# PLANKTON IN RIVER GANGA

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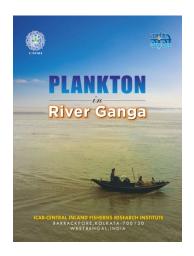






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## Plankton in River Ganga

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#### **FOREWORD**

राजीव रंजन मिश्रा, भा.प्र.से. महानिदेशक राष्ट्रीय स्वच्छ गंगा मिशन

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जल शक्ति मंत्रालय जल संसाधन, नदी विकास और गंगा संरक्षण विमाग GOVERNMENT OF INDIA MINISTRY OF JAL SHAKTI DEPARTMENT OF WATER RESOURCES, RIVER DEVELOPMENT & GANGA REJUVENATION

भारत सरकार

**FOREWORD** 

River Ganga which is endowed with thousands of aquatic floral and faunal organisms and by itself it supports the great ecosystem. Planktons are one of the major key organisms which balance the ecological hierarchy and ecosystem. Planktons are important food for many of the aquatic organisms, such as fish and molluscs. But with the advancement in society and increasing rate of pollution severe indicative changes have been recorded in their density and diversity. Although the study of plankton diversity of the river has long been of great interest of research, there is little literature available on this aspect. Bringing out a comprehensive document on the list of plankton species by the ICAR-CIFRI through the project Assessment of fish and fisheries of the Ganga River system for developing suitable conservation and restoration plan" funded by the Government of India under "Namami Gange mission" would be very useful.

The present book "Plankton in River Ganga" containing images of all the recorded planktons, taxonomical description, habitat description and its distribution status is unique in itself. It also contains detailed information about the freshwater and brackish water distribution of plankton. I am sure that this book will be helpful for environmentalists, researchers, students, ecologists and managers of water bodies. I congratulate the authors and the entire project team for bringing out this book.

Rajiv Ranjan Mishra



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उप महानिदेशक (मत्स्य विज्ञान)

Dr. J.K. Jena

Deputy Director General (Fisheries Science)

#### **FOREWORD**

River Ganga, the largest and most important river in India, originates in the Himalayas and flows down to the Gangetic plains before draining into the Bay of Bengal, forming the world's largest delta, the Sunderbans. It supports diverse species of aquatic flora and fauna which plays a vital role in defining its productivity. However, due to pollution, over-exploitation, habitat degradation and reduction in water levels, the aquatic biodiversity of the river Ganga is in perils, thus affecting its productivity.

The productivity of the aquatic system mainly depends on its plankton population. Plankton occupy the base levels of aquatic food chains and are one of the major natural food items for most of the finfish and shellfish larvae and adults. They are also reliable bio-indicators of water quality. In this direction, the effort of the ICAR-Central Inland Fisheries Research Institute (CIFRI), Barrackpore towards the assessment of plankton biodiversity of the river Ganga through a project on 'Assessment of Fish and Fisheries of the Ganga River System for Developing Suitable Conservation and Restoration Plan' under the 'Namami Gange Programme' from 2016 onwards is quite significant.

The studies of the project are lucidly composed in the book 'Plankton in River Ganga', which contains images of plankton, their morphological description and distribution in different stretches of the river Ganga. I sincerely believe the book will be of immense help to the students, fisheries professionals and policymakers. I congratulate the authors and the project team for coming out with this important document.

(J. K. Jena)



#### **PREFACE**



The mighty River Ganga is believed to be the most sacred and holy River for the whole country which flows the total approximate length of 2,550 km covering five important states of India (Uttarakhand, Uttar Pradesh, Jharkhand, Bihar & West Bengal). It is an important drinking and irrigation source for 43% of the country's population and is also a major livelihood source for thousands of nearby residents. The river traverses through three different eco-regions of India (upper stretch, middle stretch, lower stretch) and thus, sustaining a heterogeneous assemblage of aquatic flora and fauna. Microflora and fauna are considered the most dynamic component of aquatic habitat. Temporal and special variations of assemblage and abundance patterns of plankton are widely varied. These microscopic organisms' diversely vary in size i.e.  $0.2\mu m$  to more than  $500\mu m$ . To know about the actual status of the planktonic life of the Rive Ganga systematic identification is necessary. It is cumbersome to identify this minute organism without a proper pictorial guide.

The book "Plankton in River Ganga" is a pictorial guide of all the recorded plankton (Phytoplankton and Zooplankton) are present. This book also provides a taxonomical classification of the recorded plankton (131 genera, belonging to 24 classes and 11 phyla) and their distribution throughout the stretches of River Ganga. It also contains information about freshwater and brackish water plankton. All the plankton samples were collected from selected sites based on the physical and physiological characteristics of the river. Environmental factors significantly influencing plankton diversity/abundance were determined using advanced statistical tools.

The financial grants were received from the Ministry of Jal Shakti Department Of Water Resources, River Development & Ganga Rejuvenation for the study, which was started on 7<sup>th</sup> July 2016. The book will be helpful to the researchers, students and all the stakeholders of the river for a better understanding of the riverine ecosystem.

Date: 10-01-2021 B. K. Das
Place: Barrackpore Director

#### **ACKNOWLEDGEMENT**

The authors are thankful to National Mission For Clean Ganga (NMCG), Ministry of Jal Shakti, Department of water resources, River Development and Ganga Rejuvenation, Government of India (Project No. T-17/2014-15/526/NMCG-Fish and Fisheries), New Delhi for their financial assistance to ICAR- Central Inland Fisheries Research Institute (CIFRI), Barrackpore, Kolkata, West Bengal for the project entitled "Assessment of fish and fisheries of the Ganga River system for developing suitable conservation and restoration plan". The authors are also thankful to CIFRI team of NMCG project of its regional centre at Prayagraj, Uttar Pradesh for their efforts. The author also extends their gratitude towards Suman Kumari, Soma Das Sarkar for their guidance and Malay Naskar for statistical analysis. Thanks are also due to the local fishers, who incorporated their full support.

Authors



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## माँ गंगा स्तोत्रम्॥

देवि सुरेश्वरि भगवति गङ्गे त्रिभुवनतारिणि तरलतरङ्गे । शङ्करमौलिविहारिणि विमले मम मतिरास्तां तव पदकमले ॥१॥

भागीरथि सुखदायिनि मातस्तव जलमहिमा निगमे ख्यातः । नाहं जाने तव महिमानं पाहि कृपामयि मामज्ञानम् ॥ २॥

हरिपदपाद्यतरङ्गिणि गङ्गे हिमविधुमुक्ताधवलतरङ्गे । दूरीकुरु मम दुष्कृतिभारं कुरु कृपया भवसागरपारम् ॥ ३॥

तव जलममलं येन निपीतं, परमपदं खलु तेन गृहीतम् । मातर्गङ्गे त्वयि यो भक्तः किल तं द्रष्टुं न यमः शक्तः ॥ ४॥

पतितोद्धारिणि जाह्नवि गङ्गे खण्डितगिरिवरमण्डितभङ्गे । भीष्मजननि हे मुनिवरकन्ये, पतितनिवारिणि त्रिभुवनधन्ये ॥ ५॥

कल्पलतामिव फलदां लोके, प्रणमति यस्त्वां न पतित शोके । पारावारविहारिणि गङ्गे विमुखयुवतिकृततरलापाङ्गे ॥ ६॥

तव चेन्मातः स्रोतःस्नातः पुनरपि जठरे सोऽपि न जातः । नरकनिवारिणि जाह्नवि गङ्गे कलुषविनाशिनि महिमोत्तुङ्गे ॥ ७॥

पुनरसदङ्गे पुण्यतरङ्गे जय जय जाह्नवि करुणापाङ्गे । इन्द्रमुकुटमणिराजितचरणे सुखदे शुभदे भृत्यशरण्ये ॥ ८॥ रोगं शोकं तापं पापं हर मे भगवति कुमतिकलापम्। त्रिभुवनसारे वसुधाहारे त्वमसि गतिर्मम खलु संसारे॥ ९॥

अलकानन्दे परमानन्दे कुरु करुणामयि कातरवन्द्ये । तव तटनिकटे यस्य निवासः खलु वैकुण्ठे तस्य निवासः ॥१०॥

वरमिह नीरे कमठो मीनः किं वा तीरे शरटः क्षीणः । अथवा श्वपचो मलिनो दीनस्तव न हि दूरे नृपतिकुलीनः॥ ११॥

भो भुवनेश्वरि पुण्ये धन्ये देवि द्रवमयि मुनिवरकन्ये । गङ्गास्तवमिमममलं नित्यं पठति नरो यः स जयति सत्यम् ॥ १२॥

येषां हृदये गङ्गाभक्तिस्तेषां भवति सदा सुखमुक्तिः । मधुराकान्तापज्झटिकाभिः परमानन्दकलितललिताभिः ॥ १३॥

गङ्गास्तोत्रमिदं भवसारं वाञ्छितफलदं विमलं सारम् । शङ्करसेवकशङ्कररचितं पठति सुखी स्तव इति च समाप्तः ॥ १४॥

देवि सुरेश्वरि भगवति गङ्गे त्रिभुवनतारिणि तरलतरङ्गे । शङ्करमौलिविहारिणि विमले मम मतिरास्तां तव पदकमले ॥

#### **INTRODUCTION**

River Ganga is the largest in India and the fifth-largest in the world. The Ganga is 2525 km long and its basin covers nearly 26% of the total geographical area of the country (Ganga river Basin Plan). The river traverses through three different eco-regions of India and thus, sustaining a heterogeneous assemblage of aquatic microflora and fauna. River Ganga originates from the Gangotri glacier at Gomukh after that river flows about 220 km in the south. Before entering Haridwar, the river cuts at Shiwalik hills. Then, it flows a distance of 2290 km in the Indo-Gangetic plains in the states of Uttar Pradesh, Bihar, Jharkhand, and West Bengal. After entering West Bengal, the flow of the river Ganga is regulated through the Farakka barrage. The main channel flows into Bangladesh as the river Padma and meets with the Brahmaputra. Below the barrage, the feeder canal meets with the Bhagirathi river, which flows through Berhampur and Katwa, and then flows about 150 km and joins with Hooghly estuary at Nabadwip. The river Hooghly flows through Calcutta and Diamond Harbour after that it meets with the Bay of Bengal in the East. Bhagirathi-Hooghly is one of the major distributaries, which forms the biggest marshy delta in the world, called Sunderban (2340 km<sup>2</sup>). The river Ganga has many tributaries in its course through the plains. The Ganga basin covers an area of about 8,61,404 km<sup>2</sup> and expanding over 11 states, along with its tributaries and distributaries. Most of the North Indian tributaries like Ghagra, Gandak, Ram Ganga, Gomti, Kosi, and Sarda flowing from the lower Himalayan passes through the Terrain low-lands before streaming into the main Ganga, while the major southern tributaries joining Ganga are the Chambal, Yamuna, Subarnarekha, and Sone (Ganga river Basin Plan). The biodiversity of the river Ganga is marked as one of the important factors for socio-economic development along the river. It has been estimated that the river produces 89.5% of the total carp seed production for the country (Behera, 2002). Adding to this fact of immense biodiversity, the hydrological parameters also acts as an influencing factor for the riverine health and its ecosystem.

The sites of the present study were covered almost 2525 Kilometers of which the stretch of the Indian state of Uttarakhand, Uttar Pradesh, Bihar, and West Bengal and was divided into three different zones viz., Upper stretch, Middle stretch, and Lower stretch. All the sites that have been selected are based on the physical characteristics of water (flow velocity, salinity, tidal flux, etc.), soil, and altitude.



#### **PLANKTON**

Plankton are diverse collection of the aquatic organism which drifts with the help of water current and is a well-known biological indicator. Phytoplankton occupies the base position in the ecological food pyramid because of its autotrophic mode of nutrition. Phytoplankton are considered as the wealth of a healthy aquatic ecosystem, as they are an integral part of the aquatic food chain (Tas and Gonulal 2007; Saravanakumar et al. 2008). Among all the photosynthetic organisms, phytoplankton contributes 40% as it is a natural feed for fishes (Schmidt 2000). Plankton and other aquatic organisms are well-known for their role in monitoring the health status of any water bodies (Boyd 1998). Due to their short life-cycle, they are vibrantly influenced by the environmental factor. Phytoplankton can be used to determine the trophic status of the waterbody (Meena et al. 2019). The biomass and community structure of phytoplankton are found lower in the river as compared to lentic waters. The density and dimensional distribution of zooplankton narrate the biotic and abiotic factors of the water body(Marneffe et al. 1998). Among the zooplankton group, Rotifers are an important component and can influence the microbial food web of several trophic levels (Arndt, 1993).

Study reports of 1995-96 revealed that phytoplankton contribution was comparatively higher than that of zooplankton from Tehri to Farrukhabad. The contribution of zooplankton varies from 0 to 16.6%. Among phytoplankton, the dominant group was Bacillariophyceae (83.4% to 100%), followed by Chlorophyceae and Cyanophyceae. The dominant groups among zooplankton were Copepods, Cladoceras, Rotifers, and Protozoa.

Several studies on plankton communities and their dynamics along river Ganga (Kanpur–Bhagalpur stretch) have been studied by many workers viz, Ray et al. (1966), Pahwa and Mehrotra (1966), Khan et al.(1996), Bilgrami and Dutta Munshi (1979), etc. According to reports, major groups contributing to phytoplankton were Bacillariophyceae (Amphora sp., Asterionella sp., Cyclotella sp., Cymbella sp., Diatoma sp., Fragilaria sp., Gomphonema sp., Gyrosigma sp., Navicula sp., Nitzschia sp., Pleurosigma sp., Pinnularia sp., Synedra sp.), Chlorophyceae (Actinastrum sp., Ankistrodesmus sp., Chlorella sp., Closterium sp., Denticula sp., Desmidium sp., Eudorina sp, Hydrodictyon sp., Mougeotia sp., Pediastrum sp., Scenedesmus sp., Spirogyra sp.), Cynanophyceae (Anabaena sp., Lyngbya sp., Merismopoedia sp., Microcystis sp., Nostoc sp., Oscillatoria sp., Phormidium sp.). Among zooplankton, copepods, cladocerans, rotifers, and protozoans were the major groups. The

maximum abundance of plankton in terms of quality and quantity was observed in the stretch between Kanpur and Prayagraj. Among phytoplankton, the dominant group was Bacillariophyceae, followed by Chlorophyceae and Cyanophyceae. A sharp dominance of phytoplankton was observed over the entire stretch with the highest percentage of Bacillariophyceae, Chlorophyceae, and Cyanophyceae in order of their abundance. In total plankton population, 70.98 to 89.22% and 10.78 to29.02% by numbers were contributed by phyto and zooplankton, respectively. On the whole 18 taxa under phytoplankton and 11 taxa under zooplankton were encountered in the stretch between Kanpur and Allahabad.

Study reports of Hooghly-Maltah estuary, by Datta et al. (1954) surmised 105 phytoplankton species which comprised 72 species of diatoms (Bacillariophyceae), 18 species of green algae (Chlorophyceae), 9 species of blue-green algae (Cyanophyceae), 3 species of dinoflagellates (Dinophyceae), and 3 euglenoid species was found during 1991-1995. From the report of Shetty et al. (1961), it was found that 106 phytoplankton species during the study period, comprising of 50 species of diatoms, 30 species of green algae, 18 species of blue-green algae, and 8 taxa belonging to flagellates. Later on, Sinha et al. (1996) highlighted the shift in plankton community distribution in Hooghly estuary due to altered ecological conditions, owing to the freshwater release from Farakka Barrage. After that, several workers have studied the plankton dynamics in the estuary viz. (Dey et al., 1991, 1994; Banerjee and Santra, 2001; Mukhopadhyay and Pal, 2002; Sarkar and Naskar, 2002; Biswas et al., 2004; Choudhury and Pal, 2008, 2010, 2012; Manna et al., 2010; Akhand et al., 2012, Roshit et al. 2018). The most updated assessment on the phytoplankton community structure of the Hooghly-Matlah estuarine system (including Sundarbans) recorded 378 species of phytoplankton taxa, belonging to 196 genera and 109 families, based on the field studies at bibliographic sources (Roshith et.al, 2018)

During the study period (2016-2020), a total of 131 genera, belonging to 24 classes and 11 phyla were recorded from the twenty stations of different stretches of river Ganga. A total of 95 genera of phytoplankton, belonging to 13 classes and 7 phyla were found. The phyla are Bacillariophyta, Chlorophyta, Cyanophyta, Dinophyta, Xanthophyta, Zygnematophyta, and Euglenophyta. A total of 36 genera belonging to 11 classes and 4 phyla were recorded from zooplankton are Rotifera, Arthropoda, Ciliophora, and Amoebozoa. A few groups like fish eggs, larvae, nematodes, etc. could not be identified on species level. In all the stretches, the contribution of phytoplankton was found high as compared to zooplankton. Bacillariophyceae (26 genera), Coscinodiscophyceae (4 genera), Mediophyceae (6 genera),



Dinophyceae (2 genus), Ulvophyceae (2 genera), Chlorophyceae (20 genera), Trebouxiophyceae (6 genera), Zygnematophyceae (8 genera), Xanthophyceae (4 genera), Synurophyceae (1 genus), Euglenophyceae (4 genera), Cyanophyceae (12 genera) were recorded. Among zooplankton Rotifera (13 genera), Arthropoda (8 genera), Ciliophora (11 genera), Amoebozoa (4 genera) were recorded.

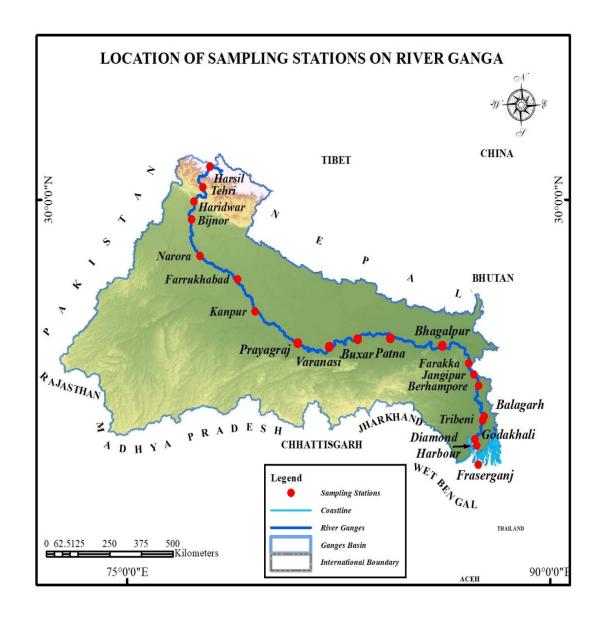
In the upper stretch, Bacillariophyceae (19 genera), Coscinodiscophyceae (2 genera), Mediophyceae (2 genera), Ulvophyceae (2 genera) Chlorophyceae (13 genera), Trebouxiophyceae (5 genera), Zygnematophyceae (5 genera), Xanthophyceae (3 genera), Synurophyceae (1 genus), Euglenophyceae (3 genera), Cyanophyceae (9 genera) were recorded. Among zooplankton Rotifera (7 genera), Arthropoda (2 genera), Ciliophora (10 genera), Amoebozoa (2 genera) were recorded.

In the middle stretch, Bacillariophyceae (23 genera), Coscinodiscophyceae (3 genera), Mediophyceae (2 genera), Dinophyceae (1 genus), Ulvophyceae (1 genus), Chlorophyceae (20 genera), Trebouxiophyceae (6 genera), Zygnematophyceae (8 genera), Xanthophyceae (3 genera), Euglenophyceae (4 genera), Cyanophyceae (12 genera) were recorded. Among zooplankton Rotifera (13 genera), Arthropoda (8 genera), Ciliophora (4 genera), Amoebozoa (3 genera) were recorded.

In the lower stretch, Bacillariophyceae (17 genera), Coscinodiscophyceae (4 genera), Mediophyceae (5 genera), Dinophyceae (1 genus), Noctilucophyceae (1 genus), Ulvophyceae (2 genera) Chlorophyceae (13 genera), Trebouxiophyceae (5 genera), Zygnematophyceae (5 genera), Synurophyceae (1 genus), Euglenophyceae (3 genera), Cyanophyceae (9 genera) were recorded. Among zooplankton, Rotifera (6 genera), Arthropoda (7 genera), Ciliophora (3 genera), Amoebozoa (2 genera) were recorded.

For a detailed study on plankton along with different ecological parameters of Ganga river system the Ministry of Jal Shakti Department of Water Resources, River Development & Ganga Rejuvenation has financially supported ICAR-CIFRI. under the project entitled "Assessment of fish and fisheries of the Ganga River system for developing suitable conservation and restoration plan". Since plankton have been linked with riverine fish and fisheries therefore it is required to assess the plankton diversity across the river.

#### GIS LOCATION OF SAMPLING STATION



The sites covered were almost 2525 Kilometers of which the stretch of the Indian state of Uttarakhand, Uttar Pradesh, Bihar, and West Bengal and was divided into three different zones viz., Upper stretch, Middle stretch, and Lower stretch. All the sites that have been selected are based on the physical characteristics of water (flow velocity, salinity, tidal flux, etc.), soil, and altitude.



#### **SAMPLING STATION**











## 20 Sampling stations are

- 1. Harshil
- 2. Tehri
- 3. Haridwar
- 4. Bijnor
- 5. Narora
- 6. Farukhabad
- 7. Kanpur
- 8. Prayagraj
- 9. Varanasi
- 10. Buxar

- 11. Patna
- 12. Bhagalpur
- 13. Farakka
- 14. Jangipur
- 15. Berhampore
- 16. Balagarh
- 17. Tribeni
- 18. Godakhali
- 19. D.harbor
- 20. Fraserganj

#### SAMPLE COLLECTION AND PRESERVATION





- A total of 100 litres of river water was filtered through the net of very fine mesh size (20μm).
- ➤ Plankton samples were collected in dry polyethylene containers using 4% buffered formalin as a preservative.
- The identification was made by following the ICBN and some handbooks.
- For valid and updated names
  Algae Base (Guiry and Guiry
  2018) was followed.
- Samples were examined by employing Trinocular microscope (40x and 60x magnification; Model No.-Zeiss scopeA1).
- ➤ The density was recorded as a number of planktons in unit litre<sup>-1</sup>.



### **ECOLOGICAL PARAMETERS ANALYSIS**







# PLANKTON

PHYTOPLANKTON BACILL ARIOPHYTA XANTHOPHYTA CHLOROPHYTA ZYGNEMATOPHYTA CYANOPHYTA MIOZOA EUGLENOPHYTA Dinophyceae Xanthophyceae Cyanophyceae Chlorophyceae Bacillariophyceae ζ Euglenophyceae Zygnematophyceae Noctilucophyceae Synurophyceae Ulvophyceae Mediophyceae Coscinodiscophyceae rrebouxiophyceae

# PHYTOPLANKTON





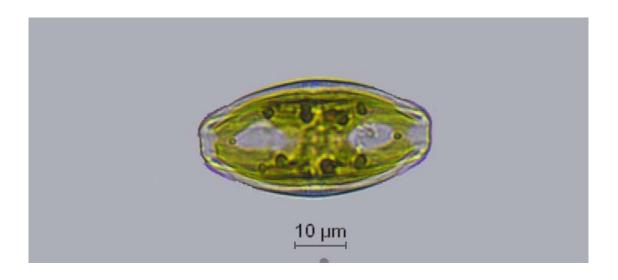
#### Bacillariophyta

(Yellow-brown algae)

#### **General Identifying Characters:**

- ➤ Diatoms are generally non-flagellate unicellular, simple colonies or chains of cells.
- These are found in a wide environment i.e. both marine and freshwater.
- ➤ Cells have a thick ornamented cell wall, which is made up of silica.
- ➤ Cell walls are known as frustules, have two halves, which are called valves.
- ➤ The outer half is called epitheca and the inner half is called hypotheca.
- > Cell walls may contain several spines, bristles.
- ➤ Diatoms are of two types based on cell shape and frustule morphology one is centric and another is pinnate.
- ➤ The centric diatoms are discoid or cylindrical while pinnate diatoms are elongated in shape.
- ➤ It has one major structure, which is associated with locomotion i.e. raphe.
- > Diatoms forms bloom in the water body during spring and early summer.
  - → Total 36 genera belonging to 3 classes and 28 families were recorded during study period.

## Amphora sp. (Ehrenberg ex Kutzing, 1844)



Class: Bacillariophyceae

**Order**: Thalassiophysales

Family: Catenulaceae

Genus: Amphora sp.

#### **Identifying feature:**

❖ The cells are seen biconvex in girdle view.

❖ Valves are dorsiventral.

❖ H- Shaped chloroplast is present with a central bridge that is flanked by two droplets.

Habitat: Freshwater and Brackish water

Major Ecological Parameter: Highly positive correlation was found

with Turbidity.



Absent
Present

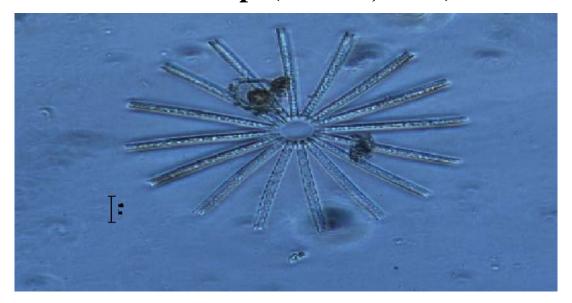
## Station wise Distribution: Upper stretch

Harshil	Tehri	Haridwar		Bijno	r	Naro	ra	Farr	ukhabad
Middle st	retch								
Kanpur	Prayagraj	Varanasi	Buxa	ar	Patna		Bhagalpur		Farakka
Lower str	etch								
Jangipur	Berhampore	Balagarh	Trib	eni	Godak	hali	D. Harbour	Fr	aserganj
STATIO		017		18		2019	)	202	
Harsh		NF	N			NF		N.	
Tehri		NF	N			NF		N.	
Haridw	ar I	NF .	N	F	NF		NF		F
Bijnor	·	NF		F	NF		NF		F
Narora	a :	10	N	F	NF		NF		F
Farrukha	bad 1	NF	N	NF NF			NF		
Kanpu	r I	NF	N	F		NF		N.	F
Prayagr	raj l	<b>VF</b>	N	F		NF		N.	F
Varana	si l	<b>VF</b>	N	F		NF		N.	F
Buxar	·	NF	N	F		NF		N	F
Patna	ľ	NF	N	F		NF		N.	F
Bhagalp	our I	NF	N	F		NF		N.	F
Farakk	a I	NF	N	F		NF		N.	F
Jangipu	ır l	NF	7	7		3		N	F
Berhamp	ore	NF	N	F		NF		N.	F
Balagai	rh I	NF	N	F		NF		N.	F
Triben		NF	N	F		NF		N.	F
Godakh	ali N	NF	N	F		NF		N.	F
D. Harbo	our N	NF	N	F		NF		N.	F
Fraserga	anj l	NF	N	F		NF		N.	F

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



## Asterionella sp. (Hassall, 1850)



Class: Bacillariophyceae

Order: Bacillariophyceae

Family: Tabellariaceae

Genus: Asterionella sp.

#### **Identifying feature:**

❖ Cells are elongated, which are joined to form stellate colonies.

❖ The basal portion of cells is slightly wider than the apical pole in the girdle view.

❖ Cells have many small plate-like plastids.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with BOD, Chloride and Total Nitrogen.



#### Absent Present

## **Station wise Distribution: Upper stretch**

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad
N.C. 1.11	. 1.				

#### Middle stretch

Kanpur	Prayagraj	Varonasi	Buxar	Patna	Bhagalpur	Farakka

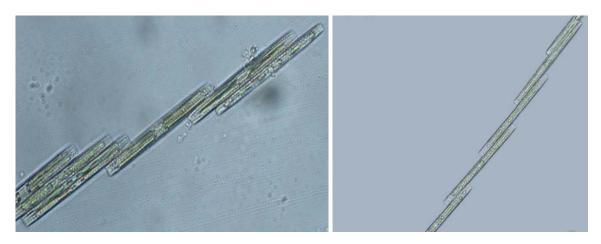
#### Lower stretch

Jangipur	Berhampore	erhampore Balagarh Tribeni Godakhali D.		D. Harbour	Frasergan
STATIO	N 2017	2018	2019	20	)20
Harshil		NF	NF		<b>IF</b>
Tehri	15	130	NF	1	80
Haridwa	r 73	NF	NF	N	NF .
Bijnor	110	330	5	N	NF .
Narora	335	135	NF	N	<b>VF</b>
Farrukhal	bad 40	600	NF	N	<b>NF</b>
Kanpui	20	4130	NF	N	<b>NF</b>
Prayagra	aj 100	110	NF	N	NF
Varanas	si NF	NF	NF	N	<b>IF</b>
Buxar	NF	NF	NF	N	NF
Patna	NF	NF	NF	N	<b>NF</b>
Bhagalpı	ur NF	NF	NF	N	NF
Farakka	a NF	NF	NF	N	<b>IF</b>
Jangipu		7	3		NF
Berhampe		NF	NF		NF
Balagar		NF	NF		NF
Tribeni		NF	NF		NF
Godakha		3	10		NF
D. Harbo		NF	NF		1
Fraserga	nj 1	2	7		3

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **+** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



## Bacillaria sp. (J.F.Gmelin, 1791)



Class: Bacillariophyceae

Order: Bacillariales

Family: Bacillariaceae

Genus: Bacillaria sp.

#### **Identifying feature:**

- ❖ Cells are attached with each other by their raphe slits to form colonies.
- ❖ The central nucleus bears two plate-like plastids on each side.

**Habitat:** Mainly Brackish water but sometimes fresh water **Major Ecological Parameters:** Highly positive correlation was found with Carbonate, Ca<sup>++</sup>, Mg<sup>++</sup>, Salinity and Specific conductivity.



Absent
Present

#### **Station wise Distribution:**

**Upper stretch** 

Upper str Harshil	Tehri	Haridwar	Bi	jnor	Narora	Farrukhabad	
Middle st Kanpur	retch Prayagraj	Varanasi	Buxar	Patna	Bhagal	pur Farakka	
-							
Lower str	etch						
Jangipur	Berhampore	Balagarh	Tribeni	Godakha	li D. Harb	our Fraserganj	
STAT	ION 2	017	2018		2019	2020	
Hars		NF	NF		NF	NF	
Teh	ri l	NF	NF		NF	NF	
Harid	war 1	NF	NF		NF	NF	
Bijn	or I	NF	NF		NF	NF	
Naro	ora I	NF	NF	NF		NF	
Farrukl	nabad I	NF		NF		NF	
Kanp	our l	NF	NF		NF	NF	
Praya	graj l	NF	NF	NF I		NF	
Varar	nasi I	NF	NF		NF	NF	
Bux	ar l	NF	NF	NF		NF	
Patr	na I	NF	NF		NF	NF	
Bhaga	lpur I	NF	NF		NF	NF	
Farak	kka l	NF	NF	NF		NF	
Jangi	pur l	NF	NF	NF		NF	
Berhan	npore 1	NF	NF		NF	NF	
Balag	arh l	NF	NF		NF	NF	
Tribe	eni l	NF	NF		NF	NF	
Godak	khali l	NF	NF		NF	NF	
D. Har	bour 1	NF	NF		NF	NF	
Fraser	ganj I	NF	NF		NF	480	

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



## Caloneis sp. (Cleve, 1894)



Class: Bacillariophyceae

Order: Naviculales

Family: Naviculaceae

Source:- Protist Information Server 1995-2018

Genus: Caloneis sp.

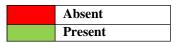
#### **Identifying feature:**

- ❖ The shapes of valves are mainly linear to lanceolate and apices cuneate to rounded or valve lanceolate with bluntly rostrate to subcapitate apices.
- ❖ The former has a single plastid having a narrow bridge across the centre of the cell.
- ❖ The latter has two plastids along the girdle sides associated with each plate.
- ❖ Striae are usually, faint, alveolar in construction.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Total Dissolved Solid.





#### **Station wise Distribution: Upper stretch**

Harshil	Tehri	Haridwar	Bijnor	Narora	a Far	rukhabad
Middle stretch	1					
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

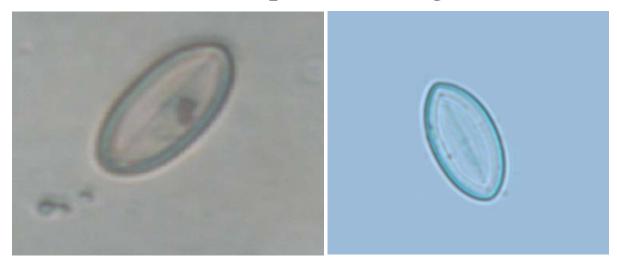
#### Lower stretch

Jangipur	Berham	pore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
STATI	ON	2017		2018	2019		2020
Harsl	nil	NF		NF	NF		NF
Tehr	i	NF		NF	NF		NF
Haridy	war	NF		NF	NF		NF
Bijno	or	NF		NF	NF		NF
Naro	ra	NF		NF	NF		NF
Farrukh	abad	NF		NF	NF		NF
Kanp	Kanpur			NF	NF		NF
Prayag	graj	NF		NF	NF		NF
Varan	asi	NF		NF	NF		NF
Buxa	ır	NF		NF	NF		NF
Patn	a	NF		NF	NF		NF
Bhagal	pur	NF		NF	NF		NF
Farak	ka	NF		NF	NF		NF
Jangip	our	NF		NF	NF		NF
Berham	pore	NF		NF	NF		NF
Balaga	arh	NF		NF	NF		NF
Tribe	Tribeni Godakhali			NF	NF		NF
Godak				NF	NF		NF
D. Hark	oour	NF		NF	NF		NF
Fraserg	ganj	NF		NF	NF		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



## Cocconeis sp. (Ehrenberg, 1835)



Class: Bacillariophyceae

Order: Cocconeidales

Family: Cocconeidaceae

Genus: Cocconeis sp.

#### **Identifying feature:**

❖ Usually, cells are slightly curved in girdle view.

Generally, Valves are slightly elliptical.

❖ A single C-shaped chloroplast is present.

**Habitat:** Freshwater

Major Ecological Parameters: Highly positive correlation was

found with BOD, Chloride and Total Dissolved Solid.



#### Absent Present

## Station wise Distribution: Upper stretch

Harshil				TI I D.			· Narora		I To 1 1 1		
Ha	rshil	Teh	ri	Haridwar		Bijno	r	Nar	ora	Far	rukhabad
	Middle str	etch									
	Kanpur	Praya	agraj Varana		Buxar		Patna		Bhagalpur		Farakka
	Lower stre	tch									
Jan	gipur	Berham	pore	Balagarh	Tri	oeni	Godak	hali	D. Harbo	ur	Fraserganj
	STATIO	ON	201	17	2018	<u> </u>		2019		20	020
	Harsh	il	N	F	NF		•	NF		N	NF
	Tehr	i	N	F	NF			NF		N	NF
	Haridw	var	N	F	NF			10		N	NF
	Bijno	r	N	F	5			5		N	NF
	Naror	'a	N	F	NF	F N		NF		N	NF
	Farrukha	abad	N	F	NF		NF			N	NF
	Kanpı	ır	N	F	NF			40		N	NF
	Prayag	raj	N	F	NF			NF		N	NF
	Varana	asi	N	F	NF			50		N	NF
	Buxa	r	N	F	NF			NF		N	NF
	Patna	a	N	F	NF			NF		N	NF
	Bhagalı	pur	N	F	NF			NF		N	NF
	Farakl	ka	N	F	NF			NF		N	NF
	Jangip	ur	N	F	NF			NF		N	NF
	Berhamj	pore	N	F	NF			NF		N	NF
	Balaga	rh	N	F	NF			NF		N	NF
	Triber	ni	N	F	NF			NF		N	NF
	Godaki	nali	N	F	NF			NF		N	NF
	D. Harb	our	N	F	NF			NF		N	NF
	Fraserg	anj	N	F	NF			NF		N	NF

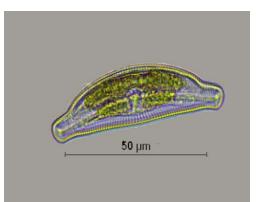
- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **∔** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



## Cymbella sp. (Agardh, 1830)







Class: Bacillariophyceae

**Order:** Cymbellales

Family: Cymbellaceae

Genus: Cymbella sp.

#### **Identifying feature:**

❖ Valves have dorsi-ventral symmetry.

- ❖ The shape of the dorsal margin is more convex than the ventral margin.
- ❖ The ventral margin may be straight or concave.
- ❖ A single chloroplast is present.

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with Dissolved Oxygen.



## Absent Present

#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### Lower stretch

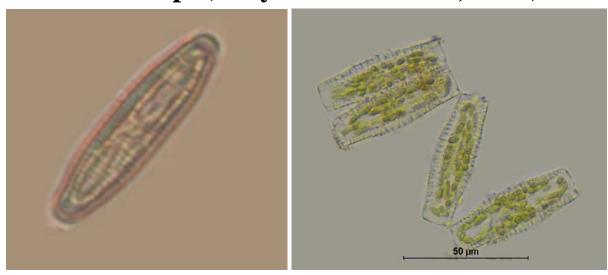
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj

STATION	2017	2018	2019	2020
Harshil	40	20	20	30
Tehri	40	40	25	NF
Haridwar	25	120	55	40
Bijnor	55	55	95	NF
Narora	80	NF	45	NF
Farrukhabad	NF	NF	40	60
Kanpur	NF	35	NF	NF
Prayagraj	NF	NF	NF	NF
Varanasi	35	NF	NF	NF
Buxar	5	NF	NF	NF
Patna	NF	5	3	NF
Bhagalpur	NF	1	NF	NF
Farakka	NF	NF	NF	NF
Jangipur	NF	NF	NF	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	NF	4	NF
Tribeni	NF	NF	NF	NF
Godakhali	NF	NF	NF	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



## Diatoma sp. (Bory de St. Vincent, 1824)



Class: Bacillariophyceae

**Order:** Tabellariales

Family: Tabellariaceae

Genus: Diatoma sp.

#### **Identifying feature:**

- Cells are joined to form long ribbon-like, or stellate, zig-zag colonies.
- ❖ Plastids are small, bacilliary, plate-like or discoid.
- ❖ 12-15 plastids are present per cell.
- ❖ Valves are elliptical to elongate.

**Habitat:** Freshwater

Major Ecological Parameters: Highly positive correlation was

found with Dissolved Oxygen and Transperancy.



Absent
Present

Farakka

Bhagalpur

# **Station wise Distribution:**

Prayagraj

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad			
Middle stretch								

Buxar

Patna

Varanasi

# Lower stretch

Kanpur

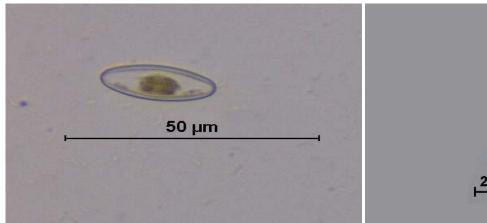
Ja	ngipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
	STATIO	ON 20	<u> 17                                     </u>	2018	2019		2020
	Harsh	il N	$\mathbf{F}$	NF	NF		40

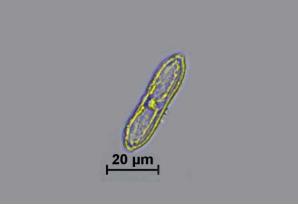
STATION	2017	2018	2019	2020
Harshil	NF	NF	NF	40
Tehri	NF	NF	35	40
Haridwar	55	NF	30	NF
Bijnor	45	NF	25	NF
Narora	10	75	NF	20
Farrukhabad	NF	NF	NF	NF
Kanpur	NF	NF	5	NF
Prayagraj	NF	NF	NF	NF
Varanasi	NF	NF	20	NF
Buxar	NF	NF	NF	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	NF	NF	NF
Farakka	NF	NF	NF	NF
Jangipur	NF	NF	NF	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	NF	NF	NF
Tribeni	NF	NF	NF	NF
Godakhali	NF	NF	NF	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Diploneis sp. (Ehrenberg ex Cleve, 1894)





Class: Bacillariophyceae

Order: Naviculales

Family: Diploneidaceae

Genus: Diploneis sp.

# **Identifying feature:**

❖ Cells have mainly elliptical valves with very blunt apices.

\* Two plastids are present on each side of the apical plane.

❖ Sometimes cells carry a central pyrenoid and highly lobed margins below the valve faces or simple plates that are lying opposite to each other near the valve apices.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Total Alkalinity.



# **Station wise Distribution:**

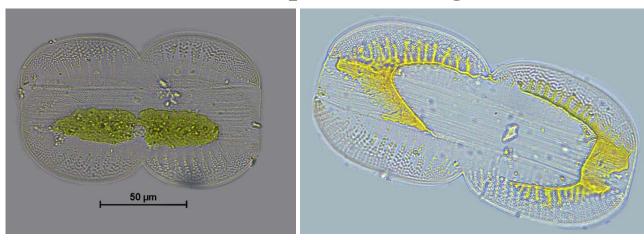
**Upper stretch** 

Upper stre									
Harshil	Tel	hri	Haridwar		Bij	nor	Na	rora	Farrukhabad
Middle str	etch								
Kanpur	Praya	graj	Varanasi	Buxai	r	Patna		Bhagalpur	Farakka
Lower stre	etch								
Jangipur	Berha	mpore	Balagarh	Tribe	ni	Godakh	lakhali D. Harbour		Fraserganj
STATION 2017 2018 2019							) 1 0		
STATIO Harsh		20 N		201 NF		<u> </u>		)19 \ <b>F</b>	2020 NF
Tehr		N		NF		NF			NF
Haridy		N		NF				VF	NF
Bijno		N		NF				NF	NF
Naron		N		NE				IF	NF
Farrukh		N		NF				NF	NF
Kanpı		N				NF		NF	
Prayag			F NF			NF		NF	
Varan		N		NF				<b>VF</b>	NF
Buxa		N		2				8	NF
Patna		N		NF	<b>?</b>			<b>IF</b>	NF
Bhagal	•	N		NF				<b>VF</b>	NF
Farak		N		NF				<b>IF</b>	NF
Jangip		N		NF				<b>IF</b>	NF
Berham			F	NF				<b>IF</b>	NF
	Balagarh N		F	NF				<b>IF</b>	NF
	Tribeni N		F	NF			N	<b>IF</b>	NF
Godakl		N	F	NF	7	N		<b>IF</b>	NF
D. Harb	D. Harbour N		IF N		7	NF		NF Control of the con	NF
Fraserg	anj	N	F	NF	7			2	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Entomoneis sp. (Ehrenberg, 1845)



Class: Bacillariophyceae

**Order:** Surirellales

Family: Entomoneidaceae

Genus: Entomoneis sp.

