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Microflora and fauna of the river Ganga in pristine conditions of Harsil, India

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ABSTRACT

The present study was conducted to document the flora and fauna from pristine of Harshil. During the study the water temperature at Harsil (31^{0}02'10''N and 78^{0}48'19'' E) was very low (2.5-11.7C ^{0}C) and velocity was very high (0.8-1.5 m/s,) with 0.2-1.5 m river depth. The present study revealed (2017 May to Jan 2020) total 49 taxa (44 flora and 5 fauna). Wherein floral taxa belonged to Bacillariophyceae -28, Chlorophyceae -11, and Myxophyceae-5, while fauna belonged to Rotifera-3 and Protozoa-2. Planktonic abundance at Harsil ranged from 10 ul^{-1}to 360 ul^{-1}and periphytic population ranged between 40µcm^{-2} to 11,150 µcm^{-2}. In the study bacillariophyceae noticed as dominant floral group at Harsil. So climatic changes resulted in occurrence of various planktonic groups, as previously only diatoms were recorded.

Figures : 26 References : 09 Tables : 02
KEY WORDS : Biodiversity, Harsil, Periphyton, Plankton, Pristine conditions, River Ganga

Introduction

The degradation in the mountain due to climate change is affecting the river ecosystem, habitats and the biotic diversity at all trophic levels. Freshwater ecosystem are vulnerable to multiple environmental stressors ,like organic and inorganic pollution, geomorphological alterations, water abstraction, invasive species climate change and scarcity of water as a key stressor, particularly in rivers, they act together producing complex responses[8].The biological receptors also differ in their sensitivities, vulnerabilities and response dynamics to different stressors[5]. The upper Ganga for the practical purpose starts at Gangotri as terrain between Gomukh to Gangotri is devoid of biota due to hostile conditions, referred as no fish zone[7]. River Ganga at Harsil (Latitude 31^{0}02'10''N and longitude 78^{0}48'19' E) is apparently uninfluenced by human interventions except due to road construction, small human settlements, some hotels and guest house, bathing and cremation at a few places. The substrate consists of mature boulders, rocks and pebbles. River water quality can still characterizes as pristine with no fish population. The only organic input to the system is through fallout of forest leaves in the form of lignocelluloses material. Hence, there is an immense need to organise information on the biodiversity and structure of major biotic communities in natural conditions. River Ganga at Harsil Latitude 31^{0}02'10''N and longitude 78^{0}48'19' E) was undertaken to study biodiversity of Ganga in pristine conditions as this stretch of upper Ganga is devoid of various man made activities and any change may be regarded due to changes in climatic conditions only.

Materials and Methods

Samples were collected quarterly from the river Ganga at Harsil, during the period of studies (2017 May to 2020 Jan.). Plankton samples were collected using bolting silk net no. 25 by filtering 50 litres water and fixed in 4 % formalin solution in 50 ml tubes for qualitative and quantitative analysis in the laboratory. Samples of plankton were analyzed using the proposed methodology[9]. Periphyton were collected by scrapping 1cm area of river stone and analysed[2]. Analysis of water quality parameters were performed[1]. For periphytic analysis samples were scrapped from one cm area of stone near river bank at Harsil.

Results and Discussion

Water quality

The water temperature was very low 2.5-11.7 ^{0}C and water velocity was very high 0.8-1.5 ms^{-1} , with 0.2-

