Research Paper

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Environmental influence on the *Meretrix casta* and *Anadara granosa* biomass and population density in the Muthupet and Adhirampattinam coast of South India

Zoology

KEYWORDS : Meretrix casta, Anadara granosa, Biomass, Population density, Environment.

***M. Ramasamy** P.G. and Research Department of Zoology and Biotechnology, A.V.V.M. Sri Pushpam College (Autonomous), Poondi-613 503, Thanjavur district.
* Corresponding Author

T. Anandaraj P.G. and Research Department of Zoology and Biotechnology, A.V.V.M. Sri Pushpam College (Autonomous), Poondi-613 503, Thanjavur district.

U. Balasubramanian P.G. and Research Department of Zoology and Biotechnology, A.V.V.M. Sri Pushpam College (Autonomous), Poondi-613 503, Thanjavur district.

ABSTRACT

The marine mollucs Meretrix casta and Anadara granosa were edible bivalve that burrows into bottom sediment to protect itself from environmental fluctuations and predation. This study examined the relationship between clam population and abiotic environmental condition in order to develop an understanding of the biological and ecological process that could be used to improve their management and exploitation. This study was conducted in Muthupet and Adirampattinam coasts during Jan.2011 to Dec.2011. The results showed that salinity and total suspended solids were the water quality parameters closely related to population density of bivalves. The combination of those variables gave the strongest correlation to bivalve densities (F = 153.670) and available biomass (F = 51.711) between stations.

Introduction

One aim of marine biologists to understand ecological processes by examining the interrelationship between abiotic parameters and biotic structures. Estuarine ecosystems are ideal for examining such interaction due to their wide range of abiotic factors. This is usually accomplished by inferential analysis of empirical data by multivariate techniques, and by manipulative experiments (Brow et al., 2000; Edgar and Barretts, 2002). Estuaries are highly productive, dynamic and unique ecosystems providing food, transport, recreation etc. and estuaries play a predominant role in the socio-economics of the coastal regions by providing valuable resources like fishes, bivalves, molluscs, crabs, shrimps etc. Water quality studies are important and have been taken up because they play a key role in aquaculture. The maximum production of bivalves is obtained, when physico-chemical factors are at optimum level. Therefore, water quality is a permanent factor in an ecosystem productivity. The reproductive cycle of bivalves influenced by exogenous or endogenous or both factors. Among exogenous factors, the habitat is one of the factor for breeding behaviour of bivalve organisms. The rainfall, temperature, photoperiod, humidity, salinity, pH, dissolved oxygen, free CO_2, solids, hardness and nutrients of water also influence the breeding, distribution and biology of the bivalves (Ramasamy and Balasubramanian, 2011).

Therefore, the present study was carried out on bivalves, Anadara granosa Linn. and Meretrix casta (Chemnitz) from Muthupet estuary and Adirampattinam coastal waters of South East Coast of India, which is an effort to document the edible bivalves distribution, water quality status and the often neglected socio-economic life based on it and their structural elucidation and determination of bioactive compounds, nutritional quality and their antibacterial activity against five pathogenic bacteria.

Materials and Methods

The study was conducted in the Muthupet and Adhirampattinam Coast of South India (Lat.10°4' N; Long.79°51'E and Lat.10°8' N, Long.79°52'E) bounded by a part of the Bay of Bengal on the nearest and Palk Straight on the South West (Fig.2 May of study sites).

The study was conducted at two stations – Data were collected at monthly intervals from January to December 2011. A clam drag was used to collect clam samples. The drag was made from stainless steel with an opening 35 cm in width and 15 cm in height. The net (mesh size 1.8 ´ 1.8 cm) was connected to the tail of the drag-clams were collected at each station by drawing the drag by hand for a distance of 15 m. The number of clams were then counted and density calculated per square meter.

Collection trips were undertaken to station I and II at a monthly interval over a period of one year from January 2011 to December 2011. Four seasons have been recognized in calendar year viz., Pre-monsoon (July – September), Monsoon (October – December), Post-monsoon (January – March) and Summer (April to June). Throughout the study period sampling of water and sediments were carried out on the basis of the last week of every month. Sampling of water was done usually during the morning hours.

The physico-chemical parameters such as air and surface water temperature, light penetration, pH, salinity, dissolved oxygen, nitrate, nitrite, silicates, ammonia and inorganic phosphates were analysed from the water samples. Rainfall data were obtained from the meteorological unit of the Regional Meteorological Station, Chennai, Tamil Nadu. India. The atmospheric and water temperatures were measured by using a centigrade thermometer and pH was measured by using digital pH meter (Elico pH 13 model). pH of the water samples were determined by immersing a commercially available direct – reading electric pH meter in the water and pH values were read directly from the digital screen. Nitrate, nitrite, ammonia, reactive silicates and inorganic phosphates were estimated by the following method of Strickland and Parsons (1972). DO concentration was measured using the modified Winkler's method as described by Strickland and Parsons (1972). The DO concentration was estimated by the standard volumetric Winkler's method.

