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DISCHERODONTUS, A NEW GENUS OF CYPRINID FISHES FROM SOUTHEASTERN ASIA

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ABSTRACT.—*Rainboth, Walter John. 1989.* Discherodontus, *a new genus of cyprinid fishes from southeastern Asia. Occ. Pap. Mus. Zool. Univ. Michigan, 718:1-31, figs. 1–6.* Three species of southeast Asian barbins were found to have two rows of pharyngeal teeth, a character unique among barbins. These species also share several other characters which indicate their close relationship, and allow the taxonomic recognition of the genus. Members of this new genus, *Discherodontus*, are found in the Mekong, Chao Phrya, and Meklong basins of Thailand and the Pahang basin of the Malay peninsula. The new genus appears to be most closely related to *Chagunius* of Burma and India, and a group of at least six genera of the southeast Asia-Sunda Shelf basins.

Key words: Discherodontus, *fishes, Cyprinidae, taxonomy, natural history, Southeast Asia.*

INTRODUCTION

Among the diverse array of barbins of southern and southeastern Asia, there are a number of generic-ranked groups which are poorly understood, or which still await taxonomic recognition. One group of three closely related species, included until now in two genera, is the subject of this paper. Prior to this study, two of the three species in this new genus have been relegated to *Puntius* of Hamilton (1822), but as understood by Weber and de Beaufort (1916), and by Smith (1945). The remaining species has been placed in *Acrossocheilus* not of

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Oshima (1919) but of Smith (1945). It is beyond the scope of this study to define properly *Puntius* and *Acrossocheilus,* which are only remotely related to the new genus.

The three species in this new genus share several characters unique among barbins of the region and at least one character which is unique for all barbins. The new genus, named *Dischero dontus* here, can be distinguished by several characters, the most obvious and unusual of which is the pharyngeal tooth pattern. These species have two rows of pharyngeal teeth rather than the three rows known from all other barbin species of Asia and Africa except one, another species from Southeast Asia, *Probarbus jullieni* Sauvage (1880). *Probarbus* is a monotypic genus in which a more pronounced serial tooth loss has resulted in a single row of broad, molariform pharyngeal teeth.

Other characteristics uniting members of this new genus are similar to characters found in several easily diagnosed genera of southeastern Asia, rather than to the two genera in which these three species had been placed. The names of some of these genera have been in use for one hundred years; however, they often have been erratically and haphazardly applied. The relationships within this entire group of southeast Asian genera are poorly understood and are currently under study.

From the new genus, the first species to be described was *Barbus halei* Duncker (1904) from the Pahang River near Kuala Tembeling, Malaysia. Later, Fowler (1937) described two species of *Barbus* from Thailand which belong to this genus. These two, *B. ashmeadi* and *B. colemani,* were represented by specimens from the Mekong and Chao Phrya basins, respectively. However, *B. colemani* has proved to be a synonym of *B. halei,* as will be discussed here. Later, Hugh Smith (1945) described a new species, *Acrossocheilus schroederi,* which belongs to *Dischero dontus.* Smith also used the generic name *Puntius* for both species taxa of Fowler. The most recently described species taxon applicable to the new genus is *Puntius somphongsi* Benl and Klausewitz (1962), another synonym of *B. halei.*

Dischero dontus is composed of species which inhabit upland rivers and streams of southeast Asia (Figure 1). They are usually found in strongly flowing, small to medium-sized rivers and streams flowing through areas of shallow to exposed bedrock, and are sporadic elsewhere. They are rarely represented in museum collections. Although they may be found in local abundance, little is known of their life histories.

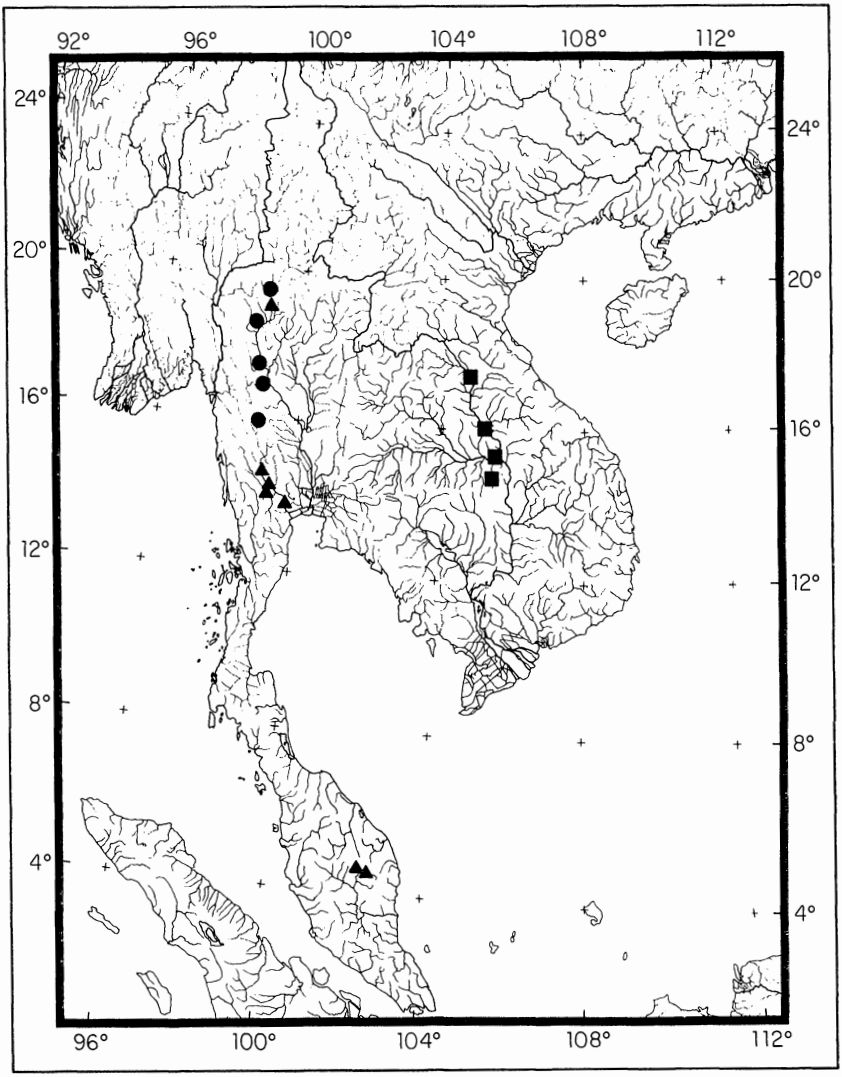

FIG. 1. The distribution of fishes of the genus *Dischorodontus* in mainland southeast Asia. Triangles represent specimens of *D. halei* examined, squares *D. ashmeadi,* and circles *D. schroederi.*

MATERIALS AND METHODS

A total of 31 measurements and 15 counts were taken on a series of individuals from each of the three members of the genus, including most of the type material. Counts and measurements follow the definitions of Hubbs and Lagler (1958), but with some modifications (Rainboth, 1981). Sample sizes are limited by the availability of known material. Body and head measurements are summarized as mean percent of standard length and head length, respectively. In Tables 1 and 2, means are listed ($\bar{x} \pm s$) where s is the unbiased estimator of the standard deviation of individuals in the sample. The 95% confidence intervals and the t-test results were calculated as specified by Sokal and Rohlf (1969).

Comparisons of scales were made from samples taken on the row above the lateral line, on the trunk of the body directly beneath some part of the base of the dorsal fin.

Lists of specimens examined are included in each species account. Museum abbreviations are listed in the acknowledgments. The distribution map was drafted by the author from U. S. Defense Mapping Agency 1:5,000,000 Series 1300 topographical maps. Mapped distribution records have been based only on specimens examined. Statements describing vegetation cover of the general countryside were made in a manner following the Mekong Atlas (Mekong Secretariat, 1968), and more precise descriptions were taken from field notes.

Dischorodontus new genus
Type species, *Barbus ashmeadi* Fowler, 1937

Barbus of authors (not Cuvier, 1816).
Acrossocheilus (not Oshima, 1919) Smith (in part), 1945.
Puntius (in part, not Hamilton, 1822) Smith (in part), 1945.

