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Euglenozoa occurring in Adzopé Reservoir, Côte D'Ivoire

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Abstract: The Euglenozoa flora of the Adzopé Reservoir in Côte d'Ivoire was investigated from January to December 2005. The species composition of the assemblage was compiled, accompanied by illustrations. Forty-four taxa were identified in the temporal survey. Ten taxa (22.22%) are new for Côte d'Ivoire. The taxonomic structure presents 22.32% of the species common to the freshwater of West Africa, with most of the taxa (89.5%) found to be cosmopolitan. An endemic taxon, *Trachelomonas pisciformis* var. *bicoronata* Couté & Iltis (Euglenaceae), was observed. The assemblage was dominated by *Trachelomonas* Ehrenberg and *Phacus* Ehrenberg, which represented 47.72% and 29.54% of identified taxa, respectively. Two common species, *Trachelomonas volvocina* (Ehrenberg) Ehrenberg (Euglenaceae) and *Trachelomonas volvocinopsis* Svirenko (Euglenaceae), were also recorded. The highest species richness of Euglenophyceae in the Adzopé Reservoir was in relation with nutrients (NO_3^- and PO_4^{3-}) and organic matter.

Key words: Euglenozoa, taxonomy, Côte d'Ivoire

1. Introduction

The Adzopé Reservoir is a shallow raw potable water reservoir, influenced by a diverse variety of anthropogenic activities. This reservoir, surrounded by urban development, receives wastewater from many sources, examples being animal farming, urban and agricultural runoff, and sewage loading. This results in significant changes in the trophic state of the reservoir. Such changes are thought to influence the algae community, although these changes may not be consistent throughout algae taxonomic groups (Piehler et al., 2004).

Euglenophyceae are very tolerant to pollution, quickly responding to changes in the organic pollution level (John et al., 2004). In most studies, organic matter is more important in a wide variety of Euglenophyceae growth (Kim & Boo, 2001; Wołowski & Hindák, 2005).

There is little information on Euglenophyceae communities in Côte d'Ivoire surface waters. The known works were by Bourrelly (1961), Uherkovich and Rai (1977), and Ouattara et al. (2000).

The main purpose of this study was to provide a taxonomic and floristic account, and to try to understand the species richness of the Adzopé Reservoir Euglenozoa. This study, based on the qualitative analysis of samples, is also a first taxonomic inventory of the Euglenozoa community occurring in the Adzopé Reservoir.

2. Materials and methods

2.1. Description of study area

The reservoir, as shown in Figure 1, located at 6°06′N and 3°51′E, lies in an urban area of the city of Adzopé, in the south-east of Côte d'Ivoire that belongs to the subequatorial zone (Iltis & Lévêque, 1982). It has a surface area of 61.44 ha. The reservoir has a maximum depth of 7 m and a length of about 2 km. It has no permanent inflowing streams, but there is an overflow channel at its southern end. The sources of water inputs are seasonal, usually being direct precipitation in the form of rainfall.

The area has 4 seasons as shown in Figure 2: the long dry season (December–February), the long rainy season (March–July); the short dry season (August), and the short rainy season (September–November). The reservoir was built in 1977 for water supplementation. Two sampling stations (St1 and St2) were sampled according to the longitudinal gradient as shown in Figure 1.

2.2. Physicochemical parameters

Some physicochemical measurements were made in the field immediately after each sample was collected. The Conductimeter Aqualitic CD24 was used to assess water temperature and conductivity. Dissolved oxygen was measured with the Oxymeter Aqualitic OX24, and pH with the pHmeter Aqualitic, pH24. For nutrients (orthophosphates and nitrates), subsamples of 30 mL were

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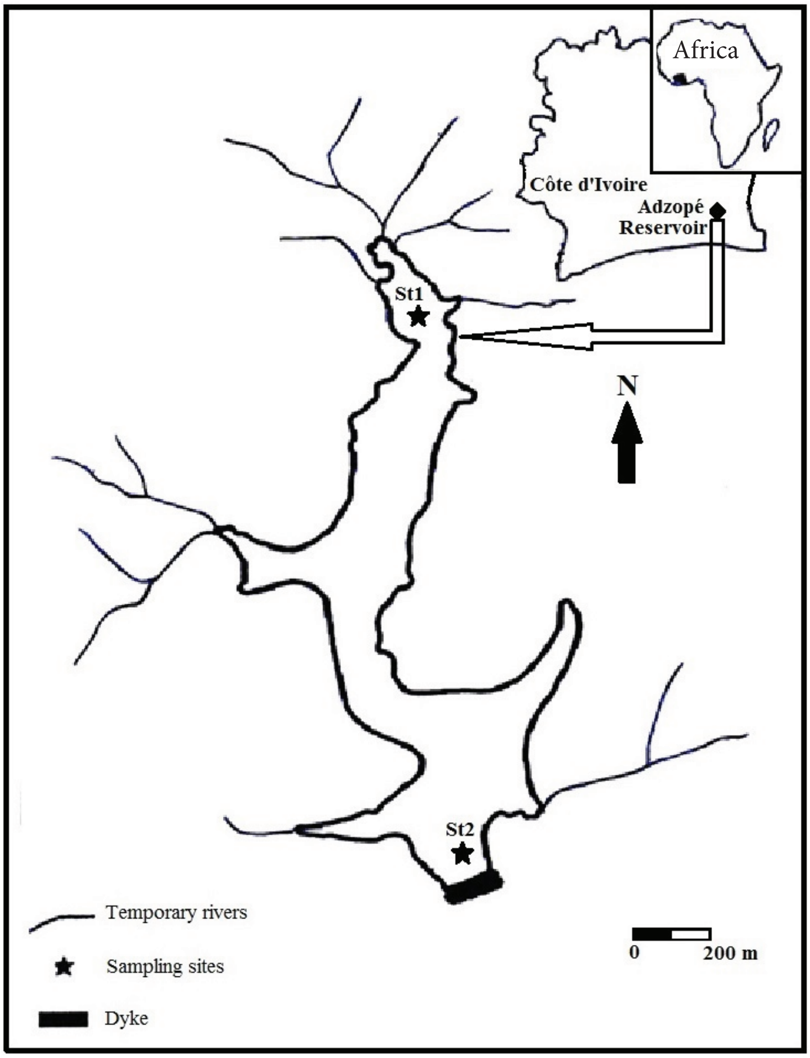

