Survey of the anguilliform Clariidae (Teleostei, Siluriformes) of Gabon and Republic of Congo, with description of two new species and key to the African clariid genera

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ABSTRACT. A survey of anguilliform African clariids from the Lower Guinea indicated the existence of four species, of which two are new to science. Thirty morphometric features as well as several meristic and descriptive characters have been studied on 174 specimens. *Channallabes ogooensis* n. sp. is recognized by the combination of distinct serrations on the posterior edge of the pectoral spine, 84–97 vertebrae, 100–113 and 85–102 dorsal and anal fin rays, a pale spot on the skull roof between the anterior and posterior fontanel, absence of an epiotic, skull moderately reduced in size, sphenotic and pterotic showing plate-like outgrowths and the posterior border of mesethmoid indented, making the anterior part of the anterior fontanel situated within the mesethmoid. *Channallabes teugelsi* n. sp. is recognized by the combination of serrations only on the anterior edge of the pectoral spine, 70–82 vertebrae, 99–109 and 90–100 dorsal and anal fin rays and a clear, pale spot on the skull roof between the anterior and posterior fontanel. The three anguilliform genera *Channallabes*, *Gymnallabes* and *Clariallabes* are diagnosed and two anguilliform species are reassigned. A revised key to all African clariid genera is provided.

KEY WORDS : Clariidae, systematics, *Channallabes alvarezi, C. longicaudatus, C. ogooensis, C. teugelsi*, new species

INTRODUCTION

A clear taxonomy/systematics and a relatively simple key to identify animals correctly, based on externally visible morphological characters is crucial for field sampling, museums, etc… and thus indispensable for all further biological research.

The anguilliform species of the catfish family Clariidae are of great biological interest, *e.g.* discovery of terrestrial feeding and its importance for understanding evolutionary transitions in the history of vertebrates (Van Wassenbergh et al., 2006) and have recently been subject of several studies (De Schepper et al., 2004; Devaere et al., 2005; 2006).

However, anguilliform clariid taxonomy is not well supported. The only key incorporating the anguilliform clariids is that of Poll (1977), who relied on the limited number of specimens used in the original descriptions of the species. However, we find this key fails to account for intraspecific variation; overlap among species in the ranges of characters used in this key, such as presence of paired fins and number of ribs and vertebrae, limits its utility.

We examined the anguilliform clariid material, including type-specimens, museum specimens and newly collected specimens from the region of interest. Anguilliform clariids of the Lower Guinea are poorly represented in museums worldwide. Only *Gymnallabes typus*, *G. alvarezi* and *Channallabes apus* are frequently found in museums. Most of this material, however, appears to be incorrectly identified. Because correct identifications of the species are difficult, we conducted a systematic survey and morphological analysis.

MATERIALS AND METHODS

We examined 174 anguilliform clariids from the Lower Guinea. Institutional abbreviations are listed in Leviton et al. (1985), except for Instituto de Biologia Aplicada, Barcelona, Spain (IBAB). For this study, we used museum material, but most specimens were collected from two sampling campaigns in Gabon (1999, 2000). Three large regions have been sampled : northern Gabon in the Woleu River system, close to the border with Equatorial Guinea and Cameroon; the Ivindo River system around Makokou; the Ogowe River system in the vicinity of Franceville. All sampling sites were characterized by shallow, muddy, still water. Most specimens were caught using fyke nets and fish hooks by local fishermen.

For all specimens, 36 point-to-point measurements were taken using digital callipers to 0.1mm (digital ruler, Mauser), following Devaere et al. (2004) : total length (TL); standard length (SL); preanal length (PaL); prepelvic length (PPvL); prepectoral length (PPcL); predorsal length (PdL); distance between the occipital process and the dorsal fin (SPDFL); pelvic fin length (PvFL), pectoral fin length (PcFL); pectoral spine length (PcSL); caudal peduncle depth (CPD); body depth at anus (ABD); maxillary barbel length (MxB); external mandibular barbel length (EmnB); internal mandibular barbel length (ImnB); nasal barbel length (NB); interpelvic distance (IpvD); interpectoral distance (IpcD); head length (HL); preorbital length (PoL); skull width (SkW); supraoccipital process length (SpL); supraoccipital process width (SpW); interorbital distance (IoD); anterior nostril interdistance (ANID); posterior nostril interdistance (PNID); rostral skull width (RSkW); orbital skull width (OSkW); skull height (SkH); eye diameter (ED); snout height (SnH); prehyoid length (PhL); internal mandibular interdistance

(ImnID); external mandibular interdistance (EmnID); mouth width (MW) and skull roof width (SkR). Measurements of bilaterally paired structures were taken on the left side. The following counts were made using radiographs : number of ribs (RB), number of non-rib bearing precaudal vertebrae (NRPCV), precaudal vertebrae (PCV), caudal vertebrae (CV), total number of vertebrae, including those comprised in the vertebral complex of the Weberian apparatus (TV), dorsal- and anal-fin ray counts (DFR, AFR). Due to the high level of decalcification of some museum specimens not all meristics could be counted on the radiographs. Seven specimens were cleared and stained following Taylor & Van Dyke (1985).

A standard Discriminant Function Analysis (DFA) was performed on the metric dataset using statistica 6.0 (Statsoft, Inc.). The analysis involved all specimens, categorized in four a priori defined groups (based on geographic distribution and meristic data) as follows : (1) all specimens of the Woleu River system, including the type material of *Gymnallabes alvarezi* (N = 85), (2) specimens of the Ivindo River system, including type material of *Clariallabes longicaudatus* (N = 67), (3) specimens of the Middle Ogowe River system (N = 6) and (4) specimens from the following locations; uppermost Ogowe, near Magogo, Lésala and Ndengué, Republic of Congo and Ivindo, Makokou, Gabon (N = 17). Group diagnoses are further explained in the Results section below. Qualitative and absence/presence characteristics were not included in the analyses but help to further identify and discriminate the species.

RESULTS

Figure one shows that the specimens in group I can be separated from the other groups based on the high number of dorsal fin rays (110–160), as well as a high number of vertebrae (96–105). Group I includes all the specimens originating from the Woleu River system as well as the holotype of *G. alvarezi* (Fig. 2). The discriminant function analysis (Fig. 3) shows that group I differs significantly ($P < 10^{-6}$) from all other groups (Table 1). Group I is clearly separated along root 1, which is highly correlated with the pelvic fins being absent (Table 2). The three specimens from group I isolated along root 3 are three aberrant specimens with one pelvic fin (Table 3)

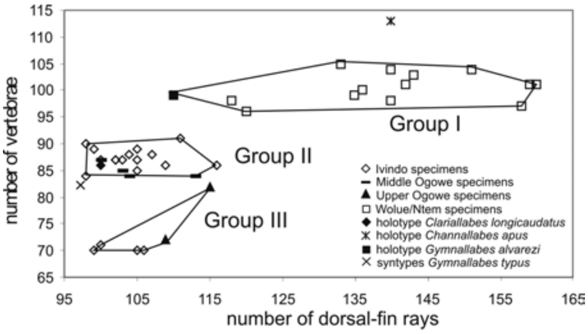

Fig. 1. – Scatterplot of dorsal fin rays counts against total number of vertebrae.

Secondly, group II includes most specimens from the Ivindo and Ogowe River System (Fig. 2) and can be separated by a lower number of both dorsal and anal fin rays (96–116 and 75–105 respectively) and vertebrae (82–91) compared to group I but still a higher number of vertebrae than the specimens in group III. The specimens from the Ivindo and the Middle Ogowe do overlap (Fig.1). However, the osteology of group II specimens allows distinguishing between both populations. The Ivindo specimens have an epiotic bone, which is absent in the Middle Ogowe specimens. Specimens from both populations have well developed serrations on the posterior edge of the pectoral spine, whereas the anterior edge of the pectoral spine is clearly serrated only in the Ivindo population. In the Middle Ogowe population serrations on the anterior edge are never as numerous and well–defined as in the Ivindo group (Fig. 4). The reduction of some of the skull bones is less extensive in the Middle Ogowe specimens. On the other hand, plate–like outgrowths of the sphenotic and pterotic of these specimens are more elaborate compared to those in the Ivindo specimens. Furthermore, in the Middle Ogowe specimens the posterior border of the mesethmoid is indented, bordering the anterior part of the anterior fontanel. This is not the case in the Ivindo specimens, with the fontanel being completely enclosed in the frontals. The discriminant function analysis shows not only that group II differs significantly ($P < 10^{-6}$) from each other group (Table 1), but also that the Ivindo specimens (Group IIa) are discriminated from the Middle Ogowe specimens (Group IIb) along root 3 (Fig. 3), based on the absence of pelvic fins of the Middle Ogowe specimens. Group II is separated from the other groups along root 1 (Table 2).

