

Heterogeneity among the Genus *Pediastrum* Meyen (1829) from District Nashik (MH) India

¹Kiran Prakash Patil [Behere], ²Udaya Ganesh Basarkar,

^{1,2}Associate Professor
Department of Botany,
G.E.Society's, H.P.T./R.Y.K. Science college, Nashik
Prin. T. A. Kulkarni Vidyanagar,
Nashik-422005 [M.S.] India,
kiranppatil1966@gmail.com

Abstract: During the investigation of phytoplankton in Nashik and its environs micro, non motile, colonial, green alga *Pediastrum* Meyen is frequently occurs in lentic fresh waters as ponds puddles lakes etc. During this study 21 taxa of *Pediastrum* are observed, among these some rare and little known taxa are *P. muticum*, *P. integrum* var. *perforatum* are occurred in Nashik and its environs. *Pediastrum* taxonomy was determined by the studying their morphological features. These taxa are first time explored from this region. This study is contributing the wealth of algal flora of Nashik.

Keywords: Heterogeneity, Taxonomy, *Pediastrum*, Fresh water, Nashik

I. INTRODUCTION:

Algae are most common and widespread primitive group of autotrophic plants and global in occurrence. They are one of the most successful and important part of the aquatic food chains in the form of primary producers of organic matter in nature, thus, playing a major role as a basic constituent of a living community. The diversity of life has continuously increased since life in the ocean originated around 3.8 billion years ago. The diversity is the property of organisms of the area or land or sea. The diversity of algae is considered at the levels of richness of species and higher taxonomic ranks. Among this Micro, non motile, colonial, green alga *Pediastrum* Meyen is frequently occurs in lentic fresh waters as ponds puddles lakes etc. This tiny alga *Pediastrum* Meyen (1829) is belonging to division Chlorophyta, class Chlorophyceae, order Chlorococcales and family Hydrodictyaceae. The purpose of study is to explore the flora of *Pediastrum* with its taxonomy and diversity in Nashik. During this investigation 21 taxa of *Pediastrum* are observed in Nashik and its environs, among these some rare and little known taxa are *P. muticum*, *P. integrum* var. *perforatum*. This study is contributing the wealth of algal flora of Nashik. Taxonomy and diversity of each taxon have been described with photomicrography.

Pediastrum is coenobium, free-floating, disc-shaped to stellate, of 4-8-16-32-64 or more polygonal cells unilayered. Colony with or without perforations. Marginal cells with or without lobes or processes (1-2-4 processes). Shape of internal cells as the marginal cells or different. Cell wall smooth, granulate or with reticulate ridges. Chloroplast single, parietal reticulum, massive with one or more pyrenoids. Cells multinucleate.

Pediastrum taxonomy were determined by the studying their morphological features such as nature of coenobium, number of cells in coenobium, arrangement of cells within coenobium, out line and shape of cells as well as coenobium, number of lobes of cell depth of incision of marginal of marginal cells, dimension of colony as length and width etc.

Pediastrum is generally occurs in fresh lentic occur rarely on brackish and salty water (Parva 1979) at present only 24 species of *Pediastrum* have been described from world among these *P. boryanum*, *P. duplex*, *P. tetras* and *P. simplex* (Komárek and Jankovska, 2001).

The outer layer of cellwall is composed of sporollenin with silicon oxide which makes its high resistance to decay. Therefore several species occurs as a fossils on lake sediments (Komárek and Jankovska, 2001).

II. Material and Method

Collection of algal samples:

The collections of algae are made during the period from 2009-2013. Algae are collected from stones in fast flowing water, aquatic plants, on dam walls and from any floating objects. Algae are also obtained by simply squeezing bryophytes and other aquatics. The phytoplanktons are collected by using a fine mesh phytoplankton net, with 25-30 μ pores. Sufficient quantity of sample is concentrated by simply scooping a jar through the water for several times. Water samples are left overnight allowing the algae to settle down at bottom.

Storage and preservation of samples:

The algal samples are collected in bottles, jars or plastic bags of different sizes with some water from the collection sites. After collection the containers are kept open. Algae can be kept alive for short periods for one or two days in open petridishes, in a cool place with reduced light for their continuous growth and further observations.

For long term storage samples are preserved in preservative solutions. Samples are preserved in commercial formations like 4% formalin and FAA.

The observations are based on living materials which are essential for its identification. The simplest method is to prepare a cavity glass slide by placing a drop of sample on to the slide with cover slip carefully over it and avoiding any air bubbles and observing

the specimen under lower magnification of microscope. Observations are made more sequentially at under 4 x, 10x, 40x, 100 x magnification.

Measurements:

The measurements of the specimens are taken and used for its identification and subsequent classification. The metric units cm, mm, and μ are utilized. Stage and eyepiece micrometers are used for measuring the length and breadth of the organism. The measurements were made by ocular and 45x, 100x objectives.

Microphotographs:

The microphotographs are taken by camera by using "Lobo"- Trinocular microscope unit. Sony Cyber Shot DSC-W80 camera is used for all microphotographs.

Identification:

The identification of algae was done by using standard monographs as Prescott (1951), Tiffany and Britton (1952), Philipose, M.T. (1967), Wendy (2012) and online available data base as algae base. The identification and systematic positions of the taxa were assigned with the help of authentic illustrations and descriptions of various related monographs mentioned above.

III. OBSERVATIONS AND DISCUSSION

Division- Chlorophyta

Class- Chlorophyceae

Order-Chlorococcales

Family- Hydrodictyaceae

Pediastrum boryanum (Turpin) Meneghini, 1840

Pl.-1

Philipose- 1967; 118: Pg.-119, Fig.- 40a.

= *Pediastrum bidentulum* A. Braun.

= *Pediastrum constrictum* Hassall.

= *Pediastrum cruciatum* Kützing 1845.

= *Pediastrum granulatum* Kützing 1845.

= *Pediastrum boryanum* var. *granulatum* (Kützing) A.Braun 1855.

= *Pediastrum boryanum* var. *perforatum* (Raciborski) Nitardy 1914.

= *Hierella boryana* Turpin, 1828 .

