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STUDY OF HYDROLOGICAL PARAMETERS OFF MIRYA AND AARE-WARE ROCKY SHORES OF RATNAGIRI, MAHARASHTRA INDIA

Pallavi K. Pakhmode[1*] and Swapnaja A. Mohite[2]

Department of Fisheries Biology, College of Fisheries, Ratnagiri - 415 629, India.
*e-mail: pallavi.pakhmode@gmail.com

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ABSTRACT : The present study was carried out to find the changes in water parameters of Mirya and Aare-Ware rocky shores, Ratnagiri coast Maharashtra, India. The ecological parameters like atmospheric temperature, water temperature, salinity and pH were measured during June 2014 to May 2016. The environmental parameters observed were atmospheric temperature (26 to 35.4 ^{0}C & 26.3 to 32.4 ^{0}C) in Mirya and Are-Ware shore respectively, water temperature (26 to 35.4 ^{0}C & 26.3 to 32.4 ^{0}C) in Mirya and Are-Ware shore respectively, salinity (18.7 to 38.4 ‰ & 5.8 to 39.2 ‰) in Mirya and Are-Ware shore respectively and pH (6.5 TO 9.5) in both shores. All parameters showed monthly and seasonal variations. Relatively low values were obtained during monsoon and high during summer period.

Key words : Environmental parameters, Mirya, Aare-Ware, Ratnagiri coast of India.

INTRODUCTION

The marine environment is a complex system influenced by physical, chemical and biological processes. Marine environmental management is assessed by proper assessment of water quality. Marine water quality monitoring is required to predict changes in the quality of particular marine environment, so that prevention measures can be taken to restore and maintain the ecological balance in the habits. Estuarine and coastal areas are complex and dynamic aquatic environment (Morries *et al*, 1995).

Intertidal rocky shores are heterogeneous environment supporting variable assemblage of sessile and mobile organisms which can be found in shoreline throughout the world. In the environment these organisms are distributed in a particular way, occurring with the strong vertical pattern- zonation which is strongly influences by the vertical gradient caused by tide and also the horizonal gradient cause by wave action (Little *et al*, 2009).

Patare (1998) studied that the physico-chemical parameters are very important in study of environment, especially aquatic environment, In the Indian coast, there are a number of rocky shores of varying dimension with different hydrographical properties like physical, chemical and varying tidal fluctuations. The seasonal variation in environmental parameters may be responsible for seasonal distribution of flora and fauna of rocky shores. The present study was conducted to evaluate the ecological parameters of Mirya and Aare-Ware Rocky shores of Ratnagiri, Maharshtra, India.

MATERIALS AND METHODS

The study area

The fortnightly sampling was carried out during June 2014 to May 2016 on the intertidal exposed rocky shore of Mirya and Aare-Ware, Ratnagiri. Ratnagiri is the coastal district of Maharashtra state along the west coast of India bound by Arabian sea. Mirya rocky beach (Lat. 17.017790 N, Long. 73.274820 E) and Aare-ware rocky beach (Lat. 16.99020 N, Long. 73.3120 E) located along the south-west side of Ratnagiri.

Water parameters were observed at every fortnight as per the standard methods given by Vekataraman and Chari (1951). Values of parameters like water temperature, salinity, pH, Dissolved oxygen, Total Dissolved Solids, atmospheric temperature were recorded on monthly basis. Temperature was recorded by using a "Tempo" brand thermometer, having the range of 0 to 110^0 C. Salinity was recorded by using a "ERMA" brand refractometer and the salinity was expressed in ppt. pH was measured by using a digital pH meter (Lab-India, Digital pH meter) having accuracy of 0.01 units.

RESULTS AND DISCUSSION

i. Atmospheric temperature

The pooled monthly variations in atmospheric

Table 1 : Monthly variation of environmental parameters in Mirya and Aare-Ware rocky shores of Ratnagiri, Maharashtra India during June 2014 - May 2016.

