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Assemblages des Algues Epibenthiques des cours d'eau du Parc National de Kahuzi-Biega (Est de la DR Congo)

[Epibenthic Algal Assemblages of Kahuzi-Biega National Park Streams (East of DR Congo)]

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ABSTRACT: This paper is a report on epibenthic algae identified in water samples recovered from Kahuzi-Biega National Park streams. The samples were collected during dry season (July-August 2007) from 10 streams. Altogether, some 170 species with 9,872 individuals have been identified, belonging to 6 algal groups containing 61 genera. Bacillariophyceae with 3,550 individuals (61 species, 20 genera) formed the most abundant group followed by Cyanophyceae with 2,551 individuals (47 species, 12 genera) and Chlorophyceae with 1,685 individuals (30 species, 15 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). The higher number of species (114 species, 55 genera) was recorded at station MV and the lesser number (91 species, 51 genera) at station MG.

KEYWORDS: Benthic algae, Species richness, Composition, Kahuzi-Biega National Park, DR Congo.

RESUME: Cet article un rapport sur les algues épibenthiques identifiées des échantillons d'eau des cours d'eau du Parc National de Kahuzi-Biega. Les échantillons ont été prélevés pendant la saison sèche (Juillet-Août 2007) à partir de 10 cours d'eau. Au total, quelque 170 espèces avec 9.872 individus ont été identifiées, appartenant à 6 groupes d'algues renfermant 61 genres. Les Bacillariophycées avec 3.550 individus (61 espèces, 20 genres) ont formés le groupe le plus abondant suivis par les Cyanophycées avec 2.551 individus (47 espèces, 12 genres) et le Chlorophycées avec 1.685 individus (30 espèces, 15 genres). Cette communauté d'algues est très diversifié et équilibré (indice de Shannon-Weiner a varié entre 4,44 à 4,67, la diversité des espèces entre 15,81 à 13,31 et l'équitabilité entre 0,97-0,99). Le nombre le plus élevé d'espèces (114 espèces, 55 genres) a été enregistré à la station MV et le plus petit nombre (91 espèces, 51 genres) à la station MG.

KEYWORDS: Algue benthique, Richesse Spécifique, Composition, Parc National de Kahuzi-Biega, RD Congo.

1 INTRODUCTION

The Kahuzi-Biega National Park (PNKB) coast is undergoing rapid environmental changes due to the increase in human population density in this area. Extremely high metropolitan growth rates in sensitive environments form a severe threat for terrestrial and aquatic ecosystems. For the past two decades in PNKB, human activities have increasingly threatened the stability of the aquatic ecosystem, thereby devastating its flora and fauna [1]. It is of particular interest because of its unique biodiversity contains, 44 species of larger mammals (including 10 primate species) have been reported from the highland region, 56 species (14 primate species) from the lowland region [2]. The highland region is characterised by bamboo forest (*Arudinaria alpine*) (37%), primary mountain forest (28%) in the west and northern parts of the Park, secondary mountain forest (20%) in the eastern part, *Cyperus latifolius* swamp (7%) and vegetation (8%), as described by Goodall [3] and Murnyak [4].

Biological surveys of stream communities have long been used to assess the impacts of human activities on receiving waters [5-8]. Stream biological integrity reveals itself in the condition, abundance, and diversity of its biota. These data may be used to assess stream condition relative to biological condition of an unimpaired stream. However, water quality assessments using biological criteria are less common than those based on stream chemistry or toxicology. A change in the physicochemical aspect of a water body brings about a corresponding change in the relative composition and abundance of the organisms in that water. Biomonitoring is the systematic use of living organisms or their responses to determine the quality of the environment [9]. Our objective is to investigate and provide information on the characteristic species and abundance of the epibenthic algal composition of PNKB streams.

The benthic algae are good bioindicators [10], since assemblages composition quickly responds to environmental changes due to their relatively short life spans and rapid immigration rates [11]. They can be also applied in general aquatic bioassessment, which uses species richness, composition and abundance to assess human impacts on aquatic environments and global biodiversity changes [7]. Habitat destruction and eutrophication threaten many epibenthic algae species with extinction. The most threatened species are these, which occur only in restricted habitats, and are usually found in low numbers. Species richness is related to environmental conditions, habitat heterogeneity [12], depends on the sample size [13] and survey intensity.

