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Revised diagnosis of the genus *Gonorhynchus* McClelland (Teleostei: Cyprinidae: Labeonini) with redescription of *G. latius* (Hamilton) and revalidation of *G. wattanah* (Sykes)

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Abstract

A new diagnosis of the genus *Gonorhynchus* McClelland 1838 from South Asia is proposed. Seven species are contained in the genus: *G. latius* (Hamilton 1822), *G. diplochilus* (Heckel 1838), *G. wattanah* (Sykes 1839), *G. macmahoni* (Zugmayer 1912), *G. burmanicus* (Hora 1936), *G. bicornis* (Wu 1977), and *G. periyarensis* (Menon & Jacob 1996). *Gonorhynchus latius*, a senior synonym of the type species *G. brevis* M'Clelland 1839 is redescribed. *Crossocheilus gohama* (M'Clelland 1839) and *Crossochilus rostratus* Günther 1868 are considered junior synonyms of *G. latius,* and a neotype is designated for *G. latius*. *Gonorhynchus wattanah* (Sykes 1839) from the Krishna and Godavari River basins in western India is revalidated and redescribed with the designation of a neotype. *Akrokolioplax* Zhang & Kottelat 2006 is a junior synonym of *Gonorhynchus*.

Key words: minnows, *Crossocheilus latius*, *Crossocheilus diplochilus*, South Asia

Introduction

Recent molecular phylogenies of the cyprinid tribe Labeonini have demonstrated the polyphyly of species long placed in the genus *Crossocheilus* Kuhn and van Hasselt 1823 (Yang *et al.* 2012; Zheng *et al.* 2012). With the most comprehensive taxon sampling to date, Yang *et al.* (2012) recognized two clades: the first being a clade of *Crossocheilus* species from Southeast Asia east of the Salween River distributed from Thailand to Indonesia—therein *C. oblongus* Kuhl and van Hasselt 1823, *C. nigriloba* Popta 1904, and *C. reticulatus* (Fowler 1934)—nested in a clade containing the genus *Epalzeorhynchos* Bleeker 1855 and several other genera, and another being those species from South Asia in the Salween River and west to Iran, sister to a clade containing most of the sampled species in the genus *Garra* Hamilton 1822—therein *C. burmanicus* Hora 1936, *C. diplochilus* (Heckel 1838), and *C. latius* (Hamilton 1822), plus *Akrokolioplax bicornis* Zhang & Kottelat 2006. Yang *et al.* (2012) retained the name *Crossocheilus* for the Southeast Asian clade containing the type species of the genus, *C. oblongus*, and assigned species in the South Asian clade to *Gonorhynchus* McClelland 1838, the oldest available name. A morphological diagnosis and a list of inclusive species was not provided for *Gonorhynchus* by Yang *et al.* (2012), although differences between these two groups have been hypothesized by Kullander *et al*. (1999) and Kottelat & Tan (2011). The goal of this paper is to provide a diagnosis and description of *Gonorhynchus*, with a particular emphasis on comparisons with the morphologically similar *Crossocheilus*. *Gonorhynchus latius* (Hamilton 1822), a senior synonym of the type species *Gonorhynchus brevis* M'Clelland 1839, is redescribed. *Gonorhynchus wattanah* (Sykes 1839) from the Krishna and Godavari River basins, long considered a junior synonym of *G. latius*, is revalidated based on an examination of more recent material.

Materials and methods

Measurements and counts mostly follow Kottelat (2001). Internarial width and cheek height follow Armbruster

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(2012). The width between the rostral barbels is defined as the distance between the insertions of the barbels on the snout, anterior to the mouth. We focused on features of the head and oromandibular structures to diagnose *Gonorhynchus* based on the preliminary assessments described in Kullander *et al.* (1999), using the terminologies of Zhang & Kottelat (2006), that in turn were based on character descriptions from Roberts (1982) and Reid (1985). These structures include the rostral cap or rostral fold, the upper lip or upper labial fold, the upper and lower jaw, lateral lobes on the sides of the snout (= rostral lobes), and lateral flaps on the tip of snout (= rostral flaps). The rostral lobe (Fig. 1A) is an elongate triangular structure located within a widened sublachrymal groove, bordering the rostral cap and directly dorsal of the rostral barbel. The rostral lobe can be firmly attached to the snout or freely movable. The rostral flap (Fig. 1B) is broader, triangular, and located in a depression at the tip of the snout, distinctly not touching the rostral barbel or the sublachrymal groove (Zhang & Kottelat 2006). The rostral flap is also movable. Lengths were measured using digital calipers on the left side, when possible, to the nearest 0.1 mm. Measurements of the body were recorded as proportions of standard length (SL) and measurements of the head were recorded as proportions of head length (HL). To examine differences in morphometric (= mensural) data between populations, we conducted a sheared principal component analysis in which the covariance matrix was factored (Humphries *et al.* 1981; Bookstein *et al.* 1985). Meristic data were analyzed using a principal component analysis in which the correlation matrix was factored. Differences between populations were then examined by plotting the first principal component of the meristic data against the sheared second principal component of the morphometric data. Vertebral counts of several specimens were made on radiographs following the terminology of Roberts (1989). Counts of abdominal vertebrae included the Weberian complex and counts of caudal vertebra included the urostyle complex. Institutional codes follow Sabaj Pérez (2014).

Gonorhynchus **McClelland 1838**

(Figures 1, 2, 3A, 3C, 5, 7, 8, 11)

Gonorhynchus McClelland 1838:943 (type species: *Gonorhynchus brevis* M'Clelland 1839:373, by subsequent designation by Jordan 1919:195). Gender masculine.

Tariqilabeo Mirza & Saboohi 1990:405 (subgenus of *Labeo* Cuvier, 1816:194; type species: *Labeo macmahoni* Zugmayer 1912:597, by original designation). Gender masculine.

Akrokolioplax Zhang & Kottelat 2006:21 (type species: *Epalzeorhynchos bicornis* Wu 1977, by original designation). Gender feminine.

McClelland (1838) first described the genus *Gonorhynchus*, but without any discussion of inclusive species or type designation. Jordan (1919) subsequently designated *Gonorhynchus brevis* M'Clelland 1839 as the type species, now recognized as a junior synonym of *G. latius* (Hamilton 1822). In the same publication, however, Jordan (1919) synonymized *Gonorhynchus* with *Crossocheilus* as M'Clelland (1839) had needlessly renamed *Cyprinus gohama* Hamilton 1822 (which at the time of Jordan's publication was considered a junior synonym of *Crossocheilus latius*) as *G. brevis*.

Cyprinus gohama was initially considered a junior synonym of *Cyprinus latius* Hamilton 1822 (= *Crossocheilus latius*) by Day (1877) but placed under the name *Cirrhina* (= *Cirrhinus* Oken 1817) *latia*. Curiously, Day (1878) later synonymized several species, including *Crossocheilus latius* (Hamilton 1822), under *Cirrhina gohama* (Hamilton 1822), but later Day (1880) reverted back to the name *Cirrhina latia*. *Cyprinus sada* Hamilton 1822 was consistently treated as a junior synonym in these publications (Day 1877, 1878). Unfortunately, the type specimens of none of these nominal taxa are available. Specimens from the Koshi River (eastern Nepal into Bihar, India), one of the rivers from which *Cyprinus gohama* was originally described, were examined by us, but are not diagnosable from specimens from the Teesta River, the type locality of *C. latius* (see account for *G. latius* below), based on the characters listed by Hamilton (1822) or additional characters examined here. As specimens from the original type localities are indistinguishable and Day (1877) served as first reviser, precedence is given to *G. latius* as the senior synonym of the type species of the genus, *G. brevis*.

The similarly named genus *Gonorynchus* Scopoli 1777 is comprised of marine species in the order Gonorynchiformes. *Gonorynchus* has been misspelled as "*Gonorhynchus*" in a few instances, as noted by Grande (1999).

Diagnosis. *Gonorhynchus* (Fig. 2) belongs to the tribe Labeonini based on the following characters: 1) incised

border on the first anal-fin pterygiophore; 2) ventrally expanded rostral fold; and 3) presence of a superficial posterior labial fold (Stiassny & Getahun 2007). Reid (1982) diagnosed Labeonini as having a vomero-palatine organ, a terete process on the basioccipital, and the neural complex of the Weberian apparatus in direct contact with the supraoccipital region. Although these characters could not be examined in specimens on loan to us, Stiassny & Getahun (2007) reported them as present in *G. diplochilus*. Molecular phylogenies place species of *Gonorhynchus* within Labeonini (Wang *et al.* 2007; Zheng *et al.* 2010, 2012; Yang *et al.* 2012).

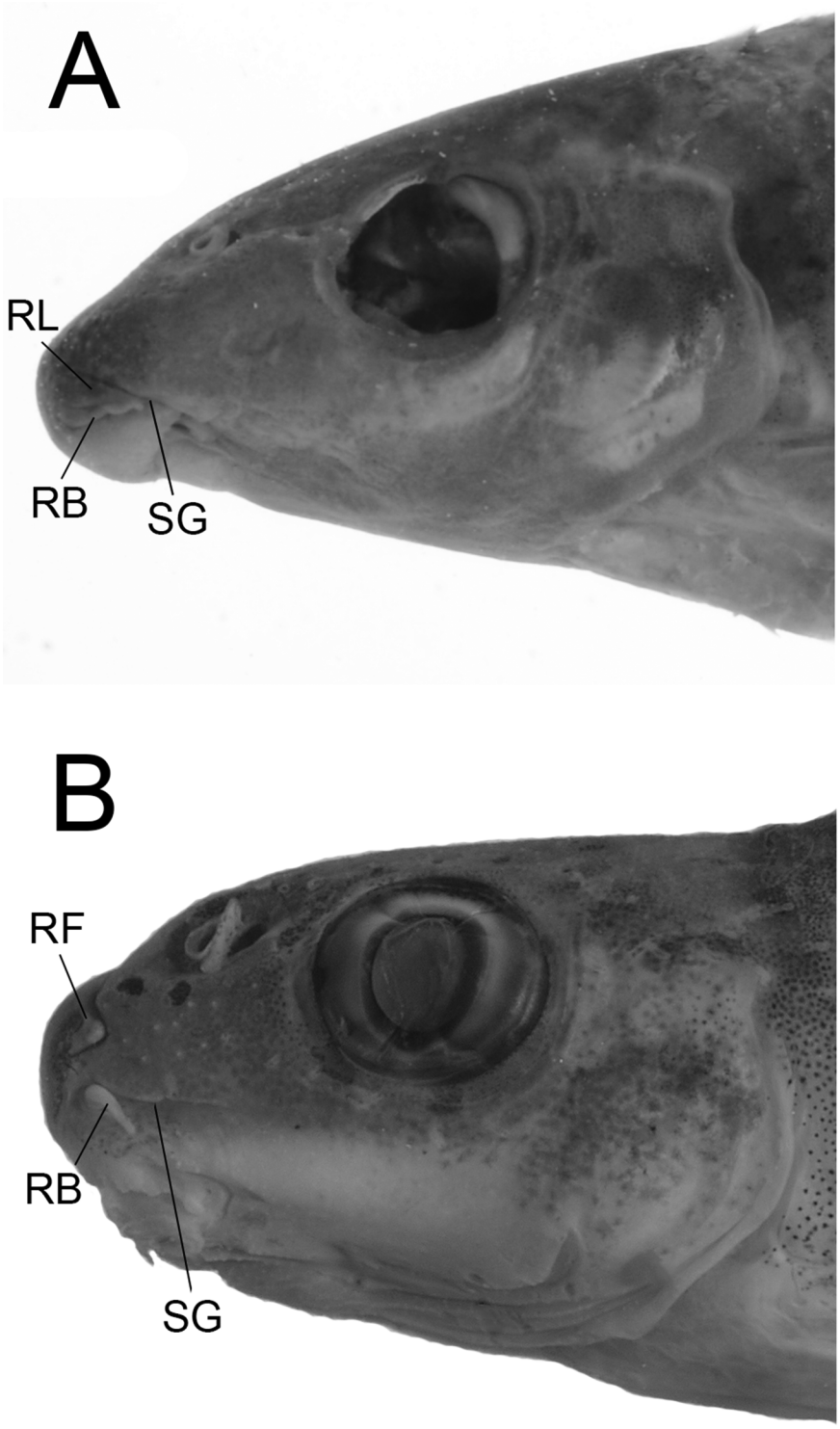

FIGURE 1. Lateral view of heads of (A) *Crossocheilus oblongus*, USNM 389867, 107.4 mm SL and (B) *Gonorhynchus bicornis*, UF 183871, 46.4 mm SL. Abbreviations: RB, rostral barbel; RF, rostral flap; SG, sublachrymal groove. Images not to scale. Photo B by Sandra Raredon, USNM.