# **Identifying feature:**

- ❖ The shape of cells is seen lanceolate in the valve view and dumb-bell shaped in girdle view.
- ❖ One plastid is present, which is an axial plate-like structure, having a constriction at the centre.

Habitat: Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Total Hardness, Water Velocity, and Total Alkalinity.



Farakka

Bhagalpur

#### **Station wise Distribution:**

Prayagraj

#### **Upper stretch**

Kanpur

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad
Middle stretch	1				

Buxar

Patna

Varanasi

	Lower stre	tch					
Ja	ngipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
	STATION		017	2018	20	10	2020
	Harshil		VF	NF	N	•	NF
	Tehr	i ľ	NF	NF	N	${f F}$	NF
	Haridy	var 1	NF	NF	N	F	NF
	Bijno	r I	NF	NF	N	F	NF
	Naroi	ra I	NF	NF	N	F	NF
	Farrukh	abad 1	NF	NF	N	F	NF
	Kanpur		NF	NF	NF		NF
	Prayagraj		NF	NF	N	F	NF
	Varan	asi I	NF	NF	NF		NF
	Buxa	r ľ	NF	NF	8		NF
	Patna	a I	NF	NF	NF		NF
	Bhagal	pur I	NF	NF	N	F	NF
	Farak	ka I	NF	NF	N	F	NF
	Jangip	ur I	NF	NF	N	F	NF
	Berham	pore 1	NF	NF	N	F	NF
	Balaga	rh I	NF	2	N	F	NF
	Tribe	ni I	NF	NF	N	F	NF
	Godakl	nali I	NF	NF	5	5	NF
	D. Harb	our I	NF	1	1	l	1
	Fraserg	anj	NF	3	3	3	NF

- **★** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Epithemia sp. (Brebisson, 1838)



Source:- Protist Information Server 1995-2018

Class: Bacillariophyceae

**Order:** Rhopalodiales

Family: Rhopalodiaceae

Genus: Epithemia sp.

### **Identifying feature:**

Cells are solitary and dorsi-ventral, normally laying in girdle view.

❖ Single plastid is lying along the ventral side of the girdle.

Habitat: Freshwater and Brackish water

Major Ecological Parameter: Highly positive correlation was found

with Total Dissolved Solid.



#### **Station wise Distribution:**

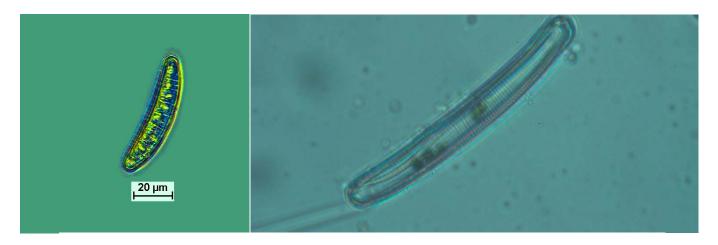
#### **Upper stretch**

На	arshil	Tehri		Haridy	var	Bijn	or	Na	rora	Farrukhabad
	Middle str									
Ka	anpur	Prayagraj	Va	ranasi	Buxar I		Patna	Patna Bhagalpa		Farakka
	Lower stre	tch								'
Ja	ngipur	ipur Berhampore Ba		lagarh	Tribeni		Godakhali D. Harbou		D. Harbour	Fraserganj
					•					
•	STATIO	ON 20	)17		20	18		2	2019	2020
	Harshil		IF.		N	F	•		NF	NF
	Tehr	i (	55		N	F			NF	NF
	Haridwar		NF		3	0	NF		NF	
	Bijnor		IF		N	F			5	NF
	Naror	<b>a</b> 1	15		N	F			NF	NF
	Farrukha	abad N	1F		N	F			NF	NF
	Kanpu	ır N	<b>IF</b>			F	NF		NF	NF
	Prayag	raj N	NF		N	F	NF		NF	NF
	Varana	asi 1	180		N	F	NF		NF	NF
	Buxa	r N	<b>IF</b>		N	F	8		8	NF
	Patna	n N	<b>IF</b>		N	F	NF		NF	NF
	Bhagalr	our N	IF .		N	F	NF		NF	NF
	Farakl	ka N	<b>IF</b>		N	F			NF	NF
	Jangip	ur N	<b>IF</b>		N	F			NF	NF
	Berhamp	oore N	<b>IF</b>		N	F			NF	NF
	Balaga	rh N	NF		N	F	N		NF	NF
	Tribei	ni N	1F		N	F			NF	NF
	Godakh	nali N	NF		N	F			NF	NF
	D. Harb	our N	NF		N	F	NF		NF	NF
	Fraserg	anj N	IF .		N	F			NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Eunotia sp. (Ehrenberg, 1837)



Class: Bacillariophyceae

**Order:** Eunotiales

Family: Eunotiaceae

Genus: Eunotia sp.

### **Identifying feature:**

❖ Various shaped valves (dorsiventral to lunate) are present.

❖ In girdle view, cells look as rectangular.

❖ Sometimes, cell has an undulate dorsal margin.

Cell has two elongated plastids that are lying on the ventral side and extending towards the valve faces.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with Transparency, Dissolved Oxygen and Total Phosphate.



#### **Station wise Distribution:**

Upper stretch											
H	arshil		Tehri	Haridwar		Bij	nor	Na	arora	Farrukh	abad
	Middle str	etch									
K	anpur	Pray	/agraj	Varanasi	Buxa	r	Patna		Bhagalpur	Farakk	a
_	Lower stre		- 1	<b>D</b> 1 1					D 77 1	1	
Ja	angipur	Ber	hampore	Balagarh	Tribe	nı	Godakh	alı	D. Harbour	Fraser	ganj
	STATI	ON	201	17	2018			2019	<u> </u>	2020	
	Harsh		NI	•	50		·	10		30	
	Tehr	i	NI	F	35			20		NF	
	Haridy	var	10	)	20		NF			NF	
	Bijno	r	NI	₹	NF		NF			NF	
	Naroi	ra	NI	F	NF		NF			NF	
	Farrukh	abad	NI	T	NF			NF		NF	
	Kanpı	ur	10	)	NF		NF			NF	
	Prayag	raj	5		NF		NI			NF	
	Varan	asi	NI	F	NF		NF			NF	
	Buxa	r	NI	F	NF	NI		NF		NF	
	Patna	a	NI	F	NF			NF		NF	
	Bhagal	pur	NI	₹	NF			NF		NF	
	Farak	ka	NI	F	NF			NF		NF	
	Jangipur		NI	F	NF			NF		NF	
	Berhampore		NI	F	NF			NF		NF	
	Balaga	rh	NI	?	NF			NF		NF	
	Tribe	ni	NI	<b>?</b>	NF			NF		NF	
	Godakl	hali	NI	<u> </u>	NF			NF		NF	
	D. Harb	our	NI	₹	NF			NF		NF	
				_							

**↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.

NF

NF

**↓** The annual average of four seasons are shown in the table.

NF

**↓** NF – Phytoplankton was not found at that time of sampling.



Fraserganj

NF

# Fragilaria sp. (Lyngbye, 1819)



Class: Bacillariophyceae

**Order:** Fragilariales

Family: Fragilariaceae

Genus: Fragilaria sp.

# **Identifying feature:**

\* Cells are joined to form ribbon-like colonies.

❖ In the girdle view, cells look like oblong at center.

Cells have two plate-shaped plastids.

❖ Valves are variously shaped like linear, linear-lanceolate, or elliptical.

❖ Spines are present surrounding the mantle-face junction.

**Habitat:** Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Dissolved Oxygen.



### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### Lower stretch

Ja	ngipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
	COD A FOX	ON AG	.d. ##	2010	201	0	2020
1	STATIO	· · · · · · · · · · · · · · · · · · ·	017	2018	201	-	2020
	Harsh		0	NF	NI		NF
	Tehr	i N	F	NF	NI	7	NF
	Haridy	var 1	55	25	NF	י	NF
	Bijno	r 1	35	100	140	)	NF
	Naror	ra 2	5	105	15		NF
	Farrukha	abad N	F	NF	NF	י	NF
	Kanpı	ur 1	5	NF	55		NF
	Prayag	raj N	F	NF	NI	7	NF
	Varana	asi N	F	10	190	)	NF
	Buxa	r '	7	8	32		NF
	Patna	a 2	3	12	180	)	NF
	Bhagalı	pur 1	2	4	NI	7	NF
	Farakl	ka 3	5	NF	75		NF
	Jangip	our 3	1	3	184	4	NF
	Berham	pore 3	9	3	434	4	NF
	Balaga	rh	6	NF	170	5	NF
	Tribe	ni 2	5	NF	889	)	NF
	Godakl	nali 1	3	1	16		10
	D. Harb	our	3	NF	20		25
	Fraserg	anj	3	2	3		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Frustulia sp. (Rabenhorst, 1853)



Class: Bacillariophyceae

**Order:** Naviculales

Family: Amphipleuraceae

Genus: Frustulia sp.

# **Identifying feature:**

Cells have two plate-like plastids, each containing a central pyrenoid.

Valves are lanceolate to rhomboidal in shape but sometimes posses slightly capitates apices.

\* Raphe slits are flanked by siliceous ribs.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Variable parameters are required for the genus.



#### **Station wise Distribution:**

#### **Upper stretch**

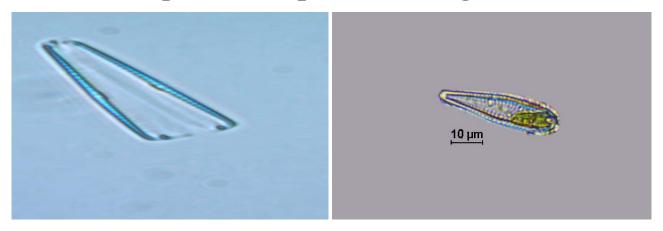
Harshil	Tehri Va		anasi	Haridwar	Bijnor	Narora	Farrukhabad			
Middle stretch										
Kanpur	Prayagraj		Varanasi	Buxar	Patna	Bhagalpur	Farakka			
Lower stre	tch									
Jangipur	Berhampo	re	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj			

STATION	2017	2018	2019	2020
Harshil	110	NF	NF	NF
Tehri	NF	NF	NF	NF
Haridwar	NF	NF	NF	NF
Bijnor	NF	NF	NF	NF
Narora	NF	NF	NF	NF
Farrukhabad	NF	NF	NF	NF
Kanpur	NF	NF	NF	NF
Prayagraj	15	NF	NF	NF
Varanasi	20	NF	NF	NF
Buxar	NF	NF	NF	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	NF	NF	NF
Farakka	NF	NF	NF	NF
Jangipur	NF	NF	NF	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	NF	NF	NF
Tribeni	NF	10	5	NF
Godakhali	NF	NF	NF	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Gomphonema sp. (Ehrenberg, 1832)



Class: Bacillariophyceae

**Order:** Cymbellales

Family: Gomphonemataceae

**Genus:** *Gomphonema* sp.

# **Identifying feature:**

In the valve view, cells look as heteropolar and in the girdle view wedge-shaped.

❖ Valve apices are various shaped i.e. protracted or capitates.

❖ A single plastid is present which is warped in valve faces.

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with Dissolved Oxygen.



#### **Station wise Distribution:**

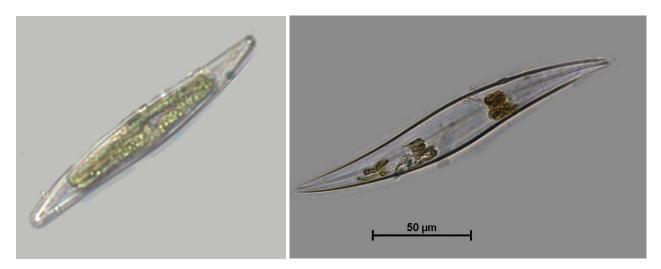
#### **Upper stretch**

Harshil	Tehri	Haridwar	Bijno	r Naro	ra	Farrukhabad
Middle str	etch					
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpu	r Farakka
Lower str	etch					
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbou	ır Fraserganj
STA	TION	2017	2018	2019		2020
	rshil	50	90	10	•	20
To	ehri	25	45	25		NF
	idwar	100	30	30		60
Bi	jnor	NF	40	60		50
Na	rora	100	NF	135		NF
Farru	khabad	NF	100	120		NF
Ka	npur	10	NF	10		NF
Pray	yagraj	NF	20	NF		NF
Var	anasi	NF	10	NF		NF
Bu	ıxar	10	25	NF		NF
Pa	atna	10	12	2		NF
Bha	galpur	10	NF	1		NF
Far	akka	25	10	NF		NF
Jan	gipur	15	5	NF		NF
Berha	ampore	10	NF	15		NF
Bala	agarh	NF	NF	NF		NF
Tr	ibeni	NF	NF	NF		NF
God	akhali	NF	NF	NF		NF
D. H	arbour	NF	NF	NF		NF
Fras	erganj	NF	NF	NF		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Gyrosigma sp. (Hassall, 1845)



Class: Bacillariophyceae

**Order:** Naviculales

Family: Naviculaceae

Genus: Gyrosigma sp.

# **Identifying feature:**

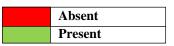
- ❖ The shapes of valves are linear to lanceolate-sigmoid, the girdle look narrowly rectangular.
- ❖ The pat of raphe is sigmoid.
- Cells have two plates like chloroplast which are lying at each side of girdle.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Carbonate, Ca<sup>++</sup>, Mg<sup>++</sup>, Total Hardness and Specific Conductivity.



#### Station wise Distribution: Upper stretch

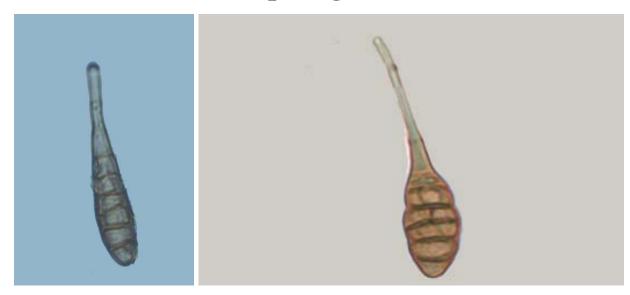


Harshil	Tehri		Haridwar		Bijnor		Naro	ra	Farrukhabad	
Middle s						1				
Kanpur	Prayagra	aj	Varanasi	В	uxar	Patna		Bhagalpur		Farakka
Lower st				1		T				
Jangipur	Berhamp	ore	Balagarh	T	ribeni	Godakhali		D. Harbour		Fraserganj
STAT	TION	20	17		2018		201	9		2020
Har	shil	N	F		NF		NI	र		NF
Tel	hri	N	F		NF		NI	7		NF
Hario	Haridwar		$\mathbf{F}$		5		NI	र		NF
Bijı	Bijnor		F		50	NF			NF	
Nar	Narora		F		NF	NF		7		NF
Farruk	habad	N	F		NF		NI	7		NF
Kan	pur	N	F		NF		NI	7		NF
Praya	agraj	NF			NF	NF		י		NF
Vara	nasi	N	NF		NF		NI	<b>?</b>		NF
Bux	kar	2	2		NF		2		NF	
Pat	na	N	F		10		NI	र		NF
Bhaga	alpur	N	F		NF		NI	र		NF
Fara	kka	N	F		NF		NI	र		NF
Jang	ipur	N	F		NF		NI	₹		NF
Berhai	mpore	N	F		NF		NI	?		NF
Bala			F		NF	2			14	
Trib	oeni	N	F		10		NI	र		NF
Goda	khali	N	F		NF		5			10
D. Ha	rbour	(	5		1		5			15
Frase	rganj	1	7		5		9			35

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Meridion sp. (Agardh, 1824)



Class: Bacillariophyceae

**Order:** Tabellariales

Family: Tabellariaceae

Genus: Meridion sp.

# **Identifying feature:**

- Cells are joined to form fan-shaped colonies and cells attached by their valve face.
- \* Across the valves ribs are prominent.
- Plastids are irregularly arranged and lying along the valve face.
- ❖ Plastids are discoid and numerous (8-12).

**Habitat:** Freshwater

Major Ecological Parameters: Highly positive correlation was

found with BOD and Total Dissolved Solid.



# Station wise Distribution: Upper stretch

Н	Harshil		Tehri	Haridwar		Bij	nor	Na	arora	Fa	Farrukhabad	
	Middle str						1		T			
K	anpur	Pra	yagraj	Varanasi	Buxa	r	Patna		Bhagalpur		Farakka	
	Lower stretch					•		•				
Ja	ngipur	Be	rhampore	Balagarh	Tribeni		Godakhali		D. Harbour		Fraserganj	
	STATI	ON	20	)17	201	<b>D</b>		20	19		2020	
	Harsl		-	F	40	•	<u> </u>		0		30	
	Tehi	ri	6	55	30			6	<b>50</b>		20	
	Haridy			)5	65				F		NF	
				45	20				0		NF	
	Narora			50	10		5			NF		
	Farrukhabad			70	60				I <b>F</b>		NF	
	Kanp			10	40		45				NF	
	Prayag			30	200	)	NF			NF		
	Varan			50	30		NF				NF	
	Buxa			I <b>F</b>	NF				F			
	Patn			IF	NF		NF			NF		
	Bhagal			IF	NF				IF		NF	
	Farak			IF	NF				IF		NF	
	Jangir			I <b>F</b>	NF				F		NF	
	Berham			IF	NF				F		NF	
	Balagarh			I <b>F</b>	NF				<b>F</b>		NF	
	Tribe			IF	NF				IF		NF	
	Godak			IF	NF				IF	NF		
	D. Harl			IF	NF		NF			NF		
	Fraser			I <b>F</b>	NF				NF		NF	
	Frasci	Sanj	1		141			1			TAT	

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Navicula sp. (Bory de St. Vincent, 1822)



Class: Bacillariophyceae

Order: Naviculales

Family: Naviculaceae

Genus: Navicula sp.

# **Identifying feature:**

- ❖ Cells have two plates like chloroplast which are present at either side of the girdle.
- ❖ Valves are variably shaped like linear to broadly lanceolate, or elliptic-lanceolate.
- Sometimes Valves have variously protracted or subcapitate apices.

Habitat: Freshwater and Brackish water

Major Ecological Parameters: Highly positive correlation was

found with Silicate, and Total Dissolved Solid.



# **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad
34:111 4 4 1					

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### **Lower stretch**

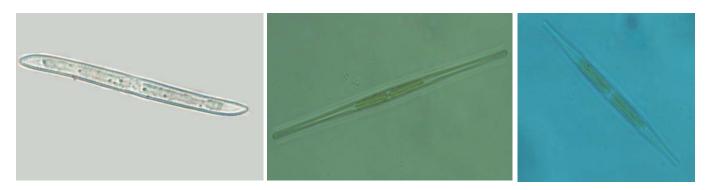
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj

STATION	2017	2018	2019	2020
Harshil	NF	NF	20	NF
Tehri	30	20	145	80
Haridwar	265	130	135	90
Bijnor	219	NF	20	110
Narora	10	30	NF	120
Farrukhabad	80	50	60	30
Kanpur	190	115	55	NF
Prayagraj	270	90	NF	NF
Varanasi	70	35	60	100
Buxar	10	65	1265	NF
Patna	3	15	272	NF
Bhagalpur	NF	89	3353	NF
Farakka	9	24	1	NF
Jangipur	NF	9	50	NF
Berhampore	7	15	7	NF
Balagarh	NF	12	10	NF
Tribeni	NF	14	154	NF
Godakhali	NF	11	20	NF
D. Harbour	NF	12	10	NF
Fraserganj	NF	45	10	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Nitzschia sp. (Hassall, 1845)



Class: Bacillariophyceae

**Order:** Bacillariales

Family: Bacillariaceae

Genus: Nitzschia sp.

### **Identifying feature:**

- Cells are often narrowly linear in shape along acute apices. But sometimes, it is sigmoid.
- \* Two plastids are arranged before and after in the cell.
- ❖ The raphe slits are often on a keel near one valve margin, which is subtended by a series of ribs.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Dissolved Oxygen, BOD, Chloride, Nitrite and Specific Conductivity.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### Lower stretch

Ja	ngipur	Berhampor	e Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
	STATI	ION	2017	2018	201	9	2020
	Hars	hil	NF	NF	NI	7	NF
	Teh	ri	NF	20	20		NF
	Haridwar		10	NF	135	5	20
	Bijn	or	NF	NF	75		60
	Naro	ra	NF	5	65		180
	Farrukh	nabad	80	NF	130	)	20
	Kanpur Prayagraj Varanasi		120	150	NF	7	70
			95	175	40		140
			NF	190	70		NF
	Buxa	ar	NF	1	5		NF
	Patr	ıa	32	5	76		NF
	Bhaga	lpur	1	NF	7		NF
	Farak	kka	16	NF	1		NF
	Jangij	pur	NF	1	NI	י	NF
	Berham	pore	NF	4	4		NF
	Balag	arh	5	7	9		NF
	Tribeni		27	NF	32		NF
	Godak	hali	18	5	17		NF
	D. Har	bour	NF	19	NF	7	NF
	Fraser	ganj	2	4	3		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Pinnularia sp. (Ehrenberg, 1835)



Class: Bacillariophyceae

**Order:** Naviculales

Family: Pinnulariaceae

Genus: Pinnularia sp.

# **Identifying feature:**

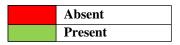
- Usually, cells have two plate-like plastids, both the plastids are present in each side of the girdle.
- Some cells may have a single pyrenoid at the center of each chloroplast plate.
- ❖ The margins move under the valve face and variously lobed.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Total Solid.



### Station wise Distribution: Upper stretch

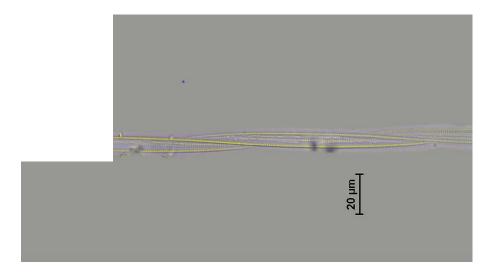


Harshil Tehri		Haridwai	r Bijno	Bijnor Narora		Farrukhabad	
Middle	stretch		•				
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka	
Lower s	tretch						

Jan	gipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
_							
-	STATIO	<del>.</del>	17	2018	201	<del>-</del>	2020
	Harsh	il 4	0	NF	NF	1	NF
	Tehr	i N	$\mathbf{F}$	NF	NF	•	NF
	Haridw	var N	F	NF	NF	1	NF
	Bijno	r N	F	NF	30		NF
	Naror	ra 2	0	NF	NF	•	NF
	Farrukha	abad N	F	NF	NF	1	NF
	Kanpı	ır 1	0	NF	NF	•	NF
	Prayag	raj 3	5	NF	NF	1	NF
	Varana	asi 5	5	NF	NF	1	NF
	Buxa	r N	$\mathbf{F}$	6	NF	1	NF
	Patna	a N	$\mathbf{F}$	6	17		NF
	Bhagalı	our N	$\mathbf{F}$	NF	NF	1	NF
	Farakl	ka N	$\mathbf{F}$	NF	NF	1	NF
	Jangip	ur N	$\mathbf{F}$	NF	NF	1	NF
	Berhamı	pore N	$\mathbf{F}$	NF	NF	1	NF
	Balaga	rh N	$\mathbf{F}$	NF	NF	1	NF
	Tribe	ni N	F	NF	NF	1	NF
	Godaki	nali N	F	NF	9		NF
	D. Harb	our N	F	NF	NF		NF
	Fraserg	anj N	F	15	4		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.

# Pseudonitzschia sp. (Peragallo, 1900)



Class: Bacillariophyceae

**Order:** Bacillariales

Family: Bacillariaceae

Genus: Pseudo-nitzschia sp.

# **Identifying feature:**

- Cells are narrow and fusiform and joined in a stepped chain with overlapping valve end.
- Cell contains two plates like chloroplast and situated along the girdle.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Total Dissolved Solid.



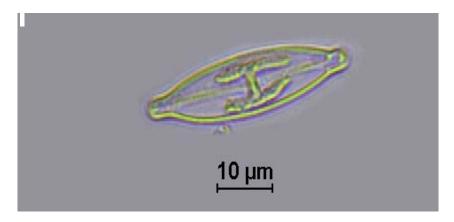
# Station wise Distribution: Upper stretch

Harshil	Tehri	Haridwar		Bij	jnor Narora		rora	Farrukhabad
Middle str		<b>T</b> 7			<b>D</b> (		DI I	
Kanpur	Prayagraj	Varanasi	Buxar		Patna		Bhagalpur	Farakka
Lower stre Jangipur	tch Berhampore	Balagarh	Triben	.;	Godakha	1;	D. Harbour	Fraserganj
Jangipui	Bernampore	Dalagaili	111001	LI.	Guakiia	111	D. Hai boui	Fraserganj
STATIO	ON 20	)17	201	Q .		20	)19	2020
Harsh		NF	NF				VF	NF
Tehr	i N	NF	NF	,		N	ı <b>F</b>	NF
Haridw	var N	NF	NF	1		N	<b>IF</b>	NF
Bijno	r N	NF	NF	1		N	ı <b>F</b>	NF
Naror	a N	<b>NF</b>	NF	•		N	<b>IF</b>	NF
Farrukha	abad N	NF	NF	,		N	ı <b>F</b>	NF
Kanpu	ır N	NF	NF	1		N	<b>IF</b>	NF
Prayag	ra <b>j</b>	10	NF	•		N	<b>IF</b>	NF
Varana	asi N	<b>NF</b>	NF	1		N	<b>IF</b>	NF
Buxa	r	1	1			N	<b>IF</b>	NF
Patna	a N	<b>NF</b>	NF	1		N	<b>IF</b>	NF
Bhagal	our N	NF .	NF	1		N	<b>IF</b>	NF
Farakl	ka N	NF	NF	1		N	F	NF
Jangip	ur N	NF	NF	•		N	<b>IF</b>	NF
Berhamp	pore N	NF	NF	1		N	<b>IF</b>	NF
Balaga	rh	5	1		NF		NF	
Tribei	ni N	NF	1		NF		NF	
Godakh	nali N	<b>NF</b>	NF	1	NF		NF	
D. Harb	our N	NF	NF	1	NF		NF	
Fraserg	anj N	<b>NF</b>	NF			N	<b>IF</b>	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Stauroneis sp. (Ehrenberg, 1843)



Class: Bacillariophyceae

**Order:** Naviculales

Family: Stauroneidaceae

Genus: Stauroneis sp.

### **Identifying feature:**

- Cells are solitary having two plastids, which are lying along the girdle sides and elongating under the valves.
- \* Each plastid contains one or many pyrenoids.
- \* Valves are linear to lanceolate shape.
- Striae are interrupted across the center of the valve to form a hyaline but sometimes thickened.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Specific Conductivity.



Absent
Present

### **Station wise Distribution:**

Upper stretch

Harshil		Tehri	Haridwar		Bijn	or	Na	arora	F	arrukhabad
Middle str										
Kanpur	Pr	ayagraj	Varanasi	Bux	ar	Patna		Bhagalpu	r	Farakka
Lower stre						<u> </u>				
Jangipur	Be	rhampore	Balagarh	Tribe	ni   (	Godakhal	li	D. Harbou	ır	Fraserganj
			_				•	10		
STATIO Harsh		201 NF		2018 NF	}		20 N			2020 NF
Tehr		NI		NF			N			NF
Haridw		NI		NF			N			80
Bijno		NI		20			N			NF
Naror		NI		5			1.			NF
Farrukha	abac	l NI	7	NF			N	F		NF
Kanpı	ır	NF	7	NF			N	F		NF
Prayag	raj	NF	י	NF			N	$\mathbf{F}$		NF
Varana	asi	NI	7	NF			N	F		NF
Buxa	r	NF	יז	NF			N	F		NF
Patna	a	NF	7	NF			N	F		NF
Bhagalı	pur	NI	7	NF			N	$\mathbf{F}$		NF
Farakl	ka	NF	7	NF			N	F		NF
Jangip	ur	NF	י	NF			N	F		NF
Berhamj	pore	. NI	7	NF			N	F		NF
Balaga	rh	NI	י	NF			NF			NF
Triber	ni	NI	7	NF			N	F		NF
Godaki	nali	NI	י	NF			N	$\overline{\mathbf{F}}$		NF
D. Harb	our	NF	7	NF			N	$\mathbf{F}$		NF
Fraserg	anj	NI	7	NF			N	F		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Surirella sp. (Turpin, 1828)



Class: Bacillariophyceae

**Order:** Surirellales

Family: Surirellaceae

Genus: Surirella sp.

# **Identifying feature:**

❖ Cells are heteropolar in the valve having girdle view.

❖ Sometimes cells have raised wings around the margins.

❖ A large lobed plastid plate is present under either of the valve face, which is linked by a narrow isthmus near one pole.

Habitat: Freshwater and Brackish water

Major Ecological Parameters: Highly positive correlation was

found with Silicate, Turbidity and Depth.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor N		ra Far	rukhabad	
Middle str	Middle stretch						
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka	

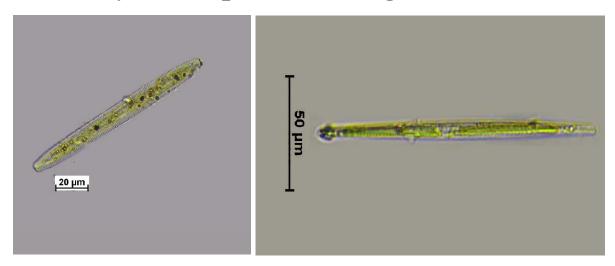
#### Lower stretch

Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
STATIO	ON 2017		2018	2019	)	2020
Harsh	il NF		NF	NF	,	NF
Tehr	i NF		NF	NF		NF
Haridw	var NF		NF	NF		NF
Bijno	r NF		NF	NF		NF
Naror	a NF		NF	NF		NF
Farrukha	abad NF		NF	NF		NF
Kanpı	ır NF		NF	NF		NF
Prayag	raj NF		NF	NF		NF
Varana	asi NF		NF	NF		NF
Buxa	r NF		NF	NF		NF
Patna	a NF		NF	NF		NF
Bhagal	pur NF		NF	NF		NF
Farakl	ka 3		NF	NF		NF
Jangip	ur NF		NF	NF		NF
Berham	pore 1		NF	2		NF
Balaga	rh 1		NF	NF		NF
Tribe	ni 1		2	NF		NF
Godaki	nali NF		NF	NF		NF
D. Harb	our NF		NF	NF		NF
Fraserg	anj NF		2	NF		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Synedra sp. (Ehrenberg, 1830)



Class: Bacillariophyceae

**Order:** Fragilariales

Family: Fragilariaceae

Genus: Synedra sp.

### **Identifying feature:**

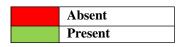
- Generally, cells are free-living but sometimes attached to a pad of mucilage to form a radiate colony.
- Cells possess two plastids that are lying against the girdles and overlapping slightly onto the valves.
- Usually, valves are linear, sometimes capitates, or centrally inflated.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Dissolved Oxygen, BOD, Free Co<sub>2</sub>, Chloride, Total Dissolved Solid.



#### Station wise Distribution: Upper stretch



Harshil		Tehri	Haridwa	r	Bi	jnor	Narora	Farrukhabad
Middle st				1		1		
Kanpur	Pra	yagraj	Varanasi	Buxar		Patna	Bhagalpur	Farakka
Lower str	1		Dalamak	Tr:1:		C - J - L L - P	D II	E
Jangipur	Ber	hampore	Balagarh	Tribeni		Godakhali	D. Harbour	Fraserganj
STAT	ION	2	017	201	8	2	019	2020
Hars	hil		NF	20		]	NF	NF
Teh	ri		85	70		1	150	40
Harid	war	1	070	565	5		50	95
Bijn	or		80	80		2	250	NF
Naro	ra		20	45		1	115	NF
Farrukl	naba	d 2	220	200	)	3	310	40
Kanp	our		80	565	5	3	315	110
Praya	graj		73	235	5	2	240	100
Varar	nasi		50	215	5	3	300	NF
Bux	ar		NF	3			4	NF
Patr	ıa		5	32			35	NF
Bhaga	lpur		NF	4			40	NF
Farak	kka		9	NF	1		16	NF
Jangi	pur		4	37		]	NF	NF
Berham	pore	9	1	4			94	NF
Balag	arh		14	NF	1	1	112	NF
Tribe	eni		NF	2		1	197	NF
Godak	hali		2	15	15		17	NF
D. Har	bour		2	28			10	NF
Fraser	ganj		2	3			2	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Tabellaria sp. (Ehrenberg ex kutzing, 1844)



Class: Bacillariophyceae

**Order:** Tabellariales

Family: Tabellariaceae

Genus: Tabellaria sp.

### **Identifying feature:**

- ❖ Cells are connected with each other in a long zig-zag manner to form partially linear or stellate colonies by forming mucilage pads.
- ❖ Plastids are short stripe-like present between the septa.
- Usually, valves are elongate, slightly capitates, and equally or more inflated in the central region.
- ❖ Sometimes the septa are extended to almost half the length of a cell.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with BOD, Chloride and Total-N.



# Station wise Distribution: Upper stretch

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### Lower stretch

Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
STATION			2018		19	2020
Harshil	NF		50	4	10	NF
Tehri	35		20	50	00	115
Haridwar	35		120	1	90	50
Bijnor	143		400	2.	35	NF
Narora	73		195	1	35	NF
Farrukhaba	ad 455		1000	32	20	NF
Kanpur	NF		756	30	)25	NF
Prayagraj	40		160	2	80	NF
Varanasi	40		20	9	00	NF
Buxar	NF		NF	N	<b>IF</b>	NF
Patna	NF		NF	N	<b>IF</b>	NF
Bhagalpui	r NF		NF	N	<b>IF</b>	NF
Farakka	NF		NF	N	IF .	NF
Jangipur	NF		NF	N	<b>IF</b>	NF
Berhampor	e NF		NF	N	<b>IF</b>	NF
Balagarh	NF		NF	N	<b>IF</b>	NF
Tribeni	NF		NF	N	<b>IF</b>	NF
Godakhal	i NF		NF	N	<b>IF</b>	NF
D. Harbou	r NF		NF	N	IF .	NF
Frasergan	j NF		NF	N	IF	NF

- **★** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Tryblionella sp. (Smith, 1853)



Class: Bacillariophyceae

**Order:** Bacillariales

Family: Bacillariaceae

Genus: Tryblionella sp.

### **Identifying feature:**

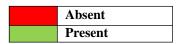
❖ The shapes of valves are linear to lanceolate; sometimes at the center a constriction is present.

Cells have two plastids which are present one on each side of the central cytoplasm.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Turbidity, Free CO<sub>2</sub>, Nitrate and Total Dissolved Solid.





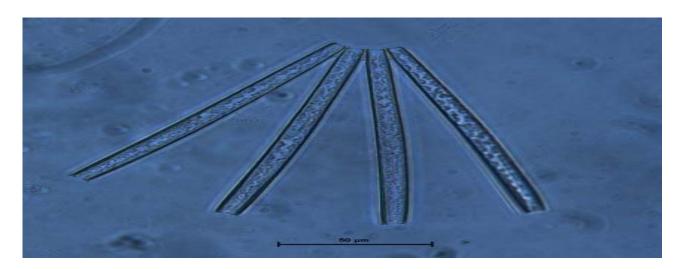
# Station wise Distribution: Upper stretch

Harshil		Tehri	Ha	ridwar		Bij	nor	or Narora		arora	Farrukhaba	
Middle str				<b>X</b> 7	•	ъ		D. 4		DI I		T 1 1 .
Kanpur		Prayagraj		Varanas	S1 	Bı	ıxar	Patr	ıa	Bhagalpi	ır	Farakka
Lower stro		erhampore	Pal	Balagarh Tribei		ni	i Godakhali		D. Harbour		Tr.	rasergan <u>j</u>
Jangipur	Ве	ernampore	Dai	agarn	Tribe	:111	Godaki	1411	υ.	narbour	<b>F</b> .	raserganj
STATI	ON	20	17		2018	}		20	19		2	2020
Harsh	nil	5	0	•	25			N	F			NF
Tehr	i		3		15			N	F			NF
Haridy	var	N	F		NF			N	F			NF
Bijno	r	N	F		NF			N	F			NF
Naro	ra	N	F		NF			N	F			NF
Farrukh	aba	d N	F		NF			N	F			NF
Kanp	ur	N	F		NF			N	F			NF
Prayag	raj	3	0		NF			N	F			NF
Varan	asi	N	F		NF			1	0			NF
Buxa	r	N	F		NF			N	F			NF
Patn	a	N	F		NF			N	F			NF
Bhagal	pur	N	F		NF			3	3			NF
Farak	ka	N	F		NF			N	F			NF
Jangip	ur	N	F		NF			N	F			NF
Berham	Berhampore		F		NF		NF				NF	
Balaga	Balagarh		NF		NF			NF			NF	
Tribe	Tribeni		NF		NF	NF		NF			NF	
Godak	hali	N	NF		NF	N		N	NF			NF
D. Hark	our	· N	F		NF			N	F			NF
Fraserg	ganj	N	F		NF			N	F			NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Thallasionema sp. (Grunow ex Mereschkowsky, 1902)



Class: Bacillariophyceae

Order: Bacillariales

Family: Bacillariaceae

**Genus:** Thallasionema sp.

### **Identifying feature:**

- Frustules are long and needle-shaped, which are united to form a zigzag colony.
- ❖ Valves are furnished with marginal areolae.

Habitat: Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Ca <sup>++</sup>, Mg <sup>++</sup>, Total Hardness and Salinity.



#### **Station wise Distribution:**

**Upper stretch** 

Middle stretch  Kanpur Prayagraj Varanasi Buxar Patna Bhagalpur Fara  Lower stretch		
Lower stretch   Jangipur   Berhampore   Balagarh   Tribeni   Godakhali   D. Harbour   Frase	arrukhabad	
Lower stretch   Jangipur   Berhampore   Balagarh   Tribeni   Godakhali   D. Harbour   Frase		
Lower stretch  Jangipur Berhampore Balagarh Tribeni Godakhali D. Harbour Frase  STATION 2017 2018 2019 2020  Harshil NF NF NF NF NF  Tehri NF NF NF NF NF  Haridwar NF NF NF NF NF  Bijnor NF NF NF NF NF  Narora NF NF NF NF NF  Farrukhabad NF NF NF NF NF  Kanpur NF NF NF NF NF  Prayagraj NF NF NF NF NF  Varanasi NF NF NF NF NF  Buxar NF NF NF NF NF  Patna NF NF NF NF NF  Bhagalpur NF NF NF NF		
STATION   2017   2018   2019   2020     Harshil   NF	kka	
STATION   2017   2018   2019   2020     Harshil   NF		
STATION 2017 2018 2019 2020  Harshil NF NF NF NF NF  Tehri NF NF NF NF NF  Haridwar NF NF NF NF NF  Bijnor NF NF NF NF NF  Narora NF NF NF NF NF  Farrukhabad NF NF NF NF NF  Kanpur NF NF NF NF NF  Prayagraj NF NF NF NF NF  Varanasi NF NF NF NF NF  Buxar NF NF NF NF NF  Patna NF NF NF NF		
HarshilNFNFNFTehriNFNFNFNFNFNFNFHaridwarNFNFNFNFNFNFNFNaroraNFNFNFFarrukhabadNFNFNFKanpurNFNFNFPrayagrajNFNFNFVaranasiNFNFNFBuxarNFNFNFPatnaNFNFNFBhagalpurNFNFNF	Fraserganj	
HarshilNFNFNFTehriNFNFNFNFNFNFNFHaridwarNFNFNFNFNFNFNFNaroraNFNFNFFarrukhabadNFNFNFKanpurNFNFNFPrayagrajNFNFNFVaranasiNFNFNFBuxarNFNFNFPatnaNFNFNFBhagalpurNFNFNF		
HarshilNFNFNFTehriNFNFNFNFNFNFNFHaridwarNFNFNFNFNFNFNFNaroraNFNFNFFarrukhabadNFNFNFKanpurNFNFNFPrayagrajNFNFNFVaranasiNFNFNFBuxarNFNFNFPatnaNFNFNFBhagalpurNFNFNF		
HaridwarNFNFNFBijnorNFNFNFNaroraNFNFNFFarrukhabadNFNFNFKanpurNFNFNFPrayagrajNFNFNFVaranasiNFNFNFBuxarNFNFNFPatnaNFNFNFBhagalpurNFNFNF		
Bijnor NF NF NF NF NF Narora NF NF NF NF NF Farrukhabad NF NF NF NF NF Kanpur NF NF NF NF NF Prayagraj NF NF NF NF NF Varanasi NF NF NF NF NF Buxar NF NF NF NF NF NF Patna NF NF NF NF NF		
NaroraNFNFNFFarrukhabadNFNFNFKanpurNFNFNFPrayagrajNFNFNFVaranasiNFNFNFBuxarNFNFNFPatnaNFNFNFBhagalpurNFNFNF		
FarrukhabadNFNFNFKanpurNFNFNFPrayagrajNFNFNFVaranasiNFNFNFBuxarNFNFNFPatnaNFNFNFBhagalpurNFNFNF		
KanpurNFNFNFPrayagrajNFNFNFVaranasiNFNFNFBuxarNFNFNFPatnaNFNFNFBhagalpurNFNFNF		
Prayagraj NF NF NF NF  Varanasi NF NF NF NF  Buxar NF NF NF NF NF  Patna NF NF NF NF NF  Bhagalpur NF NF NF NF		
VaranasiNFNFNFBuxarNFNFNFPatnaNFNFNFBhagalpurNFNFNF		
BuxarNFNFNFPatnaNFNFNFBhagalpurNFNFNF		
PatnaNFNFNFBhagalpurNFNFNF		
Bhagalpur NF NF NF NF		
Farakka NF NF NF NF		
Jangipur NF NF NF NF		
Berhampore NF NF NF NF		
Balagarh NF NF NF NF		
Tribeni NF NF NF NF		
Godakhali NF NF NF NF		
D. Harbour NF NF NF NF		
Fraserganj 3 NF 6 NF		

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **★** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



### Aulacoseira sp. (Thwaites, 1848)



Class: Coscinodiscophyceae

**Order:** Aulacoseirales

Family: Aulacoseiraceae

Genus: Aulacoseira sp.

### **Identifying feature:**

❖ The cells are tightly connected to form long filaments.

- ❖ Cell wall having rows of dots and a ring of spines, present at end of the cell.
- ❖ The deep valve mantle forms right-angled junction with the valve face. Valves are striate.
- ❖ Small disc or plates-like chloroplasts are present.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Depth and Dissolved Oxygen.



