The Hot Zone

Of Local Interest

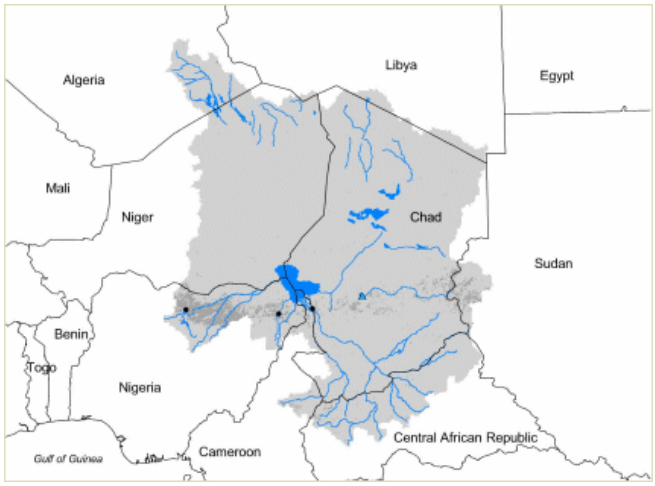
Lac Tchad

Text by J. Serpa

If you look closely at any map, you will see that Elephant Rock is right on the margin of Lake Chad. As a matter of fact, on your way there, if you had a GPS and were plotting your route as you went along, you would see that according to the map, in the last 10 km or so you would be driving through the lake! Now those of us who went there last month can tell you that Lake Chad is something that you do not see on a trip to Elephant Rock. Not on the way there, not around the Rock, not even from the top of the Rock! Mapping errors? To fully understand what is happening, we need to learn a bit about Lake Chad itself, about its drainage basin, and about what has been happening there.

Lake Chad & Its Drainage Basin

Lake Chad is the terminal reservoir of a complex, landlocked hydrological system that drains a total surface area of app. 2.5 million km^2 (what geographers refer to as a drainage basin, also known as, in more popular terms, a watershed.) This surface area represents an estimated 8% of the total land area of Africa (or roughly a quarter of the total land area of the 48 contiguous states of the US); is politically divided among 8 countries (Chad, Niger, CAR, Nigeria, Algeria, Cameroon, Sudan and Libya); and shelters an estimated population of 37 million people.



Above, Lake Chad's drainage basin., …. the 2.5 million km^2 of it! Be-

The annual rainfall in the drainage basin averages 320 mm, ranging from around 1,600 mm in its southwestern part to less than 150 mm in the north. This rainfall is monsoonal in nature, with most of it occurring between June and September. Close to 95% of the runoff generated within the basin is transported to the lake by the Chari/Logone river system, with the remaining coming mostly from the Komadougou/Yobe system.

Situated on a plateau at 280 m of altitude, Lake Chad itself has today an area of open water of close to 1,350 km^2 (nearly half the land area of Rhode Island), and an average depth of about 1.5 m (5 ft), 7 m being as deep as it gets! There are no surface flows out of Lake Chad, but being in an arid region, evaporation rates are very high (reaching 2,300 mm per year.) Lake Chad also loses water into the surrounding groundwater pool. Within the drainage basin, there are two systems of regional importance: 1- The phreatic aquifer found within the Quaternary sand deposits at depths between a few meters to about 15 m (with water essentially similar to the one at surface); and 2- The confined, often artesian, Pliocene aquifer found at greater depths, sometimes 250 to 400 m (with older and more mineralized water.) Apart from these two aquifers, there are other artesian layers at greater depth (most of them with highly mineralized fossil waters.) The process of infiltration of waters from the lake into the groundwater pool is complex and poorly understood, but it is not insignificant – it has been estimated that it could represent as much as 10 to 15% of the monthly mean water budget. This process is also partially responsible for the low salinity of the lake (in spite of high evaporation rates), as it provides an outflow to the heavier salts in the water.

A Bit of History...

