

Taxonomy of some Euglenophyta rivers Boubo and Mé in the coastal Southern of Côte d'Ivoire

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ABSTRACT : Suspended micro-algal samples taken for one year based on the different climatic seasons of the country, in coastal rivers Boubo and Mé in Southern of Côte d'Ivoire allowed us to identify thirty four taxa of Euglenophyta. Those taxa have been examined with an Olympus photonic microscope, with incorporated digital camera. Structural details observed permitted the sharing of twenty taxa between five genera : *Euglena* (ten taxa), *Lepocinclis* (three taxa), *Phacus* (sixteen taxa), *Strombomonas* (three taxa) and *Trachelomonas* (two taxa).

KEY WORDS : Taxonomy - Microalgae - Euglenophyta - River - Boubo - Mé - Côte d'Ivoire.

INTRODUCTION

Côte d'Ivoire, a state of West Africa, has a dense hydrographic network of more than 11,000 km. This water system is used in all areas; namely agriculture, industry, livestock, navigation, fishing and domestic needs. However, for more than a decade, we have witnessed the gradual disappearance of these freshwater bodies. This situation is due to eutrophication which is a phenomenon characterized by the enrichment in mineral salts of an aquatic environment resulting in an ecological imbalance and a massive proliferation of aquatic plants, especially phytoplankton. The latter according to [20], refers to all microscopic plant organisms living freely in water, whose sizes vary between 2 and 200 microns. It is fairly well established that nutrient-enriched waters (in particular ammonium nitrate and phosphates), with a temperature between 15 and 30 ° C and a pH ranging from 6 to 9, offer favorable conditions for the development of the micro-algal flora [17].

In Côte d'Ivoire, work on the systematic study of phytoplankton was conducted by a few researchers such as [19], [1], [18], [8], [16] and [13]. Of these works, only those of [7] and [10] focused on the systematic study of Euglenophyta specifically. This lack of work on this branch, especially freshwater, has given rise to the present study on the Boubo and Mé rivers, led by the Botany Laboratory of the University of Cocody in collaboration with the Ivorian Anti-Pollution Center (CIAPOL). structure of the Ministry of Environment, Water and Forests.

The choice of these study areas, namely the Boubo and Mé rivers, is due to the fact that these two rivers have never been the subject of phytoplankton research. In addition, one of them, the Boubo River, is bordered by PALMCI's large industrial palm oil plantation and oil mill. In fact, the phytosanitary products used in the plantation have a negative impact on water. It is the same for the oil mill whose discharges are dumped in said river. The Mé River, located in a zone with low activity compared to Boubo, will serve as the second pole in the process of comparing the qualitative harvests of these two aquatic ecosystems.

The present article, which deals with the systematics of Euglenophyta, is only a contribution to the inventory of taxa of this branch, which is designated as that of

bioindicators of richness in organic matter and thus of the state of eutrophication of the aquatic biotope.

1. Material and methods

1.1. Presentation of the study environment

The study environment is located in the southern part of Côte d'Ivoire. It is located between latitude 3°45' and 5°30' N, 5°15' and 6°20' W (Figure 1). The Boubo and Mé rivers, which are the sampling rivers for this study, have receiving areas of 4,702 km² and 2,458 km², respectively. On each watercourse three stations are defined according to their accessibility. Average values of temperature, conductivity and pH are given from upstream to downstream as per river and per station:

* Thus on the river Boubo, one finds the stations of :

- Divo (5°51' N and 5°24' W) located at the bridge on the Divo-Lakota axis with temperature averages = 25,70 °C; conductivity = 122,36 μS cm⁻¹ ; pH = 6,97.
- PALMCI-Boubo (5°43' N and 5°09' W) located downstream of the mill of the company PALMCI of Divo where temperature averages = 25,95 °C ; conductivity = 113,45 μS cm⁻¹ ; pH = 7,28.
- Adahidougou (5°17' N and 5°14' W) located at the bridge on the Grand-Lahou-Fresco axis with mean temperature = 26 °C ; conductivity = 293,7 μS cm⁻¹ ; of pH = 6,68.

* On the Mé River there are the stations of :

- Abou (6°03' N and 3°50' W) located on the axis Adzopé-Yakassé-Attobro with mean temperature = 25 °C ; conductivity = 133,9 μS cm⁻¹ ; pH = 6,89.
- Mafou tributary of the Mé (5°49' N and 3°59' O) located at the bridge on the axis Azaguié-Adzopé with average temperature = 25,83 °C) ; conductivity = 78,5 μS cm⁻¹); pH = 6,92.
- Mé (5°29' N and 3°52' W) located at the bridge on the axis Abidjan-Alépé with average temperature = 25,43 °C ; conductivity = 5,07 μS cm⁻¹ ; pH = 6,72.

1.2. Harvesting samples

The samples were harvested using a 20 μm mesh plum net and fixed with commercial formalin at the final concentration of 5 p.c. The sediments obtained from the 40 ml pillboxes after a few days are mounted between slide and coverslip for observation on an Olympus-type optical microscope equipped with a digital camera.

The physicochemical factors were measured *"in situ"* thanks to a pH meter (HACH EC 10), for the measurement of the pH and a conductivity meter (HACH CO 150) for the measurement of the conductivity ($\mu\text{S cm}^{-1}$), the temperature ($^{\circ}\text{C}$) and salinity (pm). The devices are first powered up before the probe dive for a digital display of values.

