



Diversity of *Navicula* (Bacillariophyceae) in the area of District bannu, Khyber Pakhtoonkhwa, Pakistan

Zain ullah khan, Sultan Mahmood, Rehman Ullah khan and Saad Ullah khan*

*Department of Botany, University of Science and Technology, Bannu, Pakistan. Email: rehman_g4u@yahoo.com

ABSTRACT

Fifteen species of the diatom genus *Navicula* (Bacillariophyceae) were collected from various freshwater habitats of Bannu of the Khyber Pakhtoonkhwa Province of Pakistan during April to December 2012. All the collected species appeared in the vegetative state and occurred during winter and spring. They were taxonomically determined and described for the first time from these areas. These species found in various habitat (Lotic & Lentic water of Kurram river Tarkhobi alged, Tangai alged, Kashu river, Tochi river, Barran nallah, Doab, Khalboi alged, Khochkat river & Barran Dam.) were *Navicula cuspidata.*, *N.platystoma*, *N.radiosa* *N.cryptoccephala* *N.salinarum*, *N.viridula*, *N.mutica*, *N.protracta*, *N.gastrum*, *N.rhynoccephala* *N.confveacea*, *N.gracilis*, *N.dicephala*, *N.bacillum* & *N. exiqua*,

Keywords: Diatoms flora, Bannu, *Navicula*, identification, preservation, taxonomy

INTRODUCTION

The district Bannu lies between 32.43 to 33.06 North latitude and from 70.22 to 70.57 E⁰ longitudes. It is bounded in the East by the Karak and in the North by tribal area District on the south by Lakki Marwat of Bannu District .The total area of the district is 1227 square kilometer. The whole area is intersected by hill torrent and deep rains. The weather of Bannu district is moist & hot. It is suitable for growth of different flora. Due to maximum rainfall occur in august (111.36 mm) so maximum collection of Diatom is possible during august. After detailed taxonomic studies on Bacillariophyta from areas now included in the north-eastern part of Pakistan (West & West, 1920; Carter,1926; Abdul-Majeed, 1935; Salim & Khan, 1960) several attempts were made to report freshwater diatoms from the Punjab, Azad Kashmir (Masud-ul-Hasan & Zeb-un-Nisa, 1986; Masud-ul-Hasan & Batool, 1987; Masud-ul-Hasan & Yunus, 1989; Balochistan (Anjum & Hussain, 1983) and Sindh (Leghari SM *et al.*, 2002, 2003 and 2004). But no detailed taxonomic study was carried out to investigate any diatomaceous genus. Therefore, a research program was started in April 2012 and a large collection of several species of genus *Navicula* of diatoms was made from freshwater habitats of districts Bannu and taxonomically evaluated (Tariq-Ali *et al.*, 2006 a, b, c).

MATERIALS AND METHOD

The collections were made from different freshwater habitats , Kurram river Tarkhobi alged, Tangai alged, Kashu river, Tochi river, Barran nallah, Doab, Khalboi alged, Khochkat river & Barran Dam.) during April-December 2012. Collected material was preserved and taxonomically investigated as described earlier (Tariq-Ali *et al.*, 2006c). The specimens were identified with the help of authentic literature (Cleve, 1895; Østrup, 1908; Hustedt, 1930; Salim & Khan, 1960; Hirano, 1964; Starmach, 1964; Gerloff & Lüdemann, 1966; Nizamuddin, 1984); Masud-ul-Hasan & Zeb-un-Nisa, 1986; Masud-ul-Hasan & Batool 1987; Masud-ul-Hasan & Yunus, 1989; Sultana *et al.*, 1991; Leghari *et al.*, 2002, 2003, 2004, Ghazala, 2006, 2007; Tariq-Ali *et al.*, 2006b, c, d.). Diatom samples were scraped from 5-10 stones (or other substrates) from each site. The stones were scratched with a toothbrush. The samples were kept in clean small plastic bottles; up-to 10m depth .The bottles were labeled accordingly and brought to the laboratory at USTB in order to study further. After 24 hours, were carefully picked up with the help of a dropper 1 ml of sample was poured onto the slide sample. Voucher specimens are kept in the research Lab, Department of Botany UST,Bannu

RESULTS AND DISCUSSION

The present work was undertaken as a part of M.Phil dissertation to explore the Diatoms of District Bannu, so far a little work has been done and less attention has been given to Diatoms (Shah *et al.*, 1996, Sultan *et al.*, 2002, 2004). A total of 15 species belonging to genus *Navicula* were collected and described taxonomically.

