Available online at http://www.journalcra.com

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

International Journal of Current Research
Vol. 17, Issue, 04, pp.32382-32386, April, 2025
DOI: https://doi.org/10.24941/ijcr.48777.04.2025

ISSN: 0975-833X

REVIEW ARTICLE

PHYTOPLANKTON COMPOSITION AND DISTRIBUTION IN THE BANDAMA RIVER (CÔTE D'IVOIRE) IN RELATION TO PHYSICO-CHEMICAL PARAMETERS

LOZO Roméo N'Guessan*, BERTE Siaka, N'GUESSAN Koffi Richard and KOUAMELAN Essetchi Paul

Laboratory of Natural Environments and Biodiversity Conservation, Biosciences Training and Research Unit, Félix Houphouët-Boigny University, 22 BP 582 Abidjan, Côte d'Ivoire

ARTICLE INFO

Article History:
Received 20th January, 2025
Received in revised form
19th February, 2025
Accepted 26th March, 2025
Published online 26h April, 2025

Key words:

Phytoplankton,
Population,
Distribution, Physico-Chemical Parameters, Bandama River.

Corresponding author: Ahmed Alharthi

ABSTRACT

The Bandama river basin offers a highly diversified range of environments: lacustrine environments and lotic environments respectively upstream of Lake Kossou, downstream of Lake Taabo and between the two lakes. It is exposed to various types of anthropogenic pressure that can disrupt its ecological functioning. Conservation of its biodiversity in order to ensure effective and sustainable management of its resources requires a better understanding of one of the primary biological compartments of the food web, which is made up of micro-algae. The aim of this study is to determine the population and distribution of phytoplankton in the waters of the Bandama River. The physico-chemical parameters (pH, Temperature, Conductivity and Dissolved Oxygen) were measured in situ using a portable multiparameter HANNA model HI9828. Samples were taken using a plankton net with a mesh size of 20 µm. The various sampling campaigns took place each season throughout 2013. Out of a total of 170 phytoplankton taxa, the Chlorophyta phylum had the highest number of taxa with 75 species, or 44.11%. Next come the Euglenophyta (44 taxa or 25.88 %), the Heterokontophyta (36 taxa or 21.17 %), the Cyanoprokaryota (12 taxa or 7.05 %) and finally the Dinophyta (3 taxa or 1.76 %). The results of the Redundancy Analysis showed that Chlorophyta and Cyanoprokaryota have a preference for nutrient-rich environments. pH and temperature had a much greater influence on the distribution of Chlorophyta. This study assesses the influence of physico-chemical parameters on the population and distribution of phytoplankton in the waters of the Bandama river basin.

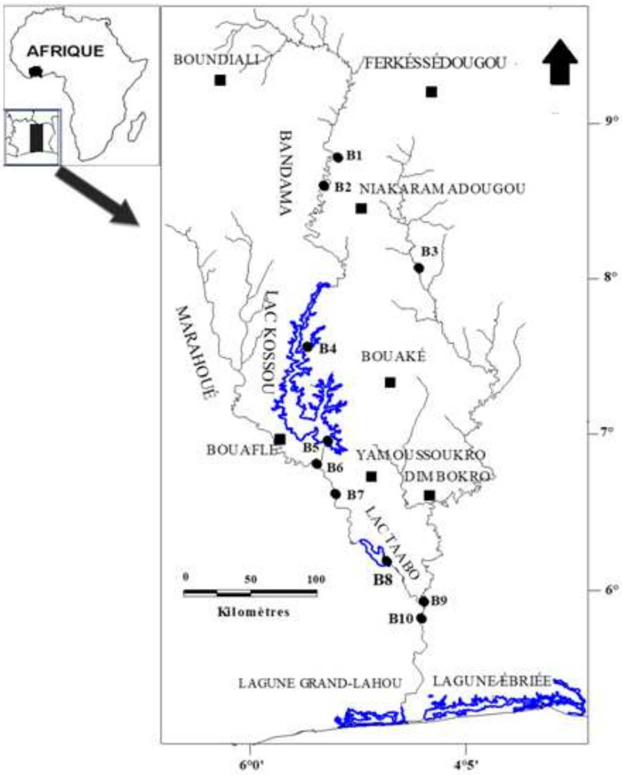
Citation: Ahmed Alharthi and Dr. Sanaa Alsulami, D.S. 2025. *"Phytoplankton composition and distribution in the bandama river (côte d'ivoire) in relation to physico-chemical parameters". International Journal of Current Research, 17, (04), 32382-32386.*

