Environmental parameters of experimental pits in relation to the stocking density of the clams *Paphia mabarica* and *Katelysia opima* of Kalbadevi estuary, Ratnagiri

M.M. GIRKAR, G.N. KULKARNI, B.R. KHARTMOL, A.T. TANDALE AND S.S. TODKARI

Asian Journal of Environmental Science, Vol. 3 No. 2 : 152-157 (Dec., 2008 to May, 2009)

SUMMARY

The two species of edible clams, *Paphia malbarica* and *Katelysia opima* were stocked at five stocking densities *viz*. 50, 100, 200, 500 and 1000nos/m^2 in the pits (1m x 1m x 0.25m) dug in the tidal flat area of Kalbadevi estuary, Ratnagiri. During seven months period, (July 2002 to January 2003) surface water temperature and salinity in the experimental pits varied from 27 to 31^{0}C and 22 to 30 ppt, respectively without any particular seasonal trend. The maximum pH of 7.83 was at 50nos/m^2, while the minimum occurred at 1000nos/m^2. The dissolved oxygen (D O) fluctuated from 2mg/l at stocking density of 1000nos/m^2 to 5.62 mg/l at 100nos/m^2 in *P. malbarica* and 5.36 mg/l at 50nos/m^2. Both the pH and dissolved oxygen showed marginal and gradual decrease with the increase of stocking density and also with the progress of the season. Dissolved sulphide increased with increase in stocking density ranging from 0.43mg/l at 50nos/m^2 to the maximum 1.12 and 1.16mg/l at 1000nos/m^2 in case of *P. malbarica* and *K. opima,* respectively. The soil sulphide fluctuated from 1.26 mg/l at stocking density of 50 nos/m^2 to the maximum of 2.86 and 2.91mg/l at 1000nos/m^2, while the pH was 7.57 and 7.44 at 1000 nos/m^2, but both species had maximum of 8.47 at 50nos/m^2. Soil sulphide and organic carbon showed gradual increase with increasing stocking density but pH showed decrease with increasing stocking density.

See end of the article for authors' affiliations

Correspondence to :
M.M. GIRKAR
Department of Fishery Hydrography, College of Fishery Science, Udgir, LATUR (M.S.) INDIA

Edible clams form cheap but important source of nutrition and employment generation especially to the coastal people. Along the coast of Maharashtra state, vast areas including muddy bays, rocky inshore areas, estuaries and backwaters are known to support the molluscan resources comprising of clams, oysters and mussels forming regular fishery along the coast. The estuarine creeks of Ratnagiri support clam species namely, *Paphia malbarica*, *Katelysia opima* and *Meretrix meretrix* regularly commanding good market.

The venerid clam, *Paphia malbarica*, commonly known as false clam contributes 80 to 90% of the total frozen clam export from India (Appukuttan *et al*., 1999). The other species *Katelysia opima* is identified to be potential clam species for export purpose (Appukuttan *et al*., 2002). The clam meat, rich in protein, is the most preferred mollusc by the local people for regular consumption. Of late, the clam has gained popularity as supplementary food in semi- intensive prawn farming during the entire culture period including nursery phase (Kripa and Gopakumar, 1996). Clams contribute substantially to the total production of molluscs for human consumption as well as for raw material for the cement and lime industry. Clams are abundantly found along the entire coast of India, however the richer resources are found along the west coast of the country.

Traditionally, the clams are kept by the fisherman in pits serving as, 'live godown' by stocking 1200 to 1500 nos/m^2 for a short period of 8 to 10 days at Shirgaon, Ratnagiri, prior to their transport to Mumbai market. These pits are constructed alongside the creek in the intertidal region of Kalbadevi and Mirya estuaries. These pits are not managed properly and sometimes large scale mortality of the clams has been observed.

In view of the culture potential and the repeated incidences of mass mortality of clams in the pits, the present investigation was undertaken in the Kalbadevi estuary, Ratnagiri to standardize optimum stocking density of *P. malbarica* and *K. opima* with reference to sulphide level.