Figure 1. Localisation of the Adzopé Reservoir with sampling sites.

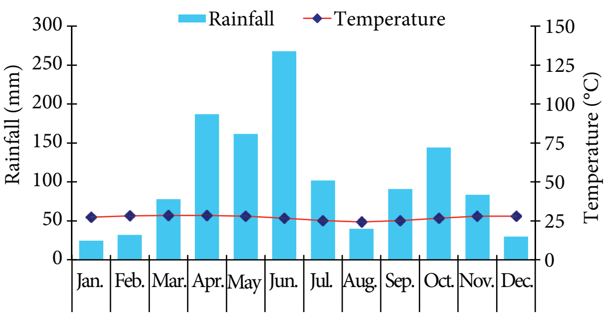

Figure 2. Climate graph of Adzopé area.

collected and refrigerated for later analysis according to the standard methods AFNOR T90-23 and T90-110. The water transparency (Z_{SD}) was measured in situ, using a white Secchi disk.

2.3. Biological parameters

Samples of algae were obtained from artificial substrates, installed as glass slides, 7.6 cm long × 2.6 cm wide, in the water column. Algae were removed monthly by scraping the substrates with razor blades, whereafter the substrates were replaced in the water column. The Euglenozoa community was immediately examined in the laboratory without any fixation. After this, samples were preserved with Lugol's Iodine solution. Observations were carried out using an Olympus BX40 microscope, equipped with a Canon camera.

The identification and distribution of the species were based on the research done by Huber-Pestalozzi (1955), Bourrelly (1961), Couté and Iltis (1981), Marin et al. (2003), Wołowski and Hindák (2005), Milanowski et al. (2006), Ciugulea et al. (2008), Da et al. (2009), Kosmala et al. (2009), and Linton et al. (2010).

On average, 50 organisms were used for measurements. The frequency of each species present was determined according to Dajoz (2000). Three frequency groups were distinguished according to value of F: Common species (1): F > 50%; occasional species (2): 25% < F < 50 %; rare species (3): F < 25%.

3. Results

3.1. Physicochemical environment

The physicochemical parameters at different sampling stations throughout the seasons are summarised in Table 1.

The reservoir water temperature fluctuated between 23.3 °C during the short dry season and 30.13 °C during the short rainy season. The conductivity exhibited low fluctuation throughout the seasons. It values varied from 190.44 µS cm^{-1} in the long dry season to 164.78 µS cm^{-1} during the long rainy season. The lowest average value of dissolved oxygen (1.99 mg L^{-1}) was measured during the long dry season, while the highest (4.37 mg L^{-1}) was in the long dry season. The measured pH varied around the neutral value 7. The lowest average values of pH were obtained during the short dry season. The water transparency was essentially low (Z_{SD} min = 35.69 cm, Z_{SD} max = 80 cm), probably reflecting the high turbidity of the lake. The highest water transparency values were measured during the short dry season. The reservoir is characterised by high concentrations of nitrate and orthophosphates. The maximum concentration values of nitrate (NO_3^-) and orthophosphates (PO_4^{3-}) determined were 2.54 mg L^{-1} and 1.68 mg L^{-1}, respectively. The minimum values of these parameters were below the limit of detection.

3.2. Taxonomic description

In this part, taxa indicated by an asterisk are reported for the first time in Côte d'Ivoire.

Phylum: Euglenozoa
Class: Euglenophyceae
Order: Euglenales
Family: Phacaceae
Genus: *Lepocinclis* Perty

Lepocinclis acus (O.F.Müller) Marin & Melkonian (Figure 3a).

Cells fusiform; 71 ± 7.6 µm long, 8 ± 1.4 µm wide; anterior end narrowed and apically truncated, posterior end tapered to a long hyaline incision; pellicle rigid to semi-rigid, striae longitudinal; paramylons grains 5 to numerous; Distribution: Cosmopolitan.

Lepocinclis globulus Perty (Figures 3b & c).

Cells elliptic to oblong-elliptic; 27 ± 1.8 µm long, 17 ± 1.2 µm broad; tail piece pellicle spiral striated to the left; chloroplasts numerous, discoid; 2 paramylons bodies, lateral, ring-shaped; Distribution: Cosmopolitan.

Lepocinclis oxyuris (Schmarda) Marin & Melkonian (Figure 3d).

