Phytoplankton and Water Quality of Three Small Lakes in Cibinong, West Java, Indonesia

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Abstract. In West Java small lakes, known as “Situ”, have many functions including flood control, irrigation, tourism, domestic water and fisheries. Lakes in urban area are vulnerable to anthropogenic impact and typically show elevated level of nitrate and phosphate which support eutrophication. Phytoplankton is sensitive to changes in aquatic ecosystems that arise from excessive eutrophication. This study is to determine the differences of phytoplankton composition and abundance and environmental factors three small lakes in Cibinong City. Two small lakes, Situ Cibuntu and Situ Lotus, receive water source which is coming from the streams flowing through agriculture and human settlement. The other lake, Situ Dora, receive water source coming from the ground water. Phytoplankton was collected weekly in July 2018, while the nutrient (TN and TP) and water quality including temperature, pH, DO, conductivity and TDS were monitored from July to December 2018. There was different phytoplankton composition and abundance and water quality between situ receiving water which flow through agriculture and settlement and groundwater. Phytoplankton composition of Situ Cibuntu and Situ Lotus was dominated by the group of Chlorophyta and Bacillariophyta with the average of phytoplankton abundance were 50967 and 16700 cells L⁻¹ and the chlorophyll-a concentration were 21.451 and 6.591 µg.L⁻¹ respectively. Phytoplankton composition of Situ Dora was dominated by the group of Chlorophyta with the lowest of phytoplankton abundance and chlorophyll-a were 5858 cells L⁻¹ and 4.072 µg.L⁻¹ respectively. The highest nutrient and species number of phytoplankton was recorded in Lake Cibuntu. Water quality of Situ Dora was also characterized by the low value of pH, nutrient (TP and TN). It is highlighted that water source enter into the lake determine status of water quality and characteristic of phytoplankton in urban small lake. Key word. Cibinong City, phytoplankton abundance, small lake, water quality.

1. Introduction

Small lake areas one of the landscape features that significantly contribute to increase the quality of life in urban area by increasing amenity, providing tourism and educational activities, and even contributing to mitigate the urban climate [1]. Lakes in urban area are vulnerable to anthropogenic impact. Increasing anthropogenic interventions influence in and around aquatic systems and their catchment areas have contributed to a larger extent towards deterioration of water quality leading to accelerated eutrophication [2]. Water movement is responsible for transporting sediment and nutrients...
from the catchment to the lake [3]. The changes of natural catchment into agricultural land or urban areas are associated with eutrophication of the waters [4]. Agricultural and urban land type uses are recognized as the main sources of nutrient input and various contaminants in lakes [5] [6].

In Indonesia especially West Java, small lakes are known as “Situ” that have many functions including flood control, irrigation, tourism, domestic water and fisheries. In general, small lake in West Java is an artificial lake with the area from 1 to 160 ha. Some of them are eutrophic as indicated by phytoplankton bloom. The degree of these small lakes sometimes proceeds to the state of hyper eutrophic by extremely high biological productivity, which further triggered the lake alteration into land areas. A study indicates that urban lakes in megacity Jakarta were at high risk of disappearing due to land use change, area shrinkage, siltation/sedimentation, eutrophication and water pollution due to the lakes as the end point collecting garbage, untreated storm water runoff and sewage inflow. Urban lakes in this area have indicated that some lakes have been disappeared and many lakes area have shrunken [7].

The awareness of people to maintain the existence and to build new small lakes is more increase now since the function of lake is important to support human life. Some effort has been done to restore the damage lake by taking out sediment and improving water flow connection, such as Lake Cibuntu in 1998, Bojongseri in 2003 [8]. Some urban lakes were also built for tourism and fisheries activity such as Dorain 2002 and Lotus in 2016. Lake Cibuntu and Lake Lotus, receive water source which is coming from the streams flowing through agriculture and human settlement, while Situ Dora receive water source coming from the groundwater.

The water chemistry in the open water related to the source of water either groundwater or atmospheric precipitation [9]. The water in some water bodies, particularly those passing through mainly agricultural land use would be a problem of nutrient contamination. The biotic response of increasing nutrient load in the catchment is includes change in community composition of phytoplankton and alteration in food web structure [3] [11]. Phytoplankton is a primary biotic community indicating changes in ecological water quality due to its sensitivity and dynamic responses to the surrounding environment [11]. As was reported that small lake receives water source coming from streams flowing through forest area has low TP concentration, low abundance of Pyrophyta and Euglenophyta group and inversely small lake receives water source coming from streams flowing through agriculture area was characterized by high concentration of TN, nitrate, low number of taxa richness and abundance of Cyanophyta [11]. A study reported that concentrations of inorganic nitrogen and phosphorus were critical in regulating phytoplankton biomass and species dominance [12].

