



A Preliminary Checklist of Epilithic Algae of Kahuzi-Biega National Park, Democratic Republic of the Congo

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ABSTRACT

In this study, the epilithic algae of Kahuzi-Biega National Park were investigated at the first time. The samples were collected from 10 streams in between 1900 and 2400 m asl during dry season (July-August 2007). Altogether, some 170 species have been encountered and identified, belonging to 61 genera were observed. Bacillariophyceae formed the most abundant group making up 61 species from 20 genera. This was followed by the Cyanophyceae with 47 species from 12 genera, the Chlorophyceae with 30 species from 15 genera, the Desmidiaceae with 17 species from 7 genera, the Euglenophyceae with 10 species from 4 genera and the Dinophyceae represented by 5 species from 2 genera. This algal community is very diversified and balanced (Shannon Weiner index varied between 4.44-4.67, Species Diversity between 15.81-13.31 and Equitability between 0.97-0.99). *Frustulia rhomboides*, *Gomphonema angustatum*, *Melosira nyassensis*, *Navicula cuspidata*, *Nitzschia acicularis*, *Nitzschia filiformis*, *Synedra pulchella*, *Cladophora aerographila*, *Crucigenia cuneiformis*, *Mougeotia planctonica*, *Penium jenneri*, *Anabaena flos-aquae*, *Coelosphaerium nägelianum*, *Microcystis aeruginosa*, *Oscillatoria geminata*, *Synechocystis elongatum*, *Closterium aciculare*, *Cosmarium moniliferum*, *Ceratium hirundinella*, *Euglena acus* and *Phacus longicauda* were more abundant and present in all stations surveyed. Comparatively, a higher number of species, 114 species was recorded at Mushuva River (station 4) and a lesser number, 91 species at Mugaba River (station 6).

1. INTRODUCTION

As a result of their importance as primary producers in freshwater ecosystems and their rapid response to environmental change, benthic algal have long been used to assess ecological conditions and monitor environmental change in streams and rivers (Claps, 1991; Chindah et al., 1993; Stoermer and Smol, 1999; Fawzi et al., 2001; Coste, 2003; Bellinger et al., 2006). For the past two decades in Kahuzi-Biega National Park (PNKB), human activities have increasingly threatened the stability of the aquatic ecosystem, thereby devastating its flora and fauna. Recently, there has been a gradual awareness on the part of individuals, corporate organizations, institutions and government of the need to study and protect the environment of PNKB.

The PNKB, world heritage site since 1980, is a part of Albertine Rift (P-BEATRA, 2005). The benthic algal communities water system of this park are surprisingly unknown despite efforts in the region since colonial times by researchers while there are various significant accounts for aquatic ecosystems, such as rivers and wetlands. This park is of particular interest because of its unique biodiversity; it is poorly known so far (Kizungu et Beyers, 1994; Kaleme et al., 2007; Masumbuko et al., 2008). Indeed, studies in PNKB are limited to terrestrial ecosystems, while aquatic ecosystems remained until far less explored. Since the 1980s, attention of researches was focused on a floristic diversity (Wilson and Catsis, 1990; Fischer, 1993; Amani ya Igugu et al., 2008; Masumbuko et al., 2008), a mammal diversity (Yamagiwa et al., 1993, 1996; Mankoto et al., 1994; Basabose, 2002; Kaleme et al., 2007; Kerbis et al., 2010) and an ornithological studies (Kizungu et Beyers, 1994; Kizungu et al., 2005 in P-BEATRA 2005).

The aim of this study was to investigate the epilithic algae community of some streams in PNKB and provide a systematic checklist that will therefore

be useful in measuring our knowledge of the park benthic algae in the region and DR Congo. Algological studies on freshwater system in Eastern DR Congo are few and these include, Bisimwa et al. (2009), who reported the periphyton epilithic of Lwiro region watercourses, Symoens et van Der Werff (1996, 1993) reported the diatoms of Kisangani region and Golama (1993, 1991) studied the Bacillariophyceae, Desmidiaceae and Euglenophyceae of Kisangani streams. Of all the mentioned streams above, the rivers of PNKB remain without phycological information hence, such study remains important because the majority of the park's wildlife, most of the time, depends on the surrounding water. This study is a pioneer phycological investigation of some streams in PNKB.

