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Research article

Species Composition of Phytoplankton in Layawan River Ecosystem, Oroquieta City Misamis Occidental, Philippines

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ABSTRACT

Layawan River Ecosystem is one of the major rivers that traverses Mt. Malindang National Park. The river receives National Award as the cleanest river in the country in 1999. Microalgae (phytoplankton) contributed to the overall health of the riverine ecosystem. To determine the species composition of phytoplankton, plankton analyses were done in three sampling sites (upstream, middle stream and lower stream). The results revealed that there were more phytoplanton species in the lower stream followed by the middle stream. There was a low diversity of microalgae in the upper stream since the water flows rapidly. *Bacillariophyta* contributed the highest percentage (47%) composition. Chlorophyceaea (26%), Cyanophyceaea (21%) and Euglenophyceae (6%). The physical factors that attributed to the phytoplankton distributions are the following: temperature, pH and water flow.

Keywords: phytoplankton, river ecosystem, microalgae, Layawan River

INTRODUCTION

Knowledge of the structure of the plankton community and the auto-ecology of individual taxa is a unique source of information in the study of the phytoplankton dynamics in aquatic environments (Muylaert & Sabbe, 1999). Microalgal organisms that exhibit oxygenic photosynthesis, they are microscopic, unicellular or multicellular, prokaryotic or eukaryotic with gametangia containing usually all fertile cells (Goss, 2005). They are usually drifting or suspended in water, nonmotile to overcome transport by water currents. The main components of phytoplankton are diatoms (Bacillariophyceae), dinoflagellates (Dinophyceae), coccolithophores (Prymnesiophyceae), and some flagellates (Chlorophyceae, Rhaphydophyceae, Cryptophyceae, Dictyochophyceae). They occur as unicellular, colonial or filamentous forms (Viques, et al. 2009).

A knowledge of the plankton algae in rivers is becoming of increasing practical importance in view of the need to develop and maintain adequate supplies of water of suitable quality for domestic and industrial use. Any treatment plant designed for raw river water must be able to deal with dense growths of phytoplankton (Belcher and Swale, 1979).

Mt. Malindang Range Natural Park is one of the protected areas of the Philippines located in the island of Mindanao. Among the catchment basins of Mt. Malindang Range is the Oroquieta watershed which is drained by Layawan River. The headwaters of Layawan River are located in Brgy. Sebucal, Oroquieta City. Layawan River receives national award as the cleanest river in 1999. The barangay/village proper, where the human community is concentrated, has the coordinates of 8o19.428‘N, 123o38.174‘E at an elevation of ca. 960 meters.

Up to this date, literature on the phytoplankton analysis on the Layawan River, Oroquieta City, Misamis Occidental is very scarce thus, this study was conducted with the following objectives: (1) to determine phytoplankton assemblage in three sampling sites, upper, middle, and lower stream of Layawan, (2) to identify physical factors which may affect plankton communities in the area and (3) to determine species richness of phytoplankton in the study area.

METHODOLOGY

Study Site

Layawan river being the region’s cleanest river (1999 - 2001) is situated at the Mt. Malindang Range National Park which traversed along seven barangays in Oroquieta City, Misamis Occidental. The Layawan River in this site is the convergence of the two tributaries, Layawan Gamay and Manimatay. High slopes dominated by original forest bounded the river valley. The riparian area, on the other hand, has patches of this forest interspersed with second-growth and sometimes with active as well as abandoned farm lots overgrown with shrubs and tall grasses. The riverbed, which is wider, is dotted still with boulders. The trail going down Brgy. Mialen and other barangays downstream is along the riverbanks. The locals traverse the trail almost daily.

The sampling site is located at the Barangay Bunga (Upper Stream), Brg. Villaflor (Middle Stream) and Pobalacion I (Lower Stream) (Figure 1) is the nearest barangay of the city proper. Maps, GPS and other equipments were provided by the DENR – PENRO.

