J. Mountain Res. ISSN: 0974-3030
Vol. 12, (2017) 73-79

Studies on the periphyton density, diversity and physico-chemical parameters of Lastar Gad stream in district Rudraprayag from India

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Received: 25.09.2017; Revised: 25.10.2017; Accepted: 10.12.2017

Abstract: The present study deals with the study of physico-chemical characteristics and the periphytic algal community of the Lastar Gad stream in district Rudraprayag, state Uttarakhand, India. During the investigation it was found that the periphytic algal community of Lastar Gad stream was represented by 27 taxa belonging to 3 major class namely Bacillariophyceae (*Gomphonema, Navicula, Nitzchia, Fragilaria, Cymbella, Synedra, Achnanthes, Amphora, Bacillaria, Diatoma, Epithemia, Tabellaria etc*), Chlorophyceae (*Cladophora, Oedogonium*, *Spirogyra* sp., *Cosmarium* sp., *Closterium* sp., *Geminela* sp., *Microspora* sp., *Volvox* sp., *Zygenema* sp. *and Ulothrix* sp.) and Cyanophyceae (*Phormidium* sp., *Rivularia* sp., *Nostoc* sp., *Calothrix* sp. and *Anabeana* sp.)

Keywords: Periphyton • physico-chemical • ecology • Himalayas

Introduction

Primary producer form the active foundation of the majority ecosystems. Periphyton refers to the entire slimy coating complex of attached aquatic biota on submerged substrates, including non-attached organisms and detritus (Van Dam et al., 2002). The community comprised of variable proportions of algae, fungi and bacteria as well as organic matter entrained from stream flow. Periphyton is a basic component of the stream ecosystem purifying waters by absorption of metal and nutrients. They are a significant component of the food resource to the stream food web. Periphyton community is highly responsive to degradation of water quality. Broadly, climate, geology and human activity dictate their morphology and hydrology. Biological production in any aquatic body gives direct correlation with its physico-chemical status which can be used as trophic status.

A few scattered reports on some Periphyton community, geological and limnological aspects of the springs of the Himalayas in India and abroad are available (Reisen, 1976; Saha et al., 1978; Qadri and Yousuf, 1979, 1988; Dobriyal et al., 1999; Bhatt and Yousuf, 2002; Bhat and Pandit, 2011; Chauhan and Sharma, 2015; Chettri and Thapa, 2016; Koshal et al., 2016). Still, work on in-depth study of biodiversity and physico-chemical stability of springs of Garhwal Himalayas is trivial. Considering these facts the present study on the periphytonic community of streams of Garhwal Himalayas has been undertaken.

Materials and Methods

Lastar is an important spring fed stream originating from the Badhani Taal peak (Latitude 30.49°85′94″ E, Longitude 78.91°94′32″ N) in the Garhwal Himalaya. The physico- Chemical Analysis of 2 sites was done as per standard Method recommended by APHA (2005). Stones of different sized were picked up from the bottom of stream and known area ($1cm^2$) was marked on the stone. The periphyton from the marked area ($1cm^2$) was scrapped with the help of scalpel and brushes and mixed with small amount of water and then labeled into the container. Periphyton sample were preserved in 5% formalin solution. In laboratory, the periphyton were further concentrated in 100ml. The counting was done with the help of Sedgwick-Rafter counting slide using following formula:

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

Where, n = number of units of Periphyton/cm^2.

a = average number of periphyton in a cubic millimeter capacity.

b = Concentration prepared in ml.

Photo micrographic images of phytoplankton were analyzed with the help of Stereo Zoom Trinocular Microscope with Tucsan camera attachment. The identification of the sample was carried with the help of taxonomical works of Prescott (1939a and 1939b); Desikachary (1959); Ward and Whipple (1992).

