Indian J. Applied & Pure Bio. Vol. 39(1), 170-183 (2024). **ISSN: 0970-2091**
A Web of Science Journal

Water quality assessment of River Penna, YSR Kadapa District, Andhra Pradesh with ectoparasites of *Wallago attu* Bloch and Schneider, 1801

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Abstract

Parasites act as potential quality indicators of an aquatic environment. Parasites are helpful in assessing the various types of water pollution caused by heavy metals, pesticides, agricultural and industrial wastes, eutrophification and thermal pollution etc. Parasitological survey on ectoparasites was carried out on the gills of *Wallago attu* (n= 95) from two different locations on River Penna flowing YSR Kadapa District, Andhra Pradesh from August, 2017 to February, 2018. A total of 3202 parasites belonging three ectoparasitic groups *i.e*., three monogeneans- *Thaparocleidus indicus, thaparocleidus wallagonius*, *Mizelleus indicus*, one copepod- *Ergasilus malnadensis* and one isopod- *Alitropus typus* were detected. There was significant correlation ($P < 0.05$) between the prevalence of ectoparasites in *W. attu* and some water quality (*e. g.* dissolved oxygen, alkalinity, total dissolved salts and electrical conductivity) parameters of River Penna. Parasitisation was analysed location wise and fishes collected from Site-II (Somasila backwaters, Vontimitta) were highly infected with ectoparasites than the Site-I. The positive correlation exists between the ectoparasitic infection and water quality variables in the two study sites have led to the conclusion that ectoparasites can act as good biological indicators in assessing the water quality of River Penna.

Key words : *Wallago attu,* ectoparasites, Monogeneans, copepods, Isopods, Indicators, Water quality, water pollution.

Parasites are the useful indicators of ecosystems[8,28]. They not only provide information on environmental stress, trophic structure and function but also contribute a major share in the biodiversity of earth[27]. Parasites can be ecto and endoparasites. Among the ectoparasites, monogeneans are the most notorious and successful flatworms (Platyhelminthes) on fish with their diverse life-history traits such as oviparity and viviparity reproductive mechanisms, camouflage, behavioural responses to host and environmental factors[16,19,51]. The direct life-cycle of monogeneans facilitated them to be a good bioindicators compared to those having multiple life-cycles such as digeneans[25]. Several scientists all over the world has acknowledged the monogenean parasites as potential bioindicators of environmental pollution due to their conventional numerical response to most of the water quality variables[7,14,18,22,23,31,45,49]. Their incidence or abundance can illustrate the condition of the environment[37]. Marcogliese *et al.*[29] observed that monogeneans increase in number at low and medium pollutant concentrations; however, they decrease or disappear at high concentration. Copepods and isopods can also be used as biological indicators of pollution[6,35]. Continuous upsurge in anthropogenic activities such as industrialization and agricultural revolution has augmented the level of pollutants in our aquatic system. Hence, the timely monitoring of the existence and effects of pollutants in aquatic systems is always obligatory. Bioindicators can serve as an effective accumulation indicator which can reflect environmental impact due to their ability to respond to habitat variation with changes in physiology or chemical composition of the host[56]. Commendable work has been done on ectoparasites (monogeneans) of fish in relation to water variables in the aquatic environment[7,21,31,32,48]. *Wallago attu* or freshwater shark is a potamodromous and demersal fish inhabiting the larger parts of South and South-east Asia. *W. attu* or 'Valaga' as it is known locally in Southern India, has been studied comprehensively in India for its helminth parasites. It serves as a very good host for a wide range of helminth parasites including both ecto and endoparasites[1,38,50]. Ectoparasitic infection includes monogeneans, copepods and isopods. These ectoparasites are highly susceptible to changes in the aquatic environment similar to that of their host. A parasite's habitat consists of both abiotic (temperature, pH, DO) and biotic factors (host age, host length, host sex and immune response). Most of the ectoparasites are not only consistently host-specific but also they are site-specific within the host [2,52]. Substantial amount of taxonomic work on ectoparasites of *W. attu* were conducted by many eminent scientists[3, 4, 11, 24, 38, 40, 41, 43, 44, 46, 54, 55, 57]. Also, significant work was done on the ecology of ectoparasites and their pathological effects on the gills of *W. attu*[17,36,50,53]. However, there are very few studies which focused on the use of ectoparasites as bioindicators of water pollution[31-33]. It is a pilot study designed to provide valuable information in understanding the relationship between occurrence of ectoparasites and water quality parameters of the river Penna.

