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Spatiotemporal distribution and composition of phytoplankton assemblages and their relationship with the environmental factors in Fresco Lagoon (Ivory Coast)

Konan Estelle Sévérine[1*], Aka N'Guessan Maryse[1], Seu Anoï Netto Mireille[2]

[1]Centre de Recherches Océanologiques, 29, Rue des Pêcheurs Treichville BPV 18 Abidjan, Côte d'Ivoire

[2]Laboratoire d'Environnement et de Biologie Aquatique, Département de Science et Gestion de l'Environnement, Université Nangui Abrogoua, Autoroute d'Abobo, Abidjan, Côte d'Ivoire

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Abstract

Spatiotemporal distribution and composition of phytoplankton assemblages and their relationship to abiotic environmental factors was investigated in the tropical coastal Fresco Lagoon monthly from March 2007 to December 2008 at five stations. Phytoplankton was sampled using a 20 µm plankton net coupled with a collector. The samples were preserved with 5% buffered formalin. For species observation, phytoplankton samples were examined in the laboratory using an Olympus BX40 microscope equipped with a calibrated micrometer and for identification with reference to different authors. The quantitative estimation of the phytoplankton was performed by counting with an inverted microscope, using the Uthermöhl (1958) technique. Cylindrical chambers were used to sediment subsamples before counting. One hundred thirty nine (139) taxa have been identified, divided in 5 phyla. The phylum of Bacillariophyta (50%) was the most represented, followed by Chlorophyta (20%), Dinophyta (11%), Cyanoprokaryota (11%) and Euglenophyta (8%). According to the abundance, Cyanoprokaryota (52.7%) and Bacillariophyta (44.2%) were recorded the highest densities. However, densities of Dinophyta (2.5%), Chlorophyta (0.45%) and Euglenophyta (0.25%) were low. Fresco Lagoon was influenced by freshwater and marine water. High values of density recorded during the rainy season at station 4 are due to the high values of nutrients. This work is a useful starting point for future research on micro algae in Fresco Lagoon.

***Corresponding Author:** Konan Estelle Sévérine ✉ estydekonan@yahoo.fr

Introduction

An estuary is a semi enclosed coastal body of water that has a free connection with the open sea. It is strongly affected by tidal action, and within it, seawater is mixed and diluted with freshwater from land drainage (Lee, 1989).

The mixing of marine and continental water generates a continuous gradient of salinity, nutrient, and other environmental gradients which has a strong impact on the spatial and temporal distribution of phytoplankton communities. Phytoplankton, including prokaryotic cyanobacteria and eukaroytic algal groups, conduct a bulk of primary production supporting food webs and play a central role in carbon, nutrient, and oxygen cycling in estuaries. Because phytoplankton have fast growth rates and can rapidly respond to a wide range of environmental perturbations, they represent a sensitive and important indicator for detecting ecological change in estuaries (Paerl, 2010).

Indeed, Fresco Lagoon undergoes the pressure of human activities including the intensification of agriculture, (industrial plantations, particularly cocoa plantations, adjacent Fresco lagoon) domestic and urban discharges from hotel complexes, the repository of junk located near the lagoon, and the water poisoning during fishing practices. Indeed, human activities are one of the major causes of aquatic ecosystems degradation (Tazi *et al.*, 2001). These activities have direct effect on the water quality, causing algal blooms.

In Ivory Coast, algological data on the lagoons are limited mainly to the 3 lagoons: the Lagoon Complex Ébrié (Plante - Cuny , 1977; Maurer, 1978; Dufour *et al* . 1979; Arfi *et al* , 1981 . Carpentier, 1982; Iltis , 1984; Tanoh , 2006; N'Gouran , 2006 and Seu - Anoi , 2012), Grand-Lahou (Komoé , 2010 and Seu - Anoi , 2012) and Aby (Adou , 1999 and Seu - Anoi , 2012). Although monitoring of phytoplankton populations has started since 1964 to Oceanological research center on the coastal area, semi- coastal area and offshore (Reyssac, 1966), no phytoplankton's study has been made on the Fresco Lagoon, while a rigorous identification of phytoplankton is crucial to holding several studies such as monitoring of algal blooms or the knowledge of the distribution and structure of phytoplankton communities. Absence of information about Fresco lagoon phytoplankton justifies this study.

This work was designed to provide information on the phytoplankton structure of the Fresco Lagoon and their relationship with environmental factors.

Material and methods

Study area description and sampling sites

Fresco Lagoon, is located between 5°40'-5°70' N and 5°32'- 5°38'W. It covers a surface area of 17 km², with a length of 6 km, a width from 2 to 4 km and an average depth of 4 m.

The lagoon is connected with the Atlantic Ocean by the non-permanent channel of Fresco. The volume of ocean water is maximal during periods of low flow of rivers Bolo and Niouniourou and minimal during flood periods (Abe *et al.*, 1993).

The lagoon receives freshwater from four coastal rivers whose two main: Niouniourou (140 km) and Bolo (84 km) and two smaller: Gnou (12 km) and Guitako (5 km).

The area climate is divided in four seasons (Durand and Skubich 1982): long rainy season (April to July), short dry season (August to September), short rainy season (October to November) and long dry season (December to Mars).

Fishing and agriculture are the main activities on the lagoon. There are also recreative activities. Five stations were chosen for this study (Fig 1).

The sites selected, based on geographical location, anthropogenic activity, major water use and access. Station 1 (st1) is near the city of Fresco and small villages. Station 2 (st2) is located between the cliffs and the artificial vegetation of mangroves. Station 3 (st3) was chosen far from human influence. Station 4 (st4) is located at the mouth of rivers bolo and Niouniourou and station 5 (st5) is near the mouth of the sea.