		Mirya				Aare-Ware			
Year	**Month**	**Atm temp (^{0}C)**	**Water temp (^{0}C)**	**Salinity (‰)**	**pH**	**Atm temp (^{0}C)**	**Water temp (^{0}C)**	**Salinity (‰)**	**pH**
2014	**June**	24	26.5	28	6.5	27	28.4	25.4	6.5
	July	24.2	26	24	7.5	25	27	18	6.5
	Aug	26	27	19.5	7.5	26	28	16	7.5
	Sep	25	26	24.6	7.5	26.5	27	20.4	7.5
	Oct	26.4	27.5	25.4	8.5	26	28	25	8.5
	Nov	27	28.4	29	7.4	28	29.4	28	8.5
	Dec	30.4	30	31	9.5	30.4	30	30	8.5
2015	**Jan**	29.4	29.7	34	8.5	28.4	28	33.5	8.2
	Feb	25.6	27	34.6	8.3	26	27.4	35	8.5
	Mar	28.4	29	37	8	26.5	28	35.7	8
	Apr	30	32.5	38	8.5	27	30	36.4	8.5
	May	30.4	35.4	38.4	7.5	28.4	32.5	39.2	8.2
	June	25.7	27	21	6.5	25	26.3	16	7.3
	July	25	28	18.7	6.5	25	28.4	5.8	6.5
	Aug	28.5	30	25	7.5	27.8	28.4	12.8	7.4
	Sep	26	27.8	25	8	28	30	15	7.8
	Oct	27.5	28	27	8.5	28.8	30.6	25	8.2
	Nov	28	30	28	7.5	27	29.5	25.8	8
	Dec	28.8	30.4	30.5	8.2	27.6	29	28	8
2016	**Jan**	29	31	30.8	8.5	28	29.4	30.2	8.5
	Feb	29.4	32	32	9	23.6	27.4	30.8	8.5
	Mar	27.5	30	36.4	9.5	27	29	32.5	9
	Apr	29	32.6	37	8.5	28	30.6	35	9.5
	May	29.3	35	38	8.5	28.4	30.5	35.8	8.5
	Min.	24	26	18.7	6.5	23.6	26.3	5.8	6.5
	Max.	30.4	35.4	38.4	9.5	30.4	32.5	39.2	9.5
	Mean±SD	**27.52±1.98**	**29.45±2.63**	**29.70±6.09**	**8.00±0.83**	**27.06±1.51**	**28.87±1.45**	**26.47±8.83**	**8.00±0.77**

temperatures of Mirya and Aare-Ware are tabulated in Table 1- 4 and Fig. 1 -8. The atmospheric temperature for the period of investigation varied from 24 to 30.4 ^{0}C. The maximum temperature was recorded in the month of December 2014 and May 2015 (30.4^{0}C) in Mirya shore while December 2014 (30.4^{0}C) in Aare-Ware shore. The minimum values was recorded in the month of June 2014 (24^{0}C) in Mirya shore while in Aare-Ware in the month of February 2016 (23.6^{0}C). Seasonally, atmospheric temperature values were maximum during summer (28.60±2.18 & 28.80±0.88^{0}C) in 2014-15 and 2015-16 respectively in Mirya shore while in Aare-Ware in the season of winter (28.20±1.80 & 27.85±0.75^{0}C) in 2014-15 and 2015-16 respectively. whereas minimum atmospheric temperature values during monsoon (24.80±0.91 & 26.30±1.53^{0}C) in 2014-15 and 2015-16 respectively in Mirya shore while in Aare-Ware in the season of monsoon (26.13±0.85 & 26.45±1.68^{0}C) in -15 and 2015-16. Correlation coefficient analysis showed that atmospheric temperature had strong positively correlation with water temperature and salinity in Mirya shore while in Aare-Ware atmospheric temperature had strong positively correlation with salinity.

Anandan (2002) recorded the water temperature was found to be positively correlated with atmospheric temperature along the coast of Mumbai. Shinde (2015) recorded the higher temperature in May while the lower temperature during mansoon and post-monsoon season at Ware and Bhatkarwada rocky shores of Ratnagiri.

ii. Water temperature

In the present study, the water temperature varied from 26 to 35.4^{0}C in Mirya shore while 26.3 to 32.4^{0}C in

Table 2 : Season wise variation of environmental parameters in Mirya and Aare-Ware rocky shores of Ratnagiri, Maharashtra India during June 2014 - May 2016.