TABLE 1

Values of *P*–levels, F–values (upper right) and Squared Machalanobis distances (D^2, lower left) of all four groups, reflecting the significant discrimination between the groups.

	Group I (*C. alvarezi*)	**Group II (*C. longicaudatus*)**	**Group II (*C. ogooensis*)**	**Group III (*C. teugelsi*)**
Group I (*C. alvarezi*)		86.2*	12.9*	25.1*
Group IIa (*C. longicaudatus*)	86.8		6.5*	20.7*
Group IIb (*C. ogooensis*)	102.5	52.3		9.6*
Group III (*C. teugelsi*)	70.0	60.2	94.6	

* : $P < 0.000001$

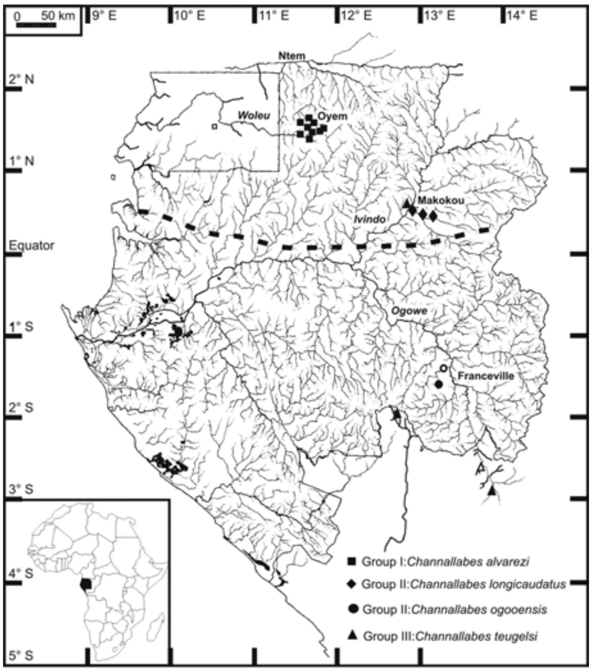

Fig. 2. – Geographic distribution of *C. alvarezi, C. longicaudatus, C. ogooensis* and *C. teugelsi* based on the localities of the examined specimens. Dotted line indicates the dividing line between the central and southern west coastal equatorial freshwater ecoregions. Open symbols are type localities. Holotype of *C. longicaudatus* not shown due to the ambiquity of the location.

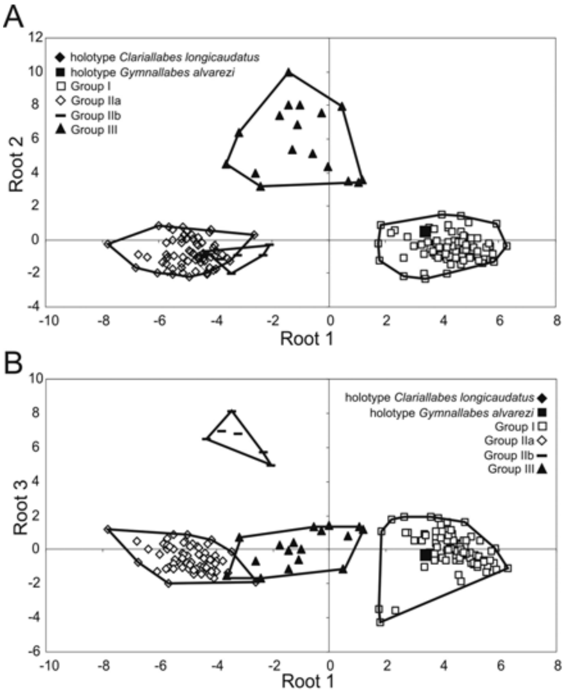

Fig. 3. – Discriminant Function Analysis (DFA) of four groups along (A) root 1 *vs*. root 2 and (B) root 1 *vs.* root 3. Group I : all specimens of the Woleu River system, including the type material of *Gymnallabes alvarezi* (N = 85), Group IIa : specimens of the Ivindo River system, including type material of *Clariallabes longicaudatus* (N = 67), Group IIb : specimens of the Middle Ogowe River system (N = 6) and Group III : specimens from the following locations; uppermost Ogowe, near Magogo, Lésala and Ndengué, Republic of Congo and Ivindo, Makokou, Gabon, with low number of vertebrae (N = 17).

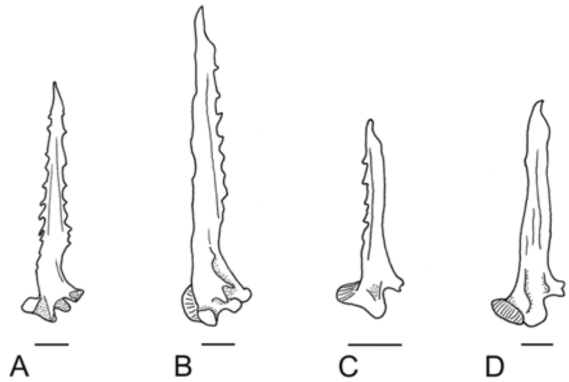

Fig. 4. – Illustrations of pectoral spine serrations (right pectoral fin). (A) both edges of the spine show strong serrations, pattern found in *C. longicaudatus*; (B) only the posterior edge of the spine shows strong serrations, anterior edge may show few, reduced serrations, pattern found in *C. ogooensis*; (C) only the anterior edge of the spine shows strong serrations, pattern found in *C. teugelsi*; (D) no serration found, pattern found in *C. alvarezi*.

TABLE 2

Factor loadings for the Discrimination Function Analysis. The most important loadings of each root are in bold. Abbreviations are defined in the text.

	Root 1	Root 2	Root 3
% of variance	78,3%	15,3%	6,4%
PAL	0,169408	**-0,681881**	-0,089365
PDL	0,162934	**-0,632736**	-0,108065
SPDFL	0,182599	**-0,617988**	-0,121439
PvFL	**-0,503113**	-0,142215	**-0,614812**
PcFL	-0,035329	**-0,571193**	0,054308
PcSL	-0,092248	**-0,642360**	0,045391
CPD	0,096979	-0,467579	-0,058974
ABD	0,104527	-0,506432	-0,036495
MxB	0,013148	-0,432189	0,072631
EMnB	-0,020167	-0,479219	0,047128
IMnB	0,019274	-0,389841	0,002671
NB	-0,004556	-0,371535	0,008710
SKL	0,111548	-0,511756	-0,056860
POL	0,127276	-0,459005	-0,071790
SPL	0,047255	-0,217631	-0,124983
SKW	0,057597	**-0,581935**	-0,047982
SPW	0,133996	-0,139753	-0,085663
IOD	0,043390	**-0,560181**	-0,065722
AIND	0,028406	-0,346476	0,057940
PIND	0,055437	-0,444574	-0,035375
RSKW	0,077946	-0,444793	-0,008590
OSKW	0,072724	-0,532620	-0,056747
SKH	0,130920	-0,409255	-0,148632
OD	0,060164	-0,387114	-0,097085
SnH	0,099646	**-0,598212**	-0,053530
OSKH	0,127567	-0,537991	-0,081838
PHL	0,095121	-0,486623	0,024198
IMnID	0,038383	-0,502322	-0,035450
EMnID	0,073970	-0,525558	-0,028242
MW	0,038949	**-0,576369**	0,021140
SKR	-0,059704	-0,479303	0,058735

Finally, Group III includes specimens from three locations in the uppermost Ogowe drainage and from one location in the Ivindo River basin (Fig. 2). The specimens of group III show an even lower number of vertebrae (70–82) than the two other groups (Fig. 1). The discriminant function analysis shows again the significant difference ($P < 10^{-6}$) with all other groups (Table 1, Fig. 3). Group III is mainly separated from the other groups along root 2 (Table 2).