2. MATERIALS AND METHODS

2.1. Description of Study area and Sampling Sites

The PNKB is located in the Albertine Rift region in Eastern DR Congo. It is located within latitudes 1°36'S and 2°37'S and longitudes 27°33'E and 28°46'E (figure 1). The PNKB spans two areas of different altitudes, low altitude located in the Congo basin near Itebero-Utu and high altitude located on the western border of the Congolese basin in the north-west of Bukavu with area of 600, 000 ha (Fischer, 1993). Because of its varied topography, the average temperature in the high altitude is around 18°C, but it varies in the corridor between 19 and 22°C. The average annual rainfall is about 1619.12 mm with a maximum of 1989.01 mm and a minimum of 1249.23 mm. The average global radiation is strong; it is about 421.8 calories/cm³ per month. The average relative humidity is also high, 83% with a maximum of 84% and a minimum of 82% (Kasisi, 1989).

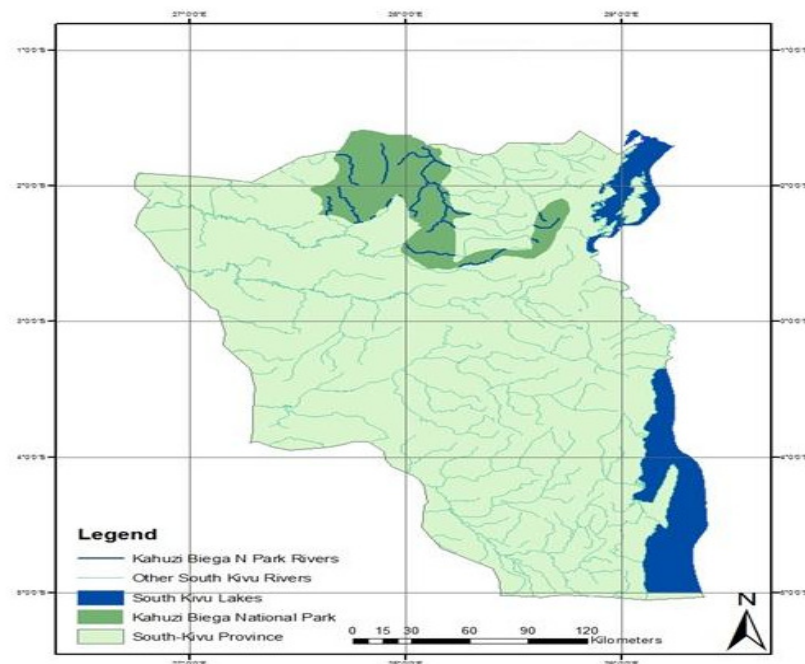


Figure 1: Location and river system of PNKB

Ten streams (Bwangizi, Chumba, Chanderema, Chitori, Cinhya, Langa, Mirembo, Mugaba, Mushuva et Nabugobugo) draining into the southeastern side of PNKB were sampled (figure 2). The streams are small second or third order systems no more than 3 m wide and less than 1 m deep. The station was always under

canopy (>50% canopy cover), while at stations 6, 8 and 10 were almost open with little direct shading during the day. Their geographical positions are described on table 1. Small pebbles, sand and clay dominated the substrate at all sampling locations.