Study area :

The river Penna is 597 km in length which originates in Karnataka and travel about 61 km and the balance of 536 km travels in Andhra Pradesh before emptying into Bay of Bengal; its basin extends over an area of 55,213 sq km which is located in Peninsular India covering areas in the States of Karnataka and Andhra Pradesh (Fig. 1). YSR Kadapa district is located 8 kilometres (5.0 mi) south of the Penna (Penneru) River and touches the three sampling sites in YSR Kadapa.

Site-I: Aadinimmayapalle Dam across the Penna River in Chennur Village (Lat.143 342 0.123 N, 783 482 03 E longitude), YSR Kadapa district (Fig. 2).

Site-II: Backwaters of Somasila reservoir across the Penna River in Somasila village (14°29'22" N 79°18'19" E) Nellore District, Andhra Pradesh reach near Vontimitta Village, Kadapa (Fig. 2). The main part of river after entering Nellore empties into Bay of Bengal. Hence, for the present study, the fishes were exclusively procured from local fishermen at the site of catchment area of River Penna flowing through YSR Kadapa district.

Fish sampling and parasitological assessment :

A total of 95 *Wallago attu* ranging between 7-15cm (mean = 11.52±1.95 cm) in total length and 150-500g (mean = 293.15±100.9g) in weight were collected from the two sampling sites. Fish samples of various sizes (small, medium and large) were transported to research laboratory to carry out parasitological examination during the study period August, 2017 to February, 2018. The gills of this fish were thoroughly scrutinized for the ectoparasites. Gills were judiciously separated and the contents of the gill filaments were observed under the stereozoom microscope (LM-52-3621 Elegant). Ectoparasites were collected with the aid of small pipettes under stereozoom microscope. Monogeneans were too small to prepare permanent slides, hence temporary slides were prepared using neutral red and ammonium picrate-glycerine mixture, following the method of Malmberg[26] and copepods and isopods were fixed in 10% formaldehyde and cleared in lactic acid for further identification[39].

Water sampling and water quality analysis:

Monthly water samples collection from the two study sites (Chennur and Somasila) was carried out to analyse the physico-chemical characteristics. Cleaned polythene bottles of one to two litres capacity were used to collect the samples. Collected water samples were placed into bottles (500ml) and acidified with sulphuric acid (H_2SO_4) to stop further microbial activities before analysis. The physical parameters such as temperature and pH were recorded on the spot, while the analysis of chemical parameters such as dissolved oxygen (DO), conductivity, Total dissolved solids (TDS), chloride (Cl^-), Sulphates (SO_4^{2-}) and Nitrate (N) were carried in the Pipepline water supply (PWS) laboratory located at Kadapa as per the methods suggested by 20th Edition, published by American Public Health Association, American Water Works Association & Water Environment Federation[5].

Data analysis :

Ecological terminology such as infection rate, prevalence, mean intensity, mean abundance and index of infection of monogenean infections was calculated for both the fish species following Margolis *et al*, Grabda-Kazubski *et al* and Bush *et al.,*[10,15,30]. The data was subjected to pearson's correlation using Microsoft Excel 2007 and IBM SPSS 21.0 version to evaluate the relation between environmental factors and prevalence of ectoparasites.

