RESEARCH ARTICLE

Biodiversity of the Genus *Oedogonium* Link ex Hirn 1900 in Ambernath and Badlapur, District Thane, Maharashtra (India)

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ABSTRACT

The present study was undertaken to study the biodiversity of the freshwater green filamentous algae in the cities of Ambernath and Badlapur in Thane district. During the study, 5 taxa of *Oedogonium* Link ex Hirn viz. *Oedogonium excavatum* var. minus, *Oedogonium sociale* f. kanwaense, *Oedogonium multisporum, Oedogonium longatum* and *Oedogonium rugulosum* were recorded.

Keywords: *Oedogonium*, biodiversity, Ambernath, Badlapur, Thane district

INTRODUCTION

The cities of Ambernath and Badlapur are a part of the Thane District in western Maharashtra. (http://www.thane.nic.in/htmldocs/DistrictProfile.html)

The climate of Ambernath and Badlapur is tropical. The average annual temperature in Badlapur is 27.1 °C. The rainfall here averages 3115 mm. The average annual temperature in Ambernath is 26.9 °C. The rainfall here averages 3089 mm. (http://en.climate-data.org/location/53230/; http://en.climate-data.org/location/53231/)

The rainfall is received from the South-West monsoons during the months of June to September and generally the highest rainfall is recorded in the month of July. October and November constitute the post monsoon season. The Winter season is from December to February and is followed by the Summer season from March to June. (http://www.thane.nic.in/htmldocs/DistrictProfile.html; http://www.dcmsme.gov.in/publications/traderep/thane.htm

Algae are the most primitive photosynthetic organisms found on Earth. They are primary producers and are the important constituents of the aquatic food chains and food webs. Algae are also used as food by man and as feed for cattle. Algae have been long used as model organisms in

research and hence are ecologically important. (Prescott, G. W., 1969; Sharma, O. P., 2011; Vashistha, B. R., Sinha A. K., Singh V. P., 2013) Gonzalves, E. A. (1981) has carried out extensive studies on the *Oedogonium* Thane, Mumbai and Raigad (then Kolaba) districts. There is very little information available about the current status of algal flora of Ambernath and Badlapur. The present study was undertaken to study the biodiversity of the filamentous algae in Ambernath and Badlapur. A total of 5 taxa of *Oedogonium* were collected and identified from Ambernath and Badlapur.

MATERIALS AND METHODS

Collection of Algae: The samples of algae were collected from various permanent and temporary sources of freshwater in some selected areas of Ambernath and Badlapur in Thane district. The collection of sample was done in small plastic containers with the help of forceps, scalpels etc. The samples were allotted 'Collection Codes' based on the name of the place of collection.

Observation and Preservation of Algae: The collected samples were brought to the laboratory and temporary mounts were prepared by mounting small part of samples in water. The slides were observed using Labomed Lx 300 Trinocular Research Microscope and photographs were taken using PixelPro Software. Part of collected samples was preserved using a preservative containing Ethanol, Formaldehyde, Glacial Acetic Acid, Glycerol, Water and Copper Sulfate.

Identification of species of *Oedogonium*: The dimensions of the algal cells in the filaments were measured using Pixel Pro Software. The algae were identified using various monographs and research papers.

The places of collection are marked in **Error! Reference source not found.**.

RESULTS

Genus *Oedogonium* Link ex Hirn 1900

Filaments unbranched, composed of cylindrical or capitellate cells. Filaments attached when young (may become free-floating later). Cells enlarged at the anterior end where usually one or two ring-like scars resulting from cell division may be observed. Basal cell usually modified to form hold-fast cell; apical cell usually broadly rounded or acuminate. Chloroplasts parietal and net-like, usually with several pyrenoids. Reproduction both sexual and asexual. Sexual reproduction oogamous. Suffultory cell sometimes inflated. A species may be monoecious or dioecious; macrandrous or nannandrous. Oogonia one to several in each filament; oogonial opening either by a pore or operculum; oospores may be smooth or variously ornamented.