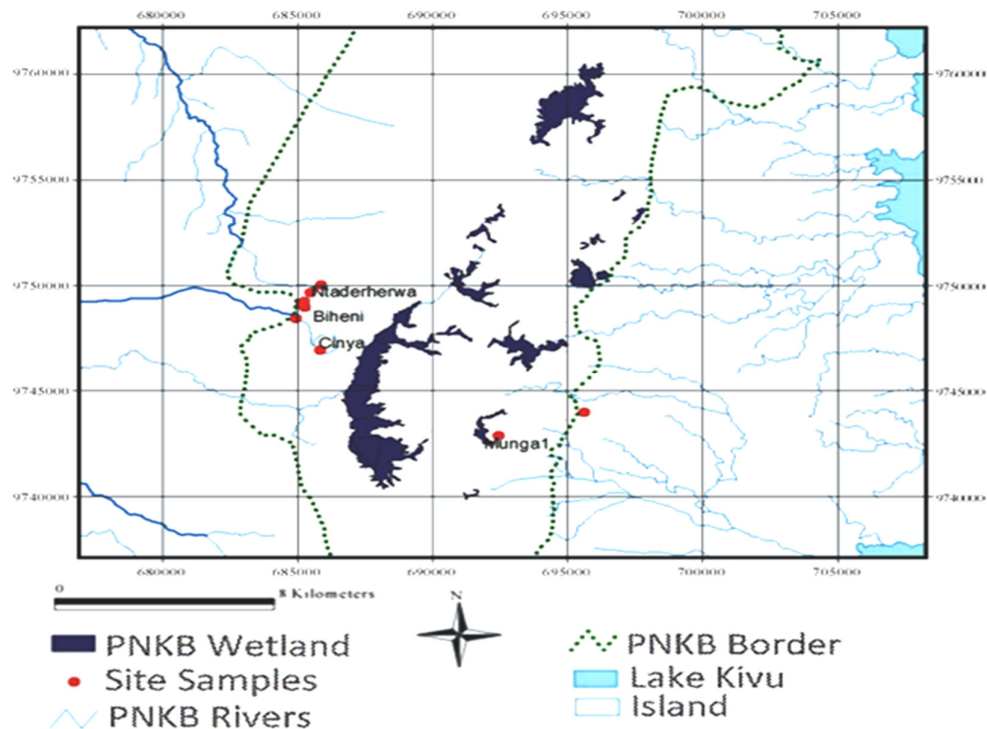


Figure 2: Location of sampling streams investigated in PNKB

Table 1: Geographical position and station name of sampled areas in PNKB

Station N°	Stream Name	GPS locations
Station 1	Langa	Lat. 02°16.106'S, Long. 028°39.889'E, Alt. 1990 m asl
Station 2	Chanderema	Lat. 02°18.908'S, Long. 028°45.545'E, Alt. 2049 m asl
Station 3	Nabugobugo	Lat. 02°16.470'S, Long. 028°39.769'E, Alt. 2161 m asl
Station 4	Mushuva	Lat. 02°19.501'S, Long. 028°43.829'E, Alt. 2175 m asl
Station 5	Mirembo	Lat. 02°16.207'S, Long. 028°32.889'E, Alt. 2264 m asl
Station 6	Mugaba	Lat. 02°16.176'S, Long. 028°39.955'E, Alt. 2275 m asl
Station 7	Bwangizi	Lat. 02°16.032'S, Long. 028°39.929'E, Alt. 2300 m asl
Station 8	Cinhya	Lat. 02°17.291'S, Long. 028°40.262'E, Alt. 2327 m asl
Station 9	Chumba	Lat. 02°15.808'S, Long. 028°40.058'E, Alt. 2332 m asl
Station 10	Chitori	Lat. 02°15.612'S, Long. 028°40.266'E, Alt. 2384 m asl

2.2. Algae collection and identification

The epilithic algae assemblages were collected from each stream at one station during the dry season between 1900 and 2400 m asl. At each station, rocks or stones were scraped clean of the epilithic algae with a toothbrush at 25 cm² of upper surfaces and preserved in 100 ml of distilled water. Samples were preserved in 4% formalin *in situ*, returned to the laboratory on ice, and refrigerated until analysis. In the laboratory, samples were homogenized, thoroughly agitated, and 1 ml of subsample was collected with a pipette for biological analysis (Chindah et al., 1993; Cocquyt, 1999). Every time after mixed, one drop of this subsample was put on a slide glass and analyzed with an Olympus CHD 6H0136 microscope at a magnification of 1000x (Chindah et al., 1993; Fawzi et al., 2001; Coste, 2003). Appropriate keys and illustrations of the following authors were used to aid identification: Whitford and Schumacher (1973), Patrick and Reimer (1975), Germain (1981), Ricard (1987), Krammer and Bertalot (2000).

2.3. Community Structure Analysis

For biological data analysis, enumerated epilithic algae were used to calculate several indices to examine the

biotic diversity of the streams. The Shannon-Weiner index (H), Species richness index (D) and Species Equitability (J) were used for within and across station comparisons as well as index comparison (Shannon and Weiner, 1963; Margalef, 1970; Pielou, 1975; Kempton, 1979; Ogbeibu, 2005).

3. RESULTS

The studied epilithic material comprised a total of 170 algae species belonging to 61 genera. Only 14 species were not identified up to specific level (table 2). The greatest species number was found at station 4 (114 species from 55 genera), followed by station 5 (106 species from 50 genera). The algae flora of station 6 was with less species number, only 91 species from 51 genera were observed during the investigation. Highest species diversity (15.81) was recorded at station 4 while station 6 had the lowest species diversity (13.31). The highest and lowest Shannon-Weiner index values (4.67 and 4.44) were recorded respectively at station 4 and station 6. The Equitability index was highest (0.99) at stations 3, 4, 7, 8 and 9 while the lowest value (0.97) was recorded at station 1 (table 3).