2 MATERIALS AND METHODS

2.1 STUDY AREA

The PNKB, having an area of 600,000 ha [1,14], is situated in Eastern DR Congo in the Albertine Rift region. It is located within latitudes 1° 36'S and 2°37'S and longitudes 27°33'E and 28°46E (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. Because of its varied topography, the average temperature in the high altitude is around 18^{o}C, but it varies in the corridor between 19 and 22^{o}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/cm^3 per month. The average relative humidity is also high, 83% with a maximum of 84% and a minimum of 82% [1,15].

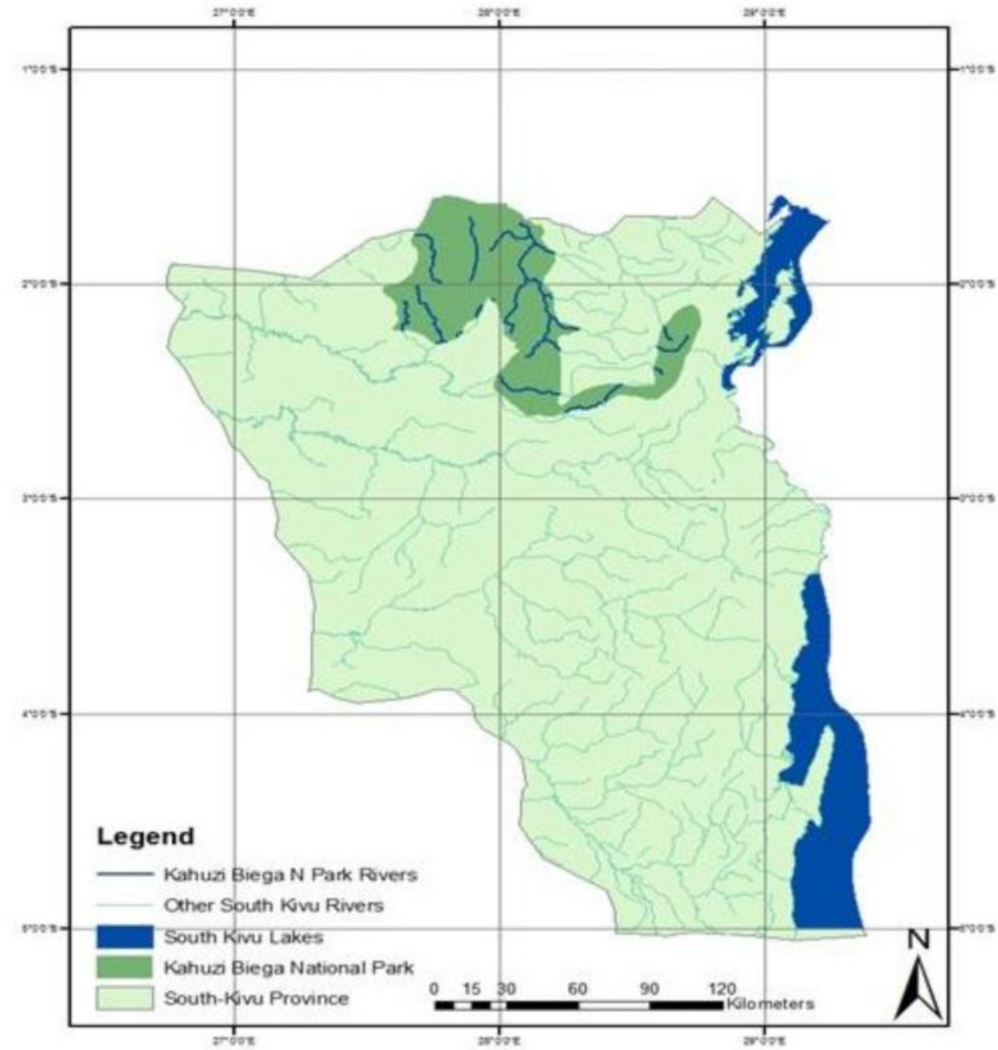

Figure 1. Geographical situation maps of PNKB

2.2 SAMPLE COLLECTIONS AND ANALYSES

Data used in our analyses were compiled by Bisimwa et al. [1] surveys of PNKB streams conducted from July to August 2009. Epibenthic algae were sampled from 10 streams (Bwangizi, Chumba, Chanderema, Chitori, Cinhya, Langa, Mirembo, Mugaba, Mushuva et Nabugobugo) (figure 2) situated between 1900 and 2400 m asl. The streams, draining into the southeastern side of PNKB, 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 MG, CY and CR were almost open with little direct shading during the day. Small pebbles, sand and clay dominated the substrate at all sampling locations. Characterization of each stream station included water chemistry variables and stream habitat/environmental variables. The methods used in, and the results of, these analyses were previously reported [1,16].

