*The Scientific Temper*
Vol. XI, No 1-2, January-July, 2020
ISSN 0976 8653, E-ISSN 2231 6396
A Web of Science Journal
**Doc ID:** https://connectjournals.com/03960.2020.11.81

# Periphyton Community Structure of the Spring-fed Foot-hill Stream Tamsa Nadi from Doon Valley, Uttarakhand, India

**Pratibha Baluni[1], Pankaj Bahuguna[2], Rajani[3], Rajesh Rayal[3*] and Nikhil Singh Kahera[3]**

[1]*Department of Botany, S.D.M. Govt. P.G. College Dehradun-248001, Uttarakhand, India.*
[2]*Aquatic Biodiversity Lab, Department of Zoology, B.D. Govt. P.G. College Jaiharikhal-246193, Uttarakhand, India.*
[3]*Department of Zoology, School of Basic and Applied Sciences, SGRR University, Patel Nagar, Dehradun-248001, Uttarakhand, India.*
**Corresponding author: drrajeshrayal@gmail.com; mundephiranji@gmail.com*

## ABSTRACT

The periphyton diversity of the spring-fed foothill stream Tamsa Nadi from Doon Valley, Uttarakhand, India was studied during March 2020 to February 2021. The outcome of the present study was that 29 different genera of periphyton, of which 49% belonged to Bacillariophyceae, 37% to Chlorophyceae, 9% to Myxophyceae and 5% to Copepoda class. It was found that the periphyton diversity in Tamsa River, 29 genera were observed in Upper stretch, 23 in middle stretch and 16 in lower stretch. Bacillariophyceae was the most dominant group of periphyton observed in all the seasons and from all upper, middle and lower stretch from Tamsa stream.

**Keywords:** Periphyton, Tamsa Nadi, Spring-fed stream, Doon Valley, Uttarakhand.

## INTRODUCTION

Periphyton in the foothill spring-fed stream form an important component of the aquatic environment, providing food and shelter for micro-macrozoobenthos (Dobriyal, et.al, 1991, 2002, 2009, 2011; Bahuguna and Negi, 2018; Bahuguna *et al*., 2019) and fish (Bahuguna and Baluni, 2019). Fragmentary studies involving Periphyton density and diversity development on the basis of riparian vegetation have been conducted (Sager et.al, 2018; Baluni and Chandola, 2019). Periphyton growth can be light and nutrient restricted and it is directly affected by temperature (Dobriyal *et al*., 1999). Periphyton community is characterized by a very speedy recovery from the hostile physical condition such as High stream velocities or high turbidity levels to which it is recurrently subjected. According to Biggs and Kilroy (2004), the periphyton community can be spatially complex and temporally variable depending on a wide range of environmental and biological factors. In streams, several factors influence periphyton diversity (a) nutrients (Biggs and close 1989), (b) light (DeNicola *et al*., 1992), (c) temperature (DeNicola 1996, Baluni *et al*., 2017, 2018; Baluni, 2020), (d) current velocity (Dobriyal *et al*., 1999; Baluni, 2020) (e) physical disturbance (Dobriyal and Kotnala, 1993), (f) substrate type (Murdock and Dodds 2007), (g) competition (Stevenson *et al*., 1991) and (h) invertebrate grazing (Peterson *et al*., 2001).

Periphyton are the primary producers in the hill-streams; they play an integral role in the aquatic food chain particularly for hill streams where the number of plankton is comparatively lesser due to fast-flowing water current, slopes as well as low nutrient content. Periphyton communities commonly prefer littoral areas of aquatic ecosystems owing to the easy availability of hard surfaces and sunlight (Baluni *et al*., 2021).

Periphyton diversity and distribution in relation to stream physicochemical parameters have a huge impact on the occurrence of several mites (Bahuguna et.al, 2020; Vladimir *et al*., 2019a,b; 2020a,b; Negi *et al*., 2021), macrozoobenthos (Kumar and Dobriyal, 1999; Rautela *et al*., 2006; Bahuguna and Dobriyal, 2018; Mamgain *et al*., 2021; ) and drifting behavior of invertebrates (Bahuguna *et al*., 2019; Bahuguna and Dobriyal, 2020; Negi *et al*., 2021) and on fish diversity (Bahuguna et.al, 2010; Bahuguna and

Joshi, 2012; Bahuguna 2020, 2021; Rayal *et al*., 2021 ).

Information regarding periphyton distribution in Indian rivers is meagre in contrast to lakes and reservoirs (Singh *et al*., 1982; Dobriyal *et al*., 1985; Dobriyal 1985; Dobriyal and Singh *et al*., 1989; Dobriyal *et al*., 1993; Dobriyal *et al*., 2005; Sagir and Dobriyal 2020 and Baluni *et al*., 2021). The present communication is an effort to scrutinize the diversity of periphyton communities of Tamsa Nadi, a perennial foot-hill stream of Dehradun-district of Uttarakhand, India.

