

# On the systematics and reproductive compatibility in Clariidae based on Osteological and morphometric parameters

## ABSTRACT

**Introduction:** Member of clariidae are the most cheered foodfish in Africa. This paper presents information on the systematic and the reproductive compatibilities in clariidae which appear not to be homologous with the clariid phylogenetic deudogram. **Material and Methods:** Morphometric and meristic courts were done on the selected species using standard procedures. The species examined were *Hetrobranchus longifilis* (Valenciennes 1840), *Clarias gariepinus* (Burchell 1822), *Clarias ebriensis* (Pellegrin 1920) and *Clarias anguillaris* (Linnaeus 1758). **Results:** Results of osteological and morphometric analyses presented two members of *Clarias* genus (*C.gariepinus* and *C.anguillaris*) and a member of another genus (*H. longifilis*) to be closer in structural affinity than *C. ebriensis* despite the fact that *C. ebriensis* belong to the genus *Clarias*. These observed morphometric result support the basis for the earlier reported reproductive compatibility between *H. longifilis* and the large *Clarias* species (*C.gariepinus* and *C.anguillaris*). **Discussion:** The published karyological analysis of these species supports this view. These results therefore show a basal dichotomy between the two outgroups of one genus which is not related to their phyloenyetic origin. Similarity members of the large *clarias* have successfully been reported to undergo hybridization leading to the production of "Heteroclarias" and "Clariabanchus", a situation probably suggestive of convergent evolution of the clariids at the genus level. **Conclusion:** It could safely be hypothesized that ecological adaptations of reproductive structures in *H. longifilis* and the large *Clarias* which is not related to their phylogenetic origin have given rise to this reproductive compatibility.

**Key words:** Clariidae, morphometry, osteology, reproductive compatibility

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## INTRODUCTION

The catfish family Clariidae comprises species in which the body shape ranges from fusiform to anguilliform. Recent studies have shown that this body elongation is the result of convergent evolution.<sup>[1]</sup> The Clariidae contains at present some 13-15 valid genera all of which is restricted to the African continent except for two genera which is also known to occur in Southeast Asia [Table 1].<sup>[2]</sup> The genera *Clarias scopoli*, 1777 and *Heterobranchus* Geoffroy St Hilaire,

1809 contain the most important species in Clariidae both in terms of number, productive biomass, preferred food fish and culture potentials.<sup>[3,4]</sup>

Tuegels *et al.*<sup>[5]</sup> mentioned that the genus *Heterobranchus* contain four valid species out of which *H. longifilis* Valenciennes 1840 and *H. isopterus* Bleeker 1863 are extremely closely related and are impossible to separate with ordinary identification keys. Another species, *H. bonlengeri* Pellegrin 1922 displays striking differences in several characters that its position within the genus seems questionable. Among the congeners of this genus, Anibeze and Inyang<sup>[6]</sup> records that *H. longifilis* is more widely distributed in the lower Niger basin and contributes significantly to the ichthyofauna of the Niger and Benue river basins.

Among the *Clarias* genus, *C. gariepinus* Burchell 1822 and *C. anguillaris*, Linnaeus, 1758 are placed in the subgenus *Clarias (Clarias)* Gronovius 1781 while *C. ebriensis* Pellegrin 1920 belong to the subgenus *Clarias (Anguilloclarias)*.<sup>[7]</sup>

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Karyological analysis show that *C. gariepinus* and *C. anguillaris* both arranged in the subgenus *C. (Clarias)* have same chromosome number ( $2n = 56$ ) and nearly identical chromosome formula, while *C. ebriensis* placed in the subgenus *C. (Anguilloclarias)* has a different number ( $2n = 48$ ); *H. longifilis* has  $2n = 52$  chromosomes.<sup>[8]</sup> This is indicative of close affinity between *Heterobranchus* species and members of the subgenus *C. (Clarias)* when compared with members of the subgenus *C. (Anguilloclarias)*. However, phenetic similarity in electrophoretic protein patterns or karyotypes does not necessarily imply a close phyletic relationship. Hence, it was simply postulated that based on karyological data all clariids share a common affinity. For proper phyletic taxonomy, outgroup comparisons based on morphological, osteological and cytogenetical data are used.

Reported growth performances of the clariids have shown similarity both in wild specimens and culture situations.<sup>[4,6]</sup> All the studies point to the fact that the *Heterobranchus* species form the largest clariids in the African waters.<sup>[9]</sup> The large *Clarias* while not growing as large as the *Heterobranchus* species grow significantly larger than members of the *C. (Anguilloclarias)* (= *C. ebriensis* and *C. buthupogon*).