Group I, includes all the specimens from the Woleu system as well as the holotype of *G. alvarezi*, and thus represents a homogenous group of specimens that should be referred to this species. The data presented here shows that group III is sufficiently distinct and consequently should be considered as representing a separate species which we describe as *C. teugelsi* n. sp. below. Group II assembles most Ivindo specimens, as well as the holotype of *Clariallabes longicaudatus,* a junior synonym of *G. typus*. As the syntype of *G. typus* does not cluster with this group (Fig. 1), we consider *Clariallabes longicaudatus* as a valid species and assign the group II Ivindo specimens to it (Fig. 1). Finally, the osteological traits of the Middle Ogowe specimens of group II differ considerably from congeners and support the hypothesis that these specimens represent an undescribed species, which we describe as *C. ogooensis* n. sp. below.

Consequently, the following species are recognized : *C. alvarezi, C. longicaudatus, C. ogooensis* n. sp. and *C. teugelsi* n. sp., *Gymnallabes alvarezi* and *Clariallabes longicauda* are rediagnosed, redescribed, and their new generic assignments discussed.

Channallabes alvarezi (Roman, 1970)

Gymnallabes alvarezi Roman, 1970 : 5, Fig. 1 (type locality : Rio Kie, cerca de Ebebiyin, Rio Muni)

Holotype : IBAB, 317mm SL; Equatorial Guinea : Rio Kie, close to Ebebiyin, Rio Muni, Roman, 1970.

Nontype material : MRAC A4-31-P-1-13, A4-31-P-14-18, A4-31-P-55-60, A4-31-P-76-77, A4-31-P-78-89, 38, 193–383mm, Gabon, Aben Lang, Metui, 1° 29'N-11° 36'E, D. Adriaens, June 2000. MRAC A4-31-P-19, MRAC A4-31-P-21, A4-31-P-24, A4-31-P-26, A4-31-P-30, A4-31-P-31, A4-31-P-32, A4-31-P-67-72, A4-31-P-90-93,17, 202–375mm, Gabon, Ebeigne, Woleu River, 1° 28'N-11° 36'E, S. Devaere, D. Adriaens, A. Herrel, September 2000. MRAC A4-31-P-20, A4-31-P-25, A4-31-P-27-28, A4-31-P-29, 5, 225-342mm, Gabon, Assok Ngomo, Woleu River, 1° 41'N-11° 39'E, S. Devaere, D. Adriaens, A. Herrel, September 2000. MRAC A4-31-P-22-23, 2, 301–412mm, Gabon, Okoallissis, Otolo, Otagna, Woleu River, 1° 31'N-11° 31'E, S. Devaere, D. Adriaens, A. Herrel, September 2000. MRAC A4-31-P-47-54, A4-31-P-73, 9, 160–398mm, Gabon, Zogongone, close to Oyem, 1° 34'N-11° 31'E, S. Devaere, D. Adriaens, A. Herrel, September 2000. MRAC A4-31-P-61-63, A4-31-P-74-75,5, 221–345mm, Gabon, Mbenga, close to Oyem, 1° 37'N-11° 41'E, S. Devaere, D. Adriaens, A. Herrel, September 2000. MRAC A4-31-P-64-65, A4-31-P-66, A4-31-P-94, A4-31-P-1-95-96, A4-31-P-97, A4-31-P-98, 8, 238–413mm, Gabon, Oyem, 1°36'N-11°34'E, S. Devaere, D. Adriaens, A. Herrel, September 2000.

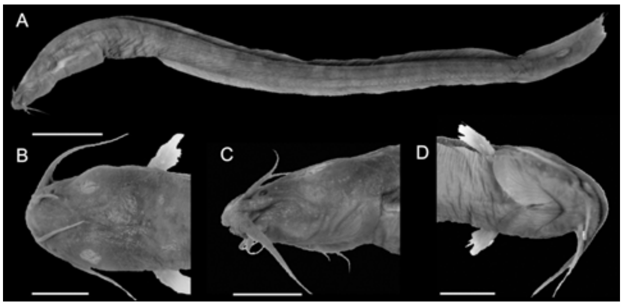

Fig. 5. – Holotype of *Channallabes alvarezi* (317mm SL), IBAB, (A) lateral view (scale = 35mm), (B) dorsal view of the head, (C) lateral view of the head and (D) ventral view of head. (scale = 10mm); (Photographs : Instituto de Biologia aplicada, Barcelona).

Diagnosis : *Channallabes alvarezi* can be recognized by the combination of following characters : a high number of vertebrae (92–105), no serrations on the pectoral spine (Fig. 4) and the body lateral line system is clearly visible as a white dotted line along the flank. It differs from all other *Channallabes,* except *C. apus*, in lacking a pale spot on the skull roof, and in a high number of dorsal and anal fin rays (110–160 *vs.* 98–116 and 101–155 *vs.* 75–105 respectively). It can be distinguished from *C. apus*, by the absence of an interdigitating joint between the entopterygoid and the quadrate and the presence of a large, well-pronounced supraorbital process on the fourth infraorbital, reaching the rostral border of the eye (Fig. 6A).

Description : Measurements and meristics for holotype and additional specimens given in Table 3. *Channallabes alvarezi* has a very elongated body (ABD 3.2–7.2% SL), preanal length 17.7–38.8% SL (Fig. 5), very short skull length, 5.8–13.8% SL. Skull width 55.6–90.7% of skull length. Very narrow skull roof, width 12.0–31.1% of skull length, remains clearly visible between bulging jaw muscles. Eyes small, but visible. Tube-like anterior nostrils small. Upper lip extends slightly beyond lower lip.

Fleshy, unpaired fins continuous. Pectorals fins always present, length 2.5–7.2% SL, with a small, unserrated pectoral spine, length of 1.3–5.4% SL. Seven branched pectoral fin rays. Pelvic fins present in only three specimens; in other specimens (n = 82) no evidence of pelvic fins. Vertebrae 92–105 (mode = 102). Ribs 12–14 (mode = 14). Branchiostegal rays 8. Dorsal fin rays 110–160. Anal fin rays 101–155.

Reduced lateral plate of frontal, only reaches up to level of orbitosphenoid (Fig. 7A). Narrow skull roof. Comparably reduced plate-like outgrowth present on posttemporo-supracleithral bone. Epiotic always absent. One or two small suprapreopercular bones present, with small plate-like outgrowth on proximal one. On prevomer, one or two posterior processes present. Entopterygoid contacting metapterygoid only on rostro-dorsal side of latter. Posteriorly on hyomandibula, three processes caudally increasing in length are present for interdigitation with neurocranium (Devaere et al., 2001; Fig. 6). Oral teeth present on dentary, premaxilla and prevomer.

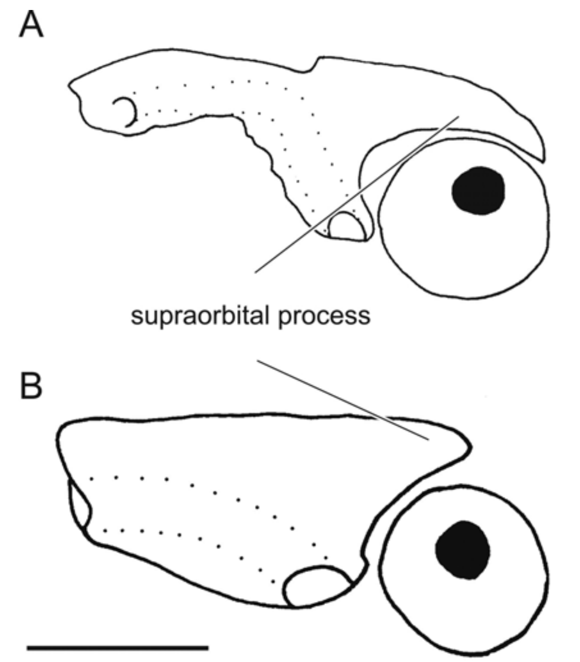

Fig. 6. – Illustration of the extent of the supraorbital process of infraorbital IV (right lateral view). (A) supraorbital process reaching the rostral border of the eye, pattern found in *C. longicaudatus*, *C. ogooensis*, *C. teugelsi* and *C. alvarezi* ; (B) supraorbital process not reaching the rostral border of the eye, pattern found in *C. apus* (scale = 1mm).

