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Synodontis acanthoperca, a new species from the Ogôoué River system, Gabon with comments on spiny ornamentation and sexual dimorphism in mochokid catfishes (Siluriformes: Mochokidae)

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Abstract

Synodontis acanthoperca, a new species of mochokid catfish, is described from rapids within the Ogôoué River system of Gabon. This relatively small species (<50 mm SL) is distinguished from all congeners by a distinctive pigmentation pattern that includes a pair of dark patches on the caudal fin and by the presence of hypertrophied opercular spines in sexually mature males.

Key words: Siluriformes, Mochokidae, *Synodontis*, new species, Africa, Gabon, Ogôoué River, spiny ornamentation, sexual dimorphism

Résumé
Synodontis acanthoperca, une nouvelle espèce de poisson-chat de la famille des Mochokidae, est décrite des rapides du système fluvial de l'Ogôoué au Gabon. Cette espèce relativement petite (<50 mm SL) se distingue de tous ses congénères par un patron de pigmentation distinctif qui inclut deux taches foncées sur la nageoire caudale et par la présence d'épines operculaires hypertrophiées chez les males sexuellement matures.

Introduction

The genus *Synodontis* Cuvier, 1816 is the most species rich and widespread genus of mochokid catfishes. As currently recognized the genus contains approximately 120 valid species distributed throughout most of the freshwaters of sub-Saharan Africa and the Nile River system. Larger *Synodontis* species are important food fishes in many parts of Africa and are commonly known as "squeakers" because they readily produce sounds by stridulating their pectoral spines when handled or disturbed. Furthermore many *Synodontis* species are prized ornamental fishes because they have striking pigmentation patterns or display unusual behaviors like an upside down swimming posture.

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Poll (1971) last revised the entire genus and noted seven species reported from Gabon based on specimens he examined or previous published accounts and faunal lists: *S. angelicus* Schilthuis 1891, *S. albolineatus* Pellegrin 1924, *S. guttatus* Günther 1865, *S. haugi* Pellegrin 1906, *S. obesus* Boulenger 1898, *S. polyodon* Vaillant 1895 and *S. tessmanni* Pappenheim 1911. Four of these species have well documented type localities within Gabon (*S. albolineatus*, *S. haugi*, *S. polyodon* and *S. tessmanni*) and appear to be endemics of the Ogôoué or Ntem Rivers and their tributaries.

In contrast, the presences of *S. angelicus*, *S. guttatus*, and *S. obesus* in Gabon are uncertain or possibly erroneous. First, the claim for *S. angelicus* is based on the junior synonym *S. tholloni* Boulenger 1901 known from a single specimen (MNHN 1890-0030) collected at an unspecified locality possibly within the Ogôoué basin of Gabon. Otherwise, *S. angelicus* is known exclusively from the Congo basin. Second, Poll (1971) did not find any specimens of *S. guttatus* from Gabon, questioned published records from Gabon by Sauvage (1880, 1884) and concluded that the species is only found in the lower Niger basin. Finally, Boulenger (1898) described *S. obesus* based on three syntypes, one from the Opobo River, Nigeria (BMNH 1896.5.5.67) and two from an unspecified locality in Gabon (BMNH 1881.7.20.5-6). Poll (1971) subsequently designated the Nigerian syntype as the lectotype for *S. obesus*. Given this type fixation and the uncertain locality data for the paralectotypes, the presence of *S. obesus* in Gabon remains ambiguous.

Since Poll's revision, the first author and others have made many more collections of Gabonese fishes. Review of this material for an upcoming edited book on the freshwater fishes of West Central Africa (Lower Guinea) has revealed the presence of at least eight *Synodontis* species in Gabon. These include the previously known endemics (*S. albolineatus, S. haugi, S. polyodon*, and *S. tessmanni*), plus four additional species. One of these, *S. batesii* Boulenger 1907, originally described from the Congo basin of Cameroon, is now known from both the Ogôoué and Ntem basins of Gabon. The other newly recorded species are currently under study by several researchers. One of these new species that has unique bony ornamentation and sexual dimorphism is described here. Further details on the identification and distribution of other *Synodontis* species will be the covered in the forthcoming book.