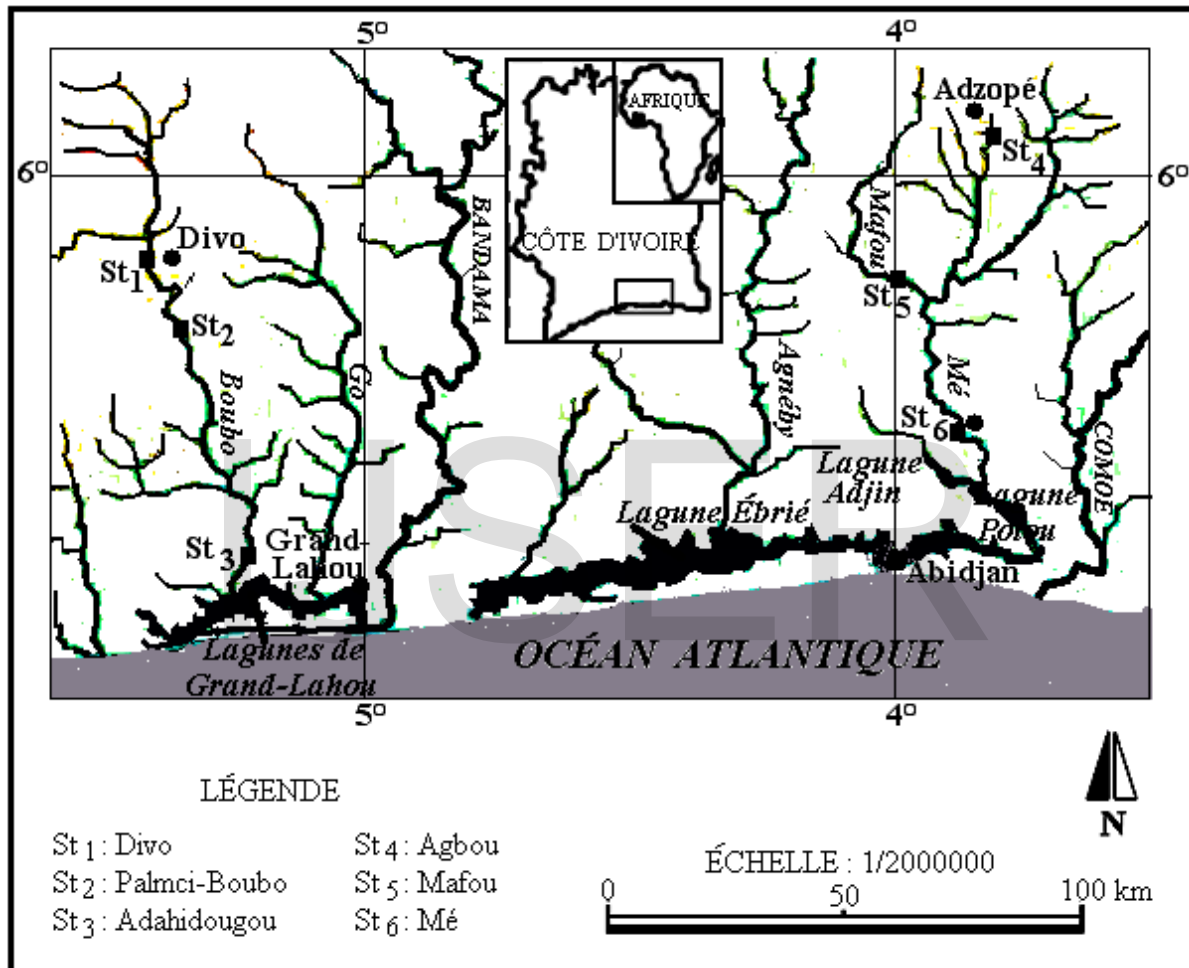


Figure 1 : Carte du milieu d'étude (Source : Service cartographique O.R.S.T.O.M.- Université-Abidjan, modifiée par SALLA)

2. RESULTS

2.1. Description of observed taxa

The description and classification followed are those proposed by [1], [3], [4], [11], [5], [16]. The species, varieties and forms described are new in the Ivorian algal flora. In addition, for each taxon, morphological, anatomical and measurement data are

provided as well as their phytogeographic distribution, harvest stations and illustrations are provided for each taxon cited. The scale lines of the illustrations represent 20 μm .

2. Euglenophyta - Euglenophyceae - Euglenales - Euglenaceae

Genus *Cyclidiopsis* Korshikov

***Cyclidiopsis acus* Korshikov** : Cells have dimensions of 167-196 x 7-9,6 μm . They have numerous small disc plastids in the cytoplasm. The species is close to *Lepocinclis acus* but here the apex is more flaring (Fig. 2). The taxon is cosmopolitan. In Africa, he has been identified in Burundi. This taxon is harvested at the Adahidougou, Divo and PALMCI-Boubo stations.

Genus *Euglena* Ehrenberg

***Euglena allorgei* Deflandre** : The cells of *Euglena allorgei* measure 90-110 x 14-17 μm . They are rigid, slightly curved, with some cytoplasm rich in discoplastics. Their paramylons are elongated into rods on either side of the nucleus (Fig. 3). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burkina Faso, Burundi. It is harvested at the Abou station.

***Euglena caudata* Hübner** : The cells are fusiform with the following dimensions : 72,8-97 x 13,7-18 μm . They are swollen in the middle part and have numerous discoid plastids, with paramylons in sticks with rounded ends (Fig. 4). The taxon is cosmopolitan. In Africa, he has been identified in Burundi. It is harvested at Divo and PALMCI-Boubo stations.

