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Impact of the Degrading Toxicity of Metallic Trace Elements on the Flora and Fauna of the Matete River in Kinshasa

Athanase N. Kusonika[a*], François Xavier M. Mbuyi[b], Thierry T. Tangou[c], Shango Mutambwe[d], Dieudonné E. Musibono[e]

[a,b,c,d,e]*Laboratory of Ecotoxicology and Ecosystem Health ERGS, Department of Environmental Sciences, Faculty of Sciences, University of Kinshasa, DR Congo*

[a]*Email: kusonikaathanase@gmail.com; athanase.kusonika@unikin.ac.cd;* [b]*Email: mbuyimusongela@haoo.fr,* [c]*Email: thierrytangou@yahoo.fr / thierrytangou1@gmail.com,* [d]*Email: mutambwe@yahoo.fr,* [e]*Email: musibon.ergs@gmail.com*

Abstract

This work presents the results for which the general objective pursued in this study is to assess the impact of the degrading toxicity of metallic trace elements on the flora and fauna of the Matete river in Kinshasa. This evaluation was studied through the understanding of the accumulative power of species of flora and fauna in this same ecosystem with metallic elements. In particular: *Pistia stratiotes* (manganese): 10.7 ± 1.1 and 236.4 × 101 ± 248.8 mg / kg, iron: from 187.5 × 101 ± 61.9 and 500.0 × 101 ± 0, 1 mg / kg, potassium: between 314.8 ± 12.1 and 119.0 × 103 ± 6981.1 mg / kg, calcium: <10 ± <0.3 and 252200 ± 1892.8 mg / kg, cobalt: <3.0 ± <0.2, nickel: <0.5 ± <0.1 and 20.6 ± 0.5 mg / kg, zinc: 1.9 ± 0.0 and 98.7 × 101 ± 0.0 mg / kg, copper: <0.5 ± <0.1 and 79.4 ± 1.2 mg / kg, aluminum: 56.3 × 101 ± 53.1 and 5229.0 × 101 ± 583, 8 mg / kg, chromium: <1.0 ± <0.1 mg / kg and 21.6 ± 4.0 mg / kg, cadmium: 2.8 ± 0.3 and 25.6 ± 0.4 mg / kg, lead: 0.5 ± 0.4 and 86.7 ± 5.5 mg / kg and for *Lemna minor* (manganese): 5.10 ± 0.1 and 5.80 ± 0.3 mg / kg, iron: 49.9 × 101 ± 18.8 and 6784.0 × 101 ± 709.5 mg / kg, potassium: 113.8 ± 4.4 and 2712.0 × 101 ± 98.8 mg / kg, calcium: <10 ± <0.1 and 97830 ± 2073.9 mg / kg, cobalt: <3.0 ± <0.2 mg / kg, nickel: 0.001 ± 0.00 and 0.004 ± 0.00 mg / kg, zinc : 3.12 ± 0.17 and 4.00 ± 0.82 mg / kg, copper: 0.001 ± 0.0001 and 0.006 ± 0.0004 mg / kg, aluminum: 0.02 ± 0.00 mg / kg and 0.15 ± 0.06 mg / kg, chromium: 0.001 ± 0.0001 and 0.003 ± 0.0002 mg / kg, cadmium: 0.0004 ± 0.00002 and 0.001 ± 0.00003 mg / kg, lead: 0.001 ± 0.00 and 0.004 ± 0.0002 mg / kg. On the other hand, *Oreochromis niloticus* (Calcium): <0.1 × 102 ± 0.3 and 25 220.0 × 101 ± 48094.1mg / kg, Iron: 10350.7 × 101 ± 5131.7 and 102158.0 × 101 ± 27182.7,

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* Corresponding author.

Manganese: 1.815 × 101 ± 0.931mg / kg and 7.945 × 101 ± 2.131 mg / kg, Cobalt: <6.0 ± <0.0 mg / kg, Nickel: <0.501 ± <0.049 mg / kg and 61.503 ± 1.302 mg / kg, Zinc: <0.736 ± 0.015 mg / kg and 42.923 × 101 ± 3.176 mg / kg, Copper: 1.902 ± 0.007 mg / kg and 35.302 ± 0.247 mg / kg, Aluminum: 1.414 × 103 ± 70.464mg / kg and 9.493 × 103 ± 147.214 mg / kg, Chromium: <1.0001 ± <0.0408 and <1.0003 ± <0.0105, Cadmium: 0.2002 ± 0.0718 mg / kg and 19.0001 ± 0.8981mg / kg and Lead: <1, 0002 ± <0.0051 mg / kg and 3.9004 ± 0.0895 mg / kg of dry matter. One of the serious causes of their persistence is their biomagnification in the food chain. This is why the response of *Pistia stratiotes*, water lettuce and *Lemna* minor from the nine sampling sites of the Matete river to large and / or low concentrations of metallic elements is reflected either by an inhibition of photosynthetic processes (antagonism and effect synergistic) and the instinct of certain species. However, this ecosystem offers an ecological niche low in dissolved oxygen and a nutrient-poor and toxic diet for the species that live there. In this regard, the flora of the Matete river accumulates the metallic elements in a significant way and according to the diversity of the environments and the size of the species.

Keywords: Impact; toxicity; metallic trace elements; Flora and Fauna; Matete river; Kinshasa.

1. Introduction

The operation of an industry has often favored for their installations sites near waterways for three reasons: the transport of raw materials, the water supply, which allows the installations to be cooled, and the possibilities of discharge. industrial effluents. For decades, rivers have inherited discharges and industrial wastewater, liquid wastes resulting from the extraction or processing of raw materials, and all forms of production activity [9]. The problems associated with heavy metal contamination were first highlighted in industrially advanced countries due to their larger industrial spills, and especially as a result of cadmium pollution accidents in Sweden. and mercury in Japan [34]. These contaminations remain there for years and accumulate in the bodies of aquatic species and consuming humans. They can cause cancer, liver damage, reproductive problems and birth defects as well as other dangerous plagues. Such as the destruction of the excretory system, teratogenesis [24]. Fish and fishery products have valuable nutritional qualities that make them particularly interesting foods. Fish is, for example, as much as meat, an excellent source of protein. It also contains minerals such as phosphorus and vitamins (A, D, E, and some of group B). In addition, certain types (oily fish) are a source of so-called "long-chain" omega 3, which are involved in the prevention of cardiovascular diseases, as well as in the development and functioning of the retina, the brain and the nervous system. However, products from rivers can be contaminated with pollutants in the water such as trace metals. The discharges into the Matete River of metallic trace elements mainly from industrial effluents directly or indirectly influence the phenomenon of bioaccumulation, degradation and growth of certain species of its flora and fauna. The general objective pursued in this study is to assess the impact of the degrading toxicity of metallic trace elements on the flora and fauna of the Matete river in Kinshasa. To do this, we have focused on the specific objectives below:

- Make an inventory of the species of aquatic flora and fauna of the Matete river, desire to determine their vulnerabilities to unchecked industrial discharges;

- determine their level of accumulation of metallic trace elements;

- propose appropriate measures relating to the sustainable management of aquatic resources

2. Material and Methods

The samples taken consisted of aquatic plants and the fish that live there (see Figure 1).