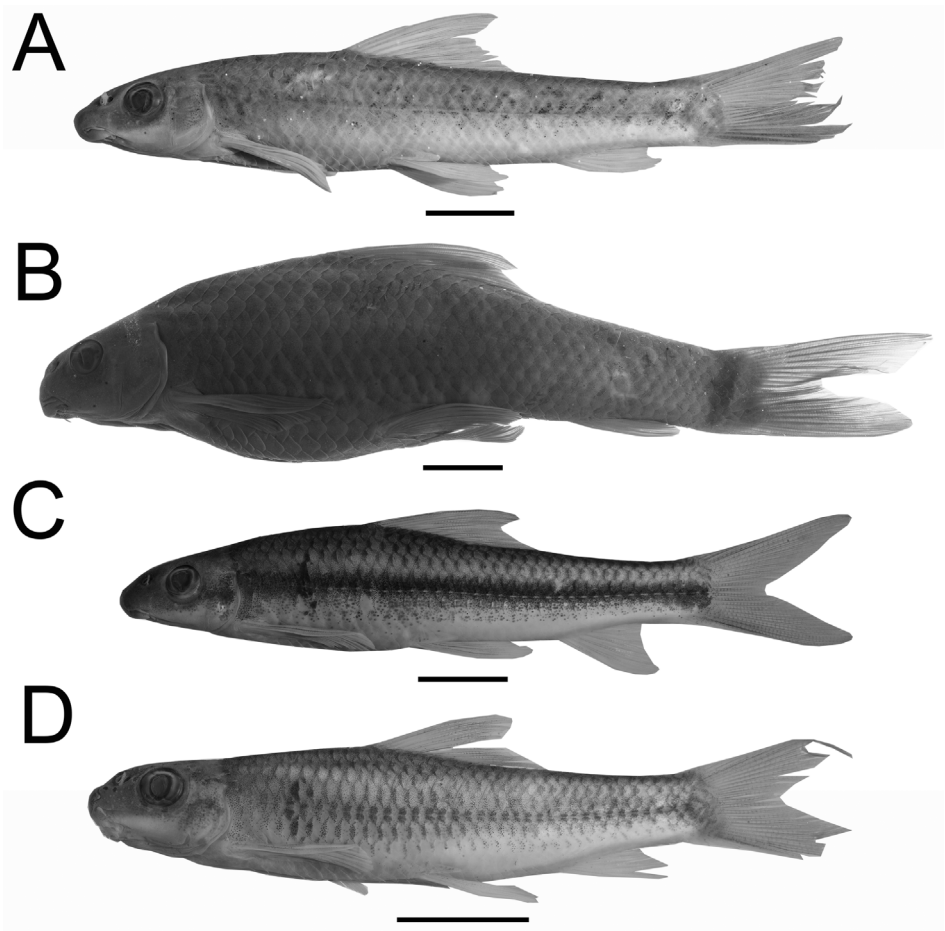

FIGURE 2. Lateral views of preserved (A) *Gonorhynchus latius*, KU 28855, 70.1 mm SL, Gandak River, Tribeni, Nawlaparasi, Nepal; (B) *G. diplochilus*, USNM 271246, 91.2 mm SL, Leh River, Rawalpindi, Punjab, Pakistan; (C) *G. burmanicus*, UF 183835, 63.7 mm SL, Mae Nam Por, Mae Hong Son, Thailand; (D) *G. bicornis*, UF 183871, 46.4 mm SL, mouth of tributary to Salween River, Mae Hong Son, Thailand. Scales bars represent 1 cm. Photos (A), (C), and (D) by Sandra Raredon, USNM.

Gonorhynchus is distinguished from other labeonin genera (see Yang *et al.* [2012] for list of genera) by the following combination of characters: 1) rostral cap covering upper lip, which is not visibly separated from snout by groove and not attached to lower lip; 2) upper lip very thin or absent, widening substantially at corner of mouth connecting upper jaw to lower lip; 3) inferior mouth; 4) lower lip free only on anterior and lateral edges, posterior edge connected to underside of head (not modified into rounded mental disc), central region equally thick as lateral edges, anterior edge with large papillae; 5) sublachrymal groove uniformly narrow from corner of mouth to rostral barbel, not expanding anteriorly to contain rostral lobe (rostral lobe absent); 6) 8½ branched dorsal rays.

Species included. *Gonorhynchus latius* (Hamilton 1822), *G. diplochilus* (Heckel 1838), *G. wattanah* (Sykes 1839), *G. macmahoni* (Zugmayer 1912), *G. burmanicus* (Hora 1936), *G. bicornis* (Wu 1977), and *G. periyarensis* (Menon & Jacob 1996).

Comparison. *Gonorhynchus* is herein compared with morphologically similar labeonins from Asia. *Gonorhynchus* is distinguished from *Crossocheilus* by the absence of a rostral lobe (although a rostral flap may be present) (Fig. 3A) vs. present (Fig. 3B) and a very thin upper lip (sometimes absent) that widens at the corner of the mouth (Fig. 3C) vs. a thicker upper lip that does not widen at the corner of the mouth (Fig. 3D). In the material examined, *Gonorhynchus* species have generally more vertebrae (34–38 vs. 31–33) and pored lateral scales (lateral-line scales plus pored scales on caudal fin 35–42 vs. 28–35) than *Crossocheilus* species. These higher counts in *Gonorhynchus* are consistent with data from previous descriptions, including those of Heckel (1838), Day (1877), Zugmayer (1912), Menon & Jacob (1996), and Zhang & Kottelat (2006). Kullander *et al.* (1999) listed several characters differentiating *Gonorhynchus* and *Crossocheilus* based primarily on examinations of *G. diplochilus* and *C. oblongus*. Two of these characters are listed above (e.g., relative upper lip size and presence/

absence of rostral lobes), but the remaining characters were not found to distinguish the two genera upon examination of additional species.

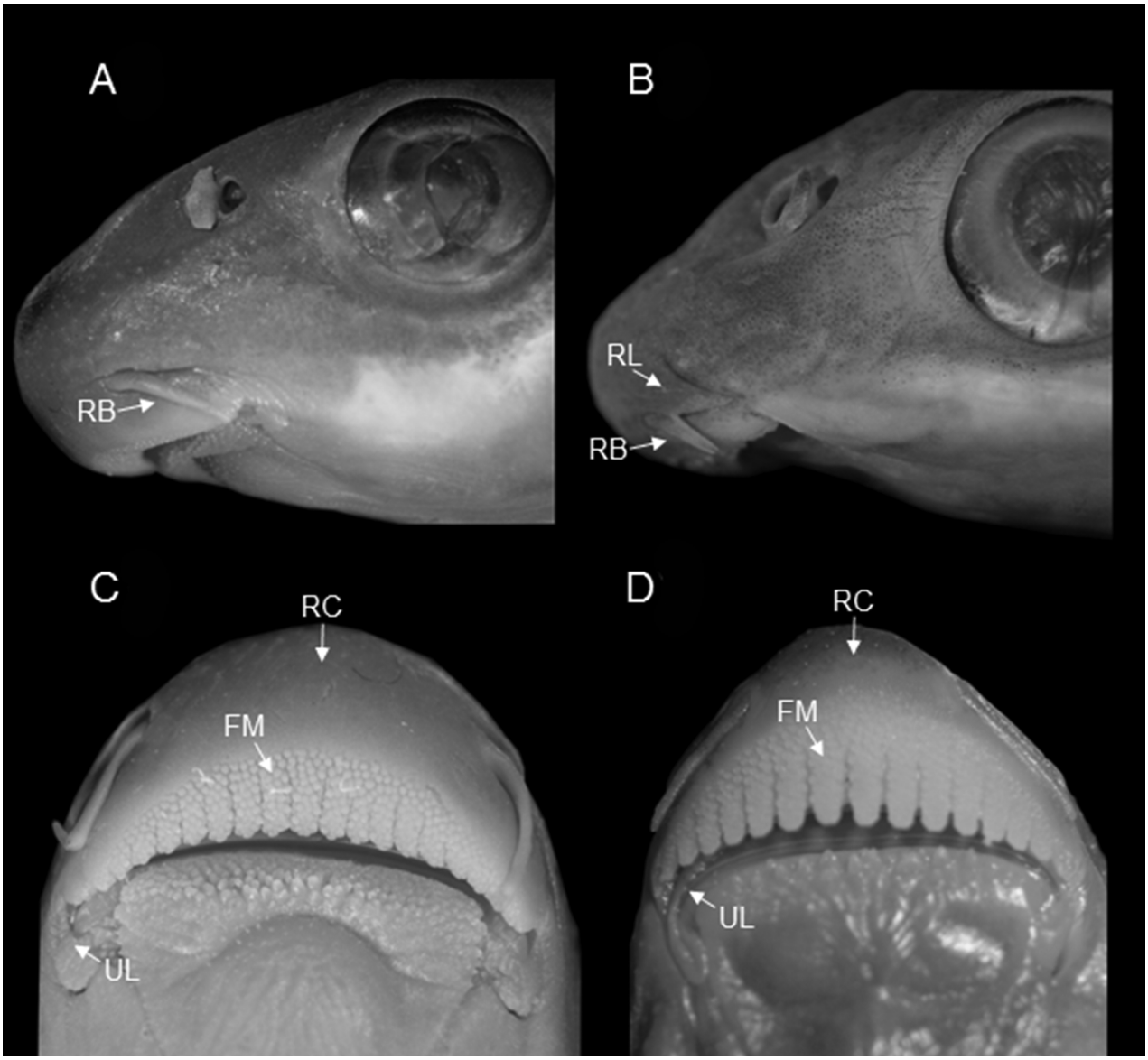

FIGURE 3. Lateral view of heads of (A) *Gonorhynchus burmanicus*, UF 183837, 86.1 mm SL and (B) *Crossocheilus atrilimes*, UF 185188, 79.9 mm SL. Ventral views of heads of (C) *G. burmanicus* (same as A) and (D) *C. oblongus*, UF 166341, 89.9 mm SL. Abbreviations: FM, fimbriae; RB, rostral barbel; RC, rostral cap; RL, rostral lobe; UL, upper lip. Images not to scale.