Salinity was estimated by using 'ATAGO' hand refractometer at the site itself. The salinity of the water sample was determined by measuring of chlorinity. Five ml of the sample was taken in the conical flask and 3 drops of 5 per cent potassium chromate was added for indicating purpose. Then it was titrated against 0.1 N silver nitrate solution. The titration was concluded at the first appearance of brick red colour.

Pearson's correlation analysis was used to assess the relationship between physico-chemical parameters and diversity of bivalves. The data were computed and analysed using Statistical Package for Social Sciences (SPSS) software version 15.0 was used for these analysis.

Sediments were collected from both stations I and II for a period of January 2011 to December 2011 using a Peterson grab, transferred to clean Polybags, transported to the laboratory and air dried. Totally 15 samples were analysed for each station. The percentage composition of sand, silt and clay in the sediment samples were determined by the combined sieving and Pipette Method of Krumbein and Pettijohn (1938). The texture of the sediment was ascertained by plotting the values on a textural triangle deviced by U.S. Department of Agriculture (Anonymous, 1951).

A survey was carried out to assess the bivalves from two study sites. Meretrix casta was collected from the study site, Muthupet estuary – Station II: Anadara granosa was collected from Adirampattinam coastal waters - Station I: the study period from January 2011 to December 2011. A bivalve drag was used to collect bivalve samples. The drag was made from stainless steel with an opening, 35 cm in width and 15 cm in height. The net (mesh size 1.8 ´ 1.8 cm) was connected to the tail of the drag. Bivalves were collected at both stations by drawing the drag by hand for a distance of 15 m. The numerical density of bivalves were calculated as No/m^2 and biomass as g/m^2. The number of bivalves were then counted and bivalve density calculated per square meter. The bivalves were identified using the standard references (Sathiyarmoorthy, 1952) and also confirmed with Zoological Survey of India.

Pearson correlation analysis was used to access the different sediment composition in Station I and Station II. The different population characteristics of M. casta and A. granosa (Density and Biomass) were tested using ANOVA. The data were computed and analysed using Statistical Package for Social Sciences (SPSS) Software.