***Euglena ehrenbergii* Klebs** : *Euglena ehrenbergii* is a long ribbon cell 155 to 180 μm long and 15 to 19,5 μm wide. Its cytoplasm contains small disc plastids and paramylon in elongated rings (Fig. 5). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: South Africa, Burundi, Ivory Coast, Libya, Morocco, Chad. It is harvested at the Divo station.

***Euglena gracilis* Klebs** : The cells of this species have the dimensions 40-48 x 10-15 μm . The cytoplasm has numerous small disc plastids and oblong or round paramoly grains scattered throughout the cytoplasm (Fig. 6).

The taxon is cosmopolitan. In Africa, he has been identified in Burundi. *Euglena gracilis* is harvested at PALMCI-Boubo station.

***Euglena polymorpha* Dangeard** : The cells, with dimensions of 83-94 x 30-40 μm , have a narrowed antapex in robust caudal appendage, and a slightly attenuated apex.

The cytoplasm has many discoid plastids (Fig. 7). The taxon is cosmopolitan. In Africa, it has been identified in Niger. It is collected at the Abou station.

***Euglena proxima* (Dangeard) Lemmermann** : The cells measure 60 to 71.5 μm in length and 16.1 to 18.5 μm in width. The cell wall is very finely striated and the cytoplasm has many discoid plasters as well as paramylon in the form of rounded scattered grains (Fig. 8). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: South Africa, Côte d'Ivoire, Democratic Republic of Congo, Sierra Leone, Chad. The taxon is harvested at PALMCI-Boubo station.

***Euglena vagans* Deflandre** : This taxon is a 38-47.6 x 5,7-8 μm cell, with small discoid plastids and two large paramylon rings on either side of the nucleus, which are observable in the cytoplasm (Fig 9). The taxon is cosmopolitan. In Africa, it has been identified in Burundi. It is harvested at the Abou station.

***Euglena variabilis* Klebs** : The cells, 29-32,4 x 14,7-16,3 μm , have a finely striated wall, numerous small disc plastids, and oblong or rounded paramylon grains scattered throughout the cytoplasm (Fig. 10).The taxon is cosmopolitan. In Africa, he has been identified in Chad. It is harvested at Divo and PALMCI-Boubo stations.

***Euglena* sp.** : The spindle cells, 59-65 x 12-13,5 microns, are provided with a veil all around them. They have a rich cytoplasm of small disc plastids and two rings of paramylon (Fig. 11). The taxon is harvested at the Abou station.

Genus *Lepocinclis* Perty

Lepocinclis acus* (O. F. Müll.) Marin & Melkonian var. *acus : These cells measure 90-108 x 8 -10 μm . Their cytoplasm contains numerous discoid plastids, as well as elongated rodlike paramylons (Fig. 12). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Algeria, Burkina Faso, Burundi, Cameroon, Côte d'Ivoire, Kenya, Libya, Malawi, Morocco, Mozambique, Nigeria, South Africa, Uganda, Democratic Republic of Congo, Rwand, Sierra Leone, Tanzania, Chad, Zambia. It is harvested at the Adahidougou and PALMCI-Boubo stations.

****Lepocinclis acus* var. *rigida* Hübner** : The cells of this taxon measure 70-94.5 x 4-6 μm . Their cytoplasm is rich in many discoid plastids. This variety is narrower than the type of the species (Fig. 13). The taxon is cosmopolitan. In Africa, he has been identified in Burundi. It is harvested at the Abou station.

***Lepocinclis fusiformis* (Carter) Lemmermann** : Here the cell, lemon-shaped, is narrowed at both poles. It has the dimensions 37-46.2 x 27,2-35,5 microns. Its wall is decorated with levogenic streaks and its cytoplasm has a paramylon in two parietal rings (Fig. 14). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burundi, Côte d'Ivoire, Egypt, Mozambique, Nigeria, South Africa, Chad. It is harvested at Divo and PALMCI-Boubo stations.

Lepocinclis ovum* (Ehrenberg) Lemmermann var. *ovum : The cells measure 29,5 to 39 µm in length and 20 to 25,2 µm in width, with an ovoid contour. They have a short caudal appendage and a rounded apex. Their wall is striated, and a paramylon formed of two large lateral rings is contained in the cytoplasm (Fig. 15). The taxon is subcosmopolite. In Africa, it has been identified in the following countries: Algeria, Burundi, Côte d'Ivoire, Equatorial Guinea, Egypt, Equatorial Guinea, Libya, Malawi, Mozambique, Nigeria, Democratic Republic of Congo, Sierra Leone, Chad. The taxon is sampled at the Divo station.

***Lepocinclis ovum* var. *bütschlii* (Lemmermann) Conrad** :

The cells are ovoid, caudate, with dimensions of 21,6-27.5 x 11,6-16 µm. A paramylon in the form of short sticks, or rounded, is present in the cytoplasm (Fig. 16). The taxon is cosmopolitan. In Africa, it was harvested in Mozambique. It is harvested at the Abou station.

***Lepocinclis oxyuris* (Schmarda) Marin and Melkonian var. *oxyuris* fo. *Charkowiensis* (Swirenko) Bourrelly** : The elongate cells measure 140-150,3 x 21,5-25 µm. Their wall is striated and their cytoplasm is rich in discoid plasters, which are small in size. Two paramylon rings, located on both sides of the nucleus, are also present in the cytoplasm (Fig. 17). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: South Africa, Algeria, Burkina Faso, Burundi, Côte d'Ivoire, Egypt, Morocco, Mozambique, Democratic Republic of Congo, Uganda, Senegal, Sierra Leone, Chad, Zambia. It is harvested at the stations Abou, Adahidougou and Mé.