Accepted :
October, 2008

MATERIALS AND METHODS

Study area:

Shirgaon creek, which is a part of the

Kalbadevi estuary, was selected for the present study. This estuary is very wide but shallow and its major portion gets exposed during low tide. Twenty experimental pits (size 1m x 1m x 0.25m) were dug on the estuarine tidal flats, which are commonly used for live storing of the clams for short period by local fishermen before marketing. The experimental pits were stocked with *Paphia malbarica* and *Katelysia opima* at different stocking densities *viz*. 50, 100, 200, 500 and 1000nos / m^2 from July 2002 to January 2003. During the period of study, water and soil parameters *viz*. water temperature, salinity, pH, dissolved oxygen, sulphide and organic carbon were measured biweekly.

Plate 1: Stocking of clams *P. malbarica* and *K. opima* in the experimental pits at Kalbadevi Estuary, Ratnagiri

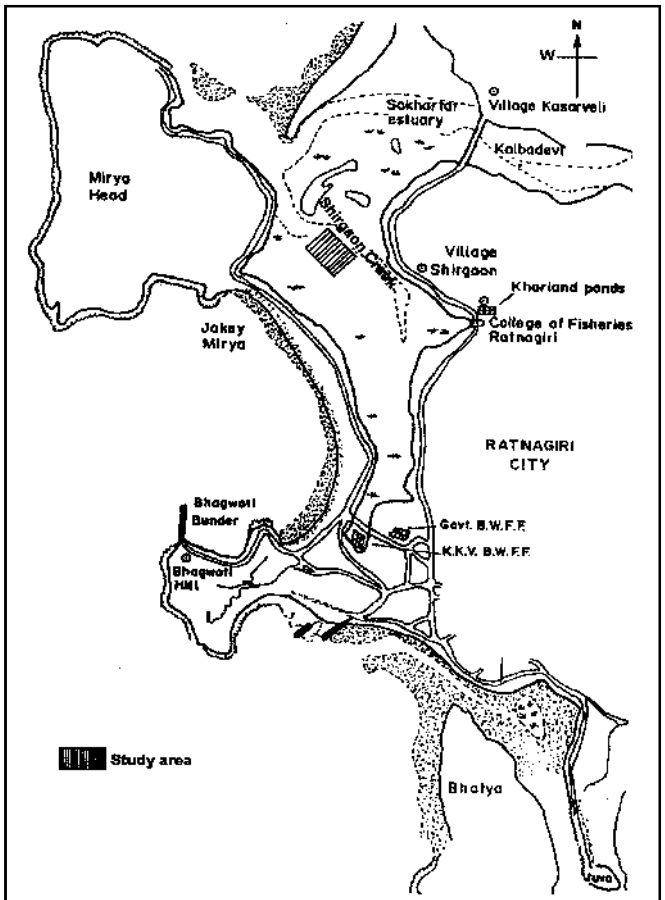

Fig. 1 : Map showing area of study (shown with zebra lines)

Temperature was recorded with a 'Tempo' brand thermometer having the range of 0 to 110^{0}C and salinity was recorded by 'ERMA' brand refractometer. The pH was measured by using digital pH meter (Lab-India, digital pH meter) having accuracy of 0.01 units. Dissolved oxygen and sulphide were analyzed by methods described in APHA (1998). Soil organic carbon was tested using chromic acid method given by Walky and Black (1934).

RESULTS AND DISCUSSION

The observation on selected environmental parameters during the study period are recorded in Table 1 and 2.

Temperature:

Surface water temperature varied from 27 to 31^{0}C. The lowest value of temperature (27^{0}C) was in August, while maximum value recorded was (31^{0}C) in November in the experimental pits containing *P. malbarica* and *K. opima* (Table 1).

Not much variation was observed in temperature in experimental pits between different stocking densities of clams. Also there was no particular seasonal trend.

During monsoon, the rainfall, influence of air and cloudy sky together may bring down the temperature to the minimum (27^{0}C). Similar observation made in the blood clam farm at Kakinada, where the monthly average water temperature fluctuated from 28.9 to 33.5^{0}C.