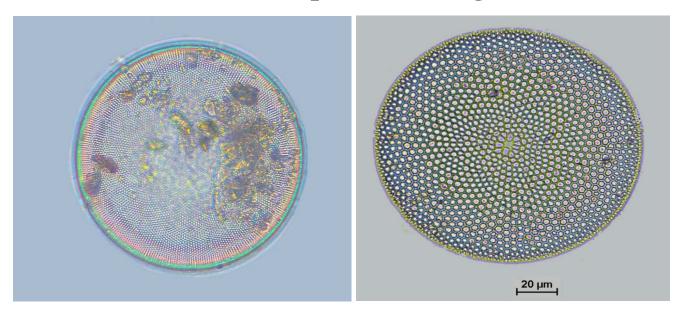
#### Station wise Distribution: Upper stretch

kka
kka
kka
rganj

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### Coscinodiscus sp. (Ehrenberg, 1839)



Class: Coscinodiscophyceae

**Order:** Coscinodiscales

Family: Coscinodiscaceae

Genus: Coscinodiscus sp.

### **Identifying feature:**

- ❖ Areola shows a radial pattern, originates from the center to the margin
- ❖ Many chloroplasts are present.
- ❖ The chloroplast is disc-shaped.
- ❖ The central area may or may not be hyaline.

**Habitat:** Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Water temperature, Depth, Velocity, Turbidity, Total Hardness and Salinity.



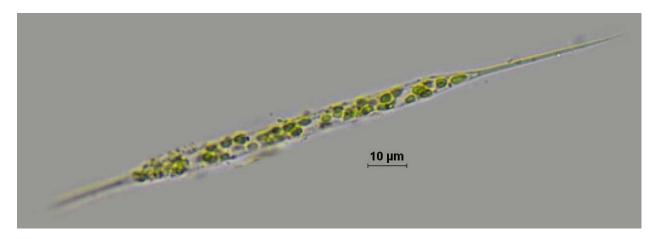
## Station wise Distribution: Upper stretch

Harshil		Tehri	Haridwar		Bijn	or	Naı	rora	Fai	rrukhabad
Middle str	etch							_		
Kanpur	Pr	ayagraj	Varanasi	Bu	xar	Patn	a	Bhagalı	pur	Farakka
Lower stre				,	ı				ı	
Jangipur	Be	rhampore	Balagarh	Trib	eni	Godak	hali	D. Harbo	our	Fraserganj
STATION		2017	2018			2019		2	020	
Harshil		NF		NF			NF			NF
Tehri		NF		NF			NF			NF
Haridwar	•	NF		NF			NF			NF
Bijnor		NF		NF			NF			NF
Narora		NF		NF			NF			NF
Farrukhab	ad	NF		NF			NF			NF
Kanpur		NF		NF			NF			NF
Prayagra	j	NF		NF			NF			NF
Varanasi		NF		NF			NF			NF
Buxar		NF		NF			NF			NF
Patna		NF		NF			NF			NF
Bhagalpu	r	NF		NF			NF			NF
Farakka		NF		3			1			NF
Jangipur		NF		2			NF			NF
Berhampo	re	NF		NF			NF			NF
Balagarh		NF		20			4			NF
Tribeni		2		NF			1			NF
Godakhal	i	264		112			107			NF
D. Harbou	r	140		198			136			8870
Frasergan	j	184		88			51			185

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### Rhizosolenia sp. (Brightwell, 1858)



Class: Coscinodiscophyceae

**Order:** Rhizosoleniales

Family: Rhizosoleniaceae

Genus: Rhizosolenia sp.

### **Identifying feature:**

- ❖ The cell is of cylindrical shape and the size of the cell varies short to very long, straight, or curved.
- \* Cells are solitary or in a long chain.
- ❖ Apex terminates into a pointed process.
- ❖ Many plate-like plastids are present.

Habitat: Brackish water

Major Ecological Parameters: Highly positive correlation was

found with Total Hardness and Salinity.



#### **Station wise Distribution:**

**Upper stretch** 

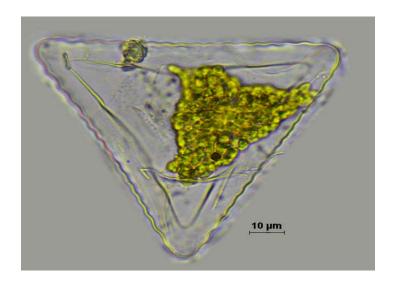
Harshil	Tehri	Haridwar	Bi	jnor	Narora	Farrukhabad
Middle stre	etch					
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka
Lower stretch		<u> </u>				<u> </u>
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
STATION	2017	201	8	2019	20	)20
STATION Harsh		2018 IF	8 NF	2019	NF 20	)20 NF

STATION	2017	2018	2019	2020
Harshil	NF	NF	NF	NF
Tehri	NF	NF	NF	NF
Haridwar	NF	NF	NF	NF
Bijnor	NF	NF	NF	NF
Narora	NF	NF	NF	NF
Farrukhabad	NF	NF	NF	NF
Kanpur	NF	NF	NF	NF
Prayagraj	NF	NF	NF	NF
Varanasi	NF	NF	NF	NF
Buxar	NF	NF	NF	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	NF	NF	NF
Farakka	NF	NF	NF	NF
Jangipur	NF	NF	NF	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	NF	NF	NF
Tribeni	NF	NF	NF	NF
Godakhali	NF	NF	NF	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	1	2	5	2

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### Triceratium sp. (Ehrenberg, 1839)



Class: Coscinodiscophyceae

**Order:** Triceratiales

Family: Triceratiaceae

Genus: Triceratium sp.

### **Identifying feature:**

❖ Valves are triangular or square in shape.

❖ Valves are ornamented having simple or branched spines.

❖ Areolae are loculate.

Habitat: Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Salinity and Total Hardness.



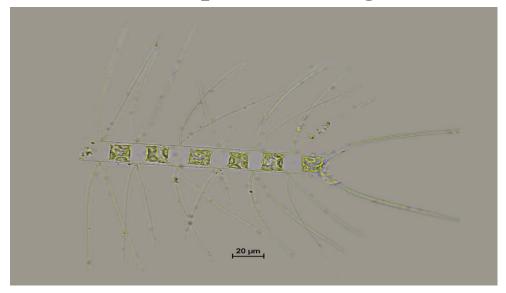
### **Station wise Distribution:**

Upper stretch						
Harshil	Tehri	Haridwar	Bijnor		Narora	Farrukhabad
Middle str		T = 7			D1 1	
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpu	r Farakka
Lower stre			,	,		
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
STATI	-	017	2018	201		2020
Harsh	nil	NF	NF	NI	₹	NF
Tehr	i	NF	NF	NI	Ŧ	NF
Haridy	var	NF	NF	NI	₹	NF
Bijno	or .	NF	NF	NI	र	NF
Naroi	ra	NF	NF	NI	T	NF
Farrukh	abad	NF	NF	NI	7	NF
Kanp	ur	NF	NF	NI	T	NF
Prayag	graj	NF	NF	NI	<b>T</b>	NF
Varan	asi	NF	NF	NI	Ŧ	NF
Buxa	r :	NF	NF	NI	₹	NF
Patn	<b>a</b>	NF	NF	NI	F	NF
Bhagal	pur	NF	NF	NI	 र	NF
Farak		NF	NF	NI	₹	NF
Jangip		NF	NF	NI		NF
Berham		NF	NF	NI		NF
Balaga		NF	NF	NI		NF
Tribe		NF	NF	NI		NF
Godakl		NF	NF	NI		NF
D. Harb	oour	NF	1	NI	7	NF
Fraserg	ganj	NF	NF	1		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### Chaetoceros sp. (Ehernberg, 18844)



Class: Mediophyceae

**Order:** Chaetocerotales

Family: Chaetocerotaceae

Genus: Chaetoceros sp.

### **Identifying feature:**

\* Cells are solitary or in a short-chains.

❖ In girdle view, cell looks rectangular while elliptical in the valve view.

❖ Cells are jointed by the fusion of setae produced from the valve.

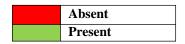
Chloroplasts are scattered in cells and its number varies.

**Habitat:** Brackish water

Major Ecological Parameters: Highly positive correlation was

found with Total Alkalinity, Total Hardness and Salinity.





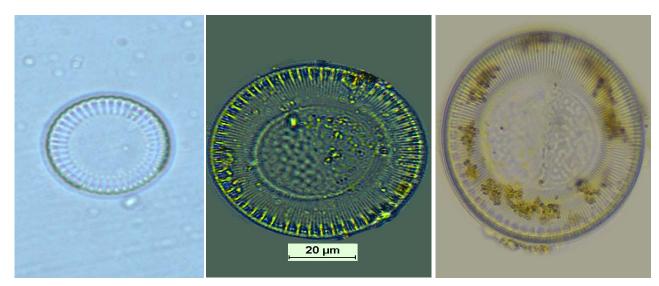
# Station wise Distribution: Upper stretch

Harshil	Tehri	Haridwar	Bijn	or	Na	rora	Farrukhabad
Middle str	etch						
Kanpur	Prayagraj	Varanasi	Buxar	Pa	tna	Bhagalpu	r Farakka
Lower stre	atch						
Jangipur	Berhampore	Balagarh	Tribeni	Godak	hali l	D. Harbour	Fraserganj
81	1	8					8
STATIO	N 2017	1	2018		2019	<u> </u>	2020
Harshi		·	NF	<u> </u>	NF	<u></u>	NF
Tehri	NF		NF		NF		NF
Haridwa			NF		NF		NF
Bijnor			NF		NF		NF
Narora			NF		NF		NF
Farrukhal			NF		NF		NF
Kanpui	r NF		NF		NF		NF
Prayagra			NF		NF		NF
Varanas	si NF		NF		NF		NF
Buxar	NF		NF		NF		NF
Patna	NF		NF		NF		NF
Bhagalpu	ur NF		NF		NF		NF
Farakk	a NF		NF		NF		NF
Jangipu	r NF		NF		NF		NF
Berhamp	ore NF		NF		NF		NF
Balagar	h NF		NF		NF		NF
Triben	i NF		NF		NF		NF
Godakha	ali NF		NF		NF		NF
D. Harbo	our NF		NF		1		NF
Fraserga	nj 7		1		30		25

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### Cyclotella sp. (Brébisson, 1838)



Class: Mediophyceae

**Order:** Stephanodiscales

Family: Stephanodiscaceae

Genus: Cyclotella sp.

### **Identifying feature:**

- ❖ Generally, cells are solitary but sometime it may be attached in chains by mucilaginous threads.
- Cells are short and disc-shaped having circular-shaped valves with a slightly undulate surface.
- \* Radiating areolae are present surrounding the central region of valves.
- ❖ Numerous discoid shaped chloroplasts are usually arranged around the margin.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Dissolved Oxygen, and Total Alkalinity.



Absent
Present

#### **Station wise Distribution:**

#### **Upper stretch**

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

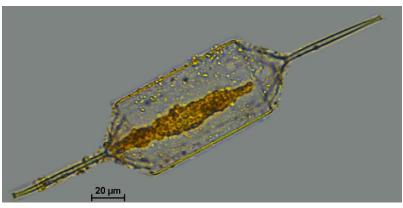
#### **Lower stretch**

Ja	ngipur	Berha	mpore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
	STATIO	ON	201	7	2018	2019	)	2020
	Harsh	il	NF		NF	10		30
	Tehr	i	NF		15	25		NF
	Haridw	ar	845	;	115	65		NF
	Bijno	r	15		50	20		NF
	Naror	a	35		15	35		NF
	Farrukha	abad	40		NF	NF		NF
	Kanpı	ır	120		245	NF		NF
	Prayag	raj	20		215	50		NF
	Varana	asi	NF		10	40		NF
	Buxa	r	5		137	1160	5	NF
	Patna	a	4		32	153		NF
	Bhagalı	our	5		12	95		NF
	Farakl	ka	NF		3	29		60
	Jangip	ur	NF		1	156		NF
	Berham	ore	2		5	1004	1	NF
	Balaga	rh	20		50	1023	3	NF
	Tribei	ni	2		3	3		NF
	Godakh	ali	6		11	133		NF
	D. Harb	our	2		51	60		NF
	Fraserg	anj	3		5	17		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



### Ditylum sp. (J.W.Bailey, 1861)





Class: Mediophyceae

**Order:** Lithodesmiales

Family: Lithodesmiaceae

Genus: Ditylum sp.

### **Identifying feature:**

Cells are elongated in girdle view.

❖ Marginal ridge is prominent and often flanked.

❖ It has no defined elevations at valve corners.

Habitat: Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Water Velocity, Total Hardness, and Salinity.



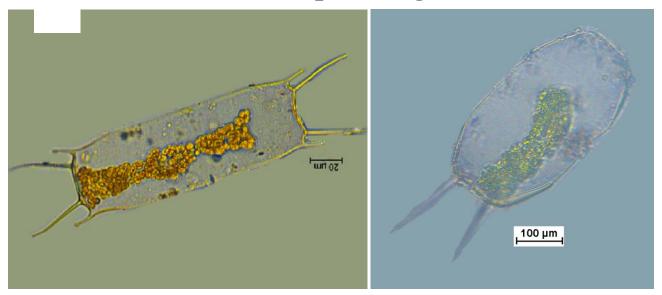
# Station wise Distribution: Upper stretch

Harshil	Tehri	ri Haridwar		Bijnor	Nare	ora	Farrukhabad	
Middle stro		T # 7			<b>.</b>	T 70 1		
Kanpur	Prayagraj	graj Varanas		ıxar	Patna	Bhagalpur	Farakka	
Lower stre			1 75 9	•   0		D II 1	T	
Jangipur	Berhampore	Balagar	h Trib	eni Go	odakhali	D. Harbour	Fraserganj	
C/T A /TI	ON	2017	2010	0	20	10	2020	
STATIO Harsh	<del></del>	2017 NF	2013 NF		20 N		2020 NF	
Tehr		NF	NF		N		NF	
Haridy		NF	NF		N		NF	
Bijno		NF	NF		N		NF	
Naror		NF		NF NF			NF	
Farrukh	abad	NF	NF		N	$\mathbf{F}$	NF	
Kanpı	ır	NF	NF		N	F	NF	
Prayag	raj	NF		NF		F	NF	
Varana	asi	NF	NF	NF N		F	NF	
Buxa	r	NF	NF	NF NI		F	NF	
Patna	a	NF	NF		N	F	NF	
Bhagal	pur	NF	NF		N	F	NF	
Farakl	ka	NF	NF		N	F	NF	
Jangip	ur	NF	NF		N	F	NF	
Berham	pore	NF	NF		N	F	NF	
Balaga	rh	NF	NF		N	F	NF	
Tribe	ni	NF	NF		N	F	NF	
Godakł	nali	NF	NF	NF		F	NF	
D. Harb	our	NF	NF		N	F	NF	
Fraserg	anj	77	4		2	2	NF	

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



### Odontella sp. (C. Agardh)



Class: Mediophyceae

**Order:** Eupodiscales

Family: Odontellaceae

Genus: Odontella sp.

### **Identifying feature:**

- ❖ In the girdle view, cell looks oblong. The shape of the valves is elliptical or lanceolate.
- **\*** Each pole having short horns.
- ❖ Cells are either straight or in zig-zag chains.
- ❖ Many chloroplasts are present.

**Habitat:** Brackish water

Major Ecological Parameters: Highly positive correlation was

found with Total Hardness and Salinity.



#### **Station wise Distribution:**

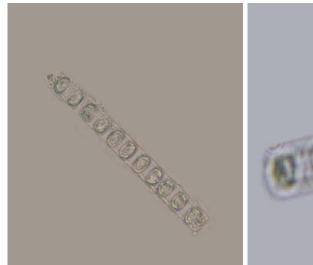
#### **Upper stretch**

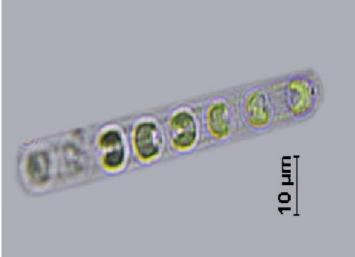
TT	Harshil 7		70.1			D.		N.T.		El-b-b-	
Hai	rshil		Tehri	Haridwar		Bijno	r	Naro	ora	Farrukhab	ad
	Middle st			T			Patna			_	
Kai	npur	Pray	yagraj	Varanasi		Buxar		H	Bhagalpur	Farakka	
	Lower stretch						ı				
Jan	angipur		hampore	Balagarh	Trib	eni (	Godakhali		). Harbour	Fraserga	nj
	STAT	ION	201	7	2018		2	019		2020	
	Hars	hil	NF		NF			NF	-	NF	
	Teh	ri	NF	1	NF			NF		NF	
	Harid	war	NF	1	NF		N			NF	
	Bijn	or	NF	,	NF			NF		NF	
	Naro	ra	NF	1	NF			NF		NF	
	Farrukh	abad	l NF	,	NF			NF		NF	
	Kanp	ur	NF	NF			N			NF	
	Praya	graj	NF	NF		N		NF		NF	
	Varar	asi	NF	1	NF	NF		NF		NF	
	Buxa	ar	NF	,	NF	F		NF		NF	
	Patr	ıa	NF	,	NF	NF		NF		NF	
	Bhagal	lpur	NF	,	NF			NF		NF	
	Farak	kka	NF	,	NF			NF		NF	
	Jangij	pur	NF	,	NF			NF		NF	
	Berham	pore	NF	7	NF			NF		NF	
	Balagarh Tribeni		NF		NF			NF		NF	
			NF	1	NF			NF			NF
	Godakhali		NF	NF		NF		NF		NF	
	D. Har	bour	NF	•	NF			NF		NF NF	
	Fraser	ganj	30		13			17			

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



### Skeletonema sp. (Greville, 1865)





Class: Mediophyceae

**Order:** Thalassiosirales

Family: Skeletonemataceae

Genus: Skeletonema sp.

### **Identifying feature:**

❖ Cells are beads like which are joined by marginal spines.

❖ The structure of the plastid is disc-like or cup-shaped.

❖ A small number of plastid present per cell.

Habitat: Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Total Hardness and Salinity.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar		Bijnor N		arora	Fa	rrukhabad			
Middle stretch											
Kanpur	Prayagraj	Varanasi	Buxaı	•	Patna	Bhagalpur		Farakka			
Lower stre	etch										
Jangipur	Berhampore	Balagarh	Triben	G	odakhali	D. Harbour		Fraserganj			
								<u> </u>			

STATION	2017	2018	2019	2020
Harshil	NF	NF	NF	NF
Tehri	NF	NF	NF	NF
Haridwar	NF	NF	NF	NF
Bijnor	NF	NF	NF	NF
Narora	NF	NF	NF	NF
Farrukhabad	NF	NF	NF	NF
Kanpur	NF	NF	NF	NF
Prayagraj	NF	NF	NF	NF
Varanasi	NF	NF	NF	NF
Buxar	NF	NF	NF	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	NF	NF	NF
Farakka	NF	NF	NF	NF
Jangipur	NF	NF	NF	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	NF	NF	NF
Tribeni	NF	NF	NF	NF
Godakhali	NF	NF	NF	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	2	NF	9	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



### Stephanodiscus sp. (Ehrenberg, 1845)



Class: Mediophyceae

Source:- sciencephotolibrary

**Order:** Stephanodiscales

Family: Stephanodiscaceae

Genus: Stephanodiscus sp.

### **Identifying feature:**

❖ A discoid or barrel-shaped cell possesses delicate threads radiating from around the edge of the valve.

❖ A ring of spines is present surrounding the edge of the valve.

Many discoid plastids are present surrounding the periphery of the cell.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter :** Highly positive correlation was found with Free  $CO_2$ .



#### **Station wise Distribution:**

**Upper stretch** 

Harshil		Tehri	Haridwar	Bi	jnor	Narora	Narora Farru		
Middle stretch									
Kanpur	Praya	agraj	Varanasi	Buxar	Patna	Bhagalpur		Farakka	

#### Lower stretch

Ja	ngipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
,	STA	ΓΙΟΝ	2017	2018	201	9	2020
	Hai	shil	NF	NF	NI	NF	

STATION	2017	2018	2019	2020
Harshil	NF	NF	NF	NF
Tehri	NF	NF	NF	NF
Haridwar	200	NF	NF	NF
Bijnor	NF	NF	NF	NF
Narora	10	NF	NF	NF
Farrukhabad	NF	NF	NF	30
Kanpur	30	NF	NF	NF
Prayagraj	95	10	NF	NF
Varanasi	NF	80	NF	NF
Buxar	NF	NF	NF	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	NF	NF	NF
Farakka	NF	NF	NF	NF
Jangipur	NF	NF	NF	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	NF	NF	NF
Tribeni	NF	NF	NF	NF
Godakhali	NF	NF	NF	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.





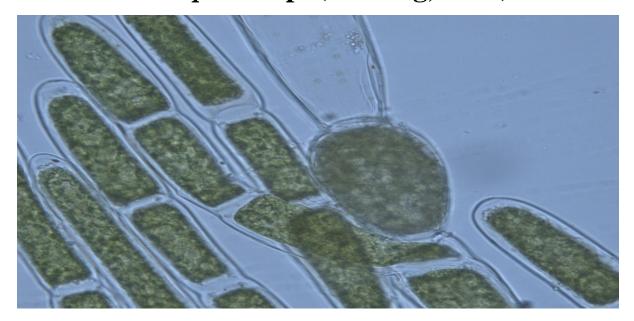
### Chlorophyta

(Green algae)

#### **General Identifying Characters:**

- ➤ The genera of groups are mostly green in color because of the presence of a photosynthetic pigment namely chlorophyll a and chlorophyll b.
- ➤ The members of the group can carry out the process of photosynthesis and starch is the reserved photosynthetic material, which is stored in pyrenoid.
- ➤ It is thallus like structure that can be unicellular, multicellular, colonial, and filamentous.
- > Cells have a cell wall, which is made up of cellulose.
- ➤ Some members of the group bear flagella. The number of flagella varies from two or numerous. The length of flagella are of equal length but rarely varies.
- Some genera are coenocytes which means the cells have no transverse cell wall so, their nuclei are scattered.
- ➤ Green algae are ecologically very important as they are the major producer of the aquatic eco-system.
  - ☐ Total 28 genera belonging to 3 classes and 14 families were recorded during study period.
  - ♣ Class:- Ulvophyceae (2 genera), Chlorophyceae (20 genera), Trebouxiophyceae (6 genera).

### Cladophora sp. (Kützing, 1843)



Class: Ulvophyceae

**Order:** Cladophorales

Family: Cladophoraceae

Genus: Cladophora sp.

### **Identifying feature:**

- ❖ Cells are cylindrical or slightly swollen in shape and elongated with a strong wall.
- ❖ Cells are 20-80µm in wide.
- ❖ It is filamentous with small branches.
- ❖ The chloroplast is distrusted as net-like throughout the cell with many pyrenoids.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with BOD.



#### **Station wise Distribution:**

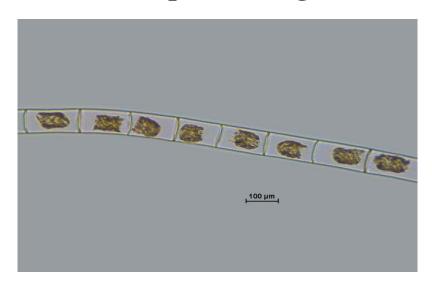
#### Upper stretch

Middle stretch Kanpur Prayagraj Varanasi Buxar Patna Bhagalpu  Lower stretch  Jangipur Berhampore Balagarh Tribeni Godakhali D. Harbou  STATION 2017 2018 2019  Harshil NF NF NF  Tehri NF NF	r Fraserganj 2020
Kanpur Prayagraj Varanasi Buxar Patna Bhagalpu  Lower stretch  Jangipur Berhampore Balagarh Tribeni Godakhali D. Harbou  STATION 2017 2018 2019  Harshil NF NF NF	r Fraserganj 2020
Lower stretch  Jangipur Berhampore Balagarh Tribeni Godakhali D. Harbou  STATION 2017 2018 2019  Harshil NF NF NF	r Fraserganj 2020
JangipurBerhamporeBalagarhTribeniGodakhaliD. HarbouSTATION201720182019HarshilNFNFNF	2020
JangipurBerhamporeBalagarhTribeniGodakhaliD. HarbouSTATION 2017 2018 2019HarshilNFNFNF	2020
STATION         2017         2018         2019           Harshil         NF         NF         NF	2020
Harshil NF NF NF	
Harshil NF NF NF	
Harshil NF NF NF	
	M H.
Tenri NF NF NF	NF
W II NE OF NE	NF
Haridwar NF 25 NF	NF
Bijnor NF NF NF	NF
Narora NF NF NF	NF
Farrukhabad NF NF NF	NF
Kanpur NF NF NF	NF
Prayagraj NF NF NF	NF
Varanasi NF NF NF	NF
Buxar NF NF NF	NF
Patna NF NF NF	NF
Bhagalpur NF NF NF	NF
Farakka NF NF NF	NF
Jangipur NF 5 NF	90
Berhampore 10 NF NF	NF
Balagarh NF NF NF	NF
Tribeni NF NF NF	NF
Godakhali NF NF NF	NF
D. Harbour NF NF NF	NF
Fraserganj NF NF NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### *Ulothrix* sp. (Kutzing, 1833)



Class: Ulvophyceae

**Order:** Ulotrichales

Family: Ulotrichaceae

**Genus:** *Ulothrix* sp.

### **Identifying feature:**

- ❖ Cells are cylindrical with thickened cell walls, which are jointed to form unbranched filaments.
- Most the species contain a holdfast, which develops from the basal cells.
- ❖ Cells have a single chloroplast.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with pH, Dissolved Oxygen, BOD, and Carbonate.



### Station wise Distribution: Upper stretch

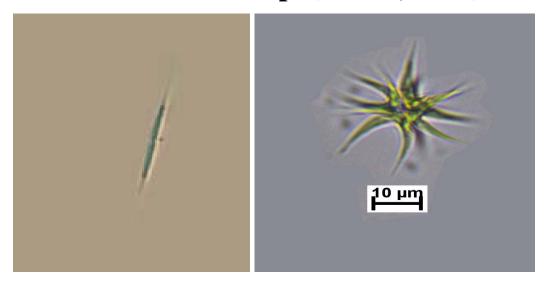
Absent
Present

Harshil		Tehri	Haridwar		Bijr	nor Narora		ora	Farrukhaba	
Middle str				,						
Kanpur	Pr	ayagraj	Varanasi	Bux	ar	Patna		Bhagalpui	r	Farakka
Lower stre		_	<b>D</b> 1	<b>7</b> 5. 11	•	G 111		D II 1	T.	
Jangipur	Bei	rhampore	Balagarh	Trib	eni	Godakł	alı	D. Harbour	F	raserganj
STATION		2017		2018			2019	)	2	020
Harshil	-	NF		10		-	NF			NF
Tehri		NF		NF			NF			NF
Haridwar		NF		NF		NF		]	NF	
Bijnor		NF		NF			NF		NF	
Narora		NF		65		NF			]	NF
Farrukhaba	ad	NF		NF			NF		]	NF
Kanpur		NF		NF		NF			]	NF
Prayagraj		20		130		NF			]	NF
Varanasi		NF		40			NF		I	
Buxar		NF		NF			NF	F		NF
Patna		NF		NF			NF		]	NF
Bhagalpur	•	NF		NF			15			NF
Farakka		1		NF			NF			20
Jangipur		NF		NF			NF			NF
Berhampor		4		NF		1			]	NF
Balagarh		NF		NF		NF			]	NF
Tribeni		NF		6		1			NF	
Godakhali	i	NF		NF		NF			]	NF
D. Harbou	r	NF		NF			NF		NF	
Frasergan	j	NF		NF			2			NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### Ankistrodesmus sp. (Corda, 1838)



Class: Chlorophyceae

**Order:** Sphaeropleales

Family: Selenastraceae

Genus: Ankistrodesmus sp.

### **Identifying feature:**

❖ Cells are distinctly curved and needle - shaped.

❖ Usually, cells are present in clusters or irregular bundles.

❖ Cells have a thin, parietal plate - like chloroplast.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with BOD, and Chloride.



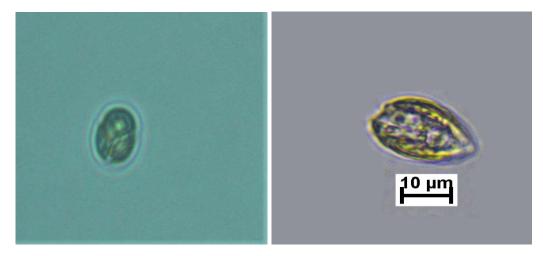
# Station wise Distribution: Upper stretch

Hai	rshil		Tehri	Haridwar		Bijno	r	Narora		Farrukhabad	
]	Middle str	etch									
Kai	npur	Pr	ayagraj	Varanasi	Buxar		Patna		Bhagalpur		Farakka
	Lower stretch										
Jan	Jangipur Berham		hampore	Balagarh	Trib	eni G	Godakha		ali   D. Harbou		Fraserganj
_	STATIO	ON	201	7	2018			201	9		2020
	Harsh		NF		NF	<u>′</u>		NF			NF
	Tehr	i	10		NF			NF	1		NF
	Haridw	var	20		25		NF		•		NF
	Bijno	r	53		135		35			60	
	Naror	a	50		1165			85			NF
	Farrukha	abad	82		2120			130	30		150
	Kanpu	ır	70		350			175	175		200
	Prayag	raj	50		675	675		350			150
	Varana	asi	NF	7	60	60		700			210
	Buxa	r	NF	7	15			NF			NF
	Patna	a	NF	7	10	10		25			NF
	Bhagalı	our	NF	י	NF			NF	1		NF
	Farakl	ka	NF	י	NF			NF	•		NF
	Jangip	ur	NF	י	NF			30			NF
	Berhampore		15		NF			NF	1		NF
	Balagarh		NF	7	NF			NF	1		NF
	Tribeni		NF	י	NF			NF			NF
	Godakhali		NF		NF	F		NF		NF	
	D. Harbour		NF	יז	NF				NF		NF
	Fraserg	anj	NF	7	NF			NF	NF		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### Chlamydomonas sp. (Ehenberg 1835)



Class: Chlorophyceae

**Order:** Chlamydomonadales

Family: Chlamydomonadaceae

Genus: Chlamydomonas sp.

### **Identifying feature:**

❖ Cells are without hyaline.

❖ Cells have large and cup-shaped chloroplast.

❖ Cells have two flagella, which are coming from the anterior side of the cell.

❖ It also possesses distinct eye-spot.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Total Dissolved Solid.



### **Station wise Distribution:**

**Upper stretch** 

Upper stretch		T			The last			Т	т	
Harshil		Tehri	Haridwar		Bijno	r	Na	rora	Fari	rukhabad
Middle st										
Kanpur	anpur Prayagraj		Varanasi	Buxa	ır	Patna		Bhagalpur		Farakka
Lower str	etch									
Jangipur	Bei	rhampore	Balagarh	Triber	i G	odakhal	li :	D. Harbou	r F	raserganj
	<u> </u>						ļ			
STATIO		2017		2018			2019			)20
Harshi	l	NF		NF			NF		N	<b>IF</b>
Tehri		NF		NF			NF		N	<b>IF</b>
Haridwa	ar	NF		NF		NF			NF	
Bijnor		NF		NF			NF		N	NF .
Narora	1	20		NF		NF			NF	
Farrukhal	bad	NF		NF			NF		N	<b>IF</b>
Kanpu	r	NF		NF		NF		N	NF .	
Prayagra	aj	80		NF		NF				<b>IF</b>
Varanas	si	50		NF			NF		N	<b>IF</b>
Buxar		NF		NF					N	<b>IF</b>
Patna		NF		NF			NF		N	<b>IF</b>
Bhagalp	ur	NF		NF			NF		N	<b>IF</b>
Farakk	a	NF		NF			NF		N	<b>IF</b>
Jangipu	r	NF		NF			NF		N	<b>IF</b>
Berhamp	ore	NF		NF			NF		N	<b>IF</b>
Balagar	h	NF		NF			NF		N	<b>IF</b>
Triben	i	NF		NF		NF		' N		<b>IF</b>
Godakha	ali	NF		NF			NF		N	<b>IF</b>
D. Harbo	ur	NF		NF			NF		N	NF .

**↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.

NF

NF

**4** The annual average of four seasons are shown in the table.

NF

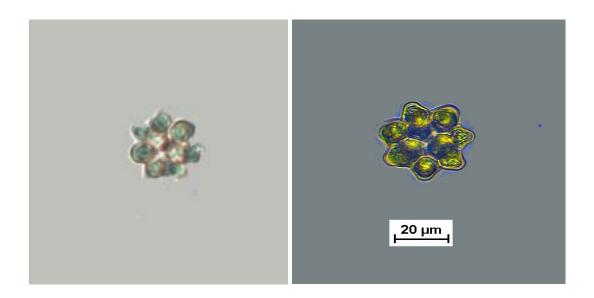
**↓** NF – Phytoplankton was not found at that time of sampling.



Fraserganj

NF

### Coelastrum sp. (Nägeli, 1849)



Class: Chlorophyceae

**Order:** Sphaeropleales

Family: Scenedesmaceae

Genus: Coelastrum sp.

### **Identifying feature:**

- The shape of colonies is spherical and each colony consists of up to 64 closely packed cells.
- $\bullet$  The shape of the cells is spherical and diameter 8-30µm.
- ❖ A single parietal chloroplast is present.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Bicarbonate and Total Alkalinity.



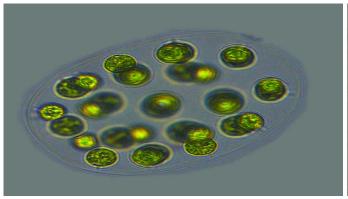
# Station wise Distribution: Upper stretch

Harshil			Tehri	Haridwar		Bijnor		Narora		Farrukhabad
Middle stretch				·			T			1
Kanpur		Prayagraj		Varanasi	i Buxa		Patna		Bhagalpur	Farakka
Lower stretch										
	ngipur		hampore	mpore Balagarh		i	Godakhali		D. Harbour	Fraserganj
Jai	igipui	Dei	патроге	Daiagain	Triber	.1	Godania	11 .	D. Hai boui	Trasciganj
	STATION		20	2017		2018		2019		2020
	Harshil		N	NF		NF		NF		NF
	Tehri		N	NF			NF		NF	
	Haridwar N		F	NF			NF		NF	
	Bijnor		N	NF			NF		र	NF
	Narora		1	10			N		?	NF
	Farrukhaba		ad NF		NF		NI		र	NF
	Kanpur		10		15		1		0	NF
	Prayagraj		NF		180		I		र	20
	Varanasi		1	10		20		NI	र	NF
	Buxar		N	NF		13		20		NF
	Patna		NF		5	5		30		NF
	Bhagalpur		NF		12	12		514		NF
	Farakka		1	13		1		30		NF
	Jangipur		1		NF		1			10
	Berhampore		NF		NF		119		9	NF
	Balagarh		NF		NF		15		5	559
	Tribeni		N	NF		5		275		100
	Godakhali		N	NF		1		6		350
	D. Harbour		N	NF		5		NF		10
	Fraserganj		NF		NF		3			NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



### Eudorina sp. (Ehrenberg 1832)





Class: Chlorophyceae

**Order:** Chlamydomonadales

Family: Volvocaceae

Genus: Eudorina sp.

### **Identifying feature:**

- ❖ The shape of the colony is ovate, obovoid, and globose in some cases.
- ❖ Each colony contains 16 to 64 cells, which are not compactly packed within a gelatinous envelope.
- ❖ Cells are biflagellate. Flagella emerge from the anterior beaks of the cell.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with Bicarbonate, Total Alkalinity, and Free CO<sub>2</sub>.



#### **Station wise Distribution:**

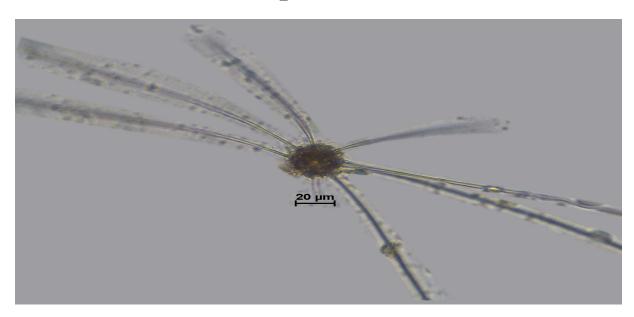
**Upper stretch** 

Upper stre		1					
Harshil	Tehri	Haridwar	Bijnor		Naror	a	Farrukhabad
Middle str	etch						
Kanpur	Prayagraj	Varanasi	Buxar	Patna I		Bhagalpu	ır Farakka
Lower stre	etch						
Jangipur	Berhampore	Balagarh '	Tribeni	Godakh	nali   D	). Harbour	Fraserganj
STATION			2018		2019	<u> </u>	2020
Harshil	NF		NF		NF		NF
Tehri	NF		NF		NF		NF
Haridwar	NF		NF		NF		NF
Bijnor	NF		NF		NF		NF
Narora	NF		NF		NF		NF
Farrukhaba	ad NF		NF		NF		NF
Kanpur	NF		NF		NF		NF
Prayagraj	j NF		NF		NF		NF
Varanasi	NF		NF		NF		NF
Buxar	NF		12		NF		NF
Patna	NF		3		NF		NF
Bhagalpu	r NF		8		224		NF
Farakka	NF		21		2		NF
Jangipur	NF		1		5		NF
Berhampor	re NF		NF	NF			NF
Balagarh	NF		NF	3			NF
Tribeni	NF		8	11			NF
Godakhal	i NF		NF	5		NF	
D. Harbou	r NF		NF	NF		NF	
Frasergan	j NF		NF		NF		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### Golenkinia sp. (Chodat, 1894)



Class: Chlorophyceae

**Order:** Sphaeropleales

Family: Neochloridaceae

Genus: Golenkinia sp.

#### **Identifying feature:**

- ❖ Spherical shaped cells, usually found solitary, but sometimes cells create a false colony by enclosing through a thin mucilaginous envelope.
- ❖ Many spines are emerging out from cell walls, which are found across the surrounding of cell.
- ❖ Cells have a single chloroplast with a pyrenoid.
- \* The diameter of cell varies from 5-21 $\mu$ m. having spine is 24-45 $\mu$ m.

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with Depth.



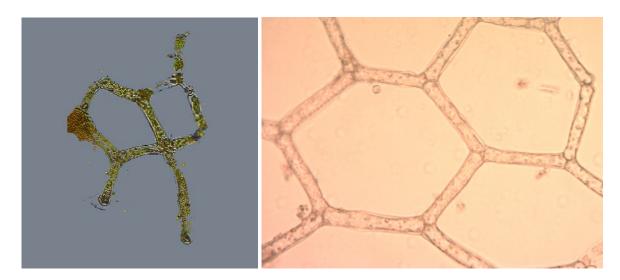
#### Station wise Distribution: Upper stretch

Harshil	Tehri	Haridwar	]	Bijno	r	Narora	Farrukhabad
Middle stre	etch						'
Kanpur	Prayagraj	Varanasi	Buxa	ır	Patna Bhagalpur		r Farakka
Lower stre	tch					_	
Jangipur	Berhampore	Balagarh	Tribeni	Go	dakhali	D. Harbou	ır Fraserganj
CTATION	2017		2010			0010	2020
STATION Harshil	2017 NF		2018 NF		-	019 NF	2020 NF
Tehri	NF		NF			NF	NF
Haridwar	NF		NF			NF	NF
Bijnor	NF		NF			NF	NF
Narora	NF		NF			NF	NF
Farrukhaba			NF			NF	NF
Kanpur	NF		NF			NF	NF
Prayagraj	NF		NF			NF	NF
Varanasi	NF		NF			NF	NF
Buxar	NF		NF			NF	NF
Patna	NF		NF			NF	NF
Bhagalpur	NF		NF			NF	NF
Farakka	NF		NF			NF	NF
Jangipur	NF		NF			NF	NF
Berhampore	e <b>NF</b>		NF			NF	NF
Balagarh	NF		NF		NF		NF
Tribeni	NF		NF		NF		NF
Godakhali	NF		1		NF		NF
D. Harbour	NF		3			NF	
Fraserganj	NF		NF			NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### Hydrodictyon sp. (Roth, 1797)



Class: Chlorophyceae

**Order:** Sphaeropleales

Family: Hydrodictyaceae

**Genus:** *Hydrodictyon* sp.

#### **Identifying feature:**

- ❖ Cylindrical cells are jointed to form branched filaments and these branched filaments are formed a net-like structure.
- ❖ The lengths of adult cells are of several millimetres.
- ❖ Each of the cells bears a chloroplast having single a pyrenoid.

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with Transparency.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil		Tehri	Ha	ridwar	•	Bijı	nor	Narora	Farrukhabad
Middle st	retch				•				
Kanpur	Pray	agraj	Varan	asi	Buxar	Patna		Bhagalpur	Farakka
Lower str	etch								
Jangipur	Berh	ampore	Balaga	arh '	Tribeni	Go	dakhali	D. Harbour	Fraserganj
	TION	1		17		018	<u>.</u>	2019	2020
Ha	rshil		N	F	NF			NF	NF
To	ehri		N	F	NF		5	NF	
Har	idwar	•	N	F	5			NF	NF
Bi	jnor		N	F	N	<b>IF</b>	IF NF		NF
Na	rora		N	F	1	10 NF		NF	NF
Farru	khaba	ad	N	F	ľ	<b>VF</b>	F NF		NF
Ka	npur		N	F	ľ	<b>IF</b>		NF	NF
Pray	yagraj	i	N	F	NF			NF	NF
Var	anasi		N	F	NI			NF	NF
Bu	uxar		N	F	NF		NF NF		NF
Pa	atna		N	F	ľ	<b>IF</b>		4	NF

5

NF

1

1

1

NF

NF

NF

NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.

NF

NF

NF

NF

NF

NF

NF

NF

NF

**♣** NF – Phytoplankton was not found at that time of sampling.



Bhagalpur

Farakka

Jangipur

Berhampore

Balagarh

Tribeni

Godakhali

D. Harbour

Fraserganj

NF

NF

NF

NF

NF

NF

NF

NF

NF

5

NF

NF

NF

NF

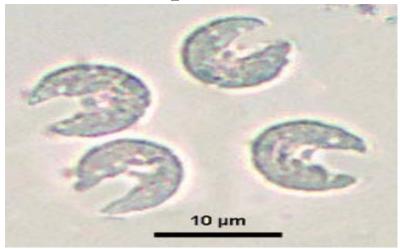
NF

NF

NF

NF

### Kirchneriella sp. (Schmidle, 1893)



Class: Chlorophyceae

**Order:** Sphaeropleales

Family: Selenastraceae

Genus: Kirchneriella sp.