The rocks or stones were scraped clean of the epibenthic algae with a toothbrush at 25 cm^2 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 [17,18]. 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 [17,19,20]. Descriptive keys and illustrations of the following authors were used: [21-25]. In order to determined community structure, the Shannon-Weiner index (*H*), Species richness index (*D*) and Species Equitability (*J*) were applied [26-30].

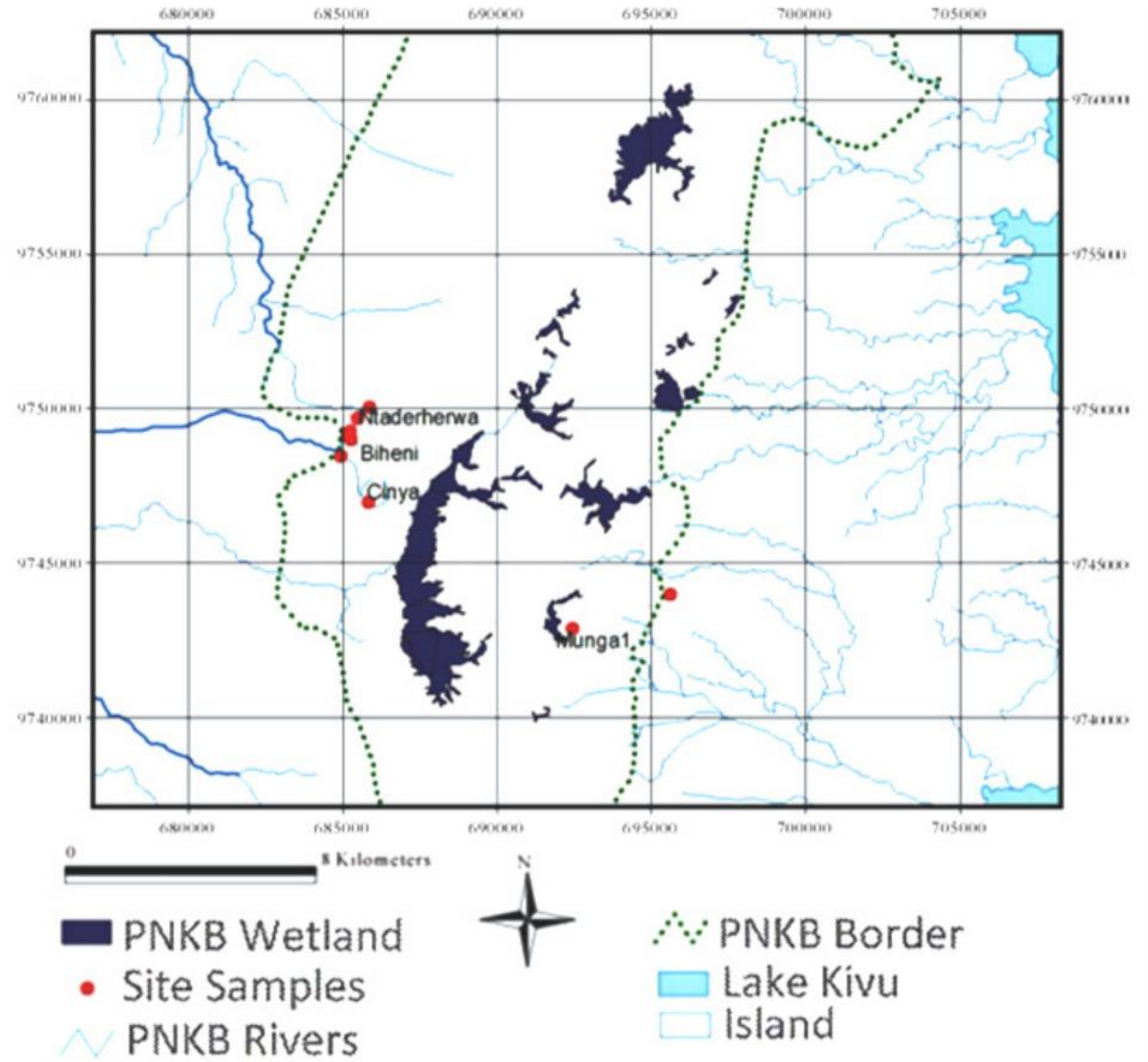

Figure 2. Locations of sampling station in PNKB

3 RESULTS

The physicochemical parameters of lakes, ponds and rivers have considerable effect on the aquatic life. These parameters determine the productivity of a water body. The results of some of chemistry parameters are summarized in table 1.

