

## MORPHO-TAXONOMICAL SURVEY OF DIATOMS IN SCHIRMACHER OASIS, EAST ANTARCTICA

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### Abstract:

The present communication deals with the morpho-taxonomic and floristics studies of 10 species of diatom belonging to families Achnantheaceae, Fragilariaceae, Gomphonemaceae, Naviculaceae and Nitzschiaceae of the class, Bacillariophyceae, which have been collected from various habitats of the Schirmacher Oasis, East Antarctica. The dominant algal flora was constituted by cyanobacteria. while members of Bacillariophyceae were low in frequency represented in nature. The composition of the algal species has been compared among the three coordinates and the study reveals that the Western. Schirmacher is comparatively more suitable site for algal habitats.

### Introduction:

The life conditions in Antarctica are very harsh. Among the autotrophic organisms, mainly cryptogamic plants are represented in the polar rock deserts and their water bodies. Of these, the algae, lichens and mosses are the most conspicuous elements thriving due to the limited availability of light, water and nutrients to extreme low temperature conditions. Among the higher plants only two kinds of native vascular plants have been reported from; the subantarctic region.

The Schirmacher Oasis (70°46'04"-70°44'21"S; 11°49'54"-11°26'03"E) is a group of relatively ice free, low lying-hills, in the Eastern Dronning Maud land, East Antarctica is approximately 70 km south of Princes Astrid Coast. It has a maximum width of 2.7 km and a length of 17 km and is oriented in East-West direction. The elevation of Oasis ranges between 0 to 228 m with an average of 100 m.

The division Bacillariophyta comprises a single class Bacillariophyceae, the members of which are popularly known as the diatoms. The diatoms are a well defined group characterized by the presence of silicified walls and a structure composed of two valves, one overlapping the other.

Although some contributions have been made on the systematic and distributional data of Antarctic diatoms from various parts of the Antarctica, yet there are several areas and habitats which are still unexplored due to insufficient sampling or imperfect investigation. There is thus a need for thorough exploration and sampling of algal species in this area.

Hirano (1965) provided the list of 236 algal taxa from the Antarctic continent, which includes taxonomy, ecology, life cycle and productivity of various groups of algae. Pankow et al. (1991) estimated ca 700 taxa of non-marine algae from Antarctica. Of these 200 taxa occur in terrestrial habitats. These estimates are tentative as there are major gaps in our knowledge of diversity of Antarctic algae. A detailed study of diversity, distribution and dispersal of Antarctic terrestrial algae was given by Broady (1996).

Some algologists also made contributions on diatoms from the various part of Antarctica. Ohtani (1986) reported *Hantzschia amphioxys*, *Navicula Muticopsis*, *Navicula sp.* and *Pinnularia borealis* on the moss community, from Langhovde Yukidori valley in the vicinity of Syowa station. Ohtani et al. (1991) detected 4 diatom species from the soil of the Yukidori valley and Langhovde using the contact slide method. Andreoli et al. (1992) studied the photoautotrophic picoplankton from some lakes located near the Italian Antarctic station of Terra Nova. Andreoli et al. (1993) studied photoautotrophic picoplankton in the Antarctic Ross sea. Andreoli et al. (1995) investigated the floristic composition and biomass of diatoms (58 species) and dinoflagellates (34 species) in Terra Nova Bay (Ross sea), Bolter (1996) analysed the soil microbial communities including autotrophs and heterotrophs from the King George island and Arctowski station. Broady (1996) listed unicellular diatoms of *Achnanthes*, *Eunotia*, *Hantzschia*, *Navicula* and *Pinnularia* from the terrestrial habitat and also compared the diatom genera from inland mountain ranges and coastal vestfold hills, continental Antarctica. Amilli et al. (1998) recorded 65 taxa of marine phytoplankton (diatoms, dinoflagellates, silicoflagellates and cyanoprokaryotes) in the transect from the cold region of the Antarctic (Weddell Sea) up to Laplata Bay, Argentine in the late austral summer. They found the diatoms to be the dominant group in a South-North transect from the Seal-Bay (Princess, Martha Land, Antarctic) and suggested that the phytoplankton species of the cold Antarctic region disappeared around 50°S where there is a steep water temperature gradient. Broady and Weinstein (1998) found 2 species of lichens, 6 cyanobacteria, 1 diatom, 10 chlorophytes and 2 mycelial fungi from La Gorce mountains at an altitude of about 1750 m. Spaulding et al. (1999) undertook taxonomic and systematic studies and revised the genus *Muelleria* (Bacillariophyta) and suggested that most of the species restricted to higher latitudes are either from the southern or northern hemisphere.

