# REDESCRIPTION OF *CLARIAS MACROCEPHALUS* (SILURIFORMES: CLARIIDAE) FROM SOUTH-EAST ASIA

by

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**ABSTRACT**. - As part of an overall revision of the Asian *Clarias* catfish species, evidence is provided demonstrating that the four syntypes of *C. macrocephalus* originally described from Thailand and presently an economically important freshwater fish species in South-East Asia, include two species. Two of them are designated lectotype and paralectotype of *C. macrocephalus*, while the two others are referred to the *C. batrachus* species complex. A redescription of *C. macrocephalus* is given.

**RÉSUMÉ**. - Nouvelle description de *Clarias macrocephalus* (Siluriformes: Clariidae) du sud-est de l'Asie.

Dans le cadre d'une révision systématique de l'ensemble des poissons-chats asiatiques du genre *Clarias*, nous avons démontré que les quatre syntypes de *C. macrocephalus*, une espèce de poisson d'eau douce décrite de Thaïlande qui a actuellement un intérêt économique dans le sud-est asiatique, représentent deux espèces. Deux d'entre eux sont désignés comme lectotype et paralectotype de *C. macrocephalus*, les deux autres appartiennent au complexe *C. batrachus*. Une nouvelle description de *C. macrocephalus* est donnée.

Key-words. - Clariidae, *Clarias macrocephalus*, Asia, Thailand, Morphology, Taxonomy.

Catfishes of the family Clariidae are recognised by an elongated body, long dorsal and anal fins and especially the presence of a suprabranchial organ, formed by arborescent structures originating from the second and the fourth gill arches and enabling direct air-breathing. Clariidae naturally occur in Africa, Minor Asia and South-East Asia. Although their monophyly has not been demonstrated yet (Teugels, 1996), the suprabranchial organ most likely forms the synapomorphy uniting them.

Clariid taxonomy is still poorly known and except for a revision of the African species of *Clarias* Scopoli, 1777 (Teugels, 1986) and *Heterobranchus* Geoffroy Saint-Hilaire, 1809 (Teugels *et al.*, 1990), no reliable keys are available to identify other representatives of this family.

One of the problematic groups of Clariidae is that of the South-East Asian species of the genus *Clarias*. Some thirty nominal species have been reported in literature. Most of them have been described in the nineteenth century and their description is often extremely short and based on a single or a few specimens.

As part of an ongoing, overall revision of the *Clarias* species from South-East Asia, important morphological differences were noted within the type material of *Clarias*

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*macrocephalus* Günther, 1864. This species was described on four specimens from "Siam", the present Thailand. Günther (1864) considered two of them as adults, while the others are referred to as half-grown and the size difference between the specimens was used to explain the observed morphological difference.

In order to verify if these differences are indeed size-related, a detailed morphological analysis of a large collection of *Clarias* specimens from Thailand, was undertaken.

## MATERIAL AND METHODS

### Material examined

This study is based on 55 *Clarias* specimens, including the syntypes of *Clarias macrocephalus*, all from Thailand and housed in different natural history Museums. Furthermore, the type material of all other *Clarias* species reported from Thailand, has also been examined, together with other specimens from throughout the distribution range of *C. macrocephalus*. The list of this additional material is given below. Museum abbreviations follow Leviton *et al.* (1985).

*Clarias batrachus* complex. - BMNH 1862.11.1.27-28, 2 syntypes of *C. macrocephalus*, 168-174 mm SL, Siam, coll. Jamrach. BMNH 1898.4.2.139, 1 spm, 191 mm SL, Menam River, Siam, coll. Royal Siamese Museum. ISNB 4814, 4 spms, 85-136 mm SL, Pak Cong, E. Siam, coll. Layang-Gaddi, 1939. ISNB 4817, 2 spms, 151-205 mm SL, Siam, coll. Layang-Gaddi, 1939. MRAC 98-03-P-16-29, 14 spms, 128-184 mm SL, So Phisai, Thailand, coll. Legendre and Pariselle, 1997.

*Clarias leiacanthus*. - BMNH 1863.12.4.55, presumed type, 200 mm SL, Borneo.