= *Micrasterias boryana* Ehrenberg, 1838 .

= *Euastrum pentangulare* Corda, 1839.

Colonies 16 cells, circular, cells arranged in concentric rings without intercellular spaces. Cells 5-6 sided with smooth or granular wall. Inner cells polygonal with straight sides. Outer margins of peripheral cells emarginated into two short processes ending in stumpy spines. Cell wall smooth. Cells 11.55-13.2 μ dia., 9.9-13.2 μ long and spines 1.65-2 μ long. Sixteen-celled colonies 49.5 -50 μ in dia.. Worldwide algae.

Habitat- Waghera Dam (04/04/09), Pimpalgaon Bhor (14/09/10), Darana Dam (19/06/2011), Anandwadi (14/11/2011).

Distribution- Gujarat (Patel and George, 1977; Brahmabhatt and Patel, 2012). Maharashtra

(Kumawat and Jawale, 2004; Deshmukh and Gunale, 2007), Tamilnadu (Kavita and Balasingh, 2007; Sankaran, 2009; Mahendrapurumal and Anand, 2009; Mayakkannam, 2010; Anuja and Chandra, 2012).

Pediastrum boryanum var. *longicorne* Reinsch, 1867:

Pl.-1

Philipose- 1967; 119: Pg.-119, Fig.- 40b.

= *Pediastrum muticum* var. *longicorne* Raciborski 1889.

= *Pediastrum glanduliferum* A.W.Bennett 1892.

Peripheral cells with outer margins extended into longer processes, than in the typical plant, apices of lobes swollen, with longer processes than in the type. Cells 20-35-40 μ in dia..

Species easily restricted (Peaty water) known from all climatic condition. (Komárek and Jankovska ,2001). It is most easily identified variety of *Pediastrum* due to its unique cell wall sculpture (Nielsen 2000)

Habitat- Makhmalabad Naka (05/09/2012), Ashawadi (11/10/2012).

Distribution- Gujarat (Patel and George, 1977), Tamilnadu (Somashekar, 1984; Mayakkannam, 2010), Maharashtra (Kumawat and Jawale, 2004).

Pediastrum constrictum Hassall, 1845:

Pl.-1

Philipose -1967;120: Pg.-119, Fig.- 41.

Colonies 16-32 celled, spherical or slightly irregular, with large intercellular space. Marginal cells with two long horn-like processes, away from each other. Marginal cell's lobes stout, slightly convex rather than parallel margins, cells join together at the base and terminal portion only. Sixteen celled colonies up to 40 - 46 μ dia.

Habitat- Dugaon (12/02/09), Vani (12/03/09), Waghad Dam (10/05/09), Darana Dam Back Water (23/11/2011), Trimbakeshwar (21/01/2012).

Distribution – Gujarat (Patel and George, 1977), Tamilnadu (Mahendrapurumal and Anand ,2009; Mayakkannam, 2010).

Pediastrum duplex Meyen, 1829:

Pl.-1

Philipose-1967;121: Pg.- 122, Fig.- 43 a-b.

= *Pediastrum napoleonis* Ralfs.

= *Pediastrum pertusum* Kützing.

= *Pediastrum selenaee* Kützing 1845.

= *Pediastrum duplex* var. *reticulatum* Lagerheim 1882.

= *Pediastrum duplex* var. *clathratum* (A. Braun) Lagerheim 1882.

Colonies 4,8,16,32,64 celled, wall smooth, with small lens-shaped perforations between the inner cells, quadrate to angular and not in contact at the central portion of the side walls. Inner side of marginal cells concave, outer margin extended into two short truncate, blunt tipped processes. Cells 16.5 μ in length, 16.5 μ in dia. 16 celled colony 115.5 μ in dia. It is common in occurrence. Worldwide algae. Typical of water bodies in temperate zone, probably with naturally increasing trophic level (Komárek and Jankovska, 2001).

Habitat- Niphad (10/06/2009), Salher(11/07/2009), Peint-Surgana (12/08/2009), PimpriTrimbak (18/09/2009), Karanjwan Dam (15/10/2009), Harsool (8/01/2010), Sakur(10/02/2010), Kashyapi Dam (28/10/2010), Nandgaon Dam(15/02/2011),Darana Dam (04/06/2011), Anandwali (14/11/ 2011),NandurMadhameshwar(29/02/2012;26/03/2010),Botanical garden (14/11/2011), Ozarkhed dam(30/03/2012),Dugarwadi (10/06/2012),Tapovan (22/06/12), Ashawadi (11/10/12), Rajurgoan (28/11/12), Kawnai (28/11/12).

Distribution- Maharashtra(Schmidle,1900a; Jawale and Patil, 2009), Karnataka (Dutta *et al.*, 1954; Mruthunjaya *et al.*, 2007), Tamilnadu (Skuja,1949; Mahendrapurumal and Anand, 2009; Sankaran,2009), Gujarat (Patel and George,1977; Patel *et al.*,1980; Brahmabhatt and Patel, 2012), Delhi (Tiwari and Chauhan,2007), Madhya Pradesh(Mishra, 2007), UttarPradesh (Misra *et al.*, 2009), Kerala (Panikkar, Jayalekshmi and Jackson, 2012).

***Pediastrum duplex* Meyen var. *clathratum* (A. Braun) Lagerheim,1882:** Pl.-1

Philipose-1967; 123: Pg.- 122, Fig.- 43e.

= *Pediastrum pertusum* var. *clathratum* A. Braun 1855.

Planktonic, coenobium, circular 8-16 celled. Sixteen- celled colonies up to 117.5 μ in dia. Cells 9-21.45 μ in dia..Cells with more deeply emarginated sides and larger intercellular spaces. Apices of peripheral cells truncate. Inner cells rectangular, not in contact with one another in the

central portion of the side wall. Worldwide in occurrence This species is most common in tropical lakes, in the temperate zone it appears during the warm season (Komárek and Jankovska, 2001).

Habitat- Ashawadi (11/10/2012).

