

Two new cis-Andean species of the South American catfish genus *Megalonema* allied to trans-Andean *Megalonema xanthum*, with description of a new subgenus (Siluriformes: Pimelodidae)

John G. Lundberg and Wasila M. Dahdul

A revised diagnosis of the pimelodid catfish genus *Megalonema* is given based on synapomorphic features of the Weberian complex and gas bladder. *Megalonema xanthum* from the Magdalena River is redescribed. Two new cis-Andean species of *Megalonema* are described, *M. amaxanthum* n. sp. from the Amazon River basin, and *M. orixanthum* n. sp. from the Orinoco River basin. These three species are differentially diagnosed by shape and size of the supraoccipital posterior process, adipose-fin shape, vertebral counts, eye size, premaxillary bone shape and dentition, length of the anal-fin base, width between the posterior nostrils and presence/absence of dentations on the pectoral spine. *Eretmomegalonema* new subgenus is established for *M. xanthum*, *M. amaxanthum* and *M. orixanthum* and supported by the uniquely synapomorphic paddle-like structure of its pelvic fin and hypertrophied basipterygium. Unambiguous synapomorphies indicate a sister-group relationship between *M. amaxanthum* and *M. orixanthum*, with *M. xanthum* basal to this pair. This topology is congruent with the Neogene origins of separate Magdalena, Amazon and Orinoco basins suggesting vicariant control of diversification of *Eretmomegalonema*.

Uma diagnose do gênero *Megalonema* é fornecida baseada em caracteres sinapomórficos do aparelho de Weber e da bexiga natatória. *Megalonema xanthum* do rio Magdalena, é redescrita. Duas novas espécies cis-Andinas de *Megalonema* são descritas: *M. amaxanthum* sp. n. da bacia Amazônica, e *M. orixanthum* da bacia do rio Orinoco. Estas três espécies são diagnosticadas pela forma e tamanho do processo supraoccipital posterior, forma da nadadeira adiposa, contagem do número de vértebras, tamanho do olho, forma do premaxilar e dentição, comprimento da base da nadadeira anal, distância entre as narinas posteriores, e presença/ausência de dentições no espinho da nadadeira peitoral. *Eretmomegalonema*, novo subgênero, é estabelecido para *M. xanthum*, *M. amaxanthum* e *M. orixanthum* e suportado pelas únicas estruturas sinapomórficas da nadadeira pélvica em forma de remo, e do basipterígio hipertrofiado. Claras sinapomorfias indicam uma relação de grupo irmão entre *M. amaxanthum* e *M. orixanthum*, com *M. xanthum* basal a esse grupo. Esta topologia é congruente com a origem Neogênica das distintas bacias do Magdalena, Amazonas e Orinoco, sugerindo um evento vicariante de diversificação de *Eretmomegalonema*.

Key words: *Eretmomegalonema*, *Megalonema amaxanthum*, *Megalonema orixanthum*.

Introduction

The pimelodid catfish genus *Megalonema* has an ample distribution in South America throughout the Paraná, Amazon, Essequibo, Orinoco, Maracaibo and Magdalena basins. The species of *Megalonema* inhabit medium to large rivers mostly in flowing marginal reaches and over fine substrates of mud or sand. These are streamlined catfishes of modest size with

adult lengths ranging among species from ca. 10-30 cm SL. Their clear to hyaline fins are gracefully shaped and often filamentous, with flexible fin spines in the dorsal and pectoral fins, and an expansive adipose fin. In color *Megalonema* are mostly plain yellowish to tan and generally without prominent marks except for the common presence of an embedded dark spot in the base of the upper caudal-fin lobe, and sometimes also the lower lobe.

Carl Eigenmann (1912a) established the genus *Megalonema* for his newly described species *M. platycephalum* from the Essequibo River, Guyana. Later in the same year he described a second species, *M. xanthum*, from the río Magdalena, Colombia (Eigenmann, 1912b). Subsequent species descriptions and taxonomic transfers have raised the number of presumed valid species in *Megalonema* to six (Lundberg & Littmann, 2003). The existence, however, of at least one undescribed cis-Andean species has been known for over 25 years and our recent study of Amazon and Orinoco populations indicates additional undescribed species. The purpose of this paper is to describe two new species that are related to *M. xanthum*, and to recognize these three as a monophyletic subgroup of *Megalonema* characterized by oddly hypertrophied pelvic fins. In a subsequent paper we are revising the remaining species of the genus.

Material and Methods

Measurements and counts follow Lundberg *et al.* (1991), Lundberg & Parisi (2002) and Lundberg & Akama (2005) with the addition of the distance from snout tip to insertion of outer pelvic-fin ray, and least distance from orbital margin to posterior nostril. Measurements are straight-line distances taken with a digital caliper to the nearest 0.1 mm from a sample of 136 specimens ranging in standard length (SL) from 38.2 to 120.0 mm. Measurement ratios are expressed in thousandths (mils) in text and Table. We used least squares regression to analyze variation in log₁₀ transformed variables, and t-tests of the residuals from regression lines to assess taxonomic differences in proportional measurements. Vertebral counts include the five elements united in the Weberian complex; the first caudal vertebra is that immediately posterior of the visceral cavity and recognized by its fully developed hemal spine; the compound centrum of the caudal skeleton is counted as one. Radiographed (R), cleared and stained (C&S), and articulated dry skeletal (Sk) specimens were used for counts of vertebrae and median-fin rays. Institutional acronyms are as listed on the Catalog of Fishes website at <http://www.calacademy.org/research/ichthyology/catalog/abtabr.html>.

Results

The genus *Megalonema* possesses nearly all of the diagnostic synapomorphies for the following nested groups (Lundberg *et al.*, 1991: 842, fig. 1; see also Hardman & Lundberg, 2006): Pimelodidae *sensu* Lundberg & Littmann (2003), non-phractocephaline pimelodids (*i.e.*, all Pimelodidae except *Steindachneridion*, *Phractocephalus*, *Leiarius*, *Perrunichthys*), and the *Calophysus-Pimelodus* clade. *Megalonema* is exceptional among Pimelodidae in lacking a deep sutural joint between the fifth and sixth centra. In the

framework of its inferred phylogenetic position in Pimelodidae, the presence in *Megalonema* of a normal intervertebral joint between these centra has been interpreted as a reversal or secondary loss of the synapomorphic sutural joint (Stewart, 1986; Lundberg *et al.*, 1991).

Beyond the aforementioned, the relationships of *Megalonema* are unsettled. Driver (1919) interpreted similarities of the reduced gas bladders, encapsulating Weberian complexes and external morphology among *Megalonema*, *Luciopimelodus* and *Pinirampus* (as *Perugia* and including *M. xanthum*) as indicative of relationship, placing these taxa together as the Luciopimelodinae. Alternatively, Stewart (1986) described a number of unambiguous synapomorphies supporting his *Calophysus* group: *Calophysus*, *Pinirampus*, *Luciopimelodus*, *Pimelodina* and *Aguarunichthys*. Stewart found that *Megalonema* exhibits unique features of the gas bladder and Weberian vertebral structure that set it apart from the *Calophysus* group, although he pointed out other possible synapomorphies in the reduced structure of the pectoral spine, elevated pectoral-fin ray count and loss of the posterior cleithral process. Lundberg *et al.* (1991) tentatively leaned toward placing *Megalonema* basal to the *Calophysus* group. We are pursuing the question of the systematic position of *Megalonema* with both morphological and molecular data.

Megalonema Eigenmann, 1912

Megalonema Eigenmann, 1912a: 150. Gender neuter.

Type species. *Megalonema platycephalum* Eigenmann, 1912a, by original designation.

Diagnosis. Eigenmann's (1912a) diagnosis of *Megalonema* is a mixture of derived and plesiomorphic character states, each with a checkered distribution among pimelodids. Accordingly, we offer an alternative diagnosis emphasizing unique or unambiguous synapomorphies. Thus, *Megalonema* is characterized by the following. A unique structure of the gas bladder and its encapsulating processes of the Weberian complex (Fig. 1) including: reduced, dumbbell-shaped gas bladder with distended lateral lobes connected by a tubular commissure ventrally crossing Weberian compound centrum; paired, ventrally incomplete bony capsules surrounding lateral lobes of gas bladder formed by deeply down-curved 4th transverse processes of Weberian complex; a prominent ventral flange of compound centrum immediately anterior to tubular commissure of gas bladder and sutural joint with 5th centrum. Paired bony canals of passage for posterior cardinal veins and median aortic canal all very short, formed by ventral flange crossing compound centrum. Bony aortic canal, in some specimens, continued anterior to ventral flange by a second thin midventral bridge (Fig. 1). Transformator process of tripus reduced to a thin tapering splint on anteromedial wall of gas bladder lobe. Vertebral centra five and six articulate by a

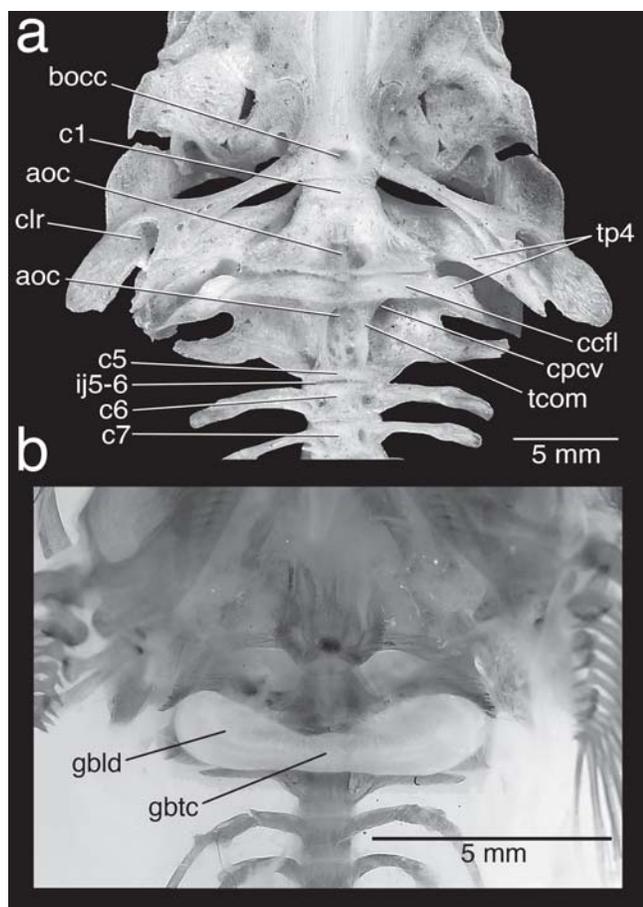


Fig. 1. **a**, Weberian complex, post-Weberian vertebrae, basioccipital region and upper bones of shoulder girdle of *Megalonema cf. platycephalum*, ANSP 178515. **b**, Weberian complex and gas bladder of *M. orixanthum*, ANSP 187450. aoc = bony aortic canal; bocc = basioccipital; ccfl = ventral flange of compound centrum; tcom = position of gas bladder tubular commissure posterior to ventral flange; clr = cleithral ring; cpcv = position of bony canal for passage of posterior cardinal vein; gbld = lateral distention of gas bladder; gbtc = transverse commissure of gas bladder; ij5-6 = typical intervertebral joint between c5 and c6; tp4 = ventrally incomplete bony capsules surrounding lateral lobes of gas bladder formed by deeply down-curved 4th transverse processes of Weberian complex; c1, c5, c6, c7 = vertebrae designated by their ordinal numbers.

typical intervertebral joint without interdigitating sutures, processes or superficial ossification (Fig. 1).