The foregoing reports are based on analysis of morphological and osteological charts of collections of members of *C. (Clarias)* (= *C. gariepinus* and *C. anguillaris*); *C. (Anguilloclarias)* (= *C. ebriensis*) and *H. longifilis*. The paper attempts to provide information on the morphological and osteological synonymy in the characters of the clariids, thereby attempting to proffer a basis for the reported hybridization and hybrid integrity existing among some members of Clariidae.

**Table 1: Valid genera of members of clariidae (in Teugels *et al.*<sup>[5]</sup> Devaere *et al.*<sup>[1]</sup>)**

Genus	Location
Channallabes Gunther, 1873	Africa
Clariallabes bonlenger, 1990	Africa
Clriallabes Bonlenger, 1990	Africa and SE Asia
Clarias Scopioil, 1777	Africa
Dinotopterus Bonlenger, 1906	Africa
Gymnallabes Gunther, 1867	Africa
Heterobranchus Geoffroy-St.Hilaire, 1809	Africa
Platyllabes Poll, 1977	Africa
Platycharias Poll, 1977	Africa
Tangenikallabes Poll, 1943	Africa
Uegitglanis Geanferrari, 1923	Africa
Xenoclarias greenwood, 1958	Africa
Encheloclarias, Herr and Myers 1937	Africa and SE
horaglanis	(Deveaere <i>et al</i> )
dolichallobes	(Deveaere <i>et al</i> )

## MATERIALS AND METHODS

*H. longifilis*, *C. gariepinus*, *C. anguillaris*, and *C. ebriensis* were collected from the potamon reaches of Idodo river basin [Figure 1] and examined by methods adopted in Inyang *et al.*<sup>[3]</sup> *Clarias* species were identified using the keys produced by Teugels<sup>[10]</sup> while the *Heterobranchus* species was identified following Teugels *et al.*<sup>[5]</sup>

Morphometric measurements and meristic counts were made according to methods adopted in Teugels *et al.*<sup>[5]</sup> as shown in Figure 2. These important body measurements of clariid specimens taken were Standard length (SL), Head length (HL), Interorbital distance, Premaxillary width, Vomerine Width, Dorsal fin length, Adipose fin length. They were expressed as percentages of head length for measured structures in the head region or percentage of standard length for other body structure measurements. Osteology was examined using radiographs.

## RESULTS

The morphometric measurements, meristic counts and osteological examinations of the species are presented in Tables 2-5. *C. gariepinus* and *C. anguillaris* showed a lot of synonymy among the three members of the *Clarias* genus. *H. longifilis*, though a different genus showed closer mean values in morphometric and osteological characters with members of *Clarias* subgenus *C. (Clarias)*. The largest divergences in the mean values of observed character were between *H. longifilis* and *C. ebriensis*. Based on these measurements a dendrogram showing the most parsimonious relationship in the clariid species examined is hypothesized [Figure 3].

