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# PHYTO PLANKTON BIO-DIVERSITY IN TIGER SHRIMP (*Penaeus monodon*) CULTURED POND UNDER NATURAL CONDITIONS AT BHEEMILI, VISAKHAPATNAM

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## Introduction:

In the worldwide aquaculture has become global economic activity. It has developed rapidly over the last three decades. In India the annual production of shrimp is approximately 0.126 million metric tons (MPEDA 2010). Phytoplankton are well known as an important source of supplement food, animal feed, bioactive compound, biofuel (Borowitzka 1999; Melis 2002; Shimizu 2003; Singh *et al*. 2005; Metzger & Largeau 2005) and also significant in bioremediation applications (Kalin et al. 2004; Munoz & Guieysse 2006) and nitrogen fixation (Vaishampayan et al. 2001). In shrimp ponds, phytoplankton were found growing naturally and their diversity and abundance often vary, depending on several environmental factors such as light, temperature, pH and salinity (Araújo & Garcia 2005; AlonsoRodriguez & Páez-Osuna 2003). *Penaeus monodon* used to be the major cultivated shrimp species in India, the qualitative and quantitative abundance of plankton in a shrimp pond are of great importance in managing the successful and sustainable aquaculture (Saraswathy *et al*., 2013). In fact, over one quarter of the shrimp traded internationally comes from aquaculture (FAO, 1998). This rapid development has been accompanied by increasingly controversial debates over the environmental, social and economic impacts of shrimp culture (Paez Osuna et al., 1998, 1999; Primavera, 1998; Costanzo et al., 2004; Sampaio et al., 2005). There is considerable uncertainty about appropriate policy and management responses, especially as shrimp culture is perceived to generate substantial benefits in coastal regions and at the national level (Rocha et al., 2004). Water quality plays a significant role in plankton productivity as well as the growth rate of shrimp (Jhingran, 1991). The water quality associated with aquaculture developments is an important concern globally, as a variety of negative environmental impacts on the receiving environment have been documented (Landesman, 1994; Lacerda et al., 2006). Physical variables and biological indicators are common and decide the water quality (Jones et al., 2001). Phytoplankton is an excellent indicator of environmental conditions and aquatic health within ponds because they are sensitive to changes in water quality and they respond to low dissolved oxygen levels, toxic contaminants, poor food quality or abundance and predation (M. Case´ *et al*. 2008). The current conditions of the ponds can be derived by looking at plankton indicators, such as biomass, abundance and species diversity (Burford, 1997; Primavera, 1998). Climate has a major influence on water quality and consequently, the biodiversity within the water bodies (Boyd and Tucker, 1998). Cremen *et al*. (2007) carried out a study to illustrate the changes in phytoplankton communities in tropical commercial shrimp ponds using green water (microalgae) with different stocking densities. The phytoplankton population represents the biological wealth of a water body (Prasad and Singh, 2003). The plankton diversity varies from location to location and from pond to pond within the same location even within similar ecological conditions (Boyd, 1982). There is a paucity of information available in phytoplankton biodiversity in *Penaeus monodon* culture pond under natural conditions, though similar studies have been reported under *P. monodon* (Tookwinas and Songasangjinda, 1999; Cremen *et al*., 2007). Hence, the present study reports on preliminary details of water quality, plankton abundance its diversity and their monthly variation during the culture period of *P. monodon* under natural conditions.

## Materials and methods:


Fig 1: Sampling station at Bheemili, Visakhhapatnam

The pond was located at Bheemili, Visakhapatnam very closely to the Gosthani River which is 0.5 km to the Bay of Bengal.

*Sampling and Identification:*

Winter crop of brackish water farming activity has been started in the 1st week of September. Samples collected from the Shrimp farms of

Bheemili, Visakhapatnam Districts of Andhra Pradesh from September to December in monthly intervals (until the farms are harvested).

