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Research Paper

SEASONAL DYNAMICS OF WATER QUALITY OF PUTHEN DAM (KANYAKUMARI DISTRICT, TAMIL NADU) WITH SPECIAL REFERENCE TO THE TEMPERATURE

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Abstract

Puthen Dam is an unique ecosystem which receives water from Kothayar left back canal from Pechipparai reservoir and canal outlet and surplus water from Perunchani Reservoir and Puthen Dam and water then goes to Pariliyar and Pandian canal. Five stations were selected from the associated water bodies. The study was carried out from April 2013 to April 2014. Air temperature, water temperature, pH, conductivity, turbidity, dissolved oxygen and BOD were studied. The seasonal variations and the mathematical relationship between various parameters with temperature were presented and discussed in light of previous literature.

Key words: Turbidity, dissolved oxygen, BOD, Puthen Dam. Reservoir ecology, pH, Conductivity.

INTRODUCTION

Water is one of the prime components responsible for the existence of life on earth. Water has been a symbol by which devotion and purity was expressed. Water is distributed in surface and ground water in different forms. Water pollution leads to alteration in physico-chemical and biological characteristics of water bodies as well as that of the environment. It is directly or indirectly affects the life process of flora and fauna of the water body surrounded by chemical toxicants (Kumari *et al*.,2006; Indira and Sivaji 2006; Krishnan *et al.,*2007). The maintenance of good water quality is essential for survival and optimal growth of fishes and plants. The dissolved oxygen in water is either due to atmospheric diffusion or due to photosynthetic activity of aquatic plants. BOD is the amount of oxygen utilized by micro-organisms in stabilizing the organic matter. On an average basis the amount of organic water to be degraded aerobically. Hussian *et al*(2012)suggested that, dissolved oxygen BOD and COD are based on changeable due to anthrophogenic and natural phenomenon therefore dissolved oxygen and BOD were determined to check the organic and inorganic pollution in water. Aquatic ecosystem is an ever changing entity due to seasonal factors that change from time to time. Lotic and lentic aquatic ecosystems have different dynamic patterns in physico-chemical and biological characteristics. The transition from lotic to lentic and vice versa may influence the quality of water contained in it. Puthen Dam is an unique ecosystem which receive water from two lotic ecosystem *viz*, Kothayar left back canal from Pechipparai reservoir and outlet a canal and

surplus water from Perunchani Reservoir. However, no detailed study is available on the ecology of this ecosystem. With this view in mind the present study was planned and carried out to analyse the seasonal variation and interrelationship of different water quality characteristics of Puthen Dam with water temperature.

MATERIALS AND METHODS

Fig-1, Map of the study area showing selected stations

STUDY AREA:

Puthen dam is situated near Perunchani Reservoir in Kanyakumari district of Tamil nadu. Five stations were selected from the Puthen Dam as shown in fig.1.The detailed description and geographical position of the sampling stations are presented in table 1.

SAMPLING AND ANALYSIS:

Air temperature and water temperature were recorded accurately using Celsius thermometer. Water samples were collected in clean two litre polythene cans. The samples for dissolved oxygen were collected separately and fixed at the site by following Winkler's method. All sample collections were made between 6.30 am to 7.30 am for the study. The water samples were carefully transported to the laboratory and analysed using APHA(2012)

STATISTICAL ANALYSIS OF DATA:

Analysis of variance and data was carried out to find out the difference between study stations using Excel.Non linear relationship of different parameter with water temperature were derived using Curvexpert software.

Table.1 Geographical position and description of stations selected

s.no	Station	Discription	Latitude	Longtitude	Altitude(Above msl)
1	I	Kothayar left back canal	8⁰ 21'29.92"N	77 20'56.52"E	244ft
2	II	Mixing point of Kothayar and Perunchani canal water	8⁰ 21'29.32"N	77 20'59.64"E	232ft
3	III	Outlet for Paraliyar River	8⁰ 21'26"N	77 20'58.7"E	231ft
4	IV	Outlet for Pandiyan canal	8⁰ 21'23.96"N	77 21'21.88"E	249ft
5	V	Water from Perunchanni outlet	8⁰ 21'47.93"N	77 21'21.64"E	252ft