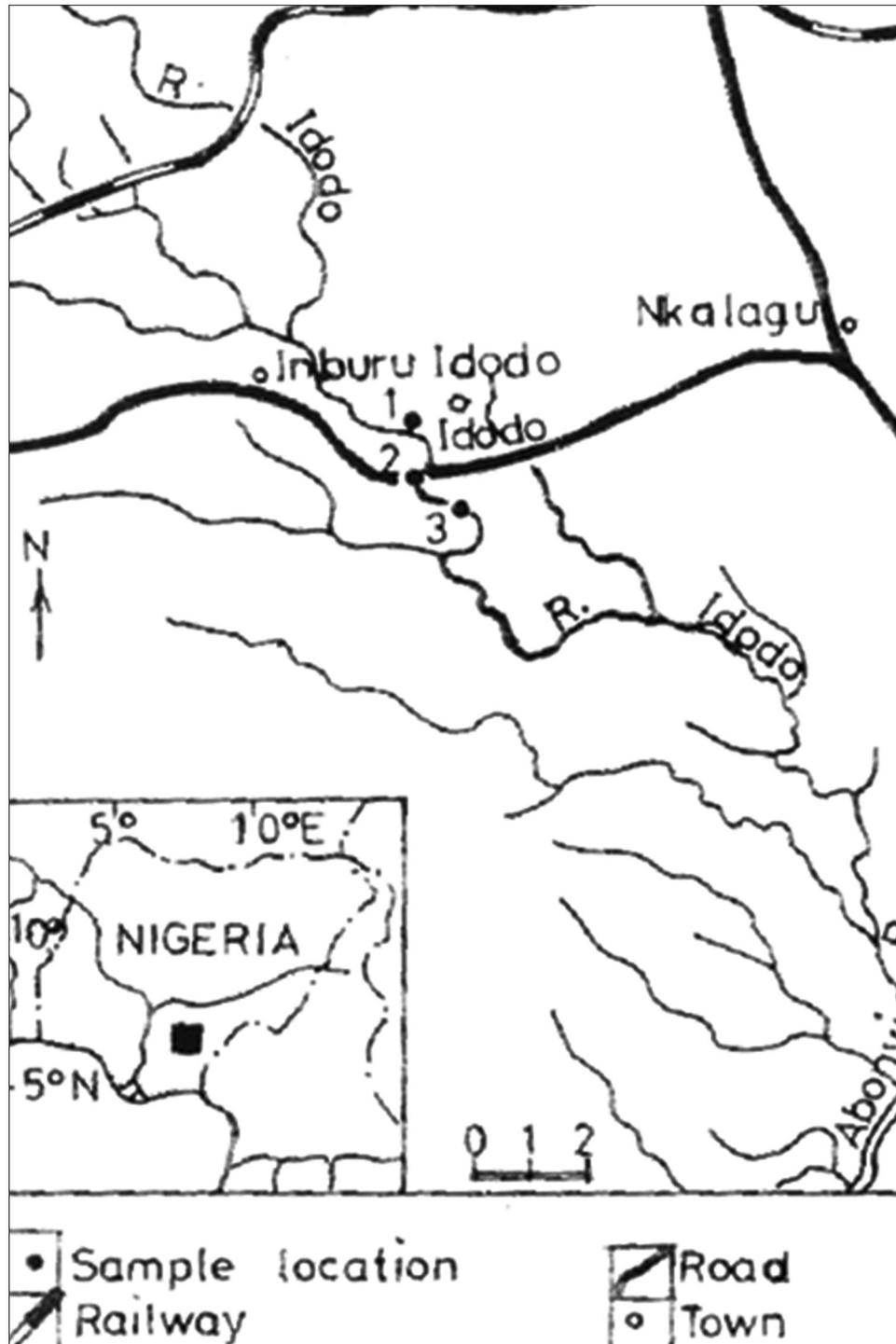
## DISCUSSION

*H. longifilis* and members of the *Clarias* genus show similarity in their morphology and differ mainly in the

**Table 2: Morphometric and osteological characters in members of *Heterobranchus longifilis***

Characters	<i>Heterobranchus longifilis</i>			
	Min-Max	N	m	SD
Standard length (SL)	105-394	20	208.2	105.1
Head length (HL) (%SL)	305-32.9	20	31.6	1.20
Interorbital distance (%HL)	43.5-52.7	20	48.2	3.4
Premaxillary width (%HL)	29.6-35.8	20	33.5	3.1
Vomerine width (%HL)	26.0-39.9	20	28.5	1.3
Dorsal fin length (%SL)	36.9-43.1	20	41.5	1.6
Adipose fin length (%SL)	20.3-29.9	20	24.5	1.6
Gill rakers on 1 <sup>st</sup> March	17-27	20		
Dorsal fin rays	40-47	20		
Anal	49-58	20		
Vertebrae	63-63	3		