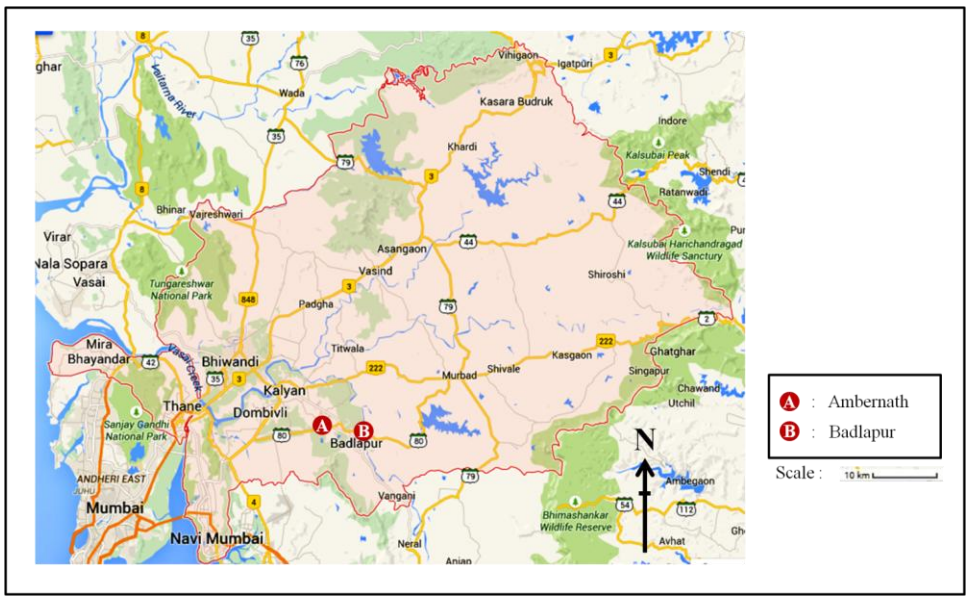

Figure 1: Map showing the places of collection

The red line indicates the boundary of Thane district. The red dots indicate the places of collection. The arrow indicates North..

Type species: *Oedogonium grande* Kützing ex Hirn 1900

Key to species

1. Monoecious …….. ***Oedogonium excavatum*** var. minus
1. Dioecious (or reproductive structures imperfectly known) ……. 2
2. With dwarf males (Nannandrous) ……. 3
2. Without dwarf males (Macrandrous) …….. ***Oedogonium sociale*** f. kanwaense
3. Oogonium opening by pore …….. ***Oedogonium multisporum***
3. Oogonium opening by operculum …….. 4
4. Oogonium 14 – 17 µm wide …….. ***Oedogonium longatum***
4. Oogonium 17 – 23 µm wide …….. ***Oedogonium rugulosum***

Oedogonium excavatum var. minus Gonzalves and Sonnad 1962
Bl (09) – 10 **PLATE I Fig. 1 (a – d)**

Reference:
Gonzalves, E. A., 1981, p. 196, Fig. 9.66 A.

Description:
Monoecious; Macrandrous. Vegetative cells cylindric; 9 – 11 X 29 – 52 µm. Oogonium single, globose or ovoid-globose, 26 – 37 X 29 – 46 µm; poriferous, pore superior. Oospore globose, filling the oogonium, 23 – 34 X 23 – 31 µm; median layer of the spore wall scrobiculate, outer and inner layer smooth. Antheridia 2 to 3 seriate, subepigynous, hypogynous, 10 – 12 X 4 – 6 µm.

Occurrence:
The alga was found in Badlapur, Dist. Thane, Maharashtra [Bl (09) – 10] along with *Mougeotia* sp., *Spirogyra* sp., *Zygnema* sp. and other species of *Oedogonium*.

Note:
The alga differs in having some vegetative cells, oogonia and antheridia that are shorter and some oogonia that are narrower than described for the species. The oospores are smaller. Some antheridia are broader than described for the species. Also, hypogynous antheridia were found in addition to subepigynous antheridia.

Distribution in India:
Karnataka (Gonzalves, E. A., 1981)

Oedogonium longatum Kützing ex Hirn 1900
Amth – 15 **PLATE I Fig. 2 (a, b)**

References:
Guiry, M.D. & Guiry, G.M., 2015; Gonzalves, E. A., 1981, p. 484, Fig. 9.389 A. (as *Oedogonium longatum* Kützing 1853); Prescott, G. W., 1970, p. 201. (as *Oedogonium longatum* Kützing 1853); Tiffany, L. H., 1930, p. 148, Plate LVIII, fig. 563. (as *Oedogonium longatum* Kützing 1853)

Description:
Dioecious; Nannandrous. Vegetative cells 5 – 7 X 10 – 16 µm. Oogonium 1, ovoid to ellipsoid, 14 – 17 X 19 – 21 µm; operculate, division superior. Oospore ellipsoid (to globose), about filling the oogonium, 12 – 16 X 12 – 18 µm; spore wall smooth. Basal cell not observed. Terminal cell not observed. Dwarf male on the oogonium, 6 – 7 X 9 – 12 µm; antheridium exterior, 1, curved.

