

## TAXONOMIC STUDY OF TEN MORE SPECIES OF *COSMARIUM* FROM NORTH-EASTERN AREAS OF PAKISTAN

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### Abstract

Ten more species of the algal genus *Cosmarium* Corda ex Ralfs (phylum Volvophycota Shameel) were collected from different freshwater habitats in Azad Kashmir as well as provinces of the Punjab and Khyber Pakhtoonkhwa of Pakistan during April 2004 and September 2006. They were collected mainly in spring and summer, only a few collections were made during autumn and winter. The specimens were identified and described for the first time from their area of collection. Among these species, *C. margasitatum* (Boldt) West et West, *C. nymannianum* Grunow in Robenhorst, *C. polygonum* (Nägeli) Archer in Pritchard and *C. pseudomeneghinii* Foster are being reported for the first time from Pakistan.

### Introduction

Desmids are important members of algal communities. They play a significant role as primary producers in aquatic ecosystems (Ali *et al.*, 2010a, b, 2011). *Cosmarium* Corda ex Ralfs is a very common genus of placoderm desmids (family Desmidiaceae, order Desmidiales, class Desmidophyceae, phylum Volvophycota; (Shameel, 2001, 2008). Its ten species were collected and taxonomically described from various freshwater habitats in the north-eastern areas of Pakistan (Waqar-ul-Haq *et al.*, 2010). This is a continuation of these studies, where 10 more species of this genus were taxonomically investigated and are being presented here.

### Materials and Methods

The material was collected from different freshwater habitats at Gujranwala, Jauharabad, Jhang, Lahore, Sheikhupura and Sialkot districts of the Punjab Province, Swat in the province of Khyber Pakhtoonkhwa as well as Chenari and Neelam Valley of Azad Kashmir during April 2004 and September 2006. The methods used for their collection, preservation, microscopic examination and preparation of drawings were the same as have been

described earlier (Waqar-ul-Haq *et al.*, 2007). The specimens were identified up to species level with the help of authentic literature (*lit. cit.* at each species). The voucher specimens are deposited in the Phycology & Phycochemistry Lab. (Room No. 18), MAH Qadri Biological Research Centre, University of Karachi, where this research work was carried out.

### Results and Discussion

The microscopic examination of the collected specimens indicated the presence of ten species of the genus *Cosmarium* Corda 1839: 242 ex Ralfs 1848: 91 (*C. alatum* Kirchner, *C. angulare* L. N. Johnson 1894, *C. baileyi* Wolle 1884: 64, *C. biloculatum* Brébisson 1835: 56 ex Ralfs 1848: 95, *C. botrytis* Meneghini ex Ralfs in Nordstedt 1888: 47, *C. canadense* Irénée-Marie 1938: 164, *C. circulare* Reinsch 1867: 108, *C. concentricum*, *C. conspersum* Ralfs 1848: 101 and *C. contractum* O. Kirchner 1878: 147), which have been described earlier (Waqar-ul-Haq *et al.*, 2010). The present investigation revealed the presence of ten more species, which may be distinguished as follows:

1. Cells up to 46 µm long ..... 2  
Cells more than 46 µm long ..... 3
2. Cells up to 21 µm broad ..... 4  
Cells more than 21 µm broad ..... 5
3. Cells less than 62 µm broad ..... *C. nymannianum* (2)  
Cells up to 62 µm broad ..... 6
4. Semi cells trapezoid ..... *C. pseudomeneghinii* (10)  
Semi cells otherwise ..... 7
5. Isthmus more than 27 µm ..... *C. pluviale* (8)  
Isthmus less than 27 µm ..... 8
6. Isthmus more than 20 µm ..... *C. pachydermum* (5)  
Isthmus up to 20 µm ..... 9
7. Cells apex rounded & straight ..... *C. orthogonum* (4)  
Cells apex otherwise ..... *C. polygonum* (9)
8. Semi cells pyramidal ..... *C. pericymatium* (6)  
Semi cells compressed ..... *C. phaseolus* (7)
9. Semi cells broadly triangular with flat apices ..... *C. obtusatum* (3)  
Semi cells otherwise ..... *C. margasitatum* (1)

### 1. *C. margasitatum* (Boldt) West et West

**General characters:** Cells transversely broadly oval with very slight rounding at the lower lateral angles of semi-cells; dentation on wall not prominent; cell length 57-58  $\mu\text{m}$  and breadth 47-48  $\mu\text{m}$ ; isthmus 20  $\mu\text{m}$  broad (Fig. 1).

