SPECIES RICHNESS OF MICROALGAE IN MOLAWIN CREEK, LOS BAÑOS, LAGUNA

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Abstract

Molawin Creek at the University of the Philippines in Los Baños, Laguna is identified as oligotrophic freshwater ecosystem with low volume and shallow stream. This study was conducted at the upstream site to assess the species of microalgae inhabiting at Molawin Creek. Phytoplankton was collected using plankton net and periphyton was scraped on submerged and surface of rocks at three sampling stations. The species were identified and counted at $25cm^2$ using a haemocytometer. There were 31 species of microalgae, 12 were phytoplankton and 28 periphyton. Phytocommunity showed that bacillariophyta (diatom) was the most dominant with 19 species, followed by chlorophyta (green algae) with 8 species, 3 cyanophyta (blue-green) and 1 species euglenophyta (euglenoid flagellate). The species composition and microalgal profile are good indicators of the water quality and the direct effect of anthropogenic activities of the creek.

Keywords: anthropogenic activity, freshwater periphyton, phytoplankton, species richness

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1.0 Introduction

Molawin Creek is characterized by very shallow water, scattered big rocks inhabited with mosses and herbs along its periphery. It is one of the tributaries of Laguna de Bay and it carries wastes and suspended particles from Mt. Makiling. It is also inhabited with microalgae which were considered as indicators of the quality of the water. These microalgae are microscopic organisms which are either unicellular or multicellular, prokaryotic or eukaryotic, and exhibit oxygenic photosynthesis (Goss, 2005). They are usually floating or known as phytoplankton, drifting or suspended in water, attached to rocks and substrates and are non-motile to overcome transport by water currents or periphyton.

The common micralgae are diatoms (Bacillariophyceae), dinoflagellates (Dinophyceae), coccolithophores (Prymnesiophyceae), and some flagellates (Chlorophyceae, Rhaphydophyceae, Cryptophyceae, Dictyochophyceae). They occur as unicellular, colonial or filamentous forms (Basavaraja, et al., 2013). One of the main factor that affects microalgae abundance, composition and species richness of microalgae is anthropogenic activity. Rapid flow of creek also can largely affect the population of microalgae, however, some species are able to adapt due to the presence of specialized structures that enable them to cling on rocks and detritus (Salmaso et. al, 2007). Physical properties of the water can also affect microalgae such as fluctuating temperature, pH, oxygen, nutrients and the presence of algae grazers. These factors could alter the distribution of microalgae, however, they quickly respond to environmental changes hence, one of the environmental function of their abundance and profile indicates the quality of the status of the aquatic ecosystem and detection of various environmental changes. Microalgae are also utilized in biological monitoring programs because of its commonly accepted criteria for indicator selection for development of protocols. They also play a key role in productivity of the water and consitutes as basis of food chain.

The objective of the study is to collect, identify, describe and assess the species richness of microalgae. Their assemblage can be used as environmental indicator of the water quality of Molawin Creek and its periphery. Specifically, it aimed to identify phytoplankton and periphyton species in the area.

2.0 Research Methodology

Description of the Study Site

Molawin Creek is a narrow stream located at the Mount Makiling traversing the University of the Philippines, Los Baños campus (Plate 1) and drains into Laguna de Bay where residential settlements are situated. At one point along its course merges with Pili Creek (Salamanca, 1992).

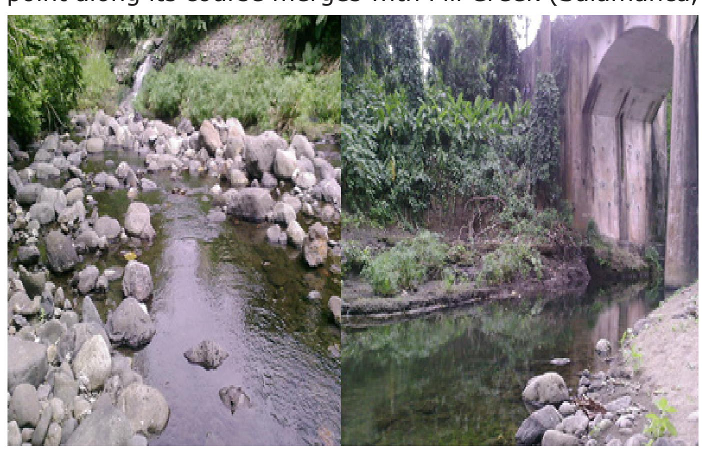

Plate 1. Molawin creek at social garden in UP, Los Baños, College, Laguna

Collection, Preservation of Water Sample

Filtered and strained water samples were collected using plankton net (simple conical rigged-vertical tow net) for phytoplankton and spatula was used to scrape