INTRODUCTION

The Bandama river basin offers a very diverse range of environments (lacustrine environments and lotic environments upstream of Lake Kossou, downstream of Lake Taaboand between the two lakes). Because of its north-south orientation, it covers different climatic and biogeographical zones. Its hydrology has been influenced by the construction of two large hydroelectric dams (Kossou in 1972, Taabo in 1978) on its main course and several hydro-agricultural and agro-pastoral dams (Traoré, 1996). Given the quality and diversity of its hydrography, there is a need to preserve this basin in order to conserve its biodiversity and ensure effective and sustainable management of its resources. This approach requires a better understanding of one of the primary biological compartments of the food web, which is made up of micro-algae. According to Dufour and Durand (1982), these organisms occupy an important trophic position and are therefore a determining factor in the functioning of aquatic environments. Knowledge of the phytoplankton organisms of the Bandama river as a whole is necessary to understand how it functions. The aim of this work is therefore to study the population and distribution of phytoplankton in the waters of the lacustrine and fluvial environments of the Bandama river basin.

MATERIEL ET METHODES

Study area: The Bandama river is 1,050 km long and has a catchment area of 97,000 km2. It is formed by the combination of its main course (Bandamablanc) and its two main tributaries, the Marahoué (Bandama rouge) and the N'Zi (Figure 1). It has an average width of 100 m and an average flow rate of 171 m3/s, with a gradient of 0.46 m/km (Savané, 2010). For the purposes of this study, 10 sampling stations were selected along the longitudinal gradient of the river. The stations are distributed as follows: B1 and B2 upstream of Lake Kossou; B4 and B5 on Lake Kossou ; B6 on the Marahoué; B7 between Lake Kossou and Lake Taabo; B8 on Lake Taabo and B3, B9 and B10, respectively upstream and downstream of the confluence of the N'Zi (Figure 1).



Measurement of environmental variables and Sampling: The physico-chemical parameters were measured in situ. Measurements of pH, water temperature (°C), conductivity (µS/cm) and dissolved oxygen (in mg/l) were taken using a HANNA portable multiparameter, model HI9828. Measurements were taken at each station between 7am and 8.30 am during each season. To measure transparency, the Secchi disc is immersed in the water until it disappears completely. It is then raised very slowly until it is visible, and this distance is recorded. The nutrient salts (nitrite, nitrate, phosphate, ammonium and silica) contained in the water were measured using a HANNA multiparameter photometer model HI 83200 series 2008. Samples were taken using a plankton net with a mesh size of 20 µm. The various sampling campaigns took place every season for one year (from February to October 2013). Two types of sampling were carried out. For the first sampling, five 10-litre buckets of water were filtered using the plankton net, while the second consisted of taking water directly from the environment using a pillbox. The water samples taken were fixed in situ with a formaldehyde solution at a final concentration of 5%. Statistical analyses of correlations between the distribution of phytoplankton taxa and environmental parameters were carried out using CANOCO version 4.5 (Ter Braak and Smilauer, 2002).

RESULTATS ET DISCUSSION

Physico-chemical parameters: Table I shows the various average values of physico-chemical parameters measured during sampling of microalgae in the Bandama River. Overall, the water is warm, alkaline and less oxygenated in lake environments.

Phytoplankton population and distribution: The taxonomic study revealed that the algal flora of the Bandama River comprises 170 species divided into 67 genera, 37 families, 12 orders, 8 classes and 5 phyla. Figure 2 shows that the Chlorophyta phylum has the highest number of taxa with 75 species, or 44.11%. Next come the Euglenophyta (44 taxa or 25.88 %), the Heterokontophyta (36 taxa or 21.17 %), the Cyanoprokaryota (12 taxa or 7.05 %) and finally the Dinophyta (3 taxa or 1.76 %).