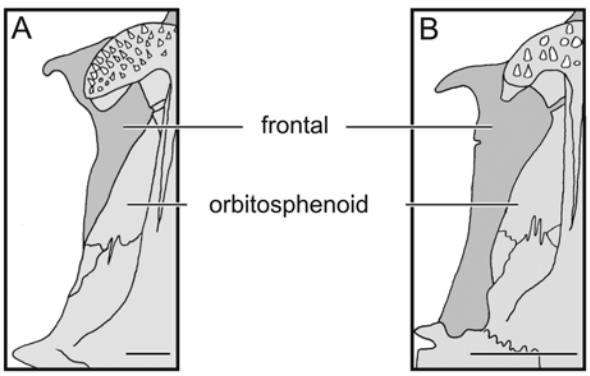

Fig. 7. – Illustration of the extent of the lateral plate of the frontal in relation to the orbitosphenoid (ventral view). (A) lateral plate reaches up to the lateral margin of the orbitosphenoid (scale = 1mm) ; (B) lateral plate extends more laterally than the margin of the orbitosphenoid (scale = 5mm).

Colour : Alcohol preserved specimens gradually fade from dark brown on dorsal side to whitish brown on ventral side. Both sides separated by white dotted line of lateral line. Skin on jaw muscles has paler brownish colour than surrounding skin of head. Barbels have darkish-brown coloration. *Channallabes alvarezi* shows no distinct pale region on skull roof.

Distribution : Currently known from the Woleu River system in the region of Oyem, Gabon, type locality is Equatorial Guinea (Fig. 2).

Channallabes longicaudatus (Pappenheim, 1911)

Clariallabes longicaudatus Pappenheim, 1911 : 519, Fig. 3 (type locality : in der Mabelle, Süd–Kamerun)

Holotype : ZMB 18401, Zoologisches Museum, Humboldt Universitat (ZMHU), Berlin, 220mm SL; in der Mabelle, South Cameroon, Pappenheim, 1911.

Nontype material : MRAC A4-31-P-99-105, A4-31-P-137-151, A4-31-P-152-157, A4-31-P-159-162, A4-31-P-163-164, 34, Gabon, Makokou, River Ivindo, 0° 33'N-12° 51'E, S. Devaere, D. Adriaens, A. Herrel, September 2000. MRAC A4-31-P-106-131, A4-31-P132-136, 31, Gabon, Etakaniabe, River Liboumba, 0° 31'N-12° 59'E, S. Devaere, D. Adriaens, A. Herrel, September 2000. MRAC A4-31-P-158, 1, Gabon, Iyoko, Makokou, 0°32'N-12° 54'E, S. Devaere, D. Adriaens, A. Herrel, September 2000.

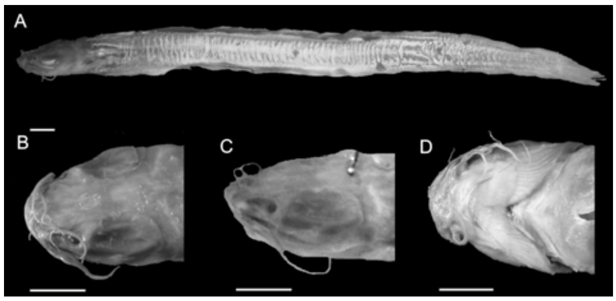

Fig. 8. – Holotype of *Channallabes longicaudatus* (220mm SL), ZMB 18401, (A) lateral view, (B) dorsal view of the head, (C) lateral view of the head and (D) ventral view of head. (scale = 10mm) ; (Photographs : Museum für Naturkunde der Humboldt-Universitaet, Berlin).

Diagnosis : *Channallabes longicaudatus* differs from *C. alvarezi*, *C. ogooensis* and *C. teugelsi* in having clear serrations on both sides of the pectoral spine (Fig. 4). *Channallabes longicaudatus* can be distinguished from *C. alvarezi* in the low number of dorsal and anal fin rays (98–116 *vs.* 110–160 and 75–105 *vs.* 101–155 respectively) and the presence of a pale spot on the skull roof. Further, it differs from *C. apus* in the presence of an interdigitation between entopterygoid and quadrate and in a large, well-pronounced supraorbital process on the fourth infraorbital, reaching the rostral border of the eye (Fig. 6A). Additionally, *C. longicaudatus* can be differentiated from *C. ogooensis* by the presence of an epiotic and a straight posterior edge of the mesethmoid, leaving the anterior fontanel completely enclosed by the frontal bones.

Description : Measurements and meristics for holotype and additional specimens given in Table 3. *Channallabes longicaudatus* has an elongated body (ABD 4.0–9.8% SL), preanal length 27.3–43.0% SL (Fig. 8). Very short skull length to SL ratio (8.7–15.9%). Skull width 64.4–79.6% of skull length. Skull roof always exposed, width 13.3–42.0% skull length. Eyes always visible. Whitish tube-like anterior nostrils strikingly visible. Lower lip clearly shorter than upper lip.

Unpaired fins continuous. Pectorals always present, length 5.0–9.7% SL, with a firm pectoral spine, length

2.9–6.8% SL. Both edges of pectoral spine serrated. Nine branched pectoral fin rays. Pelvic fins mostly present except in one specimen (intraspecific variation at this level already described by ADRIAENS et al. (2002)). Vertebrae 84–91 (mode = 88). Ribs 12–14 (mode = 13). Branchiostegal rays 8–9. Dorsal fin rays 98–116. Anal fin rays 75–105.

Lateral plate of frontal, broader than orbitosphenoid (Fig. 7B). Narrow skull roof. No other plate-like outgrowths present. Epiotic present. Only one suprapreopercular bone present. Entopterygoid contacting metapterygoid completely on rostro-dorsal side and partially on ventral side. Three processes present on hyomandibular–neurocranium connection, increasing in size caudally. Posterior border of mesethmoid forms a straight line. Teeth present on dentary, premaxilla and prevomer.

Colour : Alcohol preserved specimens light brown colour, gradually becoming more pale ventrally. Undefined paler median line present. *Channallabes longicaudatus* shows well-defined pale spot on skull roof, due to lighter thinning of neurocranium in that area.

Distribution : Due to the ambiguity of the type locality, no complete distribution can be given. Currently known from the Ivindo River system. This species mainly occurs in the Makokou region, Gabon (Fig. 2).

Channallabes ogooensis, new species

Holotype : MRAC A4-31-P-170, 150mm SL, Moanda, Gabon (1° 33'S-13° 16'E), S. Devaere, D. Adriaens and A. Herrel, September 2000.

Paratypes : MRAC A4-31-P-165-169, 5, 109–244mm, Gabon, Malima, River Kahjaka Kanjaka, 1° 40'N-13° 20'E, S. Devaere, D. Adriaens, A. Herrel, September 2000.

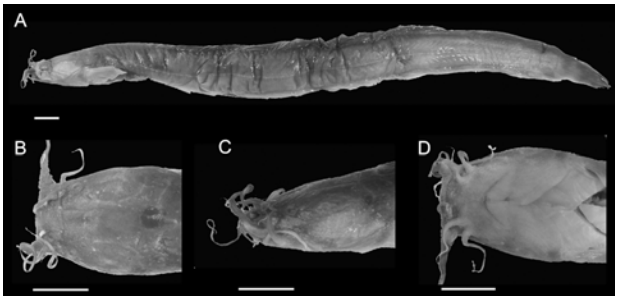

Fig. 9. – Holotype of *Channallabes ogooensis* (150mm SL), MRAC A4-31-P-170, (A) lateral view (scale = 65mm), (B) dorsal view of the head, (C) lateral view of the head and (D) ventral view of head. (scale = 10mm); (Photographs : S. Devaere).

Diagnosis : *Channallabes ogooensis* differs from *C. longicaudatus* and *C. teugelsi* by numerous and distinct serrations on posterior edge of the pectoral spine only (anterior edge shows a more irregular serration pattern) (Fig. 4). Additionally, *Channallabes ogooensis* differs from *Channallabes longicaudatus* by the absence of an epiotic, several skull bones show plate-like outgrowths (sphenotic and pterotic) giving the skull an overall less reduced appearance and the posterior border of the mesethmoid is indented, such that the anterior part of the anterior fontanel is bordered by the mesethmoid. *Channallabes ogooensis* can be distinguished from *Channallabes alvarezi* in the low number of dorsal and anal fin rays (100–113 *vs.* 110–160 and 85–102 *vs.* 101–155 respectively) and the presence of a pale spot on the skull roof. Further, it differs from *C. apus*, in the presence of an interdigitating joint between entopterygoid and quadrate, as well as the presence of a large, well-pronounced supraorbital process on the fourth infraorbital, reaching the rostral border of the eye (Fig. 6A).

