

REVISION OF THE ASIAN CATFISH GENUS *HEMIBAGRUS* BLEEKER, 1862 (TELEOSTEI: SILURIFORMES: BAGRIDAE)

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ABSTRACT. — The Asian bagrid catfish genus *Hemibagrus* is revised. Eight species groups (*H. baramensis*, *H. guttatus*, *H. menoda*, *H. nemurus*, *H. olyroides*, *H. planiceps*, *H. pluriradiatus*, and *H. wyckii* species groups) are recognised, some of which may be natural. They can be diagnosed chiefly by a combination of characters: vertebral number, length of the adipose-fin base, and colouration. The identification of *Hemibagrus* species is difficult mainly because of the lack of well-defined characters and considerable plasticity in measurements commonly used for diagnosing species in other catfish groups. In this study, other taxonomic characters have been investigated to determine their usefulness in differentiating the species. It was found that morphological characters associated with the adipose fin (length of adipose-fin base, dorsal to adipose distance, and shape of adipose fin), head (shape of snout and head width relative to its length), and eye (eye diameter and interorbital distance) are characters useful in species differentiation. Thirty-two valid species are recognised in this study, of which three are described as new, viz. *H. divaricatus* from western Peninsular Malaysia, *H. lacustrinus* from Danau Singkarak and its associated drainages in western Sumatra, and *H. semotus* from northeastern Borneo.

KEY WORDS. — Ostariophysi, freshwater fish, Southeast Asia, East Asia, South Asia, biogeography, neotypes

INTRODUCTION

The Old World catfish family Bagridae, commonly found throughout fresh- and brackish-water bodies in Asia and Africa, includes more than 200 species in 17 genera and is one of the largest catfish families presently recognised (Mo, 1991; Ferraris, 2007). The family has been poorly defined until its revision by Mo (1991), who established the families Austroglanididae and Claroteidae for all African genera (except *Bagrus*) previously considered members of the Bagridae. Mo's study of the Bagridae also led to the description of several new genera and to the revalidation of others. Among the genera revalidated was the genus *Hemibagrus* Bleeker, 1862, which was long considered a junior synonym of *Mystus* Scopoli, 1777, or *Macrones* Duméril, 1856, by numerous authors (e.g., Weber & de Beaufort, 1913).

Species of the catfish genus *Hemibagrus* are large riverine catfishes found in all river drainages east from the Godavari River drainage in India and south from the Changjiang (Yangtze) River drainage in China. The genus reaches its greatest diversity in Southeast Asia, where 32 of the

40 nominal species now known occur. Throughout its geographical range, and particularly in Southeast Asia, species of *Hemibagrus* are valuable food fishes, primarily because of their large size (more than 1 m in length in some species) and its valuable flesh. To this effect, *Hemibagrus* has been cultured for food in some parts of East and Southeast Asia, most notably in Peninsular Malaysia and Thailand, where numerous studies have been conducted to aid in increasing the efficiency of aquaculture (Khan et al., 1993, 1996; Khan, 1994; Amornsakon, 2000; Eguia et al., 2000; Ng, Tee & Boey, 2000; W. K. Ng et al., 2000; Zakaria et al., 2000; Ng et al., 2001; Abidin et al., 2006). Besides, *Hemibagrus* species have been utilised as experimental animals (Hocque et al., 1998) and some of the more colourful species (e.g., *H. wyckii* and *H. wyckioides*) are also exported as ornamental fish.

Currently, the taxonomy of *Hemibagrus* is confusing and the validity of many nominal species is unclear. Mo's (1991) rehabilitation of *Hemibagrus* was not accompanied by a comprehensive examination of types of all the nominal species; several species (e.g., *H. aubentoni* and *H. microphthalmus*) were incorrectly retained in *Mystus*. A recent checklist of catfish species by Ferraris (2007) recognises one

fossil and 32 extant species. The first author and colleagues have been working on several geographically delimited reviews of *Hemibagrus* species: Ng & Rainboth (1999) for the Indochinese species and Ng & Ferraris (2000) for the South Asian species, as part of the complete revisionary study presented herein. This revision upholds the results of these two studies, with the exception of the recognition of only two (instead of three) species of the *H. nemurus* species group in Indochina. The revision primarily utilises morphological evidence and with supporting evidence from analysis of a 300-bp sequence of the *cytb* gene in the mitochondrial DNA (amplified using the method of Taylor & Dodson, 1994; see Ng & Dodson, 1999 for detailed methodology) for some species.

MATERIAL AND METHODS

Measurements were made point to point with dial callipers and data recorded to the nearest 0.1 mm if <330 mm or made with a measuring tape and recorded to the nearest 1 mm if >330 mm. Counts and measurements were made on the left side of specimens whenever possible. Subunits of the head are presented as percent of head length (HL). Head length and measurements of body parts are given as percent of standard length (SL).

The predorsal, preanal, prepelvic and prepectoral lengths are measured from the tip of the snout to the anterior basis of the dorsal, anal, pelvic and pectoral fins, respectively. The dorsal-fin length is measured from the base of the dorsal spine to the tip of the longest dorsal-fin ray (or filament). The length of the dorsal- and anal-fin bases includes the respective bases of the first and last rays. The length of the pelvic and pectoral fin is measured from the origin to the tip of the longest ray. The length of the dorsal and pectoral spines is measured from the base to the tip. The length of the adipose-fin base is measured from the anteriormost point of origin to the posteriormost point of the adipose-fin base. The maximum height of the adipose fin is the maximum vertical distance between the base and the upper edge of the fin. The dorsal to adipose distance is measured from the base of the last dorsal-fin ray to the origin of the adipose fin. The post-adipose distance is measured from the posteriormost point of the adipose-fin base to the middle of the base of the caudal fin. The length of the caudal-fin length is the length of the longest ray of the lower lobe measured from the middle of the base of the caudal fin. The length of the caudal peduncle is measured from the base of the last anal-fin ray to the posterior edge of the hypural complex. The depth of the caudal peduncle is the least vertical distance from the midline of the dorsal surface to the midline of the ventral surface. The depth of the body at anus is measured as the vertical distance from the midline of the dorsal surface (of the body) to the midline of the ventral surface at the anus.

The length of the head is measured from the tip of the snout to the posteriormost extremity of the fleshy opercular flap. The width of the head is measured at its widest point but discounting any lateral projection of the branchiostegal

membrane. The depth of the head is measured at the base of the supraoccipital. The length of the snout is measured from the tip of the snout to the anterior orbital margin. The interorbital distance is the narrowest distance between the orbital rims. The diameter of the eye is the greatest horizontal length of the eyeball. The length of the nasal, maxillary and mandibular barbel is measured from the base to the tip. The measurements are schematically illustrated in Fig. 1.

Fin ray counts were obtained under a binocular dissecting microscope using transmitted light. Vertebral counts were taken from radiographs (which were obtained using a Hitex HAC-60 x-ray radiography system) following the method of Roberts (1994), i.e., the first vertebra bearing fully developed ribs was counted as the sixth, and the first caudal vertebra is taken to be the anteriormost vertebra having its haemal spine posterior to the anteriormost anal fin pterygiophore. Numbers in parentheses following a particular count are the numbers of examined specimens with that count. Drawings of the specimens were made with a Nikon SMZ-10 camera lucida.

In this study, the following geographical regions are defined:

1. South Asia consists of the Indian subcontinent and drainages in Myanmar west of (and including) the Salween River drainage in eastern Myanmar and western Thailand.
2. Southeast Asia consists of drainages east of the Salween River drainage and south of (but excluding) the Red River drainage in northern Vietnam. Note that this definition of Southeast Asia includes the drainages on the Greater Sunda Islands (Sumatra, Java and Borneo). Sundaic Southeast Asia is a subset of this region, consisting of the river drainages on the Greater Sunda Islands, and the Malay Peninsula south of the Isthmus of Kra.
3. East Asia consists of drainages in mainland Asia north of (and including) the Red River drainage.

Points on distribution maps represent localities for which material has been examined. Records from the literature are not indicated on the maps.

The material examined for this study is deposited in the following collections:

AMNH	American Museum of Natural History, New York, USA
AMS	Australian Museum, Sydney, Australia
ANSP	Academy of Natural Sciences, Philadelphia, USA
BMNH	Natural History Museum, London, UK
CAS	California Academy of Sciences, San Francisco, USA
CMK	Collection of Maurice Kottelat, Cornol, Switzerland
FMNH	Field Museum of Natural History, Chicago, USA
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, USA

MNHN	Muséum National d'Histoire Naturelle, Paris, France	ZMA	Zoölogisch Museum, Universiteit van Amsterdam, Amsterdam, The Netherlands
MZB	Museum Zoologicum Bogoriense, Cibinong, Indonesia	ZMH	Zoologisches Institut und Zoologisches Museum der Universität Hamburg, Hamburg, Germany
NMBE	Naturhistorisches Museum, Bern, Switzerland	ZMUH	Zoological Museum, University of Hanoi, Hanoi, Vietnam
NMW	Naturhistorisches Museum, Vienna, Austria	ZRC	Zoological Reference Collection, Raffles Museum of Biodiversity Research, Singapore
NRM	Naturhistoriska Riksmuseet, Stockholm, Sweden	ZSI	Zoological Survey of India, Calcutta, India
RMNH	Nationaal Natuurhistorisch Museum, Leiden, The Netherlands		
SBM	Sabah Museum, Kota Kinabalu, Malaysia		
UBD	University Brunei Darussalam, Bandar Seri Begawan, Brunei		
UMMZ	University of Michigan Museum of Zoology, Ann Arbor, USA		
USNM	National Museum of Natural History, Washington DC, USA		

In the listing of synonyms, the original description is listed first, followed by its synonyms in chronological order. As far as possible, the synonymies have been verified by examination of the material in question. The discussion of the taxonomy of *Hemibagrus* in this work proceeds as follows: species groups are created and defined for species that share

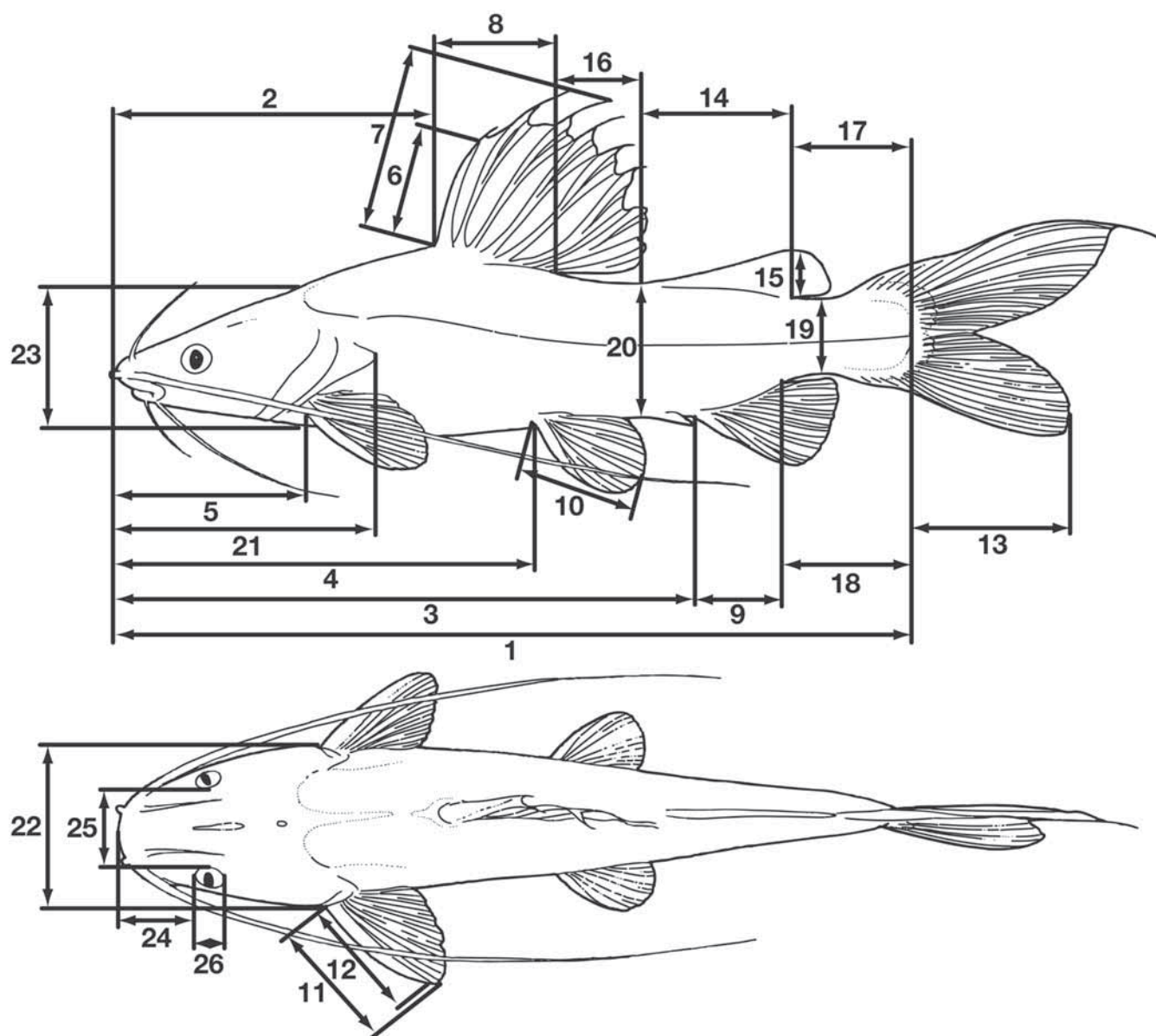


Fig. 1. Method of measurements used in this study: 1, Standard length; 2, Predorsal length; 3, Preanal length; 4, Prepelvic length; 5, Prepectoral length; 6, Dorsal-spine length; 7, Dorsal-fin length; 8, Length of dorsal-fin base; 9, Length of anal-fin base; 10, Pelvic-fin length; 11, Pectoral-fin length; 12, Pectoral-spine length; 13, Caudal-fin length; 14, Length of adipose-fin base; 15, Maximum height of adipose fin; 16, Dorsal to adipose distance; 17, Post-adipose distance; 18, Length of caudal peduncle; 19, Depth of caudal peduncle; 20, Body depth at anus; 21, Head length; 22, Head width; 23, Head depth; 24, Snout length; 25, Interorbital distance; 26, Eye diameter.

unique character sets. The species groups are then treated as distinct units, and comparisons (and discussions) made within the species groups. This avoids trivial and lengthy comparisons between obviously unrelated species.

The phylogenetic species concept (following de Pinna, 1999) is used to determine and diagnose species recognised in this study. This concept, emphasizing diagnosability and distinctness of populations in geographically widespread and polytypic species, has been used for other catfish species (e.g., Buitrago-Suárez & Burr, 2007). Many of the species are also diagnosed by unique combinations of characters, rather than discrete autapomorphies. This does not conflict with the requirement of the species as a monophyletic entity, because at least one of the characters in the combination will be uniquely derived in this context (Kullander, 2002).

TAXONOMY

Hemibagrus Bleeker, 1862

Hemibagrus Bleeker, 1862: 9 (type species: *Bagrus nemurus* Valenciennes, in Cuvier & Valenciennes, 1840, by original designation).

Macropteroagrus (subgenus of *Hemibagrus*) Nichols, 1925: 1 (type species: *Hemibagrus macropterus* Bleeker, 1870, by monotypy).

Brachymystus (subgenus of *Mystus*) Fowler, 1937: 148 (type species: *Bagrus nemurus* Valenciennes, in Cuvier & Valenciennes, 1840, by original designation). Objective junior synonym of *Hemibagrus* Bleeker, 1862.

Diagnosis. — *Hemibagrus*, *Sperata* and *Bagrus* form a natural group distinguished from other bagrid catfishes in having a combination of the following characters (after Mo, 1991): mesethmoid highly depressed (vs. not highly depressed), prominent (vs. reduced) dorsoposterior laminar extension of the mesethmoid, the first infraorbital with (vs. lacking) a posterolateral spine, enlarged (vs. moderate or small) premaxilla, and the metapterygoid with a long, free posterior margin (vs. contacting quadrate and hyomandibular). *Hemibagrus* is diagnosed from *Sperata* in having a relatively short and slender (vs. enlarged and elongate) interneural and in lacking (vs. having) a concave surface in the posterior portion of the posttemporal in which part of the swimbladder resides, and from *Bagrus* in having 7–(very rarely) 8 (vs. 8–10) soft dorsal-fin rays (Mo, 1991). Externally, *Hemibagrus* species are distinguishable by their moderate to large sizes, and strongly depressed heads (the interorbital region is typically flat or gently convex).

Description. — Body moderately compressed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile flat to anal-fin base, then sloping gently dorsally from there to end of caudal peduncle. Anus and urogenital openings separate; former located at vertical through middle of adpressed pelvic fin, latter located at vertical through tip of adpressed pelvic fin. Skin smooth.

Lateral line complete and midlateral. Vertebrae 22–31 + 20–30 = 42–61.

Head depressed and broad, acutely triangular when viewed laterally and with rounded snout margin when viewed from above. Fleshy upper lip extending anteriorly beyond upper jaw. Gill openings wide, extending from exposed surface of posttemporal to beyond isthmus. Gill membranes free from, and not attached across, isthmus. Bony elements of dorsal surface of head covered with thin skin; bones readily visible, ornamented with fine, irregular radial grooves. Midline of cranium with fossa extending from base of supraoccipital to a point midway between anterior orbital margin and tip of snout; posterior half of fossa occupied by posterior fontanel, separated from slender anterior fontanel by wide epiphyseal bar. Lateral fontanel small. Supraoccipital spine elongate, with parallel sides and blunt posterior tip buried in flesh in most individuals.

Barbels in four pairs. Maxillary barbel long and slender, extending at least to anterior origin of adipose fin and often to end of caudal peduncle. Nasal barbel slender, extending past anterior margin of orbit and sometimes to its posterior edge. Inner mandibular-barbel origin close to midline; barbel thicker and longer than nasal barbel and extending to level of posterior edge of orbit. Outer mandibular barbel originating posterolateral of inner mandibular barbel, extending past pectoral-fin origin.

Eye ovoid, horizontal axis longest; located entirely in dorsal half of head. Orbit with free margin.

Mouth subterminal, premaxillary tooth band sometimes partially exposed when mouth is closed. Oral teeth small and viliform, in irregular rows on all tooth-bearing surfaces. Premaxillary tooth band rounded, of equal width throughout. Dentary tooth band much narrower than premaxillary tooth band at symphysis, tapering laterally. Vomerine tooth band unpaired, continuous across midline; smoothly arched along anterior margin, tapering laterally into a point extending posteriorly well past level of premaxillary band; band width narrower than premaxillary band at midline, widening laterally and then tapering to a sharp point posterolaterally.

Gill openings wide, extending from posttemporal to beyond isthmus. Gill membranes free from isthmus, with 9–12 branchiostegal rays. First branchial arch with 3–6 + 6–16 rakers.

Dorsal fin located above middle of body; origin nearer tip of snout than caudal flexure, with 7–(very rarely) 8 fin rays. Dorsal-fin margin convex, usually with anterior branch of fin rays longer than other branches. First two or three rays usually with anterior branch elongated as filament in intact individuals. Last ray without posterior membranous connection to body. Spine long, straight and robust in most species, short and weakly-ossified in others.

Adipose-fin margin convex or straight for entire length; posterior end deeply incised.

Caudal fin deeply forked; upper lobe pointed and lower lobe rounded, with i,7–8,7–8,i rays. Principal ray of upper lobe sometimes extending as filament in intact specimens of some species. Procurent rays symmetrical and extend only slightly anterior to fin base.

Anal-fin base ventral to posterior half of adipose fin. Fin margin curved or straight, with iii–v,7–11 rays. Last ray without posterior membranous connection to body.

Pelvic-fin origin at vertical through posterior end of dorsal-fin base. Fin with i,5 rays; fin margin slightly convex, tip of adpressed fin not reaching anal-fin origin.

Pectoral fin with stout spine, sharply pointed at tip, with 7–11 fin rays. Anterior spine margin granular or with small serrations along entire length; posterior spine margin with strong serrations along entire length. Fin margin straight anteriorly, convex posteriorly.

Remarks.—Bleeker (1862) established the genus *Hemibagrus* for a group of bagrid catfishes that he characterised by having a depressed head, rugose head shield not covered by skin, slender occipital process, and moderately long adipose fin (see also Bleeker, 1863a). Günther (1864) soon synonymised *Hemibagrus* with *Macrones* (a name used by earlier authors for *Mystus*; *Macrones* Duméril, 1856 is preoccupied by *Macrones* Newman, 1841 in Coleoptera and *Mystus* Scopoli, 1777 was revived by Fowler (1928) as a replacement name), although he recognised it as a “subgenus” (he considered *Hemibagrus* a “group” of *Macrones*) characterised in having the adipose fin shorter than the anal fin and lacking a separate interneural shield. Later authors have tended to follow Günther’s synonymy of *Hemibagrus* with *Macrones* or *Mystus*, with a few exceptions (e.g., Nichols, 1925; Vinciguerra, 1926).

Nichols (1925) recognised that the East Asian *Hemibagrus* are morphologically very distinct from Southeast Asian species, and described a new subgenus, *Macropterobagrus*, for them. He characterised *Macropterobagrus* as species of *Hemibagrus* with an elongate body, very long adipose fin, depressed head and weakly forked caudal fin, and noted that it should be raised to a full genus, should further differences characterising the East Asian species be found in the future.

As indicated in the synonymy of *Hemibagrus*, members of the genus have been recognised as a group distinct from all other *Mystus* even when *Hemibagrus* was considered a junior synonym of *Mystus*. Fowler (1937) recognised this in describing a new subgenus of *Mystus*, *Brachymystus*, as a group of species with a broad, obtuse, and nearly truncate snout, very short rictal fold, large and depressed head, and maxillary barbels extending to anal fin. The type species of *Brachymystus* is *Bagrus nemurus* Valenciennes, in Cuvier & Valenciennes 1840, which is also the type species of *Hemibagrus* Bleeker. According to Article 61.3.3 of the International Code for Zoological Nomenclature (International Commission for Zoological Nomenclature, 1999), this makes

Brachymystus Fowler, 1937 a junior objective synonym of *Hemibagrus* Bleeker, 1862.

Although he did not find any unique synapomorphies that characterised the genus, Mo (1991) rediagnosed *Hemibagrus* to include species with the characters outlined in the diagnosis (a highly depressed mesethmoid with a prominent dorsoposterior laminar extension, a posterolateral spine on the first infraorbital, an enlarged premaxilla, a long, free posterior margin on the metapterygoid, a relatively short and slender interneural, the absence of a concave surface in the posterior portion of the posttemporal, and having 6 soft dorsal-fin rays). Although he also diagnosed *Hemibagrus* as having 10 or more branchiostegal rays, the results of our study indicate that some species have as few as 9 branchiostegal rays (a number also found in other bagrid genera such as *Mystus*; Ng, 2002).

Ng & Ng (1995) divided the Sundaic *Hemibagrus* (they did not examine any Chinese or Indian species except for the holotype of *Macrones elongatus*) into four species groups to aid comparison and discussion. The species groups were defined according to the number of vertebrae, body colour (particularly the presence or absence of a dark midlateral line), and the degree to which the longest dorsal-fin ray overlaps the adipose fin. A brief summary of characters that defined each group is given below:

Group 1 — 43–45 vertebrae, dark midlateral line present, longest adpressed dorsal-fin ray just reaching adipose fin.

Group 2 — 43–46 vertebrae, dark midlateral line sometimes present, longest adpressed dorsal-fin ray reaching or covering at least the first third of the adipose fin.

Group 3 — unknown number of vertebrae (probably 43–45), mottled body colouration, longest adpressed dorsal-fin ray covering at least the first third of the adipose fin.

Group 4 — 47–50 vertebrae, dark midlateral line absent, longest adpressed dorsal-fin ray not or just reaching the first third of the adipose fin.

After examining a very large series of specimens, it was found that the characters used may not always distinguish the species groups of Ng & Ng (1995) reliably, nor do they allow easy assignment of many of the species to any one of the groups. In particular, it was found that the members of the first three groups, with the exception of the incorrectly-placed *H. baramensis*, actually refer to *H. nemurus* and closely-related species (defined below as belonging to a single species group).

As defined in Tan & Kottelat (1998), a species group is “an assemblage of species sharing a set of diagnostic characters, which may or may not be a monophyletic lineage”. The creation of species groups within *Hemibagrus* no doubt greatly simplifies comparisons and discussions by avoiding trivial and lengthy comparisons with obviously unrelated

species (see Tan & Kottelat, 1998, for similar justification for their study of the genus *Betta*). Considering the poor characterisation of species groups of *Hemibagrus* by Ng & Ng (1995), it is necessary to redefine them here, with more distinct and reliable characters. The following species groups are here defined as:

1. *Hemibagrus baramensis* species group — characterised by 43–46 vertebrae and a long-based adipose fin that spans most of the postdorsal distance (greater than 20% SL). Nominal species in this group: *Macrones baramensis* Regan, 1906, *Mystus sabanus* Inger & Chin, 1959, and *Hemibagrus furcatus* Ng, Martin-Smith & Ng, 2000. Valid species in this group: *H. baramensis*, *H. sabanus*, and *H. semotus* new species.
2. *Hemibagrus guttatus* species group — characterised by 51–59 vertebrae, a very long-based adipose fin that spans most of the postdorsal distance (greater than 30% SL), and a colour pattern consisting of a grey or brown body with numerous dark brown spots usually present. Nominal species in this group: *Pimelodus guttatus* La Cèpède, 1803, *Macrones elongatus* Günther, 1864, *Hemibagrus macropterus* Bleeker, 1870, *Macrones chinensis* Steindachner, 1883, *Aoria amemiyae* Kimura, 1934, *Hemibagrus elongatus hongus* Mai, 1978, *Hemibagrus vietnamicus* Mai, 1978, *Hemibagrus camthuyensis* Nguyễn, 2005 and *Hemibagrus dongbacensis* Nguyễn, 2005. Valid species in this group: *H. guttatus*, *H. macropterus*, and *H. vietnamicus*.
3. *Hemibagrus menoda* species group — characterised by 44–46 vertebrae, a short-based adipose fin (less than 20% SL), and a pattern of either distinct black spots arranged in vertical columns along the sides of the body or with irregular black vertical lines running along the sides of the body. The caudal fins in the members of this species group usually have a reddish or orange hue in life. Nominal species in this group: *Pimelodus menoda* Hamilton, 1822, *Bagrus corsula* Valenciennes, in Cuvier & Valenciennes 1840, *Bagrus trachacanthus* Valenciennes, in Cuvier & Valenciennes 1840, *Bagrus punctatus* Jerdon, 1849, *Macrones peguensis* Boulenger, 1894 and *Hemibagrus caveatus* Ng, Wirjoatmodjo & Hadiaty, 2001. Valid species in this group: *H. caveatus*, *H. menoda*, *H. peguensis*, and *H. punctatus*. Members of the *H. menoda* species group are morphologically very similar to those of the *H. nemurus* species group, the only difference being the presence of dark spots or lines on the sides of the body in the former. It is possible that the *H. menoda* species group is not monophyletic in the absence of the *H. nemurus* species group (and vice versa), but this awaits further investigation. As the objective of delimiting species groups is to simplify comparisons (and not to indicate phylogenetic relationships within the genus), we maintain the distinctiveness of the *H. menoda* and *H. nemurus* species groups here.
4. *Hemibagrus nemurus* species group — characterised by 43–46 vertebrae, a short-based adipose fin (less than 20% SL) and a uniformly coloured body without any distinct black spots on the lateral line. The caudal fins in the members of this species group are usually greyish in life. Nominal species in this group: *Bagrus nemurus* Valenciennes, in Cuvier & Valenciennes, 1840, *Bagrus hoevenii* Bleeker, 1846, *Bagrus sieboldii* Bleeker, 1846, *Macrones bleekeri* Volz, 1903 (not *Macrones bleekeri* Day, 1877), *Macrones bo* Popta, 1904, *Macrones fortis* Popta, 1904, *Macrones fortis* var. *capitulum* Popta, 1904, *Macrones howong* Popta, 1904, *Mystus johorensis* Herre, 1940, *Mystus pahangensis* Herre, 1940, *Macrones filamentus* Chaux & Fang, 1949, *Hemibagrus chrysops* Ng & Dodson, 1999, and *Hemibagrus spilopterus* Ng & Rainboth, 1999. Valid species in this group: *H. capitulum*, *H. filamentus*, *H. fortis*, *H. hoevenii*, *H. nemurus*, and *H. spilopterus*.
5. *Hemibagrus olyroides* species group — characterised by an elongate body with 48–49 vertebrae, a long-based adipose fin that spans most of the postdorsal distance (greater than 20% SL), a poorly ossified, relatively short dorsal spine lacking serrations on the posterior edge, a caudal fin with an elongate and lanceolate upper lobe, and a very dark brown colouration. Nominal species in this group: *Mystus olyroides* Roberts, 1989. This species is valid.
6. *Hemibagrus planiceps* species group — characterised by an elongate body with 47–51 vertebrae, a short-based adipose fin (less than 20% SL) and a body without dark midlateral line. Nominal species in this group: *Bagrus planiceps* Valenciennes, in Cuvier & Valenciennes, 1840, *Bagrus anisurus* Valenciennes, in Cuvier & Valenciennes, 1840, *Bagrus flavus* Bleeker, 1846, *Macrones bongan* Popta, 1904, *Hemibagrus gracilis* Ng and Ng, 1995, and *Hemibagrus velox* Tan & Ng, 2000. Valid species in this group: *H. bongan*, *H. divaricatus* new species, *H. gracilis*, *H. lacustrinus* new species, *H. planiceps* and *H. velox*.
7. *Hemibagrus pluriradiatus* species group — characterised by 47–50 vertebrae and a long-based adipose fin that spans most of the postdorsal distance (greater than 20% SL). Nominal species in this group: *Macrones pluriradiatus* Vaillant, 1892, *Leiocassis hainanensis* Tchang, 1935, *Hemibagrus centralus* Mai, 1978, *Hemibagrus imbrifer* Ng & Ferraris, 2000, *Hemibagrus variegatus* Ng & Ferraris, 2000, *Hemibagrus chiemhoensis* Nguyễn, 2005, *Hemibagrus songdaensis* Nguyễn, 2005 and *Hemibagrus taybacensis* Nguyễn, 2005. Valid species in this group: *H. centralus*, *H. hainanensis*, *H. imbrifer*, *H. pluriradiatus* and *H. variegatus*.
8. *Hemibagrus wyckii* species group — characterised by a broad, very depressed head, 50–54 vertebrae, and light-coloured procurrent and outer principal caudal-rays. Nominal species in this group: *Bagrus wyckii* Bleeker, 1858, *Macrones microphthalmus* Day, 1878, *Macrones wyckioides* Chaux & Fang, 1949, *Mystus maydelli* Rössel, 1964, *Mystus aubentoni* Desoutter, 1975 and *Mystus krishnensis* Ramakrishniah, 1988. Valid species in this

group: *H. maydelli*, *H. microphthalmus*, *H. wyckii*, and *H. wyckioides*.

Although the species groups recognised here are created for the convenience of comparison and discussion, some of them may represent natural groups. An analysis of a portion of the *cyt b* gene on the mitochondrial DNA (amplified using the method of Taylor & Dodson, 1994; see Ng & Dodson, 1999 for detailed methodology) revealed that species that are more genetically similar to each other tend to be members within the species groups as defined here (J. J. Dodson, pers. comm. to HHN). For instance, the species grouped into the *H. planiceps* species group are all more similar to each other than to other congeners (likewise for the members of the *H. baramensis* species group), evidence that these species groups may in fact be natural lineages.

Artificial key to the species groups of *Hemibagrus*

1. Adipose-fin base relatively long, spanning more than three quarters of postdorsal distance.....2
 - Adipose fin-base relatively short, spanning less than three quarters of postdorsal distance.....4
2. Body uniform, with numerous dark spots (China, northern Indochina).....*H. guttatus* species group
 - Body uniform or mottled, without spots.....3
3. Dorsal spine poorly ossified, thinner than branched dorsal-fin rays; caudal fin with upper lobe elongate, lanceolate (Borneo).....*H. olyroides* species group
 - Dorsal spine well ossified, at least as thick as branched dorsal-fin rays; caudal fin with upper lobe rounded (China, northern Indochina, Myanmar).....*H. pluriradiatus* species group
4. Body with a pattern of distinct black spots or irregular black vertical lines arranged along the lateral line and sides (India, Myanmar, northern Sumatra).....*H. menoda* species group
 - Body uniformly coloured, without black spots or vertical lines on sides.....5
5. Head extremely depressed, procurrent and outer principal caudal-fin rays distinctly light-coloured (Java, Sumatra, Borneo, Malay Peninsula, Indochina, India). .*H. wyckii* species group
 - Head moderately depressed, procurrent and outer principal caudal-fin rays without distinct light colour.....6
6. Adipose-fin base at least half of postdorsal distance (Borneo).....*H. baramensis* species group
 - Adipose-fin base less than half of postdorsal distance.....7
7. Body without dark midlateral line; 47–51 vertebrae (Java, Sumatra, Borneo, Malay Peninsula).....*H. planiceps* species group
 - Body with dark midlateral line; 43–46 vertebrae (Java, Sumatra, Borneo, Malay Peninsula, Indochina).....*H. nemurus* species group

HEMIBAGRUS BARAMENSIS SPECIES GROUP

Artificial key to the members of the *H. baramensis* species group

1. Length of adipose-fin base 29–35% SL; dorsal to adipose distance 1–4% SL; depth of caudal peduncle 7–9% SL; dorsal fin lunate, with extended second ray (Borneo: Eastern Sabah: Kalabakan, Kinabatangan and Segama river drainages).....*H. sabanus*

- Length of adipose-fin base 19–26% SL; dorsal to adipose distance 5–11% SL; depth of caudal peduncle 9–11% SL; dorsal fin rounded, without extended second dorsal-fin ray.....2
- 2. Dorsal to adipose distance 8–11% SL; anal fin rhomboid, with straight distal margin; upper lobe of caudal fin regularly tapering (Borneo: western Sabah: Padas River and short coastal drainages draining western face of Crocker Range).....*H. semotus* new species
- Dorsal to adipose distance 5–9% SL; anal fin rounded, with convex distal margin; upper lobe of caudal fin rounded posteriorly (northern half of Borneo: Baram, Kalabakan, Kayan, Labuk, Sapagaya, Segaliud, Segama, Sugut, Temburong and Umas Umas river drainages).....*H. baramensis*

Remarks. — Members of this species group are relatively small (maximum size approx. 200 mm SL) compared to other species of *Hemibagrus*, which may reach sizes of up to approx. 700 mm SL or more.

Hemibagrus baramensis (Regan, 1906)

(Fig. 2)

Macrones baramensis Regan, 1906: 68 (type locality: Borneo: Baram River); Weber & de Beaufort, 1913: 338.

Mystus baramensis - Inger & Chin, 1962: 139, Fig. 70 (in part); Roberts, 1989: 123; Chin, 1990: SC39; Choy & Chin, 1994: 141, Fig. 71; 1994: 761; Chin & Samat, 1995: 24; Nyanti et al., 1995: 180; Choy, 1996: 380; Choy et al., 1996: 309; Martin-Smith, 1996a: 51; 1996b: 731; Nyanti et al., 1998: 186; Nyanti et al., 2006: 105.

Hemibagrus baramensis - Mo, 1991: 132; Kottelat & Lim, 1995b: 238; Rachmatika et al., 2005: 27; Ferraris, 2007: 87.

Hemibagrus aff. *baramensis* - Martin-Smith & Tan, 1998: 589; Martin-Smith & Laird, 1998: 334.

Hemibagrus furcatus Ng, Martin-Smith & Ng, 2000: 66, Figs. 1–3 (type locality: Sungai Segama, Danum Valley Conservation Area, Lahad Datu district, Sabah, Borneo); Ferraris, 2007: 88; Ng & Lim, 2008: 28.

Material examined. — BORNEO: Sarawak: BMNH 1895.7.2:50, holotype, 133.9 mm SL, Baram district; ZRC 36148–36156, 9 ex., 73.0–141.7 mm SL, Sungai Baram drainage, Sungai Pahang, 3°22'12"N 114°56'18"E; ZRC 42742, 2 ex., 141.9–150.0 mm SL, Mulu, tributary of Sungai Melinau; BMNH 1978.3.20.291–292, 2 ex., 155.6–155.8 mm SL, Sungai Tutoh.

BORNEO: Brunei: UBD uncat., 1 ex., 122.4 mm SL, Temburong district, Sungai Belalong, near Kuala Belalong Field Centre; ZRC 31799, 1 ex., 141.9 mm SL, Temburong district, Sungai Temburong above Kuala Temburong.

BORNEO: Sabah: BMNH 1938.12.1.137–138, 2 ex., 96.4–144.5 mm SL; CAS 132711, 11 ex., 56.4–159.3 mm SL; CAS 132713, 2 ex., 70.3–76.0 mm SL; CAS 132719, 1 ex., 85.4 mm SL, Kabili River; FMNH 44850, 1 ex., 142.1 mm SL, Labuk district, Labuk River; ANSP 169619, 8 ex., 132.1–160.3 mm SL, Imbak River, 100 km WNW of Tawau, 200 m elevation; SBM uncat., 1 ex., 138.4 mm SL [holotype of *H. furcatus*]; CAS 210089, 1 ex., 125.0 mm SL [paratype of *H. furcatus*], SBM, 1 ex., 132.3 mm SL [paratype of *H. furcatus*], ZRC 40588, 1 ex., 145.0 mm SL [paratype of *H. furcatus*], Lahad Datu district, Danum Valley Conservation Area, Sungai Segama; ZRC 40523, 2 ex., 93.1–96.6 mm SL, Lahad Datu district, Danum Valley Conservation Area, Sungai Segama, in front of Danum Valley Field Centre, 4°57'42.5"N 117°48'21.6"E

[paratypes of *H. furcatus*]; ZRC 40524, 1 ex., 128.0 mm SL, Lahad Datu district, Danum Valley Conservation Area, a small tributary of Sungai Bole approx. 500 m into coupe 93 (logging trail), 4°58'17.8"N 117°51'48.0"E [paratype of *H. furcatus*]; ZRC 40525, 2 ex., 128.6–150.0 mm SL, Lahad Datu district, Danum Valley Conservation Area, stream at km 113 on main line W after turnoff to Borneo Rainforest Lodge, 5°0'37.6"N 117°31'43.9"E [paratypes of *H. furcatus*]; ZRC 40526, 4 ex., 115.3–138.7 mm SL, Lahad Datu district, Danum Valley Conservation Area, Cabin Stream Right km 50 on road to Danum Valley Field Centre, drains from Bukit Rafflesia, 4°59'8.5"N 117°54'5.1"E [paratypes of *H. furcatus*]; ZRC 40527, 6 ex., 80.0–129.9 mm SL [paratypes of *H. furcatus*]; ZRC 45465, 1 ex., 64.3 mm SL, Lahad Datu district, Danum Valley Conservation Area, Sungai Bole Kechil tributary, 4°57'33.5"N 117°51'34.1"E [paratype of *H. furcatus*]; CMK 15119, 1 ex., 108.4 mm SL [paratype of *H. furcatus*]; ZRC 40528, 2 ex., 108.4–120.0 mm SL, Lahad Datu district, Danum Valley Conservation Area, Sungai Bilong at approx. 83 km on main line W after turnoff to Borneo Rainforest Lodge, 5°4'26.8"N 117°42'52.3"E [paratypes of *H. furcatus*]; CAS 133738, 2 ex., 114.7–135.1 mm SL, Sandakan, Sibugai River; FMNH 51825, 9 ex., 57.0–140.9 mm SL, Sandakan district, Sapagaya forest reserve, tributary of Sapagaya River; FMNH 68059, 11 ex., 17.7–140.0 mm SL; FMNH 108308, 1 ex., 168.5 mm SL, Tawau district, Kalabakan, Sungai Marikut; FMNH 68060, 18 ex., 29.8–129.5 mm SL; FMNH 68091, 2 ex., 109.1–128.7 mm SL, Tawau district, Kalabakan, Sungai Tibas camp, Sungai Tawan, 4°25'N 117°28'E; FMNH 68090, 1 ex., 143.1 mm SL, Tawau district, Kalabakan, Kalabakan River near Sungai Maga; ZRC 46123, 1 ex., 148.1 mm SL, Tawau, Sungai Umas Umas, 4°31'22.5"N 117°41'45.6"E.

BORNEO: Kalimantan Timur: MZB 9337, 1 ex., 133.8 mm SL, Bahau, En'ggeng B'io, draining into Bahau River, up to 6 riffles upstream of field station; ZRC 45552, 1 ex., 158.5 mm SL; ZRC 45655, 1 ex., 121.7 mm SL, Kayan drainage, Bahau, Lalut Birai, next to Lalut Birai field station, feeder stream to En'ggeng B'io which drains into Bahau River, 2°52'34.8"N 115°49'11.4"E.

Diagnosis. — *Hemibagrus baramensis* differs from *H. sabanus* in having a smaller adipose fin located further away from the dorsal fin (length of adipose-fin base 21.9–26.3% SL vs. 28.9–34.3; dorsal to adipose distance 4.7–8.6% SL vs. 1.2–4.4), a deeper caudal peduncle (depth 8.7–11.4% SL vs. 7.2–9.4), a shorter outer mandibular barbel (85.6–133.0% HL vs. 127.5–162.1), and the upper lobe of the caudal fin rounded posteriorly (vs. regularly tapering), and from *H. semotus* in having a smaller dorsal to adipose distance (4.7–8.6% SL vs. 8.2–10.6), the anal fin with a convex distal margin, imparting a more rounded appearance (vs. with a straight distal margin, imparting a more rhomboidal appearance) and the upper lobe of the caudal fin rounded posteriorly (vs. regularly tapering).



Fig. 2. *Hemibagrus baramensis*, ZRC 42742, 150.0 mm SL; Borneo: Sarawak, Mulu.

Description. — Biometric and meristic data as in Table 1. General description as for genus. Head depressed and broad, body moderately compressed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Caudal-peduncle depth 8.7–11.4% SL. Adipose-fin base moderately long, about 2.0–2.5 times anal-fin base (21.9–26.3% SL); distance from origin to base of last dorsal-fin ray 4.7–8.6% SL. Dorsal spine stout, with 4–13 serrations on posterior edge. Adpressed dorsal fin reaching adipose fin; second ray not extended, imparting rounded appearance to fin. Pectoral spine stout, with 8–17 large serrations on posterior edge. Anal fin with convex distal margin, appearing more rounded; origin slightly posterior to adipose origin. Caudal fin forked; upper lobe rounded posteriorly with principal ray produced into filament, lower lobe rounded posteriorly. Outer mandibular-barbel length 85.6–133.0% HL. Maximum recorded size 156 mm SL.

Colour. — Dorsal surface of head and body uniform light grey to grey (live or freshly-dead specimens with yellowish hue, fading in preserved specimens), lateral line cream to yellow; ventral surface of head and body dirty white; adipose fin and fin rays of all fins grey; inter-radial membranes of all fins dirty yellow. *Hemibagrus baramensis* shows considerable variation in colour, which seems to correspond with the colour of the substrate. Specimens caught from areas that are more well-shaded or with more silty waters are darker in colour (Ng et al., 2000).

Distribution. — *Hemibagrus baramensis* is known from the Baram and Temburong river drainages in northern Borneo,

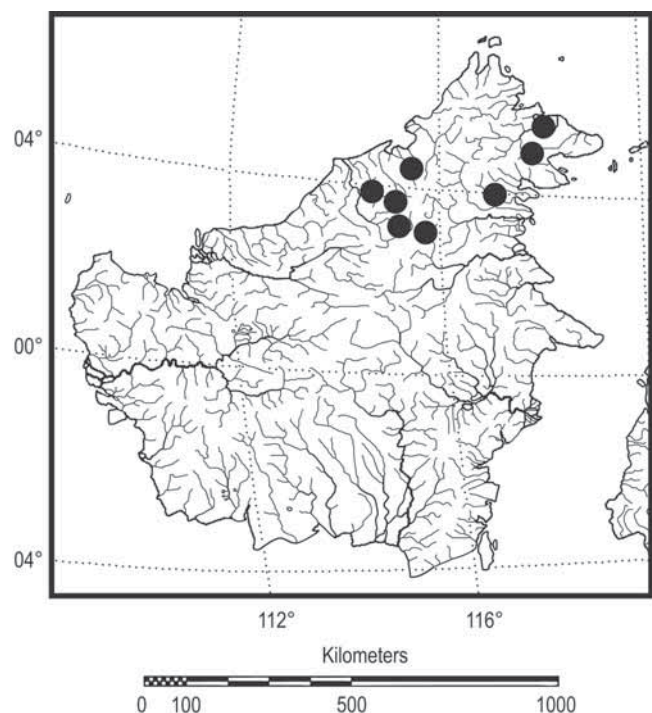


Fig. 3. Map showing collection localities of *Hemibagrus baramensis* specimens examined in this study.

Table 1. Biometric and meristic data for *H. baramensis* (n = 78).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	26.5–30.4	28.7±1.04
Head width	17.8–20.6	19.2±0.80
Head depth	13.0–15.9	14.7±0.78
Predorsal distance	37.7–41.7	39.7±0.98
Preanal length	68.8–73.5	70.5±1.22
Prepelvic length	50.2–54.2	51.6±1.10
Prepectoral length	23.1–28.2	25.9±1.25
Body depth at anus	14.1–20.0	16.6±1.40
Length of caudal peduncle	17.5–20.1	18.8±0.59
Depth of caudal peduncle	8.7–11.4	9.8±0.70
Pectoral-spine length	14.8–20.9	16.5±1.37
Pectoral-fin length	17.5–23.6	19.8±1.31
Length of dorsal fin	24.8–30.1	27.2±1.47
Length of dorsal-fin base	16.0–18.3	16.9±0.61
Dorsal-spine length	13.3–18.2	16.1±1.21
Pelvic-fin length	15.4–18.8	17.1±0.95
Length of anal-fin base	10.7–13.0	12.2±0.60
Caudal-fin length	21.7–24.2	23.1±0.78
Length of adipose-fin base	21.9–26.3	24.3±1.19
Maximum height of adipose fin	4.7–7.5	5.8±0.60
Dorsal to adipose distance	4.7–8.6	6.9±1.08
Post-adipose distance	13.0–15.9	14.1±0.70
In %HL:		
Snout length	32.3–39.8	36.4±1.97
Interorbital distance	27.7–35.5	30.5±1.89
Eye diameter	16.3–19.6	18.1±1.00
Nasal barbel length	39.6–56.9	44.9±5.24
Maxillary barbel length	215.3–315.6	269.8±28.02
Inner mandibular barbel length	49.3–85.2	59.7±8.74
Outer mandibular barbel length	85.6–133.0	105.0±12.06
MERISTICS		
Dorsal-fin rays	II,7 (78)	
Anal-fin rays	iii,8 (12), iii,9 (4), iv,8 (10) or iv,9 (52)	
Pelvic-fin rays	i,5 (78)	
Pectoral-fin rays	I,7,i (2), I,8 (8), I,8,i (2), I,9 (42), I,9,i (20) or I,10 (4)	
Caudal-fin rays	i,7,7,i (2) or i,7,8,i (76)	
Branchiostegal rays	9 (2), 10 (25), 11 (39), 12 (8) or 13 (6)	
Gill rakers	3+11 (3), 3+12 (10), 4+10 (2), 4+11 (10), 4+13 (8), 4+15 (1), 4+17 (4), 5+15 (5), 5+16 (5), 5+17 (4), 6+15 (6), 6+16 (2) or 6+18 (4)	
Vertebrae	22+21=43 (4), 22+22=44 (4), 23+21=44 (16), 23+22=45 (5), 24+21=45 (1), 23+23=46 (14), 24+22=46 (14), 25+21=46 (4) or 23+24=47 (2)	

the Labuk, Sugut, Segaliud, Sapagaya, Kalabakan, Umas Umas and Kayan river drainages in northeastern Borneo, and the Segama and Kayan river drainages in eastern Borneo (Fig. 3).

Habitat and biology. — *Hemibagrus baramensis* inhabits streams and smaller rivers with clear water and a substrate of gravel or rocks (although deep pools with leaf litter were also present in the streams they were collected in). The current in the stream was moderately fast (20 cm s⁻¹) at one locality. This species is also found in deep, slower-flowing parts of fast-flowing mountain streams with sandy or rocky substrates, usually associated with hiding places such as under large boulders, tree or wood debris, or undercut banks. Very young fish are occasionally found in shallower, faster-flowing areas. This species is carnivorous and feeds on small fish,

frogs, crustaceans and insects (Inger & Chin, 1962; Choy et al., 1996; Martin-Smith & Laird, 1998; Ng et al., 2000).

Remarks. — *Hemibagrus baramensis* is a poorly-known species and all previous records of this taxon outside of Borneo are misidentified; records of this species from the Malay Peninsula by previous authors (e.g. Herre & Myers, 1937; Mohsin & Ambak, 1982) are misidentifications of members of the *H. nemurus* species group.

Differences in the number of anal- and pectoral-fin rays, gill rakers, and branchiostegal rays between populations of material identified as *H. baramensis* from the Sandakan and Kalabakan areas in Sabah have been noted by Inger & Chin (1962) (see below), although they commented that the differences were not substantial enough to warrant recognition

of the two populations as belonging to separate species. Our study of the material examined by Inger & Chin (1962) found no substantial differences and we concur with them in considering the material from Sandakan and Kalabakan to be conspecific.

Our examination of the types of *H. furcatus* also reveal they are indistinguishable from specimens we identify as *H. baramensis*, apart from the presence of irregular serrations on the posterior edge of the pectoral spine in some individuals of *H. furcatus*. Because the irregular serrations on the posterior edge of the pectoral spine (cited as the main distinguishing character for this species by Ng et al., 2000) are not always present in *H. furcatus* and because no other distinguishing characters between *H. furcatus* and *H. baramensis* could be found, we treat the two nominal species as conspecific.

***Hemibagrus sabanus* (Inger & Chin, 1959)**

(Fig. 4)

Mystus sabanus Inger & Chin, 1959: 294 (type locality: Borneo: Sabah, Kinabatangan River at Deramakot); 1962: 137; Jayaram & Sanyal, 2003: 104, Fig. 24.

Mystus (Mystus) sabanus – Jayaram, 1966: 446.

Hemibagrus sabanus – Mo, 1991: 132; Lim & Wong, 1994: 53; Martin-Smith & Tan, 1998: 589; Ferraris, 2007: 91.

Material examined. — BORNEO: Sabah: FMNH 68088, holotype, 118.5 mm SL; FMNH 68061, 1 paratype, 97.5 mm SL; FMNH 68062, 5 paratypes, 47.7–93.3 mm SL; FMNH 68085, 1 paratype, 151.6 mm SL; FMNH 68086, 1 paratype, 130.7 mm SL; FMNH 68087, 1 paratype, 94.8 mm SL; BMNH 1958.4.28.5, 1 paratype, 122.2 mm SL, Kinabatangan District, Kinabatangan River at Deramakot camp; ZRC 41190, 1 ex., 93.2 mm SL, Sungai Kinabatangan at Sukau; ZRC 42743, 6 ex., 105.0–142.6 mm SL, Sandakan, Sungai Kinabatangan at Pekan Bukit Garam; ZRC 40493, 1 ex., 104.9 mm SL, lower Segama river at Bukit Belacong; ZRC 42741, 6 ex., 93.2–110.5 mm SL, Sungai Segama, small village on road to Sungai Kinabatangan.

Diagnosis. — *Hemibagrus sabanus* differs from all other members of the *H. baramensis* species group in having a larger adipose fin located nearer the dorsal fin (length of adipose-fin base 8.9–34.3% SL vs. 19.3–26.3; dorsal to adipose distance 1.2–4.4% SL vs. 4.7–10.6), a more slender caudal peduncle (depth 7.2–9.4% SL vs. 8.7–11.4), and (except for *H. semotus*) the upper lobe of the caudal fin regularly tapering (vs. rounded posteriorly). The dorsal fin of *H. sabanus* also has a narrower appearance. The membranes between the rays in *H. sabanus* are narrower with an extended second dorsal-fin ray (absent in all other members of this



Fig. 4. *Hemibagrus sabanus*, ZRC 40493, 104.9 mm SL, Borneo: Sabah, Segama River.

species group), with the fin having a lunate appearance, whereas in all other members of this species group, they are much broader, allowing the fin to be spread wider and imparting a more rounded appearance to the fin.

