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A REVIEW OF THE EEL-LOACHES OF THE GENUS *PANGIO* (TELEOSTEI: COBITIDAE) FROM THE MALAY PENINSULA, WITH DESCRIPTIONS OF SIX NEW SPECIES

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ABSTRACT. - Ten species of *Pangio* occur in the Malay Peninsula: *P. anguillaris*, *P. cuneovirgata*, *P. doriae*, *P. kuhlii*, *P. malayana*, *P. oblonga*, *P. shelfordii*, and the new species *P. alcoides*, *P. filinaris*, and *P. piperata*. *Pangio alcoides* is distinguished by a high vertebral count, a very small eye, and a peculiar colour pattern (usually white belly and black dorsum); *P. filinaris* by a plain brown body and a nasal barbel, *P. piperata* (which also occurs in Sumatra) by a brown body with fine black dots forming small blotches along dorsal midline and a relatively low vertebral count. Three additional new species are described from Borneo: *P. alternans* from the Mahakam basin, Borneo, is distinguished by its colour pattern of alternating blotches on lower half of body and bars and by its low vertebral count; *P. incognito* (which occurs syntopically with *P. shelfordii* in Sarawak) by a low vertebral count and details of coloration; *P. pulla* from Kalimantan Tengah, Borneo, by the absence of pelvic fins, its colour pattern consisting of broad black bars and narrow interspaces, and a high vertebral count. *Pangio malayana* and *P. myersi* (from southeastern Thailand) are removed from the synonymy of *P. kuhlii* and considered valid species; *P. muraeniformis* is considered a synonym of *P. shelfordii*; *P. borneensis* is possibly a senior synonym of *P. shelfordii* but its status cannot be solved without new collections. *Pangio shelfordii*, *P. cuneovirgata*, *P. doriae* and *P. superba* are recorded for the first time from Sumatra. Neotypes are designated for *Acanthophthalmus fasciatus* Bleeker, 1860, *Cobitis oblonga* Valenciennes, 1846, and *A. javanicus* Bleeker, 1860.

INTRODUCTION

Loaches of the genus *Pangio* are small to very small fishes, with an elongate to very elongate body. The different species inhabit a variety of habitats (but the different species are usually associated with a single type of preferred habitat) ranging from moderately swift to almost standing water, occurring from India and southern Viet Nam to Java. Some of them are commonly collected and exported as aquarium fishes and are often inappropriately called 'coolie loaches' in the aquarium literature, a depreciative alteration of the specific name of H. Kuhl. We think that the perpetuation of such a disformation of a personal name has to be avoided and we are calling these fishes eel-loaches hereunder. Other proposed vernacular names for the genus are confusing and inappropriate for a variety of reasons.

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Although recognition of individual species has usually not been difficult for field workers, a substantial number of secondary publications (aquarium literature, etc.) gives the impression of a rather chaotic systematics. We believe that this is mostly due to a lack of familiarity with the geographic area concerned and its fauna, access to limited material without reliable locality information, etc. The apparent nomenclatural instability is partly due to some of the early original descriptions, but is in our opinion mostly due to: a) the accumulation of contradictory accounts and identifications based on a few old and poorly preserved and documented museum specimens; b) lack of serious tracking and checking of original accounts and old literature; c) insufficient perception of the variability of colour patterns resulting from lack of field experience and access to small series only.

The recent publication by Burridge (1992) on some of the barred species seems to have solved the problem of the identity of the type species *P. kuhlii*, but several of her conclusions suffer from insufficient evidence. We therefore find it timely to present the following synopsis of the eel-loaches of the Malay Peninsula (Singapore, West Malaysia and Thailand south of the Isthmus of Kra) and to incorporate notes on the systematics of species from adjacent areas. We take this opportunity to present the diagnosis of six new species from West Malaysia and Indonesia.

We do not regard the present article as a definitive revision. However, its publication is justified to make data available which are needed as background for inclusion in a book on Malayan fishes in preparation. Several problems could not be solved within the frame of this paper and we consider it also useful to pinpoint areas where more work is still needed.