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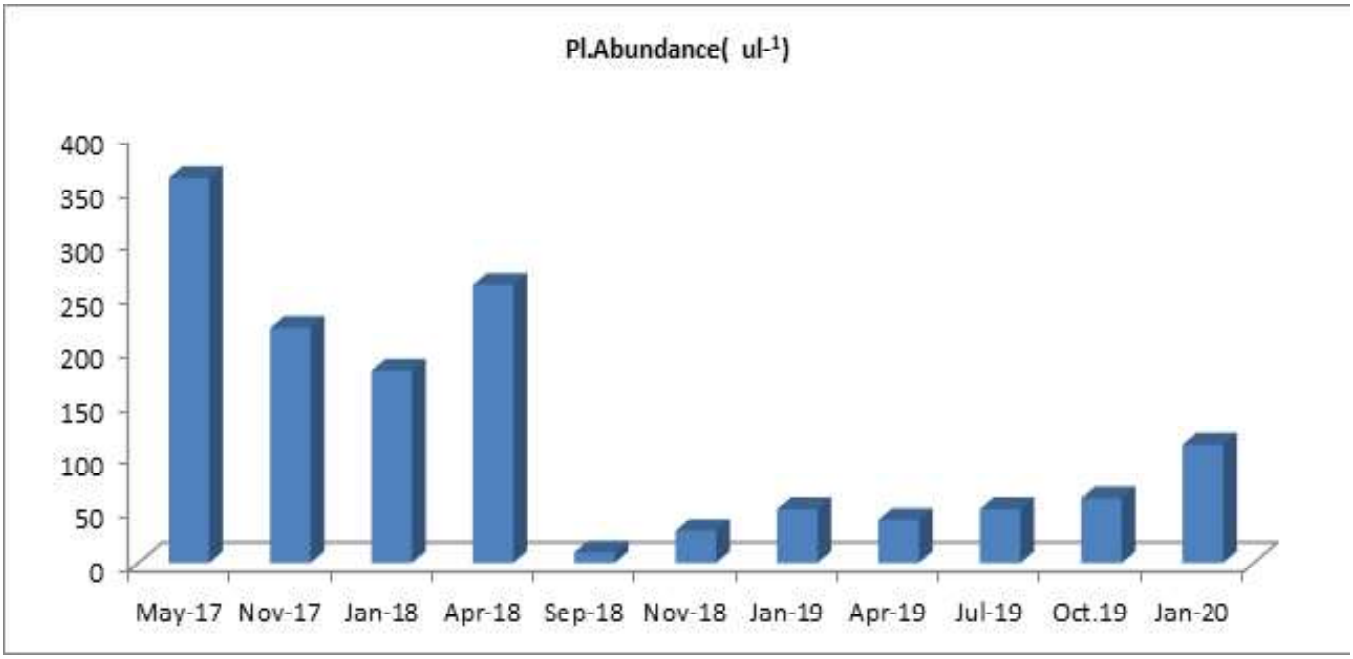


Fig. 1 : Plankton abundance at Harsil.

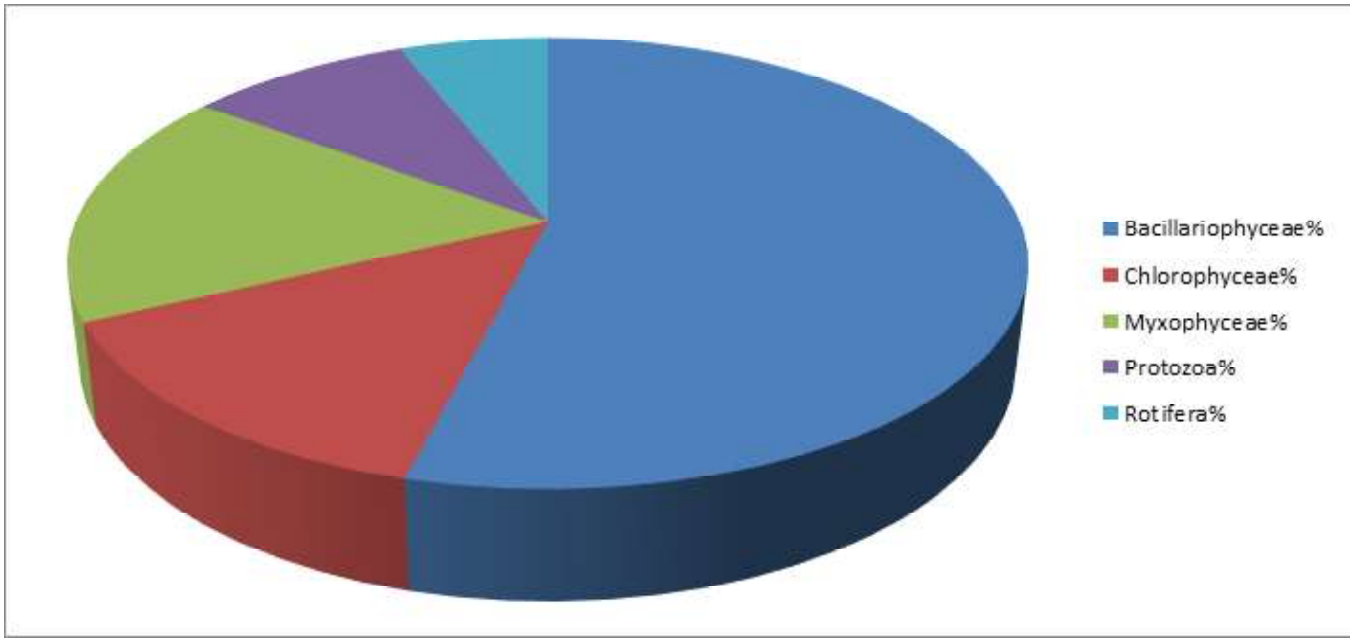


Fig.2 : Plankton composition(%) at Harsil.