#### **Identifying feature:**

- ❖ Cells are lunate shaped.
- ❖ Cells are irregularly arranged in a colony and its number can be up to 32.
- ❖ The colonies are enclosed by the mucilaginous sheath.
- ❖ Cells have a single chloroplast.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with pH, Dissolved Oxygen, Total Dissolved Solid.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### Lower stretch

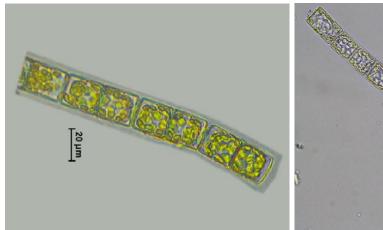
Ja	ngipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
	STATIO	ON 201	17	2018	201	9	2020
			_				

STATION	2017	2018	2019	2020
Harshil	NF	NF	NF	NF
Tehri	NF	NF	NF	20
Haridwar	NF	NF	NF	NF
Bijnor	NF	NF	30	NF
Narora	70	NF	NF	NF
Farrukhabad	150	NF	NF	NF
Kanpur	45	NF	NF	NF
Prayagraj	30	130	160	NF
Varanasi	140	60	NF	NF
Buxar	NF	NF	NF	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	NF	NF	NF
Farakka	NF	NF	NF	NF
Jangipur	NF	NF	NF	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	NF	NF	NF
Tribeni	NF	NF	NF	NF
Godakhali	NF	NF	NF	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **The annual average of four seasons are shown in the table.**
- **♣** NF Phytoplankton was not found at that time of sampling.



## Microspora sp. (Thuret, 1850)





Class: Chlorophyceae

**Order:** Sphaeropleales

Family: Microsporaceae

Genus: Microspora sp.

#### **Identifying feature:**

❖ Cells are cylindrical with the thickened cell wall, united to form unbranched filaments.

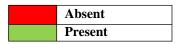
❖ Sometimes filaments contain a holdplast.

❖ Cells are 5-30µm in diameter.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Variable parameters are required for the genus.





#### Station wise Distribution: Upper stretch

Harshil	Tehri	Haridwar	Bij	nor	Na	rora	Farrukhabad
Middle str	etch				<b>'</b>		
Kanpur	Prayagraj	Varanasi	Buxar		Patna	Bhagalpu	r Farakka
Lower stre							
Jangipur	Berhampore	Balagarh	Tribeni	Goda	akhali	D. Harbou	r Fraserganj
						0.10	
	ATION arshil	2017 95	2018 40	<u> </u>		019 NF	2020 NF
	'ehri	NF	NF			NF	NF
	ridwar	NF	NF			NF	NF
	ijnor	NF	NF			NF	NF
Na	arora	NF	NF	NF		NF	NF
Farrı	ıkhabad	200	20			NF	NF
Ka	inpur	30	NF			NF	NF
Pra	yagraj	30	NF			NF	NF
Va	ranasi	40	NF			NF	NF
В	uxar	3	5			378	NF
P	atna	NF	7			1	NF
Bha	galpur	NF	NF			NF	NF
Fa	rakka	NF	NF			20	NF
Jar	ngipur	NF	3			<b>7</b> 6	NF
Berh	ampore	2	5		50		NF
	agarh	NF	NF			NF	
	ribeni	NF	NF			NF	
God	lakhali	NF	NF	F NF		NF	
D. H	arbour	NF	NF	F 6		NF	
Fras	serganj	NF	NF			NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Monoraphidiumm sp. (Komárková-Legnerová, 1969)



Class: Chlorophyceae

**Order:** Sphaeropleales

Family: Selenastraceae

Genus: Monoraphidium sp.

#### **Identifying feature:**

- ❖ Cells are unicellular and have no mucilaginous envelope around them.
- ❖ The structure of the cells varies from straight to lunate to sigmoid or helically twisted with an elongated end.
- ❖ The chloroplast is single and parietal.

**Habitat:** Freshwater

**Major Ecological Parameters:** Variable parameters are required for the genus.



## Station wise Distribution: Upper stretch

Harshil		Tehri	Haridwar		Bijr	10r	Nar	ora	Fari	ukhabad
Middle str			•			ı				
Kanpur	Pı	rayagraj	Varanasi	Bux	ar	Patna Bha		Bhagalpu	r	Farakka
Lower stre				Ι					Τ_	
Jangipur	Ве	rhampore	Balagarh	Tribe	ni	Godakh	ali I	). Harbour	Fi	raserganj
	T	2018	,	2010			2010			0.20
STATION Harshil	\ 	2017 NF		2018 NF			2019 NF			020 NF
Tehri		NF		NF			NF			NF
Haridwar	•	NF		NF			NF			NF
Bijnor		NF		NF			NF			NF
Narora		NF		NF			NF		NF	
Farrukhaba	ad	NF		NF			NF			NF
Kanpur		NF		NF			NF		NF	
Prayagraj	i	NF		NF			NF			NF
Varanasi		NF		NF			NF			NF
Buxar		NF		NF			NF		]	NF
Patna		NF		5			NF		]	NF
Bhagalpui	r	NF		NF			NF		]	NF
Farakka		NF		NF			10		]	NF
Jangipur		NF		NF			NF		]	NF
Berhampoi	re	NF		NF		NF			]	NF
Balagarh		NF		NF		NF				NF
Tribeni		NF		NF		NF			]	NF
Godakhal	i	NF		NF		NF			NF	
D. Harbou	r	NF		NF		NF			NF	
Frasergan	j	NF		NF			NF			NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



## Protococcus sp. (C.Agardh, 1824)



Class: Chlorophyceae

**Order:** Chlamydomonadales

Family: Chlamydomonadaceae

Genus: Protococcus sp.

#### **Identifying feature:**

❖ Cells are mostly unicellular and globose in structure.

Cells contain chloroplast.

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with BOD.



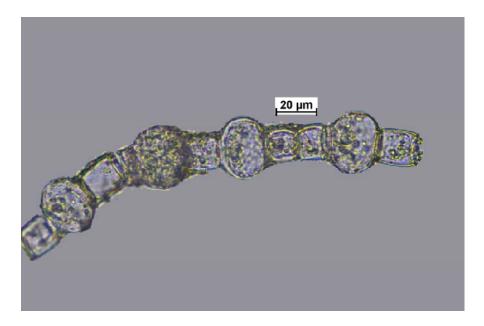
## Station wise Distribution: Upper stretch

Harshil	Tehri	Haridwar		Bijno	nor Narora		ora	Fa	rrukhabad
Middle str	1	T = 7	1.5		<b>.</b>				
Kanpur	Prayagraj	Varanasi	Buxar		Patna		Bhagalpu	Shagalpur Farakk	
T	4.1								
Lower stre	Berhampore	Balagarh	Tribeni	C	odakha	li D	). Harbour	F	raserganj
Jangipui	Der nampor e	Dalagalli	Tribelli	9	Ouakiia	.11 12	. Hai boui	ı	raserganj
STATION	2017		2018			2019			2020
Harshil	30		NF			NF			10
Tehri	NF		NF			NF			NF
Haridwar	NF		NF			NF			NF
Bijnor	NF		NF			NF			NF
Narora	NF		35			NF			NF
Farrukhaba	d 130		70			NF			NF
Kanpur	175		90			240			NF
Prayagraj	195		175			NF			NF
Varanasi	180		15			60			NF
Buxar	NF		NF			NF			NF
Patna	NF		NF			NF			NF
Bhagalpur	NF		NF			NF			NF
Farakka	NF		NF			NF			NF
Jangipur	NF		NF			NF			NF
Berhampor	e <b>NF</b>		NF		NF				NF
Balagarh	NF		NF		NF				NF
Tribeni	NF		NF		NF				NF
Godakhali	NF		NF		NF				NF
D. Harbour	NF NF		NF		NF			NF	
Fraserganj	NF		NF			NF			NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### Oedogonium sp. (Link ex Hirn, 1900)



Class: Chlorophyceae

Order: Oedogoniales

Family: Oedogoniaceae

Genus: Oedogonium sp.

#### **Identifying feature:**

- ❖ Cells are cylindrical with the firm cell wall, jointed to form unbranched filaments.
- ❖ In some species, a ring-like transverse line was found at the swollen part of filaments.
- ❖ Cells are 10-40µm wide.

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with Transparency.



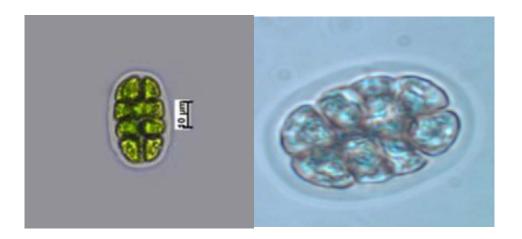
#### **Station wise Distribution:**

	etch	Upper stretch					
Harshil	Tehi	i	Haridwar		Bijnor	Narora	Farrukhabad
Middle str	etch						
Kanpur	Prayagr	aj	Varanasi	Buxa	r Patna	Bhagalr	our Farakka
Lower stre							
Jangipur	Berham	ore	Balagarh	Triben	i Godakha	li D. Harbo	our Fraserganj
STATION	T .	2017		2018		2019	2020
Harshil	· · · · · · · · · · · · · · · · · · ·	NF		NF	•	NF	NF
Tehri		20		NF		NF	80
Haridwar		NF		25		NF	NF
Bijnor		NF		NF		NF	NF
Narora		15		NF		NF	NF
Farrukhaba	ad	NF		NF		NF	NF
Kanpur		NF		NF		NF	NF
Prayagraj	j	NF		NF		NF	NF
Varanasi		50		NF		NF	NF
Buxar		NF		NF		NF	NF
Patna		NF		NF		NF	NF
Bhagalpui	r	NF		NF		NF	NF
Farakka		NF		NF		NF	NF
Jangipur		NF		NF		5	NF
Berhampor	e	NF		NF		NF	NF
Balagarh		NF		NF		NF	NF
Tribeni		NF		NF		NF	NF
Godakhal	i	NF		NF		NF	NF
D. Harbou	r	NF		NF		NF	NF
Frasergan	j	NF		NF		NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### Pandorina sp. (Bory, 1824)



Class: Chlorophyceae

**Order:** Chlamydomonadales

Family: Volvocaceae

Genus: Pandorina sp.

#### **Identifying feature:**

- ❖ Cells are ovate or ovoid and compactly arranged to form a colony, which is enclosed by gelatinous envelope.
- ❖ Each colony contains 8 to 32 cells.
- Chloroplasts are cup-shaped.
- ❖ Cells have flagellum which emerges from the mucilaginous sheath.
- \* Each cell is 8-20μm long.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with Transperency, Free Co<sub>2</sub>, and Depth.



#### **Station wise Distribution:**

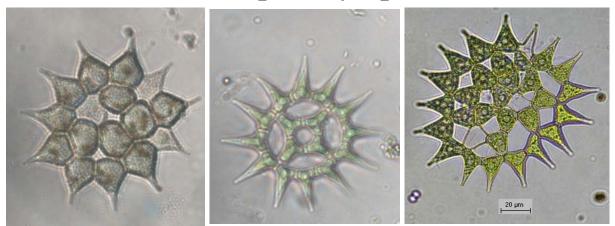
**Upper stretch** 

Upper stre	etch	T	T	1				
Harshil		Tehri	Haridwar		Bijno	r	Narora	Farrukhabad
Middle str	etch							
Kanpur	Pr	ayagraj	Varanasi	Buxa	Buxar Patna		Bhagalpur	Farakka
Lower stre		_	<b>.</b>	75. 11			D 77 1	
Jangipur	Bei	rhampore	Balagarh	Triber	ni G	odakhali	D. Harbour	Fraserganj
STATION		2017		2018		20		2020
Harshil		NF		NF		N	<b>F</b>	NF
Tehri		NF		NF		N	F	NF
Haridwar		NF		NF		N	F	NF
Bijnor		NF		NF		N	F	NF
Narora		NF		NF		N	F	NF
Farrukhaba	ıd	NF		NF		N	F	NF
Kanpur		NF		NF		N	F	NF
Prayagraj		NF		NF		N	F	NF
Varanasi		NF		NF		N	F	NF
Buxar		NF		NF		N	F	NF
Patna		NF		NF		N	F	NF
Bhagalpur	•	NF		NF		1	2	NF
Farakka		NF		20		5	0	400
Jangipur		NF		NF		N	F	NF
Berhampor	e:e	NF		NF		NF		NF
Balagarh		NF		NF		NF		NF
Tribeni		NF		NF		NF		NF
Godakhali	i	NF		NF		NF		NF
D. Harbou	r	NF		NF		NF		NF
Frasergan	j	NF		NF		N	F	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### Pediastrum sp. (Meyežþn, 1829)



Class: Chlorophyceae

**Order:** Sphaeropleales

Family: Hydrodictyaceae

Genus: Pediastrum sp.

#### **Identifying feature:**

- ❖ The shape of the colony is flat circular and are plate-like in some cases.
- ❖ Cells of the peripheral region have one or two lobes.
- ❖ The shapes of cells of the inner region are quite different from the cells of peripheral.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Total Alkalinity.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	3ti eten	Tehri		Haridw	aı	ŗ	Bi	ijnor	N	arora	Fa	arrukhabad	
Middle	stretch												
Kanpur	Praya	agraj	Vai	ranasi	Buxar			Patna		Bhagalpur		Farakka	
Lower	stretch												
Jangipur	Berha	ampore	Balagarh		7	ribeni		Godakhal	i	D. Harbour	r	Fraserganj	
STA	TION	,	2017			2018	2		20	)19		2020	
	STATION Harshil		NF			NF				NF		NF	
T	ehri		NF			NF			ľ	NF		NF	
Hai	ridwar		NF			NF			ľ	NF		NF	
Bi	jnor		45	15		NF			NF			NF	
	arora		NF			5				85		30	
Farrı	ıkhabad	<u> </u>	95			140			2	10		10	
Ka	npur		35	5		215			140			NF	
	yagraj		200		200			NF			NF		
	ranasi		45		180			3		30		NF	
В	uxar		8		934			3		363		NF	
P	atna		5			72				07		NF	
Bha	galpur		8			4713	3			59		NF	
	rakka		NF			8			]	13		560	
Jar	gipur		6			30				5		200	
	ampore	<u> </u>	6			5			2	20		NF	
	agarh		2			16				6		NF	
	ibeni		1			8			2	29		120	
God	lakhali		6			8				6		700	
D. H	D. Harbour		NF		1		F		NF			NF	
	D. narvour		111										

**↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.

NF

2

- **4** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.

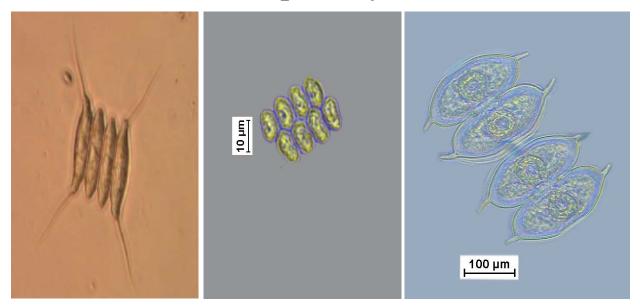


Fraserganj

3

NF

### Scenedesmus sp. (Meyen, 1829)



Class: Chlorophyceae

**Order:** Sphaeropleales

Family: Scenedesmaceae

Genus: Scenedesmus sp.

#### **Identifying feature:**

- ❖ Shape of the Cells are cylindrical, ovoid, fusiform, crescent-shaped or oblong.
- ❖ Usually, cells are lying side by side in a single series but sometimes it forms alternating rows by containing 2-32 cells.
- ❖ Each cell has a single parietal plate-like chloroplast.

Habitat: Freshwater and Brackishwater

Major Ecological Parameters: Highly positive correlation was

found with pH, BOD, and Chloride.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad
Middle stretch					

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

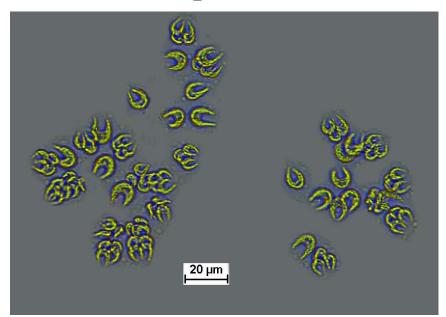
#### Lower stretch

Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
			•			
STATIO			2018	2019		2020
Harshi	l 1	0	NF	NF		NF
Tehri	4	5	10	NF		NF
Haridwa	ar N	F	NF	NF		NF
Bijnor	2	0	NF	NF		NF
Narora	1 4	5	NF	NF		NF
Farrukha	bad N	F	60	130		NF
Kanpu	r 24	15	125	NF		30
Prayagr	aj 9	5	2670	205		50
Varanas	si 12	20	115	20		160
Buxar	N	$\mathbf{F}$	20	36		NF
Patna		2	1	174		NF
Bhagalp	ur N	F	NF	NF		NF
Farakk	a N	F	NF	NF		NF
Jangipu	ır N	F	NF	4		10
Berhamp	ore N	F	2	30		NF
Balagar	h N	F	1	49		NF
Triben	i N	F	NF	33		20
Godakha	ali N	F	NF	3		140
D. Harbo	our N	F	NF	1		45
Fraserga	nj N	F	NF	1		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



### Selenastrum sp. (Reinsch, 1867)



Class: Chlorophyceae

**Order:** Sphaeropleales

Family: Selenastraceae

Genus: Selenastrum sp.

### **Identifying feature:**

\* Cells are curved, or sickle - shaped.

❖ Cells are often found in gathering without any gelatinous envelope.

❖ Each cell has a parietal chloroplast usually with a pyrenoid.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with pH .



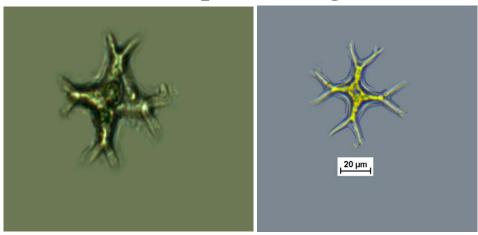
#### Station wise Distribution: Upper stretch

Harshil	Tehri	Haridwa	ar B	ijnor	Narora	Farrukhabad	
Middle str	etch	'			-		
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka	
Lower stro			Τ	T			
Jangipur	Berhampore	Balagarh	Tribeni	Godakha	li D. Harbour	Fraserganj	
ST	ATION	2017	2.0	18	2019	2020	
	Harshil			F	NF	NF	
r	Tehri		N	<b>IF</b>	NF	NF	
Ha	ridwar	NF	N	F	NF	NF	
E	Bijnor	NF	N	F	NF	NF	
N	larora	NF	N	F	NF	NF	
Farr	rukhabad	NF	N	F	NF	NF	
K	anpur	NF	N	F	NF	NF	
Pra	ayagraj	NF	N	F	NF	NF	
Va	aranasi	10	N	F	NF	NF	
F	Buxar	NF	N	F	55	NF	
I	Patna	NF	N	F	NF	NF	
Bh	agalpur	NF	N	F	NF	NF	
Fa	arakka	NF	N	F	NF	NF	
Ja	ngipur	NF	N	<b>IF</b>	NF	NF	
Berl	hampore	NF	N	F	NF	NF	
Ba	lagarh	NF	N	F	NF	NF	
T	ribeni	NF	N	F	1	NF	
Go	Godakhali		N	F	125	NF	
D. I	Harbour	NF	N	F	5	NF	
Fra	serganj	NF	N	F	NF	NF	

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



## Tetraedron sp. (Kützing, 1845)



Class: Chlorophyceae

**Order:** Sphaeropleales

Family: Hydrodictyaceae

**Genus:** *Tetraedron* sp.

#### **Identifying feature:**

❖ Cells are angular pyramidal, triangular, or polygonal in shape with a short spine.

❖ Cells have parietal discs or plates like chloroplast.

**Habitat:** Freshwater

**Major Ecological Parameter:** Variable parameters are required for the genus.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad	

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

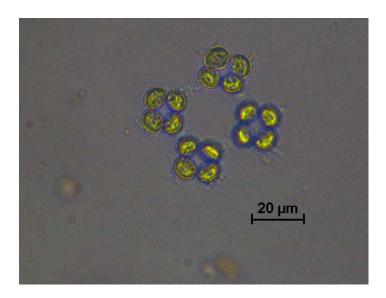
#### **Lower stretch**

Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
STATIO	N 20	)17	2018	20	19	2020
Harshil	l N	<b>IF</b>	NF	NF		NF
Tehri	N	<b>IF</b>	NF	N	F	NF
Haridwa	ır N	F	NF	N	F	NF
Bijnor	N	<b>IF</b>	NF	N	F	NF
Narora	ı N	F	NF	N	F	NF
Farrukhal	bad N	<b>IF</b>	NF	N	F	NF
Kanpui	r N	F	NF	NF		NF
Prayagra	aj N	<b>IF</b>	NF	NF		NF
Varanas	si N	<b>IF</b>	NF	NF		NF
Buxar	N	<b>IF</b>	NF	1		1
Patna	N	<b>IF</b>	NF	3		NF
Bhagalpı	ur N	<b>IF</b>	1	NF		NF
Farakka	a N	F	NF	NF		NF
Jangipu	r N	<b>IF</b>	NF	NF		NF
Berhampe	ore N	F	NF	N	F	NF
Balagar	h N	<b>IF</b>	NF	N	F	NF
Tribeni	i N	IF .	NF	N	F	NF
Godakha	ali N	<b>IF</b>	NF	N	F	NF
D. Harbo	ur N	<b>IF</b>	NF	N	F	NF
Fraserga	nj N	<b>IF</b>	NF	N	F	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **★** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



### Tetrastrum sp. (Chodat, 1895)



Class: Chlorophyceae

**Order:** Sphaeropleales

Family: Scenedesmaceae

Genus: Tetrastrum sp.

#### **Identifying feature:**

\* Cells are angular and 3-7 μm in wide.

❖ Colonies usually contain 4 cells. Sometimes it is found solitary.

❖ The spines are very fine and short.

❖ Cells have a cup-shaped chloroplast.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with BOD, Chloride and Total Nitrogen.



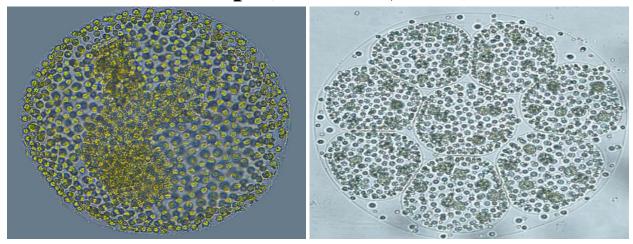
#### Station wise Distribution: Upper stretch

Harshil		Tehri		Haridwa	ır	В	Sijnor	Narora	F	arrukhabad
Middle					1					
Kanpur	Praya	agraj	Vai	ranasi	Buxar		Patna	Bhagalpu	ır	Farakka
Lower s	tretch							T		
Jangipur	Berha	ampore	Balagarh		Tribeni	G	odakhali	D. Harbou	r	Fraserganj
STAT	STATION		2017		2018			2019		2020
Hars	Harshil		NF		NF			NF		NF
Teh	ri		NF		NF			NF		NF
Harid	lwar		NF		NF			NF		NF
Bijn	or		NF		NF		NF		NF	
Naro	ora		NF		NF		NF		NF	
Farruk	habad		NF		NF		NF		NF	
Kanj	pur		NF		30			33		NF
Praya	graj		NF		NF			NF		NF
Vara	nasi		NF		NF	NF		NF		NF
Bux	ar		NF		NF			NF		NF
Pat	na		NF		NF			NF		NF
Bhaga	lpur		NF		NF			NF		NF
Fara	kka		NF		NF			NF		NF
Jangi	pur		NF		NF			NF		NF
Berhan	npore		NF		NF			NF		NF
Balag	garh		NF		NF			NF		NF
Trib	eni		NF		NF			NF		NF
Godal	khali		NF		NF			NF		NF
D. Har	bour		NF		NF			NF		NF
Fraser	Fraserganj		NF		NF			NF		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



### Volvox sp. (Linnaeus, 1758)



Class: Chlorophyceae

**Order:** Chlamydomonadales

Family: Volvocaceae

Genus: Volvox sp.

#### **Identifying feature:**

- ❖ The shape of the colony is spherical and ovate in some cases.
- ❖ Five hundred to several thousand spherical cells are interconnected through mucilaginous strands to form a colony.
- ❖ Cells are biflagellate, which are arranged at the periphery of a gelatinous sheath of a colony.

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with Bicarbonate.



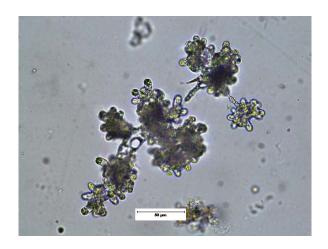
## Station wise Distribution: Upper stretch

Harshil	Tehri	Haridwaı	•	Bijnor	Narora	Farrukhabad	
Middle str		T	T		T		
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka	
Lower stre		D.11 (D.1)		Calibri	D II. I		
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	r Fraserganj	
STATIO	N 201	7	2018		019	2020	
Harshil	NI NI		NF		NF	NF	
Tehri	NI	7	NF		NF	NF	
Haridwa	r NI	?	NF		NF	NF	
Bijnor	NI	7	NF		NF	NF	
Narora	NI	NF			NF	NF	
Farrukhab	oad NI	י	NF		NF	NF	
Kanpur	NI	7	NF		NF	NF	
Prayagra	ij NI	7	NF		NF	NF	
Varanas	i NI	7	NF		NF	NF	
Buxar	NI	7	NF		NF	NF	
Patna	NI	?	1		NF	NF	
Bhagalpu	ır NI	י	3		NF	NF	
Farakka	NI NI	7	NF		NF	NF	
Jangipu	r NI	יז	NF		NF	NF	
Berhampo	ore NI	?	NF		NF	NF	
Balagarl	n NI	יז	NF		NF	NF	
Tribeni	NI	F NF			1	NF	
Godakha	li NI	י	NF		NF	NF	
D. Harbou	ur NI	7	NF		NF	NF	
Frasergai	nj NI	7	NF		NF	NF	

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



## Westella sp. (De Wildeman, 1897)



Class: Chlorophyceae

**Order:** Sphaeropleales

Family: Scenedesmaceae

Genus: Westella sp.

#### **Identifying feature:**

❖ Each colony consists of 30 to 100 spherical cells.

 $\bullet$  The diameter of the cell is 3-9µm.

❖ Cells are loosely attached to the mother cell.

Single chloroplast which is cup - shaped.

**Habitat:** Freshwater

Major Ecological Parameters: Highly positive correlation was

found with BOD, and Chloride.



#### **Station wise Distribution:**

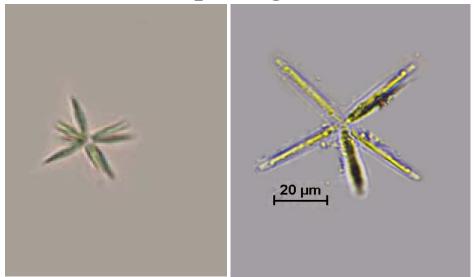
**Upper stretch** 

	Upper str	etch											
Ha	rshil		Tehri		Haridwai	•	Bijno	r	Naı	rora	Farı	rukhabad	
	Middle st	retch											
Kai	npur		agraj	V	aranasi	Buxar	,	Patna		Bhagalpu	agalpur Farakka		
		·	<b>.</b>										
	Lower str	etch											
Ion	ngipur		hampore		Balagarh	i Cod	Godakhali D. Harbou				ır Fraserganj		
Jan	igipui	Bei	nampore		Dalagaili	Triben	ı Gu	iakiiaii	D	. 11ai buui	I.	l asei gailj	
_													
	STATIC		-	17		2018			019			2020	
	Harshil NI		F		NF			NF			NF		
	Tehri NI		F		NF			NF			NF		
	Haridwa	ar	N	F		NF			NF			NF	
	Bijnor	•	N	F			NF			NF			
	Narora	a	N	F			10			NF			
	Farrukha	bad	1	0				40			NF		
	Kanpu	r	N	F		NF					NF		
	Prayagr	aj	1	0		NF NF					NF		
	Varana	si	1	0		NF	NF 10				NF		
	Buxar	•	N	F		NF			NF			NF	
	Patna		N	F		NF			NF			NF	
	Bhagalp	ur	N	F		NF			NF			NF	
	Farakk	a	N	F		NF			NF			NF	
	Jangipu	ır	N	F		NF			NF			NF	
	Berhamp		N	F		NF			NF			NF	
_	Balagar		N	F		NF			NF		NF		
	Tribeni NF		F		NF			NF			NF		
	Godakh	ali	N	F		NF			NF			NF	
	D. Harbo	our	N	F		NF			NF			NF	
	Fraserga	ınj	N	F		NF		NF				NF	

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



### Actinastrum sp. (Lagerheim, 1882)



Class: Trebouxiophyceae

Order: Chlorellales

Family: Chlorellaceae

Genus: Actinastrum sp.

#### **Identifying feature:**

- Cells are elongated and cigar-shaped and colonies are starshaped.
- ❖ Each colony has 4 to 16 cells, which are jointed at one end with each other at a common centre.
- ❖ Each cell contain a single chloroplast

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with Dissolved Oxygen, BOD, Carbonate, Total Alkalinity, Chloride, and Total Dissolved Solid, Chloride.



#### **Station wise Distribution:**

**Upper stretch** 

	Upper s	ii CiCi	1											
Ha	ırshil		Tehri		Haridwa	ır		Bijn	or	N	larora 💮	Fa	arrukhabad	
	Middle	stretc	h											
Ka	npur		Prayagra	ıj	Varana	si	Bux	ar	Patna		Bhagalpu	ır	Farakka	
	Lower s	tretcl	1											
Ja	ngipur	Berl	hampore	Bala	garh	rh Tribeni		Godakhali		D	. Harbour	•	Fraserganj	
	STAT		-	2017	<u> </u>		018		•	201	•		2020	
	Harshil			NF		1	NF			NF	,		NF	
	Tehri			NF		ľ	<b>NF</b>			NF	י		NF	
	Haridwar			NF		NF			10				NF	
	Bijnor			NF		NF		NF				NF		
	Naro	ora		NF			5		10				NF	
	Farrukl	habad	I	270		4	40			<b>70</b>			30	
	Kanp	pur		25		,	75			80			80	
	Praya	graj		30		65			70				200	
	Varai	nasi		120		NF			120				60	
	Bux	ar		NF		NF		NF			י	NF		
	Patı	na		NF		NF			56				NF	
	Bhaga	lpur		NF		ľ	<b>VF</b>		7				NF	
	Faral	kka		NF		ľ	<b>VF</b>		3				NF	
	Jangi	pur		NF		1	<b>NF</b>			NF	7	NF		
	Berhan	npore		NF		1	<b>VF</b>			36		NF		
	Balag	arh		NF		ľ	<b>NF</b>			26(	)	NF		
	Trib	eni		NF		1	<b>NF</b>			68			NF	
	Godakhali NF		NF	NF			NF			NF				
	D. Harbour NF			NF		NF			NF				NF	
	Fraserganj			NF	NF			NF					NF	

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### Chlorella sp. (Beyerinck [Beijerinck], 1890)



Class: Trebouxiophyceae

**Order:** Chlorellales

Family: Chlorellaceae

**Genus:** *Chlorella* sp.

#### **Identifying feature:**

❖ The shape of the cells is spherical to sub-spherical.

 $\clubsuit$  The diameter of the cell is 2-10µm.

❖ Cells have a cup-like or plate-likes chloroplast.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with Specific conductivity, pH, Dissolved Oxygen, BOD, Total Alkalinity, and Chloride.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### Lower stretch

Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj	
STATIO		)17	2018		)19	2020	
Harsh	il N	NF	NF	N	<b>NF</b>	NF	
Tehri	i N	NF	NF	N	NF	NF	
Haridw	ar N	<b>NF</b>	NF	N	<b>NF</b>	NF	
Bijnoi	r N	<b>NF</b>	NF	ľ	NF	NF	
Narora	a N	NF	NF	6	00	NF	
Farrukha	ıbad N	NF	100	2	00	200	
Kanpu	ır 7	70	305	N	NF	400	
Prayagr	raj	5	1130	3	00	100	
Varana	nsi N	NF	190	50		NF	
Buxar	r N	NF	NF	10		NF	
Patna	ı N	NF .	NF	12		NF	
Bhagalp	our N	<b>NF</b>	NF	320		NF	
Farakk	ka N	<b>NF</b>	NF	1		30	
Jangipu	ur N	<b>NF</b>	NF	16		NF	
Berhamp	oore N	<b>NF</b>	NF	185		NF	
Balagai	rh N	NF	NF	20		NF	
Triben	ni N	NF	NF	2		100	
Godakh	ali N	NF	NF	NF		NF	
D. Harbo	our N	NF	NF	NF		NF	
Fraserga	anj N	NF	NF	NF		NF	

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



### Crucigenia sp. (Morren, 1830)



Class: Trebouxiophyceae

**Order:** Trebouxiophyceae ordo incertae sedis

Family: Trebouxiophyceae

Genus: Crucigenia sp.

#### **Identifying feature:**

- ❖ Usually, each colony consists of 4 cells and cells are attached with each other through a thin mucilaginous sheath.
- ❖ The cells are arranged in cross by forming a gap at the center.
- ❖ The cells are oval or triangular.
- Cells consist of parietal chloroplasts.

Habitat: Freshwater and Semi saline

**Major Ecological Parameter:** Highly positive correlation was found with Nitrate.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

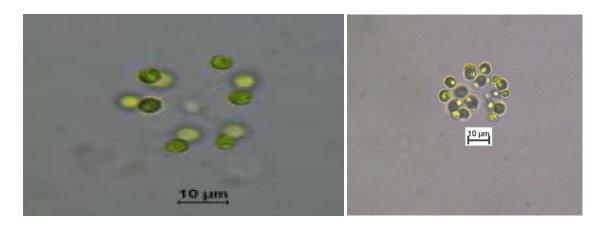
#### Lower stretch

Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
STATIO			2018	201		2020
Harshil	NF		NF	NI	7	NF
Tehri	NF		NF	NI	7	NF
Haridwa	r NF		NF	NI	?	NF
Bijnor	NF		NF	NI	7	NF
Narora	NF		NF	NI	7	NF
Farrukhal	oad 110		NF	NI	י	NF
Kanpur	· NF		NF	NI	7	NF
Prayagra	nj NF		15	NI	י	NF
Varanas	i 63		NF	30		NF
Buxar	NF		5	NI	י	NF
Patna	8		NF	11		NF
Bhagalpu	ır NF		5	NI	י	NF
Farakka	n NF		NF	NI	7	NF
Jangipu	r NF		1	NI	י	NF
Berhampo	ore NF		NF	1		NF
Balagarl	h NF		2	NI	7	NF
Tribeni	NF		NF	2		NF
Godakha	li NF		4	NI	7	NF
D. Harbo	ur NF		NF	NI	7	NF
Fraserga	nj NF		NF	NI	7	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Dictyosphaerium sp. (Nägeli, 1849)



Class: Trebouxiophyceae

**Order:** Chlorellales

Family: Chlorellaceae

Genus: Dictyosphaerium sp.

#### **Identifying feature:**

- \* Cells are spherical, ovoid, or ellipsoidal in shape and diameter varies 3-10μm.
- ❖ Cells are connected to each other by fine, branching strands that comes from a common center.
- ❖ Cells have one or two cup-shaped chloroplasts.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with Ca<sup>++</sup>, Mg<sup>++</sup>, Turbidity, and Total Dissolved Solid.



# Station wise Distribution: Upper stretch

Harshil	Tehri	Haridwar	Bijnor	Naroi	ra Fa	rrukhabad
Middle str			,		1	
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalp	our Farakka
T	4.1					
Lower stre	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbo	ur Fraserganj
Jangipui	Dernampore	Daiagain	TTIDEII	Godakiiali	D. Haibo	ui Fraserganj
STAT	ΓΙΟΝ	2017	2018	2	019	2020
Har	shil	NF	NF	I	NF	NF
Tel	hri	NF	NF	I	NF	NF
Hari	dwar	NF	NF	I	NF	NF
Bijı	nor	NF	NF	ľ	NF	NF
Nar	ora	NF	NF	I	NF	NF
Farruk	khabad	NF	NF	NF		NF
Kan	pur	NF	NF	NF		NF
Praya	agraj	NF	NF	NF		NF
Vara	nasi	NF	NF	NF		NF
Bux	xar	NF	4		12	NF
Pat	tna	1	NF		5	NF
Bhag	alpur	NF	3		36	NF
Fara	ıkka	NF	1	I	NF	NF
Jang	ipur	NF	1	ľ	NF	NF
Berha	mpore	NF	NF		1	NF
Bala	garh	NF	NF		1	NF
Trik	oeni	NF	NF	I	NF	NF
Goda	khali	NF	NF	I	NF	NF
D. Ha	rbour	NF	NF	I	NF	NF
Frase	rganj	NF	NF	ľ	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Hormidium sp. (Kützing, 1843)



Class: Trebouxiophyceae

**Order:** Prasiolales

Family: Prasiolaceae

**Genus:** *Hormidium* sp.

#### **Identifying feature:**

- ❖ Cells are cylindrical, in shape which is jointed to form unbranched filaments.
- ❖ Filaments have no basal portion.
- Chloroplast contains long or oval pyrenoid.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with Free Co<sub>2</sub>, and Total Dissolved Solid.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad
3.51.3.33					

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

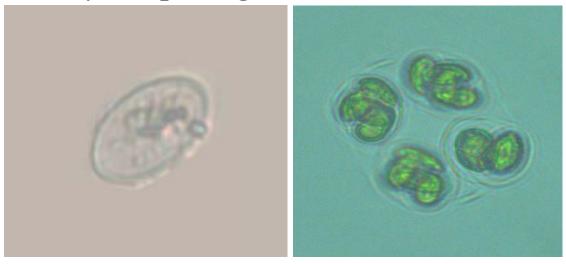
Lower stretch

Ja	ngipur	Berhar	npore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
-	STATIO	ON	201	7	2018	201	10	2020
	Harsh		NF	•	NF	NI	-	NF
	Tehr		NE		NF	NI		NF
	Haridy		15		NF	NI		NF
	Bijno		NF		NF	NI		NF
	Naror	a	30		NF	NI	F	NF
	Farrukh	abad	50		NF	NI	र	NF
	Kanpı	ur	NI	7	NF	NI	F	NF
	Prayag	raj	40		NF	NI	F	NF
	Varana	asi	30		NF	NI	F	NF
	Buxa	r	NI	יז	NF	NI	F	NF
	Patna	a	NI	7	NF	NI	F	NF
	Bhagalı	pur	NE	7	NF	NI	F	NF
	Farak	ka	10		NF	20	)	NF
	Jangip	ur	NE	7	NF	NI	F	NF
	Berham	pore	NI	7	NF	NI	F	NF
	Balaga	rh	NI	י	NF	NI	F	NF
	Tribe	ni	NF	7	NF	NI	F	NF
	Godakl	nali	NF	ז	NF	NI	F	NF
	D. Harb	our	NI	7	NF	N	F	NF
	Fraserg	anj	NI	7	NF	N	<b>र</b>	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **★** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Oocystis sp. (Nägeli ex A.Braun, 1855)



Class: Trebouxiophyceae

**Order:** Chlorellales

Family: Oocystaceae

Genus: Oocystis sp.

#### **Identifying feature:**

❖ Cells are ovoid or egg-shaped.

❖ Sometimes it forms colony, which contain 2-16 cells and is enclosed by the mother cell wall.

❖ The number and shape of the chloroplast is varied in cells.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Total Hardness, Total Alkalinity, BOD, and Chloride.



Absent
Present

### **Station wise Distribution:**

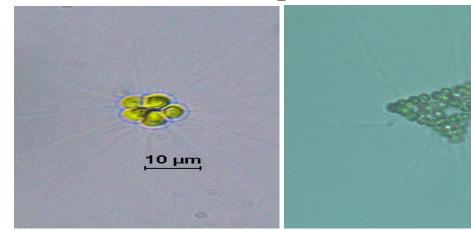
**Upper stretch** 

Upper stre Harshil	Tehri	Haridwa	Т	<b>D::</b>	Namana	Farrukhabad	1
Harshii	Tenri	Haridwa	r I	Bijnor	Narora	Farruknabad	l
Middle str Kanpur	etch Prayagraj	Varanasi	Buxar	Patna	Bhagal	pur Farakk	7.0
Kanpui	TTayagraj	v ai aiiasi	Duxai	1 atlia	Dilagai	pui Farakk	\a
Lower stre							
Jangipur	Berhampore	Balagarh	Tribeni	Godakhal	i D. Harbo	ur Frasergar	ni
oungipui -	Bernampore	Duiuguin	THOCH	Goudina	Di Hui bo	ur Trusergur	-J
STATION	2017		2018	2	019	2020	
Harshil	NF		NF		NF	NF	
Tehri	NF		NF		50	30	
Haridwar	NF		NF		NF	NF	
Bijnor	NF		NF		NF	NF	
Narora	55		NF		NF	NF	
Farrukhaba	ad 20		NF		NF	NF	
Kanpur	NF		75		NF	NF	
Prayagraj	NF		235		NF	NF	
Varanasi	15		NF		NF	NF	
Buxar	NF		21		NF	NF	
Patna	NF		NF		NF	NF	
Bhagalpur	· NF		15		NF	NF	
Farakka	NF		NF		10	NF	
Jangipur	NF		NF		11	NF	
Berhampor	re NF		NF		25	NF	
Balagarh	NF		NF		20	NF	
Tribeni	NF		NF		NF	NF	
Godakhali	NF.		NF		NF	NF	
D. Harbou	r NF		NF		NF	NF	
Fraserganj	j NF		NF		NF	NF	

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Micratinium sp. (Fresenius, 1858)



Class: Trebouxiophyceae

**Order:** Chlorellales

Family: Chlorellaceae

Genus: Micratinium sp.

#### **Identifying feature:**

❖ Cells are spherical.

- ❖ Usually, colonies contain 4 cells, sometimes more than 4 and less than 16 cells contain.
- ❖ Long spines (1-5) are protruding out from the cells.
- ❖ Cells have parietal chloroplasts.