2.1. Sample collection sites

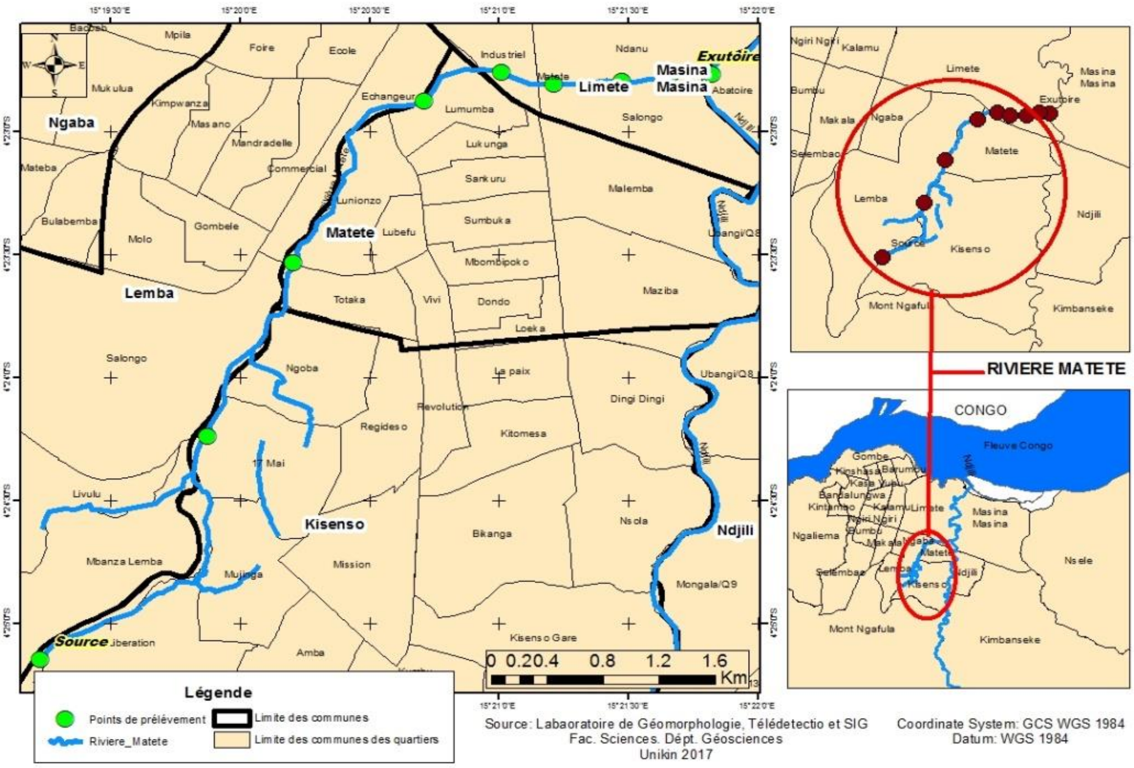

Figure 1: Illustration of the digital cartography of the sampling sites of the Matete river in Kinshasa

The samples of aquatic plants were taken during the two seasons of each year and in the different sites and then sent to the herbarium of the Department of Biology of the Faculty of Sciences of the University of Kinshasa for species identification. After identification at the herbarium, the choice of Pistia stratiotes and Lemna minor was made on the basis of the selection criteria.

After identification at the herbarium, the choice of Pistia stratiotes, water lettuce and Lemna minor obeyed a series of criteria including:

- wide geographical distribution, abundance, presence in all sampling sites (representativeness of biological organisms at parameters to be tested);

- very strong specific sensitivities with respect to certain pollutants (sensitivity to a very wide range of pollutants);

- reproducibility of results, ease of obtaining and storing the biological organisms to be tested (provide sufficient tissue for analyzes and capacity of accumulation with respect to the substances considered);

- a lifespan compatible with the temporal variations that one wishes to measure (annual species).

The harvest of Oreochromis niloticus fish specimens was carried out from August 01 to February 10, 2020 at the 9 sites of the Matete river. The fish were caught monthly by means of experimental and artisanal fisheries using gillnets 50 to 100 m long and 2.5 m high (mesh size between 8 and 50 mm) and fine mesh landing nets of 0.5 to 2mm. Sleeping gill lines were used day and night. The fish were handled differently, depending on the harvesting stations and the period. After fishing, the fish were sorted then preserved and then sent to the Hydrobiology Laboratory of the Biology Department of the Faculty of Sciences of the University of Kinshasa for species identification, i.e. a total of 160 specimens. Oreochromis niloticus fish is based on external morphological characters. The identification keys proposed by [19;20;28]. At the Central Analysis Laboratory (LCA) of CGEA / CREN-K, the fish samples were weighed using a KERN brand precision balance before and after drying in an oven at a temperature of 105^{O}C for 24 hours until constant weight, the head of each fish specimen was separated from the rest of the body and subsequently mineralized separately or incinerated at 550 ° C in the oven and the ashes obtained were kept in the different glass vials for analyzes. The physico-chemical analyzes by X fluorescence were carried out at the central analysis laboratory of CGEA / CREN-K in order to determine the concentration of aluminum, cadmium, and lead, etc. in the various sludge samples. The samples were therefore measured by an X-ray fluorescence spectrometer, using the four secondary targets, namely successively Molybdenum (39.76KV of voltage and 0.88mA of current), Aluminum oxide (49.15 KV of voltage and 0.7mA current), Cobalt (35.79KV current) and finally Bragg's HOPG Crystal (17.4KV voltage and 1.99mA current) from the palladium anode.

3. Results and Discussion

3.1. Results

3.1.1. Characterization of samples of floating aquatic plants (Pistia stratiotes, water lettuce and Lemna minor) from the Matete river

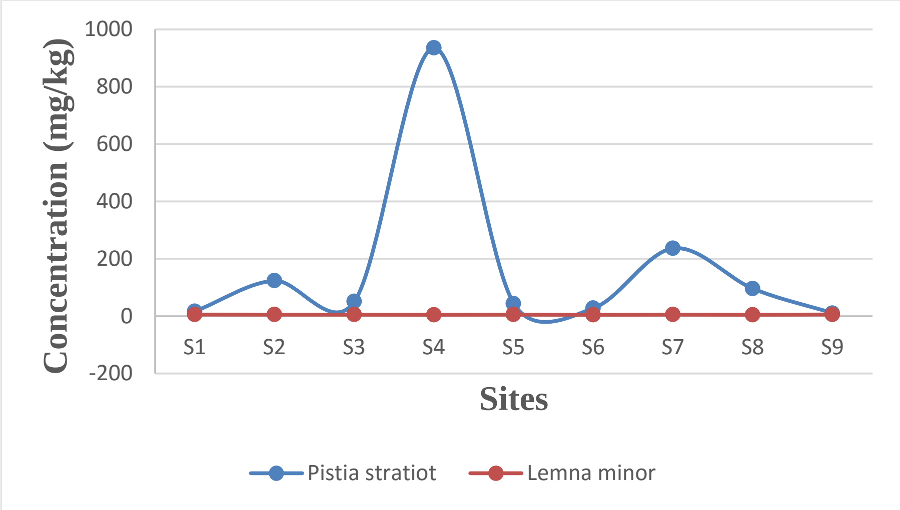

Figure 1: The manganese values of the different specimens of the floating plants of the Matete river

The manganese values in the different samples of *Pistia stratiotes* water lettuce are in the range of 10.7 ± 1.1 and 236.4 × 101 ± 248.8 mg / kg dry matter and around 5.10 ± 0.1 and 5.80 ± 0.3 mg / kg in specimens of *Lemna minor* ($p = 0.05025628 \leq 0.05$).