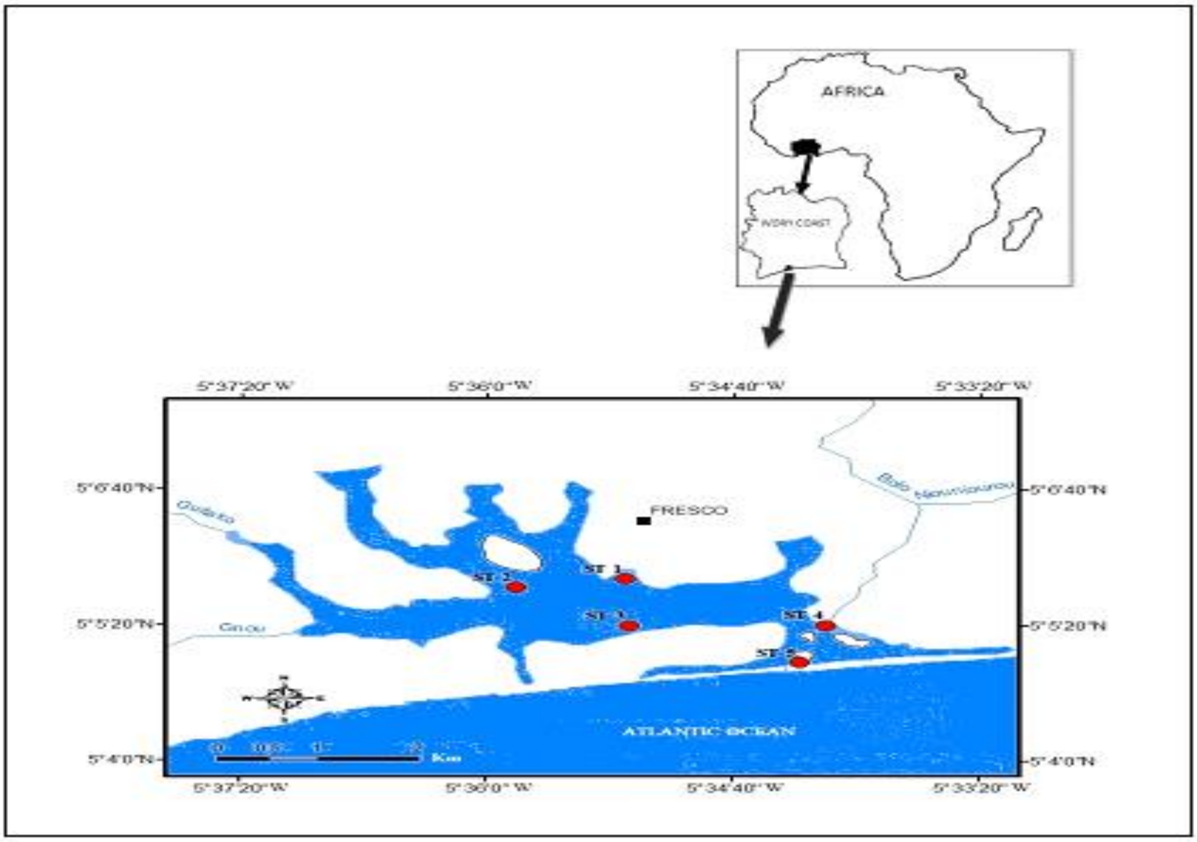


Fig. 1. Location of the study stations in Fresco Lagoon, Ivory Coast.

Sampling of environmental parameters

Surface water samples were collected monthly from March 2007 to December 2008. Temperature, conductivity, salinity and dissolved oxygen (DO) were measured in *situ* using the 315i/SET multiparameter. pH was also measured *in situ* using HI 98158 pH meter.

Transparency was determined by a Secchi disc. According suspended matters, vacuum pump and GF/F Whatman filters were used for filtration.

The nutrients (Ammonium NO4, Nitrite NO2 and Orthophosphate PO4) were determined by JASCO V-530 spectrophotometer. Ammonium molybdate, antimony and ascorbic acid have been used for determination of phosphate ions, ammonium chloride, N-naphthyl-ethylenediamine for nitrites, blue Indophenol and sodium dichlorocyanurate for ammonium ions.

Phytoplankton sampling and analysis of biotic variables

Phytoplankton was sampled in fresco lagoon, using a 20 µm plankton net.

The net was dragged horizontally in the surface water to obtain the samples of phytoplankton.

The samples were stored in polyethylene bottles and preserved with 5% buffered formalin. For species identification, phytoplankton samples were examined in the laboratory using an Olympus BX40 microscope equipped with a calibrated micrometer. Identification of the main groups was made with reference to Peragallo (1908), Krieger (1939), Van der Werff et

Huls (1957-1974), Bourrelly (1961, 1972, 1975, 1981, 1985, 1988), Amossé (1970), Compère (1975a et b, 1976a et b, 1977, 1989, 1991), Couté et Iltis (1985), Round and al (1990), Franceschini (1992), Da (1992, 2007), Zongo (1994), Komárek et Anagnostidis (1999, 2005), Ouattara (2000), Marin *et al.* (2003), Sophia *et al.* (2005), Komoé (2010). The quantitative estimation of the phytoplankton was performed by counting with an inverted Diavert microscope, using the Utermöhl (1958) technique.

Subsamples (25 ml) were settled in cylindrical chambers and left to sediment for at least 16 h. The counts of unicellular, colonial, or filamentous algae were expressed as cells l^{-1}. The total number of cells was calculated using the following formula:

$$D = \frac{Nbr}{\left(\frac{a}{A}\right) \times V}$$

D= Density of phytoplankton cells l^{-1}

Où $a = C_{40x} \times (R_{40x})^2 \times \pi$

Nbr = Quantity of cells counted for a taxon

a = Area observed under microscope

C_{40x} = Number of fields observed at objective 40x

R_{40x} = Radius of field to objective 40x (0.25 mm)

A = Area of sedimentation tank (480,8 mm^2)

V = Volume of sample used for sedimentation.

Resemblance between two communities (habitats) was estimated by the similarity index of Jaccard. According to Schaeffer *et al.* (2005), this index vary from 0 (no similarity) to 1 (same settings).

$$C_j = \frac{j}{a+b-j}$$

j = number of species between two stations

a = number of taxa own to Station 1

b = number of taxa own to Station 2

C_j = Similarity index of Jaccard

Statistical analyses

To evaluate the joint influence of several parameters on phytoplankton, a multivariate analysis was performed by Re Dundancy Analysis (RDA) using the program CANOCO 4.5.

The P-value was obtained by a Monte Carlo permutation test (499 permutations), carried out for all canonical axes. In this analysis, 16 (2007) and 13 (2008) phytoplankton taxa having a relative abundance > 2% of total abundance and 9 environmental variables were taken into account. Abundance values were transformed by log (x +1).