Mirya										
Parameter	**Year**	**Monsoon**			**Winter**			**Summer**		
2014-15		**Min.**	**Max.**	**Mean±SD**	**Min.**	**Max.**	**Mean±SD**	**Min.**	**Max.**	**Mean±SD**
Atm temp (^{0}C)	**2014-15**	24.2	26	24.80±0.91	26.5	30.4	28.30±1.91	25.6	30.4	28.60±2.18
Water temp (^{0}C)		26	27	26.38±0.48	26.5	30	28.90±1.16	27	35.4	30.98±3.72
Salinity (‰)		19.5	28	24.03±3.49	25.4	34	29.85±3.61	34.6	38.4	37.00±1.70
pH		6.5	7.5	7.25±0.50	7.4	9.5	8.48±0.86	7.5	8.5	8.08±0.43
Atm temp (^{0}C)	**2015-16**	25	28.5	26.30±1.53	27.5	29	28.33±0.70	27.5	29.4	28.80±0.88
Water temp (^{0}C)		27	30	28.20±1.28	28	31	29.33±1.30	30	35	32.40±2.06
Salinity (‰)		18.7	25	22.43±3.12	27	30.8	29.08±1.87	32	38	35.85±2.65
pH		6.5	8	7.13±0.75	7.5	8.5	8.18±0.47	8.5	9.5	8.88±0.48
Aare-Ware										
Atm temp (^{0}C)	**2014-15**	25	27	26.13±0.85	26	30.4	28.20±1.80	26	28.4	26.98±1.03
Water temp (^{0}C)		27	28.4	27.60±0.71	28	30	28.85±1.01	27.4	32.5	29.48±2.30
Salinity (‰)		16	25.4	19.95±4.05	25	33.5	29.13±3.57	35	39.2	36.58±1.84
pH		6.5	7.5	7.00±0.58	8.2	8.5	8.43±0.15	8	8.5	8.30±0.21
Atm temp (^{0}C)	**2015-16**	25	28	26.45±1.68	27	28.8	27.85±0.75	23.6	28.4	26.75±2.18
Water temp (^{0}C)		26.3	30	28.28±1.52	29	30.6	29.63±0.68	27.4	30.6	29.38±1.51
Salinity (‰)		5.8	16	12.40±4.60	25	30.2	27.25±2.34	30.8	35.8	33.53±2.30
pH		6.5	7.8	7.25±0.54	8	8.5	8.18±0.24	8.5	9.5	8.88±0.48

Table 3 : Correlation co-efficient among environmental parameters of rocky shore of Mirya, Ratnagiri. India during June 2014- May 2016.

	Atm temp. (^{0}C)	**Water temp. (^{0}C)**	**Salinity (‰)**	**pH**
Atm. temp. (^{0}C)	1			
Water temp. (^{0}C)	.854**	1		
Salinity (‰)	.688**	.724**	1	
pH	.617**	.412*	.591**	1

** Significant at the 0.01 level, * Significant at the 0.05 level.

Table 4 : Correlation co-efficient among environmental parameters of rocky shore of Aare-Ware , Ratnagiri India during June 2014- May 2016.

	Atm. temp. (^{0}C)	**Water temp. (^{0}C)**	**Salinity (‰)**	**pH**
Atm. temp. (^{0}C)	1			
Water temp (^{0}C)	.717**	1		
Salinity (‰)	0.354	.433*	1	
pH	0.397	.456*	.730**	1

** Significant at the 0.01 level, * Significant at the 0.05 level.

Aare-Ware shore, which was lowest in the month of July and September 2014 (26 ^{0}C) in Mirya shore while In Aare-Ware in the month of June 2015 (26.3^{0}C) and highest in the month of May 2015 (35.4^{0}C) in Mirya shore and May 2015 (32.5^{0}C) in Aare-Ware shore. Seasonally, the lower values of water temperature was recorded during the monsoon (26.38±0.48 & 28.20±1.28^{0}C) in the year 2014-15 and 2015-16 respectively in Mirya shore while in Aare-Ware in the season of monsoon (27.60±0.71 & 28.28±1.52^{0}C) in the year 2014-15 and 2015-16 respectively. Higher values was recorded during summer season (30.98±3.72 &32.40±2.06^{0}C) in the year 2014-15 and 2015-16 respectively in Mirya shore while in Aare-Ware in the season of summer (29.48±2.30 & 29.38±1.51^{0}C) in the year 2014-15 and 2015-16 respectively. Correlation coefficient analysis showed that water temperature had strong positively correlation with salinity in Mirya and Aare-Ware shore.