Description : Measurements and meristics for holotype and additional specimens given in Table 3. *Channallabes ogooensis* has elongated body (ABD up to 5.7–7.5% SL), preanal length 28.4–36.2% SL (Fig. 9). Short skull length, 12.0–13.8% SL. Skull width 68.4–73.4% of the skull length. Skull roof always clearly visible, width 16.1–32.9% of skull length. Eyes always visible. Whitish tube-like anterior nostrils clearly visible. Lower lip clearly shorter than upper lip.

Unpaired fins continuous. Pectorals always present, length 6.4–11.1% SL, with a firm pectoral spine, length 4.4–7.1% SL. Both edges of pectoral spine serrated, with anterior edge more irregularly serrated. Eight branched pectoral fin rays. Pelvic fins always absent. Vertebrae 84–87 (mode = 84). Ribs 12–13 (mode = 12). Branchiostegal rays 8–9. Dorsal fin rays 100–113. Anal fin rays 85–102.

Less extensive reduction of the neurocranium (compared to *C. alvarezi, C. longicaudatus* and *C. teugelsi)* evident by presence of lateral plate on frontal, wider than the orbitosphenoid (Fig. 7B) and presence of limited plate-like outgrowth on posttemporo-supracleithrum, pterotic and sphenotic. Narrow skull roof. Epiotic absent. Only one suprapreopercular bone present. Posterior border of mesethmoid shows clear indentation, bordering anterior fontanel. Entopterygoid contacting metapterygoid completely rostro-dorsal side and also partially on ventral side. Hyomandibular–neurocranium connection comprising of two processes. Teeth present on dentary, premaxilla, and prevomer

Colour : Alcohol preserved specimens are brown, gradually becoming lighter ventrally. Indefinite paler median line present, which connects different pores of lateral line system. *Channallabes ogooensis* shows well-defined pale spot on skull roof, due to lighter pigmentation of neurocranium in that area.

Distribution : Currently known from the Ogowe River system. The specimens appear in the Franceville region, Gabon (Fig. 2).

Etymology : Named for the Ogowe River where the species is found.

Channallabes teugelsi, new species

Holotype : MRAC 78-22-P-1046, 80mm SL, Magogo, 1km from Lékoli, Komono-Sibiti road, Rep. Congo (2° 36'S-13° 38'E), W. Wachters, July 1978.

Paratypes : MRAC 78-22-P-1047-050, 4, 87–144.6mm, Rep. Congo, Zanaga, Lésala, River Ogowe, 2° 46'S-13° 50'E, W. Wachters, July 1978. MRAC 78-22-P-1051, 1.51mm, Rep. Congo, Ndengué, Moungoundou-Ndziba-Ndziba road, 2° 50'S-12° 41'E, W. Wachters, July 1978. MRAC 75-24-P-683-693, 11, 31–97mm, Gabon, Loa Loa, M'Passa, Makokou, 0° 34'N-12° 45'E, A. Heymer, November 1974.

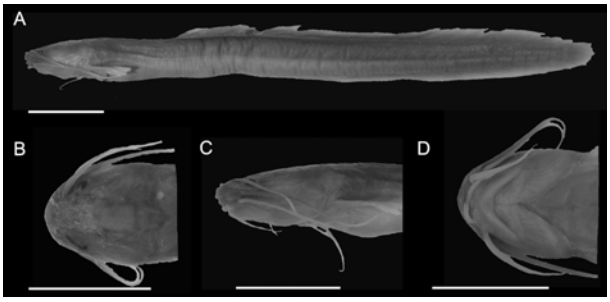

Fig. 10. – Holotype of *Channallabes teugelsi* (80mm SL), MRAC 78-22-P-1046, (A) lateral view, (B) dorsal view of the head, (C) lateral view of the head and (D) ventral view of head. (scale = 10mm); (Photographs : S. Devaere).

Diagnosis : *Channallabes teugelsi* differs from *C. longicaudatus* and *C. ogooensis* by serrations on the anterior edge of the pectoral spine only (Fig. 4). *Channallabes teugelsi* can be distinguished from *C. alvarezi* in the low number of dorsal and anal fin rays (99–109 *vs.* 110–160 and 90–100 *vs.* 101–155 respectively) and the presence of a pale spot on the skull roof. Further, it differs from *C. apus* in the presence of an interdigitation between entopterygoid and quadrate and in a large, well-pronounced supraorbital process on the fourth infraorbital, reaching the rostral border of the eye (Fig. 6A). *Channallabes teugelsi* can be diagnosed by the combination of following characters : a number of vertebrae that ranges between 70–82 and a lower lip that reaches almost equally far as the upper lip.

Description : Measurements and meristics for holotype and additional specimens given in Table 3. Body elongate, but not as extreme as other three described species, ABD 6.0–11.6% SL. Preanal length 29.8–40.6% SL (Fig. 10), indicating smaller tail section than *C. alvarezi, C. longicaudatus* and *C. ogooensis*. Skull length 12.2–27.0% SL. Skull width 45.4–71.5% of skull length. Narrow skull roof, width 14.9–57.8% of skull length, clearly visible. Eyes small, remain visible. Whitish tube-like anterior nostrils clearly present. Lower lip almost reaches upper lip.

Unpaired fins continuous. Pectoral fin length 4.5 – 11.3% SL, small pectoral spine, length 2.9–4.6% SL, sometimes present. Pelvic fin length 3.8–7.0% SL. No evidence of pelvic fins in four specimens (MRAC 8-22-P-1047-050). Only anterior edge of pectoral spine serrated. Nine branched pectoral fin rays. Vertebrae 70–82 (mode = 72). Ribs 10–12. Branchiostegal rays 8. Dorsal fin rays 99–109. Anal fin rays 90–100.

Lateral plate on frontal wider than orbitosphenoid (Fig. 7B). Distinct plate-like outgrowth on posttemporo-supracleithrum present. Epiotic always present. Two suprapreopercular bones always present, proximal one with plate-like process. Two posterior processes present on prevomer. Entopterygoid contacting metapterygoid on rostro-dorsal side and partially on ventral side of latter. Two extended processes present on hyomandibula, for interdigitating with pterotic. Teeth present on dentary, premaxilla and prevomer.

Colour : Alcohol preserved specimens equally light brown along the whole body. Clear whitish spot on the skull roof, between the anterior and posterior fontanel, due to lighter thinning of the neurocranium in that area.

Distribution : Currently known from the Ivindo River system in the region of Makokou, Gabon and the Ogowe River system in the region of Zanaga, Ndengué and Magogo, Rep. Congo (Fig. 2).

Etymology : Named after the late Guy Teugels, as a tribute to his career and his efforts on African catfish taxonomy, especially Clariidae.

TABLE 3

Measurements and meristic data for the four *Channallabes* species from Gabon and Republic of Congo. Abbreviations are defined in the text. *N*–values (in parentheses) vary because measurements and meristics were excluded from specimens with damage or unusual preservation artefacts.

