Bull. nat. Hist. Mus. Lond. (Zool.) **64**(1): 97–109 Issued 25 June 1998

Revision of *Schismatorhynchos* Bleeker, 1855 (Teleostei, Cyprinidae), with the description of two new species from Borneo

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CONTENTS

SYNOPSIS. *Schismatorhynchos* Bleeker, 1855 is revised: the genus is enlarged to accommodate two new species from Borneo, *Schismatorhynchos endecarhapis* n. sp. is described from the Kapuas and Barito rivers, Kalimantan Barat and Kalimantan Tengah and *Schismatorhynchos holorhynchos* n. sp. is described from the Rejang and Kinabatangan rivers Sarawak and Sabah, Malaysia. *Schismatorhynchos* is characterised by oro-labial features, namely the upper lip not continuous with the lower lip around the corner of the mouth, a wide crescentic lower jaw, the lower jaw lightly armoured with a thin, flexible, keratinous cutting edge and a lower labial frenulum in which the mandibular laterosensory canal is located. Only *S. heterorhynchos* (Bleeker, 1853), the type species, possesses the eponymous rostral cleft. *Nukta* Hora, 1942 is excluded from *Schismatorhynchos* on the grounds it lacks the specialisations of the three Sundaland species. A key to species in the genus is provided and annotations to currently used regional keys to cyprinid genera are suggested in order to accommodate an enlarged *Schismatorhynchos*.

INTRODUCTION

The cyprinid genus *Schismatorhynchos* Bleeker, 1855, with a disjunct distribution in Sumatra–Borneo and India, is known by a strange rostral modification, a heavily tuberculate snout with a deep horizontal cleft (Bleeker, 1853; Weber & de Beaufort, 1916; Hora, 1942). Two species, each in separate subgenera, are currently included in *Schismatorhynchos*, *S.* (*Schismatorhynchos*) *heterorhynchos* (Bleeker, 1853) from Sumatra and Borneo and *S. (Nukta) nukta* (Sykes, 1841) from India. In addition to its unusual snout the nominate subgenus is also known for unusual oro-labial morphology which includes: 1) a frenulum connecting the lower lip to the anterior gular region; and 2) a lower jaw with an elongated cutting edge which separates the upper lip from the lower lip at the corners of the mouth – the lips are not continuous around the corner of the mouth (Weber & de Beaufort, 1916). Since the description of the subgenus *Nukta* by Hora (1942) *Schismatorhynchos* has received little attention except for listing in faunal reviews.

Schismatorhynchos heterorhynchos was described from Sumatra (Bleeker, 1853) and Weber & de Beaufort (1916) reported it elsewhere only from the Kapuas River, western Borneo. More recently, Inger & Chin (1962) identified juvenile specimens from the Kinabatangan River, Sabah, Malaysia (northeastern Borneo) as *S. heterorhynchos* (Bleeker, 1853) even though this northeastern Borneo material lacks a cleft snout. Since the Sabah specimens lack tubercles on the snout in the region of the cleft in the snout of *S. heterorhynchos*, and since *S. heterorhynchos* was known only from larger specimens, Inger & Chin implied that the cleft in the snout might not develop until maturity. Roberts (1989; Fig. 58) also identified some juvenile material without a cleft snout, but from the Kapuas River, western Borneo, as *S. heterorhynchos*. The oro-labial morphology of the subgenus *Schismatorhynchos* is apparently so distinctive that both Inger & Chin (1962) and Roberts (1989) were able to identify material as belonging to it even in the absence of the eponymous rostral cleft.

We collected juveniles of an unusual fish with a distinctive colour pattern from the upper part of the Barito River basin, Kalimantan Tengah, Indonesia (central Borneo) in Jan–Feb 1991, and a larger specimen was taken subsequently in July 1992, again from the upper part of the basin. The species proved difficult to identify to genus, with a dorsal fin branched ray count of 11, a modal count of 33 lateral-line scales, the upper and lower lips not continuous around the corner of the mouth, and an undivided, moderately tuberculate snout. This Barito River material appeared identical to the illustration of a specimen from the Kapuas River identified as *S. heterorhynchos* by Roberts (1989; Fig. 58). Examination of Kapuas materials deposited by Roberts in the Museum Zoologicum Bogoriense confirmed that the Barito materials are conspecific with the Kapuas specimen Roberts illustrated. However, the disparity in the counts of branched rays of the dorsal fin between the Barito–Kapuas materials and that of *S. heterorhynchos* (eight branched rays in the dorsal fin), and differences in colour pattern, led us to conclude the Barito–Kapuas materials in question are not *S. heterorhynchos*, but instead are from a previously unrecognised species of *Schismatorhynchos*.

In order to investigate the development of the snout cleft in *S. heterorhynchos*, we examined small specimens from northeastern Borneo identified as *S. heterorhynchos* (see Inger & Chin, 1962), along with additional material collected in 1991 in Sarawak, Malaysia. Differences in snout tubercle structure and colour pattern led us to conclude that the Sabah and Sarawak materials do not conform to *S. heterorhynchos* either, but instead belong to yet another unrecognised species.

More material has become available recently from the Kapuas River, western Borneo (Sungei Sibau, an upper basin tributary of the Kapuas River). This material possesses, even as juveniles of small size, the oro-labial features of *S.* (*Schismatorhynchos*), a deeply cleft heavily tuberculate snout and a colour pattern like that described for *S. heterorhynchos*. Thus, at least two species of *Schismatorhynchos* live within the Kapuas River basin, one species with a cleft snout and another with an undivided snout.

To summarise our observations and clarify the status of material identified in the literature as *S. heterorhynchos*, we revise the genus *Schismatorhynchos*, describing two new species.

MATERIALS AND METHODS

Methods of measuring and counting follow Hubbs and Lagler (1949). Vertebral (following Siebert & Guiry, 1996) and fin-ray counts were taken from radiographs. Statistical analyses were carried out using SYSTAT for WINDOWS, version 6.0 (SPSS, Inc. 1994), Institutional abbreviations are as follows: BMNH – The Natural History Museum, London; FMNH – The Field Museum of Natural History, Chicago; MZB – Museum Zoologicum Bogoriense, Bogor; USNM – United States National Museum of Natural History, Washington, D.C.; ZMA – Zoological Museum, Amsterdam.

The systematics and generic taxonomy of cyprinid fishes related to *Labeo* Cuvier, 1817, i.e. those with a vomero-palatine organ, is in a state of flux and is likely to remain so for some time to come. There is considerable disagreement in the modern analytical literature as to what subgroups should be recognised, just what their limits ought to be, and at what rank they should be recognised (compare Reid (1985; Table 1, p. 15) with Rainboth (1996; p. vii) to see conflict at all the levels just mentioned). As regards this revision of *Schismatorhynchos*, we adopt Rainboth's rank of tribe for the entire group of cyprinids with a vomero-palatine organ, and use the informal name labeonin when referring to them in a general way. We accept Reid's restriction of *Labeo*, and, for the most part, his notions of relationships within labeonins when discussing the limits of *Schismatorhynchos*, because his groupings have been laid out following cladistic principles. We use *Tylognathus* Heckel (*sensu* Bleeker, 1863; Reid, 1985, p. 277) when discussing our exclusion of *Nukta* Hora from *Schismatorhynchos* because we are not sure of the limits of *Bangana* Hamilton. *Cyprinus nukta* Sykes, 1838 may belong in *Bangana*, but that assessment is beyond the scope of this study.

GENERIC ACCOUNT

Schismatorhynchos Bleeker, 1855

Schismatorhynchus Bleeker, 1863; unjustified emendation.
Type species *Lobocheilos heterorhynchos* Bleeker, 1853; type by monotypy.

DIAGNOSIS. Labeonins (*sensu* Reid, 1982, 1985; 1. vomero-palatine organ present, 2. neural complex of the Weberian apparatus in direct contact with supraoccipital region, 3. terete process of the basioccipital, 4. superficial labial fold developed posterior to the lower jaw) with a large, fleshy, sub-conical, rostral cap (=rostral fold of Weber & de Beaufort, 1916); two pairs of barbels, posterior pair in a deep recess at the corner of the mouth (largely to completely hidden in large material); mouth inferior, wide, C-shaped; lower jaw with an extremely long, thin, flexible, horny, cutting edge (Fig. 1A–C); no superficial labial fold in advance of the upper jaw; upper lip separated from rostral cap, moderately fleshy, adnate to upper jaw; upper lip and lower lip not continuous around corner of mouth (separated by extensions of the cutting edge of lower jaw); lower lip reflected from lower jaw, thick, very fleshy, fringed, with a distinct, elongate, longitudinally oriented, fleshy, lateral lobe in which the mandibular laterosensory canal is located (=frenulum of Weber & de Beaufort, 1916; Fig. 1A–C); no transverse postlabial groove separating lower lip from gular region.

REMARKS. The present diagnosis makes use of many oro-labial features and excludes the subgenus *Nukta* from *Schismatorhynchos*. Additional information on the oro-labial features is presented below, with an explanation of our exclusion of *Nukta*.