Some other pimelodids possess modifications of the fourth transverse processes for encapsulation of gas bladder: *Hypophthalmus* (Howes, 1983) and the genera of the *Calophysus* group (Stewart, 1986; Driver, 1919). Many osteological details of the Weberian complex, however, differ among these groups and *Megalonema*. Further, the gas bladder morphologies differ strikingly among them: bilobed

in *Megalonema*, small median sac with anterior projections in the *Calophysus* group, and a pair of small separate sacs in *Hypophthalmus*.

We also note that *Megalonema* may have a possibly diagnostic dark caudal spot embedded within the base of upper lobe of the caudal fin, internal to uppermost 4-5 branched fin rays. Some specimens show a matching spot on the lower lobe. We have observed the upper caudal spot in specimens of all species except *M. argentina* (no specimens examined) and *M. xanthum* for which the only available specimens are the faded types collected nearly a century ago. It is possible that *M. xanthum* has the caudal spot in life but it is bleached out as it is in faded specimens of other species. Upper lobe caudal spots in a similar position are also found in Pimelodidae in *Hemisorubim*, *Platysilurus* and *Platystomatichthys*, but in these the pigmentation is chromatophores in the skin, external to the fin rays.

Eretmomegalonema, new subgenus

Type Species. *Megalonema xanthum* Eigenmann, 1912, by original designation. We establish this taxon for a subgroup of the genus *Megalonema* containing *M. xanthum*, *M. amaxanthum* new species and *M. orixanthum* new species.

Diagnosis. *Eretmomegalonema* is uniquely characterized by the paddle-like structure of its pelvic fin and hypertrophied basiptyerygium (Figs. 2a-b). Both sexes and juveniles exhibit these features. The outer three pelvic-fin rays (1st-3rd) are elongated and a little thickened to form a prominent paddle-like lobe. These rays exceed twice the length of the innermost (6th) pelvic ray, and about 1.4 times the length of the 4th. The 1st pelvic ray is proximally unbranched and unsegmented for about half its length and its segments are foreshortened (square). The 2nd pelvic ray is similarly unbranched and unsegmented for about half its length, then distally it is asymmetrically branched and segmented as follows. Distal to its first division, the 2nd ray's outer primary ramus does not further divide and its segments are square; the inner primary ramus divides into secondary rami of which the outer ramus remains undivided and with short segments, whereas the inner secondary ramus divides into thin, tertiary rami with more elongated (rectangular) segments. The 3rd ray is unbranched and unsegmented for about 40% of its length; its primary rami further divide twice and have slightly elongated segments. In contrast to the outer rays, the inner three rays are slender, branched before their midlength, and their segments are elongate rectangles.

The basiptyerygium is elongated with an overall bony length nearly twice the combined width of both basiptyerygia. Also, the midline symphysis is complete along the entire length of the anteromedial process, basal plate and posterior process. The posterior process is long and has a triangular shaped tip. On the ventral side, the anteromedial process has a proximal lateral-margin crest. Dorsally, the anterolateral

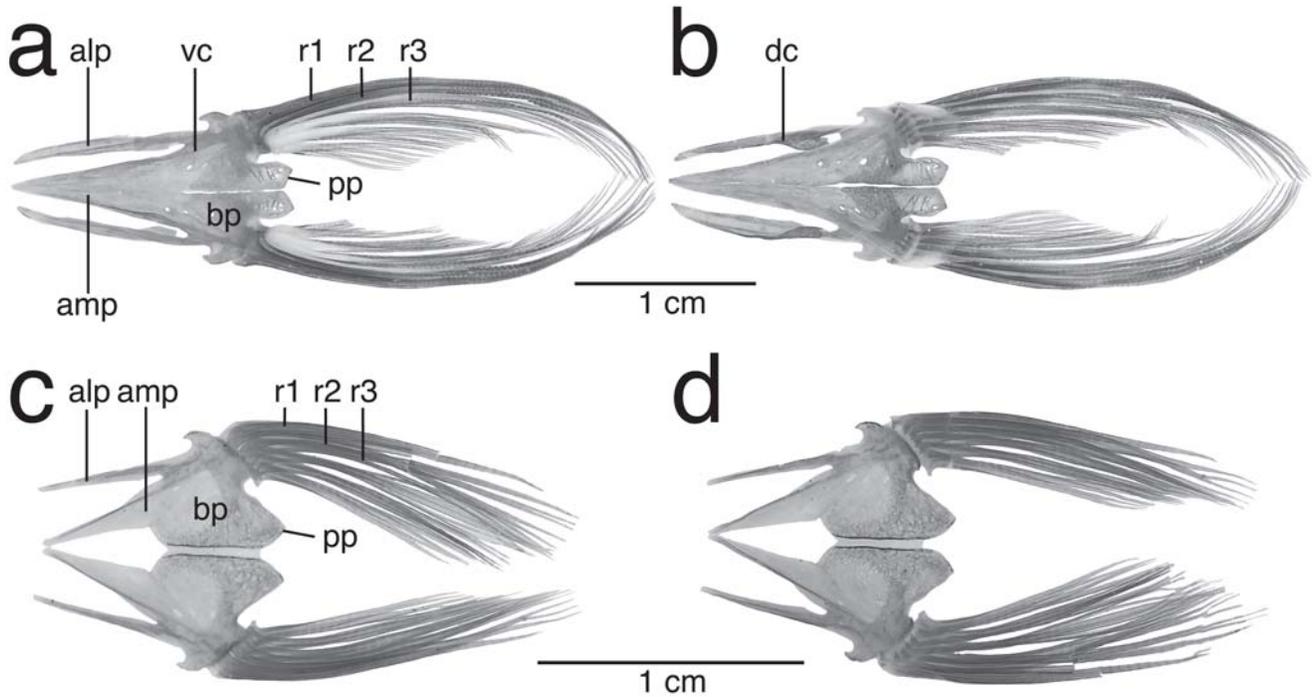


Fig. 2. Pelvic fins and basipterygia in *Megalonema orixanthum*, ANSP 187450, **a**, ventral view, **b**, dorsal view, and *M. platycephalum*, ANSP 189040, **c**, ventral view, **d**, dorsal view. alp = anterolateral process; amp = anteromedial process; bp = basal plate; dc = dorsal crest; pp = posterior process; r1-3 = pelvic-fin rays; vc = ventral crest.

process has on its lateral-margin a prominent high crest that curves medially near its tip. The crests are associated with the arrector, adductor and abductor muscles of the elongated outer pelvic-fin rays.

In marked contrast to *Eretmomegalonema*, other species of *Megalonema* (Figs. 2 c-d) and other pimelodids lack pelvic-fin lobes, although in some the pelvic fins may be generally elongated. Also, no other *Megalonema* (Figs. 2 c-d) or other pimelodids have the high dorsal crest on the anterolateral process (compare Fig. 2b). Also, other species of *Megalonema* have a wide gap across the midline between the anteromedial processes (Figs. 2 c-d), but a completely bony basipterygial symphysis including the anteromedial processes (compare Figs. 2a-b) is found in some other pimelodids (Parisi *et al.*, 2006; Rocha *et al.*, 2007): *Propimelodus*, *Exallodontus*, *Pimelodus altissimus*, *Duopalatinus peruanus*, *Cheirocerus* and the *Calophysus* group.

Etymology. Subgenus *Eretmomegalonema*, from Greek *eretmon*, oar, in reference to the paddle-like pelvic fins, and *megalonema*, name of the catfish genus to which the new taxon belongs. Gender Neuter.

Key to the species of Subgenus *Eretmomegalonema*

1. Supraoccipital posterior process narrow, its basal width less than half its length, its sides gently tapering (Fig. 3b); adipose fin rising steeply and terminating

posterior to vertical through tips of adpressed anal-fin rays; eye small, horizontal diameter contained 5-6 times in head length; pectoral spine with numerous, erect dentations along posterior margin; premaxillary tooth band broad with about 8-10 rows of teeth; 18-20 gill rakers on first arch. Magdalena River Basin *Megalonema xanthum*

1'. Supraoccipital posterior process broad based, its basal width equal to or greater than its length, and its sides abruptly tapering (Figs. 3c,d); adipose fin rising at a shallow angle from back and terminating at or anterior to vertical through tips of adpressed anal-fin rays; eye large, horizontal diameter contained 3-5 times in head length; premaxilla extremely narrow with one row of teeth or none; 25 or more gill rakers on first arch. Cis-Andean distribution.....2

2. Supraoccipital posterior process bell-shaped in outline, its tip blunt and separated by a distinct gap from supraneural (Fig. 3c); pectoral spine lacking dentations, premaxilla with a single row of teeth. Amazon River Basin *Megalonema amaxanthum*

2'. Supraoccipital posterior process triangular in outline, its tip pointed or bifid and nearly reaching supraneural (Fig. 3d); pectoral spine with numerous, erect dentations along posterior margin; premaxilla with a single row of teeth or teeth absent. Orinoco River Basin *Megalonema orixanthum*

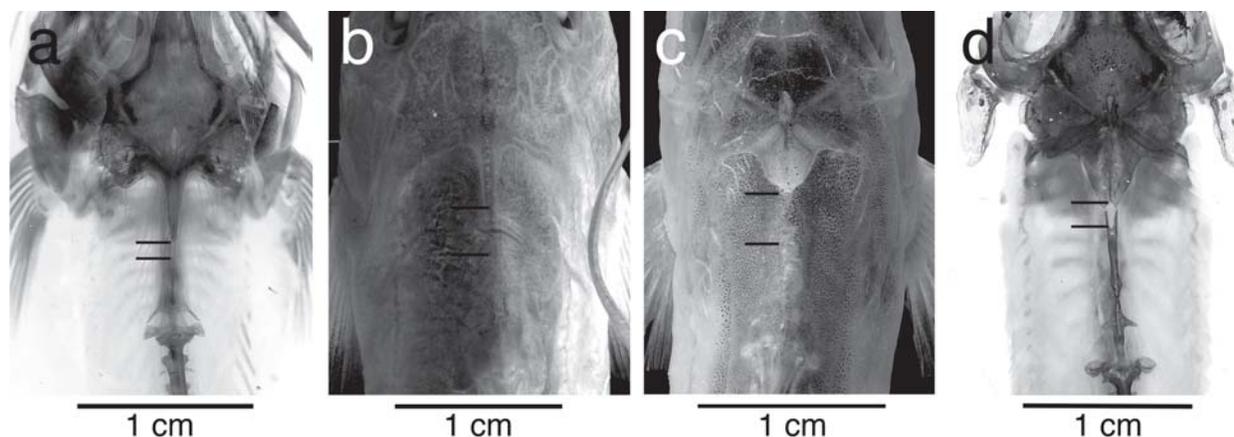


Fig. 3. Details of supraoccipital processes of **a**, *Megalonema* cf. *platycephalum* ANSP 178450, **b**, *M. xanthum* CAS 63674, **c**, *M. amaxanthum*, holotype, CBF 11896 (ex FMNH 106769), and **d**, *M. orixanthum* ANSP 148180, paratype. Paired lines on each image show the gap between the tip of supraoccipital process and supraneural anteromedial point in or just below skin.