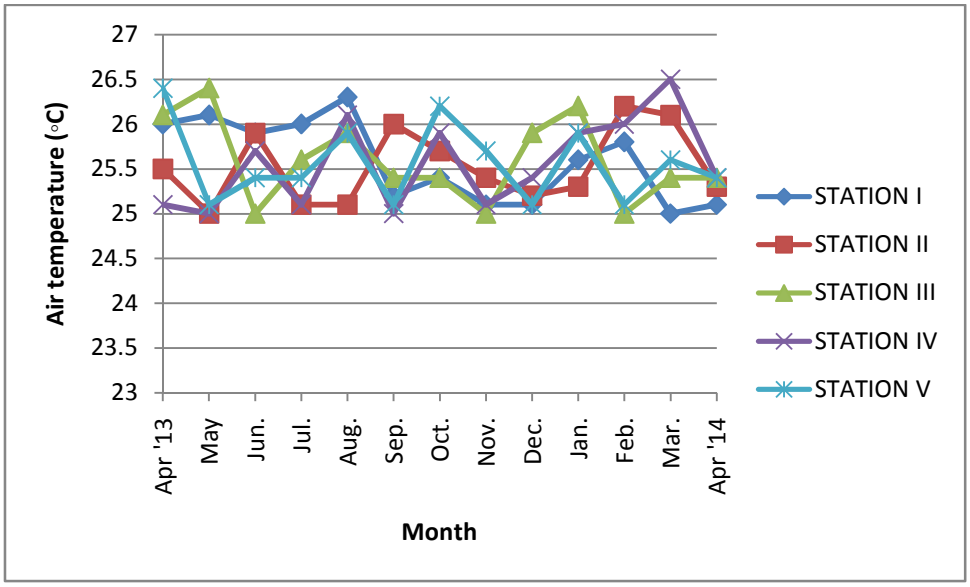

Fig-2. Seasonal variations in air temperature of Puthen Dam during study period

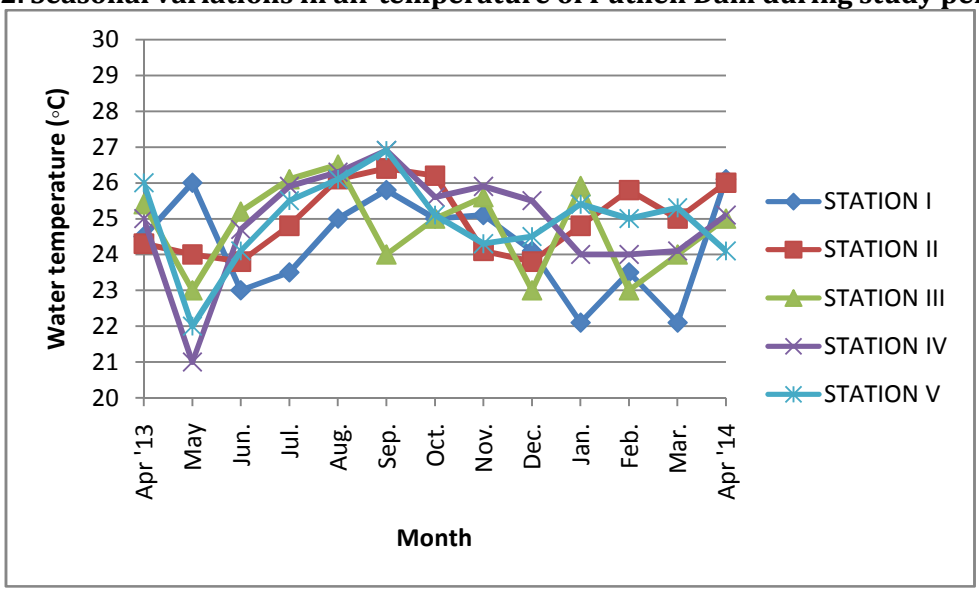

Fig-3. Seasonal variations in water temperature of Puthen Dam during study period

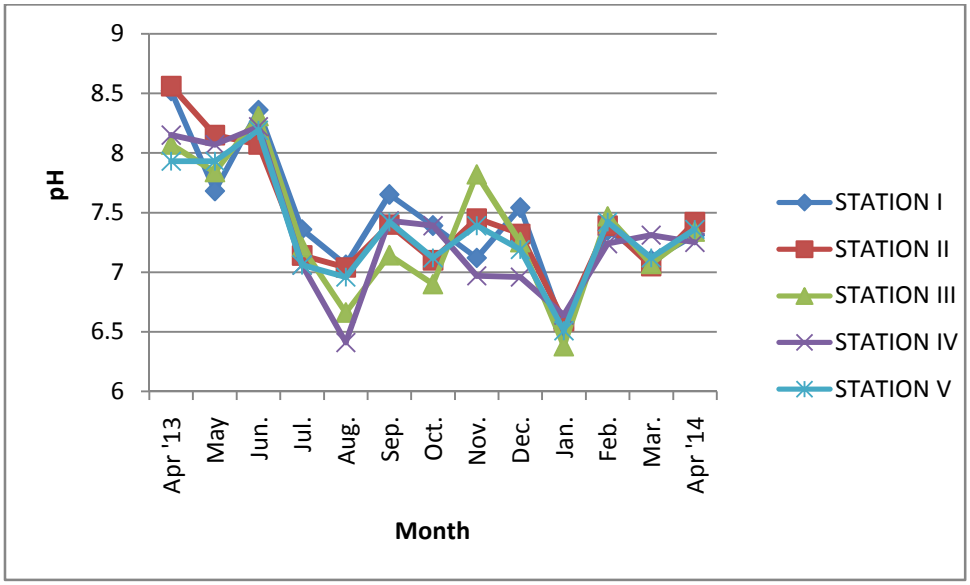

Fig-4. Seasonal variations in pH of Puthen Dam during study period

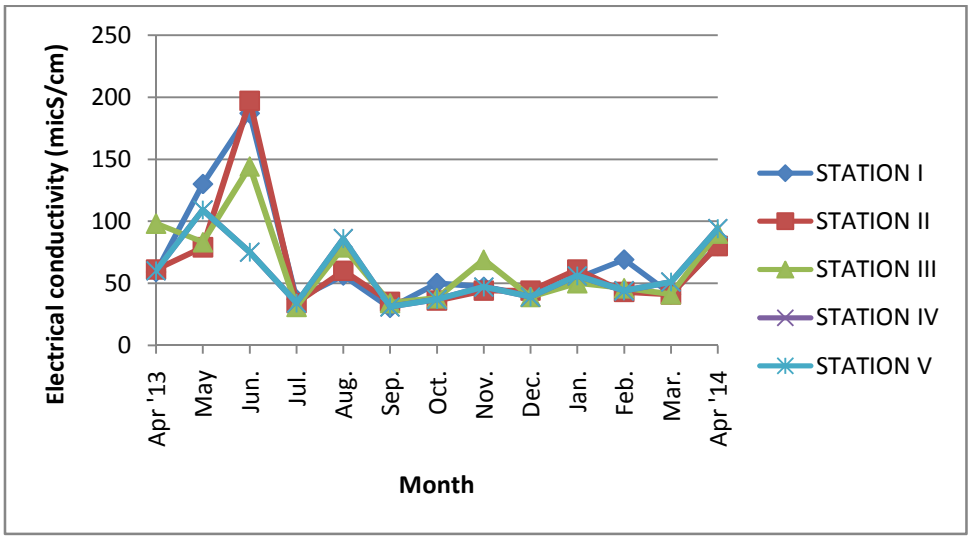

Fig-5. Seasonal variations in electrical conductivity of Puthen Dam during study period