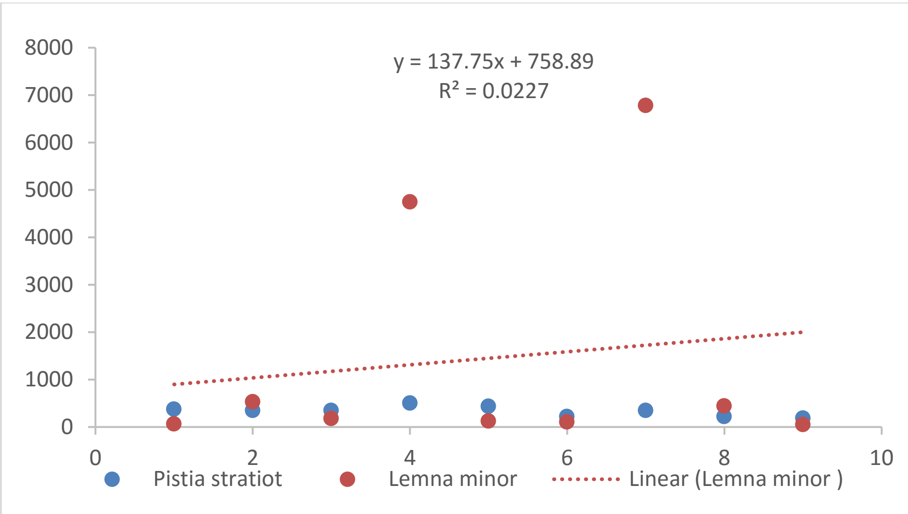

Figure 2: The iron values of the different specimens of the floating plants of the Matete river

The iron concentrations in the species *Pistia stratiotes* oscillate in the range of 187.5 × 101 ± 61.9 and 500.0 × 101 ± 0.1 mg / kg dry matter and between the concentration of 49.9 × 101 ± 18.8 and 6784.0 × 101 ± 709.5 in *Lemna minor* ($p = 0.03879687 \leq 0.05$).

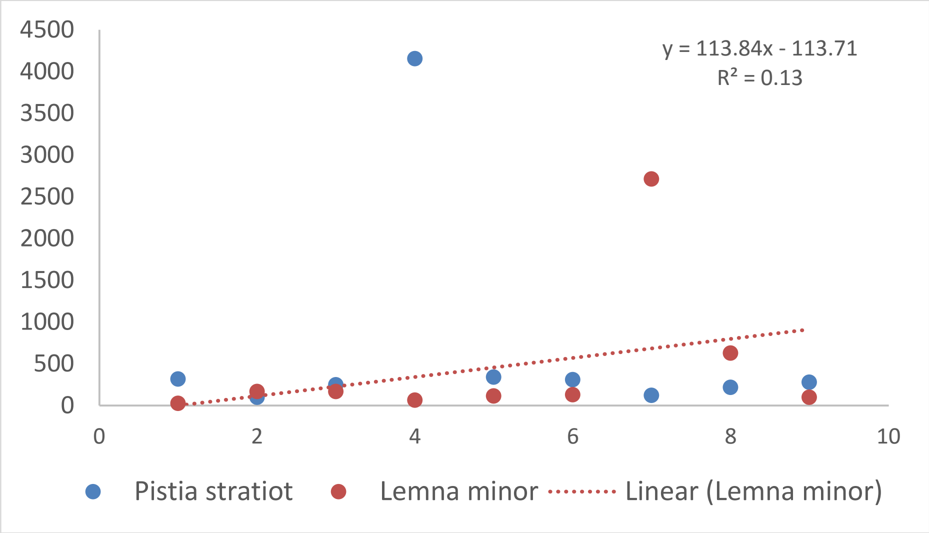

Figure 3: The potassium values of the different specimens of the floating plants of the Matete river

The potassium values in the species *Pistia stratiotes* L oscillate between 314.8 ± 12.1 and 119.0 × 103 ± 6981.1 mg / kg of dry matter and around 113.8 ± 4.4 and 2712, 0 × 101 ± 98.8 mg / kg of dry matter for *Lemna minior* ($p = 0.00590093 \leq 0.05$).

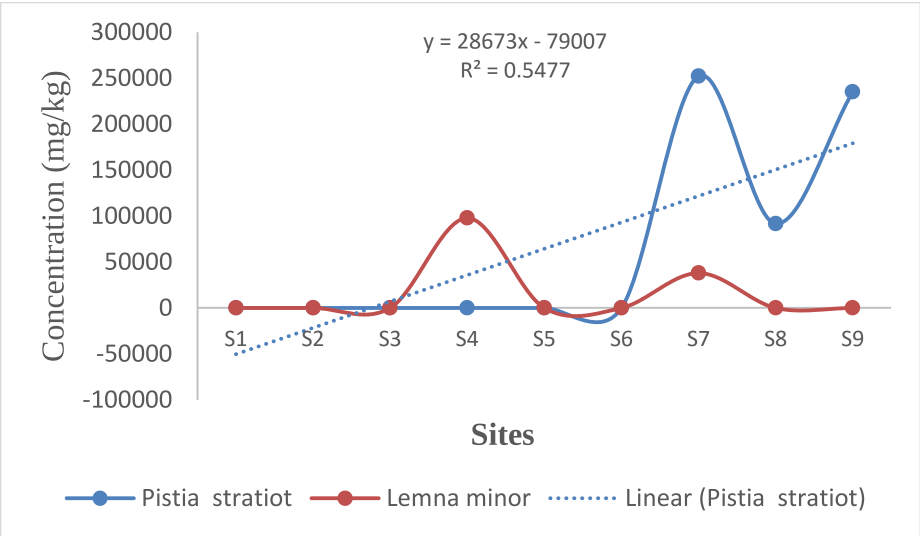

Figure 4: Calcium values of different specimens of floating plants from the Matete river

Calcium concentrations in *Pistia stratiotes* L are in the range of <10 ± <0.3 and 252200 ± 1892.8 mg / kg and <10 ± <0.1 and 97830 ± 2073.9 mg / kg in *Lemna minor* ($p = 0.03050649 \leq 0.05$).

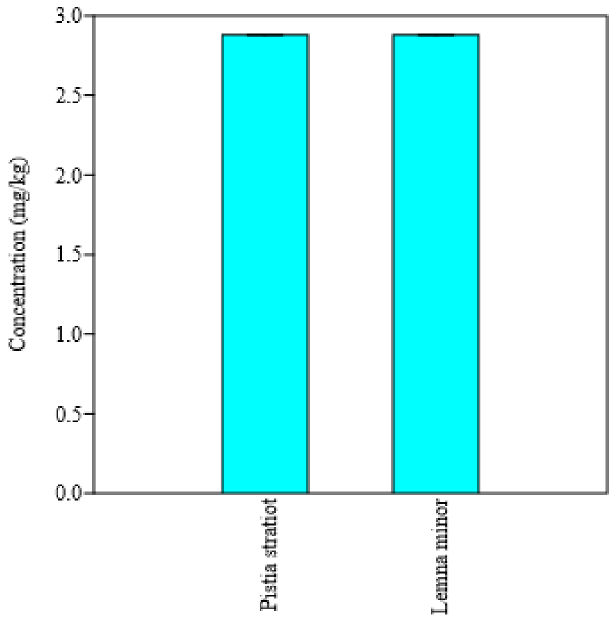

Figure 5: The cobalt values of the different specimens of the floating plants of the Matete river

The cobalt content in *Pistia stratiotes* L and *Lemna minor* species is around the values <3.0 ± <0.2 mg / kg dry matter ($p = 0 \leq 0.05$).