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periphyton from substrate and rocks. The frequency of repetitive plankton sampling was done weekly for one month while the periphyton was done by leaving a plastic bag in the creek weekly. The collected samples were placed in a labelled container and brought to the laboratory for preservation using Lugol's solution dissolved in 20g potassium iodide (KI) and 10 g iodine crystals in 200 mL distilled water containing 20 mL glacial acetic acid. The collected samples were stored at the Phycology Laboratory at IBS, UPLB. The nonbiological aspects of water quality such as temperature, pH, color and odor of the water were determined.

Identification and Cell Counting of Microalgae

The separation of the mixture was done two days after the preservation of the sample. The precipitate was left (sediments) in the bottom of the original container by carefully pouring the solution from the container using a pipette. Compound microscope were used for the examination of the specimens and identification was based on monograph guide (Prescott,1962) that described morphological characters of the species. The microalgae were counted as cells/ml using a haematocytometer where frame A was used ($1x10^4$) including the bottom and right boundaries as "count" sides while top and left boundaries as "no count" sides.

3.0 Results and Discussion

Molawin Creek has sandy type of substrate and along its periphery is natural vegetation inhabited with herbs, ferns, grasses and few small trees. There are big rocks scattered around shallow water with greenish-brown in color and slow water current. There is presence of effluent of wastewater run-off from infrastructures and its tributary to Laguna de Bay that could influence the status of the water. As observed the water is affected by anthropogenic activities giving off a slightly nasty odor. The physical characteristics of the environment implies that the site is not poor and the sedimentation from run-off effluents could be filtered by the vegetation along the periphery and this could reduce the population of polluted indicator species of microalgae such as *Nitzchia* and *Navicula*. Vegetation can also reduce turbidity that could retard algal growth and inhibit light penetration (Wang, 1974).

Some physical parameters were recorded in Table 1. The mean water temperature at 27°C is optimum (20-30°C) indicating habitable water for the survival of microalgae. This parameter is affected by air temperature, runoff, turbidity and sunlight exposure. Since the sample collection was done at noontime sampling period, the temperature was uniform throughout. The desirable temperature allows photosynthesis and reproduction of microalgae that contributes to the diversity of algal species. The mean pH recorded 8.0 is at the optimum and basic. Acidic water speeds leaching of heavy metals that can cause change in the profile of microalgae in the area. Dissolved oxygen (DO) at 4.75 mg/L is desirable which falls at the optimum (4-7 mg/L). Factors that affects the level of DO includes water temperature, depthness, rate of creek flow and anthropogenic activities. Extremely high DO causes bloom or increase in algae which can affect the survival of freashwater organisms, a phenomenon known as eutrophication.

A total of 31 species of microalgae was recorded. Of these, 7 species chlorophyta, 20 species bacillariophyta, 1 species euglenophyta and 3 species cyanophyta were identified (Table 2). Periphytons are higher than phytoplanktons (11 species) since periphytons can become attached to substrates such as rocks and other materials while planktonic species are floating and goes along with the water current. Periphyton is affected by the velocity of water, a representative remains fixed at the sampling station not subject to constant displacement as phytoplankton (Welch, 1972). The advantage of holding against the effects of water movement is especially necessary during heavy rains or strong winds that can cause the water movement and increase velocity. The characteristic of the creek might have contributed to the abundance of periphytons. The signifance of these species in the aquatic ecosystem contributes to the composition and profiling of the species of microalgae.

