

## Seasonal Variations of the Physico-Chemical Characteristics of Water Samples in Sarada and Varaha Estuarine Complex, East Coast of India

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### Abstract:

*The current study was carried out to find the seasonal variations in physico-chemical parameters of Sarada and Varaha estuarine complex, East coast of Andhra Pradesh, India. The various physico-chemical parameters like Rainfall, Temperature, Dissolved oxygen, pH, Salinity, Transparency were measured in one year period of study from January-2013 to December-2013. Rainfall varied from 0 to 171.6 mm, Atmospheric temperature varied from 27.6<sup>o</sup> to 32.7<sup>o</sup>C, Water temperature was recorded maximum. (28.6<sup>o</sup>C) in May and minimum (21.8<sup>o</sup>C) in January. Dissolved oxygen ranges from 3.68 to 8.90 mg/l. pH values ranges from 8.1 to 9.4. Salinity varies between 20.6 to 30.8 ppt. The transparency ranges between 0.84 to 1.31 (m). Correlation matrix was employed for the statistical interpretation of the tabulated data.*

**Key words:** Sarada And Varaha Estuarine Complex, Ph, Temperature, Salinity, Sacchi Disk and Seasonal Variations

### Introduction

Estuarine and coastal areas are the complex and dynamic aquatic environment [1]. Estuaries are economically important

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ecosystems for fisheries in tropical regions [2] and they act as a transitional zone between land and sea [3]. Estuarine water exhibit seasonal variations in its physico-chemical characteristics and nutrients content depending on physical and biological processes [4-12]. There are a very good reports available to describe seasonal variations of the physico-chemical characters in estuaries from Indian coast [7, 12, 13-23]. So the purpose of the present study is to trace out baseline data of the seasonal variations of physico-chemical characteristic features from Sarada and Varaha estuarine complex located 50 km away from Southwest of Visakhapatnam.

### **Sarada and Varaha estuarine complex:**

It is located at southwest of Visakhapatnam and is sheltered by hillocks on the beach. The Sarada and Varaha are two medium River systems in the east coast of India that jointly flow into the Bay of Bengal near Bangarammapalem village in Andhra Pradesh, ( latitudes 17°25'60"N and longitudes 82°52'0"E) where the Sarada and Varaha estuarine complex is formed. Sarada River rises at an elevation of 1000 meters in the Eastern Ghats and runs eastwards for a distance 122 kilometers and joins the Bay of Bengal. The river Varaha originated in Sannivaram Reserved Forest in Visakhapatnam and flows through Narsipatnam and Yellamanchili and finally merges with the Bay of Bengal at Bangarammapalem village.

### **Materials and Methods:**

The study was carried out over a period of 1 year i.e from January 2013 to December 2013 at Sarada and Varaha estuarine complex. Throughout the study period, sampling of water was carried out on a monthly basis during the last week of every month. Sampling was done usually during the morning

hours, between 7.00 a.m. to 10.00 a.m. Air temperature and Surface temperature was measured using a mercury thermometer, care was taken to obtain a constant reading and the temperature was recorded in Celsius scale.  $p^H$  (Hydrogen ion concentration) was measured by using a  $p^H$  analyzer (WTW model multi 340). Light penetration of the water column is assessed with the help of Sacchi disc and tabulated values. Salinity was also estimated with the help of hand refractometer (ERMA, Hand Refractometer, Japan). Dissolved oxygen was estimated by the modified Winkler's method [24]. Sample water collected in an air tight container and brought to the laboratory of Marine Living Resources Department, Andhra University and Department of Zoology, SGA Government Degree College, Yellamanchili for DO estimation.

## **Results**

The result of physico-chemical parameters observed in different seasons from January 2013 to December 2013 of Sarada and Varaha Estuarine Complex are represented in table.1, 2 and figures: 1-7.

### **Rainfall**

The Rainfall values ranged between 0 to 171.6 mm, minimum and maximum was recorded in the months of January, February and October respectively for the study period (Table-1, 2 and Fig.1).