MATERIALS AND METHODS

Measurements and counts follow methods explained in Kottelat (1990). For specimens smaller than about 30 mm SL, measurement of head parts were obtained from camera lucida drawings. Head length used in this paper is lateral head length. Fin-ray counts for unpaired fins were obtained from x-rays where possible; in several species, fin bases are deeply embedded in adipose tissues and rudimentary and simple rays were difficult to count with accuracy. Vertebral counts follow Roberts (1989). In the synonymy, for all nominal species we list primary types with catalogue numbers when examined or when communicated by the institution where they are lodged; in case of large syntypes series, we list only those which we have been able to locate (we made no effort to find missing syntypes).

Species of *Pangio* are often difficult to handle and to measure with accuracy: their body is usually very smooth, often twisted even in the best prepared collections, often also soft and easily disformed; several species typically fix in an arched shape (see figures) and the anterior part of the head is very easily disformed, even with very careful handling. As a result, morphometric data are not easy to collect and difficult to repeat with accuracy, thus losing their diagnostic value. Therefore we measured only a few specimens, and we provide theses values here only when they are based on reasonably straight specimens; these values are merely meant as an indication on body shape and to characterize the holotypes. Additional specimens were measured, case by case, when needed for peculiar diagnostic characters.

Abbreviations used are: BMNH, Natural History Museum, London; CAS, California Academy of Sciences, San Francisco; MCSNG, Museo Civico di Storia Naturale, Genova; MNHN, Muséum National d'Histoire Naturelle, Paris; MZB, Muzium Zoologicum Bogoriense, Bogor,

West Java, Indonesia; SM, Sarawak Museum, Kuching; ZMA, Zoölogisch Museum, Amsterdam; ZMB, Zoologisches Museum, Berlin; ZRC, Zoological Reference Collection, National University of Singapore. CMK is the first author's collection, whose primary types are presently under the care of the ZRC.

Comparison material.- *Pangio mariarum*: paratypes - 5 ex. (ZRC 941), tributary of Sg. Kinabatangan at Deramakot, Kinabatangan District, Sabah, Borneo, coll. R. F. Inger & P. K. Chin, 2.v.1956. — 7 ex. (CMK 9468), Sungei Bantul at Bantul logging camp, Sebuku basin, Kalimantan Timur, Borneo, 4°8'54"N 116°48'18"E, coll. M. Kottelat & P. McKee, 10.ii.1993. *Pangio myersi*: 1 ex. (CAS 79098), ca 19 km from junction with highway 3, large river on highway 3245, Chantaburi Prov., Thailand, coll. T. R. Roberts, 11.xii.1990. *Pangio superba*: 2 ex., juv. (CMK 8293), 54.3 km after bridge over north branch of Kampar, Sungei Paku, road from Pekanbaru to Renggat, Kampar Kiri basin, Riau, Sumatra, coll. M. Kottelat & R. Dudley, 4.iv.1992. *Pangio agma*: 1 ex. (ZRC 8408), Sg. Tapah from sawah swamp, Long Lama, Sarawak, coll. D. Watson, 6.viii.1981. — 3 ex. (ZRC 31934-31936), Sg. Barun near Barun waterworks, Tutong District, Brunei, coll. K. Lim & S. C. Choy, 14.v.1993.

TAXONOMY

Pangio Blyth, 1860

Pangio Blyth, 1860: 169 (type species: *Pangio cinnamomea* Blyth, 1860, by monotypy). Gender: feminine.

Acanthophthalmus Bleeker, 1863: 364 (type species: *A. fasciatus* Bleeker, 1863 = *Cobitis kuhlii* Valenciennes, in Cuvier & Valenciennes, 1846, by original designation). Gender: masculine. Non *Acantophthalmus* van Hasselt, 1823, non *Acanthophthalmus* van Hasselt, 1824.

Eucirrhichthys Perugia, 1892: 1009 (type species: *E. doriae* Perugia, 1892, by monotypy). Gender: masculine.

Cobitophis Myers, 1927: 4 (type species: *Acanthophthalmus anguillaris* Vaillant, 1902, by original designation). Gender: masculine.

Diagnosis. - *Pangio* is distinguished from all other genera of the family Cobitidae by its very slender to anguilliform body, compressed to very compressed, by the position of the dorsal fin whose origin is conspicuously behind the pelvic origin (vs. in front, above or slightly behind) and more vertebrae (31-52 + 12-20 = 45-71, vs. 20-29 + 8-15 = 28-43; see Roberts (1989: tab. 4) and Kottelat & Lim (1992: tab. 1) for data on various genera).

