Typology of the Phytoplankton Community of Dohou Lake, Drinking Water Supply Source in Duékoué Town (Western Côte d'Ivoire)

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Abstract

The objective is to study the phytoplankton community of Dohou Lake in order to contribute to the knowledge of its ecological quality. For this purpose, monthly samplings were carried out annually between October 2017 and September 2018. The studied physicochemical parameters (Temperature, Electrical conductivity, pH, Dissolved oxygen, Transparency, Depth, Total nitrogen, Nitrate, Nitrite, Total phosphorus) varied significantly over time. During the

rainy season months, Dohou Lake is influenced by high values of total phosphorus, total nitrogen, conductivity, nitrate, pH, transparency and depth. However, in the dry season, the lake is characterized by high values of temperature, nitrite, dissolved oxygen and conductivity. For the phytoplankton community, 373 phytoplankton taxa divided into 111 genera, 51 families, 24 orders, 11 classes and 7 phyla (Chlorophyta, Euglenophyta, Cyanobacteria, Bacillariophyta, Pyrrophyta, Chrysophyta and Xanthophyta) have been identified. Chlorophyta with 50.67% is the most represented in the taxonomic richness of the environment. Total phytoplankton densities oscillate between 100 10^5 cells / L (August) and 321 10^5 cells / L (February) with high proportions of Cyanobacteria greater than 45% during each month of the rainy season. The highest values of Shannon and Equitability diversities are observed during the dry season months.

Keywords: Phytoplankton community, Dohou Lake, Diversity, Physicochemical parameters

1. Introduction

For the satisfaction of vital needs, man has been led to master and dominate his environment. One of the voices of this quest for well-being has manifested itself in the control of Water. Storage of large amounts of water during rainy seasons to address dry season water shortages will lead to the creation of artificial water reservoirs (Baxter & Glaude, 1980).

In Côte d'Ivoire, to meet drinking water needs, surface water is exploited and processed to supply urban and rural populations (Eblin et al., 2014). This is the case of Dohou Lake in Duékoué used by the Water Distribution Company of Côte d'Ivoire (SO.DE.CI) to supply the population of the city with drinking water. This lake, formerly the extension of the city, is today subject to several human activities because of its position near the city.

Rapid and unplanned urbanization, market gardening, artisanal gravel quarries and mechanical garages on the edge of the lake make it a reservoir of urban effluent. Is the latter likely to impact the quality of this water? In order to be better located and to minimize the health risks, the examination of the quality of this water body is therefore necessary and imperative. This exercise involves studying both the chemical quality of water and biological diversity. A recent study was conducted by Kouame et al. (2019) to characterize the typology of this water from physico-chemistry and bacteriology. However, the measurement of physico-chemical parameters makes it possible to collect only simple and punctual information and their concentrations seem to influence aquatic fertility (Naselli-Flores, 2000).

To further contribute to the knowledge of the ecology of Lake Dohou, it was therefore necessary to consider the structure of the community of certain aquatic organisms, which gives a clear idea of the quality of the water, confirming the physicochemical values obtained from the same surveys, which allows us to assess the state of health of the given ecosystem (Morin, 2006). In this context, phytoplankton is therefore one of the most dynamic indicators (Collins et al., 2014, Nunes et al., 2018) because of its high species diversity and high growth rates (up to more than one division). per hour (Furnas, 1991) and its rapid responses to changes in environmental conditions (Anneville et al., 2008). These organisms are at the base of the food web and are the first link in this network to respond to even the most discrete environmental disturbances (Hays et al., 2005). The responses are variable and can be manifested in terms of the degree of disturbance in time and space. However, too much

phytoplankton production can affect the quality of drinking water and cause various ecological and health problems (Rondel et al., 2008). These blooms are particularly responsible for significant deoxygenation of the water column that can lead to high mortality among other pelagic communities. The trophic impasse that certain species represent, because of their toxicity, their size or their poor nutritional quality, can also lead to a significant reduction in the abundance and diversity of their predators and, consequently, higher trophic levels. (Carmichael et al., 2010).

The objective is to study the phytoplankton community of Dohou Lake in order to contribute to the knowledge of its ecological quality.