Among the microalgae, the diatoms are the most common and diverse group which are floating and can cling to substrates has the highest species richness compared to other groups of microalgae. Some factors that affect the presence and absence of microalgae includes light, temperature, nutrient availability and

Table 1. Physical parameters

Physical Parameters	Month of January				Mean	Optimum Value
	1	2	3	4		
Temperature (Air, °C)	27	27	27	27	27	Room T
Temperature (Water, °C)	25	20	24	23	23	20-30 (Singh and Singh, 2013)
pH	8	8	8	8	8	6.5-8.0 (Behar)
Dissolved Oxygen (mg/L)	4.6	4.6	5.2	4.6	4.75	4-7 (Behar)

Table 2. Microalgae in Molawin creek

Species	Species Richness	Species Count Cells/or units mL
Chlorophyta (Green Algae)		
*Chlorococcus***	41	1.4×10^4
*Closterium***	2	6.0×10^2
*Dictyosphaerium***	9	3.0×10^3
*Pediastrum***	1	3.3×10^2
*Scenedesmus***	1	3.3×10^2
*Sphaerocystis**/***	20	6.6×10^2
*Spirogyra***	5	1.6×10^3
Bacillariophyta (Diatoms)		
*Achnanthes***	1	3.3×10^2
*Asterionella***	2	6.0×10^2
*Cocconeis***	788	2.6×10^5
*Cymbella***	9	3.0×10^3
*Cyclotella***	2	6.0×10^2
*Diatoma**/***	18	6.0×10^3
*Flagellaria**/***	28	9.3×10^3
*Gomphonema**/***	1	3.3×10^2
*Melosira**/***	23	7.6×10^3
*Navicula sp. 1**/***	81	2.7×10^4
*Navicula sp. 2**/***	85	2.8×10^4
*Navicula sp. 3**/***	85	2.8×10^4
*Nitzchia sp. 1**/***	14	4.6×10^3
*Nitzchia sp. 2**/***	27	9.0×10^3
*Pinnularia**/***	21	7.0×10^3
*Pleurosigma***	1	3.3×10^2
*Pseudonitzchia***	29	9.6×10^3
*Stauroneis***	51	1.7×10^3
*Surirella***	21	7.0×10^3
*Synedra**/***	5	1.6×10^3
Euglenophyta (Euglenoids)		
Euglena**	1	3.3×10^2
Cyanophyta (Blue-green Algae)		
*Gleocapsa***	2	6.6×10^2
*Oscillatoria***	1	3.3×10^2
*Plectonema***	1	3.3×10^2

* - phytoplankton
** - periphyton

water movement (Ras, 2013). The diatoms might have survived better than the other groups because typically they are often well preserved in stratigraphic deposits where they can be used to infer (quantitatively or qualitatively) past environmental conditions (Moser et. a., 1996). In many studies, diatoms are used as natural monitors of environmental changes because of their range of response to ionic content and composition. According to Potapova and Charles (2003), their use in monitoring would be enhanced significantly if species responses to the concentration of major ions in fresh waters were better quantified.

The diatom and periphyton *Cocconeis* sp. obtained the highest cell count that could be attributed to the ability of the diatom to become attach on the surface of big rocks however, diatom community varies depending on the nature of physical and chemical characteristic of the rock. Molawin creek has big rocks that provide space to where these organisms could attach themselves. This diatom was collected at large rocks that are more stable, whilst small sized stones can be moved during periods of high flow (Marker and Willoughby, 1988). The presence of the abundance of *Cocconeis* could be due to the adaptability of the organism to the present condition of the ecosystem.

Fragilaria, *Gomphonema*, *Navicula*, *Melosira*, *Nitzchia* and *Sphaerocystis* have been observed weekly. The characteristics of these species are essential features that can influence their growth and efficiency in light utilization. The significance of the presence of these microalgae can be used as bioindicators of the status of the water. The presence of *Fragilaria* and *Gomphonema* is significant since this species thrive in less polluted environment. There are major environmental gradient or factors that affect the distribution of species and that includes pH, mineral content and nutrient content.

