Global Scientific JOURNALS

GSJ: Volume 7, Issue 3, March 2019, Online: ISSN 2320-9186
www.globalscientificjournal.com

ASSESSMENT (EVALUATION) OF THE TROPHIC STATUS OF OUIOUANE LAKE (MIDDLE ATLAS) -MOROCCO

Idrissi.Z[1], Benabid.M[2], Bouayad.K[1], Mansouri.I[1], Tlemcani.I[1], & El ghadraoui.L[1]

1. Laboratory of Functional Ecology and Environment, Faculty of Science and Technology Fez Sidi Mohamed Ben Abdellah University, B.P. 2202, Imouzzer Road, FEZ, MOROCCO

2. National Centre for Hydrobiology and (Fish Farming: Pisciculture) (CNHP) B.P.11 – Azrou

Abstract :

Eutrophication is the natural aging process of a lake. As the word suggests, eutrophication is characterized by a gradual enrichment of the lake with nutrients which are essential for the growth of algas and aquatic plants.
The purpose of this study is to analyze the quality of the lake's types of water in order to determine the trophic level of Ouiouane lake while following the spatiotemporal evolution of the physicochemical indicators that control the eutrophication of the lakes. This was during a spread period of 12 months (from January to December 2015). With my own sampling campaign.
During this study, Ouiouane Lake showed persistent water disturbances as its transparency is less than 2 m for a maximum depth of about 14 m. This water is poorly oxygenated, alkaline with a pH> 7. Its electrical conductivity varies between 611 and 778 µs / cm. Examination of the vertical profiles of the temperature shows that Ouiouane lake has stratification according to the period of time, when itwas under study. And the concentrations of the indicators of organic pollution (nitrogen and phosphorus compounds), allow to conclude that Ouiouane lake, which requires an emergency intervention to preserve this natural inheritance.is classified eutrophic for the year 2015.

Key words:Ouiouane lake, nitrogen, phosphorus, chlorophyll a, Eutrophic, transparency

Introduction :

The eutrophication of the types of water’s surface has become a major widespread environmental problem today and it comes from the Greek "eu" (= good) and "trophê" (= food), (MDDELCC, 2002a). It is characterized by a gradual enrichment of the lake with nutrients which are essential for the growth of algae and aquatic plants. There are several nutrients, but some are only available in limited quantities in the environment. In freshwater, phosphorus is generally the limiting nutrient that inhibits plant growth in lakes (Lévêque, 1996). An increased supply of nutrients allows a growth in overabundance of plants. These is a source of food for the lake’s fish and other organisms, which will see their populations grow

in turn. This massive production of the lake has the effect of greatly reducing dissolved oxygen levels in water. When all these organisms die, they are broken down by microorganisms, which consume a lot of oxygen during this process. This situation can cause the disappearance of some species, especially salmonid fish, and their replacement by other species with a greater tolerance to lack of oxygen. In addition to degrading the ecosystem, eutrophication results in reduced water quality (reduced transparency and poor taste due to the presence of algae) (Hade, 2003). Eutrophication occurs naturally over a very long period of time (thousands of years) but can also occur in an accelerated manner if a variety of human activities in the lake and its watershed result in nutrient inputs (MDDELCC). 2002a)

Morocco is the richest country in wetlands. There are currently around twenty permanent natural lakes, essentially divided between two mountain ranges Middle Atlas and the High Atlas [1] among which we state OUIOUANE lake. Because of the lake's proximity and accessibility, it is a frequently visited place and it becomes a space for various recreational activities (boating, fishing, ..). However, this ecosystem is not immune to threats of nature (eutrophication) and anthropogenic development and pollution. In addition, this ecosystem shelters a macrophytic flora, which is very abundant occupying a good part of its surface.

Materials and methods

Presentation of the site

Ouiouane lake is considered to be one of the most touristic spaces of the Middle Atlas, it is located in the rural municipality of El Hamamm, 68 km from Khénifra. It is a lake of artificial origin, fed by nearby sources, This is located at 1630m altitude and covers an area of 40 ha. It is rich in fish such as pike, perch, carp and roach. The latter is surrounded by vegetation composed of holm oaks, poplars, acacia, etc. Ouiouane Lake is shallow (14 meters), but the richness of its fauna and flora (aquatic and underwater) makes it a very attractive site.