Gonorhynchus differs from *Garra* through the absence of a mental sucking disc. *Epalzeorhynchos* possesses movable rostral lobes just dorsal to the rostral barbels, which are absent in *Gonorhynchus*, although *G. bicornis* has movable flaps on the tip of the snout. Differences between *G. bicornis* and several other labeonin genera (see below) discussed by Zhang & Kottelat (2006) apply to all *Gonorhynchus* species and these genera. Unlike *Paracrossochilus*, *Gonorhynchus* has a vestigial and non-papillose upper lip, if lip is present (Kottelat *et al.* 1993; Zhang & Kottelat 2006). *Gonorhynchus* differs from *Rectoris* and *Pseudocrossocheilus* by having the lower lip disconnected from the rostral cap (vs. connected), and from *Sinocrossocheilus* in the presence of 8½ (vs. 7½) branched dorsal rays, the upper jaw connected (vs. disconnected) to the lower lip by a frenum around the corner of the mouth, and the absence (vs. presence) of a centrally protruding lower lip covered by papillae (Zhang & Chen 2004; Zhang & Kottelat 2006; Yuan *et al.* 2008; Zhu *et al.* 2012).

Remarks. As noted by Kullander *et al.* (1999), *G. macmahoni* is morphologically similar to *G. diplochilus* based on initial descriptions (Zugmayer 1912; 1913). In an examination of freshly collected specimens, Mirza &

Saboohi (1990) noted the presence of lateral lobes on the snout of *G. macmahoni*, which would exclude this species from *Gonorhynchus* as diagnosed here. However, without an examination of these specimens (whereabouts unknown), it is unclear as to the exact location and features of these structures. The status of this species was most recently reviewed again by (Mirza & Arshard 2008), who observed the syntype to be morphologically similar to *G. diplochilus*, except in lacking fringes present on the rostral fold in *G. diplochilus* as well as all other species of *Gonorhynchus*. Additionally, there was no mention of the presence of rostral lobes by Mirza & Arshard (2008). We examined digital images of the syntype of *G. macmahoni* (NMW 81256), discussed and shown in figure 1 (page 465) of Mirza and Arshard (2008), and observed no rostral lobes. Also, there appear to be no fringes on the rostral fold, which distinguishes this species from all other species in the genus, which possess well-developed fringes, or fimbriae, on the rostral fold. We tentatively retain *G. macmahoni* as a valid species pending the examination of additional specimens from the type locality, the Dasht River, a coastal river in western Pakistan draining directly into the Arabian Sea, and surrounding areas.

Gonorhynchus adiscus was revalidated by Sayyadzadeh *et al.* (2015) based on morphological data and a phylogenetic analysis of the mitochondrial cytochrome *c* oxidase I (COI) gene. This species was previously synonymized with *G. diplochilus* by Bianco & Bănărescu (1982). Characters used by Sayyadzadeh *et al.* (2015) to diagnose *G. adiscus* and *G. diplochilus* included the length of rostral barbels, the presence and length of maxillary barbels, counts of rakers on the first gill arch, and counts of scales between the anus and anal-fin insertion, based on specimens from the Sistan, Mashkid, and Makran basins in eastern Iran and western Pakistan (Table 1). However, in their morphological comparisons, Sayyadzadeh *et al.* (2015) did not include specimens from the Indus River where *G. diplochilus* is extensively distributed in the headwaters, or any from the Helmand River in Afghanistan where *G. adiscus* is also reported. An examination of *Gonorhynchus* specimens from the Indus and Helmand Rivers reveals that the characters listed by Sayyadzadeh *et al.* (2015) do not differentiate *G. adiscus* from *G. diplochilus*.

TABLE 1. Character values of *Gonorhynchus diplochilus* from Sistan, Makran/Mashkid, Helmand, and Indus basins. * = values from Sayyadzadah *et al.* (2015).

Character	Sistan *	Makran/Mashkid *	Helmand	Indus
Maxillary barbels	Present	Present or Absent	Present	Present
Rostral barbel length (% of head length)	12.2–16.8%	5.5–11.4%	11.8–14.7%	13.3–17.9%
Maxillary barbel length (% of head length)	5.6–10.5%	1.4–4.1%	4.1–9.0%	3.2–7.5%
Gill rakers on first arch	19–22	22–25	20–26	21–24
Scales between anus and anal-fin insertion	3–5	2–3	2–4	3–5½

Table 1 contains comparisons of characters between Sayyadzadeh *et al.* (2015) from specimens in the Sistan, Makran, and Mashkid basins and specimens examined here from the Helmand and Indus Rivers. The inclusion of specimens from the Helmand and Indus Rivers indicates substantial overlap in the lengths of the rostral and maxillary barbels, the number of rakers on the first gill arch, and the number of scales between the anus and anal-fin insertion between populations re-validated as *G. adiscus* (Sistan and Helmand basins) and those treated as *G. diplochilus* (Makran, Mashkid, and Indus River basins) by Sayyadzadeh *et al.* (2015). Sharma *et al.* (2014) also reported gill raker counts of 17–21 in specimens of *G. diplochilus* from the Poonch River (Indus River basin) in India, which overlap those of *G. adiscus* reported by Sayyadzadeh *et al.* (2015). An additional specimen examined by us from the Makran region of southeastern Iran (USNM 205897) was consistent with data presented for *G. diplochilus* in the same region by Sayyadzadeh *et al.* (2015) in lacking maxillary barbels, possessing a rostral barbel length equal to 11.7% of head length, and possessing two scales between the anus and anal-fin insertion (we were unable to get a count of rakers on the first gill arch). Based on these additional morphological data, we recommend that *G. adiscus* continue to be treated as a junior synonym of *G. diplochilus*. The molecular phylogeny presented in Sayyadzadeh *et al.* (2015) resolved *G. adiscus* and *G. diplochilus* as monophyletic clades, with *G. adiscus* more closely related to *G. latius* than to *G. diplochilus*, supporting their claim for these populations as separate species. However, this phylogeny may not accurately reflect species relationships as only the COI gene was incorporated. The broad geographic range of *G. diplochilus* from India to Iran holds the possibility of multiple opportunities for divergence via allopatric speciation; however, thorough sampling of populations from throughout

this range is required to collect additional morphological and molecular data to test for population differences that would lead to species diagnoses.

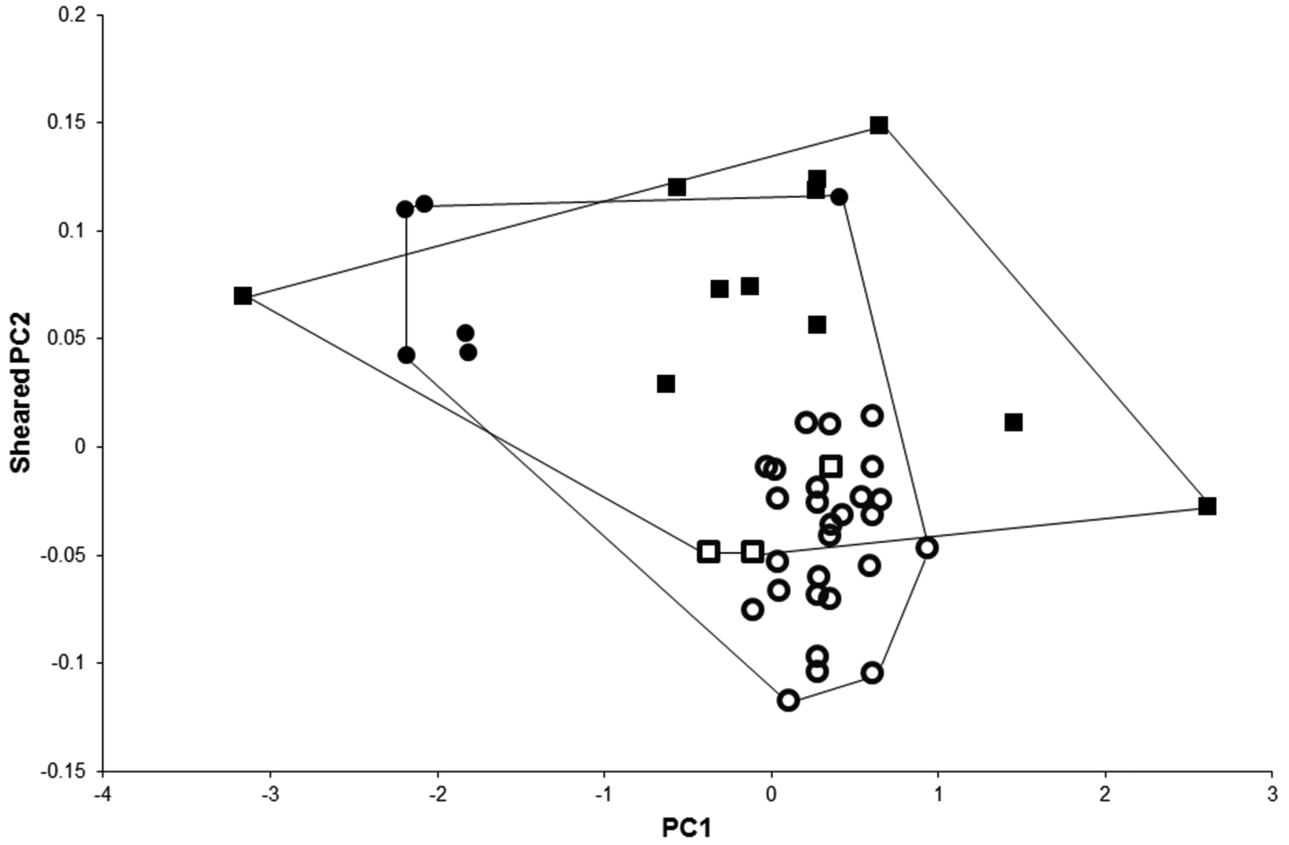

FIGURE 4. Plot of the first principal component of the meristic data (PC1) and the sheared second principal component (PC2) of *Gonorhynchus latius* from the Ganges (filled and open circles) and Brahmaputra (filled and open squares) River basins. Filled circles (●) and open circles (○) represent specimens from the Koshi River and other Ganges River populations, respectively. Filled squares (■) and open squares (□) represent specimens from the Teesta River and other Brahmaputra River populations, respectively.

The description, illustration, and reported similarities to other *Gonorhynchus* species of the specimen from the Brahmaputra basin used in the description of *G. gobioides* in M'Clelland (1839) suggest it is morphologically similar to *G. latius*. Based on M'Clelland (1839), *G. gobioides* is distinguished from all other species in the genus by the absence of barbels as all other species in the genus possess at least one pair of barbels on the snout. Bleeker (1860) and Günther (1868) recognized the species as valid in the genus *Crossocheilos*. Curiously, no mention is made of *G. gobioides* in the revisions of Indian fishes by Day (1877, 1878) or in the check list of freshwater fishes of India (Menon 1999). M'Clelland (1839) noted the absence of barbels in another species—therein *G. petrophilus*, currently recognized as a junior synonym of *Schizothorax richardsonii* (Gray 1832), which possesses two pairs of barbels (Kullander *et al.* 1999; Chen & Chao 2000; He & Chen 2006). It is possible that M'Clelland (1839) also missed this character in the description of *G. gobioides*, particularly if dealing with a small or damaged specimen. Furthermore, as noted by M'Clelland (1839), the specimen of *G. gobioides* was questionably the same species described as *Cyprinus mosario* by Hamilton (1822). The description of *C. mosario* lacks details, with the species being described as similar to *G. latius* except in lacking "tendrils" (= barbels). We have observed no specimens of *Gonorhynchus* lacking rostral barbels. In light of the absence of the types for both species to confirm the absence of barbels, but their otherwise similarity to *G. latius*, we recognize *G. gobioides* and *C. mosario* as questionable junior synonyms of *G. latius*. The remaining species of *Gonorhynchus* discussed in M'Clelland (1839) that have not been synonymized with *G. latius* (*G. bimaculatus*, *G. brachypterus*, and *G. caudatus*) belong to the genus *Garra*.

