.
- KRISHNAMOORTHY, T. M. AND S. D. SOMAN 1975. Uptake of Tritium in the marine bivalve *Katelysia optima*. *Ibid.*, 4 (1) : 47-49.
- KRISHNAMURTHY, S. AND V. D. RAMAMURTHY 1969. Studies on the rate of feeding of estuarine bivalve *Arca granosa* (Linne). *Proc. Symp. Mollusca*, MBAL, pp. 403-406.
- KURIAN, C. V. 1972. Ecology of benthos in a tropical estuary. *Proc. Ind. Nat. Sci. Acad.*, 38 (3 & 4) : 156-163.
- LAKSHMANAN, P. T. AND P. N. K. NAMBIAN 1980. Biochemical composition of the bivalve molluscs *Villorita cyprinoides* var. *cochinensis* (Hanley) and *Meretrix casta*. *Indian J. Mar. Sci.*, 9 (1) : 65-67.
- AND ————— 1983. Seasonal variation in trace metal content in bivalve molluscs *Villorita cyprinoides* var. *cochinensis* (Hanley), *Meretrix casta* (Chemnitz) and *Perna viridis* (Linnaeus). *Ibid.*, 12 (2) : 100-103.
- MANE, U. H. 1973. The early development of the clam *Katelysia optima*. *Marathwada Univ. J. Sci.*, 12 : 215-220.
- 1974. The adaptations of the estuarine clam *Katelysia optima* to the salinity fluctuations. *Rivista di Biologia*, 67 : 109-139.
- 1975. Oxygen consumption of the clam *Katelysia optima* in relation to environmental conditions. *Broteria*, 47 (71)-1-2 : 33-58.
- 1976. Growth and breeding habits of the clam *Katelysia optima* in the Kalbadevi Estuary at Ratnagiri. *Indian J. Fish.*, 21 (2) : 386-398.
- 1981. The edible clam *Katelysia optima* from the Ratnagiri Coast. *Mahasagar—Bull. Natl. Inst. Oceanogr.*, 14 (1) : 91-94.
- AND K. P. DHAMNB 1980. Adaptations of the clam *Paphia laterisulca* in Kalbadevi Estuary, West coast of India. *Indian J. Mar. Sci.*, 9 (2) : 131-134.
- , M. S. KACHOLE AND S. S. PAWAR 1979. Effect of pesticides and narcotics on bivalve molluscs. *Malacologia*, 18 : 347-360.
- AND R. NAGABHUSHANAM 1979. Studies on the growth and density of the clam *Paphia laterisulca* at Kalbadevi Estuary. *Ibid.*, 18 : 297-313.
- AND P. M. TALIKHEDKAR 1976. Respiration of the wedge-clam *Donax cuneatus*. *Indian J. Mar. Sci.*, 5 (2) : 243-246.
- MATHEW, R. AND N. R. MENON 1983. Oxygen consumption in tropical bivalves *Perna viridis* (Linne) and *Meretrix casta* (Chem.) exposed to heavy metals. *Ibid.*, 12 (1) : 57-59.
- MOHAN, M. V., R. DAMODARAN AND K. Y. M. SALIH 1984. Allometric studies in the clam *Meretrix casta* (Chemnitz). *Mahasagar - Bull. Natl. Inst. Oceanogr.*, 17 (2) : 119-124.

- \_\_\_\_\_, \_\_\_\_\_ AND \_\_\_\_\_ 1986. Allometric relationships in the wedge clam *Donax incarnatus* Gmelin. *Ibid.*, 19 (1) : 57-60.
- NAGABHUSHANAM, R. AND R. S. DESHMUKH 1976. Seasonal changes in body component indices and chemical composition in the estuarine clam *Meretrix meretrix*. *Indian J. Fish.*, 21 (2) : 531-542.
- \_\_\_\_\_, \_\_\_\_\_ AND K. P. DHAMNE 1977 a. Seasonal gonadal changes in the clam *Paphia laterisulca*. *Aquaculture*, 10 : 141-152.