Sampling and measurement of physicochemical parameters

The type of sampling

Sampling campaigns were conducted over a full year, with one campaign per month (January-December2015)
Sampling is done directly with polyethylene bottles prepared in advance and washed with water stations before each use. The measurement of some physicochemical parameters of water was made on the spot by portable devices, it is the dissolved oxygen measured by a type Orion oximeter model 3301, the potential hydrogen (ph) and temperature measured with a Ph-meter Orion type model 260 and finally the electrical conductivity measured by a conductivity meter type Orion, model 130.Water samples are taken back to the laboratory for the analysis of compounds nitrogen and phosphorus: orthophosphate, total phosphorus, nitrite, nitrate, ammonium, total nitrate analyzes are carried out by approved methods (RODIER, 1996)
Chlorophyll a concentrations are determined after extraction and spectrophotometric assay
The equations are used to calculate the concentrations which are proposed by the SCOR-UNESCO working group

Table 1: Measured parameters and methods used to carry out the analyses

settings	methods	descriptions
PH	PH meter	The pH measurement informs us about the acidity of water
Temperature	Thermometer	The temperature influences the other parameters (dissolved oxygen, conductivity, measuring the temperature over the entire depth of the lake indicates if layers of different temperatures are superimposed.
Conductivity	Conductivity	Conductivity is an indicator of dissolved substances in water
Dissolved oxygen	Oxymetre	Necessary for the respiration of the aquatic organisms, it informs us about the state of the lake's condition
Total nitrogen	415 nm colorimetric assay	Other nutrients naturally present in the soil and in precipitation. Like phosphorus, it is also found in wastewater treatment plant discharges and industrial discharges as a result of forestry activities.
Total phosphorus	Colorimetric determination at 800 nm	Nutrient naturally present in soil and soil organic matter. It can also come from wastewater treatment plant discharges, industrial discharges, forestry activities,
Chlorophyll a	.	Green pigment that is found in plants and algae and that allows them to perform photosynthesis2. It represents a measure of the amount of algas in water.
Transparency clearness	Secchi disk.	decreases with the increase in the amount of algae, but also with the increase of other suspended matter and the intensity of the color of water. In general, eutrophic (ie very productive) lakes have low transparency

