

# Distribution of *Pediastrum* in Dal Lake, Kashmir

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**Abstract:** The paper deals with the distribution of various *Pediastrum* species present in Dal lake, Kashmir. The samples were collected from Dal lake during June and July 2012. The species shows high diversity in its species composition. Some of the species restricted in distribution where as other species distributed widely. Most of the species prefer alkaline and slightly high organic environment. A total of 22 species of *Pediastrum* were identified and described.

**Keywords:** Dal lake, Morphology, *Pediastrum* and Species.

## 1. Introduction

The paper deals with the phytoplankton of the shallow Eutrophic lake Dal and our special interest was genus *Pediastrum* (Hydrodictyaceae) which appeared there is a great species diversity. These planktonic species are frequent in algal communities of ponds and lakes. The *Pediastrum* genus is well known both from taxonomical and ecological points of view. [1];[2];[6] presented reviews of the *Pediastrum*. Some information on occurrence of this genus are included in works of [7]. [9]; [8] described the morphological characters and ecology of freshwater *Pediastrum* species. The genus *Pediastrum* showed wide morphological variations in view of that the present work were under taken to present the comprehensive data of *Pediastrum* species. The present study presents information of several *Pediastrum* species and varieties recorded in the dal lake. The keys of [1]; [2] were used for determining of the taxa.

Dal Lake is a lake in Srinagar, the summer capital of Jammu and Kashmir. The urban lake, which is the second largest in the state. The shore line of the lake, about 15.5 kilometers (9.6 mi). The lake covers an area of 18 square kilometres (6.9 sq mi) and is part of a natural wetland which covers 21.1 square kilometres (8.1 sq mi), including its floating gardens. The lake is located within a catchment area covering 316 square kilometres (122 sq mi) in the Zabarwan mountain valley, in the foothills of the Himalayan range, which surrounds it on three sides. The lake, which lies to the east and north of Srinagar city covers an area of 18 square kilometres (6.9 sq mi). The average elevation of the lake is 1,583 meters (5,194 ft).

## 2. Material and Methods

Qualitative studies of phytoplankton were carried out in the Department of Botany, Osmania University. The samples were collected in regular intervals. The samples were preserved in Phycology Lab, Dept. Botany (ADL-101). The studies were carried out on preserved material. Observations were made with light microscope equipped with an oil immersion objective and photos with catcam. For each species microphotographs were made. Taxonomical description of taxa were determined on the basis of morphological features such as outline of cells, number of lobes and processi, depth of incisions in marginal cells, sculpture of cell wall. Cell dimensions

given in description concern the relations: width x length. In the case of marginal cells the length of a cell includes length of lobes and processi. All observations were made using light microscopy under oil immersion (with focus level 15x X 100).

## 3. Result and Discussion

During the period of study the phytoplankton of lake was dominated by Chlorophyceae. None of the species reached a strong quantitative predominance. Special species richness was observed in the genus *Pediastrum*. The genus *Pediastrum* consists of colonial green algae, which occur naturally in fresh water environments, in particular in standing water bodies [3]; [4]; [5]. Many species of these algae have been described. Now a day's 24 species are known from the genus, but only four have a really worldwide distribution (*P.boryanum*, *P.duplex*, *P.tetras* and *P.simplex*), other taxa belong to wide range of various ecologically and geographically different types [2]. Among worldwide distributed taxa, several varieties of *P.boryanum*, *P.duplex* and *P.tetras* could be dominant in Eutrophic reservoirs of the temperate zone in lower frequency in warm seasons.

We determined many of cosmopolitan, commonly distributed taxa, i.e *P. boryanum* (Turpin) Menegh. var.*boryanum*, *P.duplex* (Meyen) var. *duplex*, *P.tetras* (Ehrenberg). All the *Pediastrum* species were recorded in Dal Lake during summer season 2012. The result of our observations are presented below:

*Pediastrum.simplex*.var.*duodenarium* (Bailey)  
Rabenhorst (Plate: 1, Fig: 1,1a&1b)

Cellwall smooth or finely punctuate. Colonies of 4-8-16-32-64-128 (usually 8-16-32) cells. Cells 8-24 $\mu$  broad, 10-45 $\mu$  long, 16 celled colonies upto 125 $\mu$  diameter. Differ from the type in having inter cellular spaces or a single central space with the cells arranged in a ring at the periphery. Inner face of marginal cells concave, Outer face prolonged into a single delicate tapering process. Sides of marginal cells also concave or nearly straight. Distribution ubiquitous.

*Pediastrum simplex* (Meyen) Lemmermann

(Plate: 1, Fig:2)

Colonies circular to oval, of 4-8-16-32 or more cells. Inner side of marginal cells nearly straight, outer side produced into a gradually tapering process, side concave. Inner cells polygonal. Cells in contact with adjacent ones and usually without intercellular spaces. When present intercellular spaces very small and few in number. Cell wall smooth or punctuate to granulate. Cells (7-) 8-13  $\mu$  broad (15-) 19-26 (-30)  $\mu$  long.