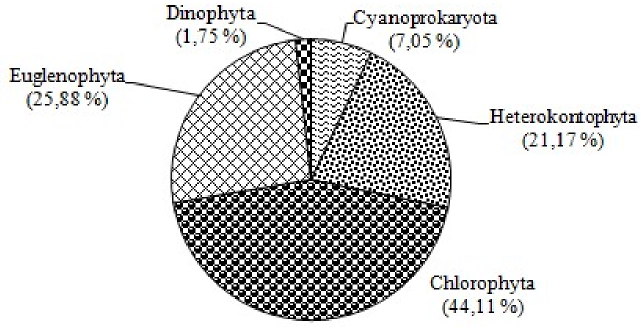


Figure 2. Spectrum of the different phyla in the Bandama River (Côte d'Ivoire)

Fluvial environments: A redundancy analysis was used to study the influences of physico-chemical variables on the distribution of taxa sampled at different stations and in different seasons. Axes I and II express 89.3% of the cumulative variance values for species data, which justifies their choice in interpreting the results of this analysis (Figure 3). Axis I is positively correlated with nutrient salts (silica, nitrites, nitrates, ammonium, orthophosphates). Axis II is negatively correlated with pH and dissolved oxygen. The taxa *Coelastrum indicum* (Coin), *Crucigeniellaapiculata* (Crap), *Merismopedia glauca* (Megl), *Microcystis aeruginosa* (Miae), *Microcystis wesenbergii* (Miwe), *Pediastrum tetras* (Pete), *Scenedesmus bicaudatus* (Scbi) and *Teilingiagranulata* (Tegr) are positively influenced by ammonium. These taxa are found at Longo (B1) and Nabédjakaha (B2) during the short rainy season and at Zambakro (B7) during the long rainy season. In addition, these two parameters negatively influence *Aphanocapsa incerta* (Apin), *Dictyosphaeriumpulchellum* (Dipu), *Merismopedia elegans* (Meel), *Pediastrum biradiatum* (Pebi), *Pediastrum duplex* var. *gracillimum* (Pegr), *Pediastrum simplex* (Pesi) and *Scenedesmus acuminatus* (Scac) found in Bozi (B6) and N'Zianouan (B9) during the rainy season and in Zambakro during the short dry season. The taxa *Aphanocapsaelachista* (Appel), *Scenedesmus bernardii* (Scbe) and *Coelastrumpulchrum* (Copu) found in Yékolo (B3) during the short rainy season and Bozi (B6) during the long dry season, are positively correlated with dissolved oxygen and pH. The group consisting of the species *Chroococcuslimneticus* (Chli), *Crucigenia quadrata* (Crqu), *Desmodesmusquadricaudatus* (Dequ), *Hyalothecadissiliens* (Hydi), *Pediastrum simplex* var. *duodenarium* (Pedu), *Scenedesmus disciformis* (Scdi) and *Trachelomonas verrucosa* (Trve) is negatively influenced by oxygen and pH. These taxa are observed in Bozi and N'Zianouan during the short dry season and in Tiassalé (B10) during the long rainy season. Nutrient salts (silica, nitrites, nitrates and orthophosphates) positively influence the taxa *Aulacoseiragranulata* var. *angustissima* (Auan), *Crucigeniellaapiculata* (Crap), *Oscillatoria princeps* (Ospr), *Pandorina morum* (Pamo) and Spirogyra sp.1 (Sps1) found at Nabédjakaha and N'Zianouan during the long dry season and short rainy season.

Lake environments: Figure 4 shows the ordination obtained from the abundance of taxa and environmental variables in the lake areas of the Bandama River. Axes I and II express 57.9%