Description. — Biometric and meristic data as in Table 2. General description as for genus. Head depressed and broad, body moderately compressed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Caudal-peduncle depth 7.4–9.0% SL. Adipose-fin base moderately long, about 2.0–2.5 times anal-fin base (8.9–34.3% SL); distance from origin to base of last dorsal-fin ray 1.2–4.4% SL. Dorsal spine stout, with 6–9 serrations on posterior edge. Adpressed dorsal fin reaching adipose fin; membranes between rays narrow; second ray extended, imparting lunate appearance to fin. Pectoral spine stout, with 15–19 large serrations on posterior edge. Anal-fin origin slightly posterior to adipose origin; distal margin straight. Caudal fin forked; upper lobe tapering with uppermost principal ray produced into filament, lower lobe rounded posteriorly. Outer mandibular-barbel length 127.5–162.1% HL. Maximum recorded size 153 mm SL.

Colour. — Dorsal surface of head and body uniform light grey to grey (live or freshly-dead specimens with yellowish hue, fading in preserved specimens), lateral line cream to yellow; ventral surface of head and body dirty white; adipose fin and fin rays of all fins grey; inter-radial membranes of all fins dirty yellow.

Distribution. — *Hemibagrus sabanus* is known from the Kalabakan, Kinabatangan and Segama river drainages in northern Borneo (Fig. 5).

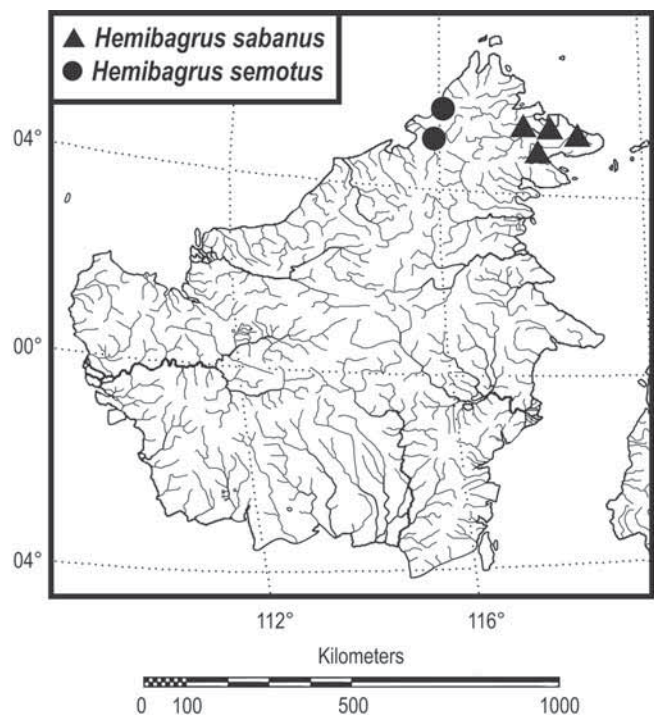


Fig. 5. Map showing collection localities of *Hemibagrus sabanus* and *H. semotus* specimens examined in this study.

Table 2. Biometric and meristic data for *H. sabanus* (n = 25).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	24.6–28.8	27.0±1.18
Head width	16.2–19.2	17.3±0.81
Head depth	12.4–18.0	14.3±1.56
Predorsal distance	34.8–38.7	36.9±1.24
Preanal length	66.8–71.4	69.9±1.27
Prepelvic length	46.9–51.3	49.3±1.54
Prepectoral length	23.4–29.6	25.2±1.74
Body depth at anus	15.4–17.9	16.4±0.90
Length of caudal peduncle	19.3–22.1	21.0±0.85
Depth of caudal peduncle	7.2–9.4	8.5±0.67
Pectoral-spine length	14.7–19.4	17.0±1.13
Pectoral-fin length	17.5–21.7	20.0±1.19
Length of dorsal fin	26.9–33.1	29.2±1.97
Length of dorsal-fin base	15.5–18.1	16.5±0.73
Dorsal-spine length	13.4–22.2	19.9±2.36
Pelvic-fin length	16.4–19.1	17.9±0.87
Length of anal-fin base	9.3–13.9	11.1±1.30
Caudal-fin length	17.0–28.4	25.0±3.03
Length of adipose-fin base	28.9–34.3	32.3±2.01
Maximum height of adipose fin	4.5–6.0	5.4±0.51
Dorsal to adipose distance	1.2–4.4	2.7±1.08
Post-adipose distance	12.3–15.0	13.7±0.79
In %HL:		
Snout length	35.8–39.6	37.8±1.31
Interorbital distance	28.6–33.3	30.7±1.50
Eye diameter	12.8–21.9	17.0±2.83
Nasal barbel length	47.5–77.2	57.2±9.67
Maxillary barbel length	241.3–388.2	338.5±40.42
Inner mandibular barbel length	63.1–77.9	71.7±5.09
Outer mandibular barbel length	27.5–162.1	136.9±11.00
MERISTICS		
Dorsal-fin rays	II,7 (25)	
Anal-fin rays	iii,8 (2), iv,8 (10), iv,9 (11) or iv,10 (2)	
Pelvic-fin rays	i,5 (25)	
Pectoral-fin rays	I,9 (15), I,9,i (6) or I,10 (4)	
Caudal-fin rays	i,7,8,i (25)	
Branchiostegal rays	10 (18), 11 (5) or 12 (2)	
Gill rakers	4+14 (2), 5+16 (10), 6+14 (8), 6+15 (4) or 6+16 (1)	
Vertebrae	23+21=44 (6), 23+22=45 (8), 23+23=46 (7) or 24+22=46 (4)	

Habitat and biology. — Unlike other members of the species group, *H. sabanus* is restricted to large rivers (at lower elevation). The diet consists largely of arthropods, both aquatic and terrestrial (Inger & Chin, 1962).

Hemibagrus semotus new species

(Fig. 6)

Mystus baramensis (non Regan, 1906) – Inger & Chin, 1962: 139, Fig. 70 (in part); Gosse, 1972: 2; Chin, 1996: 305, Fig. 19.

Holotype. — ZRC 46121, 126.0 mm SL, Borneo: Sabah, Padas River at Tenom, coll. J. Dodson, 28 Apr.1998.

Paratypes. — FMNH 96272, 1 ex., 192.0 mm SL, Borneo: Sabah, Kota Kinabalu, coll. P. K. Chin, date unknown. ZRC 46122, 9 ex., 128.9–198.8 mm SL, data as for holotype. ZRC 46789, 1 ex., 84.6

mm SL; Borneo: Sabah, Sipitang, Sungai Malamum, tributary of Mengalong River, coll. H. H. Tan et al., 9 Dec.2000.

Diagnosis. — *Hemibagrus semotus* is distinguished from *H. baramensis* in having a greater dorsal to adipose distance (8.2–10.2% SL vs. 4.7–8.6), an anal fin with a straight distal margin, imparting a more rhomboidal appearance (vs. with a convex distal margin, imparting a more rounded appearance) and the upper lobe of the caudal fin regularly tapering (vs. rounded posteriorly). It differs from *H. sabanus* in having a smaller adipose fin located further away from the dorsal fin (length of adipose-fin base 19.3–3.5% SL vs. 8.9–34.3; dorsal to adipose distance 8.2–10.6% SL vs. 1.2–4.4), a deeper caudal peduncle (depth 9.6–11.3% SL vs. 7.2–9.4), and a shorter outer mandibular barbel (81.9–120.1% HL vs. 127.5–162.1).

Description. — Biometric and meristic data as in Table 3. General description as for genus. Head depressed and broad, body moderately compressed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Caudal-peduncle depth 9.6–11.3% SL. Adipose-fin base moderately long, about 2.0–2.5 times anal-fin base (19.3–23.4% SL); distance from origin to base of last dorsal-fin ray 8.2–10.2% SL. Dorsal spine stout, with 4–7 serrations on posterior edge. Adpressed dorsal fin reaching adipose fin; second ray not extended, imparting rounded appearance to fin. Pectoral spine stout, with 10–14 large serrations on posterior edge. Anal-fin origin slightly posterior to adipose origin, with straight distal margin. Caudal fin forked; upper lobe tapering with principal ray produced into filament, lower lobe rounded posteriorly. Outer mandibular-barbel length 81.9–120.1% HL. Maximum recorded size 199 mm SL.

Colour. — Dorsal surface of head and body uniform light grey to grey (live or freshly-dead specimens with yellowish hue, fading in preserved specimens), lateral line cream to yellow; ventral surface of head and body dirty white; adipose fin and fin rays of all fins grey; inter-radial membranes of all fins dirty yellow.

Etymology. — From the Latin adjective meaning pushed aside (*semotus*); in reference to the relatively large distance between the dorsal and adipose fins.

Distribution. — *Hemibagrus semotus* is known from the Padas River drainage and the shorter coastal rivers draining



Fig. 6. *Hemibagrus semotus*, ZRC 46121, holotype, 126.0 mm SL, Borneo: Sabah, Padas River.

the western face of the Crocker Range in northern Borneo (Fig. 5).

Habitat and biology. — *Hemibagrus semotus* has been collected in slow-flowing streams with turbid water and a substrate of mud and gravel at elevation (Gosse, 1972). The species feeds primarily on arthropods (Inger & Chin, 1962).

HEMIBAGRUS GUTTATUS SPECIES GROUP

Artificial key to the members of the *H. guttatus* species group

1. Adipose fin partially confluent with principal rays of caudal fin; dark brown body typically with few very small black spots less than one quarter eye diameter; swim bladder single-chambered (Changjiang, Qiantang Jiang and Zhujiang drainages)
.....*H. macropterus*
- Adipose fin not confluent with principal rays of caudal fin; grey or light yellowish body with small black spots one quarter eye diameter or more; swim bladder double-chambered2
2. Pectoral spine extending beyond vertical through base of dorsal spine; vertebrae 51–54 (Qiantang Jiang, Song Hong and Zhujiang drainages)*H. guttatus*
- Pectoral spine not extending to vertical through base of dorsal spine; vertebrae 58–59 (Song Ca, Song Hong and Song Quan drainages)*H. vietnamicus*

Remarks. — Members of the *H. guttatus* species group are capable of growing to large sizes: *H. macropterus* has been reported to reach sizes of 408 mm SL (Anonymous, 1976) while *H. guttatus* has been reported to reach 1000 mm TL (Nichols, 1943). Specimens of *H. vietnamicus* approx. 850 mm TL in size were seen (but not preserved) by HHN in the markets of Hanoi.

Hemibagrus guttatus (La Cepède, 1803) (Fig. 7)

- Pimelodus guttatus* La Cepède, 1803: 96, Pl. 5 Fig. 1 (type locality: China); Richardson, 1846: 285; Günther, 1864: 99.
- Macrones elongatus* Günther, 1864: 77 (type locality: Singapore [error]).
- Macrones chinensis* Steindachner, 1883: 196 (type locality: Canton, China); 1884: 1111, Pl. 8; Pellegrin & Chevey, 1937: 317; Chaux & Fang, 1949: 199.
- Aoria chinensis* - Rendahl, 1928: 163.
- Hypselobagrus chinensis* - Herre & Myers, 1931: 248; Herre, 1932: 433.
- Aoria guttatus* - Herre & Lin, 1936: 23, Fig. 7.
- Leiocassis chinensis* - Tchang, 1936: 43, Fig. 3.
- Mystus elongatus* - Fowler, 1938: 52; Alfred, 1966: 35; Jayaram, 1978: 225, Fig. 2; Jayaram & Sanyal, 2003: 55, Fig. 7.
- Hemibagrus elongatus* - Nichols, 1943: 50; Tchang, 1960: 34, Fig. 27; Mai, 1985: 284; Mai, 1995: 17, 18.
- Mystus (Mystus) chinensis* - Jayaram, 1966: 446.
- Mystus (Mystus) elongatus* - Jayaram, 1966: 446.
- Hemibagrus elongatus hongus* Mai, 1978: 250, Fig. 114 (type locality: Song Hong [Red River], Vietnam)
- Mystus guttatus* - Yue, 1981: 188, Fig. 153; Ni & Wu, 1986: 173, Fig. 97; Cheng & Zheng, 1987: 216, Fig. 1088; Zheng, 1989:

Table 3. Biometric and meristic data for *H. semotus* (n = 30).

	Holotype	Range	Mean±SD
BIOMETRICS			
In %SL:			
Head length	28.0	27.2–30.2	28.5±1.05
Head width	20.1	15.6–20.9	19.4±1.76
Head depth	15.2	13.4–16.7	14.7±1.10
Predorsal distance	37.7	37.7–38.9	38.2±0.49
Preanal length	70.2	65.4–70.2	68.7±1.59
Prepelvic length	52.4	47.3–53.8	51.5±2.09
Prepectoral length	22.4	20.6–26.9	23.1±2.18
Body depth at anus	18.3	18.3–20.6	19.2±0.81
Length of caudal peduncle	19.1	17.9–19.7	18.8±0.60
Depth of caudal peduncle	9.6	9.6–11.3	10.8±0.63
Pectoral-spine length	damaged	15.2–17.8	16.5±1.84
Pectoral-fin length	damaged	15.7–20.6	19.4±1.86
Length of dorsal fin	26.3	21.0–31.3	27.7±3.56
Length of dorsal-fin base	16.3	15.8–20.1	17.7±1.47
Dorsal-spine length	damaged	13.7–15.3	14.5±1.13
Pelvic-fin length	15.5	15.5–17.8	17.0±0.81
Length of anal-fin base	11.4	11.3–14.0	12.2±0.99
Caudal-fin length	23.3	19.1–25.4	22.7±2.20
Length of adipose-fin base	21	19.3–23.4	21.1±1.41
Maximum height of adipose fin	6.3	4.7–6.9	6.1±0.75
Dorsal to adipose distance	10.6	8.2–10.6	9.6±0.79
Post-adipose distance	15.2	14.0–15.3	14.7±0.61
In %HL:			
Snout length	37.4	37.1–38.7	38.0±0.60
Interorbital distance	34.0	32.6–35.0	33.6±0.81
Eye diameter	17.8	13.6–17.3	16.1±1.43
Nasal barbel length	35.1	35.1–48.0	42.6±4.47
Maxillary barbel length	238.2	227.3–340.5	261.4±39.15
Inner mandibular barbel length	44.8	44.8–84.3	56.6±13.22
Outer mandibular barbel length	81.9	81.9–120.1	98.1±11.47
MERISTICS			
Dorsal-fin rays	II,7	II,7 (30)	
Anal-fin rays	v,8	iv,8 (15), v,8 (5) or iv,9 (10)	
Pelvic-fin rays	i,5	i,5 (30)	
Pectoral-fin rays	I,10,i	I,9 (18), I,9,i (10) or I,10,i (2)	
Caudal-fin rays	i,7,8,i	i,7,8,i (30)	
Branchiostegal rays	9	9 (15) or 10 (15)	
Gill rakers	6+18	4+16 (3), 5+15 (3), 6+15 (9) or 6+18 (15)	
Vertebrae	22+21=43	22+21=43 (20) or 23+21=44 (10)	

285, Fig. 219; Chu, 1989: 194, Fig. 3–67; Ze, 1989: 251, Pl. 17; Cui, 1990: 164, Fig. 168; Gao, 1990: 314, Fig. 190; Zheng & Dai, 1999: 72, Fig. 36; Zhou et al., 1999: 117; Yang & Zhang, 2006: 414, Fig. II-237, Pl. XII Fig. 111.

Hemibagrus guttatus - Chen, 1984: 412, Fig. 280; Mo, 1991: 132; Kottelat et al., 1998: 566; Ferraris, 2007: 88.

Mystus chinensis - Jayaram & Sanyal, 2003: 53, Fig. 6.

Hemibagrus hongus - Kottelat, 2001a: 51; Ferraris, 2007: 89.

Hemibagrus dongbacensis Nguyễn, 2005: 631, Fig. 48 (type locality: Ky Cung River, Lang Son province, Vietnam).

Material examined. — BMNH 1855.9.19:109, 1 ex., 240.7 mm SL, Singapore [holotype of *Macrones elongatus*].

CHINA: CAS 132536, 2 ex., 112.1–139.8 mm SL, Zhejiang province: Qiantang River; CAS 124203, 1 ex., 151.7 mm SL, CAS 128163, 1 ex., 271.5 mm SL, Guangdong. CAS 129448, 3 ex., 164.4–271.1 mm SL; FMNH 47268, 1 ex., 238.9 mm SL; UMMZ 238761, 1 ex., 108.3 mm SL, Guangdong province: Yingde county, Beijiang River at Beiyang; UMMZ 238988, 3 ex.,

78.6–161.0 mm SL; ZRC 42555, ex., 328.4 mm SL, Guangdong province: Beijiang River; ZRC 45661, 11 ex., 180.0–396 mm SL, Guangdong province: Xijiang River; USNM 94595, 1 ex., 251.1 mm SL, Guangxi province: Wuzhou.

VIETNAM: CAS 216759, 2 ex., 121.0–125.7 mm SL, Lang Son province: Na Sam market; ZMUH 256, 2 ex., 207.6–245.5 mm SL, Na Ri; AMNH 228041, 2 ex., 97.8–136.3 mm SL, Nghe An province: Con Cuong district, Chau Khe region, Khe Bu, right branch of river; MNHN 1937–33, 1 ex., 224.0 mm SL, Bac Thai province: Song Cau drainage, Bac Can.

Diagnosis. — *Hemibagrus guttatus* differs from *H. macropterus* in having a double-chambered (vs. single-chambered) swim bladder, the adipose fin not confluent (vs. partially confluent) with the principal rays of the caudal fin, fewer vertebrae (51–54 vs. 57–59), and a grey or light yellowish body with larger black spots at least one quarter eye diameter (vs. dark brown body with few very small black

spots less than one quarter eye diameter). It is distinguished from *H. vietnamicus* in having a longer pectoral spine (extending beyond a vertical through the base of the dorsal spine vs. to a vertical through the base of the dorsal spine) and fewer vertebrae (51–54 vs. 58–59).

Description. — Biometric and meristic data as in Table 4. General description as for genus. Head depressed and broad, body moderately compressed and elongated. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose-fin base very long, spanning almost all of postdorsal distance, about 3.0 times length of anal-fin base, not confluent with principal rays of caudal fin. Dorsal spine stout, with 6 serrations on posterior edge. Pectoral spine stout, with 13 large serrations on posterior edge, extending beyond vertical through base of dorsal spine. Anal-fin origin posterior to adipose origin. Adpressed dorsal fin reaching adipose fin. Caudal fin forked; upper and lower lobes rounded posteriorly. Swim bladder with two chambers. Vertebrae 51–54. Maximum recorded size approx. 1000 mm TL.

Colour. — Dorsal surface of head and body uniform light grey to grey (live or freshly-dead specimens with slight yellow hue, fading on preservation); many dark grey spots on side of body one quarter eye diameter or larger, located posterior to origin of dorsal fin, caudal fin with many such spots present; ventral surface of head and body dirty white; adipose fin and fin rays of all fins grey; inter-radial membranes of all fins hyaline.

Distribution. — *Hemibagrus guttatus* is known from the Hanjiang, Jiulongjiang, and Qiantangjiang drainages in southern China and the Zhujiang (Pearl River, Song Ky Cung) and Song Hong (Red River, Yuanjiang) drainages in southern China and northern Vietnam (Fig. 8). The records from the Hanjiang and Jiulongjiang drainages follow Yang & He (2008). It is also known from Hainan Island, where it has been recorded from the Nanduijiang drainage (Ni & Wu, 1986).

Habitat and biology. — *Hemibagrus guttatus* inhabits large rivers, usually favouring areas of rapid current and rocky bottoms. In the northern limit of its range, the species hibernates in deep water during the winter. It spawns in May–June, usually in shallow, sandy areas (Chen, 1984). The diet of this species in the Zhujiang (Pearl River) has been studied by Hu et al. (2003). Young fish 170 mm SL and under



Fig. 7. *Hemibagrus guttatus*, ZRC 42555, 328.4 mm SL, China: Beijiang river.

fed predominantly on arthropods, with an ontogenetic shift to a diet consisting predominantly of fish and crustaceans at 240 mm SL and larger. This is the largest species in this group: Nichols (1943) reported lengths of up to 1000 mm (most probably TL) and weights of at least 30 lbs. (16.2 kg).

Remarks. — The identity of *H. guttatus* has been somewhat problematic, and it is only recently (Kottelat et al., 1998) that it has been partially clarified. *Hemibagrus guttatus* is now a valid species, with *H. elongatus* (Günther, 1864) and *H. chinensis* (Steindachner, 1883) considered subjective junior synonyms (Kottelat et al., 1998). However, the nomenclatural problems surrounding the exact identity of *H. guttatus* has been further complicated by Mai (1978), who recognised two subspecies of *H. elongatus* (considered a junior synonym of *H. guttatus*; see Kottelat et al., 1998) from northern Vietnam: *H. elongatus elongatus* from Na Ri (from the Ky Cung River, which flows into the Xijiang River drainage in southern China) and a new subspecies, *H. elongatus hongus* from the Song Hong [Red River]. The two subspecies were distinguished by different number of anal-fin rays: *H. elongatus elongatus* with 12 anal fin-rays and *H. elongatus hongus* with 12–14 anal-fin rays. The specimens from Na Ri identified as *H. elongatus elongatus* by Mai (1978) are deposited in ZMUH, Hanoi, but the specimens identified as *H. elongatus hongus* cannot be found (Mai Dinh Yen, pers. comm. to HHN), and could not be located as well during a visit to the collection in the University of Hanoi in September 1997. We examined the specimens identified as *H. elongatus elongatus* by Mai (ZMUH 256), and found that they have 13 anal-fin rays, and not 12 as originally stated. As there are no other significant differences between Mai's *H. elongatus elongatus* from Na Ri and *H. elongatus hongus* from the Song Hong [Red River], the division of the north Vietnamese population into two subspecies is unwarranted.

Hemibagrus guttatus is known from river drainages in southern China and northern Vietnam, but we have not come across any material from Taiwan and Hainan (large islands lying off

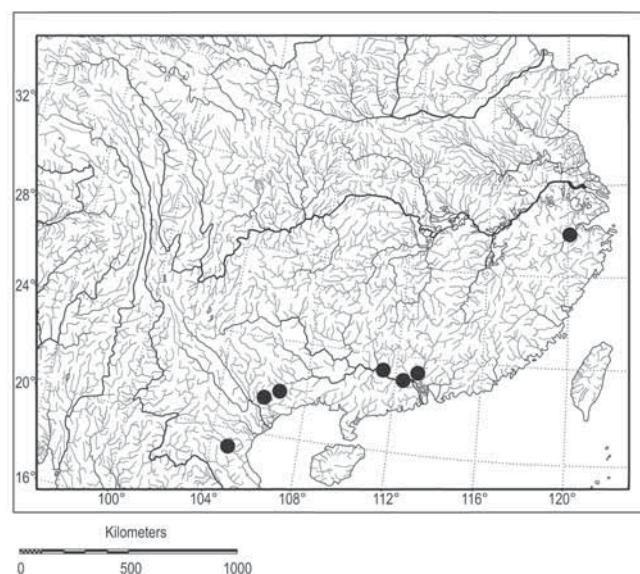


Fig. 8. Map showing collection localities of *Hemibagrus guttatus* specimens examined in this study.

Table 4. Biometric and meristic data for *H. guttatus* (n = 23).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	23.3–27.3	25.6±1.29
Head width	16.4–18.7	17.7±0.94
Head depth	11.9–14.2	12.8±1.17
Predorsal distance	32.9–38.1	35.6±2.25
Preanal length	65.8–77.9	68.4±3.37
Prepelvic length	45.4–52.6	49.7±3.62
Prepectoral length	20.6–25.2	23.3±1.40
Body depth at anus	12.7–18.0	14.2±1.67
Length of caudal peduncle	19.2–21.3	20.7±0.73
Depth of caudal peduncle	7.2–9.0	7.8±0.52
Pectoral-spine length	11.0–14.3	13.0±1.13
Pectoral-fin length	13.2–17.9	16.2±1.31
Length of dorsal fin	11.6–15.1	19.7±1.80
Length of dorsal-fin base	16.6–22.8	13.5±1.11
Dorsal-spine length	11.1–17.6	14.1±1.82
Pelvic-fin length	11.3–15.6	13.4±1.08
Length of anal-fin base	11.5–14.9	12.8±0.82
Caudal-fin length	12.3–17.7	15.0±1.54
Length of adipose-fin base	36.9–43.7	40.4±1.98
Maximum height of adipose fin	3.8–6.7	5.2±0.85
Dorsal to adipose distance	1.6–8.5	5.3±v2.35
Post-adipose distance	6.1–9.1	7.6±1.07
In %HL:		
Snout length	34.5–39.5	37.8±1.50
Interorbital distance	25.2–30.8	28.9±1.90
Eye diameter	10.8–20.7	13.3±2.60
Nasal barbel length	21.8–38.0	30.6±5.21
Maxillary barbel length	130.5–197.0	152.9±22.39
Inner mandibular barbel length	33.1–44.2	35.6±5.83
Outer mandibular barbel length	52.0–74.6.	62.5±6.16
MERISTICS		
Dorsal-fin rays	II,7 (23)	
Anal-fin rays	iv,8 (1), iv,9 (4), iv,9 (11), iv,10 (6) or iv,11 (1)	
Pelvic-fin rays	i,5 (23)	
Pectoral-fin rays	I,8 (1), I,9 (4), I,9,i (4) or I,10 (14)	
Caudal-fin rays	i,7,8,i (23)	
Branchiostegal rays	10 (14), 11 (5) or 12 (4)	
Gill rakers	5+11 (5), 5+12 (7), 4+14 (6), 4+15 (5)	
Vertebrae	26+25=51 (1), 26+26=52 (4), 27+25=52 (4), 27+26=53 (12) or 29+25=54 (3)	

the southeastern coast of China) in our extensive survey of *Hemibagrus* holdings in most major museums, except for a single case mentioned below. Although a specimen ostensibly collected from Taiwan was encountered (CAS 18294 (1), 370 mm SL), this is most probably mislabelled, as no species of *Hemibagrus* are known from the streams and rivers of Taiwan (Oshima, 1919; Chen, 2001). *Hemibagrus guttatus* is found sympatrically with *H. vietnamicus* in northern Vietnam, as both species are known from Song Cau (in Bac Thai province) at Cho Moi and Bac Can. However, it cannot be excluded that the northern Vietnamese populations of *H. guttatus* may have been introduced as *Hemibagrus* are commonly kept alive and carried around as food fishes in southern China and northern Vietnam (MK, pers. obs.).

Hemibagrus dongbacensis was described from the Ky Cung River, which forms part of the Zhujiang (Pearl River) drainage in northeastern Vietnam. Nguyễn (2005) distinguished *H.*

dongbacensis from *H. guttatus* by differences in the shape of the teeth and tooth patches, shorter maxillary barbels, darker body and smaller size. Using both information in the original description and our examination of material from the Ky Cung River drainage (CAS 216759), we were unable to distinguish *H. dongbacensis* from *H. guttatus*, and conclude that the two nominal species are conspecific.

Hemibagrus macropterus Bleeker, 1870

(Fig. 9)

Hemibagrus macropterus Bleeker, 1870: 257, Pl. (bottom Fig.) (type locality: Yangtze River, China); 1873: 125; Sauvage & Dabry de Thiersant, 1874: 6; Nichols, 1928: 8; 1943: 50, Pl. III Fig. 2; Wu, 1930a: 80; 1939: 139; Tchang & Shih, 1934: 345; Chang, 1944: 57; Anonymous, 1976: 169, Fig. 139; Chen, 1984: 411, Fig. 279; Xu, 1989: 171, Fig. 137; Mo, 1991: 132; Ferraris, 2007: 89.

- Macrones macropterus* - Günther, 1888: 430.
Macrones (Pseudobagrus) macropterus - Kreyenberg & Pappenheim, 1908: 107.
Pseudobagrus macropterus - Fowler, 1924: 400.
Aoria chinensis (non Steindachner, 1883) - Rendahl, 1933: 88, 116.
Aoria macroptera - Rendahl, 1928: 163; 1933: 115; Wu, 1930b: 51; Herre & Lin, 1936: 23.
Aoria amemiyai Kimura, 1934: 166, Pl. 5 Fig. 2 (type locality: Howchwan, Szechuan, China; spelt as *M. amemiyae* on pg. 166); Kottelat et al., 1998: 570 (first revisers in choice of spelling); Ferraris, 2007: 91 (treated as *species inquirenda*).
Hemibagrus macropterus [sic] - Shih, 1935: 10.
Leiocassis macropterus - Tchang, 1949: 7.
Mystus (Mystus) amemiyae - Jayaram, 1966: 446.
Mystus elongatus (non Günther, 1864) - Yue, 1981: 189, Fig. 154.
Mystus macropterus - Chen et al., 1986: 74, 84; Fang, 1987: 189, Fig. 143; Ze, 1989: 252, Fig. 165; Zheng, 1989: 286, Fig. 220; Chen et al., 1990: 168, Fig. 155; Gao, 1990: 313, Fig. 189; Li, 1994: 468, Fig. 365; Cao et al., 1996: 114; Yang, 1998: 289, Fig. 209; Zheng & Dai, 1999: 71, Fig. 35; Jayaram & Sanyal, 2003: 69; Zhu, 2005: 206, Fig. 78; Yang & Zhang, 2006: 417, Fig. II-239, Pl. XII Fig. 112; Zhuang et al., 2006: 118, Fig. 3-37.
Mystus amemiyae - Jayaram & Sanyal, 2003: 32.

Material examined. — CHINA: MNHN 5095, holotype, 152.9 mm SL; MNHN 5941, 1 ex., 143.6 mm SL; MNHN 1995-1093, 1 ex., 93.8 mm SL, Yangtze River; USNM 130185, 3 ex., 113.8–176.4 mm SL; MCZ 23726, 1 ex., 226.7 mm SL, China; USNM 86475, 1 ex., 256.0 mm SL, Nanjing; BMNH 1928.6.22:8, 1 ex., 160.0 mm SL; CAS 132472, 16 ex., 37.5–74.0 mm SL, Zhejiang province, Qiantang River; FMNH 43794, 2 ex., 153.0–176.3 mm SL, Zhejiang province, Luqiaozen; BMNH 1886.1.15:4, 1 ex., 137.7 mm SL, mountain stream flowing into Yichang gorge, Yangtze River; MNHN 7889, 1 ex., 133.9 mm SL, Sichuan province; BMNH 1891.6.13:22, 1 ex., 80.7 mm SL, Kia-tiang-fu, 326 m (foot of Emei Shan, Sichuan province); NRM 10167 (3), 129.3–139.7 mm SL, Jialing (Yangtze) River; FMNH 43568, 3 ex., 166.5–223.0 mm SL; FMNH 43570, 2 ex., 180.4–202.4 mm SL; FMNH 43572, 1 ex., 195.1 mm SL, Sichuan province, Leshan fish market; UMMZ 158517, 1 ex., 165.5 mm SL, Sichuan province, Chengdu or Leshan.; USNM 86862, 1 ex., 247.0 mm SL; USNM 87437, 2 ex., 220.3–283.0 mm SL, Sichuan province, Suifu; USNM 130076, 8 ex., 147.6–208.7 mm SL; AMNH 10261, 5 ex., 55.8–162.5 mm SL; FMNH 14839, 1 ex., 165.5 mm SL, Hunan province, Dongting Lake; ZRC 43359, 1 ex., 190.0 mm SL, Fujian province, Changning; ZRC 42560 (1), 363 mm SL; ZRC 45662, 13 ex., 236.0–374 mm SL, Guangdong province, Beijiang.

Diagnosis. — *Hemibagrus macropterus* differs from the other members of the *H. guttatus* species group in having a single-chambered (vs. double-chambered) swim bladder, the adipose fin partially confluent (vs. not confluent) with the principal rays of the caudal fin and a dark brown body with few very small black spots less than one quarter eye



Fig. 9. *Hemibagrus macropterus*, ZRC 53403, 117.5 mm SL; China: Suikou.

diameter (vs. grey or light yellowish body with larger black spots at least one quarter eye diameter). It also possesses more vertebrae than *H. guttatus* (56–61 vs. 51–53).

Description. — Biometric and meristic data as in Table 5. General description as for genus. Head depressed and broad, body moderately compressed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose-fin base very long, spanning almost all of postdorsal distance, about 3.0 times length of anal-fin base, partially confluent with principal rays of caudal fin; origin in contact with base of posteriormost dorsal-fin ray in some individuals. Dorsal spine stout, with 0–4 serrations on posterior edge. Pectoral spine stout, with 12–14 large serrations on posterior edge, extending to vertical through base of dorsal spine. Anal-fin origin posterior to adipose origin. Adpressed dorsal fin reaching adipose fin. Caudal fin forked; upper and lower lobes rounded. Swim bladder with single chamber. Vertebrae 56–61. Maximum recorded size 408 mm SL (Anonymous, 1976).

Colour. — Dorsal surface of head and body uniform light grey to grey (live or freshly-dead specimens with slight yellow hue, fading on preservation); few small dark grey spots less than one quarter eye diameter on side of body, located posterior to origin of adipose fin, caudal fin with few such spots occasionally present; ventral surface of head and body dirty white; adipose fin and fin rays of all fins grey; inter-radial membranes of all fins hyaline.

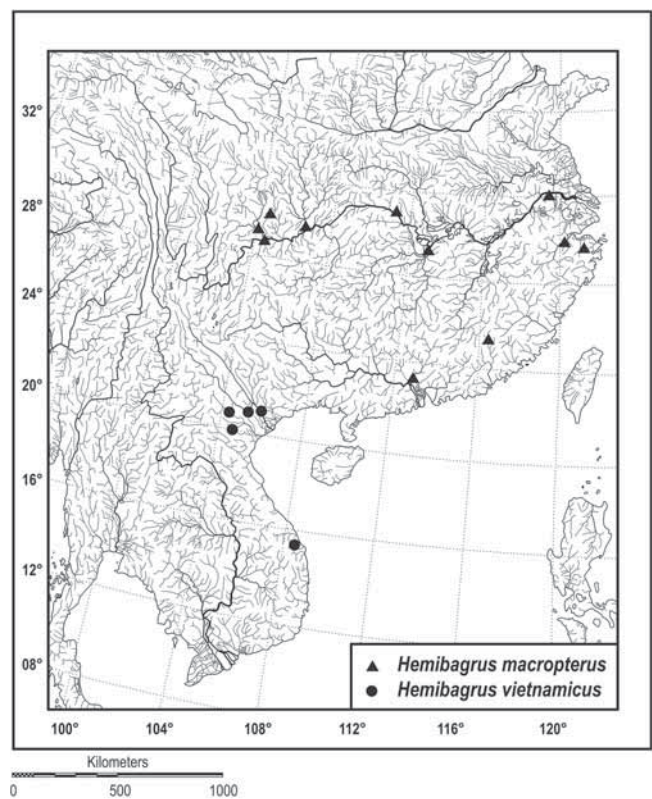


Fig. 10. Map showing collection localities of *Hemibagrus macropterus* and *H. vietnamicus* specimens examined in this study

Table 5. Biometric and meristic data for *H. macropterus* (n = 40).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	23.9–26.8	24.7±1.12
Head width	15.5–18.2	16.5±0.97
Head depth	9.5–14.6	11.6±1.23
Predorsal distance	32.5–36.8	35.0±1.62
Preanal length	64.5–71.1	67.3±2.43
Prepelvic length	45.8–51.3	47.9±2.34
Prepectoral length	19.8–25.7	22.3±1.59
Body depth at anus	9.8–13.2	12.0±0.80
Length of caudal peduncle	17.0–22.2	21.1±1.33
Depth of caudal peduncle	6.9–9.0	7.9±0.54
Pectoral-spine length	12.0–13.7	12.3±0.99
Pectoral-fin length	14.5–17.0	14.8±1.22
Length of dorsal fin	18.5–22.3	19.4±1.46
Length of dorsal-fin base	12.0–14.3	12.9±0.67
Dorsal-spine length	9.7–14.2	10.5±1.57
Pelvic-fin length	11.8–14.5	12.2±0.93
Length of anal-fin base	12.1–16.6	13.5±1.33
Caudal-fin length	12.7–16.0	13.4±0.81
Length of adipose-fin base	41.9–51.3	45.0±2.85
Maximum height of adipose fin	3.6–5.0	4.4±0.38
Dorsal to adipose distance	3.2–11.1	5.9±2.00
Post-adipose distance	0.0–5.0	4.2±1.30
In %HL:		
Snout length	32.7–39.4	36.0±2.18
Interorbital distance	24.1–28.5	26.6±1.59
Eye diameter	15.5–19.3	15.7±1.64
Nasal barbel length	26.9–37.1	30.1±4.56
Maxillary barbel length	116.1–188.9	136.2±30.3
Inner mandibular barbel length	31.3–44.6	35.8±5.08
Outer mandibular barbel length	55.7–75.7	61.1±8.83
MERISTICS		
Dorsal-fin rays	II,7 (40)	
Anal-fin rays	iii,9 (4), iii,11 (4), iv,10 (24) or iv,11 (8)	
Pelvic-fin rays	i,5 (40)	
Pectoral-fin rays	I,8,i (12), I,9 (24) or I,9,i (4)	
Caudal-fin rays	i,7,8,i (40)	
Branchiostegal rays	10 (28), 11 (8) or 12 (4)	
Gill rakers	3+14 (10), 4+14 (20) or 4+15 (10)	
Vertebrae	28+28=56 (2), 29+27=56 (1), 27+30=57 (4), 28+29=57 (6), 29+28=57 (5), 28+30=58 (6), 31+27=58 (6), 29+30=59 (4), 30+29=59 (5) or 31+30=61 (1)	

Distribution. — *Hemibagrus macropterus* is known from the following drainages in southern and central China: Zhujiang (Pearl River), Changjiang (Yangtze River) and Qiantang Jiang (Fig. 10). Zhuang et al. (2006) report that this species is becoming very rare or even locally extirpated in the lower Changjiang (Yangtze River) drainage as a result of dam construction and pollution.

Habitat and biology. — *Hemibagrus macropterus* is generally found in swift-flowing rivers with rocky substrates, where it feeds on invertebrates and fish (Anonymous, 1976). Breeding takes place in June–July, and 1300–2000 eggs of up to 1.2 mm are laid (Fang, 1987). The larvae are fully developed in about 20 days (Wang et al., 1992).

Remarks. — In discussing the status of *Aoria amemiyai*, Kottelat et al. (1998) merely stated that the figure in the

original description by Kimura (1934) appears similar or identical to *H. macropterus*, but did not definitively clarify the status of *A. amemiyai*. *Aoria amemiyai* was treated as *species inquirenda* by Ferraris (2007). Based on the information and illustration from the original description, we could find no significant differences between *A. amemiyai* and *H. macropterus* and consider them as synonyms.

Hemibagrus vietnamicus Mai, 1978 (Fig. 11)

Hemibagrus vietnamicus Mai, 1978: 252, Fig. 116 (type locality: north Vietnam); Mai, 1985: 284; Kottelat, 2001a: 51, Fig. 104; Ferraris, 2007: 91.
Macrones chinensis (non Steindachner, 1883) - Chevey & Lemasson, 1937: 113, Pl. 34, Fig. 77; Le Poulain, 1945: 68.

Mystus chinensis (non Steindachner, 1883) - Kuronuma, 1961: 6; Orsi, 1974: 161.

Mystus guttatus (non La Cepède, 1803) - Chu, 1986: 130, Fig. 86.

Hemibagrus guttatus (non La Cepède, 1803) - Kottelat, 2001b: 122, Fig. 328.

Hemibagrus camthuyensis Nguyễn, 2005: 632, Fig. 49 (type locality: Ma River, Cam Thuy district, Thanh Hoa province, Vietnam).

Material examined. — VIETNAM: ZMUH 260, 12 syntypes, 121.1–259.3 mm SL; ZMUH 250, 15 syntypes, 58.1–221.0 mm SL, northern Vietnam; AMNH 230998, 2 ex., 152.1–182.2 mm SL, Quang Nam province: Tam Ky district, Nuoc Ta River, at ferry; CAS 95031, 3 ex., 127.3–163.3 mm SL, Hoa Binh market; UMMZ 238764, 3 ex., 67.0–138.0 mm SL; Nghe Anh province: market in Anh Son; ZRC 42552, 4 ex., 560–700 mm SL, market in Hanoi

(Cho Hang Da); ZRC 42553, 2 ex., 450–495 mm SL, market in Hanoi (Cho Hang Be).

LAOS: CMK 15338, 2 ex., 154.5–208.6 mm SL, Houaphan province: Nam Xam in Ban Sopkhem; CMK 15391, 1 ex., 179.7 mm SL, Houaphan province: Nam Ma at Xiang Kho.

Diagnosis. — *Hemibagrus vietnamicus* differs from *H. macropterus* in having a double-chambered (vs. single-chambered) swim bladder, the adipose fin not confluent (vs. partially confluent) with the principal rays of the caudal fin, and a grey (vs. brown) body, and from *H. guttatus* in having a shorter pectoral spine (extending to a vertical through the base of the dorsal spine vs. beyond a vertical through the base of the dorsal spine) and more vertebrae (58–59 vs. 51–54).

Description. — Biometric and meristic data as in Table 6. General description as for genus. Head depressed and broad, body moderately compressed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose-fin base very long, spanning almost all of postdorsal distance, about 3.0 times length of anal-fin base, not confluent with principal rays of caudal fin. Dorsal spine stout, with 4–14 serrations



Fig. 11. *Hemibagrus vietnamicus*, CMK 15391, 179.7 mm SL; Laos: Nam Ma.

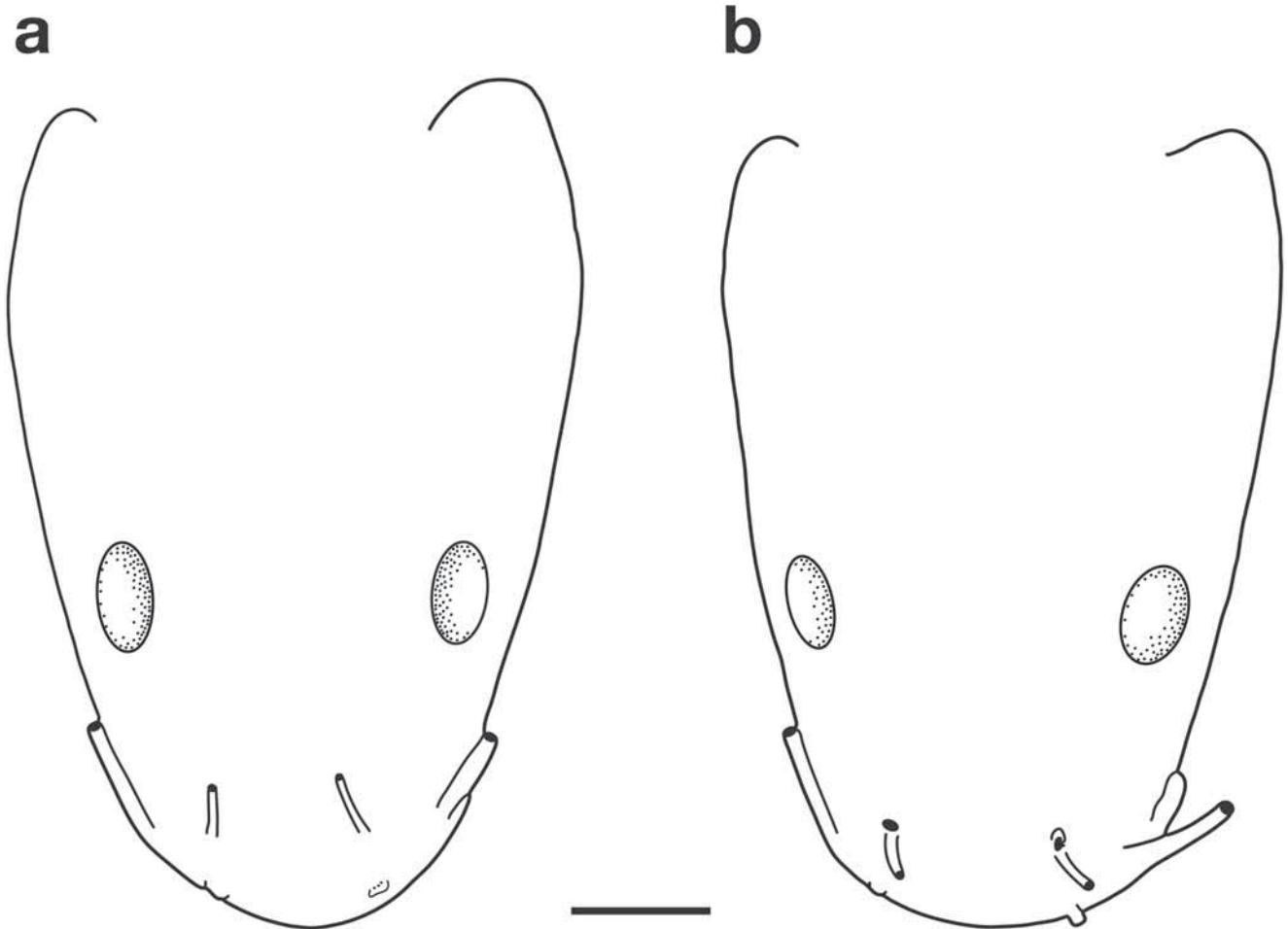


Fig. 12. Dorsal views of heads of: a, *H. menoda*, UMMZ 208726, 202.6 mm SL; b, *H. peguensis*, CAS 133789, 212.7 mm SL. Scale bar = 10 mm.

Table 6. Biometric and meristic data for *H. vietnamicus* (n = 26).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	23.8–27.9	26.2±1.20
Head width	15.6–19.3	17.3±1.43
Head depth	11.4–13.6	12.4±0.87
Predorsal distance	32.3–39.9	36.7±1.98
Preanal length	66.0–71.6	68.8±1.99
Prepelvic length	48.0–53.7	50.0±2.03
Prepectoral length	21.8–27.2	23.0±1.74
Body depth at anus	11.5–15.4	13.3±1.14
Length of caudal peduncle	16.9–21.7	19.9±1.39
Depth of caudal peduncle	6.8–9.1	7.7±0.50
Pectoral-spine length	10.1–14.2	12.0±1.03
Pectoral-fin length	14.3–18.6	15.4±1.31
Length of dorsal fin	19.8–24.1	21.2±1.86
Length of dorsal-fin base	11.8–16.1	14.3±1.41
Dorsal-spine length	10.2–13.7	12.4±1.31
Pelvic-fin length	12.4–16.9	13.9±1.03
Length of anal-fin base	11.5–15.4	12.8±1.10
Caudal-fin length	14.3–20.8	16.8±1.84
Length of adipose-fin base	30.4–43.4	38.0±5.86
Maximum height of adipose fin	3.7–5.8	4.8±0.85
Dorsal to adipose distance	3.8–6.8	4.9±1.79
Post-adipose distance	6.5–11.7	8.7±1.91
In %HL:		
Snout length	34.3–39.6	37.2±1.83
Interorbital distance	28.4–32.5	29.3±1.30
Eye diameter	9.7–14.9	14.4±2.08
Nasal barbel length	22.6–43.5	31.0±6.58
Maxillary barbel length	152.4–290.9	189.8±31.65
Inner mandibular barbel length	30.0–49.3	38.7±5.38
Outer mandibular barbel length	63.8–101.1	70.9±13.15
MERISTICS		
Dorsal-fin rays	II,7 (26)	
Anal-fin rays	iii,8 (8); iv,8 (2); iii,9 (8); iii,10 (3); iv,10 (4) or iii,12 (1)	
Pelvic-fin rays	i,5 (26)	
Pectoral-fin rays	I,8 (3); I,8,i (2); I,9 (5); I,9,i (12) or I,10 (4)	
Caudal-fin rays	i,7,8,i (26)	
Branchiostegal rays	11 (16) or 12 (10)	
Gill rakers	4+10 (2), 5+9 (4), 5+11 (8), 5+12 (4), 6+11 (4), 6+12 (2) or 6+14 (2)	
Vertebrae	29+29=58 (4), 29+30=59 (18) or 30+29=59 (4)	

on posterior edge. Pectoral spine stout, with 10–17 large serrations on posterior edge, extending to a vertical through base of dorsal spine. Anal-fin origin posterior to adipose origin. Adpressed dorsal fin reaching adipose fin. Caudal fin forked; upper and lower lobes rounded. Swim bladder with two chambers. Vertebrae 58–59. Maximum recorded size approx. 850 mm SL.

Colour. — Dorsal surface of head and body uniform light grey to grey (live or freshly-dead specimens with slight yellow hue, fading on preservation); few small dark grey spots one quarter eye diameter or larger on side of body, located posterior to origin of adipose fin, caudal fin with few such spots occasionally present; ventral surface of head and body dirty white; adipose fin and fin rays of all fins grey; inter-radial membranes of all fins hyaline.

Distribution. — *Hemigrammus vietnamicus* is presently only known from the Song Hong (Red River) drainage in northern Vietnam, the Song Ca (also known as the Song Lam) drainage in northern Vietnam and northern Laos and the Song Quan drainage in central Vietnam (Fig. 10). Its range possibly extends to the drainages in north central Vietnam between the Song Ca and Song Quan drainages. It is likely that records of *H. guttatus* from the Yuanjiang (Chinese portion of the Red River) drainage (e.g. Cui, 1990) may refer to this species, but we were unable to examine any material from China to verify if this is the case.

Remarks. — The figures given in Mai (1978) of the north Vietnamese *Hemibagrus* suffer from a serious layout problem (Kottelat, 1989) in which many were misplaced with respect to the captions. Although all the figures with their ostensibly correct numbers and legends have been printed again at the

end of the book on 48 separately-numbered pages, two of the figures of the *Hemibagrus* species are still not labelled accurately: the figures of *H. centralus* and *H. vietnamicus* (misspelled as *H. vietnammicus* in the figure legend; see Kottelat et al., 1998) have been transposed with respect to the captions (Mai Dinh Yen, pers. comm. to NHH), which explains the conclusion by Kottelat et al. (1998) that *H. centralus* resembles *H. guttatus* and *H. vietnamicus* resembles *H. pluriradiatus*. Figure 115 of the erratum in Mai (1978) shows *H. centralus* and Fig. 116 shows *H. vietnamicus*.

Hemibagrus camthuyensis is described from the Ma River (Song Ma) drainage in northern Vietnam. This species is said to be distinguished from *H. guttatus* (which is superficially very similar to *H. vietnamicus*) in having thicker lips, non-overlapping branchiostegal membranes, palatal teeth strongly curved and maxillary barbels reaching the base of the anal fin. Based on our examination of the data in the original description and examination of material from the Song Ma in Laos, we were unable to find significant differences between *H. camthuyensis* and *H. vietnamicus*, and conclude that they are conspecific.

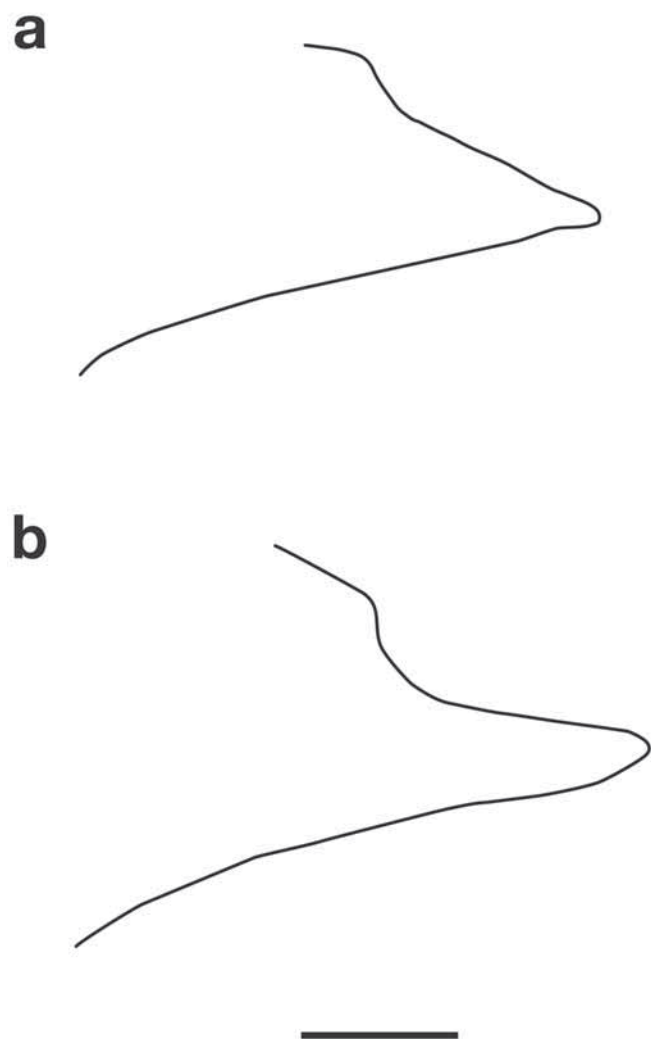


Fig. 13. Cleithral processes of: a, *H. menoda*, UMMZ 208726, 202.6 mm SL; b, *H. peguensis*, CAS 89005, 261.9 mm SL. Scale bar = 5 mm.