***Megalonema xanthum* Eigenmann, 1912**

Fig. 4

Megalonema xanthum Eigenmann, 1912b: 16 [original description; type locality: Colombia, Cudinamarca Department, Girardot, Magdalena River]. -Stewart, 1986: 670 [anatomy]. -Maldonado-Ocampo *et al.*, 2005: 170, fig. 160, map 162 [description, distribution, specimen list]. *Perugia xanthus*. -Driver, 1919:453, pl. 2, figs. A, C, D, pl. 3, fig. 5 [anatomy of Weberian complex and gas bladder, in key, relationships]. -Eigenmann, 1922: 35, pl. 3, fig. 3 [holotype photograph].

Diagnosis. A species of the subgenus *Eretmomegalonema* distinguished from others by the following combination of features. Supraoccipital posterior process (Figs. 4b, 3b) narrow, its basal width less than half its length, its sides gently tapering to a sharp tip separated by a distinct gap from supraneural; adipose-fin (Fig. 4a) large, its margin anteriorly rising steeply and straight or in a broad convex curve to a gently curved apex; adipose fin terminating posterior to vertical through tips of adpressed anal-fin rays; total vertebrae modally 47, range 45-48 (Table 1); eye relatively small, horizontal diameter 154-195 mils of HL; anal-fin base relatively short, 94-117 mils of SL (Fig. 5a); width between posterior nostrils relatively narrow, 138-179 mils of HL (Fig. 5b); pectoral spine with numerous, erect dentations along posterior margin; premaxillary tooth band broad with about 8-10 rows of teeth; and 18-20 gill rakers on first arch.

Description. Meristic data for 5 to 23 specimens are in Table 1, and morphometric data for 20 to 23 paratypes are in Table 2. *Megalonema xanthum* (Fig. 4) is a medium sized pimelodid with a maximum length known to us of 159.3 mm SL in the holotype (note that the length of 202 mm reported by Eigenmann (1912b) is consistent with Total Length). Dorsal

profile of head and nape gently convex from snout tip to vertical at insertion of maxillary barbel, then nearly straight to origin of dorsal fin, then body profile scarcely convex along dorsal-fin base, straight to posterior insertion of adipose fin, and a little concave across caudal peduncle. Ventral profile slanting convexly ventrally from snout tip to mental barbels, nearly straight to pectoral-fin origin, straight or convex across abdomen to anal-fin origin, then slanting dorsally to caudal peduncle and slightly concave along caudal peduncle.

Cross-sectional shape roughly trapezoidal from snout to supraoccipital, then deeply and broadly triangular to dorsal-fin origin, and increasingly compressed to caudal fin. Maximum body depth at dorsal-fin origin contained 4.5-6.3 times in SL. Maximum body width across cleithra in front of pectoral spine insertion, contained 5.8-6.8 times in SL.

Head of moderate length, contained 4.1-4.8 times in SL and relatively deep, its depth at base of supraoccipital posterior process slightly less than body width. Head covered

Table 1. Frequency distributions for counts of soft pectoral-fin rays, gill rakers on first branchial arch, and total vertebrae.

	soft pectoral rays			
	11	12	13	14
<i>M. xanthum</i>		1	6	5
<i>M. amaxanthum</i>	5	9	2	
<i>M. orixanthum</i>	1	6	3	

	gill rakers on first branchial arch								
	18	19	20	/	25	26	27	28	29
<i>M. xanthum</i>	1	3	1						
<i>M. amaxanthum</i>					1		1		2
<i>M. orixanthum</i>								1	3

	total vertebrae						
	42	43	44	45	46	47	48
<i>M. xanthum</i>				1	1	18	3
<i>M. amaxanthum</i>	21	21	14	5			
<i>M. orixanthum</i>			12	21	2		

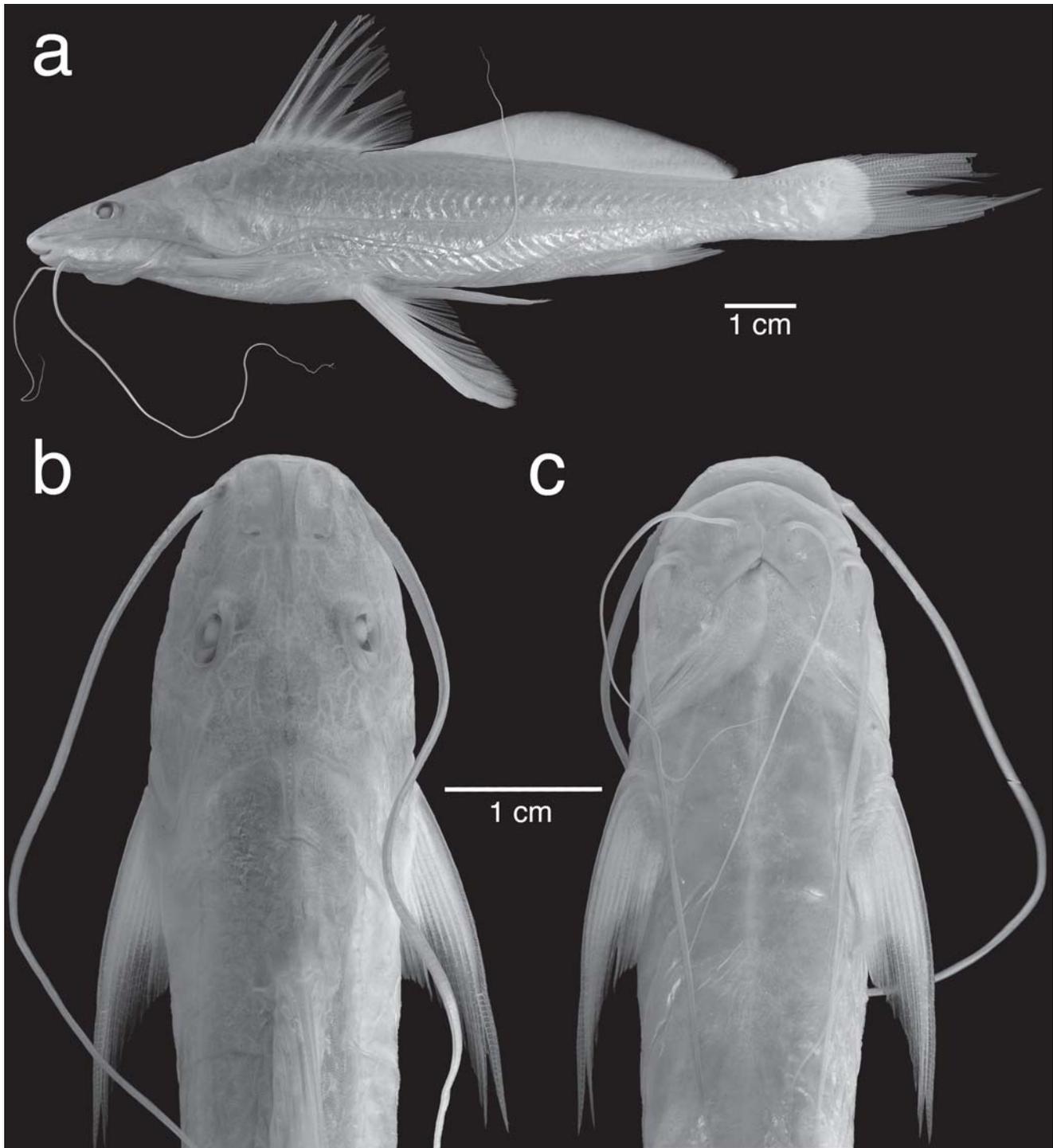


Fig. 4. *Megalonema xanthum*, CAS 63674, paratype, 118 mm SL, in **a**, lateral, **b**, dorsal and **c**, ventral view.

by thin skin, skull roofing bones relatively smooth, not ornamented with tubercles or ridges. Snout moderately long, contained 2-2.3 in head length, and with broadly rounded margin in dorsal and ventral views. Snout and upper jaw projecting; with mouth closed less than half of premaxillary dentition exposed. Anterior nostril behind snout margin in a shallow, circular depression, its aperture dorsally directed and encircled

with a low fleshy rim; width between anterior nostrils contained 1.2-1.7 times in distance between anterior and posterior nostrils. Long axis of posterior nostril oblique to longitudinal body axis; posterior nostril preceded by thin, semicircular membrane as large as nostril aperture; width between posterior nostrils contained 1.2-1.6 times in distance between anterior and posterior nostrils. Distance between anterior and

posterior nostrils equal to or a little greater than distance between posterior nostril and eye.

Eye relatively small, about 1.5-2 times longer than deep, placed dorsolaterally and centered on midpoint of bony head length; interorbital space scarcely convex. Interorbital wide, containing horizontal eye diameter 1.2-1.6 times. Anterior cranial fontanelle narrow, parallel-sided, originating behind level of posterior nostrils and terminating between eyes at epiphyseal bar. Posterior cranial fontanelle closed anteriorly, persisting as oval aperture in center of supraoccipital. Supraoccipital posterior process narrow-based (its basal width contained about 3 times in its length), dorsally flat, not angular or keeled, but prominent with sides scarcely tapering to pointed tip, failing by about half of its own length to contact supraneural (anterior nuchal plate obsolete).

Mouth subterminal, opening anteriorly and widely; gape broad, its width across inner surface of ricti twice greater than interorbital width. Lips thin-skinned and smooth. Rictal fold well defined but not fleshy or swollen, subtended above and below by deep folds respectively reaching base of maxillary barbel and about one third distance to mandibular symphysis. Premaxillary tooth band of uniform length along transverse width, with bluntly rounded posterolateral corner. Premaxillary teeth conical, fine, in about 8-10 irregular rows, more numerous in larger specimens. Dentary teeth similarly slender, arranged in about 6-8 rows at symphysis and fewer posterolaterally. No prevomerine, metapterygoid or accessory

tooth plates present on the palate.