Algological investigations and distribution of samples from the Schirmacher Oasis were summarized by Simonov (1971) and 63 algal taxa were listed. Kashyap (1988)

recorded 30 species of algae and cyanobacteria. Pankow and Haendel (1995) provide the checklist of 209 algal taxa, mainly belonging to Cyanophyceae (96), Chrysophyceae (2), Bacillariophyceae (54), Xanthophyceae (4), Dinophyceae (1) and Chlorophyceae (52). Gupta and Kashyap (1998) studied the dispersal of, microalgae through air currents and human vectors.

Studies on diatoms (Bacillariophyceae) in Schirmacher Oasis have also attracted considerable attention. Kashyap (1988) recorded two diatom species of *Pinnularia* and *Hantzschia* in association of quartz rocks. Pandey and Kashyap (1995) documented 3 diatom species, while working on the diversity of algal flora in six freshwater streams of Schirmacher Oasis, of which, *Pinnularia borealis* shows dominance as compared to *Navicula Muticopsis* and *Nitzschia obtusa*. Pandey et al. (1995) examined the nutrient status algae and cyanobacterial flora of six fresh water streams of Schirmacher Oasis and recorded 3 diatom species. Pankow and Haendel (1995) listed 57 taxa (*Melosira* 2; *Stephanodiscus*; *Cyclotella* 2; *Tabellaria* 1; *Diatoma* 2; *Asterionella* 1; *Fragilaria* 6; *Achnanthes* 6; *Cocconeis* 4; *Stauroneis*; *Navicula* 15; *Pinnularia* 1; *Rhoicosphenia* 1; *Cymbella* 2; *Epithemia* 2; *Rhopalodia* 1; *Hantzschia* 5; and *Nitzschia* 4). The dominant family is Naviculaceae and Subdominant is Fragilariaceae and Achnanthaceae.

## Materials and Methods

310 algal samples were collected aseptically from 30 different study sites of Schirmacher Oasis during XVIIIth Indian Antarctic expedition during the polar austral summer of 1999 from the various habitats of different corners of lakes, terrestrial conditions, immediate surrounding areas of moss carpet, organic incrustations on stones, meltwater streams, hilltops and lake sediments of the periphery. An inflatable boat was also used to facilitate the collection of algal samples from the Priyadarshini lake. Diatoms were collected by using plankton nets, keeping slides, in water, keeping coverslips, slides in moist soil or even keeping filter papers on moist soils. Sampling were also made in lakes/areas disturbed due to human interference.

For the purpose of survey the lakes were broadly divided into three category: Proglacial (adjacent to glacier, fed by glacier melt water, which is not much running through rock/soil), Intermountainous (surrounded by mountains and fed by melting of snow on mountain slopes. Periglacial (lakes on shelf).

The algal samples were tentatively observed microscopically within 24 h of collection and preserved in 4% formaline. The samples were brought to Northern Circle, Botanical Survey of India, Dehradun for further study.

**Cleaning of diatoms:** The diatoms are not usually found in very pure state in nature as they contain organic matter and sand etc. The diatoms have to be cleaned before observing them under microscope for the taxonomic study. It is, therefore, necessary not only to clear the frustules but also to get rid off the other unwanted matter accompanying the diatoms. The material is treated with hydrochloric acid to remove calcareous material. The material is then dried, washed and then treated with concentrated sulphuric acid and few crystal of potassium dichromate and kept for hour. Finally the material is washed with distilled water to make it suitable for study.