Occurrence:
This alga was found growing in a small pond in Ambernath, Dist. Thane, Maharashtra (Amth – 15) along with *Pithophora* sp.

Note:
This alga differs in having some oospores and oogonia that are slightly narrower and some that are slightly shorter than those of the type. Some dwarf males are slightly broader and some are slightly shorter than

those of the type. Also, some oospores are slightly globose.

Distribution in India:
West Bengal (Sahoo, S. K., Datta, B. K. and Sarma, P., 2014).

Oedogonium multisporum H. C. Wood ex Hirn 1900
Heterotypic Synonym: *Androgynia multispora* H.C.Wood 1874
Barvi (02) – 23 **PLATE I Fig. 3 (a – c)**

References:
Guiry, M.D. & Guiry, G.M., 2015.; Gonzalves, E. A., 1981, p. 408 - 410, Fig. 9. 302 A. (as *Oedogonium multisporum* H. C. Wood 1869); John, D. M., Whitton, B. A., Brook, A. J., 2011, p. 517, Plate 129 C. (as *Oedogonium multisporum* H. C. Wood 1869); Prescott, G. W., 1970, p. 196. (as *Oedogonium multisporum* H. C. Wood 1869); Tiffany, L. H., 1930, p. 131, Plate XLVI, fig. 450, 451. (as *Oedogonium multisporum* H. C. Wood 1869)

Description:
Dioecious; Nannandrous. Vegetative cells 9 – 14 X 29 – 50 µm. Oogonium 1, subovoid or subglobose, 28 – 35 X 25 – 32 µm; pore superior. Oospore globose, nearly filling the oogonium, 26 – 33 X 22 – 30 µm; spore wall smooth. Dwarf male a little curved or nearly erect, near the oogonium or scattered, 11 – 15 X 28 – 31 µm. Antheridia not observed in our collection.

Occurrence:
The alga was found in Barvi, Badlapur, Dist. Thane, Maharashtra [Barvi (02) – 23] along with *Closterium* sp.

Note:
The alga differs in having some vegetative cells that are slightly narrower and some that are longer than described for the species. Some oogonia and oospores are slightly shorter while some oospores are broader and some are narrower. Some dwarf males are broader and slightly longer.

Distribution in India:
Gujarat, Kerala, Uttar Pradesh (Gonzalves, E. A., 1981)