Phytoplankton is the main primary producer in open water and plays an important role in maintaining the healthy structure and functioning of lake ecosystems. Because the load of nutrients and their proportions are essential for phytoplankton growth so it is commonly known that phytoplankton and cyanobacteria are sensitive to changes in aquatic ecosystems that arise from excessive eutrophication [13] [14]. Therefore, phytoplankton is classified in the group of basic biological indicators of lake status [15]. We determined the differences of phytoplankton assemblage and environmental factors in Lake Cibuntu, Lake Lotus and Lake Dora to support the sustainable management in preventing eutrophication effect of nutrient load in urban small lake.

2. Materials and methods

2.1 Research location

Lake Cibuntu, Lake Dora and Lake Lotus are located at Indonesian Institute of Sciences’ Complex in Cibinong City, West Java (Figure 1) that was surrounded by agriculture and village area. The surface area of Lake Cibuntu, Lake Dora and Lake Lotus are 2.11; 1.308; 0.78 ha respectively and its maximum depth is 1.20; 1.13 and 2.0 m respectively. Lake Cibuntu has been restored in 1998 because of eutrophication. Lake Lotus is new lake built in 2016 and Lake Dora was built in 2002.
Figure 1. Research location

2.2 Data collection and physical, chemical measurement
Surface water samples were collected at 4 study site in Lake Cibuntu and Lake Dora and or 3 study sites at Lake Lotus (Figure 1) on July to December 2018 for water quality analysis which was representative dry season period (July, August, September) and rainy season period (October, November, December). Temporal distribution of TN and TP was measured in Lake Cibuntu. Water temperature, pH, Dissolved Oxygen (DO), and conductivity data were collected using a water quality checker (YSI), while water transparency was examined by the measurement of the Secchi depth. Chlorophyll-a sample was collected by filtering 200 mL of water sample through a GF/F Whatman glass filter paper and preserved by adding a saturated MgCO₃ solution. The filter was ground up and extracted in acetone solution (90%). After centrifugation the supernatant was measured with a spectrophotometer [16]. Total Nitrogen (TN) was measured using the per sulphate digestion and Brucine method [16, 17]. Total Phosphorus (TP) was determined using the per sulphate digestion and Ascorbic Acid method [17]. All samples were analyzed at Research Centre for Limnology, Indonesian Institute of Sciences (LIPI).

2.3 Phytoplankton Analysis
Phytoplankton data were collected weekly in July 2018 by filtering 2 L of water from the surface water through plankton net (40 μm mesh size). The samples were preserved with 1% lugol solution for taxonomic study in the laboratory. Phytoplankton species was identified according to some references [18][19][20][21] under magnification of 400 x through an inverted microscope. Quantitative analysis of phytoplankton used the Lackey Drop Micro Transect [22]. Direct links between environmental parameter and the percentage of phytoplankton abundance was analyzed using Canonical Component analysis (CCA)
3. Results

3.1 Water quality

The water quality value of observed lakes was presented in Table 1. There was a different water quality condition of observed lake. Lake Dora which is receive water source coming from ground water has lower value of pH, TDS, DO, Nutrient (TN and TP) and chlorophyll-a compared to Lake Cibuntu and Lake Lotus.