Table 1. Mean value of water chemistry sampled in PNKB streams

LG=Langa, CM=Chanderema, NG=Nabugobugo, MV=Mushuva, MB=Mirembo, MG=Mugaba, BZ=Bwangizi, CY=Cinhya, CB=Chumba, CR=Chitori. TP=Total Phosphorous, TN=Total Nitrogen, SM=Suspended Matters, DO=Dissout Oxygen

Parameters	Stations				
	LG	CM	NG	MV	MB
Temperature (ºC)	14.9 ± 0.12	14.1 ± 0.2	13.8 ± 0.1	11.3 ± 1.3	13.3 ± 0.3
pH	7.0 ± 0.1	6.1 ± 0.4	5.6 ± 0.4	7.7 ± 0.1	6.3 ± 0.2
Flow (m^3/S)	0.1 ± 0.02	0.02 ± 0.1	0.1 ± 0.04	0.1 ± 0.4	0.03 ± 0.01
Conductivity (µS/cm)	17.0 ± 3.2	54.0 ± 4.2	12.5 ± 1.2	64.0 ± 3.0	17.0 ± 2.0
Ammonium (µmol/L)	2.9 ± 1.2	3.4 ± 1.2	2.8 ± 0.1	2.4 ± 0.2	3.1 ± 0.1
Nitrite (µmol/L)	0.3 ± 0.04	0.5 ± 0.02	0.5 ± 0.01	0.4 ± 0.1	0.3 ± 0.1
Nitrate (µmol/L)	0.2 ± 0.3	0.4 ± 0.1	0.3 ± 0.1	0.3 ± 0.2	0.3 ± 0.1
TP (µmol/L)	0.1 ± 0.01	0.6 ± 0.04	0.1 ± 0.1	0.3 ± 0.02	0.1 ± 0.01
TN (µmol/L)	3.4 ± 0.1	4.3 ± 1.1	3.6 ± 0.01	2.8 ± 1.03	3.7 ± 1.02
Alkalinity (mg/L)	11.0 ± 0.1	14.0 ± 0.03	3.5 ± 0.02	13.0 ± 0.1	5.5 ± 0.5
SM (mg/L)	0.1 ± 0.4	1.0 ± 0.1	0.2 ± 0.1	1.5 ± 0.3	0.9 ± 0.1
DO (mg/L)	7.6 ± 0.2	7.6 ± 0.3	4.3 ± 0.2	6.2 ± 0.7	6.1 ± 0.4

Parameters	Stations				
	MG	BZ	CY	CB	CR
Temperature (ºC)	14.1 ± 0.2	13.8 ± 0.2	13.3 ± 0.01	14.6 ± 0.02	14.5 ± 0.02
pH	7.1 ± 0.4	6.1 ± 0.5	5.7 ± 0.4	5.6 ± 0.8	5.5 ± 1.1
Flow (m^3/S)	0.1 ± 0.04	0.8 ± 0.04	0.04 ± 0.01	0.1 ± 0.1	0.02 ± 0.1
Conductivity (µS/cm)	23.6 ± 0.3	13.0 ± 2.5	11.5 ± 0.8	13.0 ± 0.1	14.0 ± 2.4
Ammonium (µmol/L)	2.8 ± 0.03	1.7 ± 1.1	1.4 ± 0.02	1.4 ± 0.01	2.8 ± 0.1
Nitrite (µmol/L)	0.4 ± 0.04	0.8 ± 0.02	0.5 ± 0.04	0.5 ± 0.03	0.5 ± 0.1
Nitrate (µmol/L)	0.3 ± 0.03	0.3 ± 0.1	0.4 ± 0.01	0.3 ± 0.02	0.3 ± 0.1
TP (µmol/L)	0.2 ± 0.01	0.1 ± 0.01	0.3 ± 0.02	0.1 ± 0.01	0.1 ± 0.01
TN (µmol/L)	3.5 ± 0.1	2.8 ± 0.03	3.7 ± 0.1	2.2 ± 0.8	3.6 ± 0.04
Alkalinity (mg/L)	6.3 ± 0.7	6.0 ± 1.2	2.5 ± 0.5	2.0 ± 0.4	2.0 ± 0.8
SM (mg/L)	0.2 ± 0.1	0.8 ± 0.1	0.1 ± 0.03	0.1 ± 0.1	0.3 ± 0.01
DO (mg/L)	4.8 ± 2.1	5.7 ± 0.6	2.6 ± 0.2	5.7 ± 0.4	5.4 ± 0.3

