RESEARCH PAPER | Zoology | Volume : 4 | Issue : 12 | Dec 2014 | ISSN - 2249-555X

Effect of Physico-Chemical Parameters on the Reproduction of Marine Crab, Portunus Sanguinolentus

KEYWORDS: Physico-chemical parameter, Portunus sanguinolentus, reproduction ,inorganic constituents

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ABSTRACT *The man made activities such as addition of sewage, suspended solids, heavy metal affect adversely the ecosystem. These man made activities as well as changes in environmental parameters, apart from sources of thermal discharge and radioactive substances, affect the balance of ecosystem. Seasonal variations in the sea water parameter viz. pH, salinity, TDS, BOD and COD etc. affect biotic community. Water compositions have great influence on the supply of nutrients to the aquatic animal which ultimately affect the growth and reproduction phenomenon. Effluents released by thermal power station and industrial area affected the productivity of economically important crustaceans. Therefore, efforts were made to understand the study of effect of physico- chemical parameters of sea water on the reproduction of marine crab Portunus sanguinolentus by using standards method APHA(1985),Trivedi and Goel (1986). The pH values were fluctuating throughout the period of study. Salinity, TDS, BOD, and COD also showed variation throughout the year. The highest percentage of mature individuals of crab, Portunus sanguinolentus were found in July 2003. The lowest percentage of mature individuals were found in January 2003.*

Introduction

The pH of any aqueous system is suggestive of the acid-base equilibrium achieved by various dissolved compounds. pH is considered as an index for suitability of the environment. Spence (1967) reported that the alkalinity of pH is closely connected with an accurate measure of the tropic status of lake water. The pH proved to be an ecological factor of major importance in controlling the activities and diversity pattern of aquatic flora and fauna (Husain, 1967; Verma and Shukla, 1970; Saha and Chaudhary, 1985). Many investigators studied freshwater bodies and proved that the pH values increased during any time due to photosynthetic activity i.e. consumption of CO_2, whereas decreased at night, due to respiratory activity. (Jana, 1973; Chari, 1980; Bhatnager, 1984; Bhatt and Negi, 1985; Mahajan and Kanhere, 1995; Rao, 1999 and Thirumathal et al.2002).Salinity is the amount of inorganic material dissolved in seawater expressed, as weight in grams per kilogram of seawater. It influences the distribution of animals. Photosynthetic rates are influenced by salinity as shown by comparisons from population over a series of seasons (Dawes et al. 1978). Reddy (1980) described as salinity values were increased with raising tide and decreased with falling tide. Murugan et al. (1992) stated that the salinity was important as one of the controlling factors in determining species composition and succession. Kannupandi et al. (1997) studied the effect of salinity on the larvae of an edible estuarine crab, *Thalamita crenata*. Li-kebo et al. (1999) performed a study on water temperature, salinity and diet nutrition as the measures for rearing the river crab larvae. Lardies et al. (2001) studied effect of temperature and salinity gradient on the reproductive biology of *Pinnaoxdes chilensis*. Chacur et al. (2001) in *Callinectes danae* measured depth, salinity, dissolved oxygen, temperature, organic contents and texture of sediment and found that the species was more abundant in warmer months. Rainbow and Black (2001) observed the effect of changes in salinity on the water permeability of three crab species, *Carcinus maenas, Eriocheir sinensis* and *Necora puber*. According to Martin et al. (2005) low salinity areas are important for juvenile blue crab, *Callinectes sapidus*. The total alkalinity of water is mainly due to the cation of calcium, magnesium, sodium, potassium and additionally by carbonate and bicarbonate or occasionally as For the productivity of zooplankton and phytoplankton-water temperature, pH, BOD, alkanity etc. are remarkably responsible and moreover seasonal fluctuation in three parameters reciprocated to their growth directly or indirectly(Ali,1992). Water composition have great influence on the supply of nutrients to the aquatic animal which ultimately affect the growth and reproduction .Temperature, pH and dissolve oxygen affected the rate of feeding metabolism and growth in aquatic animals (Ali, 1992; Rath, 1993; Bradbury and William, 1997). Decapod crustaceans such prawn, crab and lobster are commercially important due to their high nutritional contents. The success of species, depend on the viability of eggs and rate of development of eggs. Of course a variety of environmental factors such as temperature, rainfall, photoperiod, salinity, dissolved gases and chemicals in seawater in combination with these factors are closely related to species survival. But the effluents released by thermal power station in this area affected by productivity of economically important crustaceans therefore, efforts are made to understand study on physico-chemical parameters of Dahanu coast. The plankton helps in growth of crustacean and other aquatic animals directly or indirectly. Hence it is essential to study the physico-chemical parameters.