### **Atmospheric temperature**

Atmospheric temperature of Sarada and Varaha Estuarine Complex varied from 27.6 to 32.7<sup>0</sup>C (Table-1, 2 and Fig. 2). Minimum Atmospheric temperature was recorded in January (27<sup>0</sup>C) and the maximum (32.7<sup>0</sup>C) was recorded in the month of May.

### **Surface water temperature**

Water temperature of Sarada and Varaha Estuarine Complex varied from 21.8°C to 28.6°C (Table-1, 2 and Fig. 3). The minimum water temperature was recorded in January (21.8°C) and maximum was observed in the month May (28.6°C).

### **Dissolved oxygen (DO)**

In the present study the dissolved oxygen range was recorded minimum (3.68 mg/l) in summer period (May) and the maximum (8.90 mg/l) during monsoon season (August) (Table-1, 2 and Fig. 4).

### **p<sup>H</sup>**

The p<sup>H</sup> of Sarada and Varaha Estuarine Complex varied from 8.1 to 9.4 respectively. The Minimum p<sup>H</sup> 8.1 in the month of February and Maximum 9.4 in the month of June were recorded (Table -1, 2 and Fig. 5).

### **Salinity**

The salinity concentration was recorded minimum (18.3 ppt) in June and the maximum was noticed (30.8 ppt) in April (Table-1, 2 and Fig. 6).

### **Transparency**

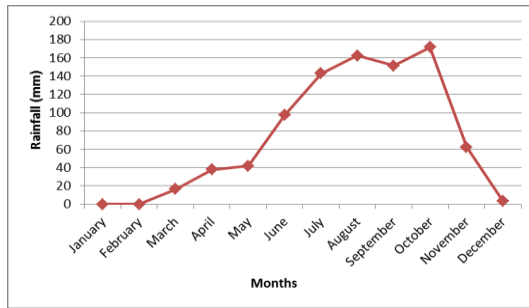
The transparency of Sarada and Varaha Estuarine Complex varies from 0.84 to 1.31 m (Table-1, 2 and Fig. 7) Minimum transparency was recorded in the month of September and Maximum was recorded in the month of June.

**Table 1. Seasonal variations in Physico-Chemical parameters of Sarada and Varaha Estuarine Complex**

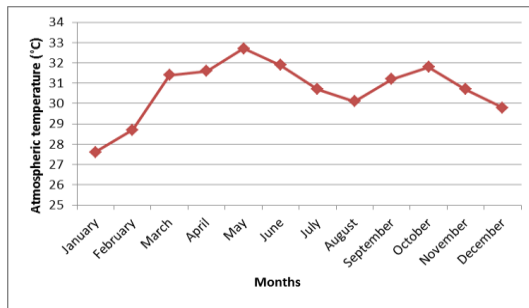
Months	Rain fall (mm)	Atmospheric temperature (0°C)	Surface water temperature (0°C)	D.O (Mg/l)	PH	Salinity (‰)	Transparency (m)
January	0	27.6±1.17	21.8±1.17	6.37±1.07	8.3±0.67	27.3±0.98	0.94±0.02
February	0	28.7±2.43	22.7±1.80	5.92±0.72	8.1±0.45	29.8±1.21	1.19±0.11
March	16.4±1.08	31.4±2.01	27.2±1.48	5.34±0.88	8.4±0.36	30.4±1.02	1.12±0.27
April	37.8±1.23	31.6±2.46	27.9±2.07	4.67±1.04	8.7±0.64	30.8±1.17	1.15±0.17
May	41.8±2.38	32.7±1.06	28.6±0.97	3.68±0.81	9.2±0.31	26.4±1.25	1.24±0.09
June	97.3±1.44	31.9±1.97	28.3±1.04	8.47±0.91	9.4±0.58	18.3±1.32	1.31±0.14
July	142.8±1.49	30.7±1.56	27.2±1.67	7.25±0.65	8.8±0.49	20.6±0.96	1.28±0.07
August	162.5±1.89	30.1±2.08	26.8±1.91	8.90±0.77	9.0±0.74	21.3±0.68	1.21±0.15
September	151.4±2.32	31.2±1.92	27.1±1.27	8.72±0.71	9.2±0.87	23.7±1.64	0.84±0.08
October	171.6±2.08	31.8±2.03	27.3±1.48	7.59±0.59	8.7±0.12	24.2±1.13	0.91±0.04
November	62.2±2.66	30.7±1.85	26.7±1.57	6.43±0.81	8.9±0.38	27.5±0.89	0.97±0.15
December	3.6±1.33	29.8±1.89	25.3±1.23	5.86±0.74	9.0±0.44	29.4±1.04	0.99±0.17