- \_\_\_\_\_, \_\_\_\_\_ AND \_\_\_\_\_ 1977 b. Neuroendocrinology of the clam *Paphia laterisulca*. *Indian J. Mar. Sci.*, 6 (1) : 88-90.
- \_\_\_\_\_, \_\_\_\_\_ AND U. H. MANE 1975. Reproduction and breeding of the clam *Katelysia optima* in the Kalbadevi Estuary at Ratnagiri, West coast of India. *Indian J. Mar. Sci.*, 4 (1) : 86-92.
- \_\_\_\_\_, \_\_\_\_\_ AND \_\_\_\_\_ 1983. Some aspects of reproductive biology of the clam *Katelysia optima* Gmelin from Ratnagiri. *Proc. Symp. Coastal Aquaculture*, MBAI, 2 : 569-573.
- \_\_\_\_\_, \_\_\_\_\_ AND P. M. TALIKHEDKAR 1975. Neurosecretory cells in the cerebral and visceral ganglia of *Donax cuneatus*. *Bull. Dept. Mar. Sci., Univ. Cochin*, pp. 447-454.
- \_\_\_\_\_, \_\_\_\_\_ AND \_\_\_\_\_ 1977 a. Reproductive biology of the wedge-clam *Dona cuneatus*. *Indian J. Mar. Sci.*, 6 (1) : 35-38.
- \_\_\_\_\_, \_\_\_\_\_ AND \_\_\_\_\_ 1977 b. Seasonal variations in protein, fat and glycogen of the wedge clam *Donax cuneatus*. *Ibid.*, 6 (1).
- NAIR, A., S. G. DALAL AND Z. A. ANSARI 1978. Growth of the bean clam *Donax incarnatus* Gmelin from a sandy beach at Benaulim, Goa. *Ibid.*, 7 (3) : 197-199.
- NAIR, G. S. 1975. Studies on the rate of growth of *Villorita cyprinoides* var. *cochinensis* (Hanley) from the Cochin Backwater. *Bull. Dept. Mar. Sci., Univ. Cochin*, 7 (4) : 919-930.
- \_\_\_\_\_, \_\_\_\_\_ AND C. S. SHYNAMMA 1975 a. Seasonal variations in the lipid and calorific values in *Villorita cyprinoides* var. *cochinensis* (Hanley). *Ibid.*, 7 (2) : 403-408.
- \_\_\_\_\_, \_\_\_\_\_ AND \_\_\_\_\_ 1975 b. Studies on the salinity tolerance of *Villorita cyprinoides* var. *cochinensis* (Hanley). *Ibid.*, 7 (3) : 537-542.
- NARASIMHAM, K. A. 1969. Studies on some aspects of biology and fishery of the cockle *Anadara granosa* (Linnaeus) from the Kakinada Bay. *Proc. Symp. Mollusca*, MBAI, 2 : 407-417.
- \_\_\_\_\_, \_\_\_\_\_ 1973. On the molluscan fisheries of the Kakinada Bay. *Indian J. Fish.*, 20 (1) : 209-214.
- \_\_\_\_\_, \_\_\_\_\_ 1983. Experimental culture of the blood clam *Anadara granosa* (Linnaeus) in Kakinada Bay. *Proc. Symp. Coastal Aquaculture*, MBAI, 2 : 551-556.
- \_\_\_\_\_, \_\_\_\_\_ 1985. Studies on some aspects of the biology and fishery of the blood clams *Anadara (Tegillarca) granosa* (Linnaeus, 1758) and *A. (T.) rhombea* (Born, 1780) from the Kakinada Bay. *Ph.D. Thesis, Andhra University, Waltair* : pp. 268.
- \_\_\_\_\_, \_\_\_\_\_ 1986. The blood clam culture. R & D Series for Marine Fishery Resources Management, No. 12 : 3 pp. Central Marine Fisheries Research Institute, Cochin, India.
- \_\_\_\_\_, \_\_\_\_\_ 1988 a. Fishery and population dynamics of the blood clam *Anadara granosa* (Linnaeus) in the Kakinada Bay. Proceedings of the National Seminar on Shellfish Resources and Farming, Tuticorin, India. *Bull. Cent. Mar. Fish. Res. Inst.*, 42 : 130-134.