## MATERIALS AND METHODS

### Sampling Area

The current study was carried out from March 2020 to February 2021. Tamsa Nadi which is a spring-fed foot-hill stream is located in the North-Eastern part of the Doon Valley between 30°21'25.84"N Latitude and 78°01'00.45"E Longitude. It is also a tributary of the Tons River.

Stones of different sizes were picked up from the bottom of the stream and a known area (1cm$^2$) was marked on the stone. The periphyton from the marked area (1cm$^2$) was scrapped with the help of a scalpel and brushes and mixed with a small amount of distilled water and then labeled into the glass vial. Periphyton samples were preserved in 5% formalin solution. In the laboratory, 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 periphyton were analyzed with the help of a Stereo Zoom Trinocular Microscope with Tucsan camera attachment. The identification of the periphyton sample was carried with the help of stranded keys Prescott 1939a,b; (Desikachary, 1959; Ward and Whipple,1999).

## RESULT

### Periphyton composition

During the present study, 29 different genera of periphyton were observed belonging to 4 classes: Bacillariophyceae, Chlorophyceae, Myxophyceae and Copepoda. In the present study, we observed that, Bacillariophyceae dominated the periphyton biomass of Tamsa Nadi spring-fed foot-hill stream (49%) followed by Chlorophyceae (37%), Myxophyceae (9%) and Animal community (5%). Periphyton composition of Tamsa Nadi stream is displayed in Fig. 1.

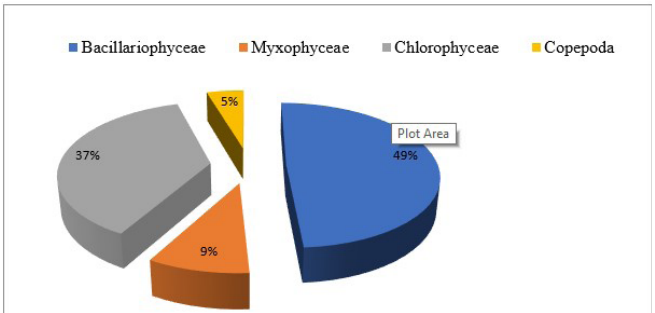


**Fig.1: Percentage of periphyton in Tamsa Nadi.**

### Periphyton diversity

Periphyton diversity at Tamsa Nadi spring-fed foot-hill stream from Doon Valley are presented in Table 1. In the present work, the stream was divided into three sections (a) Upper stretch (b) Middle stretch and (c) Lower stretch.

**Table 1: Periphyton diversity at Tamsa Nadi spring-fed foot-hill stream from Doon Valley.**

| S. No. | Periphyton Diversity | Upper Stretch | Middle Stretch | Lower Stretch |
|---|---|---|---|---|
| ***Chlorophyceae*** | | | | |
| 1 | *Cladophora* sp. | + | + | + |
| 2 | *Oedogonium* sp. | + | + | + |
| 3 | *Spirogyra* sp. | + | + | + |
| 4 | *Cosmorium* sp. | + | + | - |
| 5 | *Clasteruim* sp. | + | + | + |
| 6 | *Geminela* sp. | + | + | - |
| 7 | *Microspora* sp. | + | + | + |
| 8 | *Volvax* sp. | + | - | - |
| 9 | *Zygenema* sp. | + | + | + |
| 10 | *Ulothrix* sp. | + | + | + |
| 11 | *Chaetophora* sp. | + | - | - |
| 12 | *Characium* sp. | + | - | - |
| | Total | 12 | 09 | 07 |
| ***Bacillariophyceae*** | | | | |
| 1 | *Bacillaria* sp. | + | + | + |
| 2 | *Diatoma* sp. | + | + | + |
| 3 | *Fragilaria* sp. | + | + | + |
| 4 | *Navicula* sp. | + | + | + |
| 5 | *Nitzschia* sp. | + | + | + |
| 6 | *Synedra* sp. | + | + | + |
| 7 | *Tabellaria* sp. | + | + | + |
| 8 | *Gomphonema* sp. | + | + | + |
| 9 | *Melosira* sp. | + | - | - |
| 10 | *Pinnularia* sp. | + | + | - |

| S. No. | Periphyton Diversity | Upper Stretch | Middle Stretch | Lower Stretch |
|---|---|---|---|---|
| 11 | *Amphora* sp. | + | + | - |
| 12 | *Cyclotella* sp. | + | + | - |
| 13 | *Rhopalodia* sp. | + | - | - |
| | Total | 13 | 11 | 08 |
| ***Myxophyceae*** | | | | |
| 1 | *Rivularia* sp. | + | + | |
| 2 | *Oscillatori* sp. | + | | |
| 3 | *Nostoc* sp. | + | + | + |
| | Total | 03 | 02 | 01 |
| **Copepoda** | | | | |
| **1** | *Cyclops* sp. | - | + | - |
| | **Total** | 0 | 1 | 0 |
| Total no. of periphyton species | | 28 | 23 | 16 |