Table 1. Water quality of Lake Cibuntu, Lotus and Dora

| Parameter          | Cibuntu     | Lotus       | Dora        |
|--------------------|-------------|-------------|-------------|
| Secchi Depth (cm)  | Range 36-82 | 35-62       | 60-62       |
| Temperature (°C)   | Range 28.5-32.0 | 27.8-32.07  | 27.4-33.4   |
|                    | Average 30.3 | 29.7       | 30.2        |
| Conductivity (mS/cm) | Range 0.035-0.064 | 0.049-0.122   | 0.037-0.075 |
|                    | Average 0.048 | 0.087       | 0.061       |
| TDS (mg.L⁻¹)       | Range 21.4-37.5 | 31.7-68.31  | 24.63-48.5  |
|                    | Average 29.83 | 52.743      | 37.18       |
| pH                 | Range 6.6-7.2 | 6.2-7.2     | 5.6-6.3     |
|                    | Average 6.73  | 6.6         | 5.95        |
| DO (mg.L⁻¹)        | Range 6.74-9.15 | 6.05-9.26   | 5.6-7.4     |
|                    | Average 7.6   | 7.4         | 6.2         |
| TN (mg.L⁻¹)        | Range 0.585-1.486 | 0.756-0.844 | 0.032-1.201 |
|                    | Average 0.983 | 0.802       | 0.605       |
| TP (mg.L⁻¹)        | Range 0.005-0.373 | 0.042-0.055 | 0.023-0.038 |
|                    | Average 0.082 | 0.048       | 0.033       |
| Chlorophyll-a (µg.L⁻¹) | Range 17.861-42.901 | 3.659-13.181 | 1.592-8.144 |
|                    | Average 21.451 | 6.591       | 4.072       |

pH in Lake Cibuntu and Lake Lotus showed that the water in acidic to neutral condition, while in Lake Dora the water in acidic condition. The highest value of Conductivity (0.049-0.022 mS/cm) and TDS (31.7-68.31 mg.L⁻¹) was found in Lake Lotus, The highest of TN (0.585-1.486 mg.L⁻¹); TP (0.005-0.373 mg.L⁻¹) and Chlorophyll-a (17.861-42.901 µg.L⁻¹) was found in Lake Cibuntu. The high concentration of chlorophyll-a indicated the eutrophic condition in Lake Cibuntu. Standard value Chlorophyll-a and total phosphorus for eutrophic lake range from 7.3 – 20 µg.L⁻¹ and 24 – 48µg.L⁻¹ [23] Temperature in some observed lakes showed a tropical condition with the range from 27.4 – 33.4 °C.

Temporally water quality showed variability condition (Figure 2 & Figure 3). The higher value of temperature, conductivity, TDS were found in August, September and October. The lower value of Conductivity, TDS, pH and DO was found in December. The highest value of TN concentration in Lake Cibuntu was recorded in September, similar with TP concentration, the highest value of TP was record in September. High TN in Lake Cibuntu was also found in December or rainy season.
The most dominant assemblage in phytoplankton abundance in Lake Cibuntu and Dora is Chlorophyta 90% to 97% and 51.5 to 74% respectively, while Bacillariophyta was dominant in phytoplankton abundance in Lake Lotus (Figure 4). Other phytoplankton group contributed less than 8% of phytoplankton abundance in Lake Cibuntu. Chlorophyta contribute 7% to 21% in Lake Lotus. The highest mean abundance of phytoplankton was found in Lake Cibuntu (50967 cell.L⁻¹) and the lowest mean abundance of phytoplankton in Dora was 5858 cell.L⁻¹ (Figure 4). The abundance of phytoplankton is more than 15000 cell.L⁻¹ usually found in eutrophic water [24]. Chlorophyta is more diverse than other phytoplankton groups. There are 54 species belong to Chlorophyta found in Cibuntu, In Dora and Lotus number of species number belong to Chlorophyta group was 33 and 42 species respectively. Total species in Cibuntu, Lotus and Dora was 87, 66 and 67 species respectively (Figure 5). Chlorophyta was dominated by species belong to desmid group such as Cosmarium, and Staurastrum, Closterium. Bacillariophyta was dominated by Aulacoceira sp., Navicula sp.,
Diatoma and urosolenialongiseta. Dinobryonsp. is a species belong to Chrysophyta was also common found and abundance in Cibuntu, Dora and Lotus (Appendix)

Figure 3. Temporal distribution of TN and TP concentration in Lake Cibuntu.

Figure 4. The percentage of phytoplankton abundance of Lake Cibuntu, Dora and Lotus
Figure 5. Species numbers and abundance of Phytoplankton

3.2 Relationship between phytoplankton and physicochemical parameter
CCA analysis showed that Bacillariophyta and Euglenophyta in Lake Lotus related to high value of Conductivity and TDS, while Chlorophyta in Cibuntu related to concentration of TN and TP. Chlorophyta in Lake Dora related to TN, TP concentration, low pH and low DO concentration. Other group Cyanophyta, Chrysophyta and Pirrhophyta related to temperature.

Figure 6. CCA analysis between phytoplankton taxonomic group and physicochemical parameter (Chloro=Chlorophyta, Bacill=Bacillariophyta, Cyano=Cyanophyta, Chryso=Chrysophyta, Crypto=Cryptophyta, Pirrho=Pirrhophyta, Eugleno=Euglenophyta and physicochemical parameter in L = Lotus, C=Cibuntu, D= Dora.

