Living Lakes: Azuei and Enriquillo by Andreas Schubert

Written in 2003, actualized in 2015

Lago Enriquillo

In 2003 the two lakes Azuéi and Enriquillo entered the worldwide Living Lakes partnership, being represented by the binational environmental program PMT, between Dominican and Haitian governments, financed by the European Union. When PMT stopped functioning later on, the lakes' were no more part of the partnership and the available information on the living lake homepage was withdrawn. In order to rescue this information it is presented here in an actualized form.

Remnants of a turbulent past. Modern Hispaniola was formed some ten million years ago, when two "paleo-islands" collided. The southern paleo-island evolved near present Yucatan and moved along the fault line between the Caribbean and North American plate. The collision caused the formation of two over 2,000 m high mountain ranges and a marine channel in between. During glaciation periods the marine channel fell dry, due to descending water levels. About 18,000 years the sea level was 100 m below the current level, due to the great quantity of frozen waters (ice) in the poles. However, the depressions of the ancient marine channel were still covered with water: there were a number of lakes with different sizes and water conditions.

When the planet started to warm up again, the ice melted and the level of the oceans rose again. About 6,000 years ago the sea had gone up so much that sea water flushed into what is today Neiba Valley, forming a bay 85 km long and more than 15 km wide. This bay did not cover the western part of the ancient marine channel. Its westernmost shores got to Jimaní and Tierra Nueva.

The Haitian part of the valley was not submerged, since it is higher than the valley of the Lago Enriquillo. The bay existed for a period of more or less 1,200 years. Then the river Río Yaque del Sur, which drained right at the mouth of the bay, deposited so much silt from the mountains that the mouth was closed, turning the bay into a landlocked body of water.

Apparently, most of the water from Río Yaque del Sur kept flushing into the newly formed lake. Thus, water conditions turned from seawater to brackish and later on to freshwater. The lake level was well above sea level. When Columbus and the first Spanish historians arrived 500 years ago, they described a very large lake, called Hagueibon by the Taino Indians. In this period the lakes Azuei and Enriquillo had joined in the area of present day Jimani. This means that the lake level had to be around 15 m asl. The historians mentioned manatees and dolphins dwelling in this lake.

Since Columbus the lake level has dropped considerably. There are two lakes again: Lac Azuéi or Etang Saumatre on the Haitian side and Lago Enriquillo on the Dominican side. Lago Enriquillo´s surface went down from 15 m above to 45 m below sea level (60 m difference) within half a millennium. In the 1950s the dictator Trujillo ordered to build irrigation canals that drain water from Yaque del Sur toward Lago Enriquillo. Within a short time the lake level rose.

Besides Azuéi and Enriquillo there are other bodies of water in the ancient marine channel: Trou Caiman, 10 km west of Lac Azuéi and connected with the latter by a small canal and a shared floodplain. Laguna del Rincón, 40 km east of Lago Enriquillo is the largest freshwater lake in the Dominican Republic. It is connected to the Río Yaque del Sur system. Part of its waters drain into Lago Enriquillo through the manmade Canal Cristobal. At least two more water bodies existed on the Dominican side: Laguna del Medio and Laguna de Limón. Both dried out in the 1920s, probably due to deforestation processes.

Azuéi and Enriquillo, twins that don´t look alike. They are located in the same area, they have the same origin, but they are very different. Looking down from the nearby mountains you can tell the difference. Azuéi is blue like the sea, Enriquillo has a white - grayish color. If you have a closer look, you realize that Azuéi has a stable shoreline. Changes in the lake level and surface (112 km²), as well as in salinity (11 ppt) are minimum. Lago Enriquillo is all the opposite. Lake level can go down about a meter within just a year in times of low precipitation and can rise a meter within less than a month after a major hurricane. Salinity was at 36 ppt in 1983, 20 years later, in 2003 it reached almost 110 ppt. Lago Enriquillo lake surface changed from 280 km² in 1968 to 165 km² in 2004.

Since 2005 both lakes were rising. Lago Enriquillo rose about 10 m within less than 10 years. Its surface more than doubled from 165 to about 350 km² in 2012. This means that its volume went up from about 500 million m^3 to 4000 million m^3. This rise was caused by a series of hurricanes and tropical storms that passed through the area since 2006. The evaporation of both lakes is 2500 mm per year, which means, Lago Enriquillo loses between 314 (2005) and 633 million m^3 (2009) of water per year. Lac Azuéi has a calculated net evaporation of 197 to 228 million m^3. Here the lake level rose from 116 to 135 km^2.