Origin of maxillary barbel in depression close to base of anterior nostril and above rictus, continuing to below eye; maxillary barbel reaching just beyond posterior end of adipose fin to base of caudal fin. Outer mental barbel reaching near or onto anal fin, not beyond adipose fin. Tip of inner mental barbel reaching near pelvic fin insertion. Branchiostegal membranes anteriorly united to isthmus and overlapping before diverging. Gill rakers long, slender and bladelike, 18-20 on first gill arch (in 5 specimens): 4-5 rakers on upper limb, 14-15 on lower limb.

Dorsal-fin lepidotrichia I,7; spinelet absent or vestigial; dorsal-spine base with much reduced articulating processes. Dorsal spine and first branched fin ray distinctly longer than remaining, progressively shorter rays. Dorsal spine slender, its distal half or more segmented and flexible, its shaft smooth and non-serrate. Dorsal-fin origin at vertical through middle of adpressed pectoral fin; its posterior insertion above pelvic-fin origin. Adpressed dorsal fin reaches onto adipose fin. Adipose-fin origin located at vertical before or at tip of last dorsal-fin ray. Adipose fin expansive, anteriorly rising straight or convexly to its gently curved apex at vertical about midway between pelvic-fin base and anal-fin origin; terminating posterior to tips of adpressed anal-fin rays; 1.5-2 times longer than head, relatively high, its height 4.7-6 times in its base.

Caudal fin deeply forked with sharply pointed lobes, the lower lobe shorter, the uppermost two principal rays a little

Table 2. Measurement data for *Megalonema xanthum*, *M. amaxanthum*, and *M. orixanthum*; expressed in thousandths of the standard dimensions given in parentheses. SL=standard length, CPL=caudal-peduncle length, AFB=anal-fin base, ADL=adipose-fin length, HL=head length.

Measurement	<i>Megalonema xanthum</i>			<i>Megalonema amaxanthum</i>			<i>Megalonema orixanthum</i>				
	Mean	N	Range	Hol	Mean	N	Range	Hol	Mean	N	Range
Standard length in mm	92.1	23	64.3-120	98	66	70	40-106	100.3	75.4	40	38.2-115.8
Predorsal length (SL)	336	23	309-354	320	343	69	326-362	337	342	40	326-361
Preanal length (SL)	710	23	688-730	694	711	70	685-741	722	709	40	684-736
Prepectoral length (SL)	226	23	192-424	194	221	70	191-273	210	218	40	196-257
Prepelvic length (SL)	435	23	415-446	436	454	70	429-499	440	443	40	424-471
Head length (SL)	229	23	208-246	214	228	70	205-257	218	226	40	211-246
Caudal peduncle length (SL)	204	23	186-218	219	195	70	178-218	191	203	40	187-219
Caudal peduncle depth (CPL)	410	23	336-474	374	423	70	336-487	385	394	40	326-452
Dorsal spine length (SL)	266	20	243-287	297	290	59	244-371	299	288	28	254-320
Dorsal fin base (SL)	140	23	129-151	153	136	70	108-151	142	136	40	125-147
Pectoral spine length (SL)	216	21	196-230	199	217	64	191-257	217	215	37	192-235
Pelvic fin length (SL)	248	23	233-267	249	268	70	223-327	255	266	40	230-311
Anal fin height (AFB)	1490	20	1311-1637	1252	1341	66	1088-1673	1590	1475	38	1258-1655
Anal fin base (SL)	104	23	94-117	106	112	70	93-142	100	104	40	93-117
Adipose length (SL)	393	23	361-419	366	358	69	311-415	370	361	40	327-387
Adipose height (ADL)	185	23	165-211	185	207	68	165-257	186	199	40	156-246
Dorsal to adipose distance (SL)	55	21	42-78	64	63	69	25-94	44	56	40	38-76
Body depth (SL)	191	22	158-221	191	189	69	161-233	169	185	40	152-226
Body width (SL)	161	22	146-171	141	139	70	118-165	133	136	39	115-155
Bony interorbital (HL)	233	23	204-254	268	232	70	183-285	228	231	40	196-279
Eye diameter horizontal (HL)	168	23	154-195	244	263	70	214-321	260	258	40	209-337
Eye diameter vertical (HL)	110	23	93-136	148	158	70	112-214	169	150	40	105-194
Snout length (HL)	476	23	440-506	450	432	70	373-487	411	429	40	383-483
Internarial length (HL)	228	23	198-260	191	188	69	149-214	183	184	40	145-210
Internarial anterior width (HL)	151	23	125-162	148	156	70	131-177	137	149	40	134-174
Internarial posterior width (HL)	160	23	138-179	177	199	69	162-228	224	221	40	196-246
Eye to posterior nostril (HL)	194	23	172-226	220	183	69	140-227	164	183	40	128-220
Gape width (HL)	455	23	393-497	502	457	70	346-538	425	450	40	372-488

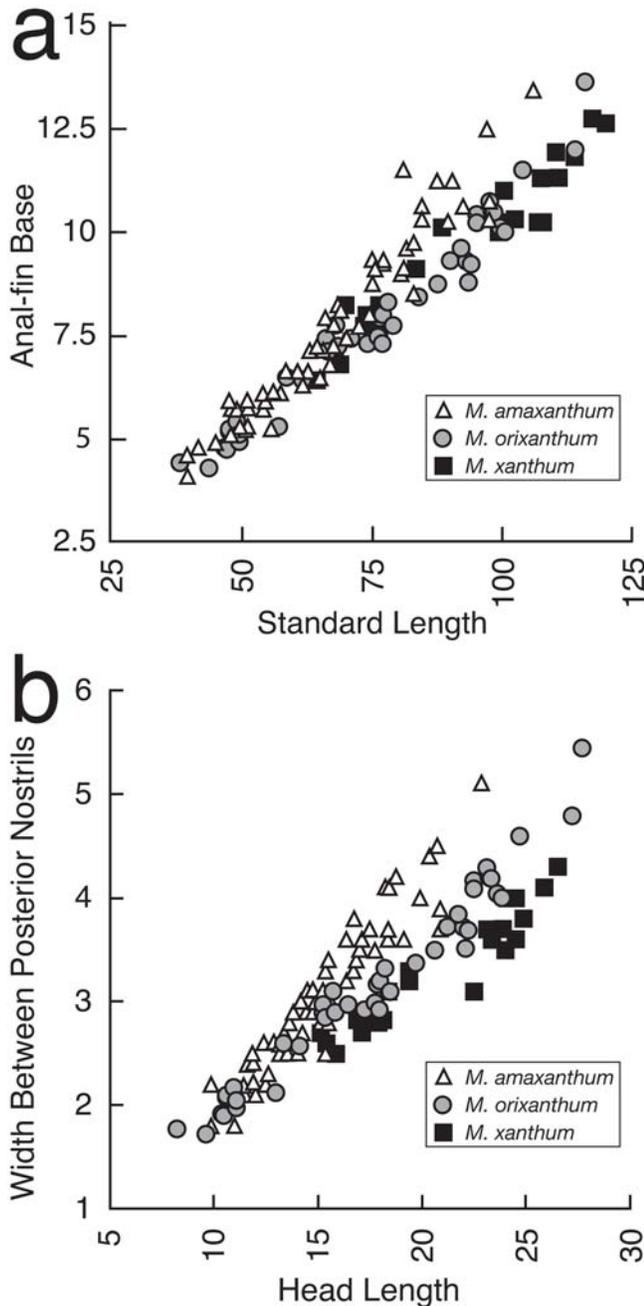


Fig. 5. Scatter plots illustrating: **a**, anal-fin base length relative to standard length, and **b**, width between posterior nostrils relative to head length, in *Megalonema xanthum* (squares, $n=23$), *M. amaxanthum* (triangles, anal-fin base $n=71$, width between posterior nostrils $n=70$), and *M. orixanthum* (circles, $n=41$). In t-tests of the residuals from regression, *M. amaxanthum* proved to have a significantly longer anal-fin base length than *M. orixanthum* and *M. xanthum* (p -values <0.0001 for pairwise comparisons), and all three species are significantly different from each other in width between posterior nostrils with increasing relative widths from *M. xanthum*, *M. amaxanthum* to *M. orixanthum* (p -values for pairwise comparisons <0.0001).

prolonged; inner margins of both lobes straight to concave. Principal caudal-fin rays 1+7-8+1.

Anal-fin origin at vertical through middle of adipose-fin base, posterior insertion before end of adipose fin, distal margin of anal fin slightly concave. Anal-fin rays 13-16, modally 14, in 19 specimens.

Pectoral fin I, 12-14, modally I, 13, in 11 specimens. Pectoral spine slender, its distal half or more segmented and flexible, its shaft anteriorly smooth, posteriorly with small erect dentations, one per segment where segments are discernable. Pectoral-spine base with much reduced articulating (fin-locking) processes. Pectoral spine and outer few branched pectoral rays prolonged but none filamentous. Pectoral-fin margin concave. Pectoral axillary gland pore absent. Posterior cleithral process obsolescent.

Pelvic fin as described for subgenus. Also, pelvic-fin insertion below posterior insertion of dorsal fin. Tip of pelvic fin not reaching anal fin.

Urogenital papilla small, located behind anus near base of inner pelvic-fin rays; no indication of sexual dimorphism.

Lateral line straight with side branches alternating dorsally and ventrally, complete and reaching at least onto caudal-fin base.

Total vertebrae in 23 specimens (Table 1), modally 47, range 45-48 including Weberian complex; in 20 specimens 18-19 precaudal vertebrae, modally 18, and 27-30 caudal vertebrae, modally 29.

Coloration in alcohol. All available specimens are types collected in 1912 that have faded or darkened in preservative. In addition to the dark retina of the eye, small, dark chromatophores are scattered over the dorsum of head and body. Many specimens show a subcutaneous silvery layer along the lower flanks. No specimens show the upper caudal lobe spot that is present in all other species of the genus, but this may be due to its loss in preservative.

In the original description, Eigenmann (1912b: 17), who collected several specimens, described the color of the species as "Plumbeous, yellow in life." An artist's illustration of *M. xanthum* in Maldonado-Ocampo *et al.* (2005: 291, fig. 160) shows the ground color as gray and otherwise without pigment pattern.

Distribution. Endemic to the Magdalena River basin, Colombia. Maldonado-Ocampo *et al.* (2005: 341, map 162) plot two localities for the species in or near the río Magdalena mainstem above the 90 m elevation contour. All of the types are from localities above 90 m.