- \_\_\_\_\_, \_\_\_\_\_ 1988 b. Aspects of the blood clam *Anadara granosa* (Linnaeus) culture in Kakinada Bay. *Ibid.*, 42 : 313-317.
- \_\_\_\_\_, \_\_\_\_\_ 1988 c. Biology of the blood clam, *Anadara rhombea* (Born) in Kakinada Bay. National Seminar on Shellfish Resources and Farming, Tuticorin, India. *Ibid.*, 42 : 135-144.
- \_\_\_\_\_, \_\_\_\_\_, G. S. D. SELVARAJ AND S. LALITHA DEVI 1984. The Molluscan resources and ecology of Kakinada Bay. *Mar. Fish. Infor. Ser. T & E Ser.*, 59 : 1-16.
- \_\_\_\_\_, \_\_\_\_\_, G. S. RAO AND G. P. K. ACHARI 1986. The clam resources. R & D Series for Marine Fishery Resources Management, CMFRI, 9, 4 pp.
- NATARAJAN, R. AND G. JOHN 1983. Reproduction in the edible ribbed clam *Anadara rhombea* (Born) from the backwaters of Porto Novo. *Indian J. Mar. Sci.*, 12 (2) : 90-95.
- NAYAR, K. N. 1955. Studies on the growth of the wedge clam *Donax (Latona) cuneatus* Linnaeus. *Indian J. Fish.*, 2 : 325-348.
- \_\_\_\_\_, \_\_\_\_\_ AND S. MAHADEVAN 1974. Edible Bivalves : Clams and others. In : R.V. Nair and K. S. Rao (Ed.) : *The Commercial Mollusca of India*. *Bull. Cent. Mar. Fish. Res. Inst.*, 25 : 40-53.
- NAYAR, K. N., K. RAMADOSS AND C. T. RAJAN 1984. Molluscan resources of Kali River estuarine system in Karnataka. *Mar. Fish. Infor. Ser. T & E Ser.*, 58 : 1-8.
- NEELAKANTAN, B., U. G. BHAT, U. G. NAIK, K. K. PHILIPPOSE AND M. S. KUSUMA 1985. On the Molluscan resources in the Uttara Karnataka. *Proc. Symp. Harvest and post-harvest Tech. Fish.*, pp. 88-90.
- PANIKKAR, N. K. AND R. G. AIYAR 1939. Observations on breeding in brackishwater animals of Madras. *Proc. Indian Acad. Sci.*, B 9 : 343-364.

- PARULEKAR, A. H., S. N. DWIVEDI AND V. K. DHARGALEKAR 1973. Ecology of the clam beds in Mandovi, Cumberjua and Zuari estuarine system of Goa. *Indian J. Mar. Sci.*, 2 (2) : 122-126.
- , S. N. NAIR, Z. A. ANSARI, S. N. HARIKANTRA, A. CHATTERJI, B. S. INGOLE AND J. M. ROY 1984. Ecology and culturing of edible bivalves in Goa. *Ibid.*, 13 (4) : 190-192.
- PATEL, B., P. M. A. BHATTATHIRI AND G. S. DOSHI 1966. Uptake of Manganese-54 by ark-shell mollusc *Anadara granosa* (Linn.). *J. Anim. Morphol. Physiol.*, 13 : 158-168.
- AND S. PATEL 1964. Studies on the haemoglobin of *Anadara* species (Marine Lamellibranchs). *Ibid.*, 11 : 143-161.
- AND ——— 1974. Blood clams — Material for physiological and biochemical studies. *J. mar. biol. Ass. India*, 14 (2) : 555-563.
- RADHAKRISHNA, Y. AND P. N. GANAPATI 1968. Fauna of the Kakinada Bay. *Bull. Nat. Inst. Sci. India*, 38 : 689-699.
- RAI, H. S. 1932. The shell fisheries of the Bombay Presidency. *J. Bombay Nat. Hist. Soc.*, 35 (4) : 826-847.