***Lepocinclis oxyuris* var. *minor* Deflandre** : The cells are elongated and measure 100-120 x 15,1-22 µm. Their wall is striated. Numerous small disc plastids are observed in the cytoplasm, as well as two elongated rings of paramylon (Fig. 18). The taxon is

cosmopolitan. In Africa, he has been identified in Côte d'Ivoire. It is harvested at the Abou and Divo stations.



Figures 2 à 20 : 2- *Cyclidiopsis acus* ; 3- *Euglena allorgei* ; 4- *Euglena caudata* ; 5- *Euglena ehrenbergii* ; 6- *Euglena gracilis* ; 7- *Euglena polymorpha* ; 8- *Euglena proxima* ; 9- *Euglena vagans* ; 10- *Euglena variabilis* ; 11- *Euglena* sp. ; 12- *Lepocinclis acus* var. *acus* ; 13- *Lepocinclis acus* var. *rigida* ; 14- *Lepocinclis fusiformis* ; 15- *Lepocinclis ovum* var. *ovum* ; 16- *Lepocinclis ovum* var. *bütschlii* ; 17- *Lepocinclis oxyuris* fo. *charkowiensis* ; 18- *Lepocinclis oxyuris* var. *minor* ; 19- *Lepocinclis salina* ; 20- *Lepocinclis spirogyra* var. *spirogyra* ; NB : Les traits d'échelle des illustrations représentent 10 µm.

***Lepocinclis salina* Fritsch** : The cells of this taxon measure 40-59,6 x 34-35,7 μm and are ovoid (Fig. 19). The taxon is cosmopolitan. In Africa, he has been identified in the Démocratique Republic of Congo. We harvested it at the Abou station.

Lepocinclis spirogyra* (Ehrenberg) Marin & Melkonian var. *spirogyra : Cells 110-130 x 18-23,7 μm , have the wall decorated with pearls arranged in spiral lines. The plastids are numerous, small, discoidal. Two large rings of paramylon on either side of the nucleus are observable in the cytoplasm (Fig. 20). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: South Africa, Algeria, Burkina Faso, Burundi, Côte d'Ivoire, Malawi, Morocco, Mozambique, Uganda, Democratic Republic of Congo, Sierra Leone, Tanzania, Zambia. We harvested it at the Divo and PALMCI-Boubo stations.

***Lepocinclis spirogyra* var. *fusca* Klebs** : This variety is large and measures 200,7-240 x 20,3-31 μm . The wall is decorated with small protuberances arranged in spiral lines. The cytoplasm is provided with numerous plastids, small and discoidal. Two large rings (not visible here in the photograph) of paramylon on either side of the nucleus are also present in the cytoplasm (Fig. 21). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Côte d'Ivoire, Madagascar, Mozambique, South Africa, Uganda. It is harvested at the Divo station.

***Lepocinclis texta* (Dujardin) Lemmermann emend. Conrad** : Obovoid to ovoid cells are 43-65 x 32,2-40,7 μm in size. The apex is asymmetrical, with lateral depression, while the posterior end is enlarged, with or without a caudal appendage (Fig. 22). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burkina Faso and Burundi. It is sampled at the Abou station.

***Lepocinclis turbiniformis* Deflandre** : The cells, 30,8-36,2 x 20-23,5 μm , are pear-shaped, with a rounded anterior pole, and attenuated at the posterior pole in a long tail. The wall has levogenic streaks. The cytoplasm has many discoid plastids, as well as two rings of paramylon (Fig. 23). The taxon is cosmopolitan. It is harvested at the Abou station.

***Lepocinclis* sp.** : Ovoid cells, 33-43,2 x 15.2-20,5 μm , are slightly attenuated forward. They are each provided with a long caudal sting. The shape is somewhat reminiscent of *Lepocinclis ovum* var. *gracilicauda* Deflandre (Fig. 24). The taxon is harvested at PALMCI-Boubo station.

Genus *Phacus* Dujardin

***Phacus acuminatus* Stokes var. *acuticauda* (Roll) Huber-Pestalozzi** : This variety, with dimensions of 26,3-32,7 x 21,5-28 μm , is clearly enlarged at the posterior part. This taxon has a generally much smaller form than the type of the species. Two unequal paramylon disks are observable in the cytoplasm (Fig. 25). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burundi, Nigeria and the Democratic Republic of Congo. It is harvested at the Abou station.

***Phacus anomalus* Fritsch & Rich** : Cells of this species are 25,5 to 29 μm long by 20 to 23,2 μm wide. They are oval, with a cytoplasm that contains paramylon grains in flattened disks (Fig. 26). The taxon is subcosmopolite. In Africa, it has been identified in the following countries : Ivory Coast, Guinea Bissau, Guinea Conakry, Mozambique, Democratic Republic of Congo. It is harvested at PALMCI-Boubo station.

***Phacus brevicaudatus* (Klebs) Lemmermann** : The taxa measure 20,6-25 x 18,7-23 μm . They have two paramylon discs facing each other, somewhat reminiscent of a two-grooved pulley (Fig. 27). The taxon is cosmopolitan. In Africa, it has been identified in the following countries : Burundi and Côte d'Ivoire. It is harvested at the station Adahidougou.

