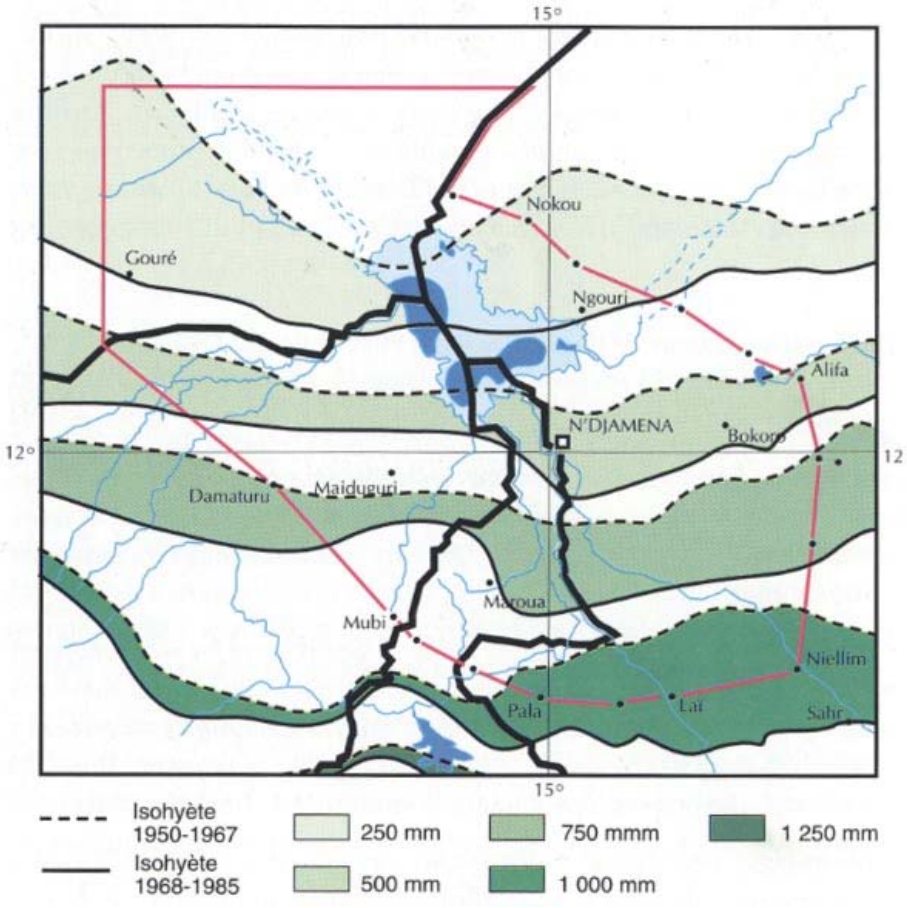
ENVIRONMENTAL CHANGES ON THE SOUTHERN SIDES OF LAKE CHAD (1951-1987)