Phytoplankton Analysis

The methodology used in the phytoplankton analysis was the Standard Methods for the Examination of Water and Wastewater by Eaton, A. et al (1985). Phytoplankton was sampled at three selected sites: Barangay Bunga (Upper Stream), Brg. Villaflor (Middle Stream) and Pobalacion I (Lower Stream). Sampling was done in the period of December 2009. Sample containers were labeled to avoid confusions. Samples for phytoplankton analysis were collected at 0.5 meter depth and were preserved in 4% formaldehyde (final concentration) 40 ml per litter and a 3 ml per litter Lugol’s soln. The sampling was done by mixing 3 litters samples obtained at the two sides and middle of the river and an aliquot of 1 litter were obtained. Ecological data such as pH, temperature and depth was also taken during field sampling collection.

The samples were allowed to settle and a concentrated amount of 10 ml was transfer to previously labeled container and was utilized for microscopic examination.

Preparation of Solution for Phytoplankton Preservation

Lugol’s solution: Lugol’s solution was prepared by dissolving 20 g potassium iodide (KI) and 10 g iodine crystals in 200 mL distilled water containing glacial acetic acid. To prepare samples with Lugol’s solution, 3 mL Lugol’s solution was added to the 1 Litter sample and stored in the dark.

Formalin: To preserve sample with formalin, 40 mL buffered formalin (20 g sodium borate. $Na_2B_2O_4$. + 1 L 37% formaldehyde) was added to 1 L sample immediately after collection.