4. Discussion
Lake Cibuntu and Lake Lotus which receive the water source coming from the streams flowing through agriculture and human settlement have high nutrient (TN & TP), while Lake Dora receive water source from ground water has low nutrient (TN & TP) concentration. Agricultural and urban land type uses are recognized as the main sources of nutrient input in lake[26].

Land use at the watershed (catchment basin scale) affects water chemistry. Lake Cangkuang and Lake Gede are small lakes in West Java, which were surrounded by high percentage of agriculture
showed a high of total Nitrogen (TN), while situ Cileunca, Patenggang was surrounded by high percentage of tea plantation area has high of total phosphorus (TP) [10]. Therefore, lakes in urban area typically show elevated level of nitrate and phosphate which support or increase productivity [25]. The highest conductivity and TDS (total dissolved solid) were recorded in Lake Lotus. The area of Lotus is smallest compared to Cibuntu and Dora. The limited of water depth and volume and type of catchment area ensured the great variability in the environmental conditions of small lake [26]. The highest chlorophyll-a concentration and the high of phytoplankton abundance was founding Lake Cibuntu, while the lowest chlorophyll-a, while the lowest of phytoplankton abundance was found in Dora. The high concentration of chlorophyll-a in Lake Cibuntu in line with the abundance of phytoplankton of these lakes. The highest TN and TP in Lake Cibuntu promote the growth phytoplankton in this lake. Nutrients carried into water bodies from non-point sources such as agricultural run offs, fertilizer and residential and sewage, increase biomass of phytoplankton and can cause eutrophication [27].

Temporally water quality showed variability during observation. The variability of water quality may be related with the season of the year, rain and radiation probability influencing water quality in lake. In Indonesia especially in Cibinong City generally from July to early of October is dry season and medium of October start in rainy season. In tropical area, water level and water volume of small lakes fluctuated depend on precipitation. Therefore, small shallow lakes have unstable hydrological condition [28]. Mostly in dry season, water level and water volume decrease because of low water flow enter into the lake. Low water volume and high evaporation in dry season could increase the high value of conductivity and TDS in this season as found in this observation. The higher DO concentration in dry season such as in August and September could be affected by photosynthesis activity and inversely the lower DO concentration in rainy season (November and December) because of low solar radiation in this season. The same phenomenon was found in TN, TP concentration, the highest value were recorded in September (dry season). Low input of the water into the lake in dry season causes accumulation of nutrient concentration. On the other hand, in tropical small and shallow lakes, water quality is also strongly affected by rainfall and wind induced sediment re-suspension which results to significant changes on their water chemistry and geochemical cycles [29]. P-exchange between sediments and the water column depends on diffusion-related processes and sediment re-suspension during wind events in shallow lakes [30]. Similar phenomenon may also occur in shallow lakes such as Lake Cibuntu. Consequently, when wind events occur in the dry season (September). The higher of TN concentration in December indicate thatload of TN from the watershed was high in the rainy season.

The highest phytoplankton abundance and number of species was recorded in nutrient-rich lake (Lake Cibuntu). A study also confirms that the highest phytoplankton abundance and biodiversity was recorded in the nutrient-rich village ponds [25]. In lake, nitrogen (N) or phosphorus (P) were limiting factor for phytoplankton growth. Concentrations and the balance of N and P ratio affect phytoplankton growth rate and abundance as well as phytoplankton composition and trophic status of Lake [30], [32].

Diversification of phytoplankton dominant and abundance in Lake Cibuntu, Lotus and Dora was closely to their preference on physicochemical parameter. Low percentage cyanobacteria (Cyanophyta) in this observation probably related to physicochemical characteristic of observed lake. The occurrence Cyanobacteria bloom in fresh water ecosystems has been explained by a series of factors related to lake morphometry, water column stability, as well as an environmental factors such as the availability of light, nutrients, temperature and pH [33], [34]. Small and shallow lake was characterized unstable hydrological condition [23]. The high percentage Bacillariophyta in Lake Lotus related to conductivity and TDS. The other factor that may promote the high percentage of Bacillariophyta was relatively unstable physical conditions such as water mixing of small lake. It is indicated by the high abundance of Aulacoceira sp. which the species is commonly found small eutrophic to medium lake and sensitive to onset stratification [35]. The high abundance of Euglenophyta was also related to conductivity and TDS. Euglenophyta was represented by some species belong to genera of Euglena, Trachelomonas, Phacus and Strombomonas. Species of Euglena
spp., Phacus sp., Strombomonas sp. Euglena spp., Phacus sp. and Strombomonas sp. were common found in ponds, rich inorganic matter from husbandry or sewages [35]. Those species are abundance in Lake Lotus which receive water coming stream flowing through settlement and agriculture which is possible have an input of organic pollutant from land surrounding area.