Material and method

Decapod crustaceans were collected from Dahanu coast during the year 2002-2003.

For analysis of various physicochemical factors, water samples were collected in 2 litre sample bottle at early hours of a day. Sample collection was done twice in a month. The reading for temperature and pH etc. were measured on the spot. The samples were analyzed to determine

Volume : 4 | Issue : 12 | Dec 2014 | ISSN - 2249-555X

pH, salinity, alkalinity, biological oxygen demand (BOD) , chemical oxygen demand on same day to avoid long storage. For analysis of water samples the methods are adopted from standard method APHA (1985), Trivedi and Goel (1986).

Result

The data of physical inorganic constituent of water such as pH, salinity, alkalinity, total dissolved solids, biological oxygen demand and chemical oxygen demand were recorded in the table 1 and 2. The pH values did not show much variation throughout the year. However the high value of pH recorded in August and September 2002 were 8.4 and 8.2 respectively and 8.1 and 8.2 for May and December 2003 respectively. The low values of pH recorded in January and March 2002 were 6.9 and 7.0 respectively and were 6.2 and 7.0 for June and August 2003. The pH values were fluctuating throughout the period of study. Salinity during the year 2002 and 2003 was maximum in the month of April. In April 2002 the salinity was 39.01 mg/litre and 38.18 mg/litre in April 2003. The Salinity declined in the month of July 2002 and 2003 i.e. 28.65 mg/litre and 30.09 mg/litre respectively. The salinity was decreased from May to July 2002 and 2003.Alkalinity of water was highest in the month of June 2002 and 2003 i.e. 461mg/litre and 672 mg/litre respectively. The lowest alkalinity was recorded in the month of February 2002-2003 i.e. 130 mg/litre and 136 mg/litre. Total dissolved solids showed variations in values during the year 2002 and 2003. Maximum values of T.D.S. were recorded in the month of March, August and September 2002 i.e. 554 mg/litre, 630 mg/litre and 607 mg/litre respectively. (Table 4) In the year 2003 the maximum values of T.D.S. were in the month of May, September and October i.e. 570 mg/litre, 610mg/litre and 541 mg/litre. (Table2). Biological oxygen demand (BOD) and chemical oxygen demand (COD) values showed fluctuations throughout the year. The highest values for BOD were 78 mg/litre and 86 mg/litre recorded in October 2002 and 2003. The lowest values for BOD were 8 mg/litre and 10 mg/litre recorded in March 2002-2003.The maximum COD values were observed in July 2002 and 2003. i.e.211 mg/litre and 238 mg/litre. The minimum values of COD were in April and September 2002 i.e. 20 mg/litre and 18 mg/litre respectively and 24 mg/litre and 36 mg/litre in March and September 2003.