Distribution- Maharashtra (Kamat 1963; Kamat and Freitas,1976; Deore, 1978; Kumawat and Jawale, 2004), Karnataka (Bharati, 1965b), Assam, W. Bengal, Orissa, Madhya Pradesh, AndraPradesh, Kerala and Tamilnadu (Philipose,1967), Gujarat (Patel,1970; Patel and George,1977; Patel *et al.*, 1980), Kerala (Panikkar, Jayalekshmi and Jackson, 2012).

Ceylon, (Holsinger, 1955), Romania (Caraus, 2002), China (Hu and Wei 2006),Taiwan (Anon, 2012).

***Pediastrum duplex* Meyen var. *genuinum* (A. Braun) Hansgirg,1886 :** Pl.-1.

Philipose-1967; 123: Pg.- 122, Fig.- 43 e.

=*Pediastrum duplex* var. *genuinum* (A.Braun) Lagerheim.

Colonies 32 celled with larger intercellular spaces, marginal cells with straight stout processes, cell membrane smooth, punctuate. Peripheral cells 9.9 μ in dia., 13.2 μ long, inner cells, horizontal, 9.9-13.2 μ in dia., 6.6 μ long.

Habitat- Darana Dam (14/06/2011).

Distribution-Manipur(Bruehl and Biswas,1926),Maharashtra (Gonzalves and Joshi, 1946), Manipur, Maharashtra (Philipose,1967),Gujarat(Patel and George,1977), Kerala (Panikkar, Jaya lekshmi and Jackson, 2012).

***Pediastrum duplex* Meyen var. *gracillimum* W.et G.S.West, 1895 :** PP.-1

Philipose-1967; 124: Pg.- 124, Fig.- 43 h, i.

= *Pediastrum gracile* A. Braun.

Colonies with very large intercellular spaces. Eight celled colony 33 μ in dia. (2 at centre, 6 periphery). Colony of 16 cells 52.8 μ dia. (1 cell at center, 5 at middle, 10 at peripherals). Cell 6.6 μ dia., 9.75-12.3 μ length, Cells vary narrow, as broad as or narrower than the processes, body of marginal cells curved outwards and with two long processes with emarginated apices. Each cell has two projections, peripheral cells attached at base only at a small portion.

Typical planktonic species appears in temperate and sub Polar Regions in large, not very eutrophic lakes. (Komárek and Jankovska, 2001).

Habitat- Dugaon(12/02/2009), Sinner (29/12/2011).

Distribution- Assam (Biswas, 1934), Assam, Uttar Pradesh, W.Bengal, Bihar, Orissa, Madhya Pradesh, AndraPradesh, Kerala and Tamilnadu (Philipose,1967), Gujarat (Patel 1970; Patel and George,1977), Maharashtra (Deore, 1978; Deshmukh and Gunale,2007), Kerala (Panikkar, Jayalekshmi and Jackson, 2012), Karnataka (Somashekar, 1984), Tamilnadu (Mayakkannam, 2010).

Northern Territory, Queensland (Day, *et al.* 1995), Spain, Portugal (Cambra Sánchez, Álvarez Cobelas and Aboal Sanjurjo,1998), Britain (John and Tsarenko 2002, Fanés Treviño, Comas González and Sánchez Castillo 2009), Romania (Caraus 2002, Whitton *et al.* 2003), China (Hu and Wei 2006), Arkansas (Smith, 2010), Singapore (Pham *et al.* 2011), Colombo (Holsinger, 1955),Taiwan (Anon,2012), New Zealand (Broady *et al.* 2012).

***Pediastrum duplex* Meyen var. *reticulatum* Lagerheim, 1882 :** Pl.-1

Philipose- 1967; 124:Fig.- 43 g.

Colonies of 16,32,64 cells, outer margins of peripheral cells having lobes with sub parallel sided. Inner cells more or less H-shaped. Inter cellular spaces large and oval. Cells 18.15-23.1 μ in dia., 9.9-14.85 μ long. 8 celled colonies 58-70 μ in dia., colony 16 celled 108.9 -115.5 μ in dia.

Habitat-Vani (12/03/2009), NandurMadhameshwar (29/2/2012).

Distribution- W.Bengal, Orissa, A. P., Kerala and Tamilnadu (Philipose,1967), Maharashtra (Kamat 1968,1974; Kamat and Freitas, 1976),Gujarat (Patel,1970; Patel and George, 1977; Patel *et al.*, 1980), Karnataka(Somashekar, 1983; 1984), Tamilnadu (Mayakkannam, 2010; Anuja and Chandra, 2012),

***Pediastrum duplex* var. *rotundatum* Luck,1907 :** Pl.-1

Prescott -1951; 224: Pl.- 48, Fig.- 8.

Marginal cells with stout lobes which have convex rather than parallel margins, apices of lobes closer together than in the typical plant. Cells 16.5-22 μ in dia., 9-15 μ . long

Rare in occurrence.

Habitat- Anandwali (14/11/11), Nandur Madhameshwar (29/3/2012), Someshwar (7/06/12).

***Pediastrum duplex* var. *subgranulatum* Raciborski, 1889:**

Pl.-1

Roth and Siba -2005; 55: Pl.-16 ,Fig.-126.

Colonies 8, 16, 32cells with small perforation between cells, inner cells quadrate to angular and not in contact at the central portion of the side walls, inner side of marginal cells concave, outer side produced into two short truncate processes. Cell wall distinctly granulate, cells 13.2-16.5 μ in dia, 32 celled colonies 112.2 μ in dia.

Habitat.- Darana dam (4/6/2011),Makhmalabad (5/9/2012).

***Pediastrum integrum* var. *integrum*, Naegeli1849:**

Pl.-1

Prescott-1951; 225: Pl. - 48, Fig.- 9, 10.

Colony entire, 16, 32 cells sub circular or oval shaped, without perforations. Cells five sided with granulated wall outer sides of the peripheral cell with 2 short and much reduced processes, outer margin of peripheral cells smooth and granular walls, cells 16.5-26.4 μ dia.

P. integrum is distributed in cold, oligo and dystrophic water biotopes of northern and temperate regions (Komárek and Jankovska, 2001).

Habitat – Sakur(10/02/2010), Gangapur Dam (25/03/2011).

