Water quality analysis of aquaculture pond located in Parangipettai, southeast coast of India

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Abstract

A study was conducted on physico-chemical parameters of water in aquaculture shrimp pond located from Parangipettai, southeast coast of India. The study was aimed at assessing its suitability for shrimp production. Water samples were collected at fortnight intervals from the surface layer. Water parameters such as salinity, temperature, DO (dissolved oxygen), pH and transparency were analyzed at regular intervals. Water temperature was varied from 21to 28^{o}C. Salinity range was 0ppt and gradually increased to 17 ppt by regular pumping of estuarine water for 3 hours. pH value was varied from 7.5 to 8.9. The dissolved oxygen level in water was ranged from 6 to8 ml/L. The transparency of shrimp pond was observed from 22 to 65 cm during the study period.

Keywords: Physico-chemical parameters, shrimp pond, temperature, Parangipettai

Introduction

Aquaculture plays a vital role in the Indian economy. Shrimp farming is very profitable business compared to agriculture and animal husbandry (Kumar, 1997). Majority of shrimp farms in India are 100 per cent export oriented. Out of a total 1.456 million hectare of brackish water area available in India, 0.902 million hectares are being utilized principally for shrimp farms. It earns foreign exchange and generated employment for large coastal contiguous population (Mishra, 1998). Water quality management is an effective force for successful farming of fish and shrimps. Hydro-biological regime is a highly complicated factor in the farming practice. Monitoring of the hydro-biological parameters ensure mainly a better quality water medium. The culture ponds are mainly extensions of estuary and are therefore subjected to wider variations in the environmental conditions. A regular monitoring of the environmental condition therefore becomes essential to understand optimum environmental condition for the culture of shrimps. Water quality is defined in terms of the chemical physical and biological contents of water. The water quality of rivers and lakes changes with the seasons and geographic areas, even when there is no pollution present. Water quality guidelines provide basic scientific information about water quality parameters and ecologically relevant toxicological threshold values to protect specific water uses. Important physical and chemical parameters influencing the aquatic environment are temperature, rainfall, pH, salinity, dissolved oxygen and carbon dioxide. These parameters are the limiting factors for the survival of aquatic organisms (flora and fauna) (Lawson, 2011). Poor water qualities may be caused by low water flow, municipal effluents and industrial discharges (Chitmanat and Traichaiyaporn, 2010). The maintenance of good water quality is necessary for the survival and better growth of shrimps. This culture pond of CAS in Marine Biology in the banks of the Vellar estuary affords an excellent condition to study the different environmental conditions that can be met in the culture ponds. The parameters were therefore monitored at regular intervals

for various physio-chemical factors such as, salinity, temperature, DO (dissolved oxygen), pH and transparency of the waters.

Materials and Methods

Water samples were collected at fortnight intervals from the surface. After collection, the samples were brought to the laboratory and analysed. Standard procedures were used for analysis of the samples.

Salinity

The water salinity was measured by using a hand held refractometer (Erma-Japan).

pH (Hydrogen Ion Concentration)

The pH of the pond was measured using an electronic pH pen.

Temperature

Water temperature was measured in the pond itself using a standard centigrade thermometer.

Dissolved Oxygen

The dissolved oxygen was estimated by modified Winkler's method as described by Strickland and Parsons (1972).

Transparency

Transparency was quantified in terms of the light penetration, using a Secchi disc.

Rainfall

The rainfall data was obtained from the meteorological records from Centre of Advanced Study in Marine Biology at Parangipettai. Since the pond was a rain fed pond hence, water from rainfall was harvested for 6 months (August-January) and the culture was carried out in the harvested rainwater..

It was seen that, the maximum rainfall was obtained in the month of November (687 cm) while the minimum amount of rainfall was received in the month of January (32 cm) which is why harvesting was done during this month (Fig. 1).