Diane Brami, Laboratoire Prodig, CNRS Paris1-Paris4 -Paris7 Ephe

Location

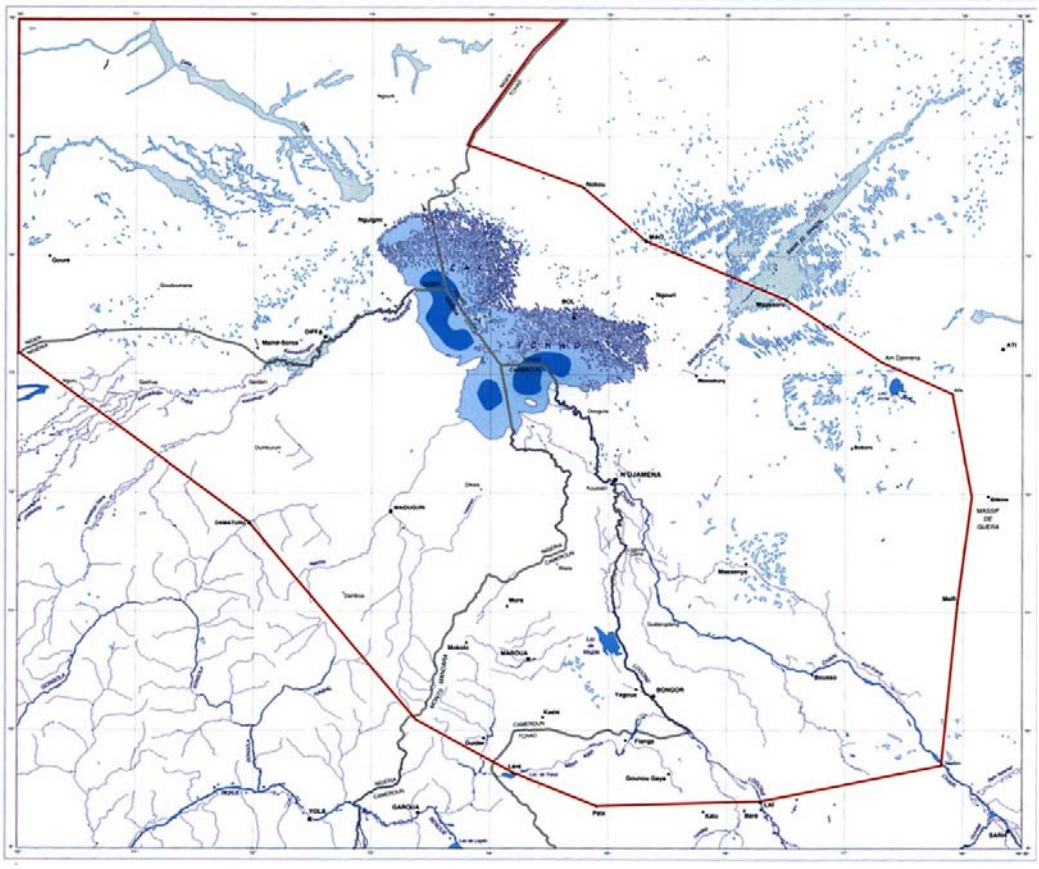
The Lake Chad Basin which lyes between the 8th N and the 16th N parallels of latitude comes under a tropical climate with unimodal rainfall. The rains occur within the boreal summer, their maximum is in august. In the northern side of the 16th parallel the rainy season lasts two or three months, whereas in the south it can last six months.

During the two last decades the rains were disminishing (carte n° 1).



Carte n° 1 : Position des isohyètes avant et après la sécheresse, agrhymet, Morel 1992

In the Chad basin and in particular on the southern sides of lake Chad (Chad), the natural environment is organized according to hydrometric and pluviometric conditions. The morphology induces a zoned organization of the plant covering whose little diversified species cover vast homogeneous areas which are comparatively easy to inventory . The balance of this natural environment is dependent upon not only rainfall but also the inputs of the rivers Logone and Chari (carte n° 2).



Carte n°2 : Carte de situation : Bassin conventionnel avec les lacs et les fleuves ainsi que les zones inondables

The rivers Chari and Logone

The major rivers are the Chari and its tributary the Logone, they have a tropical transition type of regime characterized by a main annual flow and a low flow the rest of the year (fig. n°1).

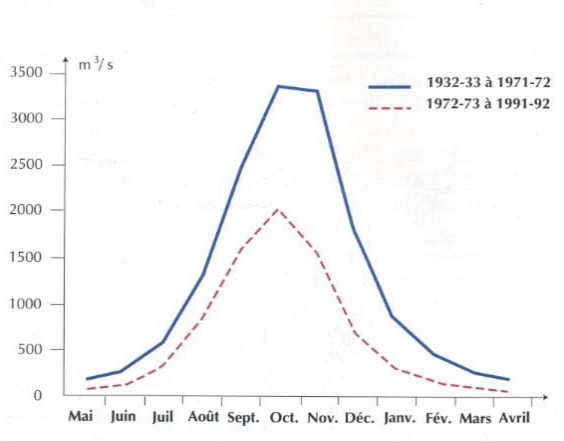


fig. n°1 : Les débits mensuels du Chari à N'Djaména. Comparaison entre la période 1932-1972 et la période de sécheresse 1972-1992

Variations of the Lake Chad

Lake Chad spans parts of Chad, Niger, Nigeria and Cameroon, between 12°n and 14°n and 13°E and 15°E.

