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S-W diversity index of plankton population of Konar dam, Hazaribagh, Jharkhand, India

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Abstract: - S.W diversity index propounded by Shannon & Weiner in 1954 is one of the most widely accepted indices which neadily provide first hand information about the species-diversity of any flora & fauna along with its richness & abundance. Present paper is an innovative approach to bring on record the statistical values of plankton species diversity, its abundance & richness proportion sampled from Konar dam which is a tributary of river Damodar being one of the easternmost tributaries of river Ganga.

Keywords : S-W Diversity, Planktons, Konar Dam, Hazaribagh.

INTRODUCTION

Plankton population is a group of small microscopic organisms of water bodies forms directly or indirectly food for fishes & bigger animals. The primary object of this investigation is to get a general picture of the changes in the plankton concentration and abundance as indicated by fluctuations in the number of planktons[1] Fresh water planktons (1952)[1] include representatives from the photosynthetic algae, bacillariophyceae (diatoms), myscophyceae (blue- green algae), chlorophyceae (green-algae) and occasionally other from the non-photosynthetic bacteria, and other fungi and among zooplankton, all clases of protozoa, (except sporozoa), rotatoria, entomostraca, some immature diptera, the gemmules of bryozoans and sponges and occasional aquatic termites, *Gantrotridis* and others.

The different species of planktons vary in their occurance with respect to seasonal changes in water temperature and physico-chemical properties as well as the number of generations of planktons produced per year in time and space. Every organism of water body whether plant or animal or whether small or large is a link in food chain or food web and thus play an important role in the flow of energy in the system. As such the present study attempts to statistically evaluate the plankton diversity of Konar Dam which function as primary producer and contribute substantially to the formation and maintainance of food chain/web as well as energetics of the water body.

Physiography

Konar is a tributary of river Damodar which is one of the eastern most tributaries of river Ganga. It is situated as about 64 km. from its origin at latitude 23'53'N. The drainage area of the river as konar dam is about 997 sq. km.which includes thick jungles, cultivated and waste lands.

MATERIALS & METHODS

Selection of sampling sites as important pre-nequiste of the study was done randomly and 10 important sites

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were identified in the southern banks of the dam alongside in the stretch of 5 km.

Sampling Methods :

Random sampling through plankton net sweep from the knee deep water of the Dam. Each sweep of planktons weeds was done was considered as quadrat as unit of sampling and atleast 5-10 sweeps were made at a particular site on fixed time.

Overall Out Search (OOS) method was adopted by hand lenses to count and collect all the representatives of planktons and fold micro sweeps including both phyto & zooplanktons.

Taxonomic Identification :

Morphologically different individuals and representatives of both phyto & zoo planktons was identified by Topani's key.

Preservation and Data Collection:

All the individuals of the sample were preserved in 70% alcohol in different vials bearing appropriate tags. The quadrate wise number of sampled individuals according to their genus and species had been recorded in tabular form. (Table 1)

Statistical Analysis:

Analysis of collected data had also been done by using following statistical indices within the habitat :

a) Alpha (α) diversity Shannon Weiner index: -

$H = \sum pi \log pi$

Where,

H = species diversity,

Pi = mean of individual species procured by the formula n/N,

logpi is the log product of pi (mean of individual species).

b) Relative abundance = ni/N x 100

Where,

Ni = number of individuals of a species.

N = number of individuals of total number of species

c) Evenness = H/log2S

Where,

S = number of species, H= diversity.

d) Simpson's dominance D = 1/Ds,

Ds= $\sum_{i-1}^{s} \frac{ni(n-1)}{N(N-1)}$

Where,

s= No. of species present

i= ith no.of species (1 to ∞)

n_i = number of individuals of ith species,

N = Total number of individuals of all the species.