Good series of small individuals are available for both new species, making possible study of certain aspects of the late ontogeny of the mouth. *Schismatorhynchos* is a labeonin, as delimited by Reid (1982, 1985). It appears to lack the superficial labial fold anterior to the upper jaw that characterises a large subgroup of these fishes, such as *Garra, Epalzeorhynchos, Osteochilus*, and *Labeo*. At small size (< 30 mm Sl) the upper lip is distinguishable as a ridge of papillate tissue closely associated with the upper jaw. This ridge thickens and becomes fully adnate to the upper jaw with growth, so that by a size of 50 mm Sl no distinction between the upper jaw and upper lip is apparent, unlike members of the subgroup of labeonins, such as *Epalzeoprhynchos*, with a scarcely developed, or regressed, but nevertheless distinguishable superficial labial fold anterior to the upper jaw. Thus, *Schismatorhynchos* appears to reside within a relatively primitive assemblage of labeonin genera, which includes *Tylognathus* (*sensu* Bleeker, 1963; Reid, 1985; p. 287) and *Lobocheilus*, but for which relationships have yet to be worked out.

More clear is that the extremely elongate cutting edge of the lower jaw, which results in the separation of the upper and lower lips around the corner of the mouth, and the development of a lateral frenulum are distinct specialisations within labeonins and unique among cyprinids. These oro-labial specialisations of *Schismato-*

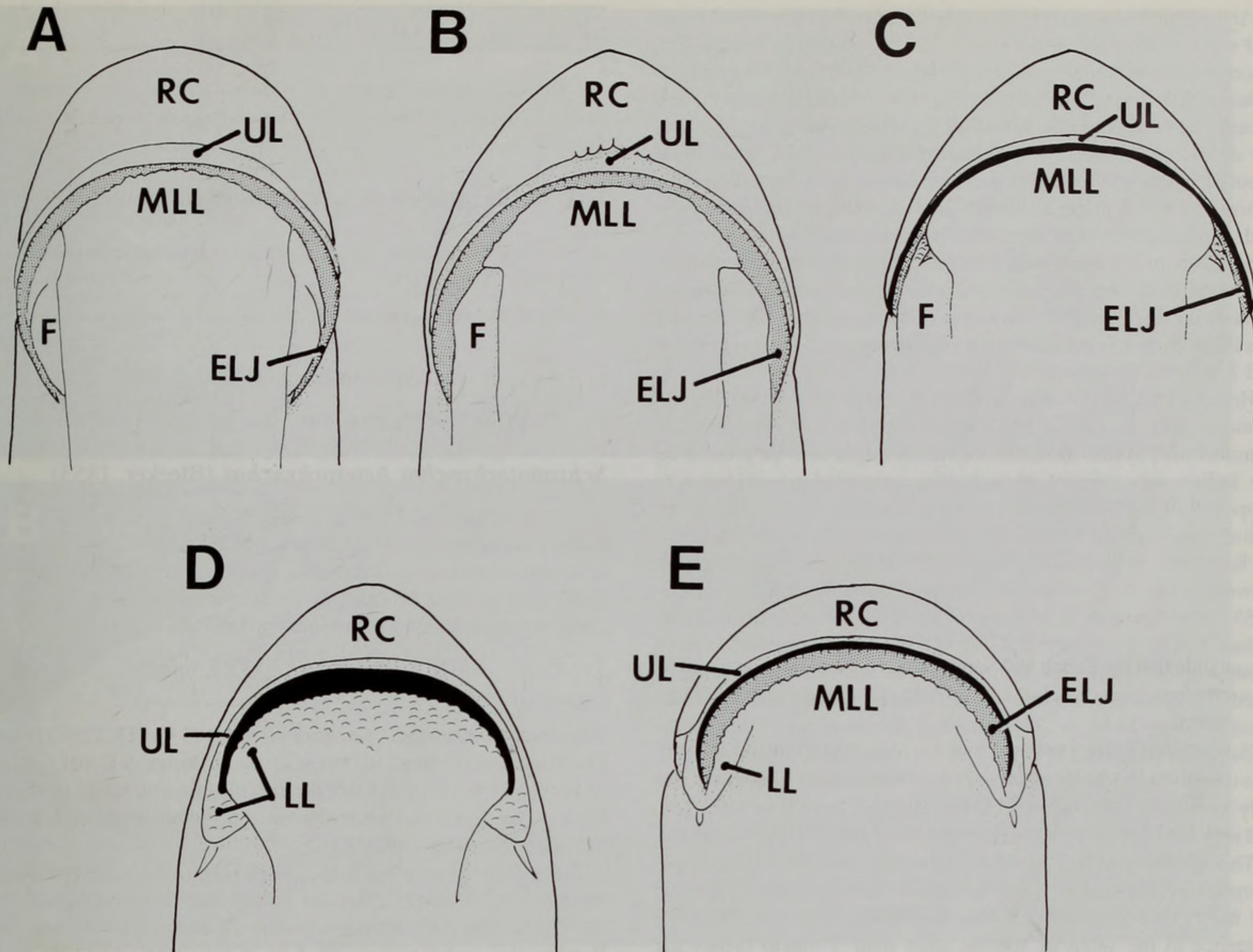

Fig. 1 Outline drawings of oro-labial structure of: A. *S. heterorhynchos*, MZB unregistered, mm Sl; B. *S. holorhynchos*, USNM 325389, 101.7 mm Sl; C. *S. endecarhapis*, MZB 6092, 179.0 mm Sl; D. *Lobocheilos bo*, BMNH 1993.5.19:1, 87.0 mm Sl; E. *Tylognathus diplostomus*, BMNH 1932.2.20:7, 215.0 mm Sl. ELJ=edge of lower jaw; F=frenulum; LL=lower lip; M=mouth; MLL=median lobe lower lip; PG=postlabial grove; RC=rostral cap; UL=upper lip.

rhynchos develop from structure general for labeonin cyprinids, exemplified by *Tylognathus diplostoma* (Heckel, 1838)(Fig. 1E) and similar to that of *Tylognatus nukta* (Hora, 1942: Fig. 9b; see Reid, 1985:p. 287 for the assignment of *Labeo nukta* to *Tylognathus*). At < 30 mm Sl oro-labial structure of individuals of *Schismatorhynchos* is like that of *T. diplostoma* or *T. nukta*. At about 30 mm SL the cutting edge of the lower jaw elongates, eventually interrupting the connection between the upper and lower lips around the corner of the mouth. At about the same time the fold in the skin which separates the region of the mandibular laterosensory canal from the rest lower labial tissue deepens, eventually forming the structure Weber & de Beaufort (1916) referred to as the frenulum. Rather than connecting the lower lip to the gular region, this frenulum houses the mandibular laterosensory canal. As the cutting edge of the lower jaw elongates, the portion of the lower lip between the lateral edge of the lower lip and the principle lobe of the lower lip regresses, completely in the two new species, nearly so in *S. heterorhynchos*.

Elongation of the cutting edge of the lower jaw progresses farther in *S. holorhynchos* and *S. heterorhynchos* and their mouths are more crescentic than that of *S. endecarhapis*; they are probably each other's closest relative.

Nukta Hora is considered by some recent authors to be a synonym of *Schismatorhynchos* (Jayaram, 1981; Eschmeyer & Bailey, 1990; Talwar & Jhingran, 1991). We do not agree with this assessment. Instead we follow Reid (1985), insofar as his exclusion of *Nukta* from *Schismatorhynchos*, and our diagnosis excludes *Nukta* from *Schismatorhynchos*. Our reasons for supporting Reid are elaborated below.

Hora (1942) erected *Nukta* as a subgenus of *Schismatorhynchos* for *T. nukta* (Sykes, 1841) in order to call attention to 'the great similarity in the form of [*S. heterorhynchos* and *T. nukta*]', by which he meant that both possess a deeply incised, heavily tuberculate snout, the upper lobe of which forms a projection from between the eyes. However, the outcome of the comparison between *S. heterorhynchos* and *T. nukta* was not straitforward.

Whilst wishing to stress the similarity in the form of the snout between the two species, Hora also recognised that they differ so greatly in oro-labial structure that he also wrote 'differences . . . in the structure of the lips and associated structures are of sufficient value to separate the two species generically'. Hora resolved the dilemma between the similarity in the form of the snout and the difference in oro-labial structure by subordinating *Nukta* under *Schismatorhynchos*.

At the time *Nukta* was erected only *S. heterorhynchos* was known and a direct comparison between it and *T. nukta* was logical. The discovery of additional species with the oro-labial specialisations of *S. heterorhynchos* complicates the issue. Hora's phyletic association focused on the remarkably modified snout found in each species but the discovery of species of *Schismatorhynchos* with unmodified snouts renders the association untenable because either the new *Schismatorhynchos* species would have had to regress to an unmodified snout condition from the modified condition of *S. heterorhynchos* and *T. nukta* or *T. nukta* would have had to regress to an unspecialised oro-labial condition from the specialised condition of *Schismatorhynchos*. Either possibility is more complex, and therefore deemed less likely, than the explanation required when just *S. heterorhynchos* and *T. nukta* were known.