The algal samples collected from Schirmacher Oasis, have been deposited in the herbarium of Botanical Survey of India, Northern Circle, Dehradun (BSD). The identification has been done with the help of pertinent literature (Hustedt, 1930; Foged, 1977; Anand, 1998, Gandhi, 1998). Microscopic illustrations have been prepared using a camera lucida attachment. Each species has been provided with brief description, status and distribution along with specimens examined. The names are arranged alphabetically at every taxonomic level.

#### Diatoms Spectrum

#### ACHNANTHACEAE

##### 1. *Achnanthes minutissima* (Kuetz.) Grun.

Frustules linear; valves 19.42-32.14  $\mu\text{m}$  long, 3.64-3.74  $\mu\text{m}$  broad, narrow, linear lanceolate with broadly rounded ends; axial area narrow; central area slightly wider; striae 24-26 in 10  $\mu\text{m}$ .

Few in Schirmacher Oasis.

*Distribution in India:* Maharashtra.

*Specimens examined:* ANT, 5, 14, 55, 143, 199, 233, 272, 344.

## FRAGILARIACEAE

2. *Fragilaria intermedia* Grun.

Frustules united to form bands; valves 60.13-71.23  $\mu\text{m}$  long, 6.35-7.43  $\mu\text{m}$  broad, linear with parallel margins; ends gradually tapering and rounded slightly capitate; axial area narrow, linear; striae 0-12 in 10  $\mu\text{m}$ .

Scarce. It is an addition to Schirmacher Oasis.

*Distribution in India:* Maharashtra.

*Specimen examined:* ANT, 147, 231, 232, 328, 344.

3. *Fragilaria virescens* Ralfs.

Valves 69.72-76.57  $\mu\text{m}$  long, 4.87-6.25  $\mu\text{m}$  broad, long linear with parallel margins and attenuated rostrate ends; pseudoraphe present; axial area narrow, lineate, parallel throughout the valve; striae 14-17 in 10  $\mu\text{m}$ .

Rare in Schirmacher Oasis.

*Distribution in India:* Eastern Himalaya. Maharashtra.

*Specimen examined:* ANT. 272. 323. 358.

## GOMPHONEMACEAE

4. *Gomphonemalanceolatum* Ehrenb.

Valve 51.26-53.42  $\mu\text{m}$  long. 8.78-11.13  $\mu\text{m}$  broad, linear lanceolate with attenuated rounded ends; raphe thin, straight; axial area, narrow, linear lanceolate; central area rectangular with isolated puncta on opposite side; striae 10-11 in 10  $\mu\text{m}$ .

Rare. It is an addition to Schirmacher Oasis.

*Distribution in India:* Gujarat. Karnataka. Madhya Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh.

*Specimen examined:* ANT. 323, 328, 344.

## NAVICULACEAE

5. *Navicula cryptocephala* Kuetz.

Valves 28.38-32.43  $\mu\text{m}$  long, 5.29-6.58  $\mu\text{m}$  broad, linear lanceolate with constricted capitate ends; raphe thin, straight median with distinct central nodules; axial area narrow; striae 20-22 in 10  $\mu\text{m}$ .

Rare in Schirmacher Oasis.

*Distribution in India:* Andhra Pradesh, Andaman and Nicobar Islands, Eastern Himalaya, Gujarat, Karnataka, Maharashtra, Rajasthan, Uttar Pradesh, West Bengal

*Specimen examined:* ANT, 235, 237, 272, 326.

6. *Navicula muticopsis* van Heurck.

Valves 25.74-32.38  $\mu\text{m}$  long, 8.23-12.56  $\mu\text{m}$  broad, elliptic with short rostrate and slightly capitate ends; striae 13-15 in 10  $\mu\text{m}$ .

Scattered in Schirmacher Oasis.

*Distribution in India:* Not recorded.

*Specimen examined:* ANT, 21, 37, 40, 55, 93, 105, 147, 189, 200, 231, 233, 272, 326, 344, 358.

7. *Navicula radiosa* Kuetz.

Valves 58.47-64.22  $\mu\text{m}$  long, 8.34-12.19  $\mu\text{m}$  broad, linear lanceolate, gradually attenuated towards rounded ends; raphe thin straight; axial area linear, central area broad; striae 9-11 in 10  $\mu\text{m}$

Rare. It is an addition to Schirmacher Oasis.