2. Material and Methods

2.1 Study Area

Dohou Lake is in the town of Duékoué, a town located in the west of Côte d'Ivoire at 470 km from Abidjan. This Dohou lake belongs to the Sassandra river basin in the Guémon region. This locality enjoys a humid tropical climate, characterized by a rainy season (April to October) and a dry season (November to March) (Brou, 2005). The vegetation consists of dense moist forest marked by grassland areas (Brou, 2005) and soils are generally ferralitic and hydromorphic (Kouassi et al., 2012). On the outskirts of the city of Duékoué on the road to Man, Lake Dohou is an artificial reservoir of water to supply the population of this city with drinking water. It covers an area of about 1 km² (Figure1) between latitudes 6°45'07"73 and 6°45'35"91 N and longitudes 7°21'06.25 and 7°21'49.31 W. The lake is subject to several human activities including fishing, vegetable crops, artisanal gravel quarries, mechanical garages and farms nearby. It also receives waste runoff from runoff as well as wastewater from nearby homes and the city.
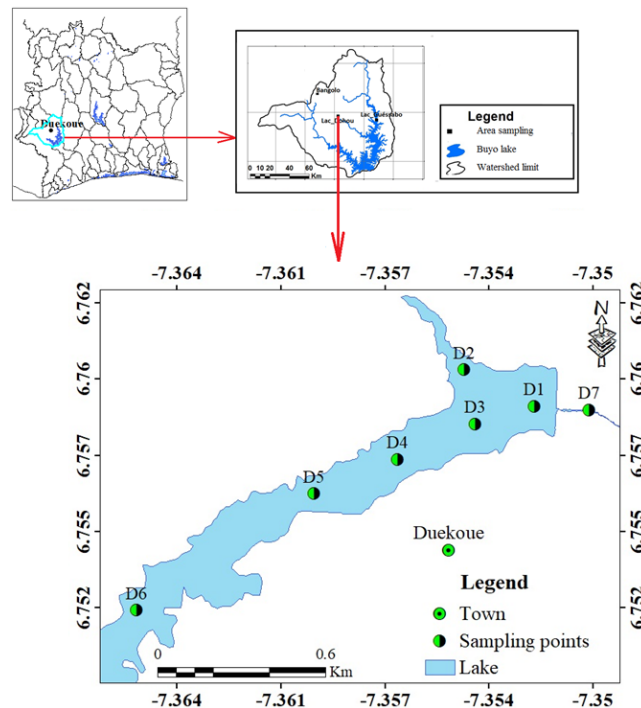

Figure 1. Map showing position of sampling points on Dohou Lake

2.2 Sampling

Sampling was conducted annually between October 2017 and September 2018 due to one campaign per month at the seven stations selected in the lake. These sampling stations were chosen according to their accessibility, water permanence and environmental characteristics.

Physico-chemical parameters such as temperature, pH, dissolved oxygen and conductivity were measured *in situ* with a multi HANNA HI 9828PH / ORP / CE. Transparency and depth were also determined with Secchi's disc and a weighted string. Nitrate, nitrite, Kjeldahl nitrogen and total phosphorus were determined by the molecular absorption spectrophotometric method according to French Standards T90-012, T90-013, T90-023 and T90-110 respectively. The spectrophotometer (pharma UV -1700 / SHIMADZU evident) was used for these analyses. Total nitrogen was estimated from the addition of Kjeldahl nitrogen to nitrate and nitrite.

For phytoplankton sampling, one liter of water samples was collected at one meter from the surface at each station with an integrated sampler. The samples collected were stored in labelled bottles (100 mL) and fixed with 5% formaldehyde.

2.3 Identification and Enumeration

The samples were first observed between slide and coverglass under optical microscope made LEICA-type with objective 40x. The identification of phytoplankton down to the species level was carried out on morphological characteristics using a combination of works (Philipose, 1967; Compère, 1977; Couté & Iltis, 1981; Komárek & Fott, 1983; Uherkovich, 1995; Ouattara et al., 2000; Komárek & Anagnostidis, 2005).

The enumeration of phytoplankton organisms was performed according to the Utermöhl (1958) method using a LEICA-type inverted microscope at 63x immersion magnification. After homogenization of the sample, a volume of 10 mL of the sample is taken and sedimented for 8 hours in a sedimentation tank. 35 fields were counted and in each field the number of cells (or counting unit) was determined. Moreover, a filament is considered as an individual and the number of cells is obtained by relating to the length of the filament the length of a cell, dimensions measured using an ocular micrometer. In the same way, the number of cells of the colonial algae is estimated by the measurement of the dimensions of the colony (form related to the nearest geometry). For simple shapes, the number of cells is determined at the time of counting. According to the AFNOR NF EN 15204 / T90-379 standard, a counting reliability of 5% is respected by counting (at least) 400 algal objects, as far as possible. Note that empty cells (without plastids) are not counted.

2.4 Data and Statistical Analysis

- Species richness, which is the number of taxa to which the taxa belong (Alliaume et al., 1990).

- The absolute density (Da) of the different algal groups encountered in a medium is determined using the following formula: $Da = n * S / s * v$ with n: the number of counted cells; S: the surface of the tank to be sedimented; s: the observed surface; v: sedimented volume.

- The relative density (Dr) is the density of each branch, group or entity on the total density of the middle individuals. It is expressed by $Dr = d / Da$ with Dr: relative density; d: density of each branch; Da: absolute density.

-Structure of the phytoplankton community was determined from the diversity index of Shannon and Weaver and the index of regularity of Pielou. The first index reflects how individuals are distributed among the various species that make up this stand (Daget, 1979) its expression is as follows: $H' = -\sum_{i=0}^{R_S} q_i \times \log_2(q_i)$, q_i = proportion of the ith species (i varying from 1 to R_s); R_s = total number of species. The second index reflects the quality of organization of a community in an environment (Amanieu & Lasserre, 1982; Dajoz, 2000) and is expressed as follows: $E = \dfrac{H'}{(Log_2 \times R_s)} \times 100$; E = equitability index; $H' =$ Shannon-Wiener diversity index; R_s = number of species

The statistical analysis was performed using PAST 3.24 software. From the principal component analysis (PCA), the realization of the factorial map, the correlation between the different parameters, and the classification of the months have been established (Hammer, 2011). The principle of the realization of the factorial map is based on the representation of the temporal distribution of the different parameters. The classification of the months rests on the grouping of these according to the parameters to study. Parametric test (t-test) was used to compare the abiotic and biotic variables studied at the 5% significance level.