1.5 m depth. Total dissolved solids were 79-174 ppm, pH 7.4-9.5, Dissolved Oxygen 8-10.4 ppm and turbidity 35 ppm . Other water quality parameters are presented in Table 1. Increase in temperature and reduction in velocity was noticed as compared to previous studies.

Plankton

Planktonic abundance at Harsil ranged from 10µl^{-1} (September 2018) to 360 µl^{-1} (May 2017).Plankton population were represented by all major algal groups (Figs.1&2) of aquatic ecosystem. Bacillariophyceae dominated during the period of studies and ranged from 44.4 % to 100 %, Chlorophyceae ranged from 7.7% to 27.7%, Myxophyceae from 7.7% to 25%, Protozoa 18% (November 2017) and Rotifera from 2.7% to 9.0%.

Total no. of planktonic taxa recorded were 29 (17 Bacillariophycea, 6 Chlorophyceae, 1 Myxophyceae, 2 Protozoa and 3 Rotifera).Dominant diatoms were *Eunotia , Achnanthes, Diatoma, Tabellaria , Cymbella, Gomphonema* and *Synedra*. Green algae were represented by *Spirogyra, Desmidium, Cosmarium*, Myxophyceae by *Phormidium,* Protozoa by Paramecium and Rotifera by few Keratella, Brachionus and Asplanchna. Some workers[6] recorded mean density of phytoplankton 149 +_ 84 quanta/dm3 with 20 diatom taxa

TABLE-1 : Water quality parameters at Harsil (2017-2020)

Parameters	Range	Parameters	Range
Time period-Year	2017-2020	COD mg O_2/L	3.9-10.5
Latitude	31^{0}02'15"N	TDS (ppm)	79-174
Longitude	78^{0}45'50"E	Turbidity (NTU)	35
Velocity (m/s)	0.8-1.5	Total Alkalinity (ppm)	14-50
Depth (m)	0.2-1.5	Free CO_2	2-5.0
Substratum	Stony	Total Hardness (ppm)	52-120
Air temp (°C)	4.5-18.2	Ca^{++} (ppm)	6.41
Water temp (°C)	2.5-11.7	Mg^{++} (ppm)	8.74
Transparency (cm)	Transparent	Chloride (ppm)	0.5-5.6
Sp. Cond. (µS/cm)	102-268	Avail. Phosphate- (ppm)	0.016-0.251
pH	7.4-9.5	Total Phosphorus (ppm)	0.067-5.5
DO (ppm)	8-10.4	Available Nitrogen (ppm)	0.05-0.274
BOD (ppm) 3 days at 27 °C	0.3-0.9	Total Nitrogen (ppm)	0.274
		Silicate (ppm)	0.08-3.11