Results and discussions

Temperature

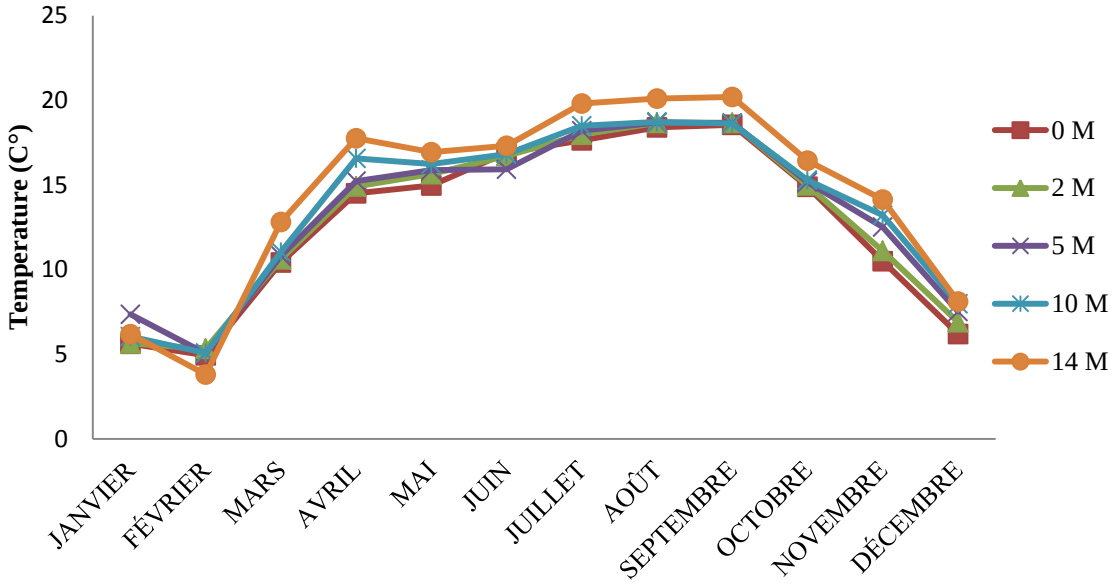

Figure 2: SPATIO-TEMPORAL VARIATION OF TEMPERATURE

Water temperature is a critical ecological factor, affecting many other parameters as well as chemical and biochemical reactions along with the development and growth of organisms living in water and especially microorganisms.
In the study area the lowest values mark the winter period with a minimum of 3.81 ° C in February 2015 for depth 14 meters while the maximum of 20.1 ° C is reported during the month of August 2015 for the same depth.These temperatures are favorable for the development of cyprinids
The statistical treatments of the results show that time has a highly significant effect on the temperature ($F = 313.56$, $ddl = 11$, $P \leq 0.001$). However, no difference was recorded at the depth level ($F = 0.43$, $ddl = 4$, $P \geq 0.05$).

PH

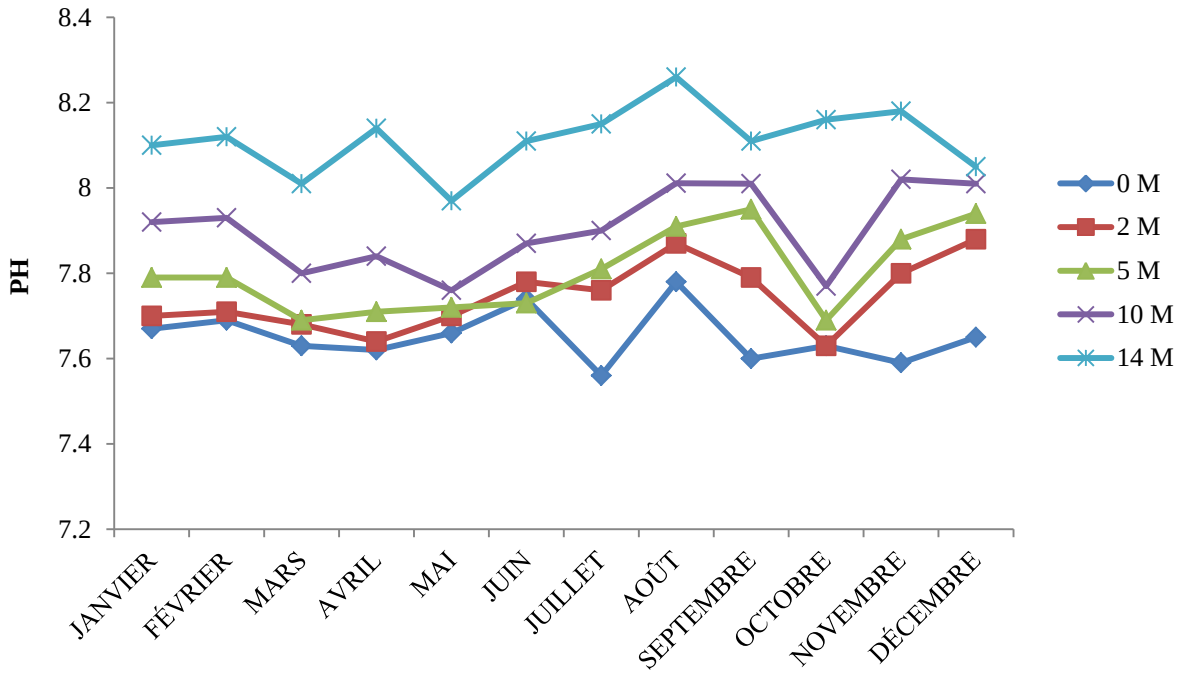

Figure 3: SPATIO-TEMPORAL VARIATION OF PH

In each natural environment, all types of water havetheir own pH value depending on the subsoil of theirwatershed:they are greater than seven in limestone regions where water is highly mineralized and less than seven in the primary subsoil region or acidic water from peat bogs. It decreases in the presence of high levels of organic matter and increases during low water periods, when evaporation is important (M.Meybeck et al 1996).