Materials and Methods

Measurements were taken to the nearest 0.1 mm with digital calipers or from scaled distances between landmark points recorded with the aid of a stereomicroscope equipped with a camera lucida. Skeletal features were studied using both dorsoventral and lateral radiographs. Specimens were sexed by external examination. As in most mochokids, males have more elongate and pointed genital papillae than similarly sized females. Morphometric measurements, meristic count formulas (except for the dorsal-fin) and terminology for premaxillary dentition follow the methods of Skelton & White (1990).

Herein the dorsal-fin count includes the dorsal spinelet and is designated along with the dorsal spine by upper case Roman numerals. Institutional abbreviations follow Leviton et al. (1985) except for the South African Institute of Aquatic Biodiversity (SAIAB).

***Synodontis acanthoperca*, new species**
(Figs. 1–3, Table 1)

Holotype: CU 89005, male, 44.1 mm SL; Gabon, Haut-Ogôoué Province, Ogôoué River at and below the Rapids of Massoukou (Masuku), 1°39'30"S 13°32'14"E; M.E. Arnegard, A. Chow, S. Lavoué, J.F. Liwouwou and J.P. Sullivan, August 15, 1999.

Paratypes: CU 89006, two specimens, one male, 45.9 mm SL, and one female, 40.4 mm SL; collection data as for holotype. MRAC A4-13-P-1, one male, 40.4 mm SL; collection data as for holotype, SAIAB 74202, one male, 40.5 mm SL; collection data as for holotype. CU 80105, eight specimens, three males, 30.0–31.4 mm SL, three females, 34.5–42.3 mm SL, and two unsexed juveniles, 27.0–28.7 mm SL; Gabon, Ngounié Province, Louétsi River just below falls at Bongolo Hydroelectric Facility, 2°14'2"S 11°27'42"E; M.E. Arnegard, J. Beck, C.D. Hopkins and J.P. Sullivan, July 20, 1999. AMNH 236128, four specimens, one male, 46.4 mm SL, and three females, 30.2–38.4 mm SL; collection data as for CU 80105.

Diagnosis: *Synodontis acanthoperca* is a relatively small species that can be distinguished from all congeners by a distinctive pigmentation pattern that includes a pair of dark patches on the caudal fin. One patch is present in the middle of each lobe of the fin (Figs. 1 & 3). Furthermore, this species is distinguished by the presence of a well-developed opercular spine in sexually mature males (Figs. 1, 2A & 3). In all other mochokid species the opercle lacks such well-developed ornamentation and sexual dimorphism of the opercle is unknown.

Description: Dorsal, lateral and ventral views in Figure 1 illustrate body shape, form and position of fins and barbels. Morphometric and meristic data for holotype and 4 syntopic paratypes are summarized in Table 1.

Small species with a maximum standard length <50 mm. Body compressed. Predorsal profile gently convex; postdorsal body sloping gently ventrally. Preanal profile horizontal. Anus and urogenital opening located at vertical though origin of adipose fin. Skin on body smooth without any enlarged tubercles, lateral line complete and midlateral along side of body.

Head depressed and broad, rounded when viewed laterally with a rounded snout margin when viewed dorsally. Gill opening restricted to lateral aspect of head from level of the base of pectoral spine dorsally to level of the ventral margin of the eye. Gill membranes broadly united to, and attached across the isthmus, supported by 6 branchiostegal rays. Bony elements of skull roof lack any superficial ornamentation. Skin covering skull roof with numerous small unculiferous tubercles. Occipital-nuchal shield large and terminating posteriorly with two rounded processes on each side of dorsal fin.

FIGURE 1. Dorsal, lateral and ventral views of *Synodontis acanthoperca*, holotype, CU 89005, male, 44.1 mm SL; Gabon, Haut-Ogôoué Province, Ogôoué River at and below the Rapids of Massoukou (Masuku). Photo by T.R. Vigliotta.

