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Estuarine Clam Resources of Dakshina Kannada District

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ABSTRACT

The estuarine clam resources of Netravathi-Gurupur, Mulki, Udyavara and Coondapur estuaries were estimated based on a study on the distribution of clams in space and time. The three commercially important species were *Meretrix meretrix*, *M. casta* and *Katelsia opima*. The average standing crop values (wet wt./m²) were-Netravathi - Gurupur, 0.174; Mulki, 0.956; Udyavara, 0.863; Coondapur, 1.024. The estimated potential yields were 661 tonnes in Netravathi-Gurupur, 2581 tonnes in Mulki, 1592 tonnes in Udyavara and 8110 tonnes in Coondapur estuaries. The present rate of commercial exploitation was the highest in Netravathi-Gurupur (44 per cent) and the least (< 10 per cent) in all the other estuaries.

IN spite of their economic importance as an item of seafood providing cheap animal protein, the estuarine clams belonging to the family Veneridae (Bivalvia : Mollusca) have attracted only very little attention in India. Biology and fisheries of several venerids inhabiting the Indian coastal waters are known (Hornell, 1917, 1922; Rao, 1941, 1951; Abraham, 1953; Durve and Dharmaraja, 1965, 1968), but quantitative data are lacking on their spatial and temporal distribution, resource potentials and rate of commercial exploitation, except for a few studies (Jones, 1970; Desai, 1971; Parulekar *et al.*, 1973; Alagarwamy and Narasimham, 1973). The Dakshina Kannada district has a coastline of 135 km with a good number of open estuaries where clams support year round fishery of considerable magnitude. No data are available on the standing crop of clams or the magnitude of commercial fishery. Therefore, an investigation was undertaken to study these aspects, and the results are presented in this paper.

MATERIAL AND METHODS

Clams were collected at monthly intervals from the Netravathi-Gurupur, Mulki, Udyavara and Coondapur estuaries during the period from December, 1972 to June 1974. In each estuary, nine stations were selected along three transects, the distance between adjacent transects being about 1 km. At each station, samples of clams were collected from the estuarine bed from within 50 cm² quadrants either by hand picking or with the aid of a clamdredge. In the laboratory, clams were analysed for species composition, number, size and wet weight. Water temperature and surface salinity were also recorded. The extent of clam beds in each of the estuary was determined by marking the upper and lower limits of the clam beds based on field observations and calculating the total area from Admiralty charts.

RESULTS AND DISCUSSION

Species composition: Five varieties belonging to three species of clams were

recorded from the estuaries during the present study. These were *Meretrix meretrix* var. *castanea* (Lamarck), *M. meretrix* var. *morphina* (Lamarck), *M. meretrix* var. *aurora* (Hornell), *M. casta* var. *ovum* (Hanley) and *Katelysia opima* (Gmelin). Populations of all the five varieties were recorded from the estuary at Coondapur while *M. meretrix* var. *castanea*, *M. casta* var. *ovum* and *K. opima* were found in good numbers in the Mulki estuary. Netravathi-Gurupur and Udyavara estuaries supported exclusive populations of *M. casta* var. *ovum*.

Standing crop: Table I presents the quantity in number and wet weight of clams per square metre of estuarine bed in the four estuaries during December 1972-June 1974. The seasonal variations in the estimated standing crop of clams in the four estuaries, expressed as wet weight per square metre.

In the Netravathi-Gurupur estuary there was only one species, *M. casta* var. *ovum*, the density of which ranged from 0.02 to 1.40 kg/m. Higher densities were recorded during the premonsoon (January-May) period than during the monsoon (June-September) and postmonsoon (October-December). The average standing crop was 0.174 kg/m². The estimated resource potential was about 661 tonnes and the average annual landing 288 tonnes. *M. casta* inhabiting this estuary was rather small sized with a mean shell-length of 29.6 mm and mean shell-height 24.1 mm.

Mulki estuary supported moderately good populations of clams during the period of study except during November 1973 and June 1974. The population density ranged from 0.03 to 5.33 kg/m². The estimated resources of the estuary was 2581 tonnes and the annual landings 240

tonnes. The mean shell-length and shell-height respectively of the three species were—*M. casta* 30.7 mm and 24.6 mm; *M. meretrix* 31.9 mm and 26.5 mm; *K. opima* 34.1 mm and 25.9 mm. Juveniles of all the three species were recorded during November-December.

The mean density in Udyavara estuary ranged from 0.10 to 3.7 kg/m². The average standing crop was 0.863 kg/m² and the estimated resources about 1592 tonnes. The fishery for clams was poor, with the annual landing constituting a meagre 72 tonnes. The mean shell-length was 26.7 mm and mean shell-height 21.97 mm. Juvenile clams were recorded during November.