*Clarias meladerma*. - BMNH 1880.4.21.201, presumed syntype, 257 mm SL, Batavia. CAS 95131, 1 spm, 83 mm SL, Sungai Golok Basin, peat swamp forest 12 km south-west of Tak Bai, Thailand, coll. Roberts, 1989. CAS 95133, 2 spms, 41-55 mm SL, Trang basin, small canal in rubber plantation, about 30 km south-east of Trang city, Thailand, coll. Roberts, 1989.

*Clarias nieuhofii*. - MNHN B.300, holotype, 405 mm SL, Inde. CAS 95128, 1 spm, 185 mm SL, Menam Bang Nara Basin, Khlong Ko about 7 km south-west of Tak Bai, Changwai Naratiwat, Thailand, coll. Roberts, 1989. CAS 95129, 1 spm, 202 mm SL, Sungai Golok Basin, Peat swamp forest 12 km south-west of Tak Bai, Thailand, coll. Roberts, 1989.

*Clarias teijsmanni*. - RMNH 6803, holotype, 94.2 mm SL, Tjikoppo, Buitenzorg Province, Java, coll. Teijsmann. ISNB 4818-4819, 9 spms, 101-181 mm SL, Trang Waterfall, S. Siam.

### Measurements

On each specimen the following measurements were taken using dial calipers: total length (TL); standard length (SL); maximal body depth (MBD); caudal peduncle depth (CPD); head length (HL); head width (HW), snout length (SNL); interorbital width (IOW); eye diameter (ED); nasal barbel length (NBL); maxillary barbel length (MBL); inner mandibular barbel length (IMBL); outer mandibular barbel length (OMBL) occipital process length (OPL); occipital process width (OPW); frontal fontanelle length (FFL); frontal fontanelle width (FFW); premaxillary toothplate width (PMW); vomerine toothplate width (VMW); predorsal length (PDL); preanal length (PAL); prepelvic length (PPL);

prepectoral length (PPEL); dorsal fin length (DFL); length between dorsal and caudal fin (DCL); length between occipital process and dorsal fin base (OPDF); pectoral spine length (PESL); pectoral fin length (PEFL); pelvic fin length (PFL); and anal fin length (AFL). Measurements follow Teugels (1986).

The following meristic counts were made on each specimen: number of gill rakers on the first branchial arch (GR); number of dorsal fin rays (DFR); number of anal fin rays (AFR); total vertebrae (TV).

Special morphological observations included: shape of the occipital process; shape of the frontal fontanelle, position of the lateral head bones (fourth infraorbital and suprapreoperculum); serrations on the pectoral spine; secondary openings of the lateral line system.

### Analyses

The morphometric data and the meristic counts were submitted to principal component analysis (PCA) (Bookstein *et al.*, 1985), using the CSS Statistica (StatSoft, Inc.) version 4.5. Morphometric data were log-transformed to minimize effects of non-normality before the PCA was run on the covariance matrix. The first principal component was considered as the size factor and the others as shape factors, independent of size. An independent PCA was run on the correlation matrix from the untransformed meristic data. The second principal component of the morphometric variables and the first principal component of the meristic variables express most of the variability and were plotted together (Bookstein *et al.*, 1985).

## *CLARIAS MACROCEPHALUS* GÜNTHER, 1864

(Fig. 1)

### Material examined

*Lectotype* (designated in this paper). - BMNH 1862.11.1.216, 300 mm TL (266 mm SL); Siam; coll. Jamrach.

*Paralectotype* (designated in this paper). - BMNH 1862.11.1.217, 305 mm TL (267 mm SL); same data as lectotype.

*Other specimens examined.* - BMNH 1897.12.28.39, 1 spm, 210 mm SL, Bangkok, river Menam, Thailand, coll. Stevens. MRAC 98-03-P-1-10, 10 spms, 141-172 mm SL, So Phisai, Thailand, coll. Legendre and Pariselle, 1997. MRAC 98-03-P-11-15, 5 spms, 166-193 mm SL, Nakhom Sawan, Thailand, coll. Legendre and Pariselle, 1997.