Hora, in making the comparison between *S. heterorhynchos* and *T. nukta*, was, in part, acting on the suggestion by Weber & de Beaufort (1916) that *Schismatorhynchos* might also be present on the Indian subcontinent, though they presented no evidence to support this suggestion. Hora's comprehensive knowledge of the Indian fish fauna led him to conclude that the only species Weber & de Beaufort could possibly have been referring to was *T. nukta*. However, they may have been simply following Bleeker (1853, 1855), who noted in his description of *S. heterorhynchos* that two Indian species illustrated in Gray (1830, 1832) appeared to have snouts similar in structure to the species he was describing. Bleeker listed *Cyprinus gotyla* Gray, 1830 (=*Garra gotyla*) and *Cyprinus falcata* Gray, 1832 (= ?*Tylognathus falcatus*; not *Tylognathus diplostomus* (Heckel, 1838) nor *T. dycocheilus* (McClelland, 1839)). The conclusion by Hora (1942:11) that Weber & de Beaufort could only have been referring to *T. nukta* may well have been mistaken, and may have led to a comparison they, nor Bleeker, ever intended.

The discovery of two additional labeonin species with oro-labial morphology like that of *S. heterorhynchos* demonstrates *T. nukta* is not the closest relative of *S. heterorhynchos*. This and Bleeker's reference to the snout of species other than *T. nukta* brings the character of a divided snout into sharp focus.

A heavily tuberculate snout commonly occurs among labeonins, as does the separation of the ethmoidal region from the premaxillary–maxillary region by creases, folds, and indentations in the skin. In some cases these are deep enough to 'divide' the snout. Since the condition occurs widely, and sporadically among labeonins its status as a synapomorphy in any particular case must be confirmed by congruence with other characters. In the case of *S. heterorhynchos* and *T. nukta* the requirement of corroboration from additional characters is not met. Rather, the oro-labial specialisations common to all species of *Schismatorhynchos* suggest any resemblance between the divided snout of *S. heterorhynchos* and *T. nukta* is one of convergence, and therefore without taxonomic significance.

In summary, we support Reid's exclusion of *Nukta* from *Schismatorhynchos* for three reasons: the oro-labial specialisations of *Schismatorhynchos* are unique among cyprinids; the 'divided' snout of *S. heterorhynchos* and *T. nukta* is not corroborated as a useful indicator of relationship; and Hora was probably mistaken when he assumed Bleeker and Weber & de Beaufort were suggesting a comparison between *S. heterorhynchos* and *T. nukta*. Subordinating *Nukta* within *Schismatorhynchos* renders *Schismatorhynchos* polyphyletic. Restricting *Schismatorhynchos* to Bleeker's and Weber & de Beaufort's concept of a group of labeonins with an elongate lower jaw cutting edge which separates the upper lip from the lower lips at the corner of the mouth, and also with a lower labial frenulum which houses the mandubular laterosensory canal, exactly matches Hora's concept (1942:12–13) for the nominate subgenus *Schismatorhynchos*.

SPECIES ACCOUNTS

An account of each species of *Schismatorhynchos* is presented below, and a comparative account for all three is given at the end of the section.

Key to the species of *Schismatorhynchos*.

1a. Snout with horizontal cleft, dark lateral band extends to the distal tips of middle caudal fin-rays .... *S. heterorhynchos*

1b. Snout without horizontal cleft, middle caudal fin-rays not pigmented .... Go to 2

2a. Dorsal fin branched ray count > 9 .... *S. endecarhapis* sp. nov.

2b. Dorsal fin branched ray count < 10 .... *S. holorhynchos* sp. nov.

Schismatorhynchos heterorhynchos (Bleeker, 1853) (Figs 1A,2,3A,5)

Lobocheilos heterorhynchos Bleeker, 1853: 524.
Schismatorhynchos lobocheiloides Bleeker, 1855: 259.
Schismatorhynchus heterorhynchus Bleeker, 1863: 193.
Tylognathus heterorhynchos Gunther, 1867: 67.

SYNTYPE. BMNH 1866.5.2.82 (143.3 mm Sl), [Indonesia], Sumatra, Solok, H.C. Schwanenfeld.

NON-TYPE MATERIALS. Sumatra – ZMA 115.911 (5, 175–228 mm Sl); [Indonesia]; Sumatra, Penetai, E. Jacobson, VII-1915. MZB 4818 (2, 119.6–156.6 mm Sl); Indonesia; Sumatra, Jambi Province; Batang Hari basin, Sungai Meringin at Muaraimat; col. Suroto and M. Siluba; 16-VIII-1982.

Borneo (Kapuas River basin, Kalimantan Barat, Indonesia) – MZB 5456 (2; 67.9–71.2 mm Sl), Sungai Kapuas at Putussibau, col. Munandar, 26-IV-1983. Upper part of Sungai Sibau, col. Ike Ratchmatica and Haryono, 25 June–7 July 1996: 1) MZB 8600, Station IV (1, 98.8 mm Sl); 2) MZB 8601, Station IV, Habitat 2 (1, 110.4 mm Sl); 3) MZB 8602, Station VI.2 (2, 86.9–97.6 mm Sl); 4) MZB 8603, Station IX, at Muara Suluk (1, 134.0 mm Sl); 5) MZB 8604, Station XIII (5, 85.4–93.8 mm Sl); and 6) MZB 8605, Station XIV, at Muara Apeang (1, 101.7 mm Sl). Sungai Putan, an upper basin tributary of Sungai Sibau; col. Ike Ratchmatica and Haryono; 22–26 Jun 1996: 1) MZB 8606, Station III (2, 91.7–93.3 mm Sl); 2) MZB 8607, Station IV (1, 106.6 mm Sl); 3) MZB 8608, Station V (1, 107.3 mm Sl); 4) MZB 869, Station VIII (2, 89.4–96.0 mm Sl); and 5) MZB 8610, Station VI (1; 92.2 mm Sl). Sungai Apeang, an upper basin tributary of Sungai Sibau; col. Ike Ratchmatica and Haryono; 30 Jun 1996: 1) MZB 8611, Station X.2 (2, 98.6–128.2 mm Sl); and 2) MZB 8612, Station X.4 (2, 104.8–136.9 mm Sl). Sungai Aring, an upper basin tributray of Sungai Sibau; col. Ike Ratchmatica and Haryono; 7 Jul 1996: 1) MZB 8613, Station XVI (1, 96.2 mm Sl); and 2) MZB 8614, Station XVI.2 (3, 97.2–131.0 mm Sl). Sungai Menjakan, an upper basin tributary of Sungai Sibau; col. Ike Ratchmatica and Haryono, 1 Jul 1996: 1) MZB 8615, Station XI.1 (1, 132.6 mm Sl); and 2) MZB 8616, Station XI.3 (1, 81.4 mm Sl). Sungai Sekedam Besar, an upper basin triburaty of Sungai Sibau; col. Ike Ratchmatica and Haryono; 25 June 1996, MZB 8617, Station II (3, 09.1–97.6 mm Sl). Sungai Berarap, an upper basin tributary of Sungai Sibau; col. Ike Ratchmatica and Haryono; 3 Jul 1996; MZB 8618, (1, 95.0 mm Sl).

DIAGNOSIS. A species of *Schismatorhynchos* with a deep horizontal cleft in snout (*S. holorhynchos* and *S. endecarhapis* without cleft in snout); snout, including cleft, heavily tuberculate, tubercles pyra-