3. Results and Discussion

3.1 Physicochemical Parameters

Monthly and seasonal variations in the physicochemical characteristics of Dohou Lake are shown in Figure 2 and Table 1, respectively. Thus, averages of temperature values are between 25.44 ± 0.56 °C (August) and 29.8 ± 1.25 °C (October) (Figure 2a). Seasonal averages of this parameter are 26.55±1.55 °C in rainy season and 27.62±1.55 °C in dry season. Concerning electrical conductivity, the lowest mean value is observed in September (39.71 ± 5.62 μS[-1]) and the highest average electrical conductivity value in June (50.14 ± 0.38 μS[-1]) (Figure 2b). During seasons, electrical conductivity changes between 43.27±3.16 μS[-1] in dry season and 43.38±4.19 μS[-1] in rainy season. For the average pH values, the extremes 4.82 ± 0.39 and 6.82 ± 0.23 are respectively recorded in March and December (Figure 2c). In rainy and dry season, averages of pH are 5.75±0.44 and 5.9±0.9 respectively. For dissolved oxygen, means monthly values range from 2.64 ± 1.06 mgL[-1] in April to 7.66 ± 0.23 mgL[-1] in March (Figure 2d). Its average values are 4.93±1.97 mg. L[-1] in dry season and 5.15±1.77 mg. L[-1] in rainy season. Transparency has the lowest average value (0.39 ± 0.14 cm) in February and the highest average value in October (0.82 ± 0.24 cm) (Figure 2e). In dry season, average value of transparency is 0.49±0.23 m. Recorded average value of this parameter is 0.6±0.22 in rainy season. As for the average of depth is low (1.53 ± 0.83 m) in February and high (2.45 ± 0.74 m) in November (Figure 2f). Depth varies on average from 2.19±0.98 m in dry season to 2.28±0.99 m in rainy season. As for the nitrate concentrations, the average values are noted between 1.56 ± 0.315 mg. L[-1] in January and 7.77 ± 2.01 mg. L[-1] in August (Figure 2g). Average nitrate value is low in dry season (3.06±2.38 mg. L[-1]) and high in rainy season (6.4±6.21mg. L[-1]). The monthly mean values of total nitrogen during the study period had the lowest average concentration (2.74 ± 0.53 mg. L[-1]) in February and the high average

concentration (29 ± 2.38 mg. L^{-1}) in November (Figure 2h). For this parameter, the averages are 11.4±10.34 in dry season and 6.4±6.21 during rainy season. The average total phosphorus was low (1.91 ± 0.45 mg. L^{-1}) in January and high (5.19 ± 2.01 mg. L^{-1}) in September (Figure 2i). For monthly mean nitrite concentrations, the values change between 0.014 ± 0.002 L^{-1} in February and 0.0482 ± 0.0141 mg L^{-1} in August (Figure 2j). Concerning seasonal changes, the averages of nitrite are 0.02±0.02 mg L^{-1} in season dry and 0.031±0.02 in rainy.