***Phacus caudatus* Hübner** : Oval cells, 60-70.6 x 35-42.7 μm , have asymmetrical and largely oval contours. Their caudal appendage is oblique. The cytoplasm contains two unequal paramylon disks (Fig. 28). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burundi, Morocco, Nigeria, Sierra Leone, Chad. It is harvested at PALMCI-Boubo station.

***Phacus curvicauda* Swirenko** : These cells are 30-37,5 x 25-30 μm in size. The cytoplasm has paramylon discs, as well as many discoid plastids (Fig. 29). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: South Africa, Burundi, Côte d'Ivoire, Mozambique, Chad. It is harvested at the station Adahidougou.

***Phacus hamatus* Pochmann** : These cells measure 50-60 x 38-43 μm . They are ovoid to ellipsoidal, with a cytoplasm containing a paramylon formed of two large concentric

disks (Fig. 30). The taxon is subcosmopolite. In Africa, it has been identified in the following countries: Burundi and Chad. It is harvested at PALMCI-Boubo station.

***Phacus heimii* Lefèvre** : This taxon is 30 to 38,5 μm long and 28,4 to 32 μm wide. He has a short and powerful caudal appendage. Two or three paramylon disks are present in the cytoplasm (Fig. 31). The taxon is subcosmopolite. In Africa, he has been identified in Côte d'Ivoire. It is harvested at PALMCI-Boubo station.

***Phacus helicoides* Pochmann** : The cells are 72,8-80 x 33-37,5 μm . They are twisted around the anteroposterior axis. They have a long straight tail. Their cytoplasm has a paramylon central disk (Fig. 32). The taxon is cosmopolitan. In Africa, it is identified in the following countries: Burkina Faso, Côte d'Ivoire. It is harvested at the Abou station.

***Phacus inconspicuus* Deflandre** : The cells are globular and measure 30,1-35,5 x 21-25 μm . Numerous and parietal plastids are contained in the cytoplasm (Fig. 33). The taxon is cosmopolitan. In Africa, he has been identified in Nigeria. The species is harvested at the Abou station.

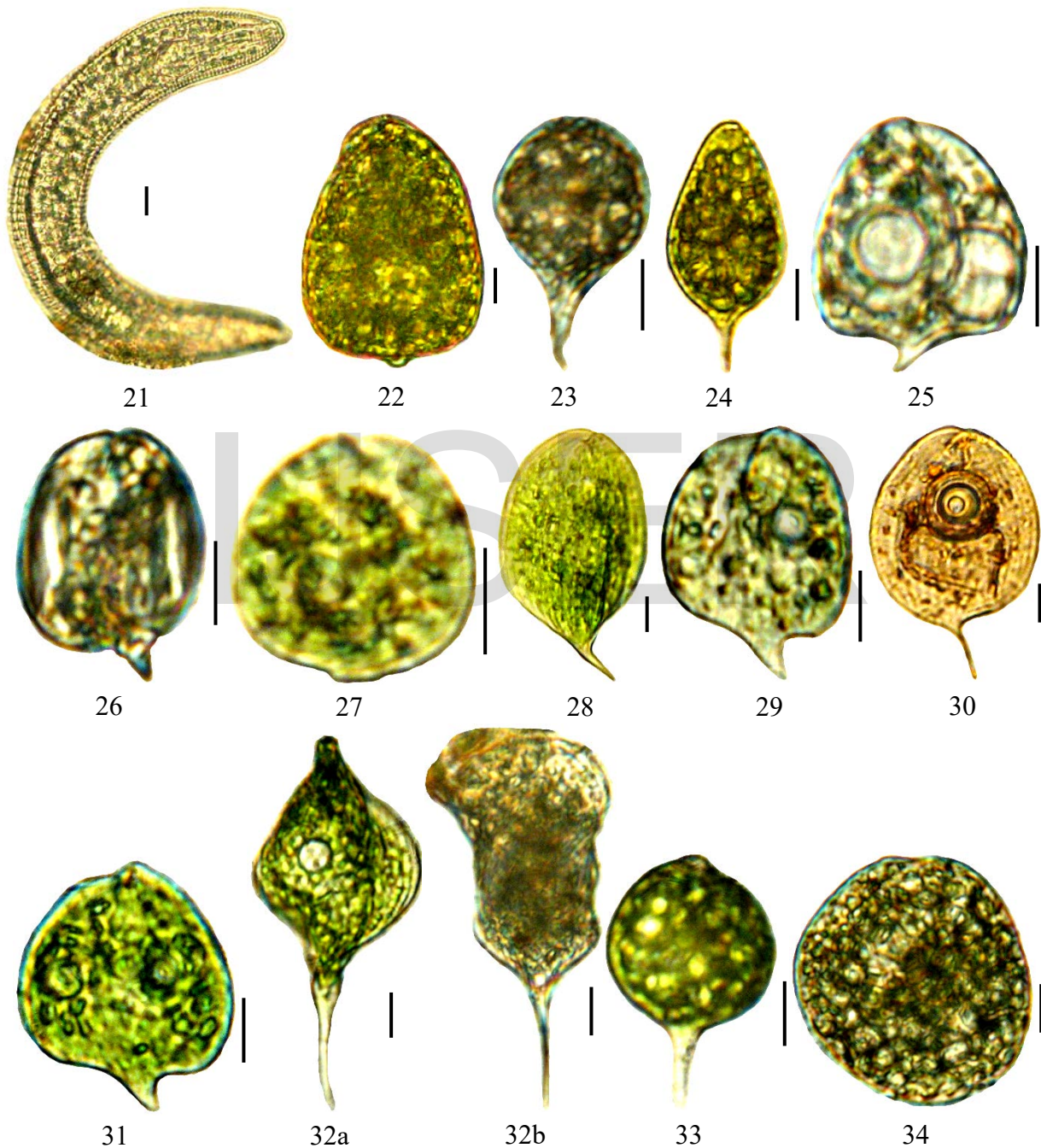
***Phacus lefevrei* Bourrelly** : The cells, which measure 44,8-49 x 45-48 μm , are ovoid. They are provided or not with constrictions in their basal part. A paramylon disc is present in the cytoplasm (Fig. 34). The taxon is cosmopolitan. In Africa, he has been identified in Côte d'Ivoire. It is harvested at the Abou station.