Distribution cosmopolitan.

*Pediastrum duplex var. clathratum* (A. Braun) Lagerheim

(Plate: 1, Fig:3&3a)

Cells with more deeply emarginated sides and larger intercellular spaces than in *P. duplex*. Colonies 8 - 64 celled. Cells 9-25  $\mu$  in diameter 16 celled colonies up to 90  $\mu$  in diameter.

Distribution Cosmopolitan.

*Pediastrum duplex var. reticulatum* Lagerheim

(Plate: 1, Fig: 4)

Cells more or less H-shaped with sides of processes of marginal cells nearby parallel. Inter cellular spaces large and oval. Cells 10-20 (-40)  $\mu$  in diameter. Colonies 8-16 celled, 58-70  $\mu$  diameter.

Distribution Cosmopolitan.

*Pediastrum duplex var. gracillimum* (Plate: 1, Fig:5)

Colonies with very large intercellular spaces. Cells very narrow, as broad or narrower than the processes. Body of marginal cells curved outwards and with two long processes with emarginated apices. Inner cells also similar to marginal cells but with shorter processes. Cells 10-18.5 (-22)  $\mu$  broad, 12-25 (-32)  $\mu$  long. Perforations 4-16  $\mu$  in diameter. Sixteen celled colonies 65-140  $\mu$  in diameter.

Distribution Cosmopolitan.

*Pediastrum biradiatum* Meyen

(Plate: 1, Fig:6,6a&6b)

Colonies 4-8-16—32-64 celled (usually 8-16-32 celled) with medium sized perforations. Marginal cells in contact at the base only, and provided with the lobes formed by an incision reaching the middle of the cell. Lobes dilated and incised at the apex. Inner cells with lobes which are neither dilate nor incised. Cells 9-22  $\mu$  board, 15-30- long. Colonies 32-celled, 80-150 $\mu$  in diameter. Differ from the type in the lobes of marginal cells being bifid instead of being just incised as in the type of the species and in the lobes ending in long horn like processes.

*Pediastrum angulosum* (Ehr) Meneghini

(Plate: 1, Fig: 7)

Colonies without perforations, usually single layered and round elliptical or kidney shaped, sometimes large and two layered with small irregular perforations. Internal cells 4-6 angled, broader than long with the outer side slightly sinuous. Marginal cells broad, outer face slightly emarginated, lobes with or without short processes. Cell wall hyaline, yellowish or reddish, sometimes thickened and with reticulate ridges, rarely smooth or coarsely granulate. Colonies 8-128 celled with variable

arrangement of cells. Cells 15-50  $\mu$  in diameter. Colonies up to 400  $\mu$ .

*Pediastrum ovatum* (Ehr.) A.Braun

(Plate: 2, Fig: 8&8a)

Colonies usually 4-8-16 (rarely 32-) celled, with the cells arranged in a ring round a central space or with one or more interior cells and a number of marginal cells, perforate or almost imperforate. The perforations being small. Cells plumper than in *P. simplex* var. *deuodenarium* with the outer sides of peripheral and often central cell convex cell wall smooth or ornamented. Four celled colonies up to 60  $\mu$ , 8 celled colonies up to 80  $\mu$  and 16 celled. Colonies up to 100  $\mu$  in diameter. Cells 8.5-19  $\mu$  broad, 14-37  $\mu$  long.

Distribution Cosmopolitan.

*Pediastrum braunii* Wartmann

(Plate: 2, Fig: 9)

Colony circular in outline, nearly entire but with a few interstices, composed of 4-16 quadrate or 5 sided cells: peripheral cells with 3 or 4 short, sharp projections which are unevenly spaced.

Distribution rare.

*Pediastrum tetras* (Ehr.) Ralfs

(Plate:2, Fig: 11,11a&11b)

Colonies rectangular, oval, or circular of 4-8-16 (-32) cells without intercellular spaces. Marginal cells divided into lobes by a deep linear to cuneate incision on the outer side reaching to the middle of the cell. Each lobe truncate, slightly emarginated, or further divided of cells 5-15 (-27)  $\mu$ . Eight celled colonies 20-33  $\mu$  and 16 celled colonies up to 50  $\mu$  diameter.

Distribution Ubiquitous.

*Pediastrum tetras var. tetradon* (Corda) Hansgirg

(Plate: 2, Fig: 12)

Colonies 4-8-16 celled. Incision of cells deep with the lobes adjacent to the incision of the marginal cells very pronounced. Cells 8-18  $\mu$  in diameter.

Distribution Cosmopolitan.