Results and discussion

Environmental parameters

Water temperature during the study period, is generally high (25.7° to 31.5°C in 2007 and 25.5° à 31.4°C in 2008). The highest values of temperature observed during March and December in 2007 were incumbent on continental and lagoon dry season.

Table 1. Similarity index of Jaccard.

Stations	st1-st2	st1-st3	st1-st4	st1-st5	st2-st3	st2-st4	st2-st5	st3-st4	st3-st5	st4-st5
Jaccard index	0.46	0.42	0.24	0.26	0.46	0.20	0.22	0.26	0.29	0.37

These periods were characterized by the low rain and low flow period of bolo and Niouniourou rivers. However, upwelling explained the lowest values in August and September in 2007 and the lowest values during 2008 were explained by the cold dry wind coming from the north (Fig 2).

Generally, the lowest values of conductivity and salinity were observed at station 4, during the months of rainy season and the highest in the months of dry season (Fig 2). Salinity varies considerably within the lagoon as a function of the action between marine and freshwater input. According the lowest values recorded at station 4, this station receives freshwater from rivers bolo and Niouniourou, reducing salinity. Contrariwise, quantities of freshwater and rainfall in stations 1, 2, 3 and 5 are inferior than oceanic water input (Issola, 2010) increasing the values of salinity at these stations. Also, the high values observed during the months of dry season is the effect of insolation, which results in greater evaporation and hence in a higher concentration of salts in the dry months.

Table 2. Taxa > 2 % of total abundance in 2007.

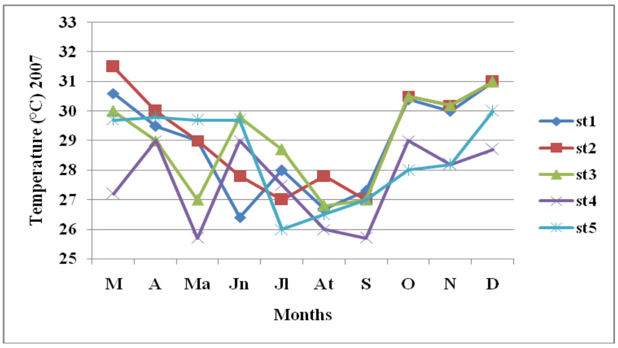
		Stations				
Taxons	Acronymes	1	2	3	4	5
Asterionellopsis glacialis Crawford et Mann	Asgl	0.45	0.22	0.45	0.73	0.45
Chaetoceros decipiens Cleve	Chde	0.81	0.42	0.84	1.1	0.67
Guinardia striata (Stolterfoth) Hasle	Gust	0.08	0	0	0.44	0.14
Gyrosigma balticum Ehrenberg	Gyba	0.31	0.2	0.14	0.17	0.14
Lauderia annulata Cleve	Laan	0.25	0.31	0	1.01	0.42
Merismopedia elegans Braun	Meel	0	10.84	0	5.51	0.63
Merismopedia glauca (Ehrenberg) Nägeli	Megl	0	0	0	7.22	7.7
Merismopedia punctata Lemmermannn	Mepu	0	0	0	3.38	4.23
Navicula sp.	Nasp	0.6	0	1.35	1.38	0
Oscillatoria subbrevis Schmidle	Ossu	0	0	2.82	7.05	0
Planktoniella muriformis (Loeblich) Wight Darley	Plmu	4.28	1.24	1.58	3	0.62
Petrodictyon gemma (Ehrenberg)Mann	pege	0.37	0.08	0.34	0.03	0.03
Surirella splendida Kützing	Susp	0.45	0.16	0.45	0.2	0.14
Thalassionema frauenfeldianum Grunow	Thfr	0.31	0.56	1.13	1.8	1.5
Thalassionema nitzschioides (Grunow) Hustedt	Thni	0	0.45	1.15	1.12	1.04
Ulnaria ulna (Nitzsch) P.Compère	Ulul	0.08	0	0	0.44	0.14

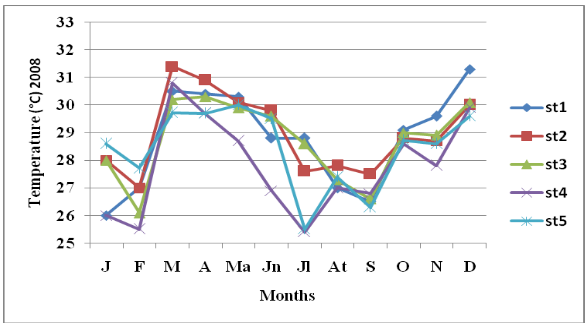
The pH of Fresco Lagoon was generally basic (Fig 2). It ranged from 6.5 to 8 in 2007 while in 2008 it ranged from 6.59 to 8.63.The lowest values were recorded during the rainy season, and the highest values during the dry season. Compared with the Grand-Lahou and Ebrié lagoon system, Fresco lagoon isn't influenced by Soudano-guinean wide stream. Moreover, the low flow of bolo and Niouniourou rivers was insufficient to acidify lagoon, contrary to Bia and Tanoé rivers which acidify some localities of Aby lagoon (Seu-Anoï, 2012).

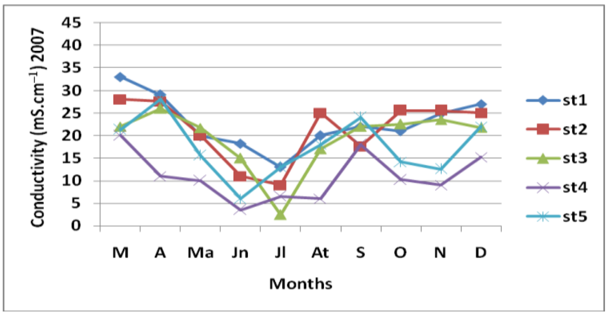
Table 3. Taxa > 2 % of total abundance in 2008.