The rise of both lakes caused a considerable impact in the human communities around the two lakes. At Boca de Cachón a village with more than 500 families had to be relocated, when Lago

Enriquillo started to flood the original village. New roads had to be built in several parts of the lake. The Dominican – Haitian border crossing was heavily affected by the rise of Lac Azuéi. A great number of farmers lost their farm lands and pastures all around the two lakes. Many of them were forced to migrate.

This great difference between the two lakes is hard to understand. Actually Lago Enriquillo should be more stable, should be larger and have a lower salinity than Lac Azuéi. Enriquillo´s watershed is three times larger than Azuéi´s. It is covered by relatively dense forests in its upper reaches with important rainfall and horizontal precipitation (capture of humidity from fog in the cloud forests) and is connected to the Río Yaque del Sur system. The majority of Lac Azuéi´s watershed is deforested, in some areas to an extreme degree. No important permanent rivers drain into the lake. On the other hand the climatic conditions with high temperatures and low rainfall (500 to 1,000 mm per year) as well as the geological set up are similar in both lakes.

Sanctuaries for fauna and flora. Both, Lago Enriquillo and Lac Azuei are of great importance for the Dominican Republic and Haiti on one side, but also on a Caribbean and global scale. Their waters and surrounding land offer habitat to several species that are considered local endemics, including invertebrates, fishes and reptiles. The high rate of endemism is caused by the union of the paleo-islands and their respective flora and fauna. Important changes in climatic and hydrological regimes are believed to be responsible for the endemism in aquatic organisms. Dry forest is the typical vegetation in the lowlands surrounding the lakes. Much of this forest has been heavily altered or destroyed by charcoal burning. Especially on the Haitian side only matorrales (bushes) and man-made savannahs are left. There are ten species of dry forest plants endemic to the island of Hispaniola. They include trees, bushes and cacti: caguey (*Neoabbottia paniculata*), melon espinoso, (*Melocactus lemairei*), palo blanco (*Croton poitaei*), pitahaya (*Harrisia nashii*), oreganillo (*Lantana cifferiana*). Lago Enriquillo has no vascular plants living in it, while Lac Azuéi has mattresses of halophytic algae growing on its lake floor, especially in shallow areas. Extensive cattail stands (*Typhus domingensis*) are spreading where freshwater streams and canals enter the lakes. Flat areas with high soil salinity are dominated by halophyte plants. Along part of the shorelines buttonwood mangroves (*Conocarpus erectus*) grow. Along Lac Azuéi most of them have been turned into charcoal.

More than 50 species of animals reported to the area of the lakes are Hispaniola endemics. Some of the crustaceans, fishes and reptiles are endemic to the lakes and their surroundings. The endemics include the invertebrates jaiva (*Epilobocera haytensis*) and uca (*Uca bergersii*), the fishes *Cyprinodon bondi*, *Limia perugiae*, *Limia tridens, Limia melanonotata, Gambusia hispaniolae, Gambusia dominicensis, Cichlasoma haitiensis*, all Hispaniola endemic. In the fresh waters of the spring fed stream of La Zurza to the south of the lake scientists have found the fish *Limia sulphurophila*, a species endemic to Lago Enriquillo.

Concerning the reptiles the iguanas *Cyclura ricordi*, endemic to Lago Enriquillo and Peninsula of Barahona, *Cyclura cornuta*, endemic to Hispaniola, are outstanding species. There are also 25 species of other lizards, all endemic to Hispaniola, including the two geckos *Sphaerodactylus cryphius* and *S. rhabdotus*, which are both endemic to the region of the two lakes. Some 13 species

of snakes have been reported for the region of the lakes, among them the racer *Alsophis anomalus*, the largest species on Hispaniola, it is endemic and very rare. The freshwater turtle *Trachemys decorata* is endemic to southern Hispaniola.

The American crocodile (*Crocodylus acutus*) lived along almost all the coasts of Hispaniola. Today Lago Enriquillo and Lac Azuéi are probably the only places, where it has survived. The American crocodile is a species that lives in coastal areas, in brackish water. Lago Enriquillo is probably the saltiest body of water in which the presence of this species has been reported. In 1984 more than 400 crocodiles were estimated for Lac Azuéi. However, severe hunting and poaching has probably brought this population to extinction.