Highest level is at 283 meters but this has not been reached since the mid-1960. From then until 1973 there was an annual reduction in level but this has risen noticeably since 1995.

The large variations in the Lake levels as a function of inflow from the Chari, from evaporation, and from infiltration cause changes in the lake ecosystem and thus influence human activity in respect of agriculture , livestock production and fishing.

Lake Chad is located in a closed basin. There is no surface outlet and its level depends on the balance between inflow from the rivers and direct rainfall on the one hand evaporation and small infiltration losses to the ground water table on the other. The main catchment area is to the south of the lake in a zone swept over by the Inter-tropical Convergence Zone. The lake is thus greatly affected by variations in the ITCZ and reflects such variations that is why it is very important to state clearly the period under consideration or the state of the lake.

Great variety and large seasonal and annual variations characterize the surface water resources of the Lake Chad and is Conventional Basin.

Lake Chad is a shallow water body. Its characteristics are intimately related to the hydrological conditions, especially to the considerable year to year variation of the water level. The lake can be divided into a southern and nothern basin, these being separated by a ridge, known as the « Grande Barrière », between Baga Kawa and Baga Sola. Both basins where distinct in 1910 and 1928 (Tilho, 1928) and then again from 1974. (fig. n° 2)

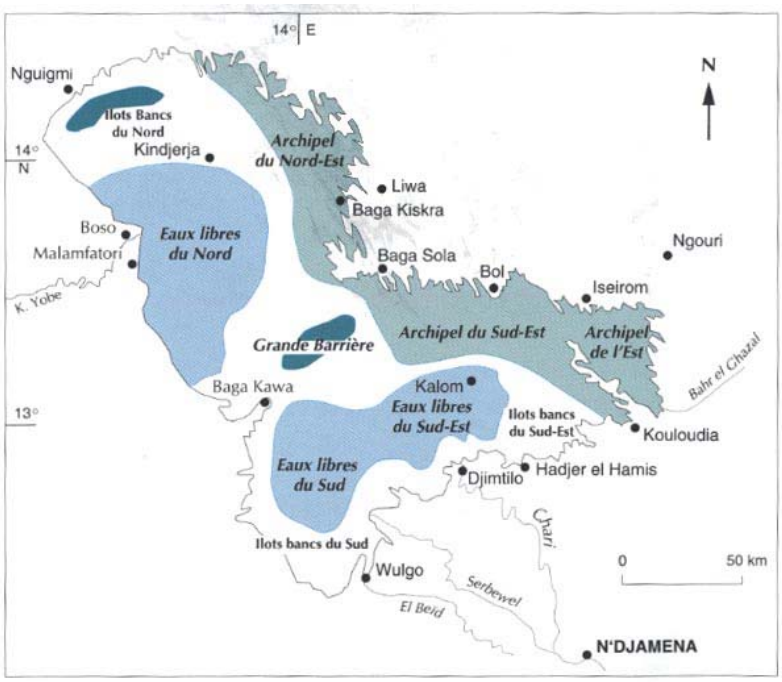
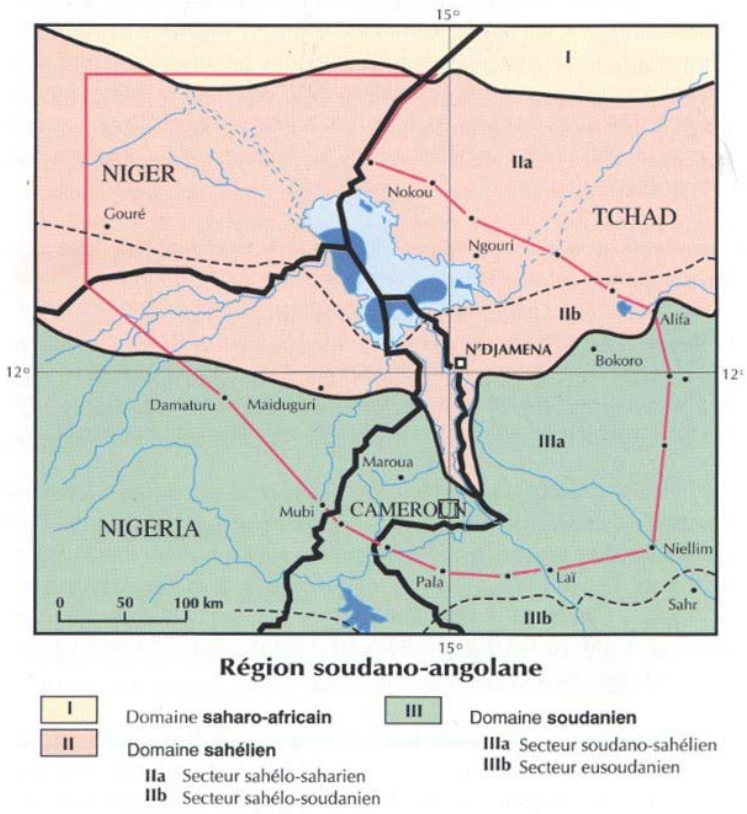