HEMIBAGRUS MENODA SPECIES GROUP

Artificial key to the members of the *H. menoda* species group

1. Sides of body with thin black vertical lines and thin midlateral line (Alas River drainage).....*H. caveatus*
– Sides of body with spots arranged in vertical columns.....2
2. Eye diameter 14–16% HL; dorsal to adipose distance 16–19% SL (Cauvery River drainage).*H. punctatus*
– Eye diameter 11–14% HL; dorsal to adipose distance 10–15% SL.....3
3. Snout rounded when viewed from above (Fig. 12); cleithral process broad, with shallow notch dorsally for about one quarter its maximum width (Fig. 13a); fins grey in life (Brahmaputra, Ganges, Godavari and Mahanadi river drainages).
.....*H. menoda*
– Snout almost truncate when viewed from above (Fig. 12); cleithral process narrow, with moderately deep notch dorsally for about one third its maximum width (Fig. 13b); fins reddish in life (Irawaddy and Sittang river drainages).....
.....*H. peguensis*

Remarks. — The members of the *H. menoda* species group are morphologically identical to those of the *H. nemurus* species groups, save for the presence of dark spots or lines on the sides of the body in the former. It is thus likely that both these groups alone are not monophyletic in the absence of the other. Although it is equally logical to combine the species in both *H. menoda* and *H. nemurus* species groups into one group, we maintain the distinctiveness of these two groups in order to simplify comparisons with congeners.

***Hemibagrus menoda* (Hamilton, 1822)**
(Fig. 14)

Pimelodus menoda Hamilton, 1822: 203, Pl. 1 Fig. 72 (type locality: Sharighat bazaar, 35 km NE of Sylhet on Sylhet–Shillong highway, Bangladesh; figure erroneously labelled *Mugil corsula*; see Ng & Ferraris, 2000 for explanation).

Bagrus trachacanthus Valenciennes, in Cuvier & Valenciennes, 1840: 419 (type locality: Bengal, India); Bleeker, 1853c: 56.

Bagrus corsula Valenciennes, in Cuvier & Valenciennes, 1840: 408 (type locality: Sharighat bazaar, 35 km NE of Sylhet on Sylhet–Shillong highway, Bangladesh); Bleeker, 1853c: 56.

Macrones menoda - Günther, 1864: 74; Day, 1871: 706 (in part).

Macrones trachacanthus - Günther, 1864: 75.

Macrones corsula - Day, 1869: 307; 1878: 446, Pl. 100 Fig. 5; 1889: 153 (in part).

Pimelodus telgagra Day, 1871: 200 (not available, name published in synonymy)

Mystus menoda - Shaw & Shebbeare, 1937: 92, Fig. 91; Hora, 1949: 72; Ataur Rahman, 1974: 7; 1989: 199, Fig. 119D; Venkateswarlu, 1976: 96; Jayaram & Singh, 1977: 263; Menon, 1977: 61; Venkateswarlu & Menon, 1979: 56; Datta Munshi & Srivastava, 1988: 238, Pl. 30 Fig. 1; Shrestha, 1994: 52, Fig. 80; Jayaram, 1999: 236 (in part); Jayaram & Sanyal, 2003:75 (in part); Hossain & Haque, 2005: 39; Khan, 2008: 32, Fig. 12; Shrestha, 2008: 150, Pl. 39 Fig. 130; Mohsin & Haque, 2009: 830.

Mystus (Mystus) menoda - Jayaram, 1954: 546, Fig. 9 (in part); 1966: 446; Motwani et al., 1962: 21; Srivastava, 1968: 73, Fig. 46; 1992: 97, Fig. 64; Misra, 1976: 95 (in part); Shrestha, 1981: 157, Fig. 75.

Mystus (Mystus) menoda trachacanthus - Jayaram, 1954: 546; 1966: 446.

Mystus (Mystus) punctatus (in part) - Jayaram, 1954: 547.

Mystus corsula - Qureshi, 1965: 41, Fig. 103.

Mystus menoda menoda - Jayaram, 1977: 33, Fig. 25B (in part); Sen, 1985: 137, Fig. 75; 1992: 183, Fig. 60; Dutta et al., 1993: 26.

Mystus menoda trachacanthus - Jayaram, 1977: 33; Yazdani et al., 1992: 231; Singh & Yazdani, 1993: 21.

Mystus trachacanthus - Mo, 1991: 130.

Hemibagrus menoda - Mo, 1991: 132; Ng & Ferraris, 2000: 130, Figs. 4 & 5; Aatur Rahman, 2005: 219, Fig. 158; Biswas et al., 2007: 64; Ferraris, 2007: 89; Vishwanath et al., 2007: 136; Siddiqui et al., 2007: 115; Saha & Bordoloi, 2009: 241; Mahanta et al., 2011: 346.

Mystus peguensis (non Boulenger, 1894) - Mamnur Rashid et al., 1997: 137.

Material examined. — BANGLADESH: UMMZ 208726, 1 ex., 202.6 mm SL [neotype of *Pimelodus menoda* Hamilton, 1822 and *Bagrus corsula* Valenciennes, in Cuvier & Valenciennes, 1840; designated by Ng & Ferraris, 2000], Surma (Meghna) drainage, Sharigat bazaar, 35 km NE of Sylhet on Sylhet–Shillong highway (said to be from Shari River).

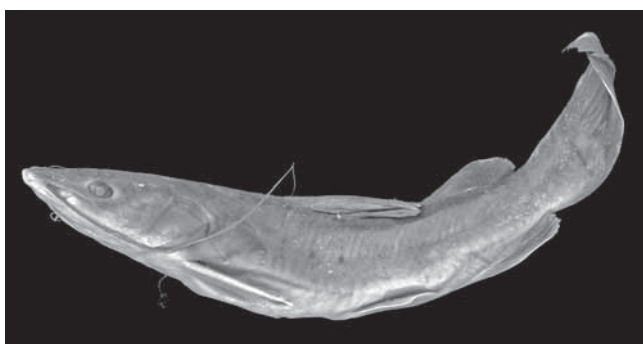


Fig. 14. *Hemibagrus menoda*, UMMZ 208726, neotype, 202.6 mm SL, Bangladesh: Shari River.

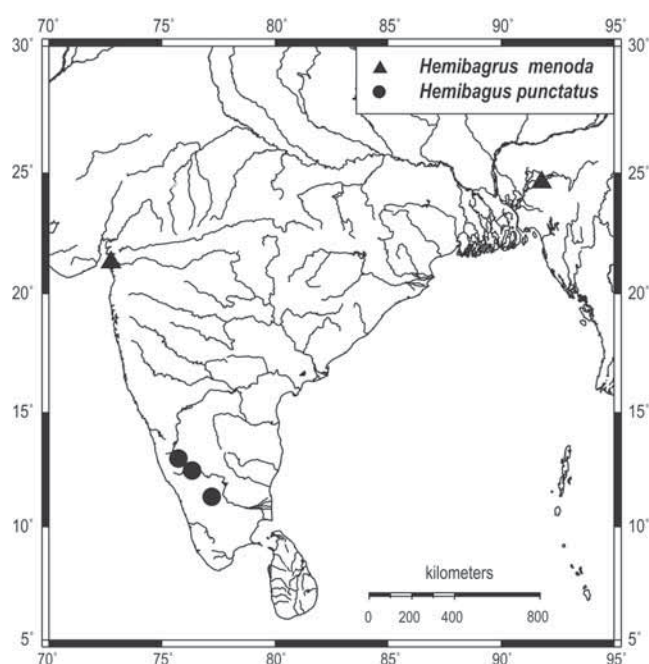


Fig. 15. Map showing collection localities of *Hemibagrus menoda* and *H. punctatus* specimens examined in this study.

INDIA: ANSP 85796, 1 ex., 113.0 mm SL; ZSI 426, 1 ex., 167.2 mm SL, Bombay; MNHN 1191, 1 ex., 285.4 mm SL, Bengal [syntype of *Bagrus trachacanthus*]; RMNH 8791, 1 ex., 184.6 mm SL, Assam.

Diagnosis. — *Hemibagrus menoda* differs from *H. caveatus* in having a pattern of dark spots arranged in vertical columns (vs. thin vertical lines and a midlateral line) along the sides of the body. It is distinguished from *H. punctatus* in having a smaller eye (12% HL vs. 14–16), and greyish (vs. reddish) fins in life, and from *H. peguensis* in having a rounded (vs. almost truncate) snout (Fig. 12) and a broader, less deeply notched cleithral process (for about one quarter its maximum width vs. about one third its maximum width; Fig. 13).

Description. — Biometric and meristic data as in Table 7. General description as for genus. Head depressed and broad, body moderately compressed. Head length 32.7–33.5% SL; head depth 14.2–15.3% SL. Snout rounded. Eye diameter 12% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Caudal-peduncle length 15.2–17.0% SL; caudal-peduncle depth 7.5–8.8% SL. Cleithral process broad, notched for about one quarter its maximum width. Adipose-fin base short, approximately as long as anal-fin base (13.0–15.8% SL); maximum height 3.8–4.5% SL. Adipose-fin origin separated from base of last dorsal-fin ray by distance of 14.2–14.9% SL. Dorsal spine stout, with 6–9 serrations on posterior edge. Pectoral spine stout, with 11–17 serrations on posterior edge. Anal-fin origin slightly posterior to adipose origin. Adpressed dorsal not reaching adipose fin. Caudal fin forked; distal margins of upper and lower lobes rounded. Maximum recorded size 285 mm SL.

Colour. — Preserved specimens have dorsal surface of head and body greyish-brown, gradually fading to dirty white on ventral surface. Lateral surface of body with about nine vertical columns of black spots, largest spots being those in middle of columns along lateral line. Dorsal, pectoral, pelvic and anal fins greyish brown, with scattered melanophores on fin rays and interradial membranes. Caudal fin greyish brown, with lighter hue along posterior edge, and on procurent and outer principal caudal rays.

Distribution. — *Hemibagrus menoda* is known from the Ganges, Brahmaputra, Mahanadi and Godavari River drainages in Bangladesh and northern India (Fig. 15).

***Hemibagrus caveatus* Ng, Wirjoatmodjo & Hadiaty, 2001 (Fig. 16)**

Hemibagrus caveatus Ng, Wirjoatmodjo & Hadiaty, 2001: 359, Fig. 1 (type locality: Sungai Soraya, a tributary of Sungai Alas, Aceh Province, Sumatra); Hadiaty, 2005: 382; Ferraris, 2007: 87.

Material examined. — SUMATRA: Nangroe Aceh Darussalam: MZB 8714, holotype, 186.3 mm SL, Sungai Soraya, a tributary of

Table 7. Biometric and meristic data for *H. menoda* (n = 5).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	32.7–33.5	30.6±2.54
Head width	19.3–21.7	19.7±1.38
Head depth	14.2–15.3	13.5±1.86
Predorsal distance	42.2–45.3	43.1±2.27
Preanal length	71.2–77.5	73.8±2.36
Prepelvic length	55.0–60.5	56.3±2.56
Prepectoral length	28.6–30.3	29.0±1.58
Body depth at anus	13.3–17.1	14.1±1.95
Length of caudal peduncle	15.2–17.0	16.2±0.87
Depth of caudal peduncle	7.5–8.8	8.1±0.85
Pectoral-spine length	14.6–19.9	18.3±2.10
Pectoral-fin length	18.6–24.0	20.9±2.26
Length of dorsal fin	24.3–27.4	25.8±1.31
Length of dorsal-fin base	14.2–16.5	15.1±0.98
Dorsal-spine length	13.7–16.6	15.2±1.08
Pelvic-fin length	14.7–16.1	14.9±0.73
Length of anal-fin base	11.9–12.6	12.2±0.89
Caudal-fin length	20.9–24.8	22.8±1.95
Length of adipose-fin base	13.0–15.8	13.3±1.93
Maximum height of adipose fin	3.8–4.5	4.3±0.37
Dorsal to adipose distance	14.2–14.9	15.2±2.97
Post-adipose distance	15.0–17.4	16.0±1.11
In %HL:		
Snout length	36.2–38.8	37.0±1.44
Interorbital distance	31.4–35.1	32.2±1.62
Eye diameter	11.9–12.3	12.4±0.56
Nasal barbel length	26.4–37.8	29.0±5.35
Maxillary barbel length	191.4–213.3	200.4±19.16
Inner mandibular barbel length	36.8–48.1	41.4±5.30
Outer mandibular barbel length	65.2–73.5	67.3±5.84
MERISTICS		
Dorsal-fin rays	II,7 (5)	
Anal-fin rays	iv,8 (3), iii,9 (1) or iv,9 (1)	
Pelvic-fin rays	i,5 (5)	
Pectoral-fin rays	I,7 (2) or I,8 (3)	
Caudal-fin rays	i,7,8,i (5)	
Branchiostegal rays	10 (3) or 11 (2)	
Gill rakers	3+9 (2) or 4+14 (3)	
Vertebrae	22+22=44 (2) or 24+21=45 (3)	

Sungai Alas; MZB 5625, 1 paratype, 195.5 mm SL, Sungai Alas; MZB 5664, 1 paratype, 130.4 mm SL, Sumatra: Aceh, Sungai Alas, 5 km upstream of Gelombang; MZB 8708, 1 paratype, 130.7 mm SL, Sungai Sembelin, a tributary of Sungai Alas. ZRC 51968, 1 ex., 51.7 mm SL; Trumon, hillstream along Subulussalam–Singkil road, 2°53'8.2"N 97°41'25.7"E.

Diagnosis. — *Hemibagrus caveatus* differs from all other members of the *H. menoda* species group in having thin vertical lines and a midlateral line (vs. dark spots arranged in vertical columns) along the sides of the body. It further differs from both *H. menoda* and *H. penguensis* in having a larger eye (14–16% HL vs. 11–14), and from *H. menoda* in having a longer caudal peduncle (17.6–19.1% SL vs. 15.2–17.0), and deeper adipose fin (maximum height of adipose fin 5.3–6.2% SL vs. 3.8–4.5).

Description. — Biometric and meristic data as in Table 8. General description as for genus. Head depressed and broad,

body moderately compressed. Head length 29.7–30.9% SL; head depth 15.8–17.2% SL. Snout rounded. Eye diameter 14–16% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Caudal-peduncle length 17.6–19.1% SL; caudal-peduncle depth 8.4–9.5% SL. Cleithral process



Fig. 16. *Hemibagrus caveatus*, ZRC 51968, 51.7 mm SL; Sumatra: Trumon.

narrow, notched for about one third its maximum width. Adipose-fin base short, approximately as long as anal-fin base (12.7–16.1% SL); maximum height 5.3–6.2% SL. Adipose-fin origin separated from base of last dorsal-fin ray by distance of 10.0–17.7% SL. Dorsal spine stout, with 5–8 serrations on posterior edge. Pectoral spine stout, with 12–17 serrations on posterior edge. Anal-fin origin slightly posterior to adipose origin. Adpressed dorsal not reaching adipose fin. Caudal fin forked; distal margins of upper and lower lobes rounded. Maximum recorded size 196 mm SL.

Colour. — Preserved specimens with dorsal surface of head and body grey, gradually fading to dirty white on ventral surface. Lateral surface of body with 11–13 dark vertical lines and dark horizontal line running along lateral line. Dorsal, pectoral, pelvic and anal fins grey, with scattered melanophores on fin rays and interradiation membranes. Caudal fin grey, with lighter hue along posterior edge, and on procurent and outer principal caudal rays. Colour in life similar, except for more greenish tone on body and orangeish/reddish anal and caudal fins.

Distribution. — *Hemibagrus caveatus* is known only from the Alas River drainage in northern Sumatra (Fig. 17).

Remarks. — *Hemibagrus caveatus* is placed within the *H. menoda* species group on account of its colour pattern (which is unique among Southeast Asian species).

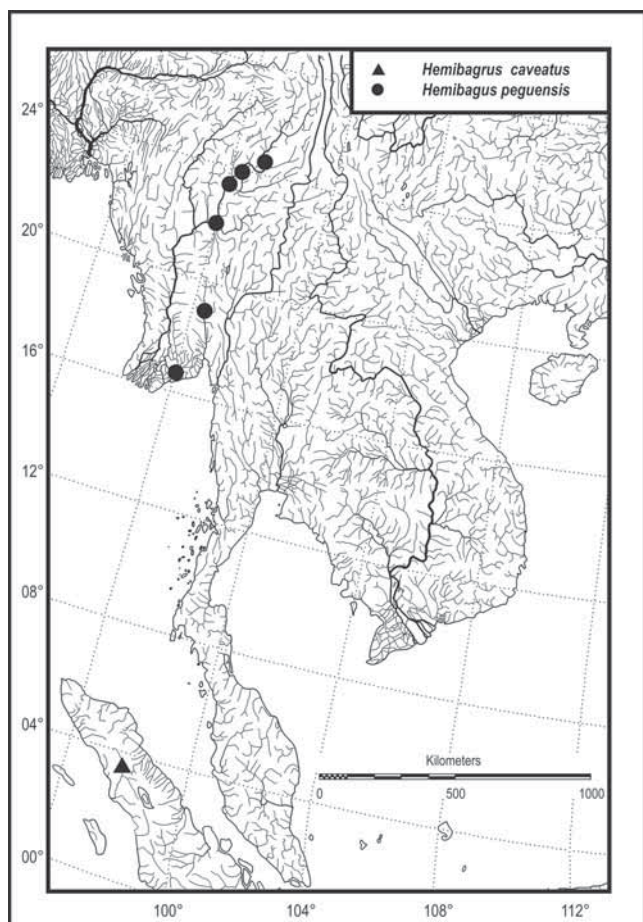


Fig. 17. Map showing collection localities of *Hemibagrus caveatus* and *H. peguensis* specimens examined in this study

Hemibagrus peguensis (Boulenger, 1894)

(Fig. 18)

Macrones peguensis Boulenger, 1894: 196 (type locality: Sittang River near Toungoo, Myanmar).

Bagrus menoda (non Hamilton, 1822) - Blyth, 1860: 285.

Macrones menoda (non Hamilton, 1822) - Day, 1871: 706 (in part); Vinciguerra, 1890: 223.

Macrones corsula (non Hamilton, 1822) - Anderson, 1879: 863; Kyaw Win, 1971: 53, Fig. 21.

Mystus (Mystus) menoda (in part) - Jayaram, 1954: 546; Misra, 1976: 95.

Mystus (Mystus) peguensis - Jayaram, 1954: 552; 1966: 446; Misra, 1976: 100.

Mystus menoda menoda (in part) - Jayaram, 1977: 33.

Mystus peguensis - Jayaram, 1977: 35; Talwar & Jhingran, 1991: 569; Jayaram & Sanyal, 2003: 92, Fig. 19; Khan, 2008: 35.

Hemibagrus peguensis - Mo, 1991: 132; Ng & Ferraris, 2000: 136, Fig. 10; Vishwanath et al., 2007: 137; Ferraris, 2007: 90; Mahanta et al., 2011: 348.

Mystus menoda (in part) - Jayaram, 1999: 236; Jayaram & Sanyal, 2003: 75 (in part).

Material examined. — MYANMAR: BMNH 1894.5.21:25–26, 2 syntypes, 168.8–185.1 mm SL, Taungoo; NRM 31068, 1 ex., 186.1 mm SL, Kachin state, Irrawaddy River drainage, Myitkyina; NRM 15064, 2 ex., 116.8–138.9 mm SL, Sagaing division, Irrawaddy River drainage, Shweli River; CAS 93201, 1 ex., 148.0 mm SL, Irrawaddy River drainage, Mandalay markets; NRM 15105, 1 ex., 166.8 mm SL, Mandalay division, Mandalay; ZRC 43707–43709, 3 ex., 176.1–189.7 mm SL; Irrawaddy River; CAS 133789, 1 ex., 212.7 mm SL, Yangon division, Bago River drainage, 9 miles NW of Hlegu; NRM 39397, 1 ex., 290.6 mm SL, Bago division, Bago; ZRC 43511, 1 ex., 243.3 mm SL, Yangon division, Win Paw Hta River, near border between Bago & Yangon divisions; BMNH 1891.11.30:200–209, 16 ex., 168.7–285.6 mm SL, Sittoung (Sittaung) River; CAS 89005, 1 ex., 261.9 mm SL, Bago division, Sittaung River at Taungoo; ZSI 550, 1 ex., 241.2 mm SL, ZSI 551, 1 ex., 265.6 mm SL, Tagoung.

Diagnosis. — *Hemibagrus peguensis* differs from *H. caveatus* in having a pattern of dark spots arranged in vertical columns (vs. thin vertical lines and a midlateral line) along the sides of the body. It is distinguished from *H. menoda* in having an almost truncate (vs. rounded) snout (Fig. 12) and a narrower, more deeply notched cleithral process (for about one third its maximum width vs. about one quarter its maximum width; Fig. 13), and from *H. punctatus* in having a longer adipose-fin base (14.2–19.3% SL vs. 10.1–13.2) and a smaller eye (11–14% HL vs. 14–16).

Description. — Biometric and meristic data as in Table 9. General description as for genus. Head depressed and broad, body moderately compressed. Head length 29.0–32.5% SL;



Fig. 18. *Hemibagrus peguensis*, ZRC 43708, 177.8 mm SL; Myanmar: Irrawaddy River.

Table 8. Biometric and meristic data for *H. caveatus* (n = 4).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	29.7–30.9	30.5±0.53
Head width	18.2–21.4	20.1±1.38
Head depth	15.8–17.2	16.5±0.58
Predorsal distance	42.3–44.4	43.5±0.88
Preanal length	68.5–71.2	70.0±1.39
Prepelvic length	52.1–53.8	53.1±0.72
Prepectoral length	25.2–30.7	28.7±2.42
Body depth at anus	13.2–17.3	15.7±1.86
Length of caudal peduncle	17.6–19.1	18.1±0.68
Depth of caudal peduncle	8.4–9.5	9.1±0.50
Pectoral-spine length	14.9–18.1	17.2±1.51
Pectoral-fin length	16.2–17.7	21.1±1.26
Length of dorsal fin	26.4–31.3	29.9±2.33
Length of dorsal-fin base	14.6–19.2	16.6±1.92
Dorsal-spine length	16.1–18.8	17.3±1.13
Pelvic-fin length	16.2–17.7	17.0±0.66
Length of anal-fin base	12.0–13.6	12.8±0.68
Caudal-fin length	23.6–26.8	24.7±1.47
Length of adipose-fin base	12.7–16.1	14.5±1.73
Maximum height of adipose fin	5.3–6.2	5.6±0.52
Dorsal to adipose distance	10.0–17.7	13.6±3.17
Post-adipose distance	17.1–17.4	17.2±0.17
In %HL:		
Snout length	36.2–39.1	37.8±1.45
Interorbital distance	29.9–34.3	32.5±1.86
Eye diameter	13.8–15.6	14.9±0.78
Nasal barbel length	33.9–42.6	38.2±3.74
Maxillary barbel length	181.4–270.1	234.3±41.01
Inner mandibular barbel length	47.0–60.1	50.8±6.29
Outer mandibular barbel length	83.0–101.5	91.2±8.55
MERISTICS		
Dorsal-fin rays	II,7 (4)	
Anal-fin rays	Iv,9 (4)	
Pelvic-fin rays	I,5 (4)	
Pectoral-fin rays	I,8 (2) or I,9 (2)	
Caudal-fin rays	i,7,8,i (4)	
Branchiostegal rays	11 (3) or 12 (1)	
Gill rakers	4+13 (1) or 5+14 (1)	
Vertebrae	21+21=42 (1) or 22+22=44 (3)	

head depth 12.9–15.2% SL. Snout almost truncate. Eye diameter 11–14% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Caudal-peduncle length 16.2–18.2% SL; caudal-peduncle depth 7.6–8.8% SL. Cleithral process narrow, notched for about one third its maximum width. Adipose-fin base short, approximately as long as anal-fin base (14.2–19.3% SL); maximum height 3.7–4.9% SL. Adipose-fin origin separated from base of last dorsal-fin ray by distance of 10.4–15.0% SL. Dorsal spine stout, with 6–11 serrations on posterior edge. Pectoral spine stout, with 15–19 serrations on posterior edge. Anal-fin origin slightly posterior to adipose origin. Adpressed dorsal not reaching adipose fin. Caudal fin forked; distal margins of upper and lower lobes rounded. Maximum recorded size 286 mm SL.

Colour. — Preserved specimens with dorsal surface of head and body greyish brown, gradually fading to dirty white on ventral surface. Lateral surface of body with about nine vertical columns of black spots, largest spots being those in middle of columns, along lateral line. Dorsal, pectoral, pelvic and anal fins greyish brown, with scattered melanophores on fin rays and interradial membranes. Caudal fin greyish brown, with lighter hue along posterior edge, and on procurrent and outer principal caudal rays.

Distribution. — *Hemibagrus peguensis* is known from the Irrawaddy, Bago and Sittang river drainages in Myanmar (Fig. 17).

Remarks. — *Hemibagrus peguensis* has long been misidentified as *H. menoda* (e.g. Day, 1889; Jayaram, 1954). Even in cases where it was considered a distinct species (e.g. Jayaram, 1977; Talwar & Jhingran, 1991; Jayaram &

Table 9. Biometric and meristic data for *H. peguensis* (n = 29).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	29.0–32.5	30.7±1.10
Head width	18.8–21.7	20.1±0.89
Head depth	12.9–15.2	13.9±0.91
Predorsal distance	39.8–44.9	42.7±1.55
Preanal length	70.6–74.0	72.7±1.12
Prepelvic length	52.5–57.6	55.4±1.38
Prepectoral length	25.4–30.8	27.8±1.68
Body depth at anus	12.3–16.3	14.5±1.55
Length of caudal peduncle	16.2–18.2	16.9±1.08
Depth of caudal peduncle	7.6–8.8	8.4±0.46
Pectoral-spine length	15.3–19.6	17.3±1.27
Pectoral-fin length	18.2–20.9	19.0±1.36
Length of dorsal fin	23.8–27.8	25.4±1.32
Length of dorsal-fin base	13.6–15.9	14.9±0.73
Dorsal-spine length	13.5–16.2	14.8±1.01
Pelvic-fin length	13.3–15.5	14.5±0.57
Length of anal-fin base	11.2–14.0	12.2±0.67
Caudal-fin length	19.3–23.9	21.4±1.23
Length of adipose-fin base	14.2–19.3	15.3±1.79
Maximum height of adipose fin	3.7–4.9	4.4±0.47
Dorsal to adipose distance	10.4–15.0	12.9±2.01
Post-adipose distance	15.4–17.4	16.6±0.61
In %HL:		
Snout length	36.3–39.9	38.0±1.02
Interorbital distance	30.5–35.4	33.1±1.68
Eye diameter	11.2–13.5	12.6±1.54
Nasal barbel length	22.7–34.0	27.6±4.64
Maxillary barbel length	160.6–212.6	178.3±31.83
Inner mandibular barbel length	34.5–45.1	37.4±5.72
Outer mandibular barbel length	57.4–70.2	63.1±6.15
MERISTICS		
Dorsal-fin rays	II,6 (1) or II,7 (28)	
Anal-fin rays	iv,6 (1), iv,7 (1), iii,8 (3), iv,8 (14), iii,9 (2), v,8 (4) or iv,9 (4)	
Pelvic-fin rays	i,5 (29)	
Pectoral-fin rays	I,8 (10), I,8,i (4), I,9 (10), I,9,i (4) or I,10 (1)	
Caudal-fin rays	i,7,8,i (29)	
Branchiostegal rays	9 (5) or 10 (24)	
Gill rakers	3+9 (8), 4+8 (18) or 4+9 (3)	
Vertebrae	23+21=44 (8), 24+20=44 (1), 23+22=45 (8) or 24+21=45 (12)	

Sanyal, 2003), no clear distinguishing character was used to separate the two species, nor was it recognised that *H. peguensis* superficially resembled *H. menoda*. As a result, these accounts often listed the presence of *H. menoda* in Myanmar when in fact the records actually refer to *H. peguensis*. The original description of *H. peguensis* gives the total lengths of the syntypes as 20 mm. This is most probably a typographical error for 200 mm (the approximate total lengths of the syntypes).

Hemibagrus punctatus (Jerdon, 1849)

(Fig. 19)

Bagrus punctatus Jerdon, 1849: 339 (type locality: Cauvery River and its tributaries, India).

Hemibagrus punctatus - Day, 1867: 284; Ng & Ferraris, 2000: 137, Fig. 11; Ferraris, 2007: 91.

Macrones punctatus - Day, 1878: 445, Pl. 100 Fig. 3; 1889: 153.

Mystus punctatus - Hora, 1937: 19; 1942: 197; Jayaram, 1977: 36, Fig. 25A; 1981: 197, 201, Fig. 95A; Jayaram et al., 1982: 87, Fig. 27; Mo, 1991: 131; Talwar & Jhingran, 1991: 570, Fig. 188; Jayaram, 1999: 236; Yazdani et al., 2001: 219; Jayaram & Sanyal, 2003: 101, Fig. 23; Karmakar & Das, 2005: 95, Fig. 120; Khan, 2008: 36, Fig. 16.

Mystus (Mystus) punctatus - Jayaram, 1954: 547 (in part); 1966: 446; Misra, 1976: 102.

Mystus menoda (non Hamilton, 1822) - Jayaram et al., 1982: 86, Fig. 26.

Mystus menoda menoda (non Day) - Barman, 1993: 223, Fig. 94.

Material examined. — INDIA: BMNH 1868.5.14:8, 1 ex., 154.6 mm SL, India; RMNH 3023, 1 ex., 143.5 mm SL, Bhavani River; ZSI F12403, 1 ex., 120.2 mm SL, Karnataka: Cauvery River at Coorg; ZSI FF 1223, 1 ex., 193.1 mm SL, India: Karnataka: Hemavathy River at Huliyaar.

Diagnosis. — *Hemibagrus punctatus* differs from *H. caveatus* in having a pattern of dark spots arranged in vertical columns (vs. thin vertical lines and a midlateral line) along the sides of the body, and from both *H. menoda* and *H. peguensis* in having a greater dorsal to adipose distance (16.3–19.4% SL vs. 10.4–15.0) and larger eye (14–16% HL vs. 11–14). It can be further distinguished from *H. menoda* in having a shorter, flatter head (head length 28.1–29.6% SL vs. 32.7–33.5; head depth 11.9–14.3% SL vs. 14.2–15.3), greater caudal peduncle depth (8.8–9.9% SL vs. 7.5–8.8), and reddish (vs. grey) fins in life, and from *H. peguensis* in having a shorter adipose-fin base (10.1–13.2% SL vs. 14.2–19.3) and a larger eye (14–16% HL vs. 11–14).

Description. — Biometric and meristic data as in Table 10. General description as for genus. Head depressed and broad, body moderately compressed. Head length 28.1–29.6% SL; head depth 11.9–14.3% SL. Snout rounded. Eye diameter 14–16% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Caudal-peduncle length 16.1–18.6% SL; caudal-peduncle depth 8.8–9.9% SL. Cleithral process broad, notched for about one quarter its maximum width. Adipose-fin base short, approximately as long as anal-fin base (10.1–13.2% SL); maximum height 3.9–5.4% SL. Adipose-fin origin separated from base of last dorsal-fin ray by distance of 16.3–19.4% SL. Dorsal spine stout, with 5–7 serrations on posterior edge. Pectoral spine stout, with 12–19 serrations on posterior edge. Anal-fin origin slightly posterior to adipose origin. Adpressed dorsal not reaching adipose fin. Caudal fin forked; distal margins of upper and lower lobes rounded. Maximum recorded size 197 mm SL (Jayaram & Sanyal, 2003).

Colour. — Preserved specimens with dorsal surface of head and body greyish brown, fading to a dirty white on ventral

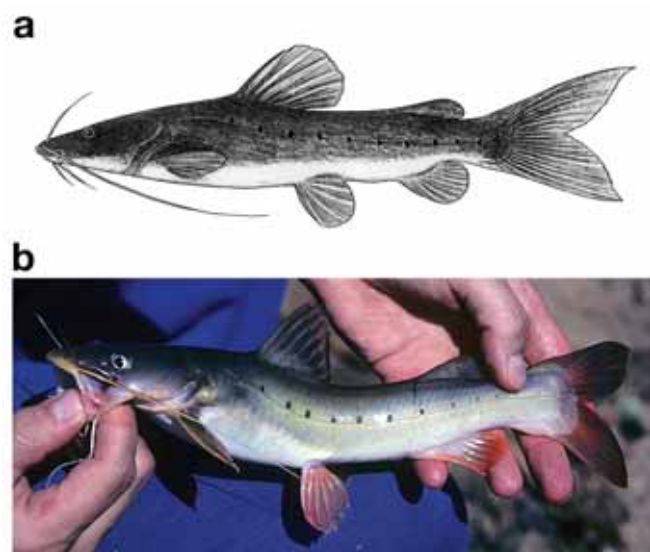


Fig. 19. a, *Hemibagrus punctatus*, ZSI FF 1223, 193.1 mm SL; India: Hemavathy River; b, Specimen (not preserved) from Cauvery River, Karnataka (approx. 250 mm SL) showing live colouration. (Photograph courtesy of Johnny Jensen; copyright www.jjphoto.

surface. Lateral surface of body with about 9–10 black spots arranged in a horizontal row along lateral line. Dorsal, pectoral, pelvic and anal fins greyish brown, with scattered melanophores on fin rays and interradial membranes. Caudal fin greyish brown, with a lighter hue along posterior edge, and procurent and first principal caudal rays.

Distribution. — *Hemibagrus punctatus* is known only from the Cauvery River drainage in southern India (Fig. 15).

Remarks. — The colour pattern of *H. punctatus* has often been described as a series of large spots along the lateral line (e.g. Ng & Ferraris, 2000), but this pattern is based on poorly-preserved material. Photographs of fresh material (Fig. 19b) show that *H. punctatus* actually possesses vertical columns of spots much like *H. menoda* and *H. peguensis*. Although the colour patterns of *H. menoda*, *H. peguensis* and *H. punctatus* are very similar in that the sides of the body are marked with a series of vertical columns of black spots, there are slight but distinct differences between *H. punctatus* and the *H. menoda*. In *H. punctatus*, the spots in the middle of the columns along the lateral line remain distinctly larger (at least twice the size of the other spots in the same column) in almost all the columns (save the last one or two) whereas in *H. menoda*, only the spots in the first three or four columns are distinctly larger.

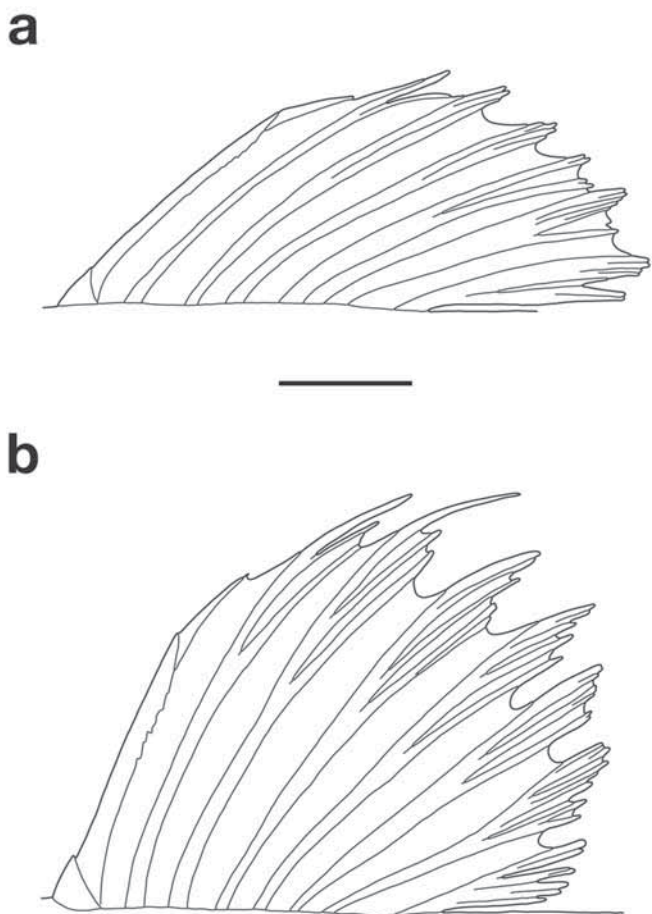


Fig. 20. Schematic illustrations of fully extended dorsal fins of members of the *H. nemurus* species group: a, *H. fortis*, ZRC 40522, 126.9 mm SL; b, other members of the *H. nemurus* species group (*H. nemurus*, ZRC 39181, 132.4 mm SL, illustrated). Scale bar = 10 mm.

Table 10. Biometric and meristic data for *H. punctatus* (n = 4).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	28.1–29.6	29.0±0.63
Head width	16.4–20.5	18.8±1.80
Head depth	11.9–14.3	13.1±1.70
Predorsal distance	39.8–42.0	40.8±1.23
Preanal length	71.0–74.2	72.7±1.33
Prepelvic length	53.9–55.7	54.5±0.81
Prepectoral length	26.2–26.6	26.2±0.54
Body depth at anus	11.9–14.3	12.5±1.45
Length of caudal peduncle	16.1–18.6	16.8±1.28
Depth of caudal peduncle	8.8–9.9	9.8±0.96
Pectoral-spine length	15.6–18.1	16.9±1.25
Pectoral-fin length	18.7–21.1	20.4±1.73
Length of dorsal fin	24.7–27.6	27.0±1.56
Length of dorsal-fin base	14.7–17.4	15.5±1.30
Dorsal-spine length	13.9–15.9	14.7±1.06
Pelvic-fin length	14.9–17.2	16.0±1.10
Length of anal-fin base	11.8–14.3	13.2±1.20
Caudal-fin length	21.4–23.9	22.7±1.77
Length of adipose-fin base	10.1–13.2	11.3±1.33
Maximum height of adipose fin	3.9–5.4	4.7±0.96
Dorsal to adipose distance	16.3–19.4	17.4±4.38
Post-adipose distance	14.8–16.2	15.5±0.99
In %HL:		
Snout length	35.7–38.9	36.8±1.46
Interorbital distance	31.3–32.5	31.8±0.54
Eye diameter	13.8–15.7	14.9±1.78
Nasal barbel length	27.5–40.3	32.9±6.64
Maxillary barbel length	163.2–203.4	188.4±21.96
Inner mandibular barbel length	31.7–45.6	37.6±7.20
Outer mandibular barbel length	68.8–80.2	72.7±6.50
MERISTICS		
Dorsal-fin rays	II,7 (4)	
Anal-fin rays	iv,8 (1) or iv,9 (3)	
Pelvic-fin rays	i,5 (4)	
Pectoral-fin rays	I,9 (3) or I,10 (1)	
Caudal-fin rays	i,7,8,i (4)	
Branchiostegal rays	9 (3) or 10 (1)	
Gill rakers	4+8 (2) or 5+13 (2)	
Vertebrae	25+21=46 (4)	

HEMIBAGRUS NEMURUS SPECIES GROUP**Artificial key to the members of the
H. nemurus species group**

1. Premaxillary tooth band partially exposed when mouth closed; caudal-fin lobes tapering; broad conspicuous dark margin around caudal fin; anal fin triangular (Sundaic Southeast Asia) *H. hoevenii*
- Premaxillary tooth band not exposed when mouth closed; caudal-fin lobes rounded; dark margin around margins of caudal fin faint or absent; anal fin rounded 2
2. All branches of each dorsal-fin ray of almost equal length, imparting rounded distal margin to fin (Fig. 20a; central and eastern Borneo)..... *H. fortis*
- Antermost branch of each dorsal-fin ray longer than other branches, imparting distinctly jagged distal margin to fin (Fig. 20b)..... 3
3. Dorsal fin (excluding filamentous extensions of fin rays) not reaching adipose-fin origin when depressed..... 4

- Dorsal fin (excluding filamentous extensions of fin rays) reaching to or beyond adipose-fin origin when depressed 5
- 4. Dorsal surface of neurocranium flat when viewed dorsally; eye diameter 9–11% HL in specimens larger than approx. 150 mm SL (Java)..... *H. nemurus*
- Dorsal surface of neurocranium gently convex when viewed dorsally; eye diameter 12–18% HL in specimens larger than approx. 150 mm SL (mainland Southeast Asia). *H. spilopterus*
- 5. Head width 59–70% HL (Sundaic Southeast Asia)..... *H. capitulum*
- Head width 55–60% HL (mainland Southeast Asia)..... *H. filamentus*

***Hemibagrus nemurus* (Valenciennes, 1840)**

(Fig. 21)

Bagrus nemurus Valenciennes, in Cuvier & Valenciennes, 1840: 423 (type locality: Java); Bleeker, 1846a: 155; 1846b: 285;

1847: 6; 1849: 10; 1851a: 260, 261; 1851d: 416, 420; 1855a: 469; 1855d: 393, 394; 1857b: 476, 477; 1858a: 418; 1858b: 48; 1858e: 150 (in part); 1859c: 357; 1859g: 134 (in part).

Bagrus Sieboldii Bleeker, 1846a: 27 (type locality: Batavia [=Jakarta], Java); 1846b: 285.

Hemibagrus nemurus - Bleeker, 1862: 55, Pl. 69 (in part); Ferraris, 2007: 90 (in part).

Macrones nemurus - Günther, 1864: 80 (in part); Weber, 1894: 420 (in part); Weber & de Beaufort, 1913: 341 (in part).

Mystus (Mystus) nemurus - Jayaram, 1966: 446 (in part).

Mystus nemurus - Roberts, 1993: 28, Fig. 63; Kottelat et al., 1993: 66 (in part; not pl. 31).

Hemibagrus cf. nemurus - Rachmatika, 2003: 57, Pl. 28.

Material examined. — JAVA: ZRC 40144, 1 ex., 53.2 mm SL, Jawa Barat: Kecamatan Cijeruk, Desa Pamoyanan, Cipinang Gading at Kampung Sawah, Bera; ZRC 42564, 5 ex., 192.6–323.0 mm SL, ZRC 41504, 1 ex., 255.7 mm SL, Jawa Barat: Sungai Sokan at Cibalagung, a probable outlet of Cirata Reservoir at Citarum, 6°47'58"S 107°16'21"E; ZRC 43855, 1 ex., 88.5 mm SL, Jawa Barat: Cisadane near Leuwiliang, 6°35'7"S 106°37'57"E; ZRC 44087, 1 ex., 420 mm SL, Jawa Barat: market in Banjar, 7°22'S 108°32'E; ZRC 43911, 3 ex., 26.2–66.0 mm SL, Jawa Tengah: Kali Progo about 15 km W to Yogyakarta, next to Moyudan, 7°47'59"S 110°14'46"E; ZMA 121.818, 2 ex., 85.2–89.0 mm SL, Jawa Tengah: Opak River at Kampung Kritek; ZRC 40554, 6 ex., 339–390 mm SL, Jawa Timur.

Diagnosis. — *Hemibagrus nemurus* differs from *H. capitulum* in having a smaller eye in specimens larger than approx. 150 mm SL (9–11% HL vs. 11–19), the adpressed dorsal fin (excluding the filamentous extensions of the fin rays if present) not reaching to (vs. reaching to or beyond) the origin of the adipose fin, and shorter maxillary barbels (reaching to origin of anal fin vs. beyond caudal-fin base but frequently to vertical through base of last anal-fin ray; 168–221% HL vs. 193–390), from *H. filamentus* in having a relatively shorter and wider head (head width 60–70% HL vs. 55–60) and longer dorsal to adipose distance (10.2–16.2% SL vs. 7.7–10.9). It is distinguished from *H. fortis* in having the anteriormost branch of each dorsal-fin ray longer than other branches (vs. branches of almost equal length) giving the dorsal fin a jagged (vs. rounded) distal margin (Fig. 20), a shorter, deeper adipose fin (maximum height of adipose fin 1.9–3.2 times in the length of its base vs. 2.8–4.9) and a smaller eye (9–15% HL vs. 16–29), from *H. hoevenii* in having the premaxillary tooth band not (vs. partially) exposed when the mouth is closed, rounded (vs. tapering) caudal-fin lobes, absence (vs. presence) of a broad and conspicuous dark margin around the caudal fin, a rounded (vs. triangular) anal fin, broader membranes of the dorsal fin which give it a rounded (vs. triangular) appearance, and lacking filamentous extensions



Fig. 21. *Hemibagrus nemurus*, ZRC 42564, 238.6 mm SL, Java: Sungai Sokan.

on the dorsal fin (vs. very long filamentous extensions of the first two dorsal-fin rays that reach beyond the posterior base of the adipose fin), and from *H. spilopterus* in having a flat (vs. gently convex) interorbital space, and smaller eye (9–11% HL vs. 12–18 in specimens larger than approx. 150 mm SL; 13–15% HL vs. 15–18 in specimens smaller than approx. 150 mm SL).

Description. — Biometric and meristic data as in Table 11. General description as for genus. Head depressed and broad, body moderately compressed; head width 60–70% HL. Interorbital space flat. Eye diameter 9–15% HL. Premaxillary tooth band not exposed when mouth is closed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose-fin base short, approximately as long as anal-fin base; maximum height 4.9–7.4% SL (1.9–3.2 times in length of adipose-fin base). Adipose-fin origin separated from base of last dorsal-fin ray by distance of 10.2–16.2% SL. Dorsal spine stout, with 10–12 serrations on posterior edge. Anteriormost branch of each dorsal-fin ray longer than other branches, imparting jagged distal margin to fin; no conspicuous filamentous extensions present on fin rays; membranes broad, imparting rounded appearance. Adpressed dorsal fin not reaching adipose fin. Pectoral spine stout, with 20–28 large serrations on posterior edge. Anal fin rounded, origin slightly posterior to adipose origin. Caudal fin forked; upper and lower lobes rounded. Maxillary barbels reaching to origin of anal fin (168–221% HL). Maximum recorded size 380 mm SL.

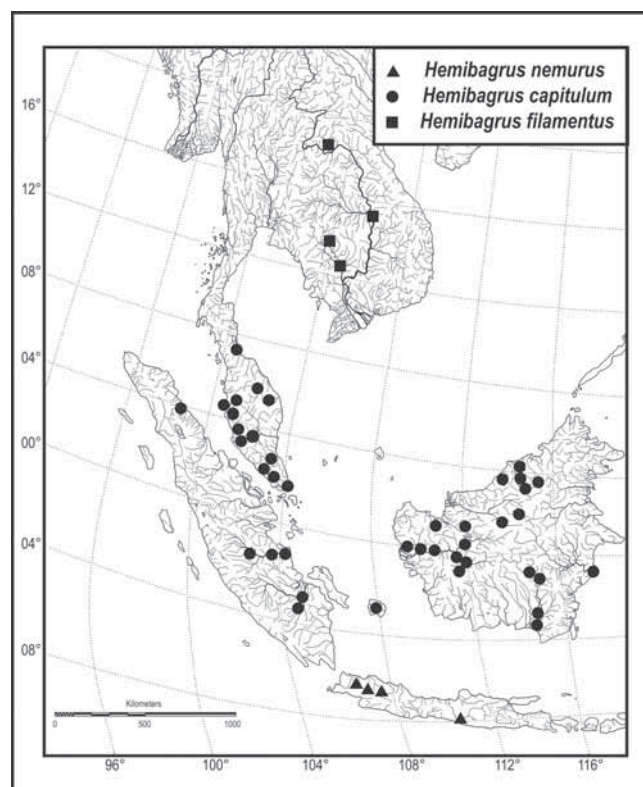


Fig. 22. Map showing collection localities of *Hemibagrus nemurus*, *H. capitulum* and *H. filamentus* specimens examined in this study.

Table 11. Biometric and meristic data for *H. nemurus* (n = 20).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	29.9–33.5	31.5±1.19
Head width	18.0–22.3	20.8±1.11
Head depth	12.5–16.9	15.6±1.38
Predorsal distance	40.5–46.4	43.1±1.59
Preanal length	68.2–75.1	72.4±1.88
Prepelvic length	49.1–58.2	55.4±2.35
Prepectoral length	26.1–28.7	27.2±0.84
Body depth at anus	13.2–19.5	16.5±1.76
Length of caudal peduncle	15.9–18.6	17.4±0.97
Depth of caudal peduncle	8.5–9.9	9.0±0.42
Pectoral-spine length	12.2–18.1	16.2±2.09
Pectoral-fin length	14.5–20.5	18.8±1.50
Length of dorsal fin	22.8–27.4	25.2±1.43
Length of dorsal-fin base	14.4–17.5	16.0±1.07
Dorsal-spine length	9.7–16.8	13.6±2.07
Pelvic-fin length	13.1–16.8	14.7±0.99
Length of anal-fin base	10.4–14.2	12.2±0.96
Caudal-fin length	16.9–26.5	21.1±3.04
Length of adipose-fin base	11.7–16.9	13.9±1.40
Maximum height of adipose fin	4.9–7.4	5.7±0.67
Dorsal to adipose distance	10.2–16.2	12.8±2.04
Post-adipose distance	15.7–17.7	16.9±0.64
In %HL:		
Snout length	33.6–39.7	36.7±1.85
Interorbital distance	29.7–35.2	33.5±1.58
Eye diameter	9.3–15.2	11.2±1.63
Nasal barbel length	19.3–40.0	25.5±5.57
Maxillary barbel length	168.4–221.0	201.1±17.35
Inner mandibular barbel length	32.6–49.1	41.9±5.49
Outer mandibular barbel length	55.0–78.8	67.0±6.74
MERISTICS		
Dorsal-fin rays	II,7 (20)	
Anal-fin rays	iii,8 (1), iii,9 (3), iv,8 (1) or iv,9 (15)	
Pelvic-fin rays	i,5 (20)	
Pectoral-fin rays	I,8 (11), I,8,i (5) or I,9 (4)	
Caudal-fin rays	i,7,8,i (20)	
Branchiostegal rays	11 (7), 12 (12) or 13 (1)	
Gill rakers	4+10 (5), 5+10 (2), 4+12 (2) or 5+11 (11)	
Vertebrae	22+22=44 (1), 23+21=44 (2), 24+21=45 (2), 24+22=46 (13) or 25+21=46 (2)	

Colour. — Dorsal surface of head and body uniform brownish-grey; ventral surface of head and body dirty white; adipose fin brownish-grey, without black spot; fin-rays and inter-radial membranes of all fins grey; dorsal surface of barbels brownish-grey, ventral surface dirty white.

Distribution. — *Hemibagrus nemurus* is known only from Java (Fig. 22).

Habitat and biology. — *Hemibagrus nemurus* is primarily an inhabitant of large rivers, and has been described as an opportunistic predator that feeds on fish and aquatic and terrestrial invertebrates (Rachmatika, 2003).

Remarks. — *Hemibagrus nemurus* was thought to be widely distributed throughout Sundaic and mainland Southeast Asia. Our examination of a large series of material from throughout Southeast Asia revealed consistent differences in

morphology and morphometrics in material initially thought to be conspecific. These led to the recognition of five other species: *H. capitulum* from Borneo, Sumatra and the Malay Peninsula (this is the species identified as *H. nemurus* in most works on Sundaic Asian fishes and distinguished from it by its larger eye in specimens greater than approx. 150 mm SL and the adpressed dorsal fin reaching to or beyond the origin of the adipose fin when depressed), *H. filamentus* from the middle and lower Mekong River drainage in Indochina (distinguished from *H. nemurus* by its longer, narrower head), *H. fortis* from central Borneo (distinguished from *H. nemurus* by its rounded dorsal fin, lower adipose fin and smaller eye), and *H. spilopterus* from the drainages throughout Indochina (distinguished from *H. nemurus* in having a flat interorbital space and larger eye in specimens greater than approx. 150 mm SL). In a previous study, Tan & Ng (2000) had identified Sumatran populations of *H. nemurus* as distinct from the Javanese population, and had

tentatively considered them conspecific with the Bornean *H. fortis*. Further investigations here have revealed that the Sumatran populations are referable to *H. capitulum*, and are not conspecific with *H. fortis*.

Valenciennes (in Cuvier & Valenciennes, 1840) described *Bagrus nemurus* from a single specimen of 15 Parisian inches (=406 mm) TL collected by Kuhl and van Hasselt in Java. The holotype is believed to be deposited in the RMNH in Leiden (Roberts, 1993a), but some of the Javanese material collected by Kuhl and van Hasselt is also deposited in the MNHN in Paris. A search of these two collections by the first author failed to find any Javanese material of *H. nemurus* collected by Kuhl & van Hasselt, save for a skeleton in the RMNH (RMNH 269) bearing the unpublished name “*Bagrus tetragonocephalus* van Hasselt”. This skeleton is too small to be the holotype (being only 175 mm SL). Although the holotype of *Bagrus nemurus* could not be located, there is little ambiguity about the identity of this species (since only one species of *Hemibagrus* with 43–46 vertebrae is known from Java), and a neotype designation would not fulfill the conditions of Article 75 of the International Code of Zoological Nomenclature. We also note that a previous attempt to stabilise the taxonomy of the species was rejected (Ng et al., 1999: Case 3061; International Commission for Zoological Nomenclature, 2002: Opinion 2011), and concur that there is no compelling argument for the designation of a neotype.