During investigation, 170 species were recorded from PNKB streams. The algal species were belonging to 6 algal groups containing 61 genera (table 2). The epibenthic algal assemblages over the sampling period were dominated by Bacillariophyceae (61 species, 20 genera), Cyanophyceae (47 species, 12 genera) and Chlorophyceae (30 species, 15 genera). The rest of the assemblages were composed by Desmidiaceae (17 species, 7 genera), Euglenophyceae (10 species, 4 genera) and Dinophyceae (5 species, 2 genera) (figure 3). The greatest species number was found at station MV (114 species from 55 genera), followed by station MB (106 species from 50 genera). The algae flora of station MG was with less species number, only 91 species from 51 genera were observed (figure 4). Highest species diversity (15.81) was recorded at station MV while station MG 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 MV and station MG. The Equitability index was highest (0.99) at stations NG, MV, BZ, CY and CB while the lowest value (0.97) was recorded at station LG.

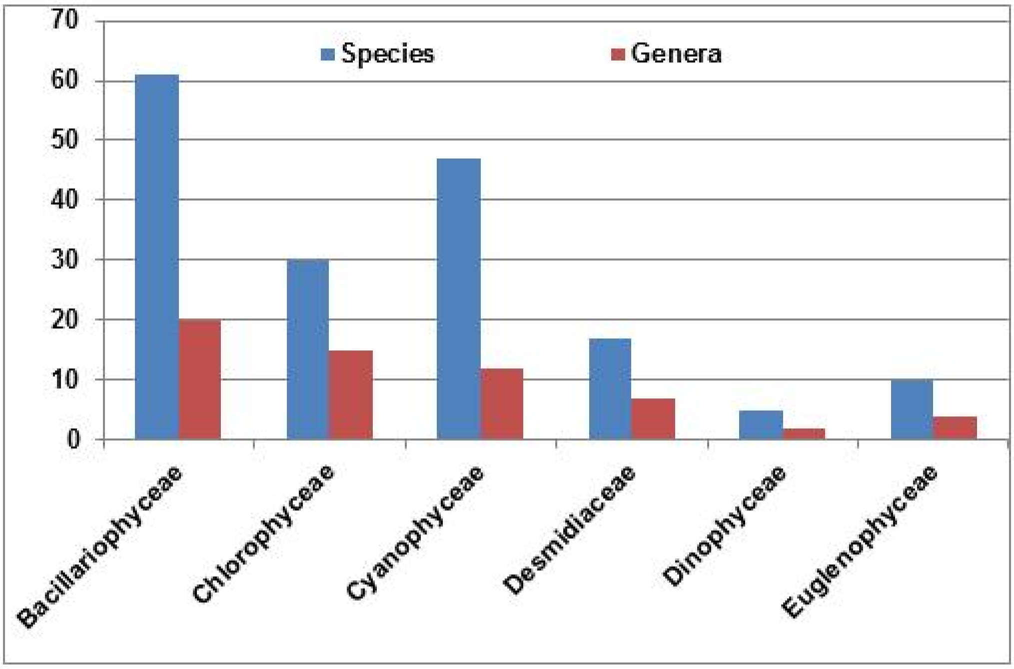

Figure 3. Distribution of epibenthic algae in different algal groups

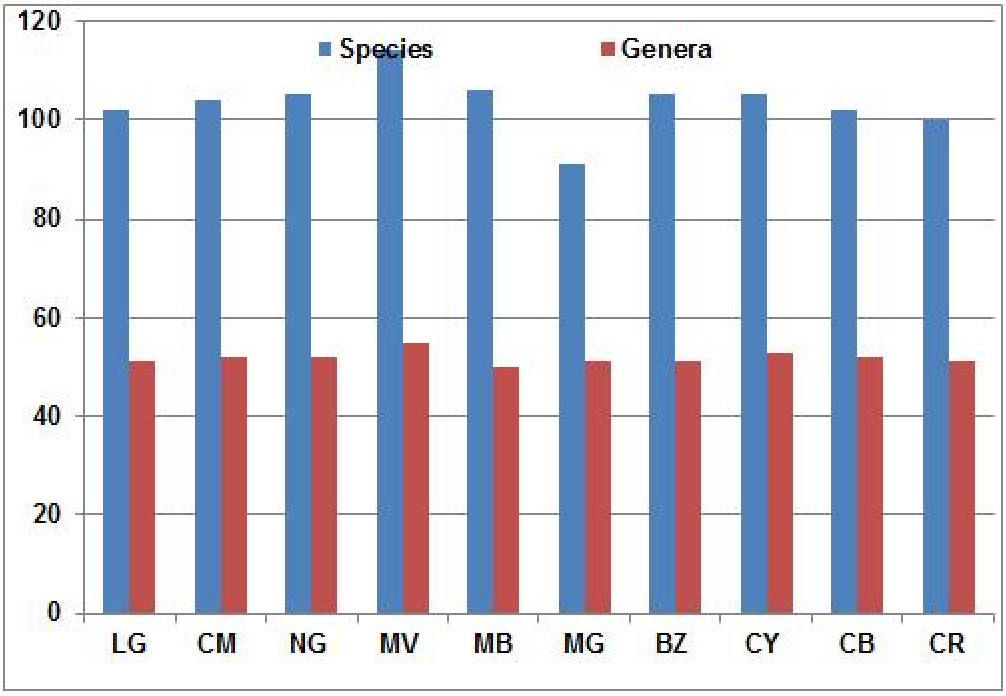

Figure 4. Variation of epibenthic algae in different streams of PNKB

Table 2: Epibenthic algae encountered during the study period in PNKB streams

LG=Langa, CM=Chanderema, NG=Nabugobugo, MV=Mushuva, MB=Mirembo, MG=Mugaba, BZ=Bwangizi, CY=Cinhya, CB=Chumba, CR=Chitori.
Grp.=Group, Com.=Community

Species	Stations										Total	% in Grp.	% in Com.
	LG	CM	NG	MV	MB	MG	BZ	CY	CB	CR			
Bacillariophyceae													
Achnanthes	11	8	0	25	16	9	5	13	10	16	113	3,2	1,1
Amphora	10	7	10	15	24	0	8	0	0	23	97	2,7	1,0
Cyclotella	0	0	8	10	34	8	18	23	10	43	154	4,3	1,6
Cymbella	33	29	28	81	41	16	30	27	18	33	336	9,5	3,4
Diatoma	0	0	22	16	13	9	7	12	7	4	90	2,5	0,9
Epithemia	10	11	0	5	0	5	18	12	18	15	94	2,6	1,0