fig n°2 : Les grandes zones écologiques du Lac Tchad « normal », d'après *Carmouze et al* 1972

Phytogeographic domains

Two phytogeographic domains : the sahelian and the soudanian ones, share the Lake Chad Basin area.The phytogeographic zonage of the vegetation was identificated by TROCHAIN (1970) . After the drought, the boundaries were revised (Gaston, 1981). (carte n°3). We can see on this figure that the southern sides of the lake Chad are at the intersection between the sahelo-saharian sector and the sahelo-soudanian sector.



Carte n°3 : Zonation phytogéographique du Bassin du Lac Tchad (d'après TROCHAIN, 1970, adapté par Gaston)

The southern limit of the sahelo-saharian sector with the sahelo-sudanian sector is about 13°N in term of vegetation types, the limit marks the change from thorny scrub to a woody non-throny vegetation in which the *Combretaceae* are important element of flora.

This band of country covering 250-300 km of latitude is commonly known as the Sahel.

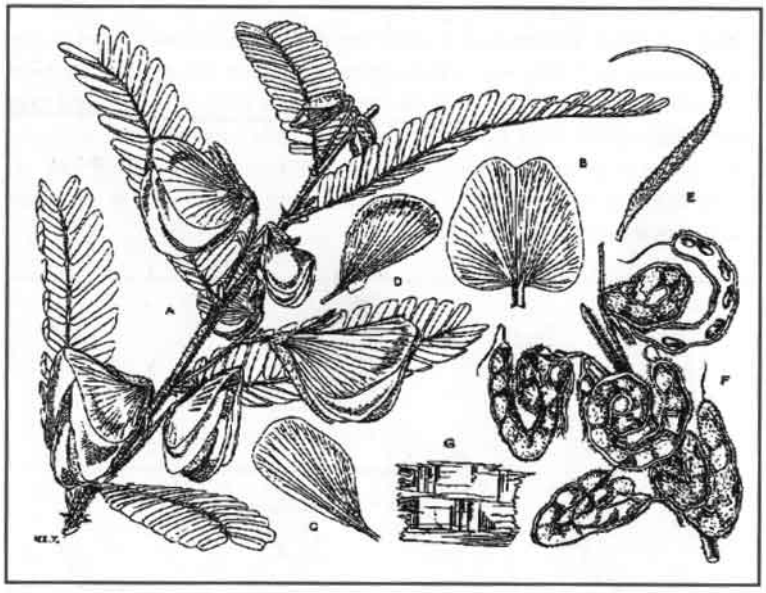
It is well-suited to livestock production as there is little competition from agriculture except on the southern sides of the Lake. In this space there is many concurrency between pastoral people, agricultural people and fishers.

-The vegetation of the lake Chad shores **:**

The sandy approaches have *cyperaceae* (*Cyperus sp.*, *Scirpus sp.*) and grasses (*Cynodon*

dactylon, *Imperata cylindrica*) which develop on the zone between high and low tide. On the banks there are « flooding borders » constitued with *Vossia cuspidata*, *Ludwigia spp*. and *Cyperus papyrus*. This last one can separate from the banks and make floating islands diverting with the winds or running waters. The sandy shallows have a vegetation with *Phragmites australis*, or by place *Typha domingensis*.