A significant difference is observed between temperature, nitrate, total phosphorus and total nitrogen from the dry season to the rainy season (t test, $p < 0.05$).
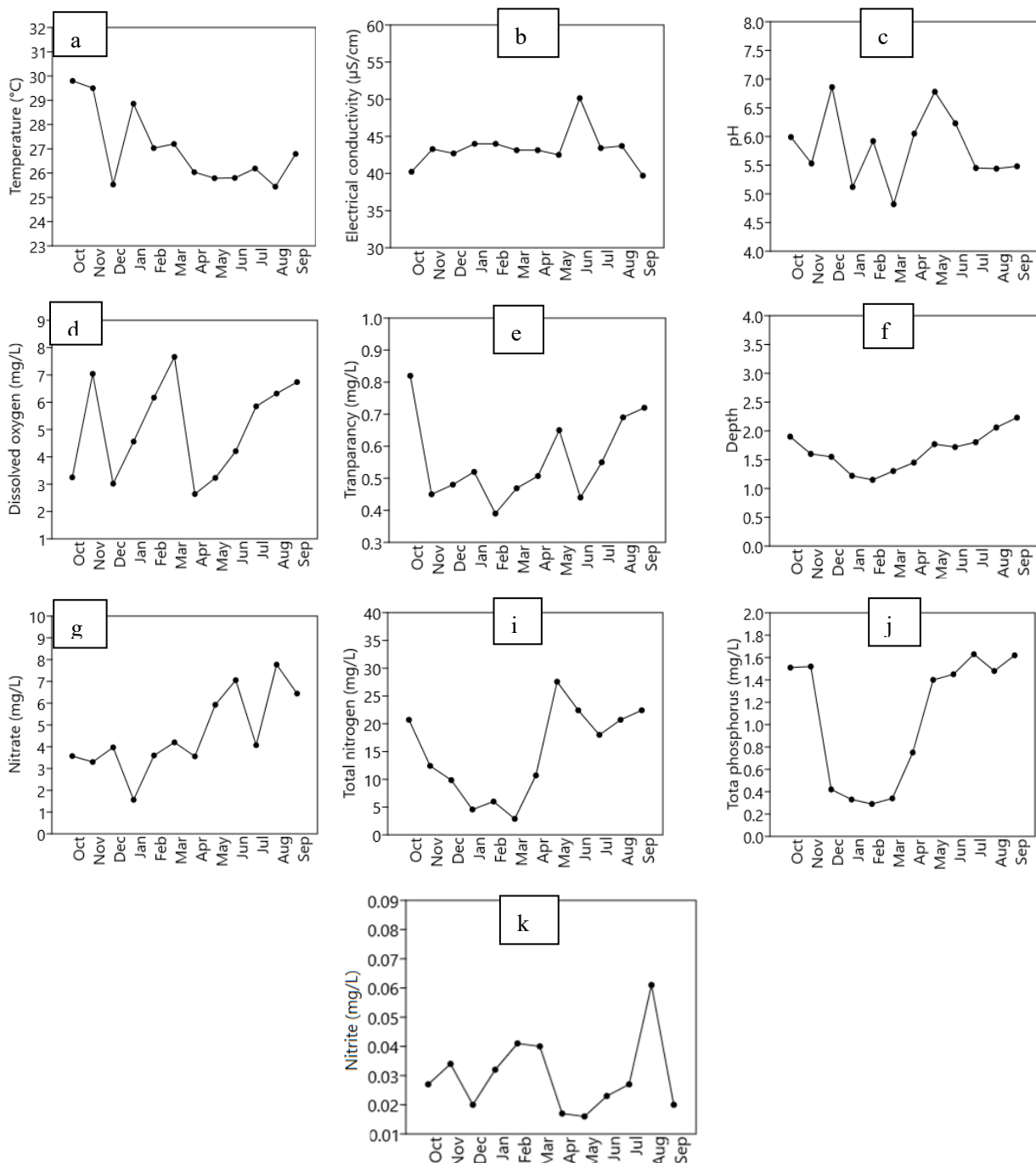
Figure 2.Monthly changes in average values of physicochemical parameters of Dohou Lake. a: Temperature, b: Electrical conductivity, c: pH, d: dissolved oxygen, e: transparency, f: depth, g: nitrate, i: total nitrogen, j: total phosphorus, k: nitrite

Table 1. Seasonal variation of physical and chemical parameters in Dohou Lake

Parameters	DS	RS	*p-value*
Temperature (°C)	27.62±1.55	26.55±1.55	$p < 0.05$
Electrical Conductivity (µS/cm)	43.27±3.16	43.38±4.19	$p > 0.05$
pH	5.9±0.9	5.75±0.44	$p > 0.05$
Dissolved oxygen (mg/L)	4.93±1.97	5.15±1.77	$p > 0.05$
Total Nitrogen (mg/L)	11.4±10.34	21.67±5.75	$p < 0.05$
Nitrite (mg/L)	0.02±0.02	0.031±0.02	$p > 0.05$
Nitrate (mg/L)	3.06±2.38	6.4±6.21	$p < 0.05$
Total phosphorus (mg/L)	0.58±0.5	1.41±0.36	$p < 0.05$
Transparency (m)	0.49±0.23	0.6±0.22	$p > 0.05$
Depth (m)	2.19±0.98	2.28±0.99	$p > 0.05$

RS: Rain season and DS: Dry season;