DIAGNOSIS.—Small barbins of southeast Asia (Figure 2), distinguished from all other barbs of Asia and Africa by the presence of two rows of pharyngeal teeth. Externally visible characteristics which allow them to be distinguished from other barbs of the region include an advanced vent with added scale rows between the vent and anal fin, small to absent dorsal-spine serrations, lack of demarcation between the lower lip and jaw, and predictable coloration of darkened dorsal-fin apex and black tips on the caudal fin lobes. Although species in other genera of south and southeast Asia may share single

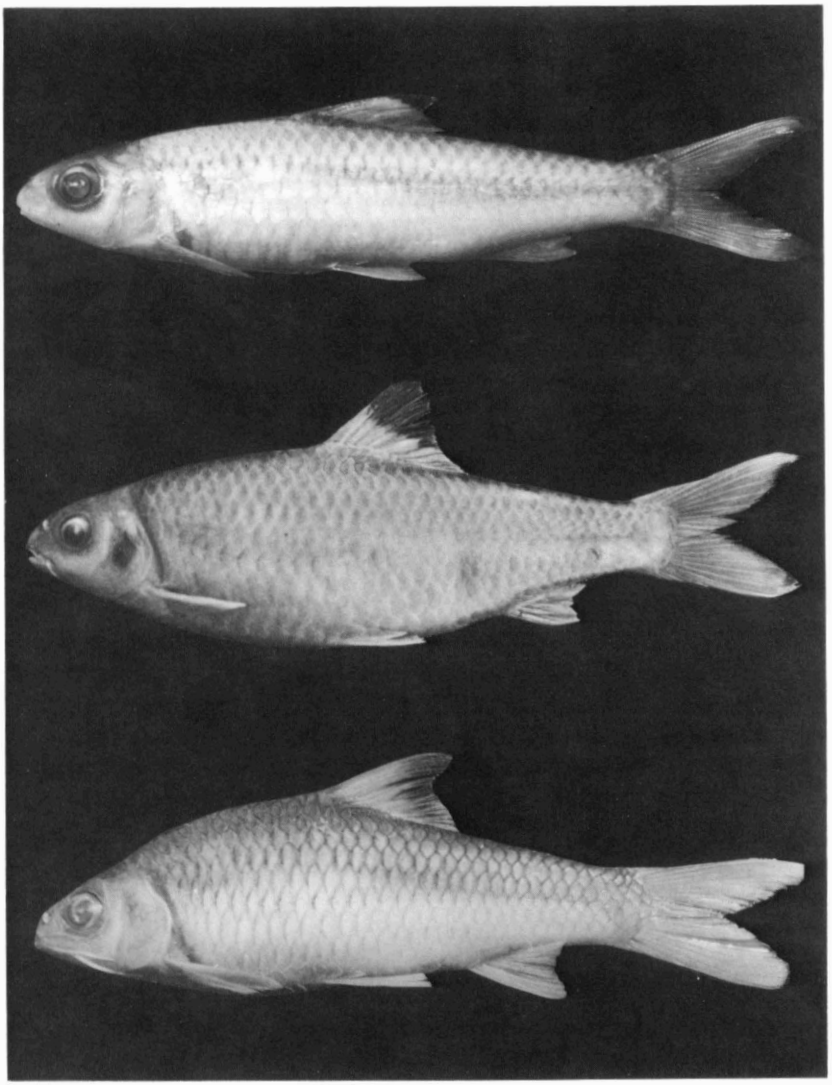

FIG. 2. Three species of *Discherodontus: D. halei* (71 mm SL) from the Kwae Yai River (top; NIFI uncat.), *D. ashmeadi* (134 mm SL) from the Lam Dom Noi River (middle; NIFI 01311); and *D. schroederi* (73 mm SL) from Huay Khai Kaeng, Meklong drainage (bottom; NIFI uncat.).

external characters mentioned above, only species in the new genus have simultaneous expression of these characters. On a more minute level, the scales of the trunk have broad laterobasal angles and completely lack radii in the lateral fields while developing numerous radii in the anterior field. The scale morphology appears to be unique among barbs of south and southeast Asia.

DESCRIPTION.—A summary of the characteristics of the three species is presented to describe the genus.

The counts of fin-rays are: dorsal iv/8; anal iii/5; pelvic i/8 or i/9; pectoral i/14 or i/15 (rarely 13 or 16); caudal procurrent rays ix-xii above, vii-x below. Dorsal and caudal apices black in juveniles, with dorsal faded in adults of one species and caudal faded in adults of two species. Dorsal spine thin; feeble serrations in two species, smooth in one species.

Scales medium to large with 26 to 35 pored lateral-line scales on body and 2 or 3 more on caudal base. Some variation in scale counts but never more than 2 from mean in either direction for any count. Scales thin with 15 to 20+ divergent striae on adults, with radii originating from central part of exposed scale base. Focus advanced, radii absent on dorsal and ventral fields, with 3 or 4 primary radii on anterior field. Sharp laterobasal angles at broadest part of scale, and slightly concave anterolateral margins. Circuli very fine with smooth to slightly irregular scale surface. Lateral-line tubes short, not more than half the scale width in any species, with pores at edge of preceding scale. No accessory pores. Scales between advanced vent and anal fin variable by species, ranging from 3 to 5. Vent advanced nearly half the distance to pelvics in one species, less in others. Circumpeduncular scales 16 in two species, 14 in the other. Circumferential scales 22 to 26.

Gill rakers always short, with long bases giving an almost triangular shape (Figure 3A). One species (*D. halei*) with gill rakers disappearing halfway down lower arm, replaced by irregularly shaped swellings of epithelial tissue. Pharyngeal bone heavy (Figure 4), possessing two rows of smooth teeth with flat grinding surfaces, except for enlarged penultimate tooth in outer row which has a conical point.

Lips somewhat fleshy with post-labial groove broadly interrupted medially. No demarcation between lower lip and jaw. Hyoid artery passes through junction of hypohyals with ceratohyal. Cheek with moderate lacrimal and broad infraorbitals; long tubes lead to individual pores.

Intestine with two complete loops, amounting to four complete (180°) direction reversals (Figure 5). This resembles the group 5

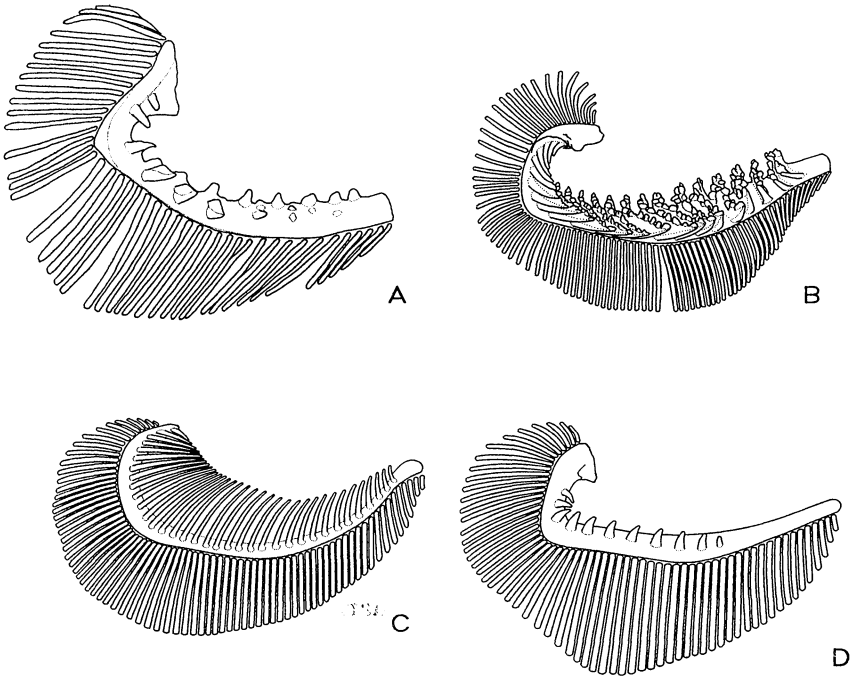

FIG. 3. Lateral aspect of right first gill arches from: (A) *Dischorodontus halei* (116 mm SL), displaying short triangular gill rakers with first few gill rakers on lower arm reduced to irregular swellings; (B) *Hypselobarbus curmuca* (186 mm SL), having long reclining gill rakers with inner margin covered with highly irregular swellings; (C) *Albulichthys albuloides* (133 mm SL), with long erect gill rakers; (D) *Poropuntius smedleyi* (121 mm SL), having short erect conical gill rakers with mesial fleshy attachment greatly reduced and laterally inconspicuous.

