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ANALYSIS OF WATER QUALITY INDEX AND THE SEASONAL VARIATION OF ODONATE LARVAE IN TIRUR -PONNANI RIVER

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Abstract: Water quality index offers a single value that represents the total water quality of the aquatic bodies using different water quality measures.This improves outreach to the public and raises knowledge of the state of water quality.This paper deals with the analysis of water quality index using different Physico-chemical parameters(PH,Hardness,D02,DCO2,TDS,Turbidity,Chloride,Total colliformbacteria) and the seasonal variation of Odonata larvae in Tirur-Ponnani riverine ecosystem in Kerala,India during March 2022 to March 2023.Compared to all other parameters total hardness and TDS in the river is relatively high indicating a major threat to the skin of aquatic life forms.The study also revealed how water quality parameters fluctuated with sites and seasons and its correlation with species richness of Odonata Larvae.The pollution is seems to be severe during Pre monsoon and low in Post Monsoon and it reflects the larval diversity maximum in Post monsoon followed by Monsoon and Pre monsoon.Hence Pollution seems to be a major threat to the existence of aquatic life forms.

Key words - Diversity indices,Odonata larvae,Water quality index

I. INTRODUCTION

Water is essential for both maintaining life and the world economy.However, because of the effects of anthropogenic and natural factors, the quality of the world's water has been steadily declining for decades[14].An key method for ensuring the safety of food and the health of people is to evaluate the quality of water before it is used for various purposes, including domestic, irrigation, conservation, and industrial use.The purpose of evaluating water quality is to locate the source of water contamination and create a plan for managing water sources sustainably while preserving and advancing human health and other aspects of social and economic development[5].

The ecological balance that is maintained by water quantity and quality impacts how people live.Aquatic water bodies become contaminated as a result of technological development in all areas, including industrialization, habitat destruction, and urbanisation.Polluted water represents the greatest source of disease and makes the land unfit for sustaining life forms.Activities that create pollution have severely harmed the freshwater aquatic ecology during the past few decades. The river water is heavily

contaminated by a variety of toxins, and severe concerns have been raised about how safe it is to use the river water for drinking and other uses.Rivers are believed to play a significant impact in determining a nation's natural, cultural, and economic elements.Industrial effluents, market wastes, electroplating, and agricultural wastes are only a few of the many toxins that are playing a significant role.

The insect order Odonata, which includes dragonflies and damselflies, is particularly vulnerable to anthropogenic stress due to their complicated life cycles including aquatic larval and terrestrial adult stages.Odonates are excellent ecological indicators due to their important role as predators and interactions with a variety of organism and habitat types.[2][8].Their abundance is positively correlated with type and structure of aquatic and terrestrial vegetations[1].

Odonata occurrence is linked to pollutants and warming during the aquatic larval stage, with impacts that carry over effect to adult.[11].Odonata larvae dependent on habitat characteristics[15]sensitive to abiotic factors ,and play significant roles as predators and prey in the trophic structure of aquatic communities[6].Many species were used to study a variety of phenomenon such as tolerance to physicochemical factors [4] accumulation of metals in larvae [7] as indicators of water quality [13] total richness and riparian quality[12].To evaluate the quality of river water for the purpose of drinking,irrigation and fisheries,identification of physico chemical parameters has to be monitored from the respective fields with their acceptable concentration.Hence the present study was focused to know about the water quality analysis of Tirur-Ponnani river and its correlation with Odonata larval diversity.

II.MATERIALS AND METHODS

2.1.Study Area

Tirur ponnani river or Tirur river is a 48km stretched water body originates from the Athavanad village of malappuram district ,south India,Kerala. It flows south -west up to Eranamkulam in the north western direction ,then turns to south west and finally joins Bharatapuzha to reach Arabian Sea near Ponnani.This river faces a lot of anthropogentic activities leading to its pollution.The present study made the water quality index analysis of 3 major study sites of Tirur-ponnani puzha viz.Kanathukadav(Site A),Thazhepalam(Site B) and Naduvilangadi(Site C)(Figure:1).The above 3 region represents major polluted stretch of Tirur-ponnani river.