### Diagnosis

Among the South-East Asian *Clarias*, *C. macrocephalus* has the highest number of gill rakers on the first branchial arch (28-33); it is further distinguished from South-East Asian congeners by an extremely short and rounded occipital process (OPL 4.8-7.8% HL) and by a very high dorsal fin. The combination of these characters are diagnostic for the species.

### Description

Based on the lectotype, the paralectotype and 16 specimens from Thailand. Measurements and meristic counts are given in table I.

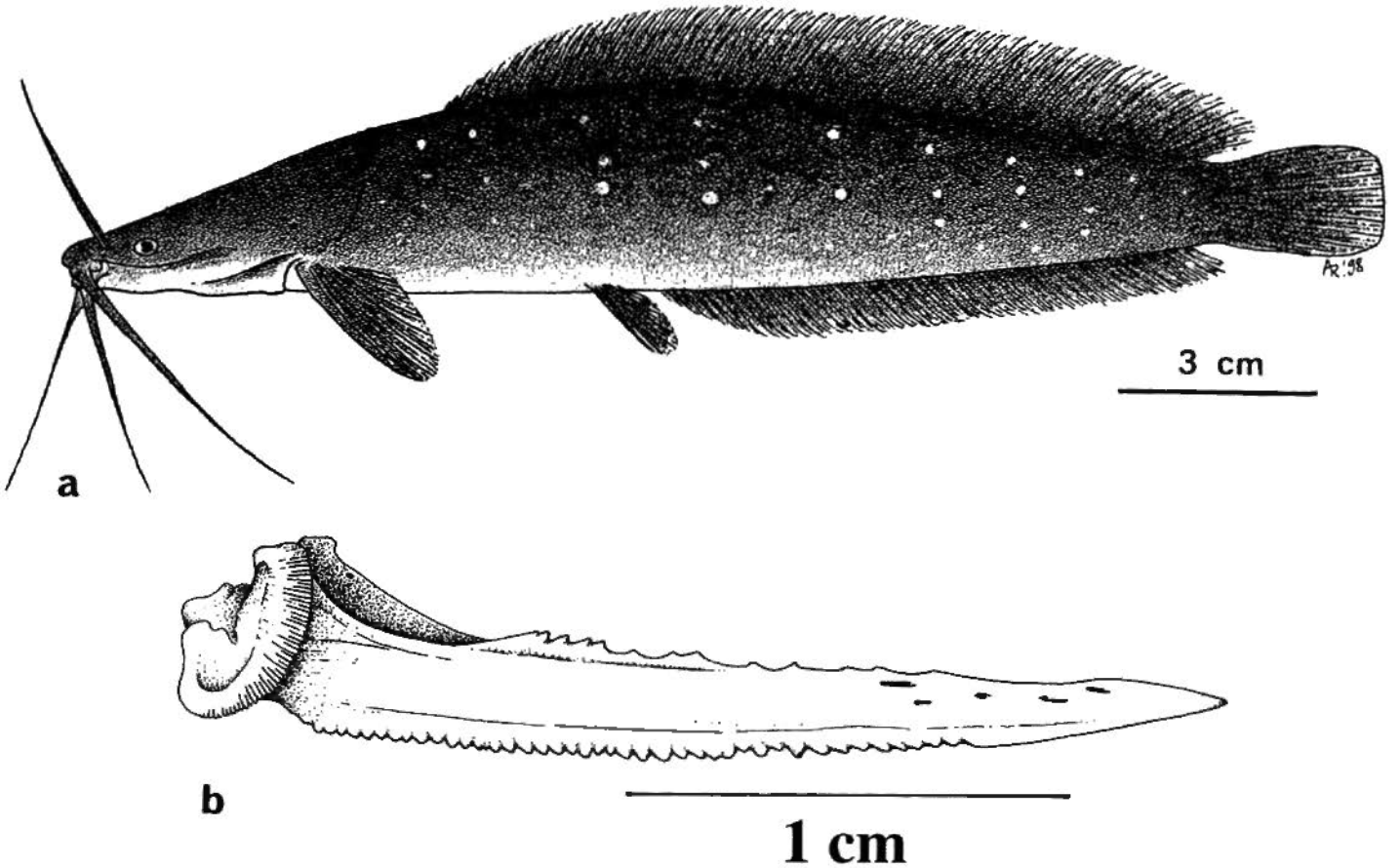


Fig. 1. - a: Lateral view of a specimen of *Clarias macrocephalus* from So Phisai, Thailand (MRAC 98-03-P-1). b: Pectoral spine of a specimen of *C. macrocephalus* from the same locality (MRAC 98-03-P-2).