*Pediastrum duplex var. subgranulatum* Raciborski

(Plate: 2, Fig: 13,13a& 13b)

Colonies 8-16-32-64 celled. Cells and intercellular spaces more or less as in the type of the species, but the cell wall distinctly granulate. Cells 10-25 $\mu$  in diameter. Colonies 16-64 celled, 100-180  $\mu$  in diameter.

Distribution Cosmopolitan.

*Pediastrum duplex* (Meyen) var. *duplex*

(Plate: 3, Fig: 15,15a&15b)

Coenobia circular, 44.5-222.2 $\mu$ m in diameter (the most) of individuals found had more than 100  $\mu$ m) with regularly distributed holes, with 32-64 cells arranged concentrically. Incision between processi v shaped. Marginal cells 7.4-19.8 x 10.0-24.7  $\mu$ m, inner cells almost quadratic, their diameter 10.0-12.5  $\mu$ m. Cell walls with very fine sculpture visible under immersion. Typical of water bodies in temperate zone, probably with naturally increasing trophic level [2].



***Pediastrum duplex* var. *coronatum* Raciborski**

(Plate: 3, Fig: 16)

Colonies 16-32-64 celled. inner cells four cornered with a small lens shaped perforation in front and another at the back. Marginal cells usually longer than board and in lateral contact along one third the length. Processes of marginal cells ending in short spines. Cell membrane with a network of punctae. Inner cells 18-26  $\mu$  broad, 18-25  $\mu$  long. Marginal cells 21-25  $\mu$  broad, 25-26  $\mu$  long. Colonies 120-124  $\mu$  in diameter.

***Pediastrum boryanum* var. *longicorne* Raciborski**

(Plate: 3, Fig: 17&17a)

Peripheral cells with outer margins extended into longer processes than in the typical plant: apices of lobes swollen: cells Cosmopolitan.

***Pediastrum boryanum* (Turpin) Meneghini**

(Plate: 3, Fig: 18)

Colonies circular to oval and usually of 16-32 (rarely 4-8 or up to 128) cells arranged in concentric rings without intercellular spaces. Inner cells polygonal with straight sides. Outer face of marginal cells slightly to deeply emarginated and with two short processes ending in stumpy spines. Cell wall usually diameter. Horns 7-10  $\mu$  long, 16 celled colonies up to 100  $\mu$  in diameter. Habitat ubiquitous. Present in unpolluted waters.

***Pediastrum areneosum* var. *rugulosum***

(Plate: 3, Fig: 19)

Differs from the type in having the sides of cells, where they are in contact with one another undulate. Cells 10-29  $\mu$  diameter. 16-32 celled colonies up to 120  $\mu$  diameter.

***Pediastrum duplex* (Meyen)**

(Plate: 2 & 3, Fig: 14&14a)

Colonies usually of 16-32 sometimes of 4, 8, 64 or 128 cells with small lens shaped perforations between cells. Inner cells quadrate to angular and not in contact at the central portion of the sides walls. Inner side of marginal cells concave, outer side produced into two short truncate processes. Cells 8-21  $\mu$  in diameter. 16 celled colonies up to 90  $\mu$  diameter. Distribution Cosmopolitan.

***Pediastrum duplex* var. *rotundatum* Lucks**

(Plate: 3, Fig: 20)

Marginal cells with stout lobes which have convex rather than paralle margins; apices of lobes closer together than in the typical plant.

***Pediastrum duplex* var. *rugulosum* Raciborski**

(Plate: 3, Fig: 21)

Colonies usually oval to elliptical with (8-) 16-32 (-64) cells having minute lens shaped perforations. Inner cells nearly rectangular or many sided. Marginal cells in lateral contact up to the middle. Processes short and ending in two spines. Walls irregularly undulate and granular. Cells 11-15 (-25)  $\mu$  in diameter. Colonies 40-86 (-240)  $\mu$  in diameter.

***Pediastrum duplex* var. *genuinum* (A. Braun) Hansberg**

(Plate: 3, Fig: 22)

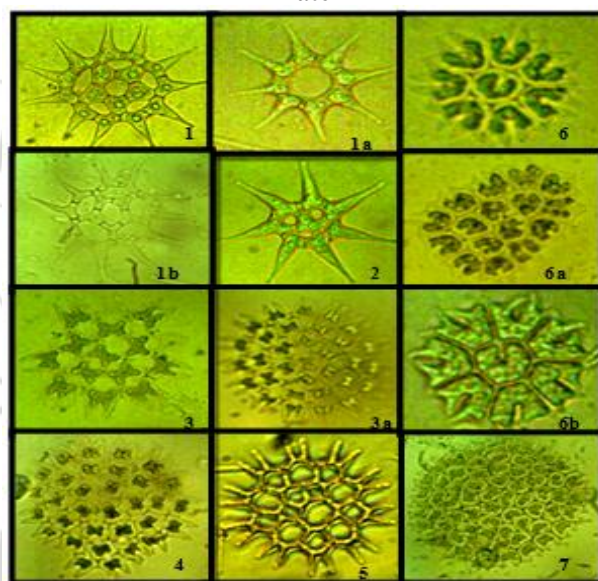
Colonies 4-8-16-32 celled with fairly large intercellular spaces. Marginal cells with stout processes which are straight or slightly curved. Cell membrane smooth or punctate. Cells 6-18  $\mu$  perforations up to 6  $\mu$  and colonies 45- 65  $\mu$  in diameter.

