

TAXONOMIC STUDY ON CERTAIN DIATOMS FROM FRESHWATER HABITATS OF NORTH-EASTERN AREAS OF PAKISTAN

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Abstract: Eight species of freshwater pennate diatoms (Bacillariophyta) belonging to four genera of three families were collected from Gujranwala, Lahore, Sargodha and Attock districts of the Punjab, and Neelum Valley of Azad Kashmir during January-October 2004. They were taxonomically determined and are being described for the first time from their area of collection. They occurred in all the four seasons of the year. The genus *Bacillaria* and the species *Achnanthes coarctata* and *Bacillaria paxillifer* are being reported for the first time from Pakistan.

Keywords: Algae, diatoms, Bacillariophyta, Bacillariales, taxonomy, freshwater.

Introduction

A comprehensive survey was conducted in March 2003 for the collection of pennate diatoms from north-eastern areas of Pakistan and the species of some collected genera like *Cymbella* C. A. Agardh, *Navicula* Bory de Saint-Vincent, *Nitzschia* Hassall and *Pinnularia* (Ehrenberg) Ehrenberg were taxonomically described [1-4]. From this collection some more genera were investigated and their species are described taxonomically in the present paper.

Materials and Methods

Collections were made from various freshwater habitats at Gujranwala, Lahore, Sargodha and Attock Districts of the Punjab and Neelum Valley of Azad Kashmir during January and October 2004. Methods for the collection of material, its investigation under microscope and preparation of drawings have already been described earlier [3]. The material was preserved in 3 % formalin in plastic bottles and identified with the help of authoritative literature [5-25]. The voucher specimens have been kept in the Phycology and Phycochemistry Lab. (Room No.

18), MAH Qadri Biological Research Centre, University of Karachi, where the present study was conducted.

Results and Discussion

Eight species of freshwater diatoms belonging to four genera viz., *Achnanthes*, *Cocconeis* of the family Achnantheaceae, *Bacillaria* of Bacillariaceae and *Diatoma* of the family Diatomaceae, order Bacillariales, class Bacillariophyceae, phylum Bacillariophyta [26] have been identified. The specimens were collected in vegetative condition, therefore no information could be recorded on their sexual reproduction. The investigated species are being described for the first time from their area of collection in Pakistan. Their taxonomic enumerations are given below.

Family Achnantheaceae

Cells are linear, elliptical to navicular in valve view and longitudinally bent or curved in girdle view; two valves of a cell are dissimilar. The epitheca is always with a pseudoraphe and convex; the hypotheca is usually convex. The gir-

dles are longitudinally bent and ornamented, numerous small discoid chromatophores; auxospores are formed. The following two genera of this family were collected, which may be distinguished as follows:

- Girdle rectangular, chromatophores many *Achnanthes*
Girdle transversely curved, chromatophore single *Cocconeis*

***Achnanthes* Bory de Saint Vincent 1822: 79**

Frustules free or epiphytic; girdle rectangular, longitudinally geniculate, valve with axial pseudoraphe, nodules absent; lower valve concave with raphe, ends subacute, punctate, transverse, delicate; chromatophores divided into many small granules. Its following two species have been collected, which may be distinguished as given below:

- Valves up to 47 μm long
..... *A. coarctata* (1)
Valves only up to 31 μm long
..... *A. hungarica* (2)

***A. coarctata* (Brébisson in W. Smith) Grunow in Cleve et Grunow 1880:20**

Basionym: *Achnanthes coarctatum* Brébisson ex W. Smith.

References: [6:290, 7:278, 20:15].

General characters: Frustules united to one another in a chain; valves 47 μm in length and 13 μm in breadth; costae 7-9 within 10 μm (Fig. 1:1).

Cytological features: Chromatophores divided into small granules.

Locality: Azad Kashmir: Neelum Valley (5-4-2004).

Geographical distribution: Faeröes (Denmark), England, Libya, Afghanistan.

Remarks: The specimens were collected during spring from Neelum Valley. This species is being reported for the first time from Pakistan.