Of all the estuaries studied, the Coondapur estuary supported the highest density of clams (mean density 1.024 kg/m²). The range in weight was from 0.1 to 6.21 kg/m². This estuary supported the highest estuarine clam resource with an estimated potential yield of 8110 tonnes against an average annual landing of 480 tonnes. The mean shell-lengths and shell heights were—*M. meretrix* var. *morphina* 52.8 mm and 42.8 mm; *M. meretrix* var. *aurora* 48.9 mm and 42.5 mm; *M. meretrix* var. *castanea* 35.5 mm and 28.7 mm; *M. casta* 29.8 mm and 23.8 mm; *K. opima* 37.9 mm and 32.7 mm.

Environmental factors: Whenever possible, variations in the two important environmental parameters, viz. water temperature and salinity, were followed in these estuaries. The lowest temperatures were during September (25.8°C) and the highest during March-May (32.0 to 33.7°C). The salinity of the estuaries ranged from almost fresh (S‰ 0.20) to typical marine (S‰ 36.0) conditions during the course of the study. The monsoon (June-September)

TABLE I

Spatial and temporal distribution of estuarine clams in the four estuaries during the period of study

Month	Station	Netravathi:Gurupur		Mulki		Udyavara		Coondapur	
		No./m ²	Wt/m ²	No./m ²	Wt/m ²	No./m ²	Wt/m ²	No./m ²	Wt/m ²
1	2	3	4	5	6	7	8	9	10
Dec. 1972	1	0	0	151	2.00	52	0.46	427	2.74
	2	56	0.51	4	0.13	335	2.36	236	1.95
	3	0	0	112	1.80	91	0.61	28	0.31
Jan. 1973	1	0	0	140	1.11	0	0	19	0.23
	2	59	0.63	101	1.61	180	1.11	179	1.79
	3	0	0	112	1.01	184	1.18	724	6.21
Feb.	1	0	0	161	2.41	64	0.68	322	3.12
	2	72	0.63	106	1.72	264	2.67	291	2.65
	3	0	0	183	1.61	184	1.86	*179	0.35
Mar.	1	0	0	105	1.67	279	2.46	100	0.99
	2	64	0.71	5	0.13	67	0.46	224	1.91
	3	0	0	4	0.09	499	3.69	252	2.13
Apr.	1	0	0	293	5.33	333	2.53	156	1.63
	2	100	1.40	73	1.14	84	0.69	257	2.58
	3	0	0	100	1.47	500	3.70	301	3.13
May.	1	0	0	125	2.01	277	1.97	37	0.44
	2	35	0.39	73	1.16	116	0.83	173	1.93
	3	0	0	66	1.07	400	2.83	484	5.39
June	1	0	0	53	0.59	23	0.27	123	1.15
	2	49	0.55	64	1.13	64	0.59	77	0.69
	3	0	0	52	0.72	112	0.91	63	0.64
July	1	0	0	71	1.27	77	0.67	27	0.31
	2	32	0.35	95	1.70	33	0.30	3	0.03
	3	0	0	73	1.35	241	2.07	73	0.68
Aug.	1	0	0	51	0.91	80	0.72	21	0.24
	2	15	0.18	65	1.11	50	0.45	17	0.19
	3	0	0	80	1.44	96	0.87	54	0.50
Sept.	1	0	0	204	2.44	145	1.50	28	0.30
	2	9	0.11	72	1.01	101	1.36	151	1.60
	3	0	0	216	3.19	161	1.66	93	0.97
Oct.	1	0	0	23	0.32	76	0.82	8	0.09
	2	13	0.13	55	0.78	37	0.45	84	0.89
	3	0	0	151	2.21	86	0.73	40	0.43
Nov.	1	0	0	18	0.25	0	0	*304	1.07
	2	17	0.07	0	0	*635	0.23	*198	0.67
	3	0	0	5	0.08	129	1.03	*208	0.73
Dec.	1	0	0	*108	0.30	27	0.29	*165	0.83
	2	2	0.02	*202	0.75	41	0.43	*236	1.13
	3	0	0	*107	0.41	21	0.28	*129	0.68

