IJMBR 7 (2019) 1-10 ISSN 2053-180X

International Journal of Modern Biological Research
www.bluepenjournals.org/ijmbr

Identification and systematic of *Staurastrum* and *Staurodesmus* of Kola, Nua and Voke Ponds in Kongo Central Province, DR Congo

doi.org/10.33500/ijmbr.2019.07.001

Muaka Lawasaka Médard[1]*, Luyindula Ndiku[2], Mbaya Ntumbula[2] and Diamuini Ndofunsu[2]

[1]Département de Biologie-Chimie, Institut Supérieur Pédagogique de Mbanza-Ngungu, DRC.
[2]Commissariat Général à l'Energie Atomique, B.P. 868, Kinshasa XI, DRC.

Article History
Received 07 June, 2018
Received in revised form 17 December, 2018
Accepted 27 December, 2018

Keywords:
Biodiversity,
Tropical pond,
Phytoplankton,
***Staurastrum*,**
***Staurodesmus*.**

Article Type:
Full Length Research Article

ABSTRACT

This study was aimed at inventorying the species belonging to *Staurastrum* and *Staurodesmus* genera of Mbanza-Ngungu ponds in Kongo Central Province. Twenty species of *Staurastrum* and four species of *Staurodesmus* are reported. These are: *Staurastrum alternans* Brebissonii ex Ralfs, *Staurastrum americanum* (W and G.S. West) G. M. Smith, *Staurastrum arcuatum* Nordstedt, *Staurastrum bieneanum* Rabenhorst, *Stuarastrum brebissonii* W. Archer, *Staurastrum cingulum* (West and G.S. West) G. M. Smith, *Staurastrum forficulatum* Lundelle, *Staurastrum furcatum* (Ralfs) Brebissonii, *Staurastrum gladiosum* Turner, *Staurastrum hexacerum* Wittrock, *Staurastrum hirsutum* Ehrenberg ex Ralfs, *Staurastrum leptodernum* L. J. Laporte, *Staurastrum longispinum (*Bailey) W. Archer, *Staurastrum margaritaceum* Ralfs var. gracilis A. M. Scott and Grönblad, *Staurastrum paradoxum* Ralfs, *Staurastrum setigerum* Cleve, *Staurastrum subavicula* (west) west and G.S. west, *Staurastrum teliferum* Ralfs, *Staurastrum tetracerum* Ralfs, *Staurastrum tohopekaligense* Wolle, *Staurastrum wildemanii* Gutwinski, *Staurodesmus convergens* (Ralfs) Lillier, *Staurodesmus dejectus* (Ralfs) Teiling, *Staurodesmus subulatus* (Kützing) Thomasson, *Staurodesmus extensus* (O. F. Andersson) Teiling. As can be observed in this report, *Staurastrum* is rich in species. Four species of *Staurodemus* from the study area are represented by several subjects.

INTRODUCTION

The algae, in particular, present an important ring of the matter cycle in an aquatic area. Some species of Cyanophyceae, species with heterocystes azote fixing present some agronomic interest. Like leguminous, in fact, they can be used as azote fertilizers, in the cultivation of irrigated rice. The importance of the microflore dwells in the consumption of numerous species, in a natural area. The microscopic algae can be exploited in a fish farm to supplement artificial fish feeding. Such a practice imposes the knowledge of biology in the microflore systemics (Da and Assemien, 1997). In Mbanza-Ngungu ponds green algae (Chlorophytes) are abundant and dominate the other groups of algae; the *Demidiaceae* constitute the major part of green algae caught in water, the pH of which is neutral or has low acid (Mpawenayo, 1996).

In the present research, the authors are interested in *Staurastrum* and *Staurodesmus* only.

Staurastrum and *Staurodesmus* belong to the Desmidiaceae and they present cells that are divided into rectangular, circular, and triangular shapes called hemisomates. These hemisomates have angles prolonged by arm-like appendices. Both genera, however are different in the sense that *Staurodesmus* has a smooth membrane.

*Corresponding author. E-mail: aimediamuini@yahoo.fr, lawasaka@yahoo.fr.