Material examined. 48 specimens, all from **Colombia**, Cundinamarca Department. FMNH 56032, holotype, 159.3 mm SL, Girardot (see digital images and radiographs online at <http://acsi.acnatsci.org/base/index.html>); BMNH 1920.12.20.112-113, paratypes 2, 74-77 mm SL; CAS 63674 [ex IU 12681-82], paratypes 11, 70-118 mm SL (4, 70-118 mm SL), Girardot; FMNH 10285, paratype 1, 107 mm SL, Apulo; FMNH 10289, paratype 1, 69 mm

SL, Apulo; FMNH 77890, 2, 101-126.5 mm SL, Apulo; FMNH 77906, 1, 108 mm SL, Apulo; USNM 76930, paratypes 24, 64-120 mm SL (8, 64-111 mm SL), Apulo; USNM 167852, paratypes 5, 88-114 mm SL, Apulo.

***Megalonema amaxanthum*, new species**

Fig. 6

Holotype. CBF 11896 (ex FMNH 106769), 98.0 mm SL, Bolivia, Pando State, río Tahuamanu from Boca Nareuda to below Cachuelita, 11°18' S, 68°44' W, 13 Sep 1996, H. Ortega *et al.*

Paratypes. All records within the Amazon drainage basin. **Bolivia**, Pando State: ANSP 187452, (ex FMNH 106769), 2, 39-42 mm SL, FMNH 106769, 48, 47-98 mm SL (8, 47-97 mm SL), USNM 393558, (ex FMNH 106769), 2, 81-95 mm SL, all collected with the holotype; AUM 23777, 3, 67-85 mm SL, río Acre at Cobija, 7-9 Feb, 1982, C. K. Swing *et al.* **Brazil**, Acre State: MCP 36198, 1, 85 mm SL, río Acre, city of Xapuri, at sand extraction encampment, 10°39'51" S, 68°30'45" W, 22 Jul 2004, R. Reis *et al.* Amazonas State: ANSP 179213, 1, 81 mm SL, río Solimões (Amazonas Dr.) below río Purus, upriver of Manacapuru, collected with 3 m bottom trawl in channel, 3°27'02" S, 60°45'07" W, 1 Aug 1996, A. Zanata *et al.* ANSP 187453, 2, 42-77 mm SL, río Solimões below río Içá, collected with 3 m bottom trawl in 1 m channel, 3°00'26.4" S, 67°52'27.1" W, 23 Nov 1993, J. Lundberg *et al.*, field number JGL 93-122; ANSP 187454, 1, 65 mm SL, río Solimões below río Jutai, collected with 3 m bottom trawl in 2.5-5.5 m channel, 2°31'32.7" S, 66°36'34.8" W, 12 Nov 1993, J. Lundberg *et al.*, field number JGL 93-45; ANSP 187455, 6, 32-60 mm SL (2, 40-59 mm SL), río Jutai above río Solimões, collected with 3 m bottom trawl in 5-10 m channel, 2°52'55.7" S, 66°57'37.2" W, 16 Nov 1993, J. Lundberg *et al.*, field number JGL 93-69; ANSP 187456, 10 alcohol and 2 C&S, 35-64 mm SL (4, 49-64 mm SL), río Jutai above río Solimões, collected with 3 m bottom trawl in 3.7-12.7 m channel, 2°57'03.8" S, 67°00'26.8" W, 16 Nov 1993, J. Friel *et al.*, field number JPF 93-76; ANSP 187457, 1, 50 mm SL, río Jutai above río Solimões, collected with 3 m bottom trawl in channel, 2°49'33.3" S, 66°55'06.8" W, 13 Nov 1993, J. Sullivan *et al.*, field number JPS 93-48; CU 84562, 3, 47.1-64.4 mm SL, río Jutai above río Solimões, collected with 3 m bottom trawl in 8.2-11.1 m channel, 2°53'42.7" S, 67°00'34.5" W, 16 Nov 1993, J. Friel *et al.*, field number JPF 93-82; INPA 29490, 1, 48 mm SL, río Solimões below río Içá, collected with 3 m bottom trawl in channel, 2°57'58.3" S, 67°49'44.4" W, 23 Nov 1993, J. Sullivan *et al.*, field JPS 93-77; INPA 29491, 3, 48-62 mm SL, río Negro, collected with 3 m bottom trawl in 3.6-5.6 m channel, 2°21'44" S, 49°28'54" W, 10 Dec 1993, M. Garcia *et al.*, field number MG 93-37; MUSM 32629, 1, 63 mm SL, río Japurá above río Solimões, collected with 3 m bottom trawl in 2.9-6.7 m channel, 3°02'58.3" S, 64°46'39.2" W, 29 Oct 1993, O. Oyakawa *et al.*, field number OTO 93-1; MZUSP 99744, 1, 65 mm SL, río Solimões, collected with 3 m bottom trawl in channel, Nov 1993, J. Friel *et al.*, field number JPF 93-143; MZUSP 99745, 1, 51 mm SL, río Negro below Curidique, collected with 3 m bottom trawl in 5-8.5 m channel, 1°58'40.6" S, 61°14'15.6" W, 5 Dec 1993, J. Friel *et al.*, field number JPF 93-154; MZUSP 99746, 1, 70 mm SL, río Negro, collected with 3 m bottom trawl in 7.7-9.8 m channel, 1°41'37.0" S, 61°26'50.1" W, 6 Dec 1993, J. Friel *et al.*, field number JPF 93-158; MZUSP 99747, 4, 42-67 mm SL (3, 51-67 mm SL), same data as CU 84562. Pará State: ANSP 187458, 1, 48 mm SL, río Tocantins above río Pará, collected with 3 m bottom trawl in 6-15 m channel, 2°21'44" S, 49°28'54" W, 19 Nov 1994, A.

Zanata *et al.*, field number AMZ 94-140; ANSP 187459, 4, 40-45 mm SL (2, 40-45 mm SL), río Tocantins above río Pará, collected with 3 m bottom trawl in 5.5-6.9 m channel, 2°23'40.2" S, 49°28'06.3" W, 19 Nov 1994, J. Lundberg *et al.*, field number JGL 94-116; ANSP 189096, 4, 29.5-38.8 mm SL, río Tocantins above río Pará, collected with 3 m bottom trawl in 3-5 m channel, 2°24'17.5" S, 49°27'55.5" W, 19 Nov 1994, J. Lundberg *et al.*, field number JGL 94-114; IAvH-P 11020, 14, 30-54 mm SL (2, 50-54 mm SL), same data as ANSP 189096; MBUCV V-35377, 4, 54-60 mm SL, río Tocantins above río Pará, collected with 3 m bottom trawl in 15.5-25.5 m channel, 2°26'52" S, 49°26'38" W, 19 Nov 1994, A. Zanata *et al.*, field number AMZ 94-145. Rondônia State: MCP 36200, 1, 69 mm SL, río Mamoré, frente ao bairro Cristo Rei no município de Guajará-Mirim, collected with 3 m bottom trawl in channel, 10°47'03" S, 65°20'58" W, 25 Jul 2004, R. Reis *et al.* Roraima State: AMNH 246010, 5, 60-68 mm SL, río Branco above río Negro, collected with 3 m bottom trawl in 3.7-7.9 m channel, 1°15'29.0" S, 61°50'37.1" W, 8 Dec 1993, J. Baskin *et al.*, field number JNB 93-17; FMNH 117835, 1, 51 mm SL, río Branco above río Negro, collected with 3 m bottom trawl in 4.3-6.7 m channel, 1°18'31.4" S, 61°51'52.3" W, 8 Dec 1993, J. Lundberg *et al.*, field number JGL 93-170; USNM 393559, 1, 67 mm SL, río Solimões below río Içá, collected with 3 m bottom trawl in 5.5-9.2 m channel, 1°17'55.4" S, 61°51'21.0" W, 23 Nov 1993, J. Lundberg *et al.*, field number JGL 93-174. **Guyana**, Rupununi: ANSP 180494, 2, 72-83 mm SL, Takutu River (R. Branco-Negro Dr.), 3.77 km SSW of Lethem. 1 Nov 2003, M. Sabaj *et al.* **Peru**, Loreto Department: ANSP 182732, 10, 44-69 mm SL (7, 54-69 mm SL), río Nanay (Amazonas Dr.), large left bank beach upstream from mouth, N of Iquitos, 15 Aug 2005, M. Sabaj *et al.*; INHS 36643, 1, 49 mm SL, río Napo (río Amazonas Dr.) mouth of río Mazan, near town of Mazan, 20 Jul 1995, L. Page *et al.*; INHS 44116, 1, 74 mm SL, río Napo and Quebrada (río Amazonas Dr.), Mazan, 33.3 km NE Iquitos at bearing 34°, 3°29'32.5" S, 73°05'11.9" W, 2 Aug 1997, M. Sabaj *et al.*; MUSM 32833, 3, same data as ANSP 182732. Madre de Dios State: ANSP 180628, 2, 79.8-81 mm SL, MUSM 32834, 1, 77 mm SL, río Tahuamanu (Orton - Madre de Dios Dr.), vicinity of San Lorenzo, 1 Aug 2004, M. Sabaj *et al.*; ANSP 180633, 1, 106 mm SL, AUM 47794, 1, 93.4 mm SL, INPA 30248, 1, 90 mm SL, MUSM 32835, 1, 97.5 mm SL, all río Acre (Purus Dr.), at town of Inapari on border with Brazil, 2 Aug 2004, M. Sabaj *et al.*

Non-types. All from the Amazon drainage basin. **Brazil**, Amazonas State: ANSP 187460, 1, 28 mm SL, río Jutai, collected with 3 m bottom trawl in 9.2-15.2 m channel, 2°52'08.5" S, 66°55'45.2" W, 16 Nov 1993, Lundberg *et al.*, field number JGL 93-70; ANSP 187461, 5, 31-42 mm SL, río Jutai, collected with 3 m bottom trawl in 1.7-7.8 m channel, 2°49'36.4" S, 66°54'57.8" W, 13 Nov 1993, Sullivan *et al.*, field number JPS 93-49; ANSP 187462, 1, 33 mm SL, río Jutai, collected with 3 m bottom trawl, 2°52'48.0" S, 66°57'03.2" W, 13 Nov 1993, Sullivan *et al.*, field number JPS 93-45; ANSP 187463, 1, 31 mm SL, río Jutai collected with 3 m bottom trawl in 2-4.3 m channel, 2°49'26.1" S, 66°54'40.2" W, 13 Nov 1993, Oyakawa *et al.*, field number OTO 93-33; ANSP 187464, 2, 32-36 mm SL, río Jutai, collected with 3 m bottom trawl in 4.9-6.7 m channel, 4.9-6.7, 2°52'13.9" S, 66°58'18.1" W, 16 Nov 1993, Oyakawa *et al.*, field number OTO 93-66. Pará State: ANSP 187465, 2, 28-33 mm SL, río Tocantins, collected with 3 m bottom trawl in 4.6-5.7 m channel, 2°24'05.4" S, 49°27'58.9" W, 19 Nov 1994, Lundberg *et al.*, field number JGL 94-115. Roraima State: ANSP 187466, 4, 31-45 mm SL, río Branco, collected with 3 m bottom trawl in 3.9 m channel, 1°20'33.6" S, 61°52'21.3" W, 8 Dec 1993, Lundberg *et al.*, field number JGL 93-176.