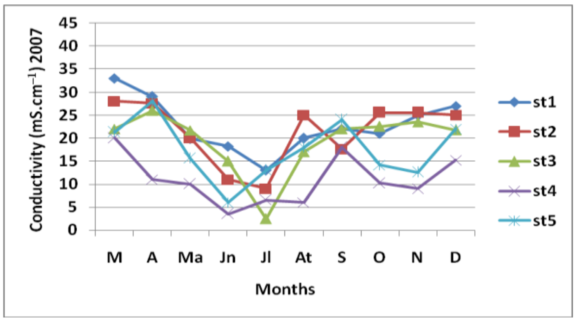
		Stations				
Taxons	Acronymes	1	2	3	4	5
Asterionellopsis glacialis Crawford et Mann	Asgl	0.4	0	0.4	0.58	0.45
Chaetoceros curvisetus Cleve	Chcu	0	0.5	0.5	0.5	1.07
Chaetoceros decipiens Cleve	Chde	0.97	0.58	0.81	1.03	0.78
Chaetoceros divsersus Cleve	Chdi	0	0	0	0.45	1.42
Guinardia striata (Stolterfoth) Hasle	Gust	0.1	0	0	0.58	0.16
Lauderia annulata Cleve	Laan	0	0.35	0	1.16	1.62
Merismopedia elegans Braun	Meel	0	12.1	0	5.18	4.1
Merismopedia glauca (Ehrenberg) Nägeli	Megl	0	3.89	0	8.30	0
Merismopedia punctata Lemmermannn	Mepu	0	8.06	0	0	0
Navicula sp.	Nasp	0.68	0.74	0.81	1.42	0
Planktoniella muriformis (Loeblich) Wight Darley	Plmu	0.64	1.43	1.81	2.91	0.71
Thalassionema frauenfeldianum Grunow	Thfr	0.45	1.03	1.5	1.75	1.7
Thalassionema nitzschioides (Grunow) Hustedt	Thni	0.58	0.4	1.03	0.97	0.58

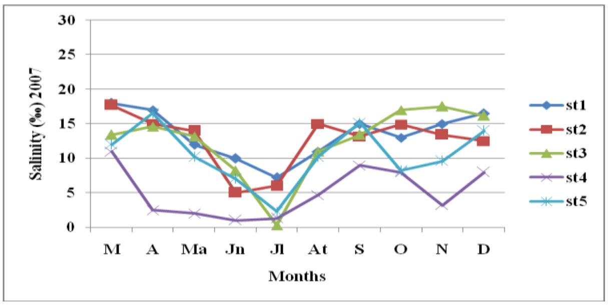
The reject of dioxide carbon molecule in water by the algaes or others vegetables reduce pH and carrying acid waters. That explains the acid values recorded in May, June and July. pH values are similar to those reported in Grand-Lahou system lagoon (Konan *et al.*, 2008) and Açu lagoon in the North of Rio De Janeiro (Chagas and Suziki, 2005).