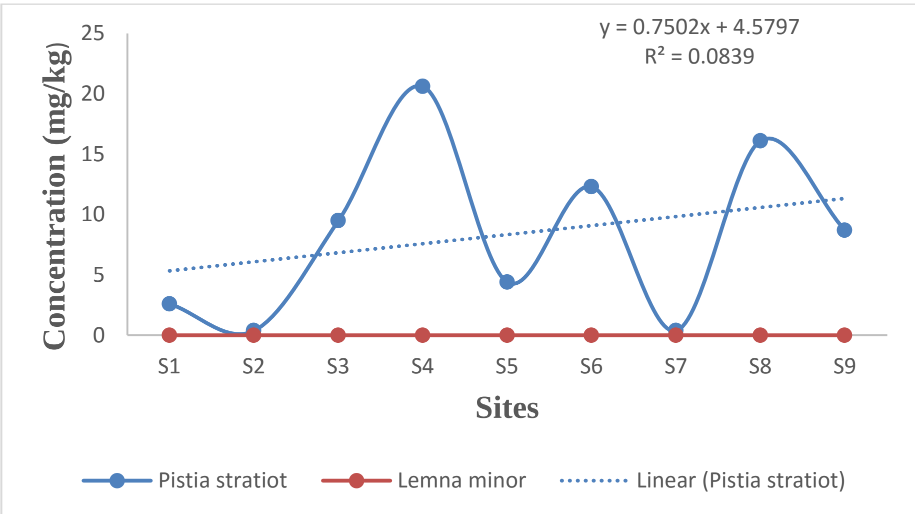

Figure 6: The nickel values of the different specimens of the floating plants of the Matete river

The relative data of nickel concentrations vary around <0.5 ± <0.1 and 20.6 ± 0.5 mg / kg in samples of *Pistia stratiotes* L and between 0.001 ± 0.00 and 0.004 ± 0, 00 mg / kg of dry matter in *Lemna minor* (p = 3.0912 × 10-5 ≤ 0.05).

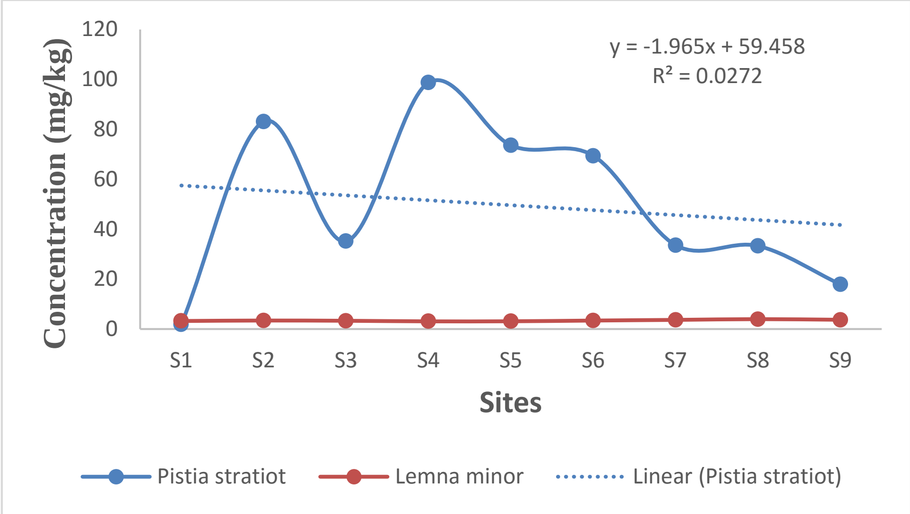

Figure 7: Zinc values of different specimens of floating plants from the Matete river

The zinc concentration in the different samples of *Pistia stratiotes* L from the Matete river is between 1.9 ± 0.0 and 98.7 × 101 ± 0.0 mg / kg of dry matter and around 3.12 ± 0 , 17 and 4.00 ± 0.82 mg / kg of dry matter in *Lemna minor* (p = 5.2783 × 10-7 ≤ 0.05).

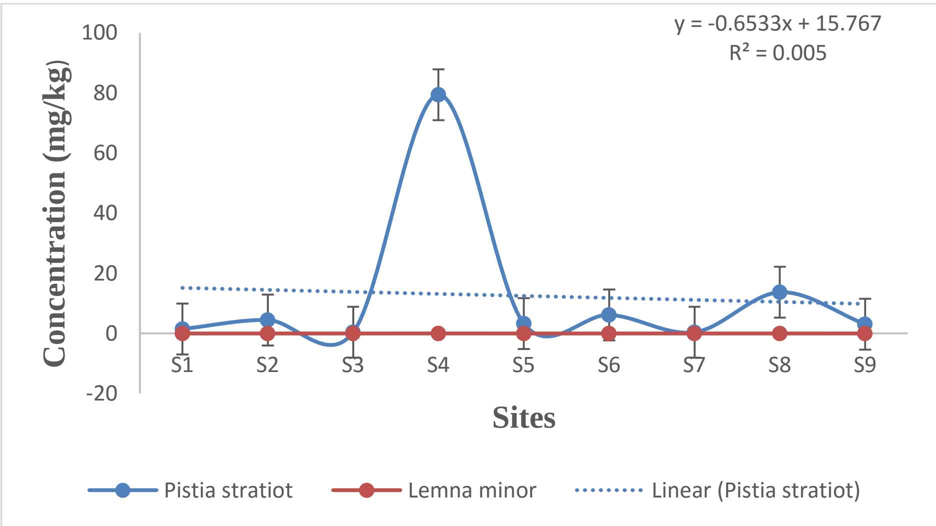

Figure 8: The copper values of the different specimens of the floating plants of the Matete river

The copper content in the specimens of *Pistia stratiotes* L is around the values <0.5 ± <0.1 and 79.4 ± 1.2 mg / kg of dry matter in contrast to 0.001 ± 0.0001 and 0.006 ± 0.0004 mg / kg of dry matter in *Lemna minor* (p = 0.05474625 ≤ 0.05).

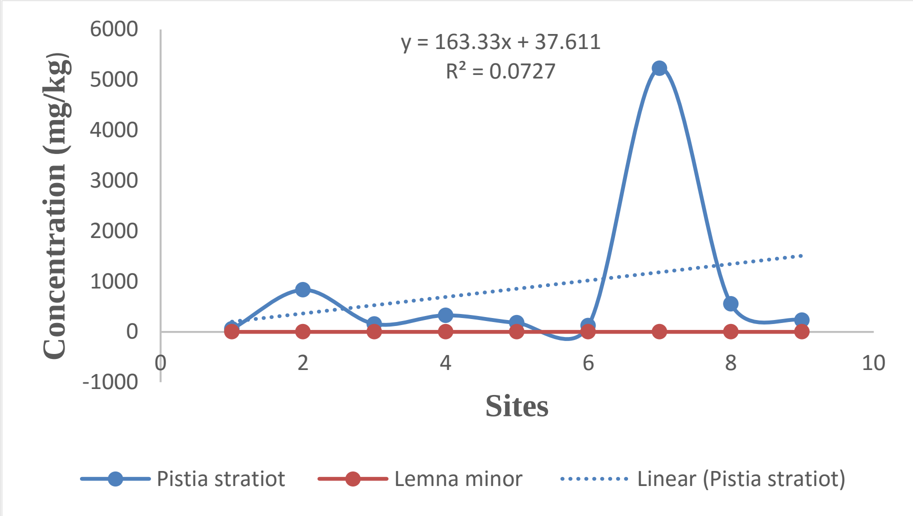

Figure 9: The aluminum values of different specimens of floating plants from the Matete river

Aluminum values are in the data range between 56.3 × 101 ± 53.1 and 5229.0 × 101 ± 583.8 mg / kg dry matter in samples of *Pistia stratiotes* and between 0.02 ± 0.00 mg / kg and 0.15 ± 0.06 mg / kg in *Lemna minor* ($p = 0.04994835 \leq 0.05$).