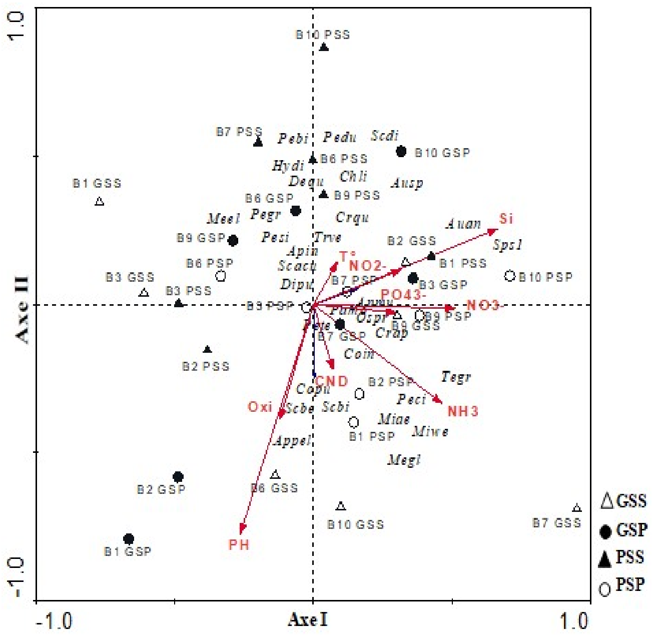


Figure 3: Redundancy analysis (R.D.A.) applied to physico-chemical parameters and micro-algal taxa collected in the fluvial waters of the Bandama River (Côte d'Ivoire). Taxon acronyms are identical to those defined in Table 3 ; Si: Silica; T°: Temperature; NO2- : Nitrite; PO43- : Orthophosphates; NO3- : Nitrate; CND: Conductivity; Oxi: Dissolved oxygen; B1 to B10: stations; GSS: long dry season; PSS: short dry season; GSP: long rainy season; PSP: short rainy season

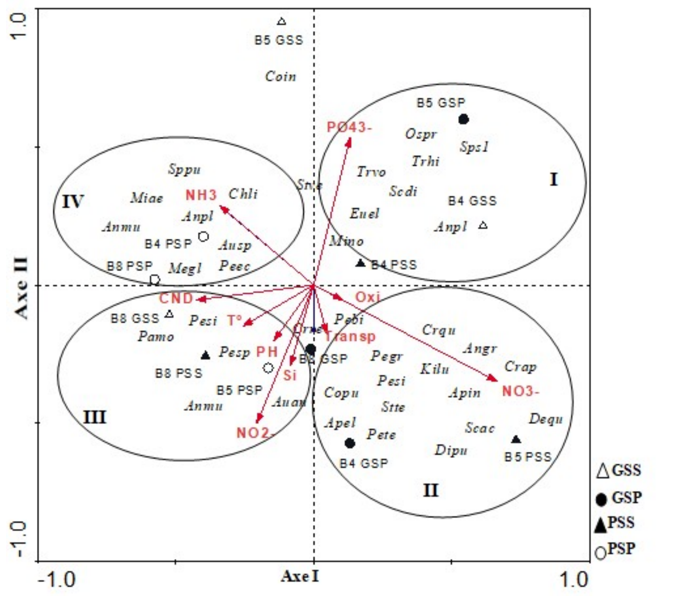


Figure 4. Redundancy analysis (R.D.A.) applied to physico-chemical parameters and micro-algal taxa collected in the waters of the Bandama River lakes (Côte d'Ivoire). The acronyms of the taxa are identical to those defined in Table 4 ; Si: Silica; T°: Temperature; NO2-: Nitrite; PO43-: Orthophosphates; NO3-: Nitrate; NH4+: Ammonium; CND: Conductivity; Oxi: Dissolved oxygen; Transp: Transparency; B1 to B10: stations; GSS: long dry season; PSS: short dry season; GSP: long rainy season; PSP: short rainy season.

of the cumulative variance values. Four groups of taxa can be distinguished. The taxa *Trachelomonasvolvocina* (Trvo), *Eudorina elegans* (Euel), *Oscillatoria princeps* (Ospr), *Spirogyra* sp.1 (Sps1), *Scenedesmus disciformis* (Scdi) and *Anabaena planctonica* (Anpl), making up group I, are found in Kossou during the dry and short rainy seasons. These taxa are influenced by orthophosphates. Group II, positively correlated with nitrates, transparency and dissolved oxygen, consists of *Kirchneriellalunaris* (Kilu), *Crucigeniellaapiculata* (Crap), *Desmodesmusquadricaudatus* (Dequ), *Scenedesmus acuminatus* (Scac), *Ankistrodesmusgracillis* (Angr), *Crucigenia quadrata* (Crqu), *Aphanocapsa incerta* (Apin), *Pediastrum biradiatum* (Pebi), *Pediastrum duplex* var. *gracillimum* (Pegr), *Pediastrum simplex* (Pesi), *Pediastrum tetras* (Pete), *Staurastrumtetracerum* (Stte), *Dictyosphaeriumpulchellum* (Dipu), *Aphanocapsaelachista* (Apel) and *Cosmariumpunctulatum* (Copu).