Salinity:

The salinity ranged from minimum of 22 ppt in August to the maximum of 31 ppt in September. Low salinity was observed during the monsoon followed by a gradual increase during post monsoon seasons. Similar observation was made in Ashtamudi lake of Kerala coast (Appukuttan *et al.*, 2002). The fluctuation pattern was similar in salinity irrespective of stocking density in both the species of clam.

pH:

The maximum pH value of 7.83 was recorded at stocking density of 50nos/m^2 in July, while the lowest was 7.39 at the highest stocking density *i.e.* 1000nos/m^2 in January in case of *P. malbarica.*

In case of *K. opima,* the maximum value of pH was

Table 1 : Water parameters of pits containing *P. malbarica* (A) and *K. opima* (B) at different densities, during seven month period (July 2002 to January 2003).

Stocking density	Month	Temperature (ºC)		Salinity (ppt)		pH		DO (mg/l)		Sulphide (mg/l)	
		A	B	A	B	A	B	A	B	A	B
50 /m^2	July	30	30	28	28	7.83	7.83	5.36	5.36	0.43	0.43
	Aug.	27	27	22	22	7.81	7.81	5.31	5.31	0.70	0.62
	Sept.	30	30	31	31	7.79	7.79	5.17	5.17	0.70	0.70
	Oct.	30	30	29	29	7.73	7.73	5.12	5.12	0.72	0.72
	Nov.	31	31	30	30	7.69	7.69	5.08	5.08	0.76	0.76
	Dec.	29	29	29	29	7.64	7.64	5.00	5.00	0.80	0.80
	Jan.	30	30	30	30	7.60	7.60	5.00	5.00	0.84	0.84
100 /m^2	July	30	30	28	28	7.85	7.84	5.62	5.17	0.45	0.45
	Aug.	27	27	22	22	7.79	7.73	5.44	4.80	0.70	0.72
	Sept.	30	30	31	31	7.71	7.71	5.38	4.30	0.72	0.74
	Oct.	30	30	29	29	7.69	7.69	5.22	3.77	0.72	0.74
	Nov.	31	31	30	30	7.64	7.64	5.20	3.20	0.78	0.79
	Dec.	29	29	29	29	7.61	7.58	5.13	2.78	0.81	0.84
	Jan.	30	30	30	30	7.56	7.53	5.00	2.50	0.87	0.91
200 /m^2	July	30	30	28	28	7.79	7.79	5.21	5.15	0.73	0.49
	Aug.	27	27	22	22	7.77	7.71	5.17	4.80	0.74	0.74
	Sept.	30	30	31	31	7.69	7.66	5.12	4.05	0.77	0.79
	Oct.	30	30	29	29	7.65	7.59	5.06	3.73	0.79	0.84
	Nov.	31	31	30	30	7.63	7.57	4.96	3.00	0.83	0.87
	Dec.	29	29	29	29	7.59	7.53	3.86	2.55	0.92	0.93
	Jan.	30	30	30	30	7.51	7.49	3.14	2.00	0.76	0.96
500 /m^2	July	30	30	28	28	7.71	7.77	5.10	5.12	0.78	0.49
	Aug.	27	27	22	22	7.66	7.68	5.00	4.80	0.83	0.74
	Sept.	30	30	31	31	7.63	7.65	4.84	4.00	0.87	0.81
	Oct.	30	30	29	29	7.57	7.59	4.23	3.14	0.94	0.87
	Nov.	31	31	30	30	7.48	7.54	3.56	2.83	0.96	0.92
	Dec.	29	29	29	29	7.48	7.51	3.46	2.37	0.96	0.95
	Jan.	30	30	30	30	7.47	7.46	2.66	3.48	0.76	0.98
1000 /m^2	July	30	30	28	28	7.73	7.73	5.10	5.14	0.80	0.53
	Aug.	27	27	22	22	7.63	7.69	3.91	4.42	0.88	0.77
	Sept.	30	30	31	31	7.54	7.63	3.17	3.35	0.94	0.83
	Oct.	30	30	29	29	7.48	7.54	3.00	2.92	0.97	0.87
	Nov.	31	31	30	30	7.47	7.47	2.42	2.20	1.03	0.95
	Dec.	29	29	29	29	7.44	7.42	2.04	2.00	1.12	1.07
	Jan.	30	30	30	30	7.39	7.34	2.00	2.80	1.16	1.16

7.34 at stocking density of 1000nos/m^2 in the month of January, while the peak (7.83) was at the lowest stocking density *i.e.* 50nos/m^2 in the month of July.