Results

In the present study the important physicochemical parameters such as rainfall, atmospheric temperature, surface temperature, pH, salinity, dissolved oxygen, inorganic phosphate, nitrate, nitrites, reactive silicate, ammonia and photoperiod were analysed from the station I and station II and the results were summarized. The rainfall data of the study area are shown in Fig.3. Rainfall varied from 4 to 96.2 mm during the study period and minimum was recorded (4 mm) during premonsoon in July 2011 and maximum (96.2 mm) during premonsoon in August 2011 at Station I. The rainfall was recorded minimum of 7.2 mm during post monsoon in January 2011 and maximum of 64 mm during monsoon in November 2011 at Station II. The rainfall was totally absent in the months of February and June 2011 at Station I and February and July 2011 at Station II of the study period. Atmospheric temperature data of the study are shown in Fig.4. It ranged from 26 – 31°C during the study period and minimum of 26°C was recorded during December 2011 and maximum of 31°C during April, May 2011 at Station I. In Station II, minimum of 28°C was recorded during January, December 2011 and maximum of 31°C was recorded during May 2011. Water temperature data are shown in Fig.5. It ranged from 27 - 31°C during study period and minimum was recorded (27°C) during December 2011 and maximum was recorded (31°C) during May, July 2011 at Station I. Minimum was recorded (29°C) during January 2011 and maximum was recorded (32°C) during February, May and June 2011 at Station II. The pH values are shown in Fig.6. It varied between 7 and 8.5 during the study period. At station I, the minimum value (7) was recorded during the months of January, February, April, September, November and December 2011. At Station II, the minimum pH (7) was recorded during the months of January to April and August to December, 2011. The maximum value (8.5) was recorded during summer in May 2011 at Station I, and 7.5 was recorded during May, June and July 2011 at Station II. Salinity values are given in Fig.7. It ranged from 30-36 ppt during the study period. Minimum salinity was recorded as 30 ppt during January, March, October 2011 and maximum was recorded as 36 ppt during June 2011 at Station I. At Station II, minimum salinity was recorded as 30 ppt during January, March 2011 and maximum was recorded as 35 ppt during May, June 2011. Dissolved oxygen concentrations are depicted in Fig.8. It varied between 2.2 to 5.4 mgl^{-1} during the study period. Dissolved oxygen concentration was minimum 2.2 mg.l^{-1} during June 2011 and maximum concentration was 3.7 mg.l^{-1} during November 2011 at Station I and minimum concentration was 2.4 mg.l^{-1} during April 2011 and maximum concentration was 5.4 mg.l^{-1} during November 2011 at Station II. Inorganic phosphate concentrations are shown in Fig.9. It varied between 0.5 and 3.5 mgl^{-1}. Concentration of phosphorus was minimum as 0.5 mgl^{-1} during March 2011 and maximum was recorded as 2.2 mgl^{-1} during December 2011 at Station I. Minimum concentration was observed as 0.9 mgl^{-1} during May and June 2011 and maximum concentration was observed as 3.5 mgl^{-1} in December 2011 at Station II. Dissolved nitrate concentrations are given in Fig.10. It ranged from 2.8 to 8.6 mgl^{-1}. The minimum value was recorded as (2.8 mg mgl^{-1}) during May 2011 and maximum value recorded was 8.0 mgl^{-1} during October 2011 at Station I. Minimum value was recorded as 3.5 mgl^{-1} during March and May 2011 and maximum was recorded as 8.6 mgl^{-1} during October 2011 at Station II. The nitrite of water ranged from 0.64 to 2.85 mg/ml in January 2011 to December 2011 (Fig.11). The minimum value 0.64 mg/ml was estimated in July 2011 and maximum value (9.5 mg/ml) in December 2011 at Station I. The minimum nitrite value (2.5 mg/ml) was recorded during summer and maximum (8.7 mg/ml) in monsoon season during the study period at Station II. Silicate concentration fluctuated between 2.15 and 6.24 mgl^{-1} (Fig.12) at both stations. The minimum value was recorded during summer season at Station I (2.15 mgl^{-1}) in April 2011 and in Station II (2.16 mgl^{-1}) in April 2011. Maximum silicate was recorded during the post monsoon season in January 2011 at Station I (6.24 mgl^{-1}) and in Station II (6.16 mgl^{-1}) during August 2011. Ammonia level varied from 0.42 to 1.92 mgl^{-1} (Fig.13). Minimum value was recorded during post-monsoon season at both stations and the maximum was recorded during the summer season at June 2011 at Station I. The minimum value of 0.42 mgl^{-1} was estimated in March 2011 and maximum value (1.92 mgl^{-1}) was estimated at May 2011 in Station II. The monthly mean light lengths in the present study showed a slight variation (Fig.14). Even though India is a tropical country, the day length showed fluctuation. It varied from 11.14 to 12.56 hours during the study period (Fig.14). It was found to be low (11.25 hrs) in March 2011 and high (12.51 hrs) in May 2011 at Station I. Maximum (12.5 hrs) was found to be in August 2011 and minimum (11.14 hrs) day length showed in March 2011 at Station II. The day length was found to be low during monsoon and post monsoon seasons and high during summer and premonsoon seasons at both stations. The Pearson co-efficient of correlation studies revealed that the physico-chemical features in Station I showed the significant positive correlation with the atmospheric temperature, water temperature, salinity with M. casta abundance and negative correlation with rainfall, DO and nutrients. In station II, also a similar correlation pattern could be observed with the population density of A. granosa. Surface water temperature and salinity were showed significant negative correlation with rainfall, dissolved oxygen, nitrate, nitrites, reactive silicates, phosphates and ammonia. pH showed a positive correlation with salinity. In station I, the percentage of sand, silt and clay fluctuated between 59.32 and 73.46 per cent, 13.90 to 22.56 per cent and 12.64 to 19.72 per cent respectively during the study period and the type of soil was sandy loam (Table 1). In station II, the percentage of sand fluctuated from 77.12 to 88.72 per cent, the silt showed 7.30 to 16.20 per cent and the clay was 1.32 to 7.98 per cent (Table 2) during the study period and the type of soil was sandy loam. The highest population (64 No/m^2) density of A. granosa was recorded during the month of August 2011 and the lowest population density (28 No/m^2) was recorded during the month of December 2011 at Station II whereas the highest population (84 No/m^2) density of M. casta was recorded during the month of May 2011 and the lowest population density (50 No/m^2) was recorded during the month of November 2011 at Station I (Fig.15). Dendrogram of cluster analysis based on Muthupet estuarine, bivalve A. granosa population density is shown in Fig.17 and the bivalve M. casta population density is shown in Fig.18 based on Adirampattinam coast. The highest biomass value (1030 g/m^2) was recorded in A. granosa which was collected during September 2011 and the lowest biomass (207.65 g/m^2) was recorded during in March 2011 at Station II and in M. casta, the highest biomass value was 815.0 g/m^2 during in August 2011 and the lowest biomass (357.65 g/m^2) was recorded during in March 2011 at Station I (Fig.16). One way ANOVA was performed for population density and biomass revealed the variation in population ($F = 153.670$) and available biomass ($F = 51.711$) between the stations.

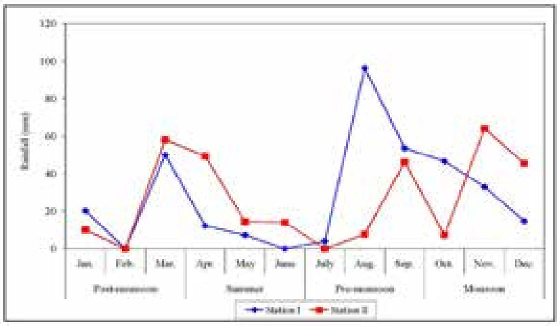

Fig.3. Average rainfall recorded at Station I (Adirampattinam coast) and II (Muthupet estuary) (January 2011 - December 2011)