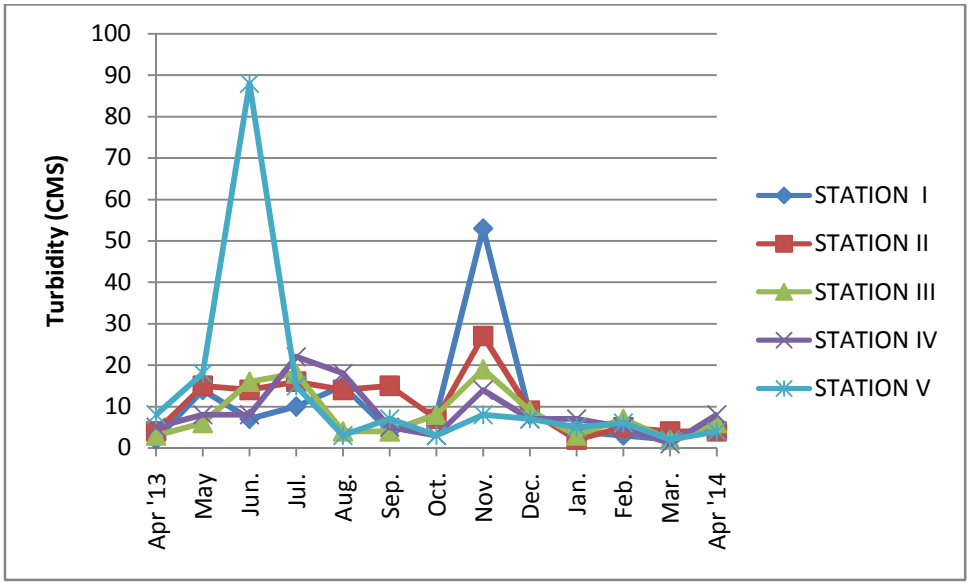

Fig-6. Seasonal variations in turbidity of Puthen Dam during study period

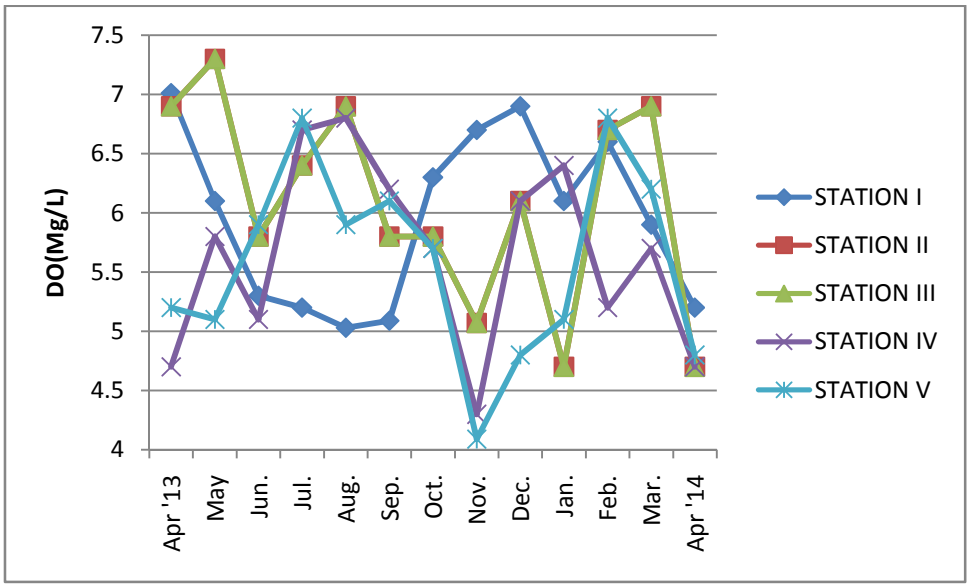

Fig-7. Seasonal variations in dissolved oxygen of Puthen Dam during study period

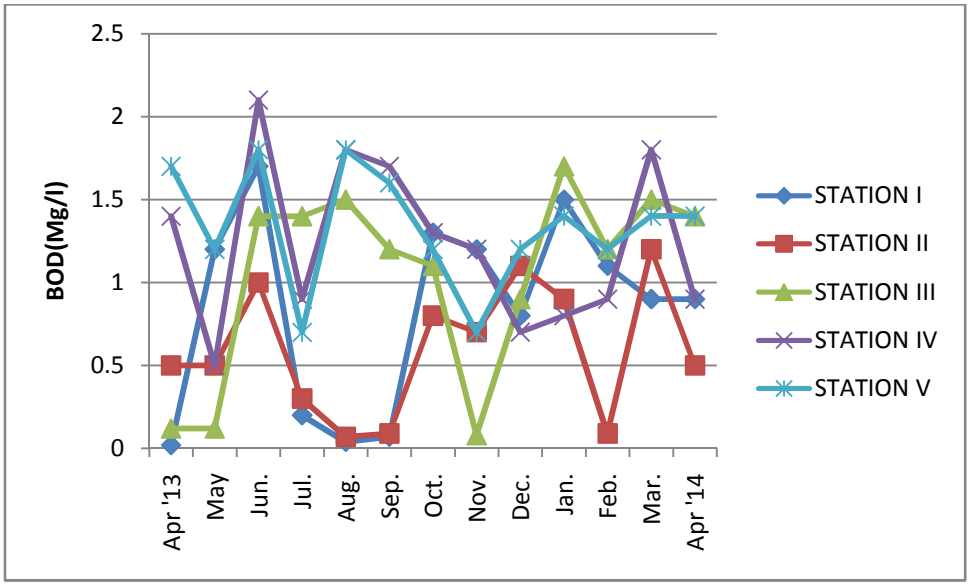

