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Epilithic Periphyton and Detritus Ecology of the Spring-fed Stream Eastern Nayar in Garhwal Himalaya

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Abstract

The paper deals with the study of epilithic periphyton and detritus standing stock in the river Eastern Nayar, which forms an important part of the food for macrozoobenthos and the fish, thus contributing greatly to the productivity of the stream.

Introduction

Epilithic periphyton and detritus plays an important role in the lotic environments where the current does'nt allow plankton to stay on in a considerable quantity. The fish inhabiting these streams mostly feed on the macrozoobenthos and the phytobenthos along with the detritus. It is the riparian vegetation, which usually contributes the detritus. Eastern Nayar is the parent stream of the Nayar that originates in the Doodhatoli peak at an elevation of about 3116 masl and confluences with other stream, the Western Nayar at Nagun Kamand near Satpuli at an elevation of about 650 masl.It is rich in carni-omnivore, omnivore and detritivore fishes. The Nayar basin is one of the important drainage basin in the Ganges river system and consists of 1997 km^2 area extending from 29^0 45' to $30^0$15' latitude and $78^0$34' to $79^0$12' longitude (Survey of India toposheet No. 53 N/4, 0/1, J/12, J/16, K/13, K/14 and K/9).The authors while conducting studies on the food and feeding biology of fishes inhabiting the Nayar river observed that the epilithic periphyton and the detritus is main food of many fishes, hence it was decided to conduct some ecological studies on these two neglected aspects.

Materials and Methods

The physico-chemical parameters were analysed by the standard methods (Welch, 1948, APHA,1975). For the quantitative estimation of periphytic algal biomass, the sample was taken from a known surface area, in centimeter square from each sampling spot. After scrapping, the periphytic algal was preserved in 5% formalin solution and was brought to the laboratory for further analysis. In laboratory, the algae collected from known area (i.e. 1cm^2 or otherwise calculated accordingly) was concentrated in either 50ml or 100 ml depending upon its concentration. The counting was made in sedgwick-Rafter counting chamber. Calulation was made as follows:

$$n = (a \times 1000) \times b$$

Where n= number of units of periphyton/ cm^2, a = Average number of periphyton in 1 chamber of 1 mm^3 capacity, b= Concentration prepared in ml.

For dry biomass, another sample of periphytic algae from 1cm^2 area was collected and dried at 105^0C in oven.For Ash free dry weight biomass, the same sample was further dried at 550^0C in a muffle furnace and biomass was measured. The estimation of the standing detritus associated with one meter square substratum up to a depth of approximately 15cm. was done. In the laboratory,

detritus was oven dried to constant weight (at 70^0 C). The final values were expressed in gram Dry weight/m^2.

Results and Discussion

The seasonal values of physico-chemical parameters in the Eastern Nayar are presented in the Table1 and the data relating to epilithic periphyton and detritus is presented in the Table 2.

Water temperature and current velocity are two important physical factors that affect the entire ecology of a lotic system.River Eastern Nayar had a moderate water temperature round the year due to its spring-fed nature of origin. It was maximum 24. 07 $\pm$ 3.89^0C during the monsoon months (June-August) and was minimum 11.45 $\pm$ 2.43^0 C during winter. The velocity or water current was also not too high if we compare it with the other hillstreams like Bhagirathi, Alaknanda and the Mandakini. It was due to less gradient in the stream during its course downwards. A maximum velocity was recorded as 0.563 $\pm$ 0.194 m/sec during monsoon and the minimum was 0.33 $\pm$ 0.05 m/sec in the Winter-Autumn. Due to moderateness in these two important physical parameters, the stream becomes conducive for the growth of periphyton as well as the detritus. And because the marcozoobenthos and fish feed on them, the entire productivity of the stream is positively affected. This observation lends support to Dobriyal and Singh (1988) and Dobriyal *et al.* (2002). River Mandakini, a glacier-fed river was studied by Negi (1998) who reported that due to low water temperature and high velocity of water current the river was less productive in comparison to the spring-fed streams.

The dissolved oxygen contents were quite high in the stream due to primary productivity activities of the periphyton (Dobriyal, 2003)and clarity of water due to less anthropogenic activities. It was recorded as high as 11.35 $\pm$ 0.33 in the winters when the respiratory activity of the biota also ceases due to less bacterial activities. It was lowest 9.15 $\pm$ 0.72 in the monsoon due to influx of organic and inorganic ion into the stream along with the flash flood. The alkalinity and pH values of the stream were high during winter (36.45 $\pm$ 3.49 ppm and 8.0 $\pm$ 0.21 respectively), which can be correlated with the high growth of algae during this period. The lowest values were recorded obviously in monsoon (25.25 $\pm$ 4.39ppm and 7.43 $\pm$ 0.18) due to rains being normally acidic in nature.

The quantitative study of periphytic algae indicated that it was observed seasonally maximum (124.0 $\pm$ 11.30 units/cm^2) in winter and minimum (24.0 $\pm$ 41.57 units/cm^2)in monsoon. The algal biomass was observed maximum 0.26 $\pm$ 0.03 mg/cm^2 (DW) and 0.126 $\pm$ 0.015 mgC/cm^2 (APDW) in winter and minimum 0.053 $\pm$ 0.092 mg/cm^2 (DW) and 0.026 $\pm$ 0.046 mgC/cm^2 (AFDW) in the monsoon. The detritus (standing stock) was observed maximum 13.96 $\pm$ 1.38 g DW/m^2 in winter and minimum 1.06 $\pm$ 1.84 g DW/m^2in monsoon 1996.