Figure 1:Sampling sites of Study area

(Site A: Kanathukadav.,Site B:Thazhepalam.,Site B:Naduvilangadi)

2.2 Physico-Chemical Analysis

The surface water samples were collected monthly during the period February 2022 to February 2023.The water analysis for 8 major water quality parameters such as PH,Dissolved Oxygen,Dissolved C02,Hardness,TDS,Turbidity,Chloride and Total colliform bacteria were analyzed by standard methods[2].The water for the determination of dissolved oxygen (DO) & PH were noted by standard methods.Water quality index was calculated using the formula

Water quality index(WQI) =Wi Qn /∑ Wi

2.3.Diversity analysis

2.3.1. Odonata Larval collection

Larvae collection was made bimonthly interval from February 2022 to February 2023 between 9am to 11 am.The study period was divided into Premonsoon (Mar,Apr,May), monsoon (July,August,Sep,Oct) and post monsoon(Nov,Dec,Jan,Feb).They were collected using D-shaped aquatic net and immediately transferred them into the collecting jar with 70% alcohol in it.For identification the larvae were placed under binocular microscope(Magnus MS24) and larval identification were done using identification keys[9].

2.3.2.Diversity indices

Dominance status of each species and also its diversity index (H) was calculated.

III.RESULTS AND DISCUSSION

3.1 Physico chemical factors analysis

The water samples collected from 3 different sites and they were carefully transported to the laboratory and are preserved for physical and chemical analysis.Samples were collected from river in the distance of about 100 meters from one sample to another.Water quality analysis of 8 different parameters(PH,Hardness,D02,DCO2,TDS,Turbidity,Chloride,Total coliform bacteria) were analysed bimonthly during February 2022-February 2023.The average water quality analysis of physico chemical factors during the study periods reflects its water quality index as 18.7 (Site 1);24.9(Site 2) and 29.4(Site 3)(Table 1).The sampling sites were belonging to high polluted stretch and belonging tho poor Water quality index(Table 2).Kaanathukadav(Site 1) is the highly polluted stretch since most of the industrial effluents,Market wastes,agriculture wastes ,wastes from Railway stations,hospitals are discharged into this area(Table 2).

Table 1: Average value of the Physic-chemical parameters analysis of Tirur-Ponnani puzha during March 2022-March 2023.

SITE 1(KAANATHUKADAV)			
Parameters	**Premonsoon**	**Monsoon**	**Post Monsoon**
PH	**7.1**	**7.5**	**8**
Hardness	**86**	**150**	**170**
D02	**1.01**	**2**	**2**
DCO2	**4.7**	**4**	**4**
TDS	**348**	**300**	**300**
Turbidity	**0.4**	**0.2**	**1**
Chloride	**178**	**200**	**210**
Total coliform	**2**	**5**	**4**
Water quality index	**18.7**	**26.516**	**29.626**
SITE 2(THAZHEPALAM)			
Parameters	**Premonsoon**	**Monsoon**	**Post Monsoon**
PH	7	7.2	7.5
Hardness	110	144	150
D02	1.5	2.2	2.7
DCO2	4	4.6	5
TDS	250	602	500
Turbidity	1	0.6	1
Chloride	3	346	300
Total coliform	0.3	0.5	0.3
Water quality index	**22.05**	**24.9**	**29.43**
SITE 3(NADUVILANGADI)			
Parameters	**Premonsoon**	**Monsoon**	**Post Monsoon**
PH	7.3	7	7.1
Hardness	260	9.5	100
D02	2.8	3	3.5
DCO2	3.5	3.7	4.7
TDS	220	231	432
Turbidity	0.1	0.2	0.3
Chloride	175	175	242
Total coliform	1	1	0
Water quality index	**25.573**	**27.226**	**29.405**

Table 2 :Table showing the Water quality index status of the study area.

Water quality index	Water quality status	
95-100	EXCELLENT	
89-94	VERY GOOD	
80-88	GOOD	
45-64	MARGINAL	
0-44	POOR	SITE 1(18) SITE 2(24) SITE 3(29)

The study revealed that the water quality parameters fluctuated with sites and seasons.The pollution is seems to be severe during Pre monsoon and low in Post Monsoon.The hardness of water was comparatively high and is mainly due to calcium and magnesium salts.According to BIS (2012) the desirable limit of hardness for drinking water was 200 mg/L and permissible limit of hardness for drinking water was 600mg/L.The present study revealed that the total hardness of water in the 3 sites were exceeded the desirable limit.

Based on the calculated score of WQI,Water quality is classified into 4 categories

Level 1: 0-44 : Water is extremly polluted,emergency treatment is required before use

Level 2:45-64: Marginal

Level 3: 80-88:Good(Water quality is suitable for irrigation and equivalent process)

Level 4:89-94 :Very good(Water quality is suitable for irrigation and equivalent purposes)

Level 5:95-100 Excellent (Water quality is suitable for domestic usage)

3.2 Diversity Analysis

3.2.1.Diversity indices

The degree of species composition or species diversity(H') for each site was determined by using the Shannon - wiener Index.This index indicates the degree of species composition per unit area.The higher the value H',the greater the diversity of species composition per unit area.The higher value of H'the cleaner the environment.

