Intra- and interspecific morphometric variation in *Clarias gariepinus* and *C. anguillaris* (Siluroidei, Clariidae)

Guy G. Teugels
Ichthyologist

The genus *Clarias* with some 32 valid species is the third most diversified catfish genus on the African continent. Within the genus, TEUGELS (1986) recognized six subgenera. One of them, *Clarias* (*Clarias*) includes two species: *Clarias gariepinus* (Burchell, 1822) and *C. anguillaris* (Linnaeus, 1758). Especially the former is of great economic importance as it is the most cultured catfish in Africa and the third most cultured catfish species in the World (GARIBALDI, 1996).

Clarias gariepinus has an almost Panafrican distribution and also naturally occurs in Minor Asia (SKELTON and TEUGELS, 1992). *Clarias anguillaris* has a more restricted distribution and is only known from the Nile and West Africa (TEUGELS, 1986).

Morphologically, both species are very similar and although sympatrical populations in some river basins may be distinguished on other characters (*e.g.* BENECH *et al.*, 1993), the only reliable feature to distinguish both is the number of gill rakers on the first branchial arch. In *Clarias gariepinus*, this number is very high (up to 110) while in *C. anguillaris* it is rather low (up to 50). In both species the gill raker number increases with the standard length (TEUGELS, 1982).

As part of a multidisciplinary project on the characterization of species and populations used in aquaculture, we examined the morphometry of eight populations of *Clarias gariepinus* and six populations of *C. anguillaris*. Origin and sample size of these populations are listed in Table I. Thirteen measurements were taken on each specimen using dial calipers. They follow AGNESE *et al.* (1997). For each specimen, the number of gill rakers on the complete first branchial arch was counted. Results obtained were log-transformed and submitted to principal component analysis (Statistica package) using the matrix of covariance and to cluster analyses.

Population	*Clarias gariepinus* n	*Clarias anguillaris* n
Dagana (Senegal)	10	25
Selingue (Mali)	2	25
Bamako (Mali)	-	9
Layo (Côte d'Ivoire)	-	15
Hadide (Chad)	3	1
Ndjamena (Chad)	13	4
Lake Manzalla (Egypt)	37	-
Cairo (Egypt)	9	-
Lake Victoria (Kenya)	23	-
Sand River Dam (Swaziland)	9	-

Table I
Origin and sample size of populations examined of *Clarias gariepinus* and *C. anguillaris*.

Results of a principal component analysis using 13 log-transformed metric variables did not reveal significant differences between the populations examined of *Clarias anguillaris* (Fig. 1). They all (except for the population from Côte d'Ivoire) originate from river systems in West Africa (Senegal, Niger, Chad) and climatological

and geological events during the Late Quaternary explain for the bigger part the similarities in their faunal composition.

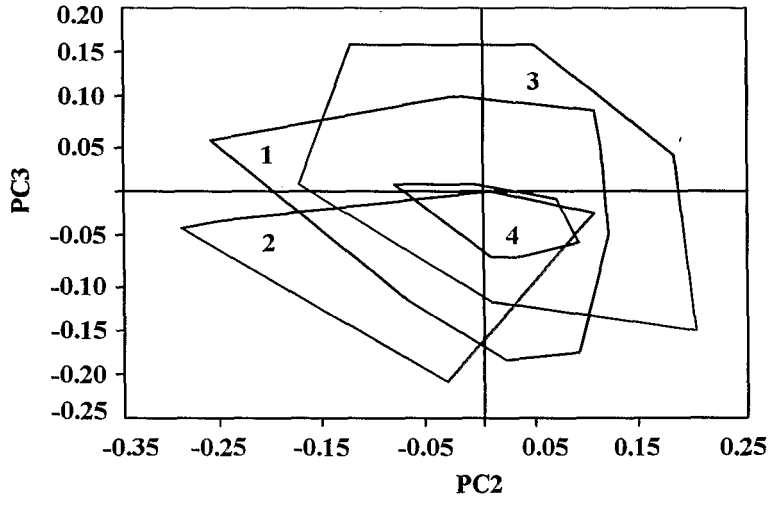

Figure 1
Plot of a principal component analysis on 13 log-transformed metric variables for all populations examined of *Clarias anguillaris*. Senegal (1); Côte d'Ivoire (2); Mali (Selingue + Bamako) (3); Chad (Hadide + Ndjamena) (4).

The same statement can be made for the West African populations (Senegal and Chad basins) and the Nile populations (Lake Manzalla and Cairo) of *Clarias gariepinus* which showed to be very similar and a principal component analysis of 13 log-transformed metric variables did not enable to separate them (Fig. 2). Historical contacts between the Nile and the West African river basins have been documented by ROBERTS (1975) and others.

An important morphometric separation between the Nile and the Lake Victoria specimens of *Clarias gariepinus* was observed (Fig. 2): the Nile specimens are located on the negative sector of the second component, while the Lake Victoria specimens are situated

on the positive sector of this component. The second component is merely defined by the width of the premaxillary toothplate, the width of the occipital process, the length of the occipital process and the dorsal fin length. GREENWOOD (1976) stated that although Lake Victoria is connected by river with the Nile, the Lake fauna is physically isolated by barriers that seemingly are impassable to fishes. The Lake Victoria and the Egypt populations of *Clarias gariepinus* however are both partly overlapped by the population from Chad, while that from the Senegal is intermediate between both. Possible hydrographic connections between the Chad and the Nile basins during the Pleistocene have been suggested by ROBERTS (1975) and are supported by the presence in Lake Victoria of taxa such as the cyprinid *Barbus apleurogramma* (see LEVEQUE, 1990).