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with Carbonate.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad
N.C. 1.11					

#### Middle stretch

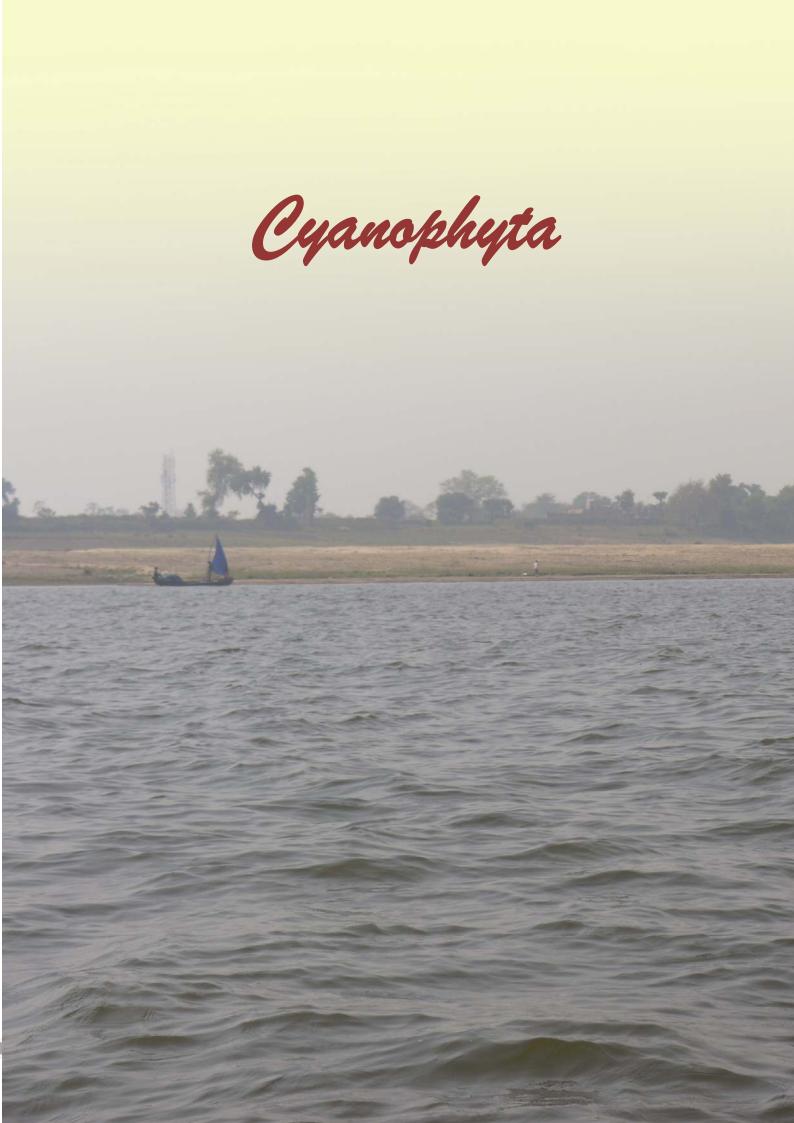
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### Lower stretch

Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
STATI		)17	2018		)19	2020
Harsh	nil N	<b>NF</b>	NF	N	<b>IF</b>	NF
Tehr	i N	NF	NF	N	NF	NF
Haridy	var N	NF	NF	N	NF	NF
Bijno	or N	<b>NF</b>	NF	N	<b>IF</b>	NF
Naro	ra N	NF	NF	N	NF .	NF
Farrukh	abad N	NF	NF	N	NF	NF
Kanp	ur N	NF	NF	N	NF .	NF
Prayag	raj N	NF	NF	N	NF	NF
Varan	asi N	NF	NF	NF		NF
Buxa	r N	NF	NF	8	80	NF
Patn	a N	NF	NF	1	12	NF
Bhagal	pur N	NF	3	N	NF	NF
Farak	ka N	NF	NF	N	NF	NF
Jangip	our N	NF	NF	N	NF	NF
Berham	pore N	NF	NF	7	76	NF
Balaga	rh N	NF	NF	N	NF .	NF
Tribe	ni N	NF	NF		54	NF
Godak	hali N	NF	NF	N	NF	NF
D. Hark	oour N	NF	NF	N	NF	NF
Fraserg	ganj N	NF	NF	N	NF .	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.





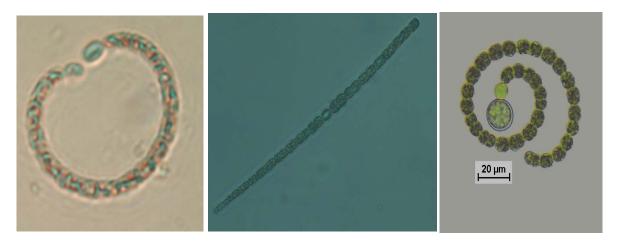
#### Cyanophyta

(Blue-green algae)

#### **General Identifying Characters:**

- ➤ Genera are unicellular, colonial, or filamentous.
- ➤ Prokaryotic cells are ovoid or circular. Some have true branching and others have false branching.
- Plastid and pyrenoid are absent.
- ➤ It bears photosynthetic pigment i.e. phycobilin and phycocyanin. Some species bears gas vacuole, which helps in buoyancy.
- ➤ Colonies are mostly surrounded by a gelatinous sheath. Some of the genera bear heterocysts and akinetes.
- ➤ They can fix nitrogen due to the presence of heterocyst. The group is found in both polluted and unpolluted water.
- ➤ The groups Cyanophyceae are prokaryotic organisms having features to conduct photosynthesis within its cell by using carbon dioxide.
- ➤ The group triggers rapid growth and produces harmful toxins, chemicals that emphasize the negative impact on the aquatic water body.
  - ♣ Total 12 genera belonging to 1 class and 11 families were recorded during study period.
  - ↓ Class:- Cyanophyceae (12 genera)

# Anabaena sp. (Bory ex Bornet & Flahault, 1886



Class: Cyanophyceae

**Order:** Nostocales

Family: Nostocaceae

Genus: Anabaena sp.

#### **Identifying feature:**

\* Trichomes have barrel-shaped or cylindrical cells.

\* Numerous heterocysts are present and commonly intercalary.

❖ Spores are single or arranged in series.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with pH, BOD, and Chloride.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad
Middle stretel	h				

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### Lower stretch

Ja	ngipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
		ATION	2017	201		2019	2020
	Ha	arshil	NF	NF	1	NF	NF
	Tehri		NF	NF	1	NF	NF
	Hai	ridwar	75	NF	1	NF	NF
	Bi	ijnor	NF	NF	1	NF	NF
	Na	arora	NF	NF	1	NF	NF
	Farru	ıkhabad	NF	40		10	NF
	Ka	anpur	NF	75		NF	NF
	Pra	yagraj	30	830	)	NF	NF
	Va	ranasi	125	65		30	NF
	В	uxar	21	13		300	NF
	P	atna	NF	2		NF	NF
	Bha	galpur	NF	NF	1	20	NF
	Fa	rakka	NF	NF	1	4	NF
	Jar	ngipur	NF	NF	1	NF	NF
	Berh	ampore	NF	3		2	NF
	Bal	lagarh	NF	NF	1	14	NF
	Tr	ribeni	NF	NF	1	9	NF
	God	lakhali	2	NF	1	20	NF
	D. H	larbour	NF	NF	1	NF	NF
	Fras	serganj	NF	NF	1	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Aphanizomenon sp. (A.Morren ex É.Bornet & C.Flahault, 1886 '1888')



Class: Cyanophyceae

**Order:** Nostocales

Family: Aphanizomenonaceae

Genus: Aphanizomenon sp.

#### **Identifying feature:**

- ❖ It is filamentous and united to form fusiform or plate-like bundles and flakes of parallel trichome.
- \* Trichomes are attenuated at both ends with rectangular cells.
- ❖ Cell walls are constricted.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with BOD, Chloride, Total Nitrogen, and Total Dissolved Solid.



#### **Station wise Distribution:**

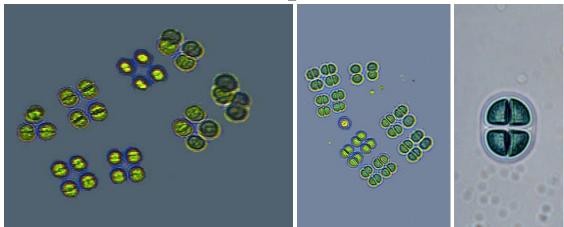
**Upper stretch** 

	Upper stret	tch									
Ha	arshil		Tehri	I.	Iaridwa	ar	Bijnor	Na	rora	Far	rukhabad
	Middle stre	etch									
	Kanpur		Prayagr	aj	Va	ranasi	Buxar	Patna	Bhagalp	ur	Farakka
	Lower stret	tch				Γ				1	
Ja	ngipur	Berl	nampore	Bala	agarh	Tribeni	Godakl	hali D.	Harbour	Fra	aserganj
								<u> </u>			
1	STATIO			2017		2018		2019			2020
	Harshi			20		NF		NF			NF
	Tehri			10		15		NF			NF
	Haridw	ar		NF		NF		NF			NF
	Bijnoı	r		NF		NF		NF			NF
	Narora	a		NF		NF		NF			NF
	Farrukha	bad	l	NF		NF		NF			NF
	Kanpu	r		15		NF		NF			NF
	Prayagr	aj		30		20		NF			NF
	Varana	si		NF		180		NF			NF
	Buxar	•		NF		NF		NF			NF
	Patna	l		NF		NF		NF			NF
	Bhagalp	ur		NF		NF		NF			NF
	Farakk	a		NF		NF		NF			NF
	Jangipu	ır		NF		NF		NF			NF
	Berhamp	ore		NF		NF		NF			NF
	Balagai	rh		NF		NF		NF			NF
	Triben	i		NF		NF		NF			NF
	Godakh	ali		NF		NF		NF			NF
	D. Harbo	our		NF		NF		NF			NF
	Fraserga	anj		NF		NF		NF			NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **★** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Chroococcus sp. (Nägeli, 1849)



Class: Cyanophyceae

**Order:** Chroococcales

Family: Chroococcaceae

Genus: Chroococcus sp.

#### **Identifying feature:**

❖ It is unicellular or colonial, which contains 2-32 spherical, hemispherical, or ovate cells.

❖ Each cell has a distinct sheath.

**Habitat:** Freshwater and Brackishwater

**Major Ecological Parameters:** Highly positive correlation was found with Water temperature, and Silicate.



#### **Station wise Distribution:**

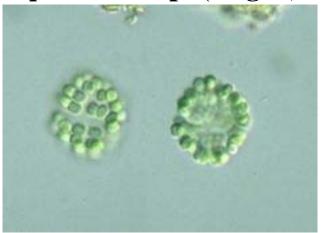
**Upper stretch** 

Harshil		Tehri		Haridwa	r		Bij	nor	Narora	Fa	rrukhabad
Middle s	stretc	h									
Kanpur	•	Prayagr	aj	Varanas	si	Buxar	•	Patna	Bhagalr	our	Farakka
Lower s	1		Ι	_					T		
Jangipur	Berl	nampore	Bal	agarh	Tr	ibeni	G	odakhali	D. Harbou	ır F	raserganj
						2010			0.1.0		
STATI Hars			2017 NF			2018 NF			019 NF		2020 NF
Teh			NF			NF			NF		NF
Harid			NF			NF			<b>NF</b>		NF
Bijn			NF			NF		NF			NF
	Narora		60			NF		I	NF		NF
Farrukh	ıabad		NF			NF		I	NF		NF
Kanp	ur		NF			NF		I	NF		NF
Prayag	graj		NF			NF		1	NF		NF
Varan	nasi		NF			NF		I	NF		NF
Buxa	ar		NF			14			10		NF
Patn	na		NF			10		:	26		NF
Bhagal	lpur		NF			NF		I	NF		NF
Farak	kka		NF			NF		I	NF		NF
Jangij	pur		NF			NF		1	NF		NF
Berham	pore		NF			NF			NF		NF
Balag	arh		NF			NF			20		NF
Tribe	Tribeni		NF			30			60		NF
Godak	Godakhali N		NF			NF			10		NF
D. Har	bour	oour NF NF NF			NF						
Fraser			NF			NF			10		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Coelosphaerium sp. (Nägeli, 1849)



Class: Cyanophyceae

Source-protest.hosei.ac.jp

**Order:** Synechococcales

Family: Coelosphaeriaceae

Genus: Coelosphaerium sp.

#### **Identifying feature:**

❖ Spherical or subpyriform cells are arranged in a globular ovate or irregularly shaped colony.

Cells contain homogenous, numerous, refractive, pseudovacuoles.

Colonial envelope has either homogeneous or radiating gelatinous fibrils.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with BOD, Chloride, Nitrate, and Silicate.



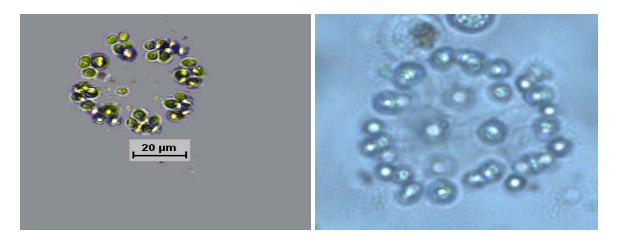
#### Station wise Distribution: Upper stretch

Harshil	Tehri		Haridy	var	Bijnor		Na	rora	Far	rukhabad
Middle	stretch									
Kanpu	r Praya	graj	Va	ranasi	Buxar	Pat	na	Bhagalp	our	Farakka
Lower s	1	1		T	1					
Jangipur	Berhampore	Bala	agarh	Tribeni	Godakh	ali	D. I	Iarbour	F	raserganj
	CEL EN ON				2010			2040		
	STATION Harshil			)17  F	2018 NF			2019 NF	-	2020 NF
	Tehri									
				IF	NF			NF		NF
	Haridwar			IF	NF			NF		NF
Bijnor			NF NF		NF	NF			NF	
	Narora				NF			NF		NF
F	arrukhabad			<b>IF</b>	NF			NF		NF
	Kanpur			IF	NF			NF		NF
	Prayagraj			<b>IF</b>	NF			NF		NF
	Varanasi			<b>IF</b>	5			NF		NF
	Buxar		N	<b>IF</b>	NF			NF		NF
	Patna		N	<b>IF</b>	NF			NF		NF
	Bhagalpur		N	<b>IF</b>	NF			NF		NF
	Farakka		N	<b>IF</b>	NF			NF		NF
	Jangipur		N	<b>IF</b>	NF			NF		NF
В	Berhampore		N	<b>IF</b>	NF			NF		NF
	Balagarh		N	<b>IF</b>	NF			NF		NF
	Tribeni		N	<b>IF</b>	NF			NF		NF
	Godakhali		N	IF .	NF NF		NF		NF	
I	D. Harbour NF		IF	NF	F NF		NF			
Fraserganj		N	<b>IF</b>	NF			NF		NF	

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Gomphosphaeria sp. (Kützing, 1836)



Class: Cyanophyceae

**Order:** Chroococcales

Family: Gomphosphaeriaceae

Genus: Gomphosphaeria sp.

#### **Identifying feature:**

- ❖ The shape of the cell pear to sub-spherical and the colony is globose or ovate.
- ❖ Cells are arranged singly or in pair at the ends of gelatinous strands which radiate from a common center.
- ❖ Each cell has a distinct gelatinous envelope and usually present in clusters.
- \* Cells are 1.5-12 μm wide and 2-16 μm long.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Water Temperature, and Silicate.



#### **Station wise Distribution:**

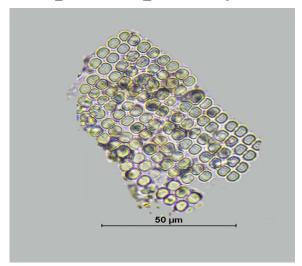
**Upper stretch** 

Opper sur				Г		1		Τ_	_	
Harshil		Tehri	Haridwar		Bijno	r	Na	rora I	arr	ukhabad
Middle st	retch									
Kanpur		Prayagraj	Varanasi	Bux	ar	Patna	ı	Bhagalp	ur	Farakka
Lower str	etch									
Jangipur	Bei	rhampore	Balagarh	Tribeni	Go	dakhali	D.	Harbour	F	raserganj
STAT	ION	2017	7	2018		20	)19		2	020
Hars	hil	NF		NF		ľ	<b>IF</b>		]	NF
Teh	ri	NF		NF		ľ	<b>IF</b>		]	NF
Harid	war	NF		NF		ľ	<b>IF</b>		]	NF
Bijn	or	NF		NF		ľ	<b>IF</b>		]	NF
Naro	ra	NF		NF		ľ	<b>IF</b>		]	NF
Farrukh	abad	l NF		NF		ľ	<b>IF</b>		]	NF
Kanp	our	NF		NF		ľ	<b>IF</b>		]	NF
Prayag	graj	NF		NF		ľ	<b>IF</b>		]	NF
Varar	nasi	NF		NF		ľ	<b>IF</b>		]	NF
Buxa	ar	NF		NF		ľ	<b>IF</b>		]	NF
Patr	ıa	NF		NF		-	10		]	NF
Bhaga	lpur	NF		NF		ľ	<b>IF</b>		]	NF
Farak	kka	NF		NF		ľ	<b>IF</b>		]	NF
Jangi	pur	NF		NF		ľ	<b>IF</b>		]	NF
Berham	pore	NF		NF		ľ	<b>IF</b>		]	NF
Balag	arh	NF		NF		ľ	<b>IF</b>		]	NF
Tribe	eni	NF		NF		Į.	50		]	NF
Godak	hali	NF		NF		ľ	<b>IF</b>			NF
D. Har	bour	NF		NF		ľ	<b>IF</b>		]	NF
Fraser	ganj	NF		NF		ľ	<b>IF</b>			NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Merismopedia sp. (Meyen, 1839)



Class: Cyanophyceae

**Order:** Synechococcales

Family: Merismopediaceae

Genus: Merismopedia sp.

#### **Identifying feature:**

- Cells are Ovate or globose in shape, which is compactly or loosely arranged in rows both transversely and longitudinally.
- ❖ Usually, group of four cells are arranged in rows.
- ❖ The shape of the colony is a plate or rectangular like and enclosed within mucilage.
- \* The sheath of the individual cells is inconspicuous.

**Habitat:** Freshwater and Brackishwater

**Major Ecological Parameters:** Highly positive correlation was found with pH, BOD, Chloride.



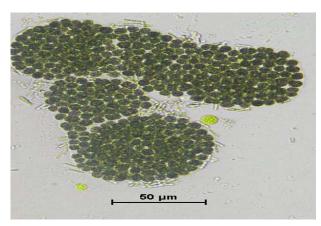
#### Station wise Distribution: Upper stretch

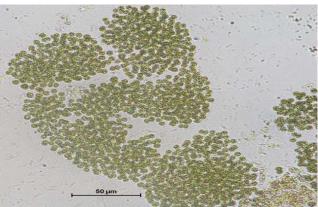
Ha	arshil	Tehri	Haridwar	Bijı	or	N	Varora	Farr	ukhabad
	Middle stre	etch							
Ka	anpur	Prayagraj	Varanasi	Buxar		Patna	Bhag	alpur	Farakka
	Lower stret	tch							
Ja	ngipur	Berhampore	Balagarh	Tribeni	Goo	dakhali	D. Har	bour	Fraserganj
-	ST A	TION	2017	2	018		2019		2020
		rshil	NF	-	NF		NF	•	NF
		ehri	NF		NF		NF		NF
		idwar	NF		NF		NF		NF
		jnor	NF		NF		NF		NF
		rora	25		NF		NF		NF
		khabad	NF		NF		NF		NF
			NF		105		15		NF
		npur vograj	230		800		NF		NF
		vagraj anasi	90				200		
					30				NF
		ıxar	NF		10		15		NF
		itna	NF		NF		16		NF
		galpur	NF		NF		NF		NF
		akka	NF		NF		12		NF
	•	gipur	NF		10		NF		NF
		ampore	NF		NF		NF		NF
		agarh	NF		NF		12		NF
		beni	NF		NF		20		NF
		akhali	NF	]	NF		10		NF
	D. Ha	arbour	NF		NF		NF		NF
	Frase	erganj	NF		NF		NF		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Microcystis sp. (Lemmermann, 1907)





Class: Cyanophyceae

Order: Chroococcales

Family: Microcystaceae

Genus: Microcystis sp.

#### **Identifying feature:**

- ❖ Numerous spherical cells are irregularly arranged within a mucilaginous sheath.
- ❖ The shape and size of the colonies are not definite.
- ❖ Cells are closely arranged in the colony.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Water Temperature, Silicate and Specific Conductivity.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad
Middle stee	4.1				

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

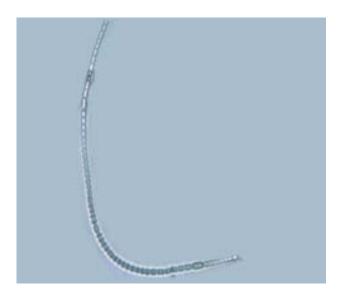
#### Lower stretch

Ja	ngipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
	STATI	*		2018	201		2020
	Harsh	nil N	F	NF	NI	?	NF
	Tehr	i N	F	NF	NI	?	NF
	Haridy	var N	F	NF	NI	?	NF
	Bijno	or N	र	NF	NI	7	NF
	Naron	ra N	₹	NF	NI	?	NF
	Farrukh	abad 17	0	NF	20		NF
	Kanpı	ur 40	)	105	NI	?	NF
	Prayag	raj 85	5	NF	NI	?	NF
	Varan	asi 20	0	100	170	0	NF
	Buxa	r 40	1	2270	850	8	NF
	Patna	a 48	3	61	233	3	NF
	Bhagal	pur 14	1	1023	1580	02	NF
	Farak	ka 68	3	12	32		210
	Jangip	our N	र	46	50		720
	Berham	pore 38	3	45	32		NF
	Balaga	nrh 33	3	2	120	5	105
	Tribe	ni N	?	40	233	3	270
	Godakl	hali 27	1	35	20		NF
	D. Harb	oour 12	2	1	NI	?	NF
	Fraserg	ganj 2		NF	NI	7	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Nodularia sp. (Mertens ex Bornet & Flahault, 1886)



Class: Cyanophyceae

**Order:** Nostocales

Family: Aphanizomenonaceae

Genus: Nodularia sp.

### **Identifying feature:**

\* Trichomes contain short and disc-shaped cells.

\* Cross walls are constricted and uniformly broad.

❖ Heterocyst is commonly intercalary.

❖ Spores are globose shape which is single or arrange in series.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Nitrate, Chloride, and BOD.



#### **Station wise Distribution:**

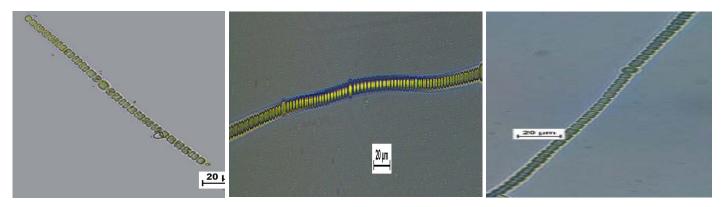
**Upper stretch** 

Harshil	Tehri	Haridwar	]	Bijnor	Narora	Farrukhabad
Middle str	retch	<b>T</b>	T		1	-
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagal	lpur Farakka
Lower str	etch	<u> </u>		1		
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbou	r Fraserganj
C/T/A /T/	TON	2015	201	10	2010	2020
STAT Hars		2017 NF	201 N		2019 NF	2020 NF
Teh		NF	N		NF	NF
Harid		NF	N		NF	NF
Bijn		NF	N		NF	NF
Naro		NF	N		NF	NF
Farruk		NF	N		NF	NF
Kan		NF	20		NF	NF
		NF	NI NI		NF	NF
Praya						
Vara		NF	N]		NF	NF
Bux		NF	N]		NF	NF
Pat		NF	N		NF	NF
Bhaga		NF	N		NF	NF
Fara		NF	N]		NF	NF
Jangi		NF	N]		NF	NF
Berhan		NF	N		NF	NF
Balag		NF	N]		NF	NF
Trib	eni	NF	N	F	NF	NF
Godal	khali	NF	N	NF NF		NF
D. Har	bour	NF	N	NF NF		NF
Frasei	ganj	NF	N]	F	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Nostoc sp. (Vaucher ex Bornet & Flahault, 1886)



Class: Cyanophyceae

**Order:** Nostocales

Family: Nostocaceae

Genus: Nostoc sp.

#### **Identifying feature:**

- \* Trichome contains globose and bead-like, barrel shaped, or cylindrical cells without basal-distal differentiation.
- ❖ Heterocyst frequently present.
- ❖ Spores are solitary or in series.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with BOD, and pH.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad		
N. (* 1.11 4 4 . 1							

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

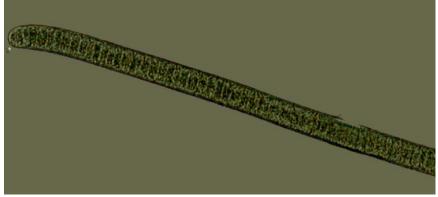
#### Lower stretch

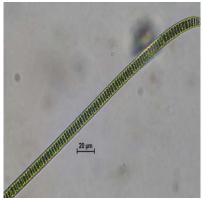
Ja	ngipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
	STATIO		<del></del>	2018	201		2020
	Harshi	50		NF	NF	ז	NF
	Tehri	NF	1	NF	NI	יז	NF
	Haridwa	nr 35		NF	NF	י	NF
	Bijnor	NF	1	NF	NF	י	NF
	Narora	NF	1	NF	NF	7	NF
	Farrukhal	oad NF	1	NF	NF	י	NF
	Kanpui	· NF	1	15	NF	7	NF
	Prayagra	aj NF	1	NF	NF	י	NF
	Varanas	si NF	•	10	NF	י	NF
	Buxar	NF	1	13	NF	י	NF
	Patna	NF	1	NF	5		NF
	Bhagalpi	ır NF	1	12	NF	י	NF
	Farakk	a NF	1	NF	3		NF
	Jangipu	r NF	1	NF	NF	י	NF
	Berhamp	ore NF	1	NF	NF	7	NF
	Balagar	h 3		4	NF	י	NF
	Triben	i NF	1	NF	4		NF
	Godakha	ali NF	1	5	NF	7	NF
	D. Harbo	ur NF	1	NF	NF	7	NF
	Fraserga	nj NF	1	1	2		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Oscillatoria sp. (Vaucher ex Gomont, 1892)





Class: Cyanophyceae

**Order:** Oscillatoriales

Family: Oscillatoriaceae

Genus: Oscillatoria sp.

### **Identifying feature:**

- ❖ It is filamentous, elongated, straight or twisted and entangled without a sheath.
- ❖ The apical cell is smoothly rounded or swollen and capitates, sometimes with a distinct sheath – like a membrane, the calyptras.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Free  $Co_2$ .



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad
Middle stre	ota <b>h</b>				

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

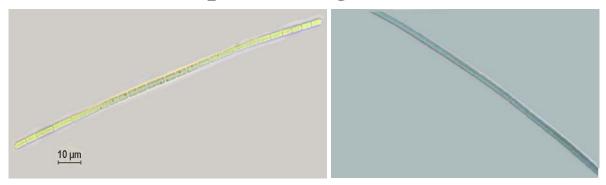
#### Lower stretch

Ja	ngipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
	STATIO			2018	<del>-</del>	19	2020
	Harshi	1 4	0	NF	N	F	NF
	Tehri	N	F	NF	3	0	NF
	Haridwa	ar 2.	5	NF	3	0	NF
	Bijnor	N	F	NF	N	F	NF
	Narora	n N	F	NF	N	F	NF
	Farrukha	bad 5	5	NF	N	F	NF
	Kanpu	r N	F	NF	2	0	NF
	Prayagr	aj 8	0	20	9	0	NF
	Varana	si N	F	20	5	70	NF
	Buxar	2:	5	12	1	8	NF
	Patna	5		3	N	F	NF
	Bhagalp	ur 7	1	116	4	0	NF
	Farakk	a 2	1	3		8	NF
	Jangipu	ır N	F	16	N	F	NF
	Berhamp	ore 3	5	17	,	2	NF
	Balagar	h 20	0	NF		9	14
	Triben	i 1	0	9	4	4	NF
	Godakha	ali 1	9	2	N	<b>IF</b>	NF
	D. Harbo	our 2	8	3	1	2	NF
	Fraserga	ınj 6	; ;	10	N	<b>IF</b>	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Phormidium sp. (Kützing ex Gomont, 1892)



Class: Cyanophyceae

**Order:** Oscillatoriales

Family: Oscillatoriaceae

Genus: Phormidium sp.

#### **Identifying feature:**

- ❖ Trichomes are cylindrical sometimes tapering slightly towards the end.
- ❖ Cells are shorter than wide, may be constricted at cross-walls.
- ❖ Apices of trichome are attenuated, straight or bent, never regularly coiled capitates or not capitates, sometimes with calyptras.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Nitrate, BOD, and Chloride.



#### **Station wise Distribution:**

**Upper stretch** 

TT1:1	1	TT2-3		D::	NT	Dannalah ahad
Harshil	Tehri	Haridwar		Bijnor	Narora	Farrukhabad
Middle str	etch					
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka
Lower stre	etch					
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbou	r Fraserganj
3 -						
STATION	N 2017	,	2018		2019	2020
Harshil	NF		20	<u> </u>	10	NF
Tehri	NF		60		30	170
Haridwa	r NF		55		15	130
Bijnor	NF		10		NF	NF
Narora	100		10		135	NF
Farrukhab	ad 90		90		90	NF
Kanpur	NF		65		43	NF
Prayagra	j 80		390		30	NF
Varanasi	i 95		100		20	50
Buxar	NF		16		7	NF
Patna	15		7		14	NF
Bhagalpu	r NF		7		10	NF
Farakka			NF		11	NF
Jangipur	. 22		NF		12	NF
Berhampo			NF		5	NF
Balagarh			2		14	NF
Tribeni	NF		10		NF	NF

NF

**10** 

7

1

6

6

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



Godakhali

D. Harbour

Fraserganj

NF

NF

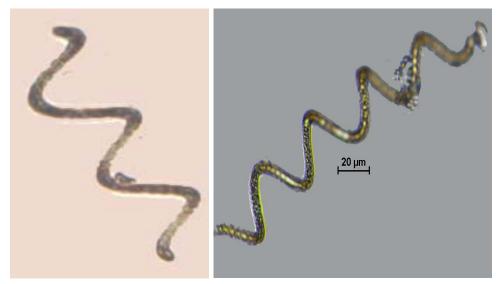
NF

NF

5

NF

# Spirulina sp. (Turpin ex Gomont, 1892)



Class: Cyanophyceae

**Order:** Spirulinales

Family: Spirulinaceae

Genus: Spirulina sp.

### **Identifying feature:**

❖ Trichome is unicellular, spirally coiled, and cylindrical without tapering toward the apices.

❖ The Cross wall of cells is not distinct.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Chloride and pH.



#### **Station wise Distribution:**

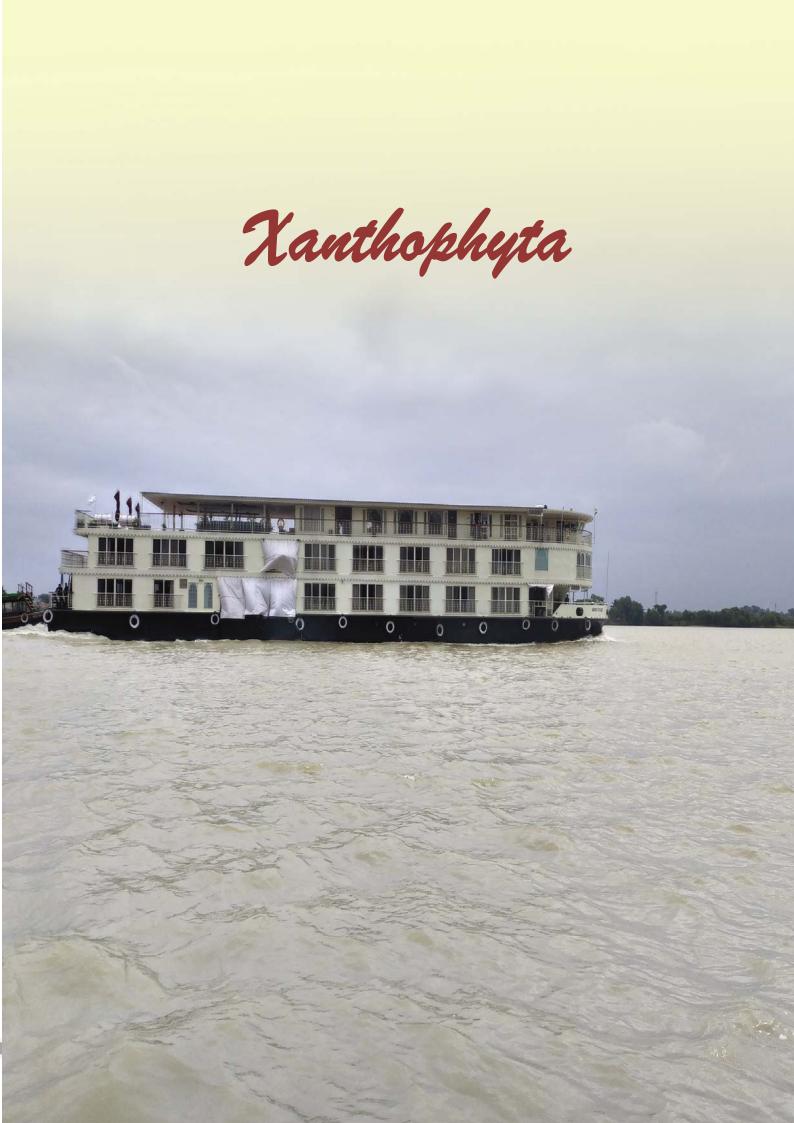
**Upper stretch** 

Harshil		Tehri		Haridwar		Bijn	or	N	arora	Fai	rrukhabad
Middle stretch											
Kanpur		Prayagraj		Varanasi	В	uxar	Patna		Bhagalp	ur	Farakka
Lower stretch											
Jangipur	Ве	erhampore	Ba	lagarh	Trib	eni	Godakhali	D	. Harbour	. ]	Fraserganj

STATION	2017	2018	2019	2020
Harshil	NF	NF	NF	NF
Tehri	NF	NF	NF	NF
Haridwar	NF	NF	NF	NF
Bijnor	NF	NF	NF	NF
Narora	NF	NF	NF	NF
Farrukhabad	30	NF	NF	NF
Kanpur	NF	NF	NF	NF
Prayagraj	NF	NF	30	NF
Varanasi	NF	50	NF	NF
Buxar	NF	NF	NF	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	NF	NF	NF
Farakka	NF	NF	NF	NF
Jangipur	NF	NF	NF	NF
Berhampore	3	NF	NF	NF
Balagarh	2	NF	NF	NF
Tribeni	NF	NF	1	NF
Godakhali	1	NF	NF	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.





## Xanthophyta

(Yellow-green algae)

## **General Identifying Characters:**

- ➤ The genera of this group are unicellular, colonial, or filamentous.
- ➤ These are simple genera and mostly free-floating. The members are yellow-green color due to the presence of carotenoids (beta-carotene).
- ➤ Chlorophyll-b is absent. Pyrenoids are absent.
- > Cell walls are composed of pectin or pectic acid.
- ➤ Filaments are broken into H-shaped. Generally, flagella are unequal in length (heterokont).
- ➤ Cells have two or more discoid shapes and grreen to yellowish-green in color.
- ➤ Sometimes cells bear eyespot. Members are present abundantly both in the lotic and lentic systems.
  - ☐ Total 5 genera belonging to one class and 5 families were recorded during study period.
  - ♣ Class:- Xanthophyceae (4 genera), Synurophyceae (1 genus).

## Botrydium sp. (Wallroth, 1815)



Class: Xanthophyceae

Source:- Baker, A.L. et al. 2012

Order: Botrydiales

Family: Botrydiaceae

Genus: Botrydium sp.

## **Identifying feature:**

- ❖ Generally, cells are present in cluster.
- ❖ Cells are small, sac-like and globose at the areal part.
- ❖ Cells 1-2 mm in diameter.
- Cells have thin cytoplasm at its periphery and multiple nuclei and discoid plastid.

**Habitat:** Freshwater

**Major Ecological Parameter:** Parameters couldnot be analysed as it is found only once in the entire sampling.



#### **Station wise Distribution:**

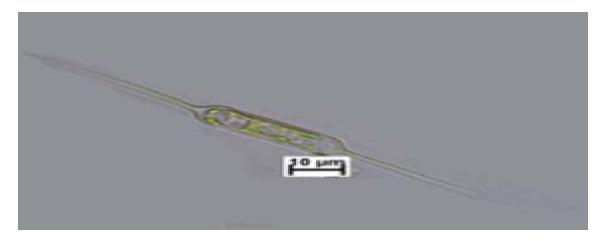
**Upper stretch** 

Upper stretch	<u>h</u>						
Harshil	Tehri	Haridwar		Bijnor	Narora	Farrukhabad	
Middle streto	ch						
Kanpur	Prayagraj	Varanasi Bux		Patna	Bhagalpı	ır Farakka	
Lower stretch	h						
Jangipur B	erhampore	Balagarh	Tribeni	Godakhali	D. Harbou	ur Fraserganj	
				<u> </u>	·	_	
STATION	2017	2018		2019		2020	
Harshil	NF		NF		NF	NF	
Tehri	NF		NF		NF	NF	
Haridwar	NF		NF		NF	NF	
Bijnor	NF		NF		NF	NF	
Narora	30		NF		NF	NF	
Farrukhabad	l NF		NF		NF	NF	
Kanpur	NF		NF		NF	NF	
Prayagraj	NF		NF		NF	NF	
Varanasi	NF		NF		NF	NF	
Buxar	NF		NF		NF	NF	
Patna	NF		NF		NF	NF	
Bhagalpur	NF		NF		NF	NF	
Farakka	NF		NF		NF	NF	
Jangipur	NF		NF		NF	NF	
Berhampore	NF		NF		NF	NF	
Balagarh	NF		NF		NF		
Tribeni	NF		NF		NF		
Godakhali	NF		NF		NF	NF	
D. Harbour	NF		NF		NF	NF	
Fraserganj	NF		NF		NF	NF	

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



## Centritractus sp. (Lemmermann, 1900)



Class: Xanthophyceae

**Order:** Mischococcales

Family: Centritractaceae

Genus: Centritractus sp.

## **Identifying feature:**

❖ Cells are cylindrical in shape and vary in lengths.

❖ Cells contain two extended spines at both ends.

\* Having two overlapping wall halves.

❖ Cells have parietal or reticulate chloroplasts.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with Ca<sup>++</sup>, Mg<sup>++</sup>, Total Hardness, and Total Solid.



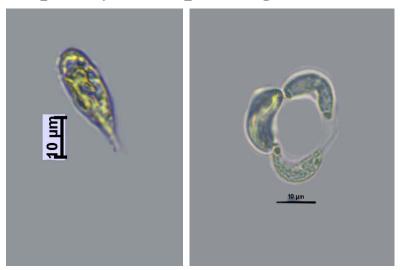
## Station wise Distribution: Upper stretch

Harshil	Tehri	Haridwar	В	ijnor	Narora	Farrukhabad
Middle str	etch					
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalp	ur Farakka
Lower stre	etch					
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbo	ur Fraserganj
STATION	2017	2018		2019		2020
Harshi	l NF	1	NF		NF	NF
Tehri	NF	1	NF		NF	NF
Haridwa	ar NF	1	NF		NF	NF
Bijnor	NF	1	NF	]	NF	NF
Narora	NF	1	NF		NF	NF
Farrukhal	bad NF	1	NF	]	NF	NF
Kanpu	r NF	1	NF		NF	NF
Prayagra	aj NF	1	NF		NF	NF
Varanas	si NF	1	NF		NF	NF
Buxar	NF	1	NF		NF	NF
Patna	NF	1	10		4	NF
Bhagalp	ur NF	1	NF		NF	NF
Farakk	a NF	1	NF		NF	NF
Jangipu	ır NF	1	NF		NF	NF
Berhamp	ore NF	1	NF		NF	NF
Balagar		1	NF		NF	NF
Triben	i NF		NF		NF	NF
Godakha	ali NF	1	NF		NF	NF
D. Harbo	our NF		NF		NF	NF
Fraserga	nj NF	1	NF		NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



## Ophiocytium sp. (Nägeli, 1849)



Class: Xanthophyceae

**Order:** Mischococcales

Family: Ophiocytiaceae

Genus: Ophiocytium sp.

## **Identifying feature:**

\* Cells are cylindrical and are having 2-27 μm width.

❖ Cells may or may not contain spine.

❖ The cells form unbranched filaments.

\* Chloroplasts are single to numerous and various shapes.

❖ Pyrenoid is absent.

**Habitat**: Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with Total Dissolved Solid.



#### **Station wise Distribution:**

**Upper stretch** 

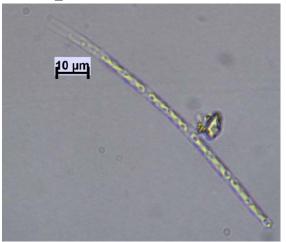
Harshil	Tehri	Haridw	var	Bijnor		Narora 1		rukhabad		
Middle stretch										
Kanpur	Prayagraj	Varanasi	Buxar	Patr	Patna		ır	Farakka		
Lower s	tretch									
Jangipur	Berhampore	Balagarh	Tribeni	Godakha	ali D	D. Harbour		raserganj		

STATION	2017	2018	2019	2020
Harshil	NF	NF	NF	NF
Tehri	NF	NF	NF	NF
Haridwar	NF	NF	NF	NF
Bijnor	NF	NF	NF	NF
Narora	5	NF	NF	NF
Farrukhabad	NF	NF	NF	NF
Kanpur	NF	5	NF	NF
Prayagraj	NF	NF	NF	NF
Varanasi	NF	NF	NF	NF
Buxar	NF	NF	NF	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	NF	NF	NF
Farakka	NF	2	5	NF
Jangipur	NF	NF	NF	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	NF	NF	NF
Tribeni	NF	NF	NF	NF
Godakhali	NF	NF	NF	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



## Tribonema sp. (Derbès & Solier, 1851)



Class: Xanthophyceae

**Order:** Tribonematales

Family: Tribonemataceae

Genus: Tribonema sp.

## **Identifying feature:**

- Cylindrical shaped cells are joined end to end and form unbranched filaments.
- ❖ Cell walls are broken into H shape.
- ❖ Cells have numerous rings or plate-shaped chloroplasts.