Redescription of *Gonorhynchus latius* (Hamilton 1822)
Gangetic Latia
(Figures 2A, 5, 7)

Cyprinus latius Hamilton 1822:345 (type locality: India/Bangladesh: Tista [Teesta] River, at base of Darjeeling Himalayas); no types known
Cyprinus sada Hamilton 1822:344 (type locality: India: Brahmaputra River, India); no types known
Cyprinus gohama Hamilton 1822:346 (type locality: India: Kosi [Koshi] and Ganges Rivers); no types known
? *Cyprinus mosario* Hamilton 1822:346 (type locality: India: Bengal); no types known
? *Gonorhynchus gobioides* M'Clelland 839:280, pl. 43, fig. 1 (type locality: India: Assam: Brahmaputra River); no types known
Gonorhynchus macrosomus M'Clelland 1839:282, pl. 43, fig.7 (type locality: India: Assam: cataracts of Brahmaputra River); no types known
Gonorhynchus fimbriatus M'Clelland 1839:282, pl. 43, fig. 3 (type locality: northern parts of Bengal), no types known
Gonorhynchus brevis M'Clelland 1839:373, pl. 43, fig. 6 (type locality: India: Kosi [Koshi] River and northwest Bengal and the Ganges River); no types known
Cyprinus sada.—Valenciennes 1842:385
Crossocheilus gohama.—Bleeker 1860:110
Crossocheilus latius.—Bleeker 1860:110
Crossochilus latius.—Günther 1868:71
Crossochilus gohama.—Günther 1868:72
Crossochilus rostratus Günther 1868:72 (type locality: India: Cossye [Kangsabati] River); holotype BMNH 1867.5.12.15
Crossochilus sada.—Günther 1868:74
Cirrhina latia.—Day 1877:548
Cirrhina gohama.—Day 1878:11
Crossocheilus latia.—Shaw & Shebbeare 1937:132
Crossocheilus latius latius.—Misra 1959:169

Cyprinus latius and *C. gohama* were originally described by Hamilton (1822) from the Teesta/Brahmaputra and Koshi/Ganges Rivers, respectively. *Cyprinus gohama* was differentiated from *C. latius* by a deeper body, clear (vs. yellow) pelvic and anal fins, circular (vs. oval) pupils, the lateral line descending from behind the operculum to the caudal peduncle (vs. straight along the middle of the body), and in possessing 8 (vs 7) rays in the anal fin. Plate 43 in M'Clelland (1839) picturing *C. gohama* and *Gonorhynchus macrosomus* (= *G. latius*) illustrates only a slightly deeper-bodied *C. gohama*, with the lateral line descending slightly more behind the operculum. None of the original specimens examined are available. We examined more recently collected specimens from streams where *C. latius* and *C. gohama* were initially described (Teesta and Koshi Rivers, respectively) and did not observe the differences noted by Hamilton (1822). All specimens possess a lateral line with a slight dip in the anterior portion behind the operculum, generally clear to yellow pelvic and anal fins with melanin on the rays of larger specimens, and no clear difference in pupil shape. Body depth overlaps between Koshi and Teesta River populations (Table 2).
Principal component analysis of the morphometric and meristic data indicates substantial overlap between populations from the Ganges and Brahmaputra River basins in India, including specimens from the Koshi and Teesta Rivers (Fig. 4). Only those specimens in good condition for data collection were included in this analysis (see Table 2). Size accounted for 94.9% of the observed variance, with the second component accounting for 1.6% of the variance. Variables with the highest loadings on the sheared second principal component were body depth (-0.48), caudal peduncle length (0.47), and orbit diameter (0.39). Variables with the highest loadings on the first principal component of the meristic data were total lateral-line scales (lateral-line scales plus scales on the caudal fin; 0.51), lateral-line scales (0.43), and scales between the pelvic-fin origin and the lateral line (0.40). A significant difference (ANOVA, $p<0.05$) was detected between specimens from the Ganges and the Brahmaputra River basins along the sheared second principal component axis, but not along the first principal component axis. However, there is overlap in morphometric traits values between these two populations as indicated by the substantial overlap in the minimum polygon clusters, and all measurements recorded have some overlap (Fig. 4, Table 2). Additionally, no fixed differences were observed in color pattern between populations. Several specimens from the Brahmaputra River basin possess a brown crescent in the humeral region, but this trait is observed in a specimen from the Ganges and from several other drainages in eastern India (as well as in *G. bicornis* and *G. burmanicus*). Based on overall morphological similarity between all Ganges and Brahmaputra River specimens, *Cyprinus gohama* is recognized as a junior synonym of *G. latius* as first proposed by Day (1877).

TABLE 2. Morphometric and meristic values of the neotype of *Gonorhynchus latius* and specimens from the Ganges and Brahmaputra River basins. Data for the Teesta River include the neotype.

MORPHOMETRICS	Neotype CAS-SU 69910	Teesta River (n=11) CAS-SU 41131, UMMZ 244858		Brahmaputra River (n=3) UMMZ 244747, 244772		Koshi River (n=6) KU 28563		Ganges River (n=27) KU 28639, 28688, 28725, 29006, 29031, 29037	
		Mean	Range	Mean	Range	Mean	Range	Mean	Range
Standard length (mm)	75.8	82.3	67.6–110.8	76.8	58.6–102.1	45.4	42.2–53.5	57.6	46.7–96.0
% Standard length									
Predorsal length	44.4	43.5	41.0–45.1	43.9	43.4–44.7	43.8	42.8–45.2	45.4	42.4–47.0
Preanal length	79.3	78.8	76.3–80.6	77.5	75.1–79.1	77.7	77.3–78.9	77.7	75.0–80.3
Prepelvic length	50.4	50.3	48.6–53.4	51.0	48.8–53.0	50.1	48.7–51.9	50.5	48.2–53.4
Head length	19.8	19.8	17.9–21.0	19.9	19.6–20.1	21.1	20.4–21.9	20.9	19.2–22.6
Body depth at dorsal fin	16.9	18.2	15.6–21.6	18.7	18.3–19.5	17.0	15.3–18.4	20.2	17.7–25.2
Caudal-peduncle depth	9.9	9.8	8.2–10.5	10.5	10.1–10.8	9.0	8.7–9.4	10.2	9.0–11.2
Caudal-peduncle length	16.1	15.9	14.7–17.0	13.8	13.1–15.0	15.8	14.8–17.3	14.4	11.9–16.3
Dorsal–fin base length	15.4	16.3	15.1–17.2	16.6	16.4–16.7	16.1	15.5–17.1	16.6	15.4–18.0
Anal–fin base length	7.1	7.2	6.4–8.1	7.4	7.4–7.4	7.6	7.0–8.3	7.6	6.4–8.4
Pelvic-fin length	19.6	19.4	17.0–21.3	18.2	17.3–18.9	18.4	17.4–19.0	18.4	16.7–20.3
Pectoral-fin length	22.0	21.6	20.1–23.0	19.7	18.8–20.5	21.1	20.6–21.7	20.7	18.6–22.6
Inter–pectoral width	11.6	12.3	11.3–14.0	13.0	11.8–13.7	12.8	12.3–13.4	13.6	12.4–15.1
Inter–pelvic width	8.3	9.5	8.3–10.2	9.3	9.1–9.7	8.8	8.0–9.4	9.3	8.4–10.6
% Head Length									
Head depth	71.3	69.0	64.3–73.2	71.1	70.5–72.0	67.8	65.1–69.6	69.8	64.3–80.8
Head width	68.3	67.5	62.4–71.6	67.8	66.1–68.8	65.1	61.0–68.3	65.7	60.5–76.6
Snout length	34.6	36.6	34.5–41.1	40.7	37.2–46.7	32.0	29.3–35.9	36.0	30.1–47.0
Orbit diameter	31.7	29.9	27.2–34.1	27.7	25.1–30.3	34.3	32.5–38.1	28.6	24.4–32.2
Interorbital width	36.1	36.9	33.2–45.4	37.9	36.0–40.6	32.5	30.7–33.7	35.1	28.7–44.2
Mouth width	45.8	42.0	36.5–46.4	38.9	38.9–39.0	39.1	37.5–40.7	39.3	36.4–43.9
Width between rostral barbels	28.8	27.4	23.5–34.3	25.3	24.5–26.7	26.2	23.8–28.2	26.1	22.5–30.0
Postorbital length	28.0	29.1	27.2–32.2	31.8	29.2–33.8	30.4	27.3–35.0	33.2	26.6–36.4
Cheek height	18.8	20.1	18.3–22.7	19.9	18.1–21.7	18.1	16.7–20.0	18.5	14.4–24.6
Internarial width	28.1	27.0	22.7–32.2	25.1	23.1–26.5	21.8	19.2–23.7	26.3	19.8–32.1
MERISTICS									
		Mode	Range	Mode	Range	Mode	Range	Mode	Range
Pectoral-fin rays	14	14	14–16	14	14–15	13	13–15	15.0	14–15
Lateral-line scales	38	37	36–40	37	36–37	37	34–37	37	36–38
Pored scales posterior to lateral line	2	2	1–3	3	2–3	2	2–3	3	2–3
Predorsal scales	10	10	8–12	9,10,11	9–11	11	9½–11	10	9–10.5
Scales between dorsal-fin origin and lateral line	5½	5½	4½–6½	5½	5½	4½,5½	4½–5½	5½	5½
Scales between anal-fin origin and lateral line	5½	5½	4½–6½	5½	5½	4½	4½–5½	5½	5½
Scales between pelvic-fin origin and lateral line	4½	3½	3½–5½	3½	3½–4½	3½,4½	3½–4½	4½	4½
Scales between anus and anal-fin origin	5½	6	5½–7	5	5–6	6	4½–6	5,6	5–6

TABLE 3. Morphometric and meristic values of *Gonorhynchus latius* from eastern India outside of the Ganges and Brahmaputra River basins.

MORPHOMETRICS	Mahanadi River (n=2) CAS 61828		Orissa, India (n=2) FMNH 5716		Hooghly River UMMZ 244942	Surma River UMMZ 208722
	Mean	Range	Mean	Range		
Standard length (mm)	56.7	55.6–57.9	53.0	51.4–54.6	67.9	60.8
% Standard length						
Predorsal length	44.1	43.4–44.7	44.3	42.5–46.1	44.2	45.4
Preanal length	79.5	78.8–80.1	78.6	77.8–79.3	75.7	78.9
Prepelvic length	51.2	51.1–51.3	50.8	50.7–50.9	48.2	51.8
Head length	20.3	20.2–20.4	20.0	19.9–20.2	18.9	20
Body depth at dorsal fin	18	17.7–18.4	19.5	18.7–20.2	21.4	20.5
Caudal-peduncle depth	10.8	10.7–10.9	11.0	10.9–11.1	10.7	10.2
Caudal-peduncle length	14.4	14.2–14.5	15.7	15.6–15.8	17.0	15.2
Dorsal-fin base length	15.1	14.5–15.6	14.6	13.7–15.5	16.3	14.7
Anal-fin base length	7.2	7.0–7.4	7.1	7.0–7.2	7.9	6.6
Pelvic-fin length	19.0	18.5–19.4	19.0	18.1–19.8	17.5	18.2
Pectoral-fin length	20.7	20.2–21.2	21.5	21.0–22.0	20.5	19.2
Inter-pectoral width	13.3	12.8–13.8	10.8	10.6–11.0	13.2	11.9
Inter-pelvic width	9.9	9.6–10.2	7.5	6.2–8.9	9.6	8.9
% Head Length						
Head depth	66.2	65.1–67.3	71.5	70.6–72.5	75.0	70.9
Head width	64.5	64.0–65.0	60.8	58.4–63.1	71.2	64.4
Snout length	35.9	35.0–36.8	28.0	27.5–28.5	39.9	39.8
Orbit diameter	30.4	29.5–31.4	34.3	33.1–35.5	30.4	31.4
Interorbital width	34.6	33.6–35.7	34.4	32.5–36.3	38.4	34.8
Mouth width	38.9	38.2–39.6	37.2	33.7–40.6	39.9	36.8
Width between rostral barbels	28.2	27.5–28.8	23.4	23.0–23.8	26.0	24.6
Postorbital length	29.8	27.7–31.9	30.9	30.1–31.8	35.2	31.2
Cheek height	17.7	16.1–19.3	18.5	16.2–20.7	18.5	17.5
Internarial width	27.6	26.5–28.6	23.9	23.4–24.3	28.2	22.4
MERISTICS						
		Range		Range		
Pectoral-fin rays		13		13–14	15	14
Lateral-line scales		35–36		35–36	37	37
Pored scales posterior to lateral line		3–4		1–2	2	3
Predorsal scales		9–9½		9½	9½	10
Scales between dorsal-fin origin and lateral line		5½		5½–6½	5½	5½
Scales between anal-fin origin and lateral line		5½		5	5½	5½
Scales between pelvic-fin origin and lateral line		4½		4½	4½	4½
Scales between anus and anal-fin origin		4½–5½		?	5½	5½

FIGURE 5. Lateral view of preserved *Gonorhynchus latius*, BMNH 1867.5.12.15 (holotype of *Crossochilus rostratus*). Scale bar represents 1 cm. Photo by James Maclaine, BMNH.

