LAGUNA DEL PLATA'S WATER QUALITY EVALUATION, CORDOBA, ARGENTINA

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Introduction

The study of saline lakes is usually considered an uncommon branch of limnology. The majority of continental saline lakes are found in endoreic areas that are subject to extreme climatic conditions, sometimes agravated by agricultural practices or other human activities. These practices occur for long periods of time, causing the ecosystem degradation by producing eutrophication of the waterbody (Martillo, 1978), and generally exist few studies on the matter before the lakes are affected. Consequently, it is difficult to describe the trophic state, the changes and other responses of these saline ecosystems to disturbances. In addition it has been observed that the complex physical chemistry of these lakes strongly affects the availability of nutrients; generating a different metabolic model in response to the changes in the trophic condition and/or the salinity.

The preservation and evaluation of the water quality are obligations of the modern society. The real process of the water quality evaluation is an appreciation of the physical-chemistry and biological nature of the water in relation to the natural quality, but also to the effects on man and to their uses; that is to say, the evaluation serves basically to verify if the observed quality is suitable for the use the water is meant (Chapman, 1992). For this reason, the follow-up is fundamental, and it is done by compilation of existing information and by obtaining new data in certain locations at regular intervals of time.

The Mar Chiquita Lagoon or Ansenuza's Sea, is the most important endoreic system of Argentine with an extension of approximately 6000 km^2. The hydrologic system constituted by the Mar Chiquita Lagoon and the Dulce River wetlands is the largest and most complex enclosed salty lake system of South America (Figure 1), it is also an area of a particular biological value declared a Multipurpose Reserve by the province of Cordoba. In the international plane, it has been named Site of Hemispheric Importance by the Western Hemisphere Shorebird Reserve Network (1993), it is Member of the Living Lakes Network (1997), and in 2002 it was declared "International Importance Wetland" by the RAMSAR convention due to its great ecological biodiversity. The Mar Chiquita Lagoon is located between 30º 20' S and 30º 57' S of latitude and from 62º 12' W to 63º 05' W of longitude (Agencia Córdoba Ambiente, 2004).

In the Southwestern zone of Mar Chiquita is found the Laguna del Plata, connected to it by a natural channel in dry periods, while in humid periods it becomes a bay. In 1970, the Laguna del Plata and the Mar Chiquita Lagoon, did not have any hydrologic connection and significant

Objective

To evaluate the water quality of the Laguna del Plata, considering the nutrients contribution that it receives from its tributary, the Primero/Suquía River, and the influence that the Mar Chiquita Lagoon has on it.

Study area

The study area is included by the lower section of the Primero/Suquía River and the Laguna del Plata, considered at the moment as a bay of the Mar Chiquita Lagoon (Figure 1).

The Suquia River, tributary of the Laguna del Plata, possesses a river basin of approximately 6,000 km2 and acquires its name when exits the San Roque dam. Its mean discharge is approximately 10 m^3/s. In its route, of approximately 200 km, it passes through many populations, among them the city of Cordoba, which spills to the river the effluents originated on the treatment plant of sewage liquids and also from a pluvial channel that receives the discharge of different industries. At the moment, the lagoon has an approximated surface of 27 km2, with a maximum depth of 4 m. and is joined to the Mar Chiquita Lagoon forming a bay that receives water from the Suquía River.

Methodology

The monitoring was designed after the analysis of satellite images, establishing seven monitoring sites, considering the morphology of the water body. The studied system is divided in three subsystems: the lower section of the Suquía river (RS1 and RS2), the Laguna del Plata (LP1, LP2, LP3 and LP4) and the Mar Chiquita Lagoon (LMC) (Figure 2). Monitorings were seasonal (spring, summer, autumn and winter), it was run a diagnosis and a follow up of the water quality through in situ analysis of several parameters in the water column and the extraction of samples for laboratory analysis. The measured physical chemistry parameters were majority ions; conductivity, salinity, total phosphorus (TP), soluble reactive phosphorus (SRP), material in suspension and turbidity; and the biological ones were chlorophyll-a and phytoplankton.