Compared to other South-East Asian *Clarias* species, the head in *C. macrocephalus* is long and broad and the snout is somewhat rectangular in dorsal outline. The eyes have a lateral position, resulting in a relatively large interorbital distance. The frontal fontanelle is "sole shaped" about twice as long than broad. Its anterior tip reaches the virtual line connecting the posterior eye borders. The occipital fontanelle is small and distantly set from the occipital process basis. The occipital process is short and extremely rounded in all specimens examined. The fourth infraorbital and the suprapreopercular, situated on the lateral sides of the head are fused in all specimens.

Table I. - Measurements and meristic counts for the lectotype, the paralectotype and 16 specimens of *Clarias macrocephalus*. Abbreviations used are explained in the text.

| | Lectotype | Paralectotype | Other specimens examined | | | | |
|---|---|---|---|---|---|---|---|
| p | | | n | min | max | mean | SD |
| TL (mm) | 300 | 305 | 16 | 162.0 | 220.0 | | |
| SL (mm) | 266 | 267 | 16 | 141.0 | 193.0 | | |
| **Measurements in % standard length** | | | | | | | |
| MBD | 18.0 | 18.4 | 15 | 16.8 | 19.2 | 18.3 | 0.7 |
| CPD | 6.2 | 5.9 | 15 | 5.9 | 6.6 | 6.2 | 0.2 |
| HL | 28.9 | 28.5 | 15 | 26.3 | 30.4 | 28.1 | 1.1 |
| HW | 19.5 | 20.3 | 15 | 18.2 | 20.4 | 19.4 | 0.7 |
| PDL | 33.9 | 30.7 | 15 | 29.9 | 34.0 | 31.7 | 1.1 |
| PAL | 50.7 | 51.9 | 15 | 50.3 | 54.0 | 52.0 | 1.1 |
| PPL | | 45.8 | 15 | 41.4 | 45.6 | 44.2 | 1.2 |
| PPEL | 20.9 | 21.2 | 15 | 20.0 | 22.9 | 21.5 | 0.7 |
| DFL | 68.7 | | 15 | 66.9 | 72.7 | 69.0 | 1.7 |
| DCL | 1.1 | 0.8 | 15 | 0.8 | 2.1 | 1.3 | 0.4 |
| OPDF | 5.1 | | 15 | 2.2 | 4.4 | 3.6 | 0.6 |
| PESL | 11.4 | 11.7 | 15 | 10.6 | 13.8 | 12.2 | 0.9 |
| PEFL | 15.1 | 15.2 | 15 | 12.8 | 15.0 | 13.8 | 0.7 |
| PFL | 10.8 | 10.3 | 15 | 8.9 | 10.6 | 10.0 | 0.5 |
| AFL | 47.5 | | 15 | 46.4 | 50.2 | 48.3 | 1.2 |
| **Measurements in % head length** | | | | | | | |
| SNL | 19.8 | 18.4 | 15 | 18.1 | 21.4 | 19.5 | 1.0 |
| IOW | 40.9 | 42.9 | 15 | 40.6 | 44.2 | 41.7 | 0.9 |
| ED | 6.8 | 6.7 | 15 | 6.4 | 7.9 | 7.2 | 0.4 |
| OPL | 6.4 | 7.7 | 15 | 4.7 | 7.8 | 6.6 | 0.9 |
| OPW | 19.8 | 21.7 | 13 | 27.4 | 33.1 | 29.7 | 1.9 |
| FFL | 18.5 | 14.7 | 15 | 15.0 | 20.0 | 17.2 | 1.5 |
| FFW | 7.4 | 5.8 | 15 | 5.9 | 9.2 | 7.1 | 0.9 |
| PMW | 19.8 | 21.7 | 15 | 21.9 | 25.7 | 23.3 | 1.1 |
| VMW | 21.1 | 21.7 | 15 | 19.3 | 21.5 | 20.4 | 0.7 |
| **Meristic counts** | | | | | | | |
| GR | 33 | 32 | 13 | 28 | 33 | 30 | 1.6 |
| DFR | | 72 | 12 | 64 | 73 | 68 | 2.6 |
| AFR | | 59 | 12 | 49 | 57 | 52 | 2.3 |
| TV | | 59 | 12 | 57 | 61 | 59 | 1.2 |