Description of the collected fifteen species of Genus *Navicula***1. *Navicula cuspidata* var. *robusta* Var. novo . (Fig.1)**

Morphology: Valves rhombo-lanceolate tapering sharply to rounded poles, transverse striations evidently punctuate longitudinal striations parallel to the narrow axial area. Differs from the type as well as var. Major Meister is being longer and broader and also having a somewhat lesser number of striae,

DIMENSION: length =207 μ Breadth =45 μ **No. of striae** =15-18 in 10 μ

Habitat: Kurram river, along margin among plants' Touchi river & Tangai alged.

2. *Navicula platystoma* Eher . (Fig.2)

Morphology: Frustules solitary, valves broadly lanceolate with broad and prostrates poles, central area wide, striae fine radial.

DIMENSION: length = 42 μ , Breadth = 16 μ **No. of striae** = 15-18 in 10 μ

Habitat: Kurram river side, Tarkhobi alged & Tangai alged.

3. *Navicula radiosa* kg. (Fig.3)

Morphology: Valve lanceolate gradually tapering to more or less pointed ends, transverse striations radial, except at the ends.

DIMENSION: length = 66.5 μ , Breadth= 11.5 μ , **No. of striae** = 10-13

Habitat: Collected by towing in a stream situated on Bannu Neurang road.

4. *Navicula cryptocephala* kuetzing. (Fig.4)

Morphology: Cells 5-7 \times 20-40 μ m; valves lanceolate with slender, somewhat capitate end, central area elongated transversely; striations, medianly radial and polar convergent, 16-18 in 10 μ m, lines fine.

Habitat: Torkhoboi alged & Kashu river.

5. *Navicula Salinarum* var. *Grunow*. (Fig.5)

Morphology: Valve lanceolate, with more or less prostrate, often lightly capitate ends, central area round, transverse striations medially alternately long and short and radial.

DIMENSION: length = 37.5 μ , Breadth = 8 μ , **No. of striae** = 13-15

Habitat: Collected from a stream situated on Bannu Neurang road.

6. *Navicula viridula* var. *rosellata* Cleve . (Fig.6)

Morphology: Frustules solitary, valves broadly lanceolate, with attenuated subrostrae ends, striae radiate, axial area narrow, central area rounded.

DIMENSION: length = 64.5 μ , Breadth = 13.5 μ , **No. of striae** = 7-9

Habitat: Scaped from surface on the sides of a freshwater canal at lohra, forming a brownish scum, Doab & tochi.

7. *Navicula mutica* Kuetzing. (Fig.7)

Morphology: Cells 7-12 \times 10- 40 μ m; valves lanceolate with broadly rounded ends, central area rectangular, with a single isolated puncta; transverse striations strongly punctate, radial, 15-20 in 10 μ m ;often difficultly visible in the middle of the valve.

Habitat: Kurram river & Touchi river.

8. *Navicula protracta* (Grunow.) cleve. (Fig.8)

Morphology: Cells 7-10 \times 20-35 μ m; valves linear with broadly rostrate ends, axial area very narrow; transverse striations slightly radial except at the extremities, 18- 22 in 10 μ m .

Habitat: Torkhoboi alged & Kashu river.

9. *Navicula gastrum* Ehrenberg. (Fig.9)

Morphology: Cells 12- 20 \times 25-60 μ m; valves broadly elliptic with short rostrate and broadly rounded ends; central area widened, irregular; transverse striations radial, 8-10 in 10 μ m, medially alternately long and short

Habitat: Kurram river & Touchi river

10. *Navicula rhyncocephala* kuetzing.(Fig.10)

Morphology: Cells 10-13 \times 35-60 μ m; valves lanceolate with slender, slightly capitate end; central area round ;transverse striations, medianly radial, polarly convergent, 10-12 in 10 μ m.

Habitat: Khochkat river & Kurram river

11. *Navicula confervacea* (kuetzing.) Gruno. (Fig.11)

Morphology: Cells 6-8 \times 17-25 μ m; valves lanceolate, axial area lanceolate and medianly broad; transverse striations often weak, radial, 20-22 in 10 μ m

Habitat: Tochi river & Kurram river.

12 *Navicula gracilis* Ehreberg (Fig.12)

Morphology: Cells 6-10 ×36-60µm; valves linear with nearly parallel sides and cuneately rounded ends, central area rectangular; transverse striations, only slightly radial in the middle, 11-12 in 10 µm.

Habitat: Khohkat river, Kurram river & Lohra nallah.

13. *Navicula dicephala* (Ehrenberg.) smith. (Fig.13)

Morphology: Cells 8-13×20-40 µm; valves broadly linear to linear lanceolate with ends abruptly rostrate and somewhat capitate; transverse striations radial, 9-10 in 10µm; central area rectangular.