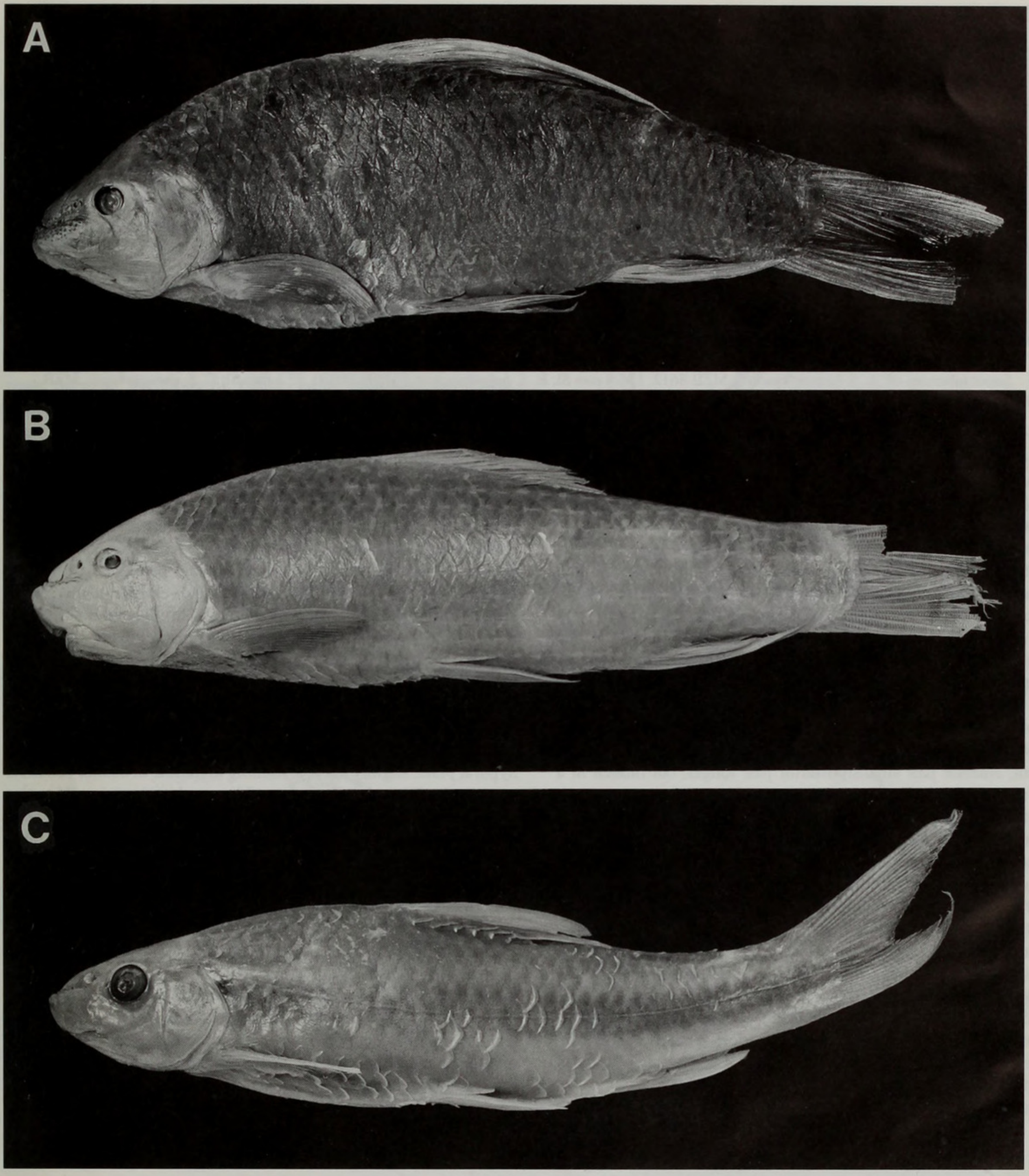

Fig. 2 Photograph of a large (A. ZMA 115.911, 224 mm Sl), medium (B. syntype, BMNH 1866.5.2.82, 143.3 mm Sl), and small (C. MZB 5456, 68.8 mm Sl) specimens of *S. heterorhynchos*.

midal, large, unicuspid (*S. holorhynchos* with conical, multi-cuspidate tubercles; *S. endecarhapis* with simple, conical tubercles); dorsal fin with eight branched fin-rays, falcate, anterior two principle fin-rays very elongate in larger individuals (*S. endecarhapis* with 11 branched rays in dorsal fin); distinct, dark lateral band extending to distal tips of middle rays of caudal fin (lateral band of *S. holorhynchos* and *S. endecarhapis* not extending onto caudal fin-rays).

Description. Material in a 70–225 mm Sl size range was available for study. No material was available below 68 mm Sl and the five largest specimens are not in good condition. They are old, poorly preserved, and flattened, limiting study of shape change in

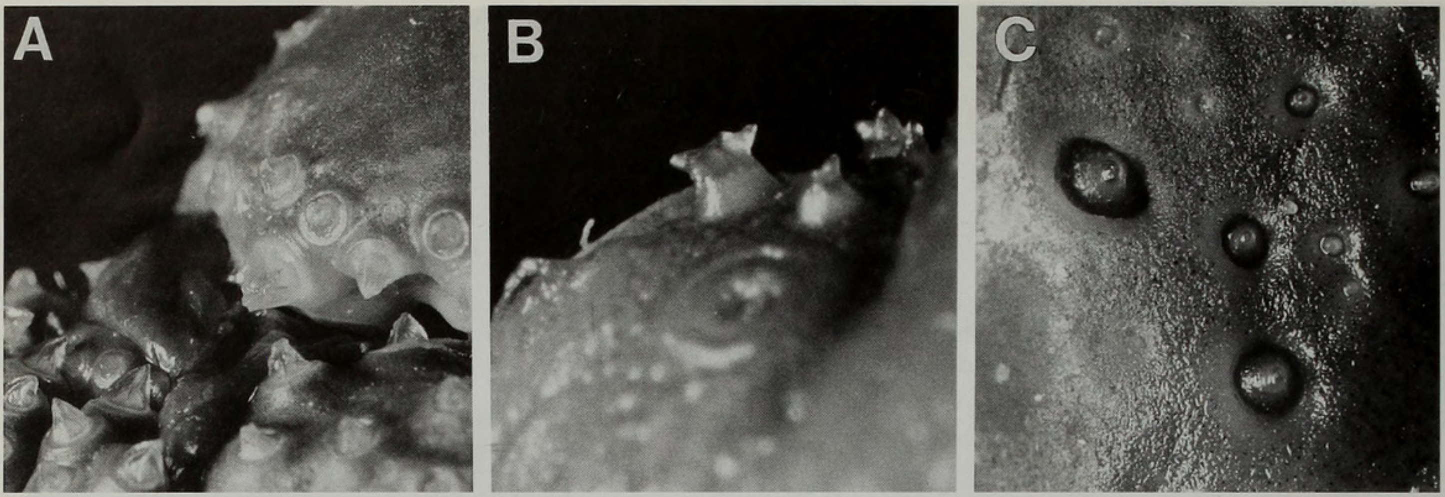

Fig. 3 Snout tubercles of: A. *S. heterorhynchos*, MZB 8612, 136.4 mm Sl; B. *S. holorhynchos*, FMNH 68550, 77.6 mm Sl; C. *S. endecarhapis*, MZB 6092, 179.0 mm Sl.

this species, which appears considerable. A photograph of a small, medium and large specimen is presented in Figure 2. Selected morphometric ratios, meristic information, and vertebral counts are reported in Tables 1–3.

Head relatively long, with a comparatively small eye, increased head length due to an elongate, pointed snout with a well developed rostral fold (=rostral cap of Roberts, 1989) which is hypertrophied in support of heavy tuberculation. Snout divided by a deep horizontal cleft above 1st infraorbital bone (Io 1). Upper (ethmoidal) lobe consists of connective tissue outgrowth from front edge of mesethmoid, supports large tubercles; in dorsal view its anterior edge indented in midline to form left and right anterior lobes. Anterior extension of rostral cap also consists of a connective mass which supports anterior tubercles of snout. Two pairs of barbels present, anterior pair small, posterior pair longer, but hidden in a deep recess at corner of mouth.

Mouth inferior, broad, C-shaped, usually a little wider than long (mean Mw:Ml = 1.3; range = 0.9–1.6., SE = 0.05, n=32). Lower jaw equipped with an emergent, thin, flexible, extremely long cornified cutting edge which is much longer than posterior extent of upper and lower lips. Posterior tips of cutting edge of lower jaw extend behind a vertical line from middle of eye.

Large, unicuspid, pyramidal tubercles, with 3–5 sides, present in and around rostral cleft (Fig. 3A). Tubercles also present around dorsal edges of upper lobe of snout formed by rostral cleft, on upper and lower interior surfaces of rostral cleft, between eye and nares, on upper half of Io 1, and over dorsal and anterior aspects of rostral cap. Large tubercles absent from dorsal surface of head except for those found at dorsal edges of upper lobe of snout.

Shape of *S. heterorhynchos* changes with size (Fig. 2). Smallest specimens examined have a relatively round body. Between 100 mm Sl and 150 mm Sl body depth and compression increases. Above 170 mm Sl body shape is deep and decidedly compressed.

Dorsal fin falcate, with first two principal fin-rays greatly elongated in large individuals, when depressed extending beyond anal-fin origin to more than mid-way along caudal peduncle. Dorsal fin height nearly 50% of SL in largest individuals examined. Increase in length of first two principal dorsal-fin rays strongly allometric with respect to Sl, with allometric coefficient much greater than unity (Fig. 4). Pectoral fin of large individuals slightly longer than head length, but in small individuals much shorter than head length. Pelvic fin inserted behind dorsal-fin origin, at 4th branched ray of dorsal fin.

Lateral line usually with 31 or 32 scales (Table 2) to end of hypural plate, slightly curved, running in middle of caudal peduncle posteriorly; 5½ scales above lateral line to dorsal origin; 4½ scales below lateral line. All specimens examined with 31 vertebrae, usually with 15 precaudal vertebrae and 16 caudal vertebrae (Table 3). Number of pairs of pleural ribs usually 12.

In alcohol dorsum dark, with ventral half of body creamy. A wide, dark lateral band present, centred on lateral line, beginning at operculum and extending to distal tips of middle rays of caudal fin. Upper anterior corner of lateral stripe, where it meets hind edge of operculum, intensified to form a dark mark, prominent in smaller individuals but less so in larger individuals. Lateral band two scale rows wide, includes lower ½ of scale row above lateral line scale row and upper ½ of scale row below lateral line scale row. Lateral band may be evident only on the posterior half of the body on large individuals. Dorsal, pectoral, pelvic, anal, and upper and lower lobes of caudal fin clear.

Table 1 Selected morphometric variables for species of *Schismatorhynchos*; the mean is followed (±) by the standard deviation; the range is reported as the minimum and maximum observation; sample size is reported in column headings.