	1	2	3	4	5	6	7	8	9	10
Jan, 1974	1	0	0	22	0.21	47	0.19	*220	0.63	
	2	46	0.28	71	0.70	64	0.29	*113	0.37	
	3	0	0	109	0.97	25	0.11	*21	0.07	
Feb.	1	0	0	26	0.39	20	0.22	14	0.16	
	2	11	0.12	49	0.56	93	1.40	161	1.81	
	3	0	0	39	0.47	25	0.13	21	0.11	
Mar.	1	0	0	4	0.03	14	0.09	9	0.07	
	2	8	0.04	20	0.17	0	0	18	0.15	
	3	0	0	17	0.25	46	0.38	12	0.16	
Apr.	1	0	0	8	0.09	4	0.03	16	0.18	
	2	7	0.03	9	0.12	8	0.05	12	0.07	
	3	0	0	29	0.24	4	0.05	4	0.03	
May.	1	0	0	73	0.25	63	0.23	74	0.87	
	2	3	0.02	53	0.22	12	0.04	66	0.67	
	3	0	0	66	0.28	43	0.13	27	0.28	
	1	0	0	0	0	0	0	0	0	
	2	3	0.02	16	0.20	20	0.15	40	0.46	
	3	3	0	0	0	0	0	0	0	

months registered the lowest salinities due to heavy freshwater influx as a result of the heavy rainfall. However, variations in these environmental parameters did not result in variations in the quantitative distribution of clams. On the other hand, physical properties of the substratum seemed to limit the distribution and abundance of clams within the estuaries. *M. casta* was more abundant in sandy beds than in muddy habitats. These beds were characterised by the presence of coarse and very coarse sand (particle size: 500-1000 and 1000 to 2000 μ) and very low organic matter (<1 per cent) and sediment (<5 per cent). At certain regions in the Mulki estuary *M. casta* populations were recorded living buried in bottom sediments. These clams were characterised by blackish shell. *M. meretrix* and *K. opima* preferred muddy substrate to sandy regions. Larger sized *M. meretrix* individuals were collected from those regions where the water depth was more than 3 m during low tides.

Information on the commercial molluscs of Karnataka coast is meagre. While enlisting the commercial species of molluscs from Indian coasts, Jones (1970) observed that *Meretrix meretrix* supported good fisheries along the Maharashtra and North Canara coast, but in the Southern regions it was comparatively rare. Alagar-swamy and Narasimham (1973) reported predominance of two species viz. *M. casta* and *Vellorita cyprinoides* in the catches of Coondapur, Sitanadi, Malpe, Mulki, Gurupur and Netravathi estuaries. They stated that "South of Malwan, *Katylisia* spp. do not form a major constituent in the clam fishery". According to them, *Vellorita cyprinoides* occurred in good quantity and was sold in the Mangalore markets at a price higher than that of *M. casta*. The findings of the present study are contrary to these reports. We have recorded five varieties of clams in the estuaries of Dakshina Kannada out of which *M. casta* and *Katylisia opima* are landed in large quantities. *Vellorita*

cyprinoides has not been collected from any of the estuaries during the present study. Subsequently one of us (MJ) has located beds of *V. cyprinoides* in the upper reaches of the Netravathi-Gurupur estuary where the salinity is low. However, there is no fishery for this species although a few kgs are marked at times. Also, there were no commercial landings or marketing of *V. cyprinoides* in any of the estuaries during the period of study. What Alagar-swamy and Narasimham (1973) reported on *V. cyprinoides* is true only in the case of *K. opima*. Both species are darkly coloured and of comparable sizes. *V. cyprinoides* has a darker periostracum which is usually eroded at the umbo region. There are several other morphological differences also. Despite these, it looks probable that what they identified as *V. cyprinoides* was nothing but *K. opima* which was abundant in the Coondapur and Mulki estuaries and for which always higher demand and better price existed.

Quantitative data on the clam resources of Indian waters are scarce. A few recent workers have attempted to assess the resources or landings of clams from the west and north east coasts of India. Ranade (1964) stated that the annual clam landings from Maharashtra State was about 2,40,300 pounds, 70 per cent of which was constituted by *M. meretrix* and *K. opima*. The annual production of clams from Kalinadi, Karwar was about 1000 tonnes (Alagar-swamy and Narasimham, 1973). They also reported that in Kakinada bay about 400 tonnes of *M. meretrix* are landed annually, while along the Orissa coast the annual landing was about 500 tonnes and Chilka lake 400 tonnes. The estimated total catch of estuarine molluscs from Mandovi estuary and Cumbarjua canal of Goa was 887 tonnes per year, out of which *M. casta* contributed to 315 tonnes (Parulekar *et al.*,