Result and Discussion

The average physico- chemical parameters of Lastar Gad (spring fed) are presented in Fig.1 to 6. Minimum water temperature was recorded in the month of Feb (12.5 ± 0.14ºC) and maximum in the month of September (21.9 ± 0.36ºC). Mean turbidity was found to be lowest in February (10.5±0.50 NTU) whereas and highest in July (95.0 ±0.70 NTU). Average water velocity continually changed throughout the year with the lowest value in the month of January (0.19±0.08 m s^{-1}) whereas highest value was noticed in the month of July (0.37±0.06 m s^{-1}). Average minimum pH was recorded in the month of August (7.5±0.50) and maximum the month of November (8.5±0.65). Average dissolved oxygen was noticed maximum in the month of February (13.7±0.42 mg l^{-1}) and minimum in the month of October (8.5±0.46 mg l^{-1}). Average total Alkalinity was found to be lowest in the month of February (20.0±1.25 mg l^{-1}) and highest in the month of November (35±1.80 mg l^{-1}).

The mean monthly variations in the density of periphyton recorded for a year from Lastar Gad stream have been presented in the Table 1. The overall mean density of the periphyton was found to be highest number in the month of January (244.0±23.15 units cm^{-2}) and minimum in the month of August (5.1±0.25 Units cm^{-2}). In the present work the annual percentage composition of periphytic flora of Lastar Gad revealed that major contribution was made by Bacillariophyceae (55%) followed by Chlorophyceae (36%) and Myxophyceae (9%) (Fig.7). Bhatt and Yousuf (2002) observed periphytonic community of seven springs of Kashmir and noticed a total of 50 taxa of periphytic algal community of which 33 belonged to Bacillariophyceae, nine to Chlorophyceae, five to Cyanophyceae, two to Chrysophyceae and one to Euglenophyceae. Periphyton species activity is restricted to certain temperature range. Brown and Hannah (2008) stated that temperature is recognized as a major role player for species distribution in spring water. Maximum abundance of periphyton was observed during winter season (November - February) in the Lastar Gad springs, which may be due to increased growth efficiency of periphyton during this period in addition to favorable physico-chemical attributes. Welch (1952) and Dobriyal et al. (1999) suggested that the adverse effect of velocity and turbidity is always due to the blanketing bottom effect of suspended bottom material, which interferes with the photosynthetic activity. Bhatnagar (1971) and Dobriyal et al. (1999) noticed that high turbidity during monsoon floods greatly reduced the light penetration which adversely affected the rate of photosynthesis.

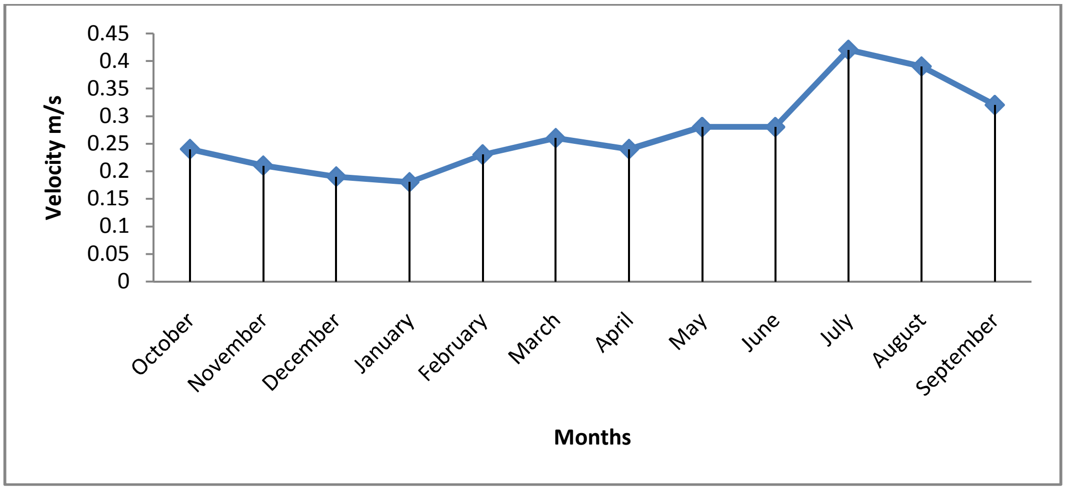

Figure 1 Monthly variation in the average velocity of Lastar Gad stream.