Images of the type specimen of *Crossochilus rostratus* (BMNH 1867.5.12.15) from the Kangsabati River (Haldi/Hooghly River basins) show characters diagnostic of *Gonorhynchus*. Even though no formal diagnosis was given, based on the original description by Günther (1868) this specimen was differentiated from *G. latius* by lacking maxillary barbels, having more transverse scale rows (12½), four scale rows between the lateral line and the pelvic-fin insertion, presence of a spot on the fifth and sixth scales of the lateral line (Fig. 5), and a longer snout. Several specimens of *G. latius* examined also lack maxillary barbels. Additionally, these scale counts are not unique to *G. latius* examined, and the presence of a spot on the anterior portion of the lateral line does not distinguish this specimen from *G. latius* as this character is also observed in specimens from the Teesta River and other localities. Based on a measurement of a digital image (Fig. 5), the snout is longer than the average snout length of *G. latius* (42% HL), but is not greater than the maximum (47% HL, Tables 2 and 3). A single specimen from the Hooghly River (UMMZ 244942, Table 3) was also not distinguishable from other *G. latius* specimens. We thus retain the synonymy of *Crossochilus rostratus* with *G. latius* first proposed by Day (1877).

Diagnosis. Member of *Gonorhynchus* as diagnosed above. *Gonorhynchus latius* is differentiated from its congeners by the following combination of characters: absence of rostral flaps on tip of snout (vs. present in *G. bicornis*); large specimens without tubercles on snout and cheek (vs. present in *G. periyarensis* and *G. wattanah*); thick midlateral stripe absent (vs. present in *G. burmanicus*). *Gonorhynchus latius* generally has more vertebrae (mode 37, range 35–38) compared to *G. diplochilus* (34–35), *G. bicornis* (34–36), and *G. burmanicus* (35), greater total lateral-line scale counts (mode 40, range 36–40) compared to *G. diplochilus* (35–38), *G. bicornis* (36), *G. burmanicus* (35–38) and *G. macmahoni* (35–36), and greater circumpeduncular scale counts (mode 20, range 16–24) compared to *G. diplochilus* (mode 16, range 16–18), *G. bicornis* (16), and *G. burmanicus* (16). The postorbital length of *G. latius* is generally smaller (mean 31.9, range 26.6–36.4 % HL) than that of *G. diplochilus* (mean 38.0, range 34.5–42.3 % HL). The orbit diameter of *G. latius* is also generally larger (mean 29.6, range 24.4–38.1 % HL) than that of *G. diplochilus* (mean 24.8, range 22.1–29.6 % HL).

In a limited number of specimens, we did not find raker counts on the first gill arch to be diagnostic as reported in Bănărescu (1986). Two specimens of *G. latius* from the Teesta River (CAS-SU 41131), which Bănărescu (1986) had examined, and several specimens from the Ganges River basin have counts of 21–26 vs. 37–39 as initially reported. The count given by Bănărescu may be a typographical error as it matches the lateral-line scale counts reported therein. *Gonorhynchus diplochilus* specimens examined here have gill raker counts in the range of 21–26, whereas two *G. burmanicus* specimens have counts of 22. These data are in accordance with gill raker counts reported in Sharma *et al.* (2014) and Su *et al.* (2000) for *G. diplochilus* and *G. burmanicus*, respectively.

Description. Morphometric and meristic data presented in Tables 2 and 3. Ventral profile from tip of snout to anal fin flat to slightly concave. Snout conical, rounded at end. Head short, longer than wide. Eyes dorsolateral. Dorsal-fin origin anterior of pelvic-fin origin. Pectoral fin reaching approximately halfway between pectoral-fin insertion and pelvic-fin origin. Pelvic fin reaching to or slightly beyond anus. Anal fin not reaching base of caudal fin. Axillary pelvic lobe well-developed. Caudal fin deeply forked with pointed lobes, approximately equal in length.

Body entirely scaled; scales large. Lateral-line scales and pored scales on caudal fin 34–40 + 1–4 (mode 37 + 3), predorsal scales 8-11 (mode 10), scale rows above lateral line 4½–6½ (mode 5½), scale rows below lateral line 4½–5½ (mode 5½), circumpeduncular scales 16–24 (mode 20), 3½–4½ scale rows between lateral line and pelvic-fin origin (mode 4½), 4½–7 scales between anus and anal-fin origin (mode 6). Dorsal fin with 3 simple and 8½

branched rays; anal fin with 3 simple and 5½ branched rays; pelvic fin with 1 simple and 8 branched rays; pectoral fin with 1 simple and 13–16 branched rays (mode 14); caudal fin with 10+9 principal rays, 9+8 branched, except one specimen with 9+9 principal rays, 8+8 branched rays (UMMZ 208722). Abdominal vertebrae 23–25, caudal vertebrae 11–13, total vertebrae 35–38 (vertebrae data from BMNH 1867.5.12.15, CAS 24234, CAS-SU 41131, CAS-SU 69910, FMNH 5716, and KU 28563). Rakers on first gill arch 21–26.

Rostral cap covering upper lip which is not visibly separated from snout by groove and not attached to lower lip; rostral cap with 11–22 fimbriae superficial to upper jaw, fewer fimbriae observed in smaller specimens as fimbriae appear to be fused along sides. Mouth inferior; upper lip very thin or absent, widening substantially at corner of mouth connecting upper jaw to lower; lower lip free only on anterior and lateral edges, posterior edge connected to underside of head (not modified into rounded mental disc), central region equally thick as lateral edges, anterior edge with large papillae; sublachrymal groove uniformly narrow from corner of mouth to rostral barbel, not expanding anteriorly to contain rostral lobe. Rostral barbels shorter than eye diameter; maxillary barbels present or absent; if present, tiny, sometimes hidden in corner of mouth.

Color in 75% Ethanol. Dorsally light to dark brown. Most specimens with dark stripe on midline of dorsum. Flanks and lateral portions of head mottled dark brown, with irregular clusters of black spots. Very thin stripe (less than one scale height) on midline of flank present in some specimens. Ventral surface of rostral cap and barbels stippled brown in some specimens. Venter cream to yellow. Some specimens with faint dark stippling on the dorsal-fin, caudal-fin, pelvic-fin, and pectoral-fins rays; inter-radial membranes otherwise clear. Anal fin clear. Lower lobe of caudal fin with dusky blotch in most specimens, darkest along distal edges of fin. Some larger specimens with dark humeral spot on 5th–6th lateral-line scale and scales directly above and below it, forming a crescent or semi-circle.

Color in Life. Silvery ventral half, brassy dorsal half of body. Black speckles overlay head and body. Fins as described above (R. Thoni and T. Sado, pers. comm.).

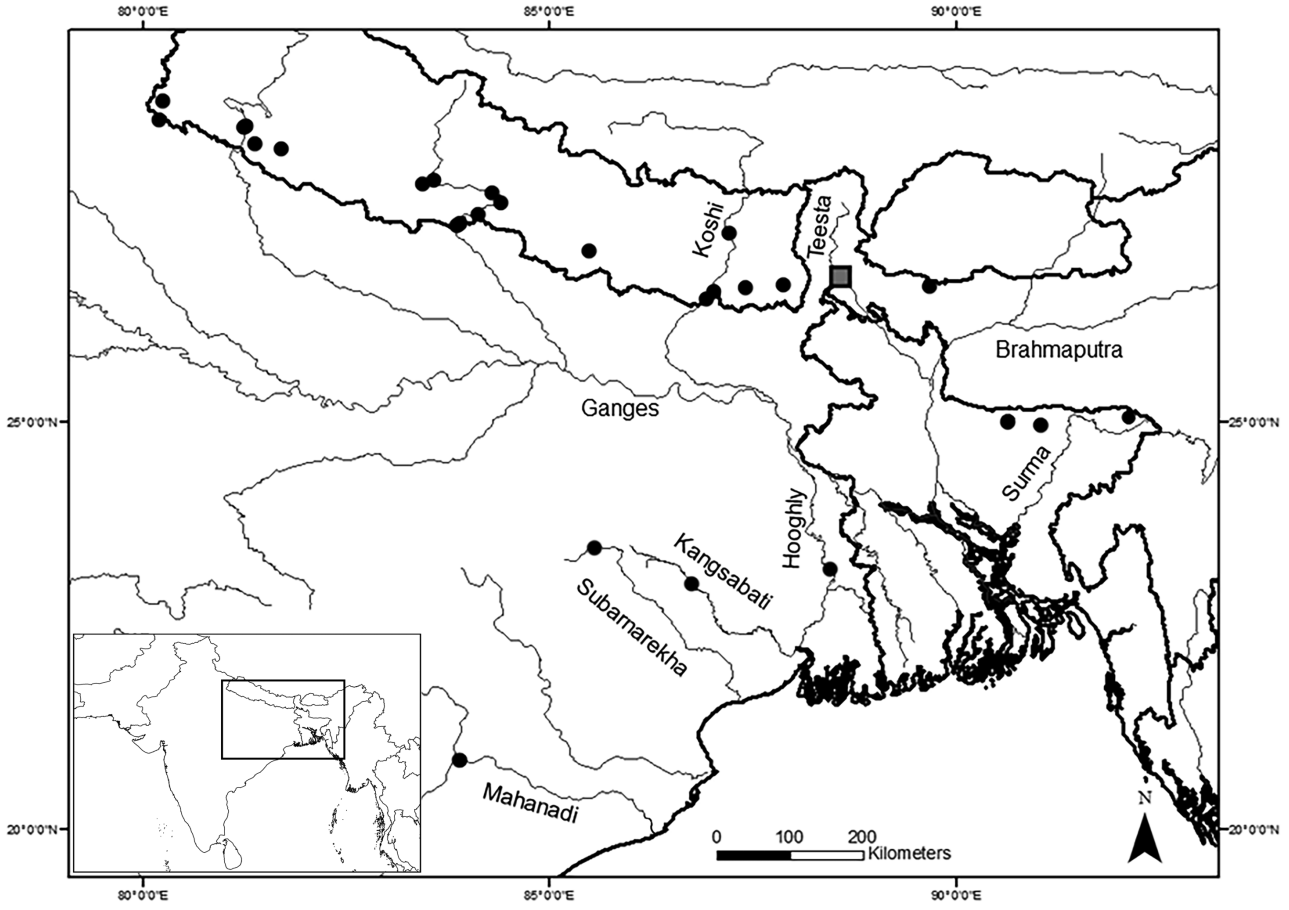

FIGURE 6. Georeferenced distribution of *Gonorhynchus latius* in eastern India and neighboring countries (inset). Grey square denotes the locality of the neotype. The locality of the Kangasabati River population was arbitrarily selected due to lack of detail on location of only available specimen (BMNH 1867.5.12.15).

