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Comparative Ecological Studies of Karanja and Panvel Creeks adjoining to Shrimp Culture Ponds in Raigad district of Maharashtra

P.E. SHINGARE*, H. SINGH and K.J. CHAUDHARI

Maharashtra Council of Agricultural Education and Research (MCAER)
132/B, Bhamburda, Bhosale Nagar - 411 007, Pune, Maharashtra

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Coastal aquatic systems are important resources for enhancing aquaculture production, exhibiting diverse ecological conditions. These resources could be utilized for food production with proper maintenance of ecological balance. Several studies have been made pertaining to characteristics of brackish water ecosystems of India, viz. Hoogly-Matlah estuary, Chilka lake, Cavery estuary and Pulicate lake along the east coast and coastal waters of Bombay west coast, Mandovi-Zuary estuary and Netravati-Gurupur estuary along the west coast. The present study was undertaken to study the different physico-chemical characteristics and heavy metal content of two different creeks viz. Karanja and Panvel, which are main source of intake for brackish water shrimp culture ponds of Uran- Panvel area in Raigad districts of Maharashtra. There was great variation in transparency, which was more at Panvel creek compared to Karanja creek. The values of salinity, specific conductivity, calcium, magnesium and total hardness were higher in the water of Karanja creek compared to Panvel creek. It may be due to immediate connection of Karanja creek to sea. Among the heavy metals, the level of cadmium and lead was higher in karanja creek, however, the level of zinc was less than Panvel creek.

(***Key Words:*** *Ecology, Creeks, Physical and Chemical characteristics*)

Brackishwater environment has unique characteristics owing to regular seawater mixing with inland drainage. Recognised as rich in productivity, they also have biodiversity of high degree. Several researchers have studied the brackishwater environment viz. estuaries, lagoons, backwaters, coastal lakes etc., however, the work on brackishwater impoundments is rather limited.

Several studies have been made pertaining to characteristics of brackishwater ecosystems of east coast of India, viz. Hoogly-Matlah estuary (Bandopadhyay and Datta 1990); Chilka lake (Banerjee and Roychoudhari 1996); Cavery estuary (Seralathan & Seetaramaswamy 1979), Pulicate lake (Kaladharan *et al*., 1996). Along the west coast of India, such as coastal waters of Bombay (Zaidy, 1995), Mandovi-Zuary estuary (De'souza *et al*., 1981) and Netravati-Gurupur estuary (Patil *et al*., 1990) have been investigated for ecological characteristics.

Due to the favorable range of salinity in monsoon season in Karanja creek compared to Panvel creek, shrimp culture can be undertaken successfully in the monsoon season in the ponds adjoining to coastal aquatic systems, which will enhance aquaculture production, under diverse ecological conditions. These resources could be utilized for food production with proper maintenance of ecological balance.

MATERIALS AND METHODS

The Uran and Panvel creeks of Raigad district of Maharashtra were selected for this study. A part of present investigation was carried out for both Uran and Panvel creek water before start of Crop I (December to April) and Crop II (May to September). The Karanja creek of Uran Tahsil is located at Lat 18°54'N and long 73°, while Panvel creek is located at Lat 18°59'N and long 73°4'E in Raigad district of Maharashtra.

The water samples of these creeks were collected and parameters such as transparency, temperature, salinity, pH, dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, calcium, magnesium, dissolved organic matter were estimated at sampling site. The total dissolved solids, specific conductivity, ammonia-nitrogen nitrite-nitrogen and nitrate-nitrogen were analyzed in the laboratory. Heavy metals such as mercury, zinc, cadmium, lead, copper were analyzed to observe the pollution level. All the parameters were estimated according to standard methods described in APHA (1980) and Strickland and Parson (1972).

RESULTS AND DISCUSSIONS

The monthly variation in rainfall and rainy days at Uran and Panvel are given in Table 1. The maximum rainfall recorded was 777.1 and 855.0 mm in the month of August at Uran and Panvel, respectively, while

**Corresponding Author :* E mail: prakashshingare@gmail.com

minimum rainfall was 63.9 and 247.0 mm in the month of September at Uran and Panvel, respectively. The rainfall of 11.8 mm was also recorded in the month of May at Panvel. The maximum total rainy days recorded were 21 at Uran and 24 at Panvel in the month of August while the minimum total number of rainy days were 7 and 9 at Uran and Panvel respectively in September. A day's rainfall was also recorded at Panvel during the month of May.

The total rainfall recorded was 1202.70 mm for 54 rainy days at Uran and 1838.0 mm for 66 rainy days at Panvel. In the present study, the variations in physico-chemical characteristics such as transparency, temperature, salinity, pH, dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, calcium, magnesium, dissolved organic matter, total dissolved solids, specific conductivity, ammonia-nitrogen nitrite-nitrogen and nitrate-nitrogen are tabulated in Table 2. The pollution level of heavy metals such as mercury, zinc, cadmium, lead, copper are shown in Table 3.

There was great variation in transparency, which was more (44 – 58cm) at Panvel creek compared to Karanja creek (37- 48cm). Water transparency of Karanja creek was comparatively lower than Panvel creek. It may be due to closeness to sea and churning of water during high tide. Panvel creek was comparatively at longer distance. Transparency was more in pre-monsoon season compared to monsoon season at both creeks. Low turbidity, clear sky and calmness of water results into high transparency during pre-monsoon period (Dharmaraj *et al*., 1986).