Distribution –Gujarat (Patel and George, 1977), Tamilnadu (Mahendrapurumal and Anand, 2009; Mayakkannam, 2010), Kerala (Panikkar, Jayalekshmi and Jackson, 12),

Ellesmere Island (Croasdale 1973), Spain (Alvárez Cobelas and Gallardo 1986, Aboal 1988b, Aboal 1989, Aboal, Prefasi and Asencio 1996, Aboal 1996, Cambra Sánchez, Álvarez Cobelas and Aboal Sanjurjo, 1998).Portugal (Cambra Sánchez, Álvarez Cobelas and Aboal Sanjurjo 1998), Britain (John and Tsarenko 2002, Whitton *et al.* 2003), Romania(Caraus 2002, 2012) ,China (Hu and Wei 06),New Zealand (Broady *et al.*2012).

***Pediastrum integrum* var. *perforatum* Raciborski,1889:**

Pl.-1

Philipose -1967;112: Pg.-113, Fig.-35 (a-c).

Colonies 16-32 celled. Inner cells spherical to rectangular with the edges rounded and with small intercellular spaces. Peripheral cells of similar shape, joined to each other at the base, and free on the outside, with two short truncate processes from the outer face, one from each side. Cells up to 19.8 μ in dia. Processes up to 6.6 μ long. Colonies up to 100-120 μ in dia. Rare in occurrence.

Habitat - Jadhav wadi(20/01/2011),Ozarkhed Dam(30/03/2012).

***Pediastrum muticum* Kuetzing, 1849:**

Pl. -1

Philipose -1967; 117: Pg.- 119, F.- 38.

Coenobium circular 8,16,32,64 celled, cells are compactly arranged, without perforations hexagonal. Internal cells 5-6 angled. Peripheral cells inverted heart-shaped, emarginated and with or without two short processes on the free side. Cell wall smooth or granular. Eight celled colony, 39.6 μ dia., cell 16.5 μ dia., 9.9 μ long 3.3 μ spine long. Sixteen celled colony 49.5 μ - 66 μ dia. Cell 19.8 μ dia., 19.8 μ in length. 32 celled colony 39.6 μ dia., 49.5 μ length, spine 1.65 μ long. It is rare in occurrence.

Habitat- Gangapur Dam (25/03/2011).

Distribution - Gujarat (Patel,1980), Karnataka (Somashekar,1983), Uttaranchal (Gupta, 2005) .

Spain (Alvárez Cobelas and Gallardo 1986, Aboal, Prefasi and Asencio 1996, Aboal 1996, Cambra Sánchez, Álvarez Cobelas and Aboal Sanjurjo 1998, Fanés Treviño, Comas González and Sánchez Castillo 2009), Portugal (Cambra Sánchez, Álvarez Cobelas and Aboal Sanjurjo 1998), Canary Islands (Cambra Sánchez, Álvarez Cobelas and Aboal Sanjurjo 1998), Romania (Caraus,2002; 2012), Pakistan (Mehwish and Aliya 2005), China (Cao *et al* ,2005, Hu and Wei 2006), Arkansas (Smith 2010), Taiwan (Anon. 2012).

***Pediastrum ovatum* (Ehr.) A. Braun, 1855:**

Pl.-1

Philipose -1967;115: Pg. -116 ,F.-37.

= *Asterodictyon ovatum* Ehrenberg 1845 .

= *Pediastrum ovatum* var. *microporum* Lemm. Brunthaler,1915 .

= *Pediastrum sturmii* Reinsch, 1867; J Brunthaler, 1915 .

= *Pediastrum sturmii* Reinsch, forma Turner, 1892 .

=*Pediastrum sturmii* var. *radians* Lemm. and var. *echinulatum* (Witr. Et Nordst.) Lemm. Brunthaler, 1915 .

= *Pediastrum simplex* var. *sturmii* (Reinsch) Wolle, 1887 .

= *Pediastrum simplex* Meyen var. *typica* in Bruehl et Biswas, 1922 .

= *Pediastrum schroetri* Lemmermann, 1899.

Colony eight celled with the cells arranged in a ring round a central space or with one more interior cells and a number of peripheral cells. With or without very small intercellular spaces. Cells oval and pyriform pear shape, outer sides of peripheral and central cells convex, cell wall smooth. Cells 8.5-19 μ broad, 14-37 μ long, eight cell colony 39.6 μ in dia.. Cell 16.5 -19.8 μ length, 9.9 μ in dia.

Habitat- Vani (12/03/2009), Rajurgoan (04/06/2011), Dugaon (12/08/2011).

Distribution- Bengal, Bihar, Orissa, Tamilnadu (Philipose, 1967), Gujarat (Patel and George, 1977; Patel *et. al.*, 1980), Maharashtra (Deore, 1978; Kumawat and Jawale, 2004; Deshmukh and Gunale, 2007; Vanjari and Kumawat, 2007; Gore and Sanap, 2009; Jawale and Patil,2009), Tamilnadu (Mayakkannam,2010; Anuja and Chandra, 2012), Uttaranchal (Gupta,2005).

***Pediastrum simplex* Meyen, 1829:**

Pl.-1

Philipose -1967; 113: Pl.-113, F.-36 a-c.

- = *Pediastrum clathratum* (Schröder) Lemmermann.
- = *Pediastrum simplex* var. *radians* Lemmermann.
- = *Pediastrum simplex* var. *duodenarium* (J.W.Bailey) Rabenhorst 1862.
- = *Pediastrum enoplum* West and G.S.West 1895.
- = *Pediastrum simplex* var. *granulatum* Lemmermann 1897.
- = *Pediastrum simplex* var. *typica* in Bruehl et Biswas, 1922 .

Colonies circular, 4, 8, 16, 32. Cells 4.95 μ broad (15)19 - 26(30) μ long. Cell wall smooth. Peripheral cells with the outer free wall extended into a gradually tapering horn like process with concave margins. Inner cells polygonal, 5-6 sided, straight. Cells in contact with adjacent cell, with or without very small intercellular spaces. Very common in occurrence.