- RAMADOSS, K. 1983. Giant clams (*Tridacna*) resources. In: K. Alagarwami (Ed.) *Mariculture Potential of Andaman and Nicobar islands — An indication study*. *Bull. Cent. Mar. Fish. Res. Inst.*, 34 : 79-80.
- RANADE, M. R. 1964. Studies on the biology, ecology and physiology of the marine clams. *Ph.D. Thesis, Bombay University*, 266 pp.
- 1973. Effects of temperature and salinity on the oxygen consumption in clams. *J. Bombay Nat. Hist. Soc.*, 70 (1) : 128-146.
- AND C. V. KULKARNI 1973. Observations on the behaviour of clams in waters of low salinity. *Ibid.*, 69 (3) : 616-634.
- RAO, G. S. 1983. Exploitation of clam shell deposits in the Kundapur Estuary. *Mar. Fish. Infor. Ser. T & E Ser.*, 49 : 20-22.
- 1984. Clam fishery of the Mulki Estuary during 1978-82. *Indian J. Fish.*, 31 (2) : 228-232.
- 1988. Biology of *Meretrix casta* (Chemnitz) and *Paphia malabarica* from Mulky Estuary, Dakshina Kannada. Proceedings of the National Seminar on Shellfish Resources and Farming, Tuticorin, India. *Bull. Cent. Mar. Fish. Res. Inst.*, 42 : 148-153.
- AND K. S. RAO 1985. Survey of clam and oyster resources of some Karnataka estuaries. *Indian J. Fish.*, 32 (1) : 74-89.
- , P. S. KURIAKOSE, N. RAMACHANDRAN, M. M. MEIYAPPAN, G. P. K. ACHARY, D. NAGARAJA AND H. S. SHIVANNA 1989. Atlas of clam resources of Karnataka. *CMFRI Spl. Publ.*, 46 : 1-53.
- RAO, K. S. 1967. Annual reproductive cycle of the wedge clam *Donax cuneatus* (Linnaeus). *J. mar. biol. Ass. India.*, 9 (1) : 141-146.
- AND G. S. RAO 1983. Experimental clam culture at Mulki, Dakshina Kannada. *Proc. Symp. Coastal Aquaculture, MBAI*, 2 : 557-560.
- RAO, K. V. 1952. Studies on the growth of *Katelysia optima* (Gmelin). *Proc. Indo-Pacific Fish. Coun. Sec.*, 11 : 94-102.
- , K. A. NARASIMHAM AND K. ALAGARSWAMI 1964. A preliminary account of the biology and fishery of the razor-shell *Solen kempfi* Preston, from Ratiagiri in Maharashtra State. *Indian J. Fish.*, 9 (2) (1962) : 542-579.
- RAO, S. R. AND M. N. KUTTY 1968. Resistance to desiccation and oxygen debt in wedge clams. *Proc. Symp. Mollusca, MBAI*, 3 : 595-606.
- RAO, V. R., T. A. RAO, S. REUBEN AND P. E. S. MANICKAM 1980. On the culture possibilities of *Meretrix casta* in Bhiminipatnam Backwater. *Indian J. Fish.*, 24 (1 & 2) : 263-268.
- RASALAM, E. J. AND M. J. SEBASTIAN 1980. Lime-shell fisheries of the Vembanad lake, Kerala. *J. mar. biol. Ass. India*, 18 (2) : 323-355.
- RAY, S. M. AND K. S. RAO 1984. *Manual on marine toxins in bivalve molluscs and general considerations of shell fish sanitation*. CMFRI Spl. Publ., 16 : 100 pp.
- SALIH, K. Y. MOHAMMED 1974. On the growth of the backwater clam *Meretrix casta* (Chemnitz) in the clam beds of Cochin bar mouth. *J. mar. biol. Ass. India*, 15 (1) : 345-353.
- 1978 a. Oxygen consumption in *Meretrix casta* (Chemnitz) in the Baypore and Korapuzha Estuary. *Indian J. Fish.*, 14 : 298-305.