In all the monitoring sites, superficial samples were extracted and in sites LP2 and LP4 samples from 1 m. from the bottom were also collected, being all conserved suitably until their arrival to the laboratory. In site RS2 it was done, in addition, the gauging of the Suquía River. The cabinet work consisted on the preparation of a data base where was entered the data of the different campaigns. This allowed the analysis of the parameters to establish the system status, in relation to its quality.

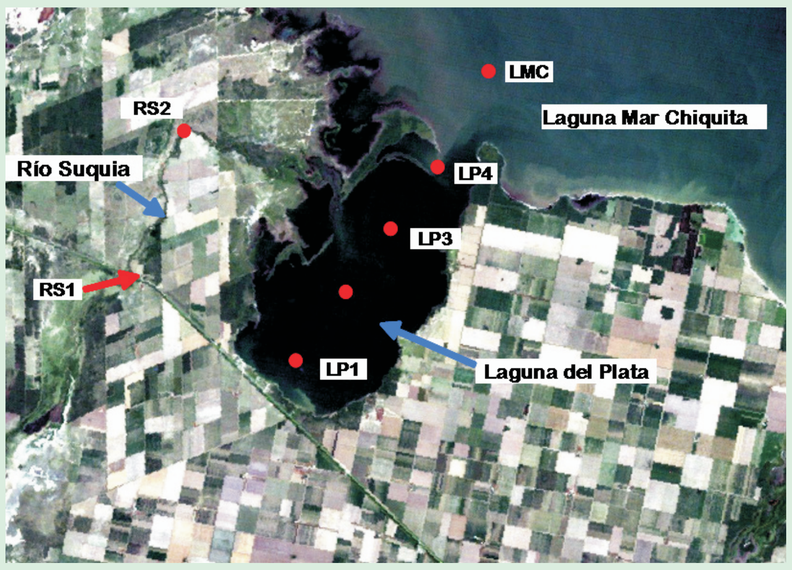

Figure2: Location of the monitoring points. Satellite image LANDSAT 7

Results and disscussion

The salinity values found in the extracted samples allowed to classify the lagoon as saline, according to what CONAMA establishes, since the values are above 30 g/L. In Figure 3 it is observed the homogenous space behavior and the temporary variation that this parameter showed. The salinity increase that took place in the period of study could be due to the reduction of the water volume on the lagoon produced by little precipitations, which is a typical situation at the winter time.

It was run the analysis for the ionic composition of the water samples, both from the Laguna del Plata and the one from the Mar Chiquita Lagoon, what let us classify the water as both chlorinated and sodic.

The value of pH stayed homogenous, in the different monitoring sites, registering values around 9.

The TP and SRP concentrations found in the Suquía River ranged from 1092 and 806 mg/L to 513 and 18 g/L, respectively. It was observed that most of the phosphorus that enters the Laguna del Plata does it as SRP (Figure 4).

The values, both of TP and SRP, registered in the water samples of the Laguna del Plata were considerably smaller to those from the river, with maximum values of 228 and 52 mg/L and minimums of 58 and 13 mg/L, respectively (Figures 5 and 6). In all the cases the phosphorus appeared mainly as TP. The decrease in the concentration could be due to the chemical properties of salty waters that by action of the pH and the calcium ion concentration, they would be favoring the precipitation of phosphorus as calcium phosphate.

Within the analyzed biological parameters, chlorophyll-a showed some space variability and an increase of its concentration in the last monitoring campaigns, especially in the sites located in the Laguna del Plata, not thus in the one located in the Mar Chiquita Lagoon (Figure 7).