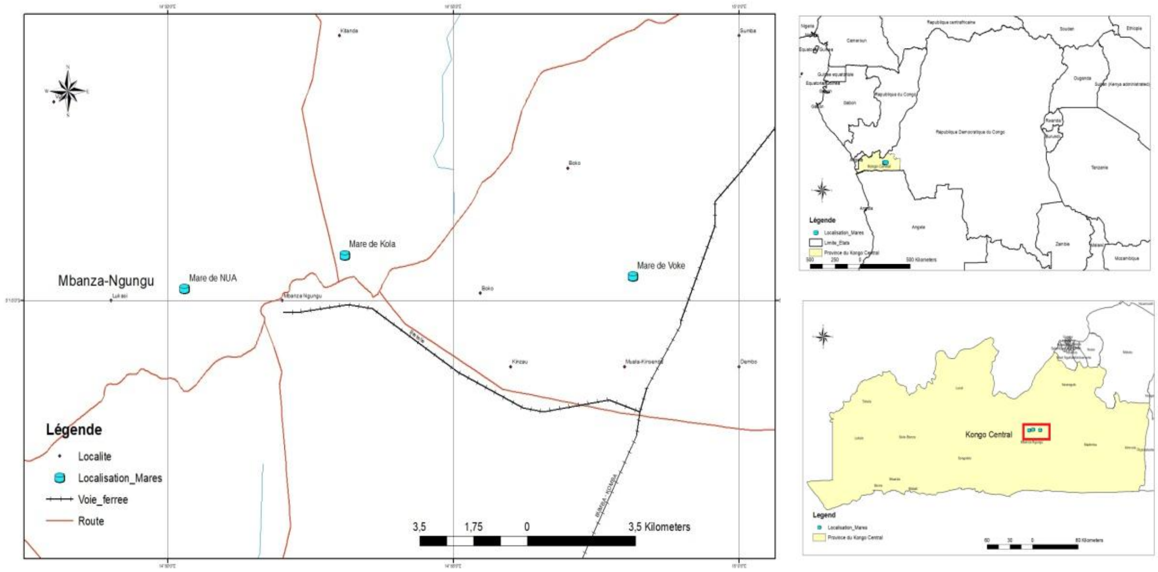

Figure 1. Chart showing localization of the zone of study.

Staurastrum apical view often demonstrates a polygonal contour having at least three triangles sometimes prolonged by an arm. Some species have biradied hemisomates. The membrane is smooth, punctuated, granulous, and thorny or verruquous (Bourrelly, 1990; Compere, 1977).

Staurodesmus cells are always solitary and have a deep sinus. The apical view is at an elliptical (biradied) or a well starry contour with 3, 4 and 5 branches. Each branch ends in a thorn sometimes reduced to a short micron. *Staurodesmus* genus was created by Teiling by reuniting Arthrodesmus section having 2 poles and 2 prickles per hemisomate and a *Staurastrum* section. The cell size, the length and direction of prickles, the shape of the hemisomate and isthmus separate *Staurodesmus* from *Staurastrum* (Bourrelly, 1990).

The polymorphism is clearly seen in *Staurastrum* and *Staurodesmus* genera. This morphological diversity explains the diversity of species. Various forms are sometimes seen within one species. This explains the presence of varieties. This diversity stems from the (climatic) physical and physico-chemical factors. Three main conditions facilitate the multiplication of algae in an aquatic ecosystem: light, temperature and (mineral salts) nutritive substances. When these factors are permanent in an area, they influence the sexed reproduction that plays an important role in the diversity.

MATERIALS AND METHODS

Field works mainly took place in three ponds (Kola, Nua and Voke) in Mbanza-Ngungu in Kongo Central Province. Mbanza-Ngungu has a wet tropical weather with the savannah as vegetation growing in a clayey and sandy soil.

This study was carried out in three ponds: Kola, Nua and Voke. They are permanent ponds, and they retain water all through the year. This makes it possible for algae to complete their evolving cycle (Figure 1).

Kola

This pond is surrounded by houses. It is in the longitude of 14° 38’50, 4’’ East, in the latitude of 05° 23’36, 8’’ South and in the altitude of 558 m. Its area is totally covered by flowing plants forming a more or less 30 cm thick cloth. This cloth has uncovered places in the centre where water is directly lit by the sun. The pond bed is muddy.

Nua

Nua is located in the North-East of Mbanza-Ngungu. It is in the altitude of 685 m, in the longitude of 14° 53’31, 7’’ East, and in the latitude of 05° 24’52, 1’’ South. It is oval-shaped. It is 400 m long and more or less 120 m wide. Its area is totally covered by aquatic macrophytes.

Voke

This pond is 17 km away in the South of Mbanza-Ngungu. It is in the longitude of 14° 36’ 3’’ East, in the latitude of 05° 27’54 3’’ South and in the altitude of 558 m. The basin is 300 m long and 200 m wide. Its bed has clayey mud. The pond is not covered. A green belt surrounds it. This belt is 3 to 7 m wide depending on the season and places.

