PRELIMINARY RESULTS ON THE MORPHOLOGICAL CHARACTERISATION OF NATURAL POPULATIONS AND CULTURED STRAINS OF *CLARIAS* SPECIES (SILURIFORMES, CLARIIDAE) FROM INDONESIA

Guy G. Teugels [1], Rudhy Gustiano [2], Ruth Diego [1], Marc Legendre [3] and Sudarto [2]

(1) Musée Royal de l'Afrique Centrale, Laboratoire d'Ichtyologie, B-3080 TERVUREN, Belgium
(2) RIFF, Jalan Raya 2, Sukamandi Subang 41256, Java Barat, Indonesia
(3) IRD (ex ORSTOM), Catfish Asia Project, Instalasi Penelitian Perikanan Air Tawar, Jalan. Ragunan-Pasar Minggu, P.O. Box 7220/jkspm, Jakarta 12540, Indonesia
and *GAMET, B.P. 5095, 34033 Montpellier Cedex 1, France*

Abstract

As part of an ongoing systematic revision of the south-east Asian *Clarias* species, this paper presents the results of a morphometric study of 317 specimens from Indonesia: 255 of them were collected from the wild in Sumatra and Kalimantan and 62 came from fish culture stations in Java and Sumatra.

The results obtained indicated the presence of five or six species : *Clarias batrachus*, *C. macrocephalus* (?), *C. meladerma*, *C. leiacanthus*, *C. teijsmanni* and *C. nieuhofii*. Preliminary identification characters are given.

INTRODUCTION

Fourteen nominal *Clarias* species have been reported in literature as naturally occurring in Indonesia: *C. batrachus* (Linnaeus, 1758), *C. leiacanthus* Bleeker, 1851; *C. macrocephalus* Günther, 1864; *C. magur* (Hamilton Buchanon, 1822); *C. melasoma* Bleeker, 1852 (with its unjustified emendation *C. melanosoma*); *C. meladerma* Bleeker, 1846 (with its unjustified emendation *C. melanoderma*); *C. olivaceus* Fowler, 1904; *C. nieuhofii* Valenciennes, 1840; *C. pentapterus* Bleeker, 1851; *C. pulcher* Popta, 1904; *C. punctatus* Valenciennes, 1840; *C. teijsmanni* Bleeker, 1857; *C. thienemanni* Ahl, 1934 and *C. cataractus* (Fowler, 1939). The original description of nine of them was based on specimens originally collected in this country: *C. leiacanthus*, *C. melasoma* (in part), *C. pentapterus* an *C. pulcher* were originally described from "Borneo" (present Kalimantan); *C. meladerma*, *C. punctatus* and *C. teijsmanni* were originally described from Java and *C. melasoma* (in part), *C. olivaceus* and *C. thienemanni* were originally described from Sumatra.

The systematic status of some of these nominal species has already been studied by previous authors. Hora (1936) considered *Clarias magur* as a junior synonym of *C. batrachus*. Bleeker (1858) synonymised *C. melasoma* with *C. meladerma*, although Fowler (1941) considered both species as junior synonyms of *C. dussumieri* Valenciennes, 1840. *Clarias olivaceus* was synonymised with *C. batrachus* by Fowler (1941). Bleeker (1857) considered *C. pentapterus* as a junior synonym of *C. nieuhofii*. Weber & De Beaufort (1913) supposed that *C. pulcher* is a junior synonym of *C. teijsmanni*. Bleeker (1858) considered *C. punctatus* as a junior synonym of *C. batrachus*. Although these synonymies have to be checked, the *Clarias* species presently reported from Indonesia mainly refer to *C. batrachus*, *C. leiacanthus*, *C. macrocephalus*, *C. meladerma*, *C. nieuhofii*, *C. teijsmanni* and *C. thienemanni*.

The identification of these species is problematic as no detailed species descriptions nor diagnostic keys are available. As part of an overall revision of the systematic of the south-east Asian *Clarias* species, this paper presents preliminary results on the morphological characterisation of *Clarias* species from Indonesia.