Dwivedi *et al* (1974) recorded the temperature of interstitial water to vary from 23. 9 to 25.9 ^{0}C along the Calangute beach of, Goa. Bhatade (2011) The highest sea water temperature during this study was 33.07°C in the premonsoon season while the lowest was 27°C during monsoon and post monsoon season at Alawa (Ratnagiri). She also recorded the water temperature was found to be positively correlated with atmospheric temperature. Lokhande (2012) interstitial water temperature varied from 22.07^{0}C to 30.57^{0}C, while the maximum value of

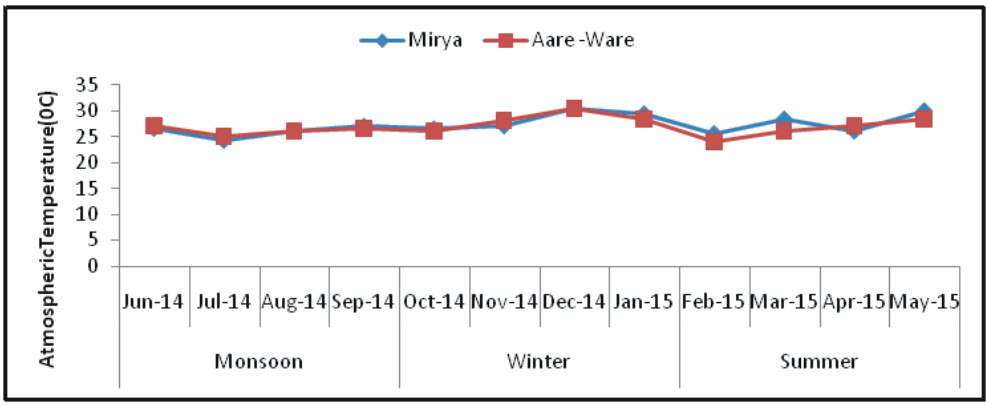

Fig. 1 : Variation in atmospheric temperature (^{0}C) in the Mirya and Aare-Ware rocky shores of Ratnagiri, Maharashtra India during 2014-2015.

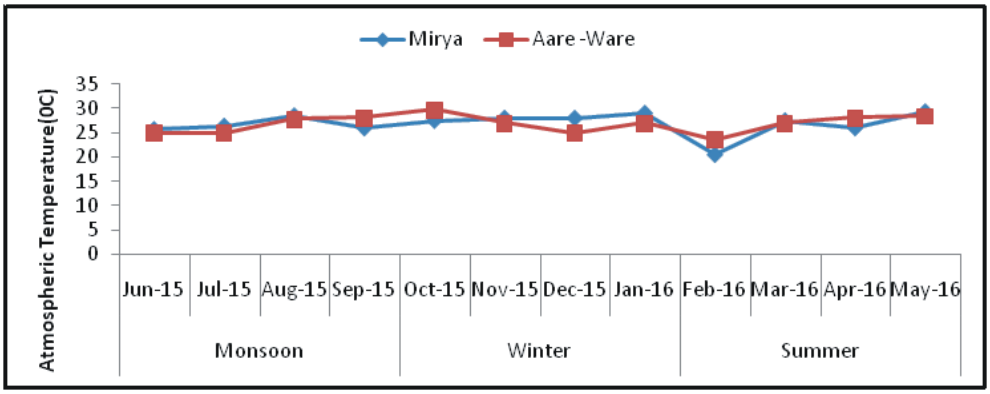

Fig. 2 : Variation in atmospheric temperature (^{0}C) in the Mirya and Aare-Ware rocky shores of Ratnagiri, Maharashtra India during 2015-2016.