Available laboratory equipment was used for collecting, measuring and analyzing and observations were made. Field works took place in the three ponds.

In Kola pond drawing sites are in the central part where open areas are found. In Nua and Voke drawing sites are in the periphery. A WTW 340i multi-parameter (Wissenschaftlich-technische Werkstaätten Gmbh, Germany) having interchangeable drill was used to measure conductivity, pH, dissolved oxygen and temperature on ground. Sample collection was carried out in each pond. Micro-algae were collected using a 20 µm plankton net of empty mesh. At each collection, water physical parameters were measured using a WTW 340i multi parameter bearing interchangeable drill. Physical parameters include dissolved oxygen, temperature, pH and conductivity.

A Motic BA 310 binocular microscope (Motic China Group, Ltd 2007-2012) was used to have micro-algae observations and their pictures in the laboratory. This microscope had a camera connected to a PC with a “measure” software helping to measure the dimensions of micro-algae observed, water samples taken in one-litre plastic bottles. Their analyses were carried out in the laboratory of Soil Physics and Hydrology of the Atomic Energy General Station in Kinshasa. These analyses helped to appreciate pond water quality under study.

Identification of taxa

The description and figures helped identified the species comparing the data obtained with previously reported works such as Bourrelly (1990), Compere (1967, 1977), Delazari-Barroso (2007), Gayral (1975), Golama (1996), Iltis (1980), Islam and Haseel (2005), Noba (2009), Therezien (1986) and Zongo et al. (2008).

RESULT

The means of physico-chemical parameters values measured reveal that waters from the three ponds under study are acidic and less mineralized. This explains the low conductivity. The highest temperature was recorded in January 2013 in Voke (28°C). The lowest temperature was recorded in September 2012 in Nua (22.1°C). Conductivity values are between 29 and 145 µs/m. Ponds waters are stagnant. The highest dissolved oxygen value is 1. 82 mg/l. Table 1 gives the principal physico-chemical parameters measured.

Each pond is a unique entity with regard to its physico-chemical, morphometric parameters and the colonization of macrophytes. After chemical analyses, many minerals intervene in an aquatic ecosystem. But some statistics revealed that pH, calcium, Nitrite, magnesium, phosphore, free brome, potassium, chrome and temperature are useful factors which are necessary for the multiplication and development of the algae population of Kola, Nuaand Voke ponds (Muaka et al., 2018).

The identification of subjects was carried out using a Motic BA 310 binocular microscope (Motic China Group, Ltd). The observation and photograph were accomplished with 400×: ocular with 40× objective. The description of species genera with pictures were given out for each subject.

Staurastrum

Staurastrum alternas Bréb. ex Ralfs

The cells have twisted hemisomates. The apical view is triangular and the angles are rounded, but not prolonged in arm. The membrane is granulous and the cell size is 18.6 – 19.5 x 6.3 – 7.2 µm. This species was found in Kola pond (Figure 2).

Staurastrum americanum (W and G.S. West) G.M. Smith

The cell is 11 – 13.7 µm long and 9 µm wide. It has a 4.3 µm isthmus. The hemisomates have two angles prolonged by lengthened and 9.5 µm denticulated arms. The apex is smooth and convex. The species was collected from Voke (Figure 3).

Staurastrum arcuatum Nordstedt

The cell is 12.9 – 30 µm long and 8.9 – 23 µm wide. It has a 6.5 µm isthmus. Each hemisomate has a triangular form bearing two dichotomic thorns at each angle. This species was collected from Voke (Figure 4).

Staurastrum bieneanum Reinsch

This cell is 19.2 – 22 µm long and 17.8 – 20 µm wide. It has a 9 µm isthmus. The hemisomate is triangular in apical view, elliptical and slightly weak in frontal view. It has sub-sharp angles. No thorns are found on walls. The species was collected from Voke (Figure 5).