**Locality:** Azad Kashmir: Neelam Valley (6-4-2005).

**Geographical distribution:** U. S. A.

**Remarks:** Collected from river water from a valley. This is the first report of its occurrence in Pakistan.

### 2. *C. nymannianum* Grunow in Rabenhorst 1868: 166

**Synonymy:** *Cosmarium hammeri* Reinsch var. *hibernicum* Cooke 1887: 81, *C. nymannianum* Grunow f. *minor* Kossinskaja 1934: 82.

**References:** Børgesen, 1901: 224; West & West, 1905: 184.

**General characters:** Cells 51-52  $\mu\text{m}$  and 40-41  $\mu\text{m}$  broad; isthmus 12-13  $\mu\text{m}$  wide; semi-cells trapezoidal in shape; ends are concave (Fig. 2).

**Locality:** Khyber Paktoonkhwa: Swat, Utrod River in Kalam (13-8-2005).

**Geographical distribution:** U. S. A.

**Remarks:** Collected from river side. This is the first record of its occurrence in Pakistan.

### 3. *C. obtusatum* (Schmidle) Schmidle 1898: 38

**Basionym:** *Cosmarium undulatum* var. *obtusatum* Schmidle 1894: 550.

**References:** Hirano, 1964: 215; Biswas, 1975: 571; Masud-ul-Hasan & Zeb-un-Nisa, 1986: 242; Croasdale & Flint, 1988: 81; Bando *et al.*, 1989: 17; Dingley, 2001: 612; Gul *et al.*, 2008: 202; Rai *et al.*, 2008: 62; Šťastný, 2009: 143.

**General characters:** Semi-cells broadly triangular with flat apices, trapezoid, sides slightly concave, with undulations on each side; surface minutely punctate, cell-wall granular and undulate; chloroplasts 2 in a semi-cell, each with a pyrenoid; length 40-60  $\mu\text{m}$  and width 30-48  $\mu\text{m}$ ; isthmus 13-20  $\mu\text{m}$  wide (Fig. 3).

**Localities:** Gujranwala District: Nandipur (12-10-2005); Sialkot District: Head Marala (7-7-2005); Azad Kashmir: Chenari (28-4-2006), Neelam Valley (5-4-2006).

**Geographical distribution:** U. S. A., Europe, Australia.

**Remarks:** Collected from canal side ponds, stagnant water pools and river sides of a valley, mixed with other species.

### 4. *C. orthogonum* Delponte 1877: 8

**References:** West & West, 1908: 118; Krieger & Gerloff, 1965: 142; Husna *et al.*, 2008: 109.

**General characters:** Cell outline circular; cells of median size, slightly longer than broad, deeply constricted; sinus not narrow, semi-cell pyramidal, truncate, basal and constricted, upper angles rounded; sides slightly convex, apex rounded and straight; cell-walls finely punctate; each semi-cell with one pyrenoid; cell length is 45-46  $\mu\text{m}$ , width of isthmus 20-21  $\mu\text{m}$  (Fig. 4).

**Locality:** Lahore District: Fountain of Jinnah Garden (20-8-2006).

**Geographical distribution:** U.S.A., Great Britain, Germany, Italy and Pakistan.

**Remarks:** Collected from fountain water (Temperature 25.8°C and pH 7.5).

### 5. *C. pachydermum* P. Lundell 1871: 39

**Synonymy:** *Cosmarium pachydermum* Lundell f. *latum* Klebs 1879: 34, *C. pachydermum* Lundell f. *typicum* Klebs 1879: 34, *C. pachydermum* Lundell f. *intermedium* Maskell 1888: 15, *C. pachydermum* Lundell var. *maius* Printz 1915: 19.

**References:** Maskel, 1888: 15; Wolle, 1892: 75; West & West, 1905: 139; Jao, 1949: 55; Croasdale, 1956: 44; Krieger & Gerloff, 1962: 13; Wasyluk, 1961: 277; Hirano, 1964: 216; Croasdale & Flint, 1988: 83; Masud-ul-Hasan & Zeb-un-Nisa, 1986: 242; Bando *et al.*, 1989: 18; Dingley, 2001: 613; Kitner *et al.*, 2004: 49; Šťastný, 2009: 143.

**General characters:** Cells 71-76  $\mu\text{m}$  long, 61-62  $\mu\text{m}$  broad; isthmus 20-28  $\mu\text{m}$  wide; over all shape broadly oval; semi-cells hemispherical; cell-wall 2.5-3.0  $\mu\text{m}$  thick with coarsely punctate surface; each cell with two chloroplasts and prominent pyrenoids (Fig. 5).