Discussion

In the present investigation pH values showed variation throughout the year 2002 & 2003. which was related to planktonic growth in this area. Alikumnhi (1957) and Shreenivasan (1976) have demonstrated that the pH ranged between 6.5 to 8.5 will have impact on the productivity of the water. Perkins (1976) stated that the release of acidic and alkaline effluents to the environment may be expected to dissrupt the buffer system and produces changes in pH at least locally. Abundant microfauna, availability of food ecological condition slighter higher temperature oxygen saturation and pH between 8.3 to 8.9 with constant salinity were responsible for larval aggregation in pools. Tiwari and Nair (1998) observed that pH variation was in narrow range. Due to heavy rains and land drainage the pH may be high. The maximum pH values were recorded in summer season and the minimum was recorded in monsoon season. The maximum temperature was observed in May and the minimal salinity was recorded on September Full moon and maximum salinity was recorded on May Full Moon (Bhagde, 2006).In the current pribe, salinity values decreased during heavy rainfall. Dilution by rainwater was resulted in low salinity. The increase in salinity values during non-monsoon months is due to evaporation. A linear increase in salinity values were observed from monsoon to post-monsoon period. Similar observations were made by Joseph (1974), Cherian (1975) and Tiwari et al. (1998). The higher salinity observed during summer season could be attributed to low rainfall reduction in river runoff and dominance of neretic waters (Santhanam, 2002). Ananthan et al. (2004) observed that salinity was high during summer season and low during winter season. Bhagde (2006) reported that high salinity was observed during summer season, the probable reason for this is high degree of evaporation of surface water due to high temperature during summer season. The low values of salinity were recorded during monsoon and post monsoon due to rainfall and freshwater input from river. Alkalinity variations were recorded throughout the year during 2002 and 2003. Alkalinity or acidity of natural freshwater is generally caused by carbonates and bicarbonates and hydroxides of calcium, magnesium, sodium, potassium etc; along with these dissolved CO_2 in freshwater, determines an equilibrium system, which is of primary importance to the dwelling animals (Rath, 1993). The total dissolved solids in water comprise mainly of inorganic salts and small amount of organic matter. Generally carbonate, bicarbonate, chloride, sulphate, nitrate, sodium potassium, calcium and magnesium contribute total dissolved solids. The total dissolved solids in water originate from natural sources and depend upon location, geological nature of the pond basin, drainage, rainfall, bottom deposit and in flowing water. The excess amount of total dissolved solids in water disturbed the ecological balance due to osmotic regulation and suffocation in aquatic fauna, even in presence of fair amount of dissolved oxygen. The excess amount of total osmotic solids resulted into high osmotic pressure, which in turn caused unbalance of osmotic regulation and suffocation in the drain water. (Verma et al.1978). Total suspended solids ranging from 40.00 mg/litre to 560 mg/litre in Chandanpura pond (Kaushik and Saxsena, 1989); 60.00 mg/litre to 66.75 mg/litre in Ravindra sarovar (Shastree et al, 1991) and 40.00 mg/litre to 1400.00 mg/litre in viveknagaer pond (Kaushik et. al, 1991).The high values during monsoon season may be because of silt, clay and other particle entering into the water bodies along with the run off water, where as during winter to summer season, the total suspended solids were decreased due to sedimentation. In the present study the total dissolved solids were high during in summer season. Massod Ahmed and Krishnamurthy (1990), Dhamija and Jain (1995), Mahajan and Kanhere (1995) and Wagh (1998) have observed similar phenomenon.biological or biochemical oxygen demand (BOD) is very important parameter, which is used to characterize the state or health and quality of water. During summer BOD load were high and low in rainy season. The productivity of water was maximum during summer and followed by winter and rainy reasons. A crab *Chasmagnathus granulsa* showed highest abundance during the period of moderate temperature, salinity and high dissolved oxygen (Dinaco et al. 1994). Similar observations reported in *Callinectes denae* (Chacur et al. 2001). Adholia and Vyas (1992) reported that the maximum species distribution of *Copepods, Cyclopes*, *Nauplius* and *Diaptomus* observed when pollution indicating parameters were low.In the present investigation it was observed that the total dissolved solids and BOD shown high values at the initiation of reproductive phase. Other parameter such as pH,alkalinity were helpful in increasing plankton in surrounding water. Thus the availability of abundant food, favorable ecological and environment factors resulted on successful reproduction of *Portunus sanguinolentus* .