Cells cylindrical; 141 ± 10.4 µm long, 21 ± 1.7 µm broad; straight or sometimes twisted; pellicle rigid to semi-rigid, striae spiral, following the cell body twisting; chloroplasts numerous, disc-shaped, parietal; 2 paramylons grains, rod-shaped; Distribution: Cosmopolitan.

Genus: *Phacus* Dujardin

Phacus acuminatus Stokes (Figure 3e).

Cells 29 ± 0.7 µm long, 25 ± 0.4 µm wide; broadly ovoid to oval; each cell depressed at the anterior end and sharp at the posterior end; pellicle longitudinally striated; disc-shaped numerous; 2 paramylons bodies; Distribution: Cosmopolitan.

Table 1. Physicochemical parameters during the study.

		Temperature (°C)	Conductivity (µS cm^{-1})	Dissolved oxygen (mg L^{-1})	pH	Transparency (cm)	Nitrates (mg L^{-1})	Orthophosphates (mg L^{-1})
St1	LDS	27.66	170.4	3.31	8.21	60	0.8	0.17
	LRS	26.4	171	3.61	7.2	35.69	0.4	-
	SDS	23.3	182.1	2.17	7.4	80	0.6	0.15
	SRS	29.31	181.44	3.09	7.39	42.33	-	0.04
St2	LDS	29.76	190.44	1.99	802	53.33	2.54	0.28
	LRS	27.9	164.78	4.374	7.56	40.8	0.40	-
	SDS	25.6	183.6	2.02	6.1	62	1.1	1.68
	SRS	30.13	176	3.2	7.56	51.34	0.5	0.11

- Values below the limit of detection

Figure 3. **a**- *Lepocinclis acus*, **b** & **c**- *Lepocinclis globulus*, **d**- *Lepocinclis oxyuris*, **e**- *Phacus acuminatus,* **f**- *Phacus angulatus*, **g** & **h**- *Phacus circulatus*, **i**- *Phacus curvicauda*, **j**- *Phacus glaber*, **k**- *Phacus limnophila*. Scale bar = 10 µm.

*__Phacus angulatus__ Pochmann (Figure 3f).

Cells 35 ± 1.5 µm long, 28 ± 0.4 µm broad; ovoid in outline; posterior end broadly rounded and slightly concave with a short curved tail-piece, anterior end slightly narrowly rounded; 1 paramylon body.

Phacus circulatus Pochman (Figures 3g & h).

Syn.: *Phacus platalea* Drezepolski*, Phacus orbicularis* K.Hübner.

Cells ovoid 53 ± 2.4 µm long, 39 ± 2.8 µm wide; ovoid in outline; posterior end broadly rounded with a short tail-piece, anterior end slightly narrowly rounded; chloroplasts numerous; pellicle longitudinally striated; 1 to 2 paramylons bodies; Distribution: Cosmopolitan.

Phacus curvicauda Svirenko (Figure 3i).

Cells 35 ± 1.2 µm long, 27 ± 0.8 µm broad; anterior end rounded, posterior end terminating in a short curved tail-piece; pellicle longitudinally striated; chloroplasts numerous; 1 or 2 paramylons bodies circular disc; Distribution: Cosmopolitan.

*__Phacus glaber__ (Deflandre) Pochmann (Figure 3j).

Cells broadly ellipsoid; 36 ± 3.5 µm long, 24 ± 2.1 µm broad; anterior end truncate with a prominent median papilla, posterior end produce slightly deflected sharp tail-piece; periplast longitudinally striated; chloroplasts numerous; 2 paramylons bodies; Distribution: Europe, Africa.

Phacus limnophila (Lemmermann) Linton & Karnkowska (Figure 3k).

Cells fusiform; 80 ± 4.5 µm long, 11 ± 0.6 µm broad; pellicle rigid, striae delicate, difficult to observe; chloroplasts numerous, disc-shaped parietal; 2 paramylons grains, rod-shaped; Distribution: cosmopolitan.

Phacus longicauda (Ehrenberg) Dujardin (Figures 4a & b).

Cells ovoid, flat; 104 ± 4.6 µm long, 41 ± 1.6 µm wide; anterior end broadly rounded posteriorly taper gradually into a long straight and sharply pointed tail-piece; periplast longitudinally striated; 1 paramylon body; Distribution: Cosmopolitan.

Phacus monilatus Stokes var. **suecicus** Lemmermann (Figure 4c).

Cells broadly ellipsoid or ovate; 34 ± 1.3 µm long, 21 ± 0.8 µm broad; anterior end truncate with a prominent median papilla, posterior end produce slightly deflected sharp tail-piece; periplast longitudinally striated with row of sharp granules; chloroplasts numerous; 2 paramylons bodies; Distribution: Cosmopolitan.

Phacus pleuronectes (O.F.Müller) Nitzsch ex Dujardin (Figure 4d).

Cells 37 ± 1.7 µm long, 26 ± 0.5 µm wide ovoid in outline; posterior end broadly rounded with a short tail-piece; pellicle with fine longitudinal striations; Many discoid chloroplasts; large circular central paramylon body; Distribution: Cosmopolitan.

*__Phacus sesquitortus__ Pochmann (Figure 4e).

Cells 74 ± 2.8 µm long, 41 ± 2.6 µm broad; more twisted than *Phacus tortus* (Lemmermann) Skvortzov; pellicle longitudinally or spirally striated; chloroplasts numerous; 1 circular central paramylon body; Distribution: Cosmopolitan.

Phacus tortus (Lemmermann) Skvortzov (Figure 4f).

