

SURVEY OF CLAM AND OYSTER RESOURCES OF SOME KARNATAKA ESTUARIES

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ABSTRACT

Of an estimated standing stock of about 6700 tonnes of clams and oysters in the estuaries on the southwest coast of India between Mangalore and Honavar 80% were clams and 20% were oysters. Among clams *Meretrix casta* was the chief species, followed by *Villorita cyprinoides*, *Paphia malabarica*, *Meretrix meretrix* and *Katelysia opima*. The important oyster was *Crassostrea madrasensis*. Mulky, Udyavara and Coondapur were the more productive estuaries, among which Mulky topped with a production rate of 18 t/ha of clams and oysters.

INTRODUCTION

Clams and oysters constitute the major molluscan resource of the estuaries of India. Rai (1932) had made some observations on the resource of clams and oysters of the old Bombay Presidency, in which the coastal stretch of Karwar-Honavar was included. Later came the study of Alagaraswami and Narasimham (1973). Information on the magnitude of shell deposits in the Karnataka estuaries and their chemical composition was due to Gopal et al (1976) and Venkatakumaran and Bhat (1978). However, notwithstanding that a traditional sustenance fishery has been in existence since long, no detailed information on the distribution of live clams and oysters in the various estuaries of Karnataka is available. A survey of the estuaries in the region between Mangalore and Honavar in Karnataka, on the west coast of India, was therefore undertaken during 1979 and 1980 and the results are discussed here.

THE DURATION AND METHODS OF SURVEY

The Nethravathi estuary was surveyed in February 1979, the Gurpur and the Mulky in March 1979, the Udyavara in December 1980, the Swarna and the Sita estuaries in May 1979, the Coondapoor in April 1979, the Uppunda and the Sharavathi in March 1980, and the Bhatkal and the Venkatapur in October 1979 (Fig. 1). A galvanized iron quadrat frame of 50 x 50 x 10 cm provided with thick nails at four corners was used for sampling clams and

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oysters. The frame was fixed on the substratum and the contents inside was removed. The clams in it were separated by sieving through a 2-mm mesh. The number of clams present, their length, weight and maturity stages were recorded. On the oyster beds, the number of oysters in an area of 50 x 50 cm was determined by enumeration. Sampling was done at the rate of 10 samples/ha on the oyster beds and 5 samples/ha in clam beds. The larger coverage of oyster beds was because the oysters were not distributed as uniformly as clams in a given bed. From the samples the average density per sq.m was derived, applying which the estimate of the standing stock in the bed was made. Data

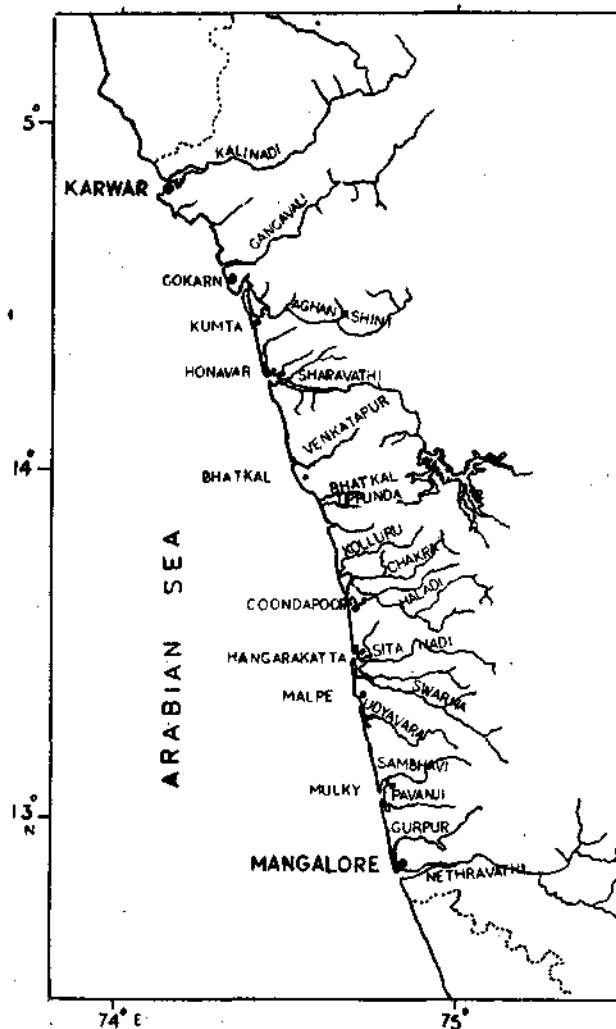


FIG. 1. Map showing the estuaries of Karnataka. The estuaries covered in the present study are from Sharavathi in the north to Nethravathi in the South.