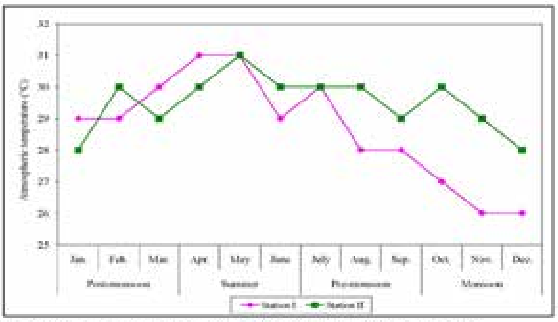

Fig.4. Monthly variations in atmospheric temperature at Station I and II (January 2011 - December 2011)

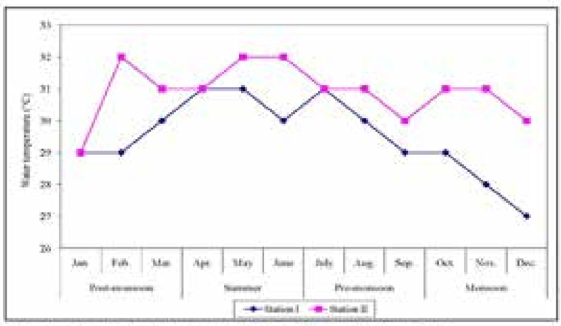

Fig.5. Seasonal variations in water temperature at Station I and II (January 2011 - December 2011)

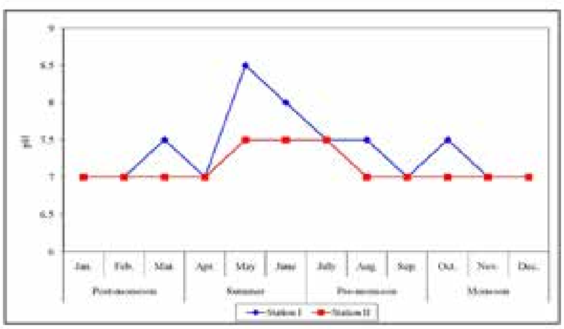

Fig.6. Monthly variations in hydrogen ion concentration (pH) at Station I and II (January 2011 - December 2011)

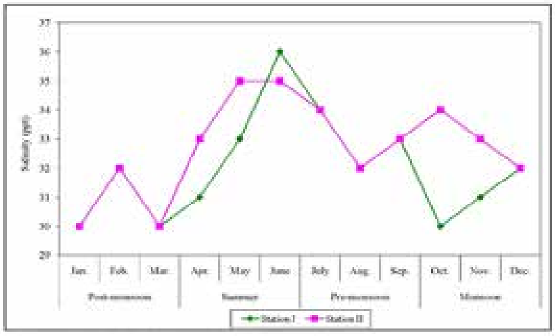

Fig.7. Monthly variations in salinity at Station I and II (January 2011 - December 2011)

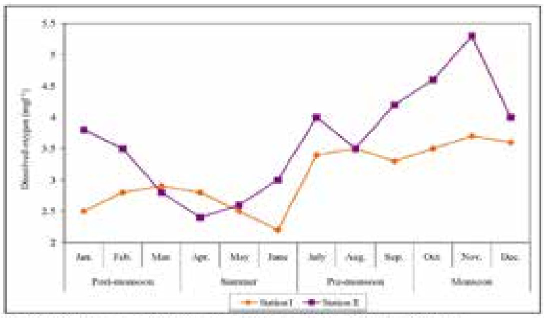

Fig.8. Monthly variations in dissolved oxygen level at Station I and II (January 2011 - December 2011)

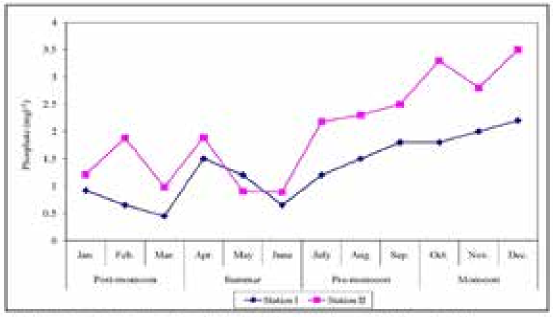

Fig.9. Monthly variations in inorganic phosphate level at Station I and II (January 2011 - December 2011)

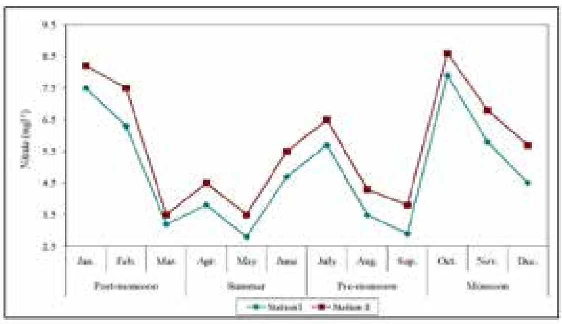

Fig.10. Monthly variations in nitrate level at Station I and II (January 2011 - December 2011)