Habitat- Dugaon(12/02/09), Vani (12/03/09), Niphad (10/06/09), Salher (11/07/2009), Peint-Surgana (12/08/2009), Pimpri-Trimbak (18/09/09), Karanjwan Dam (15/10/2009), Kashyapi Dam (28/10/2010), Rajurgoan (26/01/2011), Nandgaon Dam (15/02/2011), Benze Farm (18/8/ 2011), KTHM boat club (25/02/2012), NandurMadhameshwar (29/02/2012), Ozarkhed Dam (30/3/2012), Rajurgoan Stone Mine (09/03/2012), Dugar wadi(10/06/2012), Tapovan (22/06/ 2012), Makhmalabad Naka (05/09/2012), Ashawadi (11/10/2012).

Distribution- North East India (Carter, 1926; Singh, 1959; Turner, 1892), Gujarat (Kamat, 1962; Patel and George, 1977; Patel *et al.*, 1980), Tamilnadu (Kavita and Balasingh, 2007; Sankaran, 2009; Mahendrapurumal and Anand, 2009; Mayakkannam, 2010; Anuja and Chandra, 2012), Maharashtra (Kamat, 1962; 1963; 1974; Nandan, 1993; Kumawat and Jawale, 2004; Gore and Sanap, 2009; Jawale and Patil, 2009), Karnataka (Somashekar, 1984), Orissa (Rath and Adhikary, 2005; Jena and Adhikary, 2007), Madhya Pradesh (Shakun, 2007), Kerala (Girijakumari and Abraham, 2007; Panikkar, Jayalekshmi and Jackson, 2012).

***Pediastrum simplex* var. *biwaense* Fukushima, 1953:**

Pl.-1

Jena and Siba -2007; 168: Pl. 1, F.10

Colonial thallus, 32 celled colony, 72.6 μ in dia., circular with large intercellular spaces. Inner side of marginal cells concave with outer face prolonged into a single tapering processes, side of marginal cells slightly concave or nearly straight, central cells alike as peripheral cells except with short processes, cell wall smooth. Cell 9.9-16.5 μ long, base 6.6 μ broad.

Habitat- Planktonic in Nandur Madhameshwar (29/02/12), Ozarkhed dam (30/03/12). **Distribution-** Orissa (Jena and Adhikary, 2007).

***Pediastrum simplex* var. *duodenarium* (Bailey) Rabenhorst, 1868 :**

Pl.-2

Philipose -1967; 115: Pg.- 114, Fig.- 36 d-h.

= *Pediastrum simplex* var. *granulatum* Lemm., 1897 .

= *Pediastrum simplex* var. *typica* in Bruehl et Biswas, 1922 .

Coenobium perforate, circular of 4,8,16,32 celled, 23.1-42.9, (72.6-148.5) μ dia., having large inter cellular spaces or a single central space with the cells arranged in a ring at the periphery. Inner space of peripheral cells concave, outer face prolonged in to a single delicately tapering process. Side of peripheral cells concave or straight. Interior cells similar to peripheral cells but with shorter processes. Cells (4.95) 6.6-19.8 μ broad, (13.2) 23.1-33 μ long.

Habitat- Waghera Dam (04/04/2009), Pimpalgaon Bhor (14/09/2010), Rajurgoan (04/06/2011), Darana Dam (4/6/2011), Ashawadi (11/10/12)

Distribution- North East India (Turner, 1892, Carter 1926), Ceylon (Crow, 1923), Uttar Pradesh (Singh, 1959), Karnataka, Orissa (Philipose, 1967), Maharashtra (Deore, 1978; Kumawat and Jawale, 2004; Deshmukh and Gunale, 2007; Vanjari and Kumawat, 2007; Jawale and Patil, 2009), Gujarat (Patel *et al.*, 1980, Brahmhatt and Patel, 2012), Tamilnadu (Mayakkannam, 2010).

***Pediastrum simplex* var. *echinulatum* Wittrock n Wittrock and Nordstedt, 1883:**

Pl.- 2

Mayakkannam - 2010; 48 : Pl.- 9, Fig.- 148.

Colonies 8-16 celled, circular or slightly irregular, without perforations or space, with one or more interior cells and a number of marginal cells 16 celled colonies up to 46.2 -52.8 μ dia 56.1-62.7 μ long. Cells 16.5-23.1 μ long, 8.25-11.55 μ dia. Marginal cells with a single, long horn-like process, cell wall densely covered with small spines. *P. simplex* occurs in fresh water plankton of various eutrophic reservoirs with neutral to alkaline water var. *echinulatum* was registered only in the north, temperate zone. (Komárek and Jankovska ,2001).

Habitat –Gangapur Dam (15/02/11), Trimbakeshwar (21/01/12), Ashawadi (1/10/12).

Distribution – Tamilnadu (Mayakkannam, 2010)

Romania (Caraus, 2002), Spain (Fanés Treviño, Comas González and Sánchez Castillo 2009), Taiwan (Anon. 2012).

***Pediastrum tetras* (Ehrenberg) Ralfs, 1845 :**

Philipose - 1967; 128 : Pg.- 130, Fig.- 45 a-c.

= *Micrasterias teras* Ehrenberg, 1838 .

= *Pediastrum rotula* Kuetzing, 1845 ; C. Naegeli, 1849; Braun, 1855; W. B. Turner, 1892 .

= *Pediastrum biradiatum* Ralfs, 1848; Meyen, 1829 .

= *Pediastrum Ehrenbergii* (Corda) A. Braun, 1855 ; P. Bruehl and K Biswas, 1922.

= *Pediastrum incavatum* Turner, 1892 .

= *Pediastrum teras* var. *anamolum* Handa, 1927

= *Pediastrum incavatum* var. *irregularum* Handa, .

Colonies entire, circular of 4-8 cells, without intercellular spaces. Peripheral cells with two lobes by a deep incision on the outer free side reaching to the middle of the cell. Each lobe again divided into two lobes. Lateral margins of peripheral cells adjoining

along more than half of their length. Inner cells 4-6 sides with one margin deeply incised, cells 6.6µ in dia., 9.9µ long. Eight celled colonies 24.2-26.4µ in dia.

Species with cosmopolitan distribution, but not very common. It prefers polluted waters and probably is thermophilic (Komárek and Jankovska, 2001).