Hemibagrus nemurus differs from both *H. capitulum* and *H. spilopterus* in having a smaller eye in specimens larger than approx. 150 mm SL (9–11% HL vs. 11–19 and 12–18 respectively). In specimens smaller than approx. 150 mm SL, there is broad overlap in eye size between *H. nemurus* and *H. capitulum* (diameter 13–15% HL vs. 12–19 respectively), but the eye of *H. nemurus* is still smaller than that of *H. spilopterus* at this size (diameter 13–15% HL vs. 15–18 respectively).

The synonymy of *Bagrus sieboldii* with *H. nemurus* follows that of Bleeker (1858e) and Roberts (1989). There is no indication from available data that indicates otherwise (Ng et al., 1999), and we retain the synonymy of the two nominal species here.

***Hemibagrus capitulum* (Popta, 1904)**
(Fig. 23)

Macrones fortis var. *capitulum* Popta, 1904: 186 (type locality: Bo River, central Borneo); 1906: 48, Pl. 3 Fig. 9.

Bagrus nemurus (non Valenciennes, in Cuvier & Valenciennes, 1840) - Bleeker, 1851d: 416, 420; 1852a: 413; 1852b: 445; 1853a: 718, 722; 1853b: 181; 1854a: 428, 429, 432; 1854b: 65; 1855d: 393, 394; 1856a: 417, 419; 1856b: 4, 9; 1857a: 25; 1858d: 266; 1858e: 150 (in part); 1858f: 7; 1858g: 4; 1859d: 434; 1859e: 370; 1859g: 134 (in part); 1860a: 46; 1860b: 18.

Hemibagrus nemurus (non Valenciennes, in Cuvier & Valenciennes, 1840) - Bleeker, 1862: 55, Pl. 69 (in part); 1863a: 73; Hubrecht, 1887: 11; Fowler, 1905: 469; Mo, 1991: 132; Kottelat & Lim, 1995: 238; Ng & Tan, 1999: 357; Parenti & Downing Meisner,

2003: 45; Parenti & Lim, 2005: 189; Atack, 2006: 64; Ferraris, 2007: 90 (in part); Rahim et al., 2009: 11; Shah et al., 2009: 64; Ambak et al., 2010: 78; Jimmy et al., 2010: 56; Kamaruddin et al., 2011: 92; Hashim & Shah et al., 2012: 28; Rainboth et al., 2012: Plate 45, Fig. 944.

Macrones nemurus (non Valenciennes, in Cuvier & Valenciennes, 1840) - Günther, 1864: 80 (in part); Vinciguerra, 1880: 169; Boulenger, 1890: 38; Weber, 1894: 420 (in part); Vaillant, 1902: 54 (in part); Volz, 1904: 468; 1907: 166; Weber & de Beaufort, 1912: 536; 1913: 341 (in part); Rendahl, 1922: 201; Vinciguerra, 1926: 608; Hardenberg, 1931: 117; 1934: 306; 1935: 234; 1936: 234; Tweedie, 1936: 19.

Macrones (Hemibagrus) nemurus (non Valenciennes, in Cuvier & Valenciennes, 1840) - Steindachner, 1901: 446.

Macrones bleekeri Volz, 1903: 556 (type locality: Banjuasin, Palembang, Sumatra); 1904: 468 [primary junior homonym of *Macrones bleekeri* Day, 1877]; 1907: 167.

Macrones planiceps (non Valenciennes in Cuvier & Valenciennes, 1840) - Tweedie, 1936: 19.

Macrones baramensis (non Regan, 1906) - Hardenberg, 1936: 234.

Mystus nemurus (non Valenciennes, in Cuvier & Valenciennes, 1840) - Herre & Myers, 1937: 69; Hora & Gupta, 1941: 26; Suvatti, 1950: 297 (in part); Inger, 1955: 65; Alfred, 1961: 36; Inger & Chin, 1962: 138, Fig. 69; Mohsin et al., 1977: 76; Mizuno & Furtado, 1982: 323; Mohsin & Ambak, 1982: 104, Fig. 4; 1983: 129, Fig. 95; Watson & Balon, 1984: 933 (in part); Zakaria-Ismail, 1984: 25; 1987: 408; 1993: 207, Pl. 5d; Roberts, 1989: 121; 1993a: 28, Fig. 63; Christensen, 1992: 600; Kottelat et al., 1992: 10; 1993: 66 (in part), Pl. 31; Ng et al., 1992: 18, Fig. 61; 1994: 209; Lim et al., 1993: 6; Kottelat, 1994: 412; Zakaria-Ismail & Lim, 1995: 322, Pl. 4b; Jayaram & Sanyal, 2003: 85, Fig. 17; Nyanti et al., 2006: 105; Shah et al., 2006: 56.

Mystus baramensis (non Regan, 1906) - Herre & Myers, 1937: 68; Suvatti, 1950: 295; 1981: 90; Mohsin et al., 1977: 76; Mohsin & Ambak, 1982: 106, Fig. 6; 1983: 130, Fig. 97; Jayaram & Sanyal, 2003: 39, Fig. 3.

Aoria nemurus (non Valenciennes, in Cuvier & Valenciennes, 1840) - de Beaufort, 1939: 190.

Mystus johorensis Herre, 1940: 13, Pls. 7–8 (type locality: Sungai Kayu, 16 miles north of Kota Tinggi, Johor, Peninsular Malaysia).

Mystus pahangensis Herre, 1940: 14, Pl. 9 (type locality: Sungai Garam near Karak, Pahang, Peninsular Malaysia).

Macrones wycki (non Bleeker, 1858) - Tweedie, 1940: 70.

Mystus planiceps (non Valenciennes in Cuvier & Valenciennes, 1840) - Hora & Gupta, 1941: 27 (in part); Nyanti et al., 2006: 105.

Mystus (Mystus) johorensis - Jayaram, 1966: 446.

Mystus (Mystus) nemurus - Jayaram, 1966: 446 (in part).

Mystus (Mystus) pahangensis - Jayaram, 1966: 446.

Mystus sp. - Imaki et al., 1981: 41, Fig. 82.

Mystus cf. *planiceps* - Cramphorn, 1983: 19.



Fig. 23. *Hemibagrus capitulum*, ZRC 40482, 139.4 mm SL, Borneo: Brunei Darussalam, Sungai Merimbun.

Hemibagrus chrysops Ng & Dodson, 1999: 48 (type locality: Serian market, from Sadong River, Sarawak, Borneo); Parenti & Lim, 2005: 189; Ferraris, 2007: 87; Ng & Lim, 2008: 27, Fig. 21.

Hemibagrus aff. *nemurus* - Tan & Ng, 2000: 271.

Hemibagrus cf. *nemurus* - Kottelat & Widjanarti, 2005: 159; Rachmatika et al., 2005: 27.

Hemibagrus fortis - Ferraris, 2007: 88 (in part).

Hemibagrus johorensis - Ferraris, 2007: 89.

Hemibagrus baramensis (non Regan, 1906) - Rahim et al., 2009: 11.

Hemibagrus planiceps (non Valenciennes in Cuvier & Valenciennes, 1840) - Ambak et al., 2010: 78.

Material examined. — SUMATRA: Sumatera Utara: ZMA 121.626, 2 ex., 146.2–191.3 mm SL; ZMA 121.817, 1 ex., 168.1 mm SL, Medan.

SUMATRA: Riau: ZRC 39032, 7 ex., 122.6–227 mm SL, Sungai Bengkwan, tributary of Indragiri (Batang Kuantan), 4 hrs downstream from Rengat;

SUMATRA: Jambi: CMK 11221, 2 ex., 89.6–113.8 mm SL; ZRC 38663, 1 ex., 113.9 mm SL, Batang Hari near Tanjung Johor; ZMA 121.810, 10 ex., 130.0–296.0 mm SL, Batang Hari at Jambi; ZRC 29516–29531, 16 ex., 204.0–380 mm, Jambi; ZRC 38975, 4 ex., 136.6–206.0 mm SL; ZRC 40534, 3 ex., 230.8–247.9 mm SL; ZRC 42554, 17 ex., 33.5–70.0 mm SL, Pasar Angso Duo (fish market), Jambi; ZRC 39073, 2 ex., 62.4–71.3 mm SL; ZRC 39151, 1 ex., 115.2 mm SL, Berbak Nature Reserve, Sungai Air Hitam Dalam; ZRC 39181, 1 ex., 132.4 mm SL, Sungai Alai at 19.5 km Muara Bungo–Muara Tebo road; ZRC 42261, 10 ex., 71.7–123.2 mm SL, approx. 15 min after Kampung Rantau Panjang along Batang Hari confluence.

SUMATRA: Sumatera Selatan: NMBE 1020756, 1 ex., 129.1 mm SL, brackish water at Banjuasin [holotype of *Macrones bleekeri* Volz]; UMMZ 155720, 1 ex., 276.9 mm SL; ZMA 121.816, 2 ex., 147.4–156.8 mm SL, Palembang; FMNH 15749, 1 ex., 210.5 mm SL, Ogan River; NRM 24986, 1 ex., 319.7 mm SL, Pladju fish market, 5 km downstream from Palembang; ZMA 121.815, 1 ex., 74.6 mm SL, Biliton Island;

MALAY PENINSULA: CAS 130991, 1 ex., 100.7 mm SL, Thailand: Songkhla; CAS 66346, 1 ex., 179.1 mm SL, Kelantan: Sungai Semukat, a tributary of Sungai Galas; CMK 8198, 1 ex., 84.6 mm SL, Terengganu: tributary of Sungai Terengganu immediately downriver of Sekayu Waterfall Park, 4°57'50.6"N 102°57'45.5"E; CAS 130997, 2 ex., 97.6–141.4 mm SL, Perak: Bukit Merah; FMNH 47045, 1 ex., 92.9 mm SL, FMNH 47320, 1 ex., 107.6 mm SL, Perak: Krian, Bukit Merah; CAS 132717, 2 ex., 215.1–228.3 mm SL, Perak: Chenderoh Dam; CAS 130999, 2 ex., 76.1–85.1 mm SL, Perak: Telok Intan; ZRC 41150, 9 ex., 159.6–269.5 mm SL, Perak: Sungai Perak at Kampung Kenderong, 3 km from Gerik, 5°24'52.5"N 101°9'5.1"E; CAS 132716, 3 ex., 82.9–144.6 mm SL, Kuala Lumpur; ZRC 14899, 1 ex., 153.7 mm SL, Selangor: North Selangor Peat Swamp Forest, irrigation canal on W boundary; ZRC 21483, 1 ex., 167.0 mm SL, Pahang: Rompin, Sungai Kinchin; CAS 133025, 1 ex., 192.2 mm SL, Pahang: Sungai Garam near Karak [holotype of *H. pahangensis*]; CAS 130990, 2 ex., 51.9–58.4 mm SL, CAS 130996, 2 ex., 66.6–95.1 mm SL, Malacca: Tasik Chin Chin; USNM 101259, 1 ex., 56.5 mm SL, Malacca: Jasin, outlet of Tasek Chin Chin; CAS 133026, 1 ex., 213.1 mm SL, Johor: Sungai Kayu, 26 km north of Kota Tinggi [holotype of *H. johorensis*]; CAS 130989, 1 ex., 106.2 mm SL, CAS 131000, 1 ex., 112.5 mm SL, Johor: Ayer Hitam; CAS 131001, 1 ex., 144.8 mm SL, Singapore; CAS 132718, 1 ex., 140.5 mm SL, Johor, 8 km N of Kota Tinggi; CAS 132721, 1 ex., 199.7 mm SL, Johor: Sungai Kayu; FMNH

62314, 4 ex., 35.6–56.4 mm SL, Johor: small stream along road from Kota Tinggi to Mawai; USNM 229267, 2 ex., 29.0–30.4 mm SL, Johor: small tributaries of Sungai Sedili Besar, 10–23 km N of Kota Tinggi (on road to Mersing); ZRC 2439, 1 ex., 107.0 mm SL, Pahang: Kuala Tahan; ZRC 3053, 1 ex., 139.0 mm SL, Pahang: Tasek Bera; ZRC 9555, 1 ex., 128.7 mm SL, Johor: Mawai district; ZRC 11642, 1 ex., 190.0 mm SL, Johor, near Layang-Layang.

BORNEO: Brunei: USNM 323366, 1 ex., 46.6 mm SL, Labi, Wasah Rampayoh, off Labi road; USNM 328061, 25 ex., 34.8–111.0 mm SL, Sungai Pang, tributary of Sungai Belait, downstream from Kampung Sukang; USNM 328089, 17 ex., 16.8–99.0 mm SL, Saungai Arang, tributary stream of Ulu Belait, downstream from Sungai Tempine and Sungai Jagit; USNM 328114, 2 ex., 123.8–147.2 mm SL, Sungai Buru, tributary stream of Sungai Belait, upstream from Kampung Melilas; USNM 328118, 3 ex., 149.1–158.5 mm SL, Kuala Topi, confluence of Ulu Topi and Ulu Belait; USNM 331812, 1 ex., 176.6 mm SL, Ulu Ingei, upstream from base camp; ZRC 40482, 11 ex., 67.8–245.3 mm SL, Sungai Merimbun, outlet from Tasek Merimbun into Sungai Tutong.

BORNEO: Sarawak: ANSP 152378, 1 ex., 237.7 mm SL, Baram; BMNH 1978.9.5.49, 1 ex., 112.6 mm SL, Sungai Melinau; BMNH 1983.6.20.19–20, 3 ex., 139.7–169.3, Batang Ai; CAS 79353, 10 ex., 36.3–109.2 mm SL, USNM 325408, 18 ex., 31.4–124.3 mm SL, Baleh River, creek entering southern bank approximately 20 km E of Sut River; CAS 79354, 10 ex., 46.6–175.2 mm SL, USNM 325324, 52 ex., 32.4–176.6 mm SL, Batang Balui, tributary stream, Long Saan; CAS 79564, 67 ex., 26.5–230.7 mm SL, Fourth division, Baram drainage, Sungai Liam about 500 m above stream mouth, 3°19'26"N 114°45'19"E; FMNH 63009, 9 ex., 71.8–97.6 mm SL, Fourth division, Niah, Niah River at Pk. Lobang; FMNH 68058, 9 ex., 15.6–173.3 mm SL, Third division, Baleh River, Sungai Putai camp; FMNH 68081, 8 ex., 44.6–102.1 mm SL, Third division, tributary of Baleh River between Sungai Entunau and Sungai Putai; FMNH 68566, 1 ex., 105.2 mm SL, Fourth division, lower Niah; FMNH 103620, 10 ex., 54.0–157.7 mm SL, Batang Balui, tributary stream, Long Ulu; MCZ 100891, 29 ex., 74.9–157.4 mm SL, Fourth division, Baram River drainage, Sungai Liting, about 4100 m above stream mouth; NRM 27316, 40 ex., 20.1–224.9 mm SL, Fourth division, Baram River drainage, Sungai Kaha about 200 m from mouth, 3°23'N 114°34'E; USNM 35730, 4 ex., 132.2–188.3 mm SL; USNM 35731, 1 ex., 253.0 mm SL, Sadong; ZRC 38753, 4 ex., 131.2–196.5 mm SL, Balai Ringin, stalls by roadside next to bridge over Sungai Kerang; ZMA 114.396, 3 ex., 133.7–201.6 mm SL; ZRC 40498, 7 ex., 153.0–232.5 mm SL, Miri, Kampung Bakung from Sungai Bakung turnoff after km 62 to Batu Niah; ZRC 42653, 209.7 mm SL [holotype of *Hemibagrus chrysops*]; ZRC 40489 1 ex., 156.0 mm SL, Serian wet market, from Sadong River [paratype of *Hemibagrus chrysops*.]; ZRC 23008–23014, 7 ex., 172.0–210.7 mm SL, Rajang River at Sibul [paratypes of *Hemibagrus chrysops*]; ZRC 39518, 18 ex., 93.2–171.0 mm SL, Serian, market near Sungai Gadong [paratypes of *Hemibagrus chrysops*]; ZRC 39526, 5 ex., 198.2–219.8 mm SL; ZRC 39747, 2 ex., 135.4–146.0 mm SL; ZRC 40488, 7 ex., 131.4–212.7 mm SL, Serian market, from Sungai Kerang; ZRC 39527, 3 ex., 210.3–220.8 mm SL; ZRC 41860, 3 ex., 97.4–162.0 mm SL, Balai Ringin, stalls by roadside next to bridge over Sungai Kerang.

BORNEO: Kalimantan Barat: CAS 49378, 1 ex., 20.0 mm SL, Kapuas drainage, Sungai Engkayas, where it flows into right side of Kapuas mainstream about 2 km upstream from Sanggau; CAS 49379, 2 ex., 149.0–167.0 mm SL, Kapuas drainage, Sungai Tekam, small forest stream where it enters right side of Kapuas main stream approx. 5–6 km upstream from Sanggau; CAS 49380, 5 ex., 36.7–56.0 mm SL, Kapuas drainage, Sungai Tamang, small forested stream with rocky bottom flowing into Sungai Pinoh opposite mouth

of Sungai Kelawai; FMNH 94391, 1 ex., 85.6 mm SL, several small forest streams where they flow into Kapuas mainstream within 10 km upstream from Sanggau; CMK 10157, 1 ex., 140.6 mm SL, Kapuas River drainage, Sungai Sebadin, 0°50'22"N 111°57'12"E; CMK 10444, 1 ex., 119.9 mm SL, Kapuas River at Nanga Piasa, 0°39'18"N 112°13'46"E; CMK 10577, 3 ex., 63.5–137.4 mm SL, Kapuas River drainage: Sungai Melawi drainage, Sungai Kelawai between Nanga Pintas and about 3 km upstream, 0°36'49"N 111°47'22"E; CMK 11755, 1 ex., 81.2 mm SL, Kapuas River drainage, Sungai Pala at Pala Hulu (Kecamatan Siberuang, Kabupaten Renyai Hulu) km 101 on road from Sintang to Putussibau; MNHN 1982-704, 4 ex., 84.0–184.2 mm SL, Kapuas drainage, Sungai Tebelian, small forest stream 3–4 m wide and 50 cm deep where it flows into Sungai Pinoh, 19 km S of Nangapinoh; USNM 232082, 4 ex., 44.1–84.7 mm SL, rocky channel in mainstream of Sungai Pinoh, 37 km S of Nangapinoh; ZMA 114.420, 1 ex., 165.9 mm SL, Kapuas River at Bunut; ZMA 114.419, 1 ex., 196.9 mm SL, Kapuas River at Putussibau; BMNH 1982.3.29.156–158, 2 ex., 129.6–190.0 mm SL, Sungai Paklehung, a low-lying forested hill stream to Sungai Mempawah, 48 km NNW from Pontianak, 9 km NE of Andjongan and 1–3 km upstream from Toho; CMK 6691, 1 ex., 92.6 mm SL, Sungai Mandor at Mandor (0°19'N 109°20'E).

BORNEO: Kalimantan Tengah: ZRC 38859, 1 ex., 73.3 mm SL, Barito River between Mongkohol and Molosan; ZRC 40042, 1 ex., 224.6 mm SL, Barito River drainage, Muara Teweh, Pasar Pendopo; ZRC 40531, 1 ex., 98.4 mm SL, market in Purukcahu;

BORNEO: Kalimantan Timur: RMNH 7552, 1 ex., 197.0 mm SL, Bo [holotype of *Macrones fortis capitulum*]; ZRC 45519, 1 ex., 217.6 mm SL, Kayan drainage, Bahau, Lobok, a cut-off section of Bahau River near Kuala En'ggeng B'io, 2°52'16.8"N 115°49'28.8"E; ZRC 45525, 10 ex., 61.9–137.5 mm SL, Kayan drainage, Kayan River at mouth of Sungai Pingai; ZRC 45606, 1 ex., 186.4 mm SL, Kayan drainage, Bahau River; ZRC 45621, 2 ex., 49.1–68.2 mm SL, Kayan drainage, Bahau, Sungai Batu Bayak approx. 50 m upstream of Kuala En'ggeng B'io, 2°52'21.6"N 115°49'31.2"E; ZRC 45569, 1 ex., 122.0 mm SL, ZRC 45614, 2 ex., 161.4–177.6 mm SL, Mahakam drainage, main river upstream of Kota Bangun, 0°14'20.4"N 116°35'9.6"E; CAS 93909, 3 ex., 55.8–145.2 mm SL, Sungai Belayan, approx. 8–9 km upriver from Tabang; CAS 94726, 3 ex., 43.5–140.8 mm SL, Separi River on road from Samarinda to Sebulu (32 km from Air Putih crossroads); CAS 95051, 7 ex., 121.9–165.2 mm SL, small river on road 12.2 km from Sebulu crossroads); ZRC 40533, 10 ex., 281.4–375.0 mm SL, Samarinda; CMK 7633, 2 ex., 89.8–125.5 mm SL, Mahakam River drainage, stream connecting Mahakam River to Danau Semajang, 0°14'S 116°33'E; CMK 7687, 1 ex., 126.5 mm SL, Mahakam River drainage, swift stream entering Mahakam River downstream at Melak, 0°14'S 115°51'E; CMK 7704, 4 ex., 110.0–133.8 mm SL, Mahakam River drainage, sandbank near Benanga, 0°7'S 115°46'E; CMK 7705, 2 ex., 76.8–90.2 mm SL, Mahakam River at Mujub, 0°2'S 115°43'E; CMK 7752, 1 ex., 97.1 mm SL, Mahakam River drainage, unnamed left-side blackwater tributary of Mahakam River about 2 km upriver of Mujub, 0°1'S 115°43'E; CMK 7798, 2 ex., 89.0–101.0 mm SL, Mahakam River drainage, swift black water stream entering Mahakam River downriver of Muarapahu at 0°14'S 116°7'E.

BORNEO: Kalimantan Selatan: ZRC 40022, 1 ex., 192.2 mm SL, Barito River drainage, Banjarmasin, Pasar Lima Beton; ZRC 40070, 1 ex., 228.3 mm SL, Barito River drainage, Banjarmasin, Pasar Kuin; ZRC 40084, 4 ex., 158.8–181.4 mm SL, Barito River drainage, market at Negara; ZRC 40553, 7 ex., 270.0–303.6 mm SL, Banjarmasin.

Diagnosis. — *Hemibagrus capitulum* differs from *H. filamentus* in having a relatively shorter and wider head (head width 59–70% HL vs. 56–60). It is distinguished from *H. fortis* in having the anteriormost branch of dorsal-fin rays longer than other branches (vs. branches of the dorsal-fin rays of almost equal length) giving the dorsal fin a jagged (vs. rounded) distal margin (Fig. 20), from *H. hoevenii* in having the premaxillary tooth band not (vs. partially) exposed when the mouth is closed, rounded (vs. tapering) caudal-fin lobes, absence (vs. presence) of a broad and conspicuous dark margin around the caudal fin, a rounded (vs. triangular) anal fin, broader membranes of the dorsal fin which give it a rounded (vs. triangular) appearance, and filamentous extensions on the dorsal fin, when present, not reaching beyond middle of adipose-fin base (vs. very long filamentous extensions of the first two dorsal-fin rays, when present, that reach beyond the posterior base of the adipose fin), from *H. nemurus* in having a larger eye in specimens greater than approx. 150 mm SL (11–19% HL vs. 9–11), the adpressed dorsal fin (excluding the filamentous extensions of the fin rays if present) reaching to or beyond (vs. not reaching) the adipose-fin origin and longer maxillary barbels (reaching beyond caudal-fin base but frequently to vertical through base of last anal-fin ray vs. to origin of anal fin; 193–390% HL vs. 168–221), and from *H. spilopterus* in having a flat (vs. gently convex) interorbital space and the adpressed dorsal fin (excluding the filamentous extensions of the fin rays) reaching to or beyond (vs. not reaching) the adipose-fin origin.

Description. — Biometric and meristic data as in Table 12. General description as for genus. Head depressed and broad, body moderately compressed; head width 59–70% HL. Interorbital space flat. Eye diameter 11–19% HL. Premaxillary tooth band not exposed when mouth is closed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose-fin base short, approximately as long as anal-fin base; maximum height 4.3–6.5% SL (2.1–4.2 times in length of adipose-fin base). Adipose-fin origin separated from base of last dorsal-fin ray by distance of 7.0–14.6% SL. Dorsal spine stout, with 2–9 serrations on posterior edge. Anteriormost branch of each dorsal-fin ray longer than other branches, imparting jagged distal margin to fin; membranes broad, imparting rounded appearance. Adpressed dorsal fin (excluding filamentous extensions of rays) reaching to or slightly beyond adipose-fin origin; filamentous extensions, when present, not reaching beyond middle of adipose-fin base. Pectoral spine stout, with 6–15 large serrations on posterior edge. Anal fin rounded, origin slightly posterior to adipose origin. Caudal fin forked; upper and lower lobes rounded. Maxillary barbels reaching at least vertical through base of last anal-fin ray, sometimes beyond caudal-fin base (193–390% HL). Maximum recorded size 272 mm SL.

Colour. — Dorsal surface of head and body uniform brownish-grey (live or freshly-dead specimens sometimes

Table 12. Biometric and meristic data for *H. capitulum* (n = 50).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	27.3–35.2	31.9±1.72
Head width	16.1–22.7	20.1±1.08
Head depth	11.9–18.7	15.5±1.19
Predorsal distance	39.1–46.2	43.2±1.43
Preanal length	69.4–79.7	73.0±1.76
Prepelvic length	50.8–59.9	55.6±1.79
Prepectoral length	21.3–33.0	28.2±2.24
Body depth at anus	12.3–20.0	15.8±1.51
Length of caudal peduncle	13.8–24.3	17.0±1.58
Depth of caudal peduncle	6.4–9.6	8.5±0.47
Pectoral-spine length	13.9–20.8	17.5±1.44
Pectoral-fin length	16.1–24.0	20.8±1.44
Length of dorsal fin	24.7–35.0	29.3±2.21
Length of dorsal-fin base	14.3–19.0	16.8±1.02
Dorsal-spine length	10.4–17.3	14.6±1.43
Pelvic-fin length	13.8–18.0	15.9±0.86
Length of anal-fin base	10.6–13.9	12.3±0.75
Caudal-fin length	19.6–26.9	23.8±1.67
Length of adipose-fin base	12.8–19.5	16.2±1.72
Maximum height of adipose fin	4.3–6.5	5.3±0.56
Dorsal to adipose distance	7.0–14.6	10.4±1.93
Post-adipose distance	14.5–17.7	16.0±0.83
In %HL:		
Snout length	28.4–40.1	37.0±1.71
Interorbital distance	27.4–36.9	31.3±2.26
Eye diameter	11.2–18.6	13.9±1.57
Nasal barbel length	20.6–55.8	33.7±7.66
Maxillary barbel length	192.6–390.3	256.5±33.14
Inner mandibular barbel length	37.9–72.5	48.8±6.07
Outer mandibular barbel length	61.6–134.8	87.4±12.01
MERISTICS		
Dorsal-fin rays	II,7 (50)	
Anal-fin rays	iv,8 (29) or iv,9 (21)	
Pelvic-fin rays	i,5 (50)	
Pectoral-fin rays	I,7,i (6), I,8 (14), I,8,i (26) or I,9 (12)	
Caudal-fin rays	i,7,8,i (50)	
Branchiostegal rays	10 (4), 11 (29) or 12 (17)	
Gill rakers	4+6 (1), 4+7 (1) or 4+8 (4), 4+9 (1), 4+10 (4), 4+11 (14), 4+12 (18) 5+11 (2), 4+13 (2), 5+12 (2) or 5+13 (1)	
Vertebrae	23+22=45 (8), 24+21=45 (8), 25+20=45 (8), 23+23=46 (8) or 24+22=46 (16) or 25+22=47 (2)	

with yellow hue, fading on preservation); ventral surface of head and body dirty white; adipose fin brownish-grey, sometimes with diffuse black spot; fin-rays and inter-radial membranes of all fins grey; dorsal surface of barbels brownish-grey, ventral surface dirty white.

Distribution. — *Hemibagrus capitulum* is known from river drainages in Borneo, the Malay Peninsula northwards to at least Narathiwat and Trang, and Sumatra (Fig. 22). This species is absent from the upper reaches of river drainages in Borneo, where *H. fortis* is found instead. This species has been introduced to Singapore, where it is not native (reported as *H. nemurus* by Ng & Tan, 2010).

Habitat and biology. — *Hemibagrus capitulum* is found in a wide variety of lotic and lentic habitats. It is a predatory

species, with young fish feeding preferentially on invertebrates (especially Crustacea), and older fish being more piscivorous (Khan et al., 1988). It breeds during the rainy seasons (Khan et al., 1990).

Remarks. — The oldest available name for this species is *Macrones bleekeri* Volz, 1903, which is a primary junior homonym of *Macrones bleekeri* Day, 1877 (now *Mystus bleekeri*). The next available name is *Macrones capitulum* Popta, 1904.

We consider *H. chrysops* to be a junior synonym of *H. capitulum*, as the differences reported in Ng & Dodson (1999) are no longer as clear-cut once a larger series of material from throughout Sundaic Southeast Asia has been examined. There is a lack of a discernible pattern in the variation of

the diagnostic characters reported by Ng & Dodson (1999), i.e. head width, length of adipose-fin base, dorsal to adipose distance and body colour. Despite evidence from a molecular analysis of a 300 bp fragment of the *cyt b* gene that indicates otherwise, we have chosen to synonymize *H. chrysops* with *H. capitulum* following overwhelming morphological evidence that indicates the two are conspecific. The cause(s) of the incongruence between the morphological and molecular data are not clear, but this is not the first instance that this phenomenon has been reported for freshwater fishes as a similar incongruence is observed in Mesoamerican cichlids (Hulseley et al., 2004; Pérez et al., 2007).

***Hemibagrus filamentus* (Fang & Chaux, 1949)**

(Fig. 24)

Macrones filamentus Fang & Chaux, in Chaux & Fang, 1949: 200, Fig. 4 (type locality: Cambodia).

Mystus filamentus - Lim et al., 1996: 382; Rainboth 1996: 144, Pl. 19 Fig. 147.

Hemibagrus filamentus - Ng & Rainboth, 1999: 555, Fig. 1; Gaanantkul et al., 2000: 34; Kottelat, 2001b: 122, Fig. 327; Ferraris, 2007: 88; Vidthayanon, 2008: 114; Rainboth et al., 2012: 72, Plate 45, Fig. 943.

Material examined. — LAOS: CMK 13252, 6 ex., 54.7–186.2 mm SL, Vientiane province: confluence of Nam Leuk and Nam Ngong, 18°22'4"N 103°5'27"E; CMK 13357, 1 ex., 159.4 mm SL, Vientiane province, Houay Sala Yai, a tributary of Nam San, 18°35'17"N 103°5'0"E; CMK 13393, 9 ex., 63.2–129.3 mm SL, Vientiane province, Nam San downstream of Ban Pa Man, 18°32'3"N 102°55'48"E; UMMZ 238567, 30 ex., 62.0–138.0 mm SL, Vientiane province: Nam Tou, 8 km upstream from confluence with Nam Ngum reservoir; UMMZ 238677, 8 ex., 44.0–66.0 mm SL, Vientiane province: Nam Ngao at S end of Nam Ngum reservoir; UMMZ 240634, 12 ex., 50.0–144.5 mm SL, Vientiane province: Nam Ti at junction with Nam Ngum and upstream 100 m; NRM 15013, 1 ex., 236.8 mm SL, Sedone River, Pakse, 14°9'N 105°50'E; NRM 15019, 1 ex., 198.5 mm SL; NRM 15020, 1 ex., 191.9 mm SL; NRM 15022, 1 ex., 251.6 mm SL, Laos.

CAMBODIA: MNHN 1966–728, holotype, 419.8 mm SL, Cambodia; UMMZ 232423, 3 ex., 68.7–102.1 mm SL, Siem Reap: floating village at mouth of Siem Reap River, Mekong drainage (13°16'N 103°48'E); UMMZ 232462, 1 ex., 150.6 mm SL, Siem Reap: fish trap W of floating village at mouth of Siem Reap River, Mekong drainage, 13°16'N 103°46'E; UMMZ 232698, 5 ex., 151.8–175.1 mm SL, Kompong Chhnang morning market, Mekong drainage.

Diagnosis. — *Hemibagrus filamentus* is distinguished from *H. capitulum* in having a longer, narrower head (head width 55–60% HL vs. 59–70), from *H. fortis* in having a shorter, deeper adipose fin (maximum height of adipose fin 2.3–3.2 times in the length of its base vs. 2.8–4.9) and the anteriormost branch of dorsal-fin rays longer than other branches (vs. branches of the dorsal-fin rays of almost equal length.) giving the dorsal fin a jagged (vs. rounded) distal margin (Fig. 20), and from *H. hoevenii* in having the premaxillary tooth band not (vs. partially) exposed when the mouth is closed, rounded (vs. tapering) caudal-fin lobes, absence (vs. presence) of a broad and conspicuous dark margin around

the caudal fin, a rounded (vs. triangular) anal fin, broader membranes of the dorsal fin which give it a rounded (vs. triangular) appearance, and filamentous extensions on the dorsal fin not reaching beyond middle of adipose-fin base (vs. very long filamentous extensions of the first two dorsal-fin rays that reach beyond the posterior base of the adipose fin). It differs from *H. nemurus* in having a relatively longer and narrower head (head width 55–60% HL vs. 60–69) and a smaller dorsal to adipose distance (7.7–10.9% SL vs. 10.2–16.2), and from *H. spilopterus* in having a smaller dorsal to adipose distance (7.7–10.9% SL vs. 10.8–17.6), a flat (vs. gently convex) interorbital space, and dorsal-fin rays (excluding filamentous extensions) reaching beyond (vs. not reaching or just reaching) the adipose-fin origin.

Description. — Biometric and meristic data as in Table 13. General description as for genus. Head depressed and broad, body moderately compressed; head width 55–60% HL. Interorbital space flat. Eye diameter 10–15% HL. Premaxillary tooth band not exposed when mouth is closed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose-fin base short, approximately as long as anal-fin base; maximum height 5.0–7.2% SL (2.3–3.2 times in length of adipose-fin base). Adipose-fin origin separated from base of last dorsal-fin ray by distance of 7.7–10.9% SL. Dorsal spine stout, with 6–10 serrations along posterior edge. Anteriormost branch of each dorsal-fin ray longer than other branches, imparting jagged distal margin to fin; membranes broad, imparting rounded appearance. Adpressed dorsal fin (excluding filamentous extensions of rays) reaching beyond adipose-fin origin; filamentous extensions not reaching beyond middle of adipose-fin base. Pectoral spine stout, with 13–18 large serrations along posterior edge. Anal fin rounded, origin slightly posterior to adipose origin. Caudal fin forked; upper and lower lobes rounded. Maxillary barbels reaching barbels reaching at least vertical through base of last anal-fin ray (221–265% HL). Maximum recorded size 420 mm SL.

Colour. — Dorsal surface of head and body uniform brownish-grey; ventral surface of head and body dirty white; adipose fin brownish-grey, without black spot; fin-rays and inter-radial membranes of all fins grey; dorsal surface of barbels brownish-grey, ventral surface dirty white.



Fig. 24. *Hemibagrus filamentus*, CMK 13393, 110.2 mm SL, Laos: Nam San.

Table 13. Biometric and meristic data for *H. filamentus*(n = 30).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	31.0–34.5	33.5±1.10
Head width	18.8–20.1	19.6±0.53
Head depth	14.3–16.4	15.2±0.79
Predorsal distance	43.1–46.1	44.8±1.02
Preanal length	70.3–76.2	73.7±1.94
Prepelvic length	56.0–58.9	57.2±1.01
Prepectoral length	27.1–31.5	29.8±1.33
Body depth at anus	14.4–16.1	15.5±0.54
Length of caudal peduncle	15.6–17.2	16.2±0.61
Depth of caudal peduncle	7.6–8.7	8.2±0.34
Pectoral-spine length	15.9–18.5	17.3±1.03
Pectoral-fin length	18.8–21.8	20.2±1.18
Length of dorsal fin	26.8–30.8	28.8±1.32
Length of dorsal-fin base	14.7–17.9	16.1±1.17
Dorsal-spine length	13.1–17.4	15.4±1.52
Pelvic-fin length	14.9–16.5	15.6±0.55
Length of anal-fin base	11.0–12.9	11.9±0.70
Caudal-fin length	20.8–25.7	23.2±1.90
Length of adipose-fin base	14.0–16.8	15.8±0.89
Maximum height of adipose fin	5.0–7.2	5.9±0.67
Dorsal to adipose distance	7.7–10.9	9.4±1.14
Post-adipose distance	14.7–16.2	15.4±0.47
In %HL:		
Snout length	35.1–40.6	37.0±1.95
Interorbital distance	27.7–29.5	28.5±0.73
Eye diameter	9.5–14.8	12.8±1.68
Nasal barbel length	17.0–37.4	28.0±5.60
Maxillary barbel length	220.6–265.4	248.1±13.92
Inner mandibular barbel length	39.7–48.6	44.6±3.11
Outer mandibular barbel length	54.2–95.9	77.5±12.05
MERISTICS		
Dorsal-fin rays	II,7 (30)	
Anal-fin rays	iii,9 (3), iv,9 (6), v,8 (18) or v,9 (3)	
Pelvic-fin rays	i,5 (30)	
Pectoral-fin rays	I,7 (3), I,8 (18) or I,8,i (9)	
Caudal-fin rays	i,7,8,i (30)	
Branchiostegal rays	10 (6), 11 (15) or 12 (9)	
Gill rakers	3+8 (10), 3+9 (10) or 4+9 (10)	
Vertebrae	23+21=44 (7), 22+23=45 (8), 23+22=45 (8) or 24+22=46 (7)	

Distribution. — *Hemibagrus filamentus* is known from the middle and lower Mekong in Laos, Thailand and Cambodia (Fig. 22).

Habitat and biology. — *Hemibagrus filamentus* is found in slow-flowing or standing waters, moving into flooded forests during periods of high water levels. It feeds on crustaceans and fishes (Rainboth, 1996).

***Hemibagrus fortis* (Popta, 1904)**
(Fig. 25)

Macrones fortis Popta, 1904: 185 (type locality: Bo River, central Borneo); 1906: 44, Pl. 2 Figs. 8a–b.

Macrones howong Popta, 1904: 181 (type locality: Howong River, Mahakam drainage, Borneo); 1906: 32, Pl. 1 Fig. 4.

Macrones bo Popta, 1904: 183 (type locality: Bo River, Mahakam drainage, Borneo); 1906: 38, Pl. 2 Fig. 6.

Macrones kajan Popta, 1904: 184 (type locality: Kajan River, Mahakam drainage, Borneo); 1906: 41, Pl. 2 Fig. 7.

Macrones nemurus (non Valenciennes, in Cuvier & Valenciennes, 1840) - Vaillant, 1902: 54 (in part); Weber & de Beaufort, 1913: 341 (in part); (?)Rendahl, 1922: 201; Hardenberg, 1935: 234.

Mystus nemurus (non Valenciennes, in Cuvier & Valenciennes, 1840) - Inger & Chin, 1962: 138, Fig. 69 (in part); Samat, 1990: 343; Christensen, 1992: 600; Kottelat et al., 1993: 66 (in part; not pl. 31); Kottelat, 1994: 412; Chin & Samat, 1995: 23; Chin, 1996: 303.

Hemibagrus nemurus (non Valenciennes, in Cuvier & Valenciennes, 1840) - Lim & Wong, 1994: 53.

Hemibagrus aff. *nemurus* - Martin-Smith & Tan, 1998: 589.

Hemibagrus fortis - Tan & Ng, 2000: 272 (first revisers); Parenti & Lim, 2005: 189; Ferraris, 2007: 88 (in part).

Material examined. — BORNEO: Sarawak: ANSP 170232, 34 ex., 60.8–173.4 mm SL, Sungai Lawa, gravel area about 1.0 km up from confluence with Batang Baram, 3°30'N 114°27'E; USNM 324566, 8 ex., 63.2–170.5 mm SL, Batang Balui, tributary stream, Batang

Kuro; USNM 324989, 10 ex., 24.7–45.3 mm SL, Baleh River, tributary entering river in part of river opposite school, Sekolah Negara Bawai; USNM 324991, 1 ex., 39.5 mm SL, Batang Balui, tributary stream, Batang Taman, where it enters Batang Balui USNM 325033, 1 ex., 54.8 mm SL, USNM 325039 18 ex., 33.0–107.1 mm SL, Batang Balui, tributary stream, Sungai Doh Leng; USNM 325323, 3 ex., 106.6–152.9 mm SL, Batang Balui, tributary stream, Long Tow where it enters from Batang Balui just downstream of logging camp; USNM 325325, 2 ex., 126.1–130.2 mm SL, Batang Balui, tributary stream, Batang Luan; USNM 325326, 33 ex., 29.4–197.0 mm SL, Batang Balui, tributary stream, Long Ulu; USNM 325327, 2 ex., 243.3–265.3 mm SL, Kapit town morning market; USNM 325386, 1 ex., 104.2 mm SL, Batang Balui, tributary stream, Long Tanyit, where it enters Batang Balui; USNM 325397, 2 ex., 77.1–127.6 mm SL, Baleh River, southern tributary just E of confluence of Mujang and Baleh Rivers; USNM 325401, 1 ex., 129.0 mm SL, Batang Balui, tributary stream, Batang Luan Paha; USNM 325403, 3 ex., 61.0–145.2 mm SL, Batang Balui, tributary stream, Kemtu; USNM 325404, 2 ex., 155.9–169.0 mm SL, Batang Balui, tributary stream, Jangan Umi flowing into Batang Besua; USNM 325406, 158 ex., 28.0–148.9 mm SL, Baleh River, creek entering northern bank approximately 5 km E of Sut River; USNM 325407, 10 ex., 36.6–170.6 mm SL, Baleh River, southern tributary stream opposite logging camp just E of confluence of Baleh and Mujong Rivers; ZRC 37709, 1 ex., 189.2 mm SL, Lanjak Entimau Wildlife Sanctuary.

BORNEO: Kalimantan Tengah: BMNH 1997.7.17.22–29, 8 ex., 60.4–134.6 mm SL, Sungai Batu-Ngiring, a tributary of Sungai Kerendan (a tributary of Sungai Lahei) approximately 2 km upstream from Sungai Paku-Merah; BMNH 1997.7.17.32–41, 10 ex., 41.2–186.2 mm SL, Sungai Idow, below a waterfall approximately 7 km upstream from Sungai Kerendan (a tributary of Sungai Lahei); BMNH 1997.7.17.42–51, 8 ex., 33.0–147.6 mm SL, Barito River drainage, Sungai Mata, a small tributary at Sungai Barito approximately 2 km below Muara Laung; BMNH 1997.7.17.52–58, 7 ex., 34.8–175.6 mm SL, Sungai Panganen, a small tributary of Sungai Laung approximately 1 km from Muara Laung; BMNH 1997.7.17.59–64, 6 ex., 38.4–190.1 mm SL, Barito River drainage, Sungai Tarusan, a small tributary of Sungai Laung, approximately 1 km upstream from Dessa Maruwei. BMNH 2000.10.25.1289, 1 ex., 98.0 mm SL, Barito River approximately 2 km below Muara Laung; BMNH 2000.10.25.1359–1363, 3 ex., 101.6–176.5 mm SL, Barito River at Muara Laung; BMNH 2001.1.15.181, 1 ex., 194.4 mm SL, Sungai Busang; BMNH 2001.1.15.200, 1 ex., 210.7 mm SL, Sungai Busang; BMNH 2001.1.15.234–241, 8 ex., 50.9–78.1 mm SL, markets at Muara Teweh and Puruk Cahu; BMNH 2001.1.15.1338, 1 ex., 107.8 mm SL, Sungai Lahei and surrounding habitats, at Desa Kerendan.

BORNEO: Sabah: FMNH 44844, 1 ex., 245.0 mm SL, Kinabatangan district, Lamag; FMNH 44845, 1 ex., 63.2 mm SL, Kinabatangan district, Bukit Kretam camp, Sungai Gaja; FMNH 44846, 1 ex., 99.3 mm SL, Kinabatangan district, Danau Bukit Garam; FMNH 44847, 3 ex., 83.1–129.1 mm SL, Labuk district, Labuk River; FMNH 44848, 4 ex., 103.5–158.3 mm SL, Sandakan district, Km 25, N road; FMNH 44849, 1 ex., 50.2 mm SL, Kota Belud district, Tempasuk River; FMNH 44852, 3 ex., 125.3–195.4 mm SL, Sandakan district, Gum Gum River; FMNH 51713, 22 ex., 68.9–157.4 mm SL; FMNH 51714, 10 ex., 44.3–196.3 mm SL; FMNH 51715, 3 ex., 154.7–209.7 mm SL; FMNH 51716, 9 ex., 157.3–212.0 mm SL, Kinabatangan district; FMNH 68053, 24 ex., 59.7–203.8 mm SL; FMNH 68054, 47 ex., 41.0–179.7 mm SL, Kalabakan, Sungai Tibas camp, Sungai Tawan; FMNH 68055, 2 ex., 157.0–159.2 mm SL; FMNH 68056, 3 ex., 107.1–152.9 mm SL; FMNH 68071, 10 ex., 37.7–228.0 mm SL; FMNH 68072, 5 ex., 120.0–160.8 mm SL; FMNH 68073, 7 ex., 83.1–134.1 mm SL;

FMNH 68074, 9 ex., 97.0–187.3 mm SL; FMNH 68075, 1 ex., 126.7 mm SL; FMNH 68076, 12 ex., 98.7–141.8 mm SL; FMNH 68077, 13 ex., 110.5–230.2 mm SL; FMNH 68078, 1 ex., 51.0 mm SL; FMNH 68079, 1 ex., 78.8 mm SL; FMNH 68082, 2 ex., 43.9–51.2 mm SL, Kinabatangan district, Deramakot camp. FMNH 68057, 30 ex., 21.9–187.8 mm SL, Tawau district, Kalabakan, Sungai Marikut; FMNH 68069, 2 ex., 106.9–124.6 mm SL, Kinabatangan district, 1 mile above Sungai Tabalin Besar; FMNH 68070, 1 ex., 92.5 mm SL, FMNH 68083, 2 ex., 40.5–48.8 mm SL, Kinabatangan district, below mouth of Malubok River; FMNH 68080, 1 ex., 137.4 mm SL, Kalabakan, Kalabakan River, near Sungai Maga; FMNH 68410, 16 ex., 55.8–136.4 mm SL, Tuaram district, Tuaram River at Kiulu; FMNH 68565, 1 ex., 52.9 mm SL, Tambunan district, Sungai Kaingeran; FMNH 96271, 1 ex., 156.6 mm SL, Kota Kinabalu; FMNH 99432, 1 ex., 29.6 mm SL, Kota Marudu, Marak Parak, Sungai Khidingon. ZRC 40521, 1 ex., 190.0 mm SL, Danum, Sepat Kalisun stream; ZRC 40522, 1 ex., 126.9 mm SL, Danum, Sungai Palum Tambun, tributary of Sungai Segama upstream of Danum Valley Field Centre; ZRC 40529, 2 ex., 31.8–74.5 mm SL, Sabah: Danum Valley.

BORNEO: Kalimantan Timur: ZRC 45519, 1 ex., 217.6 mm SL, Kalimantan Timur: Kayan drainage, Bahau, Lobok, a cut-off section of Bahau River near Kuala En'ggeng B'io, 2°52'16.8"N 115°49'28.8"E; ZRC 45525, 10 ex., 61.9–137.5 mm SL, Kalimantan Timur: Kayan drainage, Kayan River at mouth of Sungai Pingai; ZRC 45606, 1 ex., 186.4 mm SL, Kalimantan Timur: Kayan drainage, Bahau River; ZRC 45640, 6 ex., 41.7–127.1 mm SL, Kalimantan Timur: Kayan drainage, Bahau, Sungai En'ggeng I'nt, approx. 200–300 m downstream of Kuala En'ggeng B'io 2°51'30.6"N 115°49'40.8"E; ZRC 45654, 7 ex., 81.5–114.5 mm SL, Kalimantan Timur: Kayan drainage, Bahau, Lalut Birai, next to Lalut Birai field station, feeder stream to En'ggeng B'io which drains into Bahau River, 2°52'34.8"N 115°49'11.4"E; RMNH 7551, 4 syntypes, 54.4–272.0 mm SL, Bo; CAS 93909, 3 ex., 55.8–145.2 mm SL, Sungai Belayan, approx. 8–9 km upriver from Tabang; RMNH 7547, 1 ex., 106.4 mm SL, Howong [holotype of *Macrones howong*]; RMNH 7549, 1 ex., 134.5 mm SL, Bo [holotype of *Macrones bo*]; RMNH 7550, 1 ex., 122.7 mm SL, Kajan [holotype of *Macrones kajan*].

Diagnosis. — *Hemibagrus fortis* is distinguished from congeners in the *H. nemurus* species group in having the branches of the dorsal-fin rays of almost equal length (vs. anteriormost branch of dorsal-fin rays longer than other branches) giving the dorsal fin a rounded (vs. distinctly jagged) distal margin (Fig. 20), and, except for *H. capitulum* and *H. hoevenii* in having a longer, lower adipose fin (maximum height of adipose fin 2.8–4.9 times in the length of its base vs. 1.7–3.2). It further differs from *H. hoevenii* in having the premaxillary tooth band not (vs. partially) exposed when the mouth is closed, rounded (vs. tapering)



Fig. 25. *Hemibagrus fortis*, ZRC 45654. 114.5 mm SL, Borneo: Kalimantan Timur, Bahau River drainage.

caudal-fin lobes, absence (vs. presence) of a broad and conspicuous dark margin around the caudal fin, a rounded (vs. triangular) anal fin and broader membranes of the dorsal fin which give it a rounded (vs. triangular) appearance, from *H. nemurus* in having a larger eye (16–29% HL vs. 9–15), and from *H. spilopterus* in having a flat (vs. gently convex) interorbital space.

Description. — Biometric and meristic data as in Table 14. General description as for genus. Head depressed and broad, body moderately compressed; head width 57–77% HL. Interorbital space flat. Eye diameter 16–29% HL. Premaxillary tooth band not exposed when mouth is closed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose-fin base short, approximately as long as anal-fin base; maximum height 3.3–6.2% SL (2.8–4.9 times in length of adipose-fin base). Adipose-fin origin separated from base of last dorsal-fin ray by distance of 8.7–14.6% SL. Dorsal spine stout, with 2–9 serrations on posterior edge. Branches of each dorsal-fin ray about equal length, imparting rounded distal margin to fin; membranes broad, imparting rounded appearance. Adpressed dorsal fin (excluding filamentous extensions of rays) not reaching adipose fin; filamentous extensions, when present, not reaching beyond middle of adipose-fin base. Pectoral spine stout, with 6–15 large serrations on posterior edge. Anal fin rounded, origin slightly posterior to adipose origin. Caudal fin forked; upper and lower lobes rounded. Maxillary barbels reaching barbels reaching at least vertical through base of last

anal-fin ray, sometimes beyond caudal-fin base (258–439% HL). Maximum recorded size 272 mm SL.

Colour. — Dorsal surface of head and body uniform brownish-grey (live or freshly-dead specimens with a yellow hue, fading on preservation); ventral surface of head and body dirty white; adipose fin brownish-grey, without black spot; fin-rays and inter-radial membranes of all fins grey; dorsal surface of barbels brownish-grey, ventral surface dirty white.

Distribution. — *Hemibagrus fortis* is known only from the upper reaches of river drainages in Borneo (Barito, Kalabakan, Kayan, Mahakam, Rajang and Segama river drainages; Fig. 26). It has not (yet) been recorded from the Kapuas River drainage.

Habitat and biology. — A typical habitat for *H. fortis* consists of a shaded stream or river with a gravel bottom (Watson & Balon, 1984), although the species reportedly favours deep pools (Chin & Samat, 1995). The species has also been caught in clear, fast-flowing streams that are the typical habitat of *H. baramensis* (see Martin-Smith & Tan, 1998). The diet consists of arthropods (Chin & Samat, 1995).

Remarks. — *Macrones fortis*, *M. howong*, *M. bo* and *M. kajan* are simultaneous subjective synonyms. Tan & Ng (2000), as first revisers, gave precedence to *H. fortis*.