The barbels, showing negative allometric growth, are well developed: the nasal barbel is half to three fourth of the head length; the maxillary barbel is about three fourth to five fourth of the head length; the inner mandibular barbel has about the same length as the nasal one and the outer mandibular barbel is usually a little shorter than the maxillary barbel.

The premaxillary toothplate is usually a little broader than the vomerine toothplate. Premaxillary teeth are conical and pointed, while vomerine teeth are subgranular.

The suprabranchial organ in all specimens examined is well developed but the suprabranchial cavity is only partially filled.

Compared to other *Clarias* species such as *C. leiacanthus* and *C. teijsmanni*, the distance between the occipital process and the base of the first dorsal fin ray, is relatively small. Neither the dorsal nor the anal fin are confluent with the caudal fin. The dorsal fin can be very high (up to 10% of the standard length). The anal fin base is situated almost halfway between the snout and the caudal fin base, usually closer to the latter. The pelvic fins have a more anterior position. The pectoral fins reach from the operculum to beyond the virtual vertical line corresponding to the dorsal fin origin. The pectoral spine (Fig. 1b) is long and clearly serrated on the inner (posterior) side, with 12-25 upward pointed serrations; the outer (anterior) side shows numerous (up to 75) small serrations, which sometimes are hardly visible, resulting in a smooth appearance.

The lateral line is hardly visible; its secondary openings however can be seen as white spots, regularly placed on the upper side of the flanks. The intensity of these white spots varies intraspecifically and we suspect that it also varies within the same specimen, depending on its condition or on the environment; further studies are necessary to demonstrate this.

### Distribution

Except for the specimens from Thailand, we have identified conspecific material originating from Laos, Cambodia and Vietnam. This range corresponds to the data reported in literature (Kuronuma, 1961; Davidson, 1975; Suvatti, 1981; Rainboth, 1996). The species has been introduced for fishculture purposes in China (Welcomme, 1988), the Peninsular Malaysia (Mohsin and Ambak, 1983), the Philippines (Conlu, 1986) and Guam (Eldregde, 1994).

## REMARKS

Figure 2 shows the distribution of the gill rakers number on the first branchial arch in relation to the standard length for all specimens examined from Thailand. The specimens are identified following their museum-identification. Awaiting the results of the overall revision of the Asian *Clarias* species, it should be noted that these identifications are tentative.

The four syntypes of *Clarias macrocephalus* clearly fall in two different groups: the smallest specimens have a reduced number of gill rakers (18), similar to that of *C. teijsmanni*; the two largest specimens have 32-33 gill rakers and are situated at the same level as those identified as *C. macrocephalus*. One could argue that this is due to the difference in size between the syntypes. It should be noted however that the *C. macrocephalus* specimens show a considerably higher number (28-32) of gill rakers than the equally sized syntypes (18).