3.2.2 Odonata diversity

About 17 diffferent species observed under 5 different families.Odonate species distribution among 3 study sites with dominant status is documented in Table .3

Table 3 : Dominant status of different species of Odonata larvae

1-4=Recedent,4-7=Subdominant,7-10=Dominant and 10-13=Eudominant

Scientific name	Number	Relative abundance(RA%)	Dominant status
Family: Gomphidae			
Merogomphus longistigma	10	4.16	Subdominant
Family: Macromiidae			
Macromidae sp	7	2.91	Recedent
Family: Libellulidae			
Brachythemis contaminata	25	10.4	Dominant
Urothemis signata	9	3.75	Recedent
Rhyothemis variegata	18	7.5	Dominant
Diplacodes trivalis	10	4.16	Subdominant
Pantala flavescence	12	5	Subdominant
Zygoxemma Petiolatum	15	6.25	Subdominant
Orthetrum lucozonicum	16	6.66	Subdominant
Trithemis aurora	13	5.44	Subdominant
Rhodothemis rufa	17	7.08	Dominant
Neurothemsi tullia	16	6.66	Subdominant
Orthetrum sabina	13	5.44	Recedent
Brachydiplax chalybaea	17	7.08	Dominant
Family:Coenagrionidae			
Ceriagrion coromendelianum	19	7.91	Dominant
Ischura aurora	12	5	Subdominant
Family:Platycnemididae			
Copera marginipes	11	4.59	Subdominant

3.2.3 Family diversity of Odonata

In the present study 12 species belonging to family Libellulidae ,2 species of family Conagrionidae and one species each of Gomphidae,Macromidae and Platycnemididae.Libelluidae is the most represented family with 12 species exploring 83% of species,Famiily Coenagriondae by 10 %,families Gomphidae,Macromidae and Platycnemididae exhibit 3% of the species.(Figure:B).The sub order Anisoptera were more abundant than Zygoptera(Figure 2).It might be due to its high dispersal ability, and their wide range of adaptability.Damselflies are less abundant which might be due to its limited dispersal ability, unstable and changing environment in water bodies and partial or absence of shade cover.

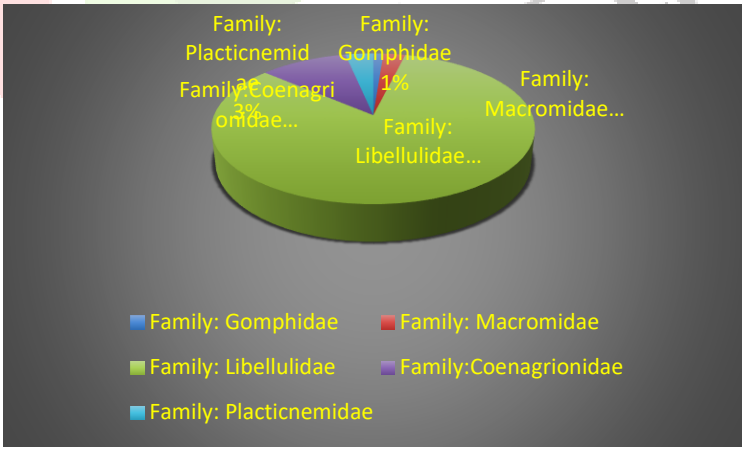

Figure 2 : Relative abundance of families of order Odonata in Tirur - river ecosystem.

3.2.4 Seasonal variation and family abundance:

In all 3 seasons,family Libelluidae & Coenagrionidae were the dominant Anisopteran & Zygopteran family .Other families are unevenly distributed.Anisoptera was the most dominant order.Post monsoon indicates the most species rich season followed by Monsoon and Pre monsoon.(Figure 3,4 &5).

Figure 3 : Relative abundance of suborders- Anisoptera and Zygoptera in Tirur river ecosystem