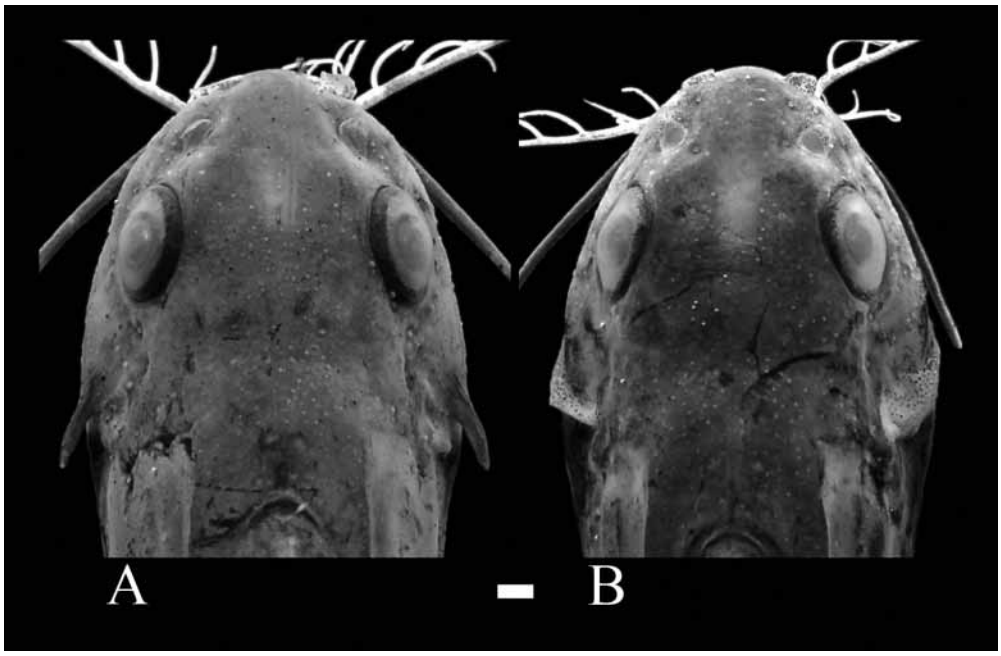

FIGURE 2. Dorsal view of heads illustrating sexual dimorphism of the opercular spine in *Synodontis acanthoperca*: A. CU 89005, male holotype, 44.1 mm SL; B. CU 89006, female paratype, 40.4 mm SL. The pectoral spines in both specimens have been removed from the images to make the margins of the head more distinct against the background. Scale bar equals 1 mm. Photo by T.R. Vigliotta.

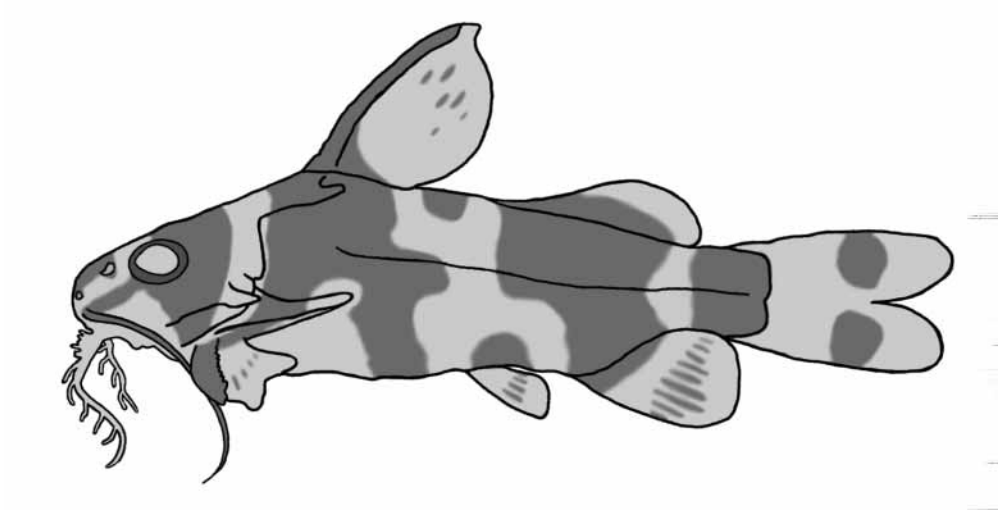

FIGURE 3. Composite illustration of the pigmentation pattern of *Synodontis acanthoperca* based on observed variation within this species. Illustration by T.R. Vigliotta.