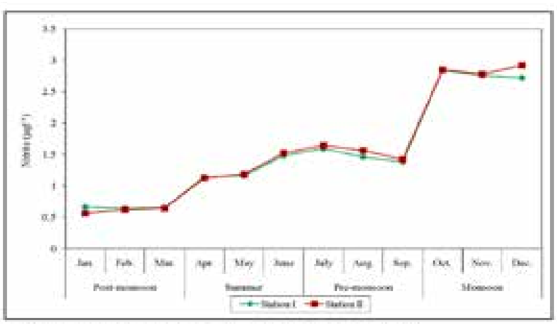

Fig.11. Monthly variations in nitrite level at Station I and II (January 2011 - December 2011)

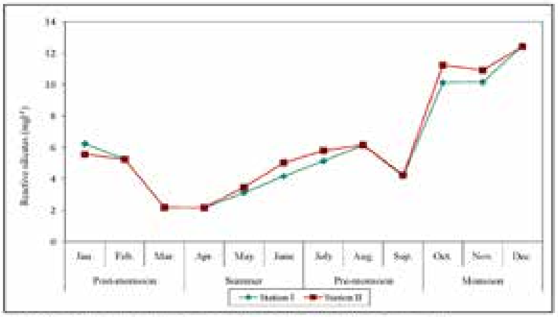

Fig.12. Monthly variations in reactive silicates at Station I and II (January 2011 - December 2011)

TABLE 1 Monthly variations of the percentage composition of sand, silt and clay particles of soil at station I (Adirampatinam coast)

Period	Soil type			Textural class
	Sand	Silt	Clay	
January 2011	69.36	16.08	14.56	Sandy loam
February	70.32	15.42	14.26	Sandy loam
March	68.62	15.86	15.52	Sandy loam
April	73.46	13.90	12.64	Sandy loam
May	70.22	14.16	15.62	Sandy loam
June	66.23	17.66	16.11	Sandy loam
July	63.12	18.56	18.32	Sandy loam
August	65.52	19.76	14.72	Sandy loam
September	64.18	22.56	13.26	Sandy loam
October	60.38	21.24	18.38	Sandy loam
November	59.32	20.96	19.72	Sandy loam
December 2011	61.40	22.32	16.28	Sandy loam

TABLE 2 Monthly variations of the percentage composition of sand, silt and clay particles of soil at station II (Muthupet estuary)

Period	Soil type			Textural class
	Sand	Silt	Clay	
January 2011	86.72	11.96	1.32	Loamy sand
February	81.00	11.02	7.98	Sandy loam
March	86.72	11.96	1.32	Sandy loam
April	88.00	9.96	2.04	Loamy sand
May	87.68	10.08	2.24	Sandy loam
June	84.02	12.64	3.34	Sandy loam
July	86.72	9.30	3.98	Loamy sand
August	87.12	10.20	2.68	Sandy loam
September	86.14	9.98	3.88	loamy sand
October	77.12	16.20	6.68	Sandy loam
November	86.98	7.30	5.72	Loamy sand
December 2011	85.04	10.98	3.98	Sandy loam

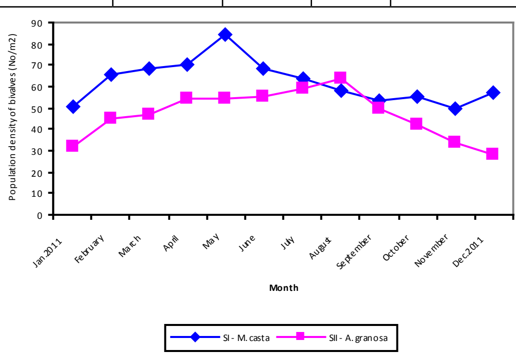

Fig.13. Mean (± SE) Population density of bivalves abundance at Station I and II.

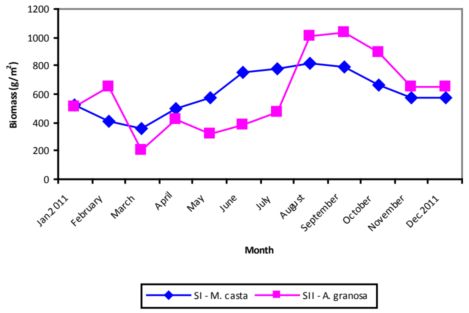

Fig.14. Mean (± SE) Biomass of bivalves at Station I and II.

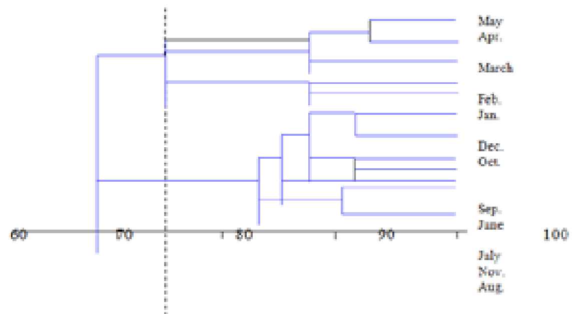

Fig.15. Dendrogram of cluster analysis based on Adirampattinam coastal waters bivalve, M. casta densities from Jan.2011 to Dec.2011.