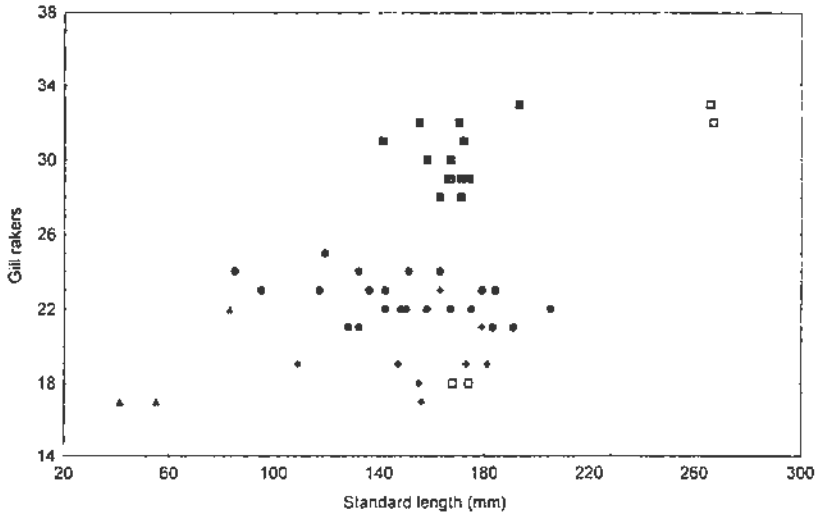


Fig. 2. - The number of gill rakers on the first branchial arch in relation to the standard length for all *Clarias* specimens examined from Thailand. ● *C. batrachus*; □ syntypes of *C. macrocephalus*; ■ *C. macrocephalus*; ▲ *C. meladerma*; ✱ *C. nieuhofii*; ◆ *C. teijsmanni*.

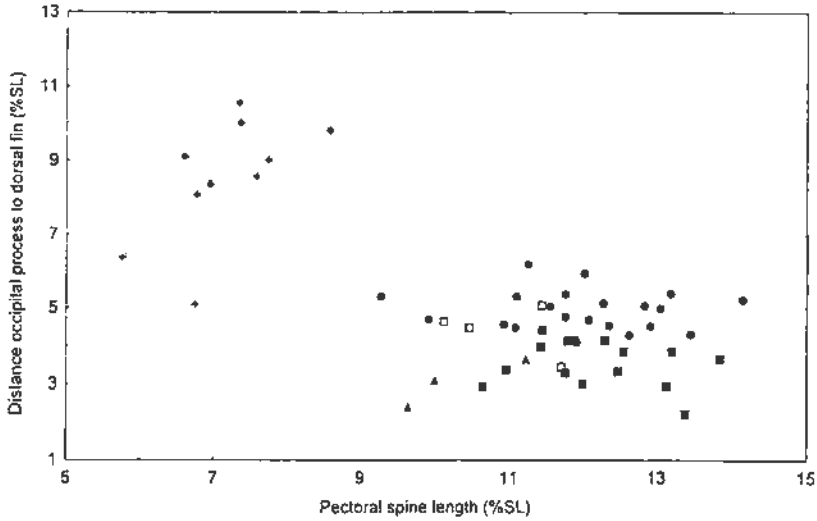


Fig. 3. - Plot of the distance between the occipital process and the basis of the first dorsal fin ray against the pectoral spine length for all *Clarias* specimens examined from Thailand. ● *C. batrachus*; □ syntypes of *C. macrocephalus*; ■ *C. macrocephalus*; ▲ *C. meladerma*; ✱ *C. nieuhofii*; ◆ *C. teijsmanni*.

*Clarias teijsmanni* clearly show a larger distance between the occipital process and the basis of the first dorsal fin ray than all the other species (Fig. 3). This character therefore enables to distinguish the two smallest syntypes of *C. macrocephalus* from this species and the possibility that they may be *C. teijsmanni* can be eliminated. From the

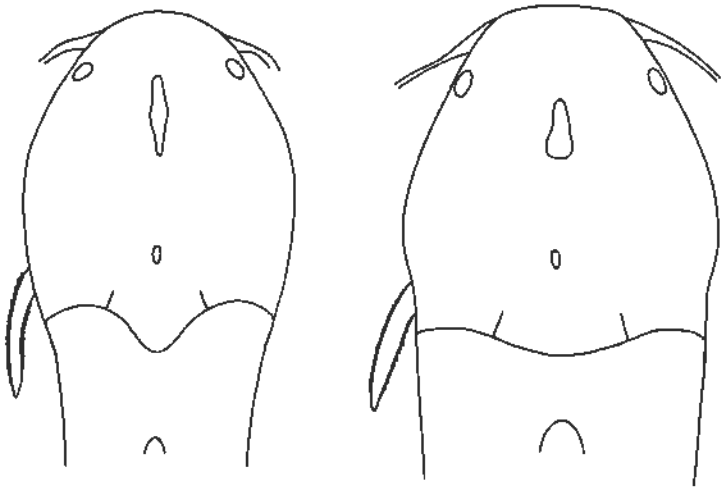

Fig. 4. - Schematic dorsal view of the head in specimens of the *Clarias batrachus* complex (left) and of *C. macrocephalus* (right).