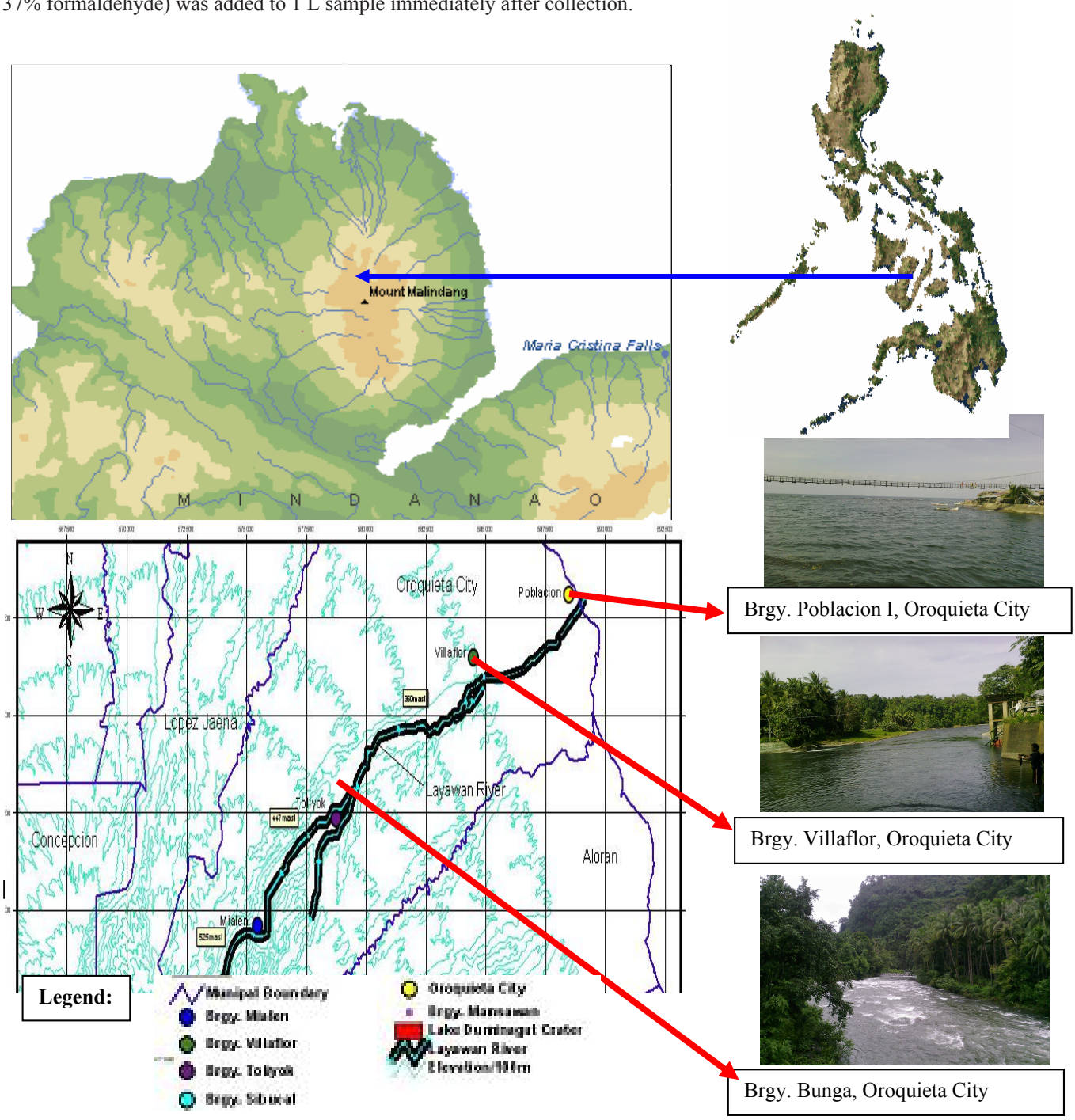


Figure 1. Map of the Philippines and Mt. Malindang Range Natural Park showing the location of the sampling sites which is situated at the Barangay Bunga, Brgy. Villaflor and Brgy. Pobalacion I, Oroquieta City, Misamis Occidental.

Phytoplankton Counting Techniques

Phytoplankton was enumerated using a Haemacytometer or counting chamber that limits the volume and area ready for calculation of population densities. In the counting field, top and left boundaries were designated as "no-count" sides, and the bottom and right boundaries as "count" sides. Number per organism was calculated as per milliliter in the following formula:

$$\text{No./ mL} = \frac{C \times A_t}{A_s \times S \times V}$$

Where:

C = number of organisms counted

A_t = area of cover slip, mm^2

A_s = area of one strip, mm^2

S = number of strips counted

V = volume of sample under the cover slip, mL

RESULTS AND DISCUSSION

Description of the three sampling sites (Barangay, Bunga, Villaflor and Poblacion I) is shown in Table 1. The result showed that elevation (masl), river depth decreases as the river flows to the down stream (Brgy. Poblacion I) and the pH also decreases going to the downstream. But the river width and temperature increases as we goes to the lower stream. It is important to note that the watershed down steam also receding the river banks.

Table 1. Description of data of the three sampling periods in Layawan River.

Study Site/ Parameters	Site 1 (Brgy. Bunga)	Site 2 (Brgy. Villaflor)	Site 3 (Brgy. Poblacion 1)
GPS readings	N 8^0 27' 55.95" E 123^0 46' 16.39"	N 8^0 27' 57.32" E 123^0 47' 09.19"	N 8^0 29' 03.15" E 123^0 48' 32.60"
Elevation	185 masl	82 masl	3 masl
River width (average)	10 m	16 m	22 m
River depth (average)	3.1 m	2.5 m	1.4 m
pH	7.1	6.7	6.5
Temperature	19^0C	20^0C	20^0C

Site 1 (Upper Stream)

The Layawan River in this site is in high slopes dominated by original forest bounded the river valley (Figure 2). The water in this area is still pristine and is crystal-clear. According the study conducted by Hansel et al. (2006), the WQI of Lower Layawan fell under the category of VERY CLEAN WATER, while that of the other sites fell under the category of a RATHER CLEAN – CLEAN WATER. This claim is very evident that some local people residing near the river obtained its drinking water directly in the pristine river. The river also harbors different kind of native fishes and shrimps which is an alternative food of the locals.

Figure 2. The crystal-clear Layawan River of the site 1 (Brgy. Bunga), meandering along the Mt. Malindang Natural Park which is the source of drinking water by the locals.

Preliminary examination of phytoplankton in Site 1 showed 4 species of phytoplankton found in the river. These were Flagellaria, Nitschia, Navicula and an unidentified species (Plate 1).