on salinity, oxygen and temperature were collected from all the estuaries. The approximate area of each estuary was calculated from the relevant maps based on the extent of the estuarine area noted during survey. The serial numbers of the beds in the tables correspond to the numbers of beds plotted in the respective maps.

The exploited quantity of clams and oysters from the Nethravathi, Gurpur and Mulky was estimated by the authors, whereas for the other estuaries approximate landings for the preceding two years were collected on enquiry from the fishermen and merchants. Sediment samples, to a depth of 10 cm, were collected with the help of a corer from the clam beds. Having had the samples oven-dried, they were passed through a set of standard sieves ranging from 2000 μ to 63 μ in mesh size. The sand fractions were classified according to the Wentworth scale (Buchanan and Kain 1971) into: Granules (2000 μ), Very coarse sand (1000-2000 μ), Coarse sand (500-1000 μ), Medium sand (250-500 μ), Fine sand (125-250 μ), Very fine sand (62-125 μ) and Silt and Clay < 63 μ .

RESULTS

The Nethravathi Estuary

The Nethravathi estuary extends up to Parangipet in the east. Only two species of clams, *Meretrix casta* and *Villorita cyprinoides*, were found in this estuary (Fig. 2, Table 1). Oysters were absent. The estimated production rate of clams was 1.3 t/ha. *M. casta* was the dominant species forming 60%. The length range of *M. casta* was 16-25 mm, whereas *V. cyprinoides* was in the range of 15-33 mm.

TABLE 1. *Estimated clam resources of the Nethravathi estuary (as in February 1979).*

Bed No.	Area of bed (ha)	<i>M. casta</i>		<i>V. cyprinoides</i>		Standing	
		density (kg/m)	stock (t)	density (kg/m)	stock (t)	stock (t)	Annual landings (t)
1	21	0.91	191	—	—	191	
2	43	0.02	9	—	—	9	
3	5	0.42	21	—	—	21	
4	90	—	—	0.08	72	72	
5	16	—	—	0.46	74	74	
Total	175		221		146	367	150

According to Gopal et al (1976), shell deposits are completely absent in this estuary, indicating poor clam resource even during earlier periods.

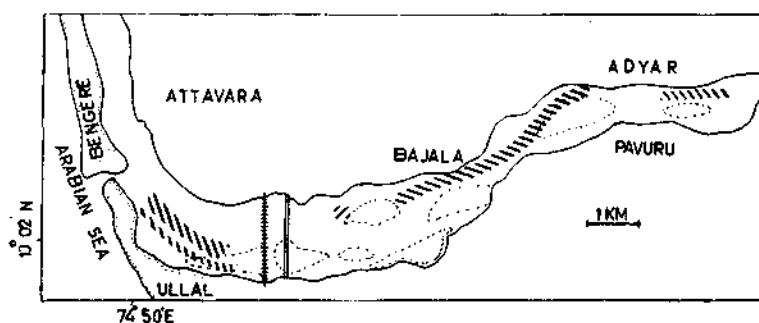


FIG. 2. Map showing the clam beds (shaded area) in the Nethravathi estuary.

The Gurpur Estuary

The Gurpur estuary extends eastwards up to Bajpe. In this estuary only two species of clams, *M. casta* and *V. cyprinoides* were present (Fig. 3, Table 2). Oysters were not found. *M. casta* progressively decreased from bed 1 to 5, which was however compensated by the presence of *V. cyprinoides*. *M. casta* was the major species, accounting for about 78% of the total clams. The estimated average production of clams was 7.9 t/ha. Seed clams of *M. casta* were found over the beds 1, 2 and 3 in high densities (2650, 1350 and 735/sq.m.). Seed clams of *V. cyprinoides* were found over the beds 3 and 4 at an average

TABLE 2. Estimated clam resources of the Gurpur estuary (as in March 1979).