MATERIAL AND METHODS

Three hundred and seventeen specimens collected during the "Catfish Asia" project have so far been examined. Of these 255 originated from the wild and were sampled in Sumatra and Kalimantan. They were tentatively identified by the collectors as *Clarias batrachus*, *C. meladerma*, *C.* "lembat" (vernacular name) and *C.* "bacot" (vernacular name). The remainder consists of cultured specimens (*C. batrachus*) originating from fish culture stations in Java and Sumatra. The specimens were deposited in the collection of the Musée Royal de l'Afrique Centrale, Tervuren, Belgium. The following type material has also been examined: the four syntypes of *Clarias macrocephalus* and the holotype of *C. leiacanthus* housed in the British Museum (Natural History) London; the holotype of *C. nieuhofii* housed in the Muséum National d'Histoire Naturelle, Paris; the two syntypes of *C. meladerma* and the holotype of *C. tejsmanni* housed in the Rijksmuseum voor Natuurlijke Historie, Leiden; the holotype and three paratypes of *C. olivaceus* housed in the Academy of Natural Sciences in Philadelphia; and the four syntypes of *C. thienemanni*, housed in the Zoölogisches Museum der Humboldt Universität, Berlin.

On each specimen 30 point-to-point measurements were taken using dial calipers. Measurements follow Teugels (1986). They include (Figure 1): 1) Total length (TL); 2) Standard length (SL); 3) Maximum body depth (MBD); 4) Caudal peduncle depth (CPD); 5) Head length (HL); 6) Head width (HW); 7) Snout Length (SNL); 8) Inter-orbital distance (IOW); 9) Eye diameter (ED); 10) Nasal barbel length (NBL); 11) Maxillary barbel length (MBL); 12) Inner mandibular barbel length (IMBL); 13) Outer mandibular barbel length (OMBL); 14) Occipital process length (OPL); 15) Occipital process width (OPW); 16) Frontal fontanel length (FFL); 17) Frontal fontanel width (FFW); 18) Premaxillary toothplate width (PMW); 19) Vomerine toothplate width (VMW); 20) Predorsal distance (PDL); 21) Preanal distance (PAL); 22) Prepelvic distance (PPL); 23) Prepectoral distance (PPEL); 24) Dorsal fin length (DFL); 25) Distance between occipital