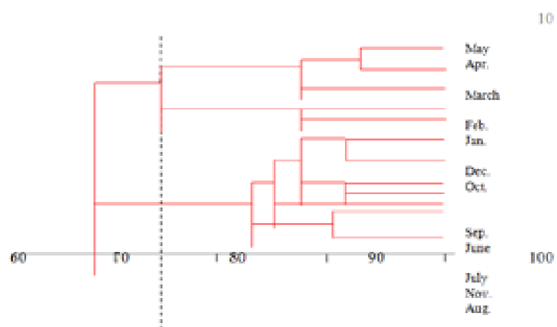

Fig.16. Dendrogram of cluster analysis based on Muthupet estuarine bivalve, A. granosa densities from Jan.2011 to Dec.2011.

DISCUSSION

The physico-chemical parameters have an impinging effect on the aquatic organisms and are of many parameters varied with temporal and spatial variations. These factors are either exogenous or endogenous or both. These parameters might affect the life activities and govern the distribution of biological organisms. All the factors are interrelated even to one another. Variation in one may affect the other. Considerable data on information are available on physico-chemical factors and their impact on the distribution, physiology and reproductive biology of the organisms (Sridhar et al., 2006; Varadharajan et al., 2010; Srilatha et al., 2012).

The rainfall data of both the study areas varied from 4 to 96.2 mm. Minimum (4 mm) was recorded in pre-monsoon season (July 2011) and maximum (96.2 mm) was recorded in monsoon season (October 2011) at Station I. The minimum rainfall of 7.2 mm and maximum of 64 mm were recorded during monsoon season in November 2011 at Station II. The rainfall was totally absent in the months of February and June 2011 at Station I and February and July 2011 at Station II. Similar observations were made by Hussain Dar et al. (2011) and Srilatha et al. (2012).

The hydrogen ion concentration (pH) is an another important hydrobiological parameter which influence the distribution, growth, metabolism and proximate composition of aquatic organisms. The variation in pH of the water was less pronounced throughout the study period. In this study, the pH values varied from 7 – 8.5 (Fig.10). The minimum pH (7.0) was recorded during the months of January, February, April, September, October, November and December 2011 and the maximum (8.5) was recorded during May and June 2011 at Station I and the minimum pH (7.0) was recorded during monsoon and post monsoon and the maximum (7.5) was recorded during summer at Station II. The high pH recorded during summer season could be due to the increased temperature coupled with salinity (Hussain Dar et al., 2011; Srilatha et al., 2012). The slight seasonal fluctuation in pH was mainly due to rainfall and freshwater inflow. Similar observations have been reported by Soundaramanickam et al. (2008) in Pitchawaram estuary. The pH of Chennai coastal waters also showed slight fluctuation, it was found to be minimum during north east monsoon and the maximum pH during summer (Subramanian and Mahadevan, 1999).

The dissolved oxygen (DO) is one of the important biological factor which influence the bioenergetics of the aquatic organisms. In the present study, DO concentrations varied between 2.2 – 5.4 $mg.l^{-1}$ during the study period (Fig.12). DO was minimum (2.2 $mg.l^{-1}$) during June 2011 in summer season and maximum (3.7 $mg.l^{-1}$) during November 2011 in monsoon season at Station I and the minimum concentration was 2.4 $mg.l^{-1}$ during April 2011 and the maximum concentration 5.4 $mg.l^{-1}$ during November 2011 at Station II. The DO level fluctuated during summer and monsoon seasons, which may be due to wind velocity, rainfall and photosynthetic activities of biological organisms. The DO level estimated in the present study also agrees with earlier workers (Sridhar et al., 2006; Satpathy et al., 2007; Soundarapandian et al., 2009; Damotharan et al., 2010). Subramanian and Kannan (1988) have also reported higher level of DO during monsoon season in Tuticorin coast in Gulf of Mannar but contradicting report at Coovam estuary have been noticed high DO concentration during monsoon season.

In the present study, the nitrate, nitrite and ammonia concentrations ranged from 2.8 to 8.0 mgl^{-1}, and 0.64 to 9.5 mgl^{-1} and 0.42 to 1.92 mgl^{-1} respectively at Station I and in Station II, the nitrate, nitrite and ammonia ranged from 3.5 to 8.6 mgl^{-1} and 0.56 to 2.85 mgl^{-1} and 0.38 to 1.92 mgl^{-1} respectively. The maximum value of nitrite was recorded as 2.84 mgl^{-1} during October 2011 and the minimum was recorded as 0.64 mgl^{-1} during February 2011 in postmonsoon season at station I and the maximum value was recorded as 2.85 mml^{-1} during monsoon season and the minimum value was recorded as 0.56 mml^{-1} during post monsoon season at Station II.