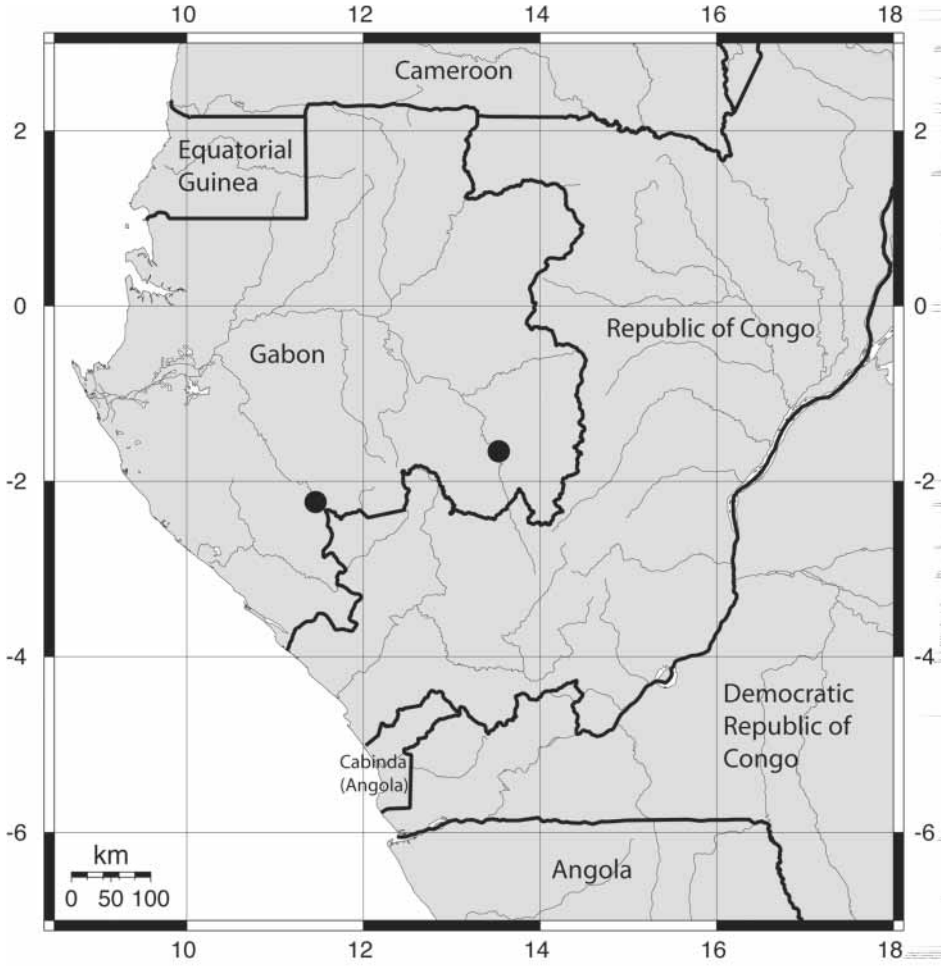

FIGURE 4. Map showing distribution of *Synodontis acanthoperca*.

Each opercle with a single posterolaterally directed spine variously developed depending on gender and size of specimen. In male specimens >30 mm SL, the spine is hypertrophied and ranges from 2.0–2.5 mm long (Fig. 2A). In adult female specimens it measures <1 mm long, but is usually visible protruding from the skin surface (Fig. 2B). In immature specimens of both sexes <30 mm SL the opercular spine may not be distinguishable beneath the overlying skin.