The principal component analysis (PCA) carried out to determine the abiotic typology of Dohou Lake is presented in Figure 3. The results of this analysis show that the two first axes represent more than half of the total variance (64.42 %) of data (Figure 3a). Axis 1 expresses 38.22% of the total variance and axis 2 represents 26.2%. The correlation circle shows that variables such as total nitrogen, total phosphorus, nitrate, transparency and depth are positively correlated with axis 1. Axis 2 is positively correlated with dissolved oxygen, the temperature and the nitrite on the other hand the conductivity and the pH are negatively correlated with this axis. From the factorial map represented by Figure 3b, the axis 2 allows to separate the samples of the months of the rainy season (November, December, January, Februaly, March) from the months of the dry season (May, Jun, July, August, September, October). During the rainy months, the waters of Dohou Lake are influenced by high values of total phosphorus, total nitrogen, conductivity, nitrate, pH, transparency and depth. However, in the dry months, the waters are characterized by high values of temperature and nitrite and dissolved oxygen and conductivity.
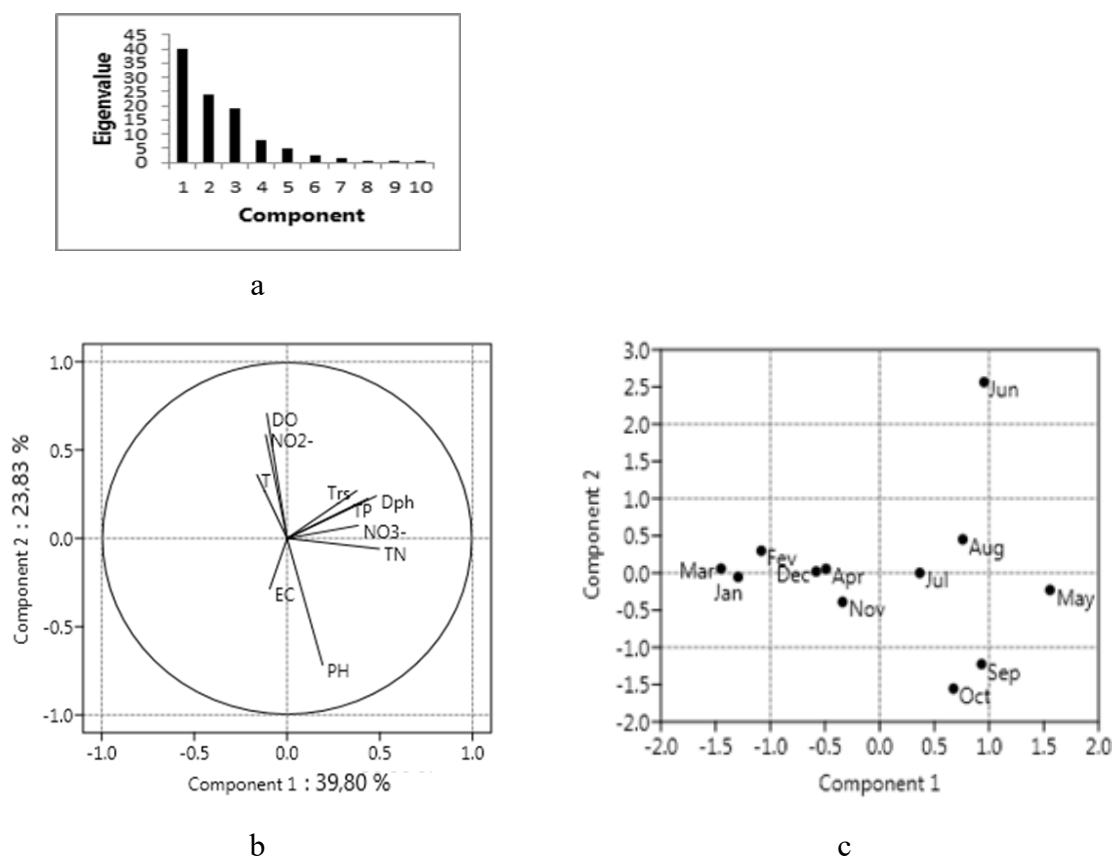
a

b

c

Figure 3. Monthly ordination of mean values of Dohou Lake physicochemical parameters from a Principal Component Analysis (PCA). a: Graph of eigenvalues; b: correlation circle; c: Factorial map. T: Temperature, EC: Electrical Conductivity, pH, O2: Dissolved Oxygen, Trs: Transparency, Dph: Depth, TN: Total nitrogen, NO3-: Nitrate, NO2-: Nitrite, TP: Total phosphorus. Oct: October, Nov: November, Dec: December, Jan: January, Feb: February, Mar: March, Apr: April, Jul: July, Aug: August, Sep: September.

3.2 Structure of the Phytoplankton Community

The present study identified a total of 373 phytoplankton taxa during the study period. These taxa are divided into 111 genera, 51 families, 24 orders, 11 classes and 7 branches. The branches, in order of predominance, are Chlorophyta with 189 taxa or 50.67%, Euglenophyta with 84 taxa or 22.52%, Cyanobacteria represented by 46 taxa or 13.33%, Bacillariophyta or diatoms with 42 taxa or 11.26%, the other branches (Dinophyta, Chrysophyta, Pyrrophyta and Xanthophyta) represented by 12 taxa or 3.21% (Figure 4).
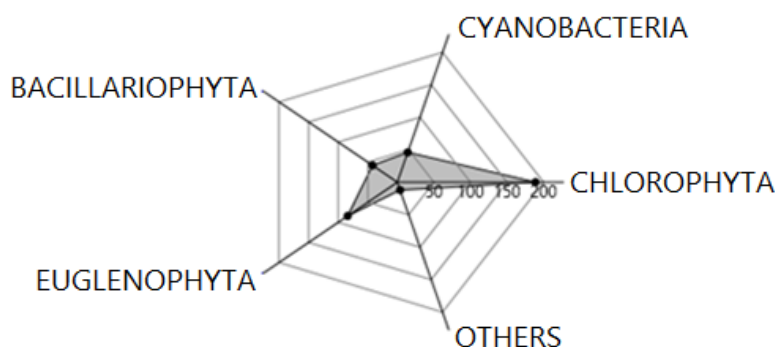
Figure 4. Phytoplankton composition of Dohou Lake