(*Ctenopharyngodon*) pattern of Kafuku (1958). One aberrant specimen of *D. halei* was found to have an incipient coiling pattern in the hindgut, such that material in adjacent segments of intestine would be moving in the same general direction rather than in opposite directions as with looped intestine. However, that individual had the same number of direction reversals in the intestine as is typical for the genus.

Four long barbels, extending to gill opening in one species, shorter in others. Small tubercles, when present, across front of snout; in one species also scattered randomly over the body.

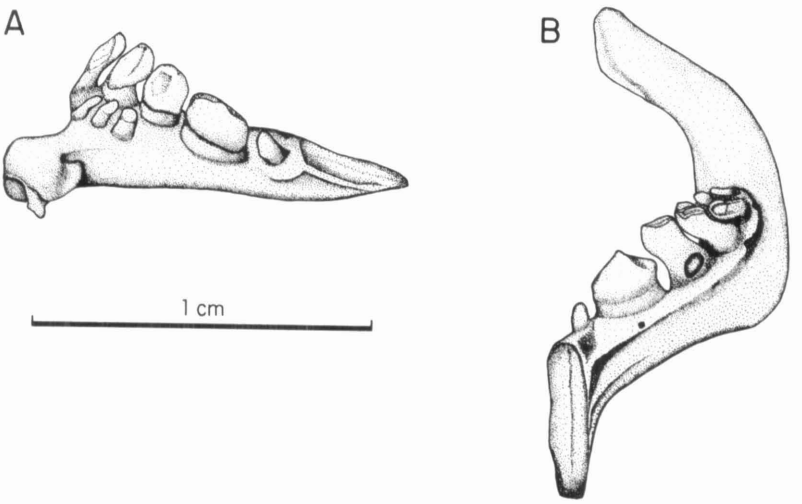

FIG. 4. Right pharyngeal arch from an adult *D. halei* (118 mm SL) with two rows of teeth. Mesial aspect (A), and posterior aspect (B).

Coloration in fins as described, with dark patterns overlying orange to red ground color in dorsal and caudal. Body greenish above, becoming silvery below with dark scale-base pattern fading ventrally. One species with a dark cleithral bar, others with bar less intense to obsolescent.

No sexual dimorphism was found in any of the species.

One species from the Malay peninsula to western Thailand, one species from the Chao Phrya and Meklong basins of northern and western Thailand, and the remaining species from the Mekong on the Korat plateau of northeast Thailand and Laos.

ETYMOLOGY.—*Dischero dontus,* gender masculine, of Greek derivation means "two rows of teeth."

KEY TO THE SPECIES OF *DISCHERODONTUS*

1a. Circumpeduncular scales 16; dorsal spine feebly serrated; 8 branched pelvic-fin rays; vent and anal fin separated by less than 1/4 the total distance between pelvic-fin insertion and anal-fin origin, and with 3 to 5 scales between vent and anal fin.... 2

1b. Circumpeduncular scales 14; dorsal spine weak and smooth; 9 branched pelvic-fin rays; vent advanced to nearly midway be-

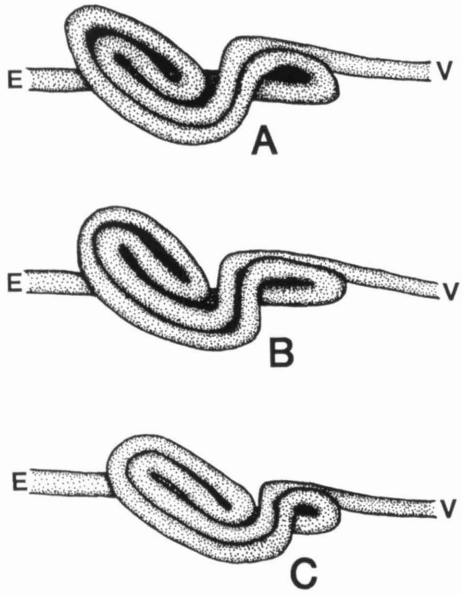

FIG. 5. Intestinal loop pattern of the three species of *Dischorodontus: D. halei* (A), *D. ashmeadi* (B), and *D. schroederi* (C). Esophagus (E) to the left and vent (V) to the right.

tween pelvic-fin insertion and anal-fin origin, with 4 scales between vent and anal fin (Chao Phrya, Meklong and Pahang basins). ..... *halei*

2a. Dorsal fin in adults with large, dark, apical blotch; usually 4 scales between vent and anal fin; maxillary barbel length 4 times or more in head length (Mekong basin). ..... *ashmeadi*

2b. Dorsal fin with apical blotch in juveniles, fading to form a dark distal margin in adults; 3 (rarely 4) scales between vent and anal fin; maxillary barbel length 2.5 to 3 times in head length (Chao Phrya and Meklong basins) ..... *schroederi*

SPECIES ACCOUNTS

Discherodontus halei (Duncker)

Barbus halei Duncker, 1904:178 (orig. descr., figure, Pahang River near Kuala Tembeling); Fowler, 1938:60 (listing, Pahang River).
Puntius halei Herre and Myers, 1937:63 (stream on Singapore Island); Alfred, 1966:25 (listing, Singapore, Pahang River near Kuala Tembeling).
Barbus colemani Fowler, 1937:197 (orig. descr., figure, Me Poon, Thailand).
Puntius colemani Smith (in part), 1945:179 (brief descr., Mepoon); Suvatti, 1950:264 (listing); Thai fisheries (anonymous), 1968:18 (Kwae Noi, Kwae Yai, Meklong); Suvatti, 1981:66 (listing).
Puntius somphongsi Benl and Klausewitz, 1962:21 (orig. descr., figure, Meklong).

DIAGNOSIS.—*Discherodontus halei* may be distinguished from its congeners by the smooth spinous dorsal ray, the vent advanced to midway between the anal-fin origin and the pelvic-fin insertion, as well as by count characters (Table 1). Two counts which always distinguish *D. halei* from its congeners are the branched pelvic rays (always 9, versus 8 for the others) and the circumpeduncular scales (always 14, versus 16 for the others).

GEOGRAPHIC VARIATION.—Specimens from the Meklong basin, in the northern half of the species distribution, differ from individuals originating from the Pahang basin of the Malay peninsula by two proportional measurements. No differences between northern and southern samples were found in any counts.

The three measured specimens from the Pahang basin have greater relative head widths than Meklong specimens, 58.6% (± 1.7%) of head length, a 54.5% to 62.7% interval for 95% confidence, in contrast to 53.3% (± 0.9%), a 52.5% to 54.1% confidence interval, giving no overlap. The single specimen of *D. halei* from the Chao Phrya, described as *Barbus colemani* by Fowler (1937), has a head width of 58.2%, closely resembling the Malay specimens, rather than the Meklong specimens which are found in a geographically intermediate basin.

The Malay individuals have greater gape widths at 31.2% (± 2.1%) of head length, giving a 27.8% to 34.6% interval for 95% confidence, as compared to Meklong specimens at 23.5% (± 1.7%) with a 21.9% to 25.1% confidence interval. With respect to gape width, the only known Chao Phrya specimen is 22.6%, which falls within the confi-

TABLE 1
COUNTS WHICH DISTINGUISH SPECIES OF *Dischorodontus*, with Numbers of Individuals in Parentheses

	halei	*ashmeadi*	*schroederi*
Branched pelvic rays	9(15)	8(25)	8(20)
			9(1)
Circumpeduncular scales	14(15)	16(25)	16(21)
Anal scales		3(3)	3(20)
	4(15)	4(20)	4(1)
		5(2)	
Lateral-line scales on body	29(5)		
	30(7)		30(2)
	31(2)	31(1)	31(8)
	32(1)	32(4)	32(7)
		33(6)	33(4)
		34(9)	
		35(5)	
Lower-arm gill rakers	5(4)		5(6)
	6(10)	6(11)	6(13)
		7(12)	7(2)
		8(2)	

dence interval of the Meklong specimens rather than those from Malaya.

