Research Paper

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Effect of Physicochemical Parameters on the Reproduction of the Marine Prawn, Penaeus Canaliculatus

Zoology

KEYWORDS : Physicochemical parameters , inorganic constituents of water pH, salinity, water analysis.

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ABSTRACT

Dahanu is a town on the border of Gujarat and Maharashtra. It is a place on coastal region of Arabian Sea and lies between 19°, 58' North longitude and 72°, 42' East latitude. The reliance thermal power station, Nuclear Atomic Centre, Tarapur and Industrial area are nearby Dahanu. As small decapods and other organisms being food for fishes, help the growth of fishes in that catchment area. The success of species depends on the viability of eggs and the rate of development of egg. 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 study the role of physicochemical parameters such as pH, salinity, alkalinity, total dissolved solids etc. on the reproduction of marine prawn, Penaeus canaliculatus. In the present investigation, it was observed that the total dissolved solids and BOD, shown high values at the initiation of reproductive phase of marine prawn. Other parameters such as pH, alkalinity was helpful in increasing planktons in surrounding water. Thus availability of abundant food favorable environmental factors resulted in successful breeding of Penaeus canaliculatus.

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. The pH of raw water sources mostly lies within the range 6.5 to 8.5. Spence reported that the alkalinity and pH are closely connected with an accurate measure of the trophic status of Lake water27. 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) The pH values increased during any time due to photosynthetic activity i.e. consumption of CO2, whereas pH value decreased at night, due to respiratory activity(Jana, 1973; Cari, 1980; Bhatnagar,1984; Bhatt and Negi,1985; Mahajan and Kanhere ,1995;Rao,1999; Thirumanthal 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(Daves et al, 1978).Reddy et al. (1979) describe that salinity values were increased with raising tide and decreased with falling tide24. Murugan et al. 1992 have stated the salinity was important as one of the controlling factors in determining species composition and succession20. Jayalakshmi and Natarajan (1996) observed influence of salinity on fertilization and hatching of *Macrobrachium idella16*. Gelin et al. (2001) The salinity affects reproductive success in brown shrimp *Crangon crangon12*. Ituarte et al. (2006) studied the effect of salinity on the embryonic development of *Palaemonetes argentinus.* 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 hydroxide of these inorganic ions. The alkalinity of natural freshwater determines an equilibrium system which is of primary importance to the dwelling animals(Rath, 1993). For the productivity of zooplankton and phytoplankton, water temperature, pH, BOD, alkanity etc. are remarkably responsible and moreover seasonal fluctuations in these parameters reciprocated to their growth directly or indirectly1(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 dissolved oxygen affected the rate of feeding metabolism and growth in aquatic animals7. Hence it is essential to study the physicochemical parameters.

MATERIAL AND METHODS

Decapod crustaceans from Dahanu coast were collected during year 2002 and 2003. To study the role of environmental and physicochemical parameter on the reproduction of marine prawn, the water samples were collected from the spot where the animal collection was made. Some of the readings were taken at the collection spot and data were made for two years.

Determination of physical, inorganic constituents of water

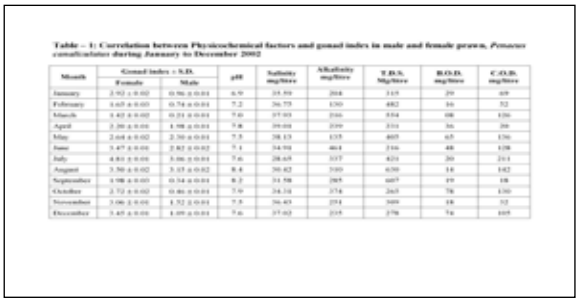
For analysis of various physicochemical factors, water samples were collected in 2 litre sample bottle at early hours of a day. Sample collection was done twice in a month. The reading for temperature and pH etc. were measured on the spot. The samples were analyzed to determine pH, salinity, alkalinity,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

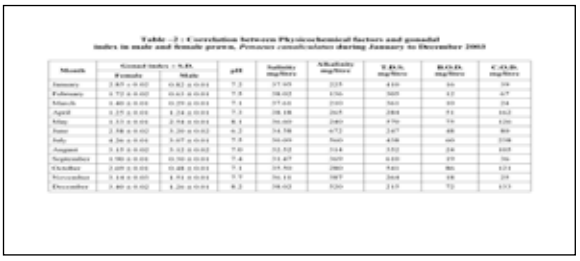
RESULTS

Determination of physical, inorganic constituents of water

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 and 2003 i.e. 130 mg/litre and 136 mg/litre respectively. 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 1) 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. (Table 2) 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 mini-

mum 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.





1.4 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 the pH value 6.5 to 8.5 will have impact on the productivity of the waters. Spence 1967 has reported that the alkalinity and pH are closely connected with an accurate measure of the trophic status of lake water. Verma and Shukla (1968) stated that alkaline water support large amount of biota. Bell (1971) believed that pH (6.5 to 9.0) appears to provide adequate protection to the life of freshwater fishes and bottom dwelling invertebrates, which are food organism for growing fishes. Tiwari and Nayar (1998) observed that pH variation was in narrow range due to heavy rains and land drainage. 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). 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 many investigators(Subhramanyam and Sen Gupta 1965) and Tiwari et al.(1998). Nagabhushanam and Joshi (1984) reported that in *Parapenaeopsis stylifera*, high and normal salinities favored ovarian development at low salinity may be due to the inability of the animal to meet the osmoregulatory demands or the low salinities may be inimical to the larvae of *P. stylifera* therefore ovarian development was slow. Steel and bert (1994) in *Callinectes sapidus* male were common in lower salinity but females preferred slightly high salinity for moulting, mating and spawning. Ananthan et al. (2004) observed that salinity was high during summer season and low during winter season. Bhagde (2006) reported that the probable reason for high salinity was 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 variation was 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 CO2 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 inflowing 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). 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, whereas 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. Similar observation was recorded by other investigators (Massod Ahmad and Krishnamurthi, 1990); (Dhamija and Jain, 1995);(Mahajan and Kanhere, 1995); (Wagh,1998). 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 when water temperature, pH, light penetration and BOD load were high *Microcystis, Navicula* and *Mitzchia* proliferated, whereas in rainy season, when these parameter were low the species like *Spirulina, Anabena, Euglena* and *Challorella* increased in population. Thus the productivity of water was maximum during summer and followed by winter and rainy reasons. *Callinectes denae* showed highest abundance during the period of moderate temperature, salinity and high dissolved oxygen Denaco et al(1994). In the present investigation it was observed that the total dissolved solids and BOD shown high values at the initiation of reproductive phase. Other parameters such as pH, alkalinity was helpful in increasing plankton in surrounding water. Thus the availability of abundant food, favorable ecological and environment factors resulted on successful breeding in *Penaeus canalicultus.*

Conclusion

The physico-chemical factors such as pH, salinity, alkalinity, total dissolved solids, BOD and COD affected the nutrition and reproduction in prawn, *P. canaliculatus.* 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 prawn, *Penaeus canaliculatus.* Decapod crustaceans are commercially important due to their high nutritional contents The success of a species depends on the viability of eggs. The variety of environmental factors and physicochemical factors are closely related to species survival. The plankton helps in the growth of crustacean and other aquatic animals directly or indirectly. Present investigation is helpful to study ecology, reproduction and fishery of crustaceans.

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