**Habitat:** Freshwater

Major Ecological Parameters: Highly positive correlation was

found with BOD, and Total Dissolved Solid.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad		

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

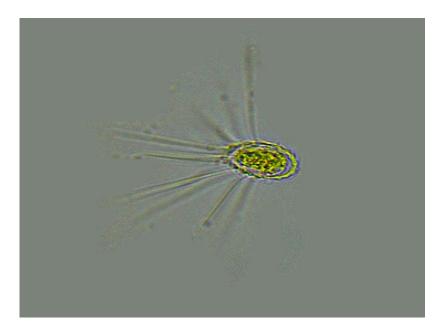
#### **Lower stretch**

Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
				•		
STATI			2018	2019		2020
Harsh	il N	F	NF	N	F	NF
Tehr	i 15	5	NF	N	F	NF
Haridy	var N	F	NF	N	F	NF
Bijno	r N	F	NF	N	F	NF
Naron	a 45	5	15	2	5	NF
Farrukh	abad 43	0	60	N	$\mathbf{F}$	NF
Kanpı	ur 52	0	120	N	F	NF
Prayag	raj 14	0	45	50		NF
Varan	asi 67	8	120	120 70		NF
Buxa	r N	र	NF	N	F	NF
Patna	a N	F	NF	N	F	NF
Bhagal	pur N	F	NF	N	F	NF
Farak	ka N	F	NF	N	F	NF
Jangip	ur N	F	NF	N	F	NF
Berham	pore N	F	NF	N	F	NF
Balaga	rh N	F	NF	N	F	NF
Tribe	ni N	F	NF	N	F	NF
Godakl	Godakhali Nl		NF	N	F	NF
D. Harb	our N	F	NF	N	NF	
Fraserg	anj N	F	NF	N	F	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



## Mallomonas sp. (Perty, 1852)



Class: Synurophyceae

**Order:** Synurales

Family: Mallomonadaceae

Genus: Mallomonas sp.

## **Identifying feature:**

- ❖ Cells are elongated oval-shaped with numerous having long bristles or spines.
- ❖ At the apical part of the cell single flagellum is present.
- \* Cells are 8-100 μm long and up to 30 μm wide.

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with Transparency.



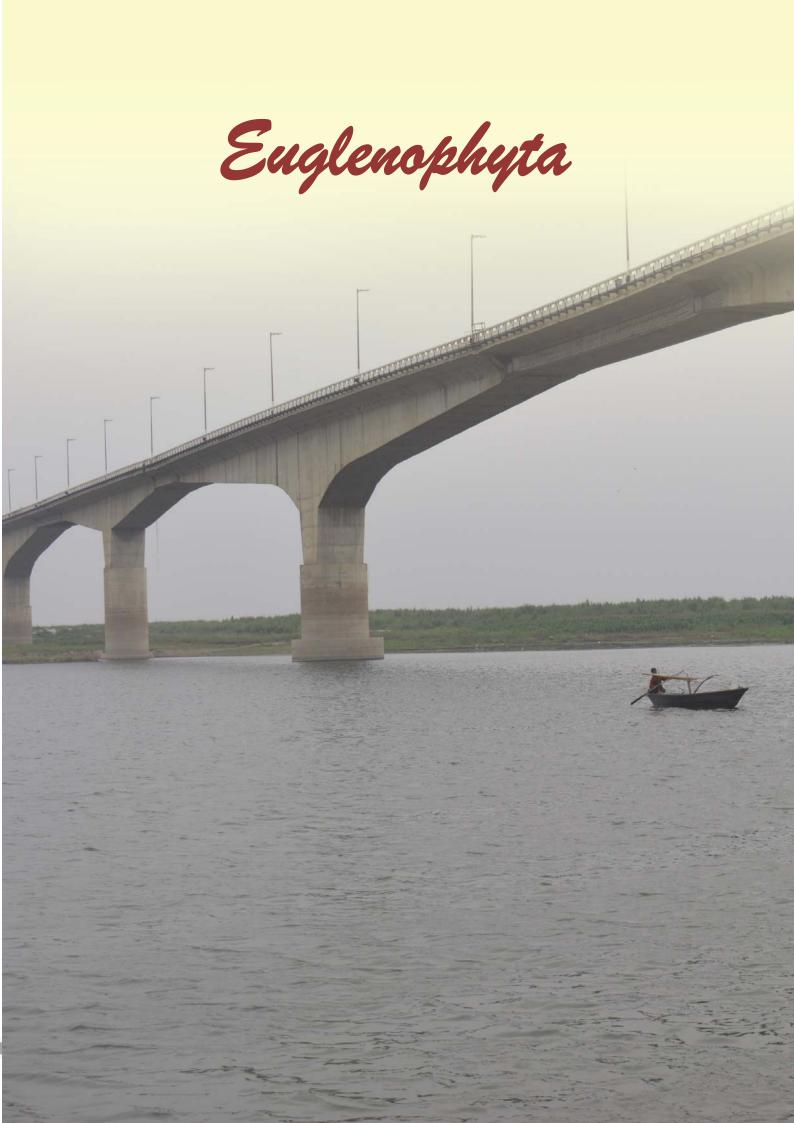
### Station wise Distribution: Upper stretch

Absent
Present

Harshil	Т	<b>Tehri</b>	Haridwar		Bij	nor	Na	rora	Fai	rrukhabad
Middle str	retch									
Kanpur	Pr	ayagraj	Varanasi	Buxa	ar	Patna		Bhagalpur		Farakka
Lower str	etch									
Jangipur	Berh	ampore	Balagarh	Tribe	ni	Godakha	ali	D. Harbo	ur	Fraserganj
STATION		2017	201			2019			2020	
Harsl	hil	N	F	NF			N	F		NF
Tehi	ri	NI	7	NF			N	F		NF
Harid	war	N	F	NF			N	F		NF
Bijno	or	N	F	NF			N	F		NF
Naro	ra	30	)	NF			N	F		NF
Farrukh	abad	N	F	NF			N	F		NF
Kanp	ur	N	F	NF		NF		F		NF
Prayag	graj	N	F NF			NF				NF
Varan	asi	N	F NF			NF				NF
Buxa	ar	N	F	NF			N	F		NF
Patn	ıa	NI	<u>F</u>	NF			N	F		NF
Bhagal	pur	N	F	NF			N	F		NF
Farak	ka	N	F	NF			N	F		NF
Jangij	our	N	<u> </u>	20			N	F		NF
Berham		N	F	NF			N	F		NF
Balaga	arh	NI		NF			N	F		NF
Tribe			₹	NF			NF			NF
Godak	hali NF		 T	NF			NF			NF
D. Harl	bour	NI	₹	NF			NF			NF
Fraser	ganj	N	T	NF			N	F		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.





## Euglenophyta

#### **General Identifying Characters:**

- > Genera of the group are mostly unicellular with colonial morphology.
- ➤ A total of 40 genera are recorded in world-wide.
- ➤ Most of the members are recorded in freshwater.
- ➤ The shape of the cells is elongated and spindles-shaped with numerous chloroplasts, with varied, shaped i.e. star, plate, and ribbon-shape.
- ➤ One-third of the genera can carry the photosynthesis process.
- ➤ Cells have flagella, which are emergent from the flask-shaped depression on the anterior side. An eye-spot is present.
- ➤ The pellicle is flexible in some genera while in others it is rigid.
  - ☐ Total 4 genera belonging to one class and 2 families were recorded during study period.

## Euglena sp. (Ehrenberg, 1830)



Class: Euglenophyceae

Order: Euglenida

Family: Euglenidae

Genus: Euglena sp.

## **Identifying feature:**

- Cells are elongated but sometimes spindle-shaped.
- ❖ It's posterior end is pointed and anterior end is narrow.
- ❖ Cells have a single flagellum, which comes from the apical part.
- Chloroplasts are variable in shapes such as ovoid disc shaped, ribbon - like bands, or star - shaped plates.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Chloride, Nitrate, and BOD.



#### **Station wise Distribution:**

**Upper stretch** 

Upper stre			T							
Harshil		Tehri	Haridy	var		Bijnor	N	arora	Far	rukhabad
Middle str	etch									
Kanpur	npur Prayagraj		Varanasi Buxar		•	Patna	Bhagalpur Farak		Farakka	
Lower stre	etch									
Jangipur	Bei	rhampore	Balagarh	Tribeni	G	odakhali	D.	Harbour	F	raserganj
STATION		2017	201	Q		2019		20	20	
Harsh		NF		NF			NF	20		NF
Tehr	i	NF	1	5		1	NF		1	NF
Haridy		NF		NF			NF			NF
Bijno		NF		5			NF			NF
Naror		10		NF			NF			NF
Farrukh				NF			NF			NF
Kanpı		20		30			NF			20
Prayag		20		160			NF			50
Varana		45		50			NF			NF
Buxa		NF	ı	NF			NF			NF
Patna		NF		NF			NF			NF
		NF		NF		1	2			NF
Bhagal <sub>l</sub> Farak							5			
		NF		NF		7				NF
Jangip		NF		NF NF			NF			NF NF
Berham <sub>j</sub> Balaga		NF NF		NF NF		NF				NF NF
Tribe		NF NF		2		4 NF				NF
Godaki		1		NF						NF NF
			ı			9				
D. Harb		NF		NF			17		NF	
Fraserg	anj	NF		NF			9		] 	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♦** NF Phytoplankton was not found at that time of sampling.



## Lepocinclis sp. (Perty, 1849)



Class: Euglenophyceae

Order: Euglenida

Family: Phacidae

Genus: Lepocinclis sp.

## **Identifying feature:**

- ❖ Cells are spherical to spindle-shaped sometime with a tapering tail.
- ❖ The posterior end is pointed.
- Chloroplasts are parietal disc-shaped.
- ❖ Two eyespot and annular-shaped paramylum granules and single flagellum are present in the cell.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Nitrate.



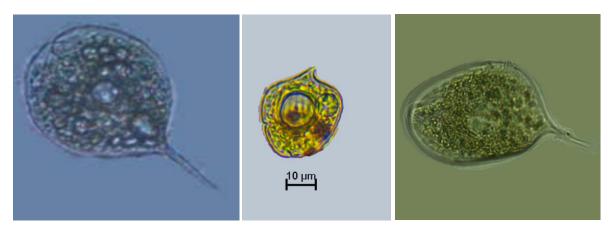
### Station wise Distribution: Upper stretch

Harshil		Tehri	Haridwar	]	Bijnor	Narora	Fa	arrukhabad
Middle st	retch							
Kanpur	]	Prayagraj	Varanasi	Buxar	Patna	Bha	agalpur	Farakka
Lower str	etch			1	Т			<u> </u>
Jangipur	Bei	rhampore	Balagarh	Tribeni	Godakhali	D. Ha	rbour	Fraserganj
						·		
STATION		2017	2018		2019		2020	
Hars		NI		NF		NF		NF
Teh		NI		NF		NF		NF
Harid		10		NF		NF		NF
Bijn		NI		NF		NF		NF
Naro		20		NF		NF		NF
Farrukl	abad	l NI	?	NF		NF		NF
Kanp	our	NI	?	15		NF		NF
Praya	graj	25		2		NF		200
Varar	nasi	30		NF		NF		NF
Bux	ar	NI	7	NF		NF		NF
Patr	ıa	NI	?	NF		NF		NF
Bhaga	lpur	NI	?	NF		NF		NF
Farak	kka	NI	7	NF		NF		NF
Jangi	pur	NI	?	NF		NF		NF
Berham	pore	NI	7	NF		NF		NF
Balag	arh	NI	?	NF		NF		NF
Tribe	eni	NI	?	NF		NF		NF
Godak	hali	NI	?	2		2		NF
D. Har	bour	NI	?	1		NF		NF
Fraser	ganj	NI	?	NF		NF		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



## Phacus sp. (Dujardin, 1841)



Class: Euglenophyceae

Order: Euglenida

Family: Phacidae

Genus: Phacus sp.

## **Identifying feature:**

- ❖ Cells are flattened (leaf-like) or sometimes twisted in shape.
- ❖ The anterior part of the cell wider and pointed at the posterior side.
- ❖ Flagellum comes from the anterior part of the cell.
- Cells have many ovoid and disc-shaped chloroplast

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with Free  $CO_2$ .



## **Station wise Distribution: Linear stretch**

**Upper stretch** 

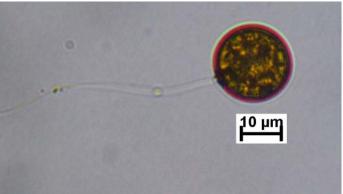
Harshil	7	<b>Tehri</b>		Hari	idwar	В	ijnor	Narora	Fai	rrukhabad
Middle str	etch									
Kanpur	Pr	ayagraj	Vara	nasi	Buxar		Patna	Bhaga	lpur	Farakka
Lower stre	tch									
Jangipur	Berh	nampore	Balaga	ırh	Tribeni	God	dakhali	D. Harbo	our	Fraserganj
STATION Harsh		2017 N	Tr	201	8 NF		2019 NI		2020	NE
										NF
Tehr		N			NF		NI			NF
Haridw		3			30		NI			NF
Bijno		N			NF		NI			NF
Naror		N			NF		NI			NF
Farrukha	abad	N			NF		NI			NF
Kanpu	ır	N			10		NI	F		NF
Prayag	raj	1	0		NF		NI	F		NF
Varana	asi	N	F		NF		NI	F		NF
Buxa	r	N	F		6		NI	F		NF
Patna	a	N	F		NF		NI	F		NF
Bhagalr	pur	N	F		12		NI	F		NF
Farakl	ka	N	F		NF		2			NF
Jangip	ur	N	F		NF		NI	F		NF
Berhamp	ore	N	F		NF		4			NF
Balaga	rh	1			NF		NI	F		NF
Triber	ni	N	F		NF		2			NF
Godakh	ali	N	F		NF		3			NF
D. Harb	our	N	F		NF		4			NF
Fraserg	anj	N	F		NF		NI	F		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



## Trachelomonas sp. (Ehrenberg, 1835)





Class: Euglenophyceae

Order: Euglenida

Family: Euglenidae

Genus: Trachelomonas sp.

## **Identifying feature:**

- ❖ Each cell of the trachelomonas is enclosed by a varied shaped and size lorica with an opening for the flagellum.
- ❖ The surface of the lorica may be smooth, granulated, or spiny.
- Cells bear a red eyespot and two or many disc-shaped chloroplasts.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with Nitrate\_N and BOD.



## **Station wise Distribution: Linear stretch**

**Upper stretch** 

Harshil	T	`ehri	Haridwar		Bij	jnor	Narora		Fa	rrukhabad
Middle str	etch					_		_		
Kanpur	Pra	ayagraj	Varanasi	Bux	ar	Patna	a	Bhagalp	ur	Farakka
Lower stre	etch									
Jangipur		ampore	Balagarh	Tribe	ni	Godakha	li	D. Harbo	ıır	Fraserganj
oungipur	Bern	широге	Duiuguin	11100		Godalina	•••	D. Harbo		Traserganj
STATION		2017	201	8		2019		20	020	
Harsh	nil	NI	र	NF		·	NF	1		NF
Tehr	i	NI	?	NF			NF	1		NF
Haridw	var	NI	र	NF			NF	1		NF
Bijno	r	NI	?	NF			NF	1		NF
Naror	a	NI	?	NF			NF	•		NF
Farrukha	abad	NI	?	NF			NF	1		NF
Kanpı	ur	NI	7	NF			NF	1		NF
Prayag	raj	NI	7	NF			NF	1		NF
Varana	asi	NI	?	NF			NF	1		NF
Buxa	r	NI	?	3			1			NF
Patna	a	NI	?	NF			1			NF
Bhagalı	pur	NI	?	5			NF	•		NF
Farakl	ka	NI	?	NF			NF	•		NF
Jangip		NI		NF			NF			NF
Berham		NI		NF			NF			NF
Balaga		NI		NF			NF			NF
Triber		NI		NF			NF			NF
Godaki		NI		NF			NF			NF
D. Harb		NI		NF			NF			NF
Fraserg	anj	NI	Ç.	NF			NF	1		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Dinophyta



## **Dinophyta**

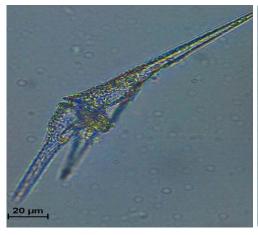
(Dinoflagellates)

## **General Identifying Characters:**

- These are unicellular or colonial.
- ➤ Dinoflagellates have chlorophyll-a and c and golden or olivebrown in color.
- ➤ The shape of the chloroplast is plate-like.
- > Cells have flagella.
- ➤ A specific arrangement and shape of many plates are covered throughout the cell surface.
- > Some species bear several horns.
- > Cells have a dorsoventral division into epitheca and hypotheca.
- ➤ Dinoflagellates come from Greek word dineo which means 'to whirl'.

  - ♣ Class:- Dinophyceae (1 genus), Noctiluciphyceae (1 genus)

## Ceratium sp. (F.Schrank, 1793)





Class: Dinophyceae

**Order:** Peridiniales

Family: Ceratiaceae

Genus: Ceratium sp.

## **Identifying feature:**

- Cells are fusiform having one anterior and two or three posterior horns.
- ❖ A narrow transverse furrow is present around the middle of the cell. Cells have two flagella
- ❖ A specific arrangement and shape of many plates are covered throughout the cell surface. Chloroplast are numerous and discoid shaped

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Carbonate, Ca<sup>++</sup>, Mg<sup>++</sup>, Total Hardness, and Salinity.



Tribeni Godakhali D. Harbour Fraserganj

#### **Station wise Distribution:**

Berhampore

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

Balagarh

#### Lower stretch

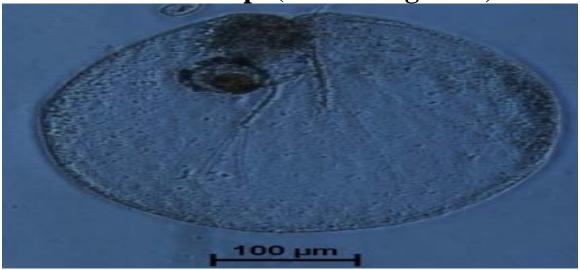
Jangipur

9 W11-8-1P W12	1					9
STATION	2017	2018		2019	2020	
Harshil	NF		NF	NF	?	NF
Tehri	NF		NF	NI	?	NF
Haridwai	r NF		NF	NI	?	NF
Bijnor	NF		NF	NI	?	NF
Narora	NF		NF	NI	?	NF
Farrukhab	ad NF		NF	NI	7	NF
Kanpur	NF		NF	NI	7	NF
Prayagra	j NF		NF	NI	7	NF
Varanasi	NF		NF	NI	7	NF
Buxar	NF		NF	NI	7	NF
Patna	NF		2	NI	?	5
Bhagalpu	r NF		NF	NI	?	NF
Farakka	NF		NF	NI	?	NF
Jangipur	NF		NF	NI	?	NF
Berhampo	re NF		NF	NI	?	NF
Balagarh			NF	NI		NF
Tribeni	NF		NF	NI		NF
Godakhal			NF	NF	? 	NF
D. Harbou	r NF		NF	NI	7	NF
Frasergan	ij NF		NF	1		10

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



Noctiluca sp. (Ehrenberg 1834)



Class: Noctiluciphyceae

**Order:** Noctilucales

Family: Noctilucaceae

Genus: Noctiluca sp.

## **Identifying feature:**

❖ It is a dinoflagellate.

❖ The cell is inflated and subspherical in shape.

❖ A deep and wide groove is present on the ventral side.

❖ The flagellum and tentacles are small.

❖ Tentacles are prominent and move posteriorly.

**Habitat:** Brakish water

**Major Ecological Parameters:** Highly positive correlation was found with Depth, Total Alkalinity, and Salinity.



## **Station wise Distribution:**

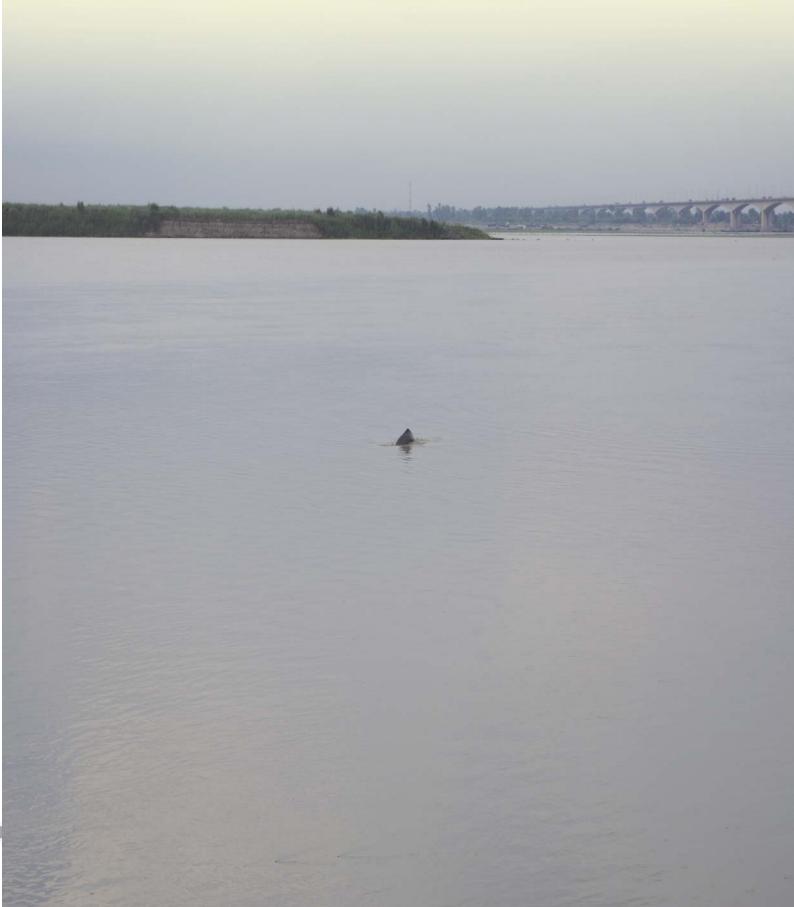
**Upper stretch** 

Harshil		Tehri	Haridwar		Bi	jnor	Na	rora	Far	rukhabad
Middle st	retch		'							
Kanpur	P	rayagraj	Varanasi	Buxa	r	Patna		Bhaga	lpur	Farakka
Lower str	etch				ı					
Jangipur	Ber	hampore	Balagarh	Tribeni	(	Godakhali	D.	Harbou	ır	Fraserganj
STATION		2017	201	0		2019			2020	
Harshil		NF		NF			NF		2020	NF
Tehri		NF		NF			NF			NF
Haridwa	ır	NF		NF			NF			NF
Bijnor	-	NF		NF			NF			NF
Narora		NF		NF			NF			NF
Farrukhal	oad	NF		NF			NF			NF
Kanpur	•	NF		NF			NF			NF
Prayagra	aj	NF		NF			NF			NF
Varanas	si	NF		NF			NF			NF
Buxar		NF		NF			NF			NF
Patna		NF		NF			NF			NF
Bhagalpı	ır	NF		NF			NF			NF
Farakka	a	NF		NF			NF			NF
Jangipu	r	NF		NF			NF			NF
Berhampo	ore	NF		NF			NF			NF
Balagar	h	NF		NF			NF			NF
Tribeni	i	NF		NF			NF			NF
Godakha	ıli	NF		NF			NF			NF
D. Harbo	ur	NF		2			4			NF
Fraserga	nj	63		NF			2			NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Zygnematophyta

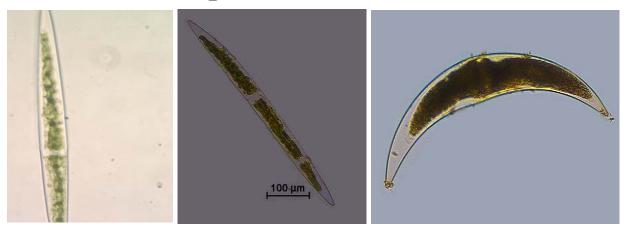


## Zygnematophyta

### **General Identifying Characters:**

- ➤ The members of Zygnematophyta are one of the most diverse green algae, with a variation in thallus types (filaments, unicellular, colonies).
- ➤ Cell walls have one to several layers, with various degrees of ornamentation due to the presence of large lobes spines, granules.
- ➤ Approximately 4,000 species are recorded World-wide.
- The group has no flagella at all stages of the life cycle.
- Abundantly found in freshwater, these are common in ponds, lakes, and streams, in surface mats, or as phytoplankton or benthic growths.
- ➤ Under this group, spirogyra and various unicellular desmids are included.
- ➤ The conjugating green algae are important as ecological indicator species and for the ecological services they provide.
  - ☐ Total 8 genera belonging to one class and three families were recorded during study period.

## Closterium sp. (Nitzsch ex Ralfs, 1848)



Class: Zygnematophyceae

**Order:** Desmidiales

Family: Desmidiaceae

Genus: Closterium sp.

## **Identifying feature:**

❖ It is unicellular.

❖ Cells are elongated or curved with the tapering end.

❖ Cells look like bow and sickle-shaped.

❖ Cells are divided into two halves without any constriction.

Cells have two chloroplasts at each half.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Total Dissolved Solid.



Absent
Present

Farrukhabad

#### **Station wise Distribution:**

Tehri

#### **Upper stretch**

Harshil

		1101101101		1,01		7 0 1 0 1 0 1 0 1 1 0 1 1 1 0 1 1 1 0 1 1 1 1 0 1			
Middle stretch									
Kanpur	Prayagraj	Varanasi	Buxar	Patna		Bhagalp	ur	Farakka	
Lower stretch									
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D.	. Harbour	r Frasergan		
CITA INVON	2015	0040		0040			•		
STATION	2017	2018		2019		20	20		
Harshil	NF		NF		NF		NF		
Tehri	NF		NF		NF			NF	
Haridwar	NF		NF		NF		NF		
Bijnor	NF		NF		NF			NF	
Narora	NF		NF		NF			NF	
Farrukhaba	d NF		NF		NF			NF	
Kanpur	10		5		NF			NF	
Prayagraj	20		30		NF			10	
Varanasi	40		NF		NF			NF	
Buxar	NF		NF		NF			NF	
Patna	1		NF	1				NF	
Bhagalpur	10	10			NF		NF		
Farakka	4		NF		NF			NF	

NF

NF

NF

NF

NF

NF

1

NF

4

NF

NF

9

NF

NF

Bijnor

Narora

Haridwar

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



**Jangipur** 

**Berhampore** 

**Balagarh** 

**Tribeni** 

Godakhali

D. Harbour

Fraserganj

NF

2

6

NF

6

2

3

NF

NF

21

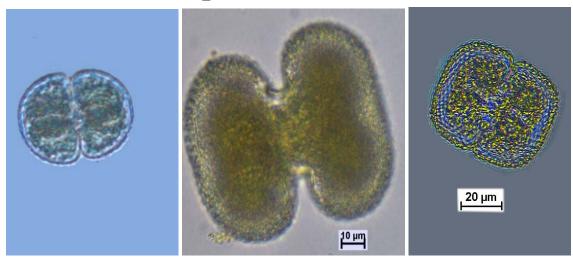
NF

NF

NF

NF

## Cosmarium sp. (Corda ex Ralfs, 1848)



Class: Zygnematophyceae

**Order:** Desmidiales

Family: Desmidiaceae

**Genus:** Cosmarium sp.

## **Identifying feature:**

- **.** Cells are ovoid or rounded in shape.
- Sometimes cells are moderately flattened.
- ❖ Cells are divided into semi cells by median groove or isthmus, which present at the center.
- ❖ The size and shape of semi-cells are varied i.e sub-elliptic, oblong, and rarely circular in some cases.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Transparency.



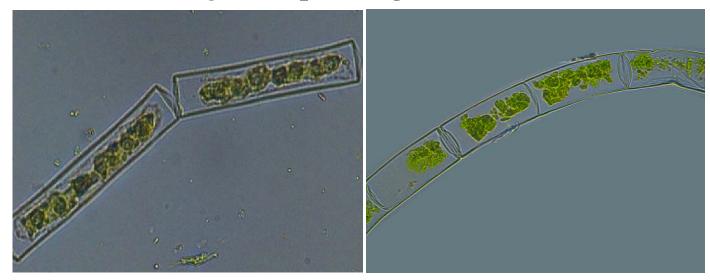
### Station wise Distribution: Upper stretch

Harshil	Tehri	Haridwar	Bijnor		Narora	Farrukhabad
Middle str	etch					
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalp	ur Farakka
Lower stre	tch					
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbou	r Fraserganj
STATION	2017	201	.8	2019	,	2020
Harsh	il N	<b>IF</b>	NF		NF	NF
Tehr	i 3	30	NF		10	40
Haridw	var N	NF	60		NF	NF
Bijno	r N	<b>IF</b>	25		NF	NF
Naror	ra 2	20	NF		NF	NF
Farrukha	abad 3	30	NF		NF	NF
Kanpı	ır N	NF .	NF		NF	NF
Prayag	raj N	NF .	20		NF	NF
Varana	asi N	<b>IF</b>	NF		NF	NF
Buxa	r N	<b>IF</b>	9		NF	NF
Patna	a N	<b>IF</b>	NF		NF	NF
Bhagalı	pur N	NF .	NF		NF	NF
Farakl	ka N	NF .	NF		NF	NF
Jangip	ur N	NF .	NF		NF	NF
Berhamj	pore N	NF .	NF		NF	NF
Balaga	rh N	<b>IF</b>	NF		NF	NF
Triber	ni N	<b>IF</b>	1		NF	NF
Godakł	nali N	<b>IF</b>	NF		3	NF
D. Harb	our N	<b>IF</b>	NF		NF	NF
Fraserg	anj	<b>IF</b>	NF		1	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



## Mougeotia sp. (C.Agardh, 1824)



Class: Zygnematophyceae

Order: Zygnematales

Family: Zygnemataceae

Genus: Mougeotia sp.

## **Identifying feature:**

- ❖ Cells are cylindrical and united to form unbranched filaments.
- ❖ Usually, rod-like single chloroplast is present in each cell.
- ❖ Pyrenoids are arranged in one axial row or scattered throughout the chloroplast.

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with pH, Carbonate, and Bicarbonate.



#### Station wise Distribution: Upper stretch

Absent
Present

Harshil	Tehri	Haridwar	В	ijnor	Nar	ora Fa	arrukhabad
Middle st	retch						
Kanpur	Prayagraj	Varanasi	Buxar	Patna		Bhagalpur	Farakka
Lower str	etch						
Jangipur	Berhampore	Balagarh	Tribeni	Godakha	li D	). Harbour	Fraserganj
					l		ı
STATION	2017	2018		2019		2020	)
Harshil	NF	1	NF		NF		NF
Tehri	NF	ı	NF		NF		NF
Haridwa	r 10		NF		NF		NF
Bijnor	NF	1	NF		NF		NF
Narora	NF	ı	NF		NF		NF
Farrukhah	oad NF	1	NF		NF		NF
Kanpur	· NF	ı	5		NF		NF
Prayagra	nj NF		10		NF		NF
Varanas	i NF	l	NF		NF		NF
Buxar	NF	 	NF		NF		NF
Patna	NF	1	6		NF		NF

NF

**10** 

4

4

**20** 

2

NF

NF

NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



Bhagalpur

Farakka

**Jangipur** 

**Berhampore** 

Balagarh

Tribeni

Godakhali

D. Harbour

Fraserganj

NF

**12** 

NF

NF

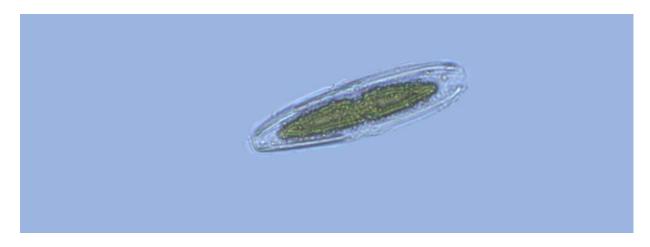
6

NF

NF

NF

## Penium sp. (Brébisson ex Ralfs, 1848)



Class: Zygnematophyceae

**Order:** Desmidiales

Family: Peniaceae

Genus: Penium sp.

## **Identifying feature:**

❖ It is unicellular. Cells are cylindrical.

- ❖ Cells are divided into two halves and each half contains a single chloroplast with numerous pyrenoids.
- Sometime near the trunked apices, a small median constriction is found.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with BOD, and Chloride.



#### **Station wise Distribution:**

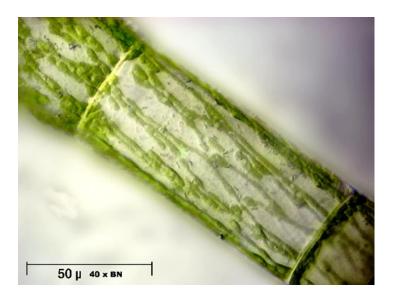
### **Upper stretch**

Harshil	Tehri	Haridwar	В	ijnor	Narora	Farrukhabad
Middle str	etch					
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagal	pur Farakka
Lower stre	tch					
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbo	our Fraserganj
					,	
STATION		201		2019	NIE	2020
Harsh		I <b>F</b>	NF		NF	NF
Tehr		IF	NF		NF	NF
Haridw		<b>IF</b>	NF		NF	NF
Bijno	r N	F	NF		NF	NF
Naror	ra N	<b>IF</b>	NF		NF	NF
Farrukha	abad N	<b>IF</b>	NF		NF	NF
Kanpı	ır N	<b>IF</b>	NF		60	NF
Prayag	raj N	<b>IF</b>	5		NF	NF
Varana	asi N	<b>IF</b>	NF		NF	NF
Buxa	r N	<b>IF</b>	NF		NF	NF
Patna	a N	<b>IF</b>	NF		NF	NF
Bhagalı	our N	I <b>F</b>	NF		NF	NF
Farakl	ka N	<b>IF</b>	NF		NF	NF
Jangip	ur N	I <b>F</b>	NF		NF	NF
Berhamj	pore N	<b>IF</b>	NF	NF		NF
Balaga		I <b>F</b>	NF	NF		NF
Tribe	ni N	<b>IF</b>	NF	NF		NF
Godaki	nali N	I <b>F</b>	NF		NF	NF
D. Harb	our N	<b>IF</b>	NF		NF	NF
Fraserg	anj N	I <b>F</b>	NF		NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Sirogonium sp. (Kützing, 1843)



Source-Baker, A.L. et al. 2012.

Class: Zygnematophyceae

**Order:** Zygnematales

Family: Zygnemataceae

Genus: Sirogonium sp.

# **Identifying feature:**

- ❖ Filaments are slender, unbranched, and made up of cells that have smooth and even septa.
- ❖ The number of chloroplasts varies from 1 to 16 and the shape is parietal nearly straight ribbon.

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with Transparency.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad
Middle stret	ch				

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### Lower stretch

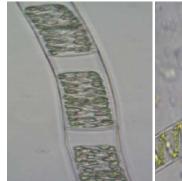
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj

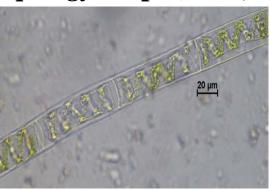
STATION	2017	2018	2019	2020
Harshil	NF	10	NF	NF
Tehri	300	NF	NF	NF
Haridwar	NF	NF	NF	NF
Bijnor	NF	NF	NF	NF
Narora	NF	NF	NF	NF
Farrukhabad	NF	NF	NF	NF
Kanpur	15	NF	NF	NF
Prayagraj	NF	NF	NF	NF
Varanasi	NF	NF	NF	NF
Buxar	NF	NF	NF	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	NF	NF	NF
Farakka	NF	NF	NF	NF
Jangipur	NF	NF	NF	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	NF	NF	NF
Tribeni	NF	NF	NF	NF
Godakhali	NF	NF	NF	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	NF	NF	NF	NF

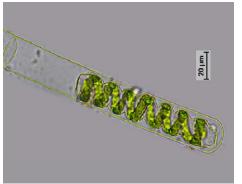
- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Spirogyra sp. (Link, 1820)







Class: Zygnematophyceae

**Order:** Zygnematales

Family: Zygnemataceae

Genus: Zygnema sp.

### **Identifying feature:**

- ❖ It is simple and unbranched filamentous algae, which consists of rows of an indefinite numbers of cylindrical cells.
- Various shape of the chloroplast is present like spiral or ribbon shaped.
- ❖ Cells are generally more in length than in breath.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Variable parameters are required for the genus.



NF

NF

NF

NF

NF

NF

NF

NF

#### **Station wise Distribution:**

**Upper stretch** 

Narora

**Farrukhabad** 

Kanpur

**Prayagraj** 

Varanasi

Buxar

Patna

Bhagalpur

NF

NF

NF

NF

**50** 

14

1

NF

Harshil	Tehri	Haridwa	Haridwar   I		Bijnor Na		Narora Fari		rrukhabad	
Middle str	etch									
Kanpur	Prayagraj	Varanasi	Buxa	ır	r Patna		Bhagalpur		Farakka	
Lower stretch										
Jangipur	Berhampore	Balagarh	Tribeni	Go	dakhali	ali D. Harbour		· F	Fraserganj	
STATION	2017	2(	)18		2019			2020		
Harsh	il N	F	NF		NF		NF			
Tehri	Tehri NF NF		5			NF				
Haridw	Haridwar NF NF		40				NF			
Bijnor NF 20				95			40			

200

**80** 

NF

**40** 

**30** 

8

NF

**10** 

NF

NF

55

NF

NF

4

1

NF

Farakka	NF	5	NF	NF
Jangipur	9	8	8	NF
Berhampore	NF	11	2	NF
Balagarh	6	28	NF	NF
Tribeni	3	40	4	NF
Godakhali	NF	2	7	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Staurastrum sp. (Meyen ex Ralfs, 1848)



Class: Zygnematophyceae

**Order:** Desmidiales

Family: Desmidiaceae

Genus: Staurastrum sp.

## **Identifying feature:**

- ❖ Cells are divided into semi cells by median groove or isthmus, which present at the center.
- Various shapes of semi cell are present such as elliptic subcircular, subtriangular.
- ❖ The outer side of semi cell increased into long horns, which forms either short stumpy or short spines.
- ❖ The cell wall is ornamented with granules or spines.
- ❖ Each semi cell has lobed chloroplast with single or sometimes several pyrenoids.

**Habitat:** Freshwater and Brackish water

**Major Ecological Parameters:** Depends on variable ecological Parameters.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwai	Haridwar		Narora	Farrukhabad	
Middle stretch							
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalp	our Farakka	
Lower stretch							
Janginur	Rerhamnore	Ralagarh	Tribeni	Godakhali	D Harbour	Frasergani	

STATION	2017	2018	2019	2020
Harshil	NF	NF	NF	NF
Tehri	NF	NF	15	NF
Haridwar	NF	NF	NF	NF
Bijnor	NF	NF	NF	NF
Narora	40	NF	NF	NF
Farrukhabad	NF	20	NF	NF
Kanpur	10	NF	NF	NF
Prayagraj	NF	NF	NF	NF
Varanasi	NF	NF	NF	NF
Buxar	NF	NF	NF	NF
Patna	NF	5	NF	NF
Bhagalpur	NF	1	2	NF
Farakka	NF	9	1	NF
Jangipur	NF	2	NF	NF
Berhampore	5	NF	NF	NF
Balagarh	NF	3	NF	NF
Tribeni	NF	NF	NF	NF
Godakhali	1	10	NF	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Zygnema sp. (C.Agardh, 1817)



Class: Zygnematophyceae

Order: Zygnematales

Family: Zygnemataceae

Genus: Zygnema sp.

## **Identifying feature:**

❖ Cells are cylindrical and jointed to form unbranched filaments.

❖ Each cell has a star-shaped chloroplast, which is not connected with each other.

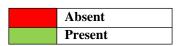
\* Cells are 16-50 μm in diameter.

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with pH.



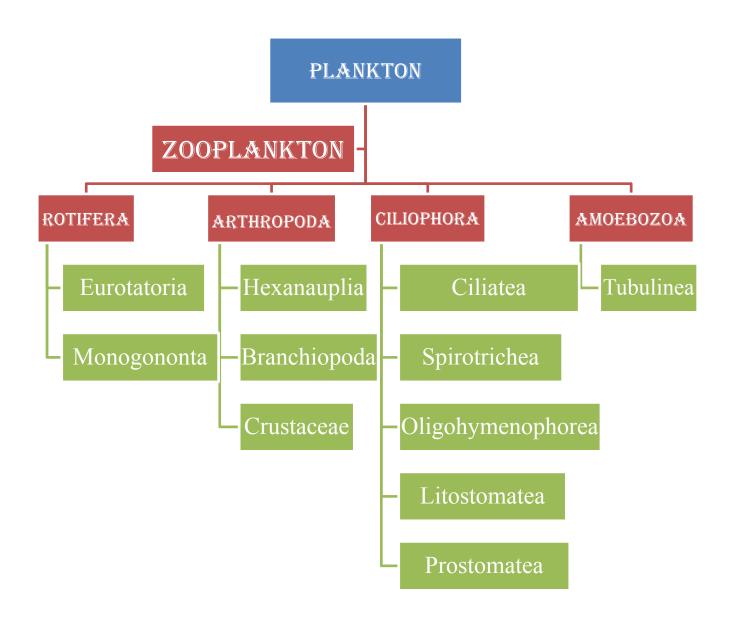
### Station wise Distribution: Upper stretch



Harshil		Tehri	Haridwar		Bijr	nor Nar		rora Fa		rrukhabad	
NC 111 4											
Middle str		ovo gwo i	Varanasi	Bux	0.11	Patn		Dhagalar		Farakka	
Kanpur	Pr	ayagraj	v aranası	Dux	аг	Pauli	a	Bhagalpu	ır	гагакка	
Lower str			<b>.</b> .			<u> </u>					
Jangipur	Berl	hampore	Balagarh	Tribe	ni	Godakh	ali	D. Harbou	ır	Fraserganj	
CE LETO	<b>N</b> T	2015	•	2010			2010			2020	
STATIO Harshil		2017 NF		2018 NF			2019 NF			2020 NF	
Tehri		NF		NF			NF			NF	
Haridwa		NF		NF		NF				NF	
-	Bijnor NF			NF			NF			20	
	Narora 10			10			NF		NF		
Farrukhal	bad	NF		20			NF			NF	
Kanpui	r	NF		NF			NF		NF		
Prayagra	aj	15		NF	NF NF			NF			
Varanas	si	NF		NF		NF			NF		
Buxar		NF		NF	NF NF			NF			
Patna		NF		NF NF				NF			
Bhagalpı	ur	NF		NF			NF			NF	
Farakka	a	NF		NF			NF			NF	
Jangipu	r	NF		NF		NF				NF	
Berhampe		NF		NF			NF			NF	
Balagar		NF		NF			NF			NF	
Tribeni		NF		NF			NF			NF	
Godakha	ali	NF		NF		NF			NF		
D. Harbo	ur	NF		NF		NF				NF	
Fraserga	nj	NF		NF		NF			NF		

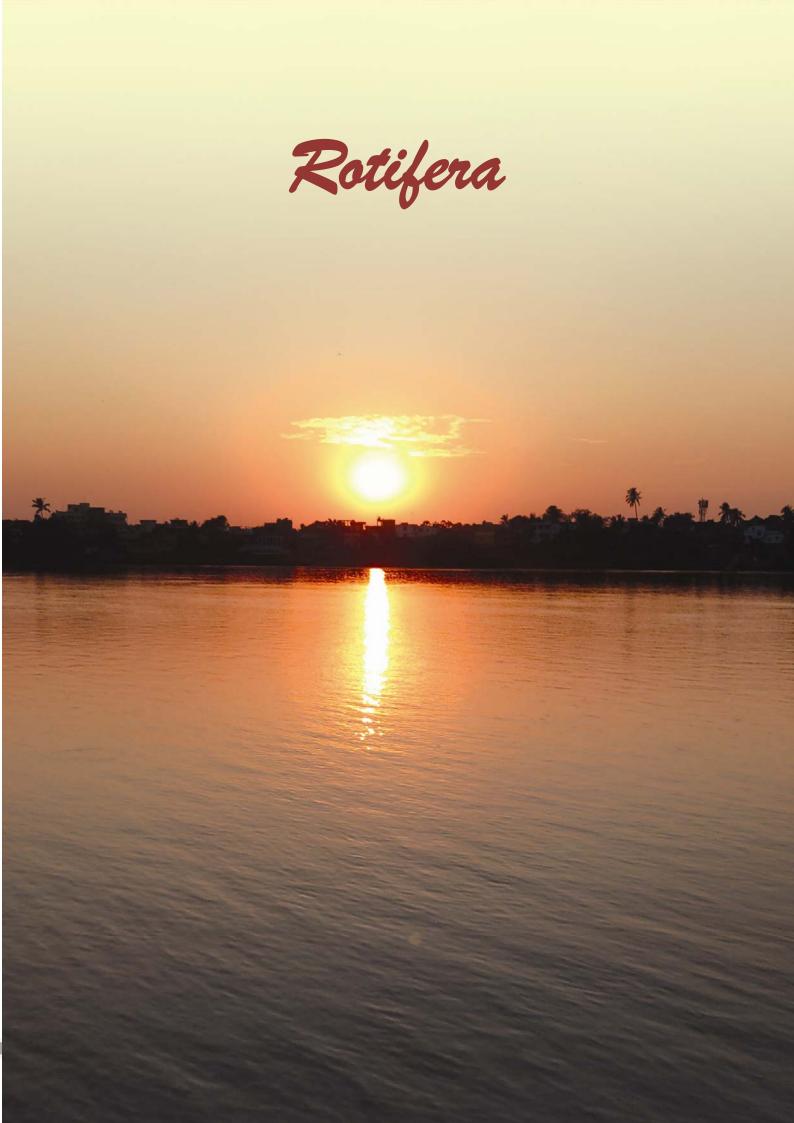
- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.