Fig-8. Seasonal variations in biological oxygen demand (BOD)of Puthen Dam during study Period

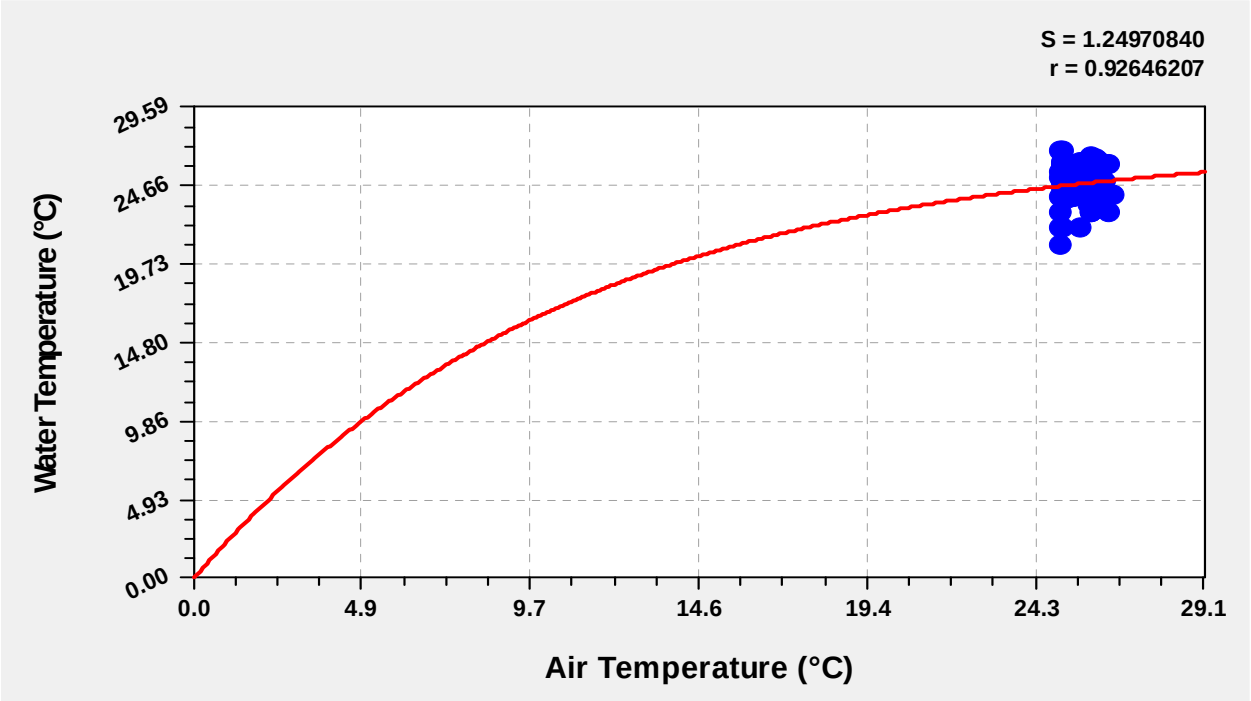

Fig-9.Exponential Association fit to compare the relationship between air temperature and Water temperature