Staurastrum brebissonii W. Archer

This cell is 20 – 25.1 x 12 – 21.3 µm short. It has a 6.9

Table 1. Principal physico-chemical parameters in the three ponds (Kola, Nua and Voke)

Physico-chemical factors	September 2012			November 2012			January 2013			March 2013			April 2013			July 2013			Unity	Guide values
	Kola	Nua	Voke	Kola	Nua	Voke	Kola	Nua	Voke	Kola	Nua	Voke	Kola	Nua	Voke	Kola	Nua	Voke		
Conductivity	29	48	31	64	59	35	60	50	38	50	37	34	52	45	37	73	68	34	μs/m	100
pH	4.15	4.06	4.60	4.46	6.09	5.53	4.42	4.66	5.79	4.72	4.66	5.47	4.70	5.30	5.31	5.3	5.50	6.30		
Temperature	22.3	22.1	22.9	24.6	26.3	26.6	27.4	27.3	28.7	27.8	25.5	27.6	25.7	25.7	28.1	23.2	24.7	24.5	°C	
Dissolved oxygen	6	5	3	7	7	6.5	5	6.5	6	8	3	5	7.5	6	7	5	7	9	mg/l	
Magnesium	0.06	0.03	0.02	1.09	2.07	0.87	0.66	0.55	0.18	0.63	1.91	1.43	0.26	0.40	0.17	1.11	0.75	0.91	mg/l Mg^{2+}	100
Calcium	0.81	0.72	0.32	1.17	57.6	1.18	0.53	0.32	0.69	0.97	4.47	1.82	2.41	1.44	1.06	0.57	0.19	0.84	mg/lCa^{2+}	30
Potassium	6.2	3.7	7.7	4.9	2.3	2.2	4.1	3.6	6.3	2.5	2.1	5.4	3.3	4	2.6	3.8	7.4	4.6	mg/l K^+	10
Ammoniac	0.15	0.09	0.05	0.09	0.10	0.13	0.09	0.09	0.06	0.10	0.07	0.11	0.09	0.1	0.09	0wx9	0.09	0.11	mg/l NH_3-H	1.5
Chromium	0.023	0.032	0.034	0.029	0.041	0.047	0.031	0.037	0.044	0.027	0.022	0.024	0.014	0.018	0.022	0.027	0.014	0.026	mg/l Cr^{6+}	0.05
Total Iron	0.12	0.26	0.13	0.19	0.38	0.21	0.17	0.34	0.23	0.026	0.16	0.041	0.32	0.58	0.047	0.31	0.56	0.14	mg/l Iron	0.3
Silica	9.8	72.4	0.6	5.8	2.1	5.5	4.6	88	28.4	1.7	111.2	2.1	1.2	70.2	1.6	0.3	21.1	10.1	mg/l SiO_2	
Free Chlorine	1.90	1.28	1.22	0.39	0.38	0.32	0.41	0.38	0.59	0.04	1.8	0.75	0.16	0.84	0.30	0.11	0.06	0.44	mg/l Cl_2	5
Free Bromine	0.016	0.006	0.012	0.46	0.61	0.64	0.0084	0.089	0.093	0.019	0.003	0.004	0.041	0.06	0.046	0.037	0.38	0.80	mg/l Br_2	0.01
Free Iodine	0.045	0.019	0.028	0.43	1.02	0.98	0.0043	0.090	0.098	0.035	0.016	0.037	0.51	1.22	0.80	0.31	0.55	0.98	mg/l I_2	
Nitrate	2.1	0.1	0.9	0.51	0.4	0.3	1.9	2.2	1.3	4.2	5.8	23.4	0.6	2.5	7.3	6.3	1.7	4.2	mg/l NO^-_3	50
Nitrite	0.009	0.004	0.0067	0.010	1.448	0.014	0.006	0.096	0.003	0.001	0.006	0.005	0.071	0.026	0.0118	0.029	0.023	0.007	mg/l NO^-_2	0.1
Phosphorus	0.21	1.41	0.13	2.25	44.8	7.32	2.74	55.36	1.28	5.21	58.41	7.16	1.29	11.97	1.53	1.27	11.97	1.45	mg/l $P0^{3-}_4$	3
Chloride	1	22.11	16.5	0.78	28.19	19.8	1.851	18.675	14.68	16.50	34.05	21.45	4.455	6.765	2.145	3.13	4.62	1.65	mg/l Cl	250
Sulphate	0.66	3	2	2	4	2	14	7	4	1	2	2	2	3	2	7	4	2	mg/l SO_4^{2-}	250

μm isthmus and a polygonal shape. The cell membrane is covered by numerous short thorns. The species was collected from Kola and Voke (Figure 6).

Staurastrum cingulum (W. West and G.S West) Smith

S. cingulum strongly resembles *Staurastrum paradoxum* Meyen Ex Ralfs, but the arms are smaller. The species is 12 – 13 μm long and 5 – 10 μm wide. The isthmus is 5 μm wide. This species was collected from Voke (Figure 7).