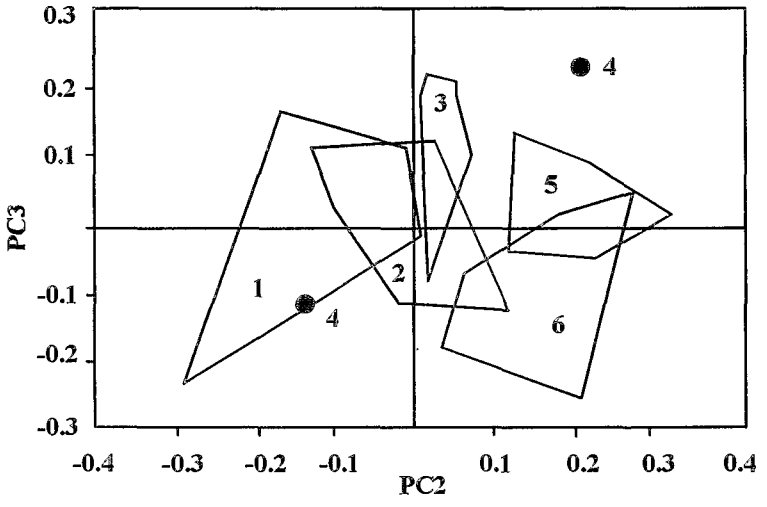

Figure 2
Plot of a principal component analysis on 13 log-transformed metric variables for all populations examined of *Clarias gariepinus*. Egypt (Cairo + Lake Manzalla) (1); Chad (Hadide + Ndjamena) (2); Senegal (3); Mali (Selingue) (4); Swaziland (5); Lake Victoria (6).

A comparison of the morphometric data of all populations examined of both species, showed an important overlap in particular between the *Clarias gariepinus* specimens from Lake Victoria and Swaziland and the *C. anguillaris* specimens (Fig. 3). When however the number of gill rakers is included in the analysis, the Lake Victoria and Swaziland populations clearly fall within the other *C. gariepinus* populations (Fig. 4), where they cannot be distinguished as a subgroup.

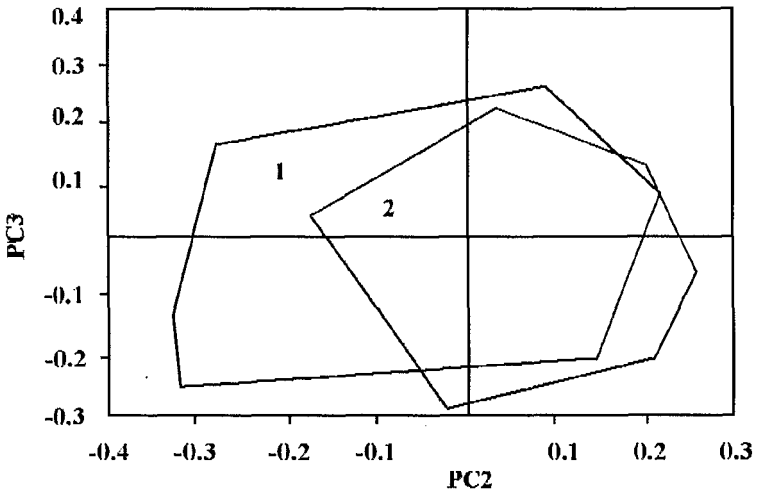

Figure 3
Plot of a principal component analysis on 13 log-transformed metric variables for all natural populations examined of *Clarias gariepinus* (1) and *C. anguillaris* (2).

In conclusion, populations from *Clarias anguillaris* showed limited morphometric variation. In populations from *Clarias gariepinus* however, those from West Africa and the Nile are morphometrically closer to each other than to those from Lake Victoria and southern Africa. Different colonization patterns, related to earlier

hydrographic connections are used to explain this intraspecific variation.

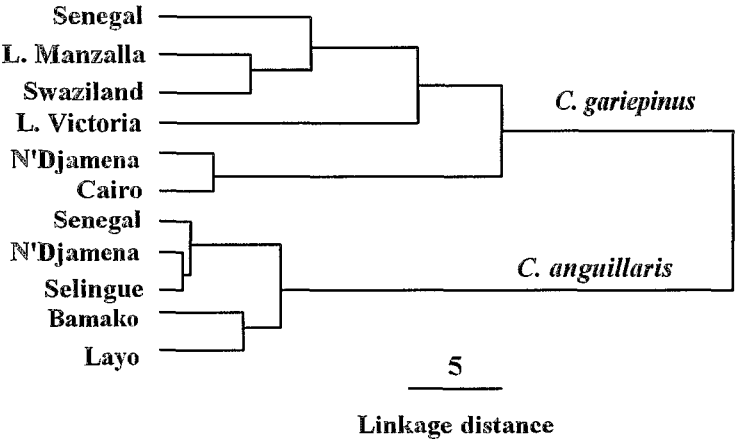

Figure 4
Cluster analysis (linkage rule: unweighed pair-group average; euclidean distance measure) using 13 log-transformed metric variables and the gill raker number for all populations examined of *Clarias anguillaris* and *C. gariepinus*.

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