	Channallabes alvarezi **(Roman, 1970)** **(*N* = 85)**			***Channallabes longicaudatus*** **(Pappenheim, 1911)** **(*N* = 67)**			***Channallabes ogooensis*** **sp. n.** **(*N* = 6)**			***Channallabes teugelsi*** **sp. n.** **(*N* = 16)**		
	Holo-type	**Range**	**Mean ± SD**	**Holo-type**	**Range**	**Mean ± SD**	**Holo-type**	**Range**	**Mean ± SD**	**Holo-type**	**Range**	**Mean ± SD**
TL (mm)	329	169–445		241	102–323		169	120–223		85	36–155	
SL (mm)	318	150–413		220	95–295		150	109–200		80	31–145	
Measurements in % standard length												
PaL	24.1	17.7–38.8	26.0 ± 2.5	30.7	27.3–43.0	32.7 ± 2.3	35.6	28.4–36.2	34.0 ± 3.0	33.9	29.8–40.6	35.6 ± 3.3
PPvL		23.4–28.3 (3)	26.2 ± 2.5	27.8	21.7–43.0	30.5 ± 2.6				32.1	32.0–37.8 (12)	34.7 ± 2.3
PPcL	8.2	5.5–13.3	8.6 ± 1.0	12.0	10.2–17.2	12.3 ± 1.2	13.3	11.3–13.4	12.5 ± 0.9	14.1	11.6–20.8	16.0 ± 2.8
PdL	16.9	15.2–27.5	18.9 ± 1.7	22.3	20.9–33.8	24.3 ± 2.4	27.5	21.4–27.5	24.4 ± 2.1	25.4	24.5–36.0	29.0 ± 3.7
SPDFL	10.1	6.6–13.1	10.2 ± 1.1	10.6	9.1–17.6	11.6 ± 1.7	13.1	9.3–13.1	11.2 ± 1.3	11.2	8.3–15.8	12.0 ± 1.7
PvFL		2.1–2.2 (3)	2.2 ± 0.1	4.3	1.9–5.6	3.8 ± 0.7				4.0	3.8–7.0 (12)	5.5 ± 1.0
PcFL	3.6	2.5–7.2	3.4 ± 0.6	5.4	5.0–9.7	6.7 ± 1.2	7.2	6.4–11.1	7.9 ± 1.8	7.5	4.5–11.3	5.3 ± 2.2
PcSL	1.6	1.3–5.4	2.0 ± 0.5	2.9	2.9–6.8	4.6 ± 0.7	5.4	4.4–7.1	5.5 ± 1.1	4.4	2.9–4.6 (9)	3.8 ± 0.7
CPD	1.8	1.4–3.6	2.1 ± 0.3	2.1	2.0–8.2	3.1 ± 0.8	3.6	2.6–3.9	3.2 ± 0.5	3.4	2.9–5.9	4.2 ± 0.9
ABD	4.8	3.2–7.2	4.4 ± 0.6	6.2	4.0–9.8	6.3 ± 0.9	7.1	5.7–7.5	6.9 ± 0.7	6.4	6.0–11.6	8.6 ± 1.7
IpvD		1.1 (3)	1.1 ± 0.01	2.3	1.5–5.3	2.5 ± 0.6				2.3	2.2–4.9 (12)	3.3 ± 0.8
IpcD	5.8	3.2–9.3	5.2 ± 0.8	7.7	6.3–10.6	8.4 ± 0.8	9.3	8.1–9.6	9.1 ± 0.7	8.5	7.5–15.7	11.7 ± 2.9
SkL	7.6	5.8–13.8	8.5 ± 1.0	11.8	8.7–15.9	12.3 ± 1.1	13.8	12.0–13.8	13.0 ± 0.6	14.6	12.2–27.0	19.0 ± 5.0

TABLE 3

MEASUREMENTS AND MERISTIC DATA FOR THE FOUR *Channallabes* SPECIES FROM GABON AND REPUBLIC OF CONGO. Abbreviations are defined in the text. *N*–values (in parentheses) vary because measurements and meristics were excluded from specimens with damage or unusual preservation artefacts.

	***Channallabes alvarezi* (Roman, 1970) (*N* = 85)**			***Channallabes longicaudatus* (Pappenheim, 1911) (*N* = 67)**			***Channallabes ogooensis* sp. n. (*N* = 6)**			***Channallabes teugelsi* sp. n. (*N* = 16)**		
	Holotype	**Range**	**Mean ± SD**	**Holotype**	**Range**	**Mean ± SD**	**Holotype**	**Range**	**Mean ± SD**	**Holotype**	**Range**	**Mean ± SD**
Measurements in % head length												
PoL	76.9	62.9–97.2	71.0 ± 4.3	69.0	62.5–92.0	68.4 ± 3.6	68.5	64.3–68.7	67.1 ± 1.7	72.2	62.5–87.0	74.4 ± 6.9
SpL	21.4	8.3–24.3	14.0 ± 3.4	16.0	7.8–24.0	15.0 ± 2.8	16.5	6.4–16.5	12.8 ± 2.6	18.6	13.0–28.6	20.0 ± 3.2
SkW	88.5	55.6–90.7	64.6 ± 5.3	69.0	64.4–79.6	71.5 ± 4.8	68.4	68.4–73.4	71.1 ± 2.0	63.4	45.4–71.5	57.8 ± 8.0
SpW	21.8	11.9–39.7	21.1 ± 6.5	16.2	10.8–28.8	16.7 ± 3.5	22.7	11.3–22.7	15.4 ± 3.9	29.2	18.6–33.6	27.1 ± 4.1
IoD	41.8	23.7–43.6	31.6 ± 3.2	38.4	30.0–50.0	36.0 ± 3.1	36.9	30.0–37.8	34.6 ± 2.9	35.2	24.9–35.2	30.2 ± 3.0
ANID	15.5	6.9–20.6	13.1 ± 2.5	12.0	8.3–25.0	15.0 ± 2.7	19.6	15.2–19.8	17.1 ± 2.2	17.3	12.1–20.7	16.4 ± 2.0
PNID	39.6	19.8–39.6	24.8 ± 2.7	28.1	20.9–36.3	27.4 ± 3.1	27.5	26.2–29.5	27.4 ± 1.2	34.4	23.3–34.4	28.0 ± 2.9
RSkW	46.0	27.9–46.2	35.2 ± 3.6	35.7	14.5–49.1	36.6 ± 4.2	36.7	35.2–44.3	38.6 ± 3.6	42.7	25.6–42.7	37.7 ± 4.7
OSkW	59.0	36.1–65.2	48.5 ± 4.1	49.2	25.5–73.0	52.1 ± 5.2	51.8	48.5–56.3	51.2 ± 2.7	49.9	40.0–52.4	46.8 ± 3.6
SkH	54.4	35.1–64.8	47.8 ± 7.6	46.1	32.9–65.6	43.1 ± 5.5	39.1	20.1–41.0	36.4 ± 8.0	41.5	33.1–52.0	41.8 ± 5.9
ED	11.3	5.0–11.3	7.1 ± 1.1	7.2	5.9–13.3	7.8 ± 1.4	6.6	5.3–9.4	7.2 ± 1.5	6.7	6.7–11.8	8.7 ± 1.3
SnH	26.0	13.3–32.0	18.2 ± 2.9	17.6	12.3–24.5	18.0 ± 2.5	19.7	14.8–19.7	18.0 ± 1.7	17.5	7.7–17.5	13.4 ± 2.6
OSkH	35.6	23.5–44.2	32.8 ± 4.7	29.6	23.0–55.5	30.1 ± 4.9	28.4	25.3–31.9	28.7 ± 2.2	32.4	17.1–32.3	24.4 ± 4.4
PhL	48.1	20.1–39.7	28.9 ± 4.9	22.9	20.2–35.0	28.5 ± 3.7	33.8	27.6–34.6	32.2 ± 2.6	25.8	19.1–30.3	24.9 ± 3.2
IMnID	33.1	16.3–33.1	22.2 ± 2.6	35.1	17.7–40.6	25.4 ± 3.5	24.6	23.7–27.7	25.2 ± 1.4	22.7	13.2–25.3	20.8 ± 3.5
EMnID	44.1	29.1–47.4	35.1 ± 3.2	37.1	25.6–53.3	37.4 ± 3.7	35.8	35.8–42.9	38.4 ± 2.7	40.0	25.0–40.0	33.4 ± 4.7
MW	36.4	19.4–40.9	29.1 ± 4.5	32.5	23.8–46.6	33.1 ± 3.8	33.3	33.7–38.8	36.4 ± 2.0	33.7	19.0–33.7	27.4 ± 5.0
SkR	11.5	12.0–31.1	18.3 ± 4.1	23.9	13.3–42.0	24.2 ± 6.1	22.6	16.1–32.9	26.0 ± 6.1	21.4	14.9–57.8	26.7 ± 11.1
Meristics		**Mode**			**Mode**			**Mode**			**Mode**	
RB	14	12–14 (76)	14	12	12–14 (52)	13	12	12–13	12	12	10–12 (3)	
TV	99	92–105 (76)	102	86	84–91 (52)	88	84	84–87	84	72	70–82 (6)	72
DFR	110	118–160 (16)	135	>100	98–116 (15)	105	104	100–113 (4)			99–109 (5)	
AFR	101	105–155 (16)	120	>100	75–105 (15)	98	88	85–102 (4)			90–100 (5)	100

Key to the species of *Channallabes*

1a Large, well-pronounced supraorbital process present on infraorbital IV (Fig. 6A), reaching rostral border of eye; fenestra between scapulo-coracoid and cleithrum present; no contact between entopterygoid and quadrate, in Gabon and Republic of Congo 2

1b Small supraorbital process on infraorbital IV (Fig. 6B), not reaching rostral border of eye; fenestra between scapulo–coracoid and cleithrum absent; interdigitation between entopterygoid and quadrate . . . . *C. apus*

2a Spot present on skull roof between anterior and posterior fontanel, low number of dorsal (98–116) and anal (75–105) fin rays. 3

2b No spot present on skull roof, high number of dorsal (110–160) and anal (101–155) fin rays. . . . *C. alvarezi*

3a Serrations only on the posterior edge of the pectoral spine (Fig. 2B) . . . . *C. ogooensis* n. sp.