Eunotia	19	22	20	16	10	5	21	18	18	21	170	4,8	1,7
Fragilaria	20	21	19	14	29	18	17	6	23	12	179	5,0	1,8
Frustulia	9	11	9	24	19	24	21	8	11	7	143	4,0	1,4
Gomphocymbella	0	12	13	8	16	0	0	4	15	28	96	2,7	1,0
Gomphonema	31	33	30	10	25	37	41	41	49	14	311	8,8	3,2
Gyrosigma	12	0	0	10	20	14	13	20	0	5	94	2,6	1,0
Melosira	6	30	17	11	13	9	17	17	16	23	159	4,5	1,6
Navicula	38	64	50	86	58	62	70	55	69	35	587	16,5	5,9
Nitzschia	36	38	52	36	23	41	14	27	38	33	338	9,5	3,4
Pinnularia	11	19	8	21	0	18	11	0	0	5	93	2,6	0,9
Rhopalodia	0	10	19	18	6	8	0	5	0	5	71	2,0	0,7
Surirella	13	7	22	26	16	17	14	12	5	9	141	4,0	1,4
Synedra	11	19	38	17	25	10	34	29	15	12	210	5,9	2,1
Tabellaria	0	6	8	10	5	4	9	14	14	4	74	2,1	0,7
Total	**270**	**347**	**373**	**459**	**393**	**314**	**368**	**343**	**336**	**347**	**3550**	100,0	36,0
Chlorophyceae													
Ankistrodesmus	10	11	0	5	5	13	22	7	32	9	114	6,8	1,2
Cladophora	21	18	23	15	14	11	13	8	10	14	147	8,7	1,5
Chaetophora	5	12	0	0	0	0	0	0	0	0	17	1,0	0,2
Chlorella	6	10	0	5	4	0	0	11	10	0	46	2,7	0,5
Crucigenia	25	39	31	30	22	11	31	13	25	45	272	16,1	2,8
Enteromorpha	6	9	10	0	27	10	0	18	0	9	89	5,3	0,9
Kirchneriella	10	9	0	0	0	12	18	0	5	0	54	3,2	0,5
Microspora	0	0	0	0	0	0	5	5	5	5	20	1,2	0,2
Mougeotia	9	12	18	15	16	13	7	11	14	10	125	7,4	1,3
Pediastrum	15	23	24	49	17	18	16	20	11	19	212	12,6	2,1
Penium	19	14	12	18	13	4	11	13	15	14	133	7,9	1,3
Protoccus	15	0	5	13	0	8	5	8	5	9	68	4,0	0,7
Rhizoclonium	19	15	11	19	17	10	23	10	9	26	159	9,4	1,6
Richteriella	4	11	7	9	0	0	0	10	5	10	56	3,3	0,6
Sorastrum	21	5	8	24	27	15	20	16	20	17	173	10,3	1,8
Total	**185**	**188**	**149**	**202**	**162**	**125**	**171**	**150**	**166**	**187**	**1685**	100,0	17,1
Cyanophyceae													
Anabaena	18	15	4	10	4	13	4	28	16	23	135	5,3	1,4
Anabaenopsis	0	10	17	10	0	0	0	0	0	0	37	1,5	0,4
Aphanocapsa	10	21	8	15	0	13	24	19	20	0	130	5,1	1,3
Coelosphaerium	11	18	6	28	19	4	15	17	21	12	151	5,9	1,5
Dactylococcopsis	14	9	22	21	5	10	18	0	10	0	109	4,3	1,1