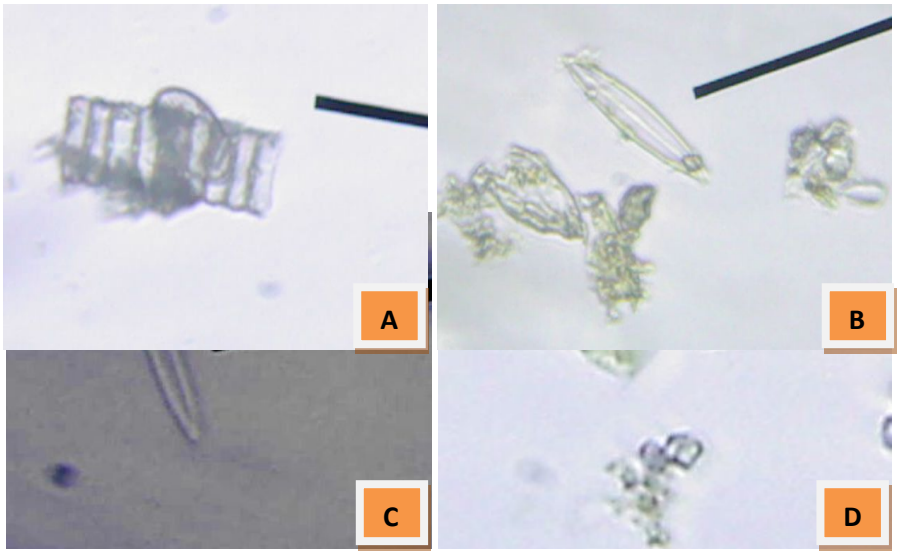


Plate 1. Phytoplankton collected in Layawan River site 1 which is dominated by Bacillariophyta (Diatom). A – Flagellaria; B – Nitschia; C – Navicula and D – unidentified sp.

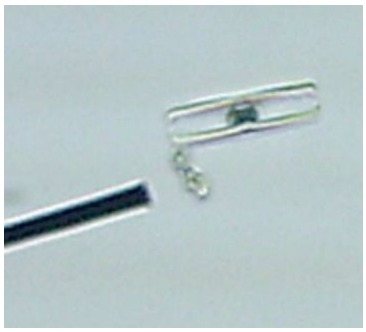
Site 2 (Middle Stream)

The Layawan River in this area was utilized in irrigation and small dam was also found near the sampling site (Figure 3 A and B). Rice fields and other agricultural plantations was found near the vicinity of the river bank in this site. Around the vicinity of the area there is a small resort and cottages for reaction purposes. The water in this area is not as clear as the water flowing in site 1 (Brgy. Bunga) which is 10 km in distance. Quarrying activities was also observed in the despite that it is illegal to quarry along the river.

Figure 3. Layawan River at site 2 (Brgy. Villaflor) showing small dam (A) for irrigation and the rice fields (B) beside the river banks.

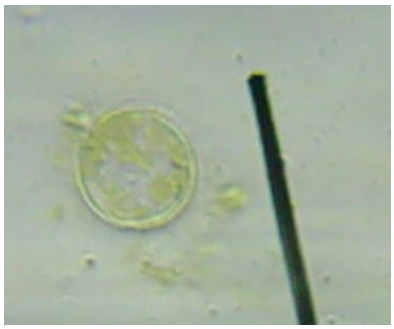
Preliminary analysis on the phytoplankton showed that there are eleven initial species of phytoplankton collected in this site. This initial investigation suggest that Site 2 support a varied species of phytoplankton than that of the site 1. There are also many freshwater fish found in the area which are a source of food from the nearby community.

Plate 2. Phytoplankton in Site 2 (Brgy. Villaflor, Oroquieta City).