Volume : 4 | Issue : 12 | Dec 2014 | ISSN - 2249-555X

Conclusion:

The physico-chemical factors such as pH, salinity, alkalinity, total dissolved solids, BOD and COD affected the nutrition and reproduction in crab, *P. saguinolentus*. The higher values of these physico-chemical factors during reproductive phase of crab and prawn were helpful in the production of plankton in surrounding water. The productivity of water was maximum in summer, which accelerate the growth of crustaceans and resulted in successful gametogenesis in crab, *Portunus sanguinolentus*. Thus these physico-chemical parameters are closely related to species survival. The present investigation is helpful to study ecology, reproductive biology and fishery of crustaceans.

Table – 1: Correlation between Physicochemical factors and gonadal index in crab, *Portunus sanguinolentus* during the year 2002

Month	Gonad index ± S.D.		pH	Salinity mg/ litre	Alka-linity mg/ litre	T.D.S. mg/litre	BOD mg/ litre	C.O.D. mg/ litre
	Female	Male						
January	0.86 ± 0.03	0.73 ± 0.02	6.9	35.59	204	315	29	69
February	1.29 ± 0.01	0.91 ± 0.06	7.2	36.75	130	482	16	52
March	1.43 ± 0.01	1.06 ± 0.01	7.0	37.93	216	554	08	126
April	2.08 ± 0.02	1.14 ± 0.01	7.8	39.01	239	231	36	20
May	2.62 ± 0.05	1.90 ± 0.03	7.5	38.13	135	405	65	136
June	3.19 ± 0.02	2.24 ± 0.05	7.1	34.91	461	216	48	128
July	4.28 ± 0.02	2.85 ± 0.02	7.6	28.65	337	421	20	211
August	2.94 ± 0.02	3.71 ± 0.01	8.4	30.42	310	630	14	142
Septem-ber	2.46 ± 0.01	1.49 ± 0.02	8.2	31.58	285	607	19	18
October	1.64 ± 0.01	0.73 ± 0.02	7.9	34.31	374	265	78	130
Novem-ber	1.27 ± 0.20	0.92 ± 0.05	7.5	36.43	251	309	18	32
Decem-ber	1.16 ± 0.04	0.83 ± 0.03	7.6	37.02	532	278	64	105

Table – 2: Correlation between Physicochemical factors and gonadal index in crab, *Portunus sanguinolentus* during the year 2003

Month	Gonad index ± S.D.		pH	Salinity mg/ litre	Alkalin-ity mg/ litre	T.D.S. mg/ litre	B.O.D. mg/ litre	C.O.D. mg/litre
	Female	Male						
January	0.80 ± 0.03	0.66 ± 2.02	7.2	37.95	225	410	16	39
Febru-ary	1.29 ± 0.01	0.85 ± 0.06	7.5	38.02	136	305	12	67
March	1.43 ± 0.01	1.03 ± 0.01	7.1	37.61	210	361	10	24
April	2.08 ± 0.02	1.10 ± 0.01	7.3	38.18	265	284	51	162
May	2.62 ± 0.05	1.47 ± 0.03	8.1	36.60	240	570	75	126
June	3.19 ± 0.02	2.06 ± 0.05	6.2	34.58	672	247	48	80
July	4.28 ± 0.02	2.72 ± 0.02	7.5	30.09	560	438	60	238
August	2.94 ± 0.02	3.37 ± 0.01	7.0	32.52	314	352	24	105
Sep-tember	2.46 ± 0.01	1.58 ± 0.02	7.4	31.47	369	610	19	36
Octo-ber	1.64 ± 0.01	0.66 ± 0.02	7.1	35.50	280	541	86	121
No-vember	1.27 ± 0.20	0.87 ± 0.05	7.7	36.11	387	264	18	45
De-cember	1.16 ± 0.04	0.70 ± 0.03	8.2	38.02	520	215	72	133

Volume : 4 | Issue : 12 | Dec 2014 | ISSN - 2249-555X

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