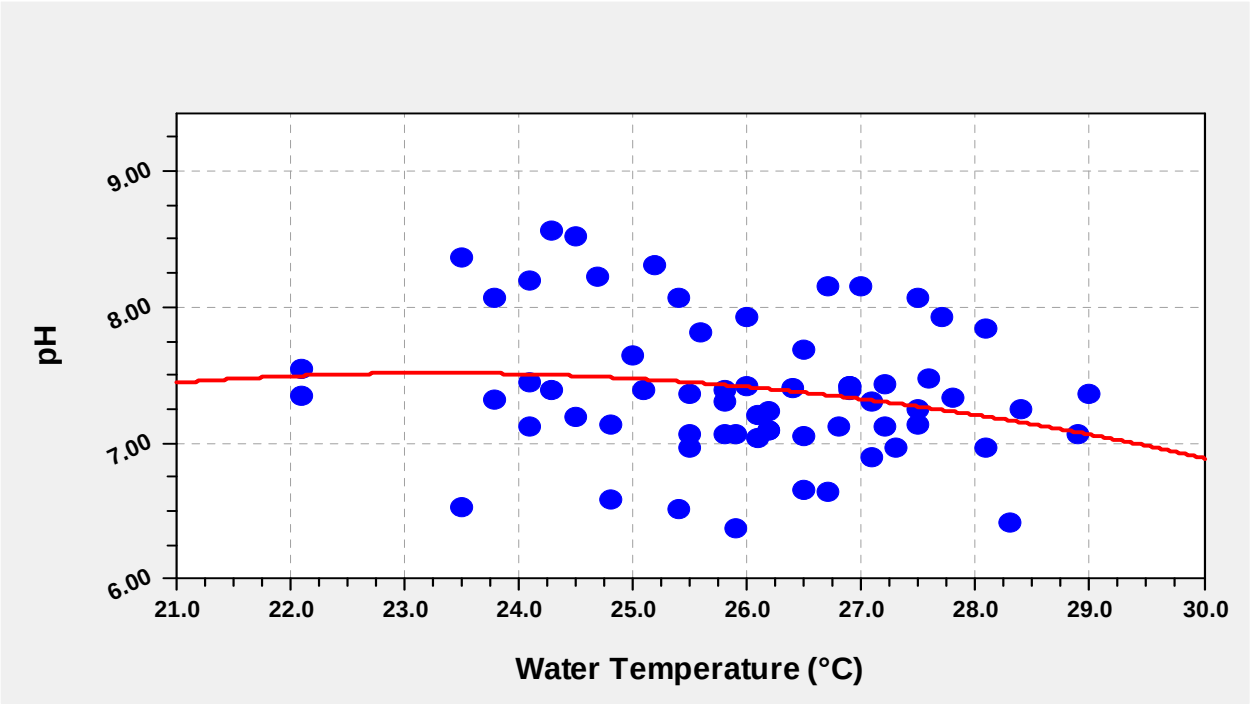

Fig-10. Quadratic Fit to compare the relationship between air temperature and pH

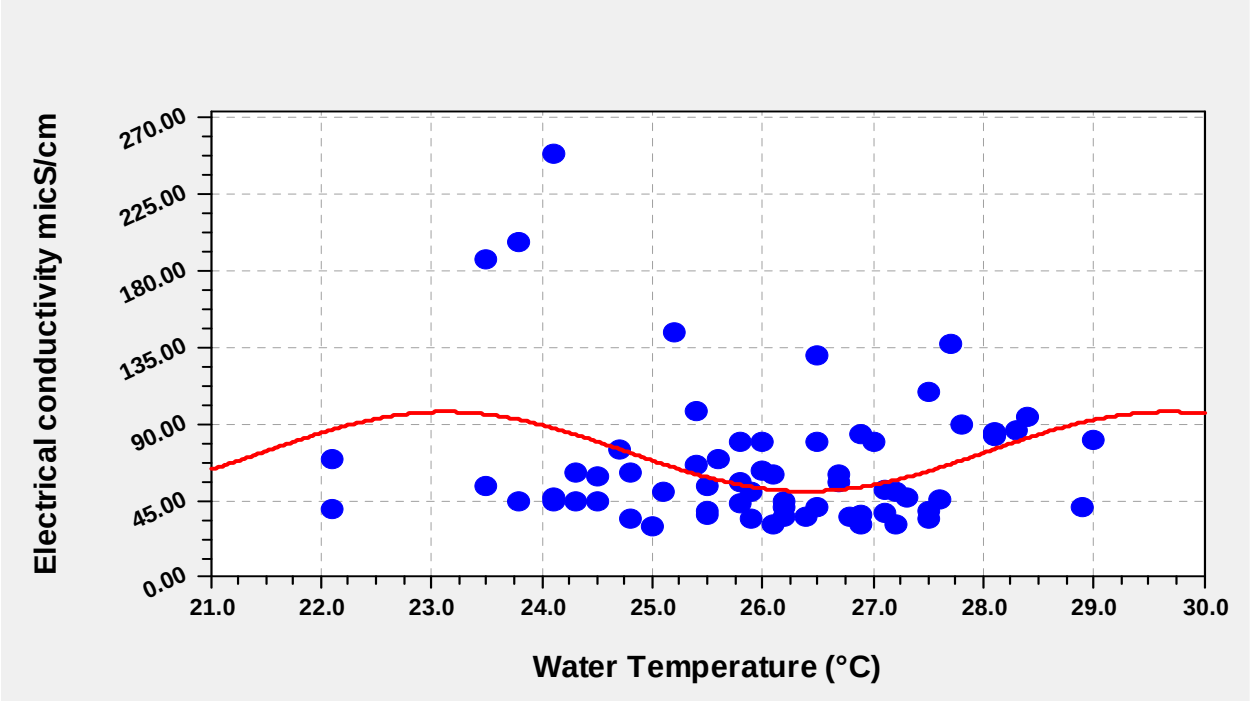

Fig-11 Sinusoidal Fit to compare the relationship between air temperature and electrical conductivity