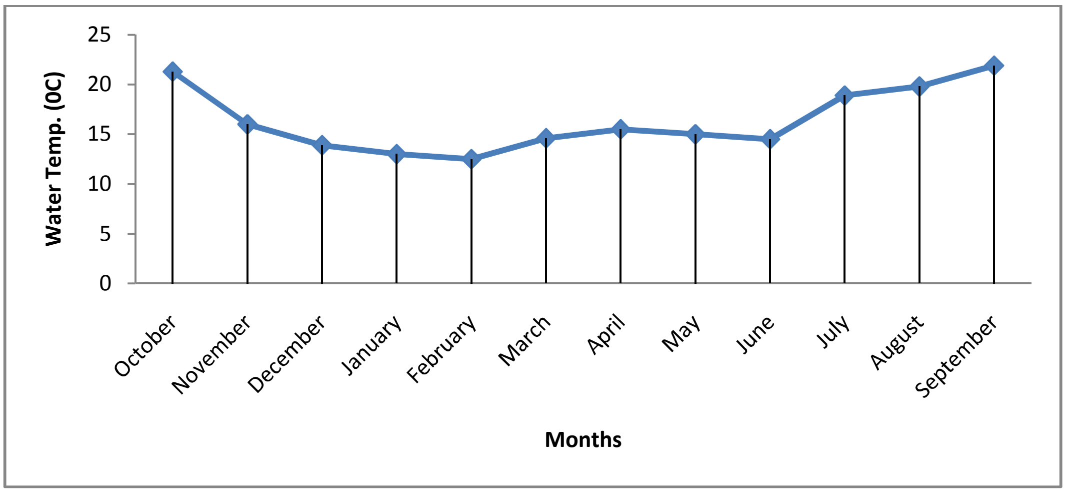

Figure 2 Monthly variation in the averagewater temprature of Lastar Gad stream.

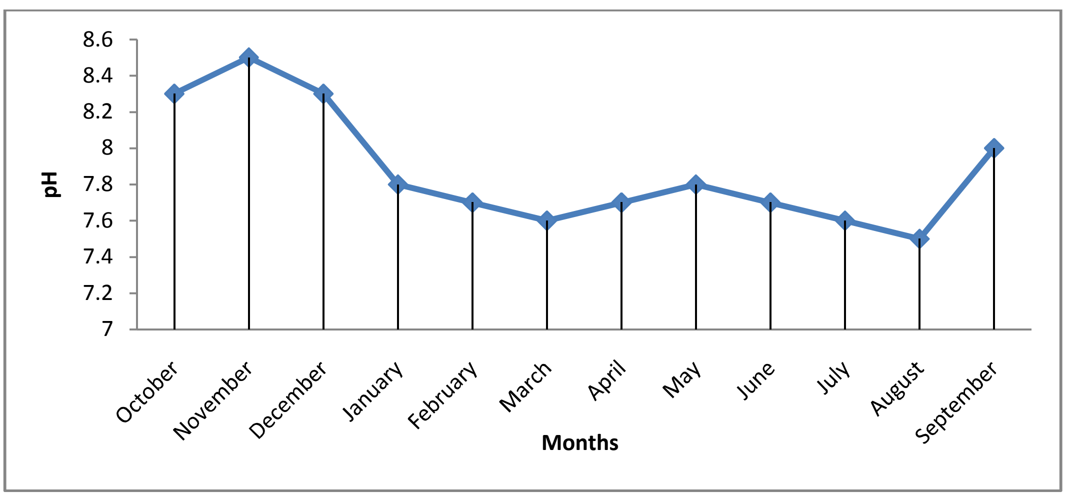

Figure 3 Monthly varaition in the average pH of Lastar Gad stream.