Nandan (1996) reported annual variation in pH of backwater of Kerala from 5.48 to 7.97 in Kodinamkulam estuary, 4.47 to 7.01 in Anehuthengu estuary, 4.6 to 6.97 in the Kayamkulam estuary, 4.20 to 8.90 in Edava-Nadayara estuary and 4.20 to 5.60 in the estuaries of Kozhikoda. The maximum pH values of the present study agree with the findings of Nandam (1996). However, lower values are quite different. A similar observation was made by Remani *et al.* (1989) in Jute retted water of West Bengal, in the Edava-Nadayara estuary, Cochin estuary and backwaters of Kozhikoda.

Dissolved oxygen:

The dissolved oxygen values fluctuated from 2mg/l in January at stocking density of 1000nos/m^2 to the

Table 2 : Soil parameters of pits containing *P. malbarica* (A) and *K. opima* (B) at different densities, during seven month period (July 2002 to January 2003).

Stocking density	Month	Sulphide (mg/l)		pH		Organic carbon (%)	
		A	B	A	B	A	B
50 /m^2	July	1.26	1.26	8.47	8.47	0.23	0.27
	Aug.	1.39	1.37	8.39	8.37	0.27	0.27
	Sept.	1.53	1.57	8.35	8.34	0.34	0.34
	Oct.	1.66	1.66	8.27	8.31	0.39	0.41
	Nov.	1.89	1.86	8.20	8.22	0.44	0.46
	Dec.	2.02	2.07	8.17	8.14	0.49	0.51
	Jan.	2.40	2.56	8.13	8.09	0.60	0.57
100 /m^2	July	1.33	1.29	8.43	8.42	0.29	0.31
	Aug.	1.44	1.47	8.39	8.27	0.33	0.34
	Sept.	1.67	1.67	8.31	8.27	0.37	0.37
	Oct.	1.81	1.86	8.23	8.22	0.47	0.53
	Nov.	2.02	2.07	8.19	8.17	0.53	0.67
	Dec.	2.17	2.22	7.97	7.96	0.61	0.73
	Jan.	2.44	2.46	7.78	7.75	0.67	0.77
200 /m^2	July	1.37	1.49	8.40	8.24	0.33	0.37
	Aug.	1.51	1.51	8.26	8.16	0.39	0.42
	Sept.	1.69	1.77	8.24	8.07	0.43	0.46
	Oct.	1.93	1.86	8.21	7.96	0.54	0.67
	Nov.	2.09	2.17	8.17	7.96	0.61	0.71
	Dec.	2.24	2.33	7.92	7.79	0.67	0.82
	Jan.	2.47	2.56	7.73	7.68	0.74	0.85
500 /m^2	July	1.45	1.52	8.29	8.24	0.37	0.41
	Aug.	1.54	1.54	8.19	8.26	0.43	0.46
	Sept.	1.73	1.86	8.13	8.17	0.47	0.51
	Oct.	2.05	2.19	8.07	7.97	0.56	0.66
	Nov.	2.14	2.27	7.98	7.87	0.67	0.71
	Dec.	2.27	2.49	7.87	7.69	0.72	0.88
	Jan.	2.59	2.67	7.69	7.52	0.78	0.91
1000 /m^2	July	1.49	1.57	8.24	8.21	0.37	0.44
	Aug.	1.63	1.61	8.12	8.16	0.44	0.46
	Sept.	1.81	1.91	8.09	8.13	0.47	0.49
	Oct.	2.22	2.19	7.92	7.98	0.64	0.65
	Nov.	2.37	2.37	7.73	7.89	0.74	0.72
	Dec.	2.47	2.67	7.70	7.57	0.86	0.98
	Jan.	2.86	2.91	7.57	7.44	0.94	1.07

maximum 5.62mg/l at 100 nos/m^2 in case of *P. malbarica* (Table 1).