**Localities:** Jauharabad: (16-3-2005); Khyber Paktoonkhwa: Swat, between Bharain and Kalam (12-8-2006); Azad Kashmir: Chenari (28-4-2004).

**Geographical distribution:** Previously reported from U. S. A. and Pakistan.

**Remarks:** Collected from river sides and stagnant water channels.

### 6. *C. pericymatium* Nordstedt 1875: 29

**References:** West & West, 1908: 34; Hirano, 1956: 148; Krieger & Gerloff, 1969: 342; Husna *et al.*, 2008: 106; Šťastný 2010: 16.

**General characters:** Over all cell outline broadly elliptical; surface of semi-cells broadly punctate, linear with dilated extremity; semi-cells pyramidal, basal angle not rounded, sinus narrowly delineated, length of semi-cell is 40.5-41.5  $\mu\text{m}$  and width 25.5-26.5  $\mu\text{m}$ ; isthmus is 21.2-22.2  $\mu\text{m}$  wide (Fig. 6).

**Locality:** Lahore District: fountain of Shalimar Garden (18-3-2006).

**Geographical distribution:** U. S. A., Canada, Sweden, Germany, Pakistan and Japan.

**Remarks:** Collected from fountain water (Temperature 32 °C and pH 7).

### 7. *C. phaseolus* Brébisson 1840: 220 ex Ralfs 1848: 106

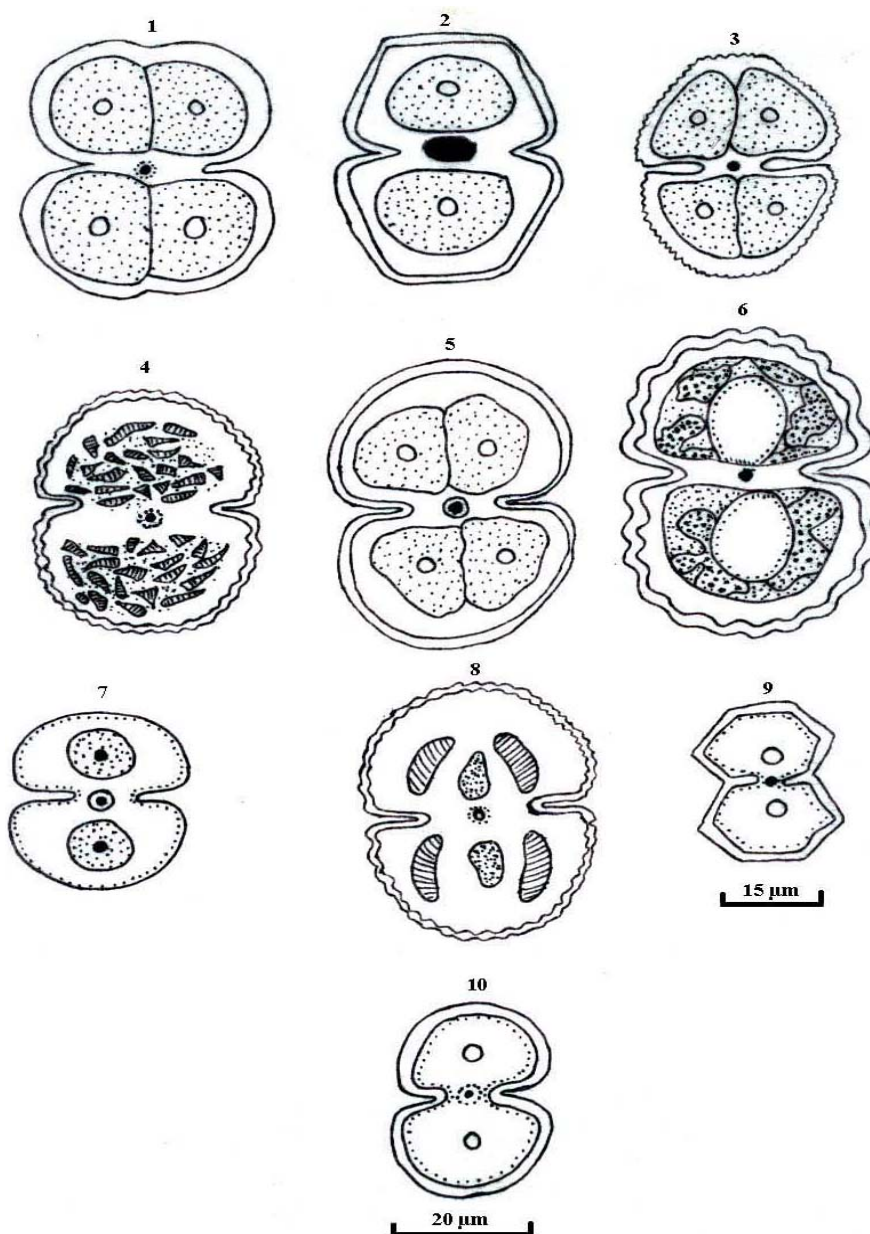
**Synonymy:** *Cosmarium phaseolus* Brébisson f. *typicum* Klebs 1879: 35, *Euastrum phaseolus* (Brébisson) Gay 1884: 59, *Heterocarpella phaseolus* (Brébisson) Cheval 272.