A legume, *Aeschynomene elaphroxylon* (dessin n°1) is charasteristic of the Lake Chad where it is known as « Ambadj » , it's very light wood is used as floats. In the low water period with is four meters high, it can make thickets.



dessin n°1 : Aeschynomene elaphroxylon (Guill. et Perr.), Taub. (Papilionaceae)

A : branche fleurie, B : étendard, C : ailes, D : carène, E : gynécée, F : fruits, G : moëlle

Dynamic of evolutions of the southern sides of the Lake between 1951-1987

Carte n°4

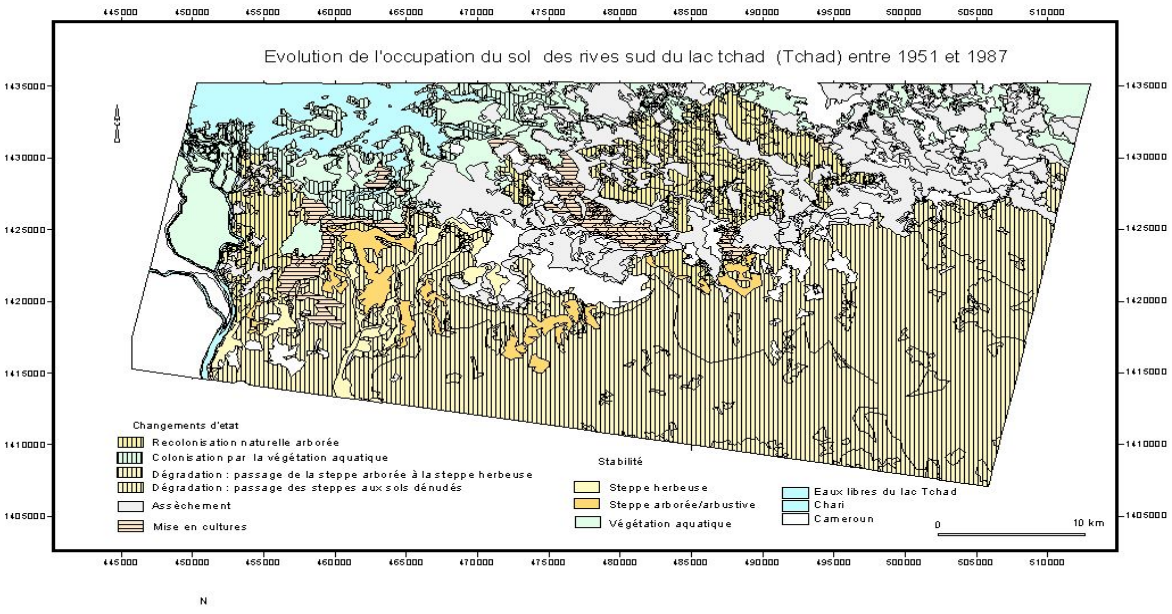
As a consequence of climatic variations the Standard Chad phases are intersected with low lake

levels. Three periods of little Chad have occured during the 20th century. The first lasted from 1904-1917, the second, around 1940, the third began in 1973 until 1997. At this date the lake Chad began to grow again.

We have realised a dynamic map based on two documents, one at the date of 1951 made by photo-interpretation by the National Geographic Institute of France, and the other based on the treatment of a Spot image taked in 1987.

We have done the implementation in a GIS of these documents (after interpretation based on vegetation thematic) to numerised them.

The superposition of the two periods indicated many new points :



After this long period of drought, different changes in the state of vegetation have been noted :

1- Species pertaining to trees and shrubs have strongly recolonized the shore in the areas where

the level of the Lake's waters have gone down and particularly between the dunes.

2- The aquatic vegetation which needs her higher water level has migrated to the north, thus spreading to the Lake's free water.

3- As migrants suffering from famine due to difficult climatic and political situations are finding refuge around the Lake farming is spreading in the region.

4- As for damaged areas, they are located relatively further away from the Lake's and the Chari flooding areas.

One of the main lessons to be learn from this period of changing climate is the absolute necessity of taking into account the ecological risks from rainfall variations.