***A. hungarica* (Grunow) Grunow in Cleve et Grunow 1880**

Synonym: *Achnanthes andicola* (Cleve) Hustedt 1911.

References: [11:24, 13:288].

General characters: Frustules epiphytic and free-floating; valves oblong, lanceolate; upper (epitheca) with pseudoraphe, the lower (hypotheca) with raphe and stauros; ends acute or subacute; polar nodules rather inconspicuous, striae dim; length 29.0-30.6 μm and breadth 6.8-7.0 μm (Fig. 1:2).

Cytological features: Chromatophores divided into many small discoid granules.

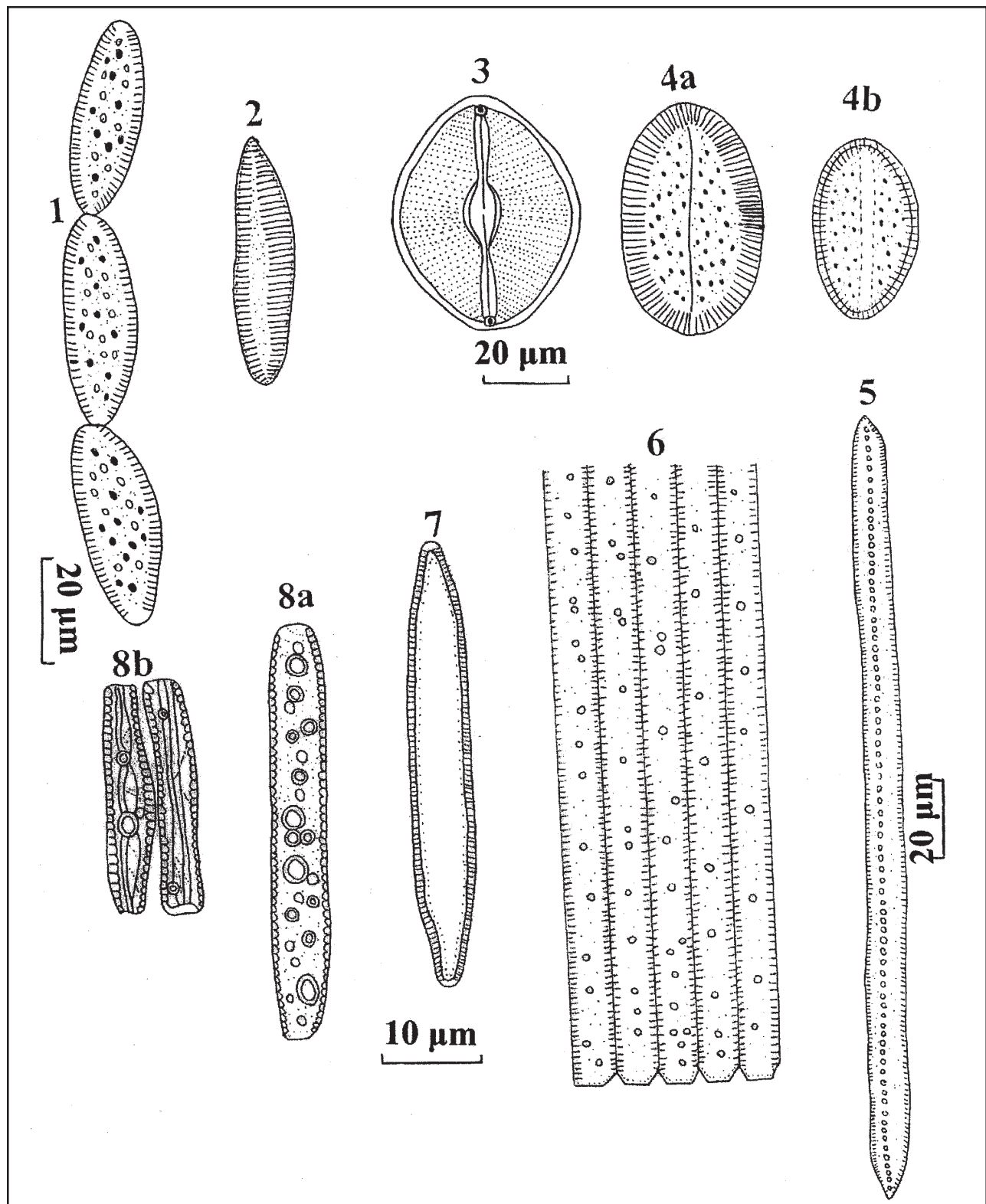
Locality: N.W.F.P.: near Attock (12-1-2004).