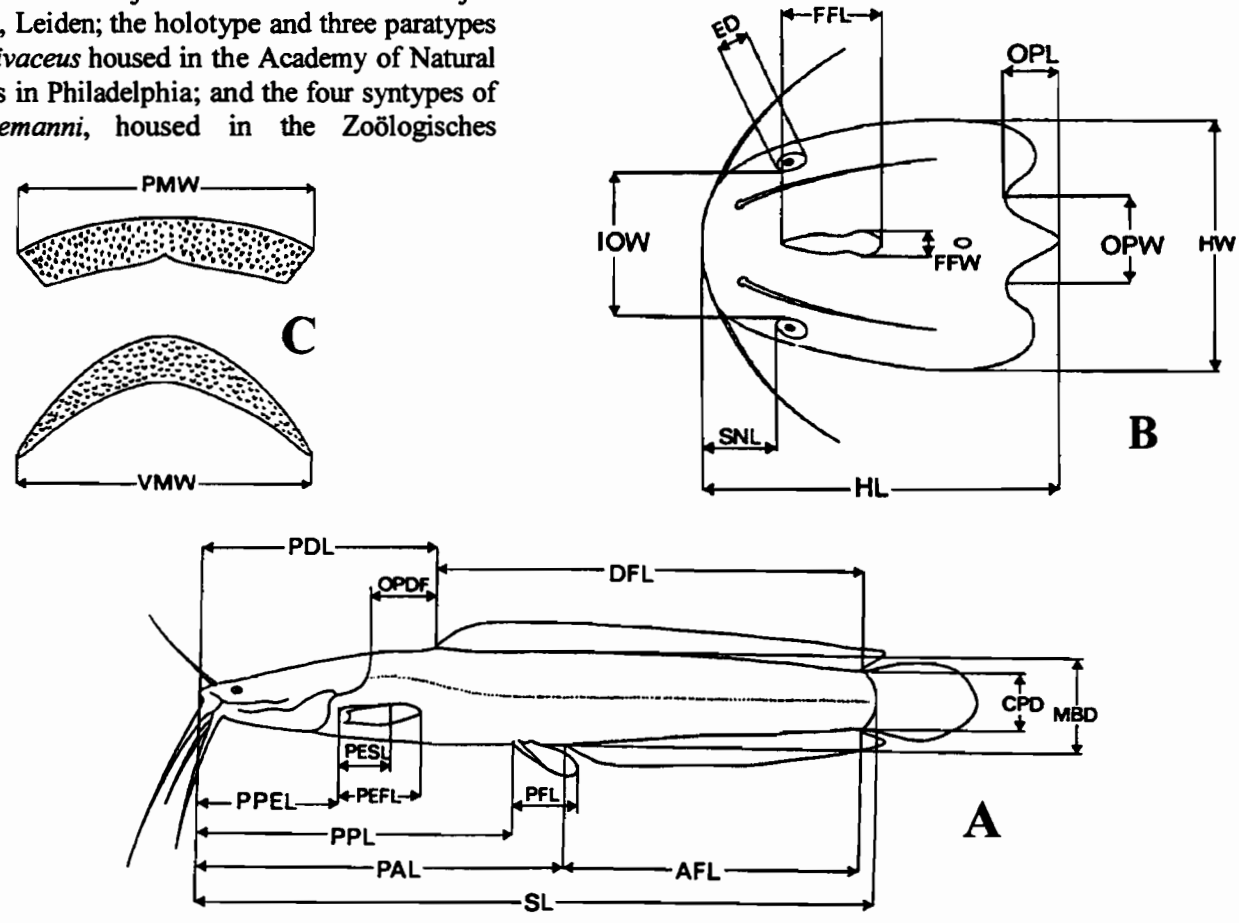


Figure 1: Measurement taken on the body (A), the head (B) and the toothplates (C)
For abbreviations see text.

process and dorsal fin origin (OP-DF); 26) Pectoral spine length (PESL); 27) Pectoral fin length (PEFL); 28) Pelvic fin length (PFL); 29) Anal fin length (AFL); 30) Caudal fin length (CFL). For each specimen, the number of gill rakers on the first branchial arch has been counted. Using radiographs the following six meristic counts were made on each specimen : 1) Number of dorsal fin rays; 2) Number of anal fin rays; 3) Number of vertebrae; 4) Number of abdominal vertebrae; 5) Number of caudal vertebrae. Finally a number of special morphological observations were noted on each specimen: shape of the occipital process; shape of the frontal fontanel; serrations on the pectoral spine.

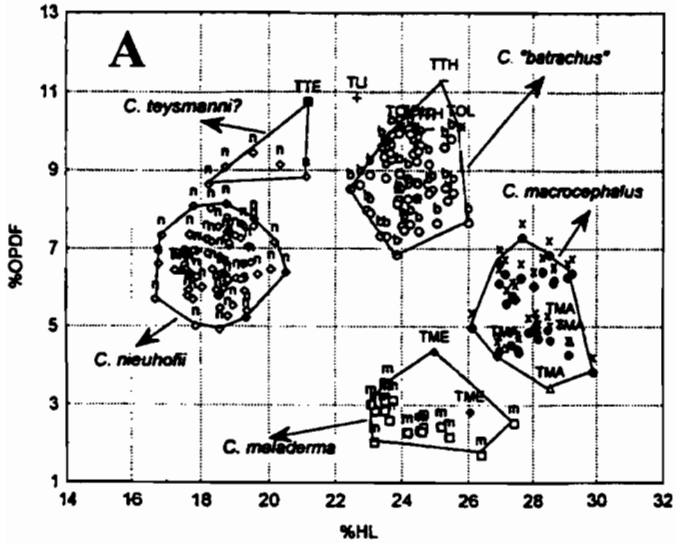
The data obtained were introduced in a database for subsequent factor analysis. Principal component analysis (PCA) was done using the STATISTICA (StatSoft Inc.) package (versions 3.1 for analysis and 4.5 for graphs). Measurements are log transformed before the PCA was run on the covariance matrix. An independent PCA was run on the correlation matrix for the untransformed meristic count data.

RESULTS

It should be noted that the results presented below are preliminary. Work is continuing on additional material.

Sumatra

We first compared the variation of the individual metric variables for all specimens examined.