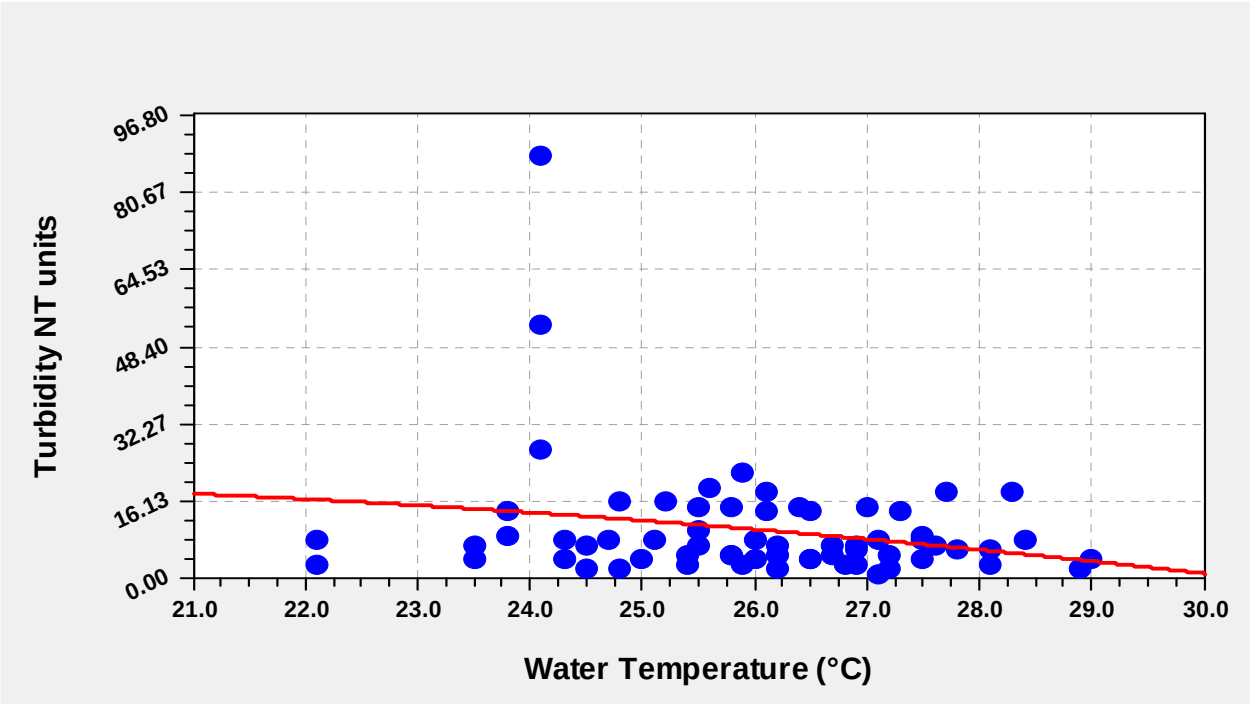

Fig-12. Harris Model to compare the relationship between air temperature and turbidity

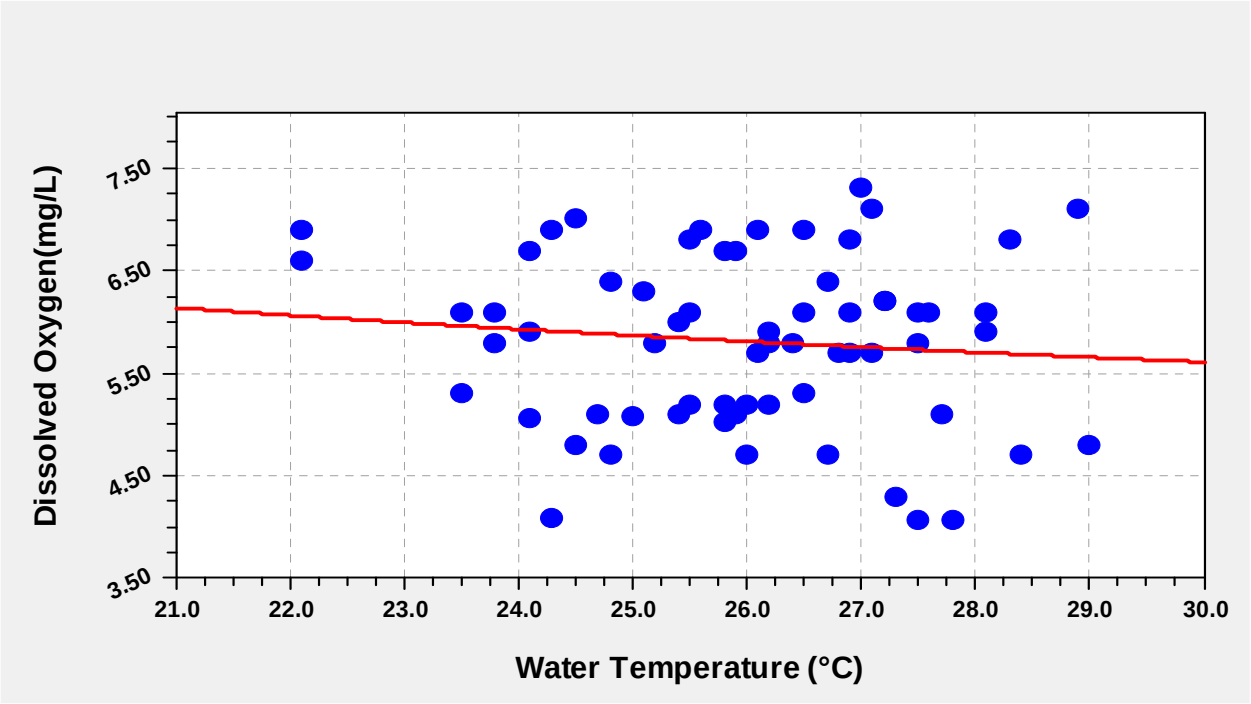

Fig-13. Harris Model fit to compare the relationship between air temperature and dissolved oxygen