OBSERVATION

The fresh water ecosystem of Jharkhand harbours a rich wealth of planktons. Depending on the quality and quantity of planktons, the quality and quantity of other higher forms of life belonging to different trophic levels of the food chain of the water body are determined. Planktons thus play an important role in the flow of energy in the ecosystem. Phyto- and Zooplanktons are important components of ecosystem which respond to ecosystem alterations rather rapidly by way of their auto-and heterotrophic roles. This is further related to the fact that the planktons play key role in the turnover of organic matter and energy in the ecosystem.

In the present investigation the observation on planktonic population has been regularly carried out and related to the each aquatic net sweeping, the numerical counts of the Phyto- & Zooplanktons population in different seasons of the year has been recorded regularly for statistical competition of their species diversity. Stiling, (2002)[8].

Statistical Analysis of Phyto- & Zooplanktons

The **phytoplankton** communities of the konar dam were represented by three groups of algae namely chlorophyta, cyanophyto and chrysophyta , of the total planktonic taxa recorded. 3 taxa belonged to the chlorophyta, 3 belonged to the chrysophyta and 2 belonged to the cyanophyta. In the present study a total of 16 taxa were recorded from the lotic region of konar of which 8 taxa belonged to phytoplankton and 8 taxa belonged to zooplankton. The phytophonkton taxa were represented by *Cosmarium* sp., *Spirogyra* sp., *Pediastrum* sp., *Microcystis* sp., *Oscillatoria* sp. *Nitzschia* sp., *Navicula* sp. and *Diatoma* sp. It is evident from the present study that among the chrysophyta showed its regular presence throughout the year. Among chlorophyta, all the three taxa showed its regular presence but *Pedistrum* sp. was absentin Nov'07. Among Cyanophyta both two taxa namely

Nuorocysti sp. and *Oscillatoria* sp. showed regular presence except in the month of June'07 *Oscillatoria* was absent.

The phylogenetic status and the numerical abundance of these phytoplankton population showing significant seasonal vartiations has also been expressed comprehensively in Table-I.

The **zooplankton** communities of the Konar Dam is also very rich and altogether eight taxa of zooplankton were recorded of which four taxa belonged to Copepod i.e. *Cyclops* sp., *Mesocyclops* sp., *Acanthodiaptomus* sp. and *Diaptomus* sp. *Daphnia* and *Ceriodaphnia* sp. belonged to Cladocera. *Brachionus* sp. and *Keratella* sp. belonged to Monogononta of Brachionidae family.

Among the zooplankton encountered the *Brachionus* sp. was recorded in all months except in the month of Nov 07. *Keratella* sp. was the only taxa among the Rotifera which showed its regular presence in all months during period of observations. Among copepods, *Cyclops* sp. & *Mesocyclops* sp. showed its regular presence in all the months during the entire period of observation. *Diaptomus* sp. showed its regular presence in all the months except in the month of June'07 where it was absent. *Acanthodiaptomus* sp. showed its regular presence in all the months during the entire period of observation but it was found to be lower in July' 07. *Ceriodaphnia* sp. was observed to vary low in number in March'07 and Aug'07.

The phylogenetic status and the numerical abundance of these zooplanktons population showing significant seasonal vartiations has also been expressed comprehensively in Table-II.

RESULTS & DISCUSSION

The dam receives pollutants from the discharge of sewage and industrial water of varying characteristics load. Seasonal variation in the phytoplanktons in temperature as well as tropical climates are common feature of any aquatic ecosystem. Singh *et. al.* (2012) Suggests that there are marked seasonal variations in the occurence and abundance of various plankton. The higher phytoplankton density during monsoon months (S-W, H= 0.464 for Chrysophyta) appear to be directly related to two relatively high concentration of nutrients such on phosphate and nitrates. The use of diatoms as indicators of pollution has been emphasized by many workers. The dam has several pollution indicator like *Navicula*, sp., *Nitzschia* sp. etc. In the present study, different phytoplankton in the dam were found to thrive well in different temperature. Cyanophyta was abundant during too low temperature period (S.W= 0.300) while Chlorophyta and Diatoms were more abundant at high temperature (S.W=0.472) as presented in the diversity Table 1 & Graph 1. The lower density of phytoplankton may be due to the prevalence of high concentration of phosphate and ammonia which appear to inhibit the photosynthesis and growth of phytoplankton.