Remarks. - The reader is referred to Burridge (1992) for a generic description and discussion of sexual dimorphism with which we generally agree. In all species but *P. alcoides, P. incognito* and *P. pulla*, we have observed that the second pectoral ray, and sometimes also the third, are much thicker than the other rays in specimens assumed to be males, while they are all the same size in females. In most species, the pectorals and the pelvics are longer in males than in females; in *P. piperata* they are about twice longer in males than in females. In some (preserved) specimens of *P. shelfordii* and *P. piperata*, the tip of the modified ray is slightly turned upwards. In *P. doriae*, *P. anguillaris* and *P. mariarum*, the whole fin is curled.

Within *Pangio*, Burridge (1992) recognized at least two complexes: the *kuhlii* complex (defined by the pattern of dark bars) and the *shelfordii* complex (defined by the presence of a pair of "labial barbels"). We have not investigated relationships within *Pangio*, but we tentatively divide the genus into four groups by general appearance. We recognize the following

species groups: *kuhlii*, *shelfordii*, *oblonga* and *anguillaris*. The *kuhlii* and *shelfordii* groups follow the definition of Burridge (1992) but, in addition to the characters she mentions, the *shelfordii* group is characterized by a dark bar at caudal base, several rows of spots on caudal fin, and a slender caudal peduncle. The *oblonga* group includes those species with a plain body, 8-9 pectoral rays, 45-51 vertebrae and conspicuous adipose dorsal and ventral keels on the caudal peduncle. The *anguillaris* group includes those species with a high vertebral count and a vermiform body. Species of the *anguillaris* group all have curled male pectoral fins. This character is also observed in *P. mariarum*, a species with a quite slender body but with a low vertebral count fitting with those observed in the *oblonga* group.

We tentatively place *P. alcoides* in the *kuhlii* group on the base of the presence of dark bars or saddles in a few specimens and the absence of labial barbels, but we are not sure that it is closely related to the other species of the group. For the same reasons, *P. alternans* is placed in the *kuhlii* group with which it also shares the general body shape, although the type of colouration is reminiscent of some populations of *P. shelfordii*.

The position of *P. pulla* is even more enigmatic and we place it in the *anguillaris* group for convenience as they share the high vertebral count. But *P. pulla* shows a very distinctive colour pattern and body shape possibly closer to the *kuhlii* group; males are not presently available, but we suspect that they will not have the curled pectoral fins of the *anguillaris* group.

Myers (1929) created the genus *Cobitophis*, with *P. anguillaris* as type species, for the very elongated species. The gap between the elongated *P. anguillaris* and the less elongated *kuhlii* and *oblonga* groups is now linked by a variety of species more or less vermiform and it does not seem justified to recognized a genus on the basis of this single character. Perugia (1892) created *Eucirrhichthys* for *P. doriae*, another elongated species which reportedly had scaled cheeks. Roberts (1989: 97) commented that the presence or absence of cheek scales is not significant and cannot be used to define a genus in the Cobitidae. We have seen cheek scales only in a few large specimens of *P. doriae*. Weber & de Beaufort (1916: 26) have illustrated one of the *P. doriae* syntypes with scaled cheeks.

Without a detailed analysis of interrelationships within the species we assign to *Pangio*, it seems premature to formally recognized some of the groups as distinct genera or subgenera. It is likely that the *anguillaris* group (with the exception of *P. pulla*) could be recognized as a distinct monophyletic lineage, but at least one of the characters presently available (high vertebral count and curled male pectoral) appeared independently in different groups: *P. pulla* has the high vertebral count, a deep body and a distinctive colour pattern, while *P. mariarum* has a slender body and a low vertebral count.