The monthly and seasonal changes in the phytoplankton density in Dohou Lake are shown in Figure 5 and Table 2 respectively. In this lake, mean of phytoplankton density values range from $14.31 \ 10^6 \pm 6.29 \ 10^6$ cells/L (August) to $45.97 \ 10^6 \pm 29.79 \ 10^6$ cells/L (January) (Figure 5a). A predominance of Cyanobacteria ($\geq 45\%$) is noted in the whole stand during the study period except November (18.19%), December (11.16%) and January (31.54%) (Figure 5b). During these months, the proportions of the Bacillariophyta individuals occupying the second place are the most dominant with respectively 58.29% and 56.09% and 37.14%. The density proportions of the two branches are followed by those of the Euglenophyta which vary from 2.74% to 12.9%. The others (Chlorophyta, Dinophyta, Chrysophyta, Xanthophyta) are in low proportion with 0.78 to 9.1%. Seasonally, the average of phytoplankton density is higher in dry season ($34.21 \ 10^6 \pm 23.8 \ 10^6$ Cells/L) than in rainy season ($24.71 \ 10^6 \pm 16.4 \ 10^6$ Cells/L) (Table 2). Concerning seasonal proportions, cyanobacteria (81%) are most dominant of the phytoplankton community in rainy season while Bacillariophyta (27%) are dominant in dry season (Table 2). A significant difference in phytoplankton density is observed between seasons (t test, $p < 0.05$).

- ■ BACILLARIOPHYTA
- ■ CHLOROPHYTA
- ■ CHRYSOPHYTA
- ■ CYANOBACTERIA
- ■ DINOPHYTA
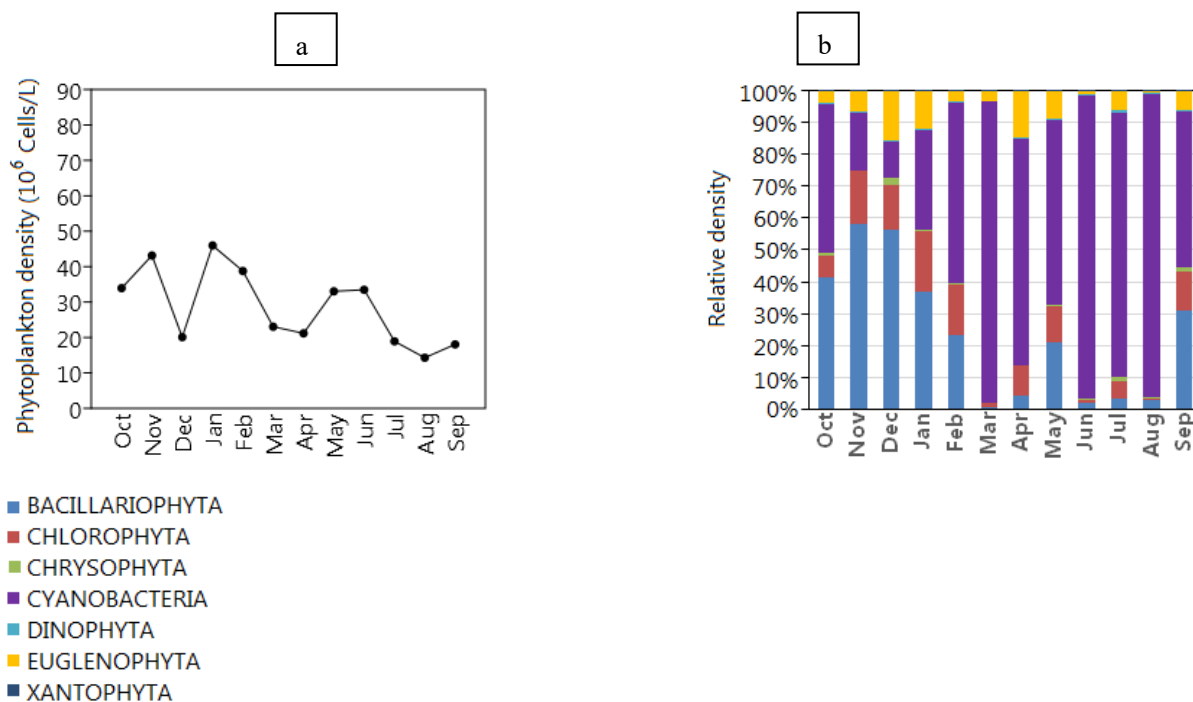- ■ EUGLENOPHYTA
- ■ XANTOPHYTA

Figure 5. Monthly changes in phytoplankton density of Dohou Lake. a: absolute density; b: relative density

Table 2. Seasonal change in the phytoplankton density and phytoplankton branches of Dohou Lake

	Seasons		
Phytoplankton Density	Dry season	Rainy season	*P-value*
%Bacillariophyta	27	11	
%Chlorophyta	15	4	
%Chrysophyta	0	0	
%Cyanobacteria	52	81	
%Dinophyta	0	0	
%Euglenophyta	6	4	
%Xanthophyta	0	0	
Total Density (10^6 Cells/L)	**34.21±23.8**	**24.71±16.4**	**$P<0.05$**