In case of *K. opima,* dissolved oxygen varied from 5.36mg/l at stocking density of 50 nos./m^2 in the month of July to the lowest value *i.e.* 2.0mg/l at 1000 nos/m^2 in January. The general trend in dissolved oxygen indicated gradual decrease with increase of stocking density and also with the season, in both the clam species tested.

In the farm of blood clam at Kakinada, Narasimham(1980) reported monthly variation in dissolved oxygen concentration from 4.98 to 7.00mg/l. Narasimham *et al.*(1984) found dissolved oxygen concentration of Kakinada bay varying from 2.0 to 7.0mg/l, the low levels associated with low temperature and high salinity profile. Nandan (1996) reported in the estuaries of Kerala, dissolved oxygen levels varying from 0 to 7.16mg/l and that the depletion of dissolved oxygen leads to anoxic condition with simultaneous production of large amount

of hydrogen sulphide due to the decomposition of coconut husk. Appakuttan *et al*. (2002) also noted low values of dissolved oxygen in Ashtamudi lake.

In the present study, the concentration of dissolved oxygen lowers down to 2 mg/l at the stocking density of 1000 nos. /m^2 in January and the production of hydrogen sulphide due to decomposition of seaweeds and dead clam meat in the experimental pits.

Sulphide:

The dissolved Sulphide values fluctuated from 0.43 mg/l at the stocking of 50nos./m^2 in case of *P. malbarica* and *K.opima*, while the peak values were 1.12mg/l and 1.16mg/l in January at the stocking density of 1000nos. / m^2 in both the species of clam tested (Table 1 and Fig. 2 and 3).

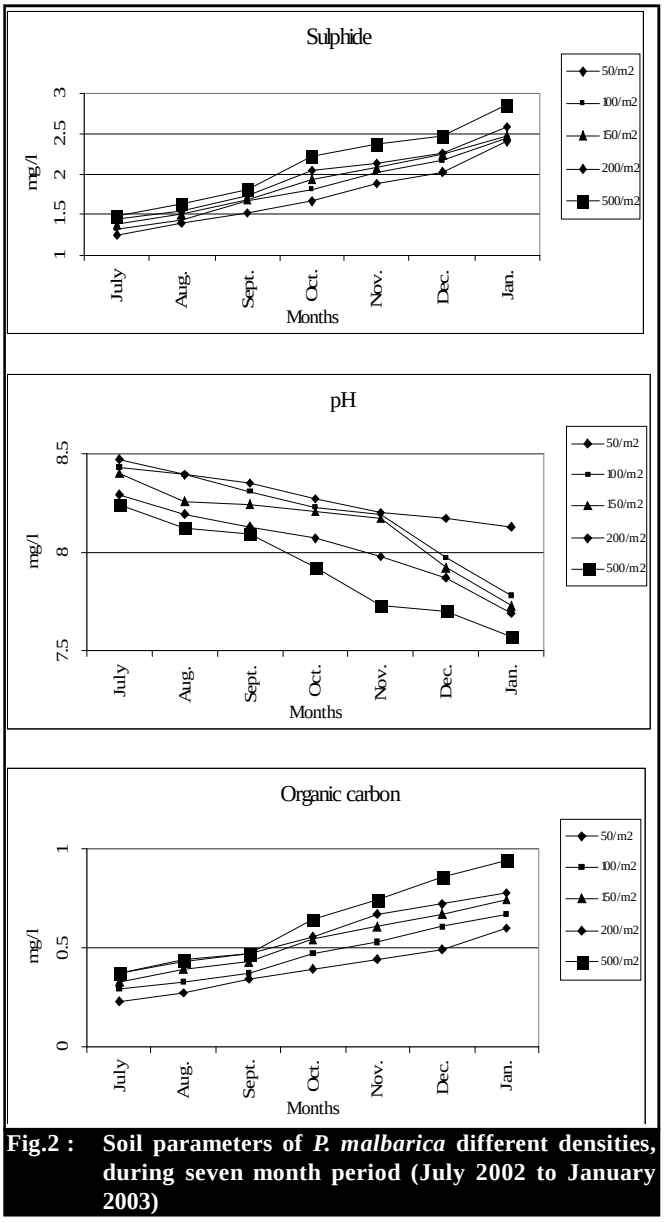

Fig.2 : Soil parameters of *P. malbarica* different densities, during seven month period (July 2002 to January 2003)