Habitat- Waghera Dam (04/04/2009), Peint-Surgana (12/08/2009), Pimpri Trimbak (18/9/2009), Karanjwan Dam (15/10/2009), Pimpalgaon Bhor (14/09/2010), Kashyapi Dam (28/10/2010), BenzeFarm(18/8/2011), Darana Dam (04/06/2011), Anandwali (14/11/2011), NandurMadhameshwar (29/02/2012).

Distribution- Maharashtra (Schmidle, 1900 e; Dixit, 1937, Gonzalves and Joshi, 1946, Philipose, 1967; Kamat, 1974; Deore, 1978; Kumawat and Jawale, 2004; Vanjari and Kumawat, 2007; Jawale and Patil, 2009), Burma (West, 1907), Bengal (Bruehl *et Biswas*, 1922; Das and Adhikary, 2012), Manipur (Bruehl *et Biswas*, 1926, *l.c.*), Assam (Carter, 1926, Biswas, 1934), Mandalay and Rangoon (Skuja, 1949), Uttar Pradesh (Venkattaraman, 1957), Bihar (Saha and Pandit, 1987), Jammu (Anand, 1975), Gujarat (Patel *et al.*, 1980, Brahmbhatt and Patel, 2012), Raipur (Roy and Sen, 1985), Himachal Pradesh (Jha *et al.*, 1985; Das and Keshri, 2012), Andhra Pradesh (Satya Mohan, 1987), Madhya Pradesh (Agarkar *et al.*, 1991; Mishra, 2007), Tamilnadu (Chandra and Krishnamurthy *et al.*, 2005; Kavita and Balasingh, 2007; Mahendrapurumal and Anand, 2008; Samuel *et al.*, 2012), Karnataka (Mruthunjaya, *et al.*, 2007), Kerala (Panikkar *et al.*, 2012).

***Pediastrum tetras* var. *apiculatum* Playfair, 1921:**

Pl.- 2

Philipose - 1967; Pg.-130, Fig.-45 h.

Four celled colony, rectangular or quadrate, without intercellular spaces. It has similar characters with *P. tetras* except its processes with apical nodular thickening. Colonies 24.6µ in dia., cells 14.5µ long, 17.5µ broad.

Habitat- Botanical Garden (14/11/2011), Sinner (2/10/2012).

Distribution- Gujarat (Patel and George, 1977; Patel *et al.*, 1980), Karnataka (Somashekar, 1984), Maharashtra (Kumawat and Jawale, 2004; Vanjari and Kumawat, 2007), Tamilnadu (Mayakkannam, 2010).

New South Wales (Day, *et al.* 1995).

***Pediastrum tetras* (Ehr.) Ralfs var. *excisum* (Rabenh.) Hansging, 1886:**

Pl.-2

Philipose - 1967; 129: Pg.- 130, Fig.- 45 f.

= *Pediastrum ehrenbergii* var. *excisum* Rabenhorst, 1868.

= *Pediastrum tetras* var. *tetraodon* Rabenhorst, 1915; H. Skuja, 1949,

Differs from the type in the lobes being more or less deeply concave. Four cell colony 16.5-19.8-21.45µ dia. Cell 6.6-9.9-13.2µ dia., (5.4) 9.9-10.7µ long. *Pediastrum tetras* var. *excisum* and var. *apiculatum* are similar in structure but they disagree the dimension, *apiculatum* larger than the *excisum*, Fritsch and Stevens (1921).

Habitat- Darana Dam (04/06/11), Benze Farm (18/8/2011), Dugarwadi (10/06/2012), Chandasi (05/09/2012).

Distribution- Maharashtra (Deore, 1978; Kumawat and Jawale, 2004; Jawale and Patil, 2009), Gujarat (Patel and George, 1977; Patel *et al.*, 1980), Uttar Pradesh (Misra *et al.*, 2009).

Spain (Alvarez Cobelas and Gallardo 1986, Aboal 1988b, Aboal, Prefasi and Asencio 1996, Fanés Treviño, Comas González and Sánchez Castillo 2009), Spain, Andorra, Balearic Islands (Cambra Sánchez, Álvarez Cobelas and Aboal Sanjurjo 1998), Britain (John and Tsarenko 2002).

***Pediastrum tetras* var. *tetraodon* (Corda) Rabenhorst, 1886:**

Pl.-2

Philipose - 1967; 129: Pg.- 130, Fig.- 45 d, g, e.

= *Euastrum tetraodon* Corda, 1839.

= *Pediastrum ehrenbergii* var. *tetraodon* (Corda) Rabenhorst, 1868.

= *Pediastrum tetras* var. *tetraodon* (Corda) Rabenhorst, 1915.

= *Pediastrum tetras* var. *burmanicum* Handa, 1927.

Colony 4-8 celled. Outer margins of peripheral cells with deep incisions, the lobes extended into sharp, horn-like processes. Cells 8.25µ in dia., 16-18µ long.

Habitat- Waghera Dam (04/04/2009), Pimpalgaon Bhor (14/09/2010), Darana Dam (14/6/2011).

Distribution- Karnataka (Bharati, 1965; Mruthunjaya *et al.*, 2007), Tamilnadu (Philipose 1967, Mayakkannam, 2010), A. Pradesh (Johnson, 2006), Maharashtra (Kamat, 1968; 1974; Deore, 1978; Kumawat and Jawale, 2004; Jawale and Patil, 2009), Himachal Pradesh (Kamat, 1968a; Misra *et al.*, 2009), Gujarat (Patel and George, 1977).

Queensland, Tasmania (Day, *et al.* 1995), Spain (Cambra Sánchez, Álvarez Cobelas and Aboal Sanjurjo 1998), Romania (Carauş, 2002), China (Hu and Wei 2006), Iran (Ramzannejad Ghadi 2008).

IV. SUMMARY AND CONCLUSION:

The present study incorporates the results of the investigation on the biodiversity of fresh water *Pediastrum* of Nashik district and its environs. The investigation mainly deals with taxonomical enumeration of taxa of *Pediastrum* studied over a period of three years from the various localities selected. The purpose of study is to explore the flora of *Pediastrum* with its taxonomy and diversity in Nashik. During this investigation 21 taxa of *Pediastrum* are observed in Nashik and its environs, among these some rare and little known taxa are *P. muticum*; *P. integrum* var. *perforatum* are observed.