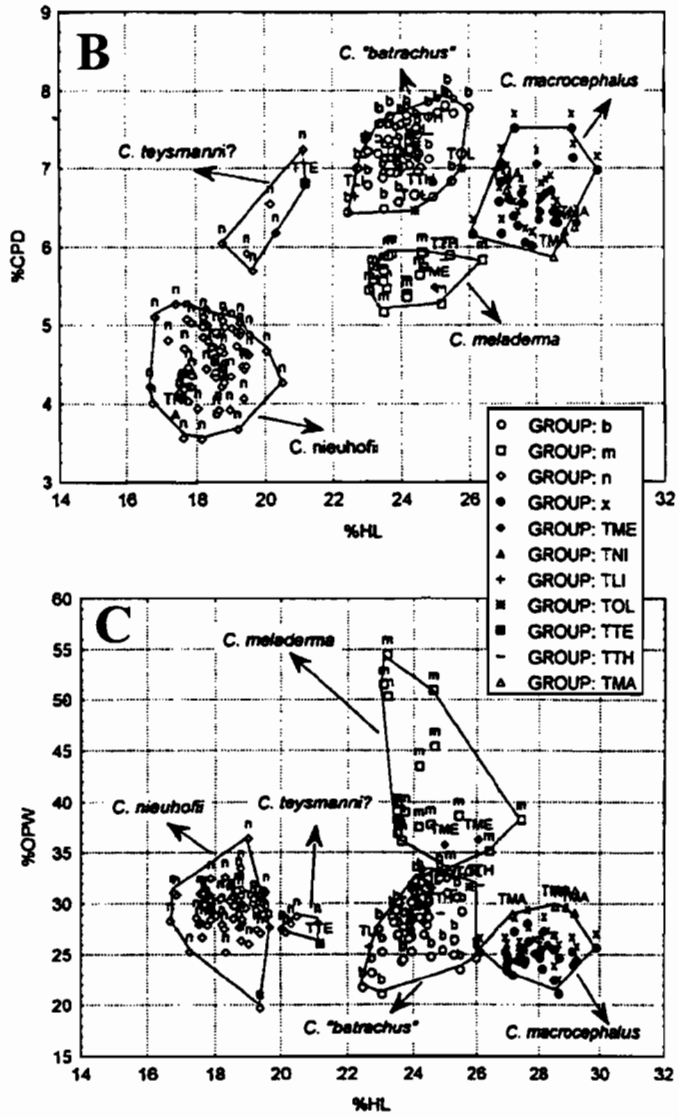


Figure 2: **A.** Distance between occipital process and dorsal fin origin (in percentage of standard length) in function of the head length (in percentage of standard length); **B.** Caudal peduncle depth (in percentage of the standard length) in function of the head length (in percentage of the standard length); **C.** Occipital process width (in percentage of standard length) in function of the head length (in percentage of standard length) for the *Clarias* specimens from Sumatra. TME = types of *C. meladerma*; TNI = type of *C. nieuhofii*; TLI = type of *C. leiacanthus*; TOL = types of *C. olivaceus*; TTE = type of *C. teijsmanni*; TTH = types of *C. thienemanni*; TMA = types of *C. macrocephalus*.

Figure 2 illustrates the results for the occipital process width, the distance between the occipital process and the dorsal fin length and the caudal peduncle depth. For each of these variables a number of groups can be distinguished. When we

look at the position of the type material, some groups can tentatively be identified: *C. nieuhofii* (= *C.* "lembat") and *C. teijsmanni* (= *C.* "bacot") are clearly separated, although some of the specimens originally identified as *C. nieuhofii* are located close to the *C. teijsmanni* type. In the group originally identified as *C. batrachus*, two groups are present: the first one may correspond to *C. batrachus* (the type specimen of this species is lost, see Teugels & Roberts, 1987); it includes the type series of *C. olivaceus* and *C. thienemanni* and also the type of *C. leiacanthus* is usually close to this group. The second group includes the types of *C. macrocephalus*. However as reported by Teugels *et al.* (1999), the syntypes of this species apparently include two species and ongoing research has to clarify their status.

Figure 3 illustrates the plot of a PCA of 24 log transformed metric variables (excluding total length, standard length, nasal, maxillary, inner and outer mandibular barbel length and caudal fin length) for 46 *Clarias* specimens from Sumatra. Only those specimens for which a complete data set is available are included in the analysis.

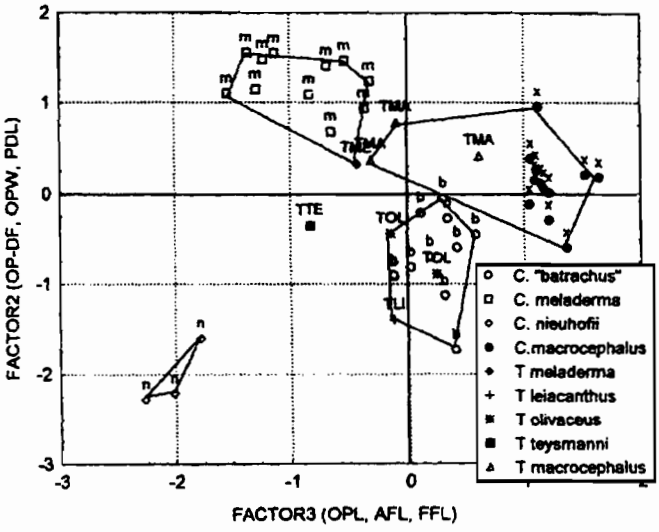


Figure 3: Plot of a principal component analyses using 24 log transformed metric variables taken on 46 *Clarias* specimens from Sumatra. T refers to types.