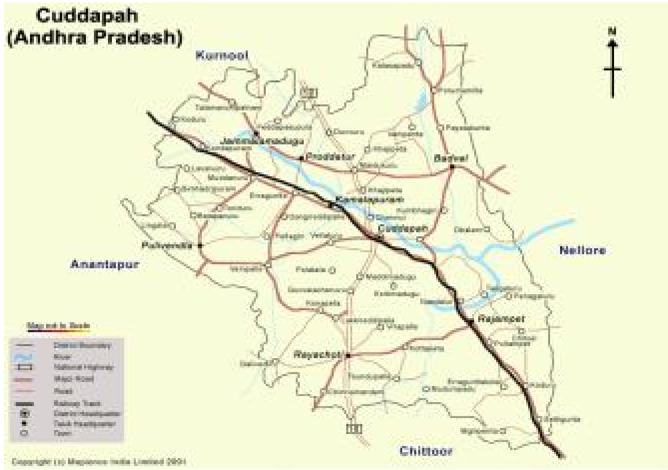
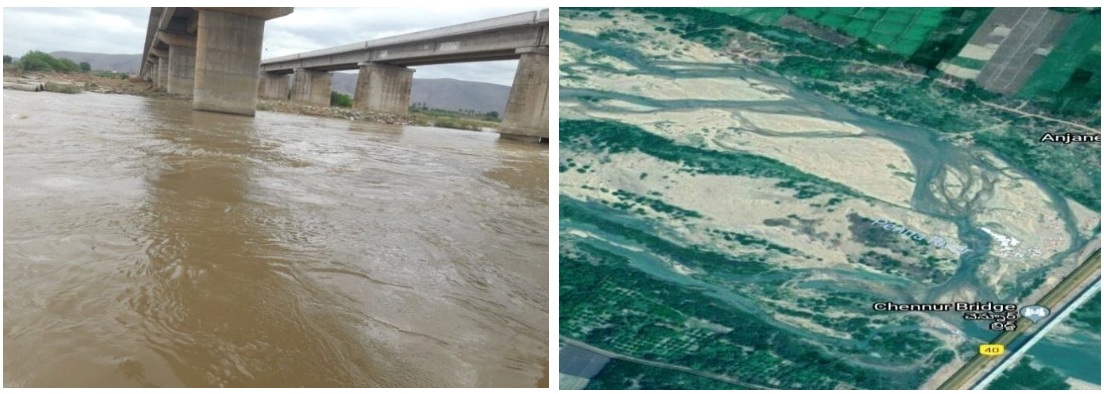
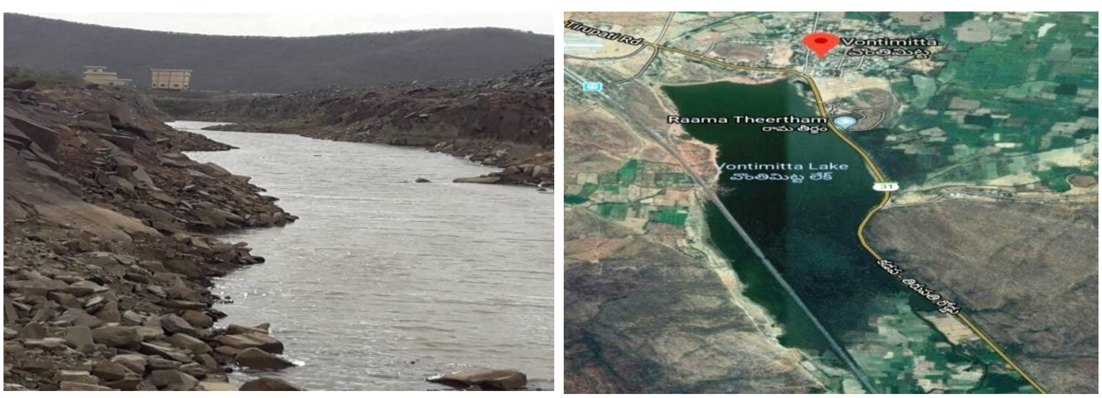


Fig. 1. Map showing the flow of river Penna in YSR Kadapa (Cuddapah) in Andhra Pradesh



Site-1: Aadinimmayapalle Dam across the Penna River in Chennur Village



Site-2: Backwaters of Somasila reservoir across the Penna River

Table-1. Prevalence, mean intensity, mean abundance and index of infection of *ectoparasites* in *Wallago attu*

Parasite species	Prevalence (%)	Mean intensity	Mean abundance	Index of infection
Ergasilus malnadensis	96.8	22.8	22.1	21.4
Alitropus typus	9.5	1.11	0.1	0
Thaparocleidus indicus	55.8	13.0	7.2	4.0
T. wallagonius	56.8	7.5	4.3	2.4
Mizelleus indicus	2.1	1.5	0.0	0.0

Table-2. Prevalence and mean intensity of ectoparasites of *W. attu* at two sampling locations of River Penna in YSR District, Kadapa

Collection sites	Total no. of fishes	Infected fishes	Total no. of parasites	Range	Preva-lence (%)	Mean inten-sity	Mean abun-dance	Index of infection
Copepods								
Chennur	34	32	432	1-30	94.1	13.5	12.7	12.0
Somasila	61	60	1664	2-234	98.4	27.7	27.3	26.8
Monogeneans								
Chennur	34	22	238	1-35	64.7	10.8	7.0	4.5
Somasila	61	39	858	1-75	63.9	22	14.1	9.0
Isopods								
Chennur	34	1	1	0-1	2.9	1.0	0	0
Somasila	61	8	9	0-2	13.1	1.1	0.1	0