Distribution and Ecological Notes. The species is distributed in streams of the Ganges, Brahmaputra, and Meghna River basins in Nepal, India, Bhutan, and Bangladesh, as well as the Subarnarekha and Mahanadi Rivers draining into the Bay of Bengal in eastern India (Fig. 6). *Gonorhynchus latius* was recently reported by Khedkar *et al.* (2014) in the Narmada River draining into the Arabian Sea in western India, although specimens from this locality warrant examination to confirm species status. Singh & Agarwal (2013) reported observations of *G. latius* in a variety of microhabitats in a headwater stream in the Ganges River basin, with a stronger preference for pools. Spawning in a Himalayan population occurred during July–September, possibly triggered by high turbidity and stream velocities from seasonal rains (Negi & Dobriyal 1997). The diet of *G. latius* consists of macrophytes, algae, and diatoms (Sharma 1984). *Gonorhynchus latius* was listed as "Vulnerable," i.e., considered to be at a substantial extinction risk, in India by Lakra *et al.* (2010), although specific threats to this species were not discussed.

Neotype Designation. There is no mention of the type material of *Gonorhynchus latius* in the original description by Hamilton (1822), nor in any subsequent discussions of the species. Furthermore, an examination of museum records does not indicate the presence of any of the original specimens, suggesting this material is lost. As *G. latius* is the senior synonym of the type species of the genus *Gonorhynchus* and will likely be included in future taxonomic research in the group, we herein designate a neotype in accordance with the conditions of Article 75 of the Code (ICZN 1999). The following specimen is selected as the neotype: CAS-SU 69910, collected by S.L. Hora at the Teesta River near Kalimpong Duars and Siliguri Terai, (26.794276°N, 88.561392°E), West Bengal, India, November 1938 (Fig. 7). This specimen possesses the characters diagnostic of *G. latius* described here (morphometric and meristic data presented in Table 1) and is topotypical in being from the Teesta River where *G. latius* was originally described by Hamilton (1822).

FIGURE 7. Dorsal, lateral, and ventral views of the neotype of *Gonorhynchus latius*, CAS-SU 69910, 75.8 mm SL, Teesta River, West Bengal, India. Photos by Sandra Raredon, USNM.

Revised Description of *Gonorhynchus wattanah*
Deccan Latia
(Figures 8, 11)

Chondrostoma wattanah Sykes 1839:160, pl. 63, fig. 4 (type locality: India: Deccan: Beema [Bhima] River); no types known

Chondrostoma wattanah from the Bhima River on the Deccan Plateau was briefly described by Sykes (1839a), with the same short description appearing again in Sykes (1839b). A slightly more complete description, as well as an illustration of a specimen (Fig. 8), were provided two years later (Sykes 1841). Sykes (1841) indicated that *C. wattanah* is similar to the '*Garra*' division of cyprinids of Hamilton (1822), which included *Gonorhynchus latius*. Day (1876) initially speculated that the specimen illustrated in Sykes (1841) may represent *Garra lamta* (Hamilton 1822), but subsequently synonymized *C. wattanah* with *G. latius* (Day 1877), presumably based on the description and illustration provided by Sykes (1841) as there are no records of Sykes having preserved material from his expedition (Kottelat 1996; Knight *et al.* 2014). Our comparison of the illustration with more recently collected specimens from the Bhima River suggest *C. wattanah* is a member of *Gonorhynchus*, consistent with previous publications (Day 1877, 1878; Menon 1999), although curiously the specimen(s) described by Sykes lacked "tendrils" [= barbels] (Sykes 1839a; 1839b; 1841). Other species that are known to possess barbels, such as *Garra mullya* (Sykes 1839), were also reported to lack barbels by Sykes (1839a; 1839b; 1841). It seems likely that Sykes missed these characters during his descriptions.

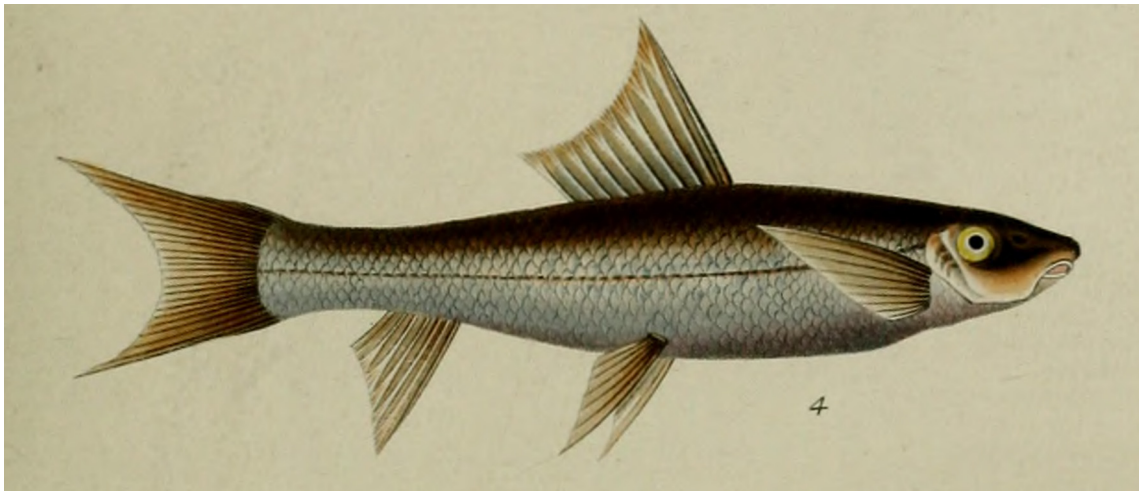

FIGURE 8. Original drawing of *Gonorhynchus wattanah* from Sykes (1841). Image from the Biodiversity Heritage Library (www.biodiversitylibrary.org); digitized by the Natural History Museum Library, London.

An examination of specimens that are identified as *Gonorhynchus* from the Bhima River were found to be morphologically distinct from *G. latius* and all other *Gonorhynchus* species. We consider these specimens to represent the species described as *C. wattanah* by Sykes (1839a, 1839b, 1841) based on similarities in meristics, body shape, and coloration (specifically the thin, dashed stripe along the lateral line). In his initial description, Sykes (1839a) stated that the names of new species, unless otherwise noted, were derived from the names used by the local people of Maharashtra, including *C. wattanah* (therein capitalized as *C. Wattanah*). We propose the common name Deccan Latia, in reference to the distribution of the species on the Deccan Plateau.

Diagnosis. A member of *Gonorhynchus* as diagnosed above. *Gonorhynchus wattanah* is differentiated from its congeners by the following combination of characters: absence of rostral flaps on tip of snout (vs. present in *G. bicornis*); larger specimens (> 65 mm SL) with small tubercles present all over head, occasionally extending onto the humeral, breast, and predorsal regions (vs. absent in all other species except *G. periyarensis* where tubercles are only present on the snout and cheek), and 20–24 rakers on the first gill arch (vs. 15–17 in *G. periyarensis*); thick midlateral stripe absent (vs. present in *G. burmanicus*). Cheek height in *G. wattanah* is generally larger (mean 26.0, range 21.2–29.8 % HL) than in *G. latius* (mean 18.9, range 14.4–24.6 % HL) and *G. diplochilus* (mean 19.7, range 12.7–22.8 % HL). Compared to *G. latius*, *G. wattanah* possesses modally fewer circumpeduncular scales (16 vs. 20), scales between the anus and anal-fin insertion (4½ vs. 6), and lateral-line scales (34 vs. 37).

Description. Morphometric and meristic data presented in Table 4. Body slightly arched dorsally, deepest at dorsal-fin insertion. Ventral profile from tip of snout to anal fin flat to slightly concave. Snout conical, rounded at end. Head short, longer than wide. Eyes dorsolateral. Dorsal-fin origin anterior of pelvic-fin origin. Pectoral fin reaching approximately halfway between pectoral-fin insertion and pelvic-fin origin. Pelvic fin to or slightly beyond anus. Anal fin not reaching base of caudal fin. Axillary pelvic lobe well-developed. Caudal fin forked.

TABLE 4. Morphometric and meristic values of *Gonorhynchus wattanah* from the Bhima and Godavari River basins. Data include the neotype.

MORPHOMETRICS			
	Neotype	Mean	Range
Standard length (mm)	86.7	58.2	31.9–86.7
% Standard length			
Predorsal length	45.6	46.3	44.8–48.7
Preanal length	78.8	78.4	76.5–80.5
Prepelvic length	52.0	52.8	51.3–56.1
Head length	19.7	20.5	19.1–22.5
Body depth at dorsal fin	20.9	21.6	18.8–25.2
Caudal-peduncle depth	11.6	10.8	9.4–11.9
Caudal-peduncle length	13.5	14.5	12.8–15.8
Dorsal-fin base length	16.9	16.1	14.8–17.8
Anal-fin base length	8.0	7.0	5.5–8.0
Pelvic-fin length	21.3	19.7	17.0–21.9
Pectoral-fin length	21.2	20.7	17.4–22.4
% Head Length			
Head depth	81.2	76.8	70.2–81.2
Head width	76.3	67.5	59.0–76.3
Snout length	38.5	34.7	28.8–38.5
Orbit diameter	26.9	31.5	26.9–37.6
Interorbital width	44.8	39.5	34.3–44.8
Mouth width	37.6	36.9	32.4–40.3
Width between rostral barbels	26.4	23.3	19.0–27.7
Postorbital length	37.4	34.6	31.0–40.1
Cheek height	29.8	26.0	21.2–29.8
Internarial width	27.4	25.6	23.6–29.5
MERISTICS			
		Mode	Range
Pectoral-fin rays	14	14	14
Lateral-line scales	35	34	34–35
Pored scales posterior to lateral line	3	2	2–3
Predorsal scales	10	9,10	9–10
Scales between dorsal-fin origin and lateral line	4½	4½	4½
Scales between anal-fin origin and lateral line	4½	4½	4½
Scales between pelvic-fin origin and lateral line	3½	3½	3½
Scales between anus and anal-fin origin	4	4	4–4½

Body entirely scaled; scales large. Lateral-line scales and pored scales on caudal fin 34–35 + 2–3 (mode 34 + 2), predorsal scales 9–10, scale rows above lateral line 4½, scale rows below lateral line 4½, circumpeduncular scales 16, 3½ scales rows between lateral line and pelvic-fin origin, 3½–4½ scales between anus and anal-fin origin (mode 4). Dorsal fin with 3 simple and 8½ branched rays; anal fin with 3 simple and 5½ branched rays; pelvic fin with 1 simple and 8 branched rays; pectoral fin with 1 simple and 14 branched rays; caudal fin with 10+9 principal rays, 9+8 branched). Abdominal vertebrae 23–24, caudal vertebrae 11–12, total vertebrae 35–36. Rakers on first gill arch 20–24 (based on 5 specimens from ANSP 85003 [n=1] and CAS-SU 41130 [n=4]).