Hemibagrus hoevenii (Bleeker, 1846)

(Fig. 27)

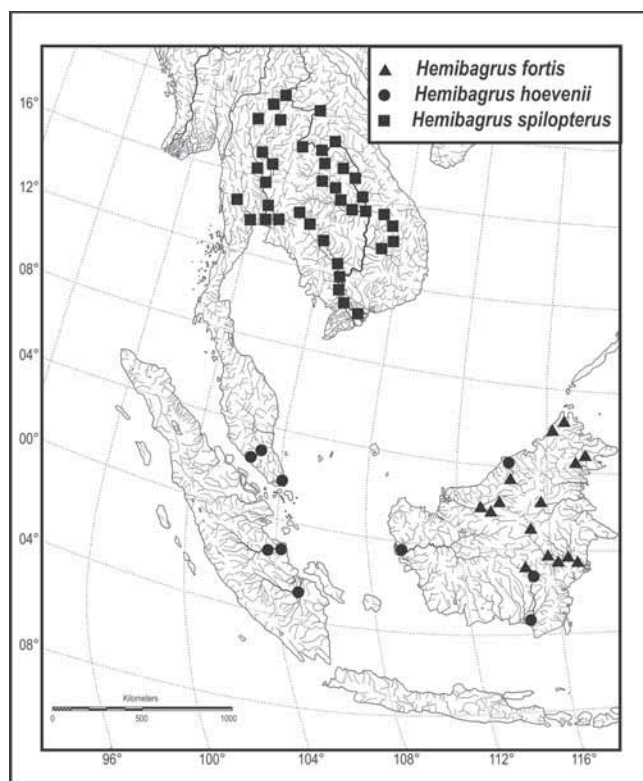


Fig. 26. Map showing collection localities of *Hemibagrus fortis*, *H. hoevenii* and *H. spilopterus* specimens examined in this study.

Bagrus Hoevenii Bleeker, 1846a: 26 (type locality: Malaysia: Johor: Muar River at Kampong Bukit Kebong); 1846b: 285; 1852a: 410, 413; 1853b: 176, 181; 1854a: 429, 432; 1854b: 65; 1855d: 393, 396; 1855e: 417, 418; 1856b: 9; 1857b: 476; 1857a: 25; 1858c: 197; 1858e: 153; 1858f: 4, 7; 1858a: 417; 1858g: 3, 4; 1859d: 370; 1859g: 134; 1860b: 18; 1860c: 1; Ng & Lim, 2008: 23, Fig. 17.

Hemibagrus Hoevenii - Bleeker, 1862: 56, Pl. 70.

Macrones Hoevenii - Vinciguerra, 1880: 170; 1926: 609.

Macrones nemurus var. *hoeveni* - Volz, 1904: 468.

Macrones hoeveni - Volz, 1907: 166.

Macrones nemurus (in part) - Weber & de Beaufort, 1913: 341.

Hemibagrus hoevenii - Bleeker, 1865b: 175; Kottelat & Lim, 1995a: 42; 1995b: 238; Ng & Rainboth, 1999: 557; Tan & Ng, 2000: 271; Ferraris, 2007: 88.

Hemibagrus nemurus (non Valenciennes, in Cuvier & Valenciennes, 1840) - Hashim & Zainuddin et al., 2012: 409.

Material examined. — SUMATRA: Jambi: ZRC 29513–29515, 3 ex., 271.6–317.4 mm SL, ZRC 29519, 1 ex., 266.6 mm SL, Jambi; ZRC 39130, 1 ex., 143.3 mm SL, Batang Berbak at Telogolima; ZRC 41526, 2 ex., 232.7–244.4 mm SL, Pasar Angso Duo (fish market), Jambi; ZRC 29544, 1 ex., 360 mm SL

SUMATRA: Sumatera Selatan: ZRC 29546–29551, 6 ex., 298.6–357 mm SL, Palembang; ZRC 51969, 2 ex., 78.0–117.3 mm SL; Sungai Gelam, approx. 1 hour downriver from Kenten Laut (Palembang), 2°50'14.6"S 104°47'49.1"E.

Table 14. Biometric and meristic data for *H. fortis* (n = 50).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	25.3–31.9	28.6±2.15
Head width	16.2–22.5	18.8±1.48
Head depth	12.2–18.5	14.1±1.60
Predorsal distance	37.6–44.0	39.8±1.79
Preanal length	67.0–73.5	69.9±1.66
Prepelvic length	46.4–58.1	51.8±2.99
Prepectoral length	21.8–31.7	26.1±2.77
Body depth at anus	11.1–17.7	14.2±1.74
Length of caudal peduncle	16.2–20.4	18.4±1.16
Depth of caudal peduncle	7.0–10.6	8.3±1.01
Pectoral-spine length	14.4–22.1	17.4±1.84
Pectoral-fin length	18.6–23.3	20.4±1.41
Length of dorsal fin	23.1–32.7	28.4±2.28
Length of dorsal-fin base	15.9–18.6	17.3±0.62
Dorsal-spine length	11.9–18.1	14.6±2.09
Pelvic-fin length	13.5–18.5	16.1±1.17
Length of anal-fin base	11.8–14.7	13.0±0.84
Caudal-fin length	20.0–27.6	23.6±1.91
Length of adipose-fin base	15.5–21.4	17.5±1.26
Maximum height of adipose fin	3.3–6.2	5.1±0.84
Dorsal to adipose distance	8.7–14.6	12.4±1.73
Post-adipose distance	14.6–17.5	16.2±0.71
In %HL:		
Snout length	35.6–41.1	37.8±1.69
Interorbital distance	27.3–35.1	31.3±1.92
Eye diameter	15.9–28.7	19.7±3.74
Nasal barbel length	23.3–62.5	41.1±11.85
Maxillary barbel length	257.6–439.0	321.1±62.97
Inner mandibular barbel length	42.6–93.3	62.1±17.11
Outer mandibular barbel length	79.3–158.7	109.9±27.40
MERISTICS		
Dorsal-fin rays	II,7 (50)	
Anal-fin rays	iv,8 (15) or iv,9 (35)	
Pelvic-fin rays	i,5 (50)	
Pectoral-fin rays	I,8 (30), I,8,i (5) or I,9 (15)	
Caudal-fin rays	i,7,8,i (50)	
Branchiostegal rays	10 (10), 11 (25) or 12 (15)	
Gill rakers	4+11 (35) or 4+12 (15)	
Vertebrae	22+22=44 (5), 22+23=45 (10), 24+21=45 (5), or 24+22=46 (30)	

PENINSULAR MALAYSIA: ZRC 37472, neotype, 114.7 mm SL, Johor: Sungai Muar at Kampung Bukit Kebong; ZRC 40590, 10 ex., 169.1–292.0 mm SL, Johor: Muar, Seram III, Tanjung Selabu port; CMK 13014, 1 ex., 123.0 mm SL; ZRC 29573–29582, 10 ex., 89.1–122.9 mm SL, Johor: Kota Tinggi.

BORNEO: Sarawak: ZRC 38002, 2 ex., 193.8–223.9 mm SL; ZRC 40511, 8 ex., 176.7–255.5 mm SL, Marudi market; ZRC 40499, 3 ex., 153.9–210.1 mm SL, Miri, Kampung Bakung from Sungai Bakung, turnoff after 62 km to Batu Niah.

BORNEO: Kalimantan Barat: ZRC 29385–29388 (4), 259.7–301.0 mm SL, Kapuas River at Pontianak.

BORNEO: Kalimantan Tengah: BMNH 2001.1.15.1365, 1 ex., 274.0 mm SL, market at Muara Teweh; ZRC 51972, 1 ex., 189.2 mm SL; Kasongan market, from Katingan River, 1°54'S 113°23'E.

BORNEO: Kalimantan Selatan: ZRC 29377–29379, 3 ex., 240.7–261.0 mm SL, ZRC 40021, 2 ex., 216.7–252.0 mm SL, Banjarmasin, Pasar Lima Beton.

Diagnosis. — *Hemibagrus hoevenii* differs from congeners of the *H. nemurus* species group in having the premaxillary tooth band partially exposed (vs. not exposed) when the mouth is closed, tapering (vs. rounded) caudal-fin lobes, presence (vs. absence) of a broad and conspicuous dark margin around the caudal fin, a triangular (vs. rounded) anal fin, narrower (vs. broader) membranes of the dorsal fin which give it a triangular (vs. rounded) appearance, and very long filamentous extensions of the first two dorsal-fin rays that reach, when present, beyond the posterior base of the adipose fin (vs. filamentous extensions if present not reaching beyond middle of adipose-fin base).

Table 15. Biometric and meristic data for *H. hoevenii* (n = 40).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	29.1–32.1	30.8±0.83
Head width	18.8–23.0	20.1±0.99
Head depth	14.4–17.6	15.6±0.83
Predorsal distance	38.3–42.9	41.0±1.32
Preanal length	69.3–74.7	72.0±1.43
Prepelvic length	47.5–57.2	54.0±2.01
Prepectoral length	24.2–30.5	26.5±1.53
Body depth at anus	12.5–18.7	15.9±1.65
Length of caudal peduncle	16.8–19.2	18.3±0.62
Depth of caudal peduncle	7.7–9.2	8.4±0.37
Pectoral-spine length	16.3–20.3	18.6±0.92
Pectoral-fin length	19.3–23.2	21.0±0.91
Length of dorsal fin	26.8–52.1	38.7±6.76
Length of dorsal-fin base	15.3–18.6	17.1±0.93
Dorsal-spine length	15.6–21.2	18.0±1.50
Pelvic-fin length	13.1–17.2	15.6±0.95
Length of anal-fin base	10.4–12.8	11.8±0.59
Caudal-fin length	25.4–34.5	29.1±2.31
Length of adipose-fin base	10.2–16.8	13.3±1.64
Maximum height of adipose fin	4.1–6.4	5.1±0.61
Dorsal to adipose distance	9.6–16.0	13.0±1.77
Post-adipose distance	17.0–19.5	17.8±0.55
In %HL:		
Snout length	36.6–41.5	38.8±1.39
Interorbital distance	28.8–34.4	31.9±1.40
Eye diameter	11.9–19.9	14.0±2.12
Nasal barbel length	17.5–38.2	32.5±4.47
Maxillary barbel length	234.3–297.3	266.9±17.95
Inner mandibular barbel length	37.6–56.4	46.8±4.24
Outer mandibular barbel length	47.6–100.8	86.9±10.85
MERISTICS		
Dorsal-fin rays	II,7 (40)	
Anal-fin rays	iii,9 (10), iv,8 (10) or iv,9 (30)	
Pelvic-fin rays	i,5 (40)	
Pectoral-fin rays	I,8,i (16), I,9 (16) or I,9,i (8)	
Caudal-fin rays	i,7,8,i (40)	
Branchiostegal rays	11 (21) or 12 (19)	
Gill rakers	3+11 (2), 4+10 (24), 2+13 (4), 3+12 (4), 4+11 (2), 4+12 (2) or 5+11 (2)	
Vertebrae	22+23=45 (6), 23+22=45 (10) 23+23=46 (4), 24+22=46 (2), 24+23=47 (10) or 25+22=47 (8)	

Description. — Biometric and meristic data as in Table 15. General description as for genus. Head depressed and broad, body moderately compressed; head width 59–75% HL. Interorbital space flat. Eye diameter 12–20% HL. Premaxillary tooth band partially exposed when mouth is closed. Dorsal profile rising evenly but not steeply from tip of



Fig. 27. *Hemibagrus hoevenii*, ZRC 39130, 143.3 mm SL; Sumatra: Batang Berbak.

snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose-fin base short, approximately as long as anal-fin base; maximum height 4.1–6.4% SL (1.9–3.6 times in length of adipose-fin base). Adipose-fin origin separated from base of last dorsal-fin ray by distance of 9.6–16.0 % SL. Dorsal spine stout, with 7–13 serrations on posterior edge. Dorsal fin with anteriormost branch of each ray longer than other branches, imparting triangular distal margin to fin; membranes narrow, imparting triangular appearance. Adpressed dorsal fin (excluding filamentous extensions of rays) not reaching adipose fin; very long filamentous extensions of first two rays reaching beyond posterior base of adipose fin typically present in individuals larger than approx. 200 mm SL; filamentous extensions not as prominent in individuals smaller than approx. 200 mm SL and when

present, not reaching beyond middle of adipose-fin base. Pectoral spine stout, with 13–25 large serrations on posterior edge. Anal fin triangular, origin slightly posterior to adipose origin. Caudal fin forked; upper and lower lobes tapering. Maxillary barbels reaching barbels reaching at least vertical through base of last anal-fin ray (234–297% HL). Maximum recorded size 360 mm SL.

Colour. — Dorsal surface of head and body uniform brownish-grey; ventral surface of head and body dirty white; adipose fin darker brownish-grey than body but without distinct dark spot; fin-rays and inter-radial membranes of dorsal, pectoral, pelvic and anal fins grey; tips of first two or three pelvic-fin rays and second to fifth anal-fin rays whitish in life. Caudal fins with black procurvent and upper and lower principal rays, faint black distal margin and reddish bases of fin lobes in life; only black colouration on procurvent and upper and lower principal caudal-rays evident in preserved material. Dorsal surface of barbels brownish-grey, ventral surface dirty white.

Distribution. — *Hemibagrus hoevenii* is known from river drainages in Borneo (Baram, Barito, Kapuas, Katingan), Sumatra (Batang Hari, Musi) and the Malay Peninsula (Johor, Muar, Pahang; Fig. 26).

Habitat and biology. — *Hemibagrus hoevenii* is found primarily in the lower reaches of rivers, although it is not restricted to such habitats. The furthest inland records for this species are at Muara Teweh (Barito River drainage) and Sintang (Kapuas River drainage), both about 300 km from the sea. In the lower Batang Hari and Musi river drainages in eastern Sumatra, it has been found in large rivers with turbid water and a substrate of fine mud. It is apparently capable of withstanding low salt concentration.

Remarks. — *Hemibagrus hoevenii* was previously considered a junior synonym of *H. nemurus* by most authors since Günther (1864), but was shown by Kottelat & Lim (1995) to be a distinct species. Since the holotype of *H. hoevenii* was probably lost (the circumstances surrounding the probable loss are discussed in Kottelat et al., 1994), a neotype was subsequently designated (International Commission for Zoological Nomenclature, 1996, Opinion 1840).

Hemibagrus spilopterus Ng & Rainboth, 1999

(Fig. 28)

Hemibagrus spilopterus Ng & Rainboth, 1999: 562, Figs. 5, 7a, 8a (type locality: Kandal, Bassac River at village of Prek Chey on Vietnamese border, Cambodia); Ferraris, 2007: 91; Vidthayanon, 2008: 114; Ng & Lim, 2008: 29; Rainboth et al., 2012: 72, Pl. 46, Fig. 946.

Bagrus nemurus (non Valenciennes in Cuvier & Valenciennes, 1840) - Bleeker, 1859f: 102.

Hemibagrus nemurus (non Valenciennes in Cuvier & Valenciennes, 1840) - Bleeker, 1864: 353; 1865a: 34; 1865b: 175; Sauvage, 1883: 154; Mo, 1991: 132; Kottelat, 1998: 100, Fig. 147; Baird et al., 1999: 91, Fig. 201; Gaanantkul et al., 2000: 34; Serov et al., 2006: 193; Vasil'eva & Vasil'ev, 2012: 201.

Macrones luridus Tirant in Pétillet, 1911: 164 (nomen nudum); Chevey, 1929: 172

Macrones nemurus (non Valenciennes in Cuvier & Valenciennes, 1840) - Hora, 1923: 171; 1924: 468; Tirant in Pétillet, 1911: 164; Chevey, 1929: 172; 1932: 17; 1934: 201; Chevey & Le Poulain, 1940: 38.

Macrones planiceps (non Valenciennes in Cuvier & Valenciennes, 1840) - Chevey, 1932: 17; Pellegrin & Chevey, 1937: 317.

Mystus nemurus (non Valenciennes, in Cuvier & Valenciennes, 1840) - Fowler, 1934: 95; 1937: 148, Figs. 44-47 (in part); Suvatti, 1936: 73; 1950: 297 (in part); 1981: 92; Kuronuma, 1961: 6; Mizuno & Mori, 1970: 109, Fig. 12C; Kawamoto et al., 1972: 27, Fig. 52; Orsi, 1974: 161; Desoutter, 1975: 448; Beeckman & de Bont, 1985: 2646; Kottelat, 1985: 270; Mai & Nguyễn, 1988: 49; Roberts, 1993b: 33; Serov, 1994a: 24; 1994b: 62; Lim et al., 1996: 382; Rainboth, 1996: 143, Pl. 19 Fig. 145; Nguyễn, 1999: 32.

Mystus planiceps (non Valenciennes in Cuvier & Valenciennes, 1840) - Suvatti, 1936: 75; 1950: 297 (in part); 1981: 92; Fowler, 1937: 148; 1939: 40, 58; Kuronuma, 1961: 6; Desoutter, 1975: 451; Kottelat, 1985: 270; Serov, 1994a: 24; 1994b: 63; Vasil'eva & Vasil'ev, 2012: 201.

Mystus wyckii (non Bleeker, 1858) - Trýõng & Trần, 1993: 213, Fig. 92.

Hemibagrus cf. *nemurus* - Ng & Rainboth, 1999: 558, Fig. 3.

Hemibagrus aff. *nemurus* - Kottelat, 2001b: 122, Fig. 329.

Hemibagrus sp. 1 - Nguyễn, 2005: 359, Fig. 184.

Hemibagrus sp. cf. *nemurus* - Rainboth et al., 2012: 72, Pl. 45, Fig. 945.

Hemibagrus planiceps (non Valenciennes in Cuvier & Valenciennes, 1840) - Vasil'eva & Vasil'ev, 2012: 201.

Material examined. — **MEKONG:** LAOS: NRM 15001, 1 ex., 267.8 mm SL, Nam Ou River near Luang Prabang; NRM 15015, 1 ex., 260.3 mm SL; NRM 15016, 1 ex., 235.1 mm SL; NRM 15017, 1 ex., 253.3 mm SL; NRM 15018, 1 ex., 222.4 mm SL, Mekong River at Luang Prabang, 19°53'N 105°50'E; BMNH 1976.7.1.35–36, 2 ex., 157.5–171.4 mm SL, fish market at Vientiane; CMK 13129, 1 ex., 169.6 mm SL, Vientiane province: Mekong River at mouth of Nam Mang and lower 100 m of Nam Mang, 18°21'48"N 103°14'16"E; CAS 92472, 4 ex., 23.8–39.4 mm SL, Attapeu province: Houay Samong, about 1 km upstream from its mouth into Xe Pian near Ban Hin Lat, Sekong watershed; CAS 92504, 15 ex., 20.8–150.6 mm SL, Sekong watershed, small mountain stream entering right side of Se Kaman just upstream from Se Kaman 1 hydropower; CAS 94757, 1 ex., 27.0 mm SL, Mekong drainage, Sekong watershed, Bolaven plateau, Xe Nam Noy mainstream 26 km by road from Ban Nam Tong about 1 km downstream, elevation 270 m; CAS 94772, 3 ex., 20.0–33.1 mm SL, Attapeu province: Sekong watershed, Xe Pian 1 km downstream from Se Pa waterfall and 5–6 km upstream from Ban Hin Lat; CAS 96793, 1 ex., 91.0 mm SL, Se Khone.

MYANMAR: ANSP 59391, 2 ex., 72.7–110.5 mm SL, Mekong River at Chieng Sen, 8 km S of Shan States border opposite Laos.

THAILAND: ANSP 89408, 13 ex., 71.2–124.2 mm SL, Khemerat; CAS 61915, 2 ex., 147.8–152.9 mm SL; CAS 61920, 2 ex., 112.0–112.2 mm SL; UMMZ 186800, 7 ex., 74.2–103.6 mm SL; USNM 317587, 21 ex., 77.4–111.9 mm SL; USNM 317589, 8 ex., 109.9–136.4 mm SL; USNM 317607, 1 ex., 90.3 mm SL, Ubon Ratchathani province, market at Ubon Ratchathani; CAS 79051, 4 ex., 72.8–126.0 mm SL, Mekong river near Ban Ha Bia, 30–40 km NW of Chiang Khan on Highway 2186; CAS 96568, 4 ex., 145.4–204.8 mm SL, Mukdahan market; CAS 96573, 5 ex., 83.9–185.3 mm SL, Mekong mainstream between Pak Ing and Jom

Paing (about 4–5 km downstream); CAS 96582, 1 ex., 157.3 mm SL, Pak Menam Mun (mouth of Mun River); CAS 96966, 3 ex., 66.5–68.9 mm SL, Huay Nam Ngam & Mekong mainstream near That Phanom; CAS 97076, 1 ex., 68.7 mm SL, Menam Chi at Maha Chana Chai; CMK 5043, 4 ex., 99.1–152.8 mm SL, market at Nong Khai; CMK 5087, 2 ex., 124.4–139.0 mm SL; ZRC 46012, 4 ex., 146.0–184.0 mm SL, market at That Phanom; UMMZ 186685, 10 ex., 45.3–56.5 mm SL, Nakorn Ratchasima province, ditches and flow, and borrow pits along drainage downstream from damsite at Pakthongchai, Korat; UMMZ 186752, 3 ex., 75.0–100.9 mm SL, Khon Kaen fish market; UMMZ 186756, 1 ex., 84.1 mm SL, Pangneeb province, Nam Phong River, about 90 km S of Udorn (25 km W of Nam Phong village); UMMZ 186769, 3 ex., 113.6–159.5 mm SL, market at Nakhon Phanom; UMMZ 186779, 5 ex., 61.0–141.9 mm SL, Nam Kham River at base of dam holding Nong Lahan; UMMZ 186784, 2 ex., 168.0–221.9 mm SL, Ubon Ratchathani province, market at Mukdahan; UMMZ 186791, 1 ex., 210.4 mm SL, irrigation reservoir at Ubon Ratchathani fisheries Station; UMMZ 186814, 1 ex., 63.6 mm SL, Ubon Ratchathani province, Mun River about 20 km downstream from Ubon Ratchathani; UMMZ 186818, 1 ex., 75.0 mm SL, Ubon Ratchathani province, Mun River about 5 km downstream from Ubon Ratchathani; UMMZ 186820, 14 ex., 52.4–156.6 mm SL, Reservoir at Maha Sarakhan. UMMZ 186827, 2 ex., 138.8–150.5 mm SL, market at Korat; UMMZ 186852, 3 ex., 104.3–116.0 mm SL, Mool River of the Mekong drainage; UMMZ 213975, 13 ex., 67.3–182.1 mm SL, Nong Khai province, Tha Bo district, Huay Kum Kang Mo at Mekong River; UMMZ 214368, 3 ex., 98.1–119.0 mm SL, Ubon Ratchathani province, Mekong River at Khemerat in front of River Patrol Station S of town. UMMZ 214370, 1 ex., 98.5 mm SL, Ubon Ratchathani province: Khong Chiam district, N shore of Mun River at Ban Dan, 2 km upstream from Mekong confluence. UMMZ 214371, 1 ex., 185.0 mm SL, Ubon Ratchathani province, Khong Chiam district, Mun River at Ban Dan, 1.5 km upstream from Mekong confluence; UMMZ 214372, 3 ex., 118.0–141.3 mm SL, Ubon Ratchathani province, Mun River, 3 km downstream from bridge at Ubon Ratchathani, at mouth of small creek on N bank of the Mun; UMMZ 214373, 2 ex., 144.1–152.2 mm SL, Ubon Ratchathani province: Khong Chiam district, Mun River at Ban Dan, 3 km upstream from confluence with Mekong River; UMMZ 214374, 2 ex., 36.0–41.8 mm SL, UMMZ 214375, 1 ex., 42.9 mm SL; UMMZ 214376, 3 ex., 34.7–48.7 mm SL; UMMZ 214377, 1 ex., 31.9 mm SL; UMMZ 214378, 4 ex., 33.9–42.9 mm SL, Ubon Ratchathani province, Khong Chiam district, Mun River at Ban Dan, 3 km upstream from confluence with Mekong River; UMMZ 214379, 1 ex., 106.2 mm SL, Ubon Ratchathani province, stream from Bung Klang Huen to Mun River, 10 km from Mun River, 3 km E of Ubon Ratchathani; UMMZ 214380, 5 ex., 43.8–51.6 mm SL, Ubon Ratchathani province, Lam Dom Noi Reservoir near Ban Kham Kom; UMMZ 214381, 1 ex., 56.8 mm SL, Nakhon Phanom province, Mekong River at Ban Tha Kai, 20 km downstream from Mukdahan; UMMZ 214382, 2 ex., 137.4–156.5 mm SL, Ubon Ratchathani province, Mun River 15 km downstream from bridge at Ubon Ratchathani; UMMZ 214383, 12 ex., 15.1–125.7 mm SL, Ubon Ratchathani province, Huay Kwang, 1.5 km upstream from Mun River; UMMZ 214384, 2 ex., 51.6–203.3 mm SL, Khon Kaen province: Nam Pong Reservoir, 3 km N of fish landing on E side of reservoir; UMMZ 214385, 8 ex., 13.0–24.8 mm SL, Ubon Ratchathani province, 6 km W of Ubon on highway 23, inundated scrub vegetation near flooded creek; UMMZ 214386, 10 ex., 100.8–150.7 mm SL, Kung Kang Moo, creek mouth into Mekong River; UMMZ 214387, 25 ex., 40.5–116.2 mm SL, Ubon Ratchathani province, Huay Thom-loe at Ban Bung Khee-lek, 7 km E of Khemerat, 2.5 km from Mekong River; UMMZ 214388, 26 ex., 39.0–104.8 mm SL, Ubon Ratchathani province, Huay Thom-loe at Ban Bung Khee-lek, 7 km E of Khemerat, 1 km from Mekong River; UMMZ 214389, 20 ex., 38.6–134.5 mm SL, Nakhon

Phanom province, Mekong River at Ban Tha Kai, 21 km downstream from Mukdahan; UMMZ 214390, 1 ex., 83.0 mm SL, Ubon Ratchathani province, Huay Kwang, S of Khong Chiam, 3 km up Mun River from Mekong–Mun River confluence; UMMZ 214391, 2 ex., 34.2–66.2 mm SL, Ubon Ratchathani province, Huay Phai, 7 km N of Khong Chiam, at confluence with Mekong River; UMMZ 214392, 13 ex., 21.3–69.5 mm SL, Nakhon Phanom province, Huay Nong Sao, 8 km SW of Nakhon Phanom, 1.5 km down footpath off main road; UMMZ 214393, 6 ex., 90.5–215.6 mm SL, Huay Mark, 8 km N of Khong Chiam, at confluence with Mekong River, 15°22'N 105°29'E; UMMZ 214394, 1 ex., 114.0 mm SL, Ubon Ratchathani province, Huay Kwang, at confluence with Mun River, 3 km from Mekong River; UMMZ 214395, 15 ex., 50.0–134.8 mm SL, Ubon Ratchathani province: Huay Mark Tai, 1 km from Mekong River; UMMZ 214396, 1 ex., 183.4 mm SL, Ubon Ratchathani province: Lam Dom Noi reservoir, approx. 2.5 km S of Ban Khan Kom on W shore; UMMZ 214397, 44 ex., 19.9–131.7 mm SL, Khon Kaen province: Nam Pong Reservoir, 2.1 km N of damsite on E shore; UMMZ 214398, 4 ex., 55.2–98.9 mm SL, Khon Kaen province: Nam Pong Reservoir, 4.8 km N of damsite on E shore; UMMZ 214938, 4 ex., 55.2–98.9 mm SL, Khon Kaen province: Nam Pong Reservoir, 4.8 km N of damsite on E shore; UMMZ 214399, 8 ex., 38.2–105.1 mm SL, UMMZ 214400, 8 ex., 33.7–92.5 mm SL, UMMZ 214401, 12 ex., 61.0–129.8 mm SL, Nong Khai province, Tha Bo district, Mekong River at Ban Tha Sa-det; UMMZ 214402, 3 ex., 50.0–72.6 mm SL, Nakhon Phanom province, roadside ditch near Ban Thong, 6 km S of That Phanom; UMMZ 214403, 3 ex., 66.6–77.9 mm SL, Ubon Ratchathani province, Mun River, 1 km upstream of Ubon Ratchathani; UMMZ 214404, 3 ex., 56.0–93.7 mm SL, Ubon Ratchathani province, Mun River, 3 km downstream from Ubon Ratchathani; UMMZ 214406, 11 ex., 37.6–55.3 mm SL, Chiang Mai province, Fang River, 23 km S of Fang on Vuang Mai Road–Highway 107; UMMZ 214407, 1 ex., 33.5 mm SL, Ubon Ratchathani province, Huay Hin Taek, just across Mun River from Ban Dan, 1.5 km up Huay Hin Taek from Mun River; UMMZ 214408, 5 ex., 16.8–23.4 mm SL, Ubon Ratchathani province, Khong Chiam district, Huay Hin Taek, just across Mun River from Ban Dan, 0.75 km up Huay Hin Taek from Mun River; UMMZ 214409, 1 ex., 137.8 mm SL, Ubon Ratchathani province, Mun River, just below Ubon Ratchathani; UMMZ 214412, 1 ex., 191.3 mm SL, Ubon Ratchathani province, Khong Chiam district, Mun River at Ban Dan, 3 km upstream from Mekong confluence; UMMZ 214487, 47 ex., 40.7–138.1 mm SL, Ubon Ratchathani province: Khong Chiam district, Huay Kwang, 0.3 km from Mun River; UMMZ 224551, 4 ex., 53.2–125.8 mm SL, Ubon Ratchathani province, Lam Dam Noi Reservoir at Ban Kham Kom; UMMZ 226867, 5 ex., 72.6–113.1 mm SL, UMMZ 226868, 20 ex., 81.5–121.5 mm SL, Nong Khai province, Tha Bo district, Mekong River backwater at Ban Tha Sadet, 17°52'36"N 102°35'30"E; USNM 109580, 1 ex., 76.8 mm SL, Mekong at Chieng Sen Kao; USNM 109582, 7 ex., 45.2–71.7 mm SL, N Thailand; USNM 305707, 2 ex., 101.4–133.1 mm SL, Ubon Ratchathani province, Warin Chamrap market; USNM 317576, 1 ex., 135.7 mm SL, Thailand, 15°14'N 104°52'E; USNM 317588, 1 ex., 162.4 mm



Fig. 28. *Hemibagrus spilopterus*, ZRC 40305, 144.3 mm SL, Thailand: Bangkok.

SL, Ubon Ratchathani province, Victory Rapids (Kaeng Ja wa) on Mun river about 5 km W of Mekong River; USNM 317590, 17 ex., 96.5–118.0 mm SL, Khon Kaen province, Huai Phra Ku, about 7 km E of Khon Khaen on highway 209; USNM 317591, 2 ex., 124.9–186.8 mm SL, Roi Et province, Lam Chi, 1.5 km below highway 23 bridge 4 km W of Selaphum; USNM 317592, 13 ex., 101.4–142.0 mm SL, Ubon Ratchathani province, Mun River at Bung Wai about 7 km W of Ubon; USNM 317593, 6 ex., 142.8–182.4 mm SL, Thailand, Khon Kaen province, Mekong River drainage, 15°45'N 102°37'E; MCZ 60936, 1 ex., 216.0 mm SL, Khon Kaen province, Lake Kaeng Lawa, 16°8'N 102°42'E; USNM 317594, 32 ex., 84.0–127.5 mm SL, Nakhon Phanom province, market at Nakhon Phanom; USNM 317595, 3 ex., 163.8–200.1 mm SL, Nong Khai province, Mekong River near Ban Kong Nang; USNM 317608, 1 ex., 115.5 mm SL, Nakhon Ratchasima province, flood plain pool of Lam Nam Mun at Amphoe Phimai; USNM 317609, 1 ex., 145.8 mm SL, Ubon Ratchathani province, purchased from fisherman on Mae Nam Mun, just E of Phibun Mangsahan; ZRC 40896, 3 ex., 59.2–101.2 mm SL, Nakhon Ratchasima province, drained irrigation ponds or padi fields along Highway 24, fed by Klong Kabau, 14°44'34.8"N 102°12'31.7"E; ZRC 46157, 1 ex., 157.0 mm SL, market at Phibun Mangsahan, 46 km E of Ubon Ratchathani; ZRC 39345, 4 ex., 95.2–135.3 mm SL, Yasothon province, Amphoe Muang Yasothon.

CAMBODIA: UMMZ 232611, holotype, 147.5 mm SL, Kandal: Bassac River at village of Prek Chey on Vietnamese border, 10°57'N 105°6'E; CAS 93949, 1 paratype, 203.2 mm SL, Stung Siem Reap near Angkor Wat; CMK 15121, 1 paratype, 168.2 mm SL; CAS 209760, 1 paratype, 171.0 mm SL; ZRC 43324, 10 paratypes, 171.7–241.4 mm SL, Phnom Penh, Chompuvon market, approx. 5 km SW of city; ZRC 43322, 1 paratype, 209.9 mm SL, Phnom Penh, Chipa Ampe market, across Tonle Sap River NE of city; ZRC 43323, 1 paratype, 309.1 mm SL, Phnom Penh, central market; UMMZ 181163, 2 paratypes, 98.8–109.0 mm SL, Kandal: Prek Andhor, tributary from E of Tonlé Sap River, 15 km NW of Phnom Penh; UMMZ 232644, 1 paratype, 126.5 mm SL, Kandal: Prek Bak Nam at fishing lot 9, just upstream of Phum Chong Sao, 11°2'N 105°8'E; UMMZ 232699, 3 paratypes, 206.4–230.0 mm SL, Kompong Chhnang, morning market, 12°15'N 104°40'E; UMMZ 232731, 2 paratypes, 93.0–127.0 mm SL, Tonlé Sap at exit to Great Lake, 4 km NW of Chhnok Trou, at Kompong Thom fishing lot 2; CAS 93268, 5 ex., 36.1–43.5 mm SL, Ratanakiri province, O Chalerm, approx. 5–10 km E of Lomphat; CAS 94779, 47 ex., 10.5–104.6 mm SL, Ratanakiri province, O Champha, 4–8 km upstream from its mouth into Tonlé San near Te Veng; CAS 96642, 5 ex., 43.3–129.4 mm SL, Ratanakiri province, O Kamang Chong, 20–25 km E of Lomphat; MNHN A1071, 3 ex., 197.8–273.4 mm SL, Cambodia. MNHN 1937–34, 1 ex., 138.7 mm SL, Angkor; MNHN 1974–27, 24 ex., 29.1–144.2 mm SL, Tonlé Sap km 9; UMMZ 181204, 1 ex., 188.2 mm SL, Mekong River N of Phnom Penh; UMMZ 214411, 1 ex., 98.7 mm SL, Mekong River and tributary from km 1393 to 1596; UMMZ 232130, 1 ex., 137.9 mm SL, Kandal: Tonle Sap River 35 km upstream from Phnom Penh (11°52'N 104°47'E); UMMZ 232634, 1 ex., 115.2 mm SL, Kandal: Prek Mong Ya, just upstream from confluence with Bassac River at fishing lot 10 (10°57'N 105°7'E); UMMZ 234410, 1 ex., 139.4 mm SL, Kandal: Prek Ta Pov, 13 km S of Phnom Penh.

VIETNAM: MCZ 25589, 1 ex., 114.9 mm SL, Thu Dau Mot; MNHN A2393, 1 ex., 268.6 mm SL; MNHN A2394, 4 ex., 137.4–247.9 mm SL; MNHN B283, 3 ex., 198.1–232.4 mm SL; MNHN B285, 3 ex., 165.0–263.5 mm SL, Cochinchina; MNHN B281, 2 ex., 86.1–106.8 mm SL, Saigon; NRM 31079, 1 ex., 256.1 mm SL, Song Langna (probably near Saigon–Da Lat road); UMMZ 214410, 1 ex., 187.1 mm SL, fish market at Vinh Long; UMMZ 224622, 1 ex., 38.5 mm SL, Chau Doc, Mekong-Bassac River, 3 km downstream

from Chau Doc; UMMZ 224645, 1 ex., 104.5 mm SL, Chau Doc fish market; UMMZ 224830, 2 ex., 47.1–76.4 mm SL, Chau Doc, S end of Vinh Tuong Island, Bassac River.

CHAO PHRAYA: THAILAND: ANSP 59375, 2 ex., 71.2–77.2 mm SL; ANSP 59377, 2 ex., 67.3–74.6 mm SL; ANSP 59379, 1 ex., 55.7 mm SL; ANSP 59380, 3 ex.; 125.0–157.7 mm SL; ANSP 59383, 1 ex., 118.5 mm SL; ANSP 59384, 3 ex., 75.9–86.1 mm SL; ANSP 59387, 2 ex., 110.7–113.5 mm SL, Chiang Mai on Mae Nam Ping; ANSP 59389, 2 ex., 100.4–127.1 mm SL, Bangkok, 48 km up the Mae Nam Chao Phraya; ANSP 59467, 1 ex., 34.9 mm SL, Silom Canal, Bangkok; ANSP 88047, 1 ex., 96.2 mm SL, Me Poon; ANSP 89483, 1 ex., 87.5 mm SL, Phitsanulok; ANSP 89533, 13 ex., 90.0–140.3 mm SL, Bangkok; ANSP 141235, 8 ex., 47.6–70.1 mm SL, Tachin; BMNH 1898.11.8.110, 1 ex., 224.0 mm SL, Ayutthaya. CAS 92860, 1 ex., 64.0 mm SL, Mae Nam Ping, about 41 km N of Chiang Mai; CMK 4834, 1 ex., 102.3 mm SL, Lampong province, Mae Nam Yom drainage, Huai Mae Phlung from Ban Pong to 17 km upstream, 18°42'N 99°58'E; CMK 4874, 3 ex., 115.0–159.6 mm SL, Ayutthaya province, market at Ayutthaya; CMK 5018, 3 ex., 96.8–116.1 mm SL, market at Sukhothai; CMK 5281, 1 ex., 157.2 mm SL; ZRC 46158, 1 ex., 202.7 mm SL, market at Nakhon Sawan; FMNH 50847, 1 ex., 89.1 mm SL, Nakhon Sawan province, Pak Nam Po; FMNH 50848, 3 ex., 169.2–174.6 mm SL, Kamphaeng Phet province, Wong Pratart farm; MCZ 35534, 2 ex., 122.1–140.6 mm SL, Mae Nam Ping at Chiang Mai, 18°48'N 98°59'E; MNHN 1554, 4 ex., 95.0–136.4 mm SL, Me Nam River; MNHN 1567, 4 ex., 87.0–127.3 mm SL, Bangkok; UMMZ 186696, 1 ex., 138.9 mm SL, Nakhon Sawan province, Chao Phraya River, floodwaters ca 20 km W of Nakhon Sawan; UMMZ 186733 (81), 62.8–173.0 mm SL, UMMZ 195382, 1 ex., 74.9 mm SL, Maharaj province, Chao Phraya River, floodwaters, 17.5 km N of Ayutthaya, Koke Tong Canal drainage; UMMZ 186740, 7 ex., 64.3–105.7 mm SL, Maharaj province, Koke Tong Canal, 17.5 km N of Ayutthaya; USNM 103197, 1 ex., 222.1 mm SL; Mae Nam Chao Phraya, Ayutthaya; USNM 109566, 14 ex., 33.9–106.2 mm SL, Mae Nam Ping at Chiang Mai; USNM 109567, 1 ex., 207.8 mm SL, Huey O, branch of Man Nam Nan; USNM 109568, 1 ex., 121.1 mm SL, Mae Nam Chem, tributary of Man Nam Ping; UMMZ 214405, 3 ex., 83.8–112.0 mm SL, creek running under Highway 1, 23 km S of Chiang Mai, Mae Nam Ping drainage; USNM 118449, 1 ex., 134.7 mm SL, Chiang Mai; ZRC 29583–29596, 14 ex., 177.6–214.2 mm SL, ZRC 29659–29665, 7 ex., 132.3–158.0 mm SL; ZRC 40305, 144.3 mm SL, Bangkok.

MAE KHLONG: THAILAND: CAS 79049, 3 ex., 102.8–131.1 mm SL, Huay Sangkalia, 7 km N of Sangklaburi on road to Chedi Sam Ong; UMMZ 186715, 5 ex., 108.2–121.5 mm SL, Rajburi province, Mae Khlong River, purchased in market at Rajburi; UMMZ 186846, 1 ex., 104.9 mm SL, Mae Nam Mae Khlong at Ban Pong, 2 km downstream;

BANGPAKONG: THAILAND: CAS 92870, 1 ex., 63.7 mm SL, Bangpakong drainage, open channel in large swamp approx. 9 km SSW of Prachinburi town.

Diagnosis. — *Hemibagrus spilopterus* is distinguished from all members of the *H. nemurus* species group in having the interorbital space gently-curved (vs. flat). This is more clearly seen when the head is viewed dorsally. It further differs from *H. capitulum* in having the adpressed dorsal fin (excluding the filamentous extensions of the fin rays if present) not reaching (vs. reaching to or beyond) the adipose-fin origin, from *H. filamentus* in having a larger dorsal to adipose distance (10.8–17.6% SL vs. 7.7–10.9), and from *H. fortis* in having the anteriormost branch of the dorsal-fin rays

Table 16. Biometric and meristic data for *H. spilopterus* (n = 50).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	27.3–34.1	30.1±1.58
Head width	16.9–23.4	19.9±1.62
Head depth	12.5–17.0	15.1±1.19
Predorsal distance	38.9–46.3	41.9±1.74
Preanal length	69.7–75.5	72.1±1.51
Prepelvic length	50.3–59.8	53.9±2.16
Prepectoral length	22.6–32.1	26.4±2.45
Body depth at anus	12.9–19.3	16.1±1.55
Length of caudal peduncle	15.5–18.7	17.5±0.85
Depth of caudal peduncle	7.3–9.7	8.6±0.59
Pectoral-spine length	15.6–19.0	17.6±1.01
Pectoral-fin length	17.6–21.8	19.7±1.03
Length of dorsal fin	22.7–37.4	26.4±2.83
Length of dorsal-fin base	13.7–18.0	15.9±0.88
Dorsal-spine length	13.6–17.3	15.6±0.98
Pelvic-fin length	14.2–16.9	15.5±0.75
Length of anal-fin base	10.2–13.9	12.2±0.91
Caudal-fin length	21.1–26.0	23.3±1.22
Length of adipose-fin base	11.3–17.9	14.4±2.17
Maximum height of adipose fin	4.7–7.4	5.6±0.68
Dorsal to adipose distance	10.8–17.6	13.9±2.06
Post-adipose distance	15.4–20.8	17.1±1.21
In %HL:		
Snout length	34.1–40.5	37.2±1.33
Interorbital distance	28.1–36.0	33.3±1.84
Eye diameter	12.2–17.6	15.4±1.36
Nasal barbel length	25.4–45.0	35.4±5.36
Maxillary barbel length	209.3–298.5	236.2±19.92
Inner mandibular barbel length	36.8–63.4	48.3±5.65
Outer mandibular barbel length	41.2–106.3	83.9±13.65
MERISTICS		
Dorsal-fin rays	II,7 (50)	
Anal-fin rays	iii,9 (4), iv,8 (12), iv,9 (28), iv,10 (2), v,8 (2) or v,9 (2)	
Pelvic-fin rays	i,5 (50)	
Pectoral-fin rays	I,7,i (5), I,8 (9) I,8,i (3) or I,9 (6) or I,10 (1)	
Caudal-fin rays	i,7,8,i (50)	
Branchiostegal rays	9 (8), 10 (24), 11 (14) or 12 (4)	
Gill rakers	3+11 (2), 4+10 (2), 4+13 (2), 5+12 (2), 4+14 (2), 5+13 (22), 6+12 (12) or 5+14 (6)	
Vertebrae	23+20=43 (1), 22+22=44 (6), 23+21=44 (22) or 24+20=44 (8), 23+22=45 (10), 24+21=45 (2) or 25+21=46 (1)	

longer than other branches (vs. branches of dorsal-fin rays of almost equal length) giving the dorsal fin a distinctly jagged (vs. rounded) distal margin (Fig. 20) and a shorter, deeper adipose fin (maximum height of adipose fin 1.7–3.2 times in the length of its base vs. 2.8–4.9). It is further distinguished from *H. hoevenii* in having the premaxillary tooth band not (vs. partially) exposed when the mouth is closed, rounded (vs. tapering) caudal-fin lobes, absence (vs. presence) of a broad and conspicuous dark margin around the caudal fin, a rounded (vs. triangular) anal fin, broader membranes of the dorsal fin which give it a rounded (vs. triangular) appearance, and filamentous extensions on the dorsal fin, if present, not reaching beyond middle of adipose-fin base (vs. very long filamentous extensions of the first two dorsal-fin rays, when present, that reach beyond the posterior base of the adipose

fin), and from *H. nemurus* in having a larger eye in specimens larger than approx. 150 mm SL (12–18% HL vs. 9–11).

Description. — Biometric and meristic data as in Table 16. General description as for genus. Head depressed and broad, body moderately compressed; head width 56–73% HL. Interorbital space gently curved. Eye diameter 12–18% HL. Premaxillary tooth band not exposed when mouth is closed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose-fin base short, approximately as long as anal-fin base; maximum height 4.7–7.4% SL (1.7–3.2 times in length of adipose-fin base). Adipose-fin origin separated

from base of last dorsal-fin ray by distance of 10.8–17.6% SL. Dorsal spine stout, with 7–11 serrations along posterior edge. Antermost branch of each dorsal-fin ray longer than other branches, imparting jagged distal margin to fin; membranes broad, imparting rounded appearance. Adpressed dorsal fin (excluding filamentous extensions of rays) not reaching adipose-fin origin; filamentous extensions not reaching beyond middle of adipose-fin base. Pectoral spine stout, with 15–26 large serrations along posterior edge. Anal fin rounded, origin slightly posterior to adipose origin. Caudal fin forked; upper and lower lobes rounded. Maxillary barbels reaching at least vertical through base of last anal-fin ray (209–299% HL). Maximum recorded size 500 mm SL (Serov et al., 2006).

Colour. — Dorsal surface of head and body uniform brownish-grey; ventral surface of head and body dirty white; adipose fin brownish-grey, posterior half with distinct black spot; fin-rays and inter-radial membranes of all fins grey; dorsal surface of barbels brownish-grey, ventral surface dirty white.

Distribution. — *Hemibagrus spilopterus* is known from the river drainages in Indochina: Mekong [upstream to Chieng Sen], Dong Nai, Ban Pakong, Chao Phraya and Mae Khlong (Fig. 26).

Habitat and biology. — *Hemibagrus spilopterus* is found in a wide variety of lotic and lentic habitats. The species feeds predominantly on small fishes and crustaceans (Beekman & de Bont, 1985; Rainboth, 1996). In the Cambodian Mekong, it moves into the flooded forests to spawn, with the young being first seen in August; the fish migrate back towards the rivers in November–December (Rainboth, 1996).

Remarks. — Ng & Rainboth (1999) considered the material identified as *H. nemurus* from central Indochina to belong to a distinct species, although they did not formally name it. They pointed out that the name *Macrones luridus* Tirant in Pétilot, 1911, possibly referring to this species, is a nomen nudum and published only once in a list of fishes (republished in Chevey, 1929) sent by Tirant to the Musée Guimet d'Histoire Naturelle, Lyon. In the same study, they described *H. spilopterus*, distinguishing it from congeners by the presence (vs. absence) of a distinct black spot on the adipose fin. Our investigation shows that the material identified by Ng & Rainboth as *H. cf. nemurus* and *H. spilopterus* are conspecific and that this material is distinct from *H. nemurus* s. str. and other Sundaic species in the *H. nemurus* species group. The only difference between the *H. cf. nemurus* of Ng & Rainboth and *H. spilopterus* is the intensity of the black spot on the adipose fin, with no other significant differences in morphology of the material being found in our study. As noted by Ng & Rainboth, a black spot is also present on the adipose fin in some individuals of *H. capitulum* (particularly those from central Sumatra), although they considered the spot in *H. spilopterus* to be more rounded and intensely coloured. Given the variability displayed among individuals of this character, we conclude that it is not a useful diagnostic character.

The species identified as *Hemibagrus* sp. 1 by Nguyễn (2005) is likely to be *H. spilopterus*. This species, for which material from the Mekong River drainage in northern Vietnam (Song Nam Rom) was examined, was described as being most similar to *H. wyckii*. It was described as differing from *H. wyckii* in having very long maxillary barbel reaching to the anal fin, short nasal barbel not reaching the orbital margin, adipose fin originating at vertical through anal-fin origin, length of adipose-fin and anal-fin bases equal and about two-fifths of the distance between the dorsal- and adipose-fin bases. Although this information is scanty and could presumably refer to *H. spilopterus* or *H. wyckioides* (two other congeners likely to occur in the area), the illustration of this species (Nguyễn, 2005: Fig. 184) is more similar to *H. spilopterus* on the account of the relatively short adipose-fin base. However, *H. spilopterus* has not (yet) been encountered in the Nam Ou drainage (of which the Song Nam Rom is a part of; MK pers. obs.). Despite this, we re-identify the *Hemibagrus* sp. 1 of Nguyễn (2005) as *H. spilopterus* based on the information available and the illustration of this species.

HEMIBAGRUS OLYROIDES SPECIES GROUP

Remarks. — The *H. olyroides* species group includes a single species, which is the most distinct of all Sundaic *Hemibagrus* species. It is easily distinguished by its elongate body, long-based adipose fin, lanceolate upper caudal-fin lobe, and a very dark brown colouration.

Hemibagrus olyroides (Roberts, 1989)

(Fig. 29)

Mystus olyroides Roberts, 1989: 124, Figs. 95–96 (type locality: Borneo: Kalimantan Barat, Kapuas drainage, Sintang market, reportedly from Sungai Kebian); Kottelat et al., 1993: 66, Pl. 32; Jayaram & Sanyal, 2003: 91.

Hemibagrus olyroides - Mo, 1991: 132; Kottelat & Widjanarti, 2005: 159; Ferraris, 2007: 90.

Material examined. — BORNEO: CAS 49382, 1 paratype, 201.6 mm SL; CMK 7009, 1 ex., 190.2 mm SL, Kalimantan Barat: market at Sintang. BMNH 1997.7.17.30–31, 2 ex., 77.6–137.0 mm SL, Kalimantan Tengah: Sungai Serendan. ZRC 51383, 4 ex., 163.6–175.0 mm SL; ZRC 51970, 3 ex., 136.2–162.8 mm SL; ZRC 51971, 10 ex., 56.5–86.2 mm SL; Kalimantan Tengah: Sungai Rungan.

Diagnosis. — *Hemibagrus olyroides* is distinguished from congeners by a unique combination of the following



Fig. 29. *Hemibagrus olyroides*, ZRC 51383, 165.6 mm SL; Borneo: Kalimantan Tengah, Sungai Rungan.

characters: elongate body, moderately high vertebral count (49–50), poorly ossified dorsal spine (spine thinner than any dorsal-soft ray) lacking serrations on posterior edge, long-based adipose fin (46.0–50.3% SL), caudal fin with elongate and lanceolate upper lobe, and very dark brown colouration in life.

Description. — Biometric and meristic data as in Table 17. General description as for genus. Head depressed and broad, body elongated and moderately compressed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose-fin base long, about 4.0–4.5 times length of anal-fin base and spanning almost entire postdorsal distance. Dorsal spine thin and poorly ossified, thinner than any soft ray, without distinct serrations on posterior edge. Pectoral spine stout, with 8–14 large serrations on posterior edge. Anal-fin origin posterior to adipose origin. Addressed dorsal fin reaching adipose fin. Caudal fin forked; upper lobe elongate and lanceolate, lower lobe rounded. Maximum recorded size 202 mm SL.

Colour. — Dorsal surface of head and body uniform purplish brown (live or freshly-dead specimens tend to be slightly paler) with lateral line prominent as very thin pale line; ventral surface of head and body very pale brown; adipose fin and fin rays of all fins purplish brown; inter-radial membranes of all fins with scattered melanophores, imparting dusky appearance.

Distribution. — *Hemibagrus olyroides* is known from the Kapuas, Kayan and Sebangau river drainages in western and southern Borneo (Fig. 30).

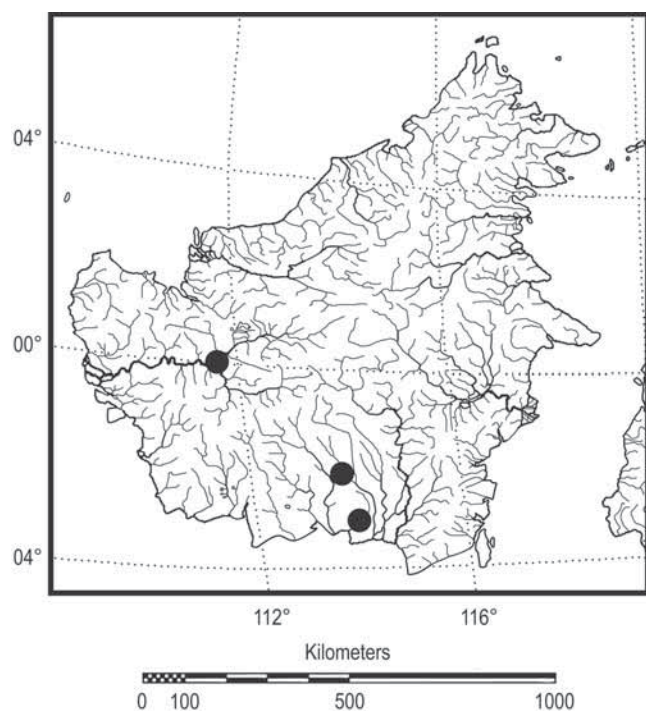


Fig. 30. Map showing collection localities of *Hemibagrus olyroides* specimens examined in this study.