	S. heterorhynchos n=38	*S. holorhynchos* n=81	*S. endecarhapis* n=19
Head length	26.6±1.4 22.6–28.9	25.4±1.2 21.5–27.7	24.5±1.4 20.5–27.0
Snout length	12.5±1.1 10.8–14.2	9.6±1.0 6.9–11.2	8.7±0.9 6.9–10.2
Eye length (%HL)	18.6±1.8 13.5–20.8	22.3±2.8 17.7–28.8	23.1±3.4 18.3–30.8
Eye length	4.9±0.6 3.4– 6.0	5.9±0.8 4.4– 7.4	5.7±1.0 4.1– 7.7
Predorsal length	47.6±1.5 43.6–50.4	47.8±2.2 39.2–52.8	47.7±1.4 45.5–50.2
Body depth	27.0±2.9 21.9–35.6	27.5±1.7 23.0–30.5	25.0±1.9 21.4–28.6
Caudal peduncle depth	12.4±1.0 11.0–15.4	12.8±0.6 11.2–13.8	11.1±0.5 10.2–12.2
Dorsal-fin base length	17.7±1.6 12.4–22.3	16.1±1.1 12.4–18.9	24.6±1.8 22.4–29.3

Table 2 Lateral line scale count frequencies for species of *Schismatorhynchos*.

	30	31	32	33	34
S. heterorhynchos	4	12	18	4	
S. holorhynchos	4	50	9	3	
S. endecarhapis			3	13	3

DISTRIBUTION. Studied material of *S. heterorhynchos* originates from three localities on Sumatra and from the Kapuas River basin, Kalimantan Barat, Borneo (Fig. 5). We consider only the two most recent reported Sumatra localities to be verifiable. Solok is reported as the type locality of the species (Bleeker, 1853), but we are not confident the types actually originate from there. Solok is located in the very upper reaches of the Indragir River basin Sumatera Barat Province, just north of the Batang Hari basin and on the overland route between the cities of Jambi, Jambi Province and Padan, Sumatera Barat Provence. Much of this route is in the Batang Hari basin and it is quite possible the material Bleeker listed as coming from Solok was actually collected along the route to Solok and within the Batang Hari basin. Within the Kapuas River basin verified localities at which *S. heterorhynchos* has been captured are all within the Sungai Sibau basin. *Schismatorhynchos heterorhynchos* has been collected only from the upper parts of river basins, near to or in foothill regions, both on Sumatra and Borneo. These parts of river basins are among the least well collected and further exploration of these habitats may reveal the species to be quite widespread.

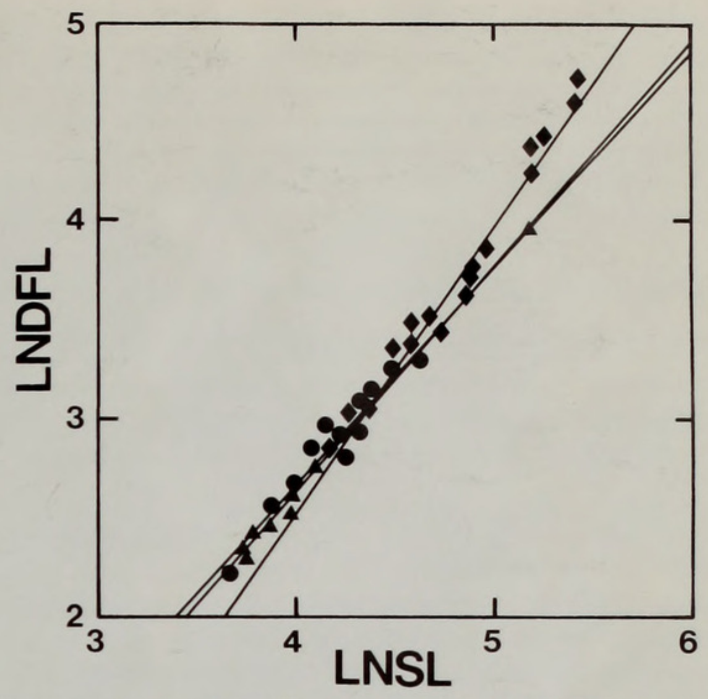

Fig. 4 Log-log plot (natural logarithms) of the relationship between height of the dorsal fin and standard length; ◆ = *S. heterorhynchos*, LnDFl = –3.2 + 1.44LnSl, SE of coefficient = 0.05, R^2 = 0.96, n = 36; ▲ = *S. endecarhapis*, LnDfl = –1.7 + 1.09LnSl, SE of coefficient = 0.07, R^2 = 0.92, n = 25; and ● = *S. holorhynchos*, LnDfl = –1.9 + 1.12LnSl, SE of coefficient = 0.04, R^2 = 0.99, n = 13.

Fig. 5 Localities from which *Schismatorhychos* material was examined in this study; ◆ = *S. heterorhynchos*, ▲ = *S. endecarhapis*, and ● = *S. holorhynchos*; target symbols = type localities.

REMARKS. Sumatra materials appear to have a more rounded head, deeper body, and longer fins than specimens from Borneo. We attribute this to larger size of the Sumatra specimens studied, but further materials in the appropriate size range (smaller specimens from Sumatra and larger specimens from Borneo) may reveal the two populations to be different species. If so, a new name will be required for the Kapuas River species.

Schismatorhynchos holorhynchos sp. nov. (Figs 1B,3,5,6)

Schismatorhynchus heterorhynchus; Inger & Chin, 1962: 86

HOLOTYPE. USNM 325389 (101.7 mm Sl); Malaysia; Sarawak; confluence of Batang Balui and Batang Kerumo; O2°22'N 113°45'E; col. L. Parenti, K. Luhat, and A. Among; 3-VIII-1991; field no. LRP 91-28.

PARATYPES. USNM 346637 (12 including 1 cleared and counter stained, 39.5–78.8 mm Sl); data as for holotype.

NON-TYPE MATERIALS. Borneo (Kinabatangan River basin, Sabah, Malaysia) – FMMN 68548 (28, 28.3–34.8 mm Sl); small stream 1 mi. above Sungei Tabalin Besar, Sta. 1; col. R. Inger and P.K. Chin; 21 April 1956. FMNH 68549 (1, 49.3 mm Sl); Deramakot Camp, hill stream; col. R. Inger; 2 May 1956. FMNH 68550 (5, 42.7–79.3 mm Sl); Deramakot Camp, hill stream below waterfall; col. R. Inger and P.K. Chin; 2 May 1956. FMNH 68551 (1, 47.8 mm Sl); Deramakot Camp, stream below water fall; col. R. Inger; 3 May 1956. FMNH 68552 (30 of 147, 30.3–49.4 mm Sl); Deramakot Camp; col. R. Inger and P.K. Chin; 8 May 1956. FMNH 94183 (1, 55.8 mm Sl); Deramakot Camp, hill stream; col. R. Inger; 2 May 1956.

Borneo (Rejang River basin, Sarawrak, Malaysia) – USNM 325359 (2, 21.8–55.8 mm Sl); Baleh River, creek entering northern bank approx 5 km E of Sut River; 2°2'N 113°07'E; col. L. Parenti *et al.*; 25 Jul 1991. USNM 324978 (2, 33.5–35.5 mm Sl); Baleh River, stream entering river opposite Sekolah Negara Bawai; 2°0'N 113°03'E; col. L. Parenti *et al.*; 24 Jul 1991. USNM 325387 (2, 59.2–59.5 mm Sl); Baleh River, creek entering southern bank approx. 20 km E of Sut River; 2°01'N 113°06'E; col. L. Parenti *et al.*; 24 Jul 1991. USNM 325388 (2, 67.6–68.7 mm Sl); Batang Balui, Batang Tamn were it enters Bantan Balui; 02°22'N 113°47'E; col. L. Parenti *et al.*; 6 Aug 1991. USNM 325390 (18, 36.2–77.2); Batang Balui, Batang Lut at Batang Balui; 2°22N 113°46'E; col. L. Parenti *et al.*; 3 Aug 1991. USNM 325411 (28, 38.7–77.6 mm Sl); Batang Balui, stream near mouth; 2°20'N 113°49'E; L. Parenti *et al.*; 6 Aug 1991.