3b Serrations only on the anterior edge of the pectoral spine (Fig. 2C) . . . . *C. teugelsi* n. sp.

3c Serrations on both edges of the pectoral spine (Fig. 2A) . . . . *C. longicaudatus*

DISCUSSION

Generic diagnoses

The four species recognized in this study are all assigned to the genus *Channallabes*, as well as the ones formerly assigned to *Gymnallabes* (*G. alvarezi*) and *Clariallabes* (*C. longicaudatus*). This generic transfer relies especially on osteological similarities between the species of *Channallabes* on the one hand and differences with other *Gymnallabes* and *Clariallabes* species on the other hand. Those diagnostic characters are discussed below and listed in Table 4.

Gymnallabes : we diagnose *Gymnallabes* by the combination of the following characters. Lateral skull bones are extremely reduced. The infraorbital series consists of small, tubular bones, lacking any plate-like processes. Consequently, infraorbital IV lacks a supraorbital process. The suprapreopercular bones similarly lack any plate-like outgrowth. Plate-like extensions of the frontal, sphenotic and pterotic bones are absent thus exposing the dorsal side of the adductor mandibulae complex completely (Fig. 11A–C).

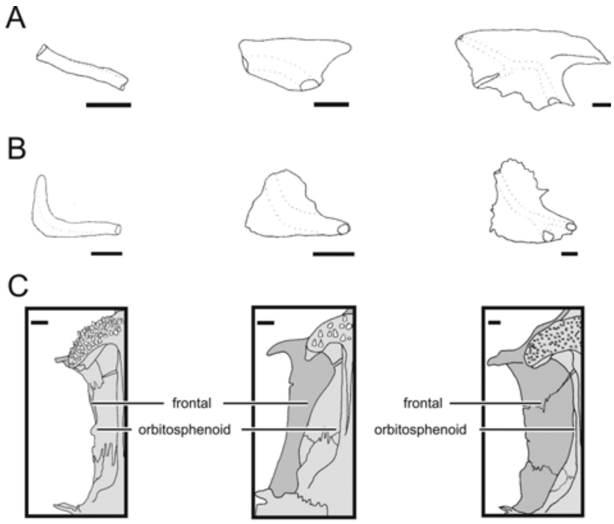

Fig. 11. – Illustration of the most important generic diagnostic characters of *Gymnallabes*, *Channallabes* and *Clariallabes* (left to right). (A) size of the plate–like extensions on the fourth infraorbital, (B) size of the plate–like extensions on the proximal suprapreopercular bone, (C) ventral view of the lateral plates of the frontals (scale = 1mm).

Clariallabes : the complex genus *Clariallabes* is characterized by an elongated body, that is somewhat intermediate between that of most species of *Clarias* and the extremely anguilliform genera (postanal length in *Clariallabes* between 50–65% SL). *Clariallabes* can be diagnosed by the combination of the following characters. The lateral skull bones (infraorbitals and suprapreoperculars) are quite large in *Clariallabes*, all bearing a clear plate-like outgrowth (Fig. 11A, B). A small gap is present between the fourth infraorbital and suprapreopercular bone. The lateral plates of the frontals (Fig. 11C), sphenotics and pterotics are large, covering the adductor mandibulae complex partially. The first dorsal fin pterygiophore is situated anterior to the sixth post-Weberian vertebrae. The dorsal and anal fins are not or only partially confluent with the caudal fin, with the different fins clearly distinguishable (Teugels et al., unpubl.). It has to be noted that little is known about the osteology of *Clariallabes* species, or of interspecific variation within the genus. The diagnosis given above is based on the current knowledge of species like *C. melas, C. longicauda* and *C. mutsindoensis*.

Channallabes : the following combination of characters helps to discriminate *Channallabes*; the infraorbitals are reduced but the third and fourth infraorbitals still bear a small plate-like outgrowth (Fig. 11A). On the fourth infraorbital a supraorbital process is present, partially or completely bordering the eye dorsally (Fig. 6). The suprapreopercular bones are reduced but a small plate-like extension is present on the proximal one (Fig. 11B). The lateral plates of the frontals are reduced, reaching only slightly more lateral than the orbitosphenoid (Fig. 7, 11C). Finally, the first dorsal fin pterygiophore is situated posterior to the sixth post-Weberian vertebrae.

TABLE 4

Comparison among *Channallabes, Gymnallabes* and *Clariallabes*

	Channallabes	***Gymnallabes***	***Clariallabes***
Size of the infraorbital bones	bears small plate-like outgrowths (especially posterior most ones)	tubular	bears large plate-like outgrowths
Size of the suprapreopercular bones	bears small plate-like outgrowths (especially proximal one)	tubular	bears large plate-like outgrowths
Extent of lateral plates on frontals	equals or slightly exceeds the boundaries of the orbitosphenoid	absent	largely exceeds the boundaries of the orbitosphenoid
Lateral plates on sphenotic and pterotic	absent	absent	present
Supraorbital process on infraobital IV	present	absent	present
Position of first dorsal fin pterygiophore	posterior to sixth post-Weberian vertebrae	anterior to sixth post-Weberian vertebrae	anterior to sixth post-Weberian vertebrae

As for the other (monotypic) genera of anguilliform clariids, the unique combination of characters presented here, clearly separates them from *Channallabes* and *Gymnallabes. Platyallabes* has a very small distance between the origin of the dorsal fin and the supraoccipital process (2.2–6.6% SL), two separate tooth plates on the prevomer and no suprabranchial organ (Devaere et al., 2005). *Platyclarias* is recognized by an extremely flattened skull (22.9% – 37.1% of SkL) and the presence of an extra muscle (musculus adductor mandibulae A_3'' pars levator tendinis) in the adductor mandibulae complex. (Devaere et al., 2006). *Dolichallabes* is characterized by the presence of a single fontanel on the skull roof and the antorbital and infraorbital IV as the only circumorbital bones present (Devaere et al., 2004).

Species belonging to *Channallabes*

The current analysis of anguilliform clariids of the Lower Guinea enables us to formulate three conclusions with respect to species of the genus *Channallabes* : (1) *Gymnallabes alvarezi* needs to be transferred to *Channallabes*; (2) the nominal species *Clariallabes longicaudatus* needs to be resurrected but transferred to

Channallabes; and (3) two new species belonging to *Channallabes* can be recognized. This adds the total number of valid species of *Channallabes* in the Lower Guinea ichthyological province to four species, with another two species known from the Congo basin (*C. apus* and a new species under description).

Differences between *C. apus* of the Congo basin and the Lower Guinea species are apparent both genetically (JANSEN et al., 2006) and osteologically. For example, *C. apus* differs in having an articulation process on the second infraorbital that never contacts with the lateral ethmoid (an obvious contact is found in the Lower Guinea taxa). Also, *C. apus* is distinct in bearing an interdigitating joint between the entopterygoid and the quadrate (DEVAERE et al., 2001) and in the absence of a fenestra between the scapulo-coracoid and the cleithrum.

The distinction between *C. alvarezi* and the other new species is clear and based on several characteristics, as noted by DE SCHEPPER et al. (2004). It is the only Lower Guinea species lacking a pale spot on the head and is characterized by a high number of dorsal and anal fin rays.

Channallabes teugelsi can be distinguished from the other Lower Guinea species mainly based on meristic characters, especially the low number of vertebrae, with a maximum of 82 (Fig. 1). Even though these specimens are small, size-related allometry could not explain the low vertebral count. Moreover, an independence of the total number of vertebrae from the length of the fish has been reported for fishes in general as well (LANDRUM & DARK, 1968).