One would expect an hydrological system such as Lake Chad's – vast, in the middle of the dry Sahel, and straddling the "arid" Sahara with the "wet" Congo – to be an extremely complex one. … And complex it is! Lake Chad is believed to be the remnant of a former inland sea that has grown and shrunk as a function of climate changes over the past 10,000 years. At its largest, this Mega-Chad (as contemporary historians often refer to it) may have occupied nearly the whole of its drainage basin. In 1823, when Europeans first surveyed it, Lake Chad was one of the largest lakes in the world. In

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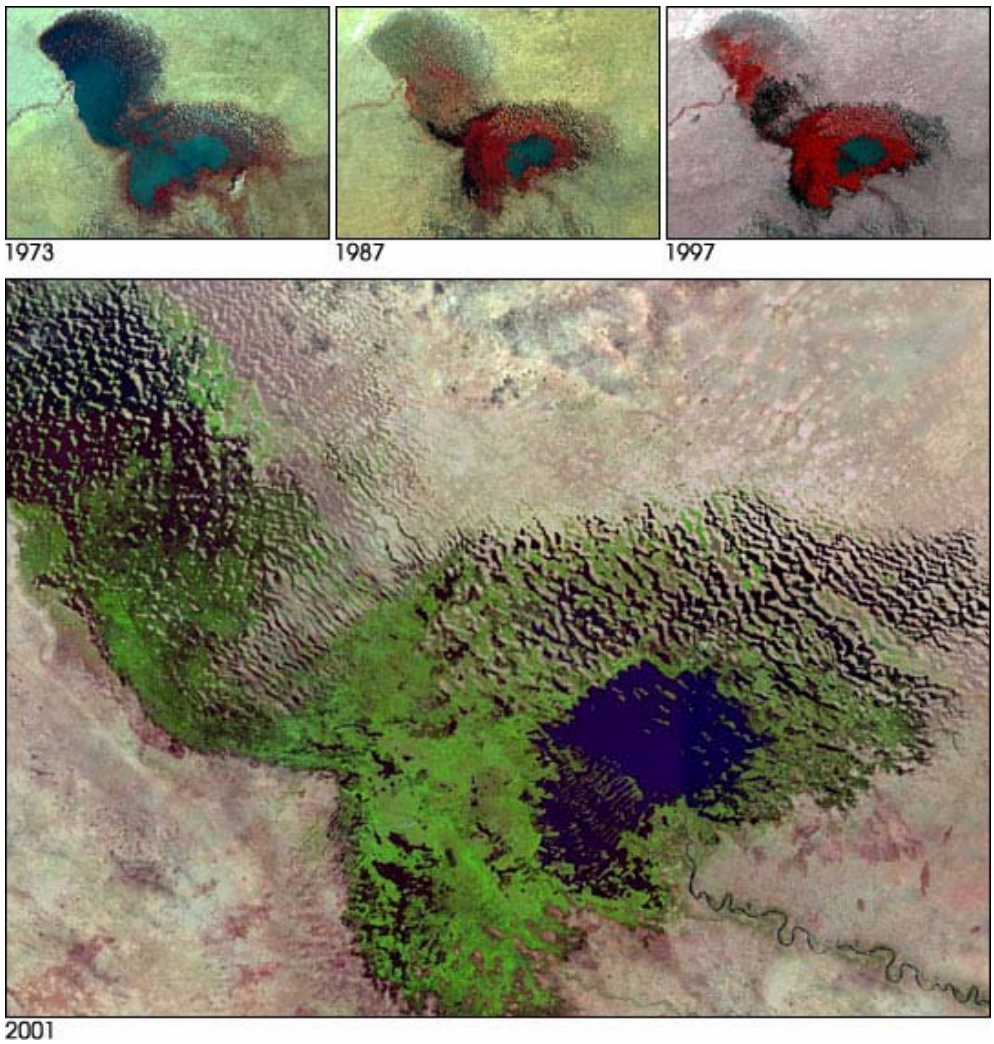
the early 1960s, the lake covered an area of 25,000 km^2, making it the fourth largest lake in Africa (and the largest in West Africa.) In the 40 years since then, Lake Chad shrunk by nearly 95% to its current area. This is not the first time that the lake has shrunk considerably. Sediment analyses indicate that the lake may have nearly dried up four times between 8500 BC and 100 BC. More recently, between 1400 and 1910, it is reported that the lake nearly dried up on yet another four instances.



Landsat views of Lake Chad.