Habitat:Khochkat river, Kurram river & Lohra nallah

14. *Navicula bacillum* Ehrenberg (Fig.14)

Morphology: Cells 10-20×30-80µm; valves linear, with straight or slightly convex sides and broadly rounded end; transverse striations slightly radial, 12-14 in 10µm at the middle and 18-20 in 10µm at the poles; central area rounded.

Habitat: Torkhoboi alged & Kashu river.

15. *Navicula exiqua* (Gregory.) Meller(Fig.15)

Morphology: Cells 7-15 ×16-35 µm ; valves elliptic –lanceolate with rostrate, sometimes slightly capitate , ends; central area transversely widened ,irregular; transverse striations radial, 12-14 in 10µm ; medianly alternately long and short.

Habitat: Kurram river Touchi river & Pond water.

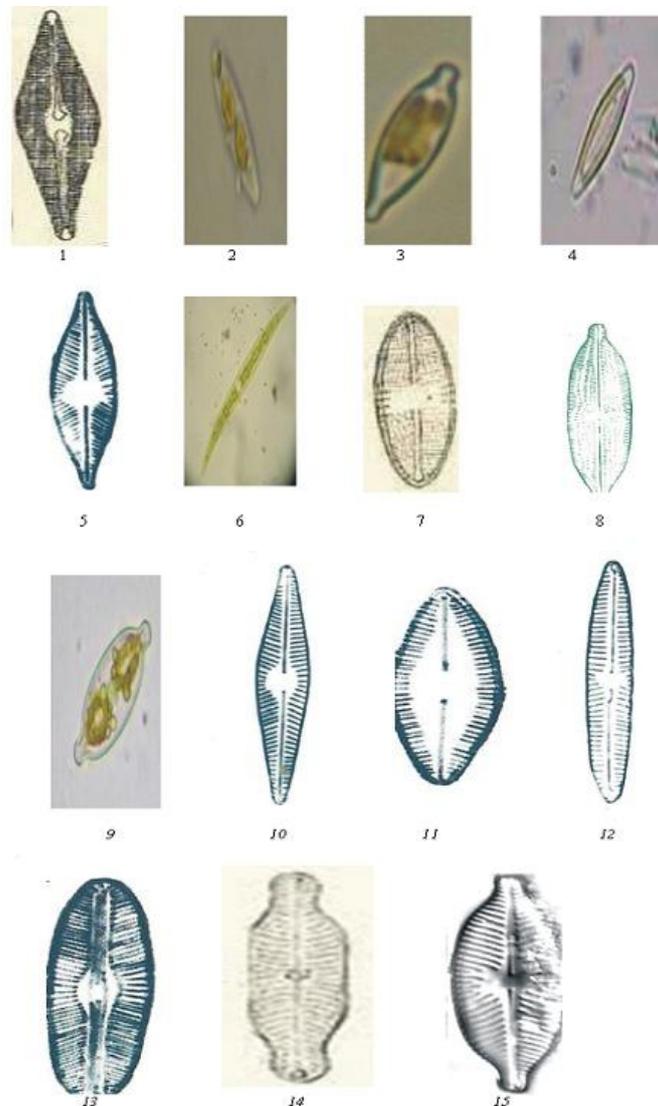


Fig.1-15.1.*Navicula cuspidata*, 2.*Navicula platystoma*, 3.*Navicula radiosa*, 4.*Navicula cryptocephala*, 5. *Navicula Salinarum*, 6.*Navicula viridula*, 7.*Navicula mutica*, 8. *Navicula protract*, 9.*Navicula gastrum*, 10. *Navicula rhyncocephala*, 11.*Navicula confevacae*, 12. *Navicula gracilis*, 13.*Navicula dicephala*, 14. *Navicula bacillum* & 15.*Navicula exiqua*.