Rostral cap covering upper lip which is not visibly separated from snout by groove and not attached to lower lip; rostral cap with 17–19 fimbriae superficial to upper jaw. Mouth inferior; upper lip very thin or absent, widening substantially at corner of mouth connecting upper jaw to lower; lower lip free only on anterior and lateral edges, posterior edge connected to underside of head (not modified into rounded mental disc), central region equally thick as lateral edges, anterior edge with large papillae; sublachrymal groove uniformly narrow from corner of mouth to rostral barbel, not expanding anteriorly to contain rostral lobe. Rostral barbels shorter than eye diameter; maxillary barbels present in 8 out of 9 specimens examined; when present, tiny, sometimes hidden in corner of mouth. Small tubercles on all surfaces of head in larger specimens, extending onto back, breast and/or flanks in largest specimens.

Color in 75% Ethanol. Dorsally light to dark brown. Flanks and lateral portions of head mottled dark brown, with irregular clusters of brown spots. Dark pigment around pores of lateral line, producing very thin dashed stripe in larger specimens. Venter cream to yellow. Dorsal-fin and pectoral-fins rays with dark stippling; inter-radial membranes otherwise clear. Anal fin and pelvic fins clear. Small, isolated dark spots on caudal fin, particularly in middle portion. Smaller specimens (43 mm SL and less) substantially less dusky; thin stripe around pores on lateral line present on anterior one-third of flank behind operculum.

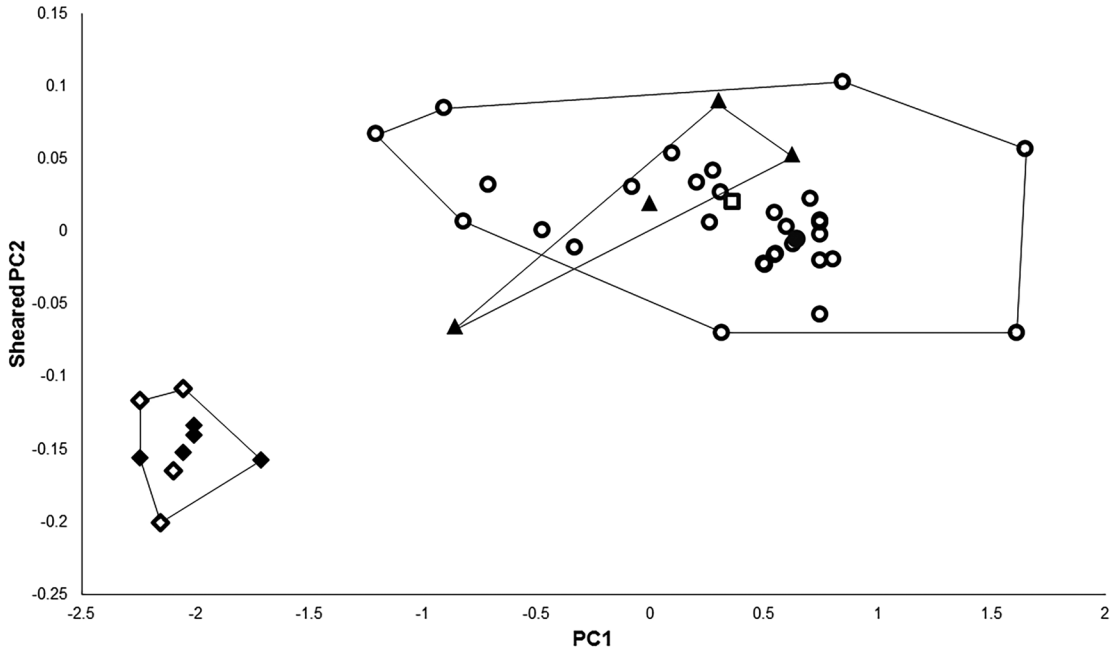

FIGURE 9. Plot of the first principal component of the meristic data (PC1) and the sheared second principal component (PC2) of *Gonorhynchus wattanah* from the Bhima (♦) and Godavari (◊) Rivers basins and *G. latius.* Filled circle (●) represents specimen from Surma River basin, open square (□) represents specimen from Hooghly River basin, open circles (○) represent specimens from the Ganges-Brahmaputra River basins, and filled triangles (▲) represent specimens from the Mahanadi River.

Remarks. In Figure 9, the minimum polygon clusters formed by plotting the second sheared principal component of the morphometric data against the first principal component of the meristic data for populations of *G. latius* and *G. wattanah* were compared. Size accounted for 93.7% of the observed variance and the second principal component accounted for 2.0%. Cheek height had the highest loading on the sheared second principal component (-0.63). The first principal component of the meristic data accounted for 60.0% of the total variance. Variables with the highest loadings were total lateral-line scales (0.41), lateral-line scales (0.38), scale rows above lateral line

(0.37), and scale rows between the pelvic-fin origin and lateral line. *Gonorhynchus wattanah* has a greater cheek height (mean 26.0, range 21.2–29.8 % HL) than *G. latius* (mean 18.9, range 14.4–24.6% HL). Scale counts in *G. wattanah* in general are lower than those of *G. latius* (Tables 2–4).

The specimens from the Godavari River are smaller than the Bhima River specimens and lack tubercles. Due to the similarity in body shape and meristic values (Fig. 9), and the occurrence in geographically close river basins, we consider the Godavari River population to be conspecific with the Bhima River populations, with these specimens likely representing sexually immature individuals. The southernmost distribution of *G. latius* is thus the Mahanadi River (Fig. 6). Specimens from the Mahanadi River are similar to *G. latius* from the Ganges, Brahmaputra, Surma, and Hooghly Rivers (all outflow into the Bay of Bengal at or near the Ganges Delta) in morphometrics, meristics, and pigmentation (Fig. 9, Tables 2–3).

Distribution. The species is distributed in the Krishna and Godavari River basins in western India (Fig. 10). Jadhav *et al.* (2011), Karat *et al.* (2012), and Laxmappa *et al.* (2015) report "*Crossocheilus cf. latius"* and "*Crossocheilus latius*" in other stretches of the Krishna River basin; presumably these were specimens of *G. wattanah*.

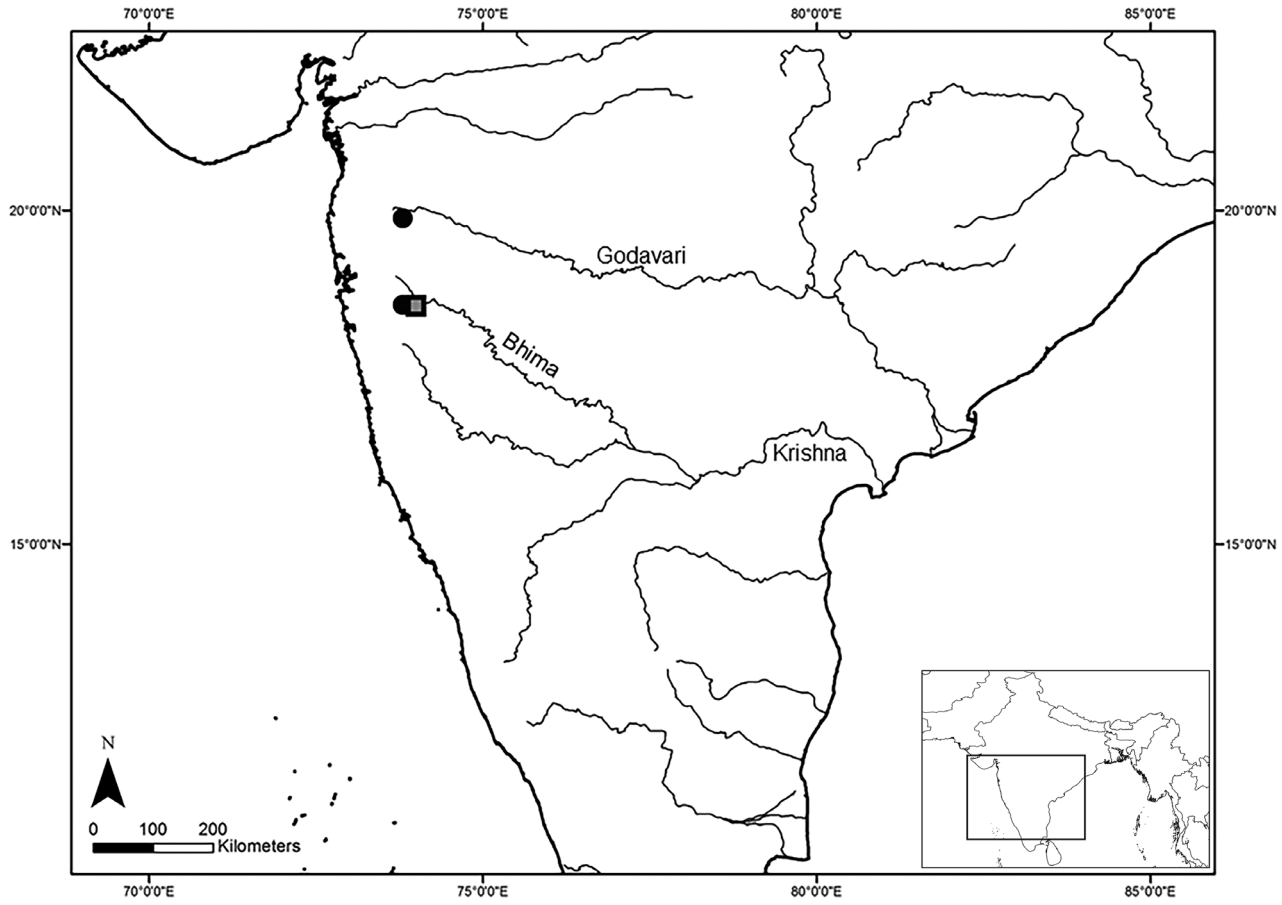

FIGURE 10. Distribution of specimens of *Gonorhynchus wattanah* examined from western India (inset). Grey square denotes the locality of the neotype.

Neotype Designation. There is no mention of type material in Sykes (1839a). In the more thorough description by Sykes (1841), an illustration is presented, presumably of one of the original specimens examined (Fig. 8), but again no type(s) are mentioned. An examination of museum records suggests that the material examined by Sykes is lost. While the illustration is available to designate as a lectotype (Article 74.4; ICZN 1999), we designate a neotype in accordance with Article 75 of the Code (ICZN 1999) in light of the historical confusion of this (and other) species in the genus and the presence of diagnostic characters in the neotype that are not evident in the illustrated specimen. Although tubercles are noted to be absent in this species by Sykes (1839a, 1839b, 1841), they are present in recently examined material and are an important diagnostic feature of the species. It seems likely that Sykes based his descriptions on females and/or sexually immature males. The following specimen

is selected as the neotype: ANSP 85003, received from the Indian Museum and collected at the right bank of the canal below the Empress Garden in Pune, India (Fig. 11). This specimen is from the Bhima River basin, near the type locality of *Chondrostoma wattanah* (Paragon, downstream of confluence of Bhima River and the Mula Mutha River), and possesses the characters diagnostic of *G. wattanah* (Table 4).