In the present study, five ectoparasites belonging to three groups *i.e.*, monogenea (*Thaparocleidus indicus, Thaparocleidus wallagonius* and *Mizelleus indicus*), copepoda (*Ergasilus malnadensis*) and Isopoda (*Alitropus typus*) were detected. The prevalence and mean intensity of the five species of ectoparasites from the two sampling sites were illustrated in Table-1. All the five species of ectoparasites were obtained from site-II but only 4 ectoparasitic species were recorded from Site-I due to absence of *M. indicus* occurrence (Table-2 and 3). Tables-4 and 5 show the correlation matrix between physico-chemical parameters of the two sampling stations-Aadinimmayepalli Dam, Chennur (Site-I) and Somasila backwaters, Vontimitta (Site-II) respectively. Significant correlation ($p<0.05$) were observed between electrical conductivity, TDS, calcium hardness, alkalinity, chlorides and nitrates in two sampling sites. Site-I showed highly significant correlation with alkalinity, electrical

Table-3. prevalence, mean intensity and physico-chemical parameter variations in two sampling sites of River Penna, YSR Kadapa district

Water parameters	Chennur	Somasila backwaters, Vontimitta
	Mean	Mean
Overall Prevalence (%)$_{W.attu}$	100±70.7	98.3±69.5
Overall Mean intensity$_{W.attu}$	19.7±13.9	42.0±29.7
DO	7.69±0.34	7.84±0.61
Temp (R^{o}C)	29.8±4.42	28.8±3.65
pH	7.68±0.19	7.77±0.10
EC	901±59.1	695.4±59.7
Alkalinity	198.7±24.62	261.1±57.2
Total hardness	211.69±39.9	256.0±34.1
Calcium hardness	106.0±16.53	90.2±12.4
TDS	576.6±37.8	431.7±36.9
Chlorides	213.5±29.4	109.9±27.2
Fluorides	0.65±0.047	0.31±0.11
Sulphates	66.3±12.8	20.1±12.1
Nitrates	5.61±0.61	2.93±0.54

conductivity, TDS, Chlorides and total hardness whereas Site-II showed significant correlation between total hardness, total dissolved solids, electrical conductivity and calcium hardness. The dissolved oxygen recorded during the present study period ranged between 7.5-7.85mg/L at temperatures ranging between 28.8-30.0 which ranges between the safety limits for freshwater ecosystem (Table-3). There were significant differences between ectoparasite prevalence and water quality parameters in the fish gills with respect to location. Both the sampling sites showed highest infection rate *i.e.*, 100% prevalence with a mean intensity of 19.2 in Site-I and 98.3% with a mean intensity of 42.0 in Site-II. It might be due to the variations in the physico-chemical parameters caused by the accumulation of different ions such as chlorides, fluorides, nitrates, calcium by various human anthropogenic activities in these two sites. The alkalinity was recorded within the acceptable range (50-300mg/L $CaCO_3$) in the two sites with highest being in Site-II (261.1mg/L $CaCO_3$). The prevalence of these parasites was interrelated to physico-chemical parameters (temperature, DO, pH, alkalinity) of the river from the two sampling sites. Table-6 and 7 showed correlation matrix between ectoparasitic prevalence and water quality variables of both the study sites. The prevalence of *E. malnadensis* was 100% in Site-I and Site-II irrespective of the water quality parameters. Mean intensity of *E. malnadensis* established a significant positive correlation with nitrates (0.534), pH (0.521), Table-4. Pearson's correlation matrix showing correlation among various physico-chemical parameters of Adinimmayepalli Dam, Chennur, Kadapa