**Table 2. Correlation coefficient (r) values between the environmental parameters**

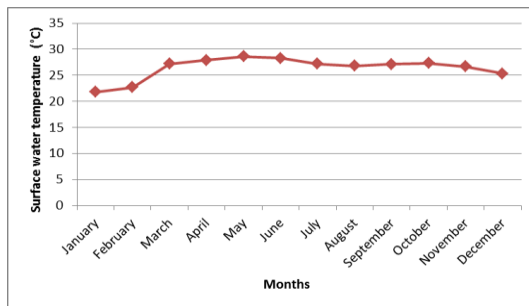
	Rainfall (mm)	Atmospheric temperature (0°C)	Surface water temperature (0°C)	DO (Mg/l)	pH	Salinity (‰)	Transparency (m)
Rainfall (mm)	1						
Atmospheric temperature (0°C)	0.394598	1					
Surface water temperature (0°C)	0.502309	0.958132	1				
DO (Mg/l)	0.745697	-0.10377	0.035959	1			
pH	0.480819	0.624678	0.712299	0.323212	1		
Salinity (‰)	-0.77155	-0.24242	-0.3673	-0.75693	-0.60273	1	
Transparency (m)	-0.03953	0.237772	0.301607	-0.14936	0.12919	-0.30739	1



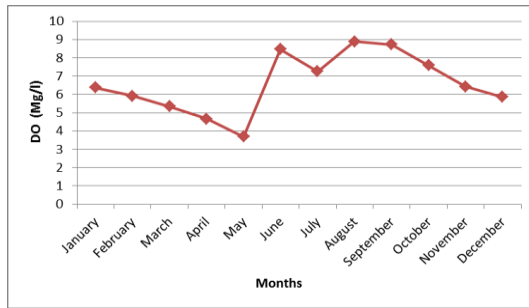
**Fig 1. Seasonal variations of Rainfall at Sarada and Varaha Estuarine Complex during the year 2013**



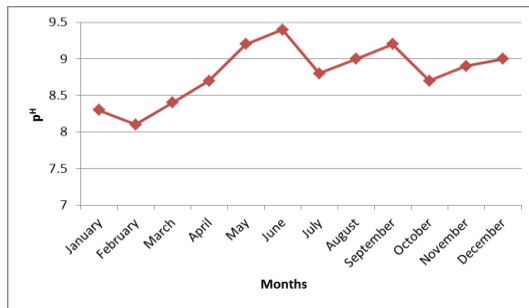
**Fig 2. Seasonal variations of Atmospheric temperature in Sarada and Varaha Estuarine Complex during the year 2013**



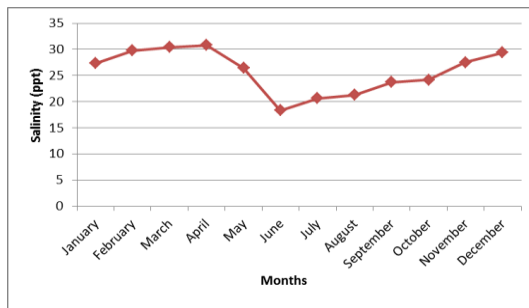
**Fig 3. Seasonal variations of Surface water temperature in Sarada and Varaha Estuarine Complex during 2013**