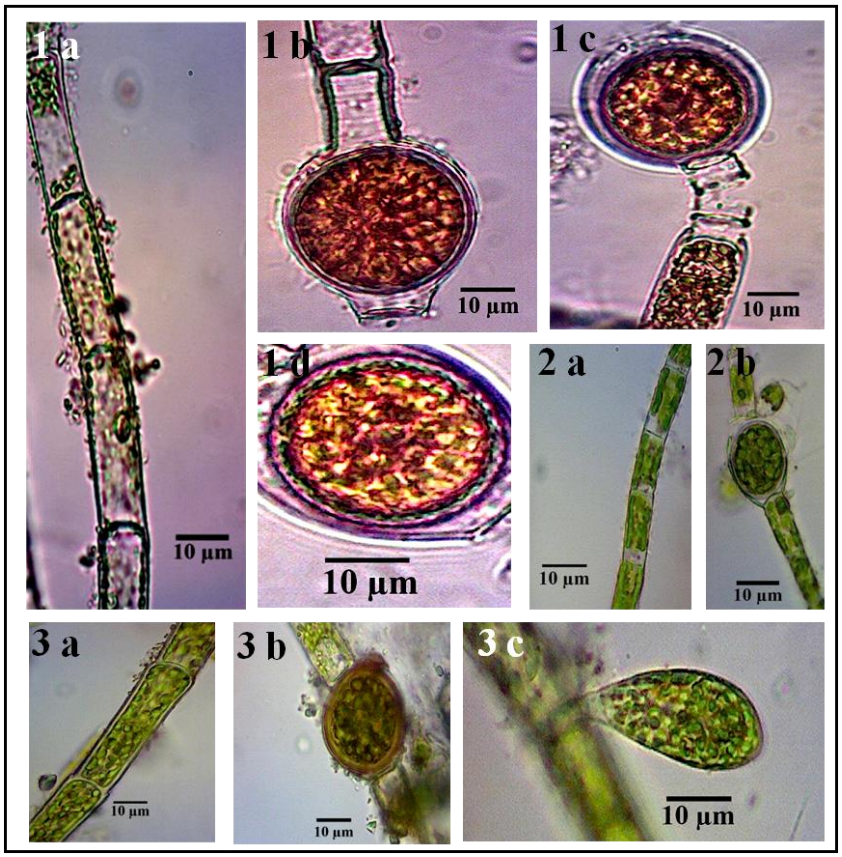

PLATE I: *Oedogonium* Link ex Hirn
Fig. 1: *Oedogonium excavatum* var. minus Gonzalves and Sonnad [Fig. 1 a – A vegetative filament; Fig. 1 b – An oogonium bearing oospore; Fig. 1 c – a filament with oogonium, oospore and antheridia; Fig. 1 d – An oospore with scrobiculate wall]; **Fig. 2: *Oedogonium longatum* Kützing ex Hirn** [Fig. 2 a – A vegetative filament; Fig. 2 b – A

filament with oogonium and oospore. The dwarf male if present on the oogonium]; **Fig. 3: *Oedogonium multisporum* H. C. Wood ex Hirn** [Fig. 3 a – A vegetative filament; Fig. 3 b – A filament with oogonium bearing oospore; Fig. 3 c – A dwarf male]