Geographical distribution: Pakistan: Peshawar; Poland and Hungary.

Remarks: The material was collected during winter from a stagnant pond mixed with other free-floating algae.

***Cocconeis* Ehrenberg 1835: 137**

Frustules in groups, epiphytic; girdle transversely curved; valves broadly rhomboidal to elliptical; median straight, raphe with polar and central nodules; striae punctate, transverse in the middle, radiate towards the poles; axial area rounded at the centre; chromatophore single, plate like, with irregularly lobed margin. Its following two species were collected, which may



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Fig. 1. Species of pennate diatoms from Pakistan.

- (1) *Achnanthes coarctata*, (2) *A. hungarica*, (3) *Cocconeis pediculus*, (4a) *C. placentula*: valve, (4b) chromatophores, (5) *Bacillaria paxillifer*, (6) *Diatoma anceps*, (7) *D. elongatum*, (8a) *D. vulgare*: chromatophores, (8b) frustules.

be distinguished as follows:

1. Frustules broadly ovoid
..... *C. pediculus* (3)
Frustules elliptical from all sides
..... *C. placentula* (4)

***C. pediculus* Ehrenberg 1838: 194**

References: [6:291, 7:276, 11:22, 15:107, 20:39, 21:2].

General characters: Frustules broadly ovoid, elliptical in valve view; pseudoraphe on the epitheca, raphe on the hypotheca with central and polar nodules; valves with prominent striae; epiphytic on aquatic plants, such as *Potamogeton pectinatus*, *Typha domogensis* etc. (Fig. 1:3).

Cytological features: Chromatophore single, plate like with irregularly lobed margin.

Locality: Sargodha District: near Sargodha (30-10-2003).

Geographical distribution: Worldwide.

Remarks: The specimens were obtained during autumn from moist dripping soil near Sargodha.

***C. placentula* Ehrenberg 1838: 194**

References: [5:169, 10:343, 11:22 15:107, 16:38, 17:10, 19:575, 20:39, 21:2, 23:121, 25:159].

General characters: Valve elliptical, upper one with a linear axial area; punctate, radiating but towards the periphery irregularly arranged; hyaline inter marginal ring and raphe on the hypothecal valve; length 38.5 μm and width 24.5 μm (Fig. 1:4a).

Cytological features: Chromatophore single, plate like (Fig. 1:4b).

Locality: Lahore District: Shalimar Garden (3-5-2004).

Geographical distribution: Kurdistan, Libya, South Africa.

Remarks: The material was obtained during spring from fountain of Shalimar Garden.

Family Bacillariaceae

Unique motile colonies, cells linked to each other via a ridge and groove arrangement of their raphae system, able to move over each other fiber-like configuration; cells seen in valve or girdle-view. Only following genus of this family was found in the present collection.

***Bacillaria* J. F. Gmelin in Linnaeus 1791: 3903**

Frustules isopolar; valve shallow, bilaterally symmetrical, linear or linear-lanceolate; pointed, rounded, cuneate, to slightly rostrate poles; striae transverse, appearing as simple lines; raphae system fibulate, central; two chloroplasts per cell, one towards each pole. This genus is being reported for the first time from Pakistan. The present collection included its following species.

***B. paxillifer* (O.F. Müller 1873: 277) Hendey 1951:74**

Basionym: *Vibria paxillifer* O.F. Müller 1873: 277.