The *C. nieuhofii* specimens are distantly set on both the second and the third factor. The *C. meladerma* polygon is distantly set from the others on the third factor, while the *"C. batrachus"* group and the *"C. macrocephalus"* (? see above) group are distantly set on the second factor. Note the isolated position of the type of *C. teijsmanni*. The second factor in this analysis is merely defined by the distance between the occipital process and the dorsal fin origin, the occipital process width and the predorsal length. The third factor is defined by the occipital process length, the anal fin length and the frontal fontanel length.

Figure 4 illustrates the plot of a PCA of 21 log transformed metric variables (excluding total length, standard length, nasal, maxillary, inner and outer mandibular barbel length, caudal fin length, dorsal fin length, distance between dorsal and caudal fin and anal fin length) for 116 *Clarias*

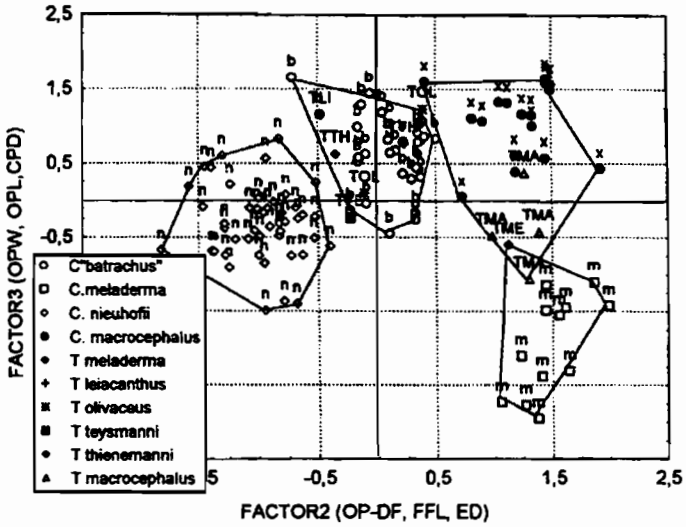


Figure 4: Plot of a principal component analyses using 21 log transformed metric variables taken on 116 *Clarias* specimens from Sumatra, Java and Kalimantan. T refers to types.

specimens from Sumatra. Only those specimens for which a complete data set is available are included in the analysis. Four groups are tentatively recognised: three of them can be separated on the second factor, which is merely defined by the distance between the occipital process and the dorsal fin origin, the frontal fontanel length and the eye diameter; the fourth group can largely be separated from the others on the third factor, which is merely defined by the occipital process length and width and the caudal peduncle depth. Naming the groups however is still problematic: the *"C. batrachus"* group includes the types of *C. olivaceus*, *C. thienemanni*, *C. teijsmanni* and *C. leiacanthus*; the *C. meladerma* group contains a syntype of *C. meladerma*, but also one syntype of *C. macrocephalus* and two other syntypes are closely set to this group. Finally the *C. nieuhofii* group appears as one complex.

Sumatra, Java and Kalimantan

Figure 5 illustrates the plot of a PCA of 24 log transformed metric variables (excluding total length, standard length, nasal, maxillary, inner and outer mandibular barbel length and caudal fin length) for *Clarias* specimens from Sumatra, Java and Kalimantan. The position of the *C. teijsmanni* specimens, close to the *C. nieuhofii* polygon, confirms what is mentioned above. Remarkably, the type series of *C. olivaceus* do not fit in the "*C. batrachus*" polygon. Also the *C. leiacanthus* type is distantly set from *C. batrachus*. Other results confirm those obtained in figure 3.