These taxa are found in Lake Kossou during the main rainy season and the short dry season. Group III is characterised by the taxa *Pandorina morum* (Pamo), *Pediastrum simplex* var. *simplex* (Pesi), *Aulacoseiragranulata* var. *angustissima* (Auan), *Peridinium* sp. (Pesp) and Anabaena mucosa (Anmu), observed in Kossou during the short rainy season and in Taabo during the long and short dry seasons. The distribution of these taxa is influenced by temperature, pH, conductivity and nutrient salts (silica and nitrite). Group IV, made up of *Anabaena planctonica* (Anpl), *Anabaena mucosa* (Anmu), *Aulacoseiragranulata* var. *angustissima*fo. *spiroïdes* (Ausp), *Chroococcuslimneticus* (Chli), *Merismopedia glauca* (Megl), *Microcystis aeruginosa* (Miae), *Pediastrum simplex* var. *echinulatum* (Peec) and *Spondylosiumpulchrum* (Sppu), is influenced by ammonium. These taxa are found in Kossou and Taabo during the short rainy season.

DISCUSSION

The parameters measured did not vary significantly from one station to another. Certain parameters such as pH, temperature, dissolved oxygen and transparency varied significantly from one season to the next ($p < 0,05$). The pH values are predominantly alkaline (mean 7.06) and do not vary significantly between the different stations. The alkalinity of the river can be explained by the nature of the soil in its catchment area (N'Douba, 2000;Arienzo*et al.,* 2001). Temperatures recorded in the Bandama River vary between 24.47°C and 33.34°C, with an average of 28.05°C. They are higher in the lakes than in the river waters. This is due to the fact that the canopy closure rate is zero at the Kossou and Taabo lake stations (Aboua, 2012), exposing them to solar radiation. The dissolved oxygen values recorded at the stations on the Bandama River indicate that the waters of the fluvial section, especially in the downstream part, are more oxygenated than those of the lakes. This could be explained by their lotic nature. In fact, the flow of water favours the supply of oxygen through the air-water interface (Villeneuve *et al.,* 2006). The low levels of dissolved oxygen in lake water can be explained by high lake temperatures. In terms of nutrient salts (nitrite, nitrate and ammonium), the downstream part of the river has higher levels than the upstream part and between the lakes. This upstream-downstream gradient in mineralisation is attributable to the fact that water laden with these nutrient salts from anthropised areas is drained from upstream to downstream.

One hundred and seventy (170) taxa were inventoried as part of the study of the taxonomic composition of the Bandama River. Lake Kossou was the most species-rich, with 148 taxa inventoried. On the whole, lake environments that are similar to each other are more diverse than river environments. This

Table I. Average values of physico-chemical parameters in different parts of the Bandama River (Côte d'Ivoire)

Paramètres	Milieu fluvial				Lac		
	Amont	Entre lacs	Aval	**Moyenne**	Kossou	Taabo	**Moyenne**
pH	7,02 ± 0,37	6,95 ± 0,40	6,68 ± 0,46	**6,88 ± 0,18**	7,32 ± 0,32	7,52 ± 0,86	**7,38 ± 0,52**
Temp (°C)	27,71 ± 1,11	27,21 ±1,03	26,2 ± 1,44	**27,04 ± 0,77**	29,94 ± 1,2	30,6 ± 2,57	**30,15 ± 1,64**
Cond (mg/l)	74,18 ± 20,68	70,28±18,32	48,84 ±10,56	**64,43 ± 13,64**	96,64 ± 12,9	110,2 ±26,3	**101,16 ± 18,4**
OD (mg/l)	5,02 ± 1,97	4,48 ± 1,12	5,41 ± 1,52	**4,97 ± 0,46**	3,2 ± 1,16	2,98 ± 1,44	**3,13 ± 1,2**
Transp (cm)	29,58 ±14,56	25,62 ± 8,33	29,12 ± 11,9	**28,10 ± 2,16**	66,43 ±38,66	89 ± 44,05	**73,96 ± 40,05**
NO_3^- (mg/l)	2,81 ± 1,65	3,47 ± 2,1	4,19 ± 2,08	**3,49 ± 0,69**	7,3 ± 2,98	6,63 ± 4,21	**7,08 ± 3,25**
NO_2^- (mg/l)	0,025 ±0,023	0,035 ±0,01	0,039 ± 0,01	**0,033 ± 0,007**	0,045 ±0,028	0,04 ± 0,02	**0,045 ± 0,25**
PO_4^{3-} (mg/l)	0,81 ± 0,36	0,74 ± 0,39	0,76 ± 0,67	**0,77 ± 0,03**	2,15 ± 0,84	2,57 ± 0,78	**2,28 ± 0,81**
NH_4^+ (mg/l)	0,262 ± 0,11	0,24 ± 0,14	0,302 ± 0,13	**0,26 ± 0,03**	0,39 ± 0,19	0,41± 0,22	**0,4 ± 0,20**
Si (mg/l)	14,75 ± 5,44	9,13 ± 3,09	11 ± 2,5	**11,62 ± 2,86**	8,25 ± 5,94	7,8 ± 8	**8,08 ± 6,32**