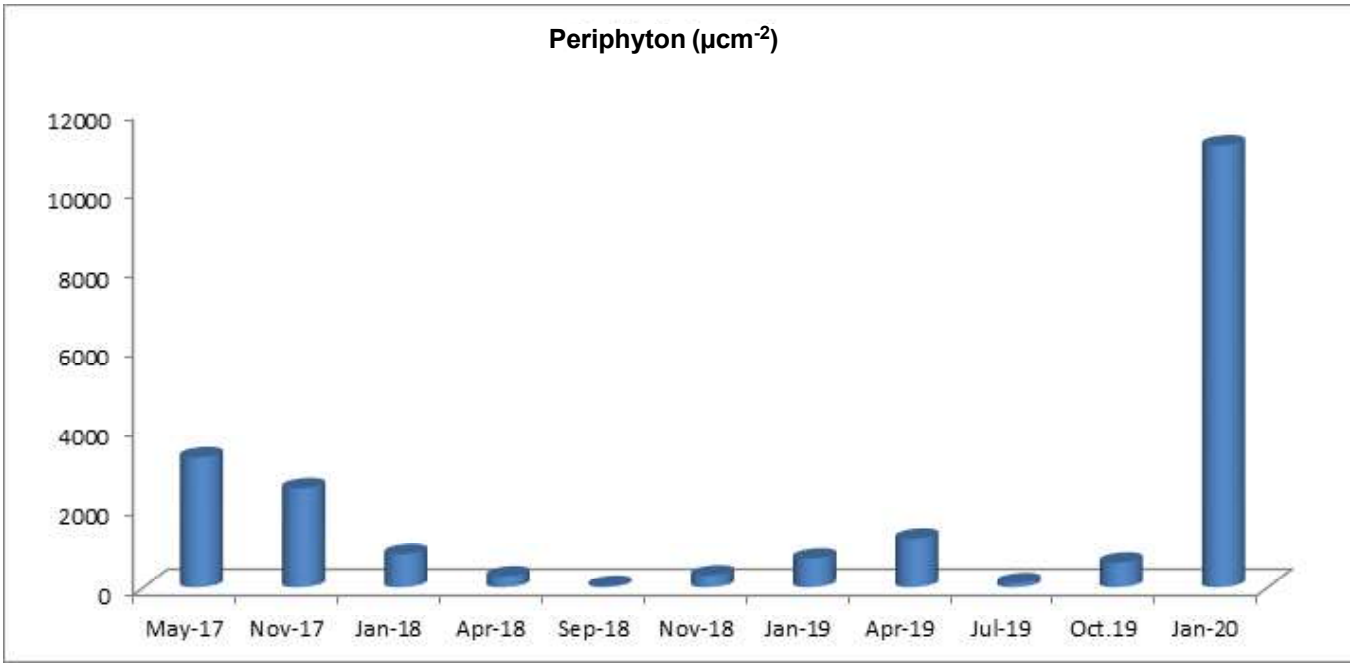


Fig.3. Periphytic abundance (µcm-^{2}) at Harsil.

with 2 taxa of green algae in this stretch. So a slight reduction in diatom flora and increase in green algae was noticed with presence of Myxophyceae, Protozoa and Rotifers.

Periphyton

This can be observed from the Table 1 that periphytic population ranged between 40 µcm-^{2} (September 2018) to 11,150 µcm-^{2} (Jan 2020).Periphyton

TABLE-2. Flora and fauna of Ganga at Harsil in planktonic and periphytic forms

Bacillariophyceae	Planktoic	Periphytic	Chlorophyceae	Planktoic	Periphytic
Cymbella	P	P	*Protococcus*	A	P
Gomphonema	P	P	*Westella*	P	P
Fragilaria	P	P	*Coelestrum*	P	P
Asterionella	P	P	*Ulothrix*	P	P
Tabellaria	P	P	*Sirogonium*	P	A
Meridion	P	P	*Spirogyra*	P	A
Eunotia	P	P	*Ankistrodesmus*	A	P
Navicula	P	P	*Scenedesmus*	P	P
Melosira	P	P	*Crucigenia*	A	P
Cyclotella	P	P	*Chlorella*	A	P
Nitzschia	P	P	*Oedogonium*	A	P
Epithemia	P	P	**Myxophyceae**		
Gyrosigma	P	P	*Oscillatoria*	A	P
Synedra	P	P	*Phormidium*	P	P
Pinnularia	P	P	*Nostoc*	A	P
Amphora	P	P	*Anabaena*	A	P
Diatoma	P	P	*Aphanezomenon*	A	P
Achnanthes	A	P	**Euglenophyceae**		
Tryblionella	A	P	*Euglena*	A	P
Denticula	A	P	*Phacus*	A	P
Hannaea	A	P	**Protozoa**		
Semiorbis	A	P	*Paramoecium*	P	A
Tetracyclus	A	P	*Epistylis*	P	A
Rhoicospheria	A	P	**Rotifera**		
Craticula	A	P	*Brachionus*	P	A
Amphipleura	A	P	*Keratella*	P	A
Placoneis	A	P	*Asplanchna*	P	A
Neidium	A	P			

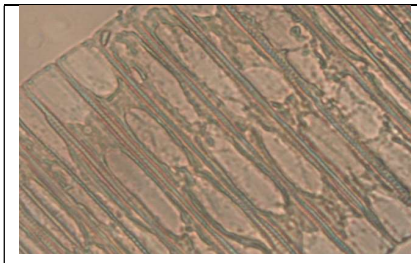
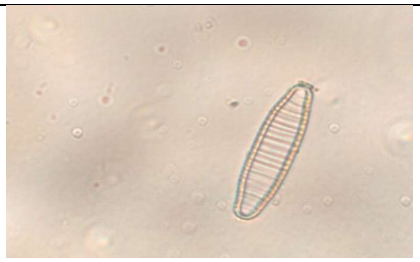
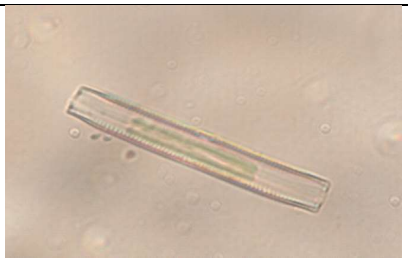
		