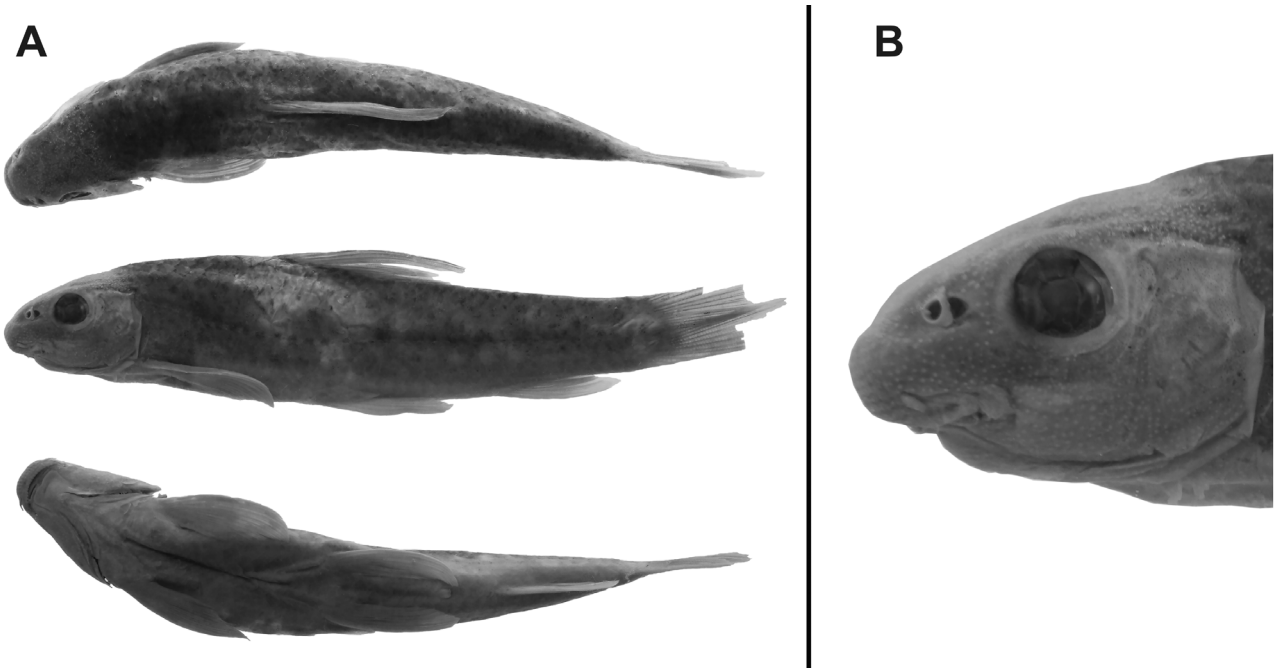

FIGURE 11. (A) Dorsal, lateral, and ventral views of the neotype of *Gonorhynchus wattanah*, ANSP 85003, 86.7 mm SL, Right bank of the canal, below Empress Garden, Pune, India; (B) Lateral view of head, enlarged.

Discussion

Four specimens of *Gonorhynchus* labeled "*Cirrhinus latius*" were examined from the Ghaggar River (ANSP 66010 and 66019, data not included above), a seasonal river located between the Ganges and Indus River basins in western India and eastern Pakistan. These specimens exhibit lateral-line scale counts (36–38) similar to those of *G. diplochilus*, but circumpeduncular scale counts (20) similar to those of *G. latius*. Additionally, the postorbital length (mean 38.5, range 34.8–43.5% HL) is similar to that of *G. diplochilus*, but the orbit diameter (mean 30.2, range 28.4–32.5 % HL) is similar to that of *G. latius* (see Diagnosis for *G. latius*). Because these individuals occur between the ranges of *G. latius* and *G. diplochilus* and exhibit characteristics of both species, we are unable to assign this population to either *G. latius* or *G. diplochilus* based on current data. We propose two hypotheses to explain these intermediate phenotypes. The first hypothesis is that populations recognized as *G. latius* and *G. diplochilus* are one species exhibiting gradation in morphological traits from one end of the range to the other. The overall morphological similarity between the Ganges (*G. latius*) and Indus (*G. diplochilus*) River forms and the placement of *G. latius* nested within *G. diplochilus* in a phylogenetic analysis of COI sequences (Sayyadzadeh *et al.* 2015) lend support to this hypothesis. The second hypothesis is the Ghaggar River populations represent an area of historical hybridization between *G. latius* and *G. diplochilus*. Archaeological, geochemical, and satellite imagery data suggest the Ghaggar River is the remnant of the perennial Saraswati River, and that the Sutlej and Yamuna Rivers, present day tributaries to the Indus and Ganges River basins, respectively, were headwater tributaries to this basin as recently as 10–50 kya (Lal 2002; Clift *et al.* 2012). These types of changes in stream configurations may have led to substantial mixture and hybridization of Ganges and Indus River *Gonorhynchus* populations in the Saraswati/Ghaggar River basin, resulting in these specimens with phenotypic characteristics of both species. Genetic analyses are clearly warranted to examine both of these hypotheses and determine the status of *Gonorhynchus* populations from the Ghaggar River. Based on the morphological differences between *G. latius* and *G. diplochilus* observed here and the long-held recognition as distinct species, we retain the names *G. latius* and *G. diplochilus* pending further data collection.

The phylogenetic relationships of four species in *Gonorhynchus* based on nuclear and mitochondrial genes were reported in Yang *et al.* (2012). *Gonorhynchus bicornis* and *G. burmanicus*, which are found on the eastern edge of the distribution of the genus in the Irrawaddy (*G. burmanicus* only) and Salween (*G. bicornis* and *G. burmanicus*) Rivers in Myanmar and Thailand, are resolved as sister species in a clade sister to *G. latius* and *G. diplochilus*, which are distributed west of the Irrawaddy River from India to Iran. Further phylogenetic analyses across the wide geographic ranges of species in this genus incorporating all putative taxa of *Gonorhynchus* would provide valuable insight into the phylogeography of the genus as well as confirm the specific status of species with small, endemic ranges (e.g., *G. macmahoni* and *G. periyarensis*).

Zhang & Kottelat (2006) erected the genus *Akrokolioplax* for *Epalzeorhynchos bicornis* (herein *Gonorhynchus bicornis*) based on the position and structure of movable lobes and flaps on the rostrum. Compared to *Epalzeorhynchos* in which the movable lobes are conical and are located just above the rostral barbel within an anteriorly expanded sublachrymal groove, in *G. bicornis* the flaps as described by Zhang & Kottelat (2006) are broadly triangular and are located on the tip of the snout dorsal to the sublachrymal groove. Although the flaps on the tip of the snout are unique among *Gonorhynchus* species and in species in the tribe Labeonini, phylogenetic analyses consistently place *G. bicornis* as sister to *G. burmanicus* (Zheng *et al.* 2010, 2012; Yang *et al.* 2012), and the oromandibular structures are otherwise similar to those of *Gonorhynchus* as discussed above (figs. 3B and 3B in Zhang & Kottelat 2006). Zhang & Kottelat (2006) also report 34–36 total vertebrae in specimens examined, consistent with data presented here.

Key to Species of the genus *Gonorhynchus*

A dichotomous key was constructed for *Gonorhynchus* based on data collected here and characters reported in Menon & Jacob (1996) for *G. periyarensis*. Species distributions by river basin are provided in parentheses after species names.

1 Triangular rostral flaps present on tip of snout . . . . . *G. bicornis* (Salween River)
- Rostral flaps absent 2
2 Large specimens (> 65 mm SL) with tubercles on snout and cheeks 3
- Large specimens without tubercles 4
3 15–17 rakers on first gill arch, tubercles only on cheeks and snout . . . . . *G. periyarensis* (Periyar River)
- 20–24 rakers on first gill arch, tubercles on head, occasionally extending onto humeral, breast, and predorsal regions. . . . . *G. wattanah* (Bhima and Godavari Rivers)
4 Thick midlateral stripe coloring entirety of midlateral scales and partially coloring scales above and below; dorsolateral spots, if present, form uniform reticulated pattern; crescent-shaped spot present on 5th–6th lateral-line scales and extending onto anterior halves of scales above and below. . . . . *G. burmanicus* (Irrawaddy and Salween Rivers)
- Thick midlateral stripe absent, although thin stripe (less than one scale wide) may be present; dorsolateral spots, if present, forming irregular patches, not uniform reticulated pattern; crescent-shaped spot occasionally present on 5th–6th lateral-line scale 5
5 Total lateral-line scales 40 (rarely 36–38); restricted to drainages of the Bay of Bengal . . . . . *G. latius* (Ganges, Brahmaputra, Meghna, Subarnarerkha, and Mahanadi Rivers)
- Total lateral-line scales 35–38; restricted to drainages of the Arabian Sea and the Gulf of Oman, and inland endorheic basins in Afghanistan and Iran 6
6 Rostral fold without fringes. . . . . *G. macmahoni* (Dasht River)
- Rostral fold with fringes . . . . . *G. diplochilus* (Indus, Sistan, and Helmand Rivers; coastal drainages of the Gulf of Oman)

Material examined. *Gonorhynchus latius*: Bangladesh: Netrokona: AUM 55299 (examined photo) (1); Sylhet: AUM 60869 (examined photo) (1), UMMZ 208722 (1); India: Bihar: USNM 205763 (2); Orissa: CAS 61828 (2), FMNH 5716 (2); West Bengal: BMNH 1867.5.12.15 (holotype of *Crossochilus rostratus*, examined photo), CAS-SU 41131 (9), 69910 (1), UMMZ 244747 (2), 244772 (1), 244858 (1), 244942 (1); Uttar Pradesh: USNM 165062 (2); Nepal: Gulmi/Syangja: KU 29031 (5), 29037 (3); Kailali: KU 29451 (5); Kanchanpur: KU 28688 (11), 28725 (6); Nawalparasi: KU 28855 (4); Nawalparasi/Tanahun: KU 29006 (3); Rautahat/Sarlahi: KU 28639 (1); Saptari/Sunsari: KU 28563 (6). ***Gonorhynchus diplochilus*:** Afghanistan: Kandahar: USNM 182278 (5); India: Himachal Pradesh or Punjab: ANSP 65989 (5); Jammu and Kashmir: UMMZ 201609 (2), USNM 12576 (1); Iran: Sistan and Baluchestan: BMNH 1919.8.16.7-8 (paratypes of *Discognathus adiscus*, examined photo) (2), USNM 205892 (4), 205897 (1); Kashmir region (country unclear): NMW 48820-1 (syntype of *Barbus diplochilus*, examined photo);

Pakistan: Punjab: USNM 271244 (1), 271246 (3), 271248 (1), 271252 (5); Sindh: CAS 24234 (2). ***Gonorhynchus bicornis*:** Thailand: Mae Hong Song: UF 183871 (1), UMMZ 215983 (21). ***Gonorhynchus burmanicus*:** Thailand: UF 183835 (2), 183837 (1); Myanmar: Kachin State: USNM 372190 (2), 372384 (2); Shan State: USNM 390465 (2). ***Gonorhynchus macmahoni*:** Pakistan: Balochistan: NMW 81256 (syntype of *Labeo macmahoni*, examined photo). ***Gonorhynchus* sp.:** India: State Unclear: ANSP 66010 (1), 66019 (3). ***Gonorhynchus wattanah*:** India: Maharashtra: ANSP 85003 (1), CAS-SU 34570 (4); 41130 (4). ***Epalzeorhynchos frenatus*:** Thailand: Ubon Ratchitani: UF 169911 (5). ***Garra cambodgiensis*:** Thailand: Nakhon Si Thammarat: UF 182838 (6). ***Garra fasciacauda*:** Thailand: Nakhon Si Thammarat: UF 183611 (8). ***Crossocheilus atrilimes*:** Thailand: Ubon Ratchithani: UF 170101 (1), 185188 (1). ***Crossocheilus cobitis*:** Indonesia: Borneo: USNM 230160 (1). ***Crossocheilus oblongus*:** Thailand: Kanchanaburi: UF 173140 (1); Loei: CAS 63035 (1); Indonesia: Sumatra: UF 166341 (2). ***Crossocheilus reticulatus*:** Thailand: Ubon Ratchithani: UF 185185 (5). ***Crossocheilus stigmaeus*:** Thailand: Chiang Mai: USNM 109763 (paratype of *Epalzeorhynchus stigmaeus*), 109765 (holotype of *Epalzeorhynchus stigmaeus*).

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