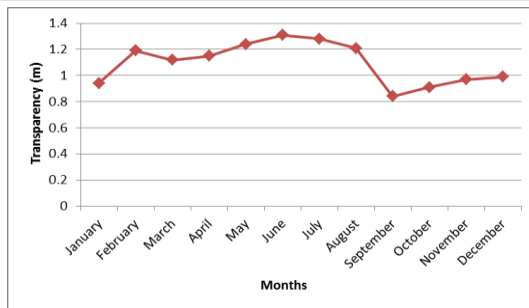
**Fig 4. Seasonal variations of Dissolved oxygen in Sarada and Varaha Estuarine Complex during the year 2013**



**Fig 5. Seasonal variations of pH in Sarada and Varaha Estuarine Complex during the year 2013**



**Fig 6. Seasonal variation of Salinity in Sarada and Varaha Estuarine Complex during the year 2013**



**Fig 7. Seasonal variation of Transparency in Sarada and Varaha Estuarine Complex during the year 2013**

## Discussion

The seasonal variations of the environmental characteristic features in the estuarine system are chiefly controlled by the spectacular regime of the rainfall during monsoon. In the present study, the peak values of rainfall were recorded during the northeast monsoon periods (September-October). The rainfall was scanty during post monsoon and summer months. Commendable works are available on Vellar estuary [25] Parangipettai coast [26-27] Muttukadu backwaters [28].

The temperature variation is one of the factors in the coastal and estuarine system, which may influence the physico-chemical characteristics and also influence the distribution and abundance of flora and fauna [9]. The reports of the present study revealed that higher temperature was recorded in the months of April to June and again from September to December, whereas lower temperature was recorded in the months of January to March. This was due to cloudy sky and rainfall brought down the temperature minimum level [29]. The study findings were similar to the observations of previous studies reported from Vellar estuary [30-32], from Pichavaram mangroves water [33-36], from Arasalar and Kaveriestuarine complex [37] from Palk Bay [29], from Uppanar estuary of Cuddalore [9].



Dissolved oxygen concentration depends on many factors like photosynthesis and respiration of plants and animals in water [9]. Dissolved oxygen concentration depends on Temperature, salinity, photosynthesis and respiration of plants and animals [12]. In the present investigation higher amounts of Dissolved oxygen (D.O.) were recorded from June to October. The present study results were quite similar to the observations of earlier reports by [21, 38].

pH-Ananthan [39] stated that the higher values of pH during summer was due to uptake of  $\text{CO}_2$  by photosynthesizing organisms. In the present study it has been observed that higher pH values were recorded from May to December and lower values were notice from January to March). Low  $\text{pH}$  observed in the month of February due to the influence of influx of water and organic matter decomposition as suggested by [40]. Similar kind of pH values were obtained previously from the Vellar estuarine system [30, 32, 41]. Mathevan Pillai [42] from Cuddalore Uppanar waters and from Pondicherry coastal waters [39] and from Uppanar estuary of Cuddalore [9].

Salinity is considered to be the basic and prime factor which may influence the physico-chemical parameters and distribution of flora and fauna in estuarine environment [9]. It is evident from the present results that the higher amount of salinity was recorded from December to May. The higher values of salinity may be due to low amount of rainfall, greater evaporation and increase the amount of neretic water. In contrast to this the low amount of salinity was noticed during the months June to November, reason for this is heavy rainfall and increase the freshwater influx. The findings of the study coincide with the reports of [9, 12, 14, 21, 29, 43] from the estuaries of Indian coastal waters.

Transparency is how easily light can pass through a substance, in estuaries this means how deep sunlight penetrates through the water. Decreased transparency will decrease light penetration, plant growth and oxygen production

into the water. It also reduced breeding and survival of fish and other aquatic animals. Suspended particles absorb heat, which causes water temperature to increase and it holds less oxygen than cold water [44]. The results of the present study clearly indicated that the transparency was greatly influenced by rains and fresh water run-offs from adjacent water bodies.

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