Barbels in three pairs. Maxillary barbel long, slender and unbranched, extending to just beyond base of last pectoral-fin ray. No basal membrane present on maxillary barbel. Mandibular barbels originate immediately posterior to lower lip in a transverse row; with primary branches; secondary branches absent. Inner mandibular barbels origin close to midline, extending to just beyond anterior margin of pectoral girdle; with 2–5 paired branches proximally and 2–4 longer unpaired branches distally. Outer mandibular barbels originate lateral to inner mandibular barbels, extending to posterior margin of pectoral girdle; with 4–6 elongate unpaired branches.

Eyes large and ovoid, horizontal axis longest; approximately two thirds of interorbital distance. Orbit with a free margin. Anterior nostrils slightly closer together than posterior nostrils. Anterior nostrils tubular with a short raised rim. Posterior nostrils with elevated flaps along anterior margin.

Mouth inferior and crescent shaped; lips plicate. All teeth unicuspid. Premaxillae tooth plate wide with broad ventral shelf. Primary, secondary and tertiary premaxillary teeth discrete. Primary teeth 15–17 in a single row. Secondary teeth 37–49 in irregular rows. Tertiary teeth 16–18 in a single row. Mandibular teeth 14–16, in a single row; concentrated at midline; strongly recurved.

Dorsal fin located at anterior third of body. Dorsal fin with spinelet, spine and 7 rays; fin membrane not adnate with body. Dorsal-fin spine long and slightly curved; smooth along anterior margin; small serrations on posterior margin. Adipose fin well developed; margin convex. Caudal fin forked, count i,7,8,i. Procurrent caudal-fin rays symmetrical and extend only slightly anterior to fin base. Anal-fin base located ventral to adipose fin; margin convex. Anal-fin count iii, 8. Pelvic-fin origin at vertical ventral to posterior end of dorsal fin base. Pelvic-fin margins convex, tip of appressed fin just reaches anal-fin origin. Pelvic-fin count i,5–6. Pectoral-fin count I,7–8. Pectoral fin with slightly curved, stout spine bearing large serrations. Anterior spine margin with 8–17 distally directed serrations along entire length of spine. Posterior spine margin with 8–13 proximally directed serrations along the entire length.

Cleithral process elongated, narrow with a distinct lateral ridge, terminating in a sharp point. Surface concave dorsal to its lateral ridge, without bony ornamentation on its surface. Slit-like axillary pore present just ventral to cleithral process.

Coloration: The preserved holotype and syntopic paratypes were kept in a darkened aquarium prior to fixation and display a darker coloration than was observed when they were collected or is seen in other specimens fixed immediately after collection. Thus it is more difficult to see the contrast between light and dark areas on the head and body of these specimens (Figs. 1–2). A composite illustration is presented that depicts the bold pigmentation pattern typically observed in this species (Fig. 3).

In dorsal view, specimens appear banded with six dark patches over a lighter colored background. Area between the nares dark brown. Maxillary barbels dark brown to black. Mandibular barbels cream colored. Head with a light band between eyes and a light transverse collar at the level of the opercular spine, band lighter ventrally. Large dark spot posterior to lighter collar continuous with pigmentation at base of dorsal fin and dorsal spine; extending posteriorly to level of pelvic fins. A small dark dorsal spot posterior to dorsal fin. A small dark ventral spot posterior to pelvic fins. A large dark patch from the base of the adipose fin extends ventrally to the base of the anal-fin rays. Large dark spot covering most of the caudal peduncle.

TABLE 1. Morphometric measurements and meristic counts for holotype (CU 89005) and four syntopic paratypes (CU 89006, MRAC A4-13-P-1 and SAIAB 74202) of *Synodontis acanthoperca*. Standard length expressed in mm. All other measurements expressed in thousandths of SL. Meristic data for holotype is identified by a "*" superscript.