Water parameters	DO	Temp (°C)	pH	EC	Alkalinity	Total hardness	Calcium hardness	TDS	Chlorides	Fluorides	Sulphates	Nitrates	Iron
DO	-												
Temp (°C)	-0.207	-											
pH	-0.235	0.525	-										
EC	0.227	0.440	0.458	-									
Alkalinity	0.296	0.337	0.54	0.78	-								
Total hardness	0.181	0.658	0.574	0.947*	0.81	-							
Calcium hardness	0.0117	0.497	0.771	0.856	0.86	0.898	-						
TDS	0.225	0.440	0.455	0.99*	0.78	0.947*	0.854	-					
Chlorides	0.26	0.533	0.604	0.908*	0.88	0.942*	0.922*	0.906*	-				
Fluorides	0.0645	0.683	0.364	0.86	0.54	0.912*	0.721	0.86	0.78	-			
Sulphates	-0.201	0.794	0.79	0.622	0.64	0.792	0.832	0.621	0.717	0.67	-		
Nitrates	0.123	0.554	0.769	0.846	0.89	0.914*	0.957	0.845	0.904*	0.70	0.90*	-	

*Correlation is significant at the ($p<0.05$) level

Table-5. Pearson's correlation matrix showing correlation among various physico-chemical parameters of Somasila backwaters, Vontimitta, Kadapa

Water parameters	DO	Temp (°C)	pH	EC	Alkalinity	Total hardness	Calcium hardness	TDS	Chlorides	Fluorides	Sulphates	Nitrates	Iron
DO	-												
Temp (°C)	-0.625	-											
pH	-0.32	0.25	-										
EC	-0.1065	-0.315	-0.166	-									
Alkalinity	-0.255	0.31	-0.167	0.04	-								
Total hardness	0.52	-0.64	-0.637	0.456	0.18	-							
Calcium hardness	0.37	-0.66	-0.52	0.64	0.22	0.956*	-						
TDS	-0.11	-0.315	-0.196	0.998*	0.054	0.47	0.654	-					
Chlorides	-0.246	-0.28	0.311	0.375	0.20	-0.196	-0.06	0.335	-				
Fluorides	-0.05	0.23	0.26	-0.44	-0.15	-0.298	-0.46	-0.43	-0.32	-			
Sulphates	0.54	-0.49	-0.17	0.107	-0.835	0.286	0.203	0.111	-0.271	-0.098	-		
Nitrates	-0.99	0.022	0.60	-0.26	-0.218	-0.466	-0.46	-0.261	-0.372	0.65	0.098	-	

*Correlation is significant at the ($p<0.05$) level

Table-6. Correlation between various physicochemical parameters of ectoparasites of *W. attu* in Site-I (Chennur), YSR District

Water parameters	Prevalence (%)					Mean intensity				
	T. indicus	*T. walla-gonius*	*M. indicus*	*A. typus*	*E. maln-adensis*	*T. indicus*	*T. walla-gonius*	*M. indicus*	*A. typus*	*E. maln-adensis*
DO	-0.0179	0.597	0	0.108	NaN	0.304	0.412	0	0.108	-0.319
Temp (^oC)	-0.054	-0.560	0	0.158	NaN	-0.176	-0.254	0	0.158	-0.279
pH	-0.473	-0.910	0	-0.506	NaN	-0.782	-0.791	0	-0.506	0.521
EC	-0.388	0.070	0	0.154	NaN	-0.006	0.135	0	0.154	0.123
Alkalinity	0.491	0.436	0	0.540	NaN	0.656	0.485	0	0.540	-0.174
Total hardness	-0.318	-0.245	0	-0.116	NaN	-0.250	-0.204	0	0.116	-0.332
Calcium hardness	-0.411	-0.705	0	-0.454	NaN	-0.667	-0.631	0	0.454	-0.323
TDS	-0.330	0.079	0	0.162	NaN	0.006	0.44	0	0.162	0.121
Chlorides	-0.711	-0.601	0	-0.166	NaN	-0.570	-0.415	0	-0.166	0.465
Fluorides	-0.510	-0.445	0	-0.348	NaN	-0.497	-0.444	0	-0.348	0.499
Sulphates	-0.111	-0.520	0	-0.364	NaN	-0.432	-0.496	0	-0.364	0.075
Nitrates	-0.349	-0.578	0	-0.484	NaN	-0.558	-0.607	0	-0.484	0.534

'Bold' Correlation is significant at the ($p<0.05$) level

*NaN-Not a number as the prevalence is 100% and the correlation coefficient

Table-7. Correlation between various physicochemical parameters of ectoparasites of *W. attu* in Site-II (Somasila backwaters, Vontimitta, YSR District)