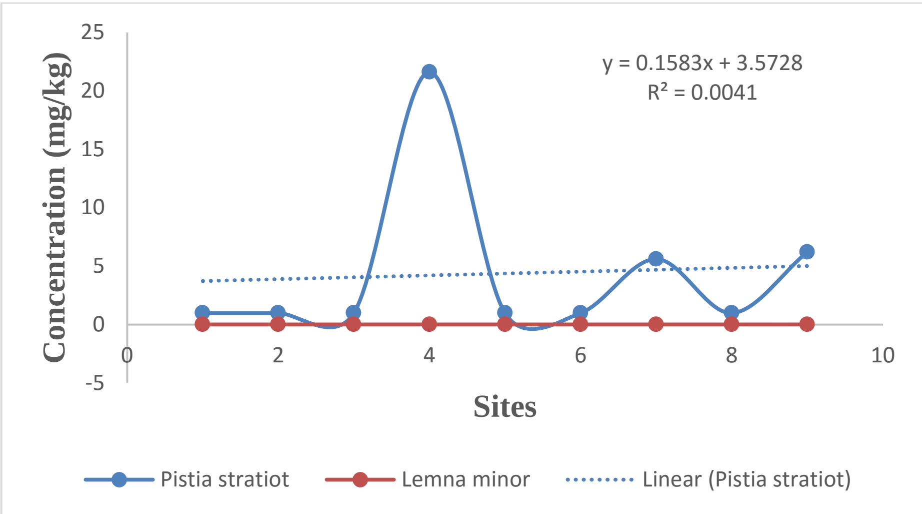

Figure 10: The chromium values of the different specimens of the floating plants of the Matete river

The chromium concentration in the different samples of *Pistia stratiotes* from the Matete river is between the values <1.0 ± <0.1 mg / kg and 21.6 ± 4.0 mg / kg of dry matter and around 0.001 ± 0.0001 and 0.003 ± 0.0002 mg / kg in *Lemna minor* ($p = 0.05824555 \leq 0.05$).

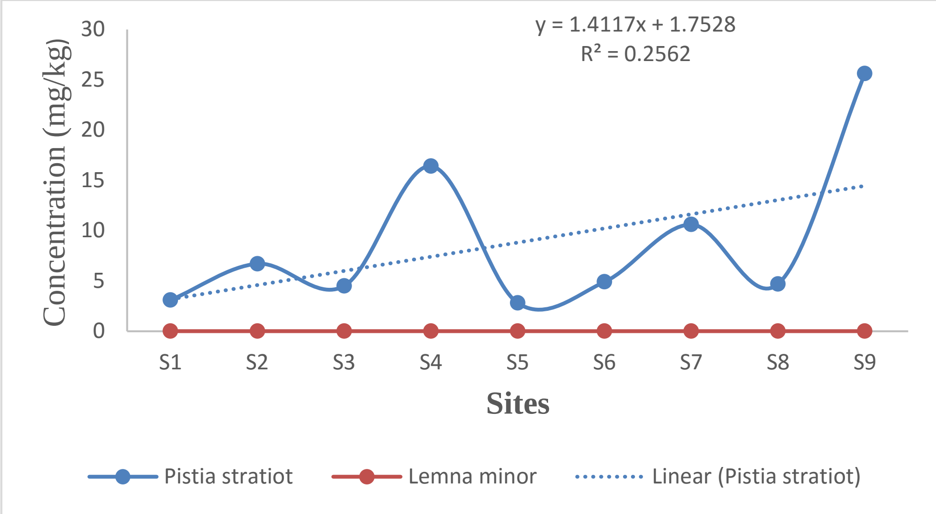

Figure 11: Cadmium values of different specimens of floating plants from the Matete river

The cadmium content in the specimens of *Pistia stratiotes* is around 2.8 ± 0.3 and 25.6 ± 0.4 mg / kg of dry matter on the other hand 0.0004 ± 0.00002 and 0.001 ± 0.00003 mg / kg of dry matter in *Lemna minor* (p = 4.1641 × 10-5 ≤ 0.05).

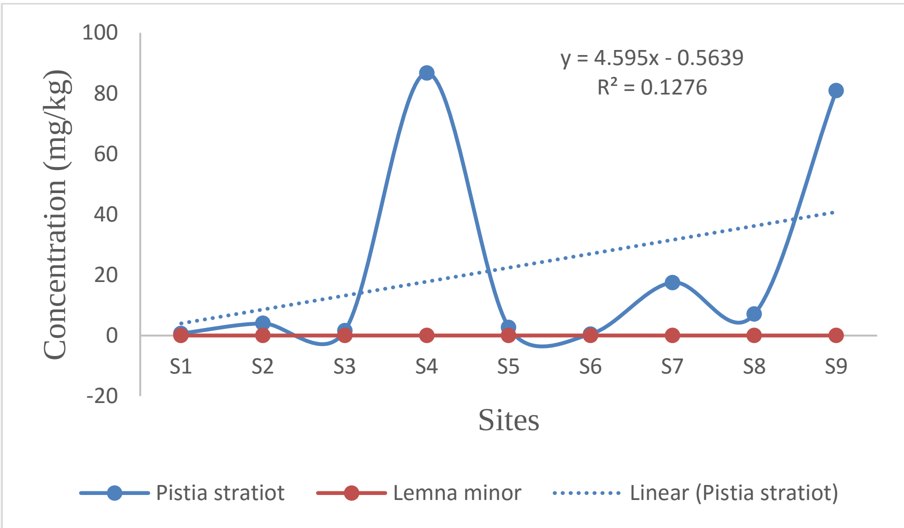

Figure 12: The lead values of the different specimens of the floating plants of the Matete river

The lead concentration is around 0.5 ± 0.4 and 86.7 ± 5.5 mg / kg of dry matter in *Pistia stratiotes* or water lettuce and between 0.001 ± 0.00 and 0.004 ± 0.0002 mg / kg of dry matter in *Lemna minor* (p = 0.05820634≤ 0.05).

3.2.1. Characterization of Oreochromis niloticus fish samples from the Matete River

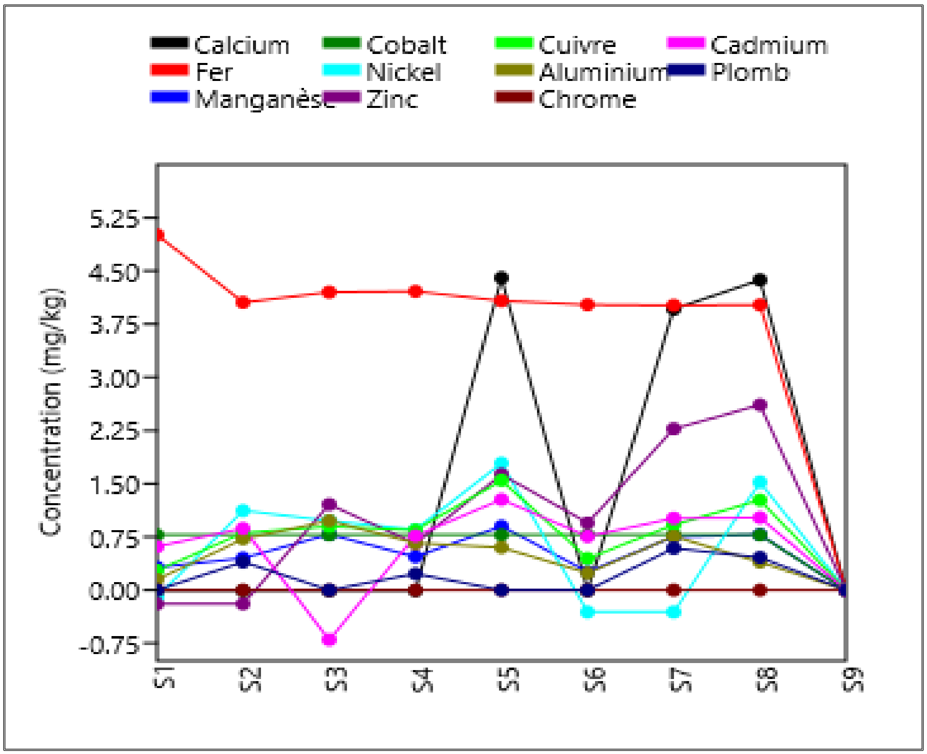

Figure 13: Characterization of samples of *Oreochromis niloticus* fish from the Matete river

