Bivalve resources of Moorad Estuary, north Kerala

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A bivalve resource survey of Moorad estuary in Badagara District of north Kerala was carried out during February 2004 to assess the bivalve species, their distribution and potential stock.

Sampling sites were fixed within five main zones of the Moorad estuary based on the clam fishery activities and local enquiries. The bivalve distribution in a unit area was taken by demarking the area of clam bed with a quadrant. Observations on the area of clam bed, water clarity, depth and temperature were recorded at each site. Surface and bottom water samples were collected and hydrographic parameters like salinity, temperature, pH and dissolved oxygen content, productivity, nitrate, phosphate and silicate were recorded. Sediment samples were collected to analyse the grain size and organic content of the clam beds. All samples were analysed within 24 h except sediment samples. Average density of bivalve per square metre area was analysed and the potential stock was estimated for each bivalve species in the estuary.

Ecology of the bed

The hydrographic parameters showed wide variations within the five zones. The average depth of the estuary was 1.55 m. The maximum depth of 2.77 m was recorded in Zone V and least in (0.6 m) in Zone I. The clarity of water was highest in Zone V (1.23 m) and lowest in Zone (0.48 m). The average clarity of water in the estuary was 0.87 m.

The surface temperature did not show much variation and it ranged from 28.1 °C to 30.5 °C reflecting an average surface temperature of 29 °C across the estuary. The surface salinity of the Moorad estuary showed almost a uniform pattern recording a high value of 34.6 ‰ in Zone I and a minimum of 23.2 ‰ in Zone V. The average surface salinity of the estuary was 31.4 ‰ indicating a uniform saline water influx upto the upper reaches of the estuary. High salinities were recorded in Zones I to III wherein direct tidal influx of seawater occurs at the barmouth. The average bottom water salinities also exhibited a similar trend and ranged from 24.2 ‰ in Zone V to 34.9 ‰ in Zone I. The average surface pH of the estuary was 7.7 with little variation from a low of 7.43 in Zone V to a high of 7.8 in Zone II. The soil pH recorded an average value of 7.2, ranging from 7.16 in Zone V to 7.37 in Zone IV.

The dissolved oxygen content of the surface water was high (3.5 ml l^{-1}) in Zone III indicating good mixing in this Zone and the minimum was 2.42 ml l^{-1} in Zone II. The average surface dissolved oxygen content in the estuary was 3.00 ml l^{-1}. The average surface water dissolved oxygen content of the bottom water was low (2.63 ml l^{-1}) in Zone I and a maximum of 3.38 ml l^{-1} was recorded in Zone III. The average bottom dissolved oxygen content in the estuary was 2.96 ml l^{-1}.

The highest gross productivity was recorded in Zone II at 1.09 mg C m^{-3} day^{-1} and lowest in Zone IV at 0.31 mg C m^{-3} day^{-1}. The average productivity in the Moorad estuary was 0.61 mg C m^{-3} day^{-1}. The maximum net productivity was 0.63 mg C m^{-3} day^{-1} in Zone II and minimum of 0.24 mg C m^{3} day in Zones III and IV. The average net productivity was 0.36 mg C m^{3} day.

The average nitrate content in the estuary was 0.77 µg at 1^{-1} with a high of 1.16 µg at 1^{-1} in Zone I and low of 0.36 µg at 1^{-1} in Zone V. The average silicate content in the estuary was 0.53 µg at 1^{-1} with a high of 0.64 µg at 1^{-1} in Zone V and low of 0.45 µg at 1^{-1} in Zone IV.

Soil composition: The Moorad estuary has predominantly sandy bottom and heavy quarrying of sand was prevalent in most parts of the estuary. Zone I was clayey, Zones II, III and IV were sandy and Zone V rocky in some parts and clayey in the upper reaches.

Bivalve resource

The Moorad estuary has significant populations of edible oyster *Crassostrea madrasensis*, *Saccostrea cuculata* as well as clams *Meretrix casta* and *Meretrix meretrix.* The Moorad estuary is dominant in edible oyster. However, there is little exploitation of the stock. *M. casta* is the only exploited resource in the estuary and significant fishery for the clam occurs from October to March.

