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Francis Nuestro Baleta
Institute of Fisheries,
Isabela State University,
Echague, Isabela 3309
Philippines

Jonathan G Donato
Isabela State University,
Centro West, Palanan, Isabela,
Philippines

Jonathan M Bolaños
Institute of Fisheries, Isabela
State University, Echague,
Isabela 3309 Philippines

Correspondence
Francis Nuestro Baleta
Institute of Fisheries,
Isabela State University,
Echague, Isabela 3309
Philippines

Some notable microalgae of the principal tributaries of Rio grande de cagayan, Philippines

Francis Nuestro Baleta, Jonathan G Donato, Jonathan M Bolaños

Abstract
The study was conducted to identify and document the microalgae present in the principal tributaries of Rio Grande de Cagayan, and the Blue Lagoons of Palanan, Isabela. Water samples were collected by bucket from the identified sampling sites along the Siffu, Mallig, Ilagan and Magat rivers from July 2013 to January 2014.

Thirty four (34) species of microalgae were identified belonging to four classes. Division Chlorophyta (17 genera), was the most abundant followed by Baccillariophyta (10 genera), Cyanophyta (4 genera), Euglenophyta (3 genera), and the most predominant genera of microalgae found along the major tributaries at Rio Grande de Cagayan and Palanan, Isabela, Philippines were the *Chorella, Kirchneriella, Scendesmus Pediastrum* and *Oedogonium* (a chlorophyta), *Aulacosiera, Cymbella, Navicula, Nitzschia* and *Pinnularia* (a bacillariophyta) *Cylindrospermum* and *Oscillatoria* (a cyanophyta) and *Euglena* (a euglenophyta).

Keywords: Microalgae, Rio Grande de Cagayan

1. Introduction

The Rio Grande de Cagayan is the longest and largest river in the Philippine Archipelago. It is located in the Cagayan Valley region in northeastern part of Luzon island and traverses the provinces of Nueva Vizcaya, Quirino, Isabela and Cagayan. The river's headwaters are at the Caraballo Mountains of the Central Luzon at an elevation of approximately 1,524 meters. The river flows north for some 505 kilometers to its mouth at the Babuyan Channel near the town of Aparri, Cagayan. The river drops rapidly to 91 meters above sea level some 227 kilometers from the river mouth. Its principal tributaries are the Chico, Siffu, Mallig, Magat and Ilagan Rivers.

Microalgae exhibit a notable biodiversity; they can in fact be found as individual cells, colonies or extended filaments. These microorganisms account for the basis of the food chain in aquatic ecosystems; they possess the intrinsic ability to take up water and carbon dioxide that, with the aid of solar energy, are used to synthesize complex organic compounds which are subsequently accumulated and/or secreted as primary or secondary metabolites. They are universally distributed throughout the environment, where they have adapted to survival under a large variety of environmental stresses such as heat, cold, drought, salinity, photo-oxidation, anaerobiosis, osmotic pressure and ultra violet exposure (Tandeau-de-Marsac, 1993) [1].

Microlagae are very sensitive to the environment where they live; so, any change in the environment may leads to the change in the planktonic communities in terms of tolerance, abundance, diversity and dominance in the habitat. Therefore, planktonic population observation can be used as a reliable tool to assess the pollution status of water bodies (Basu *et al.,* 2010; Prabhahar *et al.,* 2011) [2, 3]. Planktonic life is an essential part of aquatic ecosystem to maintain a healthy and productive environment (Khangarot and Das, 2009) [4]. The physico-chemical properties and nutrient status of aqueous medium have significant role in production of plankton which is critical to maintain aquatic food web foundations (Rahman and Hussain, 2008) [5].

Algae are widely present in present environments, such as lakes and rivers, where they are typically present as micro-organisms – visible only with the aid of a light microscope. Although relatively inconspicuous, they have a major importance in the freshwater environment, both in terms of fundamental ecology and in relation to human use of natural resources. Freshwater algae constitute a very diverse group of organisms. Their range of shapes and beauty when viewed through a microscope have delighted biologist for more than a hundred years.

They have an enormous range of size from less than one mm to several cm – equaling the size span (10^{+}) for higher plant seen in a tropical rainforest algal morphology is diverse, range from single cells complex colonies and filaments. Some species are capable of active movement. The term 'algae' embraces a number or phyla (e.g Cyanophyta Bacillariophyta and Chlorophyta) of chlorophyll – containing organisms with different growth form and cytologies (Bellinger and Sigee, 2010) [6]. The study was conducted to identify and document the microalgae present in the principal tributaries of Rio Grande de Cagayan, Philippines.

2. Materials and Methods

2.1 Collection Sites

Different collection and sampling sites were established through the major tributaries of Rio Grande de Cagayan. For Magat River, samples were taken at Ramon, Isabela. The sampling sites for Ilagan Rivers were the rivers under the Naguilian Bridge, Ilagan, and Tumauini, Isabela. Water samples were collected at Simimbaan and Nuesa, Roxas Isabela, which are part of the Siffu-Mallig River.