Cells twisted; 95 ± 7.1 µm long, 44 ± 3.1 µm broad; broadly spindle-shaped, broadest at anterior third of cell; anterior end conically rounded, tapering and spirally twisted in posterior region to form a long, straight or sometimes slightly curved tail-piece about length of cell; pellicle longitudinally or spirally striated; chloroplasts numerous; 1 circular central paramylon body; Distribution: Cosmopolitan.

*__Phacus triqueter__ (Ehrenberg) Perty (Figure 4g).

Cells ovoid; 61 ± 5.1 µm long, 38 ± 3 µm wide; anterior end rounded, posterior end narrowing to a thin, sharp and curved tail-piece; pellicle longitudinally striated; dorsal keel prominently extending full length of cell; 1 paramylon body; Distribution: Cosmopolitan.

***Phacus* sp.** (Figure 4h).

Cells 58 ± 2.1 µm long, 31 ± 0.7 µm wide; anterior end broadly rounded, posterior end taper gradually in a short tail-piece; pellicle striated twisted; 1 paramylon body.

Family: Euglenaceae

Genus: *Euglena* Ehrenberg

Euglena proxima P.A.Dangeard (Figure 4i).

Cells 46 ± 1.6 µm long, 21 ± 1.5 µm wide; spindle-shaped; anterior end slightly bluntly truncate, posterior end tapering to a short, hyaline tail-piece; pellicle distinctly spirally striated; chloroplasts numerous; Distribution: Cosmopolitan.

Euglena texta (Dujardin) Hübner (Figure 5a).

Cells ovoid to spherical; 36 ± 2.1 µm long, 25 ± 0.6 µm wide; anterior end slightly narrowed, posterior end broadly rounded; pellicle strongly spirally striated twisted to the left; Distribution: Cosmopolitan.

Genus: *Monomorphina* Mereschkowski

*__Monomorphina lepocincloides__ (Pochmann) Marin & Melkonian (Figures 5b & c).

Cells 51 ± 3.7 µm long, 27 ± 1.6 µm wide; anterior end broad, posterior end taper gradually to form a long straight pointed tail-piece; chloroplast numerous; pellicle strongly spirally striated twisted to the left; Distribution: Cosmopolitan.

Genus: *Strombomonas* Deflandre

Strombomonas acuminata (Schmarda) Deflandre var. **deflandriana** Conrad (Figure 5d).

Lorica 41 ± 2.1 µm long, 19 ± 1.3 µm wide; anteriorly ended by a cylindrical collar, posterior end in a tail-piece measured 8 µm; Distribution: Subcosmopolitan.

*__Strombomonas fluviatilis__ (Lemmermann) Deflandre (Figure 5e).

Lorica ellipsoid; 66 ± 4.3 µm long, 28 ± 0.7 µm wide; anterior end narrowed into a cylindrical neck, posterior end gradually tapering towards a subconical tail-piece measuring 8 ± 0.6 µm; Distribution: Cosmopolitan.

*__Strombomonas treubii__ (Wołoszyńska) Deflandre (Figures 5f & g).

Lorica ovoid; 40 ± 1.4 µm long, 22 ± 0.7 µm wide; posteriorly ended in a long tail-piece measuring 14 ± 1.1 µm; Distribution: Paleotropical.

Strombomonas verrucosa (E.Daday) Deflandre var. **zmiewika** (Svirenko) Deflandre (Figure 5h).

Lorica 41 ± 0.8 µm long, 22 µm wide; anterior end narrowed into a cylindrical collar, posterior end gradually tapering towards a tail-piece measuring 8 µm; Distribution: Cosmopolitan.

Figure 4. a & **b**- *Phacus longicauda*, **c**- *Phacus monilatus* var. *suecicus*, **d**- *Phacus pleuronectes*, **e**- *Phacus sesquitortus*, **f**- *Phacus tortus*, **g**- *Phacus triqueter,* **h**- *Phacus* sp., **i**- *Euglena proxima*. Scale bar = 10 µm.