Specimens of *Oreochromis niloticus* fish from the Matete River contain the elements and at concentrations in ranges around (p = 3.8441 × 10-9 ≤ 0.05):

- - Calcium: the values around the concentrations <0.1 × 102 ± 0.3 and 25220.0 × 101 ± 48094.1mg / kg of dry matter;
- - Iron: the concentrations are around 10350.7 × 101 ± 5131.7 and 102158.0 × 101 ± 27182.7 mg / kg of dry matter;
- - Manganese: the values oscillate between 1.815 × 101 ± 0.931 mg / kg and 7.945 × 101 ± 2.131 mg / kg of dry matter;
- - Cobalt: with the concentrations around the values <6.0 ± <0.0 mg / kg of dry matter;
- - Nickel: between the concentrations <0.501 ± <0.049 mg / kg and 61.503 ± 1.302 mg / kg of the dry matter;
- Zinc: the concentrations around values <0.736 ± 0.015 mg / kg and 42.923 × 101 ± 3.176 mg / kg of dry matter;
- - Copper: with the values around the concentrations 1.902 ± 0.007 mg / kg and 35.302 ± 0.247 mg / kg of the dry matter;
- - Aluminum: the values oscillate around the concentrations 1.414 × 103 ± 70.464 mg / kg and 9.493 × 103 ± 147.214 mg / kg of dry matter;
- - Chromium: values around the concentration <1.0001 ± <0.0408 and <1.0003 ± <0.0105 mg / kg of dry matter;
- - Cadmium: with the values around the concentrations 0.2002 ± 0.0718 mg / kg and 19.0001 ± 0.8981

mg / kg of the dry matter;

- - Lead: the concentrations oscillate around the data <1.0002 ± <0.0051 mg / kg and 3.9004 ± 0.0895 mg / kg of the dry matter.

3.2. Discussion

The manganese values in the different samples of *Pistia stratiotes* are in the range of 10.7 ± 1.1 and 236.4 × 101 ± 248.8 mg / kg of dry matter and around 5.10 ± 0.1 and 5.80 ± 0.3 mg / kg in *Lemna minor* specimens. Some values are above the quality criteria for the prevention of contamination of aquatic organisms [3]. set at 59 mg / kg. In particular, at S2 (123.7 mg / kg), S4 (935.0 mg / kg), S7 (236.4 × 101 mg / kg) and S8 (96.0 mg / kg) for specimens of *Pistia stratiotes*. On the other hand, the iron concentrations in the species *Pistia stratiotes* oscillate in the range of 187.5 × 101 ± 61.9 and 500.0 × 101 ± 0.1 mg / kg dry matter and between the concentration of 49, 9 × 101 ± 18.8 and 6784.0 × 101 ± 709.5 in *Lemna minor*. All these values are higher than the criteria for the prevention of contamination of aquatic organisms set at 1.3 mg / kg [3]. Under these conditions, iron and manganese would be responsible for the disruption of the prosthetic processes of this lake ecosystem and also toxic for its flora. These results are above those of [36]. who worked on "contribution to the study of the action of polluting agents on bioindicator plants" and to confirm that iron and manganese reveal their significant accumulation. by *Lemna minor*, and the mean and standard deviation values are respectively 9.02 ± 1.82 and 7.43 ± 1.58mmol / kg of dry matter. The potassium values in the species *Pistia stratiotes* L oscillate between 314.8 ± 12.1 and 119.0 × 103 ± 6981.1 mg / kg of dry matter and around 113.8 ± 4.4 and 2712, 0 × 101 ± 98.8 mg / kg of dry matter for *Lemna minor*. On the other hand, the concentrations of calcium in the species *Pistia stratiotes* L are in the range of values between <10 ± <0.3 and 252200 ± 1892.8 mg / kg and <10 ± <0.1 and 97830 ± 2073.9 mg / kg in *Lemna minor*. These results are due to the agricultural practices (leaching of its areas) carried out in certain sites along the river, to certain practices of local residents and the policy of discharging industrial wastewater without any pre-treatment upstream. These techniques could cause disruptions in the proper functioning of this ecosystem [30]. assert that potassium plays an important role in decreasing absorption processes of aluminum, manganese, nickel, cobalt, chromium, copper, zinc and lead on the one hand, and 'on the other hand, potassium in synergy with magnesium competes with calcium. On the other hand, the reduction in the content of these elements can have important consequences on the growth of the flora and also on the diet of the animal which consumes these plants [21], calcium is not a toxic element for the plant, even at high concentrations; it plays an important role in the regulation of ionic exchanges between roots and their environment. The cobalt content in *Pistia stratiotes* L and *Lemna minor* species is around <3.0 ± <0.2 mg / kg dry matter. The normative value set at 0.5 μg / L for the protection of algae, fish and invertebrates [17] is below the values found. Cobalt is important in the functioning of plants and its presence in this ecosystem is thought to be due to the occupation of the river dikes by wild dumps and to episodes of silting due to erosion in its surroundings. It is for this reason that [6] explain that cobalt is a trace element which would play a role vis-à-vis the symbiotic bacteria fixing nitrogen and whose excess could cause a decrease in chlorophylls and absorption of iron. Data for nickel concentration vary around <0.5 ± <0.1 and 20.6 ± 0.5 mg / kg in samples of *Pistia stratiotes* L and between 0.001 ± 0.00 and 0.004 ± 0.001 mg / kg of dry matter in *Lemna minor*. At these levels, the nickel is in the specimens of *Pistia stratiotes* L with concentrations higher than the criteria for the prevention of contamination of aquatic organisms set at 4.6 mg / kg, relatively in S3 (9.5 mg / kg) , S4 (20.6 mg / kg), S6