DIAGNOSIS. A species of *Schismatorhynchos* with eight branched

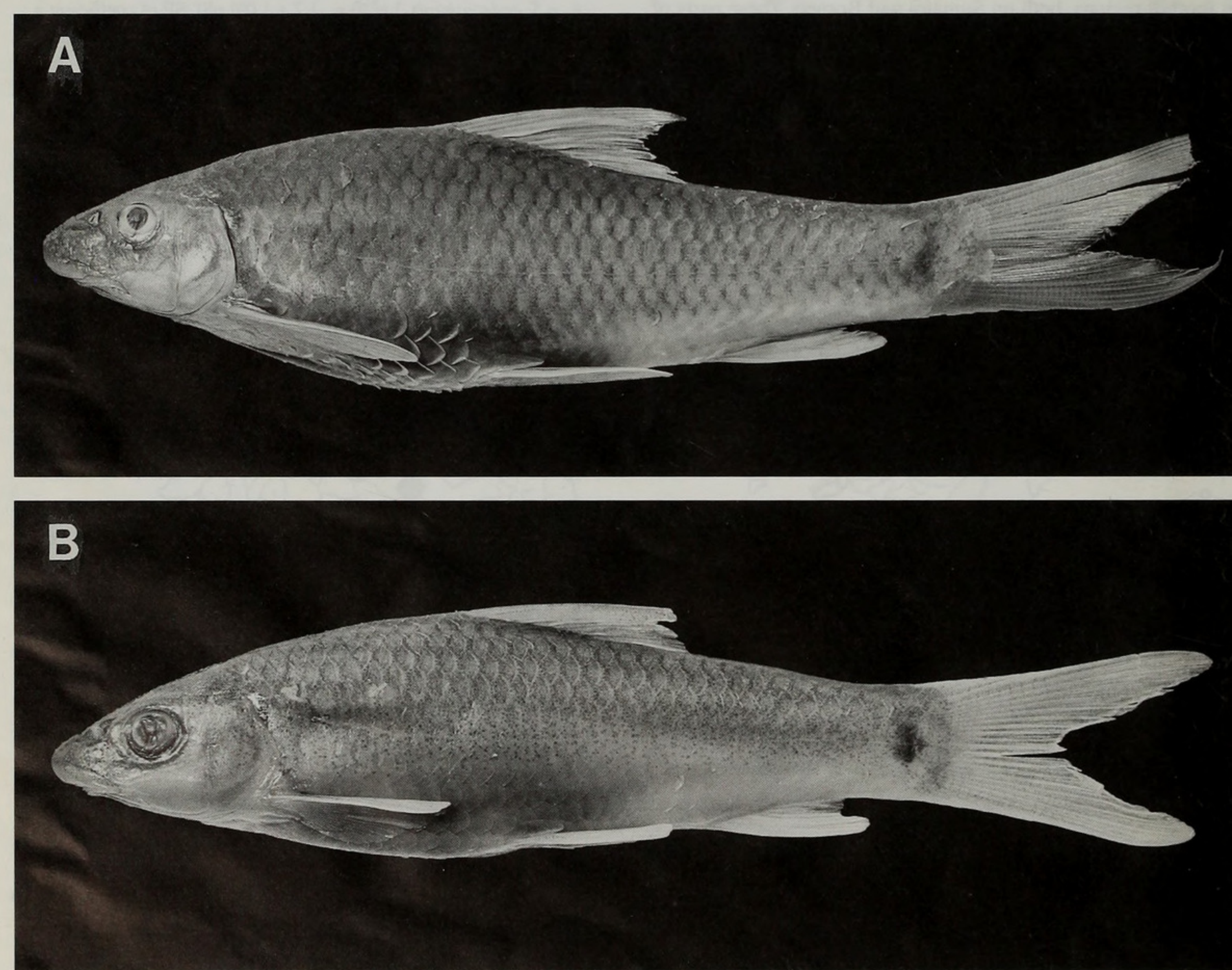

Fig. 6 Photographs of the holotype (A. USNM 325389, 101.7 mm Sl) and a small (B. USNM 325890, 43.6 mm SL) specimen of *S. holorhynchos*.

Table 3 Vertebrae, branched rays in dorsal fin, and pairs of pleural ribs counts for species of *Schismatorhynchos*; the mean is followed (±) by the standard deviation; the range is reported as the minimum and maximum observations; sample size is reported in the column heading.

	S. heterorhynchos n=38	*S. holorhynchos* n=99	*S. endecarhapis* n=45
Vertebrae	31±0.0	32.0±0.10 31–32	33.0±0.15 32–33
Precaudal vertebrae	15.9±0.23 15–16	16.0±0.17 15–16	16.9±0.32 16–17
Caudal vertebrae	15.1±0.23 15–16	16.0±0.14 16–17	16.1±0.36 15–17
Peduncular vertebrae	5.4±0.50 5– 6	5.8±0.48 5– 7	5.8±0.44 5– 6
Dorsal fin position	8.0±0.23 7– 9	7.9±0.30 7– 8	8.0±0.0
Anal fin position	18.9±0.23 18–19	19.0±0.46 19–20	20.1±0.32 20–21
Branched dorsal-fin rays	8±0.0	8.0±0.10 7– 8	11.0±0.40 10–12
Ribs	12.3±0.47 12–13	10.3±0.51 9–11	12.7±0.45 12–13

rays in dorsal fin (*S. endecarhapis* with 11 branched rays in dorsal fin); snout pointed, without cleft (*S. heterorhynchos* with deep cleft in snout), tuberculate, tubercles conical, becoming multicuspid to stellate in individuals about 60 mm SL and greater (*S. heterorhynchos* with pyramidal tubercles; *S. endecarhapis* with simple, conical tubercles); a round blotch on caudal peduncle (*S. heterorhynchos* and *S. endecarhapis* without round blotch on caudal peduncle).

Description. The largest specimen available for study is about 102 mm Sl, however the species grows considerably larger in Sungai Sebangu (K.Martin-Smith, pers. comm.) The overall form of the body is shown in Figure 6. Selected morphometric ratios, meristic information, and vertebral counts are reported in Tables 1–3.

Snout pointed, tuberculate, tubercles moderate in size, absent from region of the cleft in snout of *S. heterorhynchos*. Two pairs of barbels, anterior pair small and fitting in grove, posterior pair hidden in deep recess at mouth corner.

Mouth C-shaped, usually distinctly wider than long (mean Mw:Ml = 1.8. range 1.3–2.2, SE 0.07, n=10). Cutting edge of lower jaw emergent, its tips extend posteriorly to vertical line from anterior margin of pupil. Lateral lobe of lower lip thick.

Snout and dorsal surface of head posterior to nares and body anterior to dorsal fin tuberculate. Snout heavily tuberculate. Tubercles in region of snout well-developed, conical, multicuspidate in larger specimens (Fig. 3B) but simple in specimens less than about 60 mm SL. Rostral tubercles present laterally on first infraorbital (Io 1), around tip of snout, over dorsal surface of tip of snout, between nares, and between nares and eye. Tubercles absent from a patch between front edge of ethmoid and anterior part of snout that corresponds in position to the deep cleft in snout of *S. heterorhynchos* (Inger and Chin, 1962). Region between dorsal fin and nares covered by numerous fine tubercles.

Dorsal fin origin in advance of pelvic fin, margin slightly convex. Pelvic fin origin at 3rd branched ray of dorsal fin. Pectoral fin less than head length. Caudal fin forked.

Lateral line complete, slightly curved, running in the middle of caudal peduncle posteriorly, usually with 31 scales to end of hypural plate (Table 2), 5½ scales above lateral line to dorsal origin; 4½ scales below lateral line. Vertebrae usually 32, usually with 16 precaudal and caudal vertebrae. Number pairs of pleural ribs usually 10 or 11.

In alcohol dark from above, creamy below. Indistinct, dark, lateral band present, its origin before origin of dorsal fin. Band width equivalent to width of one scale row, anteriorly lateral band lies above lateral line, posteriorly lateral band lies over lateral line. Precaudal spot present, very distinct in small individuals, larger but may be obscure in larger individuals. Side of body above middle of pectoral fin with a few scales darkly marked.

Etymology. The name *holorhynchos* is from the Greek words *holos*, meaning whole or entire, and *rhynchos*, meaning snout. It is in reference to the new species' snout, which lacks the deep cleft found in the snout of its sister species, *S. heterorhynchos*.

Distribution. Materials of *S. holorhynchos* originate from within the Rejang River basin, Sarawak, Malaysia and the Kinabatangan River basin, Sabah (North Borneo), Malaysia (Fig. 5). The species has also been collected to the south of the Kinabatangan River, in the Segama River basin in Sabah (K.Martin-Smith pers. com.). The Sarawak and Sabah localities from which *S. holorhynchos* has been taken are distant from one another and the Rejang and Kinabantangan rivers which it is know to inhabit flow off Borneo in different directions and into different seas. It would be remarkable if *S. holorhynchos* was discovered not to inhabit some of the many river basins lying between the two rivers from which it has been collected.

Schismatorhynchos endecarhapis sp. nov. (Figs 1C,3,5,7)

Schismatorhynchos heterorhynchos; Roberts, 1989: 79, Fig. 58.

Holotype. MZB 6092 (179.0 mm SL); Indonesia; Kalimantan Tengah; Barito River drainage; Sungai Laung at Desa Maruwei (0°21.986'S 114°44.103'E); hook and line; col. D.J. Siebert, A.H. Tjakrawidjaja and O. Crimmen; 15–18 Jul 1992; field no. DS-12-1992.

Paratypes. BMNH 1993.5.12:1-19 (19, 61.9–41.8 mm S); Indonesia; Kalimantan Tengah; Barito River basin; mouth of small stream at Project Barito Ulu base camp on Sungai Busang; seine; col. D.J. Siebert, A.H. Tjakrawidjaja and O. Crimmen; 27–28 Jan 1991; field no. 3-DJS-1991. MZB 3434 (1, 88 mm Sl); Indonesia; Kalimantan Barat; Kapuas River basin; rocky channel in mainstream of Sungai Pinoh at Naga Saian, 45 km S of Nagapinoh; 0°43'S 111°38.5'E); rotenone; col.T.R. Roberts and S. Wirjoatmodjo; 26 Jul 1976; field no. Kapuas 1976-29.