The algal biomass and detritus forms are important component of the stream ecology as the macrozoobenthos as well as fish feed on it. According to Welcomme (1985) in rhithronic waters where phytoplankton is virtually absent, the production of periphytic algae and submerged vegetation is very important. The longitudinal study of river indicated that the algal biomass was high at the lower spot (Dangal) of the stream (142 units/ cm^2, dry weight 0.3 mg/cm^2, and AFDW-0.14 mgC/cm^2) in relation to the upper spot (Thalisain-126 units/cm^2dry weight 0.26 mg/cm^2 and AFDW 0.14 mgC/cm^2).which can be correlated to the heterogeneity and stability of the substraum.

The detritus standing stock was also observed high at lower spot. i.e. (10.54 $\pm$ 6.33 g DW/m^2) at Dangal in comparison to the upper one i. e., (6.25 $\pm$ 4.39 gDW/m^2) Thalisain.

Qualitative study on the periphytic algae indicated that the algal carpet of periphytic algae was mostly of the *Cladophora ,Spirogyra, Ulothrix,Hydrodictyon, Zygnema* (all chlorophyceae) and the diatoms like *Synedra, Diatoma, Navicula, Cymbella, Tabellaria, Gomphonema, Fragilaria* and *Nitzschia*, etc. The detritus standing stock was contributed by the dried twigs and leaves of the riperian vegetation at the bank of stream, mainly the herbs, shrubs and trees of Quercus and Pinus etc. The fish observed in the stream were mainly the omnivore *(Tor tor, Tor putitora, Nemacheilus sps, Barilius sps.* etc) detritovore (*Tor chilinoides)* and the herbivore (*Garra sps, Crossocheilus sps*).

References

APHA. 1976 *Standard methods for the examination of water and wastewater.* 14th edition. Am. Public Health Assoc. Washington, D.C.

Dobriyal, A. K. 2003. Structure and function of an ecosystem with special reference to river Nayar, *National symposium on ecology and aquatic biodiverstiy* (SEBAE), 15-17 February, 2003 extended Abstract No. 86: pp 1-4.

Dobriyal, A.K., Balodi, V. P., Kumar, N. and Bisht, M.S. 2002. An appraisal of the fishery potential of river Nayar with a note on its improvement possibilities.*Coldwater fish genetic resources and their conservation*. Nature Conservator Publication No. 7 pp. 235-242.

Dobriyal, A.K.and Singh, H. R.1988. Ecological basis for the ichthyofaunal variation in two hillstreams of Garhwal Himalaya.In M. Mohan Joseph (Ed.) *The First Indian Fisheries Forum proceedings*. Asian Fishery Society. Indian Branch pp. 313-317.

Negi, K. S. 1998. Some aspects of fish biology of *Crossocheilus latius latius* (Ham.) correlated with its riverine Environment.

Welch, P.S. 1948. *Limnological Methods*, Mc Graw Hill. New York.

Welcomme, R.L. 1985. *River Fisheries*. F.A.O. Fisheries Technical Paper 262 Rome. pp. 325.

Table 1: Seasonal variations in Physico-chemical Parameters of the Eastern Nayar during 1996. (Average of spot No.1 (Thalisain)and spot No.2(Satpuli)

Parameters	Season			
	Winter	**Summer**	**Monsoon**	**Autumn**
Water Temp (^{0}C)	11.45 ± 2.43	19.85 ± 4.67	24.07 ± 3.89	16.3 ± 5.44
Velocity (m/sec)	0.33 ± 0.059	0.40 ± 0.112	0.563 ± 0.194	0.33 ± 0.056
Turbidity (NTU)	7.7±1.79	9.90 ± 1.14	59.87 ± 42.96	22.4 ± 14.91
pH	8.0 ± 0.209	7.75 ± 0.104	7.43 ± 0.175	7.77 ± 0.233
Total Hardness (PPM)	75.23 ± 1.62	69.48 ± 4.36	72.25 ± 9.99	73.32 ± 2.57
DO (ppm)	11.35 ± 0.33	10.55 ± 0.28	9.15 ± 0.72	10.62 ± 0.28
Free CO_2 (ppm)	NIL	NIL	1.43 ± 0.79	0.085 ± 0.134
Total Alkalinity (ppm)	36.45 ± 3.49	31.8 ± 5.07	25.52 ± 4.39	35.75 ± 4.08
Nitrates (ppm)	0.037 ± 0.004	0.048 ± 0.015	0.073 ± 0.010	0.055 ± 0.008
Phosphates (ppm)	0.024 ± 0.005	0.030 ± 0.007	0.041 ± 0.009	0.037 ± 0.004

Table 2: Seasonal values of Periphytic algae and its biomass, and Detrius (Standing stock) in g DW/m2 in the upper stretches of Eastern Nayar during 1996.

Season	Periphytic Algae	Bio-mass		Seasonal value of detritus standingstock
	Units/cm2	Dry-weight mg/cm2	AFDW mgC/cm2	gDW/m
Winter	124.00±11.30	0.20± 0.03	0.126± 0.002	13.96± 1.38
Summer	92.67± 11.5	0.19 ±0.02	0.096± 0.011	7.29± 2.3
Monsoon	24.00± 41.57	0.053± 0.092	0.026± 0.046	1.06± 1.84
Autumn	62.00± 33.87	0.133± 0.068	0.067± 0.038	11.27± 2.20