Bed No.	Area of bed (ha)	<i>M. casta</i>		<i>V. cyprinoides</i>		Standing stock (t)	Annual landings (t)
		density (kg/m)	stock (t)	density (kg/m)	stock (t)		
1	20	0.82	164	—	—	164	
2	1	0.66	7	—	—	7	
3	8	0.42	34	0.08	6	40	
4	2	0.07	1	0.29	6	7	
5	6	0.03	2	0.78	47	49	
6	1	—	—	0.40	4	4	
Total	38		235*		65*	300	175

* Including seed clams

density of 555 and 188 per sq.m. The length range of *M. casta* was 16-26 mm, whereas that of *V. cyprinoides* was 20-30 mm. Subsoil shell deposits are reported to be absent (Gopal et al 1976)

The Mulky Estuary

This is one of the most important estuaries in Dakshina Kannada for clam and oyster resources (Fig. 4, Table 3).

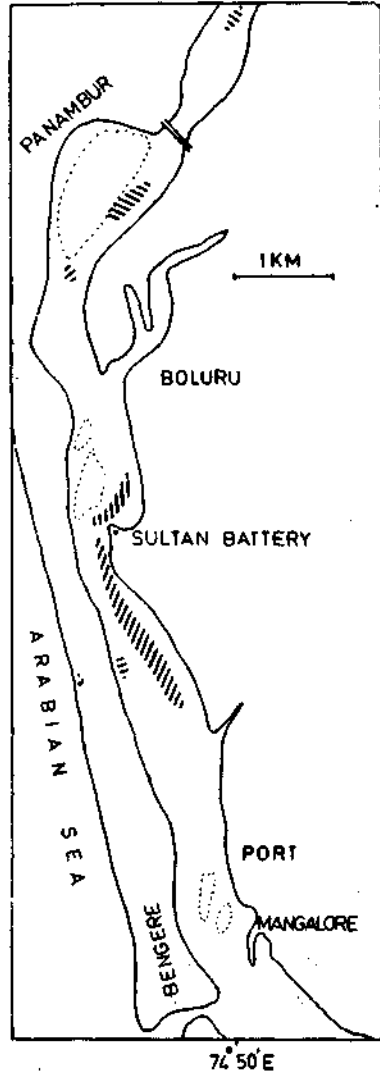


FIG. 3. Map showing the clam beds (shaded area) in the Gurgur estuary.

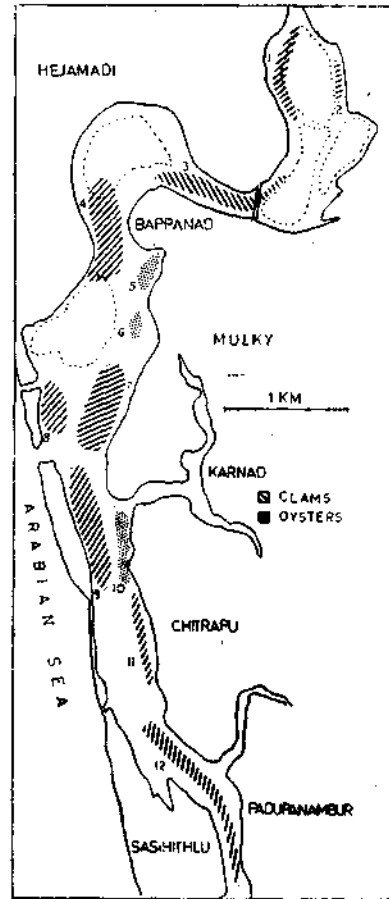


FIG. 4. Map showing the clam and oyster beds (shaded area) in the Mulky estuary.

TABLE 3. Estimated clam and oyster resources of the Mulky estuary (as in March 1979).