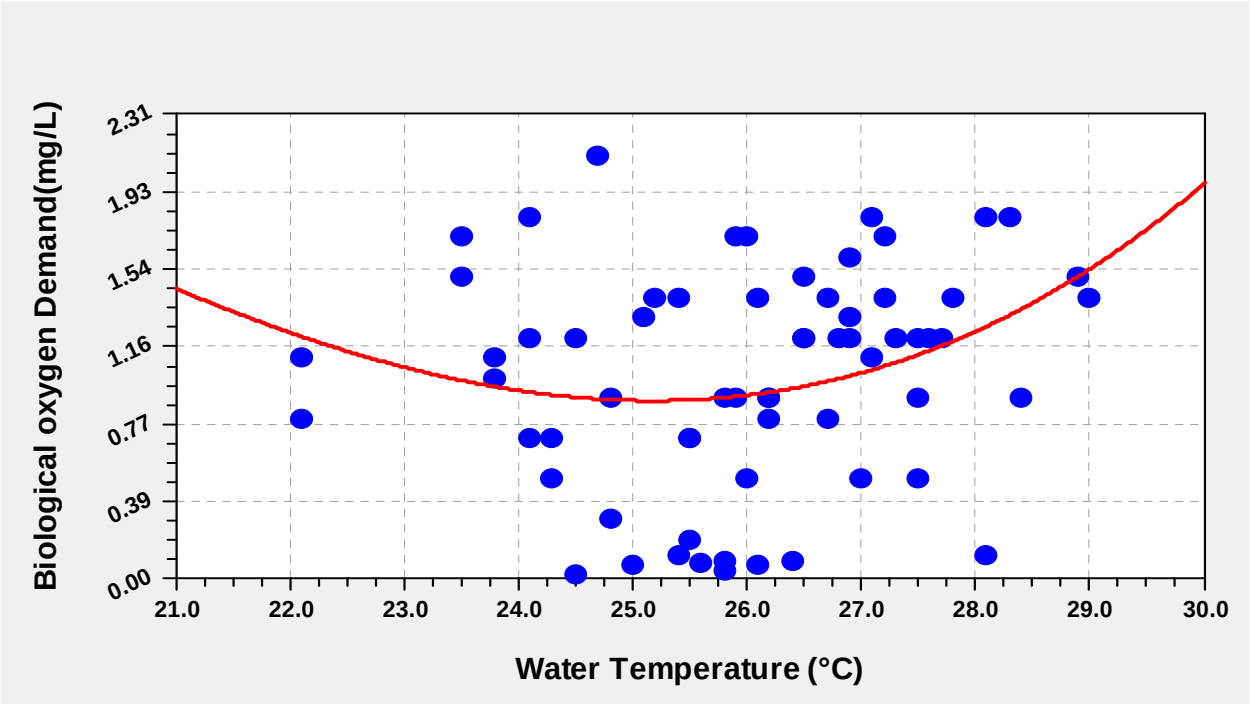

Fig-14. Polynomial Fit to compare the relationship between air temperature and biological oxygen demand

Table-2. Analysis of variance compairing the air temperature in different stations

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Station I	13	328.4	25.26154	0.810897
Station II	13	331.8	25.52308	0.170256
Station III	13	332.7	25.59231	0.222436
Station IV	13	332.2	25.55385	0.244359
Station v	13	332.3	25.56154	0.190897

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.943692	4	0.235923	0.719784	0.581778	1E+09
Within Groups	19.66615	60	0.327769			
Total	20.60985	64				

Table-3. Analysis of variance compairing the water temperature in different stations

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Station I	13	315.6	24.27692	1.840256
Station II	13	325.1	25.00769	0.959103
Station III	13	321.7	24.74615	1.499359
Station IV	13	324	24.92308	2.196923
Station v	13	324.3	24.94615	1.471026

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*	
Between Groups	4.604	4	1.151	0.722385	0.580053	1E+09	
Within Groups	95.6	60	1.593333				
Total	100.204	64					

Table-4.Analysis of variance compairing the pH of water in different stations

Groups	*Count*	*Sum*	*Average*	*Variance*
Station I	13	96.97	7.459231	0.278674
Station II	13	96.68	7.436923	0.28454
Station III	13	95.46	7.343077	0.307206
Station IV	13	95.1	7.315385	0.30831
Station v	13	95.6	7.353846	0.205242

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.204437	4	0.051109	0.184647	0.945512	2.525215
Within Groups	16.60768	60	0.276795			
Total	16.81211	64				

Table-5 Analysis of variance compairing the electrical conductivity of water in different stations

Groups	*Count*	*Sum*	*Average*	*Variance*
Station I	13	880	67.69231	1937.731
Station II	13	815	62.69231	1873.064
Station III	13	842	64.76923	1097.859
Station IV	13	763	58.69231	620.3974
Station v	13	763	58.69231	620.3974

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	794.8615	4	198.7154	0.161572	0.956943	2.525215
Within Groups	73793.38	60	1229.89			
Total	74588.25	64				

Table-6. Analysis of variance compairing the turbidity of water in different stations

Groups	*Count*	*Sum*	*Average*	*Variance*
Station I	13	135	10.38462	181.5897
Station II	13	136	10.46154	50.9359
Station III	13	105	8.076923	34.41026
Station IV	13	111	8.538462	35.9359
Station v	13	174	13.38462	524.0897

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	227.6	4	56.9	0.344031	0.84714	2.525215
Within Groups	9923.538	60	165.3923			
Total	10151.14	64				

Table-7. Analysis of variance compairing the dissolved oxygen of water in different stations

Groups	*Count*	*Sum*	*Average*	*Variance*
Station I	13	77.43	5.956154	0.526176
Station II	13	79.07	6.082308	0.754736
Station III	13	79.07	6.082308	0.754736
Station IV	13	73.4	5.646154	0.637692
Station v	13	72.49	5.576154	0.657726

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3.042191	4	0.760548	1.141598	0.345729	2.525215
Within Groups	39.97278	60	0.666213			
Total	43.01498	64				

Table-8. Analysis of variance compairing the biological oxygen demand of water in different stations