***Phacus limnophila* Lemmermann** : The cells are elongate, with dimensions 46-53,7 x 8-11 μm . The cytoplasm contains discoid plastids and two ringed paramylons on either side of the nucleus (Fig. 35). The taxon is subcosmopolite. In Africa, it has been identified in the following countries: Burkina Faso, Burundi, Côte d'Ivoire, Chad, South Africa. It is harvested at the Abou and Mé stations.

Phacus longicauda* (Ehrenberg) Dujardin var. *longicauda : The cells, 108-128 x 37,6-45 μm , have a posterior portion extended by a long tail. The cytoplasm is provided with discoid wall plastids, with one large and two small paramylon disks (Fig. 36). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burkina Faso, Burundi, Côte d'Ivoire, Democratic Republic of Congo, South Africa. It is harvested at the stations Abou , Adahidougou and Mé.

***Phacus longicauda* var. *attenuatus* (Pochmann) Huber-Pestalozzi** : The 122,5-129 x 41-45,3 μm cells are enlarged in their anterior part and gradually attenuated into a long tail at the posterior part. They have a longitudinally ridged wall and contain a large disk

of paramylon often accompanied by several others, but small (Fig. 37). The taxon is subcosmopolite. In Africa, he has been identified in Chad. It is harvested at the Abou station.



Figures 21 à 34 : 21- *Lepocinclis spirogyra* var. *fusca* ; 22- *Lepocinclis texta* ; 23- *Lepocinclis turbiniformis* ; 24- *Lepocinclis* sp. 25- *Phacus acuminatus* var. *acuticauda* 26- *Phacus anomalus* ; 27- *Phacus brevicaudatus* ; 28- *Phacus caudatus* ; 29- *Phacus curvicauda* ; 30- *Phacus hamatus* ; 31- *Phacus heimii* ; 32a et b- *Phacus helicoides* ; 33- *Phacus inconspicuus* ; 34- *Phacus lefevrei*. NB : Les traits d'échelle des illustrations représentent 10 µm.

Phacus longicauda* var. *Koczwara insecta : Cells 90-97 x 32,6-37,8 μm , with a long, straight tail, have an indented margin on the side, and longitudinally ridged walls (Fig. 38). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burundi and Côte d'Ivoire. It is harvested at the Divo station.

***Phacus longicauda* var. *rotundus* (Pochmann) Huber-Pestalozzi** : The cells of 105-121 x 32-40 μm , have an oval to elliptical body, are attenuated at both poles, and extended at the posterior pole by a long pointed tail. Their wall is striated longitudinally and the cytoplasm contains one or a few paramylon disks (Fig. 39). The taxon is subcosmopolite. In Africa, it has been identified in the following countries: Côte d'Ivoire and Mozambique. It is harvested at the Abou and Divo stations.

***Phacus orbicularis* Hübner** : Cells, 42-47,2 x 31-39 μm , largely oval, have an oblique caudal appendage and two paramylon discs of unequal size (Fig. 40). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burkina Faso, Burundi, Côte d'Ivoire, Democratic Republic of Congo. It is harvested at the Abou, Adahidougou and Divo stations.

***Phacus platalea* Drezepolski** :

Cells, 58-63 x 32-38 μm , are largely oval. An oblique caudal appendage is observed in the basal part. The cytoplasm is equipped with a single paramylon disc (Fig. 41). The taxon is subcosmopolite. In Africa, it has been identified in the following countries: Burundi, Côte d'Ivoire, Guinea Bissau, Mali, Mozambique, Chad, Zambia. It is sampled at the Abou, Divo and PALMCI-Boubo stations.

***Phacus ranula* Pochmann** : The cells, with an elliptical outline, measure 65 to 72,5 μm in length and 30 to 34 μm in width. They have an elongated, non-rectilinear tail at the posterior pole. They have a wall decorated with longitudinal streaks. Their cytoplasm contains a large central paramylon disc (Fig. 42). The taxon is paleotropical. In Africa, it has been identified in the following countries: Burundi, Ivory Coast, Mozambique. It is harvested at PALMCI-Boubo station.

Phacus suecicus (Lemmermann) Lemmermann : The cells, 30,6-36 x 19.5-22,5 μm , elliptical in outline, emarginate, are provided with a small nipple at the anterior pole and are attenuated in a tail at the posterior pole. Their walls are marked with longitudinal lines of small warts (Fig. 43). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burundi, Côte d'Ivoire, Mozambique, Uganda, Democratic Republic of Congo, Chad and Zambia. It is harvested at the Abou station

Phacus swirenkoi Skvortzov : The cells, 40,1-45 x 33-35 μm , are largely oval and are provided with oblique caudal appendage. The cytoplasm contains only one large paramylon disc (Fig. 44). The taxon is cosmopolitan. In Africa, he has been identified in Burundi. It is harvested at Divo and PALMCI-Boubo stations.