Channallabes longicaudatus and *C. ogooensis* show the greatest overall similarity, and as a group can easily be distinguished from the rest (Fig. 1). Several qualitative, osteological features are useful in their discrimination, such as serrations on both edges of the pectoral spine in *C. longicaudatus* (instead of only on the posterior edge) and the presence of the epiotic in *C. longicaudatus* (absent in *C. ogooensis*). In addition, the indented mesethmoid distinguishes *C. ogooensis* from *C. longicaudatus*.

The geographic distribution shows that the four species mainly occur in the following large river systems : *C. alvarezi* occurs in the Woleu and the other species originate mainly from the Ivindo/Ogowe. While *C. teugelsi* can be found both in the Ogowe and Ivindo, *C. longicaudatus* is situated mainly in the Ivindo River (the exact type locality is unclear), and *C. ogooensis* only in the Ogowe River (more specifically upstream from the confluence of the two large rivers). According to THIEME et al. (2004), these locations are located in two separate freshwater ecoregions : the central west coastal equatorial and the southern west coastal equatorial, respectively. The northern tributaries of the Ogowe River (Abanga, Okano and Ivindo) are included in the central west coastal equatorial freshwater ecoregion because of faunal affinities with the other rivers of that ecoregion, and show less affinity with the mainstem Ogowe (THIEME et al., 2004).

Because of biased sampling, *i.e.* swamps generally being less sampled than rivers, the occupation of that swampy niche by the anguilliform clariids could explain the possible non-continuous distribution of *C. teugelsi* in the Ogowe and Ivindo. Additional targeted sampling would be required to verify this.

As a consequence of the reassignment of several species in different genera, as well as the description of new species with a more elaborate analysis of intraspecific and interspecific biometric ranges presented in this paper, an updated key based on that of POLL (1977) to the genera of the African Clariidae is presented here.

Key to the genera of the African Clariidae

1a Adipose fin absent or very short (less than 25% SL); more than 50 dorsal fin rays 2

1b Adipose fin large (24–33% SL); less than 50 dorsal fin rays . . . . *Heterobranchus*

2a Unpaired fins separate from or only partially fused with caudal 3

2b Unpaired and caudal fins form continuous fin fold . 10

3a Eyes present, sometimes small; skull roof exposed between jaw muscles 4

3b Eyes absent; skull roof invisible . . . . *Uegitglanis*

4a Eyes lateral, adjoining lateral border of skull; dorsal and caudal fins clearly separate (gap 10% SL); lateral dermal skull bones large and separate 5

4b Eyes laterodorsal or dorsal, not adjoining lateral border of skull; dorsal and caudal fins fused or slightly separated (gap max 5% SL); lateral dermal skull bones continuous, closely adjoining or are reduced in size 6

5a Dorsal fin rays 54 or less; elongated neural spines 9–12; suprapreopercular and posttemporo-supracleithrum in contact; no serrations on pectoral spin . . . . *Dinotopterus*

5b Dorsal fin rays 59 or more; elongated neural spines 5–8; suprapreopercular and posttemporo-supracleithrum with distinct gap; pectoral spine serrated anteriorly . . . . *Bathyclarias*

6a Suprabranchial organ with developed arborescent structures 7

6b Suprabranchial organ absent or vestigial and incomplete 8

7a Head short (11–26% SL); lateral head bones separate; distance between anus and caudal fin base 50–65% SL . . . . *Clariallabes*

7b Head long (20–34% SL); lateral head bones in contact (often fused in larger specimens); distance between anus and caudal fin base 50% SL or less . . . . . *Clarias*

8a Skull length 14–19% SL; skull roof width 15–36.5% of skull width; infraorbital IV and suprapreopercular reduced and distinctly separate; vertebrae 59–71 . . . 9

8b Skull length 20–21% SL; skull roof width more than 50% skull width; large infraorbital IV and suprapreopercular in close proximity; vertebrae 51–52 . . . . *Xenoclarias*

9a Extremely dorsoventrally flattened skull (skull height 22.9–37.1% of skull length); abdominal depth 4.1–6.5% SL; skull roof width 26.0–36.5% of skull width; vertebrae 65–71; ribs 9–11 . . . . . . *Platyclarias*

9b No dorsoventrally flattened skull (skull height 50% of skull length); abdominal depth 16% SL; skull roof width 15% of skull width; vertebrae 59; ribs 8 . . . . *Tanganikallabes*

10a Suprabranchial organ with reduced arborescent organ; distance between the occipital process and the dorsal fin large (5.2–17.1% SL). 11

10b Suprabranchial organ without arborescent organs; distance between the occipital process and the dorsal fin small (2.2–6.6% SL) . . . . *Platyallabes*

11a Infraorbital series consisting of tubular bones; pale spot on skull roof always absent 12

11b Infraorbital series with plate-like extensions; pale spot on skull roof sometimes present. . *Channallabes*

12a One fontanel on neurocranium; vertebrae 95–116; skull length 6–10% SL . . . . *Dolichallabes*

12b Two fontanel on neurocranium; vertebrae 62–86; skull length 11–18% SL. . . . . *Gymnallabes*

COMPARATIVE MATERIAL EXAMINED

Gymnallabes typus : BMNH 1866.12.4.1–2, 2, 139–150mm, Nigeria, probably Old Calabar, West Africa (Syntypes).

Channallabes apus : BMNH 1873.7.28 : 16, 1, 135mm, Angola, interior of Ambriz, 7° 50’Z-13° 06’E (Holotype).

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REFERENCES

Adriaens D, Devaere S, Teugels GG & Verraes W (2002). Intraspecific variation in limblessness in vertebrates : a unique example of microevolution. Biological Journal of the Linnean Society, 75 : 367–377.

De Schepper N, Adriaens D, Teugels GG, Devaere S & Verraes W (2004). Intraspecific variation in the postcranial skeleton morphology in African clariids : a case study of extreme phenotypic plasticity. Zoological Journal of the Linnean Society, 140 : 437–446.

Devaere S, Adriaens D, Verraes W & Teugels GG (2001). Cranial morphology of the anguilliform clariid *Channallabes apus* (Günther, 1873) (Teleostei : Siluriformes) : adaptations related to a powerful biting? Journal of Zoology (London), 255 : 235–250.

Devaere S, Teugels GG, Adriaens D, Huysentruyt F & Verraes W (2004). Redescription of *Dolichallabes microphthalmus* (Poll, 1942) (Siluriformes : Clariidae). Copeia, 2004 : 108–115.

Devaere S, Adriaens D, Teugels GG & Verraes W (2005). Morphology and spatial constraints in a dorso-ventrally flattened skull, with a revised species description of *Platyallabes tihoni* (Poll, 1944). Journal of Natural History, 39 : 1653–1673.

Devaere S, Adriaens D, Teugels GG & Verraes W (2006). Morphology of the cranial system of *Platyclarias machadoi* Poll, 1977 : interdependencies of skull flattening and suspensorial structure in Clariidae. Zoomorphology, 125 : 69–85.

Jansen G, Devaere S, Weekers P & Adriaens D (2006). Phylogenetic and biogeographical analysis of African air–breathing catfish (Siluriformes : Clariidae) : inferred from ribosomal genes and spacers sequences with emphasize on anguilliformity. Molecular Phylogenetics and Evolution, 38 : 65-78.

Landrum BJ & Dark TA (1968). The distribution of mature western Alaskan and Kamchatkan sockeye salmon (*Oncorhynchus nerka*) in the North Pacific Ocean and Bering Sea. Bulletin of the International North Pacific Fishing Community, 24 : 1–110.

Leviton AE, Gibbs RH Jr, Heal E & Dawson CE (1985). Standards in herpetology and ichthyology. Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. Copeia, 1985 : 802–832.

Poll M (1977). Les genres nouveaux *Platyallabes* et *Platyclarias* comparés au genre *Gymnallabes* GTHR. Synopsis nouveau des genres de Clariidae. Bulletin de la Classe des Sciences, 5 : 122–149.

Taylor WR & Van Dyke GC (1985). Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. Cybium, 9 : 107–119.

Thieme ML, Abell RA, Stiassny MLJ, Lehner B, Skelton Ph, Teugels GG, Dinerstein E, Kamdem-Toham A, Burgess N & Olson DM (2004). Freshwater Ecoregions of Africa : a Conservation Assessment. Island Press, Washington, DC.

Van Wassenbergh S, Herrel A, Adriaens D, Huysentruyt F, Devaere S & Aerts P (2006). A catfish that can strike its prey on land. Nature, 440 : 881.

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