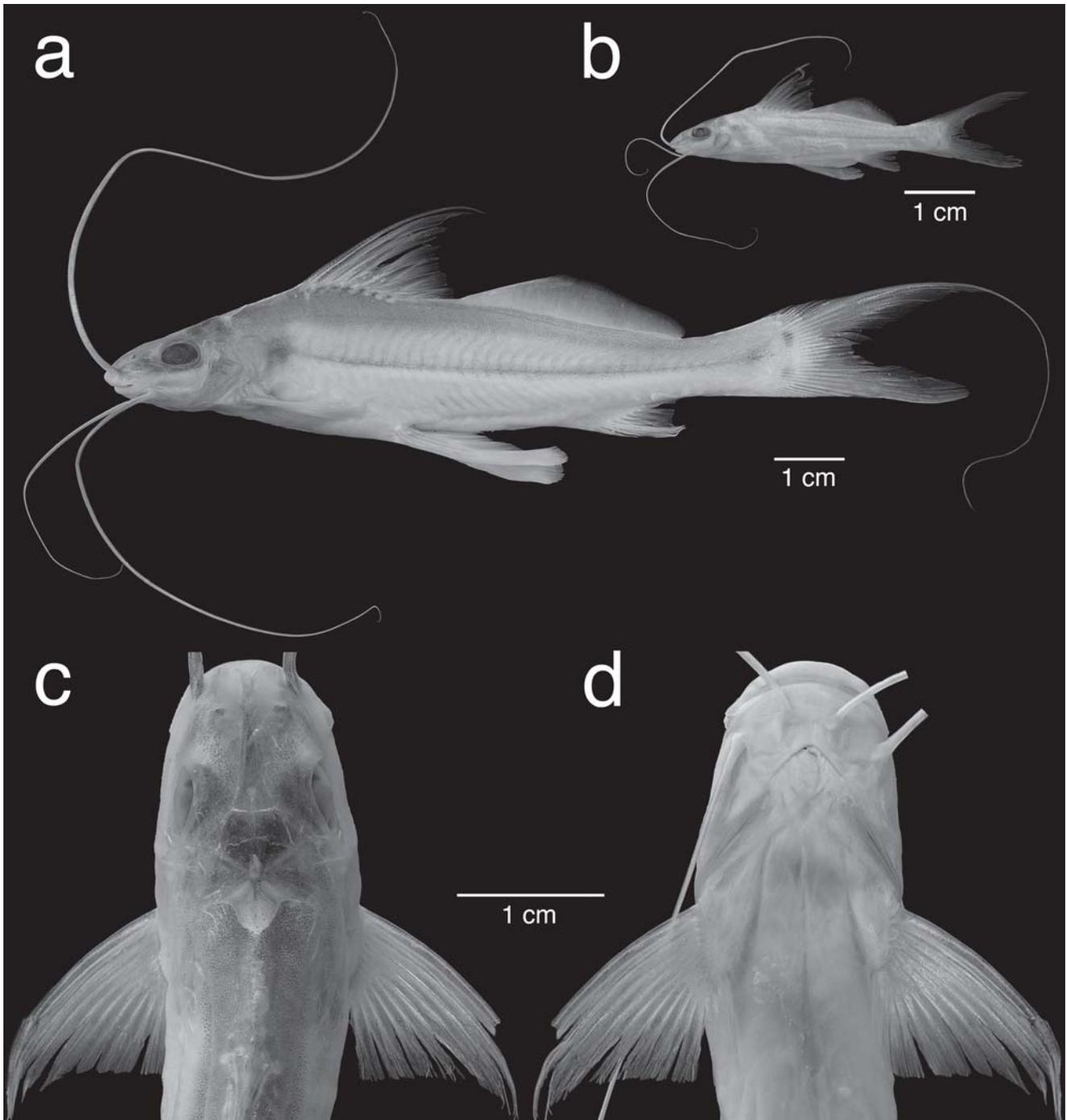


Fig. 6. *Megalonema amaxanthum*, **a**, lateral view of holotype, CBF 11896, 98 mm SL, **b**, lateral view of juvenile paratype, ANSP 187452, 39 mm SL, **c**, dorsal and **d**, ventral view of holotype; distal ends of barbels clipped from images c and d.

Diagnosis. A species of the subgenus *Eretmomegalonema* distinguished from others by the following combination of features. Supraoccipital posterior process (Fig. 3c) bell-shaped in outline, broad, its basal width equal to or greater than its length, and its sides convexly tapering to a blunt tip separated by a distinct gap from supraneural; adipose-fin (Figs. 6a,b) margin anteriorly rising at a shallow angle from back and usually in a weakly concave curve to its apex, and adipose-fin

terminating at or anterior to vertical through tips of adpressed anal-fin rays; total vertebrae modally 42-43, range 42-45 (Table 1); eye large, horizontal diameter 214-321 mils of HL; anal-fin base relatively long in larger individuals, 93-142 mils of SL (Fig. 5); width between posterior nostrils relatively narrow, 162-228 mils of HL (Fig. 5); pectoral spine lacking dentations; premaxilla extremely narrow with a single row of teeth; and 25-29 gill rakers on first arch.

Description. Meristic data for 4 to 61 specimens are in Table 1, and morphometric data for 59 to 70 specimens are in Table 2. *Megalonema amaxanthum* (Fig. 6) is a medium-sized pimelodid with a maximum length known to us of 106 mm SL. Dorsal profile of head and nape convex from snout tip to vertical at posterior nostril, then nearly straight to origin of dorsal fin, scarcely convex along dorsal-fin base, then less convex to posterior insertion of adipose fin, and gently concave across caudal peduncle. Ventral profile slanting convexly ventrally from snout tip to end of gill region, slightly convex to straight to pelvic-fin origin, abruptly stepped dorsad posterior to pelvic girdle, then straight or convex onto anal-fin base, slanting dorsally to caudal peduncle and slightly concave along caudal peduncle.

Cross-sectional shape roughly trapezoidal from snout to supraoccipital, then deeply and broadly triangular to dorsal-fin origin, and increasingly compressed to caudal fin. Maximum body depth at dorsal-fin origin contained 4.3-6.2 times in SL. Maximum body width across cleithra in front of pectoral spine insertion, contained 6.1-8.5 times in SL.

Head of moderate length, contained 3.9-4.9 times in SL and relatively deep, its depth at base of supraoccipital posterior process equal to body width. Head covered by thin skin, revealing smooth, unornamented skull roofing bones. Snout moderate, contained 2.1-2.7 in head length, and with broadly rounded margin in dorsal and ventral views. Snout and upper jaw projecting; with mouth closed less than half of premaxillary dentition exposed. Anterior nostril behind snout margin in a shallow, circular depression, its aperture dorsally directed and encircled with a low fleshy rim; width between anterior nostrils contained 1.0-1.4 times in distance between anterior and posterior nostrils. Posterior nostril aperture ovoid to subtriangular, preceded by thin, semicircular membrane as large as its aperture; width between posterior nostrils contained 0.8-1.2 times in distance between anterior and posterior nostrils. Distance between anterior and posterior nostrils equal to or a little greater than distance between posterior nostril and eye.

Eye large and somewhat bulging, about 1.5-2 times longer than deep, placed more laterally than dorsally, centered on middle of bony head length; interorbital space convex. Interorbital narrow, containing horizontal eye diameter 0.7-1.2 times. Anterior cranial fontanelle narrow, parallel-sided, originating behind level of posterior nostrils and terminating between eyes at epiphyseal bar. Posterior cranial fontanelle closed anteriorly, persisting as oval aperture in center of supraoccipital. Supraoccipital posterior process broad-based (its basal width greater than in its length), dorsally slightly convex, not angular or keeled, bell-shaped in outline, with a blunt or rounded tip, failing by about half or more of its own length to contact supraneural (anterior nuchal plate obsolete).

Mouth subterminal, opening anteriorly and widely; gape broad, its width across inner surface of ricti twice greater than interorbital width. Lips thin-skinned and smooth. Rictal fold well defined but not fleshy or swollen, subtended above

and below by deep folds respectively reaching base of maxillary barbel and about one third distance to mandibular symphysis. Premaxillary dentition reduced to a single narrow row of fine, conical teeth. Dentary teeth similarly slender, arranged in about 3 rows at symphysis and one row posterolaterally.

Origin of maxillary barbel in depression close to base of anterior nostril and above rictus, continuing to below eye; maxillary barbel reaching onto but not beyond caudal fin. Outer mental barbel reaching at least posterior half or just beyond adipose fin. Tip of inner mental barbel reaching pelvic fin insertion to half of the length of depressed pelvic fin. Branchiostegal membranes anteriorly united to isthmus and overlapping before diverging. Branchiostegal rays 8. Gill rakers long, slender bladelike, 25-29 on first gill arch (in four specimens): 6-7 rakers on upper limb, 1 at cartilaginous angle, 18-22 on lower limb.

Dorsal-fin lepidotrichia I,7; spinelet absent or vestigial; dorsal-spine base with much reduced articulating processes. Dorsal-fin spine and first branched fin ray distinctly longer than remaining, progressively shorter rays. Dorsal spine slender, its distal half or more segmented and flexible, its shaft smooth and non-serrate. Dorsal-fin origin at vertical through middle of adpressed pectoral fin; its posterior insertion above pelvic-fin origin. Only the longest anterior fin rays and dorsal-fin spine of adpressed dorsal fin reach adipose fin. Adipose-fin origin located at vertical posterior to tips of last four dorsal-fin rays. Adipose fin large, anteriorly rising with a straight or barely convex margin at a low angle to its base, its apex at vertical near anal-fin origin; terminating at or near tips of adpressed anal-fin rays; 1.4-1.8 times longer than head, relatively high, its height 3.9-6.1 times in its base.

Caudal fin deeply forked; pointed upper lobe with filamentous unbranched principal ray, the lower lobe narrowly rounded and a little shorter, and none of its rays prolonged; inner margins of both lobes straight to concave. Principal caudal-fin rays 1+7+8+1. Anal-fin origin below middle of adipose-fin base, posterior insertion before end of adipose fin, distal margin of anal fin slightly concave. Anal-fin rays 12-16, modally 13, in 40 specimens.

Pectoral fin I, 11-13, modally I, 12, in 15 specimens. Pectoral spine slender, its distal half or more segmented and flexible, its shaft entirely smooth without dentations. Pectoral-spine base with much reduced articulating (fin-locking) processes. Pectoral spine and outer few branched pectoral rays prolonged but none filamentous. Pectoral-fin margin concave. Pectoral axillary gland pore absent. Posterior cleithral process obsolescent. Pelvic fin as described for subgenus. Also, pelvic-fin insertion below posterior insertion of dorsal fin. Tip of pelvic fin close to or reaching anal fin.