Zooplanktons provide food for fishes in fresh water ponds, lakes and play a major role in the fish production. In the present study, 2 taxa of Rotifers, 4 taxa of Copepods (Crustaceans) and 2 taxa of Cladocera (Brachiopoda) have been recorded with differential population count in various seasons as presented in Table 2. (Highest S-W index for Rotifers = 0.296 in rains, 0.529 for Crustaceans in autumn & 0.296 for Brachiopods again in rains). This is nearer to the findings of Pennok (1957)[4] who suggested that the planktons found in the open water are seldom more than 1 to 3 taxa of Copepods, 2 to 4 species of Cladocera and 3 to 7 taxa of Rotifers, however the author did not report about their S-W diversity index.

It has been observed that in summer and monsoon, the factors like water temperature, turbidity, transparency etc. play an important role in controlling the density and diversity of rotifers. The highest no. of *Keratella* sp. in summer and early rainy season (S-W= 0.294 & 0.296 respectively indicates eutrophic condition of Konar dam similar to the finding of Sinha *et.al.* (2009). The present investigation indicates that the maximum number of species occurred during winter season than summer and monsoon season similar to the observation of Ugale, *et. al.*, (2005)[6]. The less number of species might be attributed to the less nutrients in the dam which consequently result in less productivity or might be due to depletion of important factors such as dissolved oxygen and pH. Most of the Cladocera species are primary consumers and feed on microscopic algae and the four particulate matter in the detritus thus influencing the cycling of matter and energy in benthic food chain of a lake ecosystem. The winter

population maxima of cladoceran in the present study can be attributed to favorable temperature and availability of abundance food in the form of bacteria, nanoplankton and suspended detritus. Related S-W diversity index also predict about the high, medium and low security of existance of plankton species in the Konar Dam.

Graph 1:- Seasonal variation in the species diversity of Phytoplanktons of Konar dam (January- December 2007)