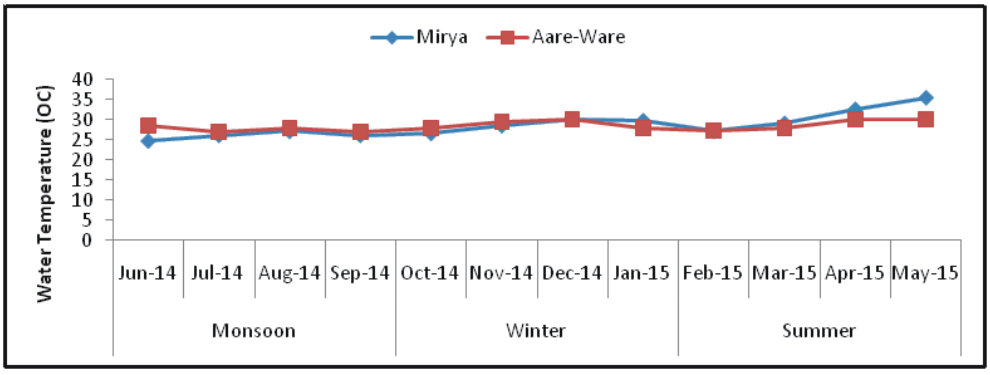

Fig. 3 : Variation in water temperature (^{0}C) in the Mirya and Aare-Ware rocky shores of Ratnagiri, Maharashtra India during 2014-2015.

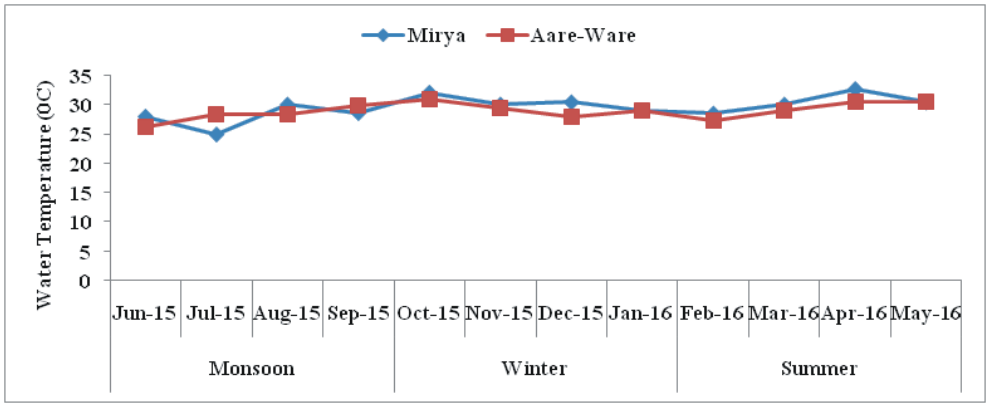

Fig. 4 : Variation in water temperature (^{0}C) in the Mirya and Aare-Ware rocky shores of Ratnagiri, Maharashtra India during 2015-2016.

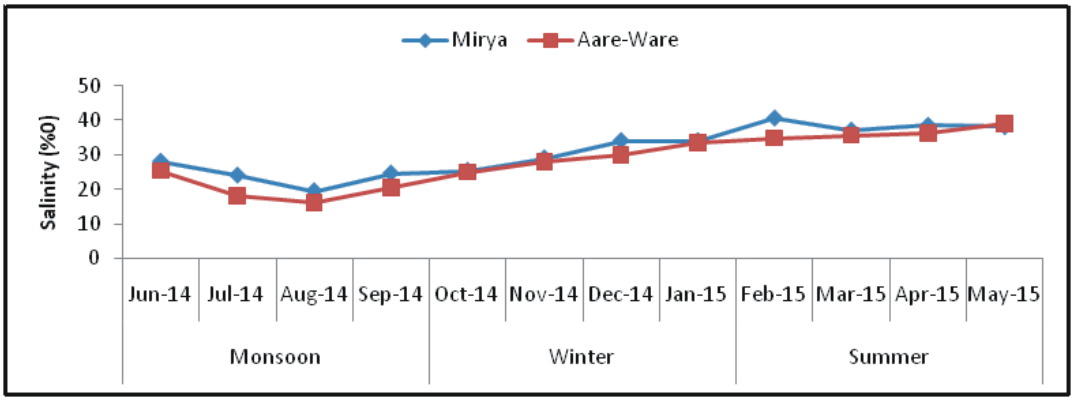

Fig. 5 : Variation in salinity (‰) in the Mirya and Aare-Ware rocky shores of Ratnagiri, Maharashtra India during 2014-2015.