Staurastrum echinatum Brébisson ex Ralfs

This cell is 24 μm long and 23 μm wide. It has a 10 μm – wide isthmus. The projections similar to arms are absent, but each hemisomate which is triangular (in apical view) has numerous short thorns. This species was collected from Voke (Figure 8).

Staurastrum forficulatum P. Lundell

This cell is 22 – 24 μm long and 9 – 11 μm wide (excluding thorns). It has a (7.5 μm) V-shaped open isthmus. The hemisomates have protuberances with dichotomic thorns. This species was collected from Kola, Nua and Voke (Figure 9).

Staurastrum furcatum Brébisson

The cell is 27 – 46 μm long and 18.5 – 23 μm wide. The isthmus is 13 μm wide. A short thorn is on the hemisomates convex sides. Six swellings with two thorns at each hemisomate apex are found. The species was collected from Voke (Figure 10).

Staurastrum gladiosum W. Turner

The cell is 24.5 – 34.9 μm long and 8.8 – 11.9 μm wide. The isthmus which is 13 μm wide presents, in frontal view, hemisomates that are cross-wide subelliptical with a deep median constriction. The apical view is triangular. The cell membrane is stuck with thorns. This species was collected from Voke and Nua (Figure 11).

Staurastrum hexacerum Wittrock

This cell is 23 μm long and 7 μm wide. Its isthmus

Figure 2. *S. alternas* Bréb. ex Ralfs.

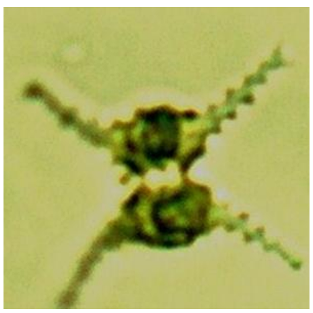

Figure 3. *S. americanum* (W and G.S. West) G.M. Smith.

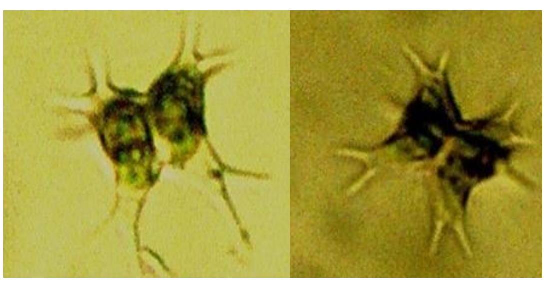

Figure 4. *S. arcuatum* Nordstedt.

Figure 5. *S. bieneanum* Reinsch.

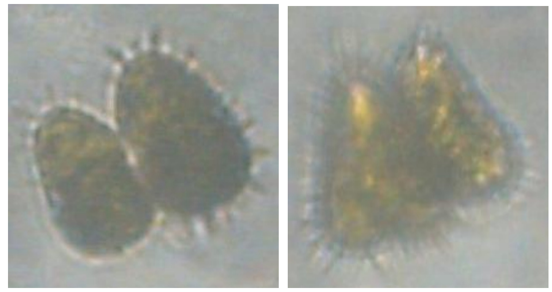

Figure 6. *S. brebissonii* W. Archer.

Figure 7. *S. cingulum* (W. West and G.S West) Smith.

Figure 8. *S. echinatum* Brébisson ex Ralfs.

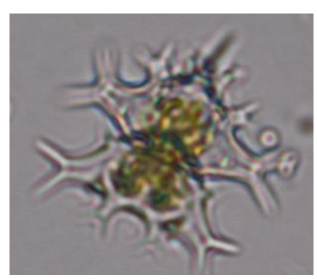

Figure 9. *S. forficulatum* P. Lundell.

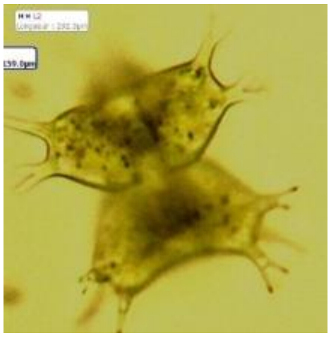

Figure 10. *S. furcatum* Brébisson.

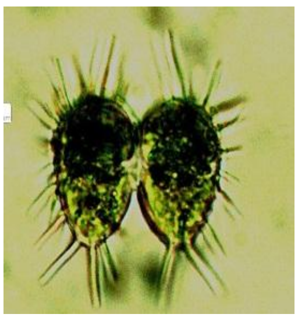

Figure 11. *S. gladiosum* W. Turner.