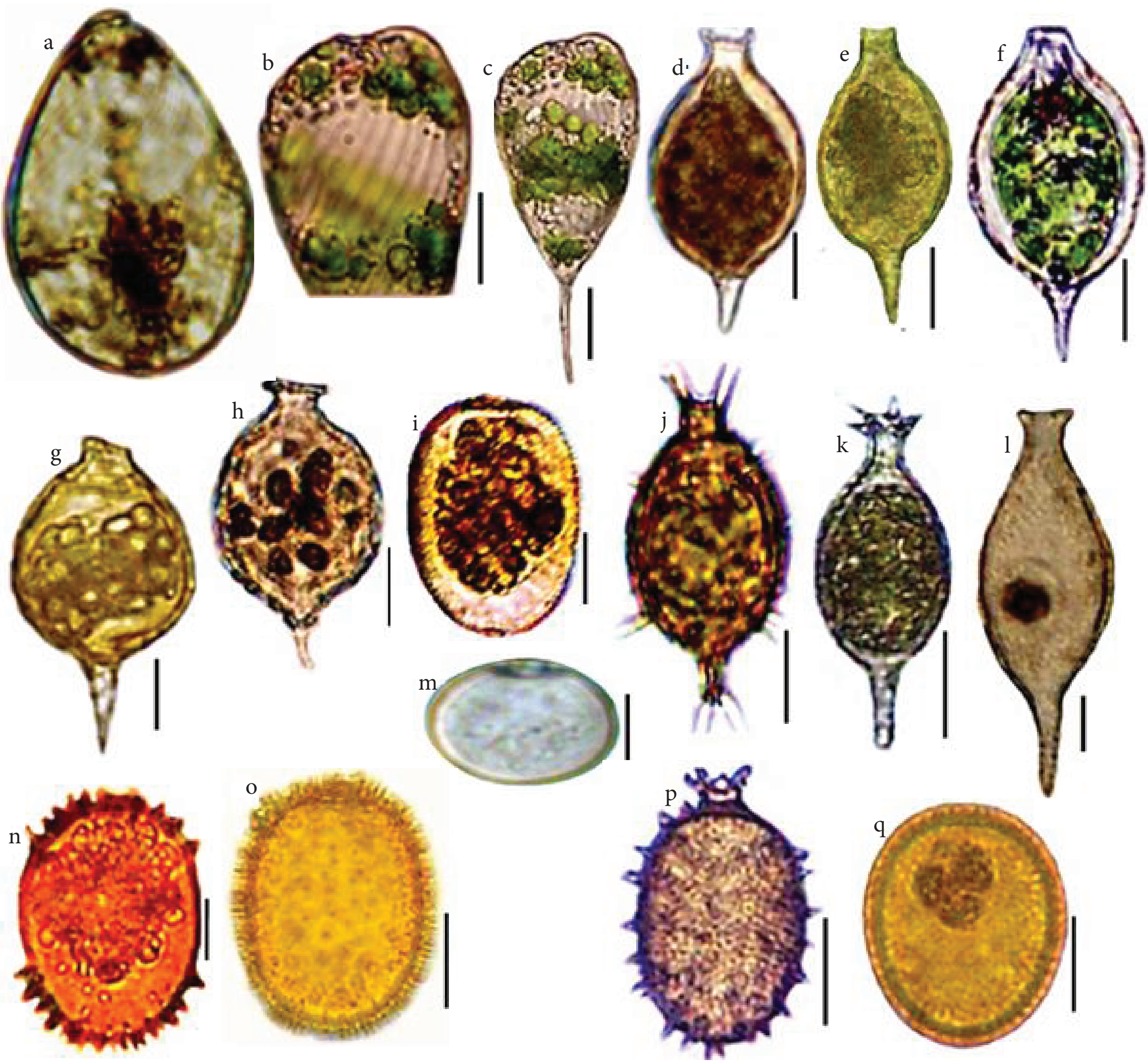

Figure 5. **a**- *Euglena texta,* **b** & **c**- *Monomorphina lepocincloides*, **d**- *Strombomonas acuminata* var. *deflandriana*, **e**- *Strombomonas fluviatilis*, **f** & **g**- *Strombomonas treubii*, **h**- *Strombomonas verrucosa* var. *zmiewika*, **i**- *Trachelomonas abrupta*, **j**- *Trachelomonas acanthophora* var. *minor,* **k**- *Trachelomonas acanthophora* var. *speciosa*, **l**- *Trachelomonas bernardinensis* var. *africana*, **m**- *Trachelomonas curta,* **n**- *Trachelomonas duplex*, **o**- *Trachelomonas hispida*, **p**- *Trachelomonas hispida* var. *crenulatocollis*, **q**- *Trachelomonas intermedia*. Scale bar = 10 µm.

Genus: *Trachelomonas* Ehrenberg

Trachelomonas abrupta Svirenko (Figure 5i).

Lorica cylindrical; 28 ± 0.6 µm long, 19 ± 0.5 µm wide; punctuate; posterior end slightly rounded; apical pore without a collar; Distribution: Cosmopolitan.

Trachelomonas acanthophora Stokes var. **minor** Conforti (Figure 5j).

Lorica 41 ± 2.2 µm long, 23 ± 1.1 µm wide; anterior end narrowed into a cylindrical neck with 4 spines, posterior end gradually tapering towards a subconical tail-piece ornamented with conical spines; smaller spines scattered on the wall; Distribution: South America.

Trachelomonas acanthophora var. **speciosa** (Deflandre) Balech (Figure 5k).

Lorica 41 ± 2 µm long, 23 ± 1 µm wide; posterior end narrowing to a thin tail-piece without spines; anterior end narrowing to a straight long collar with 4 strong spines.

Trachelomonas bernardinensis Vischer var. **africana** Deflandre (Figure 5l).

Lorica 60 µm long, 20 µm wide; posterior end narrowing to a thin tail-piece; collar long; Distribution: Africa.

Trachelomonas curta A.M.Cunha (Figure 5m).

Lorica transversally elliptic; 24 ± 3.5 µm long, 25 ± 5.7 µm wide; apical pore without a collar; Distribution: Cosmopolitan.

Trachelomonas duplex (Deflandre) Couté & Tell (Figure 5n).

Lorica ovoid 32 ± 2.5 µm long, 24 ± 0.6 µm wide, rounded at the ends with short, sharp, conical spines; apical pore without a collar; Distribution: Cosmopolitan.

Trachelomonas hispida (Perty) F.Stein (Figure 5o).

Lorica ovoid to oblong; 29 ± 1.6 µm long, 19 ± 3.6 µm wide; rounded at the ends; wall uniformly and densely covered with short, sharp, conical spines, sometimes finely punctuate; apical pore without a collar; Distribution: Cosmopolitan.

Trachelomonas hispida var. **crenulatocollis** (Maskell) Lemmermann (Figure 5p).