*Distribution in India:* Andhra Pradesh, Andaman and Nicobar islands, Bihar, Karnataka, Maharashtra, Rajasthan, South India.

*Specimen examined:* ANT, 194. 147. 199.

8. *Pinnularia borealis* Ehrenb.

Valves linear, elliptical: lateral margin slightly convex, with broadly rounded apices; axial areas widened in the middle: raphe thread like with hooked terminal: valve 40.74-45.46  $\mu\text{m}$ . 7.28-11.87  $\mu\text{m}$  broad: striae 5-6 in 10  $\mu\text{m}$ .

Common in Schirmacher Oasis.

*Distribution in India:* Cosmopolitan

*Specimen examined:* ANT, 5. 6, 8, 14, 16, 17, 21, 23, 37, 40, 52, 55, 79, 93, 103, 105, 115, 223, 231, 235, 272, 331.

NITZSCHACEAE

9. *Hantzschia amphioxys* (Ehrenb.) Grun.

Valves 56.47-64.5  $\mu\text{m}$  long, 8.35-11.5  $\mu\text{m}$  broad, slightly arcuate linear dorsal side convex, ventral side concave depressed in the middle; ends constricted, bluntly rostrate to feebly capitate; keel punctae; striae 18-20 in 10  $\mu\text{m}$ .

Frequent in Schirmacher Oasis.

*Distribution in India.* Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Tamil Nadu, West Bengal.

*Specimen examined* ANT. 5. 55. 103. 105. 143. 189. 194. 197, 233, 272, 358.

10. *Nitzschia obtusa* W. Smith

Valves 113 47-142.38  $\mu\text{m}$  long. 7.5-9.57  $\mu\text{m}$  broad, linear with oblique rounded ends. keel excentric with a slight notch in the middle; striae 28-30 in 10  $\mu\text{m}$  Scarce in Schirmacher Oasis.

*Distribution in India:* Andhra Pradesh, Maharashtra, Uttar Pradesh, West Bengal.

*Specimen examined:* ANT, 338, 331.

Table 1: Diversity of Diatoms in Schirmacher Oasis

Western Schirmacher (11°20'.11°35'E)	Central Schirmacher (11°35'-11045'E)	Eastern Schirmacher (11°40'-11055'E)
<i>Achanthes minutissima</i>	<i>Achanthes minutissima</i>	<i>Fragilaria intermedia</i>
<i>Gomphonema lanceolatum</i>	<i>Hantzschia amphioxys</i>	<i>Fragilaria virescens</i>
<i>Hantzschia amphioxys</i>	<i>Pinnularia borealis</i>	<i>Navicula cryptocephala</i>
<i>Navicula muticopsis</i>		<i>Pinnularia borealis</i>
<i>Navicula radiosa</i>		
<i>Nitzschia obtusa</i>		
<i>Pinnularia borealis</i>		

Table 2: Comparison of Diatoms in two ecological environment

Name of the Species	Aquatic habitat	Terrestrial habitat
<i>Achanthes minutissima</i>	O	ND
<i>Fragilaria intermedia</i>	■	X
<i>Fragilaria virescens</i>	X	ND
<i>Gomphonema lanceolatum</i>	X	ND
<i>Hantzschia amphioxys</i>	ND	◆
<i>Navicula cryptocephala</i>	ND	X
<i>Navicula radiosa</i>	X	X
<i>Navicula muticopsis</i>	□	□
<i>Nitzschia obtusa</i>	■	■
<i>Pinnularia borealis</i>	●	●

● Common; ◆ Frequent; □ Scattered; O Few; X Rare; ■ Scarce; ND Not detected.