To study the Biodiversity of phytoplankton in brackish water shrimp culture pond, filtering 100L. of farm water through 20µ mesh net. Each sample is collected in duplicate, one sample fixed in 5 ml of 2% formalin and 1ml of 4% of Lugols sol. (fixing agent), another sample is carried live to laboratory for observation of phytoplankton species and the sample was observed under Flouroscent Microscope (Nikon 200). During sample collection, water samples were fixed with winkler A, winkler B `in situ` for determination of Dissolved Oxygen. Salinity and pH of the farm water is noted `in situ` using refracto salinometer (ATAGO, Japan) and pH meter. Water temperature was measured with Digital Thermometer, sensitive to ± 1$^{o}$C. Samples fixed in formalin were brought to the laboratory for qualitative analysis.

**Results and discussion:**

Water quality parameters: Table 1 shows the variations in water quality parameters with mean concentrations of DO, pH, salinity and water temperature of the shrimp pond in winter crop of the shrimp cultivation period.

**Table 1**: variation in water quality parameters in different months

| parameters | September | October | November | December |
|---|---|---|---|---|
| Dissolved Oxygen | 4.37±0.25 | 4.47±0.40 | 5 .25±0.70 | 3.42±1.61 |
| pH | 7.98±0.38 | 8.43±1.11 | 8.76±0.76 | 8.76±0.63 |
| Salinity | 18.25±2.36 | 14.62±2.72 | 12.83±2.72 | 15.43±3.79 |
| Water Temp. | 29.06±1.4 | 28.75±1.03 | 25.75±3.43 | 23.34±2.54 |

Table 1 shows the monthly mean of physico chemical parameters measured of shrimp cultivation period. pH values ranged from 7.98±0.38 to 8.76±0.63. There was no seasonal influence on pH. The mean value of salinity of pond water was 12.83±2.72 to 18.25±2.36, the variation of salinity decreasing was observed from September to November and increase in the month of December, due to heavy rain fall during the culture pond. The present study of pH and salinity values was comparable with Saraswathy *et al*., 2013. During the study period dissolved oxygen levels from 3.42±1.61 to 5.25±0.70 and temperature ranges from 23.34±2.54 to 29.06±1.4. Increasing of Dissolved oxygen and decreasing of salinity were observed in the month of November, due to this diversity are less with compare to other months. In the month of there is a suddenly fallen temperature in the month of December.