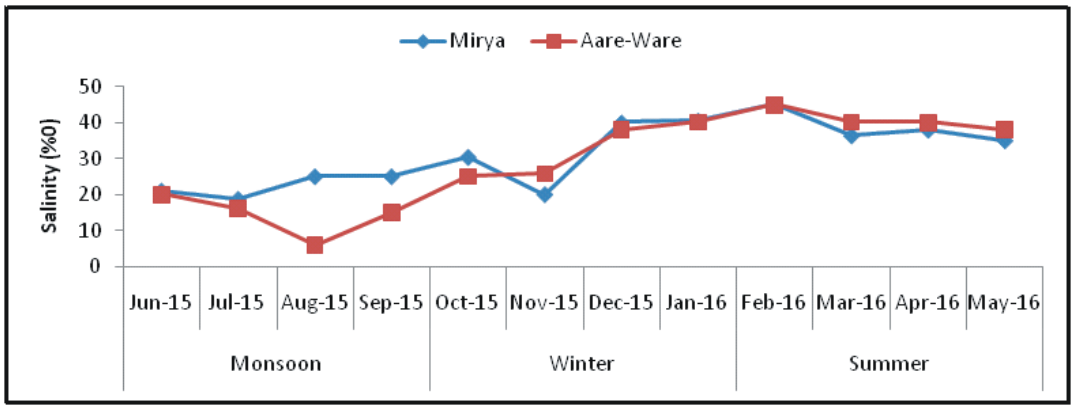

Fig. 6 : Variation in salinity (‰) in the Mirya and Aare-Ware rocky shores of Ratnagiri, Maharashtra India during 2015-2016.

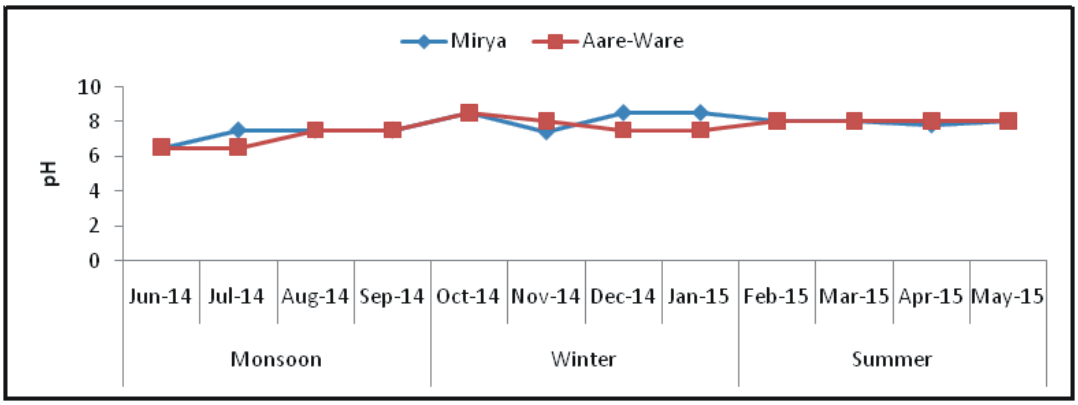

Fig. 7 : Variation in pH in the Mirya and Aare-Ware rocky shores of Ratnagiri, Maharashtra India during 2014-2015.