Figure 12. *S. hexacerum* Wittrock.

Figure 13. *S. hirsutum* Ehrenberg ex Ralfs.

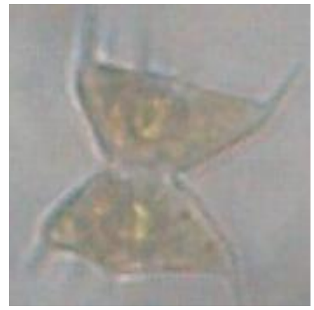

Figure 14. *S. leptodermum* L. J. Laporte.

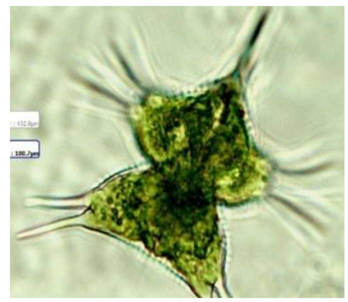

Figure 15. *S. longispinum* Bailey.

is 5 µm wide. The polygon-shaped hemisomates bear projections that are similar to arms. This species was collected from Voke (Figure 12).

Staurastrum hirsutum **Ehrenberg ex Ralfs**

This cell is triangular in apical view and has no projections similar to arms. The membrane bears numerous short thorns. Without thorns, it is 20 – 25 µm long and 12 – 16 µm wide with a 8 µm wide isthmus. The species was collected from Nua and Voke (Figure 13).

Staurastrum leptodermum **L. J. Laporte**

Without thorns, the cell is 18.9 – 20.2 µm long and 5.2 – 21 µm wide. Its isthmus is 5.7 µm wide. The hemisomates are cuneiform considerably extending to the apex slightly tumefied in the middle. The angles end in thorns. The species was collected from Voke (Figure 14).

Staurastrum longispinum **Bailey**

This cell of which hemisomates bear 4 long thorns each is 43.2 – 53 µm long and 13.7 – 19 µm wide (excluding thorns). The species was from Voke (Figure 15).

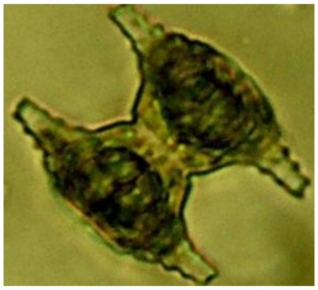

Figure 16. *S. margaritaceum* (Ehr.) Ralfs var. gracilis Scott and Grönbl.

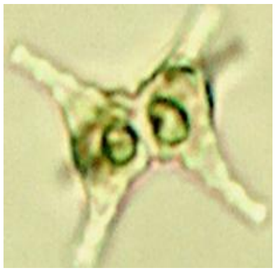

Figure 17. *S. paradoxum* Ralfs.

Figure 18. *Staurastrum setigerum* var. minus Schmidle.

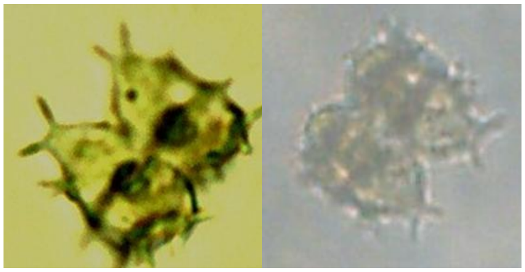

Figure 19: *S. subavicula* (West) West and G.S. West.

***Staurastrum margaritaceum* (Ehr.) Ralfs var. gracilis Scott and Grönbl**

The cells are longer, quadriradiated, short-armed and divergent. The sinus is open and the isthmus is wide. The hemisomate apex is swollen. Each hemisomatehas a plast and a pyrenoid. The cell size is 26.1 × 30 µm and the isthmus is 9.3. µm. *S. margaritaceum* was found in Voke (Figure 16).

***Staurastrum paradoxum* Ralfs**

The cells are 15.8 µm long without arms and 5.6 µm wide. In apical view, they have 3 – 4 angles that are prolonged in a denticulated arm slightly hardy. The hemisomates and apex have no ornamentation or are only decorated by some teeth (Compere, 1977). The observed species is triangular in apical view. The species was collected from Voke (Figure 17).

***Staurastrum setigerum var. minus* Schmidle**

This species is 22 – 30 × 11 – 23.6 µm. It has a 9 µm isthmus with a wall covered by thorns more or less developed. The angle is decorated by stronger thorns. The species was collected from Voke (Figure 18).