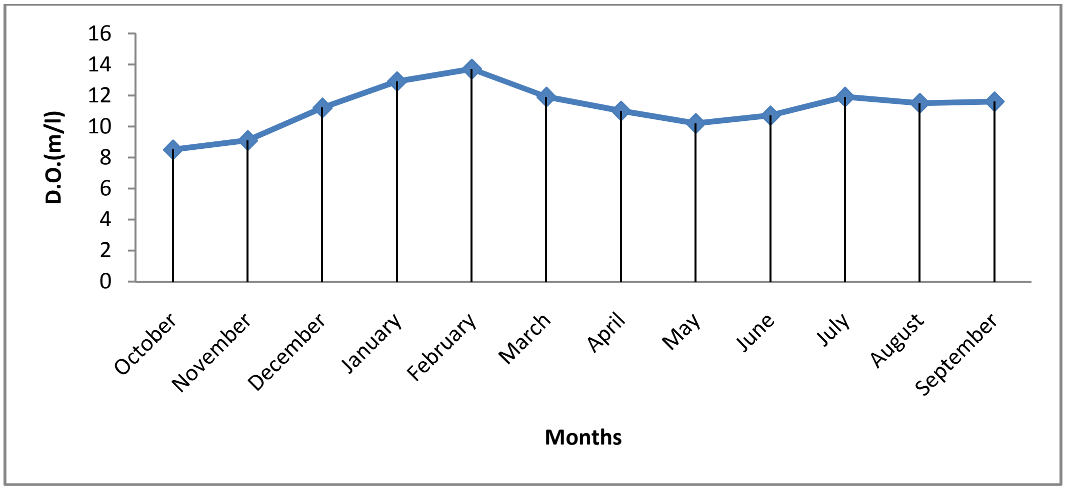

Figure 4 Monthly varaition in the average D.O. of Lastar Gad stream.

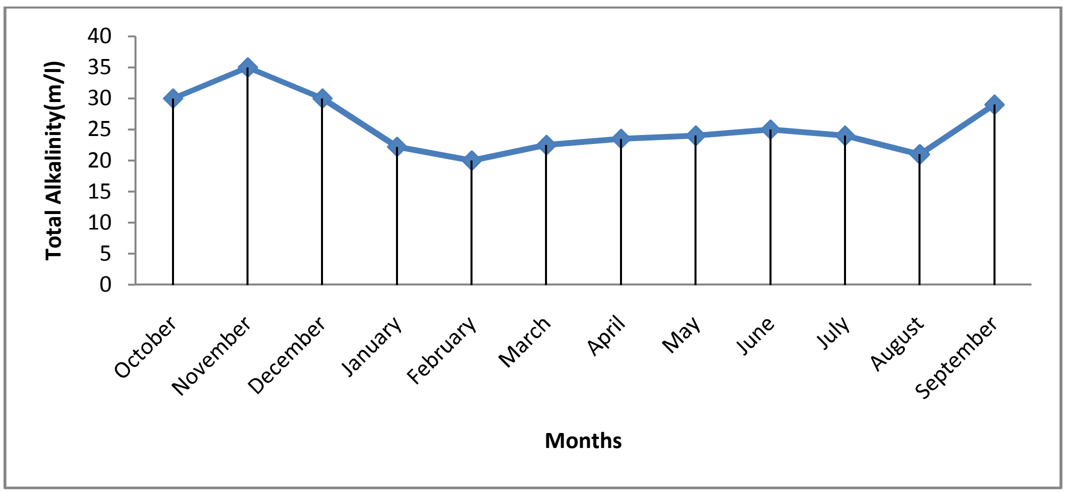

Figure 5 Monthly varaition in the average T.A. of Lastar Gad stream.