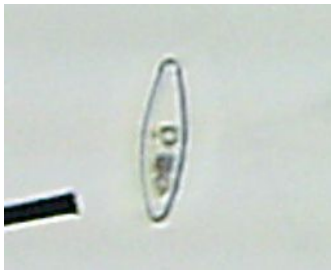


Gomphonema

Chlamydomonas

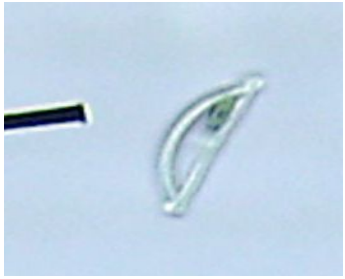


Chlorococcus

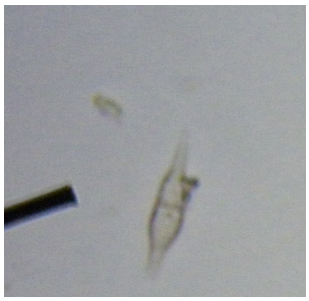


Nitzchia

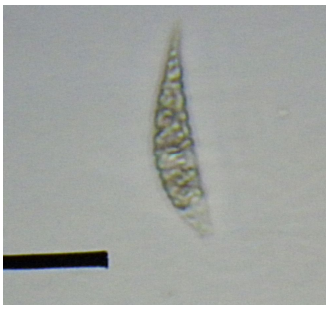
Anabaena



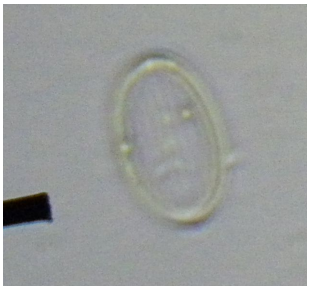
Rhopalodia



Nitzchia

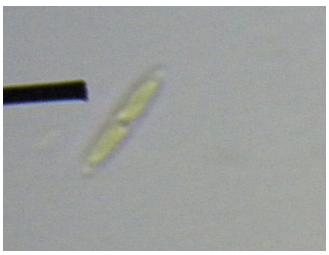


Euglena



Phacus

Carteria



Navicula

Site 3 (Downstream)

Site 3 (Downstream) (Figure 4) situated in the city proper where anthropogenic activity is very evident along the vicinity of this area. It is near the shoreline and is in the boundary of estuarine ecosystem. There are many household and a slaughter house is located near the river bank and the communities from the other side of the river were connected by a hanging bridge.

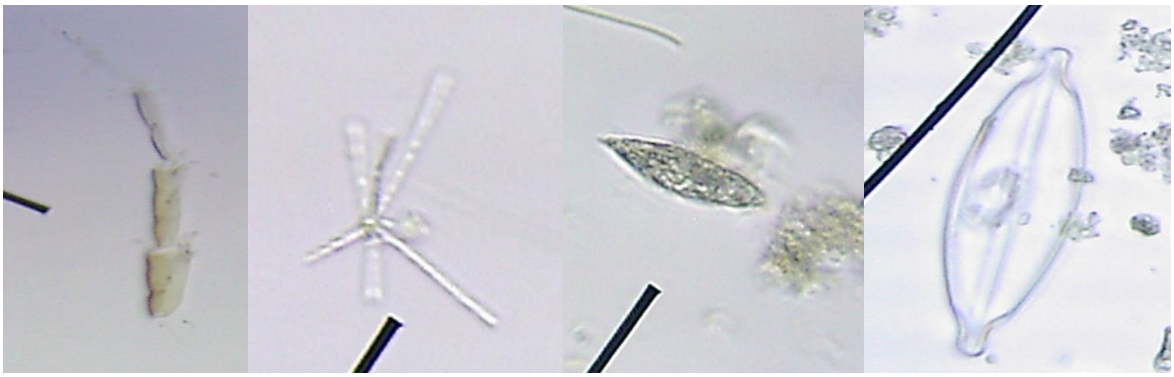
Figure 4. Layawan River in site 3 (Barangay Poblacion I) located the shoreline of Oroquieta City showing a wider area and a slightly greenish and turbid water.

Initial data on phytoplankton analysis showed that there are 12 species of phytoplankton identified so far. One notable phytoplankton collected in this area is the spirulina which is an alga of high ecological and economic value.

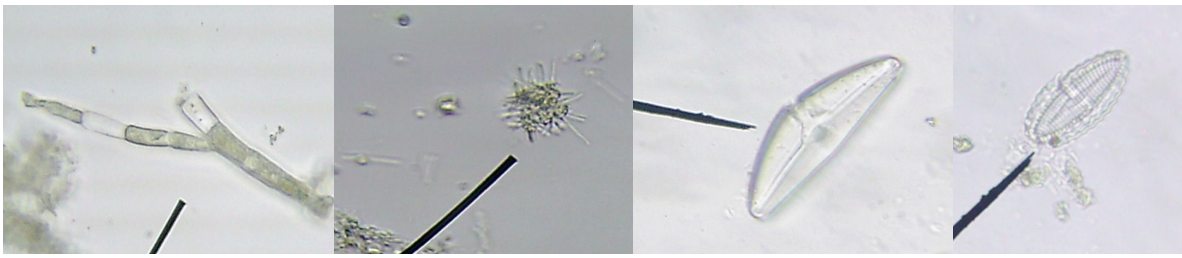
Preliminary investigation on plankton analysis in Layawan river showed that the site 1 (upper stream) is still pristine and a very clean water. Although there are only few phytoplankton observed so far, the area is an ideal for further research since it supports many native fishes like gobies, shrimps and freshwater crabs.