The hydrogen potential (PH) of Ouiouane lake's water is slightly alkaline. The average values are between 7.1 and 8.27. The minimum values are recorded during March, during which the weather conditions are not favorable for photosynthesis. maximum values are recorded during August following the intense use of carbon dioxide by aquatic plants by the phenomenon of photosynthesis

The pH variance analysis shows a highly significant difference between the different depths studied ($F = 36.39$, ddl = 4, $P \leq 0.001$) and a significant difference between the two months ($F = 1.007$, ddl = 11; $P \leq 0.05$).

Dissolved oxygen

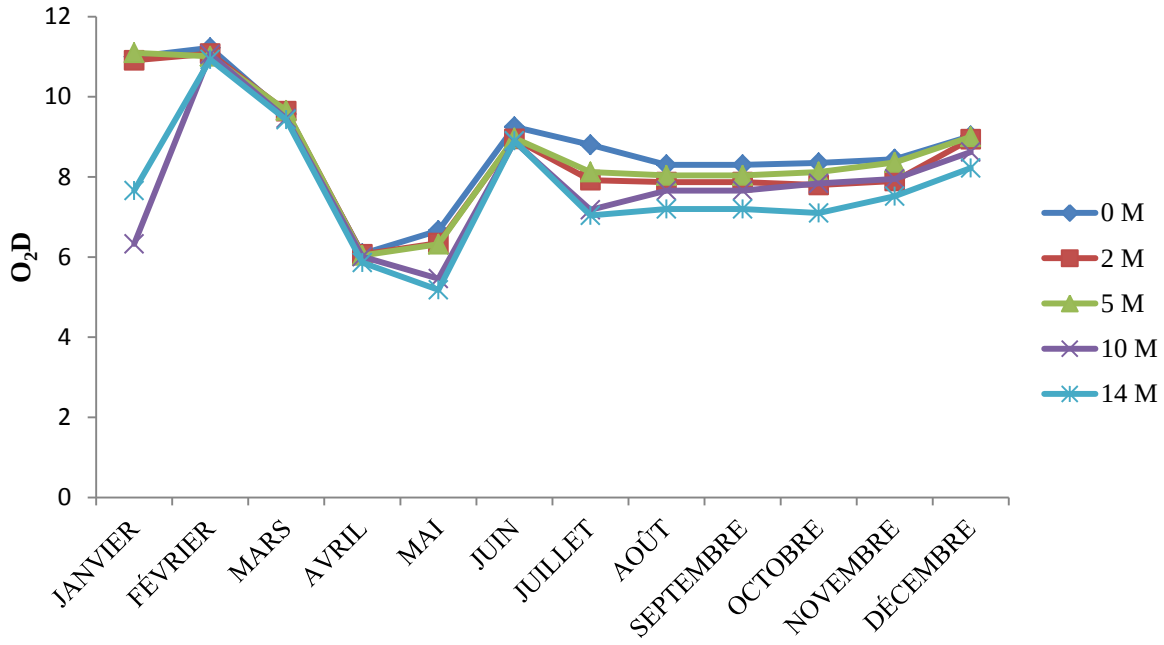

Figure 4: SPATIO-TEMPORAL VARIATION OF DISSOLVED OXYGEN

Oxygen is a key factor and an excellent indicator of water quality. Its value tells us about the degree of pollution and consequently the degree of self-purification of a watercourse. oxygen in water is related to several factors, in particular: temperature, atmospheric pressure, and saline. Dissolved oxygen function depends on the origin of water, and surface water may contain relatively deep qualities close to saturation. Deep water usually contains only a few milligrams per liter (Rodier 1944). A content of 4 to 6 mg of O 2 per liter is characteristic of good quality of water.

In our study, the seasonal evolution of dissolved oxygen shows higher concentrations in wet period than those in dry periods. This is mainly due to the decrease of the temperature of water because cold water contains a greater quantity of dissolved oxygen than hot water (Hebert and Légaré.2000). The statistical analysis of the results obtained for oxygen below shows a highly significant difference between the different months ($F = 38.509$, $ddl = 11$, $P \leq 0.001$). While, no difference was recorded between the different depths ($F = 2.33$, $ddl = 4$, $P > 0.05$).