Bed No.	Area (ha)	<i>M. cista</i>		<i>P. malabarica</i>		<i>C. madrasensis</i>		<i>S. cucullata</i>		Standing stock (t)	Annual landings (t)	
		density (kg/m)	stock (t)	density (kg/m)	stock (t)	density (kg/m)	stock (t)	density (kg/m)	stock (t)		Clams	Oysters
1	5	11.00	550	—	—	—	—	—	—	550		
2	1	11.00	110	—	—	—	—	—	—	110		
3	15	3.53	530	—	—	—	—	—	—	530		
4	21	0.33	69	—	—	—	—	—	—	69		
5	2	—	—	—	—	2.55	51	0.30	6	57		
6	2	—	—	—	—	0.69	14	—	—	14		
7	18	0.85	153	—	—	—	—	—	—	154**		
8	5	0.68	34	—	—	—	—	—	—	34		
9	16	0.48	77	0.13	21	—	—	—	—	98		
10	3	—	—	—	—	5.98	179	—	—	179		
11	3	0.98	29	—	—	—	—	—	—	29		
12	11	0.26	29	—	—	—	—	—	—	29		
Total	102		1582*		21		244		6	1853	500	100

* Including seed clams.

** Includes *M. meretrix* and *K. opima*

M. casta was the dominant clam, forming about 99% of the total population. *Paphia malabarica* was the next in abundance. Other species of clams observed in stray numbers were *Meretrix meretrix* and *Katelysia opima*. The production rate of clams was 17 t/ha. Seed clams of *M. casta* were found over the beds 3, 7 and 8 in low densities (217, 94 and 95 /sq.m). *M. casta* were in the length range of 24-40 mm and *P. malabarica* in 37-47 mm.

Crassostrea madrasensis and *Saccostrea cucullata* were the oysters observed. They were in very shallow areas of the estuary particularly towards the banks, where the substratum was soft, though predominantly composed of medium sand. *C. madrasensis* was the dominant species constituting about 98% and *S. cucullata* 2%. The production rate over the oyster beds was 36 t/ha.

The Udyavara Estuary

The Udyavara estuary joins the sea near Malpe. *M. casta* was the major clam, forming about 85% of clam population (Table 4). This was followed by *P. malabarica*, 10%, and *V. cyprinoides*, 5%. *K. opima* was found rarely. The production rate of clams was 12.7 t/ha. Seed clams of *V. cyprinoides* were found in beds 3 and 4 in a density of 18 and 45 /sq.m. The length range of

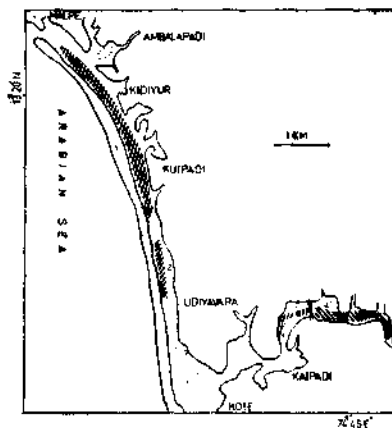


FIG. 5. Map showing the clam beds (shaded area) in the Udyavara estuary.

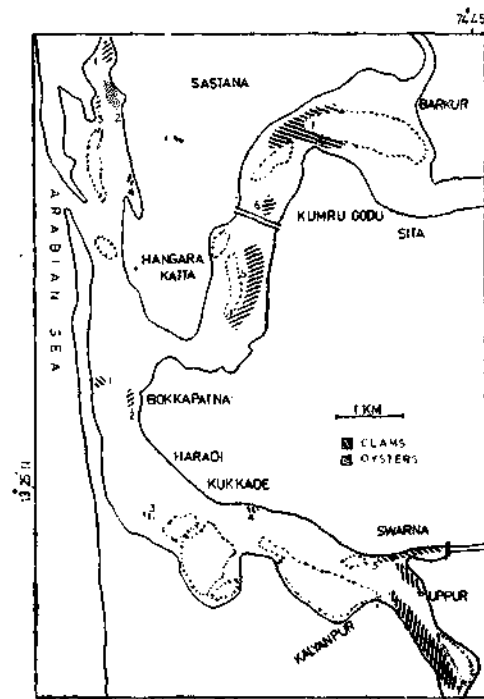


FIG. 6. Map showing the clam and oyster beds (shaded area) in the Swarna and Sita estuaries.