In Lago Enriquillo the crocodiles build their nests on sandy beaches, mainly during the month of February. The incubation takes about 85 days. The average number of eggs per nest is 22. The quantity of nests changes a lot between the years, in 1996 and in 2003 there were 51 nests on the beaches of the lake, in 1995 only 14. After hatching the mothers take the small crocodiles to places with fresh water. Here the crocodiles spend their first year, hidden in the cattail areas and in the aquatic vegetation of the streams. Later they can be found in the banks of the lake, where the fresh water of the streams mixes with the salty water of the lake.

Lago Enriquillo and Lac Azuéi as well as their adjacent waters offer a good habitat for many species of aquatic birds. The flamingo (*Phoenicopterus ruber*) is frequent near the lake shores, where it feeds on small organisms of the lake floor. In the Bay of Boca de Cachón sometimes flocks of more than 1000 individuals can be seen. From a distance the flamingo can be confused with the roseate spoonbill (*Ajaia ajaja*), another rosy bird that is abundant in shallow waters of the lakeshore. Other aquatic birds are the herons and egrets. In the lake there are many different species including the green heron (*Butorides striatus*), the blue heron (*Egretta caerulea*), the reddish heron (*Dichromanassa rufenscens*), the great egret (*Ardea alba*), the snowy egret (*Egretta thula*) and the tri-colored heron (*Hydranassa tricolor*). On the sandy beaches of the lakes different species of sandpipers and stilts (*Himantopus mexicanus*) are very common; some of them nest on the same beaches.

In the dry forests and the cultivations around the lake many species of terrestrial birds are present. Here we find the day-active burrowing owl (*Athene cunicularia*), the smallest owl on Hispaniola. The most notorious bird in the Isla Cabritos is the palm crow (*Corvus palmarum*). It´s populations has decreased a lot, product of a strong human persecution for false beliefs. Very frequent are the black whiskered vireo (*Vireo altiloquus*), the village weaver (*Ploceus cucullatus*) and the green swallow (*Kalochelidon euchrysea*). In the bushes of the dry forest lives the tody (*Todus subulatus*).

Threats to the lakes. Deforestation and soil erosion in the nearby mountains seem to have little effect on Lac Azuéi. The lake level remains relatively stable. On the other, urban growth in Fonds Parisien at the southern shore causes increased levels of eutrophication, visible through increased growth of algae. At Lago Enriquillo this problem is not as obvious, since all surrounding communities are more than three kms away from the lake shore and domestic and agricultural waste water is filtered by cattails and other vegetation. Solid waste is a great problem for both

lakes. The heavy afternoon winds blow plastics into the lakes. The communities don´t have a functioning waste management. Garbage is dumped mainly into dry river beds and during rainy periods washed into the lakes.

Lago Enriquillo level and water conditions depend heavily on Río Yaque del Sur. The majority of the Yaque water is diverted towards the Azua coastal plain, where it is used for irrigation. Many times the canals that drain Yaque water toward Lago Enriquillo are filled with sediment. In years with low rainfall Lago Enriquillo water level drops within a short time, exposing large areas of its lake bed. The always abundant winds pick up the dust and carry it far into Haiti. The diversion of irrigation water from Yaque del Sur is putting in threat the mere existence of the lake. During the last 20 years the lake has lost about two thirds of its volume.

Lac Azuei is a Nature Reserve, which only exists on paper. There are neither personnel nor infrastructure. Important populations, like the crocodiles might be extinct here, due to heavy poaching and a total lack of law enforcement.

Conservation Efforts. Lately the two countries Haiti and the Dominican Republic as well as the outside world have become aware of the importance of these water bodies and their catchment areas. Lago Enriquillo has become the first Dominican Ramsar Site and comprises one of the cores of ENRIQUILLO - BAHORUCO - JARAGUA Biosphere Reserve. Lago Enriquillo is a national park since 1996. A body of 20 park rangers surveys the lake and its shores on a regular base. Throughout the 1990s a conservation program carried out by institutions of Dominican Government saved the crocodiles from extinction and helped to maintain the lake habitat. Since 2013 Lac Azuéi forms part of the Haitian biosphere reserve “La Selle”. Both lakes were declared a Crocodile Conservation Unit due to their great importance worldwide for the protection of the American crocodile.

Sail boats on Lac Azuéi