Electrical conductivity

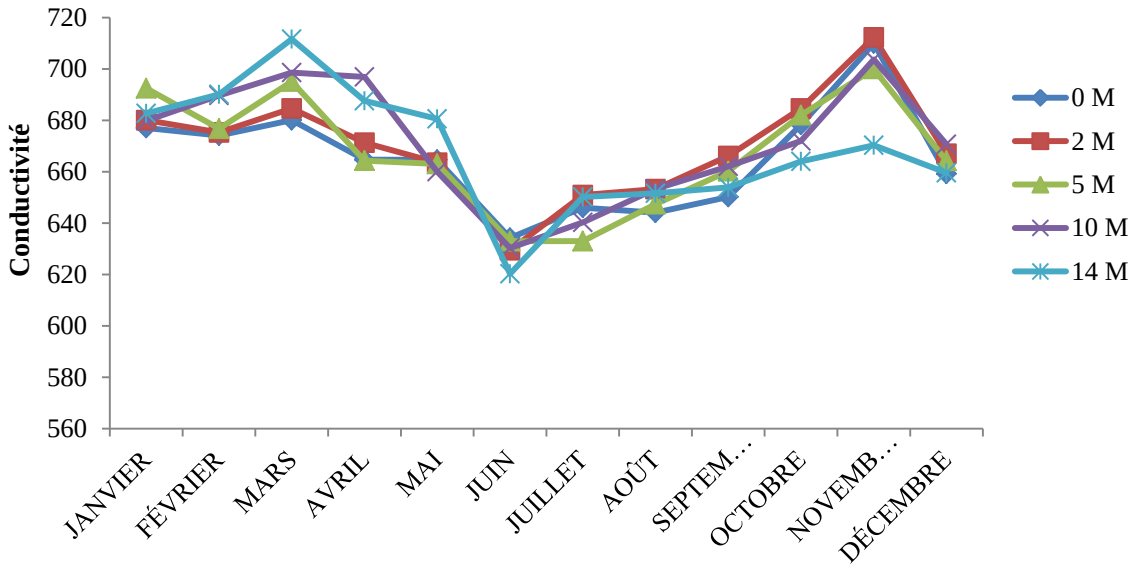

Figure 5: SPATIO-TEMPORAL VARIATION OF CONDUCTIVITY

Conductivity allows to evaluate overall mineralization and to estimate all of thesoluble salts in water, since most of the dissolved materials in water are in the form of electrically charged ions, conductivityfunction depends on the temperature of water: it is more important when the temperature increases.

The types of water of Ouiouane Lake are mineralized.

These results show that time has a significant effect on the conductivity. ($F = 0.01$, $ddl = 11$, $P \leq 0.001$). On the contrary, depth has no effect ($F = 1.17$, $ddl = 4$, $P > 0.05$).