Lorica 27 ± 1.6 µm long, 17 ± 0.8 µm wide; This variety differs from the type by presence of short, sharp, conical spines on apical cylindrical collar pore; Distribution: Cosmopolitan.

Trachelomonas intermedia P.A.Dangeard (Figure 5q).

Lorica ovoid; 22 ± 1.4 µm long, 18 ± 0.5 µm wide, posterior and anterior end rounded; apical pore without a collar; Distribution: Cosmopolitan.

***Trachelomonas lefevrei** Deflandre (Figure 6a).

Lorica 28 ± 2.3 µm long, 21 ± 0.5 µm wide; without spines; apical pore surrounded by low collar; Distribution: Cosmopolitan.

***Trachelomonas oblonga** Lemmermann var. **attenuata** Playfair (Figure 6b).

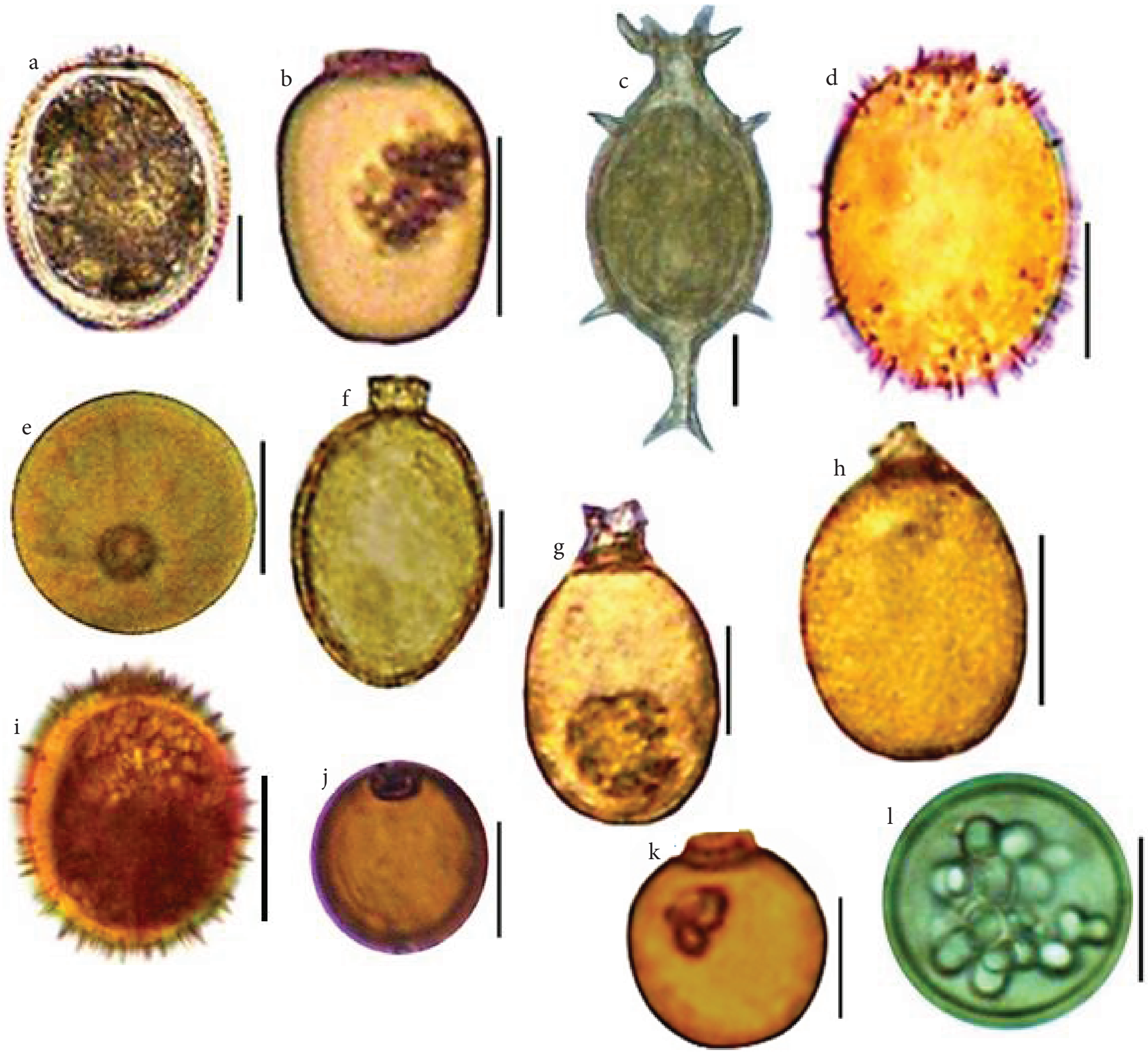

Figure 6. **a**- *Trachelomonas lefevrei*, **b**- *Trachelomonas oblonga* var. *attenuata*, **c**- *Trachelomonas pisciformis* var. *bicoronata*, **d**- *Trachelomonas raciborskii,* **e**- *Trachelomonas radiosa,* **f**- *Trachelomonas scabra,* **g**- *Trachelomonas scabra* var. *longicollis*, **h**- *Trachelomonas similis,* **i**- *Trachelomonas superba,* **j**- *Trachelomonas volvocina*, **k**- *Trachelomonas volvocina* var. *derephora*, **l**- *Trachelomonas volvocinopsis.* Scale bar = 10 µm.