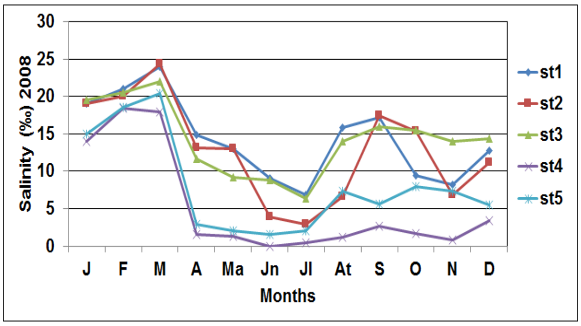


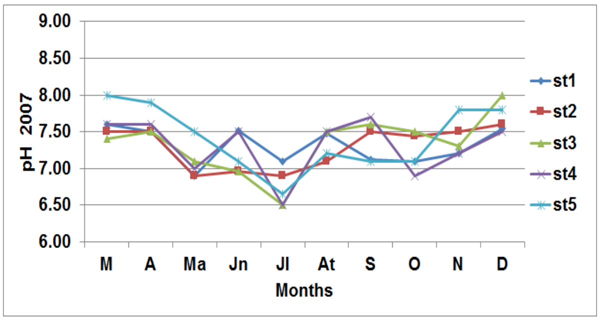


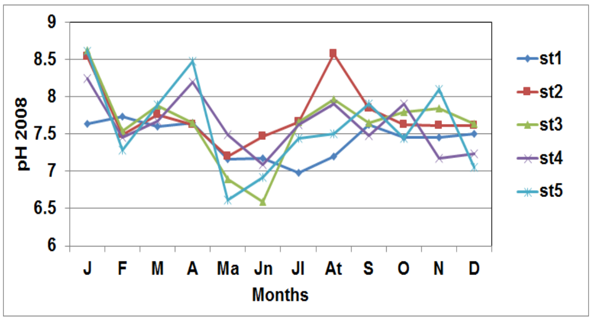


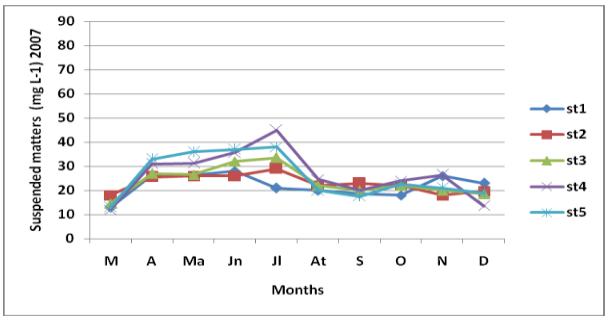


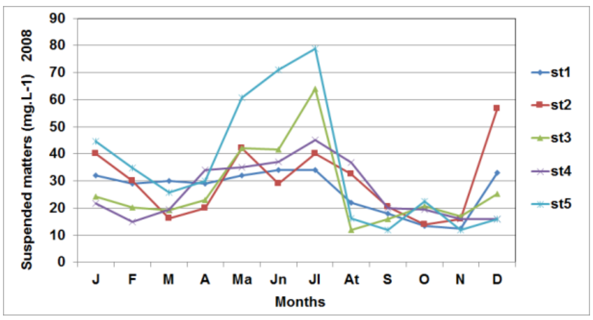












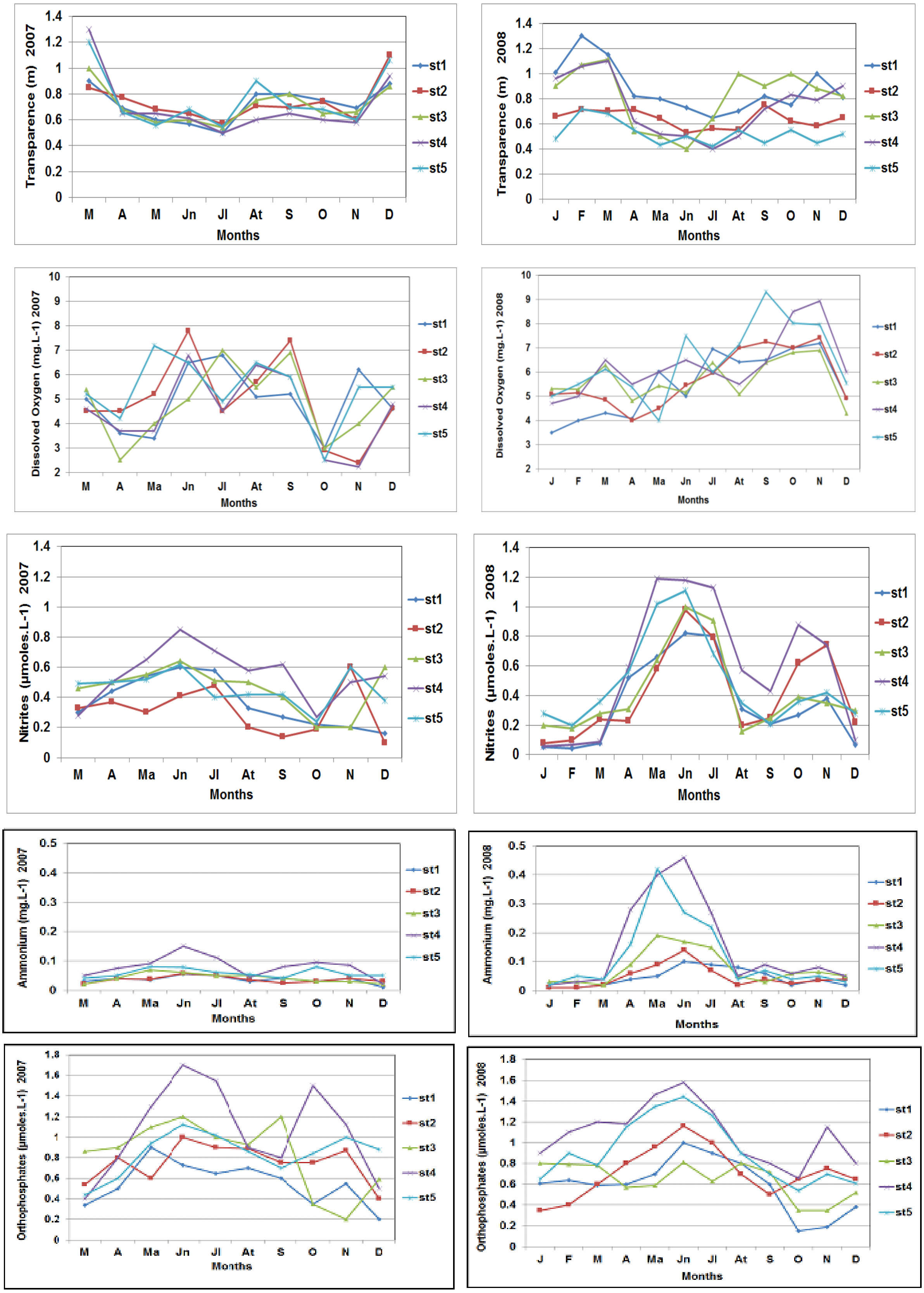


Fig. 2. Spatiotemporal variation of environmental parameters at the differents stations.

The highest values of suspended matter and the lowest values of transparency observed during the months of long rainy season at stations 4 and 5 (Fig.2) are due to the high freshwater (bolo and Niouniourou rivers) input containing sand, organic matter, plankton, and other microscopic organisms. At station 5, in 2008, the peak of suspended matter observed was the consequence of sea succion of rivers water (Issola 2010).

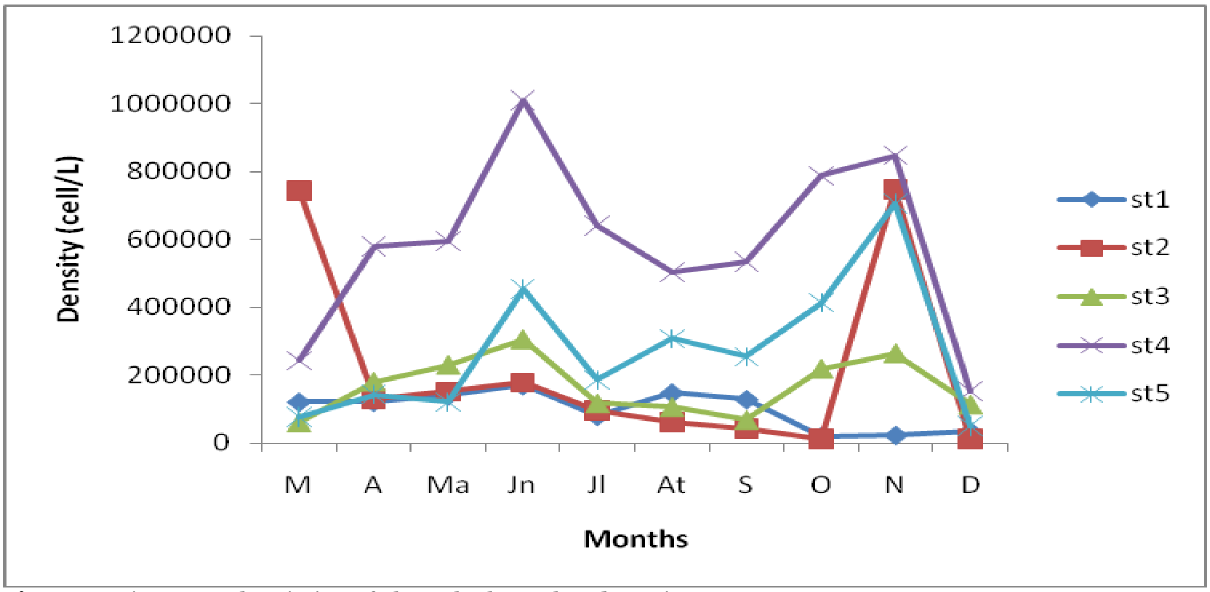


Fig. 3. Spatiotemporal variation of phytoplankton abundance in 2007.