THE TOTAL PHOSPHORUS

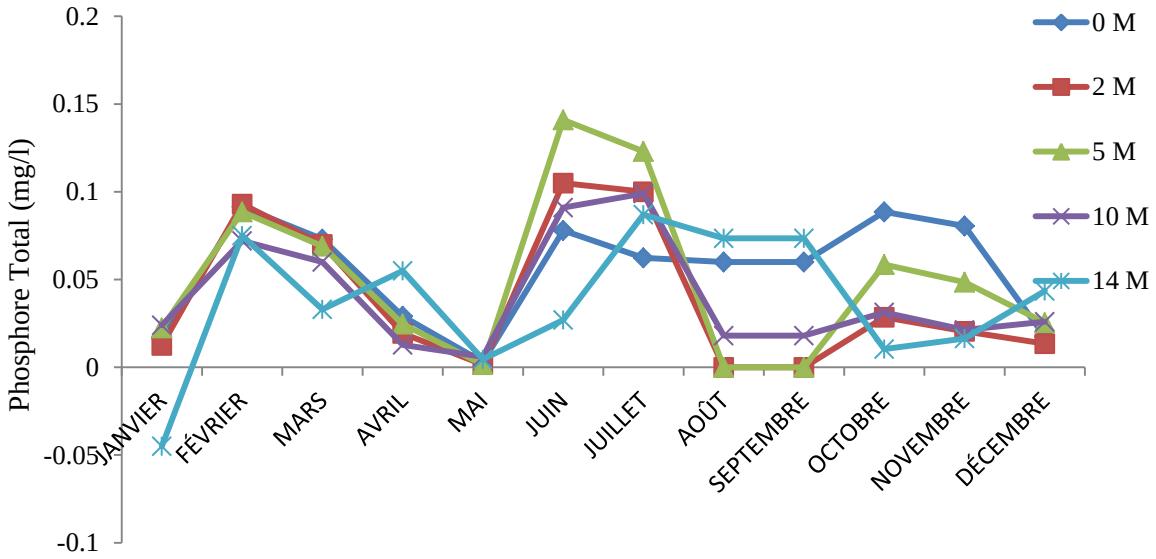

Figure 6: SPATIO-TEMPORAL VARIATION OF TOTAL PHOSPHORUS

It is an important parameter of the fertilization of waterbodies, it plays a big role in the planktonic growth. This nutrient is a relevant indicator of the trophic level of water.
Total phosphorus concentrations are zero at 14 m in January and reach 141 µg.l-1 at 5 m in June of the same year
Variance analysis for total phosphorus content revealed a highly significant effect for the time factor ($F = 3.74$, $ddl = 11$, $P \leq 0.001$). Nevertheless, the depth factor does not record any difference ($F = 0.89$, $ddl = 4$, $P > 0.05$).

Total nitrogen

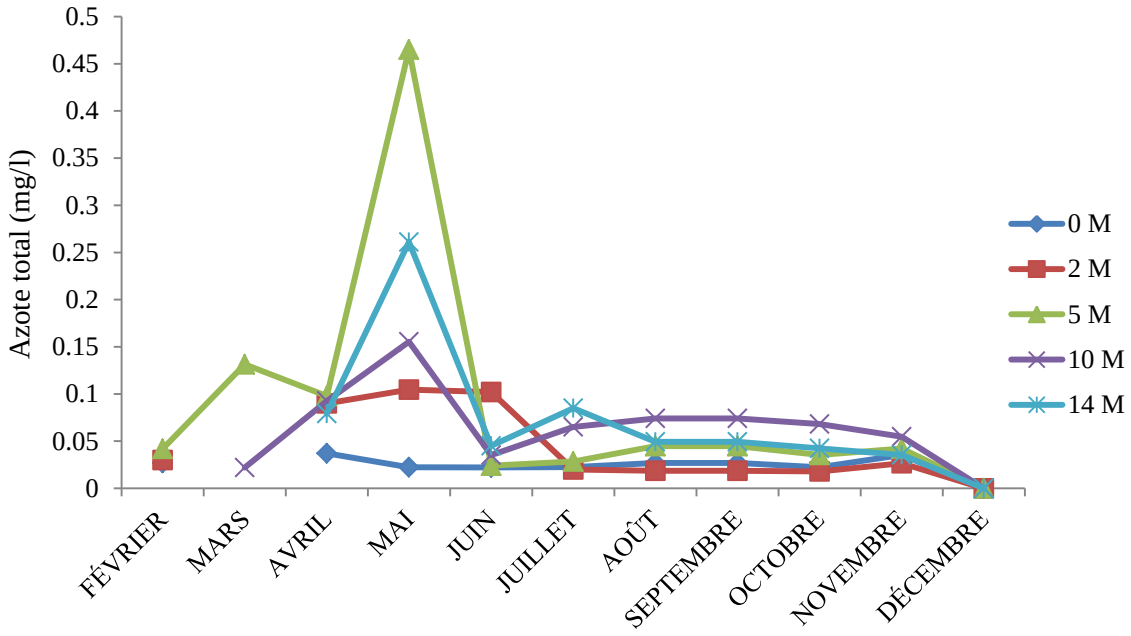

Figure 7: Spatio-temporal variation of total nitrogen in Ouiouane Lake

The spatio-temporal evolution of total nitrogen concentrations is relatively comparable to that described for nitrates. This probably reflects the predominance of nitrates in total nitrogen, the maximum values were measured in May in spring, while the lowest values were recorded in December (Figure 8). The effect of depth on the total nitrogen content is insignificant ($F = 1.84$, $dof = 4$, $P > 0.05$). On the other hand, highly significant differences were recorded between the different months ($F = 9.94$, $ddl = 11$, $P \leq 0.001$).