Table 2: A checklist of benthic algae species of the PNKB

Species	Stations									
	1	2	3	4	5	6	7	8	9	10
Bacillariophyceae										
<i>Achnanthes exigua</i> Grün.	+	+		+	+		+	+		+
<i>A. hungarica</i> Grün.	+			+	+	+			+	+
<i>Amphora coffaeiformis</i> (Agar.) Kütz.	+	+		+	+					+
<i>A. veneta</i> Kütz				+	+		+			+
<i>Cyclotella kützingiana</i> Thw.			+	+	+		+			+
<i>C. meneghiniana</i> Kütz.					+	+		+		+
<i>C. ocellata</i> Pant.					+		+	+	+	+
<i>Cymbella grossestriata</i> Müll.				+	+	+			+	
<i>C. lanceolata</i> Van Heu.	+	+	+	+	+		+	+	+	+
<i>C. placentula</i> Hust.	+			+						
<i>C. prostata</i> Berkel.	+	+	+	+	+		+	+	+	+
<i>C. silesiaca</i> Bleisch		+		+	+		+	+		+
<i>C. tumida</i> (De Bréb.) Van Heu.				+	+	+	+			
<i>Diatoma elongatum</i> (Lyng.) Agar.			+	+		+	+	+	+	+

<i>D. hiemale</i> (Lyng.) Heib.			+	+	+	+		+		
<i>Epithemia argus</i> Kütz.							+	+	+	+
<i>E. turgida</i> (Ehr.) Kütz.	+	+		+		+	+		+	+
<i>Eunotia arcus</i> Ehr.		+	+	+						
<i>E. lunaris</i> Grün.	+		+	+			+	+	+	+
<i>E. tenella</i> (Grün.) Hust.	+	+	+		+	+	+	+	+	+
<i>Fragilaria construens</i> (Ehr.) Grün		+	+	+	+	+	+		+	+
<i>F. crotonensis</i> Kit.	+	+	+		+	+	+			+
<i>F. fasciculate</i> (Agar.) L.B.	+		+	+	+	+		+	+	
<i>Frustulia rhomboïdes</i> (Ehr.) Cleve	+	+	+	+	+	+	+	+	+	+
<i>F. vulgaris</i> (Thw.) De Toni	+			+	+	+	+			
<i>Gomphocymbella aschersonii</i> Müll.			+	+	+			+	+	+
<i>G. brunii</i> (Frick.) Müll.		+	+		+				+	+
<i>Gomphonema acuminatum</i> Ehr.		+	+		+	+	+	+	+	+
<i>G. aequatoriale</i> Hust.	+		+			+	+	+	+	
<i>G. angustatum</i> (Kütz.) Rabenh.	+	+	+	+	+	+	+	+	+	+
<i>G. clavatum</i> Ehr.	+	+	+		+	+	+	+	+	
<i>Gyrosigma attenuatum</i> (Kütz.) Cleve	+			+	+	+	+	+		
<i>G. kuetzingii</i> (Grün.) Cleve					+	+	+	+		+
<i>Melosira varians</i> Agar.		+	+				+	+	+	+
<i>M. nyassensis</i> Müll.	+	+	+	+	+	+	+	+	+	+
<i>Navicula cocconeiformis</i> Greg.			+	+		+	+	+		
<i>N. cryptocephala</i> Kütz.		+	+	+	+	+	+	+	+	
<i>N. cuspidata</i> Kütz.	+	+	+	+	+	+	+	+	+	+
<i>N. gracilis</i> Ehr.		+	+		+	+		+	+	+
<i>N. muticoides</i> Hust.					+					+
<i>N. placentula</i> (Ehr.) Grün		+	+	+						
<i>N. simplex</i> Kras.	+			+		+	+		+	
<i>N. tripunctata</i> (O.F.M.) Bory	+	+		+	+	+	+	+	+	
<i>N. viridula</i> Kütz.		+	+	+	+	+	+	+		+
<i>Nitzschia acicularis</i> Smith	+	+	+	+	+	+	+	+	+	+
<i>N. filiformis</i> Hust.	+	+	+	+	+	+	+	+	+	+
<i>N. linearis</i> Smith	+	+	+	+	+			+	+	+
<i>N. pelagica</i> Müller	+	+	+	+		+		+	+	
<i>N. sp.</i>	+	+	+							
<i>Pinnularia brebissonii</i> Cleve	+	+	+	+		+	+			
<i>P. gibba</i> Ehr.	+	+		+		+	+			+
<i>Rhopalodia gibba</i> (Ehr.) Müll.		+	+	+	+	+		+		+
<i>R. gibberula</i> Ehr.		+	+	+						
<i>Surirella biseriata</i> De Bréb.	+			+	+	+				+
<i>S. linearis</i> W. Sm.	+	+	+	+		+	+	+		
<i>S. minuta</i> Bréb.			+	+			+	+	+	
<i>Synedra cunningtonii</i> West	+	+	+		+	+	+	+		
<i>S. pulchella</i> Kütz.	+	+	+	+	+	+	+	+	+	+
<i>S. ulna</i> Ehr.		+	+	+	+		+	+	+	+
<i>Tabellaria fenestrata</i> (Lyng.) Kütz.						+	+	+	+	
<i>T. flocculosa</i> Kütz.		+	+	+	+			+	+	+
Chlorophyceae										
<i>Ankistrodesmus convolutus</i> (Raben.) West	+				+	+	+		+	+
<i>A. falcatus</i> (Corda) Ralfs							+		+	
<i>A. nitzchioides</i> West		+		+				+	+	
<i>Cladophora aeragrophila</i> Raben.	+	+	+	+	+	+	+	+	+	+
<i>C. rupestris</i> Kütz.	+		+		+		+			
<i>Chaetophora sp.</i>	+	+								
<i>Chlorella vulgaris</i> Beyer.	+	+		+	+			+	+	
<i>Crucigenia cuneiformis</i> Brun.	+	+	+	+	+	+	+	+	+	+
<i>C. rectangularis</i> (Braun) Gay		+		+				+	+	+
<i>C. tetraacantha</i> West		+	+	+	+		+			+
<i>C. triangularis</i> Chodat	+	+	+				+			+
<i>Enteromorpha flexuosa</i> (Wulf.) Agar.	+		+		+			+		+
<i>E. sp.</i>					+	+		+		
<i>Kirchneriella lunaris</i> (Kirch) Möbius	+	+				+	+		+	