Urogenital papilla small located behind anus near base of inner pelvic-fin rays; no indication of sexual dimorphism.

Lateral line straight with side branches alternating dorsally and ventrally, complete, and terminating near the ends of middle caudal-fin rays.

Total vertebrae in 61 specimens (Table 1), modally 42-43,

range 42-45 including Weberian complex; in 61 specimens 16-18 precaudal vertebrae, modally 16, and in 60 specimens 25-28 caudal vertebrae, modally 27.

Coloration in alcohol. Head and body yellowish to tan in background color. Top and upper sides of head and body lightly to moderately covered with small brownish chromatophores. Top of head with dense concentrations of pigment at and posterior to maxillary barbel insertion, on the midline above mesethmoid between light olfactory organs, and along anterior cranial fontanelle except between eyes. Oval posterior cranial fontanelle dark or covered with hyaline skin. Deep lying, quadrangular dark spot across midline between level of eyes and posterior cranial fontanelle. Supraoccipital posterior process pallid, otherwise nape darker. Dark area of variable extent near or on supraneural, middle and posterior nuchal plates, and at insertion of dorsal fin. A variable series of dark spots at bases of dorsal-fin rays. Tympanic area often darker than surrounding sides behind pectoral girdle. Sclerotic coat of eyes dark or silvery. Upper caudal spot generally present. Rayed fins with hyaline rays and transparent membranes; some specimens with chromatophores along dorsal-, caudal-, anal-, pectoral and pelvic-fin rays and on membranes of dorsal and caudal fins. Adipose fin hyaline, with small, widely dispersed chromatophores.

Distribution. Amazon River basin, Brazil, Guyana (Takutu River), Peru, Bolivia, and probably Colombia and Ecuador.

Etymology. The name *amaxanthum* refers to the distribution of the species in the Amazon basin and its relationship to the species *M. xanthum*.

Megalonema orixanthum, new species

Fig. 7

Holotype. ANSP 187449 (ex ANSP 148143), 100.3 mm SL, Colombia, Meta State, río Metica, ca. 3 km SE of Hacienda Mozambique, 3°57' N, 73°02' W, 24 Mar 1975, J. Böhlke, *et al.*

Paratypes. All records within the Orinoco drainage basin. **Colombia**, Meta State: ANSP 148143, 23, 90-114 mm SL (8, 90-114 mm SL), FMNH 117836, 2, 95-97 mm SL, IAvH-P 11021, 2, 93-96 mm SL, MBUCV V-35380, 2, 90-97 mm SL, MZUSP 99748, 2, 92-96 mm SL, USNM 393560, 2, 85-95 mm SL, all collected with the holotype; ANSP 131337, 1, 92 mm SL, río Metica, ca. 1.5 km E of Rajote (Plancha 267), 3°56' N, 73°03' W, 19 Mar 1973, W. Saul and W. Smith-Vaniz; ANSP 148142, 2, 77-116 mm SL, río Metica at El Aviso, 3°59' N, 72°59' W, 30 Mar 1975, W. Saul and L. Fuiman; ANSP 148180, 1 C&S, 98 mm SL, río Metica, ca. 3 km SE Hacienda Mozambique, 3°57' N, 73°02' W, 30 Mar 1975, J. Böhlke *et al.*; ANSP 148181, 1, 95 mm SL, río Metica, ca. 3 km SE Hacienda Mozambique, 3°57' N, 73°02' W, 30 Mar 1975, J. Böhlke *et al.* **Venezuela**, Amazonas State: ANSP 160744, 1, 77 mm SL, río Orinoco: shores of Isla de Raton, 5°05' N, 67°48' W, 14 Nov 1985, B. Chernoff *et al.*; ANSP 162484, 3, 29-77 mm SL, río Casiquiare

(main channel) ca. 1.5 hr. from its confluence with río Orinoco, 16 Mar 1987, H. Lopez and O. Castillo; ANSP 162486, 22, 25-48 mm SL (3, 43-48 mm SL), río Casiquiare from mouth of río Pamoni to 4.0 km below mouth, 2°48'00" N, 65°57'00" W, 17 Mar 1987, B. Chernoff *et al.*; ANSP 185144, 6, 37-74 mm SL (3, 38-74 mm SL), río Orinoco (Atlantic Dr.), island W of Puerto Venado, 4.5 km S of Samariapo, 56.5 km SW of Puerto Ayacucho, 5°12'25" N, 67°48'32" W, 28 Feb 2005, M. Sabaj *et al.*; AUM 43048, 13, 47-50 mm SL (2, 47-50 mm SL), same data as ANSP 185144; AUM 43845, 2, 79-94 mm SL, río Orinoco, beach, 16.1 km E of La Esmeralda, 25 Mar 2005. Apure State: ANSP 160186, 2, 84-87 mm SL, río Meta, ca 40 min upstream from confluence of río Orinoco, 6°18' N, 67°37' W, 27 Nov 1985, B. Chernoff *et al.*; ANSP 165236, 5, 61-78 mm SL, río Apure: between río Portuguesa mouth and S. Fernando de Apure airport, 7°54'00" N, 67°32'00" W, 4 Nov 1989, S. Schaefer *et al.*; ANSP 187450, 4 alcohol, 1 C&S, 59-73 mm SL, río Apure between San Fernando and río Portuguesa, collected with 3 m bottom trawl, 19 Jul 1984, Lundberg *et al.* Bolivar State: ANSP 160407, 2, 66-71 mm SL, río Orinoco - río Caura confluence beaches, canals, lagoons & islands, vicinity Puerto Las Majadas, 7°38'36" N, 64°50' W, 23 Nov 1985, B. Chernoff *et al.*; ANSP 160857, 1, 57 mm SL, río Cuchivero at Cuchivero ferry crossing, 7°29' N, 65°53' W, 17 Nov 1985, B. Chernoff *et al.*; ANSP 187451, 1, 71 mm SL, río Orinoco at Ciudad Bolivar, collected with 3 m bottom trawl in 10 m channel, 8°09' N, 63°32' W, 8 Nov 1979, E. Marsh *et al.*, field number ECM 1-79.

Diagnosis. A species of the subgenus *Eretmomegalonema* distinguished from others by the following combination of features. Supraoccipital posterior process (Fig. 3d) broadly triangular in outline, its basal width equal to or greater than its length, and its sides tapering straight to a nearly pointed or bifid tip nearly reaching supraneural; adipose fin (Fig. 7a) smaller, its margin anteriorly rising at a shallow angle from back and usually in a weakly concave curve to its apex, and adipose fin terminating at or anterior to vertical through tips of adpressed anal-fin rays; total vertebrae modally 44, range 43-45 (Table 1); eye large, horizontal diameter 209-337 mils of HL; anal-fin base relatively short, 93-117 mils of SL (Fig. 5); width between posterior nostrils relatively broad, 196-246 mils of HL (Fig. 5); pectoral spine with numerous erect dentations along posterior margin; premaxilla extremely narrow with a single row of teeth or teeth absent; and 28-29 gill rakers on first arch.

Description. Meristic data for 4 to 35 specimens are in Table 1, and morphometric data for 28 to 40 specimens (a few specimens lacking data for damaged parts) are in Table 2. *Megalonema orixanthum* (Fig. 7) is a medium sized pimelodid with a maximum length known to us of 115.8 mm SL. Dorsal profile of head and nape convex from snout tip to vertical at posterior nostril, then nearly straight to origin of dorsal fin, scarcely convex along dorsal-fin base, then less convex to posterior insertion of adipose-fin, and gently concave across caudal peduncle. Ventral profile slanting convexly ventrally from snout tip to end of gill region, slightly convex to straight to pelvic-fin origin, stepped dorsad posterior to pelvic girdle,

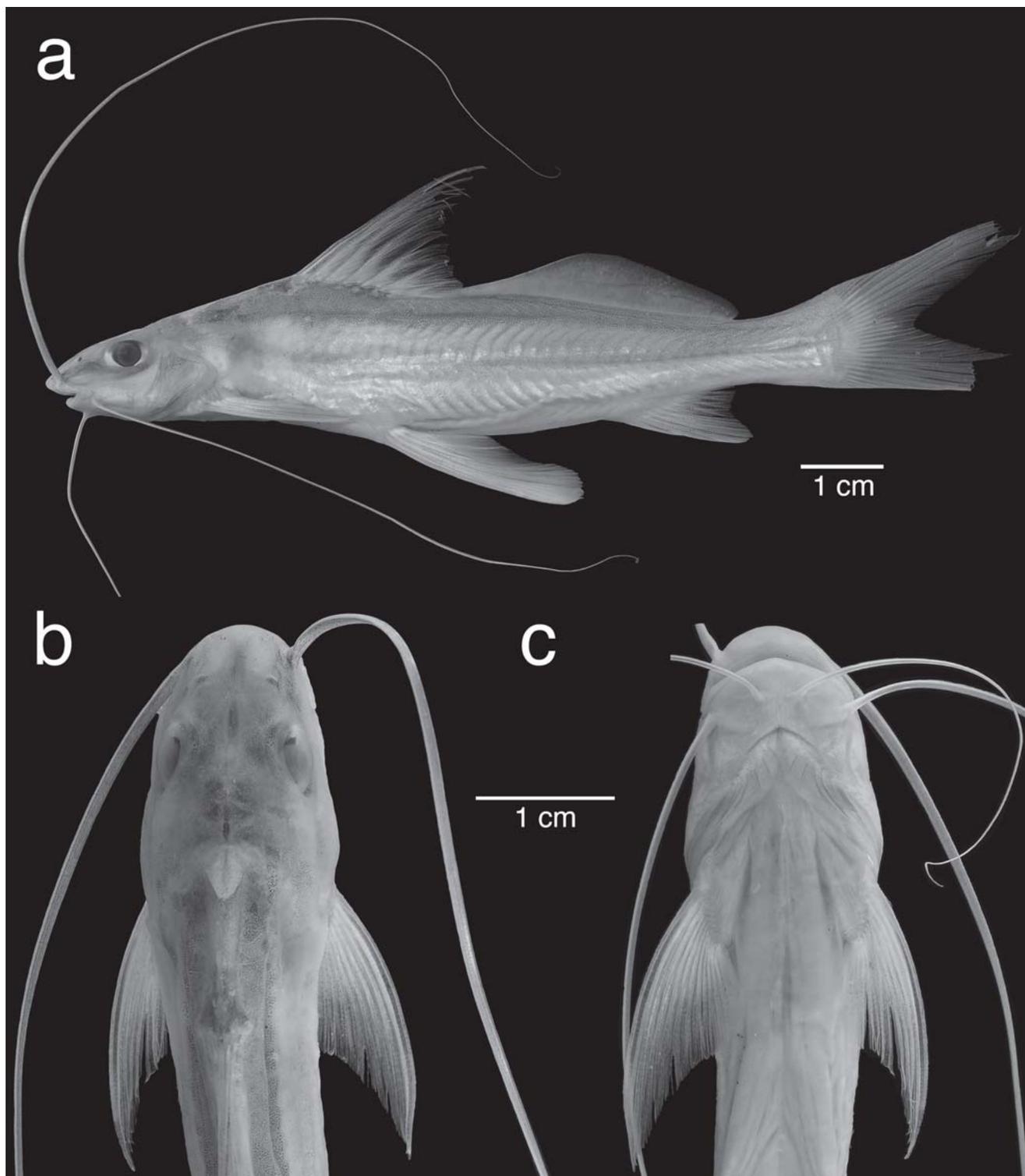


Fig. 7. *Megalonema orixanthum*, holotype, Colombia, Meta State, río Metica, ca. 3 km SE of Hacienda Mozambique. ANSP 187449, 100 mm SL, in **a**, lateral, **b**, dorsal and **c**, ventral view; distal ends of barbels clipped from image c.

then convex onto anal-fin base, slanting dorsally to caudal peduncle and concave along caudal peduncle.