Transparency

The transparency of water was estimated by measuring the depth of disappearance of the Secchi disk, it is measured around solar noon. The transparency of water allows to roughly define the level of photic compensation

The depth of disappearance of the Secchi disk varies from 1m to 1.5m for all sampling campaigns.

Chlorophyll a

Chlorophyll a is extracted with acetone at 90%, and the assay is performed spectrophotometrically according to a protocol described by MILLERIOUX (1976).

The equations used for the calculation of concentrations are those proposed by the SCOR-UNESCO working group (1966):

Chl.a (mg / m3) = (v (11.64 OD663nm - 2.16 OD645nm - 0.10 OD630nm)) / L.V

The results of our study are as follows :

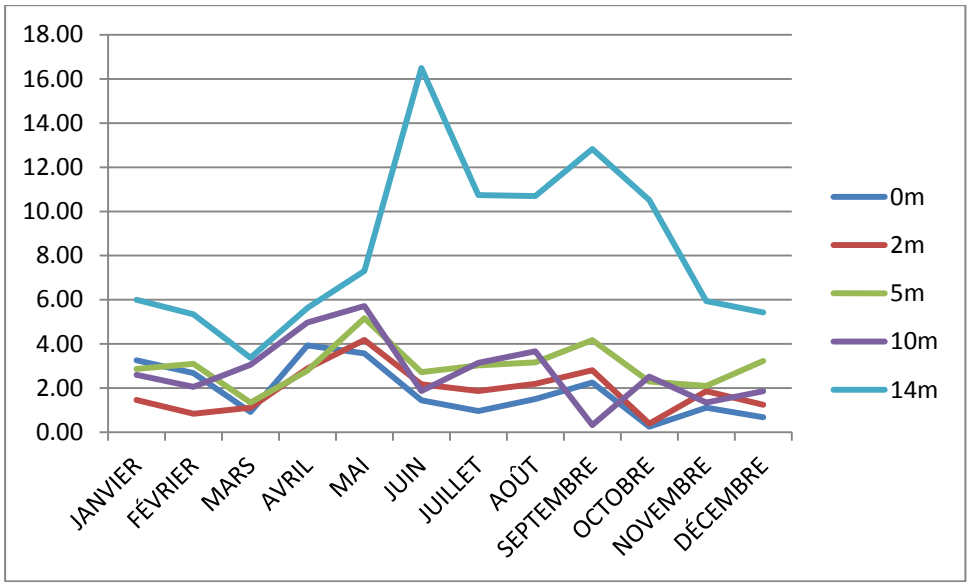

Figure 8: SPATIO-TEMPORAL VARIATION OF Chlorophyll a

We notice that chlorophyll concentration increases according to the depth that is based on the results obtained and Classes of trophic levels of lakes with the corresponding values of total phosphorus, chlorophyll a and water transparency[1] (MDDELCC, 2015b)we can deduce that Ouiouane lake is a eutrophic lake that tends towards hyper eutropia this is according to the following chart and diagram.

Trophic classes	Total phosphorus (ug/l)	Chlorophyll a (ug/l)	Transparency (m)
Main class Secondary class (transition)	Average	Average	Average
Ultra-oligotrophic	< 4	< 1	> 12
Oligotrophic	4,0 - 10	1,0 - 3	12,0 - 5
Oligo-mesotrophic	7,0 - 13	2,5 – 3,5	6,0 - 4
Mesotrophic	10,0 - 30	3,0 - 8	5,0 – 2,5
Meso-eutrophic	20,0 - 35	6,5 - 10	3,0 - 2
Eutrophic	30,0 -100	8,0 - 25	2,5 - 1
Hyper-eutrophic	> 100	> 25	< 1

Table 2: Classes of trophic levels of lakes with corresponding values of total phosphorus, chlorophyll a and water transparency1 (MDDELCC, 2015b)