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PLATE -1

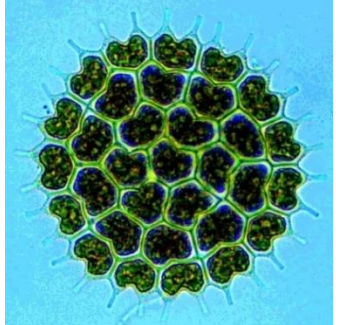

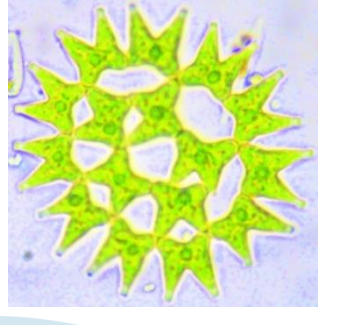
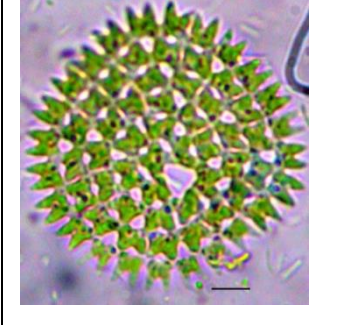
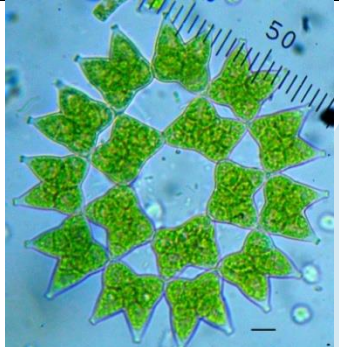
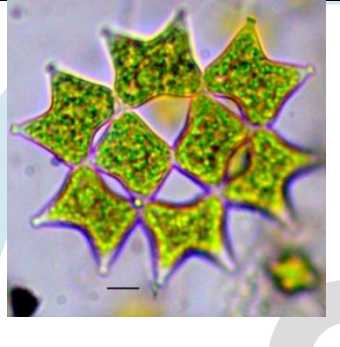
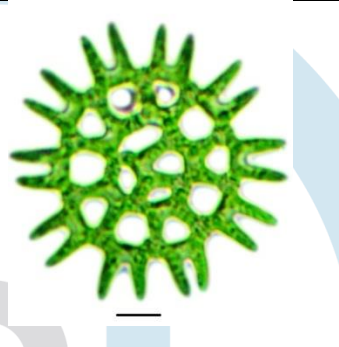
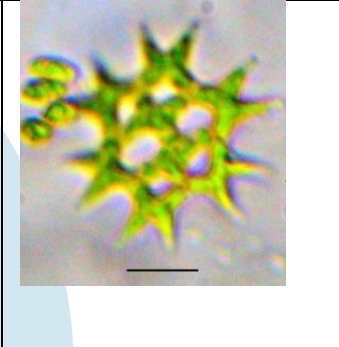
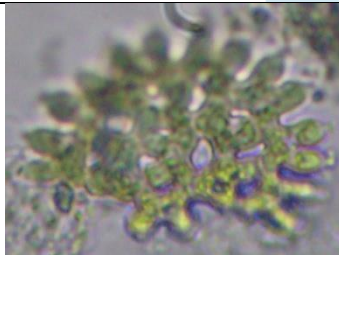
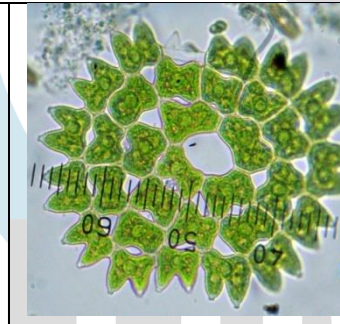
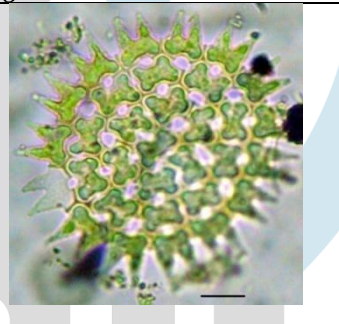
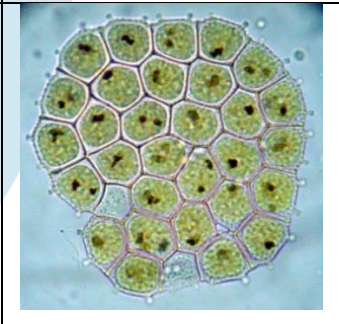