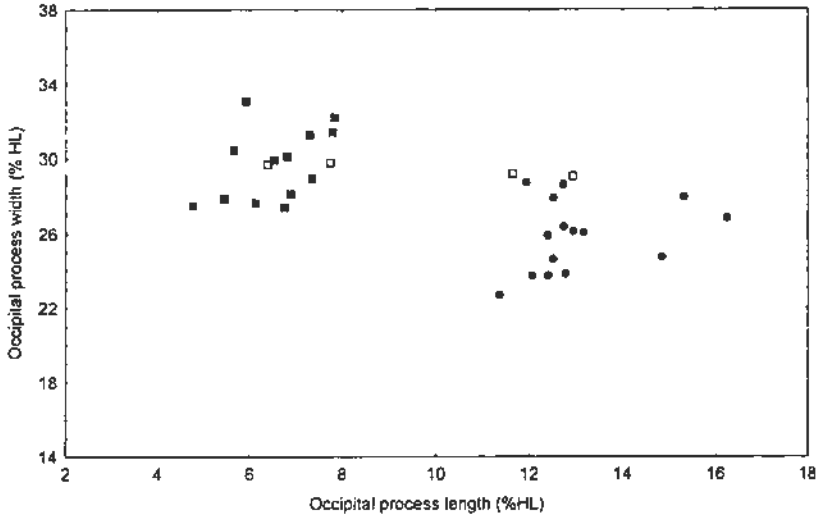


Fig. 5. - Plot of the occipital process width against the occipital process length for *Clarias* specimens from Thailand. ● *C. batrachus*; □ syntypes of *C. macrocephalus*; ■ *C. macrocephalus*.

same figure it also appears that *C. teijsmanni* and *C. nieuhofii* have shorter pectoral spines than all the other species. On the basis of these characters we exclude the specimens of those two species from the further analysis.

When looking at the pectoral spine of *Clarias meladerma*, the presence of clearly marked, long serrations on the anterior side is noted. All other specimens show small serrations on the anterior side of the spine. The *C. meladerma* specimens also have a higher number of total vertebrae (63-66 *versus* 55-61) and a higher number of anal fin rays (64-65 *versus* 46-59) than the other, remaining specimens. These characters enable to eliminate the *C. meladerma* specimens from further analysis.

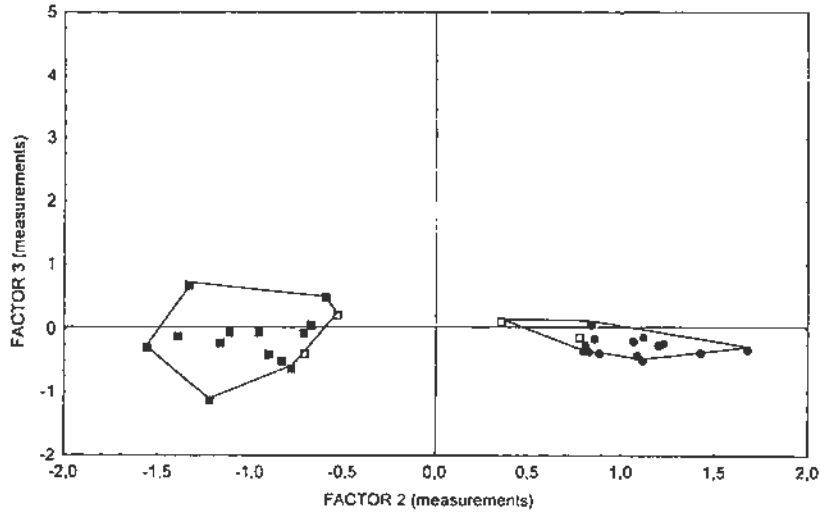


Fig. 6. - Plot of the second and the third factor of a PCA run on 20 morphometric variables (MBD; CPD; HL; SNL; IOW; OPL; OPW; FFL; FFW; PMW; VMW; PDL; PAL; PPL; PPEL; DFL; OPDF; PESL; PEFL; AFL) of *Clarias* specimens from Thailand. ● *C. batrachus*; □ syntypes of *C. macrocephalus*; ■ *C. macrocephalus*.