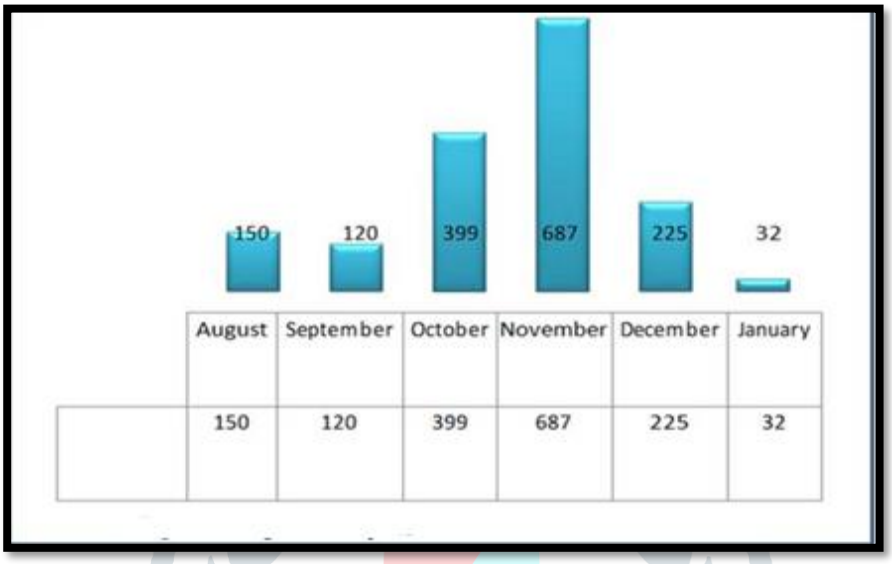

Fig. 1: Graphical representation of monthly rainfall

Results and Discussion

The hydro-biological regime is highly complicated factor in shrimp farming because of rather slow movement of water, shallow depth, intensive stocking of shrimps, algal development and accumulation of organic matter. The variations of dissolved oxygen, temperature, salinity and productivity rates are the key factors in the culture system which plays an important role in keeping the prawns in good condition (Shigueno, 1972). Salinity fluctuations in the tropical countries are noticed mainly when there is a freshwater runoff or during monsoonal months (Table 1).

Salinity

In the culture pond, the salinity originally was 0 ppt and was gradually increased to 17 ppt by regular pumping of estuarine water for 3 hours. Maximum salinity was observed in the month of January while minimum was observed in the month of August to November. Harvesting was done at 17 ppt salinity.

Table 1: Physio-chemical feature of water during the culture of *Litopenaeus vannamei*

Sl.No	Parameters	Minimum	Maximum
1.	Salinity (ppt)	0	17
2.	pH (Hydrogen Ion concentration)	7.5	8.9
3.	Temperature (^{o}C)	21	28
4.	Dissolved Oxygen (ml/L)	6	8
5.	Transparency (cm)	22	65