MORPHOMETRICS	HOLOTYPE	RANGE (n=5)	MEAN±SD as %
Standard length (mm)	44.1	40.4–45.9	-
Head length	297	281–322	305±1.64
Opercular spine length	54	15–62	47±1.84
Occipital shield width	118	105–128	118±0.93
Prepectoral length	190	190–212	200±0.79
Predorsal length	383	370–399	386±1.07
Prepelvic length	526	526–557	539±1.27
Preanal length	703	689–730	707±1.80
Eye diameter (horizontal axis)	82	72–92	84±0.81
Interorbital width	122	119–129	123±0.38
Snout length	98	81–98	89±0.68
Premaxillary width	66	59–69	65±0.42
Maxillary barbel length	345	329–392	358±2.76
Medial mandibular barbel length	166	126–166	142±1.84
Lateral mandibular barbel length	299	215–318	265±4.26
Mouth width	79	70–84	77±0.54
Pectoral spine length	254	225–267	253±1.68
Anterior pectoral branch ray length	261	193–265	239±2.86
Width at pectoral-fin insertion	252	246–275	258±1.16
Cleithral process length	229	192–248	216±2.25
Pelvic-fin length	161	134–161	146±1.03
Depth at dorsal-fin insertion	279	254–279	263±0.97
Dorsal-spine length	234	220–270	247±2.15
Dorsal-fin height	304	280–304	292±0.94
Dorsal-fin base length	168	153–168	159±0.58
Adipose-fin base length	265	179–265	201±3.61
Anal-fin base length	163	124–163	148±1.49
Caudal fin length	304	260-304	284±1.68
Caudal peduncle depth (maximum)	127	121–129	125±0.30
Caudal peduncle length	168	151-179	166±1.00

.....continued on the next page

TABLE 1 (continued)

MORPHOMETRICS	HOLOTYPE	RANGE (n=5)	MEAN±SD as %
MERISTICS			
Mandibular tooth count		14(1); 15*(2); 16(2)	
Primary premaxillary tooth count		15(1); 16*(3); 17(1)	
Pectoral-fin count		I,7(4); I,8*(1)	
Pectoral spine serrations (anterior/ posterior)		8/8(1); 11/9(1); 13/9(1); 16/12(1); 17/13*(1)	
Pelvic-fin count		i,5(1); i,6*(4)	
Dorsal-fin count (including spinelet)		II,7*(5)	
Anal-fin ray count		iii,8*(5)	
Caudal-fin count		i,7,8,i*(5)	
Total vertebrae count		35* (5)	

Ventral surface cream colored anteriorly with a series of thick, somewhat indistinct, dark bands separated by cream colored or lighter brown bands posteriorly. Darker bands are found: just anterior to the pelvic fins in v-shape (chevron); from slightly beyond posterior margin of pelvic fins to anus; along entire base of anal fin; and from narrowest point along caudal peduncle to base of caudal fin.

Dorsal and pectoral spine very dark; rays blackish against translucent, milky membranes; faint blackish band near margin in dorsal fin. Pelvic and anal fins milky with a diffuse blackish band approximately midway along the rays. Adipose fin black basally with wide cream-colored band at distal margin. Caudal fin milky colored with a pair of prominent black spots in the dorsal and ventral lobes just anterior to the fork of the fin.

Etymology: The specific name is a Latinized combination of the Greek *acantha*, meaning a thorn and the Latin *opercul*, meaning a cover or lid, alluding to the distinctive opercular spines developed by mature males in this species. Gender: feminine.

Distribution: This species is known from two sites within the Ogôoué River basin of Gabon. The type locality is the Rapids of Massoukou (Masuku) on the Ogôoué River near Franceville and a second population has been collected in rapids on the Louétsi River near Bongolo (Fig. 4). Given the significant river distance between these sites (> 500 km), we speculate that *S. acanthoperca* is widely distributed in the upper Ogôoué basin wherever similar rapid habitats exist.

Discussion

This new species is among the smallest known *Synodontis* species and has a distinctive pigmentation pattern. We initially considered that these specimens might be conspecific

with *S. marmoratus* Lönnberg 1895 described from the Mémé River of Cameroon and later illustrated by Poll (1971). This is another small *Synodontis* species with a similar body pigmentation consisting of contrasting dark patches on a light background. However, *S. marmoratus* does not possess a distinctive pair of spots on the caudal fin, lacks any evidence of opercular spines in similar sized specimens and also differs in head, barbel and body proportions from *S. acanthoperca*.