Isocystis	0	0	0	0	13	6	18	0	10	0	47	1,8	0,5
Lyngbya	26	10	30	24	14	30	42	29	68	38	311	12,2	3,2
Merismopedia	29	40	35	18	17	42	0	43	31	56	311	12,2	3,2
Microcystis .	32	36	24	31	22	32	24	19	8	14	242	9,5	2,5
Oscillatoria	87	90	84	71	81	29	52	89	64	54	701	27,5	7,1
Psedanabaena	24	25	10	31	35	6	17	18	10	22	198	7,8	2,0
Synechocistis	15	16	17	17	25	5	24	24	13	23	179	7,0	1,8
Total	**266**	**290**	**257**	**276**	**235**	**190**	**238**	**286**	**271**	**242**	**2551**	100,0	25,8
Desmidiaceae													
Closterium	26	10	14	35	20	25	21	19	22	27	219	19,9	2,2
Cosmarium	16	17	8	21	20	13	6	21	18	17	157	14,3	1,6
Desmidium	10	20	20	10	20	0	10	10	20	20	140	12,7	1,4
Docidium	10	10	4	9							33	3,0	0,3
Gonatozygon	0	20	29	27	23	4	15	10	17	20	165	15,0	1,7
Micrasterias	25	9	20	20	10	15	19	20	17	13	168	15,3	1,7
Spirotaenia	0	12	10	9	0	9	10	10	0	0	60	5,5	0,6
Staurastrum	18	12	17	15	13	19	14	10	24	16	158	14,4	1,6
Total	**105**	**110**	**122**	**146**	**106**	**85**	**95**	**100**	**118**	**113**	**1100**	100,0	11,1
Dinophyceae													
Ceratium	14	18	13	18	16	12	17	19	17	15	159	52,3	1,6
Peridinum	26	19	12	28	10	0	10	9	21	10	145	47,7	1,5
Total	**40**	**37**	**25**	**46**	**26**	**12**	**27**	**28**	**38**	**25**	**304**	100,0	3,1
Euglenophyceae													
Euglena	38	36	50	31	45	21	43	32	25	51	372	54,5	3,8
Leponicilis	10	0	10	0	13	5	0	12	10	0	60	8,8	0,6
Phacus	11	13	15	9	8	14	10	16	14	12	122	17,9	1,2
Trachelomonas	20	0	10	30	10	0	10	10	28	10	128	18,8	1,3
Total	**79**	**49**	**85**	**70**	**76**	**40**	**63**	**70**	**77**	**73**	**682**	100,0	6,9
Grand Total	**945**	**1021**	**1011**	**1199**	**998**	**766**	**962**	**977**	**1006**	**987**	**9872**		100,0

Bacillariophyceae stood out due to their numerical abundance and frequency of occurrence, and together accounted for 3,550 individuals representing 36.0% of the algal community (table 2). The large number (459 individuals with 45 species) was recorded at station MV and the small number (270 individuals with 32 species) on station LG. The *Navicula* represent 16.5% of the bacillariophyceae with 9 species which *Navicula cuspidata* was the most important. The *Cymbella* and *Nitzschia* ranks second (9.5%) with respectively 6 and 5 species. 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.