Non-type materials. Borneo (Barito River basin, Kalimantan Tengah, Indonesia) – BMNH 1993.5.12:52–61 (10, 43.3–22.3 mm Sl); sand bars of Sungai Joloi above its confluence with Sungai Busang; seine; col. D.J. Siebert, A.H. Tjakrawidjaja and O. Crimmen; 8 Feb 1991; field no. 13-DJS-1991. BMNH 1993.5.12:62–74 (13, 48.0–26.5 mm Sl); sand bars of Sungai Murung around Project Barito Ulu base camp on Murung River; seine; col. D.J. Siebert, A.H. Tjakrawidjaja and O. Crimmen; 12 Feb 1991; field no. 16-DJS-1991. BMNH 1993.5.31–51 (21, 48.2–19.4 mm Sl); Barito River at Desa Muara Laung; O°34.576'S 114° 44.205'E; seine; D.J. Siebert, A.H. Tjakrawidjaja and O. Crimmen; 20–22 Feb 1991; field no. 22-DJS-1991. BMNH 1993.5.12:20–30 (11, 46.7–34.4 mm S); sand bars of Sungai Busang at Project Barito Ulu base camp on Sungai Busang; seine; D.J. Siebert, A.H. Tjakrawidjaja, O. Crimmen; 14–15 Feb 1991; field no. 18-DJS-1991.

Borneo (Kapuas River basin, Kalimantan Barat, Indonesia) – MZB 3434 (1, 88 mm Sl); Sungai Pinoh at Naga Saian; O°43'S

Fig. 7 *Schismatorhynchos endecarhapis*: A. MZB 6092, holotype, 179.0 mm Sl; B. *S. endecarhapis*, BMNH 1993.5.12:1–19, paratype, juvenile, 59.4 mm Sl.

111°38.5'E; rotenone; T.R. Roberts; 26 July 1976; field no. Kapuas 1976-29. MZB 3433 (2); Sungai Pinoh 37 km S of Nagapinoh; O°39.5'S 111°40'E; rotenone; T.R. Roberts; 24 July 1976; field no. Kapuas 1976-27.

DIAGNOSIS. A species of *Schismatorhynchos* with 11 branched rays in dorsal fin (*S. heterorhynchos* and *S. holorhynchos* with eight branched rays in dorsal fin); snout entire (*S. heterorhynchos* with cleft snout); tubercles conical, simple (*S. heterorhynchos* with pyramidal tubercles, *S. holorhynchos* with multicuspid tubercles); gape not reaching vertical from anterior margin of eye (*S. heterorhynchos* and *S. holorhynchos* with gape reaching to beyond anterior margin of eye); modally 33 pored lateral line scales (*S. heterorhynchos* usually with 31–32 pored lateral line scales, *S. holorhynchos* usually with 31 pored lateral line scales).

DESCRIPTION. Material available for study consists of small specimens and one larger individual (holotype). The gap in size between the largest of the smaller material and the holotype is so large that study of allometry and shape change with size is not feasible. The overall form of *Schismatorhynchos endecarhapis* is shown in Figure 7. Selected meristic, morphometric, and vertebral data are presented in Tables 1–3.

Head length moderate (Table 1); gape reaching to a little before anterior margin of eye; snout with well developed rostral cap. Two pairs of barbels, anterior barbel in grove on snout, shorter than posterior barbel; posterior barbel about equal to eye diameter.

Mouth crescentic, more than twice as wide as long (mean Mw:Ml = 2.4; range 2.2–2.8; SE 0.08; n=9). Upper lip well separated from rostral cap, not continuous with lower lip around corner of mouth. Lower jaw with a sharp horny covering. Median lobe of lower lip wide, covering most of lower jaw, continuous with isthmus, separated from well developed lateral lobes of lower lip by a deep post labial grove.

Only a single large specimen of this species is known; observations of the extent of tuberculation are thus limited in scope. Small individuals with a few small tubercles, large individual with many small tubercles. Snout tuberculate, a small patch of large, unicuspid, conical tubercles present just above and before rostral barbel (Fig. 3C). Smaller tubercles present around anterior face of rostral cap. No large tubercles on Io 1 nor in space between nares and eyes. Fine tubercles present over dorsal surface of head but appear to be absent between nape and dorsal fin.

Dorsal fin long, with 11 branched fin-rays (1 individual with 10, 1 individual with 12), origin well in advance of pelvic fins. Margin of dorsal fin falciform, first few anterior principal rays long. Caudal fin forked.

Lateral line nearly straight, with 33 scales to end of hypural plate; 5 ½ scales above lateral line to dorsal origin; 4½ scales below lateral line. Vertebrae usually 33 (2 of 35 individuals with 32), usually with 17 precaudal vertebrae and 16 caudal vertebrae. Number of pairs of pleural ribs usually 13.

Colour in alcohol dark above, lighter below (Fig. 7). Scale pockets of scale rows to at least 2 scales rows below lateral line with a distinct, dark crescent. A dark lateral stripe evident, terminating in a distinctly triangular precaudal spot. In larger individuals stripe consists of coloration centred over 3 scale rows; stripe on lateral line scale row begins below posterior end of dorsal fin, on 1st scale row above lateral line stripe beings at dorsal origin and ends at precaudal spot, on 2nd scale row above lateral line stripe begins midway between occiput and dorsal origin and ends midway along peduncle; in small individuals stripe evident on lateral line scale row only. Small individuals with a prominent mark on side at 5th or 6th scale along lateral line (Fig. 1b), usually a scale above and below lateral line darkened along with 1 or 2 scales on lateral line. Dorsal and caudal fins dusky, interradial membranes heavily marked with melanophores. Interradial membranes of pectoral and pelvic fins lightly marked with melanophores.

ETYMOLOGY. The species name *endecarhapis* is formed from the Greek words *endeka* (eleven) and *rhapis* (rod), referring to the modal number (11) of branched rays in dorsal fin. It is proposed as a noun in apposition.

DISTRIBUTION. *Schismatorhynchos endecarhapis* is known from the Barito River above Muara Teweh and from Sungai Pinoh of the Kapuas River system (Fig. 5). Whether or not the species occurs in the lower reaches of these watersheds where streams are larger is not yet known. In the Barito small individuals were seined at creek mouths and on sand bars along the mainstream.

REMARKS. The largest individual was taken by hook and line, baited with beetle larvae, below floating houses at Desa Maruwei, indicating that the species is an opportunistic feeder even though the length of its intestine would indicate it is predominately a herbivore.

Intrageneric comparisons

Species of *Schismatorhynchos* are easily distinguished from one another and gross differences are employed in the key to species. The meristic information of Table 3 is summarised graphically in Figure 8. Axis 1, which can be interpreted as an axis of dorsal fin branched ray and caudal vertebrae counts, provides a dimension along which *S. endecarhapis* is clearly separable from *S. heterorhynchos* and *S. holorhynchos*. Axis 2, interpreted as an axis of overall vertebral pattern and rib count, separates *S. heterorhynchos* and *S. holorhynchos*. Figure 9 summarises the morphometric information of Table 1. Complete separation of the three species is achieved in the two dimensions of Axis 1 and Axis 2. Axis 1 is interpreted as a head length/dorsal-fin base length axis. Axis 2 is a contrast of dorsal-fin base length and caudal peduncle depth.

TUBERCULATION PATTERNS. Species specific tubercle distribution patterns in *Schismatorhynchos* are evident at small size. The regions of the snout which will eventually contain large tubercles are apparent at sizes smaller than 30 mm SL in *S. endecarhapis*. and *S. holorhynchos*, well before the tubercles undergo obvious enlargement.

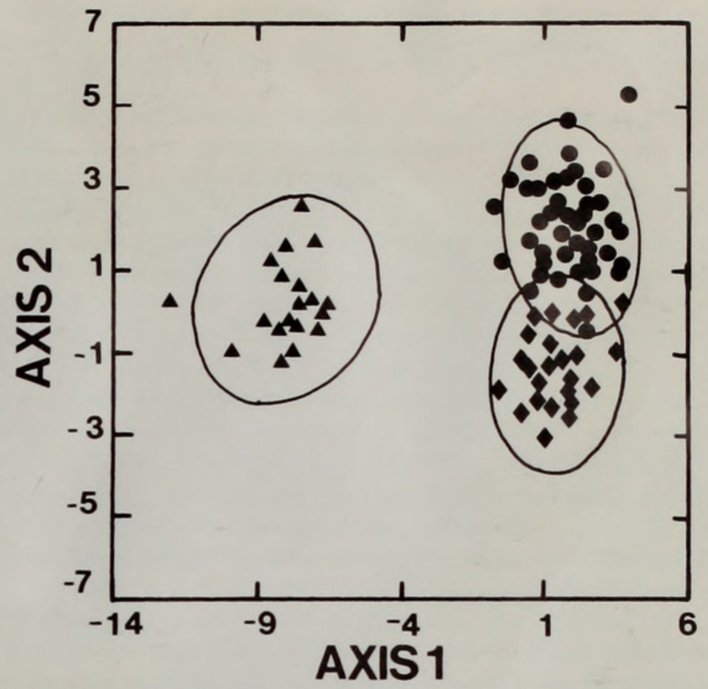

Fig. 8 Graphical joint summary of the meristic information for species of *Schismatorhynchos* with 0.95 confidence ellipses of samples (*S. heterorhynchos* = ◆; *S. holorhynchos* = ●; *S. endecarhapis* = ▲). Standardised discriminant function for: Axis 1 = 0.03 × anal fin position + 0.26 × peduncular vertebrae count – 1.68 × caudal vertebrae count – 1.49 × precaudal vertebrae count – 0.09 × rib count – 0.04 dorsal fin position – 0.75 × number of branched rays in dorsal fin; Axis 2 = 0.01 × anal fin position + 1.32 × caudal vertebrae count + 0.05 × peduncular vertebrae count + 1.23 × precaudal vertebrae count – 0.57 × rib count – 0.03 × dorsal fin position – 0.49 × number of branched rays in dorsal fin; Wilk's lambda = 0.001, df 7,2,173, $p < 0.0001$.