Therefore, although two characteristics can distinguish the Meklong and Malay specimens, the Chao Phrya specimen resembles the Malay sample in one character and the Meklong sample in the other.

COMMENTS AND TAXONOMY.—Three nominal taxa are referable to this species. The first name was that given by Duncker (1904), who found this species in Kuala Tembeling of the Pahang basin in Malaya. Very few specimens of the Malay population have been collected, and the species seems to be rare in the basin where it was first recorded. Although Herre and Myers (1937) listed a specimen reportedly from a stream on Singapore Island, the label on the specimen (SU 31098) indicates merely that the individual was received from the Raffles Museum of Singapore. All specimens remaining in that same Singapore collection are from the Pahang basin, which casts doubt on Singapore as the locality of collection. The Singapore locality probably represents shipment origin rather than a field collection record. Alfred (1966), assuming that Herre and Myers had trustworthy locality data, listed *D. halei* from Singapore, as well as the type locality

from the Pahang River near Kuala Tembeling on the Malay Peninsula.

The single known specimen of *Barbus colemani* Fowler indicates synonymy of the taxon with *D. halei.* The lateral line count given by Fowler is erroneous; the specimen has 29 scales on the body plus 2 on the caudal fin base, the same as *D. halei.* All statements in Fowler's description of *colemani* are equally applicable to *halei.* No other specimens of *halei* have been encountered from drainages to the north or east of the Meklong. The holotype of *colemani* is the only known individual of *halei* from the Chao Phrya basin. The published locality was listed as Me Poon of central Thailand, but there has been some difficulty in ascertaining the whereabouts of this locality. Smith (1945) interpreted Me Poon as the Mae Nam Phum (a river), 43 km SW of Phrae, and tributary to the Yom River in northern Thailand. In fact, the Me Poon locality is in the Mae Nam Ping drainage, north of Chiang Mai, northern Thailand (R. M. de Schauensee, pers. comm. through Barry Chernoff). Inspection of Thai language maps indicates that a better transliteration of the locality name is Mae Poong, and it identifies a small village 60 km NNE of Chiang Mai.

A specimen from the Mechem gorge, identified as *Puntius colemani* by Smith (1945), is actually *Poropuntius faucis* (Smith) and was part of the same collection which produced the holotype of *Puntius faucis* Smith (1945).

The name *Puntius somphongsi* Benl and Klausewitz (1962) has been given to Meklong representatives of *D. halei,* and is placed in synonymy here. Thus, this species has received a new name in each drainage where it has been found.

A species called *Puntius colemani* has been recorded from the Mekong by researchers from the Thai Department of Fisheries (Bhukaswan, 1968; Sidthimunka, 1970). The species reported on had the local Thai name of *pla tapien* or *pla khao.* Because *colemani* (= *halei*) is not known to occur in the Mekong, the identity of the species recorded is difficult to ascertain. Using the local names can help during attempts to re-collect the species except that both authors record several species of barbs under both local names listed for *Puntius colemani.*

The northern (Meklong basin) and southern (Pahang basin) forms are distinguishable, on the basis of two proportional measurements. However, the presence of a more northern third population which agrees with the Meklong sample in one diagnostic ratio and agrees with the Pahang sample in the other diagnostic ratio indicates that the difference may be little more than simple geographic variation.

Therefore, I prefer not to separate these forms taxonomically until it is possible to examine more material from the Chao Phrya and areas intermediate to the Pahang and Meklong drainages. It is possible that additional research may indicate that what appears to be an array of disjunct populations may be recognizable subspecies.

HABITAT.—In Thailand, *D. halei* comes from the southern part of the Thanon Thong Chai mountain range, much of which is covered by dense evergreen and dense mixed deciduous forest. The type specimen of *colemani* came from an area of deciduous forests, although much of the land is now under cultivation. The specimens from the Malay peninsula come from a densely forested area in the Pahang basin. I have not personally collected the species, and have no descriptions of any collection localities. One of the specimens in UMMZ 209096 is a female with well developed ova. It was collected in March and probably would have spawned in the wet season, which usually begins in May.

MATERIAL EXAMINED.—MALAYSIA: PAHANG: NUS 2297 (1; 85 mm SL) Kuala Tahan, King George V Natl. Park, J. Hendrickson; NUS 532 (2; 82 and 88 mm) Kuala Tahan, C. Olgilvie; NUS 2298 (2; 30 and 35 mm) Kuala Tahan, E. Alfred, 1956. SINGAPORE: SU 31098 (1; 86 mm) received from Raffles Mus., no data in jar, probably specimen mentioned in Herre and Myers, 1937. THAILAND: ANSP 68152 (1; 59 mm) Me Poon, R.M. de Schauensee, 1936 (holotype of *Barbus colemani* Fowler, 1937); SMF 5471 (1; 61 mm) Meklong basin, obtained from Somphong's Aquarium exporters, 1961 (holotype of *Puntius somphongsi* Benl and Klausewitz, 1962); SMF 5472–4 (3; 51–56 mm) same data (paratypes of *P. somphongsi* Benl and Klausewitz); UMMZ 195827 (1; 54 mm) Kwae Noi R., 20 km upstream from Kanchanaburi, K. Lagler, M. Boonbrahm, and C. Suvatti, 23 III 1965; UMMZ 195857 (3; 41–47 mm) Kwae Yai R., 10 km upstream from Kanchanaburi, K. Lagler, M. Boonbrahm, and C. Suvatti, 24 III 1965; UMMZ 195885 (1; 75 mm) Meklong, 2 km downstream from Ban Pong, K. Lagler, M. Boonbrahm, and C. Suvatti, 25 III 1965; UMMZ 195904 (3; 44–52 mm) Meklong, 5 km upstream from Ban Pong, K. Lagler, M. Boonbrahm, and C. Suvatti, 25 III 1965; UMMZ 209096 (5; 54–118 mm) Kwae Yai R., at Srisawat, Kanchanaburi Prov., J. Karnasuta, 11 III 1975; NIFI uncat. (2; 68 and 71 mm) same data; USNM 191530 (2; 51 and 52 mm) Thailand, no other data, Axelrod.

Dischérodontus ashmeadi (Fowler)

Barbus ashmeadi Fowler, 1937:193 (orig. descr., figure, Kemrat).
Puntius ashmeadi Smith, 1945:190 (listing); Suvatti, 1950:261 (listing); Taki, 1974:131 (listing); Suvatti, 1981:65 (listing).

DIAGNOSIS.—*Dischérodontus ashmeadi* is distinct in usually lacking the small peg-like, lowermost tooth in the outer row of the pharyngeal arch, giving the row a total of four teeth rather than the five typical of its congeners and most other barbins. *D. ashmeadi* is distinguished from *D. halei* by counts of 8 (versus 9) branched pelvic fin rays and 16 (versus 14) circumpeduncular scales, and by the serrated (versus smooth) spinous dorsal fin ray. *D. ashmeadi* most closely resembles *D. schroederi,* with slight modal differences in some counts but with significant differences in several proportional measurements particularly those of barbel length for both maxillary and rostral barbels, as well as gape width and upper jaw length (Table 2). The differences in dorsal fin coloration are pronounced, with *ashmeadi* always having a jet-black apical blotch in the dorsal fin, even in large adults. In contrast, *D. schroederi* has an apical blotch in the juvenile dorsal fin, fading with age to form a narrow dark border along the outer margin of the fin.

GEOGRAPHIC VARIATION.—All individuals examined come from a fairly small geographical area within a single basin and, for systematic purposes, belong to a single population. No variation indicating otherwise has been observed.