The influence of environmental parameters on population densities of bivalves has been performed elsewhere (Absalo, 1991; Baron and Clavier, 1992; Soares-Gomes and Pres-Vanin, 2005; McLead and Wing, 2008; Tanyaros and Tongnunui, 2011). A population of the bivalve, Meretrix casta from estuarine ecosystems in the coastal area of Trang Province, Thailand has been studied (Songrak et al., 2009; Tanyaros and Tongnunui, 2011).

In general, the distribution of bivalves are influenced by physicochemical and biological characteristics, prevailing in the environment. In the present study, bivalves, Anadara granosa was recorded highest abundance in the Muthupet environs whereas Meretrix casta was recorded predominance in coastal waters of Adirampattinam. Similar species were observed in Coleroon estuary by Prabha Devi and Ayyakannu (1989). Vellar estuary by Chandran et al. (1982) and Aiyyampattinam and Arukkattuthurai by Varadharajan et al. (2010). Salinity and temperature is an important ecological factors which influence the distribution of bivalves. High temperature 35°C recorded in summer season influence the distribution of both bivalves in both stations predominantly. Low temperature recorded in December influence higher faunal density. Low density of bivalves recorded in November due to heavy downpour, which caused drastic fluctuations in the sampling stations. Positive relationship between the abundance of bivalves and concentration of organic carbon in sediments had been documented by Parulekar et al. (1975) and Prabha Devi (1994). The salinity also considered to be a dominant factor, in the distribution of bivalves in Dammar Cornice and half moon Bay of Arabian Gulf by Anvar Batcha (1997). pH and DO did not play any considerable role in bivalves abundance in the present study in both stations. Similar findings were also reported by Prabha Devi and Ayyakannu (1989), Prabha Devi (1994) and Varadharajan et al. (2010).

In the present study, station I (Adirampattinam) have less species of M. casta during the months of November and January 2011. This is due to abundance of salt ponds and also salt refinery industries wastes that drained in the shore environment. Because of this the population of bivalves diversity is disturbed. So the present study conforming that pollution in the intertidal coastal areas directly affecting the species diversity of bivalves as well as indirectly the fishery potential.

M. casta prefers high salinity and sandy bottom (Laxmilatha et al., 2006) and have salinity ranging from 20 to 33 ppt due to its proximity to the sea. The average density of M. casta was 51 No/m^2 in Zone II and 12 numbers per sq.m. in zone VI, in Chettuva estuary reported by Laxmilatha et al. (2006). In the present study, the average maximum density of M. casta was 86 No/m^2 in Station I (Adirampattinam off-shore coastal waters) during summer season.

The average biomass of M. casta, denoted by the total weight in grams per sq.m. was highest in Chettuva estuary (674.75 g/m^2) reported by Laxmilatha et al. (2006). In the present, the average biomass of M. casta denoted by the total weight in g/m^2 was highest in Adirampattinam coastal waters (756.67 g/m^2) during the premonsoon season. The total average biomass of M. casta (609.16 g/m^2) was recorded in Station I. The overall total biomass of the coastal waters of Adirampattinam was 7309.92 g/m^2.

The bivalve, A. granosa prefers high temperature and sandy bottom (Ramasamy and Balasubramanian, 2011) and have temperature ranging from 35 to 38°C due to its proximity to the sea. The average density of A. granosa was 54 No/m^2 in Muthupet estuary (Station II) during the summer season. The average biomass of A. granosa was highest in Muthupet estuary (815.0 g/m^2) during the premonsoon season. The Adirampattinam and Muthupet estuary remains saline for most part of the year and therefore offers immense scope for bivalves, M. casta and A. granosa respectively, culture in both stations.