1973). The highest biomass values were during July followed by a decline during August-December coinciding with active fishing. Standing crop expressed as kg dry weight/m² showed peaks during July-October at Banastarim and April-May and July-October at Rabandar. Values higher than 1.0 kg/m² were observed only during July at Rabandar and July-September at Banastarim. During the rest of the year the values were less than 0.4 kg/m². The present study shows that the estimated clam resources were about 661 tonnes in Netravathi-Gurupur estuary, 2581 tonnes in Mulki estuary, 1592 tonnes in Udyavara estuary and 8110 tonnes in Coondapur estuary. The estimated annual landings were about 288 tonnes in Netravathi-Gurupur estuary, 240 tonnes in Mulki estuary, 72 tonnes in Udyavara estuary and 480 tonnes in Coondapur estuary. Thus, the present rate of exploitation was about 44 per cent in Netravathi-Gurupur estuary, 9 per cent in Mulki estuary, 5 per cent in Udyavara estuary and 9 per cent in Coondapur estuary. The standing crop expressed as wet weight in kg/m² was less than 1.0 for Netravathi-Gurupur throughout the period under study. In the Mulki estuary the standing crop was more than 1.0 kg/m² during December 1972-October 1973 and less than 0.5 during the rest of period. In the Udyavara estuary during December 1972-September 1973 the standing crop values varied from 0.68 to 2.31 kg/m² while during the rest of the period they were less than 0.70 kg/m². During the first six months of study values higher than 1.60 kg/m² were recorded in the Coondapur estuary while during the rest of the period they were low (0.09 to 0.83 kg/m²). In all the four estuaries, changes in the standing crop with respect to seasons were not distinct. Also, it is probable that increased rate of commercial exploitation

would have resulted in reduction of standing crop as observed during the latter part of the study. The present study also indicates that the clam beds in the Netravathi-Gurupur are over-exploited while in all the other estuaries there is considerable scope for increased exploitation.

Although it is reported that the stability of clam beds depend on the quantity of organic matter present in the habitat (Swan, 1953), no such correlation was noticed in the present study as bulk of the population inhabited sandy beds with organic matter < 1 per cent which is lower than the world average of 2.5 per cent for nearshore sediments (Trask, 1939). The present observation agrees with a similar report by Parulekar *et al.* (1973) on *Meretrix casta* inhabiting the estuarine systems of Goa.

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REFERENCES

ABRAHAM, K. C., 1953. Observations on the biology of *Meretrix casta* (Chemnitz). *J. Zool. Soc. India*, 5: 163-190.

ALAGARASWAMY, K. AND NARASIMHAM, K.A., 1973. Clam, cockle and oyster resources of the Indian coasts. *Proc. Symp. Living Resources of the Seas around India, C.M.F.R.I., Cochin*, 648-658.

DESAI, B.N., 1971. Dominance of mollusca in the benthic population off Cochin. *J. Bombay nat. Hist. Soc.*, 68: 355-362.

DURVE, V. S. AND DHARMARAJA, S. K., 1965. A study on the dimensional relationship in the clam *Meretrix casta* (Chemnitz) collected from two localities. *J. mar. biol. Ass. India*, 7: 69-79.

DURVE, V.S. AND DHARMARAJA, S.K., 1968. On the probable change of form in the clam *Meretrix casta* (Chemnitz) during its growth. *Proc. Symp. Mollusca Mar. biol. Ass. India*, pt. 2: 387-395.

HORNELL, J., 1917. The edible molluscs of the Madras Presidency. *Madras Fish. Bull.*, 11: 1-51.

HORNELL, J., 1922. Common Molluscs of South India. *Madras Fish. Bull.*, 14: 1-31.

JONES, S., 1970. The molluscan fishery resources of India. *Proc. Symp. Mollusca, mar. biol. Ass. India*, Pt. 3: 906-918.

PARULEKAR, A.H., DWIVEDI, S.N. AND DHARGALKAR, V.K., 1973. Ecology of clam beds in Mandovi, Cumbarjira Canal and Zuari estuarine system of Goa. *Indian J. mar. Sci.*, 2: 122-126.

RANADE, M.R., 1964. Studies on the biology, ecology and physiology of the marine clams. *Ph.D. Thesis*, University of Bombay. pp. 226.

RAO, H.S., 1941. Indian shell fish and their fisheries. *Sci. Cult.*, 7: 69-78.

RAO, K. V., 1951. Studies on the growth of *Katelysia opima* (Gmelin). *Proc. Indo-Pacif. Fish. Council.*, 3: 94-102.

SWAN, E. F., 1953. IVth Annual Conference on clam research (U.S. Fish and Wildlife Service, Boothbay Harbour, Maine), 43.

TRASK, P. D., 1939. Organic content of recent marine sediments. Society for economic paleontology and mineralogy. Tulsa, Oklahoma, 736 pp.