Lorica 15 ± 1.6 µm long, 10 ± 0.6 µm wide; apical pore surrounded by low collar; posterior end attenuated; Distribution: Cosmopolitan.

Trachelomonas pisciformis G.W.Prescott var. **bicoronata** Couté & Iltis (Figure 6c)

Lorica 50 ± 6.5 µm long, 18 ± 1.6 µm wide; posterior end narrowing to a thin tail-piece with 2 strong spines; anterior end narrowing to a slightly long collar with 4 strong spines; 2 crown of strong spines are on the lorica: the first is situated anteriorly under the collar, the second posteriorly up to the tail-piece; Distribution: Endemic to Côte d'Ivoire.

***Trachelomonas raciborskii** Wołoszyńska (Figure 6d).

Lorica ellipsoidal; 32 ± 5.7 µm long, 31 ± 4.9 µm broad; pore without collar; wall with conical short spines distributed mainly around the ends, some also scattered on the middle surface; Distribution: Cosmopolitan.

Trachelomonas radiosa F.E.Fritsch (Figure 6e).

Lorica spherical; 17 ± 2.3 µm in diameter; apical pore without a collar; presence of radial coast on wall; Distribution: Cosmopolitan.

***Trachelomonas scabra** Playfair (Figure 6f).

Lorica ellipsoidal; 24 ± 1.5 µm long, 15 ± 0.6 µm broad; pore with a long and cylindrical collar.

Trachelomonas scabra var. **longicollis** Playfair (Figure 6g).

Lorica ellipsoidal; 27 ± 1.2 µm long, 17 ± 1.3 µm wide; pore with a long collar; Distribution: Cosmopolitan.

Trachelomonas similis A.Stokes (Figure 6h).

Lorica ellipsoidal; 21 ± 0.6 µm long, 16 ± 1.2 µm broad; pore with a collar always bent; wall roughened by irregular shaped granulations; Distribution: Cosmopolitan.

Trachelomonas superba Svirenko (Figure 6i).

Lorica ellipsoidal; 30 ± 5.6 µm long, 21 ± 4.5 µm broad; Pore without collar; wall with conical short spines scattered on the wall; Distribution: Cosmopolitan.

Trachelomonas volvocina (Ehrenberg) Ehrenberg (Figure 6j).

Lorica spherical; 16 ± 1.5 µm wide in diameter; walls yellowish, sometimes colourless, smooth; apical pore without a collar; Cell with 2 chloroplasts each with pyrenoid; Distribution: Cosmopolitan.

Trachelomonas volvocina var. **derephora** Conrad (Figure 6k).

Lorica spherical; 16 ± 4.7 µm in diameter; pore surrounded by a depressed collar; membrane smooth, hyaline yellowish, clear to deep reddish-brown; Distribution: Cosmopolitan.

Trachelomonas volvocinopsis Svirenko (Figure 6l).

Lorica spherical; 17 ± 4.3 µm in diameter; reddish-brown; cell with several small discoid chloroplasts; Distribution: Cosmopolitan.

3.3. Algae composition

In the samples from the Adzopé Reservoir, a total of 120 taxa were identified belonging to 5 phyla, of which 44 belonged to Euglenozoa. The Euglenozoa and Chlorophyta were the most diversified groups with 40.19% and 36.3%, respectively, of total species, followed by the Ochrophyta (17.86%) and the Cyanobacteria (10.71%). The Myzozoa were the least diversified group.

According to Euglenozoa the 44 identified taxa (Table 2) were distributed amongst 1 order, 2 families, and 6 genera. Ten species and subspecies were recorded for the first time in Côte d'Ivoire.

Species richness was dominated by *Trachelomonas* and *Phacus* species, accounting for 47.72% and 29.54% of the total taxa, respectively.

Based on the species occurrence frequency, 23 rare, 19 occasional, and 2 common species were found in February, during the long dry season. In contrast, in May and July, during the long rainy season 4 rare, 6 occasional, and 2 common species were found.

In February, regarding the common taxa, *Trachelomonas volvocina* (72.91%) and *Trachelomonas volvocinopsis* (64.56%) were recorded commonly in all samples. Concerning occasional taxa, *Lepocinclis oxyuris* (33.33%), *Lepocinclis globulus* (29.17%), *Phacus circulatus* (32.16%), and *Strombomonas verrucosa* var. *zmiewika* (25%) were identified.

The time sequence of species richness of the Euglenozoa is presented in Figure 7, which highlights its dominance during dry seasons. Species richness was weakly represented during rainy seasons. The highest species richness (43) was obtained in February during the long dry season; the lowest (13) was registered in June during the long rainy season. Species richness of Euglenozoa was correlated with nutrient concentration. In the dry season, when high nitrates and orthophosphates concentrations were measured (2.54 mg L^{-1} and 1.68 mg L^{-1}), 43 and 37 taxa were observed, respectively. During the rainy season, when concentrations of these nutrients decreased, a small number of taxa were obtained.

4. Discussion

Based on the threshold values for different trophic states suggested by Forsberg and Ryding (1980), the measured Secchi disk transparency for the Adzopé Reservoir and the nutrient charges place it in a eutrophic category.

The algal flora of the Adzopé Reservoir can be considered as rich in species. This richness can be explained by the fact that the water of the reservoir was stagnant. Indeed, the stagnant nature of the reservoir promotes biological processes such as complete cycles of reproduction and development of algae.