Habitat. — *Hemibagrus olyroides* is known from blackwater habitats, where the water is tannin-stained and of a low pH (approx. 5; Roberts, 1989). According to local fishermen in the area of Danau Sentarum lakes, Kapuas drainage, this species inhabits the upper reaches of the main rivers among wood debris and sunken trees and logs (Kottelat & Widjanart, 2005).

Remarks. — *Hemibagrus olyroides* is recorded here from the Kayan and Sebangau river drainages in southern Borneo, representing the first record outside of the Kapuas River drainage. The material from southern Borneo differs from that from the Kapuas River drainage in having a shorter adipose-fin base (46.0–48.6% SL vs. 49.9–50.3) and a wider head (16.7–18.6% SL vs. 15.8–16.0). However, these differences are very slight and until a larger series of material from the Kapuas River drainage can be obtained to fully understand the degree of variation within a single river drainage, we consider all the known populations to be conspecific.

HEMIBAGRUS PLANICEPS SPECIES GROUP

Remarks. — Members of the *H. planiceps* species group are found in the upper reaches of large rivers, where the water is usually clear and fast-flowing (generally with a sandy or rocky bottom); they have not usually been found syntopically with members of the *H. nemurus* species group, which are common in the slower-flowing middle and lower reaches of rivers, but almost never occur in the upper reaches.

No *Hemibagrus* belonging to this group has been found in Indochina (Ng & Rainboth, 1999; MK, pers. obs.). Although Ng & Rainboth (1999) reported the presence of an elongate *Hemibagrus* from the Mekong River at That Phanom in Thailand resembling *H. planiceps* based on a photograph of a specimen, the specimen is actually that of *H. wyckioides* lacking the characteristic red colour of the fins (C. Vidthayanon, pers. comm.). Previous records of *H. planiceps* (as *Mystus planiceps*) by Fowler (1935: 104, Fig. 30) have turned out to be misidentifications of *Mystus* aff. *gilio*.

Artificial key to the members of the *H. planiceps* species group

1. Dorsal to adipose distance 8–11% SL, addressed dorsal fin in contact with or surpassing origin of adipose fin (Danau Singkarak and associated drainages, Sumatra) *H. lacustrinus*, new species
- Dorsal to adipose distance 11–18% SL, addressed dorsal fin not reaching origin of adipose fin. 2
2. Interorbital distance 32–37% HL (Java). *H. planiceps*
- Interorbital distance 28–34% HL. 3
3. Snout length 30–34% HL (eastern Malay Peninsula). *H. gracilis*
- Snout length 33–41% HL. 4
4. Adipose fin relatively deep, maximum height 1.9–3.2 times in length of base (western Malay Peninsula). *H. divaricatus* new species
- Adipose fin relatively low, maximum height 2.9–5.0 times in length of base. 5

Table 17. Biometric and meristic data for *H. olyroides* (n = 15).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	26.0–29.5	27.7±1.00
Head width	15.8–18.6	17.2±0.77
Head depth	11.4–17.4	13.7±1.57
Predorsal distance	36.2–39.6	37.8±0.89
Preanal length	65.2–70.5	67.7±1.34
Prepelvic length	45.1–52.2	47.6±2.09
Prepectoral length	23.9–27.5	25.3±1.03
Body depth at anus	12.5–16.0	14.1±1.11
Length of caudal peduncle	19.6–22.9	21.0±0.90
Depth of caudal peduncle	6.3–8.4	7.5±0.68
Pectoral-spine length	9.4–12.0	10.7±0.82
Pectoral-fin length	14.8–19.9	17.0±1.28
Length of dorsal fin	24.1–26.8	25.2±0.90
Length of dorsal-fin base	13.2–16.1	14.9±0.79
Dorsal-spine length	5.9–8.7	7.0±0.75
Pelvic-fin length	15.6–18.1	16.5±0.69
Length of anal-fin base	11.2–13.3	12.6±0.79
Caudal-fin length	23.8–30.9	27.3±2.03
Length of adipose-fin base	46.0–50.3	47.7±1.31
Maximum height of adipose fin	5.1–8.3	6.7±0.81
In %HL:		
Snout length	0.0–1.2	0.3±0.47
Interorbital distance	30.2–33.7	32.1±1.13
Eye diameter	25.7–29.6	27.5±1.11
Nasal barbel length	9.0–11.1	11.1±0.60
Maxillary barbel length	34.6–61.7	52.0±7.11
Inner mandibular barbel length	258.0–372.0	312.4±29.24
Outer mandibular barbel length	62.2–93.3	80.8±10.33
MERISTICS		
Dorsal-fin rays	II,7 (15)	
Anal-fin rays	iv,10 (1), v,8 (2) or v,9 (1)	
Pelvic-fin rays	i,5 (15)	
Pectoral-fin rays	I,8 (15)	
Caudal-fin rays	i,7,8,i (15)	
Branchiostegal rays	9 (15)	
Gill rakers	2+8 (1), 2+9 (4) or 2+10 (10)	
Vertebrae	23+24=47 (1), 23+25=48 (9), 24+24=48 (1), 24+25=49 (2) or 24+26=50 (2)	

5. Genital papilla in males not reaching anal-fin origin; upper lobe of caudal fin rounded posteriorly, principal ray not produced into a filament (Borneo).*H. bongan*
 – Genital papilla in males reaching anal-fin origin; upper lobe of caudal fin regularly tapering, principal ray produced into a filament (Sumatra). *H. velox*

Hemibagrus planiceps - Bleeker, 1862: 56, Pl. 71 (in part); Ferraris, 2007: 90.
Macrones planiceps - Steindachner, 1868: 1004; Koumans, 1940: 182.
Hemibagrus planiceps - Jordan & Seale, 1907: 536.
Mystus (Mystus) planiceps - Jayaram, 1966: 446.
Mystus planiceps - Roberts, 1989: 123; 1993: 30, Figs. 65–66.

***Hemibagrus planiceps* (Valenciennes, in Cuvier & Valenciennes, 1840)**

(Fig. 31)

Bagrus planiceps Valenciennes, in Cuvier & Valenciennes, 1840: 421 (type locality: Java); Bleeker, 1846a: 26; 1846b: 285; 1857b: 477; 1858a: 417; 1858e: 154 (in part); 1859g: 134 (in part); Ng et al., 1999: 38 (lectotype designation).
Bagrus anisurus Valenciennes, in Cuvier & Valenciennes, 1840: 422 (type locality: Java); Kottelat, 1999: 272 (lectotype designation).
Bagrus flavus Bleeker, 1846a: 28 (type locality: Batavia [=Jakarta], Java); 1846b: 285.

Material examined. — JAVA: BMNH 1870.6.7:11–13, 3 ex., 163.0–176.0 mm SL, Java; CAS 120505, 4 ex., 94.9–195.8 mm SL; MCZ 30421, 2 ex., 156.5–177.8 mm SL, USNM 72542, 1 ex., 206.2 mm SL, USNM 72543, 1 ex., 180.8 mm SL, ZMA 121.593, 3 ex., 67.5–124.7 mm SL, Jawa Barat: Bogor; MNHN B615, 1 ex., 97.9 mm SL, RMNH 2956, 1 ex., 283.0 mm SL (lectotype of *Bagrus anisurus*), RMNH 2939, 1 ex. 179.0 mm SL, USNM 62347, 2 ex., 85.9, 185.5 mm SL, Java. MZB 1117, 7 ex., 41.9–146.1 mm SL, Java: Jawa Barat, Bogor, Lolongok, Cisadane River; MZB 1119, 6 ex., 56.8–73.0 mm SL, Java: Jawa Barat, Bogor, Cisindang Barang River, Parakan Salak; MZB 1122, 3 ex., 31.3–98.6 mm SL, Jawa Barat: Empang Bogor, Cipakancilan River; MZB 1125, 1 ex., 140.5 mm SL, Bogor, Paku, Cikaniki River; MZB 1129, 3 ex., 88.0–93.0

mm SL, Jawa Barat: Bogor, Leuwiliang, Cianten River; MZB 1130, 6 ex., 44.1–69.0 mm SL, Jawa Barat: Bogor, Jayanti, Cikeas River; MZB 1132, 1 ex., 118.0 mm SL, Jawa: Jawa Barat, Bogor, Jasinga, Cidurian River; MZB 1472, 2 ex., 195.5–202.6 mm SL, Jawa: Jawa Barat, Bogor, Cibinong, Cikaret lake; MZB 1473, 1 ex., 192.1 mm SL, Bogor, Parung, Lebak Wangi lake; MZB 5555, 1 ex., 82.2 mm SL, Jawa: Jawa Barat, Bogor, Cipakancilan; MZB 9313, 4 ex., 198.0–216.0 mm SL, ZRC 42563, 9 ex., 171.0–263.0 mm SL, ZRC 43859, 1 ex., 113.0 mm SL, Jawa Barat: Garut, Cimanuk, Kampung Patro (7°10'52.7"S 107°56'13.1"E); RMNH 16745, 1 ex., 131.8 mm SL, Jawa Barat: Cisokan near Bukaduku; UMMZ 155719, 2 ex., 72.2, 152.9 mm SL, Jawa Barat: vicinity of Bogor; UMMZ 155720, 2 ex., 140.2, 167.7 mm SL, Jawa Barat: Ciliwung, Bogor Botanical Garden; ZMA 121.810, 1 ex., 107.3 mm SL, Jawa Barat: Garut; ZRC 44073, 2 ex., 43.5–102.9 mm SL, Jawa Barat, Kabupaten Sukabumi, Kecamatan Kadudampit, Sungai Cibogo.

Diagnosis. — *Hemibagrus planiceps* is distinguished from all other species of the *H. planiceps* species group in having relatively fewer vertebrae (47–49, mode=47 vs. 48–50, mode=49 for *H. bongan*; 51 for *H. divaricatus*; 50–52, mode=52 for both *H. gracilis* and *H. velox*; 49–50, mode=49 for *H. lacustrinus*) and a greater interorbital distance (32–37% HL vs. 28–34). It further differs from all other congeners in the group (except *H. lacustrinus* and *H. velox*) in having shorter maxillary barbels (148–220% HL vs. 199–283). *Hemibagrus planiceps* further differs from *H. divaricatus* in having a longer adipose-fin base (15.5–20.6% SL vs. 11.1–15.5) and shorter dorsal spine (8.2–12.4% SL vs. 12.3–12.9), and from *H. lacustrinus* in having a shorter pectoral spine (10.0–16.5% SL vs. 15.0–16.7), and a longer dorsal to adipose distance (12.0–17.3% SL vs. 7.6–10.9; adpressed dorsal fin not reaching vs. reaching origin of the adipose fin) It can be further distinguished from both *H. gracilis* and *H. velox* in having a deeper caudal peduncle (7.1–8.6% SL vs. 6.2–7.6), from *H. gracilis* in having a longer snout (33–40% HL vs. 30–35) and from *H. velox* in having a relatively shorter genital papilla in the males (not reaching anal-fin origin, vs. reaching), the upper lobe of the caudal fin rounded posteriorly (vs. upper lobe regularly tapering), and fewer branchiostegal rays (8–10 vs. 10–11).

Description. — Biometric and meristic data as in Table 18. General description as for genus. Head depressed and broad, body moderately compressed. Snout length 33–40% HL. Interorbital distance 32–37% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then



Fig. 31. *Hemibagrus planiceps*, ZRC 44073, 102.9 mm SL; Jawa: Sungai Cibogo.

sloping dorsally to end of caudal peduncle. Body depth at anus 11.3–14.7% SL. Adipose-fin base short, approximately as long as anal-fin base (15.5–20.6% SL); maximum height 2.5–5.2 times in length of base; separated from base of last dorsal-fin ray by distance of 12.0–17.3% SL. Dorsal spine stout, with 7–8 serrations on posterior edge; length 8.2–12.4% SL. Adpressed dorsal fin not reaching adipose-fin origin. Pectoral spine stout, with 14–16 large serrations on posterior edge; length 10.0–16.5% SL. Anal-fin origin slightly posterior to adipose-fin origin. Caudal-peduncle depth 7.1–8.6% SL. Caudal fin forked; upper lobe rounded posteriorly, lower lobe rounded posteriorly. Maxillary-barbel length 148–220% HL. Inner mandibular-barbel length 34–64. Vertebrae 47–49. Branchiostegal rays 8–10. Maximum recorded size 263 mm SL.

Males with elongate genital papilla reaching to origin of anal fin. Anus separated from genital appendages of both sexes by 4.5–6.8% SL.

Colour. — Dorsal surface of head and body uniform light grey to grey (live or freshly-dead specimens with yellowish hue, fading in preserved specimens); lateral line cream to yellow; ventral surface of head and body dirty white; adipose fin and fin rays of all fins grey; inter-radial membranes of all fins dirty yellow.

Distribution. — *Hemibagrus planiceps* is known only from the Ciantern, Cidurian, Cikeas, Ciliwung, Cimanuk, Cisokan, and Citarum River drainages in western Java (Fig. 32).

Remarks. — Considering the relative scarcity of *H. planiceps* in collections, it is not surprising to find other *Hemibagrus* species (in particular members of the *H. nemurus* species group) misidentified as *H. planiceps* in museum material. Our study shows that *H. planiceps* is restricted to Java. Material identified as *H. planiceps* from other areas in Southeast Asia belongs to distinct species: *H. gracilis* from eastern Peninsular Malaysia (Ng & Ng, 1995), *H. velox* from Sumatra (Ng &

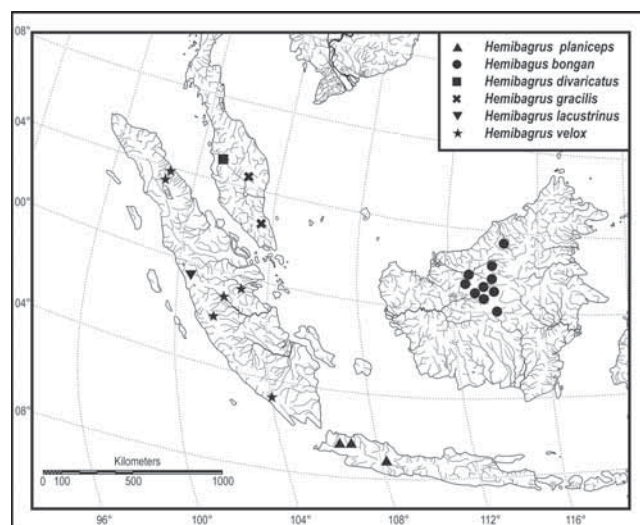


Fig. 32. Map showing collection localities of *Hemibagrus planiceps*, *H. bongan*, *H. divaricatus*, *H. gracilis*, *H. lacustrinus*, and *H. velox* specimens examined in this study.

Table 18. Biometric and meristic data for *H. planiceps* (n = 50).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	23.8–27.1	25.3±0.91
Head width	15.9–19.8	17.7±0.86
Head depth	10.0–14.9	12.0±1.07
Predorsal distance	34.9–39.1	36.9±1.24
Preanal length	64.8–71.6	67.7±2.02
Prepelvic length	45.4–55.8	49.9±2.49
Prepectoral length	20.5–27.3	23.2±1.63
Body depth at anus	11.3–14.7	12.8±0.79
Length of caudal peduncle	16.4–20.4	18.9±0.92
Depth of caudal peduncle	7.1–8.6	7.7±0.43
Pectoral-spine length	10.0–16.5	14.0±1.50
Pectoral-fin length	14.5–20.9	16.8±1.85
Length of dorsal fin	20.9–27.2	24.6±1.35
Length of dorsal-fin base	14.2–16.4	15.3±0.52
Dorsal-spine length	8.2–12.4	10.3±1.26
Pelvic-fin length	12.5–16.3	14.0±1.04
Length of anal-fin base	12.0–16.6	14.6±1.42
Caudal-fin length	16.6–24.3	20.1±1.74
Length of adipose-fin base	15.5–20.6	17.6±1.45
Maximum height of adipose fin	3.6–6.4	4.6±0.64
Dorsal to adipose distance	12.0–17.3	14.7±1.52
Post-adipose distance	14.4–17.7	16.3±0.98
In %HL:		
Snout length	33.2–39.8	37.6±1.44
Interorbital distance	32.2–37.3	35.1±1.35
Eye diameter	13.0–21.7	15.7±2.28
Nasal barbel length	25.4–37.3	31.9±3.61
Maxillary barbel length	147.5–220.1	191.5±21.96
Inner mandibular barbel length	33.8–63.7	46.8±5.95
Outer mandibular barbel length	71.1–95.8	80.9±7.98
MERISTICS		
Dorsal-fin rays	II,7 (50)	
Anal-fin rays	iii,8 (4), iii,9 (10), iv,7 (2), iv,8 (12), iv,9 (8), iv,10 (6) or iv,11 (8)	
Pelvic-fin rays	i,5 (50)	
Pectoral-fin rays	I,8 (16), I,8,i (6), I,9 (24) or I,9,i (4)	
Caudal-fin rays	i,7,8,i (50)	
Branchiostegal rays	8 (4), 9 (16), 10 (10), 11 (12) or 12 (6)	
Gill rakers	3+12 (4), 4+11 (4), 3+13 (4), 4+13 (13), 5+12 (17), 4+14 (4) or 5+13 (4)	
Vertebrae	24+23=47 (4), 25+22=47 (2), 24+24=48 (4), 25+23=48 (24) or 25+24=49 (16)	

Tan, 1999) and *H. bongan* from Borneo (Ng & Rachmatika, 1999). In the course of this study, we found that material from northwestern Peninsular Malaysia identified as *H. planiceps* represents an undescribed species, which is described here as *H. divaricatus*, new species.

The synonymy of *Bagrus flavus* with *H. planiceps* follows that of Bleeker (1858e) and Roberts (1989). There is no indication from available data that indicates otherwise (Ng et al., 1999), and we retain the synonymy of the two nominal species here.

***Hemibagrus bongan* (Popta, 1904)**
(Fig. 33)

Macrones bongan Popta, 1904: 182 (type locality: Borneo: Bongan [=Bungan] River); 1906: 35, Pl. 2 Fig. 5.

Bagrus planiceps (non Valenciennes, in Cuvier & Valenciennes, 1840) - Bleeker, 1860c: 18.
Hemibagrus planiceps (in part) - Bleeker, 1862: 56, Pl. 71.
Macrones planiceps (non Valenciennes, in Cuvier & Valenciennes, 1840) - Vaillant, 1902: 18.
Macrones nemurus (in part) - Weber & de Beaufort, 1913: 341.
Mystus planiceps (non Valenciennes, in Cuvier & Valenciennes, 1840) - Inger & Chin, 1962: 141, Fig. 71.
Mystus nemurus (in part) - Watson & Balon, 1984: 933.
Mystus nemurus (in part) - Roberts, 1989: 121.
Mystus cf. planiceps - Roberts, 1989: 123.
Hemibagrus cf. planiceps - Kottelat & Lim, 1995b: 238.
Hemibagrus bongan - Parenti & Lim, 2005: 189; Ferraris, 2007: 87.

Material examined. — BORNEO: Sarawak: ANSP 176572, 1 ex., 194.1 mm SL, Sungai Lawa, gravel area about 1.0km up from confluence with Batang Baram (3°30'N 114°27'E); CAS 55105, 5 ex., 104.5–187.1 mm SL, FMNH 68092, 13 ex., 74.0–211.0 mm SL, Third division, Baleh River, Sungai Putai camp, Sungai Dapu;

Table 19. Biometric and meristic data for *H. bongan* (n = 50).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	23.4–31.6	26.5±1.78
Head width	15.8–20.0	17.2±1.13
Head depth	10.2–14.8	11.5±1.24
Predorsal distance	36.1–43.1	38.3±1.75
Preanal length	65.0–71.0	68.2±1.54
Prepelvic length	45.5–54.1	48.6±2.25
Prepectoral length	20.6–28.3	23.8±2.14
Body depth at anus	9.5–12.9	11.1±0.96
Length of caudal peduncle	17.1–21.5	19.2±0.95
Depth of caudal peduncle	5.7–8.8	7.1±0.80
Pectoral-spine length	12.1–19.3	15.6±1.54
Pectoral-fin length	16.2–20.6	18.3±1.28
Length of dorsal fin	22.9–28.1	26.3±1.19
Length of dorsal-fin base	14.7–17.3	15.9±0.73
Dorsal-spine length	10.3–13.7	12.3±0.86
Pelvic-fin length	12.4–16.4	14.7±0.98
Length of anal-fin base	12.2–16.8	14.4±1.20
Caudal-fin length	18.3–25.3	21.0±1.85
Length of adipose-fin base	15.1–21.1	17.6±1.47
Maximum height of adipose fin	3.3–5.9	4.4±0.62
Dorsal to adipose distance	11.0–16.6	14.1±1.69
Post-adipose distance	15.2–18.6	16.8±0.76
In %HL:		
Snout length	33.4–41.1	36.8±2.04
Interorbital distance	28.1–34.0	30.8±1.37
Eye diameter	16.0–20.4	18.1±1.39
Nasal barbel length	29.0–46.7	38.0±4.90
Maxillary barbel length	199.4–283.0	243.4±20.16
Inner mandibular barbel length	33.8–88.4	56.0±9.83
Outer mandibular barbel length	69.6–115.0	94.4±9.09
MERISTICS		
Dorsal-fin rays	II,7 (50)	
Anal-fin rays	iii,8 (3), iii,9 (22), iii,10 (14), iii,11 (1), iv,8 (4), iv,9 (4) or iv,10 (2)	
Pelvic-fin rays	i,5 (50)	
Pectoral-fin rays	I,8 (8), I,8,i (30), I,9 (8) or I,9,i (4)	
Caudal-fin rays	i,7,8,i (50)	
Branchiostegal rays	10 (10), 11 (20) or 12 (20)	
Gill rakers	5+10 (7), 5+11 (11) or 5+12 (9)	
Vertebrae	24+24=48 (4), 25+23=48 (4), 24+25=49 (10), 25+24=49 (20), 26+23=49 (4) or 25+25=50 (8)	

FMNH 68063, 7 ex., 41.7–216.0 mm SL, Third division, headwaters of Baleh River, 1000–1700 ft; FMNH 68064, 1 ex., 201.5 mm SL, Third division, headwaters of Baleh River, Sungai Bunoh; FMNH 68084, 4 ex., 47.5–104.9 mm SL, Third division, tributary of Baleh River between Sungai Entunau and Sungai Putai; FMNH 68093, 4 ex., 72.1–161.4 mm SL, Third division, Baleh River Sungai Putai camp (1°48'N 113°45'E); FMNH 68411, 1 ex., 77.7 mm SL, Third division, headwaters of Baleh River; FMNH 68925, 18 ex., 44.1–109.3 mm SL, Third division, Kapit district, Mengiong River, Nanga Tekalit camp, tributary of Sungai Tekalit; FMNH 68931, 48 ex., 36.7–174.6 mm SL, Third division, Kapit district, Mengiong River, Nanga Tekalit camp, Sungai Satu; FMNH 96273, 1 ex., 46.0 mm SL, Sarawak; NRM 41295, 1 ex., 217.7 mm SL, Fourth division, Baram River drainage, Sungai Kaha about 200 m from mouth; USNM 324567, 1 ex., 158.7 mm SL, Batang Balui tributary stream, Jangan Aya flowing into Batang Besua; ZRC 40496, 1 ex., 152.8 mm SL, Kapit River.

BORNEO: Kalimantan Barat: RMNH 7548, 2 ex., syntypes, 60.4–128.2 mm SL, Bongon [Bungan]; MZB 9429, 1 ex., 120.72 mm SL, Kapuas River drainage, Sungai Embaloh drainage, Sungai Dajo; MZB 6545, 1 ex., 123.8 mm SL, Kapuas River drainage, Sungai Embaloh, near the mouth of Sungai Tekelan; MZB 9166, 2 ex., 97.6–111.5 mm SL, Kapuas River drainage, Sungai Embaloh; MZB 9428, 1 ex., 45.1 mm SL, Kapuas River drainage, Sungai Embaloh drainage, Sungai Pajau; MZB 9425, 1 ex., 77.0 mm SL, Kapuas River drainage, Sungai Embaloh drainage, Sungai Sebaya;



Fig. 33. *Hemibagrus bongan*, ZRC 43014, 174.9 mm SL, Borneo: Kalimantan Barat, Sungai Haloi.

MZB 9427, 1 ex., 78.3 mm SL, Kapuas River drainage, Sungai Embaloh drainage, Sungai Senentang; MZB 9437, 2 ex., 63.4–134.1 mm SL, Kapuas River drainage, Sungai Mendalam drainage, Sungai Jepala; MZB 9438, 7 ex., 56.6–153.5 mm SL, ZRC 43014, 2 ex., 152.4–174.9 mm SL, Kapuas River drainage, Sungai Mendalam drainage, Sungai Haloi; MZB 9436, 2 ex., 94.8–99.3 mm SL, Kapuas River drainage, Sungai Mendalam drainage, Sungai Menjulung; MZB 9439, 5 ex., 51.8–116.8 mm SL, Kapuas River drainage, Sungai Mendalam drainage, Sungai Mentibat; ZRC 43015, 1 ex., 205.0 mm SL, Kapuas River drainage, Sungai Mendalam drainage, Sungai Nyampi; MZB 9434, 3 ex., 99.4–162.0 mm SL, Kapuas River drainage, Sungai Mendalam drainage, Sungai Otang; MZB 9440, 3 ex., 60.6–165.7 mm SL, ZRC 43013, 1 ex., 100.1 mm SL, Kapuas River drainage, Sungai Mendalam drainage, Sungai Sebangkan Ke; MZB 7844, 1 ex., 91.7 mm SL, Kapuas River drainage, Sungai Putan; MZB 7715, 1 ex., 85.6 mm SL, Kapuas River drainage, Sungai Sibau drainage, Sungai Sekedam Besar; MZB 7958, 3 ex., 42.7–76.9 mm SL, Kapuas River drainage, Sungai Sibau; RMNH 7828, 1 ex., 144.3 mm SL, Kapuas River drainage, Raoen.

BORNEO: Kalimantan Tengah: BMNH 2001.1.15.180, 1 ex., 140.0 mm SL, Sungai Busang.

Diagnosis. — *Hemibagrus bongan* differs from *H. divaricatus* in having a longer adipose-fin base (15.1–21.1% SL vs. 11.1–15.5), a deeper adipose fin (maximum height 2.9–5.0 times in length of base vs. 1.9–3.2) and a larger eye (16–20% HL vs. 11–17), from *H. gracilis* in having a longer snout (33–41% HL vs. 30–35), and slightly fewer vertebrae (48–50, mode=49 vs. 50–52, mode=52), and from *H. lacustrinus* in having a more slender body (depth at anus 9.5–12.9 vs. 12.2–13.6), and a longer dorsal to adipose distance (11.0–16.6% SL vs. 7.6–10.9; adpressed dorsal fin not reaching vs. reaching origin of the adipose fin). It is distinguished from *H. planiceps* in having more vertebrae (48–50 mode=49 vs. 47–49, mode=47), a more slender body (depth at anus 9.5–12.9% SL vs. 11.3–14.7), a smaller interorbital distance (28–34% HL vs. 32–37) and longer maxillary barbels (199–283% HL vs. 148–220), and from *H. velox* in having fewer vertebrae (48–50, mode=49 vs. 50–52, mode=52), a relatively shorter genital papilla in the males (not reaching anal-fin origin, vs. reaching, Fig. 48) and the upper lobe of the caudal fin rounded posteriorly with principal ray not produced into a filament (vs. upper lobe regularly tapering with principal ray produced into a filament).

Description. — Biometric and meristic data as in Table 19. General description as for genus. Head depressed and broad, body moderately compressed. Snout length 33–41% HL. Interorbital distance 28–34% HL. Eye diameter 16–20% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Body depth at anus 9.5–12.9% SL. Adipose-fin base short, approximately as long as anal-fin base (15.1–21.1% SL); maximum height 2.9–5.0 times in length of base; separated from base of last dorsal-fin ray by distance of 11.0–16.6% SL. Dorsal spine stout, with 5–7 serrations on posterior edge; length 10.3–13.7% SL. Pectoral spine stout, with 13–22 large serrations on posterior edge; length 12.1–19.3% SL.

Adpressed dorsal fin not reaching adipose-fin origin. Anal-fin origin slightly posterior to adipose-fin origin. Caudal-peduncle depth 5.7–8.8% SL. Caudal fin forked; upper lobe tapering with principal ray not produced into a filament, lower lobe rounded posteriorly. Maxillary-barbel length 199–283% HL. Inner mandibular-barbel length 34–88% HL. Vertebrae 48–50. Branchiostegal rays 10–12. Maximum recorded size 218 mm SL.

Males with elongate genital papilla not reaching origin of anal fin. Anus separated from genital appendages of both sexes by 5.5–7.5% SL.

Colour. — Dorsal surface of head and body uniform light grey to grey (live or freshly-dead specimens with yellowish hue, fading in preserved specimens); lateral line cream to yellow; ventral surface of head and body dirty white; adipose fin and fin rays of all fins grey; inter-radial membranes of all fins dirty yellow.

Distribution. — Known from the Kapuas, Rejang, Baram and Barito River drainages in western and southern Borneo (Fig. 32).

Remarks. — The caption accompanying the photograph of one of the syntypes in Popta (1906: Pl. II, Fig. 5) lists the specimen as being 20 mm (TL). This is a typographical error, as the smaller syntype that the photograph illustrates is 60 mm SL (approx. 80 mm TL).

***Hemibagrus divaricatus* new species**
(Fig. 34)

Hemibagrus planiceps (non Valenciennes, in Cuvier & Valenciennes, 1840) - Sauvage, 1884: 219.

Mystus planiceps (non Valenciennes, in Cuvier & Valenciennes, 1840) - Herre & Myers, 1937: 68.

Mystus aff. *planiceps* - Zakaria-Ismail & Lim, 1995: 322, Pl. 4c.



Fig. 34. *Hemibagrus divaricatus*, ZRC 41151, holotype, 308.0 mm SL, Peninsular Malaysia: Sungai Perak.

Table 20. Biometric and meristic data for *H. divaricatus* (n = 6).

	Holotype	Range	Mean±SD
BIOMETRICS			
In %SL:			
Head length	26.6	26.6–30.6	28.5±1.80
Head width	19.4	17.0–19.4	18.3±0.91
Head depth	14.5	11.7–14.5	12.9±1.44
Predorsal distance	39.1	38.4–43.1	40.1±1.97
Preanal length	69.8	67.7–73.9	70.8±2.60
Prepelvic length	52.3	50.4–58.4	54.5±3.21
Prepectoral length	28.1	23.7–28.2	46.1±2.02
Body depth at anus	13.9	11.7–13.9	13.2±0.89
Length of caudal peduncle	19.3	15.5–20.7	18.1±2.43
Depth of caudal peduncle	7.7	7.3–8.0	7.6±0.26
Pectoral-spine length	damaged	16.9–17.0	17.0±0.07
Pectoral-fin length	damaged	17.1–19.2	18.4±0.95
Length of dorsal fin	25.1	24.3–26.1	25.1±0.70
Length of dorsal-fin base	15.3	14.8–15.9	15.3±0.48
Dorsal-spine length	damaged	12.3–12.9	12.6±0.42
Pelvic-fin length	14.4	13.3–14.4	13.9±0.39
Length of anal-fin base	13.4	12.9–15.2	13.9±0.86
Caudal-fin length	21.7	21.7–24.0	22.4±1.09
Length of adipose-fin base	13.4	11.1–15.5	13.0±1.70
Maximum height of adipose fin	4.9	4.2–5.9	4.8±0.68
Dorsal to adipose distance	16.9	14.0–17.6	16.1±1.41
Post-adipose distance	16.2	16.2–17.9	17.0±0.64
In %HL:			
Snout length	36.9	33.3–37.3	35.7±1.64
Interorbital distance	31.7	27.7–31.7	30.3±1.79
Eye diameter	11.4	11.4–17.3	15.3±2.32
Nasal barbel length	27.5	21.9–38.3	29.7±5.97
Maxillary barbel length	213.7	213.7–249.6	233.2±16.22
Inner mandibular barbel length	37.1	37.1–43.9	41.6±2.91
Outer mandibular barbel length	67.8	67.8–81.8	76.5±6.01
MERISTICS			
Dorsal-fin rays	II,7	II,7 (6)	
Anal-fin rays	iii,9	iii,9 (3) or iv,9 (3)	
Pelvic-fin rays	i,5	i,5 (6)	
Pectoral-fin rays	I,8	I,8 (2), I,9 (2) or I,10 (2)	
Caudal-fin rays	i,7,8,i	i,7,8,i (5) or i,8,8,i (1)	
Branchiostegal rays	12	10 (2), 11 (3) or 12 (1)	
Gill rakers	4+13	3+11 (2), 4+13 (3) or 4+14 (1)	
Vertebrae	26+25=51	25+26=51 (3) or 26+25=51 (3)	

Holotype. — ZRC 41151, 308.0 mm SL, Malaysia: Perak, Sungai Perak at Kampung Kenderong, 3 km from Gerik (5°24'52.5"N 101°9'5.1"E), coll. H. H. Ng et al., 21 Feb.1997.

Paratypes. — CAS 114179, 1 ex., 277.7 mm SL, Peninsular Malaysia: Perak, Chenderoh Dam, coll. A. W. Herre, 18–23 Mar.1937; CAS 114252, 1 ex., 262.0 mm SL, Peninsular Malaysia: Perak, Chenderoh Dam, coll. A. W. Herre, 19 Mar.1937; CAS 131002, 1 ex., 164.3 mm SL, Peninsular Malaysia: Perak, Plus River near Kuala Legap, coll. M. W. F. Tweedie, Mar.1933. MNHN 1884-96, 2 ex., 134.2, 205.0 mm SL, Peninsular Malaysia: Perak, Kinta River at Pengkalan Pegoh, coll. J. Errington de la Croix, date unknown.

Diagnosis. — *Hemibagrus divaricatus* differs from all congeners in this species group except *H. gracilis* and *H. velox* in having a shorter adipose-fin base (11.1–15.5% SL vs. 15.1–21.1); the adipose fin is also relatively deeper compared to all species except *H. planiceps* (maximum height 1.9–3.2

times in length of base vs. 2.9–6.0). It is distinguished from *H. gracilis* in having a deeper caudal peduncle (7.3–8.0% SL vs. 6.2–7.5) and a smaller eye (11–17% HL vs. 17–21), and from *H. velox* in having a deeper caudal peduncle (7.3–8.0% SL vs. 6.2–7.6) and shorter inner mandibular barbels (37–44% HL vs. 42–57). *Hemibagrus divaricatus* further differs from *H. bongan* in having a smaller eye (11–17% HL vs. 16–20), from *H. lacustrinus* in having a shorter adipose-fin base (11.1–15.5% SL vs. 18.8–20.4), a longer dorsal to adipose distance (15.4–17.6% SL vs. 7.6–10.9; adpressed dorsal fin not reaching vs. reaching origin of adipose fin), and smaller eye (11–17% HL vs. 17–19), and from *H. planiceps* in having a smaller interorbital distance (28–32% HL vs. 32–37), longer dorsal spine (12.3–12.9% SL vs. 8.3–11.7) and maxillary barbels (214–250% HL vs. 148–220).

Description. — Biometric and meristic data as in Table 20. General description as for genus. Head depressed and broad,

body moderately compressed. Snout length 33–37% SL. Interorbital distance 28–32% HL. Eye diameter 11–17% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Body depth at anus 11.7–13.9% SL. Adipose-fin base short, approximately as long as anal-fin base (11.1–15.5% SL); maximum height 1.9–3.2 times in length of base; separated from base of last dorsal-fin ray by distance of 4.0–17.6% SL. Dorsal spine stout, with 6–8 serrations on posterior edge; length 12.3–12.9% SL. Adpressed dorsal fin not reaching adipose-fin origin. Pectoral spine stout, with 22–23 large serrations on posterior edge; length 16.9–17.0% SL. Anal-fin origin slightly posterior to adipose-fin origin. Caudal-peduncle depth 7.3–8.0% SL. Caudal fin forked; upper lobe tapering with principal ray produced into a filament, lower lobe rounded posteriorly. Maxillary-barbel length 214–250% HL. Inner mandibular-barbel length 37–44% HL. Vertebrae 51. Branchiostegal rays 10–12. Maximum recorded size 308 mm SL.

Males with elongate genital papilla not reaching to origin of anal fin. Anus separated from genital appendages of both sexes by 5.2–7.6% SL.

Colour. — Dorsal surface of head and body uniform light grey to grey (live or freshly-dead specimens with yellowish hue, fading in preserved specimens); lateral line cream to yellow; ventral surface of head and body dirty white; adipose fin and fin rays of all fins grey; inter-radial membranes of all fins dirty yellow.

Etymology. — From the Latin *divaricatus*, meaning spread apart, in reference to the relatively large distance between the dorsal and adipose fins of this species.

Distribution. — Known from the Perak River drainage in western Peninsular Malaysia (Fig. 32).

***Hemibagrus gracilis* Ng & Ng, 1995**
(Fig. 35)

Hemibagrus gracilis Ng & Ng, 1995: 136, Figs. 1–3, 4A (type locality: Sungai Jasin, Endau drainage, Malaysia); Ng & Tan, 1999: 357; Ferraris, 2007: 88; Ng & Lim, 2008: 28, Fig. 22.

Macrones nemurus (non Valenciennes, in Cuvier & Valenciennes, 1840) - Duncker, 1904: 172.

Mystus planiceps (non Valenciennes, in Cuvier & Valenciennes, 1840) - Hora & Gupta, 1941: 27 (in part); Zakaria-Ismail, 1984: 25; 1987: 408; Kottelat *et al.*, 1993: 66 (in part); Jayaram & Sanyal, 2003: 96.

Mystus aff. *nemurus* - Lim, Kottelat & Ng, 1990: 316; Lim, Ng & Kottelat, 1990: 44.

Mystus aff. *planiceps* - Lim *et al.*, 1993: 6; Zakaria Ismail, 1993: 208, Pl. 5f.

Mystus cf. *planiceps* - Ng & Lim, 1994: 62.

Material examined. — PENINSULAR MALAYSIA: Johor: ZRC 21484, holotype, 247.0 mm SL; ZRC 21482, 21486–21487; 3 paratypes, 162.0–214.0 mm SL, Ulu Endau, Sungai Jasin.

PENINSULAR MALAYSIA: Pahang: ZRC 8294–8295, 2 paratypes, 236.0, 266.0 mm SL; ZRC 8757–8759, 3 paratypes, 230.0–277.0 mm SL, Rompin, Sungai Kinchin.; ZRC 8296, 1 paratype, 198.0 mm SL, Rompin, Sungai Kinchin at confluence of Sungai Selindang; ZRC 8726–8728, 3 paratypes, 182.0–264.0 mm SL, Rompin, Sungai Kernam (tributary of Sungai Kinchin); ZRC 8752–8753, 2 paratypes, 295.0–405.0 mm SL, Johor–Pahang border, Sungai Taku (tributary of Sungai Endau); FMNH 62308, 1 ex., 73.6 mm SL, King George V National Park; FMNH 62307, 1 ex., 179.7 mm SL, Sungai Tahan. ZRC 2436, 1 ex., 140.7 mm SL, Sungai Lumpat; ZRC 2438, 1 ex., 113.0 mm SL, Kuala Tahan; ZRC 3233, 1 ex., 69.0 mm SL, 0.5 mile up Sungai Tahan; ZRC 2422, 1 ex., 113.0 mm SL, Ulu Jelai; ZRC 42629, 1 ex., 260.5 mm SL, Sungai Kinchin near mouth of Sungai Kernam.

Diagnosis. — *Hemibagrus gracilis* differs from *H. bongan* in having a shorter snout (30–35% HL vs. 33–41), and more vertebrae (50–52, mode=52 vs. 48–50, mode=49), from *H. divaricatus* in having a deeper adipose fin (maximum height 2.9–4.3 times in length of base vs. 1.9–3.2), a more slender caudal peduncle (depth 6.2–7.6% SL vs. 7.3–8.0) and a larger eye (17–21% HL vs. 11–17), and from *H. lacustrinus* in having a longer dorsal to adipose distance (10.6–16.8% SL vs. 7.6–10.9; adpressed dorsal fin reaching vs. not reaching origin of adipose fin), a more slender caudal peduncle (depth 6.2–7.6% SL vs. 7.3–8.1) and more vertebrae (50–52, mode=52 vs. 49–50, mode=49). It is distinguished from *H. planiceps* in having more vertebrae (50–52, mode=52 vs. 47–49, mode=47), a more slender caudal peduncle (depth 6.2–7.6% SL vs. 7.1–8.6), a shorter snout (30–35% HL vs. 33–40) and longer maxillary barbels (216–278% HL vs. 148–220), and from *H. velox* in having a relatively shorter genital papilla in the males (not reaching anal-fin origin, vs. reaching), the genital papilla located further away from the anus (anus separated from genital papilla by a distance of 5.4–7.6% SL vs. 4.3–5.9) and regular (vs. irregular) serrations on the posterior edge of the dorsal spine.

Description. — Biometric and meristic data as in Table 21. General description as for genus. Head depressed and broad, body moderately compressed. Snout length 30–35% HL. Interorbital distance 29–34% HL. Eye diameter 17–21% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Body depth at anus 8.4–13.5% SL. Adipose-fin base short, approximately as long as anal-fin base (13.5–17.4% SL); maximum height 2.9–4.3 times in length of base; separated from base of last dorsal-fin ray by distance of 10.6–16.8% SL. Dorsal spine stout, with 0–9 serrations on posterior edge; length 8.6–13.5% SL. Adpressed dorsal fin not reaching adipose-fin origin. Pectoral spine stout, with 12–23 large



Fig. 35. *Hemibagrus gracilis*, ZRC 21484, holotype, 247.0 mm SL, Peninsular Malaysia: Sungai Jasin.

Table 21. Biometric and meristic data for *H. gracilis* (n = 22).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	24.3–30.5	26.6±1.54
Head width	16.5–19.8	17.8±0.96
Head depth	10.1–13.4	11.5±1.04
Predorsal distance	34.7–41.0	37.6±1.38
Preanal length	64.0–73.5	67.2±2.57
Prepelvic length	45.6–54.0	49.1±2.40
Prepectoral length	21.7–30.3	24.1±2.11
Body depth at anus	8.4–13.5	11.6±1.27
Length of caudal peduncle	16.5–20.5	18.3±1.17
Depth of caudal peduncle	6.2–7.6	6.8±0.40
Pectoral-spine length	14.5–17.0	16.2±0.69
Pectoral-fin length	16.5–19.2	18.2±0.83
Length of dorsal fin	22.4–30.6	25.5±1.88
Length of dorsal-fin base	13.5–16.9	15.1±0.95
Dorsal-spine length	8.6–13.5	11.8±1.16
Pelvic-fin length	11.4–14.9	13.7±0.92
Length of anal-fin base	12.0–15.2	13.4±0.90
Caudal-fin length	18.7–22.5	20.6±1.21
Length of adipose-fin base	13.5–17.4	15.8±1.23
Maximum height of adipose fin	3.8–5.2	4.4±0.42
Dorsal to adipose distance	10.6–16.8	13.7±2.03
Post-adipose distance	15.4–19.5	16.9±1.12
In %HL:		
Snout length	29.9–34.8	31.9±1.47
Interorbital distance	28.9–34.3	30.8±1.65
Eye diameter	16.8–21.4	18.5±1.40
Nasal barbel length	22.2–46.6	36.4±5.89
Maxillary barbel length	216.1–277.7	247.2±17.20
Inner mandibular barbel length	37.5–53.3	45.5±3.63
Outer mandibular barbel length	69.3–91.9	81.1±6.66
MERISTICS		
Dorsal-fin rays	II,7 (22)	
Anal-fin rays	iii,9 (9), iv,8 (7) or iv,9 (6)	
Pelvic-fin rays	i,5 (22)	
Pectoral-fin rays	I,8 (4), I,8,i (6) or I,9 (12)	
Caudal-fin rays	i,7,8,i (22)	
Branchiostegal rays	10 (13), 11 (6) or 12 (3)	
Gill rakers	3+11 (2), 4+10 (6), 4+13 (2), 5+12 (2), 4+14 (2), 5+14 (6) or 6+13 (2)	
Vertebrae	24+26=50 (4), 25+25=50 (6), 25+26=51 (10) or 26+25=51 (2)	

serrations on posterior edge; length 14.5–17.0% SL. Anal-fin origin slightly posterior to adipose origin. Caudal-peduncle depth 6.2–7.6% SL. Caudal fin forked; upper lobe tapering with principal ray produced into a filament, lower lobe rounded posteriorly. Maxillary-barbel length 216–278% HL. Inner mandibular-barbel length 38–53% HL. Vertebrae 50–52. Branchiostegal rays 10–11. Maximum recorded size 405 mm SL.

Males with elongate genital papilla not reaching to origin of anal fin. Anus separated from genital appendages of both sexes by 5.4–7.6% SL.

Colour. — Dorsal surface of head and body uniform light grey to grey (live or freshly-dead specimens with yellowish hue, fading in preserved specimens); lateral line cream to yellow; ventral surface of head and body dirty white; adipose

fin and fin rays of all fins grey; inter-radial membranes of all fins dirty yellow.

Distribution. — Known from the Endau and Pahang River drainages in eastern Peninsular Malaysia (Fig. 32).

Hemibagrus lacustrinus new species

(Fig. 36)

Macrones planiceps (non Valenciennes, in Cuvier & Valenciennes, 1840) - Weber and de Beaufort 1913: 342–343 (in part).

Hemibagrus velox (non Tan & Ng, 2000) - Tan & Ng, 2000: 272 (in part).

Holotype. — MZB 17183, 135.3 mm SL, Sumatra: Sumatera Barat, Hulu Batang Ombilin, coll. D. Roesma, 2007.

Paratypes. — CMK 4625, 3 ex., 78.1–143.0 mm SL, Sumatra: Sumatera Barat, market at Solok, coll. P. G. Bianco & M. Kottelat, 4 Dec.1984; UMMZ 243355, 1 ex., 122.8 mm SL, Sumatra: Sumatera Barat, market at Solok, 0°48'S 100°39'E, coll. H.H. Ng et al., 16 Dec.2003; UMMZ 155684, 2 ex., 183.7, 194.8 mm SL, Sumatra: Sumatera Barat, Danau Singkarak, coll. A. Thienemann, 23 Feb.1929; ZMA 121.812, 2 ex., 179.8–223.2 mm SL, Sumatra: Sumatera Barat, Danau Singkarak; ZRC 51974, 1 ex., 155.5 mm SL; data as for holotype.

Diagnosis. — *Hemibagrus lacustrinus* differs from all members of the *H. planiceps* species group in having a shorter dorsal to adipose distance (7.6–10.9% SL vs. 10.6–17.6; adpressed dorsal fin reaching vs. not reaching the origin of the adipose fin) and (except for *H. bongan* and *H. planiceps*) a longer adipose-fin base (18.8–20.4% SL vs. 11.1–17.9). It is further distinguished from *H. bongan* in having a deeper body (depth at anus 12.2–13.6% SL vs. 9.5–12.9), and from *H. divaricatus* in having a deeper adipose fin (maximum height 4.1–6.0 times in length of base vs. 1.9–3.2) and larger eye (17–19% HL vs. 11–17). *Hemibagrus lacustrinus* further differs from *H. gracilis* in having a deeper caudal peduncle (7.3–8.1% SL vs. 6.2–7.6) and slightly fewer vertebrae (49–50, mode=49 vs. 50–52, mode=52) and *H. planiceps* in having a smaller interorbital distance (30–32% HL vs. 32–37) and slightly more vertebrae (49–50, mode=49 vs. 47–49, mode=47).

Description. — Biometric and meristic data as in Table 22. General description as for genus. Head depressed and broad, body moderately compressed. Snout length 33–38% HL. Interorbital distance 30–32% HL. Eye diameter 17–19% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Body depth at anus 12.2–13.6% SL. Adipose-fin base short,



Fig. 36. *Hemibagrus lacustrinus*, MZB 17183, holotype, 135.3 mm SL, Sumatra: Hulu Batang Ombilin.

approximately as long as anal-fin base (18.8–20.4% SL); maximum height 4.1–6.0 times in length of base; separated from base of last dorsal-fin ray by distance of 7.6–10.9% SL. Dorsal spine stout, with 2–3 serrations on posterior edge; length 10.7–12.6% SL. Adpressed dorsal fin not reaching adipose-fin origin. Pectoral spine stout, with 8–13 large serrations on posterior edge; length 15.0–16.7% SL. Anal-fin origin slightly posterior to adipose origin. Caudal-peduncle depth 7.3–8.1% SL. Caudal fin forked; upper lobe tapering with principal ray produced into a filament, lower lobe rounded posteriorly. Maxillary-barbel length 141–247% HL. Inner mandibular-barbel length 42–52% HL. Vertebrae 49–50. Branchiostegal rays 10. Maximum recorded size 223 mm SL.

Males with elongate genital papilla reaching to origin of anal fin. Anus separated from genital appendages of both sexes by 4.1–7.9% SL.

Colour. — Dorsal surface of head and body uniform grey or dark grey (becoming dark brownish on preservation); lateral line paler; ventral surface of head and body dirty white; adipose fin and fin rays of all fins grey; inter-radial membranes of all fins dirty yellow.

Etymology. — From the Latin *lacustrinus*, meaning of a lake, in reference to the primary habitat of this species (a tectonic lake).

Distribution. — Known only from Danau Singkarak, a lake in central west Sumatra; this species is also found in the upper Ombilin River, which is a natural outflow of the lake (Fig. 32).

Habitat. — Danau Singkarak is a relatively deep (maximum depth 286 m) tectonic lake with a surface area of 107.8 square kilometres located on the Barisan range in western Sumatra (Verstappen, 1961; Zen, 1971). The microhabitats in the lake that the catfish occupies are not known, but it is believed that this species inhabits the inshore areas of the lake. The upper Ombilin River where this catfish occurs is relatively swift flowing, with a substrate of gravel and rock.

Remarks. — *Hemibagrus lacustrinus* is found sympatrically with *H. velox*: nearly all the paratypes of *H. lacustrinus* (except for ZRC 51974) have been misidentified by Tan & Ng (2000) as *H. velox*. As given in the diagnosis, *H. lacustrinus* differs from *H. velox* in having a shorter dorsal to adipose distance (7.6–10.9% SL vs. 13.2–17.5; adpressed dorsal fin reaching vs. not reaching the origin of the adipose fin) and a longer adipose-fin base (18.8–20.4% SL vs. 13.0–17.9). It is also distinguished from *H. velox* by the darker colouration of the head and body. However, given the paucity of material of this species, it is premature to conclude that this is a useful diagnostic character, since in our experience, the colour of *Hemibagrus* may vary greatly depending on water conditions and type of substrate.

Table 22. Biometric and meristic data for *H. lacustrinus* (n = 5).

	Holotype	Range	Mean±SD
BIOMETRICS			
In %SL:			
Head length	26.3	26.3–29.1	27.3±1.18
Head width	17.5	17.5–20.5	19.0±1.20
Head depth	10.6	10.6–15.2	12.8±2.08
Predorsal distance	38.0	37.1–39.0	37.9±0.74
Preanal length	69.4	68.2–69.5	39.0±0.51
Prepelvic length	51.5	49.9–54.8	52.2±1.79
Prepectoral length	22.2	22.2–27.7	25.2±2.39
Body depth at anus	13.5	12.2–13.6	13.1±0.57
Length of caudal peduncle	19.1	17.8–20.0	19.1±0.87
Depth of caudal peduncle	7.9	7.3–8.1	7.8±0.31
Pectoral-spine length	15.9	15.0–16.7	15.8±0.73
Pectoral-fin length	19.1	17.0–19.1	18.2±0.87
Length of dorsal fin	27.3	22.5–27.7	24.9±2.43
Length of dorsal-fin base	17.1	16.1–17.2	16.7±0.45
Dorsal-spine length	12.6	10.7–12.6	11.9±0.74
Pelvic-fin length	14.6	13.5–15.9	14.5±0.97
Length of anal-fin base	13.8	13.3–15.8	14.2±1.02
Caudal-fin length	21.4	18.8–22.6	20.3±1.64
Length of adipose-fin base	19.7	18.8–20.4	19.7±0.67
Maximum height of adipose fin	4.8	3.4–4.8	4.1±0.55
Dorsal to adipose distance	10.4	7.6–10.9	9.4±1.31
Post-adipose distance	15.4	15.2–17.8	16.4±1.15
In %HL:			
Snout length	36.0	32.7–37.5	35.9±1.94
Interorbital distance	29.8	29.6–31.9	30.7±1.03
Eye diameter	18.8	16.8–19.1	18.2±1.00
Nasal barbel length	33.7	32.7–39.4	34.7±2.70
Maxillary barbel length	230.9	140.5–247.2	199.1±43.18
Inner mandibular barbel length	50.8	42.2–51.8	47.9±4.31
Outer mandibular barbel length	90.2	71.8–90.2	82.3±7.66
MERISTICS			
Dorsal-fin rays	II,7	II,7 (5)	
Anal-fin rays	iv,8	iv,8 (4) or iv,9 (1)	
Pelvic-fin rays	i,5	i,5 (5)	
Pectoral-fin rays	I,8	I,8 (4) or I,9 (1)	
Caudal-fin rays	i,7,8,i	i,7,8,i (5)	
Branchiostegal rays	10	10 (5)	
Gill rakers	5+12	5+12 (1), 5+15 (3) or 6+14 (1)	
Vertebrae	24+26	23+26=49 (1), 25+24=49 (1) or 24+26=50 (2)	

***Hemibagrus velox* Tan & Ng, 2000**

(Fig. 37)

Hemibagrus velox Tan & Ng, 2000: 272, Figs. 2–4 (type locality: Sungai Dareh, Sumatra); Ferraris, 2007: 91; Ng & Lim, 2008: 30.