COMMENTS.—This species was collected first by R. M. de Schauensee, and the specimens were used in the original description by Fowler (1937). The species was not found again until the 1970's, when it was collected by researchers for the Mekong Secretariat/University of Michigan Mekong Basinwide Fishery Studies, the collections of which are housed at the University of Michigan Museum of Zoology. Specimens collected by the Thai Department of Fisheries in the early 1970's are in the collection of the National Inland Fishery Institute, Bangkok, and some of those specimens were also donated to the University of Michigan.

HABITAT.—The region around Khemerat, the type locality of the species, is an area of dry dipterocarp forest with mostly open to moderate canopy, much of which remained as recently as the 1975 visits of project workers for the Mekong Basinwide Fishery Studies.

Dischérodontus ashmeadi was collected by the Mekong Basinwide Fishery Studies several times in northeastern Thailand. Huay Mark

Tai, a small stream directly tributary to the Mekong mainstream just downstream from the mouth of the Mun River, yielded 67 individuals of *D. ashmeadi,* making it the second most abundant species among the 21 present. Field notes indicate that at the time of collection the stream was small, measuring 22 m in width and up to 1.8 m in depth, with strong current, clear water, and dense growth of submerged aquatic macrophytes. The bottom was rocky, with sand and much decaying vegetation. The banks were rocky slopes with low plant cover, rising to a flat plain covered by a banana plantation, backed by mixed deciduous forest. The area has dissected plains topography covered by open to moderate forest. The amount of vegetation in the stream may explain why the most common fish species was *Cyclocheilichthys apogon,* a species which proliferates in ponds, lakes or impoundments which have luxuriant growth of aquatic macrophytes.

Huay Kwang, which yielded only a single individual, was another small stream, measuring 13 m in width and up to 1.5 m in depth. At the time of sampling the water was heavily silt-laden, although this was not true at other times. There was no vegetation in the sampling area, the current was sluggish, and the bottom was rocky with some silt and sand. The collection was made 0.3 km from the confluence with the flooded Mun River at the end of the rainy season. The banks were steep slope with large rocks, leading to rice paddy with scattered patches of open dry deciduous forest. No dense forest cover was within the drainage of Huay Kwang, and most of the drainage was under crop cultivation.

The Lam Dom Noi drainage is the origin of other specimens examined. Much of the lower and central part of that watershed has become permanently inundated by the reservoir of Sirinthorn Dam. Most of the eastern half of this northward-draining watershed is covered by moderate to dense mixed deciduous forest, and the western part of the watershed has a cover of dry deciduous, including dipterocarp, forest. Specimens were taken upstream from the reservoir in 1972 by researchers of the Thai Department of Fisheries.

The single specimen taken from the Mekong at Nakhon Phanom came from 20 to 60 m offshore and up to 16 m in depth, and was caught by gill-net fishermen. This individual was taken near the end of the dry season, when river water level was at its lowest. The water was fairly clear and there was a lot of filamentous algae present, along with a few other aquatic plants. The bottom was silt, probably over sand, with emergent weeds along the shore. The Thai side of the river is a flat floodplain with some swamps, now supporting extensive rice culture. The Lao side of the river is a narrow flat belt of forested

TABLE 2

FIFTEEN DISCRIMINATING PROPORTIONAL MEASUREMENTS FOR *Dischorodontus*, WITH STUDENT'S *t*-TEST FOR EQUALITY OF MEANS AT RIGHT*

Standard length range	*D. halei* $n=10$ 56.2-117.5 mm $\bar{x}=81.5$	*D. ashmeadi* $n=10$ 54.3-122.4 mm $\bar{x}=77.1$	*D. schroederi* $n=21$ 42.0-85.8 mm $\bar{x}=66.6$	*t*-tests cols. 1,2	cols. 2,3	cols. 1,3
	range $x \pm s$	range $x \pm s$	range $x \pm s$	df=18	df=29	df=29
1. Predorsal length	45.3 - 48.1 46.8 ± 0.9	46.2 - 50.6 48.9 ± 1.4	51.1 - 52.9 51.2 ± 1.2	P<.005	P<.005	P<.005
2. Head length	21.3 - 23.9 23.2 ± 0.7	20.2 - 25.7 23.5 ± 1.7	23.6 - 25.8 24.7 ± 1.1	NS	P<.05	P<.005
3. Body depth	22.7 - 29.8 26.2 ± 2.2	25.2 - 31.0 27.7 ± 1.6	26.8 - 31.7 29.1 ± 2.3	P<.05	P<.05	P<.005
4. Peduncle depth	9.9 - 11.2 10.5 ± 0.4	10.6 - 12.1 11.5 ± 0.5	11.8 - 13.4 12.5 ± 0.7	P<.005	P<.005	P<.005
5. Caudal fin length	27.7 - 35.1 32.1 ± 2.2	29.7 - 35.5 33.4 ± 1.7	31.8 - 38.9 35.5 ± 2.0	NS	P<.005	P<.005
6. Dorsal spine length	9.2 - 11.7 10.3 ± 0.9	11.5 - 15.3 13.4 ± 1.5	12.0 - 16.6 14.7 ± 1.3	P<.005	P<.025	P<.005
7. Pectoral fin length	15.8 - 18.4 17.2 ± 0.9	15.8 - 19.4 18.3 ± 1.1	18.8 - 23.5 20.8 ± 1.5	P<.025	P<.005	P<.005
8. Pelvic fin length	15.6 - 19.0 16.7 ± 1.1	15.4 - 19.0 17.4 ± 1.1	16.4 - 20.0 18.2 ± 1.1	NS	P<.025	P<.005

9. Preoccipital length	88.0 - 96.4 92.0 ± 2.7	79.5 - 90.6 85.0 ± 3.7	83.8 - 94.4 88.3 ± 3.0	P<.005	P<.01	P<.005
10. Upper jaw length	29.0 - 35.7 31.9 ± 1.9	24.4 - 29.4 26.1 ± 1.4	26.9 - 32.0 29.2 ± 1.4	P<.005	P<.005	P<.005
11. Preorbital length	28.2 - 32.3 30.2 ± 1.3	26.1 - 29.1 28.0 ± 1.1	28.1 - 33.3 30.6 ± 1.5	P<.005	P<.005	NS
12. Orbit width	28.2 - 36.8 34.5 ± 2.6	29.8 - 33.5 31.6 ± 1.1	29.1 - 35.7 32.0 ± 1.8	P<.005	NS	P<.01
13. Gape width	21.5 - 33.5 25.6 ± 4.1	16.1 - 21.6 18.7 ± 1.9	19.2 - 30.3 25.0 ± 2.9	P<.005	P<.005	NS
14. Maxillary barbel	16.7 - 27.0 21.3 ± 3.1	10.6 - 26.7 16.8 ± 5.5	29.2 - 57.3 43.8 ± 7.7	P<.025	P<.005	P<.005
15. Rostral barbel	14.4 - 21.8 17.7 ± 2.2	8.4 - 20.8 12.2 ± 4.5	25.4 - 51.5 43.0 ± 7.1	P<.005	P<.005	P<.005

* Measures 1 to 8 are percent of standard length and 9 to 15 are percent of head length.

lowland with scattered ricefields, followed by a series of high limestone ridges densely covered with dry evergreen forest.

MATERIAL EXAMINED.—THAILAND: UBON RATCHATHANI: ANSP 68137 (1; 58 mm SL) Kemrat, R. M. de Schauensee, 1936 (holotype of *Barbus ashmeadi* Fowler, 1937); ANSP 68138–9 (2; 43 and 51 mm) same data (paratypes of *Barbus ashmeadi* Fowler); UMMZ 209103 (5; 56–69 mm) Ubon Prov., 20 VII 1972; UMMZ 214037 (67; 29–84 mm) Huay Mark Tai, 1 km from Mekong, 1/2 km down Mekong from Mun R. mouth, T. Maknuan and S. Sairaj, 16 X 1975; UMMZ 214038 (1; 44 mm) Huay Kwang near Mun R., 3 km from Mekong, T. Maknuan and V. Kathong, 1 XII 1975; NIFI 01311 (3; 78–134 mm) Lam Dom Noi R., Mun drainage; NIFI uncat. (3; 62–76 mm) Lam Dom Noi R., Boondaric Dist., upstream from reservoir, 20 VII 1972. NAKON PHANOM: UMMZ 214036 (1; 82 mm) Mekong at Nakon Phanom, E. Buskirk, 26 IV 1975.