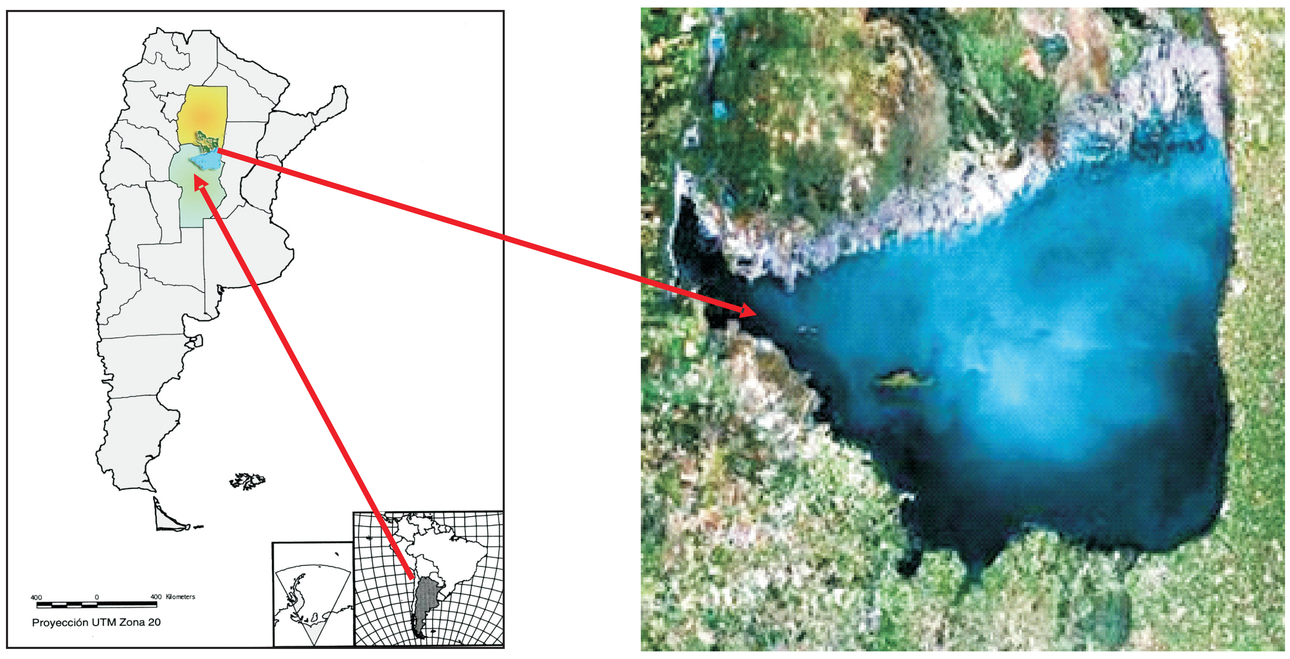

Figure 1: Location of the study zone

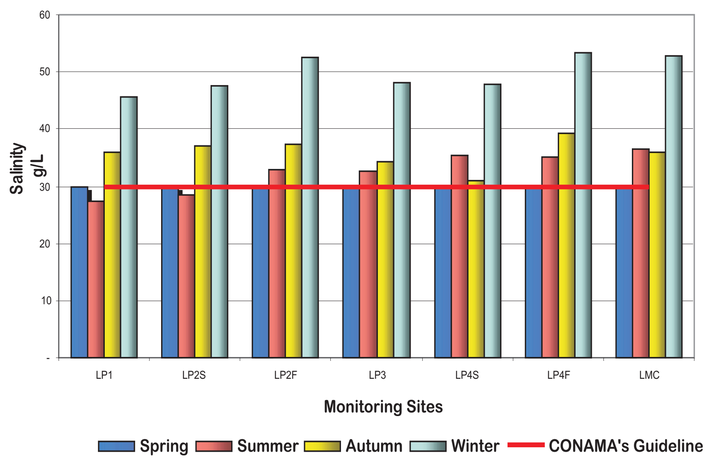

Figure 3: Space and temporary variation of the salinity in the lagoons

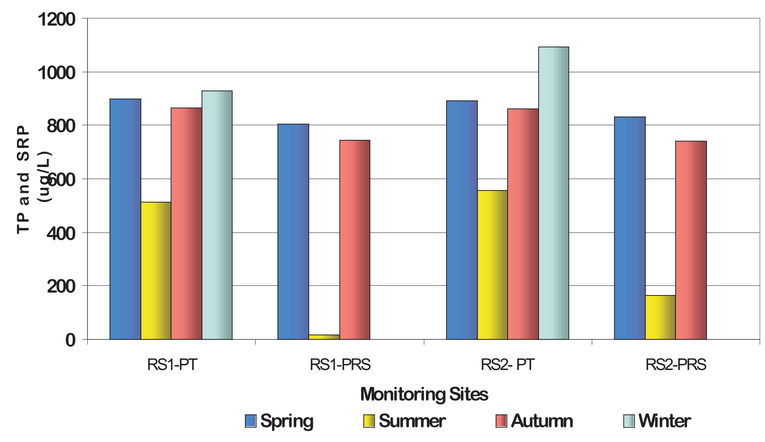

Figure 4: Variation of TP and SRP in sites of monitoring in the Suquía River

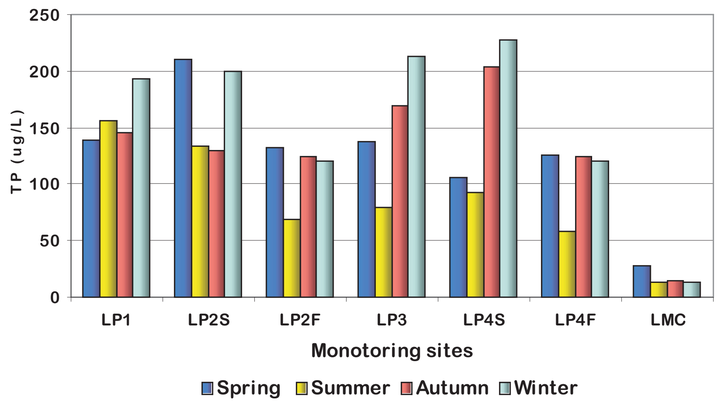

Figure 5: Concentration of TP in the lagoons

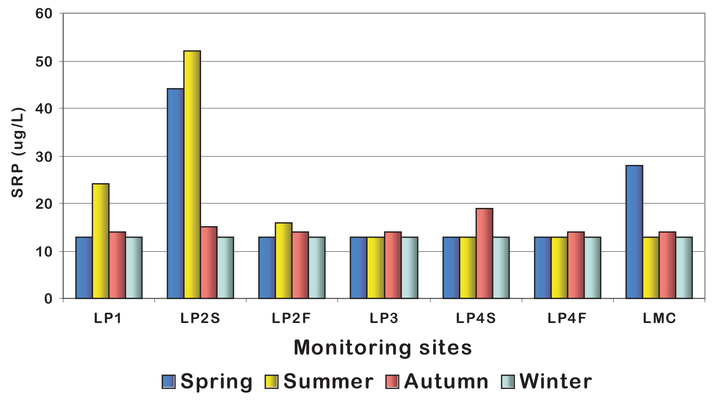

Figure 6: Concentration of SRP in the lagoons

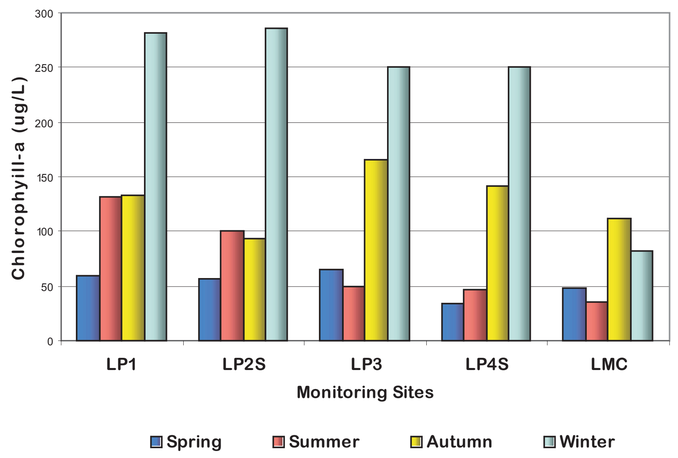

Figure 7: Space and temporary distribution of chlorophyll-a in the lagoons

Conclusions

The analysis of majority ions resulted interesting for the chemical characterization of the the Laguna del Plata's water, through this analysis it can be classified like saline, and we found that chloride and sodium were the majority ions. .

The phosphorus contributions that enter by the Suquía River are important, lowering considerably their concentration in the lagoon. This remarkable reduction on the concentration could be due to the chemical properties of salty waters that by action of the pH and the ion concentration, would be favoring the precipitation of phosphorus as calcium phosphate. This allows us to suppose that most part of the phosphorus that enters the lagoon would sediment on it.

Certain variability was observed when evaluating the space and temporary distribution of TP, SRP and chlorophyll-a. It was demonstrated an increase in the concentrations of the TP and of chlorophyll-a, which makes us suppose that pat of the TP would come from the phytoplankton present in the water.

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