High percentage of Chlorophyta was recorded in Lake Cibuntu and Lake Dora is represented by the highest of species number belong to Chlorophyta. Among them, the representatives of family Desmidiaceae were consisted of genera Euastrum, Cosmarium, Closterium, Staurastrum and Micrasterias. The other members of the Chlorophyta were Scenedesmus, Crucigenia, Coelastrum, Pediasstrum, Ankistrodesmus, Selenastrum and Kirchneriella. Lake Cibuntu and Lake Dora mostly have similar phytoplankton composition particularly family of Desmidiaceae although those two Lakes have different nutrient, chlororophyll-α concentration. Many species of Desmidiaceae cosmopolitan such as from genera of Cosmarium. Fewer desmids occur as phytoplankters in eutrophic lakes, usually some species belonging to the genera Closterium, Cosmarium, and Staurastrum as indicator for eutrophic [36]. In this observation the highest abundance of phytoplankton in Lake Cibuntu was Staurastrum sp. Species of Netrium which is often common in acidic, oligotrophic of habitat was only recorded in Lake Dora [36].

5. Conclusion
Lake Cibuntu and Lake Lotus which is water sources coming from the streams flowing through agriculture and human settlement and Lake Dora which is water source from ground water showed different characteristic of water quality, phytoplankton abundance and phytoplankton composition. The highest concentration of TN, TP, Chlorophyll-α, phytoplankton abundance and rich of species number was recorded in Lake Cibuntu. Inversely the lowest of TN, TP, chlorophyll-α concentration, phytoplankton abundance and species number was recorded in Lake Dora. Medium concentration of TN, TP and Chlorophyll-α concentration and phytoplankton abundance was record in Lake Lotus. The composition of phytoplankton in Lake Cibuntu and Lake Lotus showed some species are common found in rich nutrient of lake. The composition and abundance some species of Euglenophyta in Lake Lotus indicate the waters was rich of organic matter in the waters. Species of Netrium which is often found in acidic and oligotrophic lake was recorded in Lake Dora. It is highlighted that water source enter into the lake determine of water quality status and characteristic of phytoplankton abundance and composition in urban small lake.

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## Appendix 1

List of phytoplankton species in Lake Cibuntu (C), Lake Lotus (L) and Lake Dora (D)

| Chlorophyta | C | L | D | Chlorophyta | C | L | D |
|-------------|---|---|---|-------------|---|---|---|
| Ankistrodesmus falcatus | *** | * | ** | Pediastrum duplex var. regulotom | * | | |
| Ankistrodesmus sp. | * | | | Pediastrum duplex var. reticulatum | * | | |
| Ankistrodesmus spiralis | * | * | | Pediastrum Boryanum var. undulatum | * | | |
| Closterium turgidum | * | | | Pediastrum Boryanum var. Meyen | * | | |
| Closterium sp. | * | | | Pediastrum sp. | * | | |
| Closterium libellula | * | * | | Quadrigula | * | * | |
| Closteriumlineatum | * | | | Scenedesmus bijuga | * | * | |
| Closterium striolotum | * | | | Scenedesmus muscinatus | * | | |
| Coelastrum cambricum | * | * | ** | Scenedesmus longus | * | * | |
| Coelastrum microparum | * | * | | Scenedesmus quadriculatum | * | | |
| Coelastrum cucurbitinum | * | * | | Scenedesmus arcuatus | * | | |
| Coelastrum sp. | * | | | Scenedesmus quadricauda var. Westii | * | | |
| Cosmarium obtusum | * | * | ** | Sphaerocystis sp. | * | * | |
| Cosmarium spp. | * | * | ** | Scenedesmus var. longus | * | * | |
| Cosmarium pseudonatum | * | | | Sphaerocystis sp. | * | | |
| Cosmarium quadri vir. Rucosum | * | | | Staurastrum gracile | * | * | |
| Cosmarium quadriventerucosum | * | | | Staurastrum gracile | * | * | |
| Cosmarium quadri vel. Rucosum | * | | | Staurastrum gracile | * | * | |
| Cosmarium pseudophyramidatum | * | | | Staurastrum gracile | * | * | |
| Cosmarium sp. | * | | | Staurastrum megacantum | * | * | |
| Cosmarium sp. | * | | | Staurastrum megacantum | * | * | |
| Cylindrocystis brebiessonii | * | * | * | Staurastrum gracile | * | * | |
| Cosmarium spp. | * | | | Staurastrum gracile | * | * | |
| Draparnaldia platyzonata | * | * | | Staurastrum gracile | * | * | |
| Eudorina sp. | * | * | | Staurastrum gracile | * | * | |
| Euastrum sp. | * | | | Staurastrum gracile | * | * | |
| Euastrum subvalidum | * | * | | Staurastrum gracile | * | * | |
| Gloeocystis sp. | * | | | Tetraedron sp. | * | * | |
| Goniochlorissp. | * | * | | Tetraedron trigonum | * | | |
| Kirchneriellalunaris | * | * | | Staurastrum identatum | * | * | |