2.3 Collection of water samples

Water samples were collected at each sampling site using an improvised water collector (bucket). Five liters of water from the top, middle and bottom layers of the river were then filtered in an improvise plankton net. Then, 50 ml of the filtered water sample was then poured in a polyethylene bottle and was immediately brought to the laboratory for identification, isolation and fixation. Water quality parameters (dissolved oxygen, temperature, turbidity) were also recorded during sampling and collection of water samples.

2.4 Identification of microalgae from the water samples

The concentrated sample was mixed thoroughly and then 100 µl was placed in a glass slide and the microalgae present in the water sample were identified based on the taxonomic keys of (Bellinger and Sigee, 2010; Van Vuuren *et al.,* 2006; Prescott, 1976) [6, 7, 8]. Pictures were taken for proper identification of the microalgae.

2.5 Preparation and dilution of filtered water sample

For the first dilution, 1 ml of the filtered water sample was added to 9 ml of water. The next method followed was rigorous stirring, using magnetic bar and stirrer for 10 minutes at low speed. Then 1 ml aliquot from the first dilution was pipetted into 9 ml of distilled water to obtain second dilution (10^{-2}). The same process was repeated until five dilutions was achieved (10^{-5}). In each dilution, 1mL of the solution was inoculated into a plate containing the BG-11+N agar medium, using the same pipette. In spreading the inoculum, a glass spreader or the L-rod was used while rotating the plates.

2.6 Culture of microalgae

Microalgae was grown in BG 11 liquid medium, BG 11 agar slant and BG 11 agar in petri plates. One ml of filtered water sample was mixed to 6 ml BG 11 liquid medium in culture tubes and mixed thoroughly. Then the culture tubes were incubated under continuous illumination.

BG 11 agar slants and plates were incubated for three weeks under continuous illumination under laboratory condition. The agar slants and plates was maintained in an upright position for the first three days of incubation before inverted, it allowed the agar to absorb the inoculum. The positions were interchanged every two days to allow the same light exposure.

3. Results and Discussion

Thirty four (34) species of microalgae were identified belonging to four classes. Division Chlorophyta (17 genera) (Figure 1), was the most abundant followed by Bacillariophyta (10 genera) (Figure 2), Cyanophyta (4 genera) (Figure 3), Euglenophyta (3 genera) (Figure 4) and the most predominant among the identified species belongs to the following major groups: Cyanophyta (Blue-green algae) (*Anabaena, Cylindrospermum, Microcystis, Oscillatoria*); Euglenophyta (Euglenoids) (*Euglena, Phacus, Strombomonas*); *Chlorophyta* (Green algae) (*Actinastrum, Ankistrodesmus, Chlamydomonas, Cladophora, Chlorella, Closterium, Coelastrum, Golenkinia, Haematococcus, Kirchneriella, Lagerheimia, Monoraphidium, Scenedesmus, Spirogyra, Oedogonium, Pandorina, Pediastrum*); Bacillariophyta (Diatoms) (*Aulacoseira, Craticula, Cymbella, Gyrosigma, Fragilaria, Navicula, Nitzschia, Pinnularia, Synedra, Tabelleria*).

The Chlorophyceae are enormous and important group of freshwater green algae and it include some of the most common species, as well as many members that are important both ecologically and scientifically (Palmer, 1980) [9]. This occurs in large free floating submerged mats, rivers, freshwater ponds, ditches and slow moving streams (Bold and Wynne, 1978) [10]. The seasonally distribution of algal diversity shows dominance nature as Bacillariophyceae, Chlorophyceae, Cyanophyceae (Dwivedi and Pandey, 2002) [11].

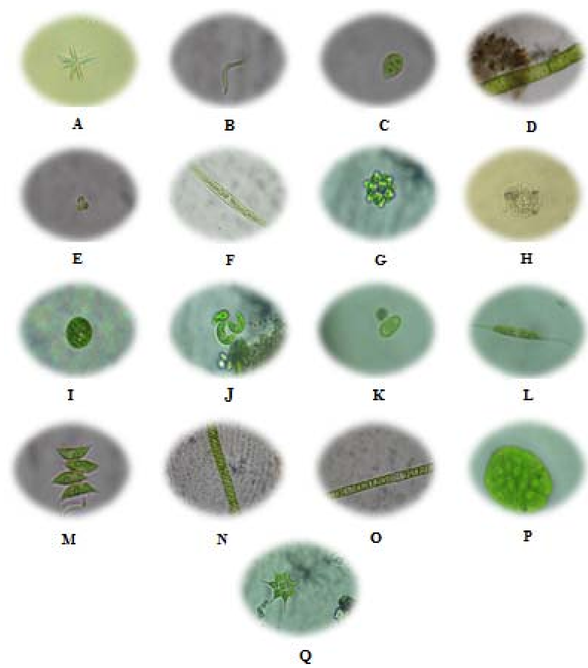

Fig 1: Photograph of chlorophyta (Green algae) present at the different sampling sites.