The low temperature of estuarine water during monsoon season is reported by Selvaraj and Verghese (1996). In present study, there was no significant fluctuation in temperature at both sites. Patil *et al*. (1990) recorded water temperature between 25.5 – 32.3°C in Netravati-Gurupur estuary and found this fluctuation due to seasonal variation. Gaidhane (2002) also recorded such low value during monsoon and high value during summer season.

Table 1. *Monthly Rainfall at Uran and Panvel*

Sr. No.	Months	Uran		Panvel	
		Rainfall (mm)	Total rainy days	Rainfall (mm)	Total rainy days
1	May, 2002	–	–	11.8	1
2	Jun., 2002	255.8	16	430.4	19
3	Jul., 2002	105.4	10	293.8	13
4	Aug., 2002	777.1	21	855.0	24
5	Sept., 2002	63.9	7	247.0	9

Table 2. *Physico-chemical parameters of Karanja and Panvel creeks*

Parameters	Karanja creek	Panvel creek
Transparency (cm)	37 - 48	44 - 58
Temperature (^{0}C)	28 - 32	28 - 28.5
Specific conductivity (ms)	19.56 - 61.6	8.66 - 59.4
Total dissolved solids (g l^{-1})	9.80 - 30.8	4.32 - 29.5
Salinity (g l^{-1})	13.5 - 39.0	4.5 - 38.5
pH	7.7 - 7.9	7.75 - 7.8
Dissolved oxygen (mg l^{-1})	4.6 - 5.2	4.8 - 5.6
Free carbon dioxide (mg l^{-1})	Nil	Nil
Total alkalinity (mg l^{-1})	100 - 136	108 - 146
Total hardness (mg l^{-1})	2040 - 7920	1120 - 7340
Calcium (mg l^{-1})	138.8 - 576	64 - 512
Magnesium (mg l^{-1})	413.09 - 1581.12	234.24 - 1478.64
Dissolved organic matter (mg l^{-1})	0.6 - 1.8	0.45 - 1.13
Ammonium-nitrogen (mg l^{-1})	0.015 - 0.02	0.020 - 0.04
Nitrite-nitrogen (mg l^{-1})	less than 0.01	less than 0.01
Nitrate-nitrogen (mg l^{-1})	0.15 - 0.20	0.12 - 0.16

Table 3. *Heavy metals of Karanja and Panvel creeks*

Parameters	Karanja creek	Panvel creek
Mercury (mg l^{-1})	Nil	Nil
Zinc (mg l^{-1})	0.012 - 0.026	0.020 - 0.053
Cadmium (mg l^{-1})	0.039 - 0.082	0.018 - 0.046
Lead (mg l^{-1})	0.068 - 0.317	0.012 - 0.029

The values of salinity, specific conductivity, calcium, magnesium and total hardness were higher in the water of Karanja creek compared to Panvel creek. It may be due to immediate connection of Karanja creek to sea. Among the heavy metals, the level of cadmium and lead was higher in karanja creek, however, the level of zinc was more in Panvel creek.

Several researchers have revealed the importance of salinity as a major regulating factor in different brackishwaters, inshore and offshore regions of the marine environment [Qasim and Poxton (1990), Sengupta, (1981), Krishnakumari and Nair (1984-85)]. The salinity gradually decreased due to rainfall and influx of freshwater in the creek water during monsoon season. The similar trend of salinity fluctuation in brackishwater ponds near Netravati estuary was recorded by Nagarajaih and Gupta (1983).

Gaidhane (2002) reported the seasonal variation of 0.99 – 27.55 g l^{-1} in total dissolved solids with low mean value occurring in monsoon and high mean value in pre-monsoon season. The results of present study are comparable with these observations. The pH variation between 7.23 – 9.35 in different brackishwater ponds were reported by several workers (Patnaik and Misra, 1990, Das and Saxena, 2001). In present investigation, pH was in the favorable range. Sundararajan *et al*. (1980) recorded dissolved oxygen in tidal brackishwater ponds in the Santhome farm, Madras, located near the mouth of Adyar estuary ranging from 3.6 – 8.94 mg l^{-1}. Dissolved oxygen level was also above the level required by fishes and shrimp.

Saraladevi *et al*. (1991) observed increase in the level of ammonia concentration from mouth towards upstream in the Periyar river estuary with water collected close to bottom showing higher concentration of ammonia throughout the year except during January. Ammonia is more toxic when pH is more and concentration of dissolved oxygen is low (Boyd, 1979). However, effect is probably nullified in ponds if free carbon dioxide concentration is high when dissolved oxygen level is low (Boyd, 1979). Nitrite-nitrogen is an intermediate product in bacterial oxidation of ammonia to nitrate. It is generally toxic to aquatic organisms, beyond the limit of 0.5 mg l^{-1} (Munilkumar, 2000). Nitrate is not toxic to fish unless present at very high levels more than 100 mg l^{-1} (Qasim and Poxton, 1990), although tolerance levels may vary according to species. However, the favourable range of nitrate-nitrogen for brackishwater is 0.01 – 3.0 mg l^{-1}. In the present study the levels of ammonia-nitrogen, nitrite-nitrogen and nitrate-nitrogen were within the range suitable for aquatic fauna.

Among the heavy metals, the level of cadmium and lead was higher in karanja creek, however, the level of zinc was less than Panvel creek. Copper content was in the permissible limit at both sites.

CONCLUSION

The water of both creeks was observed to be suitable for brackish water fish and shrimp culture. Due to more but within the favorable range of salinity in monsoon season in Karanja creek compared to Panvel creek, shrimp culture can be undertaken more successfully even in the monsoon season in the ponds adjoining to Karanja creek. However, the culture of shrimp can be undertaken at Panvel area, if creek water of high salinity is filled in ponds before onset of monsoon.

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