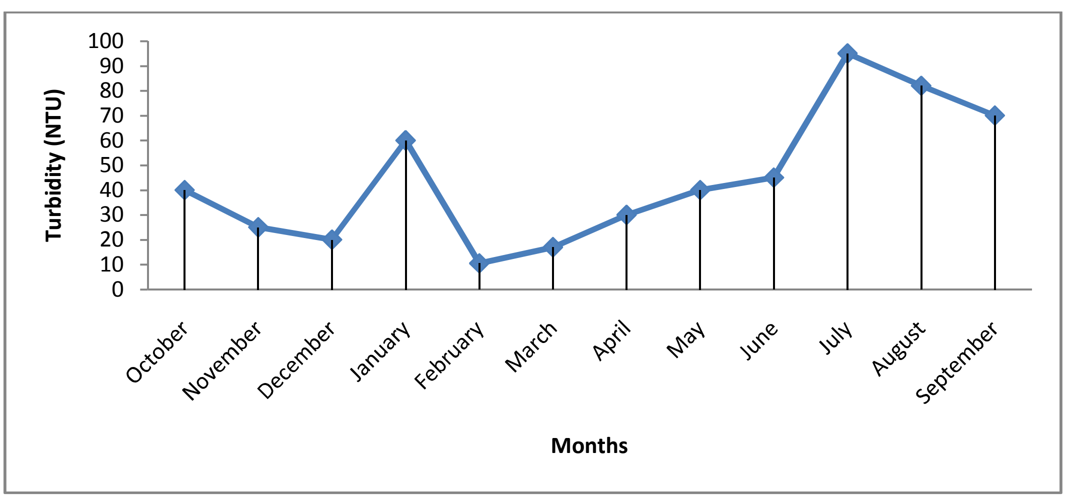

Figure 6 Monthly varaition in the average turbidity of Lastar Gad stream.

Table 1 Monthly variations of periphytic algae of the Lastar Gad streams.

Months	Diatoms	Blue green algae	Green algae	Total numbers of periphyton units/cm^2.
October	59.10±3.70	80.5±5.2	50.2±6.1	189.8±8.25
November	89.72±7.40	37.10±3.9	77.5±5.2	204.3±20.40
December	137.50± 20.4	8.2±2.80	79.5±3.70	225.6±26.45
January	151.3± 8.6	10.7±1.05	82.2±19.5	244.0±23.15
February	126.1±7.4	9.9±0.90	87.9±2.81	233.9±20.18
March	113.7±3.94	4.6±0.58	67.5±6.24	185.8±14.55
April	86.2±3.01	4.21±0.78	69.7±3.75	165.1±13.50
May	81.8±6.2	3.97±0.54	54.8±2.71	140.5±16.24
June	75.9±5.8	3.16±0.74	47.2±6.51	126.2±10.15
July	10.0±2.4	nil	nil	10.0±2.4
August	05.1±0.25	nil	nil	5.1±0.25
September	40.6±3.4	2.1±0.50	27.4±4.75	70.4±3.75

In the present study, density of periphyton was found to be decreasing from February to August. This may be due interaction of various physico-chemical parameters with periphyton. Cantonati et al. (2012) observed that the hydrological factors particularly flow permanence, water chemistry and temperature are important ecological factors determining species distribution and community composition of periphyton. Cantonati (1998) also suggested that among various environmental factors, pH and conductivity are the most important factors influencing diatom assemblages.

When compared to structurally simple substrates, such as a sand and bedrock, the physical substrate types (leaves, gravel, wood and macrophytes) generally support more diversity (Angradi, 1996; Hawkins, 1984). This can be a good explanation for the high abundance and diversity of periphyton at sampling stream Laster Gad, which has high macrophyte growth. The highest number of periphytic concentration was noticed in the month of January (244.00± 23.15 units cm^{-2}) which was attributed to diatoms (151.3±8.6 units cm^{-2}), green algae (82.2±19.5 units cm^{-2}) and blue green algae (10.7±1.05 units cm^{-2}). The lowest number of periphyton was observed in August (5.1±0.25 units cm^{-2}) which was dominated by the diatoms (5.0±2.0 units cm^{-2}).

Table 2 List of periphyton from Lastar Gad streams during study periods.