TABLE 4. *Estimated clam resources of the Udyavara estuary (as in December 1980).*

Bed No.	Area (ha)	<i>M. casta</i>		<i>P. malabarica</i>		<i>V. cyprinoides</i>		Standing stock (t)	Annual landings (t)
		density (kg/m)	stock (t)	density (kg/m)	stock (t)	density (kg/m)	stock (t)		
1	60	1.92	1152	0.24	144	—	—	1301**	
2	17	0.53	90	—	—	—	—	90	
3	11	—	—	—	—	0.17	19	19	
4	27	—	—	—	—	0.11	30	30	
Total	115		1242		144		66*	1457	250

* Including seed clams.

** Includes 5 t of *K. opima*.

M. casta was 25-35 mm, *P. malabarica* 33-51 mm, *V. cyprinoides* 22-32 mm and *K. opima* 32-45 mm.

C. madrasensis was found attached to the newly constructed wharf near the bar-mouth, on the northern side of the estuary, over an area of about 0.8 ha with a production rate of 30 t/ha. At present this bed remains unexploited because of the poor demand for oysters and the difficult approach.

The Swarna Estuary

In this estuary, which joins the sea near Hangarakatta, oysters were absent (Table 5).

TABLE 5. *Estimated clam resources of the Swarna estuary (as in May 1979).*

Bed No.	Area (ha)	Estimated standing stock				Standing stock (t)	Estimated Annual landings (t)
		<i>V. cyprinoides</i>		<i>M. casta</i>			
		density (kg/m)	stock (t)	density (kg/m)	stock (t)		
1	1	—	—	0.22	2	6**	
2	1	—	—	0.78	8*	8	
3	1	0.09	1	0.56	6	7	
4	1	0.09	1	—	—	1	
5	4	0.06	2	—	—	2	
6	4	0.32	13	—	—	13	
7	23	0.08	18	—	—	18	
Total	35		35		16	55	25

* Including seed clams.

** Includes 4 t of *K. opima* and *M. meretrix*

V. cyprinoides was the major clam forming about 60% of the clam population, the rest being constituted by *M. casta*. *K. opima* and *M. meretrix* were observed only in stray numbers. Seed clams of *M. casta* were observed in bed 2 at an average density of 1617 /sq.m. The production rate of clams over the clam beds was about 1.6 t/ha. The length range of *V. cyprinoides* was 22-35 mm, *M. casta* 22-35 mm, *K. opima* 24-35 mm and *M. meretrix* 20-45 mm.

The Sita Estuary

This estuary after confluencing with the Swarnanadi joins the sea near Hangarakatta. Both clams and oysters were observed (Table 6).

TABLE 6. Estimated clam and oyster resources of the Sita estuary (as in May 1979).

Bed No.	Area (ha)	Estimated standing stock						Standing stock (t)	Estimated Annual landings (t)	
		<i>M. meretrix</i> density (kg/m)	<i>M. meretrix</i> stock (t)	<i>V. cyprinoides</i> density (kg/m)	<i>V. cyprinoides</i> stock (t)	<i>C. madrasensis</i> density (kg/m)	<i>C. madrasensis</i> stock (t)		Clams	Oysters
1	2	0.02	1	—	—	—	—	2**		
2	4	—	—	—	—	2.28	91	91		
3	1	0.20	2	—	—	—	—	2		
4	1	0.23	2	—	—	—	—	2		
5	15	0.21	32	—	—	—	—	32		
6	4	0.80	32	—	—	—	—	32		
7	16	0.84	134	0.28	45	—	—	179		
Total	43		204*		45		91	340	75 50	

* Including seed clams.

** Includes *K. opima* and *M. meretrix*.

M. casta was the major clam forming about 82% of the clam population. *V. cyprinoides*, found beyond Mabakala bridge was the next important species. *M. meretrix* and *K. opima* were found sporadically in bed 1. The overall production of clams in this estuary was 6.4 t/ha. Seed clams of *M. casta* were observed in high densities (700 and 1664 /sq.m) over the beds 5 and 6. The length range of *M. casta* was 16-31 mm, *V. cyprinoides* 20-38 mm, *K. opima* 22-37 mm and *M. meretrix* 22-49 mm.