# **ZOOPLANKTON**

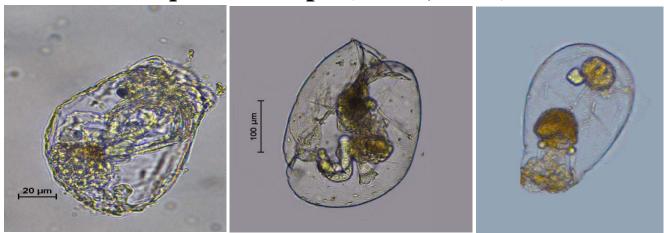


#### Rotifera

### **General Identifying Characters:**

- ➤ It is microscopic organism with an unique feature is having ciliated corona.
- The cilia is used for movement as well as filter feeding.
- ➤ Rotifers are capable of tolerating a wide range of ecological condition.
- > They can multiply asexually in good condition.
- They eat variety of food such as bacteria, detritus, other rotifer, algae and protozoa.
- ➤ Some rotifers species are regarded as eutrophication indicator i.e. Keratella and Trichocera (Karabin, 1985)
- $\triangleright$  Size generally varies between from 50 to 200  $\mu$ m.
- ➤ The body is divided into head (Corona), trunk (lorica and Pseudocoelom), and foot ( no tail with attachment glands).
- ☐ Total 13 genera belonging to 2 classes and 10 families were recorded during study period.

# Asplanchna sp. (Gosse, 1850)



Class: Monogononta

Order: Ploima

Family: Asplanchnidae

Genus: Asplanchna sp.

# **Identifying feature:**

❖ The body is large and sac-like structure, without an anus.

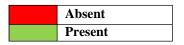
❖ The foot is absent.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with Water Temperature, BOD, Chloride and Nitrate.



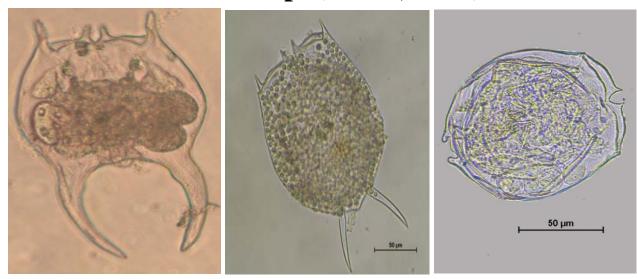
### Station wise Distribution: Upper stretch



Harshil	r	Tehri	Hari	dwar	]	Bijnoı	•	Bijnor Na		rora Farrukhabad	
Middle st	retch										
Kanpur	P	rayagraj	Va	Varanasi Buxa		kar	· Patna		Bhagalpur		Farakka
Lower str	etch										
Jangipur	Berha	mpore	Balagar	h Tri	beni	Goda	akhali	D	. Harbour	F	raserganj
STATI Hars		20 N	17 TE		)18 			2019 NF			2020 NF
Teh		N			IF			NF			NF
Harid		N		NF		NF			NF		
	Bijnor NF				IF			NF		NF	
Naro		N			<b>IF</b>			NF		NF	
Farrukh		1		NF				NF			NF
Kanp	ur	N			<b>IF</b>			NF			NF
Prayag	graj	N	F	N	<b>IF</b>			20			NF
Varan	asi	N	F	N	<b>IF</b>			NF			NF
Buxa	ar	N	F	2	20			NF			NF
Patn	ıa	N	F	N	<b>IF</b>	10				NF	
Bhagal	pur	N	F		5			50			NF
Farak	kka	N	F	N	<b>IF</b>			NF			15
Jangij	Jangipur NF		N	<b>IF</b>			NF			NF	
Berham	pore	N	NF		<b>IF</b>			NF			NF
Balaga	arh	N	F	N	<b>IF</b>		NF				NF
Tribe	eni	N	F	N	NF		NF				NF
Godak	hali	N	F	N	NF		NF			NF	
D. Harl	bour	N	F	N	<b>IF</b>		NF			NF	
Fraser	ganj	N	F	N	<b>IF</b>			NF			NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.

# Brachionus sp. (Pallas, 1766)



Class: Monogononta

Order: Ploima

Family: Brachionidae

Genus: Brachionus sp.

### **Identiying feature:**

- ❖ The body is compressed and consists of upper and lower plates with a strong cuticular outer covering called, lorica.
- ❖ Six distinct spines are projecting out from the anterior region, with intermediate spines being longer and rest being shorter.
- ❖ Egg pouches numbering in one or two may be present occasionally.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with BOD, Chloride and Nitrate.



#### **Station wise Distribution:**

Absent
Present

#### **Upper stretch**

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

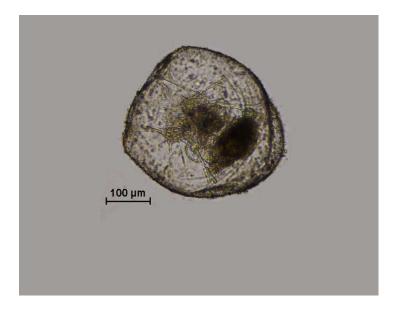
#### Lower stretch

Lower stretch							
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj	
ST	ATION	2017	2018	20	019	2020	
F	Iarshil	NF	NF		20	NF	
-	Tehri	NF	90	ľ	NF	NF	
Ha	aridwar	NF	NF	1	NF	NF	
1	Bijnor	NF	NF	ľ	NF	NF	
N	Narora	380	80	1	.50	NF	
Fari	rukhabad	NF	510		12	NF	
K	Kanpur	110	60	,	25	NF	
Pr	ayagraj	50	15	2	40	NF	
V	aranasi	35	656		5	NF	
]	Buxar	18	82	,	21	NF	
	Patna	47	43	(	69	NF	
Bh	agalpur	4	12	,	36	NF	
F	arakka	67	51		3	NF	
Ja	ngipur	6	80		2	NF	
Ber	hampore	14	26		1	NF	
Ba	alagarh	61	6		5	NF	
Т	Cribeni	NF	101		6	NF	
Go	dakhali	NF	21		2	NF	
<b>D.</b> ]	Harbour	2	NF		3	NF	
Fra	aserganj	NF	NF	I	NF	NF	

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Chromogaster sp. (Lauterborn, 1893)



Class: Monogononta

Order: Ploima

Family: Gastropodidae

**Genus:** *Chromogaster* sp.

## **Identifying feature:**

- ❖ The body is composed of two plates i.e. dorsal plate and ventral plate, which is fused laterally.
- ❖ Cilia are present throughout the body.
- ❖ One to three finger-like projections are present.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with BOD, Chloride and Nitrate.



#### **Station wise Distribution:**

Absent
Present

#### **Upper stretch**

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

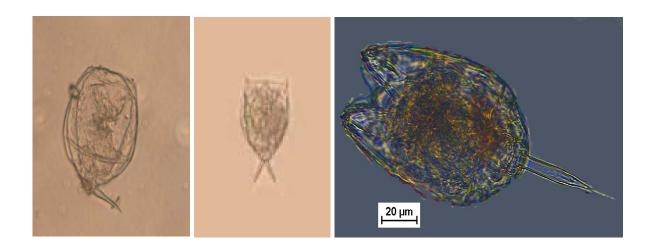
#### Lower stretch

Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
STATION	2017	2018	<u> </u>	2019	2020	)
Harshi			NF	N.		NF
Tehri	NI	?	NF	N	F	NF
Haridwa	ar NI	7	NF	N	F	NF
Bijnor	NI	?	NF	N	F	NF
Narora	n NI	?	NF	N:	F	NF
Farrukha	bad NI	?	NF	N:	F	NF
Kanpu	r NI	?	NF	N.	F	NF
Prayagr	aj NI	?	NF	N.	F	NF
Varana	si NI	र	20	N	F	NF
Buxar	NI	?	NF	5		NF
Patna	NI	?	NF	N	F	NF
Bhagalp	ur NI	?	NF	N.	F	NF
Farakk	a NI	र	NF	N	F	NF
Jangipu	ır NI	?	NF	N	F	NF
Berhamp	ore NI	?	NF	N	F	NF
Balagar	h Nl	?	NF	N.	F	NF
Triben	i NI	?	NF	N.	F	NF
Godakha	ali Nl	?	NF	N	F	NF
D. Harbo	our NI	?	NF	N	F	NF
Fraserga	nj NI	7	NF	N	F	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Lecane sp. (Nitzsch, 1827)



Class: Monogononta

Order: Ploima

Family: Lecanidae

Genus: Lecane sp.

# **Identifying feature**:

- ❖ The body is dorso-ventrally compressed, with retractile head.
- ❖ Dorsal and ventral plates are almost equal in size.
- ❖ The foot originates from a hole in the ventral plate.
- ❖ It has one toe which may be split towards the distal end.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Chloride and Total Dissolved Solid.



#### **Station wise Distribution:**

Absent
Present

#### **Upper stretch**

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### Lower stretch

Ja	ngipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
-	STATI	ON	2017	2018	201	19	2020
	Harsh		NF	NF	N	•	NF
	Tehr	i	NF	NF	N	F	NF
	Haridy	var	NF	NF	N	F	NF
	Bijno	r	NF	NF	N	F	NF
	Naroi	ra	NF	NF	N	F	NF
	Farrukh	abad	NF	NF	N	F	NF
	Kanp	ur	NF	NF	N	F	NF
	Prayag	graj	NF	50	N	F	NF
	Varan	asi	NF	40	N	F	NF
	Buxa	r	NF	NF	N	F	NF
	Patn	a	NF	NF	N	F	NF
	Bhagal	pur	NF	10	20	)	NF
	Farak	ka	NF	5	N	F	20
	Jangip	our	NF	NF	N	F	NF
	Berham	pore	NF	NF	N	F	NF
	Balaga		NF	NF	N	F	NF
	Tribe		NF	NF	N		NF
	Godakl		NF	NF	N		NF
	D. Harb	oour	NF	NF	N	F	NF
	Fraserg	ganj	NF	NF	N	F	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Kellicottia sp. (Ahlstrom, 1938)



Source- Joe Connolly, Cornell University

Class: Monogononta

Order: Ploima

Family: Brachionidae

Genus: Kellicottia sp.

## **Identifying feature:**

❖ The body has one long posterior spine.

❖ Anterior spines are four to six in number, out of these three are very long.

❖ Lorica is spinus and composed of two plates attached laterally.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with BOD, Chloride and Nitrate.



Farakka

Bhagalpur

#### **Station wise Distribution:**

Prayagraj

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

Buxar

Patna

NF

NF

NF

NF

NF

NF

NF

NF

Varanasi

#### Middle stretch

Farakka

Jangipur

Berhampore

Balagarh

**Tribeni** 

Godakhali

D. Harbour

Fraserganj

Kanpur

Lower stre	etch						
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj	
STATION	2017	2018		2019	2020		
Harsh	•	•	NF	NI	-	NF	
Tehri	N	F	NF	NI	F	NF	
Haridw	ar N	F	NF	NI	F	NF	
Bijnoi	r N	F	NF	NI	F	NF	
Naror	a N	F	NF	NI	F	NF	
Farrukha	ibad N	F	60	NI	F	NF	
Kanpu	ır N	F	200	NI	F	NF	
Prayagi	raj N	F	NF	NI	F	NF	
Varana	nsi N	F	40	NF		NF	
Buxar	· N	F	NF		<b>?</b>	NF	
Patna	Patna N		NF		F	NF	
Bhagalp	our N	F	NF	NI	<u> </u>	NF	

NF

NF

NF

NF

NF

NF

NF

NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **★** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



NF

# Keratella sp. (Bory de St Vincent, 1822)



Class: Monogononta

Order: Ploima

Family: Brachionidae

**Genus:** *Keratella* sp.

# **Identifying feature:**

❖ The body,indefinitely in shape.

- ❖ The outer covering or lorica is box-like, consisting of 2 plates closely joined at the sides. The dorsal side marked with polygonal facets, 4-6 spines on the anterior dorsal margin, while 1-2 on the posterior side.
- ❖ The foot is absent

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with Depth, Transparency.



#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj Varanasi Buxa		Buxar	Patna	Bhagalpur	Farakka

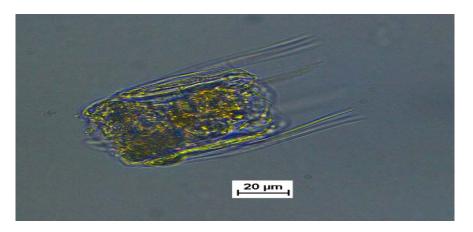
#### Lower stretch

Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
STATION	2017	20	)18	2019	20:	20
Harsh		NF	NF		NF	NF
Tehr	<b>'i</b>	NF	NF	]	NF	NF
Haridy	var	NF	NF	]	NF	NF
Bijno	or .	NF	NF	]	NF	NF
Naroi	ra	90	45		50	NF
Farrukh	abad	NF	60	]	NF	20
Kanpı	ur	NF	20	]	NF	50
Prayag	raj	11	NF	1	180	NF
Varan	asi	NF	44		8	1
Buxa	r	NF 21		11		NF
Patn	a	26 5		18		NF
Bhagal	pur	30	12	855		NF
Farak	ka	10	142	4		NF
Jangip	our	5	192		28	4
Berham	pore	1	NF		12	0
Balaga	rh	39	NF	13		8
Tribe	ni i	NF	700		6	9
Godakl	hali	19	8		1	NF
D. Hark	oour	4	NF	NF		1
Fraserg	ganj	NF	NF	]	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Polyarthra sp. (Ehrenberg, 1834)



Class: Monogononta

Order: Ploima

Family: Synchaetidae

**Genus:** *Notholca* sp.

# **Identifying feature:**

❖ The body has circular appendages, which are flattened in shape.

❖ These appendages are jointed at the dorso-lateral and ventrolateral side of the body near to the anterior end.

❖ It is mainly used for skipping and are twelve in number.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with Depth, Nitrate and Turbidity.



D. Harbour | Fraserganj

#### **Station wise Distribution:**

Berhampore Balagarh

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj Varanasi		Buxar	Patna	Bhagalpur Farakka	

Tribeni Godakhali

#### Lower stretch

Jangipur

STATION	2017	2018	2019	2020
Harshil	NF	NF	NF	NF
Tehri	NF	NF	NF	NF
Haridwai	· NF	NF	NF	NF
Bijnor	NF	NF	NF	NF
Narora	NF	NF	NF	NF
Farrukhab	ad NF	NF	NF	NF
Kanpur	NF	NF	NF	NF
Prayagra	j NF	NF	20	NF
Varanasi	. 1	4	NF	NF
Buxar	1	1	NF	NF
Patna	11	NF	5	NF
Bhagalpu	r 2	NF	31	NF
Farakka	NF	20	1	NF
Jangipur	NF	NF	NF	NF
Berhampo	re NF	2	NF	NF
Balagarh	NF	NF	NF	NF
Tribeni	2	NF	NF	NF
Godakhal	i NF	NF	NF	NF
D. Harbou	r NF	NF	NF	NF
Frasergan	j NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Ploesoma sp. (Herrick, 1885)



Class: Monogononta

Order: Ploima

Family: Synchaetidae

Genus: Ploesoma sp.

**Identifying feature:** 

The body is laterally flattened and the head protected by a shield.

\* Ridges and grooves are present throughout the surface of lorica.

❖ The dorsal antenna is present on lorica.

Corona having frontal flaps.

❖ The long and annulated foot is present with a foot- aperture.

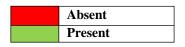
**Habitat:** Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with BOD, Chloride and Nitrate.



Source- http://cfb.unh.edu

### Station wise Distribution: Upper stretch



	Harshil		Tehri	Haridwa	ar	Bi	jnor	N	Narora Farrukh		rukhabad
					9		J-1-0-1				
	Middle str	retch									
	Kanpur		ayagraj	Varanas	ri Rı	ıxar	Patna		Bhagalp	niir	Farakka
	Kanpui	11	ayagraj	v ai aiias	,1 D(	ixai	1 atila		Dhagair	,ui	Tarakka
_	Lower str			<b>.</b>					** .		
Ja	ngipur	Berha	mpore	Balagarh	Tribe	ni G	odakhali	D	. Harbour	Fi	raserganj
	STATION	J	2017	201	18		2019		202	20	
	Harsh	nil	NF	7	NF		]	NF		N	F
	Tehr	i	NF	י	NF		]	NF		N	$\mathbf{F}$
	Haridy	var	NF	י	NF		]	NF		N	F
	Bijno	or	NF	י	NF		]	NF		N	F
	Naro	ra	NF	7	NF		]	NF		N	F
	Farrukh	abad	NF	7	NF		]	NF		N	F
	Kanp	ur	NF	F NF			NF			N	F
	Prayag	raj	NF	IF NF			NF			N	F
	Varan	asi	NF	F 30			NF			N	F
	Buxa	ır	NF	IF NF			NF			N	F
	Patn	a	NF	IF NF			NF			N	F
	Bhagal	pur	NF	י	NF		NF			N	F
	Farak	ka	NF	7	NF		]	NF		N	F
	Jangip	our	NF	IF NF			NF			N	F
	Berhampore N		NF	F NF			NF			N	F
	Balaga		NF	F NF			NF			N	F
	Tribe	ni	NF	F NF			NF			N	F
	Godak	hali	NF	7	NF		NF			N	F
	D. Harl	bour	NF	7	NF		]	NF		N	F

**↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.

NF

NF

**↓** The annual average of four seasons are shown in the table.

NF

**♣** NF – Phytoplankton was not found at that time of sampling.

Fraserganj

NF

# Notholca sp. (Gosse, 1886)



Class: Monogononta

Source- Michael Plewka

Order: Ploima

Family: Brachionidae

**Genus:** *Notholca* sp.

## **Identifying feature:**

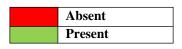
- ❖ The body has no foot.
- ❖ Lorica is stout.
- ❖ The anus is present.
- ❖ The surface of lorica is striated that follows the longitudinal pattern.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with Chloride and Total Dissolved Solid.



### Station wise Distribution: Upper stretch



Harshil	Tehri	Haridw	ar l	Bijnor	Narora	Farrukhabad
Middle st	rotch					
Wildle St	Teten					
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpu	r Farakka

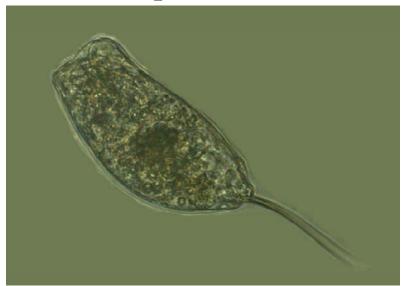
#### **Lower stretch**

Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
STATION	2017		18	2019	20:	
Harsh	il N	F	NF		NF	NF
Tehri	N	F	NF		NF	NF
Haridw	ar N	F	NF		NF	NF
Bijnoi	· N	F	NF		NF	NF
Narora	a N	F	10		NF	NF
Farrukha	bad N	F	NF		NF	NF
Kanpu	r N	$\mathbf{F}$	30		NF	NF
Prayagr	aj N	F	20		NF	NF
Varana	si N	F	NF		NF	NF
Buxar	· N	F	NF		NF	NF
Patna	N	F	2		2	NF
Bhagalp	our N	F	5		4	NF
Farakk	xa N	$\mathbf{F}$	NF		NF	NF
Jangipu	ır N	F	NF		NF	NF
Berhamp	oore N	$\mathbf{F}$	NF		NF	NF
Balagai	rh N	F	NF		NF	NF
Triben	i N	F	NF		NF	NF
Godakh	ali N	F	NF		NF	NF
D. Harbo	our N	F	NF		NF	NF
Fraserga	anj N	F	NF		NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Trichocera sp. (Lamarck, 1801)



Class: Monogononta

Order: Ploima

Family: Trichocercidae

**Genus:** *Trichocer*a sp.

### **Identifying feature:**

❖ The body is asymmetric, twisted in the segment of the helix.

❖ The body is transpicuous and small.

❖ Corona is convexicular in structure.

❖ A single long and thin foot, extending outward.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with Nitrate, Total Hardness, Total Alkalinity, Turbidity and Chloride.



### Station wise Distribution: Upper stretch

Absent
Present

Harshil	Tehri		Haridwa	r	J	Bijnor	Narora	Farrukhabad
Middle s	tretch							
Kanpur	Prayagraj		Varanasi	В	uxar	Patna	Bhagalpu	ır Farakka
Lower st	retch							
Jangipur	Berhampore	Ba	alagarh	Tribeni (		Godakhali	D. Harbour	Fraserganj
STATION	2017	NIE	2018		Б	2019	-	020
Harshi		NF		N.			NF	NF
Tehri		NF		N.			NF	NF
Haridwa		NF		N.			NF	NF
	<b>Bijnor</b>			N.		NF		NF
Narora	Narora			N.	F	20		NF
Farrukha	bad	NF	F		F	NF		NF
Kanpu	r	NF		N.	F		NF	NF
Prayagr	aj	NF	<b>IF</b>		F		10	NF
Varana	si	NF		N.	F		NF	NF
Buxar	•	NF		N.	F		10	NF
Patna		NF		N.	F		NF	NF
Bhagalp	ur	NF		N.	F		50	NF
Farakk	a	NF		50	0		NF	NF
Jangipu	ır	NF		9(	90		NF	NF
Berhamp	ore	NF		N.	F		NF	NF
Balagar	·h	NF			F		NF	NF
Triben	i	NF			0		NF	NF
Godakh	ali	NF			F		NF	NF
D. Harbo	our	NF					NF	NF
Fraserga		NF		N.	F		NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Filinia sp. (Bory de St Vincent, 1824)



Class: Eurotatoria

Order: Flosculariaceae

Family: Trochosphaeridae

Genus: Filinia sp.

# **Identifying feature:**

❖ It is a free-floating organism.

❖ The body shape is indefinite, 2-3 movable appendages are set in form of extension of the cuticle.

❖ The foot is absent.

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with Turbidity.



#### **Station wise Distribution:**

**Upper stretch** 

Absent
Present

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

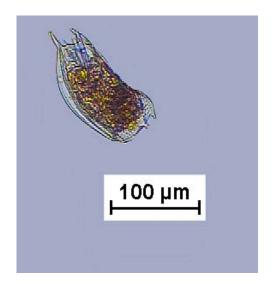
Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka					
Lower stretch											
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj					
STATION	2017	201		2019	2020						
Harsh		NF	NF	NF		NF					
Tehri	i .	NF	NF	NF		NF					
Haridw	ar	NF	NF	NF		NF					
Bijno	r	NF	NF	NF		NF					
Naror	a	NF	NF	NF		NF					
Farrukha	ıbad	NF	NF	NF		NF					
Kanpu	ır	NF	NF	NF		NF					
Prayagi	raj	NF	NF	10		NF					
Varana	nsi	NF	40	NF		NF					
Buxai	ŗ	2	NF	NF		NF					
Patna	1	NF	20	7		NF					
Bhagalp	our	NF	30	10		NF					
Farakk	xa .	NF	10	5		NF					
Jangip	ur	NF	5	NF		30					
Berhamp	ore	NF	10	NF		NF					
Balaga	rh	NF	10	20		NF					
Triber	ni .	NF	30	10		NF					
Godakh	ali	NF	2	NF		NF					
D. Harbo	our	NF	NF	NF		NF					
Fraserg	anj	NF	NF	NF		NF					

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Mytilina sp. (Bory de St. Vincent, 1826)



Class: Eurotatoria

Order: Ploima

Family: Mytilinidae

**Genus**: *Mytilina* sp.

## **Identifying feature:**

❖ The body shape is barrel-shaped.

❖ The foot is present, having two well-developed toes spines or spur are absent.

**Habitat:** Freshwater

**Major Ecological Parameters:** Highly positive correlation was found with pH, Dissolved Oxygen, BOD, Chloride, Nitrate and Total Dissolved Solid.



## Absent Present

Fraserganj

#### **Station wise Distribution:**

Berhampore Balagarh

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad
Middle strete	h				

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

Tribeni Godakhali D. Harbour

#### Lower stretch

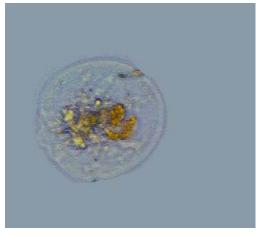
**Jangipur** 

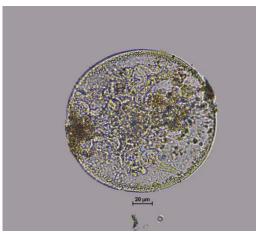
		g				g g		
STATION	2017	201	8	2019	2020	)		
Harsh		NF	NF		NF	NF		
Tehri	i I	NF	NF	N	NF	NF		
Haridw	ar I	NF	NF	N	NF	NF		
Bijnoi	r I	NF	NF	N	NF	NF		
Naror	a I	NF	NF	N	NF	NF		
Farrukha	ıbad l	NF	NF	N	NF	NF		
Kanpu	ır I	NF	NF	N	NF	NF		
Prayagi	raj l	NF	NF	N	NF	NF		
Varana	nsi I	NF	NF	1	10	NF		
Buxar	r I	NF	NF	N	NF	NF		
Patna	ı	NF	NF	N	NF	NF		
Bhagalp	our I	NF	NF	N	NF	NF		
Farakk	ka I	NF	NF	N	NF	NF		
Jangipi	ur I	NF	NF	N	NF	NF		
Berhamp	ore I	NF	NF	N	NF	NF		
Balaga	rh l	NF	NF	N	NF	NF		
Triber	ni I	NF	NF	N	NF	NF		
Godakh	ali	NF	NF	N	NF	NF		
D. Harbo	our I	NF	NF	N	NF	NF		
Fraserga	anj l	NF	NF	N	NF	NF		

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Testudinella sp. (Bory de St Vincent, 1826)





Class: Eurotatoria

Order: Flosculariaceae

Family: Testudinellidae

Genus: Testudinella sp.

## **Identifying feature:**

❖ A circular body which is dorso-ventrally flat.

❖ The corona is ciliated marginally.

❖ The foot is long retractile with a tuft of cilia at its tip.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with BOD, Chloride, Salinity and Nitrate.



#### **Station wise Distribution:**

Berhampore

Balagarh

Absent
Present

Fraserganj

D. Harbour

#### **Upper stretch**

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

Tribeni

Godakhali

#### **Lower stretch**

**Jangipur** 

STATION	2017	2018	2019	2020
Harshil	NF	NF	NF	NF
Tehri	NF	NF	NF	NF
Haridwar	NF	NF	NF	NF
Bijnor	NF	NF	NF	NF
Narora	NF	NF	NF	NF
Farrukhabad	NF	10	NF	NF
Kanpur	NF	NF	NF	NF
Prayagraj	NF	NF	30	NF
Varanasi	NF	NF	NF	NF
Buxar	NF	NF	NF	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	NF	2	NF
Farakka	NF	NF	NF	NF
Jangipur	NF	NF	3	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	2	NF	NF
Tribeni	NF	NF	NF	NF
Godakhali	NF	NF	NF	NF
D. Harbour	NF	NF	5	NF
Fraserganj	NF	10	7	NF

- **4** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Arthropoda



# Arthropoda

The group include crustaceans, such as Copepoda, Cladocera. The most unique characteristics of crustacean is having two pairs of antenna.

- ♣ This phylum include 3 classess and 2 order.

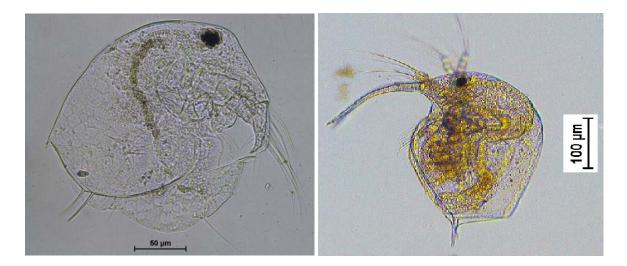


#### Cladocera

## **General Identifying Characters:**

- > It is shelled crustaceans and commonly known as the water flea.
- ➤ These are small crustaceans.
- Their size varies from 0.2 mm to 3.0 mm.
- The body has two valve carapace or outer shell, which cover most of the body.
- A compound eye is present on the head.
- ➤ It bears 4 to 6 trunk appendages.
- ➤ Antennules and setae are present.
- Rostrum and cervical sinus may be or may not be present.
  - ☐ Total 6 genera belonging to 4 family were recorded during the study period.
- ↓ Family:- Bosminidae (1 genus), Chydoridae (2 genera), Daphniidae (2 genera), Sididae (1 genus),

# Bosmina sp. (Baird, 1845)



Class: Crustaceae

Order: Cladocera

Family: Bosminidae

Genus: Bosmina sp.

## **Identifying feature:**

- ❖ The shape of the body is oval and rounded, and the size is short and high.
- ❖ Valves are present throughout the body and abdomen.
- ❖ Antennules are almost parallel to each other.
- ❖ The post-abdomen is quite quadrate in shape.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with BOD and Nitrate.



## Absent Present

#### **Station wise Distribution:**

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad
Middle stretch					

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### Lower stretch

Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
STATION	2017	2018		2019	2020	<u> </u>
Harshi		2010	NF	2019 N		NF
Tehri	NF		NF	N	f F	NF
Haridwa	ır NF		NF	N	$\mathbf{F}$	NF
Bijnor	NF		NF	N	${f F}$	NF
Narora			NF	N		NF
Farrukhal			NF	N		NF
Kanpui			NF	N		NF
Prayagra			5	N		NF
Varanas			1	N		NF
Buxar	NF		20			NF
Patna	13		520			NF
Bhagalpi			1	]		NF
Farakka			59	1		6
Jangipu	r NF		NF	9	9	NF
Berhampe	ore NF		NF	7	7	NF
Balagar	h NF		2	1	0	NF
Tribeni	i NF		NF	2	2	NF
Godakha	ali NF		NF	2	2	NF
D. Harbo	ur NF		NF	2	2	NF
Fraserga	nj NF		NF	N	F	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Eurycercus sp. (Baird, 1843)



Class: Crustaceae

Order: Cladocera

Family: Chydoridae

Genus: Eurycercus sp.

## **Identifying feature:**

❖ The anus is terminal.

❖ The Post-abdomen with a single row of over 80 denticles creating a saw-like appearance

**Habitat:** Freshwater and Brackishwater

Major Ecological Parameters: Highly positive correlation was found with pH, Dissolved Oxygen, Carbonate, and Chloride.



Source- Center for Freshwater

Biology

#### **Station wise Distribution:**

**Upper stretch** 

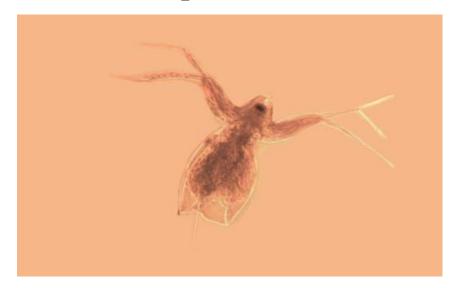
Absent
Present

Harshil	Tehri	Haridwar	Bijnor		N	Narora		Farrukhabad	
Middle str	otah								
Kanpur	Prayagraj	Varanasi	Buxar		Patna	Bhaga	alnur	Farakka	
Kanpar	Tayagraj	varanası	Buxui		1 atma	Dilago	приг	Tarakka	
Lower stre	etch								
Jangipur	Berhampore	Balagarh	Tribeni	God	akhali	D. Harbou	ır Fr	aserganj	
<b>9 1</b>	•	9						<u> </u>	
							<u> </u>		
STATION	2017	2018			2019		2020		
Harshil	NF		NF		N	F	N	<b>IF</b>	
Tehri	NF		NF		N	F	N	<b>IF</b>	
Haridwa	r NF		NF		N	F	N	<b>IF</b>	
Bijnor	NF		NF		N	F	N	<b>IF</b>	
Narora	NF		NF		N	F	N	<b>IF</b>	
Farrukhab	oad NF		NF		N	F	N	<b>IF</b>	
Kanpur	NF		NF		N	F	N	<b>IF</b>	
Prayagra	j NF		NF		N	F	N	<b>IF</b>	
Varanas	i NF		5		N.	F	N	<b>IF</b>	
Buxar	NF		NF		N	$\mathbf{F}$	N	NF .	
Patna	NF		NF		N	F	N	<b>IF</b>	
Bhagalpu	r NF		NF		N	$\mathbf{F}$	N	<b>IF</b>	
Farakka	NF		NF		N.	F	N	<b>IF</b>	
Jangipu	r NF		NF		N	F	N	NF .	
Berhampo	ore NF		NF		N	F	N	<b>IF</b>	
Balagarl	n NF		NF		N	F	N	<b>IF</b>	
Tribeni	NF		NF		N	F	N	<b>IF</b>	
Godakha	li NF		NF		N	F	N	NF .	
D. Harbou	ır NF		NF		N	F	NF		
Frasergai	nj NF		NF		N	$\mathbf{F}$	N	<b>VF</b>	

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# *Moina* sp. (Baird, 1850)



Class: Crustaceae

Order: Cladocera

Family: Daphniidae

Genus: Moina sp.

# **Identifying feature:**

❖ The head is large, thick, and round in the front.

❖ Sometimes, a deep depression is present above the eye.

❖ Antennules are long and freely movable.

❖ Post-abdomen extended into the conical post-anal part.

❖ Abdominal setae very long.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with BOD, Chloride and Nitrate.



#### **Station wise Distribution:**

Absent Present

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### Lower stretch

Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj

STATION	2017	2018	2019	2020
Harshil	NF	NF	NF	NF
Tehri	NF	NF	NF	NF
Haridwar	NF	NF	NF	NF
Bijnor	NF	NF	NF	NF
Narora	NF	20	60	NF
Farrukhabad	NF	NF	NF	NF
Kanpur	NF	50	NF	NF
Prayagraj	NF	20	NF	NF
Varanasi	NF	10	NF	NF
Buxar	NF	NF	NF	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	3	1	NF
Farakka	2	NF	NF	NF
Jangipur	NF	NF	NF	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	NF	NF	NF
Tribeni	NF	1	1	NF
Godakhali	NF	3	1	NF
D. Harbour	NF	5	NF	NF
Fraserganj	NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **+** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Daphnia sp. (Muller, 1785)



Class: Branchiopoda

Order: Cladocera

Family: Daphniidae

Genus: Daphnia sp.

# **Identifying feature:**

- ❖ The body is laterally compressed and bivalve having a caudal spine.
- ❖ The head is rounded and bears compound eyes, paired and jointed antennae, and a beak-like rostrum.
- ❖ The trunk is segmented contain 4-5 appendages.
- ❖ The abdomen is without segmentation.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Nitrate, Total hardness, Total alkalinity, Turbidity and Chloride.



#### **Station wise Distribution:**

**Upper stretch** 

Absent
Present

Н	arshil	Tehri	Haridwa	 r	Biji	nor	Na	arora	Fa	rrukhabad
	Middle stre	etch								
	Kanpur	Prayagraj	Varanas	si Buz	kar	Patna		Bhagalpı	ır	Farakka
	Lower stre	tch								
Jangipur Be		Berhampore	Balagarh	Tribeni	Go	Godakhali		D. Harbour F		raserganj
	STATION	2017	201			2019	787	202		N THE
	Harshi		F	NF			IF			NF
	Tehri	N	F	NF		ľ	IF			NF
	Haridwa	ar N	F	NF		N	IF			NF
	Bijnor	· N	F	NF		ľ	<b>IF</b>			NF
	Narora NF		F	NF		ľ	<b>IF</b>			NF
	Farrukha	bad N	F	NF		N	<b>IF</b>			NF
	Kanpu	r N	F	NF		1	IF			NF
	Prayagr	aj N	F	NF		ľ	IF			NF
	Varana	si N	F	NF		N	<b>IF</b>			NF
	Buxar	· N	F	NF			2			NF
	Patna	N	F	NF		N	<b>IF</b>			NF
	Bhagalp		F	20			3			NF
	Farakk		F	NF		N	IF .			NF
	Jangipu		F	NF			IF			NF
	Berhamp		F	5			IF			NF
	Balagar		F	NF			IF			NF
	Triben		F	NF			IF			NF
	Godakh		F	2			5			NF
	D. Harb		$\mathbf{F}$	NF			J VF			NF
	Fraserga	anj N	F	NF		Λ	<b>IF</b>			NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Diaphanosoma sp. (Fischer, 1850)



Class: Branchiopoda

Order: Diplostraca

Family: Sididae

Genus: Diaphanosoma sp.

## **Identifying feature:**

❖ The body has rostrum, which is not a fornix or ocellus.

❖ Antennule is small truncated.

❖ At the dorsal side two antennae are jointed and at the ventral side three-antennae are jointed.

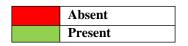
Claws have three basal spines.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Total Alkalinity and Salinity.



## Station wise Distribution: Upper stretch



Harshil		Tehri	Haridwar		Bijn	or	Naro	ra	Far	rukhabad
Middle str	etch	l								
Kanpur		Prayagraj	Varanasi	Bux	ar	Patr	ıa	Bhagalp	ur	Farakka
Lower stre	etch		-		-					
Jangipur	Be	rhampore	Balagarh	Tribei	ni (	Godakha	li D.	Harbour	F	raserganj
STATION	1	2017	2018			2019	NIE	202		NITS.
Harshi	I	NF		NF			NF			NF
Tehri		NF		NF			NF			NF
Haridwa	ar	NF		NF			NF		]	NF
Bijnor	•	NF		NF			NF		]	NF
Narora	Narora			NF			NF		]	NF
<b>Farrukha</b>	bad	NF		NF			NF		]	NF
Kanpu	r	NF		NF			NF		]	NF
Prayagr	aj	NF		NF			NF		]	NF
Varanas	si	NF		NF			NF		]	NF
Buxar		NF		3			20		]	NF
Patna		NF		NF			14		]	NF
Bhagalp	ur	NF		40			321		]	NF
Farakk	a	NF		NF			NF		]	NF
Jangipu	ır	NF		7			NF		]	NF
Berhamp	ore	NF		NF			1		]	NF
Balagar		NF		NF			NF			NF
Triben	i	NF		NF			NF		]	NF
Godakha	ali	NF		NF			NF		]	NF
D. Harbo	our	NF		NF			NF		]	NF
Fraserga	nj	NF		NF			1		]	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Leydigia sp. (Schoedler 1863)



Class: Branchiopoda

Family: Chydoridae

Genus: Leydigia sp.

## **Identifying feature:**

Usually, the body is oval shape. Much compressed without crest.

❖ The head small and extended.

❖ The post-abdomen is very large, semi-elliptical.

❖ The post-anal part is extended with many spines.

❖ Eyes are smaller than ocellus.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Carbonate, Mg<sup>++</sup>, Total Hardness, and Salinity.



## Absent Present

#### **Station wise Distribution:**

**Upper stretch** 

Upper stretch									
Harshil Tehri Haridwar Bijnor			Nar	ora	Farrukhabad				
Middle st	retch								
Kanpur	P	rayagra	j	Varanasi Bu		r P	atna	Bhagalpu	r Farakka
Lower str	etch								
Jangipur	Berl	ampore	9	Balagarh	Tribeni	Godak	hali	D. Harbou	r Fraserganj
STATION		2017		2018		2	019		2020
Harsh	il		NF		NF		]	NF	NF
Tehri			NF		NF		]	NF	NF
Haridw	ar		NF		NF		]	NF	NF
Bijnor	•		NF		NF		]	NF	NF
Naror	a		NF		NF		]	NF	NF
Farrukha	bad		NF		NF		]	NF	NF
Kanpu	r		NF	NF			]	NF	
Prayagi	aj		NF		NF			NF	
Varana	si		NF		NF	NF NF		NF	NF
Buxar	•		NF		NF			NF	NF
Patna	l		NF		NF	NF			NF
Bhagalp	ur		4		NF		]	NF	NF
Farakk	a		NF		NF			NF	NF
Jangipu	ır		NF		NF			NF	15
Berhamp	ore		NF		NF		]	NF	NF
Balagar	ch		NF		NF			NF	NF
Triben	n <b>i</b>		NF		NF		]	NF	
Godakh	ali		NF		NF			NF	NF
D. Harbo	our		NF		NF		]	NF	NF
Fraserga	anj		3		NF			10	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Copepoda



## Copepoda

## **General Identifying Characters:**

- ➤ The body is elongated and divided into head, abdomen, and thorax.
- Their size varies from 0.3 mm to 3.5 mm.
- ➤ A pair of appendages is present on each thoracic region while abdominal segment does not bear appendages.
- ➤ Most of the copepods bear a single median compound eye, generally red in color at the center of the head.
- The body has two pairs of antennae, the first pairs conspicuous and usually long with a variable number of segments.