The difference this time is that, in the last 40 years or so, humans have become a material (and potentially determinant) factor on the delicate water balance on Lake Chad's drainage basin. It is well established that, up to the late 1960s, early 1970s, climate factors accounted for materially all seasonal fluctuations of the lake level. The small amount of water extraction for land irrigation and other uses (a maximum of about 5% of the total input to the lake) had little affect on the lake system. This picture has changed drastically: according to research done by two geophysicists with the University of Wisconsin-Madison, the shrinkage of Lake Chad since 1975 can be attributed, in roughly equal parts, to climate variability and water use by humans. In the 1970s and 1980s, the region was hit by back-to-back droughts. At this time, and partially as a response to these droughts, the governments of some of the countries in the region started developing large-scale, intensive irrigation schemes such as the South Chad Irrigation Project in Chad, the MAMDI Polder Project in Nigeria, and the SEMRY Projects in Cameroon. It is estimated that, after 1983, water withdrawals for irrigation increased fourfold compared with rates in the previous two decades.

Aggravating further the situation, it is widely believed that this increase of water use by humans has had an indirect but significant impact in the amount of rainfall in the region. Less water (together with some ill conceived dams and bank stabilization projects) has led to smaller annual floods in the floodplains of the region and to reduced groundwater recharge. The disappearance of the large annual floods also caused degradation of the river channels, enhancing siltation and the growth of invasive weeds, such as *Typha*. All these factors adversely affected traditional farming and have led to a significant loss of canopy cover. These, in turn, have led to land being exposed to erosion by water and wind, producing virtually sterile soils in many areas of the Lake Chad's drainage basin. As a matter of fact, the vegetation on the northern part of the lake has disappeared almost completely, replaced by sand dunes that have formed on the dry lakebed. This

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desertification leads to even less rainfall. Overall, since the mid 1970s, there has been a 47% decrease in the number of large rainfall events. Since the end of the 1960s, the lake water receded for more than 150 km from its northern and eastern shores and by more than 80 km from its western shoreline

The results of all these combined factors are drastic: the observed flow rates of the Chari River in N'djamena averaged for the decade of 1985-94 decreased by more than 60% compared to the decade of 1955-64 (from 1,420 to 545 m^3/sec.) The lake, being extremely shallow, responds very rapidly to all these changes in inflows. And the problem is expected to worsen in the future, as population and irrigation demands continue to increase.

Assets At Risk

The impact to wildlife from a disappearing lake is substantial. Up to a million wintering ducks congregate on the lake each year, making it the third most important area for migratory birds in West Africa. Some 49 of the 83 major Palaeo-artic species attracted to the Sahel depend on the wetlands of the lake for their migration cycles. In addition, these wetlands are the preferred habitat for 10 other species of birds. The lake also supports two near-endemic birds, the rusty lark and the river prinia, and the marbled teal, which is thought to be declining worldwide, is also occasionally seen here. A few populations of elephant, hippo, otter, kob, and red-fronted gazelle still live in sections of the lake's ecoregion. Although human hunting has essentially wiped out other large mammals and crocodiles, small mammals (such as the endemic Lake Chad gerbil), smaller reptiles, and amphibians remain. Around 90 species of fish, 9 of which endemic, are found in the waters of Lake Chad. As a matter of fact, Lake Chad and its basin used to be one of the most productive regions of freshwater fish in Africa. The annual fish catch in the lake alone decreased from 130,000 to 140,000 metric tons in the early 1970s to an estimated 60,000 to 80,000 metric tons today. The situation is even worse in the Logone River south of the SEMRY irrigation scheme. Here the collapse in fish yields is estimated to be around 90%.

Lake Chad viewed from Apollo 7.

The damage is not limited to the flora and the fauna. The range of conflicts that have arisen as a result of the lake's receding waters is vast: from water disputes between competing irrigation schemes to territorial disputes between countries over emerging islands in the lake (e.g., Darak); and from commonly reoccurring inter-ethnic conflicts over the use of natural resources (basically, water for livestock over land for agriculture, leading to the encroachment of farmers into pasture land and vice versa), to conflicts caused by fishermen who kept on following receding waters and ended up settling across national borders without fully realizing it.

Going Forward

Recently, the Lake Chad Basin Commission, an intergovernmental agency established in 1964 to jointly regulate the utilization of water and other natural resources in the lake's basin, and to promote the settlement of inter-country water related disputes, decided to move forward with what is known as the Lake Chad's Restoration Project. The goal of this project is to bring up water to the lake's basin from the Congo River basin. At the moment the solution being consider envisions the construction of a 100 to 150 km navigable canal that would bring up to 900 m^3/sec of water annually from the Oubangui River upstream from a dam to be constructed at Palambo, CAR (which would also produce about 30 to 35 GWh of electrical power.) Will it work? Isn't it already too late? The multi-million dollar studies to answer these and many other questions are just about to get underway. Let us hope for a positive verdict!

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