richness could be linked to their lentic nature. The stagnant nature of lakes encourages biological processes such as the complete reproduction and development cycles of algae. This algal richness in relation to water stability was observed by Ouattara (2000) on Lake Ayamé in Côte d'Ivoire. In terms of composition, the phytoplankton community is characterised by a predominance of Chlorophyta (44.11%) followed by Euglenophyta (25.88%), Heterokontophyta (21.17%), Cyanoprokaryota (7.05%) and Dinophyta (1.76%). The dominance of Chlorophyta and Euglenophyta in particular is due to the fact that the physico-chemical characteristics (nutrient salts, temperature and transparency) recorded in the waters of the Bandama River are favourable to them. Chlorophyta are typically thermophilic and photophilic (Sheath and Wehr, 2003). As for the Euglenophyta, their great diversity is due to the richness of organic substances in the environment (Xavier, 1985; Kim and Boo, 1998). This dominance of Chlorophyta was observed by Bourrelly (1961a) in all the water collections in the south of Côte d'Ivoire, Iltis (1982a and b) in the Haute Comoé and Bagoé rivers and Ouattara (2000) in the Biariver. Outside Côte d'Ivoire, the work of Couté and Rousselin (1975), Franceshini (1991) and Zongo (2007) in the Upper Volta, Porto Alegre and Bagré respectively has highlighted this state of affairs.

The production of algal communities in an ecosystem is a function of environmental parameters (Reynolds, 1995). The results of the study (Redundancy Analysis) show that Chlorophyta and Cyanoprokaryota have a preference for nutrient-rich environments. The proliferation of Chlorophyta in these nutrient-rich environments is in line with the observations of Beman *et al.* (2005) according to which the availability of nutrients is an essential factor in the proliferation of Chlorophyta. On the other hand, pH and temperature had a much greater influence on the distribution of Chlorophyta. This influence could be explained by the fact that Chlorophyta are typically thermophilic and photophilic (Sheath and Wehr, 2003). Alkaline pH levels are favourable for the development of many Desmidiales (Da, 2007). High phytoplankton densities in lakes are due to the abundance of certain Cyanoprokaryota species influenced by orthophosphates and ammonium. This result suggests that the Cyanophyceae causing this surge develop in the presence of relatively high levels of these nutrients. This result was observed by Ouattara (2000) in Lake Ayamé. The positive influence of silica on the distribution of the species *Aulacoseiragranulata* var. *angustissima* can be explained by the fact that silica is one of the essential factors in primary production, necessary for the formation of diatom frustules (Capdevielle, 1978).

CONCLUSION

A study of the floristic composition revealed 170 species divided into 67 genera, 37 families, 12 orders, 8 classes and 5 phyla. The Chlorophyta phylum, with 44.11%, is the most diverse in terms of taxa. Dinophyta is the least diverse, with 1.76% of taxa. The distribution of algal species in relation to physico-chemical parameters in the Bandama River is influenced by nutrient salts, dissolved oxygen, pH and temperature. The Bandama river remains diversified and constitutes a hydrosystem with very significant biological potential. It is therefore essential to preserve these natural resources.

REFERENCES

Aboua B.R.D., 2012. Développement d'un indice d'intégrité biotique piscicole pour la préservation de la biodiversité du fleuve Bandama. Thèse de Doctorat, Université Félix Houphouët-Boigny, Côte d'Ivoire, 227 p.

Arienzo M., Adamo P., Bianco M.R. &Violante P., 2001. Impact of land use and urban runoff on the contamination of the Sarno River basin in Southwestern Italy. *Water Air Soil Pollution*, 131 : 349-366.

Beman J.M., Arrigo K.R. & Matson P.A., 2005. Agricultural runoff fuels large phytoplankton blooms in vulnerable areas of the ocean. *Nature,* 434 : 211-214.

Bourrelly P., 1961a. Algues d'eau douce de la République de Côte d'Ivoire. *Bulletin de l'Institut Français de l'Afrique Noire,*série A, 23 (2) : 283-374.