SD=Standard deviation

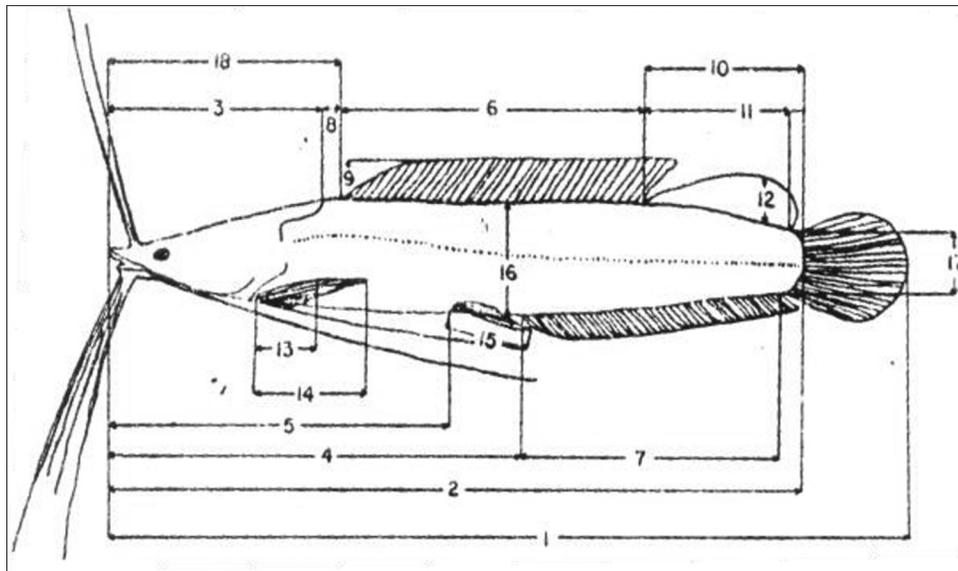


**Figure 1:** The Idodo River with sampling stations 1, 2 and 3 (●). The closed square in the insert shows the relative position of the Idodo River in Nigeria

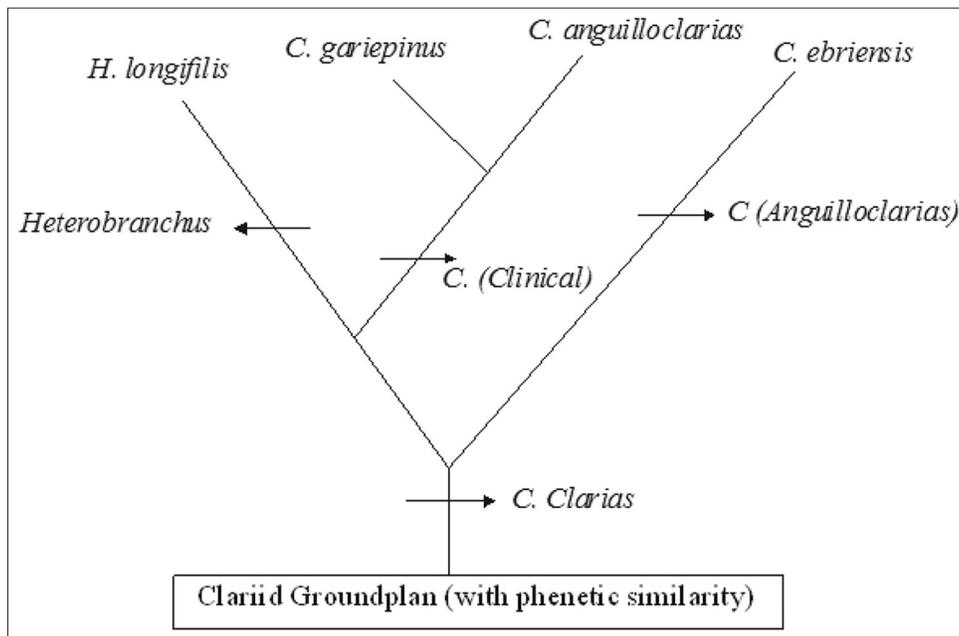
adipose fin complex present in the former [Tables 2-5]. Among the clariids, *H. longifilis* and members of *C. (Clarias)* have shown closer affinity in morphological and osteological characters than with *C. ebriensis*. However the hyperdevelopment of the adipose fin complex is restrictive to the *Heterobranchus* genus as earlier observed in the existing identification keys.<sup>[5]</sup> Due to this fact the

genus have formed monophyletic assemblage within clariidae.

These observations on morphometric and osteological similarity between *H. longifilis* and members of *C. (Clarias)* agree with karyological variations of members of Clariidae.<sup>[6]</sup> This affinity was attributed to symplesiotypy



**Figure 2:** Important body measurement of *Heterobranchus* specimens: 1. total length (TL); 2. standard length (SL); 3. head length (HL); 4. preanal distance 5. prepelvic distance; 6. dorsal hm length; 7. anal final length; , distance between occipital process and dorsal fin original; 9, dorsal fin depth; 10, distance between dorsal and caudal fin; 11, adipose fin length; 12, adipose fin depth; 13, pectoral spine length; 14, pectoral fin length ; 15, pevlc fin length; 16, body depth atanus; 17, caudal peduncle depth; 18, predorsal distance



**Figure 3:** Hypothesis on the phonetic relationships among members of the subgenera *Clarias* (*Clarias*), *Clarias* (*Anguilloclarias*) and *Heterobranchus*

which represents a primitively designed groundplan. This would suggest that based on morphological and osteological data observed in this study and karyological data,<sup>[8]</sup> all the members of Clariidae share a common groundplan. Teugels *et al.*,<sup>[8]</sup> showed that in terms of karyological polymorphism, *C. gariepinus* and *C. anguillaris* both arranged in *C. (Clarias)* have the same number of chromosomes ( $2n = 56$ ) while *C. ebriensis* placed in the subgenus *C. (Anguilloclarias)* has a different number ( $2n = 48$ ). *H. longifilis* which belongs to another genus has a closer chromosome number ( $2n = 52$ ) with members of *C. (Clarias)*.