The different values contrasted with those of Konan *et al.* (2008) who observed the high values during short rainy season. However, suspended matter values are similar to those Komoé (2010) and Seu-Anoï (2012).The dissolved oxygen in 2007, ranged from 2.4 to 7.8 mg.L^{-1} and in 2008, from 3.5 to 8.92 mg.L^{-1} (Fig 2). High values of dissolved oxygen recorded in June and November, were explained according to Hamaidi *et al.* (2009), by the low consumption of oxygen by microorganisms and zooplanktons, or a high photosynthetic activity.

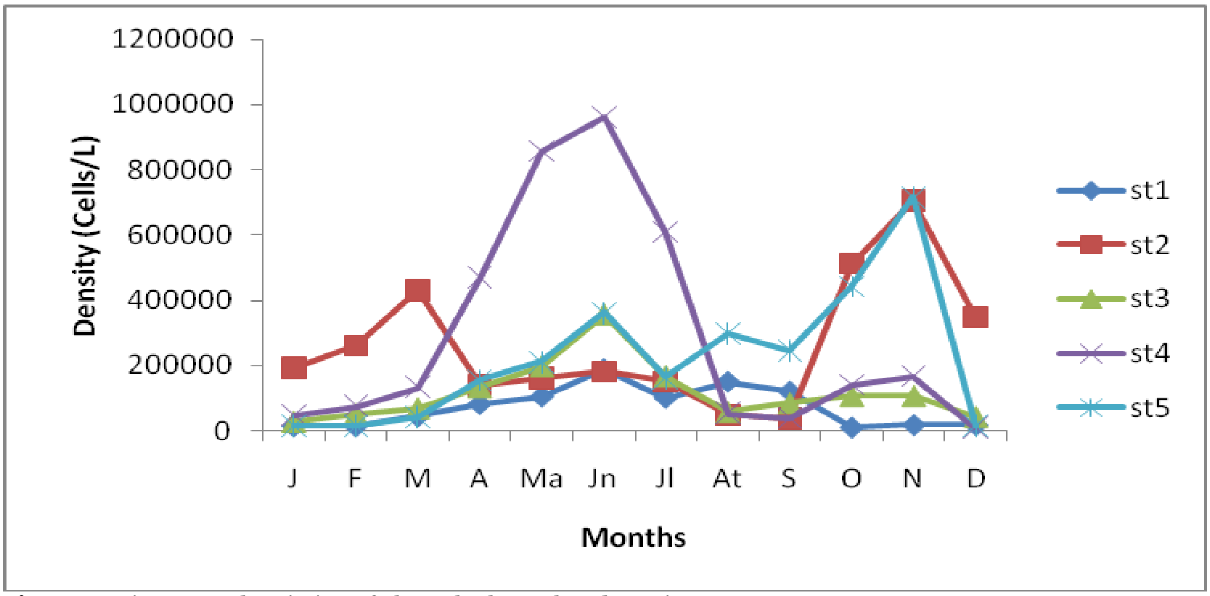


Fig. 4. Spatiotemporal variation of phytoplankton abundance in 2008.

The lowest values can be due to organic matter decomposition which uses large amounts of oxygen, and this depleting all the oxygen.

Concerning the nutrients (ammonium, nitrite, orthophosphate), the highest values observed during the rainy season and at station 4 (Fig 2), resulted of the intrusion of Bolo and Niouniourou rivers and runoff water from cultivated soils rich in fertilizer. Furthermore, with the weak depth of the lagoon, sediment ascends during the rainy season increasing nutrients quantities. Metongo (1989) and Konan *et al.* (2008), found also the high values during the long rainy season. However, these values were generally low. According ammonium ion, these low values can be due to the transformation for these ions on nitrates and the absorption phenomenon. Indeed, in aquatic ecosystem, algaes absorb preferentially ammonium instead of nitrates (Fogg, 1963; Prochazkova *et al.*, 1970). With regard to orthophosphate, the low values could be resulted by the fast assimilation of phytoplankton and bacteria (Van-Den-Broeck and Moutin, 2002).

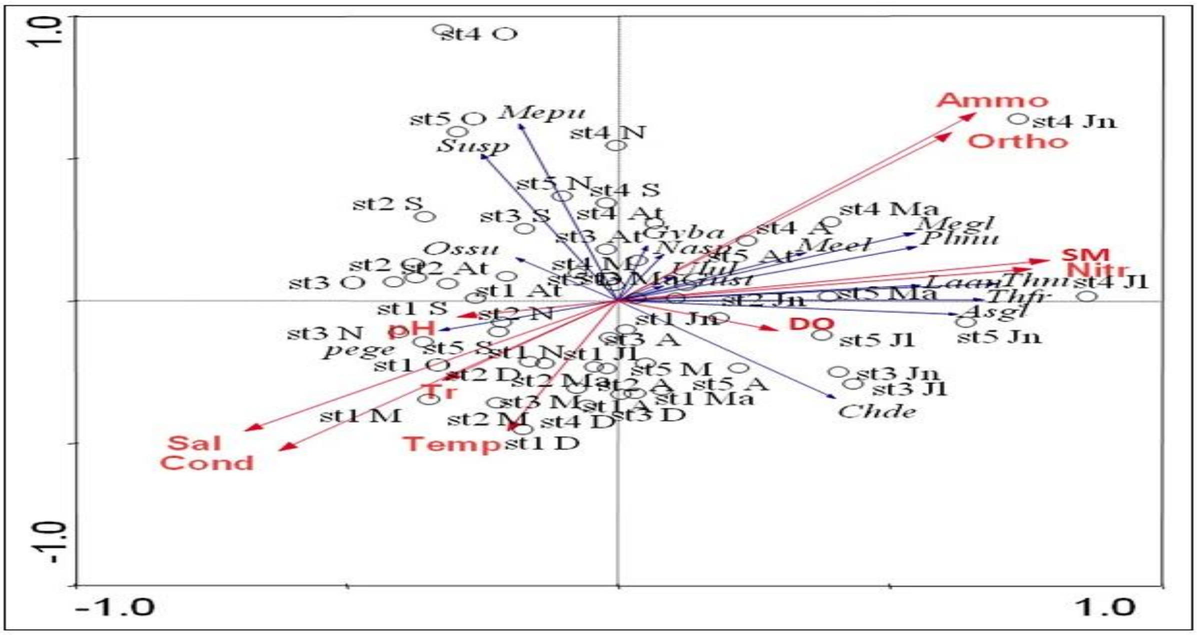


Fig. 5. Triplots obtained through the RDA of physico-chemical variables and taxa abundance in Fresco Lagoon with 2007 data. (See Table 2 for abbreviations).