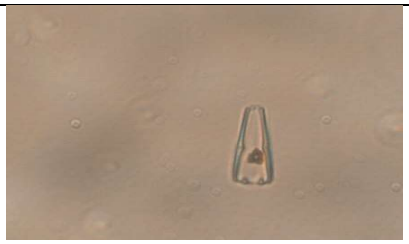
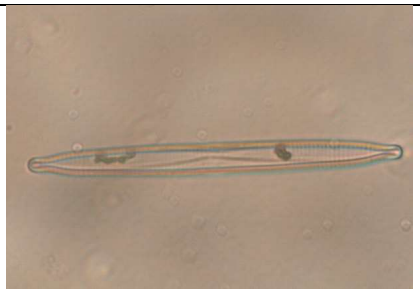
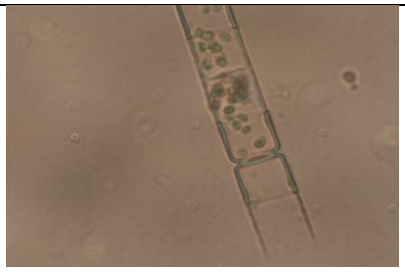
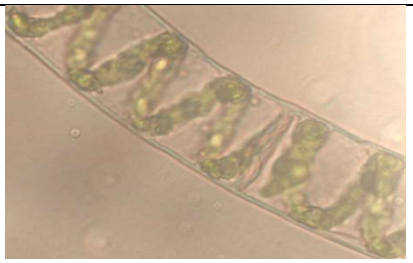
Fig. 4. Diatoma sp 1	*Fig. 5. Diatoma sp 2*	*Fig. 6. Eunotia sp.*
		
Fig. 7. Cymbella sp.	*Fig. 8. Gomphonema sp.*	*Fig. 9. Nitzschia sp.*
		
Fig. 10. Surirella sp.	*Fig. 11. Synedra sp.*	*Fig. 12. Hannaea Sp*
		
Fig. 13. Denticula sp	*Fig. 14. Melosira sp.*	*Fig. 15. Gyrosigma sp.*
		
Fig. 16. Navicula sp.	*Fig. 17. Cymatopleura sp*	*Fig. 18. Spirogyra sp.*

Fig. 19. Desmidium sp.

Fig.20. Cosmarium sp.

Fig.21. Ankistrodesmus sp.

Fig. 22. *Scenedesmus* sp.

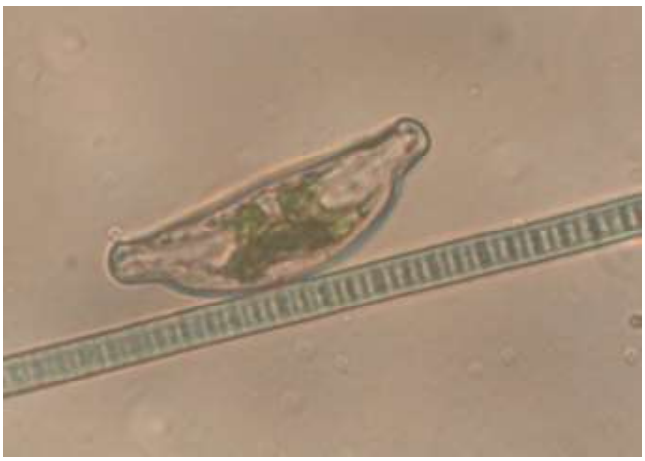


Fig. 23. *Oscillatoria* sp. (Blue green algae)

Zooplanktons

Fig. 24. Keratella sp.