Capdevielle P., 1978. Recherches écologiques et systématiques sur le phytoplancton du Lac de Cazaux-Sanguinet-Biscarosse. Thèse de Doctorat, Université de Bordeaux 1, Bordeaux, 312 p.

Couté A. & Rousselin G., 1975. Contribution à l'étude des Algues d'eau douce du Moyen Niger (Mali). *Bulletin du Musée National d'Histoire Naturelle, Paris*, 277 : 73-175.

Da K.P., 2007. Étude taxinomique du phytoplancton dulçaquicole des masses d'eaux lentiques et lotiques de quelques sites au Sud de la Côte d'Ivoire, entre les fleuves Bandama et Bia : apports de la microscopie électronique à balayage. Thèse de Doctorat d'État ès Sciences Naturelles. U.F.R. Biosciences, Université de Cocody-Abidjan, Côte d'Ivoire, 402 p.

Dufour P. & Durand J.R., 1982. Production végétale des lagunes de Côte d'Ivoire. *Revue Hydrobiologie tropicale*, 15 : 209-230.

Franceschini I.M. & Couté A., 1991. Quelques Chrysophycées (Algae, Chromophyta) à écailles siliceuses de l'extrême Sud-Est du Brésil. *Archive d'Hydrobiologie Supplement,* 89 / *Algologies Studies*, 62 : 45-61.

Iltis A., 1982a. Peuplements algaux des rivières de Côte d'Ivoire. 1. Stations de prélèvement, méthodologie, remarques sur la composition qualitative et biovolumes. *Revue d'Hydrobiologie tropicale*, 15 (3) : 231-239.

Iltis A., 1982b. Peuplements algaux des rivières de Côte d'Ivoire. II. Variations saisonnières des biovolumes, de la composition et de la diversité spécifique. *Revue d' Hydrobiologie tropicale*, 15 (3) : 241-251.

Kim J.T. & Boo S.M., 1998. Morphology, population size, and environmental factors of two morphotypes in *Euglena geniculata*(Euglenophyceae) in Korea. *Archivfür Hydrobiologie*, *Supplement*, 126 : 27-36.

N'Douba V., 2000. Biodiversité des Monogènes parasites des poissons d'eau douce de Côte d'Ivoire : Cas des poissons des rivières Bia et Agnébi. Thèse Doctorat d'Etat. Université de Cocody, Abidjan (Côte d'Ivoire) 250 p.

Ouattara A., 2000. Premières données systématiques et écologiques du phytoplancton du lac d'Ayamé (Côte d'Ivoire). Thèse de doctorat, Université Catholique Leuven, Belgique, 226 p.

Reynolds C.S., 1995. River plankton: the paradigm regained. *In :*Harper D. M. et Ferguson A. J. D. (Éds) : The Ecological Basis for River Management. Wiley, New York ; 161-174.

Savané I., 2010. La géographie physique. *In* : Konaté S. et Kampmann D., 2010. Atlas de la biodiversité de l'Afrique de l'Ouest, tome III : Côte d'Ivoire. Abidjan et Frankfurt. pp. 122-123.

Sheath R.G. & Wehr J.D., 2003. Freshwater Algae of North America. Ecology and classification. California, U.S.A, 918 p.

Ter Braak C.J.F. & Smilauer P., 2002. CANOCO reference manual and Canodraw for Windows user's guide : software for canonical community ordination (version 4.5). Microcomputer Power, Ithaca, New York, 500 p.

Traoré K., 1996. État des connaissances sur les pêcheries continentales ivoiriennes. Rapport de consultation Avril 1996. Projet F.A.O. TCP/ IVC/4553, 135 p.

Villeneuve V., Légaré S., Painchaud J. & Warwick V., (2006). Dynamique et modélisation de l'oxygène dissous en rivière. *Revue des Sciences de l'Eau* 19 (4), 259-274.

Xavier M.B., 1985. Estudocomparativo da flora de Euglenaceaepigmentadas (Euglenophyceae) de lagos do parque Estadualdas Fontes do Ipiranga, Sao Paulo (Brasilia). Tese de Doutoramento. Faculdade de Saude Publica da USP, 378 p.

Zongo F., 2007. Inventaire et systématique des micro-algues dulçaquicoles du réservoir de Bagré au Burkina Faso (Province de Boulgou). Thèse de Doctorat d'État, Université de Ouagadougou (Burkina Faso), 164 p.

****