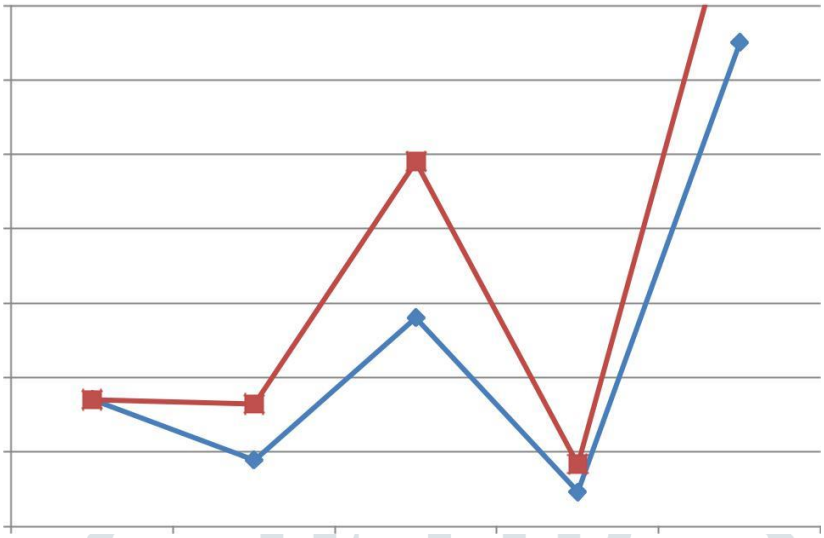

Fig. 2: Graphical representation of water quality parameters

Temperature

In India the temperature is quite high during the dry pre-monsoon season but with the advent of the southwest monsoon (June-September) water temperature reaches its lowest value (26°C) in August (Dwivedi *et al*., 1974).The temperature in the pond varied from 21-28ºC. The maximum temperature was recorded in the month of November when DOC was 30 while minimum was observed during the month beginnings when DOC was 15. Initially temperature was low due to fresh introduction of water while gradually temperature increased in course of time during the running culture.

pH (Hydrogen Ion Concentration)

The pH varied from 7.5 to 8.9 was recorded in the aquaculture pond during the study period. The maximum pH was found during the month of November when the DOC was 15 days and the minimum was observed during month ends i.e. on 30 DOC. The pH values didn't show a great fluctuation and it was always on the alkaline side which is the ideal condition for shrimp culture. The lower pH values in the pond during the month ends might be due to the decomposition

of organic matter associated with the influx of rainwater. Hydrogen ion concentration or pH as one of the vital, environmental characteristics decides the survival, metabolism, physiology and growth of aquatic organism (Ramanathan *et al*., 2005).

Dissolved oxygen

Dissolved oxygen (DO) is one of the most important abiotic parameters influencing the life in the coastal environment. Normally high dissolved oxygen is encountered in unpolluted areas, while at polluted areas levels of DO is very low. Further depletion of DO to the level of anaerobia is the most critical manifestation of pollution (Lester, 1975).The oxygen level in water ranged from 6-8 ml/L. The maximum DO was observed during the beginning of the culture period when water was freshly introduced while gradual decrease in the DO level was observed due course of time. The oxygen content was maximum due to the input natural waters from the rainfall. Low O_2 level might be due to the heavy inflow of organic matter which ultimately demand for oxygen. In the culture pond, the fluctuation of dissolved oxygen level might be due to the respiration by organisms. In the night times, the DO level was low. Dissolved oxygen in the pond water plays an important role in keeping the shrimps in good condition as a key element to the life of the shrimps (Fig.2).

Transparency

The transparency ranged from 22 to 65 cm to maintaining a stable water colour (Phytoplankton bloom) is the key factor in maintaining good water quality. The colour of the water in the pond indicates the type of plankton groups in the pond. The phytoplankton density is measured by using a secchi disc and recommended reading is between 30-40 cm. Phytoplankton and zooplankton standing stocks pay an important role in determining the turbidity. Secchi disc d

epth measurements can give a rough indication of the chlorophyll concentration and therefore algal population densities (Fig. 3) and still has a useful place in characterizing water quality parameters.

The present observations clearly indicate that the pond was highly productive and suitable for shrimp culture. Environmental conditions and high organic production are conducive for the growth of shrimps and for maintaining a high biomass in the pond ecosystem.

Algae and other organisms recorded in the aquaculture pond

Aquaculture operations are seriously affected on account of the interference of algae and insects and therefore needs serious attention. Hence, weekly survey was made o the algal growth and insect fauna of the pond. The samples were analysed for their species composition, distribution pattern and succession.

The most abundant and dominant group of algae was the filamentous algae mainly *Spirogyra* and A*nabena* and were recorded throughout the study period. This may be the salt tolerating nature of these algae. The two common insects that were recorded in the pond were water strider (Gerridae) and common backswimmers (*Notonecta* sp.). The pattern of distribution of these insects clearly shows that the organism tolerates a wide salinity range. Mechanical removal or chlorination might prove helpful in removal of these algae and insects.