***Staurastrum subavicula* (West) West and G.S. West**

This cell is triangular in apical view and has thorns, but no projections similar to arms. The cell size is 15.9 – 20 × 10 – 20 µm with a 8.7 µm isthmus. The species was collected from Nua and Voke (Figure 19).

***Staurastrum teliferum* Ralfs**

The cells are solitary and are separated into two hemisomates by a constriction. The apical view shows a polygonal contour with 3 angles prolonged by arms. All the body is covered by small teeth. The size of each cell is 21 × 10 µm. The observed species is composed of two cells. *Staurastrum teliferum wa*s from Voke (Figure 20).

***Staurastrum tetracerum* Ralfs**

This cell is 16 × 50 µm with a 10 µm isthmus showing two arms per hemisomate. Two denticulated arms end in 4 horns. The apical section is convex and framed by two projecting thorns. The sinus is rounded. Both hemisomates are not in the same skeleton, but form a sharp angle. The apical view is fusiform and

Figure 20: *S. teliferum* Ralfs.

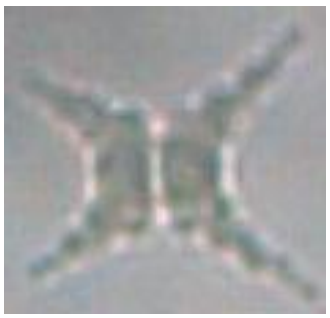

Figure 21: *S. tetracerum* Ralfs.

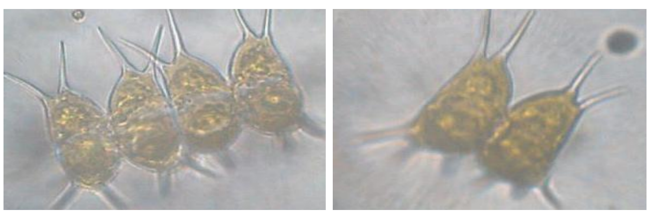

Figure 23: *S. wildemanii* Gutwinski.

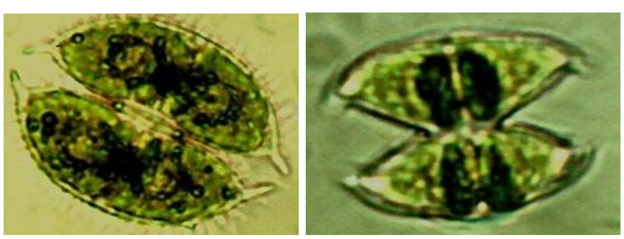

Figure 24. *S. convergens* (Ralfs) Lillier *A. convergens* Ralfs.

dissymmetric. One of the faces has a more marked convexity. This species was collected from Kola and Voke (Figure 21).

Stauratrum tohopekaligense **Wolle**

This cell hemisomates have projections that are similar to smooth arms. The cell is 28 µm long excluding projections and 14 µm wide excluding projections with a 25 µm wide isthmus. This species is collected in Kola and Voke (Figure 22).

Staurastrum wildemanii **Gutwinski**

This species can be solitary or in colony. Each cell is 30 µm long and 11 µm wide with a 6 µm wide isthmus. It presents two prickles at each pole. The cell membrane is smooth. The species is collected in Voke (Figure 23).

Staurodesmus

Staurodesmus convergens **(Ralfs) Lillier Arthrodesmus convergens Ralfs**

These cells are elliptical in apical view. The elliptical hemisomates are fusiform and convex on top. They are ornamented at each side by a prickle giving downward and prolonging the top curve. The cell size is 30 × 15.6 µm. Its isthmus is 8.2 µm wide. This species comes from Nua (Figure 24)

Stauradesmus dejectus **Brébisson**

This cell is 19.1 – 20.2 µm long and the wide. It is triangular in apical view and the isthmus is a bit prolonged (5.7). The sinus is open and rounded. The hemisomates are triangular in frontal view and the flat apex is decorated at each angle by a small vertical thorn. This species is collected in Kola, Nua and Voke (Figure 25).

Staurodesmus subulatus **(Kütz) Thomasson**

These cells are 25 × 8 µm. They are radiated in apical view. The elliptical hemisomates are triangular and rounded. The base is much more convex than the apex and the thorns are generally well developed and subparallel (Compere, 1977). This species is collected in Voke (Figure 26).

Staurodesmus Extensus **(O.F. Andersson) Teiling**

These cells have triangular hemisomates in frontal view. Each hemisomateis prolonged by a long divergent thorn. The isthmus is 4.9 µm wide and the cell dimensions are

Figure 25. *S. dejectus* Brébisson.