Dischorodontus schroederi (Smith)

Barbus binotatus Fowler (not Valenciennes, 1842) in part, 1934:122 (misidentification, Chiang Dao).

Barbus orphoides Fowler (not Valenciennes, 1842) in part, 1934:125 (misidentification, Chiang Mai).

Acrossocheilus schroederi Smith, 1945:203 (orig. descr., figure, Mekang on Doi Angka).

DIAGNOSIS.—*Dischorodontus schroederi* is distinct from its congeners in the length of the barbels (maxillary barbels about 1.7–3 times in head length versus 4 or more, and rostral about 2–4 times in head length versus 5 or more). It is also distinct in that the apical blotch of the dorsal fin, present in juveniles, fades in adults to a narrow dark border. *D. schroederi* further differs from *D. halei* in having 16 circumpeduncular scales (versus 14) and 8 branched pelvic-fin rays (versus 9). The holotype of *Acrossocheilus schroederi* Smith (1945) has 9 branched dorsal rays and is, thus far, the only individual of this genus found to be sporting an additional dorsal ray. Other characteristics mentioned in Smith's original description fit the species well.

GEOGRAPHIC VARIATION.—*Dischorodontus schroederi* occurs in two drainages, and individuals from each exhibit measurable differences. There is an array of seven measurement proportions, any one of which can be used to distinguish individuals from the Meklong and Chao Phrya basins. Meklong specimens have a broader gape, deeper head, trunk, and peduncle, and longer fins than individuals from the Chao Phrya (Table 3). In all of these tabulated measurements except

TABLE 3
MEASUREMENTS DISTINGUISHING SAMPLES OF *D. schroederi* FROM TWO BASINS IN WESTERN THAILAND*

	MEKLONG			CHAO PHRYA		
	$n=8$ 64-82 mm SL $x=74.2$			$n=13$ 42-86 mm SL $x=61.8$		
	range	$x \pm s$	95% int.	range	$x \pm s$	95% int.
Gape width	25.7-30.3	27.4 ± 1.6	26.1-28.7	19.2-28.1	23.5 ± 2.4	22.0-25.0
Head depth	80.4-88.2	83.6 ± 2.8	81.3-85.9	75.4-85.6	79.7 ± 3.4	77.5-81.7
Body depth	28.4-31.8	30.7 ± 1.2	29.7-31.7	23.1-31.7	28.2 ± 2.3	26.8-29.6
Peduncle depth	12.4-13.8	13.0 ± 0.5	12.6-13.4	10.7-13.2	12.2 ± 0.7	11.8-12.6
Anal fin height	15.6-17.5	16.9 ± 0.6	16.4-17.4	14.3-16.8	15.8 ± 0.9	15.3-16.3
Pect. fin length	21.2-23.5	22.4 ± 0.8	21.8-23.0	18.8-20.8	19.8 ± 0.6	19.4-20.2
Pelv. fin length	18.1-20.0	19.1 ± 0.7	18.5-19.7	16.4-18.9	17.8 ± 0.9	17.3-18.3

*The first two measurements are percent of head length and the last five are percent of standard length. Only those percentages with no overlap in the 95% sample confidence intervals have been included.

one, gape width, the Chao Phrya measure is less than the Meklong, and measurements of congeners are less than either geographic sample of *schroederi* (Tables 2 and 3). Therefore, it appears that the Chao Phrya sample bears greater resemblance in body proportions to other species of the genus than does the Meklong population.

For gape width, the situation differs slightly from that just described. In *D. schroederi,* the Meklong specimens have a wider gape width than those from the Chao Phrya. The mean gape width for *halei* (Table 2) falls between means for the samples of *schroederi* only when the large-mouthed southern *halei* are included. For northern *halei,* which are sympatric with *schroederi,* the gape width for *halei* is less than that of either sample of *schroederi.*

The assortment of differing body shapes among various populations allows an interesting observation to be made. When considering all northern material of the three species, for the proportions which distinguish the samples of *schroederi,* each Meklong measure is greater than the Chao Phrya measure, and both are larger than the same measures for *ashmeadi* and the Meklong *halei.* Thus, *schroederi* and *halei* look most different in the Meklong where they might be expected to encounter a congener. Although both are known from the Chao Phrya, *D. halei* has not been found there in the 50 years subsequent to its original discovery, and is rare, if still present at all. Given the rarity and possible present-day absence of *D. halei* in the Chao Phrya, congeneric encounters in the Chao Phrya would also be rare, if such encounters occur at all. Therefore, it may be that differences found between *schroederi* of the two drainages are due in part to character displacement in the Meklong drainage where *schroederi* could commonly occur with a congener. This should be studied in greater detail using syntopic populations if and when they are discovered.

COMMENTS AND TAXONOMY.—*Dischерodontus schroederi* has not been reported in literature records subsequent to the original description by Smith (1945), and until now has not been reported in a drainage other than the Chao Phrya. Although Meklong and Chao Phrya specimens have measurable differences, it is not my choice to recognize the Meklong population taxonomically. Considering the limited amount of material available so far, it is not possible to examine within-drainage variation in populations over broad geographic areas. It is possible that the differences are the result of localized sampling, and that possibility should be addressed before the population is recognized at some taxonomic level. In *D. schroederi,* all counts taken are similar or nearly identical in both geographic samples, and

it appears that no count or combination of counts will serve to distinguish these samples. Measurement proportions are highly dependent on overall size and stage of development, and interpreting proportions requires more than a calculation of means and confidence intervals. A more certain interpretation of these differences also requires more preserved material of broader geographical range and greater size range from both drainages.

HABITAT.—A collection of a large series of juvenile (18–30 mm SL) *D. schroederi* in the Meping about 40 km N of Chiang Mai was made by me in late October, 1975. No individuals were taken from the main stream, but instead they were found in a fairly large side-pool which had a mere trickle of water flowing through it. The maximum depth was about 1.2 m, and the bottom was covered by a deep layer of rotting allochthonous vegetation. The pool was shaded by dense overhanging vegetation, much of it bamboo. The juveniles collected were presumably the result of a summer (wet season) spawning, but whether it occurred at a period when the pool had greater flow and better access from the main stream is not known. No adults were found, and I do not know whether the spawning occurred in the main stream near the pool entrance, or in the slow water of the pool. The entire river nearby was gravel-boulder run with no pools or slow water evident in the main channel. The collection came from an area of dissected plains bordering mountains, and the vegetation was open to dense mixed deciduous forest.

MATERIAL EXAMINED.—THAILAND: CHIANG MAI: MCZ 35528 (1; 86 mm SL) Mekang R. on Doi Angka, Harvard Primate Expedition, IV 1937 (holotype of *Acrossocheilus schroederi* Smith, 1945); UMMZ 209097 (8; 42–65 mm) Kod R., Phrao Dist., J. Karnasuta, 16 I 1976; ANSP 58435–6 (2; 61 and 69 mm) Chiang Mai, R. M. de Schauensee, 22 I 1933; ANSP 58233 (1; 63 mm) Chiang Dao, R. M. de Schauensee, 8 II 1933. TAK: UMMZ 209131 (2; 72 and 78 mm) Larn Sao falls, trib. to Bhumipol Reservoir, Meping dr., 10 III 1971; NIFI uncat. (2; 72 and 78 mm) Lam Sang Falls, Meping dr., 10 III 1971. UTHAI THANI: NIFI uncat. (8; 61–79 mm) Huay Khai Kaeng, Meklong dr., J. Karnasuta, 23 IV 1976.

DISCUSSION

Natural History

Fishes belonging to the genus *Dischorodontus* are rarely collected and information about their ecology is difficult to obtain. Specimens of *D. ashmeadi* collected by workers for the Mekong Basinwide Fishery Studies usually came from small upland rivers and streams. These streams contained boulders and occasionally had runs over bedrock substrates. The streams were often shaded and drained forested land. There was usually rotting vegetation on the stream-bottom. None of the collections of *D. ashmeadi* included small juveniles or individuals which were ready to spawn.