Phacus tortus (Lemmermann) Skvortzov : Cells, 58-68,3 x 29-33 μm , are bent and have a long tail. The wall is striated and the cytoplasm contains concentric paramylon disks (Fig. 45). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burkina Faso, Côte d'Ivoire, Madagascar, Mozambique, Chad, South Africa and Zambia. It is harvested at the Abou and PALMCI-Boubo stations.

Phacus tropicalis Conforti : Cells, 42,1-48 x 21 -35,6 μm in size, are orbicular to broadly ovate, with a short apical furrow, an enlarged basal portion ending in a straight, pointed tail. The cytoplasm has many discoid plastids and a large central paramylon disc (Fig. 46). The taxon is cosmopolitan. It is harvested at the Abou station.

Phacus undulatus (Skvortzov) Pochmann : The cells, 60-67,5 x 43-46,2 μm , contain two unequal paramylon disks. The cells have lateral undulations (Fig. 47). The taxon is cosmopolitan. In Africa, he has been identified in Côte d'Ivoire. It is harvested at the Abou and Mé stations.

Phacus sp. : The cells, 60-68 x 30-35,7 μm , are striated, slightly tapered at the apex, and are marked with two protuberances on the sides (Fig. 48). The taxon is harvested at the Abou station.

Genus Strombomonas Deflandre

Strombomonas acuminata var. deflandreana Conrad : The ellipsoidal stalls, 28-32 x 17-21 μm in size, are broad in their middle part, attenuated at the front in a flared, sloping neck and ending at the back with a robust tail (Fig 49). The taxon is subcosmopolite. It is harvested at Divo and PALMCI-Boubo stations.

***Strombomonas fluviatilis* (Lemmermann) Deflandre var. *Levis* (Lemmermann)**

Skvortzov : The stalls, 56-63 x 23.4-27 μ m, are attenuated in their anterior part by a neck with serrated edges. The basal part is prolonged by a pointed and narrow caudal appendage (Fig. 50). The taxon is cosmopolitan. It is harvested at the Adahidougou and Divo resorts.



Figures 35 à 50 : 35- *Phacus limnophila* ; 36- *Phacus longicauda* var. *longicauda* ; 37- *Phacus longicauda* var. *attenuatus* ; 38- *Phacus longicauda* var. *insecta* ; 39- *Phacus longicauda* var. *rotundus* ; 40- *Phacus orbicularis* ; 41- *Phacus platalea* ; 42- *Phacus ranula* ; 43- *Phacus suecicus* ; 44- *Phacus swirenkoi* ; 45- *Phacus tortus* ; 46- *Phacus tropicalis* ; 47- *Phacus undulatus* ; 48- *Phacus* sp. ; 49- *Strombomonas acuminata* var. *deflandreana* ; 50- *Strombomonas fluviatilis* var. *levis*. NB : Les traits d'échelle des illustrations représentent 10 μ m.

***Strombomonas gibberosa* (Playfair) Deflandre** : The cells, 60,5-66 x 34-39 μm , have a very broad median part and an attenuated caudal appendage, 15 to 22 μm in length. The apex ends with a neck of 5-10 x 5-9 μm (Fig. 51). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burkina Faso, Burundi, Democratic Republic of Congo. It is harvested at the station Adahidougou.

***Strombomonas girardiana* (Playfair) Deflandre** : The stalls, 38,8-45 x 22-27 μm , are ovoid to ellipsoidal. They have a caudal appendage with an average length of 8.5 μm and a rough wall (Fig. 52). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burundi, Democratic Republic of Congo. It is harvested at the Mé station.

***Strombomonas schauinslandii* (Lemmermann) Deflandre** : The stalls, 24,2-26,7 x 13-15 μm , are largely ovoid to ellipsoidal, attenuated in a more or less oblique neck at the front, and a strong conical tail at the back. The wall is finely rough (Fig. 53). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burundi, Nigeria, Democratic Republic of Congo. It is harvested at the Abou station.

***Strombomonas verrucosa* (Daday) Deflandre** : The cells are elliptical, 23,7-27,7 x 20,5-24 μm , with a rounded antapex. The stall is provided with a short neck and its wall is warty (Fig. 54). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burkina Faso, Burundi and the Democratic Republic of Congo. It is harvested at the Mafou station.

Genus *Trachelomonas* Ehrenberg

***Trachelomonas hispida* (Perty) Stein emend. Deflandre** : The stalls, 22-30 x 18-22,7 μm , are elliptical-oblong. The wall is covered with short conical spines (Fig. 55). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Algeria, Burkina Faso, Burundi, Ivory Coast, Guinea Bissau, Kenya, Libya, Malawi, Morocco, Mozambique, Uganda, Democratic Republic of Congo, Rwanda, South

Africa, Sierra Leone, Tanzania, Chad, Tunisia and Zambia. It is harvested at the station Adahidougou.

***Trachelomonas lefevrei* Deflandre** : The stalls, 30-40 x 24-31 μm , are ellipsoidal, with a straight neck, denticulated around the edge of the rim. The wall is finely punctured over the entire surface of this cell, which resembles *Trachelomonas planctonica* Swirenko (Fig. 56). The taxon is cosmopolitan. In Africa, he has been identified in Côte d'Ivoire. It is harvested at the Abou station.