Identification of phytoplankton in Layawan River needs further verification for future studies and physico-chemical parameters like DO, COD, BOD, TSS, etc. showed be conducted in the area to identify factors or drivers that affect phytoplankton assemblages in the area.

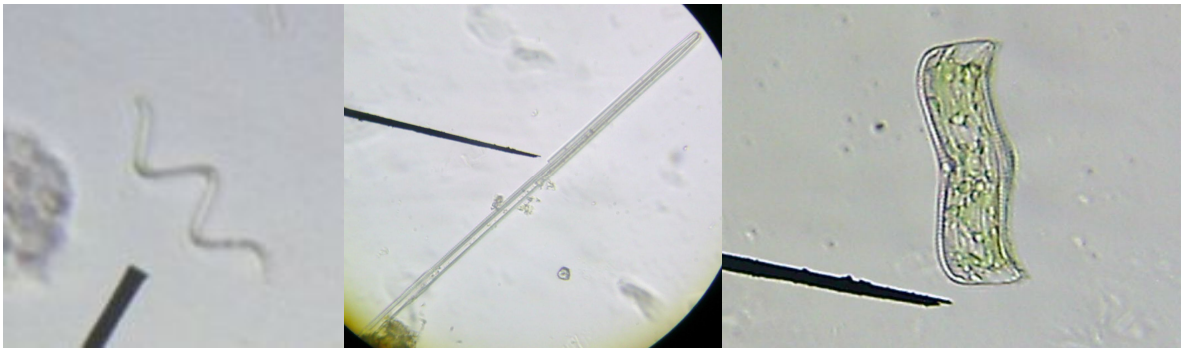
Plate 3. Phytoplankton in Site 3 (Brgy. Poblacion I, Oroquieta City).



Dinobryon Asterionella Euglena Navicula



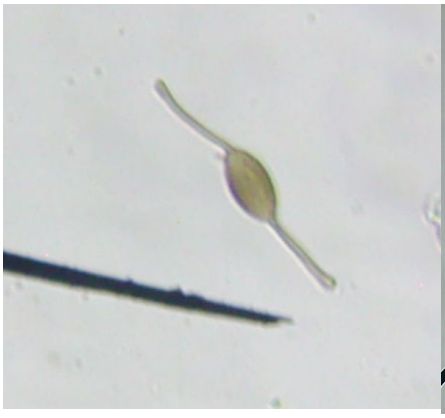
Chaetomorpha *Micractinium* Cymbella Coconies



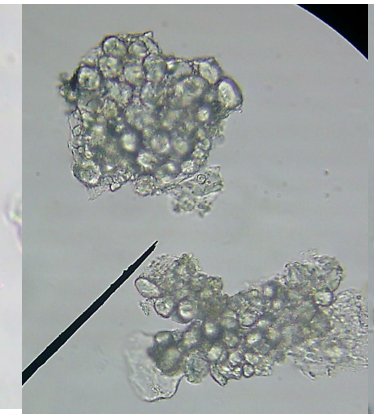
Siprulina Synedra Achnanthidium

Cynsella

Cyclotella *Stichococcus*

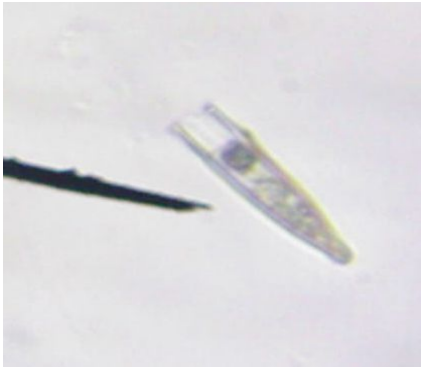


Centritractus



Botryococcus

Tribonema



Diatomella

Navicula amphibola

Staurosirella

The phytoplankton species collected from the three study sites comprises of Bacilariophyceae (47%), Chlorophyceaea (26%), Cyanophyceaea (21%) and Euglenophyceae (6%) (Figure 5). Most of the species collected were from the Brown Algae (Bacillariophyceae). This result is similarly observed by Rosser (2004) in phytoplankton river ecology which suggest that diatoms are more likely can tolerate rapid water ecosystem. Moreover, Euglenophytes can tolerate mostly on eutrophic water ecosystem.