Phytoplankton composition

The phytoplankton composition of Fresco Lagoon consisted of 5 phyla, 9 classes, 27 orders, 34 families, 69 genera and 139 taxa. The number of taxa recorded in Fresco lagoon is almost similar to those of Adou (1999) on Aby Lagoon, harvesting 134 taxa, Maurer (1978) and Seu-Anoï (2012), respectively with 138 taxa and 122 taxa in the Ebrié Lagoon.

The floristic composition showed a predominance of Bacillariophyta (50%) followed by Chlorophyta (20%), Dinophyta (11%), Cyanoprokaryota (11%) and Euglenophyta (8%). The studies of Maurer (1978), Komoé (2010), and those of Seu-Anoï (2012) conducted on the Ivorian lagoons showed also a predominance of Bacillariophyta unlike Adou (1999) where dominated Chlorophyta. Studies conducted by Onyemazéa and Nwanko (2010) in a Lagos Lagoon and by Melo *et al.* (2007) on the Imboassica Lagoon in Brazil also recorded dominance of Bacillariophyta.

Chlorophyta and Euglenophyta observed are freshwater origin. This confirms their high presence at station 4 located at the mouths of Bolo and Niouniourou rivers. According to Sanaa (2006), Euglenophyceae can only produce biomass peaks in association with Chlorophyceae. Moreover, Chlorophyceae shows a preference for low salinities and low temperatures.

According algae distribution thirty-eight (38) taxa were recorded at station 1. At station 2, twenty-four (24) taxa were collected. Thirty-three (33) taxa were counted at Station 3, 100 taxa at station 4, and eighty-one (81) at station 5.

Station 4 was recorded the highest floristic richness. This is due to the position of this station near the continental waters. So freshwater and marine species addition increases the number of species, unlike the other stations (1, 2, 3) where freshwater species (Chlorophyta and Euglenophyta) are less represented. Seu-Anoï (2012) reported similar result in Aby Lagoon, where phytoplankton is more diversified in stations near river. However, at this station, despite the massive presence of chlorophyceae and Euglenophyceae, Bacillariophyta predominated. Indeed, Niamien-Ébrottié (2010) reported that diatoms are well represented in the continental waters of Ivory Coast. After station 4, station 5, is the richest. It is situated near the sea and the sea exerts a suction force of continental waters, driving the taxa from station 4 to station 5, increasing the floristic richness at this station.

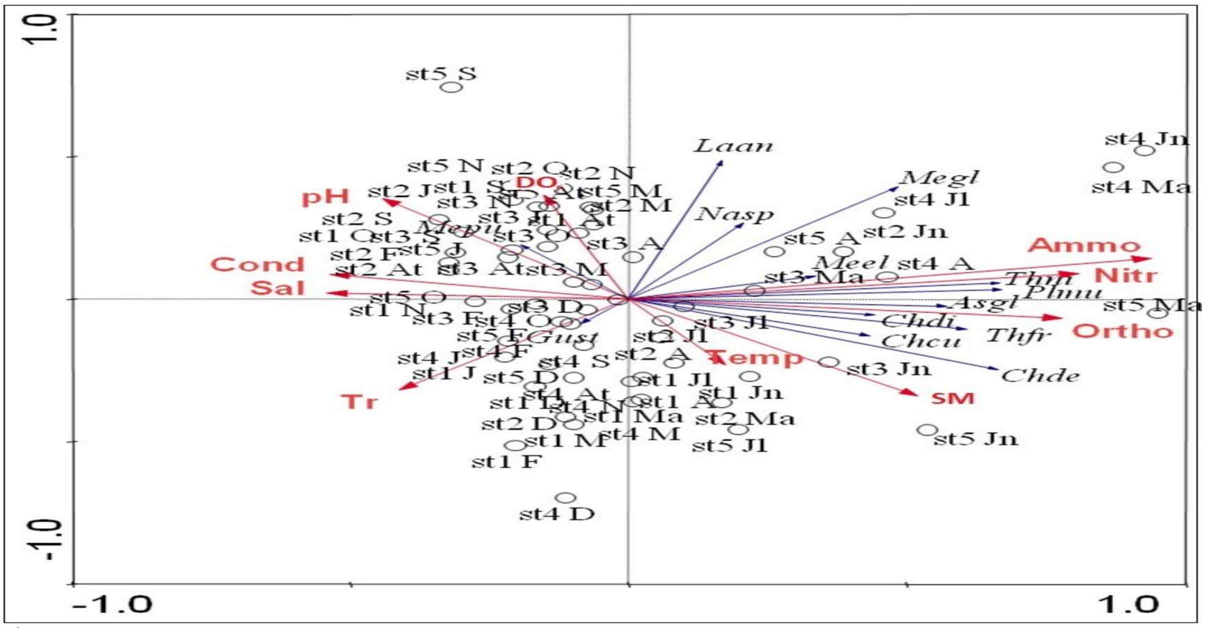


Fig. 6. Triplots obtained through the RDA of physico-chemical variables and taxa abundance in Fresco Lagoon with 2008 data. (See Table 3 for abbreviations).

This could also explain the high values of the similarity indices between stations 4 and 5 (Table 1). Among the five phyla recorded, only Bacillariophyta, Dinophyta and Cyanoprokaryota are present at all stations. Indeed, Bacillariophyta have specialized structures that allow them to colonize effectively and rapidly aquatic environments (Hoagland *et al.*, 1986). The presence of Dinophyta at all stations and especially on stations under oceanic influence, reveals the preference of these species for marine areas. The presence of Cyanoprokaryota at all stations is due that they are characterized by high ecological plasticity and are able to adapt to any type of environment (Anonymous, 2011).