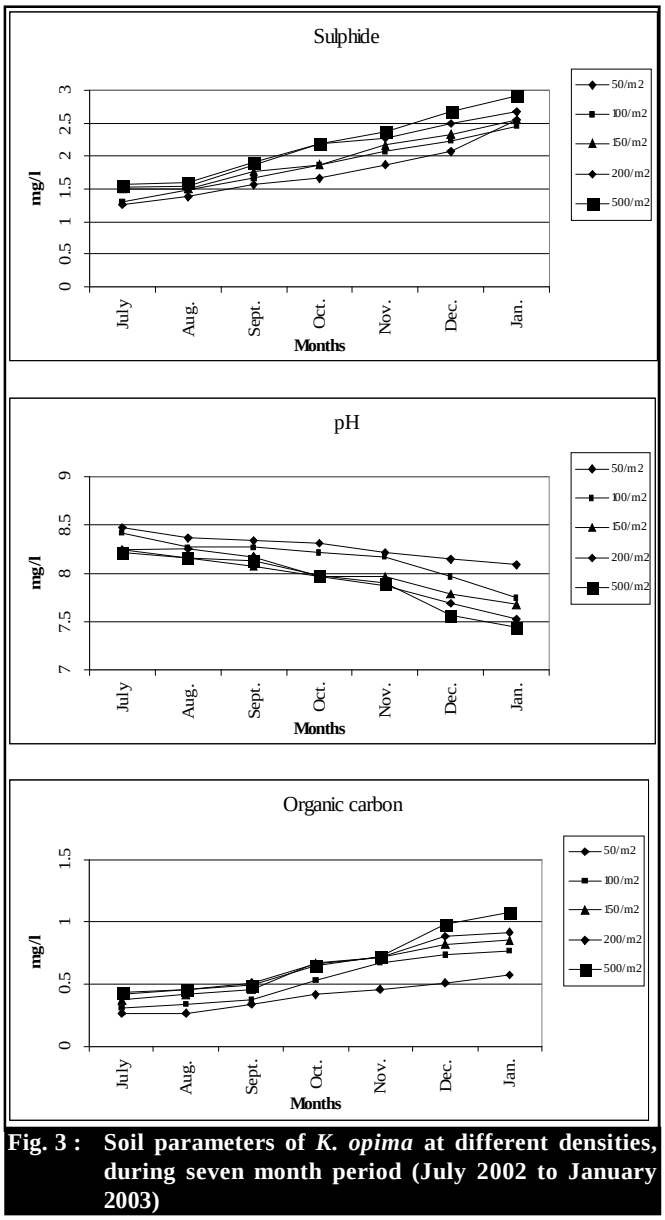

Fig. 3 : Soil parameters of *K. opima* at different densities, during seven month period (July 2002 to January 2003)

Nandan (1996) observed wide range of dissolved sulphide from 0.47 to 41.10mg/l in the estuaries of Kerala due to decomposition of coconut husk. In the present study, the production of hydrogen sulphide may due to decomposition of drifted seaweeds and dead clam meat in the experimental pits.

Soil Parameters:

Sulphide:

The sulphide values of the sediment fluctuated from 1.26 nos/m^2 to the maximum 2.86 mg/l in *P. malbarica* in the month of January at stocking density of 1000 nos/m^2. The lowest levels of sulphide in *K. opima* observed was 1.26mg/l at 50 nos./m^2 in July, while the peak value recorded was 2.91mg/l at the highest stocking density

i.e. 1000 nos/m^2 in January (Table 2).

pH:

The minimum soil pH was in January at stocking density of 100nos./m^2 with the value of 7.57, while the maximum of 8.47 was noted in July 50nos./m^2 in case of *P. malbarica.* In case of *K. opima,* pH varied from 7.44 in January at stocking density of 1000nos./m^2 to the maximum of 8.47 in July 50nos. /m^2.