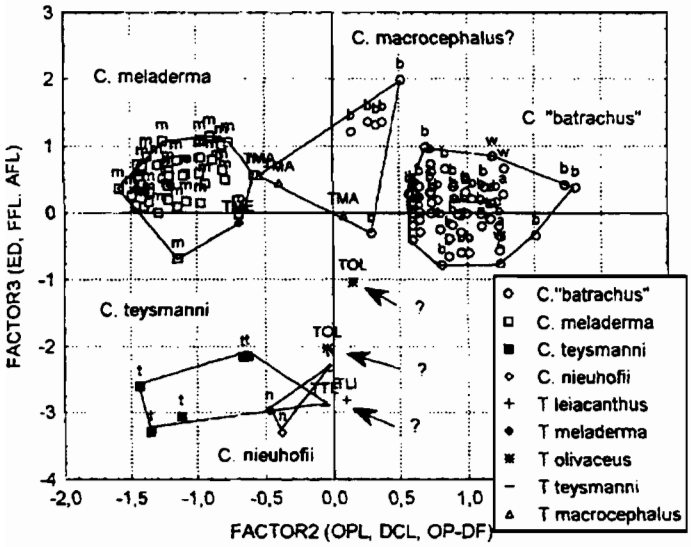


Figure 5: Plot of a principal component analyses using 24 log transformed metric variables taken on *Clarias* specimens from Sumatra, Java and Kalimantan. T refers to types.

***Comparison between wild and cultured specimens from* C. batrachus**

Figure 6 illustrates the plot of a PCA of 24 log transformed metric variables (excluding total length, standard length, nasal, maxillary, inner and outer mandibular barbel length and caudal fin length) taken on wild and cultured specimens from *Clarias batrachus* from Sumatra, Java and Kalimantan. Neither on the second nor on the third factor the wild specimens can be distinguished from the cultured strains. Also the specimens from the different islands cannot be distinguished morphometrically.

DISCUSSION

The preliminary results obtained on the morphometric characterisation of *Clarias*

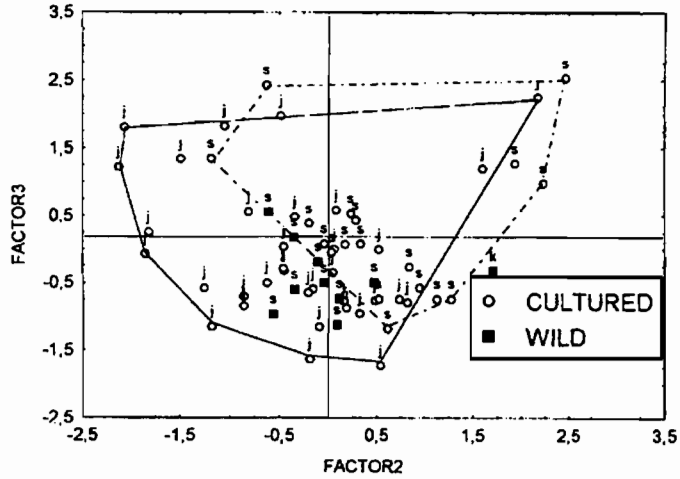


Figure 6: Plot of a principal component analyses using 24 log transformed metric variables taken on wild and cultured *Clarias batrachus* specimens from Sumatra, Java and Kalimantan.

populations from Indonesia, indicate the presence of probably five or six species: *C. batrachus*, *C. macrocephalus* (?), *C. meladerma*, *C. leiacanthus*, *C. teijsmanni* and *C. nieuhofii*.

Clarias batrachus is recognised amongst others by the pointed occipital process, the short distance between the occipital process and the dorsal fin origin, the reduced number of gill rakers (20-25), the head length and the small toothplates; *C. macrocephalus* (?) has a rounded occipital process, its pectoral spine shows numerous serrations (up to 70) on both sides and it has a high number of gill rakers on the first arch (up to 35); *C. meladerma* has a very rounded occipital process, the inner side of its pectoral spine has no serrations and there are 20-25 gill rakers on the first arch; *C. leiacanthus* seems close to, and may be identical to *C. batrachus*; *C. teijsmanni* is recognised by a very long distance between the occipital process and the dorsal fin origin; *C. nieuhofii* differs by a very short head, an anguilliform body and a confluency between dorsal, caudal and anal fins.

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THE BIOLOGICAL DIVERSITY AND AQUACULTURE OF CLARIID AND PANGASIID CATFISHES IN SOUTH-EAST ASIA

Proceedings of the mid-term workshop of the
"Catfish Asia Project"
Cantho, Vietnam, 11-15 May 1998

Edited by :
Marc LEGENDRE
Antoine PARISELLE

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