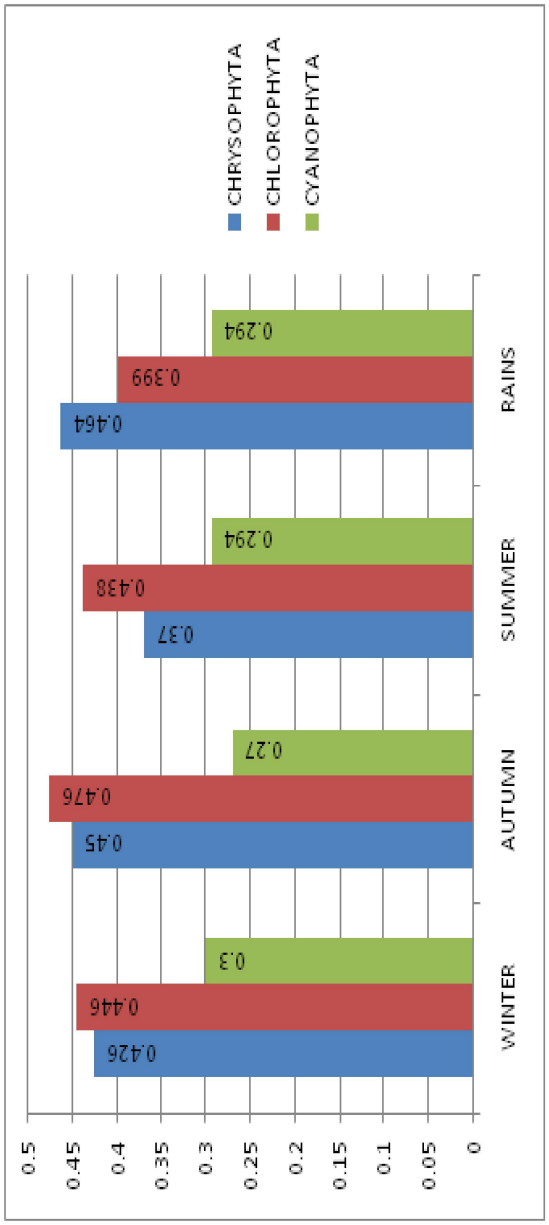


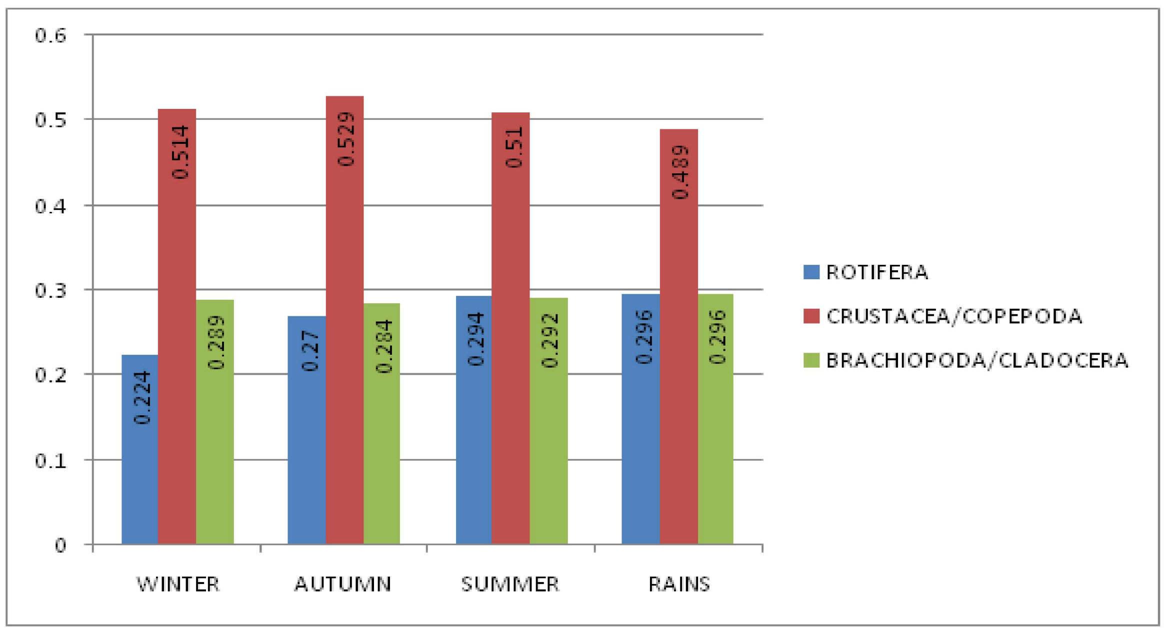
Table 1: Seasonal mean population of Phytoplanktons (January 2007- December 2007) & its species diversity indices

SEASONS →	WINTER					AUTUMN					SUMMER					RAINS				
GROUP & GENUS →	Mean Popl.	pi	log pi	pi x log pi	H	Mean Popl.	pi	log pi	pi x log pi	H	Mean Popl.	pi	log pi	pi x log pi	H	Mean Popl.	pi	log pi	pi x log pi	H
(A) CHRYSOPHYTA																				
(i) *Navicula* sp.	28	0.14	-0.85	-0.119		208	0.20	-0.69	-0.138		146	0.38	-0.42	-0.159		248	0.27	-0.56	-0.151	
(ii) *Diatoma* sp.	69	0.35	-0.45	-0.157	0.426	400	0.39	-0.40	-0.156	0.450	209	0.55	-0.25	-0.137	0.370	367	0.40	-0.39	-0.156	0.464
(iii) *Nitzschia*	100	0.50	-0.30	-0.150		405	0.39	-0.40	-0.156		24	0.06	-0.22	-0.073		297	0.32	-0.49	-0.156	
Total	197			-0.426		1013			-0.450		379			-0.370		912			-0.464	
(B) CHLOROPHYTA																				
(i) *Spirogyra*	58	0.34	-0.46	-0.156		149	0.28	-0.55	-0.154		70	0.29	-0.53	-0.153		50	0.31	-0.50	-0.155	
(ii) *Pediastrum*	32	0.19	-0.72	-0.136	0.445	74	0.33	-0.48	-0.158	0.472	50	0.20	-0.69	-0.138	0.438	19	0.11	-0.95	-0.104	0.399
(iii) *Cosmarium*	76	0.45	-0.34	-0.153		203	0.38	-0.42	-0.159		119	0.49	-0.30	-0.147		91	0.56	-0.25	-0.140	
Total	166			-0.445		426			-0.472		239			-0.438		160			-0.399	
(C) CYANOPHYTA																				
(i) *Oscillatoria* sp.	69	0.5	-0.30	-0.150		35	0.32	-0.49	-0.156		47	0.43	-0.36	-0.154		130	0.46	-0.33	-0.151	
(ii) *Microcystis* sp.	69	0.5	-0.30	-0.150	0.300	72	0.67	-0.17	-0.113	0.270	60	0.56	-0.25	-0.140	0.294	147	0.53	-0.27	-0.143	0.294
Total	138			-0.300		107			-0.270		107			-0.294		277			-0.294	
Grand Total	**501**					**1546**					**725**					**1349**				