Synonyms: *Bacillaria paradoxa* J. F. Gmelin 1788: 3903, *Oscillaria paxillifera* (O.F. Müller) Schrank 1823:539, *Nitzschia paxillifer* (O.F. Müller) Heilberg 1863:113, *Nitzschia paradoxa* (J. F. Gmelin) Grunow 1880:85, *Oscillatoria Paxillifera* (O.F. Müller) Schrank ex Gomont 1892: 239, *Homeocladia paxillifer* (O.F. Müller) Elmore 1921:143.

References: [18:49, 20:28].

General characters: Cells usually forming a colony; 197.2 μm long, at the centre 12.9 μm and at the tip 6.12 μm broad; keels central; costae 20 within 10 μm (Fig. 1:5).

Cytological features: Chromatophores one or two, elongate, with irregular margin.

Locality: Sargodha District: Saim Nala in Sargodha (30-10-2004).

Geographical distribution: Europe, U. S. A., Libya, Indian Ocean.

Remarks: The specimens were collected during autumn from a Saim Nala near Sargodha. This species is being reported for the first time from Pakistan.

Family Diatomaceae

Valve is bilaterally symmetrical having longitudinal and transverse axes. Cells are oblong, solitary or frequently united in zig zag manner. Valves have transverse striae in addition to costae and there may be a conspicuous pseudoraphe down the middle of a valve. Girdles of the frustule are usually separated from each other by intercalary bands. There are numerous small discoid chromatophores within a cell. Only following genus of this family was found in the present collection.

***Diatoma* Bory de Saint-Vincent 1824:461, nom. cons.**

Frustules rectangular, broad at the end; cohering to one another by gelatinous cushions at the corners to form linear or zig zag chains; valve linear or lanceolate or elliptical; costae transverse across the valve, touching the intercalary band in girdle, between them fine punctate striae; pseudoraphe narrow, indistinct in the middle;

chromatophores numerous, appearing like small rounded granules. The following three species were collected, which may be distinguished as given below:

1. Valves elliptical *D. vulgare* (8)
Valves linear 2
2. Apices of valve rostrate *D. anceps* (6)
Apices of valve rounded
..... *D. elongatum* (7)

***D. anceps* (Ehrenberg) Grunow**

References: [13: 143, 25: 160,].

General characters: Valve linear with rostrate apices; costae robust; striae delicate, 20 in 10 μm ; zonal view quadrangular (Fig. 1:6).

Cytological features: frustules containing the nuclei and chromatophores.

Locality: Lahore District: Nasir Bagh (12-6-2004).

Geographical distribution: U. S. A., Poland.

Remarks: The material was obtained during summer from fountain of Nasir Bagh.

***D. elongatum* (Lyngbye) C. A. Agardh 1824:4**

References: [6:285, 7:286, 8:127, 9: 432, 11:17, 13:141, 14:566, 15:107, 20:47, 24:14].

General characters: Valve rectangular, linear, straight, elongated; apices slightly rounded; length 45.0-48.8 μm and breadth 6-7 μm (Fig. 1: 7).

Localities: Gujranwala District: Raja Village (18-12-2004); Lahore District: Baowala Village (21-8-2004).

Geographical distribution: Libya, Poland,

Faeröes (Denmark), Germany, U.K.

Remarks: The specimens were collected during winter from a roadside pond at Raja Village and also during summer from Baowala Village.

***D. vulgare* Bory de Saint Vincent**

References: [6:285, 8:127, 9:434, 13:139, 14:565, 15:107, 24:14].

General characters: Frustules rectangular; solitary but mostly united to one another by gelatinous cushions; valve elliptical with rostrate or capitate apices, costae pervious; pseudoraphe narrow and indistinct; length 56.7-58.7 µm and breadth 8.9-10.9 µm (Fig. 1:8b).

Cytological features: Chromatophores small and granular (Fig. 1:8a).

Locality: Lahore District: Baowala Village (21-8-2004).

Geographical distribution: Poland, Germany, and U.K.

Remarks: The material was obtained during summer from stream in Baowala Village.

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