Table 2. List of taxa observed in the Adzopé Reservoir (F: species occurrence frequency, * presence, LDS: long dry season, LRS: long rainy season, SDS: short dry season, SRS: short rainy season).

	F	LDS	LRS	SDS	SRS
Lepocinclis acus	3	*		*	
Lepocinclis globulus	2	*	*	*	*
Lepocinclis oxyuris	2	*	*	*	*
Phacus acuminatus	3	*	*	*	*
Phacus angulatus	3	*			
Phacus circulatus	2	*	*	*	*
Phacus curvicauda	3	*	*	*	*
Phacus glaber	2	*		*	
Phacus limnophila	2	*		*	*
Phacus longicauda	2	*		*	
Phacus monilatus var. *suecicus*	3	*		*	*
Phacus pleuronectes	2	*	*	*	*
Phacus sesquitortus	3	*			
Phacus tortus	2	*	*	*	*
Phacus triqueter	3	*		*	
Phacus sp.	2	*		*	
Euglena proxima	3	*		*	*
Euglena texta	3			*	
Monomorphina lepocincloides	3	*		*	
Strombomonas acuminata var. *deflandriana*	3	*		*	*
Strombomonas fluviatilis	2	*		*	*
Strombomonas treubii	3	*		*	*
Strombomonas verrucosa var. *zmiewika*	2	*	*	*	*
Trachelomonas abrupta	3	*		*	*
Trachelomonas acanthophora var. *minor*	3	*		*	*
Trachelomonas acanthophora var. *speciosa*	3	*		*	
Trachelomonas bernardinensis var. *africana*	3	*		*	*
Trachelomonas curta	2	*		*	*
Trachelomonas duplex	2	*		*	*
Trachelomonas hispida	3	*	*		*
Trachelomonas hispida var. *crenulatocollis*	2	*			*
Trachelomonas intermedia	3	*		*	*
Trachelomonas lefevrei	3	*		*	
Trachelomonas oblonga var. *attenuata*	3	*		*	*
Trachelomonas pisciformis var. *bicoronata*	2	*			
Trachelomonas raciborskii	3	*		*	*
Trachelomonas radiosa	3	*			*
Trachelomonas scabra	3	*		*	*
Trachelomonas scabra var. *longicollis*	3	*			*
Trachelomonas similis	2	*		*	
Trachelomonas superba	2	*	*	*	
Trachelomonas volvocina	1	*	*	*	*
Trachelomonas volvocina var. *derephora*	2	*	*	*	*
Trachelomonas volvocinopsis	1	*	*	*	*
		43	13	37	30

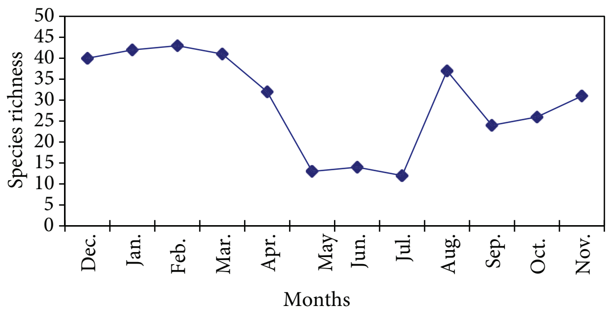

Figure 7. Temporal sequence of species richness.

In the Adzopé Reservoir several Euglenozoa taxa have been collected, which showed that they were largely restricted to eutrophic and hypertrophic conditions (Visitación et al., 2009). Species richness of Euglenozoa in this reservoir is more important than that recorded by Shams et al. (2012) in Zayandeh-Rood Dam Lake (Isfahan, Iran).

Of the identified taxa, 24.73% are common to Côte d'Ivoire lakes, reservoirs, and ponds (Bourrelly, 1961; Uherkovich & Rai, 1977; Ouattara et al., 2000).

Trachelomonas and *Phacus* species were found widespread in both shallow lakes and reservoirs of Côte d'Ivoire. This result, typical for many lakes and reservoirs of West Africa (Woodhead & Tweed, 1960; Compère, 1975, 1991), was similar to those reported by Keppeler et al. (1999) and confirm that loricate *Trachelomonas* is an important component of the Euglenophyceae community occurring in reservoirs (Wołowski & Grabowska, 2007). Wolowski and Hindák (2004) found that *Trachelomonas* are generally resistant to organic pollution. Sládecek (1973) considered *Trachelomonas* as a typical indicator of medium to high organic matter concentrations in water, especially associated with high ammonium concentrations (Alves-da-Silva et al., 2008; Da et al., 2009).

The high occurrence of *Trachelomonas volvocina* and *Trachelomonas volvocinopsis* corresponds well with their occurrence reported by Kočárková et al. (2004) in the pools of Poodří Protected Landscape Area (Czech Republic).

The highest species richness in the Adzopé reservoir, mainly during dry season seems to be associated with increasing of nutrients (NO_3^- and PO_4^{3-}) and decreasing of dissolved oxygen. They are some indications that nutrient charges may affect the algae community, although these changes may not be consistent throughout algae taxonomic groups (Piehler et al., 2004). The higher NO_3^- values may have resulted in the reservoir of Adzopé from the decomposition of organic material. The low dissolved oxygen values may be the result of the increasing decomposition of organic matter. Increasing organic matter has been shown to stimulate Euglenophyceae in some standing waters (Wołowski & Hindák, 2005). Decreasing of species richness with the rainy season might be attributable to the reduced nutrient charges and dilutional effects of rain.

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