C. madrasensis was found in a very shallow area south of Iradi. The production rate was about 23 t/ha. The size range of this oyster was 41-160 mm.

The Coondapoor Estuary

This is one of the biggest estuarine systems in Karnataka, where both clams and oysters were found.

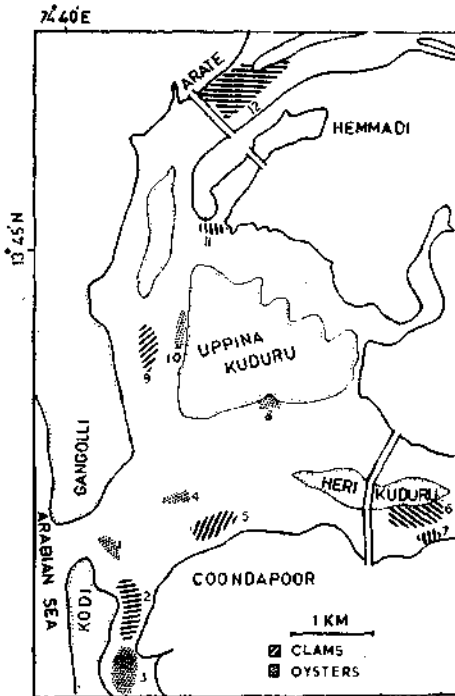


FIG. 7. Map showing the clam and oyster beds (shaded area) in the Coondapoor estuary.

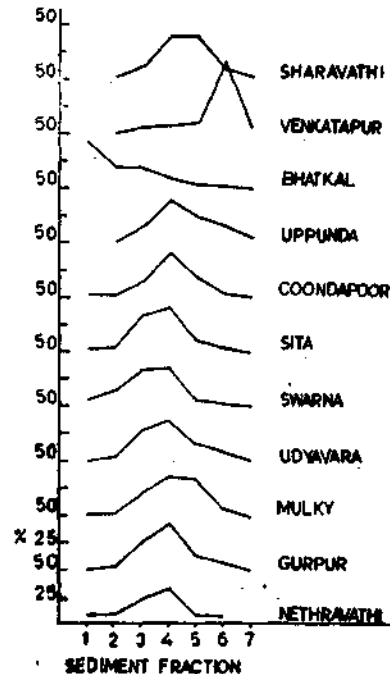


FIG. 8. Sediment composition of clam beds in different estuaries. 1 granules, 2 very coarse sand, 3 coarse sand, 4 medium sand, 5 fine sand, 6 very fine sand and 7 silt & clay.

M. casta was the major clam forming about 91% of the clam population. *M. meretrix* was the next in importance forming about 5%, followed by *P. malabarica* 4%. *P. malabarica* was found at a depth of 5 m near Gangolli. *K. opima* was found only in bed 10, in stray numbers. *V. cyprinoides* was observed occasionally, near Hattakuduru, opposite Basrur. The overall production of clams was about 16 t/ha (Fig 7, Table 7). The length range of *M. casta* was 17-29 mm, *M. meretrix*, 20-60 mm, *P. malabarica*, 29-40 mm and *V. cyprinoides*, 22-33 mm.

TABLE 7. Estimated clam and oyster resources of the Coondapoor estuary (as in April 1979).

Bed No.	Area (ha)	<i>M. casta</i>		<i>P. malabarica</i>		<i>M. meretrix</i>		<i>C. madrasensis</i>		<i>S. cucullata</i>		Standing stock (t)	Annual landings (t)	
		density (kg/m)	stock (t)	density (kg/m)	stock (t)	density (kg/m)	stock (t)	density (kg/m)	stock (t)	density (kg/m)	stock (t)		Clams	Oyster
1	3	—	—	—	—	—	—	3.64	109	0.73	22	131		
2	17	—	—	—	—	0.12	20	—	—	—	—	20		
3	118	—	—	—	—	—	—	0.46	83	0.05	9	92		
4	3	—	—	—	—	—	—	—	—	—	33	151		
5	10	—	—	—	—	0.09	9	9.93	118	1.09	—	9		
6	12	4.48	538	—	—	—	—	—	—	—	—	538		
7	2	0.16	3	—	—	—	—	—	—	—	—	3		
8	3	—	—	—	—	—	—	1.97	59	—	—	59		
9	10	—	—	0.41	41	0.30	30	—	—	—	—	70**		
10	2	—	—	—	—	—	—	0.69	14	0.19	4	18		
11	1	—	—	0.33	3	—	—	—	—	—	—	3		
12	20	2.26	452	—	—	—	—	—	—	—	—	452		
Total	101		1064*		44		59		383		68	1624	375	75