S. No.	Periphyton	Name
1	Bacillariophyceae	*Gomphonema sp.*
		Navicula sp.
		Nitzchia sp.
		Fragilaria sp.
		Cymbella sp.
		Synedra sp.
		Achnanthes sp.
		Amphora sp.
		Bacillaria sp.
		Diatoma sp.
		Epithemia sp.
		Tabellaria sp.
2	Chlorophyceae	*Cladophora*
		Oedogonium
		Spirogyra sp
		Cosmarium sp
		*Closterium*sp.
		Geminela sp.
		Microspora sp.
		Volvox sp.
		Zygenema sp.
		Ulothrix sp.
3	Cyanophyceae	*Phormidium* sp.
		Rivularia sp.
		Nostoc sp.
		Anabeana sp.
		Calothrix sp.

While, green algae and blue green algae were completely absent due to heavy monsoon period. Algae attached in the fast flowing water should be firmly anchored to hard surfaces. Algal growth on natural substrate like pebbles, stones, leaves and sand etc. represent the natural flora. In the present study of Lastar Gad streams, the submerged macrophytes were not recorded. The Periphyton study was carried out only from submerged stones and pebbles. The distribution of lithophytic algae showed basically three major species groups Bacillariophyceae, Chlorophyceae and Cyanophyceae (Table 2). The order of dominance was Bacillariophyceae > Chlorophyceae > Cyanophyceae. In general, the distribution of lithophytic algae showed Bacillariophyceae as the most dominant group from Lastar stream which constitute the most dominant species group of phytoplankton. The diatoms were mainly represented by the species of *Gomphonema, Navicula, Nitzchia, Fragilaria, Cymbella, Synedra, Achnanthes, Amphora, Bacillaria, Diatoma, Epithemia, Tabellaria,* etc. *Navicula* and *Cymbella* sp. was recorded to be the most dominant species amongst Bacillariophyceae.

Chlorophyceae was mainly represented by *Cladophora, Oedogonium*, *Spirogyra* sp., *Cosmarium* sp., *Closterium* sp., *Geminela* sp., *Microspora* sp., *Volvox* sp., *Zygenema* sp. and *Ulothrix* sp. *Spirogyra* sp. was found to be the most dominant species at sampling sites. Blue greens were noted as the third but least dominant group represented by 5 taxa. Species of *Phormidium* sp., *Rivularia* sp., *Nostoc* sp., *Calothrix* sp. and *Anabeana* was recorded in good number. Periphyton communities respond not only to natural change in the stream, but may also present variations as consequences of human intervention affecting water body, either directly or through activities carried out in the immediate catchment on whole. The primary conclusion based on the present study showed that the stream is having crystal clear water, and are free from pollution as Chlorophyceae are better represented. Further as a result of less anthropogenic pressure the quality of water is fairly good.

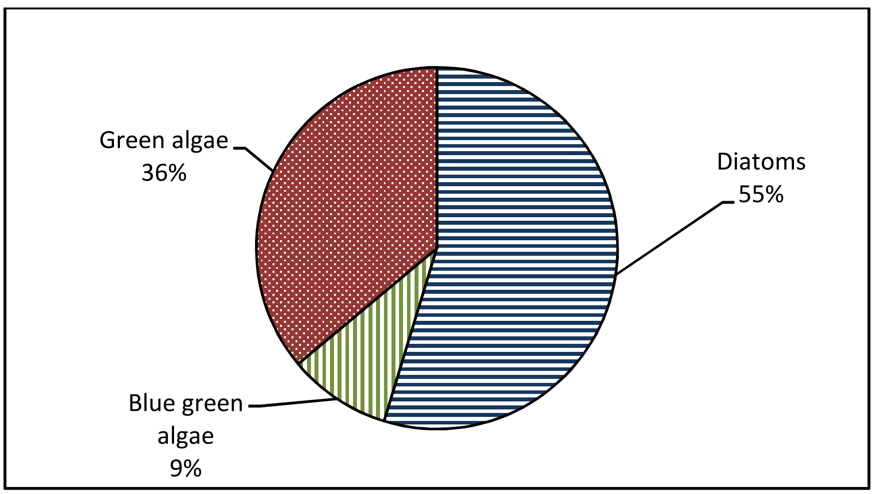

Figure 7 Percentage distribution of periphyton in Lastar Gad stream.

References

APHA (2005) Standard methods for the examination of water and waste water. 21st edition New York: American Public Health Association. pp. 11-41.