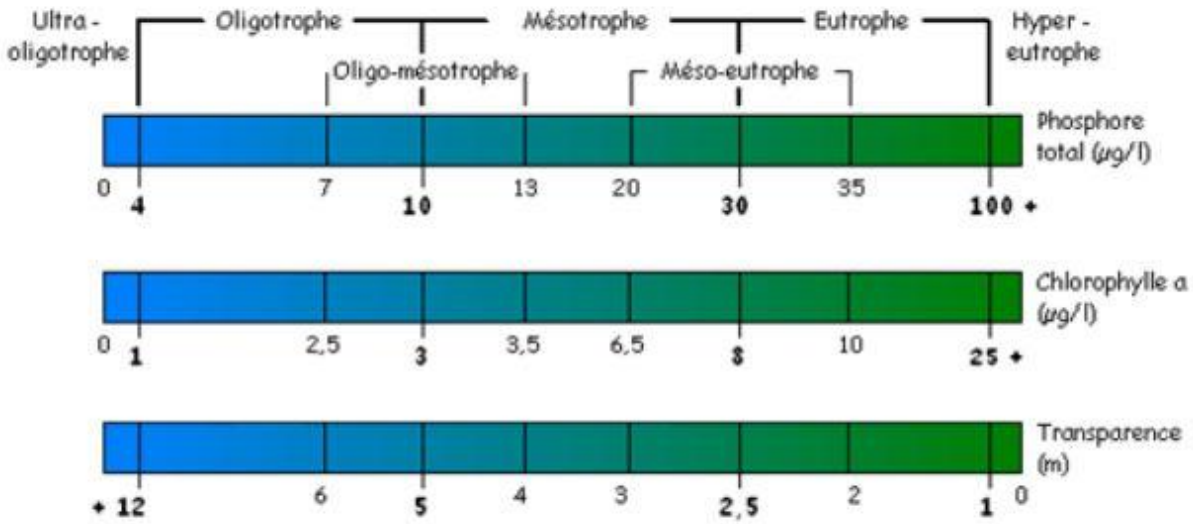

Figure 9:Ranking diagram of trophic level of lakes, MDDELCC 2015

Conclusion:

The diagnostic study of Ouiouane lake, which is the main source of water for the inhabitants of the region, aimed to characterize the trophic state of the lake. A follow-up of a full year (January 2015 to December 2015), including a sampling campaign per month, was carried out about the lake showed that the latter is classified eutrophic in 2015 according to the results obtained and the correlation with the Trophic level chart illustrates that it requires additional studies to tackle this situation.

Bibliography :

1) Chillasse L, Dakki M &Abbassi M. 1999. Les lacsnaturels du Moyen Atlas, Zone d'intérêt majeur pour la conservation de la biodiversité,Proceding of First International Conference on Biodiversity and Naturel Ressorces Preservation, School of Science Engineering, Al Akhawayn University, Ifrane Morocco, May 13-14.

2) Chillasse L, Dakki. M &Abbassi M 2001. Valeurs et Fonctions écologiques des zones humides duMoyen Atlas (Maroc). Humedales Mediterraneos, SEHUMED,Valencia (España), 139-146.

3) RODIER J.1984. L'analyse de l'eau : Eaux naturelles, eaux résiduaires, eauxde mer. Edition Dunod, Paris.

4) RODIER J., BAZIN C., BROUTIN J.P., CHAMBON P., CHAMPSAUR H.,RODI L. 1996. L'analyse de l'eau, 8ème édition, Edition Dunod, Paris,France.

5) MEYBECK M., KUUSISTO E., MAKELA A., MALKKI E. 1996. A pratical guide to the design and implementation of fresh water quality studies and monitoring programme, E & F.N. Spon, Water quality Monitoring. In : J.Bartram, R. Balance, London. 9-34.

6) Institut Bruxellois pour la Gestion de l'Environnement(IBGE) 2005 .Qualité physico-chimique et chimique des eaux de surface. Observatoire des Données de l'Environnement.

7) Bellaud. A. 1996. Oxygénation de l'eau en aquaculture intensive. Cépadues- Ed, Collection POLYTHEC, 207p.

8) HÉBERT S.et LÉGARÉ S. 2000. Suivi de la qualité des rivières et petits cours d'eau, Québec, Canada.

9) Schlumberger, O.2002. Mémento de pisciculture d'étang. 4e édition. CEMAGREF, 237p.

10) Trion,J-F.Et Berriane,M.2002.Maroc :Régions,pays,territoires.(Paris :Maisonneuve &larose)

11) MDDELCC, 2015, rapport annuel de gestion 2015-2016