* Including seed clams

** Includes 6 t of *K. opima*

C. madrasensis and *S. cucullata* were found with an estimated production rate of 16 t/ha. These oyster beds were located in very shallow areas, mostly near the bank of the estuary over soft substratum. The size of *C. madrasensis* ranged between 21 and 120 mm, and *S. cucullata* between 20 and 49 mm.

The Uppunda Estuary

This is a small estuary near Baindoor, with no appreciable clam resource. Oysters were absent.

M. casta, *K. opima* and *M. meretrix* were found in very low densities, with a standing stock of 0.1, 0.1 and 1.8 tonnes respectively. In another bed *P. malabarica* and *M. meretrix* were found at a depth of 4 m, with a standing stock of 1 t and 0.4 t. The length range of *M. casta* was 19-28 mm, *M. meretrix* 20-39 mm, *K. opima* 25-34 mm and *P. malabarica* 24-39 mm.

The Bhatkal Estuary

This is a small estuary in Uttara Kannada. Oysters were absent. Among clams *P. malabarica* was the dominant species (73%), followed by *K. opima* (15%) and *M. casta* (12%) (Table 8).

The Venkatapur Estuary

Clams and oysters were present in this estuary.

P. malabarica was the chief clam, found near the bar mouth forming about 96% of the clam population and *M. casta* and *M. meretrix* forming the rest. *Anadara granosa* was found in stray numbers. The rate of production of clams over the beds was 4 t/ha.

C. madrasensis was found in two beds with a standing stock of about 23 t (Table 8).

The Sharavathi Estuary

This is one of the largest estuaries of Uttara Kannada. Both clams and oysters were present.

M. casta and *M. meretrix* were found near river mouth very sparsely distributed over an area of 11 ha. Another clam bed was near the Mavinakurve islet, 600 m east of Sharavathi bridge, in a shallow area. Here also the standing stock was negligible (Table 8). The length range of *M. casta* was 18-33 mm and *M. meretrix* 21-53 mm.

The *C. madrasensis* found only near the river mouth were all small, measuring 20-50 mm. The absence of oysters elsewhere in the estuary may be

TABLE 8. *Estimated clam and oyster resources of Bhatkal, Venkatapur and Sharavathi in Uttara Kannada.*

Bed No.	Area (ha)	<i>P. malabarica</i>		Estimated standing stock				<i>C. madrasensis</i>		Standing Stock (t)
		density (kg/m)	stock (t)	<i>M. casta</i> density (kg/m)	<i>M. casta</i> stock (t)	<i>K. opima</i> density (kg/m)	<i>K. opima</i> stock (t)	density (kg/m)	stock (t)	
Bhatkal estuary (as in October 1979)										
1	4	—	—	0.02	1	0.02	1	—	—	2
2	5	0.08	4	—	—	—	—	—	—	4
Total	9		4		1		1			6
Venkatapur estuary (as in October 1979)										
1	28	0.47	132	—	—	—	—	—	—	132
2	5	—	—	0.10	5	—	—	—	—	6**
3	11	—	—	—	—	—	—	0.16	18	18
Total	14		132		5				18	156
Sharavathi estuary (as in March 1980)										
1	11	—	—	0.01	1	—	—	—	—	1
2	11	—	—	—	—	—	—	4.68	515*	515
Total	22		136		1*		1		515	516
Grand Total	45		136		7		1		533	678

* Seed oysters

** Including *M. meretrix*

due to the continuous fresh water discharge from the Sharavathi hydroelectric project and the consequent low salinities. There is considerable difference in the salinity between the high tide (17.57 ‰) and low tide (5.89 ‰), even during summer.