Edible oysters are distributed all along the sides of Zones I to IV while clam beds occur in Zones II and III only. Both clams and oysters are totally absent in Zone V.

The average density of *M casta* in bed area of 152 ha was 1096 No. m^{-2} (Table 1). The average density of *M meretrix* was 96 No. m^{-2}. The average density of *C. madrasensis* in an area of 2.71 ha was 1286 No. m^{-2}. The average density of *S cucullata* was 143 No. m^{-2}.

Biomass of clam and edible oyster

The total average biomass of bivalves in the Moorad estuary was 112 kg m^{-2}. The average biomass of *M. meretrix*, *C. madrasensis* and *S. cuculata* were 0.7 kg m^{-2}, 97.8 kg m^{-2} and 11 kg m^{-2}, respectively.

Estimated population of clams and edible oysters in the Moorad Estuary:

The total estimated number of bivalves in the Moorad estuary was 9210 lakh in a total estimated bed area of 155 ha. *M. casta* (8418 lakh m^{-2}) contributed highest to the total estimated number, followed by *M. meretrix* (635 lakh m^{-2}); *C. madrasensis* 141 lakh m^{-2} and *S. cucullata* 16 lakh m^{-2}.

The total biomass (standing stock) of bivalves in the Moorad estuary was estimated as 3368 t in an estimated bed area of 155 ha. The estimated biomass of *M. casta* was 2074 t ha^{-1}**,** contributing 62% to the total biomass and *M. meretrix* 552 t ha^{-1} forming. 16% to the total biomass**.** The estimated biomass of *C. madrasensis* was 668 t ha^{-1} forming 20% of the total estimated biomass and *S. cucullata* 74 t ha^{-1} forming 2% of the total estimated biomass.

The total clam biomass was estimated at 2626 t forming 78% of the total estimated biomass. The total edible oyster biomass was estimated at 742 t forming 22% of the total estimated biomass in the Moorad estuary (Table 1).

Table 1. Estimated density and biomass of bivalves in the various zones of Moorad Estuary

	Area of distribution (ha)			Average density (No. m^{-2})					Estimated number (Lakhs)					Average biomass (g m^{-2})					Estimated biomass (t)				
	Clam bed	Oyster bed	Total	M c	M m	C m	S c	Total	M c	M m	C m	S c	Total	M c	M m	C m	S c	Total	M c	M m	C m	S c	Total
Zone I	Nil	0.23	0.2	Nil	Nil	225.00	25.00	250.0	Nil	Nil	51.75	5.75	57.5	Nil	Nil	22961.13	2551.2	25512.4	Nil	Nil	52.81	5.87	58.7
Zone II	57.33	0.71	58.0	523.60	71.40	254.70	28.30	878.0	3001.97	409.36	17.96	2.00	3431.3	745.42	289.88	25992.00	2888.0	29915.3	427.37	166.20	183.24	20.36	797.2
Zone III	94.67	1.19	95.9	572.16	23.80	403.20	44.80	1044.0	5416.45	225.31	47.78	5.31	5694.8	1738.75	407.85	24408.00	2712.0	29266.6	1646.01	386.10	289.23	32.14	2353.5
Zone IV	Nil	0.59	0.6	0.00	0.00	403.20	44.80	448.0	0.00	0.00	23.59	2.62	26.2	0.00	0.00	24408.00	2712.0	27120.0	0.00	0.00	142.79	15.87	158.7
Zone V	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Total	152.00	2.71	154.7	1095.76	95.20	1286.10	142.90	2620.0	8418.42	634.67	141.07	15.67	9209.8	2484.16	697.74	97769.13	10863.2	111814.3	2073.38	552.30	668.08	74.23	3367.99

M c: Meretrix casta; M m: Meretrix meretrix; C m: Crassostrea madrasensis, S c: Saccostrea cucullata