<i>Microspora sp.</i>							+	+	+	+
<i>Mougeotia planctonica</i> Virieux	+	+	+	+	+	+	+	+	+	+
<i>Pediastrum bidentulum</i> Braun		+	+		+	+		+		+
<i>P. boryanum</i> (Turpin) Menegh.	+	+		+						
<i>P. clathratum</i> (Schröder) Lemm.		+		+						
<i>P. duplex</i> Meyen			+	+	+	+	+		+	
<i>P. simplex</i> (Meyen) Lemm.	+		+	+		+	+	+	+	+
<i>Penium jenneri</i> Ralfs	+	+	+	+	+	+	+	+	+	+
<i>Protococcus sp.</i>	+		+	+		+	+	+	+	+
<i>Rhizoclonium crassipellitum</i> West					+	+	+	+		+
<i>R. hieroglyphicum</i> (Agar.) Kütz.	+	+	+	+						
<i>R. riparian</i> Harvey	+	+	+	+	+	+	+		+	+
<i>Richteriella botryoides</i> (Schmid) Lemm.	+	+	+	+				+	+	+
<i>Sorastrum americanum</i> (Bohlin) Schmid	+			+	+	+	+	+	+	
<i>S. hathoris</i> (Cohn) Schmid	+			+	+	+	+	+		+
<i>S. spinulosum</i> Nägeli		+	+	+	+		+		+	+
Cyanophyceae										
<i>Anabaena circinalis</i> Raben	+	+				+		+	+	+
<i>A. flos-aquae</i> (Lyng.) De Bréb.	+	+	+	+	+	+	+	+	+	+
<i>Anabaenopsis tanganyikae</i> (West) Wolosz.		+	+	+						
<i>Aphanocapsa delicatissima</i> West		+		+		+	+	+	+	
<i>A. stagnina</i> (Spreng.) Braun	+	+	+	+			+	+	+	
<i>Coelosphaerium kützingianum</i> Nägeli		+		+	+		+	+	+	
<i>C. nägelianum</i> Unger	+	+	+	+	+	+	+	+	+	+
<i>Dactylococcopsis acicularis</i> Lemm.	+	+	+	+						
<i>D. fascicularis</i> Lemm.	+		+	+	+	+	+		+	
<i>Isocystis sp.</i>					+	+	+		+	
<i>Lyngbya brachyneuta</i> Skuja						+	+	+	+	
<i>L. lacustris</i> Lemm.			+	+		+	+	+	+	+
<i>L. nigra</i> Agard			+	+	+	+			+	
<i>L. pseudospirulina</i> (Uterm.) Pasch.	+		+		+		+	+	+	+
<i>L. spiralis</i> Geitler	+						+		+	+
<i>L. sp.</i>	+	+				+	+		+	+
<i>Merismopedia elegans</i> Braun					+	+		+	+	+
<i>M. glauca</i> (Ehr.) Nägeli	+	+		+	+	+		+	+	+
<i>M. glauclata</i> Skuja	+	+	+	+				+	+	+
<i>M. punctata</i> Mayen		+	+			+				+
<i>M. sp.</i>	+	+	+			+		+		+
<i>Microcystis aeruginosa</i> Kütz.	+	+	+	+	+	+	+	+	+	+
<i>M. elachista</i> West	+	+	+	+		+	+			
<i>M. hansgirgiana</i> Elenk.	+	+		+						
<i>M. robusta</i> (Clarke) Nygaard		+	+		+	+	+	+		+
<i>Oscillatoria acuminata</i> Gomont	+	+	+	+	+		+	+	+	+
<i>O. agardhii</i> Gomont					+	+		+		+
<i>O. chalybae</i> (Mertens) Gomont	+	+		+				+	+	
<i>O. formosa</i> Bory	+		+					+		+
<i>O. geminata</i> Meneg	+	+	+	+	+	+	+	+	+	+
<i>O. lemmermannii</i> Woloszyn.	+	+		+	+		+			+
<i>O. limetica</i> Lemm.					+			+	+	+
<i>O. limosa</i> Agard.							+	+	+	
<i>O. maior</i> Vauch.	+		+		+	+	+	+	+	
<i>O. okenii</i> Agard	+	+	+	+	+					+
<i>O. quadripunctulata</i> Bruhl.		+	+	+	+	+				
<i>O. rubescens</i> Gomont	+	+	+							
<i>O. sancta</i> (Kütz) Gomont	+	+					+	+	+	
<i>O. setigera</i> Aptekari		+	+	+						
<i>O. sp.</i>	+	+	+		+			+		
<i>Psedanabaena africana</i> Schw.	+	+	+	+	+			+		
<i>P. crassa</i> Vozz.	+			+	+			+		
<i>P. minuta</i> Skuja	+			+	+	+	+		+	+