#### Results and Discussion:

Ten species of diatoms recorded from the various ecological niches of Schirmacher Oasis are presented in Table 1 and 2. Species of *Pinnularia borealis* and



*Morpho-taxnomical survey of Diatoms.*

*Hantzschia amphioxys* are dominant among the diatom species. The algal flora is dominated by cyanobacteria and diatoms are frequent associates. The diatoms are also recorded in association of *Anabaena*, *Gloeocapsa*, *Lyngbya*, *Microcoleus*, *Nostoc*, *Oscillatoria*, *Phormidium*, *Scenedesmus*, *Schizothrix*, *Stigonema* and *Synochococcus*, species belonging to cyanobacteria and green alga. The intermountainous lakes have slightly higher salt concentration and conductivity in comparison to proglacial and periglacial lakes, which has direct bearing on the algal diversity. It has also been noticed that the algal population in intermountainous lakes shows the higher density. Only three cosmopolitan species of diatoms, viz. *Hantzschia amphioxys*, *Navicula muticopsis* and *Pinnularia borealis* are encountered regularly. The cosmopolitan species exist but they are always delimited by ecological factors. The richness in the species composition of diatoms was among different localities compared which suggest that Western Schirmacher is more suitable for algal habitats especially cyanobacteria and diatoms.

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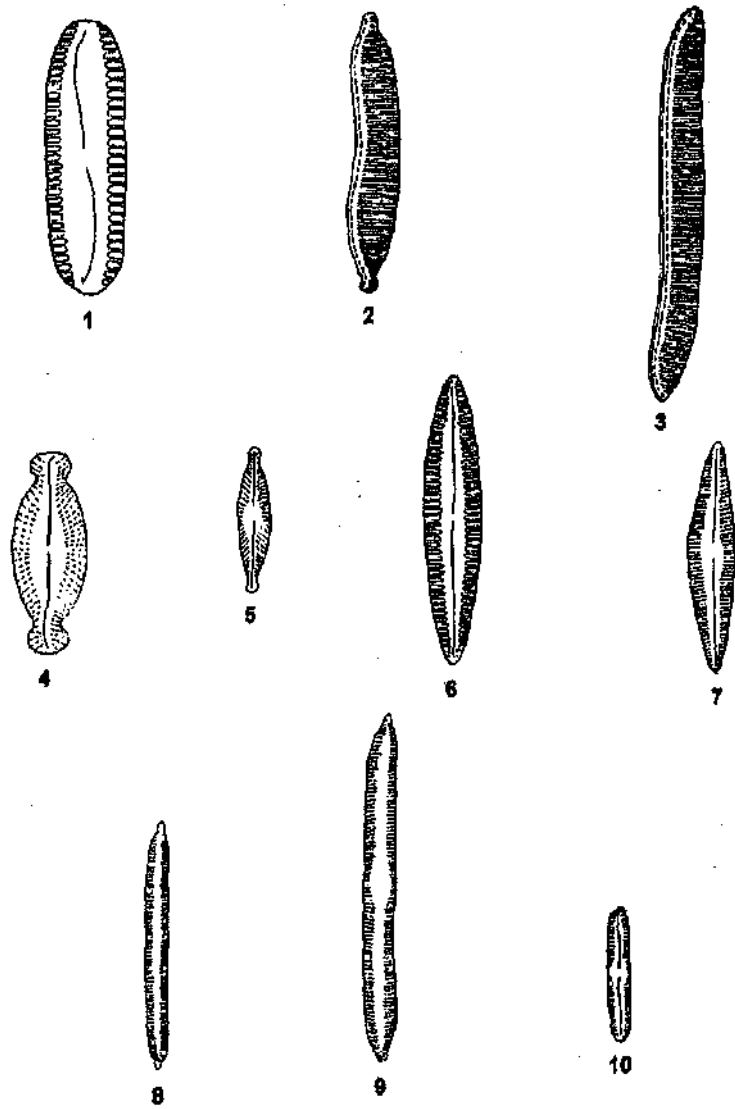
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Morpho-taxonomical survey of Diatoms  
Plate-I



Explanation of Figs. 1-10. 1. *Pinnularia borealis*, 2. *Hantzschia amphioxys*, 3. *Nitzschia obtusa*, 4. *Navicula muticopsis*, 5. *Navucyla cryptocephala*, 6. *Navicula radiosa*, 7. *Gomphonema lanceolatum*, 8. *Fragilaria*, 9. *Fragilaria intermedia*, 10. *Achnanthes minutissima*.



Photo 1. Collection of algal samples through plankton net in the Priyadarshini lake, with the help of Indian army.



Photo 2 collection of algal samples from the lake periphery