REFERENCES

- Abdul-Majeed, M. 1935. *Freshwater Algae of the Punjab. I. Bacillariophyta (Diatomeae)*. Punj. Univ. Publ., Lahore, 45 pp.
- Carter, N. 1926. "Fresh water algae from India". *Rec. Bot. Surv. Ind.* 9: 263-30
- Cleve, P.T. 1894. Synopsis of the naviculoid diatoms-I. *Kongl. Svensk. Vet-Akad. Handl.*, 26: 1-194.
- Gerloff, J. and D. Lüdemann. 1966. *Leitfaden der Trink- und Brauch-wasserbiologie*. 2nd ed., Gustav Fisch. Verlag, Stuttgart, 360 pp.
- Ghazala, B R. Ormond and F. Hannah. 2006. Phytoplankton communities of Pakistan: I. Dinophyta and Bacillariophyta from the coast of Sindh. *Int. J. Phycol. Phycochem.* 2(2): 183-196.
- Ghazala B. R. Ormond and F. Hannah. 2007. "Phytoplankton communities of Pakistan": II. Dinophycota and Bacillariophycota from the coast of Balochistan. *Int. J. Phycol. Phycochem.* /3(2) 127-135.
- Hirano, M. 1964. Freshwater algae of Afghanistan. In: *Plant of West Pakistan and Afghanistan*. (Ed.): S. Kitamura, Kyoto, Univ., Japan, p. 167-245.
- Jahangir, T.M., M.Y. Khuhawar, S.M. Leghari, W.A. Balouch, A.A. Leghari and A. Leghari. 2000. Some studies on water quality and biological life at Kinjhar and Haleji lakes of district Thatta, Sindh, Pakistan. *Pak. J. Biol. Sci.*, 3:1965-1972.
- Jahangir, T.M., M.Y. Khuhawar, S.M. Leghari and A. Leghari. 2001. Physico-chemical and biological study of Mangho Pir eutermal springs Karachi, Sindh, Pakistan. *Online J. Biol. Sci.*, 1: 636-639.
- Leghari, M.K, M.Y. Leghari and M. Shah. 2002. Ecological study of algal flora of Korang Nalla of Rawal Dam Islamabad. *Biologia*, 48: 65-80.
- Leghari, M.K, M.Y. Leghari, M. Shah and S. N. Arbani. 2003. Ecological study of algal flora of Wah Garden district Attock Pakistan. *Pak. J. Bot.*, 35: 705-716.
- Leghari, M.K., M.Y. Leghari M. Shah and S.N. Arbani. 2004. Water chemistry and its relation with algae of Rawal Dam, Islamabad and Wah Garden district Attock. *Sindh Univ. Res. J. (Sci.Ser.)*, 36: 29-48.
- Masud-ul-Hasan and Zeb-un-Nisa. 1986. Taxonomic studies of some freshwater algae from Azad Kashmir and Jammu Kashmir. *Biologia*, 33: 345-366.
- Masud-ul-Hasan and A. Yunus. 1989. An addition to the algal flora of Lahore. *Biologia*, 35: 99-131.
- Masud-ul-Hasan and I. Batool. 1987. A Taxonomic study of same freshwater algae from Attock and Sargodha districts. *Biologia*, 33: 345-366
- Østrup, E. 1908. Freshwater diatoms. In: *Botany of the Faeröes Based Upon Danish Investigations*. (Ed.): E. Warming. Gyldendalske Boghandel, Nordisk Forlag, Copenhagen, p. 260-290.
- Salim, K.M. and M.H. Khan. 1960. *The Diatomales: The Fresh Water Diatoms of Peshawar Valley*. Dept. of Botany, Peshawar Univ., Peshawar, 66 pp. + 11 pls.
- Shah, J. and Hassan, U.M. 1996 "Diatoms of Borit lake, Hunza Valley, Pakistan", *Scientific Khyber*, 9 (2), 71-7.
- Sultan mehmoed wazir (2002). first time study diatom in jail sailf ul malook lake kaghan valley.. *Journal of Research (Science)*, Vol.13, No.1, June 2002, pp. 45-51
- Starmach, K. 1964. *Flora Slodkowodna Polski. 6. Chrysophyta II. Bacillariophyceae - Okrzemki*. Panstwowe Wydawnictwo Naukowe, 610 pp.
- Sultana, K. M.K. Leghari, B. Inam and F Bano. 1991. Some diatoms of Valley Dadar III. *Biologia*, 37: 69-72.
- Sultan 2004. Diatoms of Sail-ul - malook Kaghan Valley- Pakistan" *Journal of Research of (science) bahaudin Zakariya University Multan Pakistan*. vol.13, No. 1, 45-51.
- Tariq-Ali, S. A. Zarina, Masud-ul-Hasan and M. Shameel. 2006b. Taxonomic studies on *Navicula* (Bacillariophyta) from certain areas of the Punjab, Pakistan. *Pak. J. Bot.*, 38: 435-441.
- Tariq-Ali, S. A. Zarina, Masud-ul-Hasan and M. Shameel. 2006c Taxonomic studies on *Nitzschia* (Bacillariophyta) from Kasur and Lahore districts of Pakistan. *Proc. Pak. Acad. Sci.*, 43: 151-155.
- Tariq-Ali, S A. Zarina, Masud-ul-Hasan and M. Shameel. 2006d. Diversity of *Pinnularia* (Bacillariophyta) in the North-Eastern areas of Pakistan. *Pak. J. Bot.*, 38: 1249-1255
- West, G.S. and W. West. 1902. "A contribution to the freshwater algae of Ceylon". *Trans. Linn. Soc. Bot. ser.*, 2(6): 123-215.