<i>P. schmidlei</i> Jaag.		+			+		+			+
<i>Synechocystis aquatilis</i> Sauv.		+		+	+		+	+		
<i>S. elongatum</i> Nägeli	+	+	+	+	+	+	+	+	+	+
<i>S. sp.</i>	+		+		+		+	+	+	+
Desmidiaceae										
<i>Closterium abruptum</i> West	+			+						
<i>C. aciculare</i> West	+	+	+	+	+	+	+	+	+	+
<i>C. leibleinii</i> Kütz.	+			+	+	+	+	+		+
<i>C. polystichum</i> Nyg							+		+	+
<i>Cosmarium australe</i> (Racib) Lütke	+	+		+	+			+	+	+
<i>C. moniliferum</i> (Turpin) Ralfs	+	+	+	+	+	+	+	+	+	+
<i>Desmidium baileyi</i> (Ralfs) Norst	+	+	+	+	+		+	+	+	+
<i>D. grevillii</i> (Kütz.) De Bary		+	+		+				+	+
<i>Docidium</i> sp.	+	+	+	+						
<i>Gonatozygon aculeatum</i> Schmid		+	+	+	+		+	+	+	+
<i>G. kinahani</i> Raben.		+	+	+	+	+	+		+	+
<i>Micrasterias cunningtonii</i> West	+		+	+	+	+	+	+	+	+
<i>M. divisa</i> (West) Krieger	+	+	+	+		+	+	+	+	
<i>Spirotaenia condensata</i> De Bréb		+	+	+		+	+	+		
<i>Staurostrum dickiei</i> Ralfs	+		+	+	+	+	+		+	+
<i>S. paradoxum</i> Meyen	+	+	+	+						
<i>S. tetracerum</i> Ralfs					+	+		+	+	
Dinophyceae										
<i>Ceratium hirundinella</i> Bergh	+	+	+	+	+	+	+	+	+	+
<i>Peridinium africanum</i> Lemm	+			+				+	+	+
<i>P. cinetum</i> Bergh	+	+	+	+						
<i>P. inconspicuum</i> Lemm							+			
<i>P. sp.</i>					+				+	
Euglenophyceae										
<i>Euglena acus</i> Ehr.	+	+	+	+	+	+	+	+	+	+
<i>E. caudata</i> Hubner	+	+			+		+	+		+
<i>E. gracilis</i> CKebs.					+	+	+			+
<i>E. granulata</i> (Klebs) Schmitz		+	+	+			+	+		+
<i>E. polymorpha</i> Dang	+	+	+							
<i>E. sp.</i>			+	+	+				+	
<i>Leponicilis ovum</i> (Ehr) Lemmer	+		+		+	+		+	+	
<i>Phacus longicauda</i> Ehr	+	+	+	+	+	+	+	+	+	+
<i>Trachelomonas ovalis</i> Von Daday	+		+	+			+	+	+	+
<i>T. sp.</i>	+			+	+	+			+	