Table 2: Seasonal mean population of Zooplankton (January 2007- December 2007) & its species diversity indices

SEASONS →	WINTER					AUTUMN					SUMMER					RAINS				
GROUP & GENUS ↓	Mean Popl.	pi	log pi	pi x log pi	−H̄	Mean Popl.	pi	log pi	pi x log pi	−H̄	Mean Popl.	pi	log pi	pi x log pi	−H̄	Mean Popl.	pi	log pi	pi x log pi	H̄
(A) ROTIFERA																				
(i) *Keratella* sp.	81	0.77	-0.11	-0.084		97	0.67	-0.17	-0.113		160	0.53	-0.27	-0.143		85	0.48	-0.31	-0.148	
(ii) *Brachionus* sp.	24	0.22	-0.64	-0.140	0.224	46	0.32	-0.49	-0.156	0.270	138	0.46	-0.33	-0.151	0.294	91	0.51	-0.29	-0.147	0.296
Total	105			-0.224		143			-0.270		298			-0.294		176			-0.296	
(B) CRUSTACEA / COPEPODA																				
(i) *Cyclops* sp.	100	0.16	-0.79	-0.126		110	0.27	-0.56	-0.151		133	0.36	-0.44	-0.158		63	0.07	-1.15	-0.080	
(ii) *Mesocyclops* sp.	68	0.11	-0.95	-0.104		78	0.19	-0.72	-0.136		102	0.27	-0.56	-0.151		105	0.12	-0.89	-0.106	
(iii) *Acanthodiaptomus* sp.	123	0.20	-0.69	-0.138	0.514	34	0.08	-1.09	-0.087	0.529	122	0.33	-0.48	-0.158	0.510	338	0.40	-0.39	-0.156	0.489
(iv) *Diaptomus* sp.	318	0.52	-0.28	-0.145		175	0.44	-0.35	-0.154		10	0.27	-1.56	-0.042		325	0.39	-0.40	-0.156	
Total	609			-0.514		397			-0.529		367			-0.510		831			-0.489	
(C) BRACHIOPODA / CLADOCERA																				
(i) *Daphnia* sp.	92	0.58	-0.23	-0.133	0.289	99	0.63	-0.20	-0.126	0.284	109	0.57	-0.24	-0.136	0.292	69	0.48	-0.31	-0.148	0.296
(ii) *Ceriodaphnia* sp.	64	0.41	-0.38	-0.155		56	0.36	-0.44	-0.158		80	0.42	-0.37	-0.155		72	0.51	-0.29	-0.147	
Total	156			-0.289		155			-0.284		189			-0.292		141			-0.296	
Grand Total	**870**					**695**					**854**					**1148**				

Graph 2:- Seasonal variation in the species diversity of Zooplanktons of Konar dam (January- December 2007)



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