The above karyological postulations clearly mirror the observations in this study on the species' morphometry. This will appear to provide a basis for the reported hybridization between *H. longifilis* and members of *C. (Clarias)*. Hecht and Lublinkhof,<sup>[11]</sup> Legendre<sup>[12]</sup> successfully hybridized *H. longifilis* and *C. gariepinus* and reported that the F1 hybrids are vigorous. Madu and Ita<sup>[13]</sup> also successfully propagated the hybrids of *H. longifilis* and *C. anguillaris*. The morphotype of the hybrid specimens obtained were intermediate between that of the parents. Assaying the efficacy of extracted and

**Table 3: Morphometric and osteological characters in members of *Clarias gariepinus***

Characters	<i>Clarias gariepinus</i>			
	Min-Max	N	m	SD
Standard length (SL)	51-20	15	118	76.1
Head length (HL) (%SL)	25.1-28.5	15	27.1	1.5
Interorbital distance (%HL)	46.1-49.2	15	47.2	1.8
Premaxillary width (%HL)	27.5-28.3	15	28.9	2.3
Vomerine width (%HL)	23.3-24.5	15	23.7	1.1
Dorsal fin length (%SL)	46.1-49.5	15	48.1	0.9
Adipose fin length (%SL)		15		
Gill rakers on 151 arch	15-26	15		
Dorsal fin rays	51-58	15		
Anal	46-55	15		
Vertebrae	55-58	15		

SD=Standard deviation

**Table 4: Morphometric and osteological characters in members of *Clarias anguillaris***

Characters	<i>Clarias anguillaris</i>			
	Min-Max	N	m	SD
Standard length (SL)	46-220	15	102	69.1
Head length (HL) (%SL)	23.0-26.1	15	24.1	1.8
Interorbital distance (%HL)	45.1-48.5	15	46.7	2.3
Premaxillary width (%HL)	25.1-28.6	15	26.9	1.9
Vomerine width (%HL)	24.5-26.1	15	25.6	1.8
Dorsal fin length (%SL)	45.1-46.5	15	45.7	0.9
Adipose fin length (%SL)		15		
Gill rakers on 151 arch	16-25	15		
Dorsal fin rays	50-59	15		
Anal	48-54	15		
Vertebrae	56-60	15		

SD=Standard deviation

**Table 5: Morphometric and osteological characters in members of *Clarias ebriensis***

Characters	<i>Clarias ebriensis</i>			
	Min-Max	N	m	SD
Standard length (SL)	46-220	10	62	23
Head length (HL) (%SL)	23.0-26.1	10	39.5	1.3
Interorbital distance (%HL)	45.1-48.5	10	48.9	1.1
Premaxillary width (%HL)	25.1-28.6	10	34.1	0.9
Vomerine width (%HL)	24.5-26.1	10	35.3	0.8
Dorsal fin length (%SL)	45.1-46.5	10	64.1	1.3
Adipose fin length (%SL)		10		
Gill rakers on 151 arch	16-25	10		
Dorsal fin rays	61-69	10		
Anal	51-53	10		
Vertebrae	43-46	10		

SD=Standard deviation

purified HCG from early pregnant urine, Anibeze<sup>[14,15]</sup> successfully induced ovulation in *H. longifilis* and

*C. gariepinus* and observed clutch sizes which were not significantly different ( $P < 0.05$ ) in the two species. Report on the clutch size of *C. ebriensis* showed that the group possess a significantly ( $P > 0.05$ ) smaller clutch size than *C. gariepinus* and *H. longifilis* (Anibeze, 1998).<sup>[15,16]</sup>

An attempt has been made in this study to present information on the morphometric and osteological polymorphism in some clariids and to show how this is related to their reproductive compatibilities. It is observed that phenetic relationships inferred from morphometric and osteological features and that also demonstrated from karyological analysis of allozyme frequencies do not necessarily reflect phylogenetic origins in clariids. Thus, facts derived from hybridization of the species may not reflect phylogenetic relationships. It could safely be hypothesized that ecological homology of reproductive structures in *H. longifilis* and the large *Clarias* have given rise to their reproductive compatibility. Hence, in terms of phylogenetic relationships the clariids as earlier observed earlier<sup>[7]</sup> share a common groundplan and cladogenesis may explain the observed differences in *C. ebriensis* in the *Clarias* genus.

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