The monthly and seasonal changes in the means values of diversity indexes of the Dohou Lake are shown in Figure 6 and Table 2 respectively. The highest averages values of the Shannon index (2.12 bits/cells) and Equitability (0.6) are observed in January. The smallest average index is recorded in June with respectively 1.1 bits / cells for the Shannon index and 0.32 for Equitability index. The average values of Shannon index (1.91±0.66 bits/cells) and Equitability (0.54±0.15) are higher during dry season than in rainy season (Table 2). A

significant difference in diversity index is observed between seasons (t test, p <0.05).
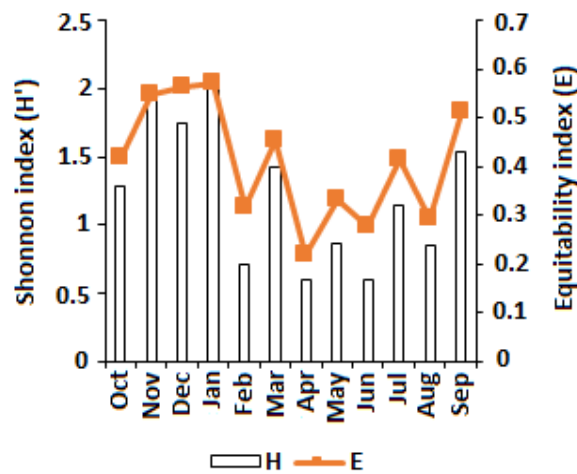

Figure 6. Monthly variations of the Shannon and equitability indexes of phytoplankton community in Dohou Lake

Table 2. Seasonal changes of the diversity indexes of phytoplankton community in Dohou Lake

Index	Rainy Season	Dry Season	*p-value*
Shannon (bits/cells)	1,49±0,74	1,91±0,66	*p < 0.05*
Equitability	0,44±0,18	0,54±0,15	*p < 0.05*

3.3 Discussion

3.3.1 Physicochemical Parameters

Changes in physicochemical parameters of Dohou Lake have highlighted several interactions between ecological factors. The average monthly temperature above 25 °C shows that the lake is relatively hot. However, water temperatures generally remain influenced by climatic conditions due to insolation and precipitation, which could control (accelerate or slow down) the rates of chemical and biochemical reactions (Issola et al., 2008). These recorded temperature values correspond to those obtained by Kouassi-blé (2013) in the Adzopé reservoir and those often observed in aquatic ecosystems with a subequatorial climate (Agadjihouèdé et al., 2016). Over the months, water of Dohou Lake is relatively acidic with average pH values of 4.82 and 6.86. This acidity is related to the production of CO_2 under the action of biological activities and rainy inputs (Lasm et al., 2008). Indeed, the hydration of CO_2 produces the carbonic acid whose ionization releases H^+ ions that contribute to the acidity of the water (Konan et al., 2017). According to some authors, the acidity of inland waters is related to the supply of humic acids from soil leaching, wastewater discharge and macrophyte decomposition under the action of bacteria (Korfali & Davies, 2003). These results are consistent with those of Kouamé et al. (2019) obtained on the same lake. In general, natural waters have pH values between 4.5 and 9 (Kortatsi, 2007). The average water conductivities

(less than 55 µS/cm) of the lake suggest an average dissolution of minerals in the watershed. The mean dissolved oxygen level of 4.93 mg/L during the dry season months and 5.15 mg/L during the rainy month is above the critical limit value (4 mg/L) set according to Sewage Discharge Ordinance, below which the life of aerobic microorganisms is threatened (Cornaz, 2004). This variation in the oxygenation of the lake water may be due either to exchanges at the air-water interface, to the diffusion within the body of water or to the photosynthetic activity of the algae which, in the presence of sunlight, captures the atmospheric CO_2 to transform it into O_2 to aerate the medium or to a consumption of oxygen dissolved by aerobic bacteria for the degradation of organic matter (Amon, 2017). The values of this parameter are similar to those found by Kouamé et al. (2019) on the same lake. The average transparency of the lake water does not exceed 1 meter during the study period. On the other hand, the average values of this parameter are lower in the rainy season (0.49 m) than in the dry season (0.6 m). The high average transparency values during the dry season can be explained by stability due to the lack of water flow, which leads to a decrease in the density of suspended particles. In addition, during the rainy season, the arrival of runoff water loaded with solids and suspended matter would contribute to disturbing lake water, resulting in low average transparency values. Our results are similar to those of Kouamé et al. (2019) on Dohou lake. Nitrogen compounds (total nitrogen, nitrate, nitrite) are essential constituents of organic matter and enter into the composition of cellular proteins. These compounds in mineral form are used by algae for their development. Their high concentration in Dohou Lake especially during the rainy season could be related to the leaching of cultivated land, maintained by fertilizers (chemical and organic) and phytosanitary products. The high monthly concentrations of nitrates coincide with the rainy season (Jun, August, September) whereas they gradually decrease at the end of the dry season (November, December, January, February, March) following the limitation of inputs and probably to intensification of the denitrification process. Nitrite comes from the oxidation of nitrogenous organic matter. They are maintained only in low oxygenated environments, because, unstable they tend to oxidize nitrates (Dussart, 1992). Nitrites are a form of transition during ammonium oxidation or nitrate reduction. The monthly averages of nitrite concentrations in the lake are in the same direction as those of nitrate and total nitrogen. The monthly mean total phosphorus during the study period remains high during the months of the rainy season (April, May, Jun, July, August, September) and low during the dry season months (December, January, February, March). These high monthly average values of total phosphorus in the rainy season could be due to human activities. Indeed, urban effluents and waste from vegetable crops, chicken farm, stray animals and quarry nearby are discharged directly into the lake. Finally, all the conditions favoring the eutrophication of the environment are characterized by the high nutrients, dissolved oxygen during the rainy season and the high temperature, pH in the dry season. It is precisely at this time that the nuisances of eutrophication are likely to manifest themselves.