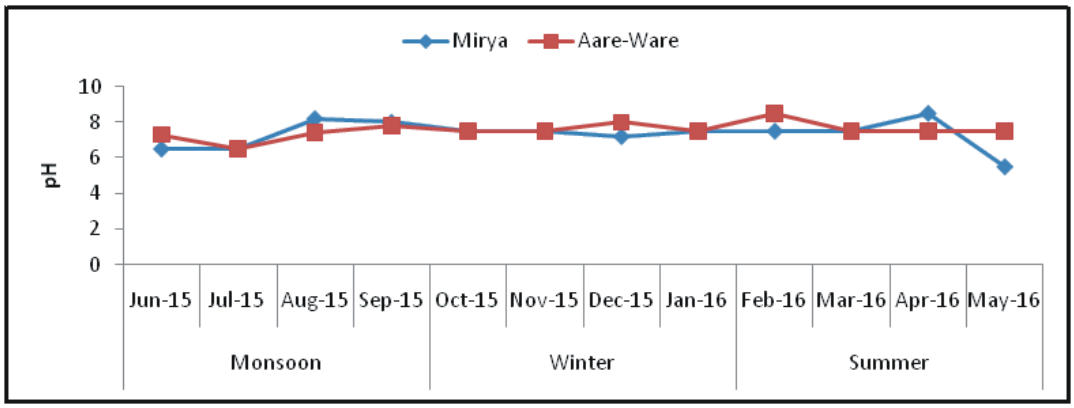

Fig. 8 : Variation in pH in the Mirya and Aare-Ware rocky shores of Ratnagiri, Maharashtra India during 2015-2016.

water temperature was recorded during the post monsoon (28.6^{0}C) and minimum during the monsoon period (25.5^{0}C).

iii. Salinity

During study period salinity of water varied from 18.7 to 38.4‰ and 5.8 to 39.2‰ in Mirya and Are-Ware shore respectively. In the month of July 2015 (18.7 & 5.8‰) lowest salinity were recorded in Mirya and Are-Ware shore respectively while highest in the month of May 2015 (38.4 & 39.2‰) in Mirya and Are-Ware shore respectively. Seasonally, during monsoon (24.03±3.49 & 22.43±3.12‰) and (19.95±4.05 & 12.40±4.60 ‰) minimum salinity were observed during the year 2014-15 and 2015-16 in Mirya and Are-Ware shore respectively while maximum during summer (37.00±1.70 & 36.58±1.84‰) and (36.58±1.84 & 33.53±2.30‰) during the year 2014-15 and 2015-16 in Mirya and Are-Ware shore respectively.

Rao (1967) observed the lowest salinity value in December (25.84‰) and the highest value in April (36.29‰) along Madras coast. Bhatate (2011) recorded the maximum (35 psu) salinity during pre-monsoon season and minimum (23.33 psu) in monsoon along the Alawa rocky shore, Rtnagiri. Shinde (2015) recorded the maximum salinity (35.5 psu) during post monsoon while minimum (28.5 psu) during monsoon season along Bhatkarwada rocky shore and maximum salinity (34.3 psu) while minimum salinity (28 psu) in monsoon season in Aare rocky shore of Ratnagiri.

iv. pH

pH varied from 6.5 to 9.5 in both shores with its minimum value in the month of June 2014, June and July 2015 (6.5) in Mirya shore and June, July 2014 and July 15 in Aare-Ware shore while maximum in the month of December 2014 and March 2016 (9.5) in Mirya shore and April 2016 (9.5) in Aare-Ware shore. The lowest value of pH was found during monsoon (7.25±0.50 & 7.13±0.75) and (29.48±2.30 & 29.38±1.51^{0}C) i in the year 2014-15 and 2015-16 respectively in Mirya and Aare-Ware shore respectively. Highest pH was recorded during winter season (8.48±0.86 & 8.43±0.15) in the year 2014-15 in Mirya and Aare-Ware shore respectively and during summer (8.88±0.48) in the year of 2015-16 in both shores.

Philip (1970) observed the variation of pH of intertidal water was observed between 7.9 and 8.1. Mense (1988) and Bhatade (2011) recorded pH remained more or less neutral during all the seasons. Wafer *et al* (1980) observed the pH of surf water varied from 7.7 to 8.3 at Colva, 7.6 to 8.2 at Armbol and 7.7 to 8.2 at Bawal along the Goa coast.

CONCLUSION

The complex ecosystem of marine habitat is influenced by physical, chemical and biological processes governed by the seasonal changes in factors such as temperature, salinity, pH, etc. These changes affect the marine flora and fauna which are reflected in their abundance, growth and diversity. Current work highlights the seasonality of the selected ecological parameters, which is a characteristic of the tropical regions. These seasonal variations determine the diversity of the selected locations along the Ratnagiri coast of Maharashtra, India.

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