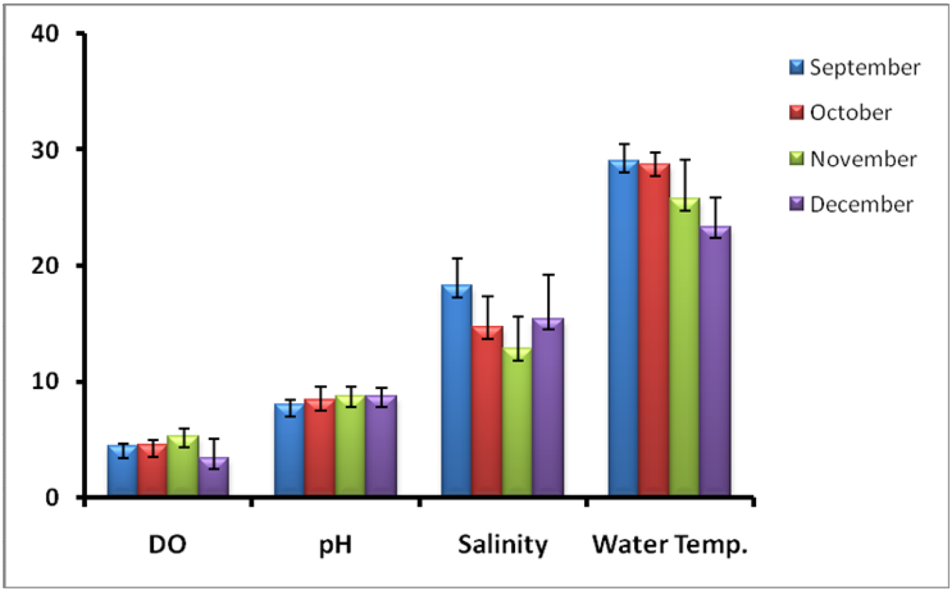


**Fig 2**: Physico Chemical parameters in different months

*Phytoplankton Composition:*

According to Paerl (1988), blooms exist as massive accumulations of a single or less often two coexisting species with densities of 10 – $10^6$ cells $mL^{-1}$, and the nuisance species account for as much as 95–99% of the resident biomass. Smith (1985) suggested that highly diverse algal communities are less likely to collapse than blooms dominated by one species. Copepods, other crustaceans, larvae of polychaetes, larvae of insects, mollusks, ostracods and rotifers have been considered the most important sources of food for shrimp (Rubright et al., 1981). Data obtained from some lakes associated with mathematical models indicate that cyanobacteria dominance is an alternative stable-state of a phytoplankton community in shallow aquatic systems. This is because cyanobacterians are more adapted to low water transparence, and they promote the water turbidity, favoring their own competitive advantages (Scheffer et al., 1997). Therefore, the high temperature and turbidity of the water and the long water retention time in shrimp ponds (>100 days) must raise the probability of cyanobacteria blooms. The plankton diversity showed that water quality parameters in optimum range influenced the growth of phyto plankton groups, similar observation was reported by Hossain et al. (2007).

**Table 2.** Variation of Phyto plankton abundance in winter crop

| September | October | November | December |
|---|---|---|---|
| *Asterionella* | *Chaetoceros* | *Chaetoceros* | *Biddulphia* |
| *Biddulphia mobilensis* | *Gymnodinium sp** | *Coscinodiscus* | *Chaetoceros* |
| *Chaetoceros* | *N.closterium* | *N.closterium* | *Coscinidiscus* |
| *Coscinodiscus* | *N.longissima* | *Navicula* | *Gymnodinium sp** |
| *Ditylum sol* | *N.sigma* | *Nitz.closterium* | *Gyrosigma* |
| *Fragellario* | *Navicula* | *Pleurosigma* | *N. closterium* |
| *Gymnodinium sp** | *Nitz. Closterium* | *Thalassiosira* | *N.longissima* |
| *Gyrosigma* | *Noctiluca** | | *N.sigma* |
| *Navicula* | *Pleurosigma* | | *Navicula* |
| *Nitzschia sigma* | *Skeletonema* | | *Nitz. Closterium* |
| *Pleurosigma* | *Thalassiosira* | | *Pleurosigma* |
| *Thalassiosira* | *Triceratium** | | *Prorocentrum** |
| | | | *Pyridinium** |
| | | | *Rhizisolenia* |
| | | | *Thalassionema* |
| | | | *Thalassiosira* |

Note: * - Dinoflagellates, remaining all are diatoms

Phytoplankton species distribution shows wide spatio-temporal variations due to the differential effect of hydrographical factors on individual species and they serve as good indicators of water quality including pollution (Gouda and Panigrahy, 1996). The salinity acts as a limiting factor in the distribution of living organisms and its variation caused by dilution and evaporation is most likely to influence the fauna in the coastal ecosystem (Balasubramanian and Kannan, 2005; Sridhar et al., 2006). Plankton plays an important role in fish production in the pits of' khadan'of china clay mines (Mandal et.al.,2008).

In the present study, Table 2 shows the microalgae species composition in the shrimp pond in the winter season of shrimp cultivation period. A total of 22 phytoplankton species were identified, in which 17 species were diatoms and 5 species encountered viz., Gymnodinium, Noctiluca, Prorocentrum, Pyridinium and Triceratium were dinoflagellates. 12 species were identified in the month of September and October, 7 species in the month of November and 16 species in December month. Chaetoceros, Gymnodinium, Navicula, Nitzschia sigma, Pleurosigma and Thalassiosira sp. were common in all the months. Prorocentrum and Pyridinium were observed in the month of December only. Phytoplankton undergoes a frequent succession of dominant species due to dynamic changes of growth factors like light, temperature and physico chemical properties in an aquatic environment (Goldman and Mann, 1980; Yusoff and McNabb, 1997; Yusoff et al., 2002). Dinoflagellates were observed more in the month of December with the phytoplankton species.

**Conclusion**: From this study of Tiger shrimp (Penaeus Monodon) cultured pond, no significant variations in the physico chemical parameters under natural conditions upto harvesting.

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