3.3.2 Structure of the Phytoplankton Community

During the study period, 373 were recorded in Lake Dohou. The study lake can be considered taxon-rich. This richness may be related to the high number of taxa belonging to the Chlorophyta branch. This number is approximately equal to the number of taxa reported by Compère (1991) who determined 397 taxa at Lac Guiers. The number of taxa is also higher

than those found in the Azopé water reservoir in Côte d'Ivoire (212 species, Adon, 2012). In this taxonomic composition, the predominance of Chlorophyceae is noted. This result is similar to that of Bouvy (2006) after the construction of the Diama Antisel dam on the Senegal River, where a high proportion of Chlorophyceae is observed. According to Iltis (1982), in fresh water, Chlorophyta has the highest species richness.

Overall, Dohou Lake phytoplankton is abundant and heterogeneous over time. A significant difference appears in seasonal density fluctuations. Samples collected generally during the dry months (November, January and February) are higher in phytoplankton densities than the months of the rainy season. The high densities during these months coincide with the high temperature that would stimulate the biological process such as multiplication of phytoplankton cells in relation to nutrient consumption. This abundance is due to a very large number of filaments or cells united in colonies belonging to some species. These species are *Aphanocapsa conferta, Microcystis aeruginosa, Planktolyngbya limnetica, Chroococcus minutus, Asterionella formosa, Aulacoseira ambigua, Pinnularia acrosphaeria, Trachelomonas volvocina, Trachelomonas cylindrica and Dictyosphaerium pulchellum.* The density of phytoplankton in the samples made it possible to note a contribution of various taxonomic groups.

The dominance of Cyanobacteria clearly appeared in our results. During each month of the study period, Cyanobacteria contribute significantly to increase the absolute density of Dohou Lake except during the dry season months (November, December, January) when Bacillariophyta dominates the phytoplankton community. The dominance of Cyanobacteria during months and / or seasons is due to the fact that this category of algae adapts to a multitude of environmental conditions and is able to proliferate under extreme conditions (Lavoie et al., 2007). Indeed, during the months of the rainy season (April, May, Jun, July, August, September) the predominance of Cyanobacteria could be justified by several environmental factors including the high availability of nutrients (nitrogen and phosphorus) in mineral form, coming from watershed leaching for which Cyanobacteria have more affinity than other algae (Blais, 2002). On the other hand, the period of excessive multiplication (November, December, January) of Bacillariophyta (Diatoms) coincides with a low nutrient content. This result is supported by the assertion of Berdalet et al. (1996) that diatom multiplication is mainly related to the decline of nitrogen nutrients. This same seasonal period with the months of February, March and April also causes the proliferation of Cyanobacteria. The predominance of this taxonomic group may be related to adaptation strategies developed by this group to avoid being targeted by phytophagous organisms (zooplankton and phytophagous fish). Indeed, according to Haney (1987), Cyanobacteria can secrete toxins of various types that give them a "bad taste" to protect themselves against grazers, but also to eliminate competitors competing for the same resources (Pearl and Millie, 1996). They also live in large colonies to pass through the filtering mechanisms of grazers (Lampert, 1987). This can be seen with the dominant species such as *Planktolyngbya limnectica, Aphanocapsa conferta, Chroococcus minutus,* and *Microcystis aeruginosa.* The production of these toxic compounds would contribute to increasing the competitive advantage of Cyanobacteria on other branches of algae in achieving the dominance of an aquatic environment (Affsa / Afsset, 2006).

The temporal variations of the average values of the Shannon indices generally do not exceed 2 bits/cells. These values show a low diversity characterized by a young population with a high breeding power including one species or a small number of predominant species (Kemka et al., 2004). Some authors, Bozniak and Kennedy (1968), Margalef (1964) and Mason (1991), mention that eutrophic lakes generally have a low specific diversity compared to oligotrophic lakes and present macrophyte invasions. With regard to the specific diversity values obtained in Dohou Lakes (2 bits/cell on average), and the presence of blooms during the study year could indicate eutrophic lake conditions. Within the same range of variation, Elber and Schanz (1989) found H' diversity values ranging from 0.13 to 2.32 in Lake Kaminsee I and from 1.26 to 2.83 in Lake Kaminsee II in Germany. As for the fairness index, time values range from 0.22 in April to 0.57 in January. These values reflect the heterogeneity of the phytoplankton community studied, which would be regularly unbalanced.

4. Conclusion

This study identified 373 phytoplankton taxa in Dohou Lake. These taxa are divided into 7 phytoplankton branches and the most diverse in terms of species richness are Chlorophyta and Euglenophyta. The structure of the phytoplankton community shows variability over time. In terms of density, cyanobacteria and Bacillariophyta are the most dominant in the Dohou Lake phytoplankton community. This structure based on diversity index values reflects a disturbed and unstable environment. An assessment of the trophic status and ecological quality of this lake would therefore be necessary in perspective.

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