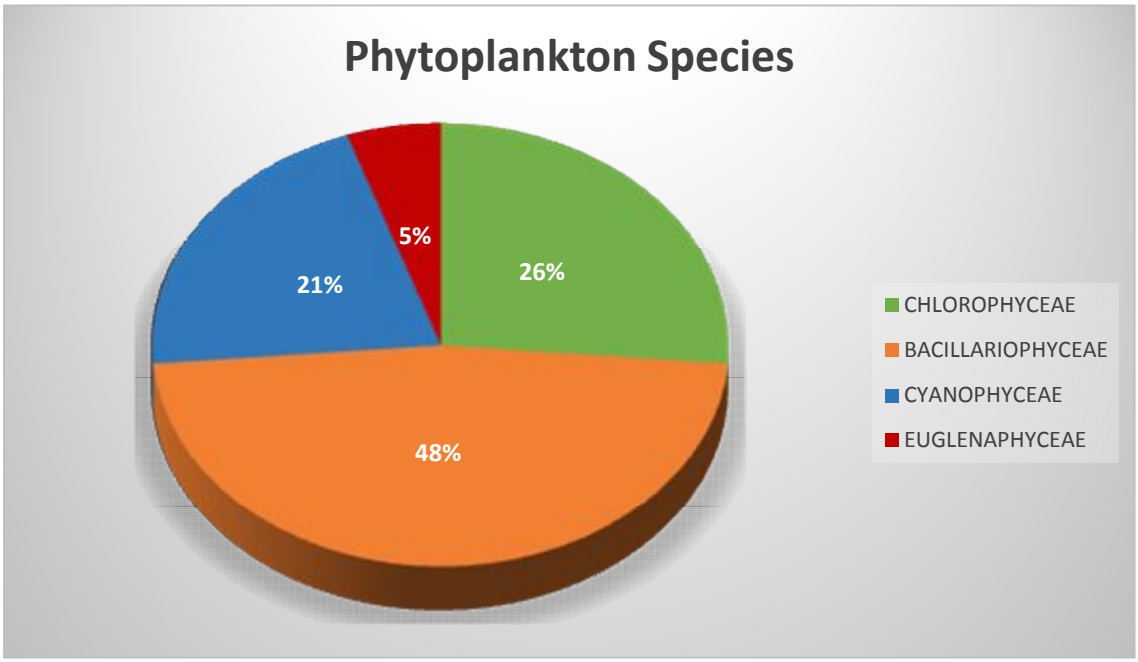


Figure 5. Phytoplankton species assemblage in Layawan River.

Apparently, most of the phytoplankton species observe in this study were in the lower stream (Table 2). The availability of nutrient in the downstream which is near the Estuary resulted into diverse phytoplankton species.

Table 2. Summary of the list of species of microalgae found in Layawan River, Oroquieta City

Species	Distribution of Species		
	Upper stream	Middle stream	Lower stream
CHLOROPHYTA: CHLOROPHYCEAE: (Green algae)			
1. Sphaerocystis	/		/
2. Pediastrum			/
3. Scenedesmus			/
4. Spirogyra			/
5. Haematococcus			/
BACILLARIOPHYCEAE: DIATOMS			
1. Melosira		/	/
2. Pinnularia	/	/	/
3. Fragilaria	/	/	/
4. Gomphonema	/	/	/
5. Navicula	/	/	/
6. Nitzchia		/	/
7. Synedra		/	
8. Diatoma		/	
9. Gomphonema		/	/
EUGLENOPHYCEAE			
Euglena			/
MYXOPHYCEAE / CYANOPHYCEAE: Blue-Green Algae			
1. Chloroococcus			/
2. Gloeocapsa			/
3. Plectonema			/
4. Unidentified			/

CONCLUSION

There is an increasing trend of phytoplankton species as the river flows downstream. The increasing trend could be attributed to the nutrient – loading from domestic and agricultural and domestic run-off down the stream**.** Family Bacilariophycea (47%) comprises majority of the species observed followed by Chlorophyceaea (26%), Cyanophyceaea (21%) and Euglenophyceae (6%). The physical factors that attributed to the phytoplankton distributions are the following: temperature, pH and water flow.

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