### a) Chlorophyceae

Chlorophyceae were represented by 12 genera in upper stretch (*Cladophora sp., Oedogonium sp., Spirogyra sp., Cosmorium sp., Clasteruim sp., Geminela sp., Microspora sp., Volvox sp., Zygenema sp., Ulothrix sp., Chaetophora sp., Characium sp.*). In the middle stretch, 9 genera belonging to Chlorophyceae (*Cladophora sp., Oedogonium sp., Spirogyra sp., Cosmorium sp., Clasteruim sp., Geminela sp., Microspora sp., Zygenema sp., Ulothrix sp., Chaetophora sp.*) were noticed. In lower stretch, 07 genera were collected (*Cladophora sp., Oedogonium sp.., Spirogyra sp., Clasteruim sp., Microspora sp., Zygenema sp., Ulothrix sp*.)

### b) Bacillariophyceae

Bacillariophyceae were represented by 13 genera in the upper stretch of Tamsa stream (*Bacillaria sp., Diatoma sp., Fragilaria sp., Navicula sp,. Nitzschia sp., Synedra sp., Tabellaria sp., Gomphonema sp., Melosira sp., Pinnularia sp., Amphora sp., Cyclotella sp., Rhopalodia sp*.). 11 genera (*Bacillaria sp., Diatoma sp., Fragilaria sp., Navicula sp., Nitzschia sp.. Synedra sp., Tabellaria sp., Gomphonema sp., Pinnularia sp., Amphora sp., Cyclotella sp.*) were obtained from middle stretch whereas 08 genera (*Bacillaria sp., Diatoma sp., Fragilaria sp, Navicula sp. Nitzschia sp., Synedra sp., Tabellaria sp., Gomphonema sp.,*) were noted from the lower stretch of Tamsa stream.

### c) Myxophyceae

Myxophyceae were represented by 03 genera in upper stretch of Tamsa stream (*Rivularia sp., Oscillatori sp., Nostoc sp.*). 02 genera (*Rivularia sp., Nostoc sp.*) were available in middle stretch however only 01 genera (*Nostoc sp.*) was noted from the lower stretch of Tamsa stream.

### d) Copepoda

In the present work, Copepoda were represented by 01genera (*Cyclops sp.*) in middle stretch only.

## DISCUSSION

Periphyton diversity is less in the lotic ecosystem of hill streams due to high water velocity and the absence of old leafs or logs for its attachment. In the present investigation, it was found that periphyton diversity in Tamsa stream, 29 genera were observed in Upper stretch, 23 in the middle and 16 genera noted from the lower stretch.

Bacillariophyceae evolved as the most dominant group of periphyton in all the seasons and from upper, middle and lower stretch from Tamsa stream. Gurumayum *et al*., (2000), Daimari (2003), Liang and Li (2008), Singh and Das (2009), Baluni *et al*., 2017, 2018 and Baluni (2020) also reported dominance of Bacillariophyceae in periphyton count. According to Hynes (1970), factors that influence the growth of periphyton population are light, temperature, water current, substrate, scoring effect of floods, water chemistry and grazing. The influence of light on periphyton distribution is considerable.

In the present study, it was observed that by the end of monsoon, when river water is very clear and light intensity reached up to stream bed due to swallow depth. Bacillariophyceae, genera showed greatest diversity in the all three stretches (Upper, Middle and lower). At all three sites, the average percentage of Bacillariophyceae was calculated to be 49%, Chlorophyceae 37%, Myxophyceae 9% and Copepoda 5%.

It was observed that during monsoon the periphyton population was lowest which may be due to fact that the surface destruction by monsoon rain or flood leads to deposition of silt particles on the foot-hill stream bed. Lesser diversity of Chlorophyceae and Myxophyceae in periphyton population is a common phenomenon observed by several workers (Daimari, 2003, Baluni *et al*., 2017, 2018).

Stream substrate influences periphyton population and diversity in addition to stability against the high flow (Baluni, 2020). In the present observation, only *Cyclops sp.* animal community was associated with the periphyton attached to the surface of the rocks. Animal community under periphyton was noticed by Gurumayum *et al*. (2000) from the Subansiri river of Arunachal Pradesh.

## CONCLUSION

The overall study of periphyton diversity in the spring fed-hill stream Tamsa Nadi with moderate water current velocity revealed the dominance of Bacillariophyceae in all the three stretches. A total of 29 genera were observed

in the Upper stretch, 23 in middle stretch and 16 in lower stretch.

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