**References:** Wolle, 1892: 80; West & West, 1905: 158; Chapman *et al.*, 1956: 717; Croasdale, 1956: 45; Krieger & Gerloff, 1962: 53; Hirano, 1964: 216; Duthie & Ostrofsky, 1975: 262; Leghari *et al.*, 2002: 76; Sterlyagova, 2008: 917.

**General characters:** Semi-cells compressed; hemispherical with slightly rounded lower angles; cells 25-26  $\mu\text{m}$  long and 22-23  $\mu\text{m}$  broad; isthmus 10-11  $\mu\text{m}$  wide (Fig. 7).

**Locality:** Jhang District: River Chenab near Riwarz Chund Bridge (23-1-2005).

**Geographical distribution:** U. S. A. and Pakistan.



Figs. 1-10. Species of *Cosmarium*: 1. *C. margasitatum*, 2. *C. nymannianum*, 3. *C. obtusatum*, 4. *C. orthogonum*, 5. *C. pachydermum*, 6. *C. pericymatium*, 7. *C. phaseolus*, 8. *C. pluviale*, 9. *C. polygonum*, 10. *C. pseudomeneghinii*.

**Remarks:** Collected from a pond of river side.

**8. *C. pluviale* Brébisson 1861: 734**

**References:** Krieger & Gerloff, 1969: 344; Husna *et al.*, 2008: 108.

**General characters:** Cell outline circular, almost perfectly so; each cell a hemisphere in face view, with rounded end; cell surface finely punctate; sinus deep and narrowly linear to narrow, rare in median; length of semi-cells in 41-42 µm; width of isthmus is 27-29 µm; single pyrenoid is each semi-cell (Fig. 8).

**Locality:** Lahore District: Fountain of Jinnah Garden (20-8-2004).

**Geographical distribution:** U.S.A., Norway, Sweden and Finland and Pakistan.

**Remarks:** Collected from fountain water (Temperature 28.5 °C and pH 7.5).

**9. *C. polygonum* (Nägeli) W. Archer in Pritchard 1861: 732**

**Basionym:** *Euastrum polygonum* Nägeli 1849: 120.

**Synonymy:** *Didymidium polygonum* (Nägeli) Reinsch 1867: 111, *Cosmarium regnellii* Wille var. *minor* Turner 1892: 49, *C. bireme* Nordstedt in Krieger 1932: 172.

**References:** West & West, 1908: 76; Jao, 1949: 56; Croasdale, 1956: 46; Krieger & Gerloff, 1965: 214; Sterlyagova, 2008: 917.

**General characters:** Cells 17.2-19.2 µm long and 13-14 µm broad; isthmus 5.4-7.6 µm wide; semi-cells irregularly hexagonal in shape, flattened laterally, uppermost lateral margins often concave; sinus linear or narrowly wedge shaped; prominent knob in the center of semi-cells, visible at the end or side view, rare in medium; tips of semi-cells flat; walls smooth (Fig. 9).

**Localities:** Lahore District: Mahmood Booti (22-6-2005); Sheikhpura District: Mureedke and Narang Mundi (12-9-2006).

**Geographical distribution:** U. S. A., Norway, Sweden and Finland.

**Remarks:** Collected from paddy fields. This is the first report of its occurrence in Pakistan.

#### 10. *C. pseudomeneghinii* Foster

**General characters:** Semi-cells trapezoid, apices truncate or slightly curved; single pyrenoid in each semi-cell; cell length 27-28 µm and breadth 18-19 µm; isthmus 6-7 µm broad (Fig. 10).

**Locality:** Azad Kashmir: Neelam Valley (5-4-2005).

**Geographical distribution:** Previously reported from Brazil.

**Remarks:** Specimens collected from river side ponds. This is the first report of its occurrence in Pakistan.

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