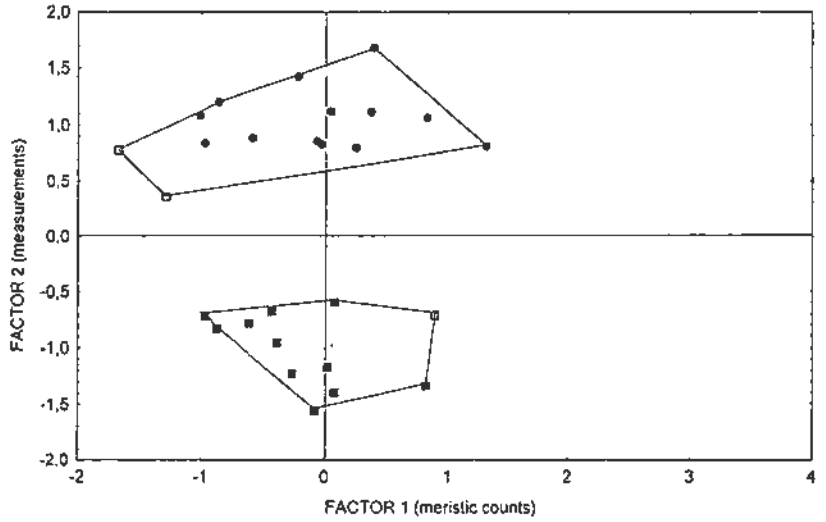


Fig. 7. - Combined plot of the first principal component of a PCA run on four meristic variables (GR; AFR; DFR; TV) against the second principal component of a PCA run on 19 morphometric variables (MBD; CPD; HL; SNL; IOW; OPL; OPW; FFL; FFW; PMW; VMW; PDL; PAL; PPL; PPEL; DFL; OPDF; PESL; PEFL; AFL) of *Clarias* specimens from Thailand. ● *C. batrachus*; □ syntypes of *C. macrocephalus*; ■ *C. macrocephalus*.

The smallest syntypes of *Clarias macrocephalus* have a pointed occipital process while the largest show a broadly rounded process (Fig. 4). When plotting the two variables expressing the occipital process shape, *i.s.* width and length (Fig. 5), the remainder of the specimens is divided in two groups and the four syntypes of *C. macrocephalus* are equally divided between them.

A plot of the second and the third factor of a PCA run on the morphometric variables is given in figure 6. Two groups are distinguished. One is situated on the positive sector of the second factor, while the second group is located on the negative sector of this factor; the latter is merely defined by the occipital process length, the distance between the occipital process and the basis of the first dorsal fin ray and the frontal fontanelle length. The syntypes of *C. macrocephalus* are equally divided between the two groups.

Similar results were obtained when combining the first principal component of a PCA run on the meristic variables against the second principal component of a PCA run on the morphometric variables (Fig. 7). The syntypes of *C. macrocephalus* are once again divided into the two groups (one syntype is not illustrated because of an incomplete meristic data set, which excluded it from the PCA).

As a result, the type material of *Clarias macrocephalus* includes two different species.

In the short and rather general original description by Günther (1864) there is only a single character that enables to separate the syntypes of *Clarias macrocephalus*: "Occipital process very obtuse and rounded in adult specimens, rather more prominent in younger individuals". The two largest syntypes (300 and 305 mm TL) indeed show a very rounded occipital process: they perfectly fit in the group of specimens displaying this feature (Figs 5, 6) and identified as *C. macrocephalus*. They are here selected as lectotype and paralectotype (*cf. supra*).The two smallest syntypes (195 and 196 mm TL) have a pointed occipital process but differ significantly from equally sized *C. macrocephalus* and thus can no longer be considered as "half-grown" specimens of that species. From our results they seem similar to specimens identified as *C. batrachus* (Linnaeus, 1758). The taxonomic status of that species however is also problematic as the type specimen is missing (Teugels and Roberts, 1987); the species is presently being revised and awaiting the outcome of that study, we temporary consider it as the *C. batrachus* complex.

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