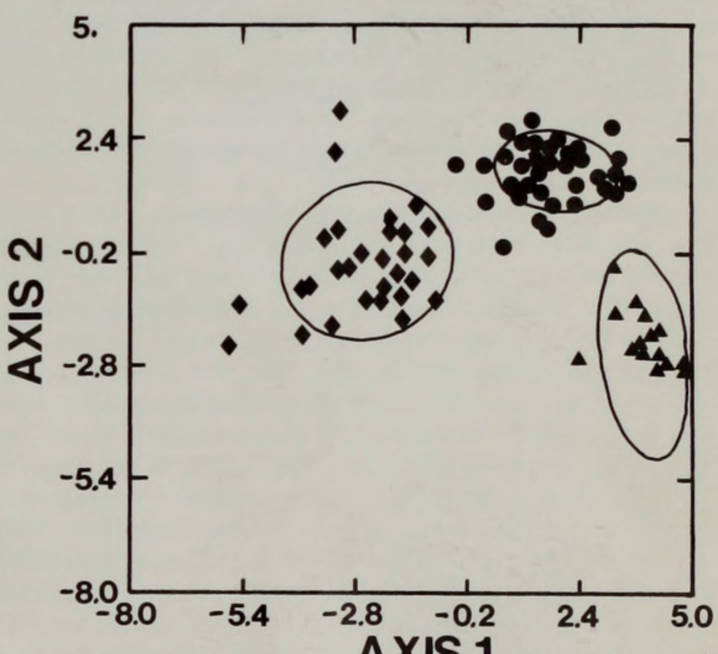

Fig. 9 Graphical joint summary of the selected morphometrics of species of *Schismatorhynchos* with 0.75 confidence ellipses of samples (*S. heterorhynchos* = ◆; *S. holorhynchos* = ●; *S. endecarhapis* = ▲). Standardised discriminant function for: Axis 1 = 2.39 × body depth + 2.01 × dorsal base + 1.55 × predorsal length – 1.21 caudal peduncle depth – 0.49 × eye length – 3.77 × head length – 0.88 × snout length; Axis 2 = 0.98 × body depth + 4.90 × caudal peduncle depth + 0.85 × eye length + 0.74 × predorsal length – 5.28 × dorsal base – 1.40 × head length – 0.91 × snout length; Wilk's lambda = 0.04, df 7,2,229, $p < 0.0001$.

DISCUSSION

Including *Schismatorhynchos endecarhapis* and *S. holorhynchos* in the genus *Schismatorhynchos* raises a number of theoretical and practical problems, as would including them in the obvious alternative, *Lobocheilos*. Bleeker's (1863) diagnosis of *Schismatorhynchos* includes, among other things, mention of a deep, transverse cleft of the snout and the upper and lower lips not continuous around the corner of the mouth. Weber & de Beaufort (1916; Fig. 86) described an additional oro-labial structure of *Schismatorhynchos*, a frenulum between the lateral lobe of the lower lip and the isthmus (Fig. 2A). Hindsight shows that the cleft snout is characteristic, so far as is known, of a single species (*S. hetero-rhynchos*) while the oro-labial features are found in at least two additional species. Our decision to include the new species in *Schismatorhynchos* rests on these oro-labial features, which we consider derived for Southeast Asian labeonins (we recognise them as synapomorphies of the genus *Schismatorhynchos*).

The problem, and it is nothing more than that of including additional species in any monotypic genus with a very specific, highly descriptive name, of including the two new species in *Schismatorhynchos* is that both lack a cleft in the snout. However, the problem is not so much that the two new species lack a cleft snout but that the highly descriptive generic name *Schismatorhynchos* is apt for only one species of the genus. Generic names serve two functions in modern classification: 1) the first element of a unique binomen; and 2) the name of a group of species that are close phylogenetic relatives of each other. The first function is a matter of nomenclature. The second function lies within the realm of the science of Systematics and we believe it to be of greater importance. Since there is good evidence (the oro-labial features) that the two new species are close relatives of *S. heterorhynchos* we include them in *Schismatorhynchos* even though they lack a cleft snout. This leaves the name *Schismatorhynchos* apt for only one of the three species in the genus but we do not see this as reason enough to propose a new generic name for the other two, especially since *S. holorhynchos* is probably more closely related to *S. heterorhynchos* than it is to *S. endecarhapis*.

Lobocheilos is herein recognised as that group of Southeast Asian cyprinids possessing a very wide median lobe of the lower lip and with the lower and upper lips continuous around the corner of the mouth (Fig. 1D). This definition conforms to that of Smith (1945), who followed de Beaufort's (1927) comment on an Indo-Australian subgroup of *Tylognathus* Heckel. The two new species of *Schismatorhynchos* could have been assigned to *Lobocheilos*, as lip structure (generally) and scale and vertebral counts of the new species of *Schismatorhynchos* do conform to those of species of *Lobocheilos*. Some may prefer such an assignment, especially since the new species lack a rostral cleft, but to do so on the basis of the absence of a rostral cleft ignores the two derived oro-labial characters which all species of *Schismatorhynchos* share. As we pointed out above, we choose to focus on the evidence that the two new species are closely related to *S. heterorhynchos* rather than their lack of a cleft in the snout.

A more practical problem is that *Schismatorhynchos endecarhapis* will not key to genus using any regional key in general use of which we are aware (Weber and de Beaufort, 1916; Smith, 1945; Inger and Chin, 1962; Kottelat *et al.*, 1993). The initial problem encountered in these keys is the count of branched rays in the dorsal fin. *Schismatorhynchos heterorhynchos* Bleeker, *S. holorhynchos*, and members of the closely related genus *Lobocheilos* possess fewer than 10, usually only eight, branched rays in the dorsal fin. *Schismatorhynchos endecarhapis*, with 11 branched rays in the dorsal fin, fails this distinction, instead falling into *Tylognathus*, *Labeo*, or *Cirrhinus* (depending on which key is used).

The second problem is that a deep rostral cleft is used to separate *Schismatorhynchos* and *Lobocheilos*. Both new species of *Schismatorhynchos* fail this distinction. However, to our knowledge, the characters of upper and lower lips not continuous around the corner of the mouth and presence of a frenulum between the lower lip and the isthmus always separates *Lobocheilos* and *Schismatorhynchos* correctly.

Annotations to keys to cyprinid genera of the region.

We suggest the following annotation to the Cyprininae key of Weber & de Beaufort (1916; p. 94):

1. Suborbital bone covering greatest part of cheek; lower jaw with symphysial tubercle; the broadly reflected lower lip not separated from jaw .... *Barbichthys*

2. Ring of suborbital bones not enlarged, lower jaw without symphysial tubercle; lower lip distinct from lower jaw.
   - a. lower and upper lips not continuous around the corner of the jaw .... *Schismatorhynchos*
   - b. lower and upper lips continuous around corner of lower jaw.
     - aa. Dorsal with 10–18 branched ray .... *Labeo*
     - bb. Dorsal with 8–9 branched rays .... *Lobocheilos*

The key to genera of Cyprinidae of Kottelat, *et al* (1993;p. 29) can accommodate an expanded *Schismatorhynchos* with the following modifications (which make couplet 30 unnecessary).

27a. Suborbital bones enlarged and covering most of cheek (Fig. 109); lower jaw with a symphysal knob; lower lip reflected backwards,but not separated from jaw .... *Barbichthys*

27b. Suborbital bones not enlarged; no symphysial knob on lower jaw; lower lip distinctly separated from lower jaw .... go to *

*a. lower and upper lips not continuous around corner of lower jaw .... *Schismatorhynchos*

*b. lower and upper lips continuous around corner of lower jaw .... go to 28

28a. 10–18 ½ branched dorsal rays .... go to 29

28b. 8–9 ½ branched dorsal rays .... *Lobocheilos*

Acknowledgements. Many institutions and individuals contributed to make our survey efforts in the Barito River possible. The Indonesian Institute of Sciences (LIPI) granted permission to conduct research in Kalimantan; the Natural History Museum and the Research and Development Centre for Biology (PPPB), Bogor allowed the authors to make this effort; The Worshipful Fishmongers Co., London provided a generous grant to fund the second expedition; the Royal Society, London, the Godman Fund for Exploration, London, the Natural History Museum, London, and the National Museum of Natural History, Washington, D.C. all contributed toward the first expedition. Project Barito Ulu provided invaluable logistic and other support for the first expedition. The Sumanti family of Desa Maruwei, Kalimantan Tengah provided gracious hospitality, without which the holotype would never have been obtained. Rony Huys is thanked for translation of old Dutch.

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