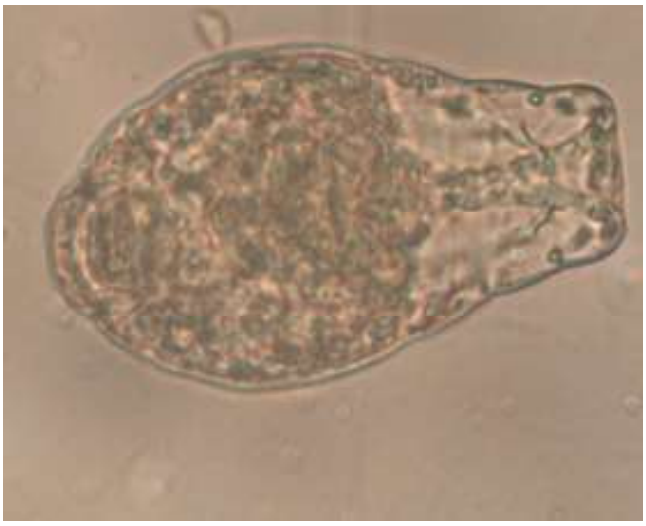


Fig. 25. *Asplanchna* sp.

were dominated by Bacillariophycae during the entire study period and dominant diatoms were the same as planktonic flora. Only minor differences were observed in dominant planktonic and periphytic taxa. Presence of Euglenophyceae was also noticed as periphytic flora. Sixteen periphytic taxa have been reported[4] while in our present studies 44 periphytic taxa (Fig.3) belonging to Bacillariophyceae 28, Chlorophyceae 9, Myxophyceae 5 and Euglenophyceae 2 were recorded. However Diatoms contribution was maximum.

Typical flora and fauna at Harsil of the river Ganga are presented in figures from 4 to 26 (Figs. 4-17 diatoms,

Fig . 26. *Brachionus* sp.

Figs. 18-22 green algae, Fig. 23 blue green algae Figs. 24-26 zooplankton- rotifers). All microphotographs of phytoplankton are in 1000x, while those of zooplankton are in 400x.

The river Ganga at Harsil is devoid of various stressors like habitat alteration, industrial effluents, construction of dams, accumulation of nutrients and other anthropogenic activities. The only stressor is climate change which was represented by change in temperature and river depth as well as velocity. Workers[3] reported temp range of 4.3-9. 8 ^{0}C and velocity 2-3m/s in 2010 at Harsil. In our present studies Increase in temp and reduction in velocity was noticed .

Climate change influences the environmental parameters that have a direct bearing on several aspects of ecosystem, such as changes in water temperature, changes in precipitation and water availability, increase in frequency and intensity of storms and erratic weather etc..Changing temperature would affect the water quality in terms of altered pH, nutrient concentration, higher productivity leading to the emergence of new strains of flora and fauna. So change in river velocity/depth and temperature variation resulted in occurrence of other planktonic groups, as previously only diatoms were recorded. This can be observed from the Fig.1-3 that no definite pattern of plankton abundance and periphytic deposition could be recorded. It appeared that water current or river velocity played important role in algal biodiversity. Most of the taxa were common in planktonic and periphytic forms (Table 2) which may be detached algae due to fast water current, except few taxa of Myxophyceae, recorded as periphyton only.

Temperature also alters the toxicity of natural and anthropogenic pollutants (by changing their metabolism and physiology) leading to many unfavourable outcomes to the aquatic organisms, as in the middle stretch of the river Ganga at Kanpur (most polluted centre) ,plankton quantity , quality and diversity were affected by multiple stressors. Therefore in middle stretch, increase in plankton abundance, dominance of Chlorophyceae, more number of planktonic and periphytic taxa as compared to pristine conditions were noticed. Because accumulation of nutrients, higher temperature, urbanization, pollution of industrial effluents and drastic change in habitat alteration resulted in eutrophication and finally development in adaptive species of phytoplankton and zooplankton. However planktonic groups were the same as in pristine conditions only new taxa/ species/strains developed in the course of river Ganga , like development of various species of *Scenedesmus and Ankistrodesmus (Green algae) and Brachionus* (Rotifers) *etc.*. So knowledge of taxa in natural or near natural conditions at Harsil will help us in understanding changes in the flora and fauna due to climatic stressors.

Conclusion

The river Ganga at Harsil is devoid of various stressors like habitat alteration, industrial effluents, construction of dams, accumulation of nutrients and other anthropogenic activities. The only stressor is climate change which was represented by change in temperature and river depth as well as velocity. Changes in climatic conditions such as increase in water temperature, decrease in river depth and river velocity resulted in occurrence of various planktonic groups like diatoms, green algae, blue green algae, Rotifers, desmids as previously only diatoms were recorded. This was noticed that near the source of origin of a big river like Ganga, diatom taxa like *Eunotia , Achnanthes, Diatoma, Tabellaria , Cymbella,* and *Synedra* were found as dominant algal taxa.

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