The type of habitat is similar for the only specimens of *D. schroederi* having detailed collection data. They were all small juveniles, and were found in a small and nearly stagnant side-pool of a fast-flowing stream. The pool had much decaying vegetation.

Much less specific information is available for *D. halei,* although the general vegetation cover of the areas where the specimens originated hints at a similar pattern of occurrence. Like *D. schroederi,* it spawns in the wet season.

Dischorodontus ashmeadi and *D. halei* apparently attain a larger size than *D. schroederi.* The largest *ashmeadi* seen was approximately the same size as the largest *halei* examined, and nearly half again as long as the largest *schroederi* found. However, the total number of specimens seen is still relatively small. Even so, the range of sizes in the preserved material should reflect the actual range of body size because none of these species is known to grow too large for easy preservation. If any of them did, then size of preserved specimens could not be assumed to be representative of near-maximum size for species in this genus. The largest specimens of each species appeared to be adults, and one *D. halei* of 90 mm SL was in breeding condition. The largest *D. halei* found was five years old as indicated by growth rings on its scales.

Relationships

The genus *Dischorodontus* is described as a new taxon in order to recognize the relationship among three species which have two rows of pharyngeal teeth per side, a character unique in cyprinine minnows, which usually possess three rows. This fact prompted Smith (1945:180) to state that Fowler's specimen of *B. colemani* must have

been defective because teeth in his (Smith's) genus *Puntius* were normally triserial. At the time that Smith questioned the biserial rows in *colemani* he had in his possession a specimen which he had misidentified as *colemani.* That specimen turned out to be *Poropuntius faucis* (Smith) and came from the same lot that produced the type specimen of *P. faucis,* mentioned earlier in this paper. Smith made no comment about the similar biserial tooth pattern mentioned in Fowler's description of *Barbus ashmeadi* a few pages earlier in the same paper that included a description of *colemani* (Fowler, 1937:193). Smith (1945:203) did not include information on the pharyngeal teeth in the original description of *Acrossocheilus schroederi.* The pharyngeal teeth were not mentioned in species descriptions by either Duncker (1904) or Benl and Klausewitz (1962). Thus, although presence of biserial pharyngeal teeth was mentioned by Fowler in connection with two species, in one instance it was subsequently disputed based on misidentification. Relationship among this group of fishes based on possession of biserial pharyngeal teeth has not been noted previously.

Several other characters found in *Dischérodontus* indicate relationship with a group of barbin genera which are only remotely related to the small barbs of the genus *Puntius* (*sensu lato*). The relationships of *Dischérodontus* clearly lie with the large barbs, of which there are numerous genera in southeast Asia. In the following discussion, several characters which may be useful indicators of relationships between *Dischérodontus* and two closely related genera, *Chagunius* and *Hypselobarbus* both from the Indian subcontinent, are mentioned. Although this paper does not include a quantitative phylogenetic analysis, these characters will be included in a such a study in progress for the genera mentioned herein. In the present study, the primarily external characters which demonstrate monophyly of *Dischérodontus, Chagunius,* and *Hypselobarbus* are discussed, as well as several characters which vary among these and related barbin genera. All characters examined are not equally useful for diagnosis of monophyletic groups because of parallelism or convergence among members of these genera. However, some characters have been retained in the table because of their general usefulness among large groups of barbins.

Besides the immediate closest relatives to *Dischérodontus,* a group of genera from southeast Asia with poorly understood relationships are also compared. This group of genera is termed "group A" and includes: *Albulichthys, Cosmochilus, Amblyrhynchichthys, Cyclocheilichthys, Balantiocheilos, Puntioplites,* and *Neobarynotus.* I have not included *Sikukia* in this group, although it may eventually be considered part

of this assemblage. The discussion also utilizes information about a group of more distant genera, which includes *Barbodes, Acrossocheilus,* and *Poropuntius,* and is termed "group B." This array of genera has been included because these represent the genera into which members of *Discherodontus* had been classified previously.

It is necessary to mention a nomenclatural problem with the name *Hypselobarbus,* which refers to a poorly known genus from peninsular India. I have mentioned this genus previously Rainboth (1985, 1986), but until now have used the name *Gonoproktopterus* because of the current status of the type species of *Hypselobarbus.* Both names date from Bleeker (1859–60), with *Gonoproktopterus* (type species, *Barbus kolus* Sykes) listed as a subgenus of *Hypselobarbus* (type species, *Barbus mussullah* Sykes). Bleeker's knowledge of these species stems from the literature accounts, including figures, by Sykes (1838, 1840). The subgenera were erected for individuals with different barbel counts. The problem with these generic names is in the identity of *Barbus mussullah* Sykes. Hora (1942, 1943) concluded that *B. mussullah* belonged to the genus *Tor* Gray (1833), and that Sykes' illustration (1840) was incorrect in having twice as many scales in horizontal and transverse series as it should have had. Until now, I have accepted that conclusion without comment. If *B. mussullah* were demonstrated to be a member of the genus *Tor,* then *Hypselobarbus* would become a subjective synonym of *Tor.* By most recent revision, *B. mussullah* is a member of *Tor;* however, this classification may be incorrect. If the figure of *B. mussullah* were accurate, then *B. mussullah* would not belong in *Tor,* making available the name *Hypselobarbus.* Although Hora (1942, 1943) considered the scales to be inaccurate, another character in Sykes' illustration escaped his attention. That character is the shape of the anal fin, which has a strongly convex distal margin, with the second, third, and fourth branched rays being considerably longer than the first branched ray. Although this does occur in some *Neolissochilus* from Southeast Asia, and at least one species of *Tor* from Java, I have never seen this fin shape expressed in *Tor* from the Indian subcontinent. A convex distal margin of the anal fin does occur commonly in species which I have included in *Gonoproktopterus.* In my opinion, Sykes' illustration is accurate, and during the intervening century between Sykes' description of *Barbus mussullah* and Hora's search for it, the species had disappeared from the area near the type locality. Hora (1942) noted the habitat degradation due to extreme silting at the type locality. This problem will be discussed further in papers dealing with the species in question. At this time, I follow Bleeker's

indication that *Gonoproktopterus* is a subgenus of *Hypselobarbus* and use the latter generic epithet for members of this group of species from peninsular India.

Characters indicating relationships have been tallied (Table 4) and are discussed in order of their tabular listing.

In the dorsal fin, *Dischorodontus* has ray counts which are typical for most barbins of Asia. Members of *Chagunius* all have a synapomorphy in having 5 unbranched dorsal rays. Members of *Hypselobarbus* have 9 branched dorsal rays, giving them the same total number of fin-ray elements (13) as *Chagunius*. The structure of the spinous dorsal ray also varies among these genera. In group A, all members have a strongly serrated dorsal spine. In group B, out of approximately sixty species, only one, *Poropuntius faucis,* has a weakly serrated spine. In *Chagunius,* one species in three (*Chagunius nicholsi*) has a weakly serrated spine. In *Dischorodontus,* both *D. ashmeadi* and *D. schroederi* have a weakly serrated spine, and *D. halei* has a weak and unserrated spinous ray. All members of *Hypselobarbus* lack a serrated spinous dorsal ray.

In other fins, a character is found in the anal fin; the presence of 4 unbranched rays in species of *Chagunius* may be unique for all barbs. In the pelvic fin, most of the genera listed have some variable expression, with species having either 8 or 9 branched rays. Within species, there is usually little variability. In *Chagunius* and group B, all members seen have typical counts of 8 branched rays.

In fin coloration, useful characters may be present also. Members of *Dischorodontus* have black caudal tips, a character which occurs in *Hypselobarbus curmuca,* with other species of *Hypselobarbus* having caudal tips which are dusky but not black. In south and southeast Asia, the only other barbs which have black caudal tips are "*Barbus*" *denisoni* (Day, 1865), and "*Barbus*" *filamentosus* (Valenciennes, 1844), both belonging to *Puntius* (*s. l.*). However, their relationship to *Dischorodontus* and the array of barbins from south and southeast Asia is remote at best. The dark apex of the dorsal fin is shared by *Dischorodontus, Hypselobarbus,* and *Chagunius.* A dark apex in the dorsal fin is absent in all species of group A, with the qualification that the darkened apex in *Balantiocheilos* is merely a continuation of the black border of the entire distal margin. In group B, a few of the members of *Barbodes* (*B. altus, B. schwanefeldi,* and *B. belinka*) have a dark apex on the dorsal fin.