- 1978 b. Salinity tolerance of *Meretrix casta* (Chemnitz). *Bull. Dept. Mar. Sci., Univ. Cochin*, 9 : 96-104.
- SESHAPPA, G. 1971. Some observations on the backwater clam *Meretrix casta* (Chemnitz) in the Beypore and Korapuzha estuaries. *Indian J. Fish.*, 14 (1 & 2) : 298-305.
- SILAS, E. G. AND K. ALAGARSWAMI 1967. On the instance of parasitisation by the pea-crab (*Pinnotheres* sp.) on the backwater clam *Meretrix casta* (Chemnitz) from India, with a review of the work on the systematics, ecology, biology and ethology of pea-crabs of the genus *Pinnotheres* Latreille. *Proc. Symp. Crustacea, MBAI*, 2 : 1160-1227.

- \_\_\_\_\_, \_\_\_\_\_, K. A. NARASIMHAM, K. K. APPUKUTTAN AND P. MUTHIAH 1982. Country report India. In: F. B. Davy and M. Graham (Ed.) *Bivalve Culture in Asia and the Pacific*. Proceedings of a workshop held in Singapore, 16-19 February, 1982. Ottawa, Canada. IDRC--200 : 34-43.
- SREENIVASAN, P. V. 1983 a. Distribution of *Meretrix casta* (Chemnitz) in Vellar Estuary. *Proc. Symp. Coastal Aquaculture, MBAI*, 2 : 561-563.
- \_\_\_\_\_ 1983 b. Growth of the clam *Meretrix casta* (Chemnitz) transplanted in the Vellar Estuary. *Ibid.*, 2 : 564-568.
- \_\_\_\_\_ 1985. Clam fishery resources of the Vellar Estuary. *Proc. Symp. Harvest and post-harvest Tech. Fish.*, pp. 57-62.
- TALIKHEDKAR, P. M., U. H. MANE AND R. NAGABHUSHANAM 1978. Growth rate of the wedge clam *Donax cuneatus* at Mirya Bay, Ratnagiri. *Indian J. Fish.*, 23 (1 & 2) : 183-193.
- THANGAVELU, R. AND P. J. SANJEEVARAJ 1988. Distribution of molluscan fauna in Pulicat Lake. Proceedings of the National Seminar on Shellfish Resources and Farming, Tuticorin, India. *Bull. Cent. Mar. Res. Fish. Inst.*, 42 : 58-67.
- VENKATKUMARAN, C. N. AND A. S. BHAT 1978. Limeshell deposits of coastal beds, North Kanara District, Karnataka. Geological studies No. 122. *Dept. of Mines and Geology. Govt. of Karnataka*.
- VENKATARAMAN, R. AND S. T. CHARI 1951. Studies on oysters and clams. Biochemical variations. *Ind. J. Med. Res.*, 39 : 533-541.
- VICTOR, A. C. C. AND T. SUBRAMONIAM 1988 a. Reproductive biology of the wedge clam *Donax cuneatus* Linnaeus. Proceedings of the National Seminar on Shellfish Resources and Farming, Tuticorin, India. *Bull. Cent. Mar. Fish. Res. Inst.*, 42 : 177-183.
- \_\_\_\_\_ AND \_\_\_\_\_ 1987 b. Population density of the wedge clam *Donax cuneatus* Linnaeus in and around Madras Coast. *Ibid.*, 42 : 42-46.
- VIJAYARAGHAVAN, S., M. V. M. WAFER, P. G. JACOB, T. BALASUBRAMANIAN, M. D. RAJAGOPAL AND L. KRISHNA KUMARI 1975. Caloric value of estuarine and marine organisms from Goa. *Mahasagar — Bull. Natl. Inst. Oceanogr.*, 8 : 9-14.
- WAFER, M. M. V. 1975. Biochemical composition of the lamellibranchs *Meretrix casta* (Chemnitz) and *Sanquinolaria diplos* (Gmelin). *Indian J. Fish.*, 21 : 289-292.
- WINCKWORTH, R. 1931. On the growth of *Pahia undulata* (Veneridae). *Proc. Mal. Soc.*, 19 : 171-174.