- ♣ Total 2 genera belonging to 2 families were recorded during study period.
- ♣ Family:- Cyclopidae (1 genus), Diaptomidae (1 genus)

# Mesocyclops sp. (G. O. Sars, 1914)



Class: Hexanauplia

Order: Cyclopoida

Family: Cyclopidae

Genus: Mesocyclops sp.

# **Identifying feature:**

❖ Body is slender and divided into anterior and posterior parts.

❖ Caudal rami relatively short ranging between 2.5 to 3.5 times as long as wide.

❖ Antennule are 17-segmented.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Water Temperature.



#### **Station wise Distribution:**

Station wise Distribution

Absent Present

U	nn	er	str	etch	ì
$\sim$	$\sim$	~		CUCI.	•

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### **Lower stretch**

Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj

STATION	2017	2018	2019	2020
Harshil	NF	NF	NF	NF
Tehri	NF	NF	NF	NF
Haridwar	NF	NF	NF	NF
Bijnor	NF	NF	NF	NF
Narora	NF	20	NF	NF
Farrukhabad	NF	NF	NF	NF
Kanpur	NF	NF	NF	NF
Prayagraj	NF	NF	NF	NF
Varanasi	NF	NF	NF	NF
Buxar	NF	6	NF	NF
Patna	NF	2	4	NF
Bhagalpur	28	36	128	NF
Farakka	16	9	9	NF
Jangipur	34	NF	2	NF
Berhampore	1	1	NF	NF
Balagarh	6	6	NF	NF
Tribeni	5	4	NF	NF
Godakhali	NF	8	NF	NF
D. Harbour	4	15	1	NF
Fraserganj	NF	12	1	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Diaptomus sp. (Westwood, 1836)



Class: Hexanauplia

Order: Calanoida

Family: Diaptomidae

Genus: Diaptomus sp.

# **Identifying feature:**

❖ It is a copepod with a single eyespot.

❖ The size and appearance are similar to cyclops.

❖ It has very long antennae and the length is almost equal to body length.

**Habitat:** Freshwater

**Major Ecological Parameter:** Highly positive correlation was found with Water Temperature.



## Absent Present

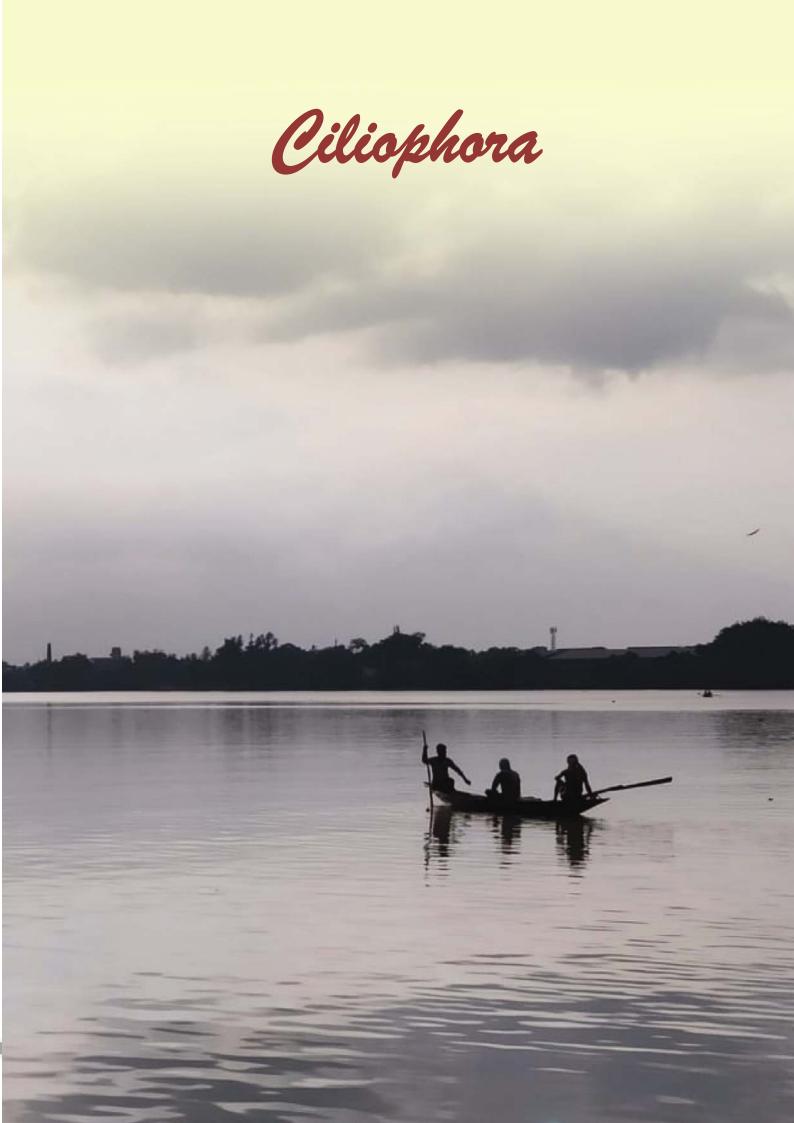
#### **Station wise Distribution:**

Innar stratch

Upper stre	etch							
Harshil	Tehri	Haridwar		Bijno	r	Na	rora	Farrukhabad
Middle str	etch							
Kanpur	Prayagraj	Varanasi	Buxa	r	Patna		Bhagalpur	Farakka
Lower stretch								
Jangipur	Berhampore	Balagarh	Triben	i G	odakha	li	D. Harbour	Fraserganj
CITE A PER CAN	2018	2010			2010		2020	
STATION Harshil	2017 NF	2018	NF		2019	NF	2020	NF
Tehri	NF		NF			NF		NF
Haridwar			NF			NF		NF
Bijnor	NF	NF			NF		NF	
Narora	NF		NF			NF		NF
Farrukhaba			NF			NF		NF
Kanpur	NF		NF			NF		NF
Prayagraj			NF			NF		NF
Varanasi	NF		NF			NF		NF
Buxar	NF		4			20		NF
Patna	NF		100			4		NF
Bhagalpu	r 28		14			65		NF
Farakka	4		1			5		NF
Jangipur	NF		8			6		NF
Berhampor	re NF		2			3		NF
Balagarh	1		6			7		NF
Tribeni	NF		3			3		NF
Godakhal	i 15		3			NF		NF
D. Harbou	r 13		NF			7		NF
Frasergan	j 1		NF			12		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.





## Ciliophora

#### **General Identifying Characters:**

- > Protozoans are variable in shapes.
- The size ranges from 5-50 μm in diameter.
- ➤ Generally, they are naked but sometimes they have outer covering, which is known as pellicle.
- Some of the protozoan possesses two types of nuclei i.e. smaller micronuclei and larger macronuclei.
- ➤ They include amoebas, flagellates, ciliates, sporozoans, and many other forms. Cells have cilia and flagella, which are used for locomotion. According to their shape, they are classified into different groups;

Ciliates: Cells have hair-like projection called cilia, which are present surrounding the edge of protozoa. They can swim in the water by beating their cilia in a rhythmic pattern.

 ☐ Total 11 genera belonging to 5 classes and 11 families were recorded during study period.

# Coleps sp. (Nitzsch, 1827)



Source: Protist.i.hosei.ac.jp

**Class:** Prostomatea

**Order:** Prostomatina

Family: Colepidae

Genus: Coleps sp.

## **Identifying feature:**

- ❖ The body is barrel-shaped and small to medium in size, having a truncated anterior end and rounded posterior end.
- ❖ Posterior end possess spines. The Cuticular surface of the cell is divided into numerous symetrical quadrangular facets.
- ❖ The mouth is apical and surrounded by cilia. Single contractile vacuoles are present.

Habitat: Freshwater and Brackish water

**Major Ecological Parametesrs:** Highly positive correlation was found with Specific Conductivity, Dissolved Oxygen, and Total Dissolved Solid.



#### **Station wise Distribution:**

**Upper stretch** 

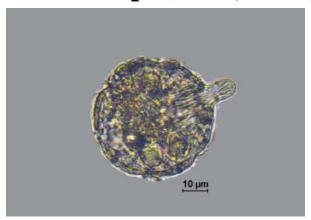
Absent
Present

Harshil		Tehri	Haridwar		Bijnor		Narora		Farrukhabad	
Middle str	etch									
Kanpur	F	Prayagraj	Varanasi	Buxa	ar	Patna		Bhagalpu	F	`arakka
Lower stre	tch									
Jangipur	Bei	rhampore	Balagarh	Tribeni	i (	Godakhali	D.	. Harbour	Fra	serganj
STATION		2017	2018			2019	NIE	20	20	
Harshil		NF		NF			NF			IF
Tehri		NF		NF			NF			F
Haridwa	r	NF		50			NF			F
Bijnor		NF		NF			NF			F
Narora		NF		NF			NF			F
Farrukhab	ad	NF		NF			NF		N	F
Kanpur		NF		NF			NF		N	<b>IF</b>
Prayagra	j	NF		NF			NF		N	$\mathbf{F}$
Varanasi	i	NF		NF			NF		N	F
Buxar		NF		NF			NF		N	<b>IF</b>
Patna		NF		NF			NF		N	F
Bhagalpu	r	NF		NF			NF		N	<b>IF</b>
Farakka		NF		NF			NF		N	<b>IF</b>
Jangipur	•	NF		NF			NF		N	<b>IF</b>
Berhampo	re	NF		NF			NF		N	<b>IF</b>
Balagarh		NF		NF			NF		N	<b>IF</b>
Tribeni		NF		NF			NF		N	<b>IF</b>
Godakhal	li	NF		NF			NF		N	<b>IF</b>
D. Harbou	ır	NF		NF			NF		N	<b>IF</b>
Frasergan	ıj	NF		NF			NF		N	<b>IF</b>

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Didinium sp. (Stein, 1859)



Class: Litostomatea

**Order:** Haptorida

Family: Didiniidae

Genus: Didinum sp.

## **Identifying feature:**

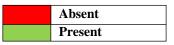
- ❖ The shape of the body is large, oval and dorso-ventrally flattened, rounded posteriorly.
- ❖ Conical projection is present at the anterior side.
- ❖ The body surface possesses two ciliary girdles but no cilia are present.
- ❖ A single contractile vacuole is present. Macronucleus is horseshoe-shaped.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Parameters Could not be analysed as it is found twice in the entire sampling.



### Station wise Distribution: Upper stretch

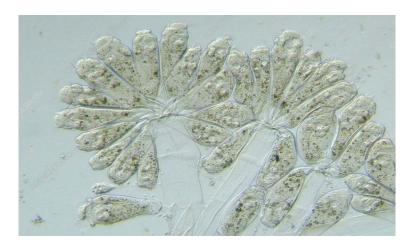


Harshil		Tehri	Haridwar		Bijı	Bijnor		Narora		rrukhabad
Middle st	retch									
Kanpur	Pr	ayagraj	Varanasi	Buxai	r	Patna		Bhagalpu	ır	Farakka
Lower str	etch									
Jangipur	Berl	hampore	Balagarh	Tribeni	G	odakhali		D. Harbou	ır	Fraserganj
CITA INTONI		2015	201	0		2010			0.20	
STATION Harshi	1	2017 NF	201	NF		2019	NI		020	NF
Tehri		NI		NF 40			NI			NF NE
Haridw		NI		40			NI			NF
Bijnor		NI		NF			NI			NF
Narora		NI		NF			NI			NF
Farrukha		NI		NF			NI			NF
Kanpu	r	NF		NF			NI			NF
Prayagr	aj	NF	7	NF			NI	₹		NF
Varana	si	NI	7	NF			NI	र		NF
Buxar	•	NI	7	NF			2			NF
Patna	l	NI	7	NF			NI	र		NF
Bhagalp	ur	NI	7	NF			NI	र		NF
Farakk	a	NF	י	NF			NI	<u>?</u>		NF
Jangipu	ır	NI	י	NF			NI	र		NF
Berhamp	ore	NF	7	NF			NI	?		NF
Balagai	rh	NF		NF			NI	र		NF
Triben	ni	NI	י	NF			NI	?		NF
Godakh	ali	NE		NF			NI	7		NF
D. Harbo	our	NE	7	NF			NI	?		NF
Fraserga	anj	NI	י	NF			NI	र		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Epistylis sp. (Ehrenberg, 1830)



Class: Oligohymenophorea

Order: Sessilida

Family: Epistylidae

Genus: Epistylis sp.

Source-Corolina Biological Supplyco/visuals unlimited.inc/science photo library

## **Identifying feature:**

- ❖ The body is vase-shaped and ciliated.
- ❖ It has an oral disc, collar, and a stalk.
- ❖ Each branch of the colony contains one individual at the end.
- ❖ Peristomial furrow is deep, which separates the disc border.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Nitrate.



## Absent Present

#### **Station wise Distribution:**

**Upper stretch** 

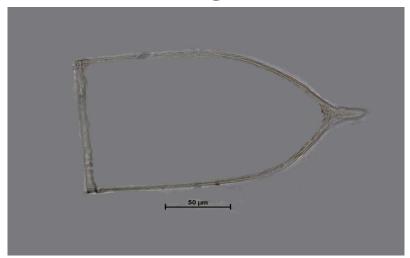
opper str								
Harshil		Tehri	Haridwar		Bi	jnor	Narora	Farrukhabad
Middle stı	etch			•				
Kanpur	P	rayagraj	Varanasi	Buxa	r	Patna	Bhagalpur	Farakka
Lower stretch								
Jangipur	Ber	hampore	Balagarh	Tribeni	(	Godakhali	D. Harbour	Fraserganj
STATION		2017	2018	8		2019	202	0
Harshil		80		NF			NF	NF
Tehri		20		NF			NF	NF

STATION	2017	2018	2019	2020
Harshil	80	NF	NF	NF
Tehri	20	NF	NF	NF
Haridwar	110	250	NF	NF
Bijnor	NF	NF	NF	NF
Narora	NF	NF	NF	NF
Farrukhabad	NF	NF	NF	NF
Kanpur	NF	NF	NF	NF
Prayagraj	5	NF	NF	NF
Varanasi	23	30	NF	NF
Buxar	NF	NF	NF	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	NF	NF	NF
Farakka	NF	NF	NF	NF
Jangipur	NF	NF	NF	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	NF	NF	NF
Tribeni	NF	NF	NF	NF
Godakhali	NF	NF	NF	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Tintinids (Jorgensen, 1924)



Class: Spirotrichea

Order: Tintinnida

Family: Xystonellidae

Genus: Tintinids sp.

# **Identifying feature:**

❖ The body is conical or trumpet-shaped.

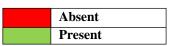
❖ The body has loricae, with loose fitting variable shaped and size envelope.

Habitat: Brackish water

**Major Ecological Parameters:** Parameters could not be analysed as it is found only twice in the entire sampling.



## Station wise Distribution: Upper stretch



Harshil	Tehri	Haridwa	ır	Bijnor	Narora	Farrukhabad
Middle str	retch					
Kanpur	Prayagraj	Varanasi	Buxaı	· Patna	Bhagalpur	Farakka
Lower str	etch					
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
STATION	2017	201	18	2019	202	20
Harshil	N		NF		NF	NF
Tehri	N	F	NF		NF	NF
Haridwa	r N	F	NF		NF	NF
Bijnor	N	F	NF		NF	NF
Narora	N	F	NF		NF	NF
Farrukhab	ad N	F	NF		NF	NF
Kanpur	N	F	NF		NF	NF
Prayagra	j N	F	NF		NF	NF
Varanasi	i N	F	NF		NF	NF
Buxar	N	F	NF		NF	NF
Patna	N	F	NF		NF	NF
Bhagalpu	r N	F	NF		NF	NF
Farakka	. N	F	NF		NF	NF
Jangipur	· N	F	NF		NF	NF
Berhampo	re N	F	NF		NF	NF
Balagarh	n N	F	NF		NF	NF
Tribeni	N	F	NF		NF	NF
Godakha	li N	F	5		NF	NF
D. Harbou	ır N	F	NF		NF	NF
Frasergar	nj N	F	1		10	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



# Frontonia sp. (Ehrenberg, 1838)



Class: Oligohymenophorea

Order: Peniculida

Family: Frontoniidae

Genus: Frontonia sp.

**Identifying feature:** 

❖ The shape of the cell is ovoid a or elongated.

❖ Several cilia and trichocysts are present surrounding the body.

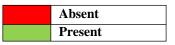
❖ Near the anterior half of the cell, one small pear-shaped oral aperture is present.

❖ The mouth is supported by microtubular rods.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Phosphate.

Source- *Frontonia fusca* (Quennerstedt 1869)

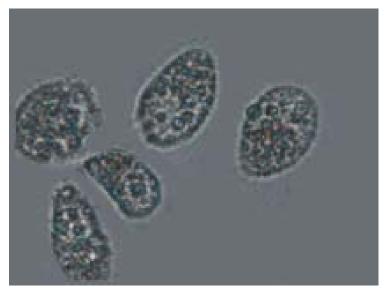


Harshil	Tehri	Haridwar	F	Bijnor	Naro	ra	Farrukhabad
Middle stre	tch					•	
Kanpur	Prayagraj	Varanasi	Buxaı	· Patn	a	Bhagalpur	Farakka
Lower stret	ch			T			1
Jangipur	Berhampore	Balagarh	Tribeni	i Godakh	ali	D. Harbour	Fraserganj
CTATION	2017	2010		2010		2020	
STATION Harshil	2017 NF	2018	NF	2019	NF	2020	NF
Tehri	NF		NF		NF		NF
Haridwar			30		20		NF
Bijnor	NF		NF		NF		NF
Narora	NF		NF		NF		NF
Farrukhaba			NF		NF		NF
Kanpur	NF		NF		NF		NF
Prayagraj	NF	•	NF		NF		NF
Varanasi	NF	,	NF		NF		NF
Buxar	NF	•	NF		NF		NF
Patna	NF	•	NF		NF		NF
Bhagalpur	· NF	1	NF		NF		NF
Farakka	NF	1	NF		NF		NF
Jangipur	NF	,	NF		NF		NF
Berhampor	e NF		NF		NF		NF
Balagarh	NF	1	NF		NF		NF
Tribeni	NF		NF		NF		NF
Godakhali	i NF	7	NF		NF		NF
D. Harbou	r NF		NF		NF		NF
Frasergan	j NF	,	NF		NF		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



## Paramecium sp. (Müller, 1773)



Class: Oligohymenophorea

Order: Peniculida

Family: Parameciidae

Genus: Paramecium sp.

## **Identifying feature:**

- ❖ The body is elongated and slipper with numerous cilia throughout the body structure and is about 250 microns long.
- ❖ The posterior end is more pointed than the anterior one.
- \* Two contractile vacuoles are present.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Total Dissolved Solid.



#### **Station wise Distribution:**

Absent Present

**Upper stretch** 

Harshil	Tehri	Haridwar	Bijnor	Narora	Farrukhabad

#### Middle stretch

Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka

#### Lower stretch

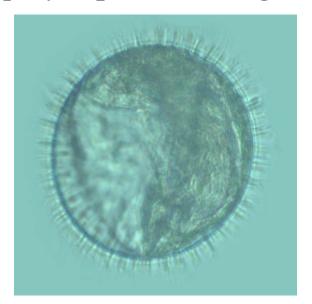
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj

STATION	2017	2018	2019	2020
Harshil	60	NF	NF	NF
Tehri	10	NF	NF	NF
Haridwar	100	70	60	NF
Bijnor	NF	NF	20	NF
Narora	20	NF	NF	NF
Farrukhabad	60	NF	NF	NF
Kanpur	NF	NF	NF	NF
Prayagraj	50	NF	NF	NF
Varanasi	80	NF	60	NF
Buxar	NF	NF	NF	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	NF	NF	NF
Farakka	NF	NF	NF	NF
Jangipur	NF	NF	NF	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	NF	NF	NF
Tribeni	NF	NF	NF	NF
Godakhali	NF	NF	NF	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



## Podophrya sp. (Ehrenberg, 1838)



Class: Ciliatea

Order: Suctorida

Family: Podophryidae

Genus: Podophry sp.

## **Identifying feature:**

- ❖ The body is either spherical or subspherical in shape having a stalk.
- ❖ Several knobbed tentacles are emerged out of the body.
- ❖ Sometime contractile vacuoles are found.
- ❖ Near the center of body single oval-shaped macronucleus.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Parameters couldnot be analysed as it is found only once in the entire sampling.



Absent
Present

Harshil	Tehri	Ha	ridwar	]	Bijnor	Narora		Farrukhabad
Middle st	retch			_				
Kanpur	Prayagra	j Va	aranasi	Buxa	r Patna	Bhag	galpur	Farakka
I arrow at	o t ala							
Lower str		<u> </u>			T	T	_	Τ
Jangipur	Berhampoi	e Bala	garh 1	Γribeni	Godakhali	D. Har	bour	Fraserganj
STATION	2017		2018		2019		202	0
Harshi	1	NF		NF		NF		NF
Tehri		NF		NF		NF		NF
Haridwa	ar	NF		40		NF		NF
Bijnor	•	NF		NF		NF		NF
Narora	a	NF		NF		NF		NF
Farrukha	bad	NF		NF		NF		NF
Kanpu	r	NF		NF		NF		NF
Prayagr	aj	NF		NF		NF		NF
Varana	si	NF		NF		NF		NF
Buxar	•	NF		NF		NF		NF
Patna		NF		NF		NF		NF
Bhagalp	ur	NF		NF		NF		NF
Farakk	a	NF		NF		NF		NF
Jangipu	ır	NF		NF		NF		NF
Berhamp		NF		NF		NF		NF
Balagar		NF		NF		NF		NF
Triben		NF		NF		NF		NF
Godakh		NF		NF		NF		NF
D. Harbo	our	NF		NF		NF		NF

**↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.

NF

NF

- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



Fraserganj

NF

NF

## Urostyla sp. (Ehrenberg, 1830)



Source- Protist Information Server 1995-2008

Class: Spirotrichea

Order: Urostylida

Family: Urostylidae

Genus: Urostyla sp.

## **Identifying feature:**

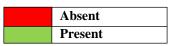
❖ The body is oval, elongated, and dorso-ventrally flattened.

❖ Numerous cirri are present throughout the body.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Parameters couldnot be analysed as it is found only once in the entire sampling.



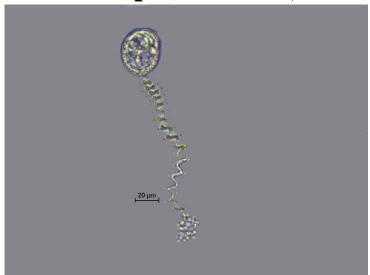


Harshil	Tehri	Haridwar	Bij	nor N	arora Fa	rrukhabad
Middle st	retch					
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpui	Farakka
Lower str	etch					
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbou	r Fraserganj
STATION	2017	2018		2019	202	0
Harshi	il N	IF	NF	NF	י	NF
Tehri	N	I <b>F</b>	NF	NF	י	NF
Haridw	ar N	<b>IF</b>	70	NF	י	NF
Bijnor	· N	IF .	NF	NF	י	NF
Narora	a N	<b>IF</b>	NF	NF	י	NF
Farrukha	bad N	IF .	NF	NF	י	NF
Kanpu	r N	IF .	NF	NF	7	NF
Prayagr	raj N	IF.	NF	NF	7	NF
Varana	si N	IF .	NF	NF	7	NF
Buxar	·	IF.	NF	NF	7	NF
Patna	. N	<b>IF</b>	NF	NF	י	NF
Bhagalp	our N	if.	NF	NF	7	NF
Farakk	ka N	IF .	NF	NF	7	NF
Jangipu	ır N	I <b>F</b>	NF	NF		NF
Berhamp		I <b>F</b>	NF	NF		NF
Balagai		<b>IF</b>	NF	NF		NF
Triben		I <b>F</b>	NF	NF		NF
Godakh		<b>IF</b>	NF	NF		NF
D. Harbo	our N	I <b>F</b>	NF	NF		NF
Fraserga	anj N	<b>IF</b>	NF	NF		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



## Vorticella sp. (Linnaeus, 1767)



Class: Oligohymenophorea

Order: Sessilida

Family: Vorticellidae

Genus: Vorticella sp.

## **Identifying feature:**

❖ The body is bell-shaped and ciliated and has an oral cavity and contractile stalk.

The stalk is either branched or unbranched and has contractile myonemes.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Total Dissolved Solid, and Specific Conductivity.



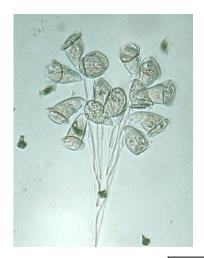
Absent
Present

Harshil	Tehri	Haridwa	r E	Bijnor	Narora		Farrukhabad
Middle st	retch						
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bha	agalpur	Farakka
Lower str	etch						
Jangipur	Berhampore	Balagarh	Tribeni	Godakha	ali D. H	Iarbour	Fraserganj
STATION	2017	2018		2019		2020	
Harshi	l NI	?	NF	•	NF		NF
Tehri	NI	?	NF		NF		NF
Haridwa	ar 70		NF		NF		NF
Bijnor	NI	?	NF		NF		NF
Narora	NI NI	?	NF		NF		NF
Farrukha	bad 10		NF		NF		NF
Kanpu	r NI	7	NF		NF		NF
Prayagr	aj NI	?	NF		NF		NF
Varanas	si NI	7	NF		NF		NF
Buxar	NI	7	NF		NF		NF
Patna	NI	?	NF		NF		NF
Bhagalp	ur NI	?	NF		NF		NF
Farakk	a NI	?	5		10		20
Jangipu	r NI	?	2		NF		40
Berhamp	ore NI	?	30		NF		350
Balagar	h NI	7	NF		NF		NF
Triben	i NI	?	NF		NF		NF
Godakha	ali NI	?	NF		2		10
D. Harbo	ur NI	?	NF		NF		4
Fraserga	nj NI	?	10		NF		10

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



## Zoothamnium sp. (Bory de Saint-Vincent, 1826)



Source- Protist Information Server 1995-2008

Class: Oligohymenophorea

Order: Sessilida

Family: Zoothamniidae

**Genus:** *Zoothamnium* sp.

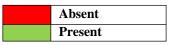
## **Identifying feature:**

- ❖ It is mainly branching colonial.
- Spherical cell with a stalk at its posterior side and attached to the main stalk.
- Two rows of numerous cilia are covered on the anterior side of the body.
- ❖ A small spherical oral aperture is present on the body.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Parameters couldnot be analysed as it is found only once in the entire sampling.



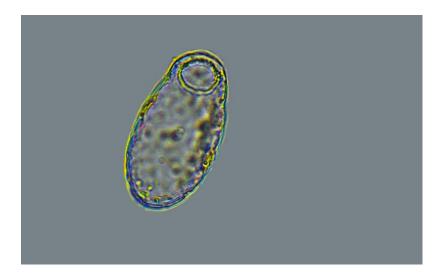


Harshil	Tehri	Haridwar	Bi	ijnor Nar	ora	Farrukhabad
Middle str	etch					
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka
Lower stre	etch					
Jangipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
STATION	2017	2018		2019	2020	)
Harshil	NF	7	NF	NF		NF
Tehri	NF	7	NF	NF		NF
Haridwa	r NF	7	10	NF		NF
Bijnor	NF	7	NF	NF		NF
Narora	NF	7	NF	NF		NF
Farrukhab	oad NF	יז	NF	NF		NF
Kanpur	NF	7	NF	NF		NF
Prayagra	nj NF	יז	NF	NF		NF
Varanas	i NF	י	NF	NF		NF
Buxar	NF	יז	NF	NF		NF
Patna	NF	י	NF	NF		NF
Bhagalpu	ır NF	י	NF	NF		NF
Farakka	NF	י	NF	NF		NF
Jangipu	r NF	י	NF	NF		NF
Berhampo	ore NF	י	NF	NF		NF
Balagarl	n NF	7	NF	NF		NF
Tribeni	NF	· ·	NF	NF		NF
Godakha	li NF	7	NF	NF		NF
D. Harbou	ur NF		NF	NF		NF
Fraserga	nj NF	7	NF	NF		NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



## Trinema sp. (Dujardin, 1841)



Class: Imbricatea

Order: Euglyphida

Family: Euglyphidae

Genus: Trinema sp.

## **Identifying feature:**

❖ The body is pouch-shaped with a rounded end.

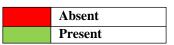
❖ In the Ventral view, body is broad and oval shape and from the lateral view tapering towards the aperture.

❖ The body has two types of scales.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Parameters couldnot be analysed as it is found only once in the entire sampling.





Harshil		Tehri	Haridwar		Bijı	nor	Na	rora	Farrukhabad
Middle str	retch								
Kanpur	Pı	rayagraj	Varanasi	Bux	ar	Patna	1	Bhagalpur	Farakka
Lower str	etch								
Jangipur	Ber	hampore	Balagarh	Triben	i (	Godakhal	i	D. Harbour	Fraserganj
STATION		2017	201	0		2019		202	0
Harshil		NF	2010	NF		2019	N		NF
Tehri		NF		NF			N		NF
Haridwa	r	NF		NF			N		NF
Bijnor	-	NF		NF			N		NF
Narora		NF		30			N	F	NF
Farrukhah	ad	NF		NF			N	F	NF
Kanpur	•	NF		NF			N	F	NF
Prayagra	ıj	NF		NF			N	F	NF
Varanas	i	NF		NF			N.	F	NF
Buxar		NF		NF			N	F	NF
Patna		NF		NF			N	F	NF
Bhagalpu	ır	NF		NF			N	F	NF
Farakka	ı	NF		NF			N.	F	NF
Jangipu	r	NF		NF			N	F	NF
Berhampo	ore	NF		NF			N	F	NF
Balagarl		NF		NF			N		NF
Tribeni		NF		5			N		NF
Godakha		NF		NF			N		NF
D. Harbou		NF		NF			N	F	NF
Fraserga	nj	NF		NF			N	F	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **4** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.



# Amoebozoa



#### Amoebozoa

#### **General Identifying Characters:**

- Amoebozoa is a major taxonomic group, containing about 2,400 described species of amoeboid protists, often possessing blunt, fingerlike, lobose pseudopods and tubular mitochondrial cristae.
- ➤ Several irregular projections come out from the cell, which are called pseudopods, which can be stretch out, bend and curved.

 ☐ Total 4 genera belonging to 1 class and 4 families were recorded during study period.

## Amoeba sp. (Bory de St. Vincent, 1822)



Class: Tubulinea

Order: Euamoebida

Family: Amoebidae

Genus: Amoeba sp.

**Identifying feature:** 

❖ The body is granulated and has variable irregular shapes.

❖ The cell has a large nucleus and contractile vacuole.

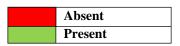
❖ The body has lobopodia with hemispherical tips.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Parameters couldnot be analysed as it is found only once in the entire sampling.



Source- Protist Information Server 1995-2008

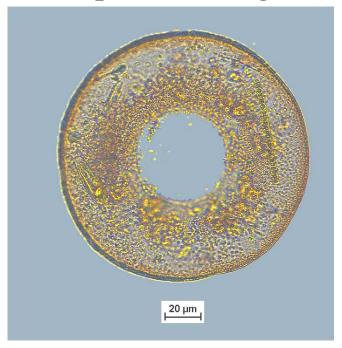


Harshil	Tehri	Haridwar		Bijnor	N	larora	Farrukhabad
Middle st	retch						
Kanpur	Prayagraj	Varanasi	Buxar	]	Patna	Bhagalpur	Farakka
I ovvon str	ot ala						
Lower str Jangipur	Berhampore	Balagarh	Tribeni	Goda	khali	D. Harbour	Fraserganj
Jangipui	Bernampore	Dalagain	Tribein	Goda	Kliali	D. Hai boui	Frasciganj
CT A TION	2017	2010			3010	202	20
STATION Harshil	2017 NF	2018	NF		2019 N	202 NF	NF
Tehri	NF		NF			NF	NF
Haridwar			50			NF	NF
Bijnor	NF		NF			NF	NF
Narora	NF		NF			NF	NF
Farrukhaba	nd NF		NF		ľ	NF	NF
Kanpur	NF		NF		ľ	NF	NF
Prayagraj	NF		NF		ľ	NF	NF
Varanasi	NF		NF		ľ	NF	NF
Buxar	NF		NF		ľ	NF	NF
Patna	NF		NF		ľ	NF	NF
Bhagalpur	· NF		NF		N	NF	NF
Farakka	NF		NF		ľ	NF	NF
Jangipur	NF		NF		N	NF	NF
Berhampor			NF			NF	NF
Balagarh			NF			NF	NF
Tribeni	NF		NF			<b>NF</b>	NF
Godakhali			NF			<b>NF</b>	NF
D. Harbour			NF			NF	NF
Frasergan	j NF		NF		N	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



## Arcella sp. (Ehrenberg, 1832)



Class: Tubulinea

Order: Arcellinida

Family: Arcellidae

Genus: Arcella sp.

## **Identifying feature:**

❖ The cell is circular or hemispherical shape.

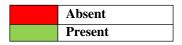
❖ It has two or more nuclei, which are vesicular.

❖ Sometimes small pseudopodia are attached to the cell wall.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Highly positive correlation was found with Carbonate, Ca<sup>++</sup>, Mg<sup>++</sup>, Total Hardness, Salinity, and Total Solid.



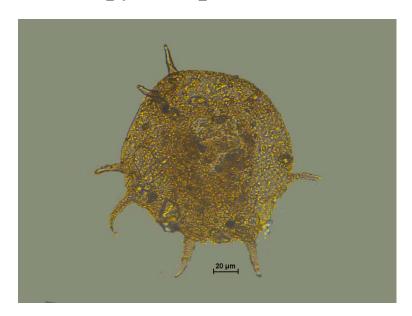


На	arshil	Tehri	Haridwa	r B	Bijnor	Narora	Farrukhabad
	Middle str	retch					
]	Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhagalpur	Farakka
	T	-4-h					
_	Lower str		D. 1	(T) •1	0 111 1	D II I	T
Ja	ngipur	Berhampore	Balagarh	Tribeni	Godakhali	D. Harbour	Fraserganj
	STATION		20		2019		020
	Hars	hil	NF	NF		NF	NF
	Teh	ri	NF	NF		NF	NF
	Harid	war	NF	NF		NF	NF
	Bijn	or	NF	NF		NF	NF
	Naro	ra	NF	NF		NF	NF
	Farrukh	nabad	NF	NF		NF	NF
	Kanp	our	NF	NF		NF	NF
	Praya	graj	NF	NF		NF	NF
	Varan	nasi	NF	NF		NF	NF
	Buxa	ar	NF	NF		NF	NF
	Patn	ia	NF	NF		NF	NF
	Bhagal	lpur	NF	NF		NF	NF
	Farak		NF	NF		NF	NF
	Jangij	pur	NF	NF		NF	NF
	Berham		NF	NF		NF	NF
	Balag		NF	NF		NF	NF
	Tribe	eni	NF	NF		NF	NF
	Godak	hali	NF	NF		NF	NF
	D. Harl	bour	NF	NF		NF	NF
	Fraser	ganj	NF	2		NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **★** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



## Centropyxis sp. (Stein, 1857)



Class: Tubulinea

Order: Arcellinida

Family: Centropyxidae

Genus: Centropyxis sp.

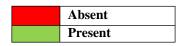
## **Identifying feature:**

- ❖ The body is rounded in the dorsal side and flat in the ventral side.
- ❖ It is yellow or brown in color.
- ❖ At the lateral side, four to five spines are present.

Habitat: Freshwater and Brackish water

**Major Ecological Parameter:** Parameters couldnot be analysed as it is found only once in the entire sampling.



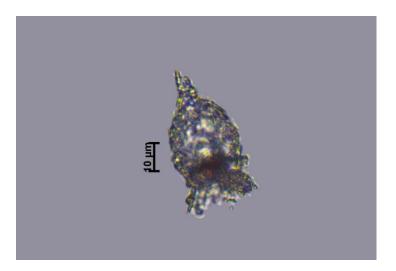


Harshil	Tehri	Haridwar	Bijnor	Na	rora	Farru	ıkhabad
Middle st	retch						
Kanpur	Prayagraj	Varanasi	Buxar	Patna	Bhag	alpur	Farakka
Lower stretch							
Jangipur	Berhampore	Balagarh	Tribeni	Godakha	li D. Haı	rbour	Fraserganj

STATION	2017	2018	2019	2020
Harshil	NF	NF	NF	NF
Tehri	NF	NF	NF	NF
Haridwar	NF	NF	NF	NF
Bijnor	NF	NF	NF	NF
Narora	NF	NF	NF	NF
Farrukhabad	NF	NF	NF	NF
Kanpur	NF	NF	NF	NF
Prayagraj	NF	NF	NF	NF
Varanasi	NF	NF	NF	NF
Buxar	NF	2	NF	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	NF	NF	NF
Farakka	NF	NF	NF	NF
Jangipur	NF	NF	NF	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	NF	1	NF
Tribeni	NF	NF	NF	NF
Godakhali	NF	NF	NF	NF
D. Harbour	NF	NF	1	NF
Fraserganj	NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **↓** NF Phytoplankton was not found at that time of sampling.

## Difflugia sp. (Leclerc, 1815)



Class: Tubulinea

Order: Arcellinida

Family: Difflugidae

Genus: Difflugia sp.

## **Identifying feature:**

❖ The shape of the body is globular to elongate.

❖ Large spines are present at the margin.

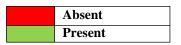
❖ The posterior part is rounded.

❖ The body has a distinct and constricted neck.

Habitat: Freshwater and Brackish water

**Major Ecological Parameters:** Highly positive correlation was found with Specific Conductivity, Dissolved Oxygen, and Total Dissolved Solid.





Harshil	Tehri	Haridwar	E	ijnor	N	Narora	Farrukhabad
Middle str	etch						
Kanpur	Prayagraj	Varanasi	Buxa	ır	Patna	Bhagalpur	Farakka
Lower stre	etch						
Jangipur	Berhampore	Balagarh	Triben	i G	odakhali	D. Harbour	Fraserganj

STATION	2017	2018	2019	2020
Harshil	NF	NF	NF	NF
Tehri	NF	NF	NF	NF
Haridwar	NF	20	NF	NF
Bijnor	NF	NF	NF	NF
Narora	NF	NF	NF	NF
Farrukhabad	NF	NF	NF	NF
Kanpur	NF	NF	NF	NF
Prayagraj	20	NF	NF	NF
Varanasi	NF	NF	NF	NF
Buxar	NF	5	1	NF
Patna	NF	NF	NF	NF
Bhagalpur	NF	NF	NF	NF
Farakka	NF	NF	NF	NF
Jangipur	NF	NF	NF	NF
Berhampore	NF	NF	NF	NF
Balagarh	NF	NF	NF	NF
Tribeni	NF	NF	NF	NF
Godakhali	NF	NF	NF	NF
D. Harbour	NF	NF	NF	NF
Fraserganj	NF	NF	NF	NF

- **↓** The density was recorded as a number of planktons in unit litre<sup>-1</sup>.
- **↓** The annual average of four seasons are shown in the table.
- **♣** NF Phytoplankton was not found at that time of sampling.



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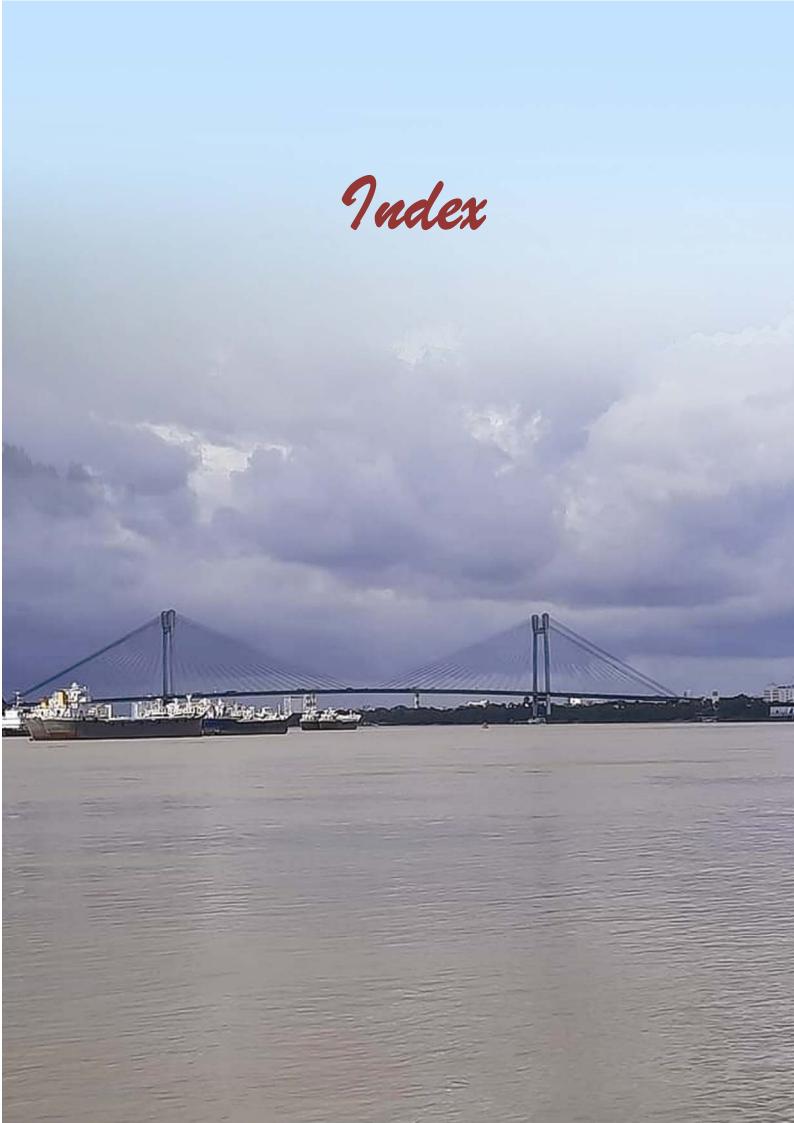


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