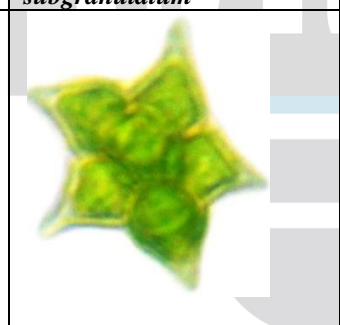
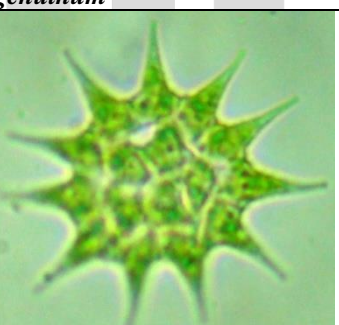
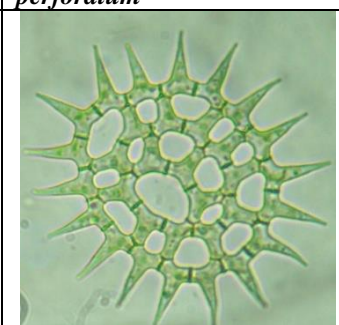
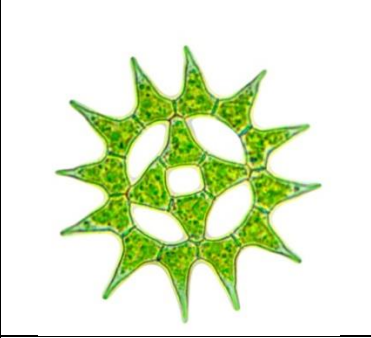
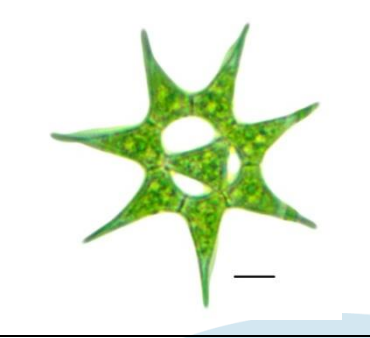
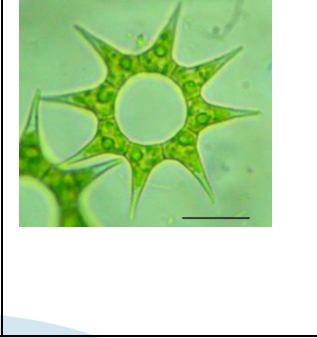
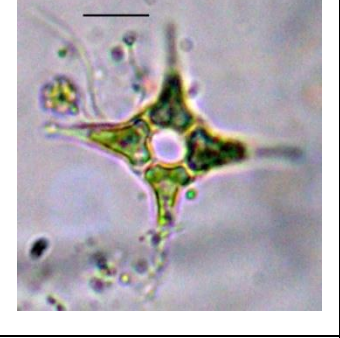
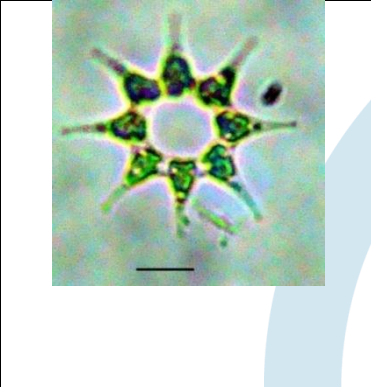
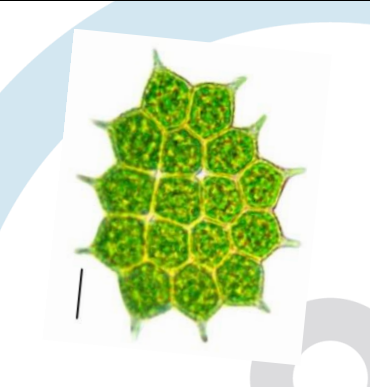
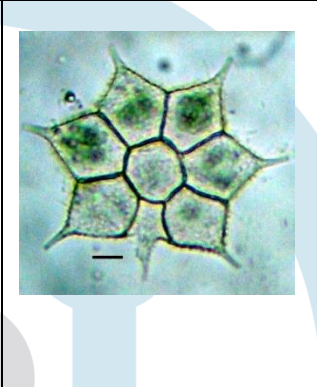

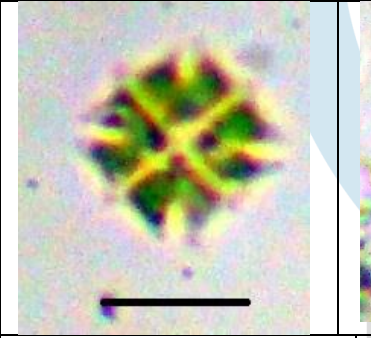
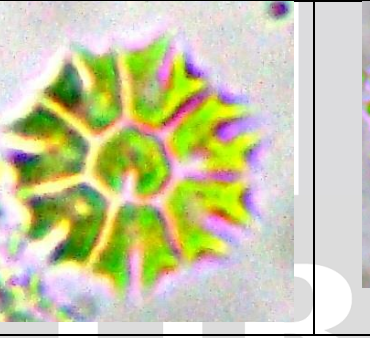
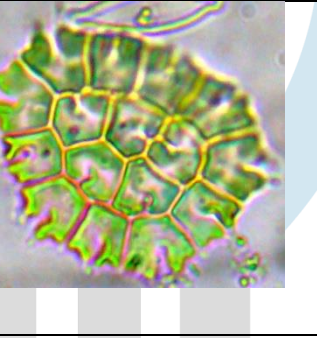
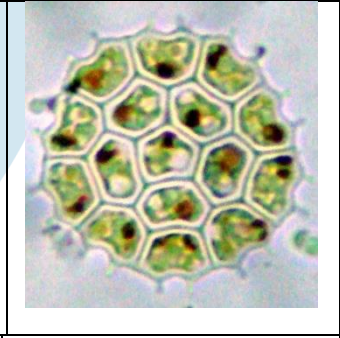
			
<i>Pediastrum boryanum</i> var. <i>longicorne</i>	<i>Pediastrum constrictum</i>		<i>Pediastrum duplex</i>
			
<i>Pediastrum duplex</i> var. <i>clathratum</i>	<i>Pediastrum duplex</i> var. <i>gracillimum</i>	<i>Pediastrum duplex</i> var. <i>reticulatum</i>	
			
<i>Pediastrum duplex</i> var. <i>rotundatum</i>	<i>Pediastrum duplex</i> var. <i>subgranulatum</i>	<i>Pediastrum duplex</i> var. <i>genuinum</i>	<i>Pediastrum integrum</i> var. <i>perforatum</i>
			
<i>Pediastrum muticum</i>	<i>Pediastrum ovatum</i>	<i>Pediastrum simplex</i>	<i>Pediastrum simplex</i> var. <i>biwaense</i>
Scale Bars measures 10 μ			

PLATE- 2

			
<i>Pediastrum simplex var. duodenarium</i>			
			
<i>Pediastrum simplex var. duodenarium</i>	<i>Pediastrum simplex var. echinulatum</i>		<i>Pediastrum tetras var. apiculatum</i>
			
<i>Pediastrum tetras var. excisum</i>	<i>Pediastrum tetras var. tetraodon</i>		<i>Pediastrum integrum var. integrum</i>
Scale Bars measures 10 μ			