Cross-sectional shape roughly trapezoidal from snout to supraoccipital, then deeply and broadly triangular to dorsal-

fin origin, and increasingly compressed to caudal fin. Maximum body depth at dorsal-fin origin contained 4.4-6.6 times in SL. Maximum body width across cleithra in front of pectoral spine insertion, contained 6.5-8.7 times in SL.

Head of moderate length, contained 4.1-4.7 times in SL and relatively deep, its depth at base of supraoccipital posterior process slightly less than body width. Head covered by thin skin, revealing smooth, unornamented skull roofing bones. Snout moderate, contained 2.1-2.6 in head length, and with broadly rounded margin in dorsal and ventral views. Snout and upper jaw projecting; with mouth closed less than half of premaxillary dentition exposed. Anterior nostril behind snout margin in a shallow, circular depression, its aperture dorsally directed and encircled with a low fleshy rim; width between anterior nostrils contained 0.9-1.5 times in distance between anterior and posterior nostrils. Posterior nostril aperture ovoid to subtriangular, preceded by thin, semicircular membrane as large as its aperture; width between posterior nostrils contained 0.7-1.0 times in distance between anterior and posterior nostrils. Distance between anterior and posterior nostrils equal to distance between posterior nostril and eye.

Eye large and somewhat bulging, about 1.5-2 times longer than deep, placed more laterally than dorsally, centered on middle of bony head length; interorbital space convex. Interorbital narrow, containing horizontal eye diameter 0.6-1.2 times. Anterior cranial fontanelle narrow, parallel-sided, originating behind level of posterior nostrils and terminating between eyes at epiphyseal bar. Posterior cranial fontanelle closed anteriorly, persisting as oval aperture in center of supraoccipital. Supraoccipital posterior process broad-based (its basal width equal to or greater than its length), dorsally slightly convex, not angular or keeled, parabolic in outline, failing by less than half its own length to contact supraneural (anterior nuchal plate obsolete).

Mouth subterminal, opening anteriorly and widely; gape broad, its width across inner surface of ricti twice greater than interorbital width. Lips thin-skinned and smooth. Rictal fold well defined but not fleshy or swollen, subtended above and below by deep folds respectively reaching base of maxillary barbel and about one third distance to mandibular symphysis. Premaxillary toothless or with a single row of a few fine, conical teeth. Dentary teeth slender, arranged in about 3 rows at symphysis and one row posterolaterally.

Origin of maxillary barbel in depression close to base of anterior nostril and above rictus, continuing to below eye; maxillary barbel reaching onto but not beyond caudal fin. Outer mental barbel reaching posterior end of or just beyond adipose fin. Tip of inner mental barbel reaching pelvic-fin insertion to half of the length of depressed pelvic fin. Branchiostegal membranes anteriorly united to isthmus and overlapping before diverging. Branchiostegal rays 8. Gill rakers long, slender blade-like, 28-29 on first gill arch (in four specimens); 6-8 rakers on upper limb, 1 at cartilaginous angle, 20-21 on lower limb.

Dorsal-fin lepidotrichia I,7; spinelet absent or vestigial; dorsal-spine base with much reduced articulating processes. Dorsal-fin spine and first branched fin ray distinctly longer than remaining, progressively shorter rays. Dorsal spine slender, its distal half or more segmented and flexible, its shaft

smooth and non-serrate. Dorsal-fin origin at vertical through middle of adpressed pectoral fin; its posterior insertion above pelvic-fin origin. Only the longest anterior fin rays and dorsal-fin spine of adpressed dorsal fin reach adipose fin. Adipose-fin origin located at vertical posterior to tips of last four dorsal-fin rays. Adipose fin large, anteriorly rising with a straight or barely convex margin at a low angle to its base, its apex at vertical near anal-fin origin; terminating at or near tips of adpressed anal-fin rays; 1.4-1.7 times longer than head, relatively high, its height 4.1-6.4 times in its base.

Caudal fin deeply forked; pointed upper lobe with filamentous unbranched principal ray, the lower lobe narrowly rounded and a little shorter, and none of its rays prolonged; inner margins of both lobes straight to concave. Principal caudal-fin rays 1+7+8+1. Anal-fin origin below middle of adipose-fin base, posterior insertion before end of adipose fin, distal margin of anal fin slightly concave. Anal-fin rays 12-15, modally 13, in 27 specimens.

Pectoral fin I,11-13, modally I,12, in 9 specimens. Pectoral spine slender, its distal half or more segmented and flexible, its shaft smooth anteriorly and with numerous erect dentations along posterior margin. Pectoral-spine base with much reduced articulating (fin-locking) processes. Pectoral spine and outer few branched pectoral rays prolonged but none filamentous. Pectoral-fin margin concave. Pectoral axillary gland pore absent. Posterior cleithral process obsolescent. Pelvic fin as described for subgenus. Also, pelvic-fin insertion below posterior insertion of dorsal fin. Tip of pelvic fin close to or reaching anal fin.

Urogenital papilla small located behind anus near base of inner pelvic-fin rays; no indication of sexual dimorphism.

Lateral line straight with side branches alternating dorsally and ventrally, complete, and terminating near the ends of middle caudal-fin rays.

Total vertebrae in 35 specimens (Table 1), modally 44, range 43-45 including Weberian complex; in 36 specimens 16-18 precaudal vertebrae, modally 17, and 26-29 caudal vertebrae, modally 27.

Coloration in alcohol. Head and body yellowish to tan in background color; skin translucent often revealing broad subcutaneous silvery band along sides and lower flanks. Top and upper sides of head and body lightly to moderately covered with small brownish chromatophores. Top of head with dense concentrations of pigment at and posterior to maxillary barbel insertion, on the midline above mesethmoid and between light olfactory organs, along anterior cranial fontanelle except between eyes and over oval posterior cranial fontanelle in supraoccipital. Deep lying, quadrangular dark spot across midline between level of eyes and posterior cranial fontanelle. Supraoccipital posterior process pallid, otherwise nape darker. Dark area of variable extent near or on supraneural, middle and posterior nuchal plates, and at insertion of dorsal fin. A variable series of dark spots at bases of dorsal-fin rays. Tympanic area often darker than surrounding sides behind

pectoral girdle. Sclerotic coat of eyes dark or silvery. Upper caudal spot generally present. Rayed fins with hyaline rays and transparent membranes; some specimens with chromatophores along dorsal-, caudal-, anal-, pectoral and pelvic-fin rays and on membranes of dorsal and caudal fins. Adipose fin hyaline, with small, widely dispersed chromatophores.

Distribution. Orinoco River basin, Colombia and Venezuela.

Etymology. The name *orixanthum* refers to the distribution of the species in the Orinoco basin and its relationship to the species *M. xanthum*.

Discussion

Two unambiguous synapomorphies described in the species diagnoses indicate a sister-group relationship between *M. amaxanthum* and *M. orixanthum* within *Eretmomegalonema*: broad and short supraoccipital posterior process (Figs. 3c,d) and greatly reduced premaxilla and upper jaw dentition. As inferred from its similarities to species of *Megalonema* not belonging to *Eretmomegalonema*, *M. xanthum* has the plesiomorphic conditions of these elements, *i.e.* long, narrow supraoccipital posterior process (Fig. 3b, compare Fig. 3a) and broad, well-toothed premaxilla. Thus, trans-Andean *M. xanthum* is considered to be phylogenetically basal within *Eretmomegalonema* to the cis-Andean species pair in the Amazon and Orinoco. The sequence of two cladistic events in the tree topology of *Eretmomegalonema* matches the sequence of origin of drainage divides separating the Magdalena, Amazon and Orinoco basins (Lundberg *et al.*, 1998; Lundberg, 2005). The Magdalena watershed was formed and isolated from the Amazon and Orinoco by about 10 Ma in the Middle to Late Miocene when the Eastern Andes was uplifted. The low divides that now separate the Amazon and Orinoco originated later in the Miocene at about 8 Ma. The picture that emerges is one of vicariant control of cladogenesis and divergence of the three species in *Eretmomegalonema*, and the persistence of their allopatric distributions.

Comparative material. *Megalonema platycephalum* Eigenmann, 1912, **Guyana**, Demerara-Berbice: ANSP 179249, 1 Sk, 145 mm SL, Essequibo River (east bank) at Kurukupari, 04°39'41"N, 058°40'31"W. Rupununi: ANSP 179697, 2, 92-133 mm SL, Rupununi River (Essequibo Dr.) at Kwatamang, 4 km SE of Annai, 03°55'03"N, 059°06'01"W. *Megalonema cf. platycephalum*. **Peru**, Loreto Department: ANSP 178450, 2 alcohol, 1 C&S, 105-110 mm SL, río Nanay (tributary río Amazonas) at Pampa Chica, village 4.54 km W of Iquitos (large beach along N bank), 3°45'09"S, 73°17'00"W; ANSP 178515, 1 Sk, río Napo, near town of Mazan, 3°29'10"S, 73°06'24"W. Madre de Dios State: ANSP 187323, 1 Sk, 240 mm SL, río Tahuamanu (Orton-Madre de Dios Dr.), vicinity of San Lorenzo. **Colombia**, Meta State: ANSP 131341, 45-81 mm SL, río Metica, upstream from entrance to Lake Mozambique, halfway to entrance to Laguna 'Arrotas.' **Venezuela**, Apure State: ANSP 189040 (ex DU F998), 6 alcohol, 1 C&S, 53-76 mm SL, río

Apure between San Fernando and río Portuguesa, collected with 3 m bottom trawl, 19 Jul 1984, Lundberg *et al.* *Megalonema platanum* (Günther, 1880), **Brazil**, Rio Grande do Sul: MZUSP 78465, 1 Sk, 210 mm SL, río Uruguai, em frente ao porto de São Borja. **Paraguay**, Asunción: UMMZ 207635, 2, 180-205 mm SL, Pettirossi fish market (=Mercado Cuatro), Asunción (from nearby río Paraguay).

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