The pH, in general, showed gradual decrease with increase of stocking density. The value also decreased with the season in both the species of clam studied.

Organic carbon:

The level of soil organic carbon was lowest *i.e.* 0.23 (%) in the month of July at the stocking density of 50nos./m^2, while the highest of 0.94 (%) was recorded in January at the stocking density of 1000nos./m^2 of *P. malbarica.* In case of *K. opima,* the minimum organic carbon (%) was in July at stocking density of 50nos. /m^2 with the value of 0.27 and the maximum of 1.07 was noted in January at 1000nos./m^2.

Similar observation was made by Patil (2002) in Kalbadevi estuary, Ratnagiri. Rao (1967) recorded highest organic carbon (>1 %) in the sediment in the tidal flats along the Western side of the Kakinada bay and the lowest (<0.4%) in the sandy area of Guderu. In the present study, formation of organic carbon may be associated with decomposition of dead clam meat and drifted seaweed in the experimental pits.

Acknowledgements:

Authors are thankful to the Associate Dean, College of Fisheries, Shirgaon, Ratnagiri for the required facilities to conduct the experiment.

Authors' affiliations

G.N. KULKARNI, B.R. KHARTMOL, A.T. TANDALE AND S.S. TODKARI, Department of Fishery Hydrography, College of Fishery Science, Udgir, LATUR (M.S.) INDIA

REFERENCES

APHA (1998). Standard methods for the examination of water and wastewater, 20th edition (Eds.) L.S. Cesceri, A. E. Greenberg and A. D. Eaton. American Public Health Association, American Works Association, Water Environment Federation, Washington, D. C.

Appukuttan, K.K., Aravindan, C.M., Yohanan, T.M. and Balasubramaniun, N.K. (1999). Population dynamics of an exploited stock of the clam *Paphia malbarica* of Astamudi estuary (South India) In: Proc. 4th Indian Fisheries Forum held at Kochi during November (1996) : 31 - 34.

Appukuttan, K. K., Velayudhan, T. S., Laxmilatha, R., Kripa, V., Alloycious, P. S., Vinod, M., Gayatri, G. S. and Narasimham, K. A. (2002). Clam resource in the Astamudi lake, a tropical estuary in Sothern India: Management and Conservation Concerns. Mar. Fish. Infor. Serv., T and E Series, **15** : 127 - 128.

Kripa, V. and Gopakumar, G. (1996). Utilisation of clam meat as feed in the shrimp farms of Kerala. *J. Seafood Export.*, **7** (5) : 7 - 14.

Walky, A. and Black, C.A. (1934). Estimation of soil organic carbon by chromic acid libration method. *Soil Science*, **37**: 29 –38.

Nandan, S.B. (1996). Modelling and monitoring the impact of retting of coconut husk on the ecology and resources of the estuarine systems on the south west coast of India. In: Proc. 4th Indian Fisheries Forum held at Kochi during Novemher (1996) : 505 - 509.

Remani, K. N., Nirmal, E. and Nair, S. R. (1989). Pollution due to coir retting mud its effect on the estuarine flora and fauna. *International J. Envt. Studies,* **32:** 285 - 295.

Narasimham, K. A. (1980). Culture of blood clams at Kakinada. Mar. Fish. infor. Serv., T and E Series., No. **23:** 7 - 9.

Narasimham, K. A., Selvaraj, G. S. D and Lalitha Devi, S. (1984). The molluscan resources and ecolgy of Kakinada bay. *Mar. Fish. infor. Serv., T and E Series,* No. **59** : 1- 15.

Patil, S. V. (2002). Effect of stocking density, salinity and aerial exposure on survival of the clam *Paphia malbarica*. M. F. Sc. Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, 1 - 117 pp.

Rao, M. S. (1967) Studies on the Kakinada bay on the East coast of India. *Quart. J. Geol. Min. Met. Soc. India,* **39** (2) : 75 - 91.