(12.3 mg / kg), S8 (16.1 mg / kg) and S9 (8.7 mg / kg). These values could negatively influence the growth of the flora of the Matete River and they affirm the results of [16] who exposed *Lemna minor* (vazdiviana) for three weeks to nickel concentrations ranging from 0.01 to 1.0 mg / l and found that 0.05 mg / 1 stimulated growth and that only concentrations greater than 0.1 mg / l inhibited growth compared to control plants. In addition, [33] found that 0.125 mg Ni / l inhibited the growth of Anabaena inequalis but that 10 mg / l was needed to inhibit photosynthesis and 20 mg / l to inhibit nitrogenase. While the zinc concentration in *Pistia stratiotes* L is between 1.9 ± 0.0 and 98.7 × 101 ± 0.0 mg / kg of dry matter and around 3.12 ± 0.17 and 4, 00 ± 0.82 mg / kg of dry matter in *Lemna minor*. At sites S2 (83.1 mg / kg), S3 (35.2 mg / kg), S4 (98.7 × 101 mg / kg), S5 (73.6 mg / kg), S6 (69.4 mg / kg), S7 (33.6 × 101 mg / kg) and S8 (33.3 × 101 mg / kg) specimens of *Pistia stratiotes* have zinc concentrations above the criteria for prevention of contamination of organisms aquatic values set at 26mg / kg of dry matter. However, zinc is said to be toxic to this species and could affect the processes of photosynthesis. Thus [10] shows that the accumulation of copper, zinc and other metals in aquatic mosses (fontinalis antipyretica) are inhibited by an increase in calcium in the medium. The copper content in the specimens of *Pistia stratiotes* L is around the values <0.5 ± <0.1 and 79.4 ± 1.2 mg / kg of dry matter on the other hand 0.001 ± 0.001 and 0.006 ± 0.004 mg / kg of dry matter in *Lemna minor*. Compared to the criteria for the prevention of contamination of aquatic organisms set at 38 mg / kg, the S4 site (79.4 mg / kg) of *Pistia stratiotes* has a concentration above this value. Naturally, *Pistia stratiotes* not only contributes to the decrease in light intensity for the underlying submerged species due to the increased reflection of incident rays and blocks the diffusion of oxygen from the air, causing conditions anaerobic that are directly detrimental to aquatic macrofauna and microfauna (decrease in specific richness, abundance and alteration of the invertebrate and fish community on invaded sites) but also to the acceleration of sedimentation of organic matter and increased evapotranspiration. At these values below or below the normative value, the effects of which are, among other things, to inhibit the processes of photosynthesis. These results confirm those of [18] who showed that the growth of green algae (Scenedesmus subspicatus, Chlamydomonas reinhardtii and Chlorella fusca) is inhibited. when the free copper (Cu2 +) content is greater than 6.3 µg / L. Toxicity varies among algal species, the most sensitive being cyanobacteria [22]. On the other hand [31] showed that the inhibition of the growth of 50% of individuals in 72 hours was effective for a copper content varying from 25.5 µg / L for Synechococcus leopoliensis (cyanobacteria) to 973 , 5 µg / L for Scenedesmus subspicatus (green algae) and 1212.7 µg / L for Chlorella kessleri (green algae) in a synthetic culture medium. Reference [18] also showed that the growth of green algae (Scenedesmus subspicatus, Chlamydomonas reinhardtii and Chlorella fusca) is inhibited when the free copper (Cu2 +) content is greater than 6.3 µg / L. Aluminum values are in the data range between 56.3 × 101 ± 53.1 and 5229.0 × 101 ± 583.8 mg / kg dry matter in samples of *Pistia stratiotes* and between 0.02 ± 0.00 mg / kg and 0.15 ± 0.06 mg / kg in *Lemna minor*. Reference [14] showed that for a pH close to neutrality (6.8) and for an aluminum concentration of the order of 100 to 200 µg / L, the growth of two phytoplankton species Monoraphidium griffithii and Monoraphidium dybowskii (Chlorophyceae) is very reduced whereas for a pH of 4.8 only the growth of Monoraphidium griffithii is affected. This shows that the polynuclear aluminum species can be as toxic as the monomeric forms in this pH range. On the other hand, the chromium concentration in the different samples of *Pistia stratiotes* from the Matete river is between the values <1.0 ± <0.1 mg / kg and 21.6 ± 4.0 mg / kg of the dry matter and around 0.001 ± 0.001 and 0.003 ± 0.002 mg / kg in *Lemna minor*. Only the concentration of chromium at the S4 site (21.6 mg / kg) of *Pistia stratiotes* is above the criteria set at 9.4 mg /