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REFERENCE

Absalao, R.S., 1991. Environmental discrimination among soft-bottom mollusc associations off Lagoa dos Patos, South Brazil. Estuarine Coastal and Shelf Science, 32: 71-85. | Anonymous, 1951. Soil survey manual. U.S: Department Agriculture Handbook, (18): 210-211. | Baron, J., and Clavier, J., 1992. Effects of environmental factors on the distribution of the edible bivalves Atactodea striata, Gafrarium tumidum and Anadara scapha on the coast of New Caledonia (SW Pacific). Aqua. Living Res., 5: 107-114. | Brown, D.J., Clark, G.C., Van-Beneden, R.J., 1998. A new cytochrome P450 (CYP30) family identified in the clam, Mercenaria mercenaria. Comp. Biochem. Physiol.-C, 121C(1-3): 351-360. | Chandran, R., Thangaraj, G.S., Sivakumar, V., Srikrishnadhas, B., and Ramamoorthy, K., 1982. Ecology of macrobenthos in Vellar estuary. Indian J. Mar. Sci., 11: 1122-1127. | Damotharan, P., Vengadesh Perumal, N., Perumal, P., Arumugam, M., Vijayalakshmi, S., and Balasubramanian, 2010. Seasonal variation of physico-chemical characteristics in point calimere coastal waters (Southeast coast of India). J. Sci. Res., 6(4): 333-339. | Edgar, G.J., and Barrett, N.S., 2002. Benthic macrofauna in Tasmanian estuaries, Scale of distribution and relationship with environmental variables. J. Exp. Mar. Biol. Ecol., 270: 1-24. | Krumbein, W.C., and Pettijohn, E.J. eds. 1938. Manual of sedimentary petrography. New York: Appleton-Century Crofts. | Laxmilatha, P., Velayudhan, T.S., Mohamed, K.S., Kripa, V., Radhakrishnan, P., Mathew Joseph and Jenny Sharma, 2006. Bivalve resources of the Chettuva estuary, Kerala. Indian J. Fish., 53(4): 481-486. | Lee, N.H., Han, K.N., and Choi, K.S., 2004. Effects of salinity and turbidity on the free amino acid composition in gill tissue of the pacific oyster, Crassostrea gigas. J. Shellfish Res., 23: 129-134. | McLeod, R.J., and Wing, S.R., 2008. Influence of an altered salinity regime on the population structure of two infaunal bivalve species. Estuarine, Coastal and Shelf Science, 78: 529-540. | Parulekar, A.H., Rajammanickam, G.V., and Dwivedi, S.N., 1975. Bemthic studies in Goa estuaries. Biomass and faunal composition in the zuari estuary. Indian J. Mar. Sci., 4: 202-204. | Powell, E.N., Kasschau, K., Chen, E., Koenic, M., and Pecon, J., 1982. Changes in the free amino acid pool during environmental stress in the gill tissue of the oyster Crassostrea virginica. Comp. Biochem. Physiol., Part A Physiol., 71: 591-598. | Prabha, Devi, L., and Ayyakannu, K., 1989. Macrobenthos of the Buckingham canal and backwaters of Coleroon estuary. J. Mar. Biol. Asso. India, 31(2 and 3): 80-85. | Ramasamy, M., and Balsubramanian, U., 2012. Antibacterial activity of bivalves Meretrix casta and Tridacna maxima from Southeast coast of India. Intl. J. Pharmaceut. Sci. Rev. Res., 13(2): 137-140. | Sara, G., Romano, C., Widdows, J., and Staff, F.J., 2008. Effect of salinity and temperature on feeding physiology and scope for growth of an invasive species (Brachidontes pharaonis – Mollusca: Bivalvia) within the Mediterranean Sea. J. Exp. Mar. Biol. Ecol., 363: 130-136. | Satpathy, K.K., Mohanty, A.K., Sahu, G., Prasad, V.M.R., Venkatesan, R., Natesan, U., and Rajan, M., 2007. One the occurrence of Trichodesmium erythraeum (Ehr.) bloom in the coastal waters of Kalpakkam, east coast of India. Indian J. Sci. Technol., 1(2): 1-9. | Soares-Gomes, A., and Pires-Vanin, A.M.S., 2005. Bivalve mollusk assemblages on Sao Paulo's northern continental shelf, Southeast Brazil. Brazilian J. Biol., 65: 717-727. | Songrak, A., Tongnunui, P., Sawasdee, A., and Kongpom, A., 2009. Population dynamics of hard clam (Meretrix casta Chemnitz, 1782) in the coastal area of Trang Province, Thailand. Proc. Confer. Intl. J. Arts Sci., Salzburg, Austria, June 1-4, pp.55-62. | Soundarpandian, P., Premkumar, T., and Dinakaran, G.K., 2009. Studies on the physico-chemical characteristics and nutrients in the Uppanar estuary of Cuddalor, Southeast coast of India. J. Biol. Sci., 1(3): 102-105. | Sridhar, R., Thangaradjou, T., Senthil Kumar, S., and Kannan, L., 2006. Water quality and phytoplankton characteristics in the palk Bay, Southeast coast of India. J. Environ. Biol., 27(3): 561-566. | | Strikcland, D.J., and Parsons, T.R., 1972. A Practical Handbook of Seawater Analysis: Fishery Board of Canada Bulletin. 2nd edn. Ottawa, Canada: Fishery Research Board of Canada. 167: 310-322. | Subramanian, B., and Mahadevan, A., 1999. Seasonal and diurnal of hydrobiological characters of coastal water of Chennai (Madras), Bay of Bengal. Indian J. Mar. Sci., 28: 429-433. | Subramanian, S.K., and Kannan, L., 1998. Environmental parameters of the Indian biosphere reserve off Tutcorin in the Gulf of Mannar. Seaweed Res. Utilizn., 20(1-2): 85-90. | Tanyaros, S., and Tongnunui, P., 2011. Influence of environmental variables on the abundance of estuarine calm Meretrix casta (Chemnitz, 1782) in Trang Province, Southern Thailand. Songklanakarin J. Sci. Technol., 33(1): 107-115. <http:// www. sjst.psu.ac.th> | Thajuddin, N., 1991. Marine cyanobacteria of south east coast of India – survey and ecological studies. Ph.D Thesis, Tiruchirappalli, Tamilnadu, India: Bharathidasan University. | Varadharajan, D., Soundarapandian, P., Gunalan, B., and Babu, R., 2010. Seasonal abundance of macro benthic composition and diversity along the Southeast Coast of India. European J. Appl. Sci., 2(1): 1-5. |