Figure 26. *S. subulatus* (Kütz) Thomasson.

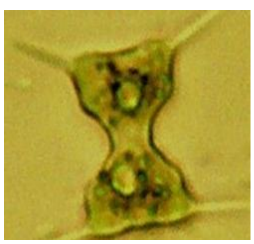

Figure 27. *S. extensus* (O.F. Andersson) Teiling.

15.2 × 10.8 µm (Figure 27).

DISCUSSION

The quantity of available nutritious elements is the key factors of the biological production of water and species diversity. The algae multiply as soon as the area conditions are favorable. The conditions indispensable forthe development of all algae (*Staurastrum*, *Staurodesmus*) are light, temperature (climatic factors) and nutritious substances (minerals). Substrate is added to these two types of factors. The quality of water and macrophytes as substrate explains the clan of algae population in the aquatic ecosystem.

The high numbers of species particularly that of *Staurastrum* and the number of subjects in each species of *Staurodesmus* show the existence of a certain number of conditions that facilitate the multiplication and the growth of species in the ponds under study.

Kola, Nua and Voke ponds are in a wet tropical weather in which luminosity and temperature are relatively high. The mean concentration of mineral elements determines weak conductivity (29 – 68 us/m). The species of both *Staurastrum* and *Staurodesmus* genera are collected in these ponds characterized by acid waters. Zongo et al (2008) noticed that, in Burkina Faso, some green algae genera were collected from alkaline acid waters. Bourrelly (1990) supports the opinion that a lot of species belonging to Desmidiaceae family are related to alkaline waters in terms of ecology. It can be said that micro algae easily adapt themselves to the ecological features. This polymorphism remarked in both genera explains clearly the luminosity and the permanent high temperatures in the ponds area under study.

Conclusion

The results of this study demonstrate a specific important diversity of Kola, Nua and Voke ponds. They also indicate that Kongo Central Province has an interesting and diversified algal flora and particularly that of the *Staurastrum* genus.

Among all the three ponds (Kola, Nua and Voke), Voke is the richest in both genera. It contains a macrophyte that is not very tight. This substrate lets solar light pass. The light illuminates all the water column.

REFERENCES

Bourrelly P. (1990). Fresh water algae. Green Algae. Volume I. Paris: N. Boubée Ed.

Compere P. (1967). Algae from Sahara and Lake Tchad region. Belgium: Brussels.

Compere P. (1977). Algae from Lake Tchad region. VII-Chrorophycophytes 3rd part: Desmidiaceae. Belgium: O.R.S.T.O.M.

Da K. P. & Assemien A. (1997). Scenedesmus genus in the microflora of the pisciculture complex pond of banco national park. Ivory Coast.

Delazari-Barroso A., LeiteSant Anna C. & Americo Cabral Senna P. (2007). Phytoplankton from Duas Bocas Reservoir, Espirito Santo State, Brazil (except diatoms). Brazil: Hoehnea. 34(2)211-229.

Gayral P. (1975). Algae: morphology, cytology, reproduction and ecology. Paris: Doin editor. 166p.

Golama (1996). Bacillariophyceae, Desmidiaceae and Euglenophyceae in Kisangani region. Zaïre.

Iltis A. (1980). Algae. In: J.R. Durand and Levêque, aquatic flora and fauna of Sahelo-sudanese Africa. Volume I. Paris: O.R.S.T.O.M. Ed. Collection Initiation. Technical documents. 44:9-61.

Islam A. K. M. & Haseel M. D. I. (2005). Hydrobiological studies within the tea gardens at srimargal, Bangladesh III. Chlorophyceae (excluding desmids).

Mpawenayo B. (1996). Waters of Rusizi plain (Burundi). Areas, flora and algal vegetation.

Muaka L., Luyindula N., Mbaya T. & Diamuini N. (2018). Identification and taxonomic studies of scenedesmus and desmodesmus species in some mbanza-ngungu ponds in kongo central province (DR Congo).

Noba K. (2009). Inventory and study of mycrophytes diversity (cyanobacteries and micro algae) and associated fresh water plants in Senegal. Senegal: Cheikh Anta Diop University.

Therezien Y. (1986). New contribution to the study of fresh water algae of the Amazonian part of Boliva, 2nd part: desmidiales.

Zongo F., Zongo B., Boussin J. & Couté A. (2008). New taxa of fresh water micro-algae for Burkina Faso, West Africa: I-Chlorophyta.