Bagrus planiceps (non Valenciennes, in Cuvier & Valenciennes, 1840) - Bleeker, 1855c: 260; 1857a: 25; 1858e: 154 (in part); 1859a: 338; 1859b: 339; 1859g: 134 (in part); 1860a: 8, 46.

Hemibagrus planiceps (non Valenciennes, in Cuvier & Valenciennes, 1840) - Bleeker, 1862: 56, Pl. 71 (in part); Hubrecht, 1887: 11.

Macrones planiceps (non Valenciennes, in Cuvier & Valenciennes, 1840) - Günther, 1864: 81 (in part); Boulenger, 1890: 39; Weber, 1894: 420; Volz, 1904: 468; 1907: 166–167; Weber and de Beaufort 1913: 342–343 (in part); Regan, 1920: 308.

Mystus planiceps (non Valenciennes, in Cuvier & Valenciennes, 1840) - Kottelat *et al.*, 1993: 66 (in part).

Material examined. — SUMATRA: Sumatera Utara: BMNH 1889.11.12:61, 1 ex., 224.0 mm SL, Medan; CMK 4441, 1 ex., 187.4 mm SL, CMK 4455, 1 ex., 75.3 mm SL, Sungai Seruai at Biru Biru; MCZ 57967, 1 ex., 128.4 mm SL, Boharok River about 1 km from Bukit Lawang; ZMA 121.813, 1 ex., 129.0 mm SL, Serdang, Sungai Ular.

SUMATRA: Riau: CMK 9038, 1 paratype, 132.3 mm SL, Kecamatan Seberida, Sungai Gangsal.

SUMATRA: Sumatera Barat: MZB 9305, holotype, 175.0 mm SL; ZRC 41505, 23 paratypes, 68.7–162 mm SL; UMMZ 243334, 6 ex.,



Fig. 37. *Hemibagrus velox*, UMMZ 243334, 174.3 mm SL; Sumatra: Sungai Dareh.

Table 23. Biometric and meristic data for *H. velox* (n = 40).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	24.3–28.3	25.6±1.12
Head width	16.1–19.6	17.7±1.20
Head depth	10.2–14.4	12.0±1.27
Predorsal distance	35.4–39.6	37.8±1.62
Preanal length	66.1–69.6	67.8±1.14
Prepelvic length	47.0–55.5	51.1±2.39
Prepectoral length	20.5–27.7	23.8±1.89
Body depth at anus	10.2–13.8	11.7±1.19
Length of caudal peduncle	17.8–20.8	19.0±0.95
Depth of caudal peduncle	6.2–7.5	7.0±0.35
Pectoral-spine length	15.3–17.6	16.6±0.84
Pectoral-fin length	15.8–20.2	17.9±1.55
Length of dorsal fin	22.6–27.6	25.4±1.36
Length of dorsal-fin base	13.6–16.6	15.4±0.90
Dorsal-spine length	10.0–14.3	11.9±1.54
Pelvic-fin length	11.7–15.7	14.3±1.19
Length of anal-fin base	12.5–16.0	14.4±0.99
Caudal-fin length	19.2–25.3	21.5±1.75
Length of adipose-fin base	13.0–17.9	15.7±1.74
Maximum height of adipose fin	3.0–5.1	4.3±0.53
Dorsal to adipose distance	13.2–17.5	15.7±1.45
Post-adipose distance	14.3–20.8	16.6±1.78
In %HL:		
Snout length	33.3–38.9	36.2±1.79
Interorbital distance	29.4–3.9	32.2±1.46
Eye diameter	13.9–23.6	18.1±3.25
Nasal barbel length	25.6–43.1	33.7±4.64
Maxillary barbel length	185.7–250.5	220.8±16.42
Inner mandibular barbel length	41.6–56.9	48.6±4.84
Outer mandibular barbel length	70.9–106.4	81.3±9.50
MERISTICS		
Dorsal-fin rays	II,7 (39) or II,8 (1)	
Anal-fin rays	ii,9 (3), iii,9 (21), iv,8 (4), iii,9,i (3), ii,10 (3) or iii,10 (6)	
Pelvic-fin rays	i,5 (40)	
Pectoral-fin rays	I,8 (3), I,8,i (28) or I,9 (9)	
Caudal-fin rays	i,7,8,i (40)	
Branchiostegal rays	10 (19) or 11 (21)	
Gill rakers	4+11 (3), 4+13 (3), 5+10 (3), 5+12 (11) or 5+13 (20)	
Vertebrae	25+25=50 (1), 25+26=51 (3), 26+25=51 (15), 26+26=52 (16) or 27+25=52 (5)	

44.1–208.2 mm SL, Sungai Dareh, Pulau Punjung market. ZMA 121.627, 5 paratypes, 162.0–185.0 mm SL, highlands of Padang, Batang Pangian. ZMA 121.628, 3 paratypes, 238.0–357.0 mm SL, highlands of Padang, Batang Pangian, from the cave of Buo. ZMA 121.629, 1 paratype, 264.0 mm SL, highlands of Padang, Batang Sario near Puntian (Kumanis). UMMZ 243333, 5 ex., 114.6–234.6 mm SL, market at Kiliranjao.

SUMATRA: Jambi: ZRC 40549, 1 paratype, 269.0 mm SL; ZRC 40550, 2 paratypes, 236.0, 249.0 mm SL; ZRC 41503, 3 paratypes, 145.2–199.0 mm SL, Kerinci, Sungaipenuh market. BMNH 1915.8.24:12, 1 ex., 212.0 mm SL, Lake Kerinci.

SUMATRA: Sumatera Selatan: UMMZ 155685, 4 paratypes, 191.4–263.6 mm SL, UMMZ 155717, 2 paratypes, 240.3–276.9 mm SL; UMMZ 155718, 3 paratypes, 261.8–277.0 mm SL, Danau Ranau.

Diagnosis. — *Hemibagrus velox* differs from *H. bongan* in having slightly more vertebrae (50–52, mode=52 vs. 48–50, mode=49), a relatively longer genital papilla in the males (reaching anal-fin origin, vs. not reaching), and the upper lobe of the caudal fin regularly tapering with principal ray produced into a filament (vs. upper lobe rounded posteriorly with principal ray not produced into a filament), from *H. divaricatus* in having a deeper adipose fin (maximum height 3.1–4.4 times in length of base vs. 1.9–3.2), a more slender caudal peduncle (6.2–7.5% SL vs. 7.3–8.0) and longer inner mandibular barbels (42–57% HL vs. 37–44), and from *H. gracilis* in having a relatively longer genital papilla in the males (reaching anal-fin origin, vs. not reaching), the genital papilla located nearer the anus (anus separated from genital papilla by a distance of 4.3–5.9% SL vs. 5.4–7.6) and irregular (vs. regular) serrations on the posterior edge of the dorsal spine. It is distinguished from *H. lacustrinus* in having a

longer dorsal to adipose distance (13.2–17.5% SL vs. 7.6–10.9; adpressed dorsal fin not reaching vs. reaching origin of the adipose fin) and a shorter adipose-fin base (13.0–17.9% SL vs. 18.8–20.4), and from *H. planiceps* in having more vertebrae (50–52, mode=52 vs. 47–49, mode=47), a relatively longer genital papilla in the males (reaching anal-fin origin, vs. not reaching), the upper lobe of the caudal fin regularly tapering (vs. rounded posteriorly), and more branchiostegal rays (10–11 vs. 8–10).

Description. — Biometric and meristic data as in Table 23. General description as for genus. Head depressed and broad, body moderately compressed. Snout length 33–39% HL. Interorbital distance 29–34% HL. Eye diameter 14–24% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose-fin base short, approximately as long as anal-fin base (13.0–17.9% SL); maximum height 3.1–4.4 times in length of base; separated from base of last dorsal-fin ray by distance of 13.2–17.5% SL. Dorsal spine stout, with 0–9 irregular serrations on posterior edge; length 10.0–14.3% SL. Adpressed dorsal fin not reaching adipose-fin origin. Pectoral spine stout, with 12–23 large serrations on posterior edge; length 15.3–17.6% SL. Anal-fin origin slightly posterior to adipose-fin origin. Caudal-peduncle depth 6.2–7.5% SL. Caudal fin forked; upper lobe tapering with principal ray produced into a filament, lower lobe rounded posteriorly. Maxillary-barbel length 186–251% HL. Inner mandibular-barbel length 42–57% HL. Vertebrae 50–52. Branchiostegal rays . Maximum recorded size 357 mm SL.

Males with elongate genital papilla reaching to origin of anal fin. Anus separated from genital appendages of both sexes by 4.3–5.9% SL.

Colour. — Dorsal surface of head and body uniform light grey to grey (live or freshly-dead specimens with yellowish hue, fading in preserved specimens); lateral line cream to yellow; ventral surface of head and body dirty white; adipose fin and fin rays of all fins grey; inter-radial membranes of all fins dirty yellow.

Distribution. — Known from the Batang Hari, Deli, Indragiri, and Musi River drainages in Sumatra (Fig. 32).

Habitat. — *Hemibagrus velox* is known primarily from large, swift-flowing rivers with a substrate composed predominantly of gravel and rock, although it has also been found in some of the large volcanic lakes (excluding Danau Singkarak) in the Barisan range in western Sumatra.

HEMIBAGRUS PLURIRADIATUS SPECIES GROUP

Artificial key to the members of the *H. pluriradiatus* species group

1. Body grey; length of adipose-fin base 38–44% SL; sensory pores large, arranged in vertical columns along sides of body,

- visible to naked eye (Myanmar and western Thailand)
.....*H. imbrifer*
- Body brown; length of adipose-fin base 28–39% SL; sensory pores small, not visible to naked eye.....2
- 2. Post-adipose distance 13–14% SL body mottled brown (southern Myanmar)*H. variegatus*
- Post-adipose distance 9–12% SL body uniform brown.....3
- 3. Dorsal to adipose distance 10% SL (Hainan Island).....
.....*H. hainanensis*
- Dorsal to adipose distance 0–9% SL4
- 4. Adipose fin in contact with dorsal fin; interorbital distance 28–31% HL (southern China, northern Vietnam and Laos).....
.....*H. pluriradiatus*
- Adipose fin separated from dorsal fin by 6–9% SL; interorbital distance 31–34% HL (central Vietnam).....*H. centralus*

Hemibagrus pluriradiatus (Vallant, 1892)

(Fig. 38)

Macrones pluriradiatus Vaillant, 1892: 126 (type locality: Nam-Tiong-Kong, a small tributary of Song Da, Lai Chau province, northern Vietnam); Vaillant, 1904: 462, Pl. 23 Fig. 2 (additional locality information: area of Lai-Chau or Muong-Lai: Nam-Tiong Kong, a stream whose source is near Na-Ho village, first left-hand tributary of Nam Ma on which Pou-Fang [22°18'N 100°06'E] is located); Chu, 1986: 131, Fig. 87.

Mystus pluriradiatus - Jayaram, 1954: 555; 1978: 226, Fig. 1; Cheng & Zheng, 1987: 217, Fig. 1089; Cui, 1990: 165, Fig. 169; Gao, 1990: 316, Fig. 191; Zheng & Dai, 1999: 70, Fig. 34 (in part); Zhou et al., 1999: 117; Jayaram & Sanyal, 2003: 97, Fig. 21; Yang & Zhang, 2006: 416, Fig. II-238.

Mystus (Mystus) pluriradiatus - Jayaram, 1966: 446.

Mystus planiceps (in part) - Desoutter, 1975: 451.

Hemibagrus pluriradiatus - Mo, 1991: 132; Kottelat, 2001a: 51, Fig. 103 (Figure mislabelled *Pelteobagrus pluriradiatus*); 2001b: 122, Fig. 330; Ferraris, 2007: 90.

(?) *Hemibagrus chiemhaoensis* Nguyễn, 2005: 627, Fig. 46 (type locality: Gam River, Chiem Hoa district, Tuyen Quang province)

(?) *Hemibagrus songdaensis* Nguyễn, 2005: 629, Fig. 47 (type locality: Van Yen, Yen Chau, Son La province)

(?) *Hemibagrus taybacensis* Nguyễn, 2005: 625, Fig. 45 (type locality: Lai Chau)

Material examined. — CHINA: ZRC 54068, 1 ex., 90.0 mm SL, Guangxi province: Napo county, market at Baihe. VIETNAM: MNHN 1892–48, holotype, 155.6 mm SL, Lai Chau province: Nam-Tiong-Kong, a small tributary of Song Da; AMNH 211146, 3 ex., 110.1–149.4 mm SL, Ha Giang province: Duc River, Thanh Thuy village at Chinese border; AMNH 211251, 4 ex., 78.5–146.5 mm SL, Ha Giang province: Ha Giang fish markets; AMNH 211252, 2 ex., 117.0–122.0 mm SL, Ha Giang province: Vi Xuyen district, Bac Trao River at big bridge downstream from camp 1 in broad pools.



Fig. 38. *Hemibagrus pluriradiatus*, CMK 15305, 140.8 mm SL; Laos: Houay Taungoua.

Table 24. Biometric and meristic data for *H. pluriradiatus* (n = 12).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	26.3–29.0	27.4±0.82
Head width	17.1–19.4	18.3±0.72
Head depth	11.4–13.5	12.5±0.63
Predorsal distance	36.6–40.2	38.6±1.11
Preanal length	66.9–72.2	69.2±1.64
Prepelvic length	49.1–55.5	50.9±1.91
Prepectoral length	20.9–26.3	23.7±1.64
Body depth at anus	11.4–14.3	13.1±0.88
Length of caudal peduncle	17.8–21.2	19.4±0.95
Depth of caudal peduncle	7.6–9.0	8.2±0.49
Pectoral-spine length	11.4–14.6	12.9±0.84
Pectoral-fin length	15.4–19.4	17.1±1.11
Length of dorsal fin	20.8–25.9	24.3±1.55
Length of dorsal-fin base	13.3–18.2	16.1±1.24
Dorsal-spine length	11.1–15.5	13.6±1.09
Pelvic-fin length	13.8–16.8	15.7±0.87
Length of anal-fin base	11.2–13.6	12.4±0.74
Caudal-fin length	22.9–28.0	25.8±1.60
Length of adipose-fin base	35.3–39.2	37.2±1.38
Maximum height of adipose fin	3.6–5.8	5.2±0.63
Post-adipose distance	9.1–10.9	10.1±0.58
In %HL:		
Snout length	35.6–39.6	37.7±1.47
Interorbital distance	28.2–30.6	29.6±0.80
Eye diameter	14.4–20.7	17.4±1.82
Nasal barbel length	25.4–49.5	40.6±6.56
Maxillary barbel length	171.6–270.7	243.8±27.10
Inner mandibular barbel length	36.3–59.5	48.8±6.04
Outer mandibular barbel length	67.8–103.6	86.2±10.40
MERISTICS		
Dorsal-fin rays	II,7 (11) or II,8 (1)	
Anal-fin rays	iii,8 (1), iv,8 (10) or iv,9 (1)	
Pelvic-fin rays	i,5 (12);	
Pectoral-fin rays	I,9 (10), I,9,i (1) or I,10 (1)	
Caudal-fin rays	i,7,8,i (12)	
Branchiostegal rays	9 (1), 11 (1) or 12 (1)	
Gill rakers	4+12 (12)	
Vertebrae	25+22=47 (1), 25+23=48 (2), 26+22=48 (6), 26+23=49 (1), 27+22=49 (1) or 27+23=50 (1)	

LAOS: CMK 15305, 2 ex., 140.8–161.4 mm SL, Houaphan province: Houay Taungoua, small stream entering Nam Xam in Ban Houataungoua.

Diagnosis. — *Hemibagrus pluriradiatus* differs from *H. centralus* in having the adipose fin in contact with the base of the last dorsal-fin ray (vs. separated by a distance of 5.8–8.5% SL) and smaller interorbital distance (28–31% HL vs. 31–34), from *H. hainanensis* in having the adipose fin in contact with the base of the last dorsal-fin ray (vs. separated by a distance of 10.1–10.4% SL) and a larger eye (diameter 14–21% HL vs. 13–14), from *H. imbrifer* in having a brown (vs. grey) body in life, a shorter adipose-fin base (35.3–39.2% SL vs. 38.4–44.2), and sensory pores on body not easily visible (vs. relatively large sensory pores arranged in vertical columns along the sides of the body), and from *H. variegatus* in having fewer gill rakers on the first gill arch (16 vs. 19–21), a shorter post-adipose distance

(9.1–10.9% SL vs. 12.9–14.1), and a uniform (vs. mottled) brown body in life.

Description. — Biometric and meristic data as in Table 24. General description as for genus. Head depressed and broad, body moderately compressed. Interorbital distance 28–31% HL. Eye diameter 14–21% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose fin with long base, about 3.0 times length of anal-fin base (35.3–39.2% SL) and origin in contact with base of posteriormost dorsal-fin ray. Post-adipose distance 9.1–10.9% SL. Dorsal spine stout, without serrations on posterior edge. Pectoral spine stout, with 12–14 large serrations on posterior edge. Caudal-peduncle depth 7.6–9.0% SL. Caudal fin forked; upper lobe rounded with principal ray produced into a filament, lower lobe

rounded posteriorly. Sensory pores on body not prominent. Rakers on first gill arch 16. Maximum recorded size 212 mm SL (Cui, 1990).

Colour. — Preserved specimens with dorsal and lateral surfaces of head and body uniform brown, lateral line cream; ventral surface of head and body dirty white; adipose fin and all fin rays brown; inter-radial membranes of all fins hyaline.

Distribution. — Known from the Song Da and Song Hong (Red River, Yuanjiang) drainages in southern China, northern Vietnam and northern Laos, as well as Hainan Island and the Beilun River, which drains the southern face of the Shiwandashan Range at the border of southeastern China with Vietnam (Fig. 39).

Habitat and biology. — *Hemibagrus pluriradiatus* is found in fast-flowing streams with sand or gravel substrate and shows a marked preference for deep pools (R. Schelly, pers. comm.; MK pers. obs.). It is a euryphagous species that feeds on a wide range of food items, including small fishes (mainly loaches), aquatic insect larvae, aquatic and terrestrial insects, molluscs, annelids, crustaceans, fish eggs, frogs, rotifers, cladocerans, copepods, macrophytes and algae (Du et al., 2010).

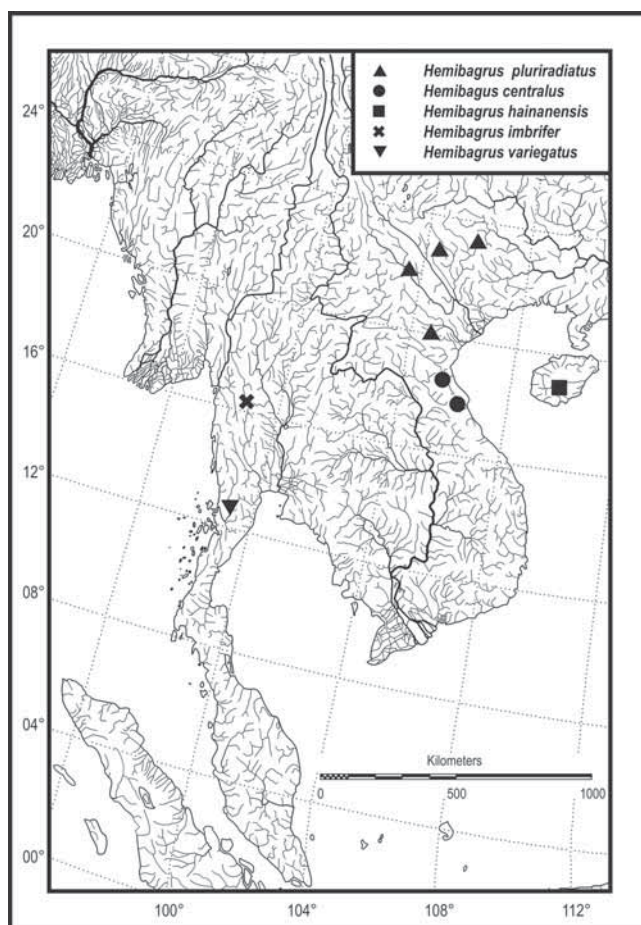


Fig. 39. Map showing collection localities of *Hemibagrus pluriradiatus*, *H. centralus*, *H. hainanensis*, *H. imbrifer*, and *H. variegatus* specimens examined in this study

Remarks. — The identity of *H. pluriradiatus* has been particularly problematic, a problem somewhat exacerbated by the paucity of material. Kottelat et al. (1998) discussed the validity of *H. pluriradiatus* and commented on the synonymy of this species by various Chinese authors (e.g. Ni & Wu, 1986; Cui, 1990). They concluded that *H. pluriradiatus* is a valid species and that *H. pluriradiatus* reported by Cheng & Zheng (1987), Gao (1990) and Cui (1990) from southern China, and the *H. elongatus* of Ni & Wu (1986) from Hainan Island are all conspecific with the holotype of *H. pluriradiatus*. They also commented that *H. centralus* is either the same as or very closely related to *H. guttatus*, but this conclusion was based solely on the figures in the original description (Mai, 1978) before the problem with Mai's figures came to light (see remarks under *H. vietamicus*).

Hemibagrus chiemhaoensis was described from the Song Gam [which flows into the Song Hong (Red River) via the Song Lo], Chiem Hoa district, Tuyen Quang province. Nguyễn (2005) considered this species to be most similar to *H. pluriradiatus*, distinguishing it from the latter by differences in the following characters: eye shape (oval in *H. chiemhaoensis* vs. rounded in *H. pluriradiatus*); the relative positions of the anterior and posterior nares (said to be further apart in *H. chiemhaoensis*); the distance of the posterior nare from the tip of the snout (smaller than the distance from the posterior nare to the anterior orbital margin in *H. chiemhaoensis* and larger than the distance from the posterior nare to the anterior orbital margin in *H. pluriradiatus*); the width of the mouth (three-quarters of head width in *H. chiemhaoensis* vs. equal to head width in *H. pluriradiatus*); the contact between the base of the last dorsal-fin ray and the adipose fin (present in *H. chiemhaoensis* vs. absent in *H. pluriradiatus*); the morphology of the dorsal spine (distal third non-osseous with its posterodistal margin with 3–4 serrations in *H. chiemhaoensis* vs. distal half non-osseous with a smooth posterodistal margin in *H. pluriradiatus*); the morphology of the anterior margin of the pectoral spine (weakly serrate in *H. chiemhaoensis* vs. smooth in *H. pluriradiatus*); the shape of the caudal-fin lobes (rounded in *H. chiemhaoensis* vs. sharply tapering in *H. pluriradiatus*); the extent of the maxillary barbels (to the middle of the pelvic fin in *H. chiemhaoensis* vs. beyond the anal fin in *H. pluriradiatus*); and the shape of the vomerine tooth band and teeth (tooth band strongly curved and teeth of noticeably different sizes in *H. chiemhaoensis* vs. tooth band gently curved and teeth of approximately the same size in *H. pluriradiatus*). The stated differences between *H. chiemhaoensis* and *H. pluriradiatus* appear to be very slight and might presumably be the result of fixation or intraspecific variation. The shape of the eye, while diagnostic for some catfishes (e.g. Ng, 1999), is dependent on fixation and length of time spent in preservative in the case of bagrid catfishes: there is a tendency for the eyes to shrink and assume a more rounded shape in specimens that have been stored in alcohol for some time. We measured the distance between the posterior nares, the snout and the anterior orbital margin in our specimens of *H. pluriradiatus*, and could find the character state for *H. chiemhaoensis* (the distance of the posterior nares from the snout smaller than the distance from the posterior nares to the anterior orbital margin) present in

some of the material we examined. Contrary to the account in Nguyễn (2005), the adipose fin is in contact with the base of the last dorsal-fin ray in *H. pluriradiatus*. Furthermore, our examination of *Hemibagrus* indicates that the anterior margin of the pectoral spine frequently bears a series of low bumps (but not distinct serrations), especially in larger specimens. These low bumps on the anterior margin of the pectoral spine are thus most likely to be the “serrations” referred to in the original description. Because all *Hemibagrus* possess the bumps on the anterior margin of the pectoral spine, this cannot be considered a diagnostic character. Lastly, all of the caudal-fin lobes of the *H. pluriradiatus* specimens we have examined are gently rounded (particularly the lower lobe), and none are sharply tapering, as claimed in Nguyễn (2005). Therefore there are only the following characters that may be useful in distinguishing *H. chiemhoaensis* from *H. pluriradiatus*: mouth width, dorsal-spine morphology, maxillary-barbel length, and the shape of the vomerine tooth band and teeth. We have not examine sufficient material to fully understand intraspecific variation in these characters, but we note that many of these stated differences are slight and are likely to be the result of intraspecific variation. Despite the illustration of *H. chiemhoaensis* in the original description (Nguyễn, 2005: Fig. 46) being very crudely retouched with a pen, it is referable to *H. pluriradiatus* as far as we can see. Based on the distribution of *H. chiemhoaensis*, our examination of material from the Song Hong [Red River] drainage and the information discussed above, we consider *H. chiemhoaensis* a junior synonym of *H. pluriradiatus* pending the availability of additional material from the Song Hong [Red River] drainage for study.

Hemibagrus songdaensis was described from Van Yen, Yen Chau district, Son La province (which lies within the Song Da drainage). Some of the diagnostic characters for this species are not immediately clear in the original description. In the account for this species, it is said to be distinguished from *H. guttatus* (the only species it is directly compared with) in having the body without black spots, branchiostegal membranes not overlapping, palatal teeth continuous, dorsal spine serrated on both margins, and adipose fin very thin. However, both the original description and the key for *Hemibagrus* in Nguyễn (2005) indicate that it is the pectoral spine that is serrated on both margins. Our examination of *Hemibagrus* indicates that the anterior margin of the dorsal spine is always smooth, while the anterior margin of the pectoral spine frequently bears a series of low bumps (but not distinct serrations), especially in larger specimens. These low bumps on the anterior margin of the pectoral spine are thus most likely to be the “serrations” referred to in the original description. Because all *Hemibagrus* possess the bumps on the anterior margin of the pectoral spine, this cannot be considered a diagnostic character. The other key diagnostic character would be the absence of black spots on the body (all members of the *H. guttatus* species group possess black spots on the body), which is a feature also seen in *H. pluriradiatus*. Although the illustration in the original description (Nguyễn, 2005: Fig. 47) shows a fish with a longer adipose-fin base, we note that this feature is heavily and crudely retouched with a pen, rendering the

accuracy of the illustration highly questionable. Based on the distribution of *H. songdaensis*, our examination of material from the Song Da drainage and the information discussed above, we consider *H. songdaensis* a junior synonym of *H. pluriradiatus* pending the availability of additional material from the Song Da drainage for study.

Hemibagrus taybacensis was described from Lai Chau (which lies within the Song Da drainage). This species is said to resemble *H. wyckioides* in body shape and colour (Nguyễn, 2005), but the photograph accompanying the original description (Nguyễn, 2005: Fig. 45) shows a species with an adipose fin that spans nearly all of the postdorsal distance (this is despite the heavy and crude retouching with a pen, as with a number of photographs in this work). Given that *H. wyckioides* has a shorter adipose fin that spans only about half the postdorsal distance and that the illustration in Nguyễn (2005) shows a fish similar to *H. pluriradiatus*, we consider *H. taybacensis* a junior synonym of *H. pluriradiatus* pending the availability of additional material from the Song Da drainage for study.

The species identified as *Hemibagrus* sp. A in Kottelat (2001a: 52, Fig. 105) is clearly a member of the *H. pluriradiatus* species group, as it possesses a long-based adipose fin that spans most of the postdorsal distance and a uniformly grey body. It appears to have a deeper caudal peduncle than *H. pluriradiatus*, but as this material is unavailable to us for further study, we are unable to comment further on its taxonomic status. The figured specimen had been collected in the Song Gam in Chiem Hoa (22°11'07.4"N 105°16'18.2"E), Chiem Hoa district, Tuyen Quang Province, Vietnam.

A comparison of specimens from northern and central Vietnam and Hainan Island reveals significant morphological differences among all three populations and therefore, the conspecificity of *H. pluriradiatus* of Vaillant with that reported from Hainan Island by various authors (as postulated by Kottelat et al., 1998) is highly doubtful. The results of this study show that the three populations represent three distinct species: *H. centralus* from central Vietnam, *H. hainanensis* from Hainan Island, and *H. pluriradiatus* from northern Vietnam.

***Hemibagrus centralus* Mai, 1978**

(Fig. 40)

Hemibagrus centralus Mai, 1978: 253, Fig. 115 (type locality: Quang Binh province, central Vietnam); Mai, 1985: 284; Mai & Nguyen, 1991: 52; Kottelat, 2001a: 51; Ferraris, 2007: 87; Vu & Vo, 2012: 13.

Material examined. — VIETNAM: ZMUH 409, 2 syntypes, 147.8–155.6 mm SL; Quang Binh province; AMNH 227901, 1 ex., 126.1 mm SL; Quang Binh province: Minh Hoa district, Cha Lo frontier station, streams near station; AMNH 227933, 1 ex., 143.0 mm SL; Ha Tinh province: Minh Hoa district, Quy Dat market; AMNH 227983, 3 ex., 94.0–170.8 mm SL; Ha Tinh province: Huong Son district, Rao An region, deep pool in main stream below base camp; AMNH 228019, 1 ex., 253.4 mm SL; Ha Tinh province: Huong Son district, Rao An region market.

Table 25. Biometric and meristic data for *H. centralus* (n = 8).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	25.3–29.2	26.9±1.39
Head width	16.4–19.4	18.1±1.12
Head depth	11.4–14.8	13.0±1.13
Predorsal distance	35.9–40.5	38.1±1.39
Preanal length	68.3–71.6	70.2±1.05
Prepelvic length	49.5–52.4	51.0±1.02
Prepectoral length	21.1–25.2	23.1±1.45
Body depth at anus	11.5–16.5	14.7±1.58
Length of caudal peduncle	17.6–20.4	18.8±0.77
Depth of caudal peduncle	8.0–9.8	9.1±0.61
Pectoral-spine length	10.6–13.7	11.8±0.95
Pectoral-fin length	14.1–18.9	15.9±1.70
Length of dorsal fin	20.0–24.2	22.3±1.46
Length of dorsal-fin base	14.0–16.3	15.3±0.74
Dorsal-spine length	11.2–14.3	12.5±1.18
Pelvic-fin length	13.7–15.8	14.8±0.71
Length of anal-fin base	11.8–13.3	12.7±0.58
Caudal-fin length	19.7–24.7	22.7±2.09
Length of adipose-fin base	31.3–37.5	32.8±2.15
Maximum height of adipose fin	3.6–6.4	5.2±1.18
Dorsal to adipose distance	5.8–8.5	7.1±0.97
Post-adipose distance	8.7–10.6	9.8±0.61
In %HL:		
Snout length	35.6–39.8	37.4±1.54
Interorbital distance	31.1–34.0	31.9±0.93
Eye diameter	13.1–17.6	15.6±1.69
Nasal barbel length	27.1–44.9	34.6±5.87
Maxillary barbel length	142.2–215.7	181.3±23.16
Inner mandibular barbel length	36.3–53.6	45.6±5.48
Outer mandibular barbel length	65.0–92.7	76.7±9.23
MERISTICS		
Dorsal-fin rays	II,7 (8)	
Anal-fin rays	iv,8 (4) or iv,9 (4)	
Pelvic-fin rays	i,5 (8)	
Pectoral-fin rays	I,8 (1), I,9 (4) or I,9,i (3)	
Caudal-fin rays	i,7,8,i (8)	
Branchiostegal rays	9 (5), 10 (2) or 11 (1)	
Gill rakers	5+10 (1), 4+13 (1), 5+12 (1), 4+14 (3), 5+14 (1) or 5+16 (1)	
Vertebrae	25+23=48 (1), 26+22=48 (2), 26+23=49 (3), 27+22=49 (1) or 27+23=50 (1)	

Diagnosis. — *Hemibagrus centralus* is distinguished from *H. hainanensis* in having a deeper caudal peduncle (8.0–9.8% SL vs. 7.7–7.8), a longer adipose-fin base (31.3–7.5% SL vs. 27.8–29.3), a smaller dorsal to adipose distance (5.8–8.5% SL vs. 10.1–10.4), and a greater interorbital distance (31–34% HL vs. 30), from *H. imbrifer* in a brown (vs. grey) body in life, a shorter adipose-fin base (31.3–7.5% SL vs. 38.4–44.2),



Fig. 40. *Hemibagrus centralus*, AMNH 227983, 126.2 mm SL; Vietnam: Rao An region.

and sensory pores on body not easily visible (vs. relatively large sensory pores arranged in vertical columns along the sides of the body), from *H. pluriradiatus* in having the adipose fin separated from (vs. in contact with) the base of the last dorsal-fin ray by a distance of 5.8–8.5% SL and a greater interorbital distance (31–34% HL vs. 28–31), and from *H. variegatus* in having a shorter post-adipose distance (8.7–10.6% SL vs. 12.9–14.1), and a uniform (vs. mottled) brown body in life.

Description. — Biometric and meristic data as in Table 25. General description as for genus. Head depressed and broad, body moderately compressed. Interorbital distance 31–34% HL. Eye diameter 13–18% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose fin with long

base, about 3.0 times length of anal-fin base (31.3–39.2% SL) and spanning most of postdorsal distance. Origin of adipose fin separate from base of posteriormost dorsal-fin ray by distance of 5.8–8.5% SL. Post-adipose distance 8.7–10.6% SL. Dorsal spine stout, without serrations on posterior edge. Pectoral spine stout, with 9–10 large serrations on posterior edge. Caudal-peduncle depth 8.0–9.8% SL. Caudal fin forked; upper lobe rounded with principal ray produced into a filament, lower lobe rounded posteriorly. Sensory pores on body not prominent. Rakers on first gill arch 15–17. Maximum recorded size 253 mm SL.

Colour. — Preserved specimens with dorsal and lateral surfaces of head and body uniform brown, lateral line cream; ventral surface of head and body dirty white; adipose fin and fin rays of all fins brown; inter-radial membranes of all fins hyaline.

Distribution. — Known from Quang Binh province, Song Ngan Pho in Ha Tinh province, Song Thu Bon in Da Nang province, and Song Tra Khuc in Quang Ngai province (all in central Vietnam) (Fig. 39).

***Hemibagrus hainanensis* (Tchang, 1935)**

(Fig. 41)

Leiocassis hainanensis - Tchang, 1935: 175, Fig. 2 (type locality: Hainan Island, China), 1937: 100; Herre, 1938: 427; Nichols, 1943: 44.

Macrones elongatus - Koller, 1927: 28.

Aoria chinensis (non Steindachner, 1883) - Harada, 1943: 9, Pl. 3, Figs. 5–6.

Pseudobagrus hainanensis - Tchang, 1960: 22, Fig. 14.

Mystus elongatus (non Günther, 1864) - Ni & Wu, 1986: 174, Fig. 98.

Mystus pluriradiatus (non Vaillant, 1892) - Zheng & Dai, 1999: 70, Fig. 34 (in part).

Hemibagrus pluriradiatus (non Vaillant, 1892) - Chan & Chen, 2008: 51.

Hemibagrus hainanensis - Ferraris, 2007: 88.

Material examined. — CHINA: Hainan Island: CAS 134022, 1 ex., 59.0 mm SL, Hainan Island; CAS 139619, 2 ex., 104.2–168.5 mm SL, central part of Hainan Island; ZRC 46156, 1 ex., 71.2 mm SL, Tongzha market.

Diagnosis. — *Hemibagrus hainanensis* is distinguished from both *H. centralus* and *H. pluriradiatus* in having a greater dorsal to adipose distance (10.1–10.4% SL vs. 0.0–8.5), from *H. imbrifer* in a brown (vs. grey) body in life, a shorter



Fig. 41. *Hemibagrus hainanensis*, ZRC 46156, 71.2 mm SL, China: Hainan Island, Tongzha.

adipose-fin base (27.8–29.3% SL vs. 38.4–44.2), and sensory pores on body not easily visible (vs. relatively large sensory pores arranged in vertical columns along the sides of the body), and from *H. variegatus* in having fewer gill rakers on the first gill arch (18 vs. 19–21), a shorter post-adipose distance (11.2–11.6% SL vs. 12.9–14.1), and a uniform (vs. mottled) brown body in life. It further differs from *H. centralus* in having a shorter adipose-fin base (27.8–29.3% SL vs. 31.3–39.2), a more slender caudal peduncle (7.7–7.8% SL vs. 8.0–9.8), and a smaller interorbital distance (30% HL vs. 31–34) and from *H. pluriradiatus* in having a smaller eye (diameter 13–14% HL vs. 14–21),

Description. — Biometric and meristic data as in Table 26. General description as for genus. Head depressed and broad, body moderately compressed. Interorbital distance 30% HL. Eye diameter 13–14% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose fin with long base, about 3.0 times length of anal-fin base (27.8–29.3% SL) and spanning most of postdorsal distance. Origin of adipose fin separate from base of posteriormost dorsal-fin ray by distance of 10.1–10.4% SL. Post-adipose distance 11.2–11.6% SL. Dorsal spine stout, without serrations on posterior edge. Pectoral spine stout, with 11–18 large serrations on posterior edge. Caudal-peduncle depth 7.7–7.8% SL. Caudal fin forked; upper lobe rounded with principal ray produced into a filament, lower lobe rounded posteriorly. Sensory pores on body not prominent. Rakers on first gill arch 18. Maximum recorded size 550 mm SL (Ni & Wu, 1986).

Colour. — Preserved specimens with dorsal and lateral surfaces of head and body uniform brown, lateral line cream; ventral surface of head and body dirty white; adipose fin and fin rays of all fins brown; inter-radial membranes of all fins hyaline.

Distribution. — Known from Hainan Island off southeastern China (Fig. 39).

Habitat and biology. — This species feeds on fishes, shrimps and aquatic insects, and breeds in May–June. The eggs are about 1.8–2.4 mm in diameter (Ni & Wu, 1986).

***Hemibagrus imbrifer* Ng & Ferraris, 2000**

(Fig. 42)

Hemibagrus imbrifer Ng & Ferraris, 2000: 126, Fig. 1 (type locality: Mae Nam Moei at Ban Wa Le, Thailand); Ferraris, 2007: 89; Ng & Lim, 2008: 29, Fig. 23.

Material examined. — THAILAND: ZRC 45406, holotype, 186.6 mm SL, CMK 13445, 1 paratype, 144.2 mm SL, Thailand: Tak province, Salween drainage, Mae Nam Moei at Ban Wa Le, 16°17'24"N 98°42'21"E).

Diagnosis. — *Hemibagrus imbrifer* is distinguished from its congeners within this species group having a grey (vs.

Table 26. Biometric and meristic data for *H. hainanensis* (n = 4).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	27.4–27.5	27.5±0.07
Head width	17.0–18.0	17.5±0.71
Head depth	11.2–12.2	11.7±0.71
Predorsal distance	37.6–39.5	38.6±1.34
Preanal length	68.6–70.2	69.4±1.13
Prepelvic length	46.9–48.0	47.5±0.78
Prepectoral length	21.7–23.6	22.7±1.34
Body depth at anus	13.1–13.8	13.4±0.49
Length of caudal peduncle	17.8–21.4	19.6±2.55
Depth of caudal peduncle	7.7–7.8	7.8±v0.07
Pectoral-spine length	11.0–11.6	11.3±0.42
Pectoral-fin length	16.0–17.1	16.6±0.78
Length of dorsal fin	20.7–23.6	22.2±2.05
Length of dorsal-fin base	14.2–14.4	14.3±0.14
Dorsal-spine length	11.6–13.2	12.4±1.13
Pelvic-fin length	15.3–15.4	15.4±0.07
Length of anal-fin base	10.1–10.9	10.5±0.57
Caudal-fin length	18.5–21.6	20.1±2.19
Length of adipose-fin base	27.8–29.3	28.6±1.06
Maximum height of adipose fin	4.3–6.0	5.2±1.20
Dorsal to adipose distance	10.1–10.4	11.4±0.28
Post-adipose distance	11.2–11.6	10.3±0.21
In %HL:		
Snout length	37.2–37.7	37.4±0.35
Interorbital distance	29.8–30.2	30.0±0.28
Eye diameter	12.9–14.0	13.4±0.78
Nasal barbel length	31.3–39.3	35.3±5.66
Maxillary barbel length	175.0–176.1	175.5±0.78
Inner mandibular barbel length	37.5–41.1	39.3±2.55
Outer mandibular barbel length	73.9–74.4	74.1±0.35
MERISTICS		
Dorsal-fin rays	II,7 (4)	
Anal-fin rays	iv,8 (4)	
Pelvic-fin rays	i,5 (4)	
Pectoral-fin rays	I,8 (2) or I,9 (2)	
Caudal-fin rays	i,7,8,i (4)	
Branchiostegal rays	10 (4)	
Gill rakers	5+13 (4)	
Vertebrae	22+26=48 (4)	

brown) body in life, a longer adipose-fin base (38.4–44.2% SL vs. 27.8–39.2), and relatively large sensory pores arranged in vertical columns along the sides of the body (vs. sensory pores not easily visible).

Description. — Biometric and meristic data as in Table 27. General description as for genus. Head depressed and broad, body moderately compressed. Interorbital distance 32% HL. Eye diameter 17% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Sensory pores of lateral line system readily visible, arranged in nine vertical columns on sides of body. Adipose fin with long base, about 3.5 times length of anal-fin base (38.4–44.2% SL) and spanning most of postdorsal distance. Origin of adipose fin in contact with base of posteriormost dorsal-fin ray. Post-adipose distance 8.1–10.1% SL. Dorsal spine stout, without

serrations on posterior edge. Pectoral spine stout, with 12–13 large serrations on posterior edge. Caudal-peduncle depth 9.8–11.1% SL. Caudal fin forked; distal margins of upper and lower lobes rounded. Sensory pores on body prominent and arranged in vertical columns along sides of body. Rakers on first gill arch 14. Maximum recorded size 187 mm SL.

Colour. — Dorsal surface of head and body uniform grey; ventral surface of head and body dirty white; adipose fin grey, distal edge fading to light grey; caudal and anal fins grey,



Fig. 42. *Hemibagrus imbrifer*, ZRC 45406, holotype, 186.6 mm SL, Thailand: Mae Nam Moei.

Table 27. Biometric and meristic data for *H. imbrifer* (n = 2).

	Holotype	Paratype
BIOMETRICS		
In %SL:		
Head length	26.6	28.4
Head width	18.8	20.0
Head depth	13.1	13.0
Predorsal distance	39.2	38.8
Preanal length	68.4	70.6
Prepelvic length	51.5	51.0
Prepectoral length	23.7	24.5
Body depth at anus	14.4	14.9
Length of caudal peduncle	18.8	19.5
Depth of caudal peduncle	9.8	11.1
Pectoral-spine length	12.2	12.3
Pectoral-fin length	16.6	16.6
Length of dorsal fin	22.6	23.5
Length of dorsal-fin base	14.4	16.9
Dorsal-spine length	11.7	12.5
Pelvic-fin length	13.5	14.6
Length of anal-fin base	11.1	13.2
Caudal-fin length	19.7	21.6
Length of adipose-fin base	38.4	44.2
Maximum height of adipose fin	4.2	5.5
Post-adipose distance	10.1	8.1
In %HL:		
Snout length	39.3	39.8
Interorbital distance	32.3	31.7
Eye diameter	17.3	17.3
Nasal barbel length	41.3	41.7
Maxillary barbel length	175.4	211.7
Inner mandibular barbel length	52.0	48.8
Outer mandibular barbel length	88.1	85.4
MERISTICS		
Dorsal-fin rays	II,7	II,7
Anal-fin rays	iv,8	iv,8,i
Pelvic-fin rays	i,5	i,5
Pectoral-fin rays	I,10,i	I,10
Caudal-fin rays	i,7,7,i	i,7,8,i
Branchiostegal rays	11	10
Gill rakers	3+1	3+11
Vertebrae	26+22=48	26+21=47

with melanophores more dense on fin rays. Distal two-thirds of pectoral and pelvic fins grey, with melanophores more dense on fin rays and proximal third dirty white.

Distribution. — Known from only the Mae Nam Moei River in the Salween (Thanlwin) River drainage (Fig. 39). The Mae Nam Moei marks the border between Thailand and Myanmar.

Remarks. — The photograph of this species in the original description (Ng & Ferraris, 2000: Fig. 1) is erroneously captioned. The photograph in question is of the paratype (CMK 13445), and not of the holotype (ZRC 45406) as indicated.

***Hemibagrus variegatus* Ng & Ferraris, 2000**
(Fig. 43)

Hemibagrus variegatus Ng & Ferraris, 2000: 139, Fig. 12 (type locality: Tenasserim River, Myanmar); Vidthayanon et al., 2005: 95; Ferraris, 2007: 91.

Material examined. — MYANMAR: BMNH 1992.11.16:11, holotype, 121.2 mm SL, Tenasserim (Taninthari) River. UMMZ 248183, 1 ex., 85.9 mm SL; ZRC 51967, 3 ex., 86.8–285.6 mm SL; Taninthayi division, Tenasserim River drainage in the vicinity of Same, 13°36'N 99°2'E.

Diagnosis. — *Hemibagrus variegatus* can be easily distinguished from congeners in this species group in having a longer post-adipose distance (12.9–14.1% SL vs. 8.1–11.6), and a mottled greenish yellow (vs. uniform grey or brown) body with irregular dark vertical bars in life. It further differs from congeners in this species group except

Table 28. Biometric and meristic data for *H. variegatus* (n = 5).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	26.8–27.3	27.0±0.21
Head width	15.1–18.4	17.1±1.32
Head depth	12.3–13.8	13.1±0.60
Predorsal distance	37.2–39.6	38.7±1.18
Preanal length	67.7–72.4	70.1±1.96
Prepelvic length	48.2–51.2	49.9±1.23
Prepectoral length	23.7–27.4	25.0±1.51
Body depth at anus	11.3–15.3	13.5±1.55
Length of caudal peduncle	19.7–21.3	20.3±0.70
Depth of caudal peduncle	7.6–9.1	8.0±0.61
Pectoral-spine length	11.0–13.0	12.2±0.87
Pectoral-fin length	16.5–19.7	17.8±1.55
Length of dorsal fin	21.4–24.8	23.9±1.40
Length of dorsal-fin base	14.7–15.8	15.2±0.43
Dorsal-spine length	14.8–17.2	16.1±0.89
Pelvic-fin length	14.6–18.6	16.3±1.73
Length of anal-fin base	9.8–11.8	10.5±0.79
Caudal-fin length	21.4–25.4	23.6±1.66
Length of adipose-fin base	28.0–30.8	29.1±1.30
Maximum height of adipose fin	4.5–5.6	5.1±0.45
Dorsal to adipose distance	5.0–8.6	7.4±1.62
Post-adipose distance	12.9–14.1	13.7±0.47
In %HL:		
Snout length	34.2–40.6	37.8±2.66
Interorbital distance	23.7–29.8	26.6±2.53
Eye diameter	20.5–23.1	22.2±1.17
Nasal barbel length	10.6–36.3	25.2±9.39
Maxillary barbel length	201.9–256.6	232.8±20.21
Inner mandibular barbel length	42.6–51.0	48.2±3.38
Outer mandibular barbel length	78.2–93.2	83.4±6.51
MERISTICS		
Dorsal-fin rays	II,7 (5)	
Anal-fin rays	iv,7 (3) or iv,8 (2)	
Pelvic-fin rays	i,5 (5)	
Pectoral-fin rays	I,8 (3), I,9 (1) or I,10 (1)	
Caudal-fin rays	i,7,8,i (5)	
Branchiostegal rays	11 (5)	
Gill rakers	4+15 (1) or 5+16 (1)	
Vertebrae	28+21=49 (1), 26+24=50 (2) or 28+23=51 (1)	

for *H. centralus* in having more gill rakers on the first gill arch (19–21 vs. 14–18).

Description. — Biometric and meristic data as in Table 28. General description as for genus. Head depressed and broad, body moderately compressed. Interorbital distance 24–30% HL. Eye diameter 14–23% HL. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then



Fig. 43. *Hemibagrus variegatus*, ZRC 51967, 285.6 mm SL, Myanmar: Tenasserim River drainage.

sloping gently ventrally from there to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose fin with long base, about 3.0 times length of anal-fin base (28.0–34.6% SL) and spanning most of postdorsal distance. Origin of adipose fin separate from base of posteriormost dorsal-fin ray by distance of 0.0–8.6% SL. Post-adipose distance 12.9–14.1% SL. Dorsal spine stout, without serrations on posterior edge. Pectoral spine stout, with 9–22 large serrations on posterior edge. Anterior base of adipose fin not touching base of posterior ray of dorsal fin. Caudal-peduncle depth 7.6–9.1% SL. Caudal fin forked; distal margins of upper and lower lobes straight. Sensory pores on body not prominent. Rakers on first gill arch 19–21. Maximum recorded size 800 mm SL (Vidthayanon et al., 2005).

Colour. — Dorsal surface of the head and body brown with irregular dark brown markings forming a variegated pattern;

this colour fades to a dirty white on the ventral surface. All fins brown, with melanophores on fin rays and interradi- al membranes; melanophores are more concentrated in the interradi- al membranes of the dorsal, pectoral, pelvic and anal fins. Colour in life greenish yellow.

Distribution. — Known only from the Tenasserim (Thaninthari) River drainage in southern Myanmar (Fig. 39).

Habitat. — *Hemibagrus variegatus* inhabits the upper reaches of rivers, where the substrate is composed primarily of rocks and gravel (Vidthayanon et al., 2005).

HEMIBAGRUS WYCKII SPECIES GROUP

Artificial key to the members of the *H. wyckii* species group

1. Dorsal spine long (12–16% SL), well ossified (at least as thick as branched dorsal-fin rays), with 10–12 serrations on posterior edge; humeral region cream-coloured; maxillary barbels reaching to middle of dorsal-fin base (mainland and Sundaic Southeast Asia)..... *H. wyckii*
- Dorsal spine short (8–13% SL), poorly ossified (thinner than branched dorsal-fin rays), without serrations on posterior edge; cleithral region grey, brown or green; maxillary barbels reaching at least to middle of adipose-fin base.2
2. Dorsal to adipose distance 4–7% SL; body olive green; fins orange (southern India)..... *H. maydelli*
- Dorsal to adipose distance 9–14% SL; body grey; fins grey or red.3
3. Fins red in life; head wide (20–24% SL); eyes set wider apart (32–37% HL) (mainland Southeast Asia)..... *H. wyckioides*
- Fins grey in life; head narrow (18–20% SL); eyes set nearer together (28–32% HL) (Myanmar)..... *H. microphthalmus*

Remarks. — A fossil species of *Hemibagrus* (*H. major*) described from Miocene deposits in Lake Phetchabun, north central Thailand, is presumably a member of this species group, as evidenced by the high vertebral count (54–56) and its general resemblance to *H. wyckioides* and *H. microphthalmus* (see Roberts & Jumnonghai, 1999).