The presence of high species richness of *Navicula sp.* is an indication of the type of low water quality since these species are pollution tolerant suggesting eutrophic environment. Human generated disturbances throughout the creek contribute a great deal of nutrient content and pollution to the water. The algal composition may indicate the quality of the water in Molawin Creek. There are several useful microalgae found to be used in bioremediation. In the study of Pradhan et al. (2008) on planktons as water quality indicator showed that the algae that are useful as indicators are *Nitzchia, Scenedesmus, Cyclotella, Melosira, Navicula, Euglena, Fragilaria, Pediastrum* and *Synedra* were polluted water tolerant species. These species were present in Molawin Creek which may indicate the status of water in the area. However, these species may play the important role of removing contamination from the water and soil. These microalgae can sequester heavy metals either by surface adsorption, intracellular accumulation or by conditioning the surrounding chemical environment and organic contaminants to be degraded and may be completely mineralized (Pradhan et al., 2008). The presence of microalgae which are indicators of clean water quality and pollution tolerant species indicates that the creek is under healthy condition but pollution is now taking its toll.

4.0 Conclusion

Molawin Creek is inhabited with 31 species of microalgae and among these, diatoms had the highest species richness which are good indicators of the status of the water in Molawin creek. Based on the species of microalgae, pollution has now taking its toll in Molawin creek and it is recommended that constant monitoring of the profile of microalgae and utilize as bioremediators of water. It is further recommended to stabilize the water quality since the drainage of Molawin Creek is through Laguna de Bay with residents dependent on the water for livelihood.

References

Basavaraja, D., J. Narayana, E. T. Puttaiah and K. Prakash. 2013. Phytoplankton species diversity indices in Anjanapura reservoir, Western Ghat region, India. Journal of Environmental Biology. Vol. 43, 805-810.

Goss, Milagrosa R. Martinez. 2005. Culture and Use of Microalgae, J. Nature Studies 4:1-19. ISSN 1655-3179.

Marker, A.F.H. & Willoughby, L.G. (1988). *Epilithic and epiphytic algae in streams of contrasting pH and hardness.* In Round, Fe. (Ed.). Algae and the aquatic environment. Briston: Biopress. p. 312-325.

Moser, K.A., MacDonald, G.M. & Smol, J.P. (1996). Applications of freshwater diatoms to geographical research. *Progress in Physical Geography, 20(1), 21-52.*

Potapova, M. & Charles, D.F. (2003). Distribution of benthic diatoms in U.S. rivers in relation to conductivity and ionic composition. F*reshwater Biology, 48, 1311–1328.* doi:10.1046/j.1365-2427.2003.01080.x.

Pradhan, A., Bhaumik, P., Das, S., Mishra,M., Khanam,S., Hoque, B.A., Mukherjee, I., Thakur, A.R. & Chaudhuri, S.R. (2008). Phytoplankton diversity as indicator of water quality for fish cultivation. *American Journal of Environmental Sciences, 4 (4): 406-411.* doi:: 10.3844/ajessp.2008.406.411.

Prescott, G.W., 1962. *Algae of the Western Great Lakes area with an illustrated key to the genera of desmids and freshwater diatoms.* Wm. C. Brown, Dubuque, Iowa, ISBN: 0-697-04552-8, pp: 143.

Ras, Monique, Jean-Pjilippe Steyer, Olivier Bernard. Temperature effect on microalgae: a crucial factor for outdoor production. Reviews in Environmental Science and Bio/Technology, Springer, 12 (2) pp. 153-164.

Salamanca, N.E. (1992). *Systematics of the benthic diatoms along Molawin creek. (*Undergraduate Thesis). University of the Philippines, Los Banos, Laguna.