Table 3: Summary of algal communities from streams of PNKB

	Stations									
	1	2	3	4	5	6	7	8	9	10
Algae abundances	965	1041	1035	1272	1079	865	1041	1037	1079	1010
Algae species	102	104	105	114	106	91	105	105	102	100
Algae genera	51	52	52	55	50	51	51	53	52	51
Species richness (<i>D</i>)	14.70	14.82	14.98	15.81	15.03	13.31	14.97	14.98	14.46	14.31
Shannon-Weiner (<i>H'</i>)	4.47	4.57	4.60	4.67	4.59	4.44	4.59	4.59	4.56	4.53
Equitability (<i>J</i>)	0.97	0.98	0.99	0.99	0.98	0.98	0.99	0.99	0.99	0.98

Six major algal groups were represented in the microflora of the sampled areas within the PNKB. These were the Bacillariophyceae (35.9%) with 20 genera, Chlorophyceae (17.6%) with 15 genera, Cyanophyceae (27.6%) with 12 genera, Desmidiaceae (10.0%) with 7 genera, Dinophyceae (2.9%) with 2 genera and Euglenophyceae (5.9%) with 4 genera. Bacillariophyceae and Cyanophyceae are the two groups represented in the PNKB's streams (table 2).

Bacillariophyceae

A total of 61 species of bacillariophyceae were identified (35.9% of the total) and distributed in 20 genera. The large number of species, 45 is recorded at station 4 and the small number (32) on station 1. The genera *Navicula* represent 14.8% with 9 species which *Navicula cuspidata* is the most important. The

Cymbella ranks second with six species (9.8%), but no species has dominated all stations. Beside *N. cuspidata*, there are a number of bacillariophyceae in proportion dominant and present in all stations such as *Frustulia rhomboides*, *Gomphonema angustatum*, *Melosira nyassensis*, *Nitzschia acicularis*, *Nitzschia filiformis* and *Synedra pulchella*. On the other hand, *Cymbella placentula*, *Eunotia arcus*, *Navicula muticoides*, *Navicula placentula*, *Nitzschia sp.* and *Rhopalodia gibberula* were localized only at most 3 stations.

Chlorophyceae

In total 30 species of chlorophyceae were identified (17.6% of the total) and distributed in 15 genera. The large number of species (19) recorded at stations 1, 4 and 7. The small number of species (15) is recorded at station 6.

They are dominated by the genera *Pediastrum* (5 species, or 16.7% of total chlorophyceae). In second place comes *Crucigenia* with 4 species and constitutes 13.3% of total chlorophyceae, the most important is *Crucigenia cuneiformis*. Dominant species and present in all stations are *Cladophora aerographila*, *C. cuneiformis*, *Mougeotia planctonica* and *Penium jenneri*. On the other hand, *Ankistrodesmus falcatus*, *Chaetophora sp.*, *Enteromorpha sp.*, *Pediastrum boryanum* and *Pediastrum clathratum* were localized only at most 3 stations.

Cyanophyceae

A total of 47 species of cyanophyceae were identified (27.6%) and distributed in 12 genera. The large number of species, 31 species was collected at station 2 and the small number (23) at station 6. The genera *Oscillatoria* (15 species or represents 31.9%) dominate this class and an important species is *Oscillatoria geminata*. The genera *Lyngbya* is the second with 5 species, representing 10.6% of the stock of cyanophyceae. No species of *Lyngbya* was found dominant in all stations. *Anabaena flos-aquae*, *Coelosphaerium nägelianum*, *Microcystis aeruginosa* and *Synechocystis elongatum* have dominated all stations. On the other hand, *Anabaenopsis tanganyikae*, *Microcystis hansgirgiana*, *Oscillatoria limosa*, *Oscillatoria rubescens*, *Oscillatoria setigera* were limited at most 3 stations.