Continued

Appendix 1

| Chlorophyta | C | L | D | Chlorophyta | C | L | D |
|-------------|---|---|---|-------------|---|---|---|
| Kirchneriellalunaris | * | * | Staurastrum identatum | * | * | |
Meugotiasp* *** Staurastrumdickei* 
Nephrocytiumaghardianum* Staurastrumformosum* **
Netriumdigitus* Staurastrum cerates* 
Micrasterias thomasiana* Staurastrumcurvatum* 
Micrasteriasfoliacea* Staurastrumidentatum* **
Micrasteriasalata* Staurastrumdickelt** 
Oocystislipteca* Staurastrumformosum** 
Pediastrum duplex** Staurastrumspinicep* 

** Bacillariophyta **

| Bacillariophyta | C | L | D | Cyanophyta | C | L | D |
|----------------|---|---|---|------------|---|---|---|
| Achnanthes | * | * | * | Merismopedia | * | * | * |
| Amphora sp.| * | * | * | Microcystis | * | * | * |
| Aulacoseriasp.| ** | **** | * | Nostocsp.| * | * | * |
| Cymbella | * | * | * | Oscillatoriasp.| * | * | * |
| Diatomavulgare | * | * | * | Stigonemasp.| * | * | * |
| Diatomaelongatum | * | * | * | Spirulina sp.| * | * | * |
| Euonitiasp.| * | * | * | Centritactusbelonophorus | * | * | * |
| Flagilariasp.| * | * | * | Dinobryonsp.| *** | * | * |
| Gomphonemasp.| * | * | * | Cryptophyta | 
| Gyrosigmaacuminatum | * | * | * | Cryptomonasssp.| * | * | * |
| Naviculasp.1 | ** | * | * | Chlamidomonas | * | * | * |
| Naviculasubtilissima | * | * | * | Rhodomonas | * | * | * |
| Nitzchiasp.| * | * | * | Euglenophyta | 
| Pinnulariasp.| * | * | * | Euglena acus | ** | ** | * |
| Pinnulariasubolaris | * | * | * | Euglena proxima | * | * | * |
| Synedra ulna | ** | * | * | Euglena oxyuris var. minor | * | * | * |
| Surirellarobusta | * | * | * | Euglena ehrenbergii | * | * | * |
| Surirellabiseriata var. bifrons | * | * | * | Trachelomonasssp.| *** | * | ** |
| Surirellatenera | * | * | * | Trachelomonasarmata | * | * | * |
| Tabellariasp.| * | * | * | Phacalongicauda | * | * | * |
| Urosolenialongiseta | **** | * | * | Strombomonasssp.| * | * | * |
| Cyanophyta | Peridiniumsp. | * | * | * | * | * | * |
| Cyanophyta | * | * | * | Peridiniumcinctum | * | * | * |
| Cyanophyta | * | * | * | Peridiniumcinctum | * | * | * |
| Cyanophyta | * | * | * | Peridiniumsp. | * | * | * |
| Cyanophyta | * | * | * | Peridiniumsp. | * | * | * |
| Cyanophyta | * | * | * | Peridiniumsp. | * | * | * |
| Cyanophyta | * | * | * | Peridiniumsp. | * | * | * |

Note: **** = dominant; *** = abundant; ** = frequent; * = occasional.