Water parameters	Prevalence (%)					Mean intensity				
	T. indicus	*T. walla-gonius*	*M. indicus*	*A. typus*	*E. maln-adensis*	*T. indicus*	*T. walla-gonius*	*M. indicus*	*A. typus*	*E. maln-adensis*
DO	0.287	0.605	0.506	0.503	NaN	0.096	0.673	-0.506	0.840	-0.319
Temp (ºC)	-0.201	-0.521	-0.626	-0.33	NaN	0.022	-0.509	-0.626	-0.731	0.279
pH	0.351	0.095	-0.244	0.004	NaN	0.424	-0.092	-0.244	-0.217	0.521
EC	-0.263	-0.324	0.171	-0.528	NaN	-0.127	-0.546	0.171	-0.460	0.123
Alkalinity	-0.062	-0.240	-0.899	0.299	NaN	0.092	0.271	-0.899	-0.106	-0.174
Total hardness	0.271	0.496	0.284	0.548	NaN	-0.075	0.464	0.284	0.625	-0.332
Calcium hardness	0.209	0.388	0.184	0.487	NaN	-0.116	0.333	0.184	0.476	-0.323
TDS	-0.263	-0.324	0.170	-0.527	NaN	-0.127	-0.543	0.170	-0.458	0.121
Chlorides	0.211	-0.078	-0.390	-0.128	NaN	0.452	-0.066	-0.390	-0.304	0.465
Fluorides	0.203	-0.0188	-0.072	-0.259	NaN	0.408	-0.163	-0.072	-0.274	0.499
Sulphates	0.250	0.511	0.995	-0.015	NaN	-0.036	0.021	0.995	0.434	0.074
Nitrates	-0.209	-0.429	-0.403	-0.551	NaN	0.368	-0.345	-0.403	-0.626	0.534

*NaN-Not a number as the prevalences is 100% and the correlation coefficient is NaN fluorides (0.499) and chlorides (0.465) in both sampling sites while the remaining parameters showed negative insignificant correlation with the occurrence of *E. malnadensis*. Similarly, the prevalence and mean intensity of *T. indicus* established a significant positive correlation with alkalinity (0.491, 0.656) and a strong negative correlation with chlorides (-0.711, -0.570) and fluorides (0.510, -0.497) in Site-I whereas the occurrence of *T. indicus* in Site-II showed a moderate positive correlation with water quality parameters like DO (0.287, 0.673) and total hardness (0.271, 0.464).The prevalence and mean intensity of *T. wallagonius* showed a moderate positive correlation with DO (0.597, 0.412) and alkalinity (0.436, 0.485) and a strong negative correlation with pH (-0.910, -0.791), calcium hardness (-0.705, -0.631) and chlorides (-0.601, -0.415) in Site-I. Similarly, prevalence and mean intensity of *T. wallagonius* in Site-II showed a strong positive correlation with DO (0.605, 0.673), low to moderate correlation with sulphates (0.511, 0.021), total hardness (0.496, 0.464) and significant negative correlation with temperature (-0.521, -0.509) and nitrates (-0.429, -0.403). The occurrence of *M. indicus* was nil in Site-I however, it displayed a strong positive correlation with sulphates (0.995) and the remaining parameters showed low to moderate positive and negative correlations with the parasitization of *M. indicus* at site-II. The isopod, *A. typus* showed a moderate positive correlation with alkalinity (0.540) and the remaining parameters showed low to negative correlations with parasitization of *A. typus* in Site-I. Similarly, the parasitization of *A. typus* showed moderate correlation with total hardness (0.548, 0.625), DO (0.503, 0.840) and calcium hardness (0.487, 0.476) and low to negative correlation with the remaining parameters at site-II (Table-6 & 7). In the present study, both the sampling sites fall within the safety limits of DO. The Site-I showed comparatively low levels of ectoparasitic infection in fish as the oxygen rich water in this dam seems to support the health conditions and immune system of the fish leading to reduction in the parasitic infection. Hydrogen ion concentration (pH) seems to have no impact on infection variables of ectoparasites during the present study as both the sites did not show marked variations in pH.