Several genera share the trend of advancement of the vent and addition of scale rows between the vent and anal fin, a character not seen in the group B barbins, or in the great array of species closely

TABLE 4

COMPARATIVE CHARACTER EXPRESSION FOR *Dischorodontus* AND OTHER BARBIN GENERA OF SOUTH AND SOUTHEAST ASIA. CHARACTERS INCLUDED ARE POSSIBLE INDICATORS OF PHYLOGENY.

CHARACTER	GROUP A*	*Dischorodontus*	*Chagunius*	*Hypselobarbus*	Group B†
1. Dorsal fin unbranched rays	4	4	5	4	4
2. Dorsal fin branched rays	8	8	8	9	8
3. Dorsal fin spine serrations	strong	weak (2 spp.) none (1 sp.)	strong (2 spp.) weak (1 sp.)	none	strong
4. Anal fin unbranched rays	3	3	4	3	3
5. Pelvic fin branched rays	8 or 9	8 or 9	8	8 or 9	8
6. Black tips on caudal fin	no	yes	no	yes	no
7. Black apex on dorsal fin	no	yes	yes	yes	yes (*Barbodes*)
8. Scale rows between vent and anal fin	3+	3+	3+	2 or 3	1 or 2
9. Demarcation between lower lip and jaw	no	no	no	no	yes
10. Rows of pharyngeal teeth	3	2	3	3	3
11. Gill raker base, size/inclination	long large/erect	long small/prone	long large/prone	long large/prone	short small/erect
12. Intestine loops	2 to 4	2	1 or 2	3	4 to 6

* Group A: *Albulichthys, Amblyrhynchichthys, Balantiocheilus, Cosmochilus, Cyclocheilichthys, Neobarynotus, Puntioplites.*

† Group B: *Acrossocheilus, Barbodes, Poropuntius,* and one undescribed genus.

related to *Puntius*. This character seems to be useful in distinguishing barbs of group A and their close relatives from the barbs of group B within south and southeast Asia. This character does not work for all members of *Hypselobarbus*.

The lower lip and jaw are continuous in all genera except those of group B. Species in group B have a groove separating the lower lip from the lower jaw, which may be keratinized and sharp (Figure 6). Such derived modification to the lower jaw never occurs in the species of *Dischorodontus, Chagunius, Hypselobarbus,* or group A, all of which have soft, fleshy skin continuous with and covering the lower jaw. The two pharyngeal tooth rows of *Dischorodontus* (Figure 4) have already been mentioned as being unique for all barbs. Only one other barb has reduction of tooth rows, and that species is *Probarbus jullieni* Sauvage, a monotypic genus. *Probarbus* has a single row of extremely heavy, molariform teeth. In *Probarbus* the tooth base is very broad, extending across the arch, suggesting that there may have been fusion, rather than loss, of germinative centers. My inclination is to regard the reduction in tooth rows in *Dischorodontus* and *Probarbus* as independent events that are not indicative of relationship.

The gill rakers of *Dischorodontus* (Figure 3) are not nearly as large as those in *Chagunius;* however, the long bases of the triangular rakers in *Dischorodontus* are reminiscent of the development of rakers in juvenile *Chagunius* and *Hypselobarbus*. The large gill rakers which recline along most or all of the lower arm of the arch are found in *Chagunius* and their resemblance to the rakers of *Hypselobarbus* has already been noted (Rainboth, 1986). Species of group A have enlarged, sometimes ornamented gill rakers also, but the rakers in those species are erect rather than reclining. Species of group B all have erect gill rakers, but the rakers are short and bluntly rounded in most species of the group. Species of group B with slightly larger rakers still lack the long base which gives the rakers of *Dischorodontus* their characteristic triangular shape.

The simple looping pattern assumed by the intestine of *Dischorodontus* is indistinguishable from the pattern of *Chagunius baileyi*. Among all the species in all genera mentioned in this discussion, only *Chagunius chagunio* is known to have a simpler intestine configuration than *Dischorodontus*. The same two-loop pattern found in *Dischorodontus* has been observed in some of the members of group A, although a more convoluted pattern of up to four loops is usually found. Members of *Hypselobarbus* usually have three loops, although I have not yet examined the intestines in all species of that genus. The intestinal loop pattern is more involved in members of group B, which always

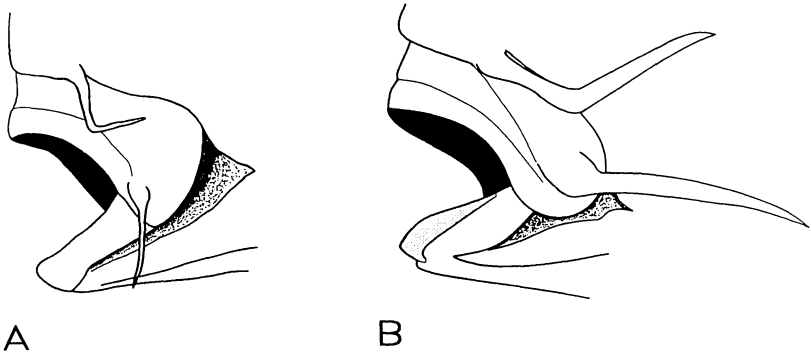

FIG. 6. Structure of the continuous lower lip and jaw in *Discherodontus halei* (A), compared to the separate lower lip and jaw (tinted) of *Poropuntius smedleyi* (B). Both specimens approximately 115 mm SL.

have at least four loops and up to six loops, with examinations complete on all described and several undescribed species.

Inspection of Table 4 provides evidence concerning the monophyly of *Discherodontus, Chagunius,* and *Hypselobarbus.* Character 10 indicates monophyly of *Discherodontus,* whereas characters 1 and 4 indicate monophyly of *Chagunius,* and character 2 supports monophyly of *Hypselobarbus.* Character 3 exhibits homoplasy, which might be expected in a character which would presumably have high selective value as an anti-predation device. It provides no evidence of monophyly in *Chagunius, Discherodontus,* or *Hypselobarbus.*

Monophyly of a group comprising *Discherodontus, Hypselobarbus,* and *Chagunius* is indicated by prone gill rakers (character 11), and by a black apex on the dorsal fin (character 7). The presence of similar coloring in some species of *Barbodes* (Group B) is presumably a homoplasy, since monophyly of group B is supported by character 9, modified jaw morphology. Relationship between group A, *Discherodontus, Hypselobarbus,* and *Chagunius* is suggested by the long bases of the gill rakers (character 11) (in Fig. 3C, the long bases are not apparent since the axis of the rakers is perpendicular to the page). The members of group A have erect gill rakers, with similar inclination found in group B. However, the gill rakers for group B are short conical points, usually with smooth surfaces, whereas the inner surfaces of the large gill rakers of group A are densely ornamented with minute swellings or even branches.

Earlier it was suggested (Rainboth, 1981) that *Barbus dorsimaculatus*

described by Ahl (1923) from Sumatra might be a member of *Dischero-dontus,* based on the description and subsequent illustration by Ahl (1929). The species has not been reported since then, and no individuals have turned up with any Sumatran material in collections with good Sumatran holdings, despite a thorough search. In the original description, Ahl indicated that he was uncertain of the supposed Sumatran origin of the specimens. Examination of type material of that species indicates that *Barbus dorsimaculatus* Ahl belongs in *Puntius* of Hamilton (1822) in the strict sense.

It should be noted here that I have referred to the genus *Dischero-dontus* using a different name in my dissertation (Rainboth, 1981). At the present time, it is the policy of the International Committee of Zoological Nomenclature to regard such names as unpublished. Further, the name has never appeared in any published fashion, and so is not cited in this paper.

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