Desmidiaceae

A total of 17 species of desmidiaceae were identified (10.0%) and divided into 7 genera. The large number of species (14) was collected at station 4 and the small number (9) at station 6. The desmidiaceae are represented by the genera *Closterium* which forms 28.6% of quantity with one species more important, *Closterium aciculare*. Only *Cosmarium moniliferum* is dominant and present in all stations and *Closterium abruptum* and *Closterium polystichum* were present only at most 3 stations.

Dinophyceae

A total of 5 species of Dinophyceae were identified (2.9%) and divided into 2 genera. The large number of species was collected in three stations 1, 4 and 9; and the small number (1) at station 6. They are mainly dominated by *Peridinium* (4 species, or 80.0% of dinophyceae) but none has dominated all stations. *Ceratium hirundinella* is the only dominant species present in all stations. *Peridium inconspicuum* and *Peridinium sp.* were limited at most two stations.

Euglenophyceae

A total of 10 species of euglenophyceae were identified (5.9%) and divided into 4 genera. The large number of species (7) was sampled at stations 1, 3 and 5; and the small number (5) at stations 2 and 6. They are represented by the genera *Euglena*, which forms 60.0% with 6 species of which *Euglena acus* is important. *Phacus longicauda* is the dominant species and present in all stations. Only *Euglena polymorpha* is limited to 3 stations.

DISCUSSION AND CONCLUSION

The epilithic algae of PNKB had never been studied. Our results raised that these benthic algal assemblages are very diversified and mainly composed of Bacillariophyceae followed by Cyanophyceae, Chlorophyceae, Desmidiaceae, Dinophyceae and finally Euglenophyceae. The list of species recorded in this paper was in general similar to the benthic algae composition found two years ago in watercourses of Lwiro region (Bisimwa et al., 2009). This species composition is also similar to the epibenthic algal community of the Bonny estuary (Chindah et al., 1993). The highest Shannon-Weiner index value (4.67) was recorded at station 4, this consequently resulted in the highest species diversity value (15.81) recorded at station 4 (table 3). This observation is in line with the earlier work reported by Bisimwa et al. (CRSN-Lwiro, personal communication) that the higher the value of Shannon-Weiner index (*H*) the greater the benthic algae diversity.

Some of the more abundant and present epilithic algae species recorded in all stations surveyed are *F. rhomboides*, *G. angustatum*, *M. nyassensis*, *N. cuspidata*, *N. acicularis*, *N. filiformis*, *S. pulchella*, *C. aerographila*, *C. cuneiformis*, *M. planctonica*, *P. jenneri*, *A. flos-aquae*, *C. nägelianum*, *M. aeruginosa*, *O. geminata*, *S. elongatum*, *C. aciculare*, *C. moniliferum*, *C. hirundinella*, *E. acus* and *P. longicauda* were less abundant but also present in all stations. According to Symoens et van Der Werff (1993) and Maillard (1978), these species are cosmopolitan with a wide ecological distribution. They are characteristic of bit mineralized, acid or dystrophic water. This group has a good value indicative of the chemical composition of the waters of these rivers less polluted. Many of these species occur also regularly in both

algal associations acidoclines peat lands in temperate regions, in associations acidobiontes tropical streams (Symoens et van Der Werff, 1993).

Distribution of epilithic algae with more dominant species in some stations may have several ecological implications. One possible alternative explanation for this phenomenon is the preference of environment by algae species, which may be associated with the physicochemical parameters and climatic factors but especially with the nutrient load of the river (Bennasser et al., 1997). In PNKB, these nutrients come from the decomposition of plant scraps, especially leaves, falling abundantly in or near some rivers. Phosphorus and nitrate are important in the development of benthic algae. They stimulate their growth and multiplication (Chindah et al., 1993). Similarly, the distribution of Bacillariophyceae species spread regardless of station, implied that the optimum conditions for its growth and reproduction is beneficial for this large group, despite variations in physicochemical parameters observed in all stations (Bagalwa et al., 2012).

This investigation showed that these benthic algal assemblages are much diversified. The epilithic algae of the PNKB were dominated by Bacillariophyceae followed by the Cyanophyceae, the Chlorophyceae, the Desmidiaceae, the Euglenophyceae and the Dinophyceae. There is need for other extensive ecological studies to be carried out in the PNKB.

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