***Hemibagrus wyckii* (Bleeker, 1858)**
(Fig. 44)

Bagrus Wijckii - Bleeker, 1858a: 418 (nomen nudum); 1859g: 135.
Bagrus Wyckii Bleeker, 1858e: 156 (type locality: Java in flumine Tjitarum, provinciae Preanger, prope vicum Parongkalong [Java: Preanger province, Tjitarum [Citarum] river, near village of Parongkalong]).
Hemibagrus Wyckii - Bleeker, 1862: 57, Pl. 72.
Macrones wyckii - Günther, 1864: 83; Bishop, 1973: 350, 354, 357, 358.
Macrones wycki - Weber & de Beaufort, 1913: 343.
Mystus wycki - Smith, 1929: 12; Hora & Gupta, 1941: 28; Suvatti, 1950: 300; Orsi, 1974: 161; Rainboth, 1996: 144.
Mystus wyckii - Fowler, 1935: 104, Fig. 31; Smith, 1945: 388; Kuronuma, 1961: 6; Desoutter, 1975: 452, Fig. 4; Imaki et al., 1981: 41, Fig. 81; Cramphorn, 1983: 19; Mohsin & Ambak,

1983: 132, Fig. 99; Mai & Nguyen, 1988: 49; Kottelat, 1989: 14; 1994: 413; Roberts, 1989: 126; 1993: 33; Kottelat et al., 1993: 67, Pl. 32; Lim et al., 1993: 6; Roberts & Warren, 1994: 102; Khan et al., 1996: 38.
Macrones Wycki - Durand, 1940: 29.
Mystus (Mystus) wyckii - Jayaram, 1966: 446.
Mystus wickii - Kottelat, 1985: 270.
Hemibagrus wyckii - Mo, 1991: 132; Baird et al., 1999: 92, Fig. 203; Ng & Rainboth, 1999: 563, Fig. 9; Gaanantkul et al., 2000: 34; Kottelat, 2001b: 122, Fig. 331; Kottelat & Widjanarti, 2005: 159; Parenti & Lim, 2005: 190; Ferraris, 2007: 91; Vidthayanon, 2008: 116; Ambak et al., 2010: 79; Rainboth et al., 2012: 72, Pl. 46, Fig. 947.
Mystus sp. nov. - Christensen, 1992: 600.

Material examined. — LAOS: NRM 15006, 1 ex., 226.5 mm SL, Mekong River, Pakse; NRM 15012, 1 ex., 232.2 mm SL; NRM 15014, 1 ex., 201.9 mm SL, Sedone River, Pakse; NRM 15021, 1 ex., 269.4 mm SL, Laos.

THAILAND: ANSP 60733, 1 ex., 143.8 mm SL, Bangkok; CAS 67222, 1 ex., 176.7 mm SL, Khong Chiam market; USNM 109578, 1 ex., 99.8 mm SL, Mae Nam Chem, 80 km above mouth, tributary of Mae Nam Ping; USNM 109579, 1 ex., 119.1 mm SL, Mae Nam Ping at Chiang Mai.

CAMBODIA: MNHN 1974–36, 1 ex., 201.0 mm SL; MNHN 1974–37, 1 ex., 290.0 mm SL, Mekong River at Beng Cha; MNHN 1974–43, 1 ex., 126.3 mm SL, Kampot; UMMZ 232311, 1 ex., 252.0 mm SL; UMMZ 234581, 1 ex., 207.1 mm SL, Stung Treng morning market (13°30'N 105°58'E).

PENINSULAR MALAYSIA: CAS 114175, 2 ex., 276.5–410 mm SL, Perak: Chenderoh Dam; ZRC 2446, 1 ex., 88.1 mm SL; ZRC 2447, 1 ex., 73.5 mm SL, Pahang: Kuala Tahan.

SUMATRA: NMW 45279, 1 ex., 160.8 mm SL, Sumatera Barat: Padang; ZMA 121.811, 1 ex., 106.0 mm SL, Jambi: Batang Hari; ZRC 41900, 5 ex., 270.7–564 mm SL, Jambi: Pasar Angso Duo (fish market).

JAVA: RMNH 6897, 1 syntype, 330.0 mm SL; BMNH 1863.12.4.88, 1 syntype, 242.5 mm SL, Jawa Barat, Citarum River; ZMA 121.860, 1 ex., 96.5 mm SL, Jawa Barat, Bogor.

BORNEO: Sarawak: USNM 325328, 1 ex., 288.0 mm SL, Batang Besua where it enters Batang Balui; USNM 325409, 1 ex., 226.3 mm SL, Long Paha where it enters Batang Balui.



Fig. 44. *Hemibagrus wyckii*: a, UMMZ 234581, 207.1 mm SL, Cambodia: Stung Treng; b, Specimen about 230 mm SL (not preserved); Thailand: Chao Phraya River, Nakhon Sawan Province. (Photograph courtesy of Nonn Panitvong).

BORNEO: Kalimantan Barat: CAS 49382, 3 ex. 33.5–204.8 mm SL, Kapuas drainage, rocky channel in main stream of Sungai Pinoh at Nanga Saian; CAS 49384, 1 ex. 18.6 mm SL, Kapuas drainage, Kapuas main stream, opposite Silat, rocky area on left bank; CAS 49385, 1 ex., 24.8 mm SL, Kapuas drainage, rocky ledge in middle of Sungai Melawi near confluence with Kapuas main stream; USNM 230284, 2 ex., 65.4–149.0 mm SL, Kapuas mainstream 58 km NE of Sintang and 1 km downstream from Sebruang.

BORNEO: Kalimantan Tengah: ZRC 51973, 1 ex., 291.0 mm SL; Kasongan market, from Katingan River, 1°54'S 113°23'E;

Diagnosis. — *Hemibagrus wyckii* is distinguished from other members of the species group in having a well ossified dorsal spine at least as thick as the branched dorsal-fin rays (vs. poorly ossified spine thinner than soft dorsal-fin rays) with 10–12 (vs. without) serrations on the posterior edge, a cream-coloured (vs. grey or olive green) cleithral region, cream-coloured (vs. orange, red or grey) procurent and first principal caudal-fin rays and a shorter maxillary barbel (reaching to the middle of the dorsal-fin base; 144–195% HL vs. reaching to at least the middle of the adipose fin base; 230–301% HL). It can be further distinguished from both *H. maydelli* and *H. wyckioides* in having a predominantly grey (vs. reddish or orange-colored) caudal fin, and from *H. maydelli* in having a greater dorsal to adipose distance (7.1–11.0% SL vs. 4.0–7.0), smaller post-adipose distance (9.3–13.6% SL vs. 14.1–14.6), and a smaller eye (diameter 8–10% HL vs. 12).

Description. — Biometric and meristic data as in Table 29. Head extremely depressed and broad; length 9.7–32.1% SL; width 9.3–23.8% SL. Interorbital distance 29–32% HL. Eye diameter 8–10% HL. Body moderately compressed. Dorsal

profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then gently sloping ventrally to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Dorsal spine stout, with 10–13 serrations along posterior edge. Adipose dorsal fin reaching adipose-fin origin. Pectoral spine stout, with 18–21 large serrations along posterior edge. Adipose-fin origin separated from base of last dorsal-fin ray by distance of 7.1–11.0% SL. Post-adipose distance 9.3–13.6% SL. Caudal-peduncle length 14.0–7.4% SL; caudal-peduncle depth 8.1–8.9% SL. Caudal fin forked; upper and lower lobes rounded. Maxillary barbel reaching to middle of dorsal-fin base (144–195% HL). Maximum recorded size 710 mm SL (Kottelat et al., 1993: Pl. 32; Kottelat & Widjanarti, 2005), but a larger maximum size is expected.

Colour. — Dorsal and lateral surfaces of head and body uniform dark grey, ventral surface of head and body cream grading to light grey towards the lateral surface of body, cleithral region cream; adipose fin grey with cream dorsal margin; anteriormost anal-fin rays, first pelvic-fin rays, and procurent and first principal caudal-fin rays cream, fin-rays and inter-radial membranes of all other fins dark grey; barbels cream (Fig. 44b).

Distribution. — Known from the Mekong and Chao Phraya drainages in central Indochina (Fig. 45). Also known from the Batang Hari and Musi River drainages in Sumatra, the Pahang River drainage in Peninsular Malaysia, the Citarum drainage in Java, and the Baram, Rejang, Kapuas and Barito River drainages in Borneo (Fig. 45).

Habitat and biology. — *Hemibagrus wyckii* is a large predatory species feeding on crustaceans and fishes (Rainboth, 1996) found in large rivers (usually in the middle portion of a river drainage). Observations of individuals (about 60–200 mm SL) kept in aquaria indicate that it is a highly territorial species that is aggressive to conspecifics (pers. obs.).

Remarks. — Desoutter (1975) noted the presence of fewer pectoral fin-rays (10–11 vs. 11–12) and more vertebrae (45 vs. 41–44) in Indochinese specimens of *H. wyckii* when compared to the types (from Java); Ng & Rainboth (1999) concur that this is intraspecific variation and that the Indochinese and Sundaic populations are conspecific.

Hemibagrus maydelli (Rössel, 1964) (Fig. 46)

Mystus maydelli Rössel, 1964: 149. Fig. 1 (type locality: Wadgaon, Bhima River); Wilkens 1977: 159; Jayaram & Sanyal, 2003: 73, Fig. 13.

Mystus (Mystus) maydelli - Jayaram, 1966: 446.

Mystus sp. - Govind & Rajagopal, 1975: 79.

Mystus malabaricus (in part) - Jayaram, 1977: 32; Talwar & Jhingran, 1991: 564.

Mystus krishnensis Ramakrishniah, 1988: 139, Figs. 1–2 (type locality: Krishna River below Nagarjunasagar Reservoir, India); Talwar & Jhingran, 1991: 563; Jayaram, 1995: 97, 105, 108; Jayaram, 1999: 236; Jayaram & Sanyal, 2003: 66, Fig. 10; Karmakar & Das, 2005: 93; Khan, 2008: 29.

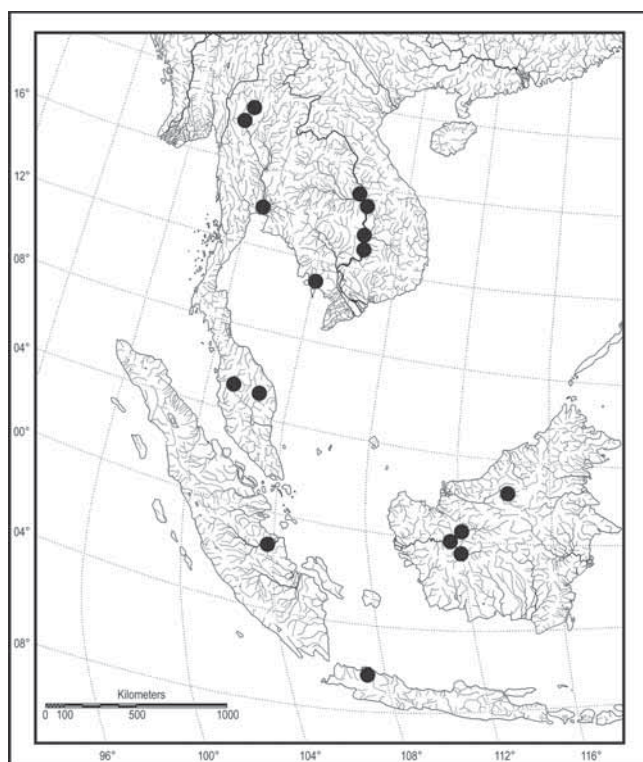


Fig. 45. Map showing collection localities of *Hemibagrus wyckii* specimens examined in this study.

Table 29. Biometric and meristic data for *H. wyckii* (n = 35).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	29.7–32.1	30.9±1.24
Head width	19.3–23.8	21.6±1.54
Head depth	11.7–14.9	13.6±1.12
Predorsal distance	41.9–45.6	42.7±1.72
Preanal length	72.6–77.8	73.8±4.29
Prepelvic length	55.1–60.0	56.8±2.32
Prepectoral length	25.5–31.8	27.6±1.94
Body depth at anus	13.6–15.8	14.7±1.46
Length of caudal peduncle	14.0–17.4	16.2±1.27
Depth of caudal peduncle	8.1–8.9	8.1±0.58
Pectoral-spine length	11.1–15.9	13.0±1.30
Pectoral-fin length	15.8–19.6	17.1±1.39
Length of dorsal fin	20.0–28.7	23.4±2.65
Length of dorsal-fin base	10.9–15.3	14.7±1.79
Dorsal-spine length	11.9–15.8	12.1±2.63
Pelvic-fin length	14.0–16.2	14.6±0.70
Length of anal-fin base	10.4–15.7	12.3±1.58
Caudal-fin length	17.6–24.8	21.8±2.45
Length of adipose-fin base	19.4–24.5	20.9±1.99
Maximum height of adipose fin	4.5–5.8	5.5±0.54
Dorsal to adipose distance	7.1–11.0	10.00±1.48
Post-adipose distance	9.3–13.6	12.6±1.44
In %HL:		
Snout length	32.6–36.6	35.0±1.53
Interorbital distance	28.7–31.8	31.5±1.74
Eye diameter	7.7–10.2	8.2±1.49
Nasal barbel length	15.8–21.1	21.8±5.10
Maxillary barbel length	143.7–195.4	193.8±60.88
Inner mandibular barbel length	26.2–31.7	33.3±10.25
Outer mandibular barbel length	47.4–59.5	63.9±20.00
MERISTICS		
Dorsal-fin rays	II,7 (35)	
Anal-fin rays	iii,8 (8), iii,8,i (10), iv,9 (15) or v,7 (2)	
Pelvic-fin rays	i,5 (40)	
Pectoral-fin rays	I,9,i (5), I,10 (10), I,10,i (10) or I,11 (10)	
Caudal-fin rays	i,7,8,i (33) or i,8,8,i (2)	
Branchiostegal rays	10 (33) or 11 (2)	
Gill rakers	3+8 (25) or 3+9 (10)	
Vertebrae	26+24=50 (4), 27+24=51 (15), 28+23=51 (4) or 24+27=51 (2)	

Mystus punctatus (non Jerdon) - Barman, 1993: 225, Fig. 96.

Hemibagrus maydelli - Grant, 1999: 172, Fig. 2; Ng & Ferraris, 2000: 128, Fig. 3; Ferraris, 2007: 89.

Mystus menoda (non Hamilton, 1822) - Yadav, 2003: 19.

Material examined. — INDIA: ZMH 2180, holotype, 82.0 mm SL, Maharashtra: Bhima River at Wadgaon (photograph and radiograph examined); ZSI FF2532, 1 ex., 271.8 mm SL [holotype of *H. krishnensis*]; ZSI FF2533, 1 ex., 403 mm SL [paratype of *H. krishnensis*]; ZSI FF2534, 1 ex., 228.0 mm SL [paratype of *H. krishnensis*]; ZSI FF2535, 1 ex., 278.8 mm SL [paratype of *H. krishnensis*], Andhra Pradesh: Krishna River below Nagarjunasagar Reservoir; CAS 62087, 2 ex., 167.2–214.7 mm SL, Karnataka: Bellary District, Krishna River drainage, Tungabhadra River and reservoir at Hospet, Hampi and Kampli.

Diagnosis. — *Hemibagrus maydelli* is distinguished from congeners in the *H. wyckii* group in having an olive green (vs. grey) body. It further differs from *H. microphthalmus* and *H. wyckioides* in having a smaller dorsal to adipose distance

(4.0–7.0% SL vs. 8.6–14.2), and from *H. microphthalmus* in having a shorter and deeper caudal peduncle (length 15.3–16.1% SL vs. 16.4–18.1; depth 7.8–8.5% SL vs. 6.8–7.7), a longer head (30.8–32.4% SL vs. 29.4–31.0), and *H. wyckii* in having a poorly ossified dorsal spine (thinner than soft dorsal-fin rays; vs. well ossified spine at least as thick as the branched dorsal-fin rays) without (vs. with 10–12) serrations on the posterior edge, an orange (vs. grey) caudal fin without (vs. with) pale procurrent rays, a smaller dorsal to adipose distance (4.0–7.0% SL vs. 7.1–11.0), a greater post-adipose distance (14.1–14.6% SL vs. 9.3–13.6), a larger eye (diameter 12% HL vs. 8–10), and a longer maxillary barbel (reaching to at least the middle of the adipose fin base; 238–299% HL vs. reaching to the middle of the dorsal-fin base; 144–195% HL).

Description. — Biometric and meristic data as in Table 30. General description as for genus. Head extremely depressed

Table 30. Biometric and meristic data for *H. maydelli* (n = 6).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	30.8–32.4	31.5±0.58
Head width	18.9–20.5	19.6±0.68
Head depth	11.7–13.3	12.6±0.60
Predorsal distance	42.0–46.7	43.9±1.80
Preanal length	71.1–73.8	72.6±1.16
Prepelvic length	54.8–58.8	56.8±1.28
Prepectoral length	25.4–28.7	27.3±1.11
Body depth at anus	13.0–15.6	13.7±0.54
Length of caudal peduncle	15.3–16.1	15.8±0.37
Depth of caudal peduncle	7.8–8.5	8.1±0.78
Pectoral-spine length	13.6–15.3	14.2±0.86
Pectoral-fin length	17.1–19.1	18.2±1.34
Length of dorsal fin	24.4–27.3	25.8±0.27
Length of dorsal-fin base	14.4–15.2	14.8±0.67
Dorsal-spine length	11.4–12.9	12.1±0.59
Pelvic-fin length	13.9–15.5	14.8±0.96
Length of anal-fin base	10.7–13.1	11.8±1.30
Caudal-fin length	19.7–23.2	22.0±2.79
Length of adipose-fin base	14.3–20.3	16.8±0.44
Maximum height of adipose fin	4.0–5.1	4.4±1.81
Dorsal to adipose distance	4.0–7.0	8.3±1.29
Post-adipose distance	14.1–14.6	14.7±0.54
In %HL:		
Snout length	31.1–35.2	32.7±1.61
Interorbital distance	28.6–29.9	29.3±0.53
Eye diameter	11.5–12.3	11.9±0.34
Nasal barbel length	31.9–35.4	33.3±2.49
Maxillary barbel length	237.6–298.9	265.7±22.25
Inner mandibular barbel length	44.1–48.9	44.4±4.98
Outer mandibular barbel length	78.2–93.9	85.7±7.96
MERISTICS		
Dorsal-fin rays	II,7 (6)	
Anal-fin rays	iv,8 (3), v,8 (2) or iv,10 (1)	
Pelvic-fin rays	i,5 (6)	
Pectoral-fin rays	I,7 (1), I,8 (1) or I,9 (4)	
Caudal-fin rays	i,7,8,i (6)	
Branchiostegal rays	9 (6)	
Gill rakers	3+9 (6)	
Vertebrae	27+25=52 (6)	

and broad; length 30.8–32.4% SL; width 18.9–20.5% SL. Interorbital distance 29–30% HL. Eye diameter 12% HL. Body moderately compressed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then gently sloping ventrally to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose fin with moderately long base (about 1.5–2.0 times anal-fin base) and gently-sloping



Fig. 46. *Hemibagrus maydelli*, CAS 62087, 214.7 mm SL, India: Tungabhadra River.

anterior margin. Dorsal spine thin and poorly ossified, without serrations on posterior edge. Adpressed dorsal fin reaching adipose-fin origin. Pectoral spine stout, with 13–19 serrations on posterior edge. Adipose-fin origin separated from base of last dorsal-fin ray by distance of 4.0–7.0% SL. Post-adipose distance 14.1–14.6% SL. Caudal-peduncle length 15.3–16.1% SL; caudal-peduncle depth 7.8–8.5% SL. Caudal fin forked; first principal ray of upper lobe extending into a long filament; distal margin of upper and lower lobes rounded. Maxillary barbel reaching to at least middle of adipose fin base (238–299% HL). Maximum recorded size approx. 1290 mm SL (1650 mm TL; Govind & Rajagopal, 1975).

Colour. — Preserved specimens with dorsal surface of head and body brown, gradually fading to dirty white on ventral surface. Pectoral, pelvic, anal and caudal fins brown with melanophores concentrated in interradial membranes. Dorsal fin brown with melanophores evenly distributed.

Live specimens olive green with orange-tipped fins (after Ramakrishniah, 1988).

Distribution. — Known only from the middle reaches of the Krishna River drainage in southern India (Fig. 47).

Habitat and biology. — *Hemibagrus maydelli* is one of the largest species of this genus; sizes of 1650 mm TL and weights of 58 kg have been reported (Govind & Rajagopal, 1975). The Krishna River in which it occurs is fairly swift-flowing, with a sandy or pebbly bottom (Govind & Rajagopal, 1975; Jayaram, 1995).

***Hemibagrus microphthalmus* (Day, 1878)**

(Fig. 48)

Macrones microphthalmus Day, 1878: 446, Pl. 100 Fig. 4 (type locality: Irrawaddy River, Myanmar), 1889: 154; Vinciguerra, 1890: 225; Ferraris et al., 2000: 299.

Mystus (Mystus) menoda microphthalmus - Jayaram, 1954: 547; 1966: 446.

Mystus microphthalmus - Tint Hlaing, 1971: 513; Jayaram, 1977: 34; Viswanath & Singh, 1986: 197, Fig. 1; Mo, 1991: 130; Talwar & Jhingran, 1991: 566; Vishwanath et al., 1998: 323; Jayaram, 1999: 236; Jayaram & Sanyal, 2003: 80, Fig. 15; Khan, 2008: 33, Fig. 13.

Hemibagrus microphthalmus - Ukkatawewat & Vidthayanon, 1998: 46; Ng & Ferraris, 2000: 133, Fig. 8; Vidthayanon et al., 2005: 94; Ferraris, 2007: 90; Vishwanath et al., 2007: 137; Mahanta et al., 2011: 347.

Material examined. — MYANMAR: ZSI 2952, 1 ex., syntype, 138.9 mm SL, AMS B.7918 1 ex., syntype, 164.0 mm SL, Irrawaddy River; BMNH 1893.2.16.7, 1 ex., 133.5 mm SL, Myanmar; CAS

93192, 3 ex., 132.0–151.5 mm SL; USNM 44754, 1 ex., 158.7 mm SL; USNM 344670, 2 ex., 201.6–239.8 mm SL, Irrawaddy River drainage, Mandalay; NRM 13892, 1 ex., 116.1 mm SL, Mandalay division: Irrawaddy River drainage, Mandalay area; NRM 24979, 2 ex., 144.6–165.1 mm SL, Sagaing division: Irrawaddy River drainage, Shweli River; NRM 31072, 1 ex., 147.1 mm SL, Yangon division: Yangon River at Yangon.

THAILAND: CMK 14706, 1 ex., 204.6 mm SL, Tak province: Mae Nam Moei at Mae Sarid, 17°26'25"N 98°3'41"E.

Diagnosis. — *Hemibagrus microphthalmus* is distinguished from both *H. wyckioides* and *H. maydelli* in having grey (vs. red) fins in life. It differs from *H. wyckii* in having, a poorly ossified dorsal spine (thinner than soft dorsal-fin rays; vs. well ossified spine at least as thick as the branched dorsal-fin rays) without (vs. with 10–12 serrations on the posterior edge, absence (vs. presence) of pale procurrent and first principal caudal-fin rays and a grey (vs. cream) cleithral region. *Hemibagrus microphthalmus* further differs from *H. maydelli* in having a longer and less deep caudal peduncle (length 16.4–18.1% SL vs. 15.3–16.1; depth 6.8–7.7% SL vs. 7.8–8.5), a shorter head (29.4–31.0% SL vs. 30.8–32.4), a greater dorsal to adipose distance (8.6–14.2% SL vs. 4.0–7.0), a smaller eye (diameter 9–11% HL vs. 12), and from *H. wyckioides* by a narrower head (width 18.0–19.7%



Fig. 48. *Hemibagrus microphthalmus*, CMK 14706, 204.6 mm SL, Thailand: Mae Name Moei.

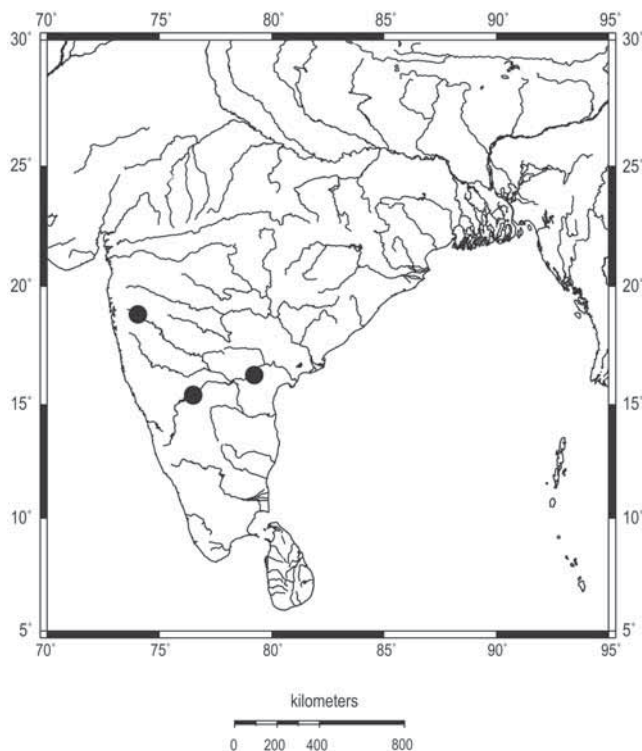


Fig. 47. Map showing collection localities of *Hemibagrus maydelli* specimens examined in this study.

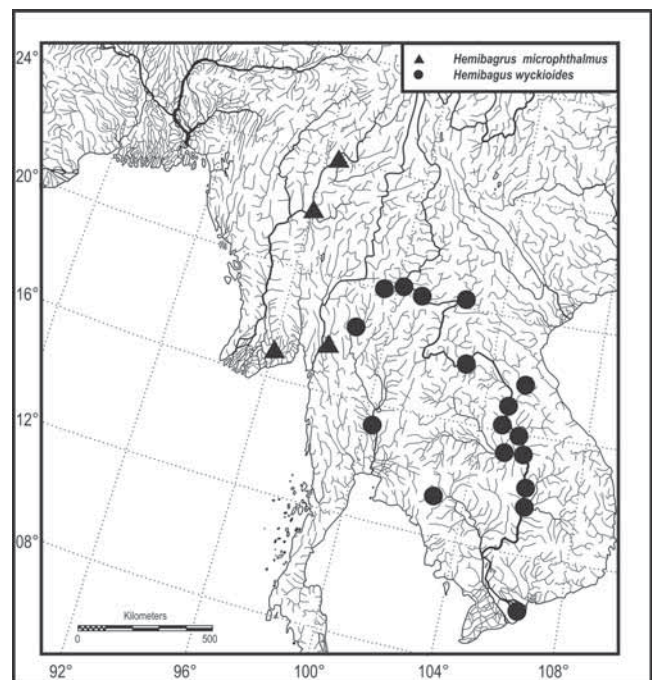


Fig. 49. Map showing collection localities of *Hemibagrus microphthalmus* and *H. wyckioides* specimens examined in this study.

Table 31. Biometric and meristic data for *H. microphthalmus* (n = 14).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	29.4–31.0	29.7±0.85
Head width	18.0–19.7	19.5±1.04
Head depth	11.2–14.0	12.8±1.13
Predorsal distance	40.6–44.1	41.8±1.44
Preanal length	70.8–74.8	72.8±1.48
Prepelvic length	53.2–55.9	54.7±1.01
Prepectoral length	25.5–28.9	27.0±1.26
Body depth at anus	10.2–14.5	12.7±1.52
Length of caudal peduncle	16.4–18.1	17.3±0.54
Depth of caudal peduncle	6.8–7.7	7.4±0.68
Pectoral-spine length	11.0–14.1	12.3±1.03
Pectoral-fin length	13.9–17.6	16.5±1.15
Length of dorsal fin	23.0–25.5	24.3±0.89
Length of dorsal-fin base	13.7–16.7	14.6±0.84
Dorsal-spine length	9.2–10.8	10.6±1.78
Pelvic-fin length	13.1–15.4	14.3±0.83
Length of anal-fin base	11.2–13.3	12.2±0.78
Caudal-fin length	19.8–23.5	21.8±1.55
Length of adipose-fin base	18.4–25.9	21.9±3.24
Maximum height of adipose fin	4.2–5.8	5.1±0.67
Dorsal to adipose distance	8.6–14.2	11.9±2.18
Post-adipose distance	12.4–16.1	14.1±0.97
In %HL:		
Snout length	32.9–34.7	33.9±1.18
Interorbital distance	28.4–31.8	30.9±1.07
Eye diameter	9.2–11.3	11.1±1.73
Nasal barbel length	19.3–35.3	27.3±5.00
Maxillary barbel length	256.4–300.6	265.1±49.13
Inner mandibular barbel length	36.0–57.6	41.7±8.50
Outer mandibular barbel length	65.8–97.2	81.1±16.03
MERISTICS		
Dorsal-fin rays	II,7 (14)	
Anal-fin rays	iv,8 (6), iii,9 (4) or iv,9 (4)	
Pelvic-fin rays	i,5 (14)	
Pectoral-fin rays	I,7 (1), I,7,i (1), I,8 (1), I,8,i (1), I,9 (6) or I,9,i (4)	
Caudal-fin rays	i,7,8,i (14)	
Branchiostegal rays	9 (4) or 10 (10)	
Gill rakers	2+9 (1), 2+10 (8), 3+7 (4) or 3+9 (1)	
Vertebrae	26+25=51 (1), 28+23=51 (1), 28+24=52 (5), 28+25=53 (5), 29+25=54 (1) or 30+24=54 (1)	

SL vs. 19.5–23.9), a smaller interorbital distance (28–32% HL vs. 32–37), a shorter dorsal-fin base (13.7–16.7% SL vs. 16.3–18.3), a longer maxillary barbel (reaching to at least the middle of the adipose fin base; 256–301% HL vs. reaching to the middle of the dorsal-fin base; 144–195% HL) and grey (vs. reddish) caudal and distal margin of dorsal fins.

Description. — Biometric and meristic data as in Table 31. General description as for genus. Head extremely depressed and broad; length 29.4–31.0% SL; width 18.0–19.7% SL. Interorbital distance 28–32% HL. Eye diameter 9–11% HL. Body moderately compressed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then gently sloping ventrally to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose fin with moderately long base (about 1.5–2.0 times anal-fin base) and gently-sloping

anterior margin. Dorsal spine thin and poorly ossified, without serrations on posterior edge. Adpressed dorsal fin reaching adipose-fin origin. Pectoral spine stout, with 9–10 serrations on posterior edge. Adipose-fin origin separated from base of last dorsal-fin ray by distance of 8.6–14.2% SL. Post-adipose distance 12.4–16.1% SL. Caudal-peduncle length 16.4–18.1% SL; caudal-peduncle depth 6.8–7.7% SL. Caudal fin forked; distal margins of upper and lower lobes rounded. Maxillary barbel reaching to at least middle of adipose fin base (256–301% HL). Maximum recorded size 1500 mm SL (Vidthayanon et al., 2005).

Colour. — Preserved specimens with dorsal surface of head and body uniform grey (live or freshly-dead specimens generally darker, fading on preservation); ventral surface of head and body dirty white; adipose fin grey, distal edge orange in life but fading to light grey on preservation; caudal

fin grey with very light grey procurrent and outer principal caudal-rays in life and on preservation; all other fins grey. Maxillary barbel white.

Distribution. — Known from the Salween (Thanlwin), Irrawaddy (Irrawaddy) and Sittang (Sittoung) River drainages in Myanmar and Thailand, and the Manipur River drainage in India (Fig. 49).

Remarks. — This species has been reported to have red fins in life by Ng & Ferraris (2000), which is in error (in part caused by confusion with *H. wyckioides*). The fins of this species are grey in life.

***Hemibagrus wyckioides* (Fang & Chaux, 1949)**

(Fig. 50)

Macrones wyckioides Fang & Chaux, in Chaux & Fang, 1949: 199, Fig. 3 (type locality: Cambodia).

Macrones rubicauda Bardach, 1959: 32a (nomen nudum).

Mystus wickii (non Bleeker, 1858) - Taki, 1968: 20.

Mystus wyckii (non Bleeker, 1858) - Taki, 1974: 57; Mai et al, 1992: 193; Jayaram & Sanyal, 2003: 117, Fig. 28.

Mystus aubentoni Desoutter, 1975: 449, Figs. 2–3 (type locality: Cambodia, Stung Treng); Kottelat, 1985: 270; Mo, 1991: 130.

Mystus wycki (non Bleeker, 1858) - Taki, 1978: 39.

Mystus nemurus (non Valenciennes, in Cuvier & Valenciennes, 1840) - Cheng & Zheng, 1987: 216, Fig. 1086; Zheng & Dai, 1999: 69, Fig. 33.

Mystus wyckoides - Kottelat, 1989: 14.

Mystus wyckioides - Cui, 1990: 163, Fig. 166; Rainboth, 1996: 144, Pl. 19, Fig. 147.

Hemibagrus wyckoides - Mo, 1991: 132.

Mystus microphthalmus (non Day, 1878) - Roberts, 1993: 42, Fig. 7; Roberts & Warren, 1994: 101.

Hemibagrus wyckioides - Kottelat, 1998: 100, Fig. 148; 2001b: 124, Fig. 332; Baird et al., 1999: 92, Fig. 202; Ng & Rainboth, 1999: 565, Figs. 10, 11b; Gaanantkul et al., 2000: 35; Ferraris, 2007: 91; Vidhayanon, 2008: 116; Zheng et al., 2009: 339; Rainboth et al., 2012: 72, Pl. 46, Figs. 948–9.

Hemibagrus microphthalmus (non Day, 1878) - Nguyễn, 2005: 361, Fig. 185.

Material examined. — **Mekong drainage:** LAOS: CAS 94877, 2 ex., 57.7–149.0 mm SL, Mekong at Ban Hang Khone, just below Khone falls; CMK 12511, 2 ex., 202.4–220.6 mm SL, Khammouan province: Nam Theun at NT2 dam site (17°59'50"N 104°57'10"E); CMK 13253, 1 ex., 81.5 mm SL, Vientiane province: confluence of Nam Leuk and Nam Ngong, 18°22'4"N 103°5'27"E; UMMZ 240596, 1 ex.: 126.1 mm SL, Bokeo province: Mekong River, 5 km upstream from Houay Xai; UMMZ 240609, 1 ex., 136.7 mm SL, Luang Prabang province: Nam Nga, about 3 km upstream from confluence with Nam Ou; USNM 317621, 1 ex., Champasak province: morning market at Muang Khong.

THAILAND: ANSP 87236, 1 ex., 95.9 mm SL, Khemerat, 16°2'N 105°12'E; CAS 61917, 7 ex., 37.9–235.2 mm SL; CAS 96788, 2 ex., 63.7–103.8 mm SL; UMMZ 213974, 2 ex., 177.9–200.9 mm SL; ZMA 120.851, 1 ex., 105.7 mm SL, fish market at Ubun Ratchathani; CAS 67223, 2 ex., 140.3–193.1 mm SL, Khong Chiam market; CAS 93280, 1 ex., 129.3 mm SL, Menam Mun, Gaeng Sa-Pu (rapids) at Phibun, 43 km E of Ubun Ratchathani; CAS 94611, 2 ex., 122.0–132.6 mm SL, mouth of Huay Ngao where it flows into

Mekong, 1 km S of Ban Chaem Pong (approx. 30 km SE of Chiang Khong); CAS 95029, 1 ex., 145.0 mm SL, Nam Kok near Tha Ton; CMK 5044, 1 ex., 115.8 mm SL, market at Nong Khai; CMK 5086, 2 ex., 142.6–155.6 mm SL, market at That Phanom; UMMZ 213968, 1 ex., 79.4 mm SL, Nakhon Phanom province: Mekong River, off Ban Tha Kai, 20 km downstream from Mukdahan, 1 km from Thai side, 5 km from Laos side; UMMZ 213971, 1 ex., 60.6 mm SL, Ubun Ratchathani province: Huay Kwang, S of Khong Chiam, 3 km up Mun River from Mekong–Mun confluence; UMMZ 213973, 1 ex., 159.2 mm SL, Ubun Ratchathani province: Khong Chiam district, Huay Kwang, 1.5 km upstream from Mun River; UMMZ 214369, 1 ex., 237.6 mm SL, Ubun Ratchathani province: Khong Chiam district, creek at Ban Tha Mui, mouth into Mekong River; USNM 348912, 1 ex., 221.5 mm SL, Ubun Ratchathani province: Mun River at Bung Wai about 7 km W of Ubun; USNM 317577, 1 ex., 158.3 mm SL, Nakhon Ratchasima province: Nai Muang, 15°14'N 104°52'E.

CAMBODIA: MNHN 1966–727, holotype, 402.2 mm SL, Cambodia. MNHN 1974–39 (1), 294.0 mm SL, Stung Treng [holotype of *Mystus aubentoni*]; MNHN 1974–38, 1 ex., 181.3 mm SL, Battambang [paratype of *M. aubentoni*]; MNHN 1974–40, 1 ex., 359 mm SL [paratype of *M. aubentoni*]; MNHN 1974–41, 1 ex., 454 mm SL [paratype of *M. aubentoni*]; MNHN 1974–42, 1 ex., 446 mm SL, Stung Treng [paratype of *M. aubentoni*]; CAS 93472, 1 ex., 82.9 mm SL, rapids in Se San or Tonlé San, 7 km upstream from Stung Treng; UMMZ 232312, 3 ex., 203.5–286.6 mm SL, Stung Treng morning market, 13°30'N 105°58'E.

VIETNAM: UMMZ 224950, 1 ex., 38.0 mm SL, Phung Ding province: S side of Can Tho Island, 3 km SE of Can Tho.

Chao Phraya drainage: THAILAND: ANSP 59398, 2 ex., 76.1–82.7 mm SL, Chiang Mai on Mae Nam Ping. ANSP 59400, 2 ex., 65.2–73.6 mm SL, Chiang Mai on Mae Nam Ping; CMK 14480, 1 ex., 159.1 mm SL, Mae Nam Chao Phraya near Uthai Thani.

Diagnosis. — *Hemibagrus wyckioides* is distinguished from congeners in the *H. wyckii* species group except *H. maydelli* in having red (vs. grey) fins. It is distinguished from *H. maydelli* in having a grey (vs. olive green) body and a greater dorsal to adipose distance (9.6–13.6% SL vs. 4.0–7.0). It further



Fig. 50. *Hemibagrus wyckioides*: a, CMK 14480, 159.1 mm SL; Thailand: Mae Nam Chao Phraya near Uthai Thani; b, Specimen about 400 mm SL (not preserved); Laos: Nam Kading drainage: Nam Theun, at Keng Sauak.

Table 32. Biometric and meristic data for *H. wyckioides* (n = 40).

	Range	Mean±SD
BIOMETRICS		
In %SL:		
Head length	28.1–31.7	29.8±1.06
Head width	19.5–23.9	20.4±1.31
Head depth	10.4–14.1	12.0±1.32
Predorsal distance	39.1–44.5	41.7±1.61
Preanal length	67.5–78.1	71.4±2.64
Prepelvic length	53.7–61.1	54.8±2.29
Prepectoral length	24.3–32.7	26.6±1.43
Body depth at anus	11.5–15.7	12.5±1.75
Length of caudal peduncle	15.4–18.9	17.5±0.68
Depth of caudal peduncle	6.7–8.1	7.5±0.66
Pectoral-spine length	11.1–15.3	13.0±1.73
Pectoral-fin length	14.9–18.8	17.3±1.17
Length of dorsal fin	21.9–30.9	26.7±1.22
Length of dorsal-fin base	16.3–18.3	15.8±1.09
Dorsal-spine length	7.5–11.4	9.5±1.80
Pelvic-fin length	13.2–15.6	14.5±0.74
Length of anal-fin base	12.0–14.6	12.9±0.76
Caudal-fin length	19.1–22.7	21.5±1.34
Length of adipose-fin base	18.7–25.7	20.7±2.69
Maximum height of adipose fin	3.9–6.9	5.3±0.82
Dorsal to adipose distance	9.6–13.6	11.3±2.95
Post-adipose distance	12.7–15.1	13.4±0.55
In %HL:		
Snout length	34.8–38.1	36.3±2.05
Interorbital distance	31.6–36.9	33.0±1.99
Eye diameter	7.9–16.1	12.1±2.80
Nasal barbel length	21.5–31.9	29.5±2.57
Maxillary barbel length	230.1–297.0	280.6±13.81
Inner mandibular barbel length	40.8–49.0	42.5±5.15
Outer mandibular barbel length	76.6–97.1	88.1±8.55
MERISTICS		
Dorsal-fin rays	II,7 (38) or II,8 (2);	
Anal-fin rays	iii,9 (1), iii,9,i (4), iii,11 (1), iv,9 (30) or v,8 (4)	
Pelvic-fin rays	i,5 (40)	
Pectoral-fin rays	I,8 (2), I,9 (32), I,10 (4) or I,11 (2);	
Caudal-fin rays	i,7,8,i (40)	
Branchiostegal rays	9 (6), 10 (28) or 11 (6)	
Gill rakers	2+8=10 (10), 3+8=11 (10), 3+9=12 (10) or 4+8=12 (10)	
Vertebrae	26+26=52 (10), 27+25=52 (20) or 27+26=53 (10)	

differs from *H. microphthalmus* by a wider head (19.5–23.9% SL vs. 18.0–19.7%), a greater interorbital distance (32–37% HL vs. 28–32) and a longer dorsal-fin base (16.3–18.3% SL vs. 13.7–16.7) and from *H. wyckii* in having a poorly ossified dorsal spine (thinner than soft dorsal-fin rays; vs. well ossified spine at least as thick as the branched dorsal-fin rays) without (vs. with 10–12) serrations on the posterior edge, absence (vs. presence) of pale procurrent caudal-fin rays, grey (vs. cream) cleithral region, and a longer maxillary barbel (reaching to at least the middle of the adipose fin base; 230–297% HL vs. reaching to the middle of the dorsal-fin base; 144–195% HL).

Description. — Biometric and meristic data as in Table 32. General description as for genus. Head extremely depressed and broad; length 28.1–31.7% SL; width 19.5–23.9% SL. Interorbital distance 32–37% HL. Eye diameter 8–16% HL. Body moderately compressed. Dorsal profile rising evenly

but not steeply from tip of snout to origin of dorsal fin, then gently sloping ventrally to end of caudal peduncle. Ventral profile horizontal to origin of anal fin, then sloping dorsally to end of caudal peduncle. Adipose fin with a moderately long base (about 1.5–2.0 times anal-fin base) and gently-sloping anterior margin. Dorsal spine thin and poorly ossified, without serrations on posterior edge. Adpressed dorsal fin reaching adipose-fin origin; dorsal fin-base length 16.3–18.3% SL. Pectoral spine stout, with 11–15 serrations on posterior edge. Adipose-fin origin separated from base of last dorsal-fin ray by distance of 9.6–13.6% SL. Post-adipose distance 12.7–15.1% SL. Caudal-peduncle length 15.4–18.9% SL; caudal-peduncle depth 6.7–8.1% SL. Caudal fin forked, upper and lower lobes rounded posteriorly; first principal ray of the upper lobe elongated, forming filament. Maxillary barbel reaching to at least middle of adipose fin base (230–297% HL) Maximum recorded size 1300 mm SL (Roberts & Jumnonthai, 1999).

Table 33. P values for bivariate analyses (ANCOVA) of the regression lines on SL of select biometric measurements for members of the *H. baramensis* species group. Figures in bold indicate significant differences. NS = no significant difference (P>0.05).

	<i>H. baramensis</i>	<i>H. sabanus</i>	<i>H. semotus</i>
Length of adipose-fin base			
<i>H. sabanus</i>	<0.0000005	—	<0.0000005
Dorsal to adipose distance			
<i>H. baramensis</i>	—	<0.0000005	<0.0000005
<i>H. sabanus</i>	<0.0000005	—	<0.0000005
Depth of caudal peduncle			
<i>H. sabanus</i>	0.005379	—	<0.0000005
Outer mandibular barbel length			
<i>H. sabanus</i>	0.00567848	—	0.00037

Table 34. P values for bivariate analyses (ANCOVA) of the regression lines on SL of select biometric measurements for members of the *H. menoda* species group. Figures in bold indicate significant differences. NS = no significant difference (P>0.05).

	<i>H. menoda</i>	<i>H. caveatus</i>	<i>H. peguensis</i>	<i>H. punctatus</i>
Length of adipose-fin base				
<i>H. punctatus</i>	NS	NS	0.033407	—
Eye diameter				
<i>H. punctatus</i>	0.021936	NS	0.000762	—

Colour. — Adult specimens with dorsal surface of head and body uniform grey (live or freshly-dead specimens generally have darker shade which tends to fade on preservation); ventral surface of head and body dirty white; adipose fin grey, distal edge orange in life but fading to light grey on preservation; caudal fin red or grey with red distal margins in life, fading to grey with very light grey procurvent and first principal caudal-rays on preservation; all other fins grey with distal portions of fin rays and inter-radial membranes occasionally orange or red in life (Fig. 50b), fading to light grey on preservation. Red colouration on fins absent in some specimens. Live colouration of juvenile specimens similar, but with white procurvent and first principal caudal-rays.

Distribution. — Known from the Mekong and Chao Phraya drainages (Fig. 49).

Habitat and biology. — *Hemibagrus wyckioides* is probably the largest Southeast Asian species of the genus, reportedly reaching sizes of up to 1300 mm TL (Roberts & Jumnonthai, 1999) and weights of up to 70 or 80 kg (Roberts, 1993). It is a predatory species feeding on shrimps, crabs and fish and is not migratory, but enters the flooded forest in the Mekong during high water (July–October; Roberts, 1993b). Specimens about 30 mm SL have been collected in April in Laos (MK, pers. obs.).

Remarks. — *Hemibagrus wyckioides* has been considered a junior synonym of *H. microphthalmus* by Roberts (1993) and Roberts & Warren (1994), evidently on the basis of similar external anatomies. However, there are differences in biometrics and fin colour as outlined above. Some of the records of *H. nemurus* from the Lancangjiang (upper Mekong) River drainage (Menglun) in Yunnan (e.g. Cheng & Zheng, 1987; Zheng & Dai, 1999) are in fact *H. wyckioides*.

DISCUSSION

The identification of *Hemibagrus* species, particularly those of the *H. nemurus* species group, has always been difficult, mainly due to the lack of well-defined characters and considerable plasticity in measurements that are useful for diagnosing other catfish species (e.g. body depth at anus). In addition, other potentially useful features normally used in diagnosing catfish species are not useful in *Hemibagrus* because of either extreme variation (such as colour), or close similarity (such as the number of serrations on the pectoral spine).

In this study, other taxonomic characters have been investigated to determine their usefulness in distinguishing species. We found that biometric characters associated with the adipose fin (length of adipose-fin base, dorsal to adipose distance, and shape of adipose fin), head (shape of snout and head width relative to its length) and eye (eye diameter and interorbital distance) are characters useful in diagnosing species. Bivariate analyses (ANCOVA) of the regression lines of these biometric measurements on SL are significantly different (given the number of taxa used in the analysis, it is not possible to display the biplots). The P values of the analyses are given in Tables 33–38, and only regression lines that are significantly different are indicated therein. It was also found that *Hemibagrus* species can be sexed by the size and shape of the genital papilla (males have a relatively large, elongate papilla, while females have a relatively small and conical papilla), but are otherwise not sexually dimorphic. In the *H. planiceps* species group, the size and shape of the male genital papilla may be useful as a character diagnostic at the species level.

Some general biogeographic patterns already observed in other freshwater teleost groups can be discerned within

Table 35. P values for bivariate analyses (ANCOVA) of the regression lines on SL of select biometric measurements for members of the *H. nemurus* species group. Figures in bold indicate significant differences. NS = no significant difference (P>0.05).

	<i>H. nemurus</i>	<i>H. capitulum</i>	<i>H. filamentus</i>	<i>H. fortis</i>	<i>H. hoevenii</i>	<i>H. spilopterus</i>
Maximum adipose-fin height						
<i>H. filamentus</i>	NS	NS	—	0.00049178	NS	NS
Adipose-fin base length:height ratio						
<i>H. fortis</i>	0.00001012	NS	NS	—	NS	0.00003324
Dorsal to adipose distance						
<i>H. filamentus</i>	0.00027007	NS	—	NS	NS	0.000602
HW:HL ratio						
<i>H. filamentus</i>	0.00000264	0.00248199	—	NS	NS	NS
Eye diameter						
<i>H. nemurus</i>	—	NS	NS	< 0.00000005	NS	< 0.00000005

Table 36. P values for bivariate analyses (ANCOVA) of the regression lines on SL of select biometric measurements for members of the *H. planiceps* species group. Figures in bold indicate significant differences. NS = no significant difference (P>0.05).

	<i>H. planiceps</i>	<i>H. bongan</i>	<i>H. divaricatus</i>	<i>H. gracilis</i>	<i>H. lacustrinus</i>	<i>H. velox</i>
Length of dorsal spine						
<i>H. planiceps</i>	—	NS	< 0.00000005	NS	NS	NS
Length of adipose-fin base						
<i>H. divaricatus</i>	< 0.00000005	0.000003	—	0.000914	0.00010978	NS
<i>H. lacustrinus</i>	NS	NS	0.00010978	0.00011701	—	0.00133972
Adipose-fin base length:height ratio						
<i>H. divaricatus</i>	NS	NS	—	NS	0.00017270	NS
Dorsal to adipose distance						
<i>H. lacustrinus</i>	0.03715959	0.00000651	0.00004702	0.00347058	—	0.00023496
Body depth at anus						
<i>H. bongan</i>	0.000007	—	NS	NS	0.00154247	NS
Depth of caudal peduncle						
<i>H. planiceps</i>	—	NS	NS	0.000255	NS	0.000422
<i>H. gracilis</i>	0.000255	NS	0.023156	—	0.03431702	NS
Snout length						
<i>H. gracilis</i>	0.000636	0.001007	NS	—	NS	NS
Eye diameter						
<i>H. divaricatus</i>	NS	NS	—	NS	0.04239378	NS
Interorbital distance						
<i>H. planiceps</i>	—	0.000022	NS	NS	0.03726689	NS
Maxillary barbel length						
<i>H. planiceps</i>	—	0.000008	0.000018	< 0.0000005	NS	NS
<i>H. bongan</i>	0.000008	—	NS	NS	NS	0.039392
Inner mandibular barbel length						
<i>H. bongan</i>	NS	—	0.010257	0.002375	NS	0.014933

Table 37. P values for bivariate analyses (ANCOVA) of the regression lines on SL of select biometric measurements for members of the *H. pluriradiatus* species group. Figures in bold indicate significant differences. NS = no significant difference (P>0.05).

	<i>H. pluriradiatus</i>	<i>H. centralus</i>	<i>H. hainanensis</i>	<i>H. imbrifer</i>	<i>H. variegatus</i>
Length of adipose-fin base					
<i>H. pluriradiatus</i>	—	NS	NS	0.014156	NS
<i>H. centralus</i>	NS	—	0.001176	NS	NS
Dorsal to adipose distance					
<i>H. pluriradiatus</i>	—	<0.0000005	NS	NS	NS
Eye diameter					
<i>H. pluriradiatus</i>	—	NS	0.006414	NS	0.008082
Interorbital distance					
<i>H. pluriradiatus</i>	—	0.035624	NS	NS	NS

Table 38. P values for bivariate analyses (ANCOVA) of the regression lines on SL of select biometric measurements for members of the *H. wyckii* species group. Figures in bold indicate significant differences. NS = no significant difference (P>0.05).

	<i>H. wyckii</i>	<i>H. maydelli</i>	<i>H. microphthalmus</i>	<i>H. wyckioides</i>
Length of dorsal-fin base				
<i>H. wyckioides</i>	0.000003	NS	0.008714	—
Dorsal to adipose distance				
<i>H. maydelli</i>	0.000458	—	0.03426	NS
Post adipose distance				
<i>H. wyckii</i>	—	0.001308	NS	NS
Depth of caudal peduncle				
<i>H. microphthalmus</i>	<0.0000005' 0.004341	—	NS	
Head length				
<i>H. maydelli</i>	NS	—	0.000076	NS
Head width				
<i>H. microphthalmus</i>	NS	NS	—	0.026236
Eye diameter				
<i>H. maydelli</i>	0.000002	—	0.048244	NS
Interorbital distance				
<i>H. microphthalmus</i>	NS	NS	—	0.011563

the genus, particularly among the Southeast Asian species. Material identified as *H. nemurus* from throughout mainland and Sundaic Southeast Asia in the older literature is found to consist of six distinct species, with none in common between mainland and Sundaic Southeast Asia. Such a dichotomy in species composition frequently occurs in freshwater teleosts of the region (e.g. Ng & Kottelat, 2004), and it is hypothesized that this is due to widespread colonization in the early Pleistocene, and rising sea levels that eventually drowned the lower courses of the North Sunda River and separated the drainages between mainland and Sundaic Southeast Asia (McConnell, 2004). However, there is genetic evidence that introgression may have occurred in the late Pleistocene (Dodson et al., 1995; McConnell, 2004).

Recent reconstructions of river drainages in South and East Asia (e.g. Brookfield, 1998; Clark et al., 2004) have provided plausible hypotheses of vicariant biogeography for *Hemibagrus* that await further testing: for instance, the similarities between the Red and Yangtze River species (members of the *H. guttatus* species group are found in both drainage systems) are hypothesized to be due to the upper Yangtze River system being formerly part of a much larger Palaeo-Red River drainage (Clark et al., 2004). Similarly, the similarities between the *Hemibagrus* of the Irrawaddy

and the Ganges-Brahmaputra drainages (members of the *H. menoda* and *H. wyckii* species groups are found in both systems) are hypothesized by the former connection between the Tsangpo (upper Brahmaputra) and the Irrawaddy River drainages (Brookfield, 1998; Clark et al., 2004).

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