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Station I	13	10.93	0.840769	0.336441
Station II	13	7.75	0.596154	0.152576
Station III	13	13.62	1.047692	0.327969
Station IV	13	16	1.230769	0.248974
Station v	13	17.3	1.330769	0.127308

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	4.588446	4	1.147112	4.806597	0.001979	2.525215
Within Groups	14.31922	60	0.238654			
Total	18.90766	64				

RESULTS AND DISCUSSION :

Seasonal variations of air temperature is presented in fig-2. It reveals that the air temperature of the study sites vary between 26.5^{0}C to 25^{0}C. Highest air temperature was recorded in during May 2013 in Station III (Outlet for Paraliyar river) and low temperature recorded June 2013 Station III (Outlet for Paraliyar river) September 2013 Station IV (Outlet for Pandiyan canal) November 2013 Station III (Outlet for Paraliyar river) February 2014 Station III (Outlet for Paraliyar river) and March 2014 Station IV (Outlet for Pandiyan canal).Analysis of variances (Table 2) reveals that the air temperature of the different stations do not differ significantly in different Stations (p >0.1).The air temperature was found to be significally related to water temperature in Exponential association (r=0.9262) and the relationship can be expressed as

y= 2.66(1-exp(-1.05x)

Where

x= Air temperature

y= Water temperature

Seasonal variations of water tepmerature is presented in figure-3. It reveals that the water temperature of the study sites vary between 21^{0}C to 26.7^{0}C. Highest air temperature was recorded in during Sep 2013 in Station V (Perunchani river outlet water)and May 2013 Station IV. (Outlet for Pandiyan canal). Analysis of variances (Table-3) reveals that the water temperature that the water tepmerature of the different stations do not differ significally in different Stations (p >0.1) .

pH is a common index of water quality of any aquatic ecosystem (Sheeja and Ebanasar, 2006). Seasonal variations in pH of different stations associated with Puthen Dam is presented in figure 4.It reveals that the highest pH of 8.5 was recorded during April 2013 and least and acidic was recorded during Aug '13 and Jan '14. The pH value was alkaline in all other month. The acidic pH may be due to the flow of water from the reservoir during post monsoon season. The pH the different stations do not differ significantly in different stations (p>0.1). Jhingran and Sugunan (1990) reported that reservoir with high pH are more productive than water bodies with low pH. Accordingly, they classified the water bodies as follows

1. Low productive (pH less than 6.0)
2. Medium productive (pH in between 6.0 and 8.5)
3. High productive (pH more than 8.5) the results of the present study reveals that the Puthen dam may be medium production as suggested by

Sugunan (1990). The pH was found to the significantly related to water temperature can be expressed as

y =1.3838+6.4453x+-1.3845x^2

Where,

y= pH

x= water temperature

Electrical conductivity of water is the capacity to transmit electrical current and is generally used as an indicator of the mineral or other ionic concentration conductivity is a measure of the purity of water or the concentration of ionised. Seasonal variations in electrical conductivity of different stations associated with Puthen Dam is presented in figure 5. It reveals that the higher Electrical conductivity of 35.7 was recorded during June 2013 and least was recorded during July '13 and Sep 2013. Higher electrical conductivity in the above month may be due to flow of water from the reservoir during postmonsoon season. The electrical conductivity of the different stations do not differ significantly in different stations (p>0.1).This reveals a through mixing of water in the Puthen Dam.The electrical conductivity was found to be not significantly related to electrical conductivity in Sinusoidal Fit (r=0.3498)

Seasonal variations of turbidity is presented in fig-6. It reveals that the highest turbidity of 88NTU was recored in during June 2013 in Station V (Perunchani river outlet water). This may be due to heavy rainfall during this month in the catchment of Perunchani reservoir area due to South west monsoon. In November month turbidity slightly higher due to the North East Monsoon rainfall, sudden increase in turbidity during both June and November

may be due to the release of surplus water from Perunchani reservoir from the two monsoons of Northeast and Southwest. The turbidity of different stations Perunchani reservoir due to heavy rain received due to both monsoon do not differ significantly in different stations (p >0.1). The turbidity was found to the not significantly related to water temperature in Harris Model Fit (r=0.2495).

Seasonal variations of dissolved oxygen is presented in figure-7. It reveals that the highest dissolved oxygen 7.4mg/l was recored in June 2013 in Station III (Paraliyar). This may be due to heavy rainfall during this month. It is fit for healthy aquatic life and aquaculture practice. The dissolved oxygen of the different stations do not differ significally in different Stations (p >0.1). The dissolved oxygen was found to be significally related to water temperature in Harris Model Fit (r=0.6557) and the relationship can be expressed as

Y =1/(-2.4332+2.4683x1.6576)

Where,

y=dissolved oxygen

x=water temperature

Seasonal variations of biological oxygen demand is presented in fig-8. It reveals that the highest biological oxygen demand during June 2013 in StationI V (Perunchani river outlet water) was recorded in Augest 2013 and Februvary 2014 least biological oxygen demand value was recorded. The highest Biological Oxygen Demand 2.1 found in June 2013 which is with in safe limit and hence, it can be inferred that reservoir water is free from microbial contamination.

The bological oxygen demand of the different stations do not differ not significally in different Stations (p >0.1) biological oxygen demand was found to the not significally related to biological oxygen demand in Polynominal Fit (r=0.3486).The study reveals that the dynamic change of water quality of Puthen Dam and associated canal as it is a mixture of water from two different areas.It is suggested that it is a suitable water for intensive aquafarming as it recevies continous flow of water.

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