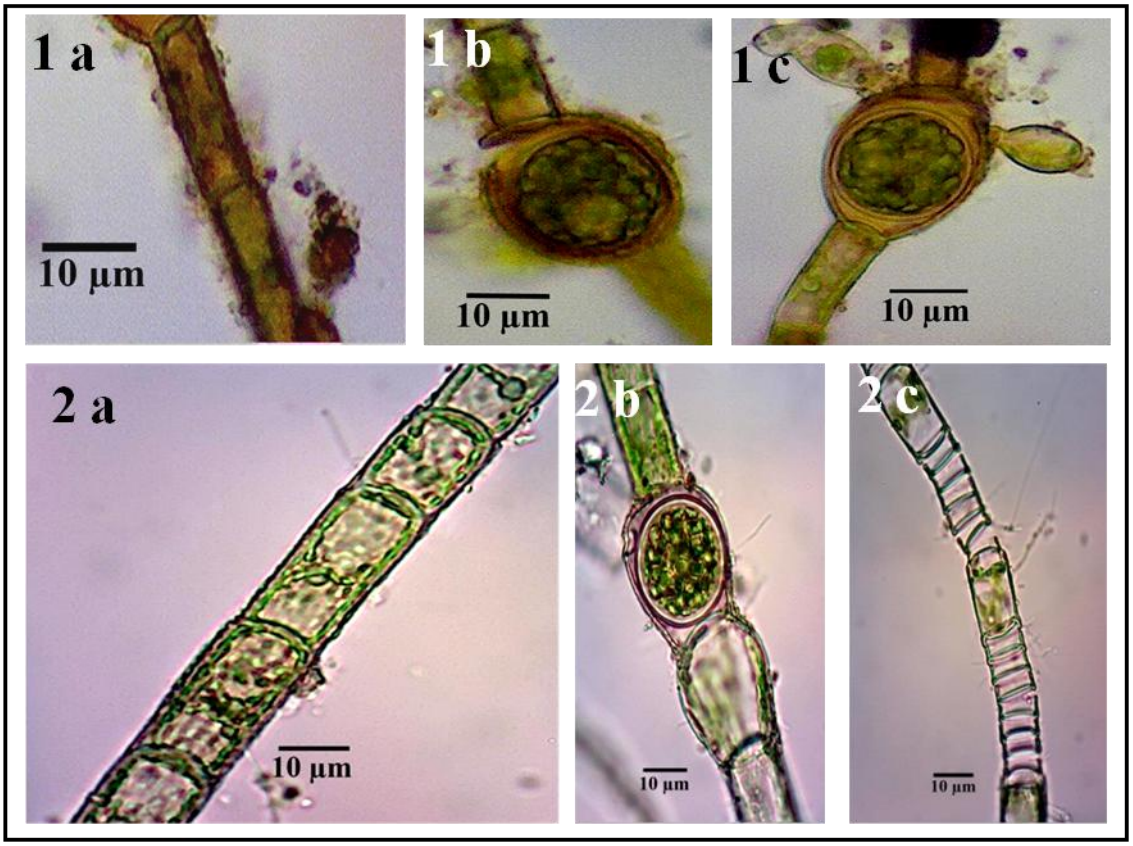

PLATE II: *Oedogonium* Link ex Hirn

Fig. 1: *Oedogonium rugulosum* Nordstedt ex Hirn [Fig. 1 a – A vegetative filament; Fig, 1 b – An oogonium opening by superior operculum with oospore; Fig. 1 c – The dwarf males attached on the oogonium]; **Fig. 2: *Oedogonium sociale* f. kanwaense Singh** [Fig. 2 a – A vegetative filament; Fig. 2 b – Filament with oogonium bearing oospore and superior pore; Fig. 2 c – Filament with antheridia]

Oedogonium rugulosum Nordstedt ex Hirn 1900
Amth – 16 **PLATE II Fig. 1 (a – c)**

References:

Guiry, M.D. & Guiry, G.M., 2015; Gonzalves, E. A., 1981p. 498 - 499, Fig. 9.400 A. (*Oedogonium rugulosum* Nordstedt 1877); Prescott, G. W., 1970, p. 207, Plate 44, fig. 14, 15. (*Oedogonium rugulosum* Nordstedt 1877); Tiffany, L. H., 1930,. 148, Plate LVIII, fig. 560. (*Oedogonium rugulosum* Nordstedt 1877)

Description:

Dioecious; Nannandrous. Vegetative cells 5 – 7 X 11 – 20 µm. Oogonium 1, obovoid or obovoid-ellipsoid, 17 – 23 X 19 - 25 µm; operculate, division superior. Oospore globose-ellipsoid, not filling oogonium (sometimes filling oogonium), 14 – 18 X 14 – 19 µm; spore wall smooth. Androsporangium not observed. Dwarf male on oogonium, 5 – 8 X 8 – 13 µm; antheridium exterior, 1; 3 – 5 X 4 – 7 µm.

Occurrence:

This alga was found growing attached to Pithophora oedogonia var. polyspora in a small pond, along with another species of *Oedogonium* and *Scenedesmus* sp. in Ambernath, Dist. Thane, Maharashtra (Amth – 15).

Note:

The alga differs in having some oogonia and dwarf males that are broader than those of the type while some are shorter than described for the species. Some oospores and antheridia are narrower and some are shorter than described for the type. Also, some antheridia are longer than described for the species.

Distribution in India:

Andhra Pradesh, Gujarat, Maharashtra, Karnataka (Gonzalves, E. A., 1981)

Oedogonium sociale f. kanwaense Singh 1938
Bl (09) - 01 **PLATE II Fig. 2 (a – c)**

Reference:
Gonzalves, E. A., 1981, p. 296, Fig. 9.173 B.

Description:
Dioecious; Macrandrous. Vegetative cells cylindric or slightly capitellate; Female vegetative cells 10 – 16 X 23 – 31 µm; Male vegetative cells 10 – 14 X 14 – 25 µm. Oogonia single or in twos, intercalary, subglobose, 23 – 29 X 27 – 46 µm; poriferous, pore superior or almost superior. Oospore globose or subglobose, quite filling the oogonium, 21 – 28 X 23 – 34 µm; spore wall thick, smooth. Antheridia 5 – 8 seriate, 9 – 13 X 4 – 6 µm; spermatozoids not observed.

Occurrence:
The alga was found growing in Badlapur, Dist. Thane, Maharashtra [Bl (09) – 01] along with *Uronema* sp. and other species of *Oedogonium*.

Note:
The alga differs in having some vegetative cells (male and female) that are narrower and some that are shorter than described for the species. Also, some female cells are broader. The oogonia and oospores are narrower, some are shorter and some are longer than described for the species. The antheridia are shorter and some are narrower than described for the species. Also, the antheridia are more in series i. e. 5 – 8 than described which is 4 – 5.

Distribution in India:
Maharashtra, Uttar Pradesh (Gonzalves, E. A., 1981); Maharashtra (Patil, K. J., Mahajan, R. T., and Mahajan, S. R., 2012).

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