Biological tags help to sense the changes in the environment and help to understand the alarming environmental degradation. Fish parasites, especially ectoparasites (monogeneans, isopods and copepods) can be used as prospective and extremely sensitive bio-indicators due to their monoxenic life-cycle with a high reproductive rates and immediate response to changes in the aquatic environment[13]. Water quality determines the goodness of the water necessary to sustain life in water. The temperature, alkalinity, pH, DO, TDS, electrical conductivity, total hardness, calcium hardness, Nitrates, sulphates, chlorides and fluorides etc are various water quality indicators which need to be timely tested and correlated with aquatic fauna such as aquatic macro invertebrates, parasites and fishes *etc*[42]. Temperature of an aquatic body is very significant because it affects the amount of dissolved oxygen in the water. The amount of oxygen that will dissolve in water increases as temperature decreases. Water at 0°C will hold up to 14.6 mg of oxygen per litre, while at 30°C it will hold only up to 7.6 mg/L. The rate of photosynthesis of aquatic plants, metabolic rate of aquatic animals, rates of development, timing and success of reproduction, mobility, migration patterns and the sensitivity of organisms to toxins, parasites and disease are affected by temperature[32,47]. Dissolved oxygen (DO) in aquatic ecosystems is deemed to be an essential abiotic factor. Low and high DO due to pollution in water may make the life of aquatic organisms vulnerable[34]. In the present study, the DO was between 7.5-7.85mg/L at temperatures between 28.8-30.0°C which falls within the safety limits of the freshwater ecosystem and did not show any marked variation. Hydrogen ion concentration (pH) plays an important role in fish development and predisposition of various diseases. The studies of Kurovskaya and Stril'ko[20] on impact of pH on ectoparasitic levels in cyprinids showed a significant decrease in parasitic infection in changing water pH levels under experimental conditions. However, the present study was in natural environment and any slight variation in pH seems to have no impact on infection variables of ectoparasites which correlates with the studies of Biswas and Pramanik, El-Naggar *et al.* and Modi *et al.*[9,12,31]. Similarly, the ectoparasites respond to other parameters such as total dissolved solids, total hardness, electrical conductivity, calcium hardness, chlorides, sulphates, nitrates and alkalinity. These parameters were more in the polluted environment i.e., Site-II which flows downstream to site-I gathering more pollutants due to anthropogenic activities and further deteriorating the water quality and making the fish more vulnerable to ectoparasitic infestations due to weakened immune systems. Hence, the present study authenticates that the ectoparasites serve as efficient biological indicators due to their immediate response to the changing environment.

The present study is evidence that ectoparasites especially monogeneans can serve as an excellent biological tags and understanding their ecological aspects under natural conditions could provide baseline data for the benefit of this fish stock in the extensive aquaculture.

List of abbreviations :

$CaCO_3$- Calcium carbonate
DO- Dissolved oxygen
PWS- Pipeline Water Supply
SPSS- Statistical package for Social Sciences
TDS- Total dissolved solids
YSR Kadapa District- Y.S. Rajasekhar Reddy Kadapa District

Declarations :

Ethics approval and consent to participate:

All procedures contributing to this work comply with the ethical standards of the relevant national guides on the care and use of laboratory animals and have been approved and authorized by IAEC (Institution of Animal Ethics Committee-Regd. No.1460/PO/a/11/CPCSEA, dt. 20.05.2011), Zoology Department in Faculty of Life Sciences, Yogi Vemana University, Andhra Pradesh.

Consent for publication

Not applicable

Availability of data and materials :

The raw data used to support the findings of this study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that no competing interests exist.

Funding

The work was funded to Late, Mrs. Asha Kiran Modi (AKM) under UGC Faculty improvement programme (FIP)- Award No.APSC021/001(TF)ZOOLOGY/PH.DXII PLAN/2016-17 dt. July 2016.

Authors' contributions

The author dedicates this work to UGC-FIP Research Scholar, Late Dr. Asha Kiran Modi (AKM) who was involved in host sample collection and parasite collection and literature survey while the corresponding author (APV) who was the research supervisor has designed the concept and was the major contributor in writing the manuscript. The author has read and approved the final manuscript.

The corresponding author commemorates this work to late Dr. Asha Kiran Modi, who worked under the financial assistance of UGC Faculty improvement programme (FIP)- Award No. APSC021/001(TF)ZOOLOGY/PH.DXII PLAN/2016-17 dt. July 2016. The author is also thankful to the Department of Zoology, Yogi Vemana University, YSR Kadapa (A.P) for providing necessary facilities to carry out this work.

Significance statement :

This type of study ascertains the fact that the ectoparasites especially monogeneans can act as exceptional biological indicators. These types of studies are timely needed to analyse the magnitude of pollution in a particular water body and take necessary steps to reduce the pollution levels of the water body.

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