kg. While the cadmium content in specimens of *Pistia stratiotes* is around 2.8 ± 0.3 and 25.6 ± 0.4 mg / kg of dry matter on the other hand 0.0004 ± 0.0002 and 0.001 ± 0, 0003 mg / kg dry matter in *Lemna minor*. All cadmium values in the different specimens of *Pistia stratiotes*, in particular at S1 (3.1 mg / kg), S2 (6.7 mg / kg), S3 (4.5 mg / kg), S4 (16.4 mg / kg), S5 (2.8 mg / kg), S6 (4.9 mg / kg), S7 (10.6 mg / kg), S8 (4.7 mg / kg), and S9 (25, 6 mg / kg) are beyond the criteria set at 0.13 mg / kg. Reference [35] added that metals such as cadmium, copper or zinc are inhibitors of the incorporation of manganese into marine phytoplankton, probably by competition at membrane sites or by internals involved in manganese homeostasis. The toxic metal is also transported into the cell via the mechanism of manganese incorporation, especially at low concentrations. The lead concentration is around 0.5 ± 0.4 and 86.7 ± 5.5 mg / kg of dry matter in *Pistia stratiotes* or water lettuce and between 0.001 ± 0.00 and 0.004 ± 0.002 mg / kg of dry matter in *Lemna minor*. The amounts of lead at sites S2 (4.0 mg / kg), S3 (1.6 mg / kg), S4 (86.7 mg / kg), S5 (2.7 mg / kg), S7 (17, 5 mg / kg), S8 (7.1 mg / kg), and S9 (80.9 mg / kg) in *Pistia stratiotes* are greater than the normative value set at 0.19 mg / kg. Furthermore, Reference [7] showed that in plants, exposure to Pb leads to a strong inhibition of photosynthesis (by the decrease in chlorophyll and carotenoid contents, chlorophyll b seems more sensitive than chlorophyll a because in general , chlorophyll a is three times more abundant than b). In general, the response of aquatic plant species to large and / or low concentrations of metallic elements results in either an inhibition of photosynthetic processes, thus demonstrating the alteration of the various important biological pathways or by tolerance, which is undoubtedly due to the protective role of these plants. However, this ecosystem provides a low dissolved oxygen niche and a nutrient-poor and toxic diet for the species that live there. Iron concentrations in *Oreochromis niloticus* are around 10350.7 × 101 ± 5131.7 and 102158.0 × 101 ± 27182.7 mg / kg dry matter. These values are above the protection criteria set at 1.3 mg / kg. On the other hand, those of manganese oscillate around 1.815 × 101 ± 0.931 mg / kg and 7.945 × 101 ± 2.131 mg / kg of dry matter. The S3 (6.075 × 101 mg / kg), S5 (7.945 × 101 mg / kg) and S8 (6.035 × 101 mg / kg) sites have values beyond the criteria set at 59 mg / kg. The depth of this river allows *Oreochromis niloticus* to forage for food even in sediments. However, the buildup of high concentrations of iron and manganese in some specimens. This is what [12] have asserted that manganese deficiency will lead to skeletal and reproductive problems, while an excess of manganese can lead to effects on the structure and function of several cells and organs. . However, its vulnerability is observed vis-à-vis different predations. And [32] add that an iron deficiency can lead to anemia and a disruption of many metabolic functions, as well as a loss of resistance to predators (pathogens). On the other hand, the calcium values are around the concentrations <0.1 × 102 ± 0.3 and 25220.0 × 101 ± 48094.1mg / kg of dry matter. Calcium is a very important element for the skeletal structure of living organisms for the consolidation of the bones of *Oreochromis niloticus*. Cobalt concentrations are around <6.0 ± <0.0 mg / kg dry matter. They are higher than the standard used (0.1 mg / kg). Cobalt is an essential microelement which, when present in too high concentrations, can be toxic to living organisms. On the other hand, Reference [11] have shown that the presence of other metallic elements can interfere with the accumulation of cobalt by aquatic animals: the presence of zinc, for example, reduces the concentration factor of cobalt in a mollusk by 40%. While the nickel values oscillate around <0.501 ± <0.049 mg / kg and 61.503 ± 1.302 mg / kg of dry matter. Compared to the standard set at 4.6 mg / kg, the sites S2 (13.202mg / kg) S3 (9.504mg / kg) S4 (7.103mg / kg) S5 (61.503 mg / kg) S8 (33.301 mg / kg) have values above the normative criteria. Under these conditions, nickel has been shown to be very toxic to the fauna of the Matete River ecosystem in general and to *Oreochromis niloticus* in particular. In contrast, Reference [26] found in one study that nickel concentrations were 0.38 mg / l and below (0.18 and 0.08) had no negative effect on survival, growth and reproduction of the species. However, a nickel concentration of 0.73 mg / L had a statistically significant effect on the number of eggs per clutch and the hatching of these eggs, while it did not affect survival and growth. of the first generation of fish. Those of zinc are around <0.736 ± 0.015 mg / kg and 42.923 × 101 ± 3.176 mg / kg of dry matter. These data are beyond the protection criteria set at 26 mg / kg at S5 (42.923 × 101mg / kg), S7 (188.035 mg / kg) and S8 (407.245 mg / kg). Poor management of industrial wastewater is believed to be responsible for the exposure of aquatic organisms. On the other hand, the copper concentrations are between 1.902 ± 0.007 mg / kg and 35.302 ± 0.247 mg / kg of the dry matter. The copper results are below the normative value set at 38 mg / kg. Although these values are below the norm, fish are arguably the most affected organisms, after algae. The effect varies according to the environmental conditions (temperature, alkalinity, turbidity, additional toxicity, etc.) and according to the species, sex, stage of development, state of health, etc. [23] have shown that on invertebrates, toxicity is recognized to affect many species including molluscs and especially zooplankton. Copper is also very toxic to daphnia, which partly explains the rebound phenomenon observed after treatment with copper. The death or even the inhibition of zooplankton allows new generations of phytoplankton to proliferate without control [5]. Aluminum values in *Oreochromis niloticus* samples hover around 1.414 × 103 ± 70.464mg / kg and 9.493 × 103 ± 147.214 mg / kg dry matter. Thus [28] proposed a theory of the toxicity of aluminum to fish according to which acute toxicity can develop as soon as aluminum is introduced into the environment. This toxicity phenomenon is thought to be due to the polymerization of aluminum in the form of hydroxides on the gills, these polymerization reactions increasing with pH. This polymer causes a respiratory gene and then the death of fish. On the other hand, the Chromium values are around <1.0001 ± <0.0408 and <1.0003 ± <0.0105 mg / kg of dry matter. These data are in accordance with the guideline set at 9.4 mg / kg. The cadmium concentration in *Oreochromis niloticus* specimens from all sites is around 0.2002 ± 0.0718 mg / kg and 19.0001 ± 0.8981 mg / kg of dry matter. These values are higher than the set normative value 0.13 mg / kg. While those of Lead oscillate around <1.0002 ± <0.0051 mg / kg and 3.9004 ± 0.0895 mg / kg of dry matter. At this range, these data are above the standard cut at 0.19 mg / kg. These results corroborate those of [15] who worked on heavy metals (lead and cadmium) in the sediments of the lake city of Ganvie and the toxicological quality of water and fish, thus noting that the species Penaeus Kerathurus has accumulated the same lead content (29.52mg / kg) than Chysichthys Auratus; while Liza falcipinnis with its high content (31.7mg / kg), proves to be the species most accumulating lead and 2.03mg / kg of cadmium accumulation. Despite the presence of *Oreochromis niliticus* in the 8 sites upstream of the outlet, its absence in the Matete river estuary is a major indicator of pollution and chemical degradation of species' ecological habitats. On the other hand [4] shows that estuaries are considered to be ecosystems of high productivity. For [25], tropical estuaries mainly provide diverse habitats and nutrient inputs for the growth and development of many species of fish of marine, estuarine or freshwater origin. They thus constitute ecosystems particular for reproduction and for the growth of larvae and juveniles of many species of fish. Among the latter, many migrate and exploit the estuarine environment in the larval and / or juvenile stages and return to the sea in the adult stage for reproduction [2;1]. Under these conditions, the estuary of the Matete river, rich in chemical pollutants, constitutes a chemical barrier for ecological movements between its fauna and that of the N'djili river. Hence the presence of a single species of *Oreochromis niliticus* and its poor biologica diversity in fish. However, the Matete river is considered as a natural enclosure and / or happa whose fauna evolves in confinement. It is then that chronic exposure to metals in the environment, at sublethal concentrations, induces an alteration in the secretion of corticosteroids as well as an alteration in the ability to respond to other stressors such as predation or confinement [13]. The higher values in the rainy season are the result of urban leaching of wild dumps and septic tanks [25]. The aquatic ecosystem of the Matete River is commonly contaminated with metallic elements that are present in water and sediment. Iron (Fe), manganese (Mn), zinc (Zn) and copper (Cu) are essential trace elements for plants and their presence in the aquatic environment is a necessary condition for life. However, above a certain concentration, these elements become toxic. Other trace elements (lead, cadmium, nickel, etc.) have no apparent biological role and are toxic even at low concentrations. At the Matete river, these metals are accumulated by the species *Lemna minor*, *Pistia stratiotes* L and *Oreochromis niloticus* and magnified along the trophic chain which multiplies the impact of these pollutions. This is how their bioaccumulation is quite natural. This is what [8] reports that the bioaccumulation of metallic trace elements by flora and fauna is the result of the processes of absorption-assimilation, distribution, storage and excretion. However, [29] affirms that all living organisms have a property of being able to store in their system any substance that is little or not biodegradable, as a result, phenomena of biological amplification will appear in any contaminated ecosystem. Indeed, the organisms which have thus concentrated such or such toxic substance will serve as food for other animal species which will in turn accumulate them in their tissues. He in this way, a contamination of the entire food web of the ecosystem will occur step by step, initiated by the primary producers who pump the pollutants dispersed in the biotope, the phenomena of bioaccumulation occurring throughout the trophic chain.

4. Conclusion and perspectives

At the end of this work, the general objective of which was to assess the impact of the degrading toxicity of metallic trace elements on the flora and fauna of the Matete river in Kinshasa. To do this, the experimental and observation method supported by physico-chemical analyzes by X fluorescence were carried out at the central analysis laboratory of CGEA / CREN-K in order to determine the concentration of aluminum, cadmium, and lead, … In the various sludge samples. The samples were therefore measured by an X-ray fluorescence spectrometer, using the four secondary targets, namely successively Molybdenum (39.76KV voltage and 0.88mA current), Aluminum oxide (49.15 KV voltage and 0.7mA current), Cobalt (35.79KV current) and finally HOPG Crystal from Bragg (17.4KV voltage and 1.99mA current) from the palladium anode. In general, the presence of metallic elements in the ecosystem of the Matete river is one of the consequences of their dissolution in water, it is bioavailability, whose main targets are *Lemna minor*, *Pistia stratiotes* L, *Oreochromis niloticus* which accumulate them in their tissues and organs for lack of degradation. One of the serious causes of their persistence is their biomagnification in the food chain. This is why the response of *Pistia stratiotes*, water lettuce and *Lemna minor* from the nine sampling sites of the Matete river to large and / or low concentrations of metallic elements is reflected either by an inhibition of photosynthetic processes (antagonism and effect synergistic) and the instinct of certain species. However, this ecosystem offers an ecological niche low in dissolved oxygen and a nutrient-poor and toxic diet for the species that live there. In this regard, the flora of the Matete river accumulates the metallic elements in a significant way and according to the diversity of the environments and the size of the species. In conclusion, we affirm the hypothesis according to which the discharges into the Matete river of metallic trace elements coming mainly from industrial effluents directly or indirectly influence the phenomenon of bioaccumulation, degradation and growth of certain species of its flora and its fauna.

In view of the above, we recommend the following:

- pretreat and control industrial effluents before they are released into the receiving environment;

- apply the urban wastewater management policy to preserve the quality and balance of the receiving ecosystem;

- develop and protect the banks of the Matete river by living hedges and not by wild loads. Desire to protect this ecosystem against the erosion of its banks and finally to multiply the ecological niches of species.

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