***Sorastrum americanum* var. *undulatum* G.M Smith**

(Plate: 2, Fig: 10)

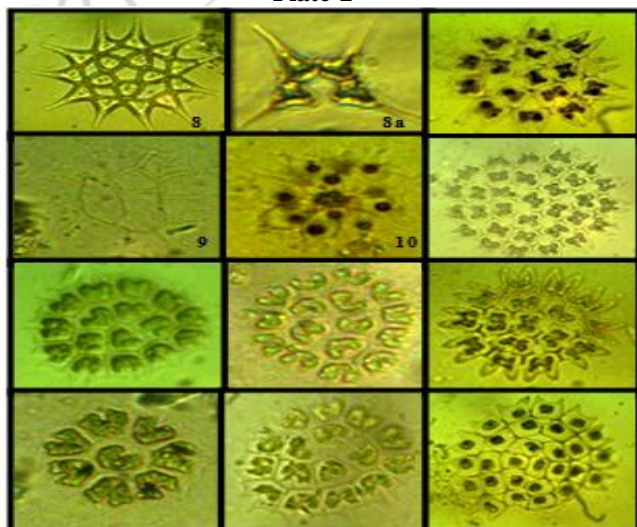
A free -floating spherical colony of 16-128 heart shaped or sub-pyramidate cells with the outer free walls emarginated and furnished at each of the 4 angles with a long, stout, outwardly directed spine. Rarely appeared in Dal lake.

**Plate-1**



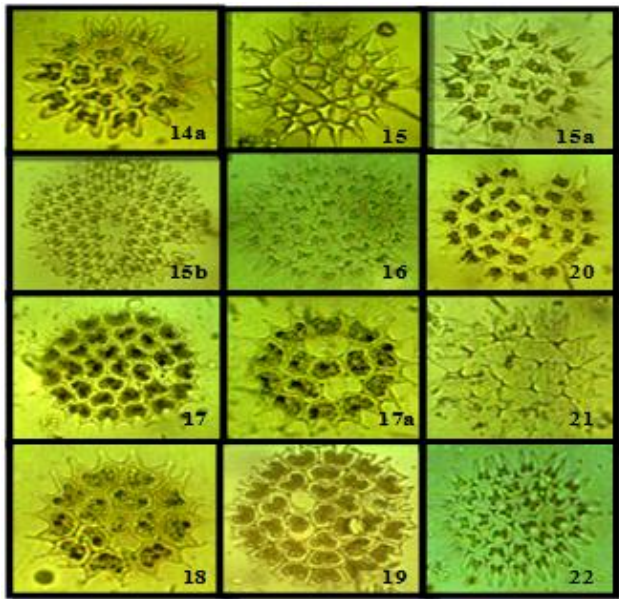
1,1a & 1b. *P. simplex* var. *duodenarium* (Bailey) Rabenhorst 2. *P. simplex* (Meyen) Lemmermann 3 & 3a. *P. duplex* var. *clathratum* (A. Braun) Lagerheim 4. *P. duplex* var. *reticulatum* Lagerheim 5. *P. duplex* var. *gracillium* West & West 6, 6a & 6b. *P. biradiatum* Meyen 7. *P. angulosum* (Ehr) Meneghini

**Plate-2**



8 & 8a. *P. ovatum* (Ehr.) A. Braun 9. *P. braunii* Wartmann 10. *Sorastrum americanum* var. *undulatum* G.M. Smith 11, 11a & 11b. *P. tetras* (Ehrenb.) Ralfs 12. *P. tetras* var. *tetradon* (Corda) Rabenhorst 13, 13a & 13b. *P. duplex* var. *subgranulatum* Raciborski 14. *P. duplex* Meyen

Plate-3



14a. *P.duplex* Meyen 15,15a & 15b. *P.duplex* var. *duplex*  
 16. *P.duplex* var. *coronatum* Raciborski 17&17a  
*P.boryanum* var. *longicornis* Raciborski 18. *P.boryanum*  
 (Turp.) Meneghini 19. *P. arancosum* var. *rugulosum*  
 G.M.Smith 20. *P.duplex* var. *rotundatum* Luck 21. *P.duplex*  
 var. *rugulosum* Raciborski 22. *P.duplex* var. *genuinum*

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