Angradi TR (1996) Inter-habitat variations in benthic community structure function and organic matter storage in 3 Appalachian headwater streams. *J. Am. Benthos. Soc.* 15: 42-63.

Bhat SU and Pandit AK (2011) Limnochemistry of three freshwater springs of Kashmir Himalaya. *Hydro Nepal J. Wat. Energy Env.* 7: 54-59.

Bhatnagar GP (1971) Primary organic production and chlorophyll in Kille backwaters, Port Novo. Proceeding of symposium on emphasis on organic productivity, New Delhi. 351-362.

Bhatt FA and Yousuf AR (2002) Ecology of periphytic community of seven springs of Kashmir. *J. Res. Dev.* 2: 47-59.

Brown LE and Hannah DM (2008) Spatial heterogeneity of water temperature across an alpine river basin. *Hydrol. Process*. 22: 954-967.

Cantonati M (1998) Diatom communities of springs in the Southern Alps. *Diatom Res.* 13: 201-220.

Cantonati M, Fureder L, Gerecke R, Juttner I and Cox EJ (2012) Crenic habitats, hotspots for freshwater biodiversity conservation: toward an understanding of their ecology. *Fresh. Sci.* 31(2): 463-480.

Chauhan A and Sharma RC (2015) Seasonal Variation in Periphytonic Community in Mountain Springs of Sahashradhara, Garhwal Himalaya. *Int. J Reent Sci. Res.* 6(3): 3109-3112.

Chettri D and Thapa MP (2016) Physico-chemical characteristic and periphytic algal communities of river roru-chu, east sikkim, India: a preliminary investigation. *Int. J. Adv. Bio. Res.* 6(1): 85-91.

Desikachary TV (1959) Cyanophyta. ICAR. New Delhi, page. 686.

Dobriyal, AK, Kotnala CB, Kumar N and Balode VP (1999) Density and Primary Productivity of periphyton correlated with physico-Chemical parameters in the Western Nayer of Garhwal, central Himalaya, India. *Adv. Biosci* 18(2): 35-44.

Hawkins CP (1984) Substrate association and longitudinal distribution in species of Ephemerellidae (Ephemeroptera:Insect) from Western Oregon. *Freshw. Invertebr. Biol.* 3 (94): 18-88.

Koshal Kumar, Anita Rawat Rana and Kotnala CB (2016) Water quality and pollution status of Rawasan stream in Garhwal Himalaya, Uttarakhand, India. *J. Mountain Res.* (11): 9-14

Prescott GW (1939a) How to know the fresh water Algae. Brown Co. publishers. 450 Pages.

Prescott GW (1939b) Some relationship of phytoplankton to limnology and aquatic biology. *Publ. Amer. Asso. Adv. Sci*. 10: 65-78.

Qadri MY and Yousuf AR (1979). Physico-chemical features of Beehama Springs. *Geobios.* 6: 212-214.

Qadri MY and Yousuf AR (1988) A comparative study of the limnology of three typical water bodies of Kashmir.. In: *Recent Advances in Fish Ecology, Limnology and Eco-conservation* S. Nath (Ed.). Creative Publishers, New Delhi. pp 79-89.

Reisen WK (1976) The ecology of Hoey Creek: Temporal patterns of the travertine periphyton and selected physicochemical parameters, and *Myriophyllum* community productivity. *Proc. Okla. Acad. Sci.* 56: 69-74.

Saha SK, Datta M, Jayashree and Sarkar HL(1978) Limnobiotic survey of thermal springs of Bhimbundh. *Geobios.* 5(5): 205-207.

Van Dam AA, Beverigde MCM, Azim ME, Vergegem MCJ (2002)The potential of fish production based on periphyton. *Rev. Fish Biol. Fish.*12: 1-31.

Ward HB and Whipple GC (1992) *Freshwater Biology* .New York; John Wiley and Sons. 1243 Pages.

Welch, P.S. (1952). Limnology Mc Graw-Hill Book Company, New York. 381 Pages.

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