(A)	*Actinastrum* sp.	(B)	*Ankistrodesmus* sp.	(C)	*Chlamydomonas* sp.
(D)	*Cladophora* sp.	(E)	*Chlorella* sp.	(F)	*Closterium* sp.
(G)	*Coelastrum* sp.	(H)	*Golenkinia* sp.	(I)	*Haematococcus* sp.
(J)	*Kirchneriella* sp.	(K)	*Lagerheimia*	(L)	*Monoraphidium* sp.
(M)	*Scenedesmus* sp.	(N)	*Spirogyra* sp.	(O)	*Oedogonium* sp.
(P)	*Pandorina*	(Q)	*Pediastrum*		

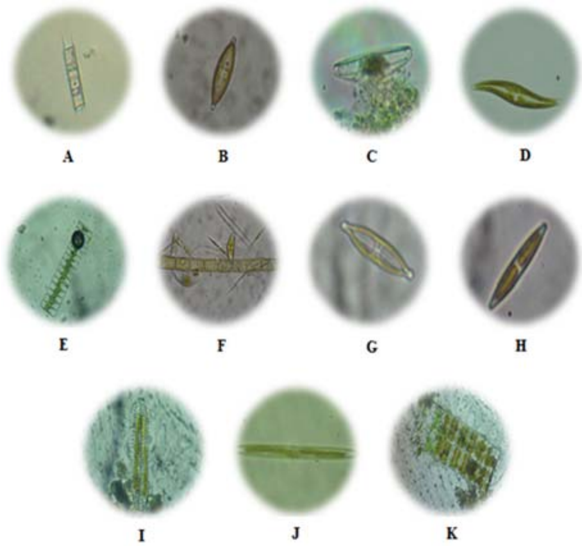

Fig 2: Photograph of bacillariophyta (diatoms) present at the different sampling sites.

(A)	Aulacusiera sp.	(B)	Craticula sp.	(C)	Cymbella sp.
(D)	Gyrosigma sp.	(E)	Fragilaria sp.	(F)	Melosira sp.
(G)	Navicula sp.	(H)	Nitzschia sp.	(I)	Pinnularia sp.
(J)	Synedra sp.	(K)	Tabelleria sp.		

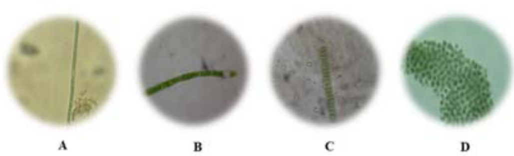

Fig 3: Photograph of bacillariophyta (diatoms) present at the different sampling sites.

(A)	Anabaena sp.	(B)	Cylindrospermum sp.	(C)	Microcystis sp.
(D)	Oscillatoria sp.				

Fig 4: Photograph of Euglenophyta (Euglenoids) present at the different sampling sites.

(A)	*Euglena* sp.	(B)	*Phacus* sp.	(C)	*Strombomonas* sp.

The color of freshwater algae is an important aspect their classification and range from blue green (Cyanophyta) to grass green (Chlorophyta), golden brown (Chrysophyta, Bacillariophyta), brown (Phaeophyta) and red (Rhodophyta). The use of color as a taxonomic marker can be deceptive, however, since the normal balance of pigment may vary. Apart from color, the other obvious characteristics under the light microscope are overall size, whether the organism the organism is unicellular or colonial or whether it is motile (actively moving) or non – motile within different groups, algae may be largely unicellular (Euglenoids, Dinoflagelallates, Cryptophytes), multicellular (brown algae) or mixture of two (other groups). Motility (single cell or entire colony) is also an important feature, with some algal groups being entirely flagellate (dinoflagelates, cryptophytes) while others are a mixture of flagellate and non – flagellate organism (green algae xanthophytes). Other groups of algae are entire without flagella, but are able to move by buoyancy regulation (blue greens) gliding movements on substratum (blue green - diatoms,) or are entirely non – motile (red and brown algae) (Bellinger and Sigee, 2010) [6].

The macrophytes stimulate the growth of microalgae which helps in the recycling of organic matter; this can be positively correlated with high microalgal density. Biodiversity is fluctuated with different factors like water level, temperature and nutrient level (Meshram, 2003) [12]. Microalagal diversities are natural existences, and they depending on weather and water quality conditions of the certain habitat. The occurrence of rich algal flora results generally at the place where there are high levels of nutrients present, together with the occurrence of favorable environmental conditions (Kumar and Sahu, 2012) [13]. The nitrogen and phosphorus in fertilizers enhanced the growth of small unicellular microalgae that provide food for fish and other aquatic animals (Culver *et al.,* 1993) [14].

4. Conclusion

The most abundant microalgae belonging to four classes namely Chlorophyceae, Cyanophyceae, Euglenophyceae and Bacillariophyceae were observed in the study area. Their good population is often influenced by the available nutrients and the physico-chemical conditions of the ecosystem.

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