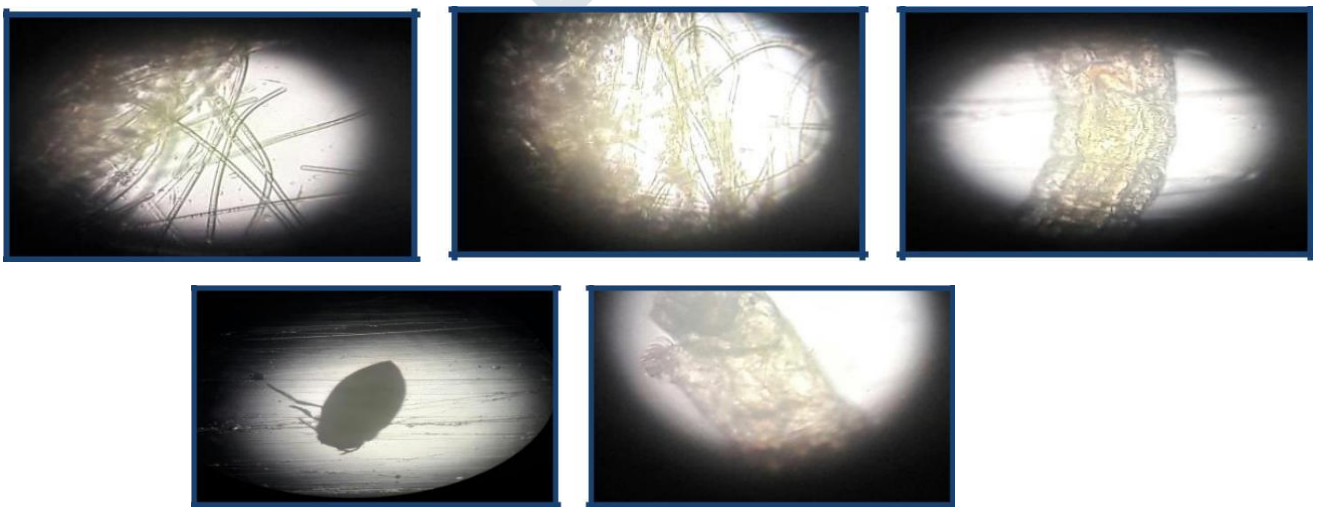

Fig. 3: Observation of algae and insects as seen under a compound microscope

Predatory fishes in the pond

The control of predators in a shrimp farm is a very important aspect because the predators may cause large scale destruction to cultured organisms which in turn affect the economic output of the farm. Proper management of the shrimp farm will ensure the total control of the predators.

Predatory fishes were collected by cast-net during the culture operations as well after harvest and preserved in 10% formalin and identified. The predatory fish which were found in the culture pond were *Elops machnata*, *Oreochromis mossambicus*, *Anabas testudineus* and *Arius maculates.* Tampi (1960) considered *Elops machnata* to be the most important fish predator in South India. Some of these predators entered the pond with the incoming flush of rain water and some entered the pond through the sluice and grew with the shrimps due course of time. Materials that can be used to control these predatory fishes are Derris root powder, Tea-seed cake and Mahua oil cake.

Majority of the shrimp farms are in the small scale sector with water spread of overall area of less than two hectare. The traditional and extensive methods of farming do not adversely affect the environment. However, semi intensive and intensive methods of farming as well the clustering of farms in a particular locality can lead to degradation of coastal zone. The problems are due to unplanned and unregulated development of aquaculture ponds (Mishra *et al*., 2008). The shrimp farm activity around the refuge though has no such significant impact on the flora and fauna at present however there is a fluctuation in the physico chemical parameters which if continues, would result in imbalance in the ecosystem in long run.

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