****Trachelomonas planctonica* Swirenko** : The stalls measure 32-41,6 x 30-37,4 μm . They are spherical to subspherical and provided with an annular thickening adorned with warts. The wall is densely granular over its entire surface (Fig. 57). The taxon is cosmopolitan. In Africa, he has been identified in Burundi. It is harvested at the Mé station.

Trachelomonas scabra* Playfair var. *playfair longicollis : The cubicles, with dimensions of 34,8-39 x 18-21,3 μm , are ellipsoid, rounded at the poles, prolonged by a slightly inclined corrugated neck, 4,8-5,2 x 6-6,8 μm of length, and distinct from the anterior part. The wall of this species is finely rough (Fig. 58). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Burundi, Côte d'Ivoire, Nigeria and the Democratic Republic of Congo. It is harvested at the Abou, Adahidougou, Mé and PALMCI-Boubo stations.

***Trachelomonas superba* Swirenko emend. Deflandre** : The stalls, 32,7-38,5 x 26-31 μm , have an elliptical contour. They are rounded to the poles. The wall is finely punctuated and decorated with thorns (Fig. 59). The taxon is cosmopolitan. In Africa, it has been identified in the following countries: Algeria, Burundi, Côte d'Ivoire, Madagascar, Mozambique, Sierra Leone, Chad, Zambia and Zimbabwe. This taxon is harvested at the station Adahidougou.

***Trachelomonas volvocina* Ehrenberg var. *derephora* Conrad** : Stalls, 21,1 to 29,7 μm in diameter, are spherical or subspherical. The cell has a straight cylindrical neck 2,8-5 x 2,5-3,7 μm (Fig. 60). The taxon is cosmopolitan. It is harvested at the Divo station.

***Trachelomonas volvocinopsis* Swirenko** : The stalls, 38-44 μm in diameter, are spherical and have no neck. The wall is warty on its entire surface (Fig. 61). The taxon is harvested at the Mafou station.

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Inter ISSN Figures 51 à 61 : 51- *Strombomonas gibberosa* ; 52- *Strombomonas girardiana* ; 53- *Strombomonas schauinslandii* ; 54- *Strombomonas verrucosa* ; 55- *Trachelomonas hispida* ; 56- *Trachelomonas lefevrei* ; 57- *Trachelomonas planctónica* ; 58- *Trachelomonas scabra* var. *Longicollis* ; 59- *Trachelomonas superba* ; 60- *Trachelomonas volvocina* var. *Derephora* ; 61 *Trachelomonas volvocinopsis*. NB : Les traits d'échelle des illustrations représentent 10 µm.

3. Discussion

The comparative analysis of this branch with those identified by other authors on some Ivorian rivers is recorded in the table below. The results of this study are consistent with those of [9], but differ from those of [15] and [13]. The differences observed in the results could be related to the different methods used and to the characteristics specific to each harvesting environment, but especially to the sampling periods [15].

Table : Euglenophyta composition of the Boubo and Mé rivers of Southern Côte d'Ivoire.

	Present work on the rivers Boubo and Mé	Niamien-Ébrotte (2010) on the rivers Soumié, Éholié, Éhania and Noé	Da (2007) on the Bia	Ouattara River (2000) on the Agnéby and Bia rivers
Number of taxa	60	51	59	39

The seasonal study showed that river waters are richer in taxa in the rainy season than in the dry season. The increase in the water level and certainly the flow force would favor this predominance observed during the flood period. In addition, periphytic algae are often found in drift after pulling by the current. This phenomenon is very common in running waters [2], [6], [12]. According to these authors, the stronger the current, the more the algae are detached from the substrates.

The results relating to the phytogeographic distribution of micro-algae show that cosmopolitan and subcosmopolite taxa dominate almost all the water harvests of the Boubo and Mé rivers. African taxa are less represented. The preponderance of cosmopolitan species is justified by the fact that they are widespread in all regions of the globe; in addition, they adapt to all ecological conditions [9]. These results are

similar to those of [15] on the Agnéby and Bia rivers and [9] in the Bia River in Côte d'Ivoire.

The Abou station (upstream), although less rich in taxa compared to other stations, seems to have a high density in number of individuals. This density is attributed to Euglenophyta composed mainly by the genera *Phacus*, *Lepocinclis*, *Euglena*. The taxa in this group proliferate in media rich in organic matter [11]. The densities observed are high during the great and small rainy seasons, because during these seasons rivers are enriched with nutrients and organic matter brought by the runoff. In addition, the high levels of BOD5 recorded during the rainy season confirm the abundance of Euglenophyta. [15] and [14] have made the same observations on rivers in south-eastern Côte d'Ivoire.

CONCLUSION

The observation of the Euglenophyta rivers Boubo and Mé in southern Côte d'Ivoire (area with strong human, agricultural and industrial), has inventoried 34 species, varieties and forms divided into five genera : *Euglena*, *Lepocinclis*, *Phacus*, *Strombomonas*, *Trachelomonas*.

The genus *Phacus* is the most observed (over 47%) and the Boubo River is the richest in terms of the number of taxa harvested (more than 61%). *Trachelomonas similis* has been observed in almost all stations.

More than 76% of the species, varieties and forms identified are cosmopolitan, compared with less than 34% subcosmopolites and no taxon typical to the tropical zone only.

A more in-depth taxonomic study will make it possible to draw up a complete list of the floristic richness of these two rivers, could justify a possible study project, based on the biological indices of algae in order to prevent the risks of disturbance due to various pollutions.

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