Cyanophyceae was the second most numerous group (2,551 individuals, 25.8% of the algal community), although with a smaller contribution than bacillariophyceae (table 2). The large number (290 individuals with 31 species) was collected at station CM and the small number (190 individuals with 23 species) at station MG. The *Oscillatoria* (27.5%, 15 species) dominate this class and an important species was *Oscillatoria geminata*. The *Lyngbya* and *Merismopedia* were the second genera with respectively 6 and 5 species, representing 12.2% of the stock of cyanophyceae. *Anabaena flos-aquae, Coelosphaerium nägelianum, Microcystis aeruginosa* and *Synechocistis elongatum* have dominated all stations. On the other hand, *Anabaenopsis tanganikae*, *Microcystis hansgirgiana*, *Oscillatoria limosa, Oscillatoria rubescens, Oscillatoria setigera* were limited at most 3 stations.

Chlorophyceae was the third numerous group with 1,685 individuals representing 17.1% of the epibenthic algal assemblages (table 2). The large number of chlorophyceae (202 individuals with 19 species) was recorded at stations MV. The small number (125 individuals with 15 species) was recorded at station MG. They are dominated by the genera *Crucigenia* (4 species), 16.1% of total chlorophyceae. In second place comes *Pediastrum* with 5 species and constitutes 12.6% of total chlorophyceae, the most important species was *Crucigenia cuneiformis*. Dominant species and present in all stations were

Cladophora aeragrophila, *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.

Desmidiaceae was the fourth numerous groups accounted for 1,100 individuals representing 11.1% of the algal community. It was represented by *Closterium* which forms 19.9% of the group with 4 species and *Micrasterias* which forms 15.3% with 2 species. *Closterium aciculare* was more important species. The large number of desmidiaceae (146 individuals with 14 species) was collected at station MV and the small number (85 individuals with 9 species) at station MG. Only *Cosmarium moniliferum* is dominant and present in all stations and *Closterium abruptum* and *Closterium polystichum* were present only at most 3 stations.

Euglenophyceae (682 individuals, 6.9%) and Dinophyceae (304 individuals, 3.1%) were represented respectively by *Euglena* (54.5% with 6 species) and *Ceratium* (52.3% with 1 species). The large number of Euglenophyceae (85 individuals with 7 species) was sampled at stations LG; and the small number (40 with 5 species) at stations MG. *Euglena acus* is important species of the group. *Phacus longicauda* is the dominant species and present in all stations. Only *Euglena polymorpha* is limited to 3 stations. The large number of Dinophyceae (46 individuals with 3 species) was collected at stations MV; and the small number (12 with 1 species) at station MG. *Ceratium hirundinella* is the only dominant specie present in all stations. *Peridium inconspicuum* and *Peridinum sp.* were limited at most two stations.

4 Discussion and Conclusion

The results of this study showed that these epibenthic algal assemblages are much 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 other benthic algae composition of the tropical rivers [1,31-34]. It is possible that natural potential of habitat for colonization, presence of different ecological niches as well as nutrient quantity and quality are main factors responsible for diverse (170 species) epibenthic flora. This is in agreement with the work of Lindahi and Melin [35] showing that nitrate and phosphate stimulate the growth of algae. The highest Shannon-Weiner index value (4.67) was recorded at station MV, this consequently resulted in the highest species diversity value (15.81) recorded at station MV. This observation is in line with the earlier work reported by Bisimwa et al. [1] that the higher the value of Shannon-Weiner index (*H*) the greater the benthic algae diversity. Heterogeneous bottom habitat of station MV (muddy bed with non-decomposed fragments of water plants, sand and gravel), accompanied with high concentration of detritus and high average concentration of dissolved oxygen, probably contributes to species richness and abundance of epibenthic algae.

The development of large numbers of cosmopolitan species in PNKB streams, such as *F. rhomboides, G. angustatum, M. nyassensis, N. cuspidata, N. acicularis, N. filiformis, S. pulchella, C. aeragrophila, C. cuneiformis, M. planctonica, P. jenneri, A. flos-aquae, C. nägelianum, M. aeruginosa, O. geminate, S. elongatum, C. aciculare, C. moniliferum, C. hirundinella, E. acus* and *P. longicauda* is typical of many other tropical rivers [1,31-34]. 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 [1,16]. Many of these species occur also regularly in both algal associations acidoclines peat lands in temperate regions, in associations acidobiontes tropical streams [1,33]. The abundance and diversity of epibenthic algae vary according to limnological features and the trophic state of freshwater bodies [36]. Total epibenthic algae abundance may increase with increasing eutrophication. Composition and diversity of epibenthic algae provide information on the characteristics and quality of the water body [19,20,37,38].

The distribution of the 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 [19,20,37-39]. 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 [17]. 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 [16]. Bisimwa et al. [1] reported that there was need for other extensive ecological studies to be carried out in the PNKB streams.

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