While the well-developed opercular spines in *S. acanthoperca* are unique in mochokids, bony spines on structures other than the dorsal and pectoral spines have been reported in several other mochokid taxa including some *Synodontis* species. The best-known example is the spiny ornamentation on the humeral processes in three larger *Synodontis* species. *S. bugetti* Boulenger 1911 and *S. omias* Günther 1864, both from the Niger basin, have up to three spines developed along the ventral portion of the humeral process. A more extreme condition is seen in *S. acanthomias* Boulenger 1899, from the Congo basin. This species develops multiple spines that can completely cover the posterior portion of the humeral process. In this species the number and size of these spines increases with body size and large specimens (>400 mm SL) may have up to 20 well-developed spines (personal observations of the authors).

Another type of spiny ornamentation of the pectoral girdle is seen in *Acanthocleithron chapini* Nichols & Griscom 1917. As the genus name implies, this small mochokid from the Congo basin bears one or more small bony spines just above and anterior to the pectoral spine. Furthermore, while reexamining the types series of this species (AMNH 6548, 6552, 6575 & 6681), we discovered that the skull roof bears numerous minute bony spines that give it a prickly texture. This skull ornamentation has not previously been reported and is distinct from the rough surface texture observed on the skull roofs of some mochokids.

Although not as apparent as in *S. acanthoperca*, the opercle is weakly ornamented in two other mochokid taxa, *Brachysynodontis batensoda* (Rüppell 1832) found in the Nile, Chad, Niger, Sénégal, and Gambia basins, and *Hemisynodontis membranaceus* (Geoffroy Saint-Hilaire 1809) found in the Nile, Chad, Niger, Sénégal, Gambia and Volta basins. In both species the margin of the opercle bears a comb-like series of small spines at its posterior apex (Taverne & Aloulou-Triki 1974). In *Hemisynodontis* the spines are more numerous, but are so small as not be visible through the skin. Whereas in *Brachysynodontis*, the spines are fewer, and large enough to be visible externally, yet never reach beyond the opercular membrane. In neither species are the series of opercular spines known to be sexually dimorphic and we do not consider this ornamentation to be homologous with the opercular ornamentation observed in *S. acanthoperca*.

Sexual dimorphism has been reported in about half of all families of catfishes (Rapp Py-Daniel & Cox Fernandes 2005). Among African catfishes, sexual dimorphism is probably most widespread and strikingly apparent in the Mochokidae. Well known examples include the elongate anal and caudal fins found in adult males of many

Chiloglanis species (Roberts 1989; Seegers 1996). In addition, enlarged humeral processes have been reported in males of some *Chiloglanis* species (Roberts 1989). In such cases, the humeral process is hypertrophied and may protrude away from the body axis, but is not ornamented with any bony spines or dermal tubercles.

Many mochokid species have rough skins that bear unculiferous tubercles and sexual dimorphism of this feature has been reported in *Microsynodontis* (Ng 2004). Males in several *Microsynodontis* species have denser aggregations of tubercles on the dorsal and lateral surfaces of their heads than females, especially along the area between the snout and the preopercle.

As previously mentioned the skull roof of *Acanthocleithron* is covered with numerous small spines and the cleithral region directly anterodorsal to the pectoral spine bears one or more larger spines. Sexual dimorphism may exist in both of these bony features, as they appear to be best developed in males among the type series examined.

In summary, neither spiny ornamentation nor sexual dimorphism appears to be uncommon in mochokid catfishes. However, an association between these features has not previously been reported in any members of this family. Thus the new species described here represents the first documented case in mochokids in which such ornamentation and sexual dimorphism are clearly linked. A similar relationship may also occur in *Acanthocleithron*, and we would not be surprised if additional cases are discovered in the future within the Mochokidae.

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