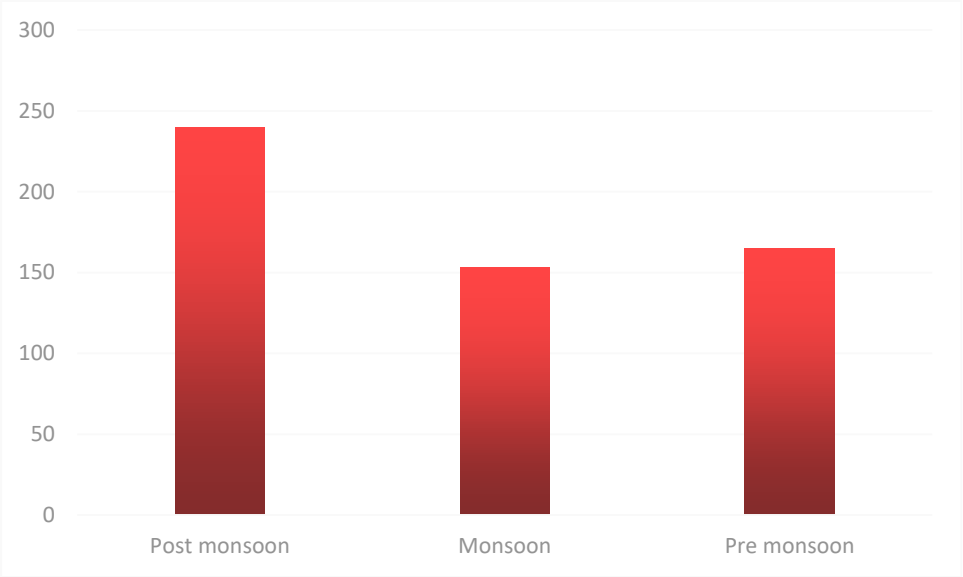

Figure 4: Seasonal variations in the total abundance of Odonata larvae in Tirur river ecosystem

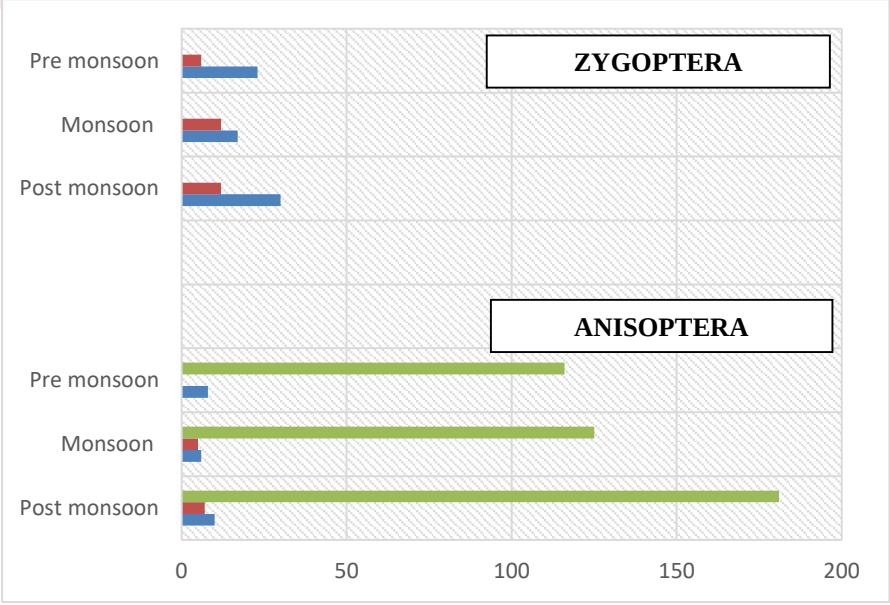

Figure 5:Seasonal abundance of Anisoptera and Zygoptera in Tirur river ecosystem.

Diversity indices

Diversity indices among three seasons show that the distribution and diversity of Odonata are somewhat similar in 3 different seasons among 3 sites.Compared to Monsoon & Pre monsoon ,Post monsoon is the most diverse and highly distributed season(Table :4).The study reveled that the water quality parameters fluctuated with sites and seasons.The pollution is seems to be severe during Pre monsoon and low in Post Monsoon.In this study the number of Odonates observed were 240 in Post monsoon which gets decreased into 165 individuals in Monsoon and 153 in Pre monsoon. This indicates that Pollution adversely affects the species richness.About 13 species were observed throughout the year.*Brachythemis contaminata* is the most abundant species in all seasons indicating Pollution.*Brachydiplax chalybaea,Ceriagrion coromendelianum* and *Rhyothemis variegata* were also dominant during the study period.A total of 13 species distributed in 4 families were observed .Libellulidae is the most dominant family with (12species) followed by Coenagrionidae(2 species),Gomphidae (1 species),Aeshnidae(1 species) and Platycnemididae (1 species).During the study,the Shannon diversity index was calculated as a measure of diversity in 3 different seasons.The Shannon diversity index indicated that Post monsoon season is relatively diverse(2.79) followed by Monsoon (2.68) and Pre monsoon(2.36)(Table : 4).Anisopterans were more abundant due to its high dispersal ability and wide range of adaptability.

Table 4 : Seasonal variation in number ,species diversity of Odonates in Tirur river ecosytem

Parameters	**Pre Monsoon**	**Monsoon**	**Post monsoon**
Number of Individuals	165	153	240
Number of Species	17	12	17
Shannon diversity index	**2.68**	**2.36**	**2.79**

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