Phytoplankton abundance

Cyanoprokaryota were recorded the highest densities (55% in 2007 and 50.4% in 2008), followed by Bacillariophyta (43.3% in 2007 and 45 % in 2008). Dinophyta, Chlorophyta and Euglenophyta density were very low, with respective values: 1.6% in 2007 et 3.3% in 2008; 0.1 % in 2007 et 0.8 % in 2008 and 0 % in 2007 et 0.5 % en 2008. Cyanoprokaryota were generally mentioned like the dominant species in tropical ecosystems. Several assumptions are cited to explain their dominance and flowering: the elevation of temperature (Mc Queen and Lean. 1987), the production of harmful substances which forbid the growth of others groups of phytoplankton (Norris and Kholer. 1976) and Cyanoprokaryota low grazing (Jacobson et Simonen. 1993). Cyanoprokaryota are also able to stock up nutrients when they are in excess, and this stock allow their growth during the period of low food (Reynolds *et al.* 1987). Seu-Anoï (2012) and Domingo *et al.* (1994) have reported similar result, respectively in Ivorian lagoon (Aby, Ébrié and Grand-Lahou) and Brazilian lagoon.

Generally, the highest abundance was observed during the rainy season mainly in the months of June (2 121 530 cells.L^{-1} in 2007 and 2 051 992 cells.L^{-1} in 2008) and November (2 588 570 cells.L^{-1} in 2007 and 1 713 070 cells.L^{-1} in 2008) at stations 1, 3, 4, 5 (Figs.3 & 4).

This could be attributed by the high values of nutrients during this season. Indeed, the presence of nutrients is responsible for phytoplankton growth (Caron *et al.*, 2000). However, high values observed during dry season at station 2, are due to number of Cyanoprokaryota cells. Species of *Merismopedia* are responsible of high values. A peak of Chlorophyta is appeared in November at station 4. Colonies of *Pandorina*, *Volvox* and *Pediastrum* have increased the density of Chlorophyta. Iltis (1984), working on phytoplankton biomass in Ebrié lagoon, reported that, during the rainy season, water is heterogeneous. Indeed, during the rainy season water of purl drains an important quantity of nutrients in lagoon stirring algae proliferation.

The peak richness was recorded at station 4 (5 896 450 cells.L^{-1} in 2007 and 3 558 810 cells.L^{-1} in 2008), while the lowest values were recorded at station 1 (985 400 cells.L^{-1} in 2007 and 879 280 cells.L^{-1} in 2008).

Concerning the highest abundance observed at the mouth of bolo and Niouniourou rivers (station 4), according to Dufour (1984) waters which dilute lagoon waters, enrich lagoon when this one is most rich in phytoplankton. On the other side, the low densities observed at station 1 might be due to absence of industrialization of Fresco city.

Further, there is no large industrial farms near the lagoon like Grand lahou lagoon where fertilizers carry phytoplankton growth.

These differences of densities can be due according to some authors (Legendre et Demers, 1984; Levasseur *et al.*, 1984) to the frequencies variations of physical factors, or others factors like, turbulence movement, and by the grazing action inducing increase or reduction of phytoplankton density (Tolomio *et al.*, 1992).

Correlation taxa with environmental factors

According to the Redundancy analysis (RDA) on the 16 most abundant taxa (Table 2) and the physical and chemical parameters in 2007, the first axis explained 39.4 % and the second 22 % of the variance. These axes were selected for graphical representation (Fig.5). The direct ordination distinguished three species assemblages in Fresco Lagoon, differentiated mainly by salinity (sal) and the nutrients. The first mainly group *Merismopedia glauca*, *Merismopedia elegans*, *Ulnaria ulna*, *Lauderia annulata*, *Planktoniella muriformis*, *Thalassionema frauenfeldianum*, *Thalassionema nitzschioides*, *Asterionnellopsis glacialis* constituted by samples of months of the high rainy season was positively correlated by axis 1 and associated nitrite (nitr), ammonium (ammo) and orthophosphate (ortho). The second group composed only by *Petrodyction gemma* was negatively correlated by axis 1 and associated pH and salinity. The group 3 composed of samples of the months of low rainy season *Merismopedia punctata* and *Surirella splendida* was positively correlated by axis 2 and isn't associated any parameters.

The result of RDA on the 13 most abundant taxa (Table 3) and the different parameters in 2008, indicated that the first two axes express 76.2% of the variance; 44% for the first axis and 32.2% for the second axis. The direct ordination distinguished two assemblages differentiated by nutrients (ammonium, nitrite, and orthophosphates), suspended matters, and temperature and by salinity and pH (Fig.6).

The first group *Merismopedia glauca*, *Merismopedia elegans*, *Chroococcus dispersus*, *Chaetoceros decipiens*, *Chaetoceros curvisetus*, *Ulnaria ulna*, *Lauderia annulata*, *Planktoniella muriformis*, *Thalassionema frauenfeldianum*, *Thalassionema nitzschioides*, *Asterionnellopsis glacialis*, constituted by samples of months of high rainy season was positively correlated by axis 1 and associated nitrite, ammonium and orthophosphate . The second group composed only by *Merismopedia punctata* was negatively correlated by axis 1 and associated by salinity.

The redundancy analysis indicated that the high densities of phytoplankton were significantly correlated with the nutrients. It also showed that taxa growth is independent of salinity, although these species are mostly of marine origin. Indeed, in aquatic environments, nutrients in ionized form, constitute the form that can be assimilated by phytoplankton, and promote their growth (Anras and Guesdon, 2007, Beman *et al.* 2005). In addition, during the rainy months, reduced salinity promoted the proliferation of freshwater algae: Chlorophyta and Euglenophyta.

Conclusion

This study showed a preliminary investigation about phytoplankton community in Fresco lagoon. These data contribute to have new knowledge on spatial and temporal distribution of phytoplankton. A total of 139 taxa represented by 69 genera, 9 classes and 5 major phytoplankton phyla were identified. Among these taxa marine and freshwater species were recorded. Few are brackish. The phytoplankton community was dominated largely by Bacillariophyta (50%) followed by Chlorophyta (20%), Dinophyta and Cyanoprokaryota (11%) and Euglenophyta (8%). The floristic composition of stations 4 and 5 is significantly higher than the other stations. Bacillariophyta remained predominant at all stations. Cyanobacteria were the numerically abundant group. The highest densities observed during the rainy season, on station 4 are due to the high values of the nutrient recorded and the input of rivers Bolo and Niouniourou rich in phytoplankton species.

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