Salmaso, N. & Padisak, J. (2007). Morpho-functional groups and phytoplankton development in two deep lakes (Lake Garda, Italy and Lake Stechlin, Germany). *Hydrobiologia, 578(1), 97–112.*

Wang, W.C. (1974). *Effect of turbidity on algal growth.* ISWS-74-CIR121. Circular 121, State of Illinois, Department of Registration and Education , Illinois State Water Survey Urbana

Welch, E.B., Emery, R.M., Matsuda, R.I. & Dawson, W.A. (1972). The Relation of Periphytic and Planktonic Algal Growth in an Estuary to Hydrographic Factors. *Limnology and Oceanography, 17(5). 731-737.*

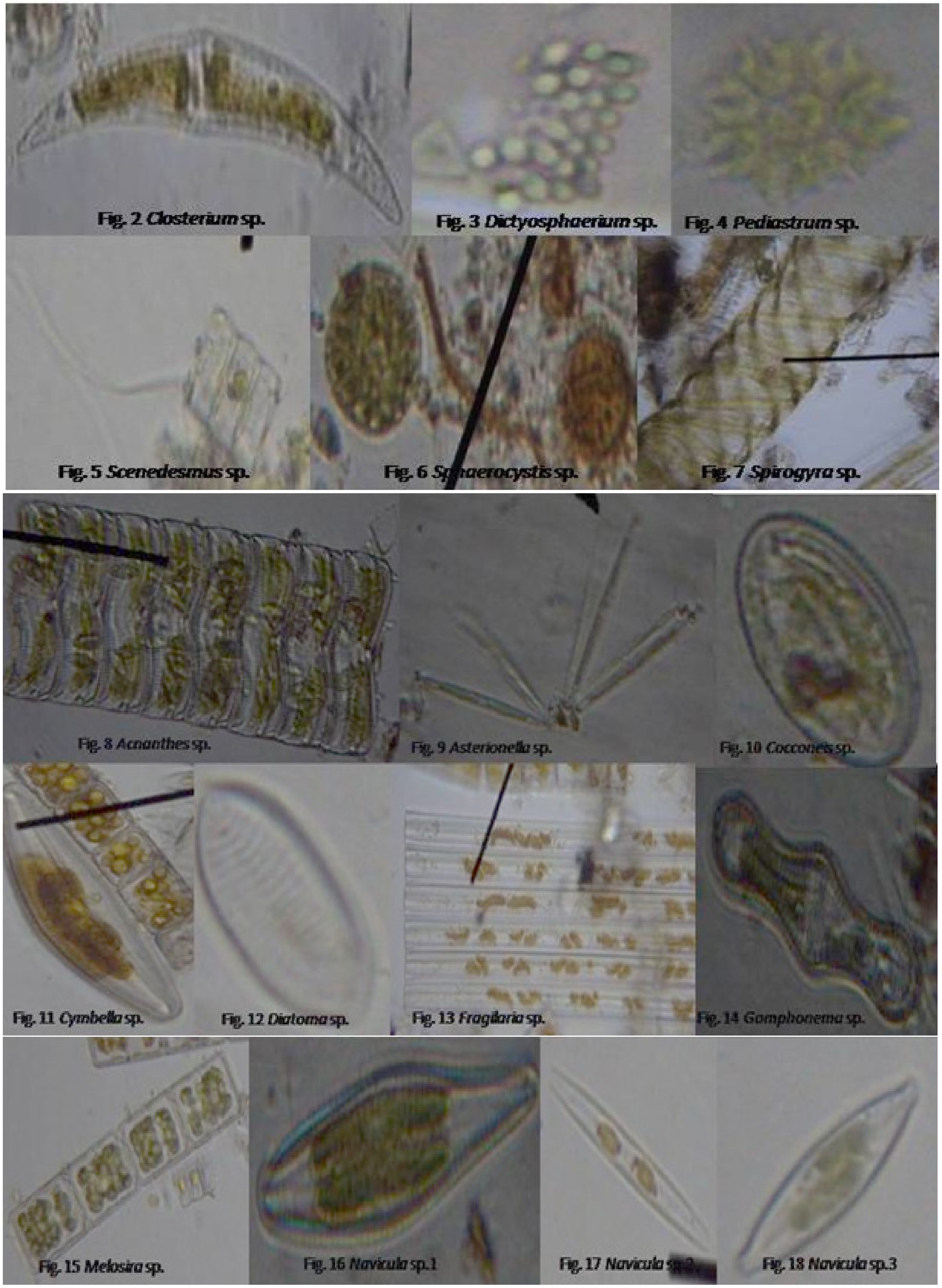

Plate 2. Microalgae species in Molawin Creek, Los Baños, Laguna

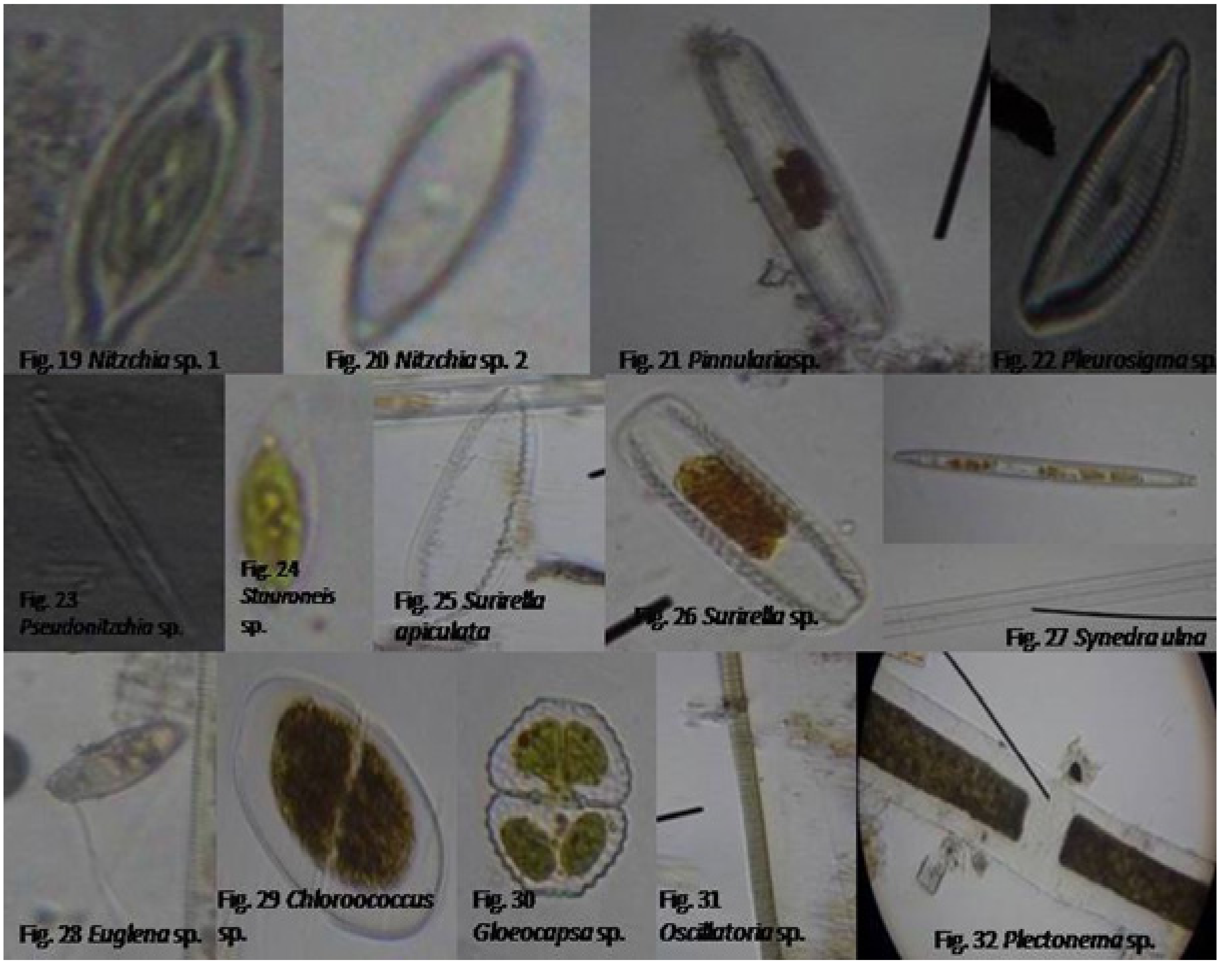

Plate 2 (cont). Microalgae species in Molawin Creek, Los Baños, Laguna