An earlier survey (Venkatakumaran and Bhat 1978) had revealed the presence of good lime-shell deposits, indicating that there were good clam and oyster resources during the past.

Sediment Structure of Clam Beds

'Medium' sand is the predominant fraction of clam beds in all the estuaries of Dakshina Kannada. In the Bhatkal estuary, 'Granules' type of sand was

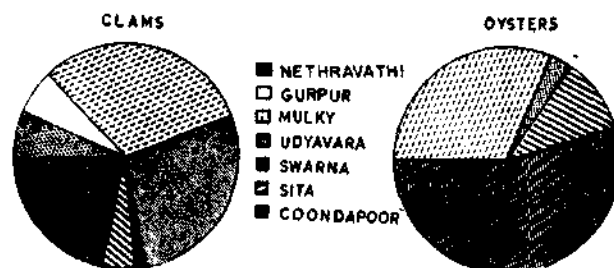


FIG. 9. Relative magnitude of clam and oyster resources in the estuaries of Dakshina Kannada.

predominant. In the Venkatapur 'Very fine sand' was the major fraction. In the Sharavathi, both 'Medium' and 'Fine' sand were almost in equal proportions (Fig. 8). The sand size in the Swarna, Bhatkal and Venkatapur estuaries were 575μ , 1600μ and 106μ , respectively, and that in the other estuaries were in the range $250-500 \mu$.

DISCUSSION

In Karnataka, the major estuaries are located in the Dakshina Kannada district, with an estimated total area of about 8800 ha. *Meretrix casta*, forming about 88% of the clams, occurs in all the estuaries with varying degree of abundance. The important estuaries for this species are the Mulky, the Udyavara and the Coondapoor, which together account for about 85% of the production of this species. Next in abundance is *Villorita cyprinoides*. This resource is also significant in most of the estuaries accounting for about 7% of the clam resource. The important estuaries for this species are the Nethravathi, the Gurpur, the Udyavara, the Sita and the Swarna. *Paphia malabarica*, which inhabits relatively deeper parts of the estuary, is always in better demand and has better price than any other clam. The average price per hundred clams of *P. malabarica* during the period of study was Rs. 2.50, when *M. meretrix* fetched Rs. 2.00, *V. cyprinoides*, Rs. 0.75 and *M. casta*, Rs. 0.50. *P. malabarica* is abundant in the Udyavara, Coondapoor and Mulky estuaries in that order. This species forms about 4% of the clam resources of Dakshina Kannada. *Meretrix meretrix* and *Katylisia opima* are of minor importance, though the former is better distributed in the Coondapoor estuary. Thus the Mulky, Udyavara and Coondapoor estuaries are the chief producers of clams (81%) in Dakshina Kannada.

Oysters are present in a few estuaries and their standing stock forms about 14% of the bivalve resource. The Coondapoor, Mulky and Sita have 97% of oysters. Among the Uttara Kannada estuaries surveyed, Venkatapur had good oyster resource. *Crassostrea madrasensis* is the dominant species (95%). The total area inhabited by clams and oysters in Dakshina Kannada is about 7% of the estuarine area.

Sediment is considered as one of the most important factors controlling the distribution and abundance of clams. Gray (1974) states many invertebrate larvae are able to delay metamorphosis until the suitable type of sediment is found. According to Gray (1966) though grain size of the sediment is very important it may not offer uniformly the same distribution.

Kristensen (1957) has observed that, where there are dense populations of adult cockles, the young ones are taken in by the inhalent siphon and then rejected covering them in mucus, so that, unable to free themselves, they perish. This may be one of the reasons for the sparse distribution of seed clams in the areas of adult population. It may be mentioned that the experiments on clam culture in ponds conducted at Mulky have indicated the possibility to grow *Meretrix casta* to marketable size, in an area where the substratum was loose and dominated by fine sand (Rao and Rao 1980a, b). Interestingly there was no seed fall in the ponds, although adult clams were observed in spawning condition. This indicated that sediment may act as a limiting factor for the seed fall. Though adult clams were observed in the substratum dominated by fine sand or medium sand, seed clams were found only on firm substratum with dominant Medium sand fraction. There were many areas in the estuaries with loose sandy or muddy bottom, where no natural seed fall occurred.

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