KEY TO THE SPECIES OF *PANGIO* IN THE MALAY PENINSULA BASED ON MALAYAN MATERIAL

1a. Body plain brown or very finely peppered 2
b. Body with contrasting black bars or blotches on a white to pinkish or yellowish background, or with upper half of body black and belly white 6

2a. Anterior nostril pierced at the anterior base of a long nasal barbel 3
b. Posterior rim of anterior nostril not produced into a nasal barbel 4

3a. Body elongated, worm-like, its depth 16-21 times in SL; 46-49 + 15-18 = 62-67 vertebrae ..... *P. doriae*
b. Body comparatively deep, its depth 8-10 times in SL; 33-36 + 12-14 = 45-49 vertebrae ..... *P. filinaris*

4a. Body elongated, worm-like, its depth 14-18 times in SL; 50-52 + 19-20 = 69-71 vertebrae ..... *P. anguillaris*
b. Body depth 7-11 times in SL; 31-33 + 12-16 = 45-49 vertebrae 5

5a. Body comparatively deep, its depth 7-8 times in SL; body uniformly brown when preserved, reddish and somewhat translucent in life; 33-35 + 12-13 = 45-47 vertebrae ..... *P. oblonga*
b. Body slender, its depth 9-11 times in SL; body background whitish, finely peppered with very closely set greyish black dots, sometime with a series of small black saddles along dorsal mid-line; body not translucent in life; 31-35 + 13-16 = 46-49 vertebrae ..... *P. piperata*

6a. Anterior nostril pierced at the anterior base of a long nasal barbel; colour pattern consisting of 7-13 short saddles restricted to the dorsal half of body and a black bar at caudal fin base; caudal hyaline, without marking; dark epaxial stripe conspicuous; caudal truncate ..... *P. cuneovirgata*
b. Posterior rim of anterior nostril not produced into a nasal barbel; colour pattern different; if colour pattern similar to above then caudal conspicuously emarginate and bars on caudal peduncle irregular, narrower and reaching almost ventral midline 7

7a. Dorsal half of body usually entirely black, seldom with a barred colour pattern; 39-40 + 12-16 = 51-55 vertebrae ..... *P. alcoides*
b. Body barred or mottled; 32-37 + 12-16 = 45-51 vertebrae 8

8a. Caudal fin hyaline and emarginate, caudal base with a slender dark bar ..... *P. malayana*
b. Caudal fin either with a large black basal blotch or several vertical rows of dark pigment on rays 9

9a. Colour pattern consisting in 6-10 bars, usually irregular, with a dark large quadrangular blotch occupying the proximal half of caudal fin; head with two dark bars (not including blotch on snout); median lobe of lower lip not produced into a barbel; 34-37 + 12-15 = 47-51 vertebrae ..... *P. kuhlii*
b. Colour pattern consisting in a more or less conspicuous mid- lateral series of irregular blotches, sometimes forming a mid-lateral stripe; back finely mottled (Singapore, Johor), or colour pattern consisting in a series of black midlateral blotches alternating or connected with a series of middorsal saddles (Terengganu); a vertical black blotch at caudal base; caudal mottled; head with three dark bars (not including blotch on snout); median lobe of lower lip produced into a labial barbel; 32-36 + 14-16 = 46-51 vertebrae ..... *P. shelfordii*

Pangio alcoides, new species

(Fig. 1)

Material examined. - Holotype - (39.3 mm SL), (ZRC 17209), stream at 154 km stone to Kuantan from Kuala Terengganu, Rantau Abang, Terengganu, Malaysia, coll. K. Lim, 11.ix.1991 (Fig. 1a).

Paratypes - 5 ex. (25.6-35.8 mm SL), (ZRC 17210-17214), same data as holotype. — 1 ex. (30.9 mm SL), (ZRC 24690), swamp at km 56 on Kuantan - Kuala Terengganu road, Rantau Abang, Terengganu, Malaysia, coll. T. H. T. Tan & D. S. L. Chung, 3-5.viii.1992. — 1 ex. (ZRC 34914), 2 ex. (CMK 8242), (23.0-27.8 mm SL), pool at km 94 on road from Kuala Terengganu to Kota Bahru, south of Jerteh, Terengganu, Malaysia, 5°32'38"N 102°43'44"E, coll. M. Kottelat & P. K. L. Ng, 19.iii.1992. — 1 ex. (31.2 mm SL), (CMK 8511), pool ca. 50-55 km from Kota Tinggi on road to Mersing, Johor, Malaysia, coll. M. Kottelat, P. K. L. Ng *et al.*, 24.vii.1992.

Diagnosis. - *Pangio alcoides* is distinguished by its peculiar colour pattern, usually consisting of a white ventral half and a black dorsal half, seldom with 8-11 saddles. Further, it is distingued from all congeners in having the unique vertebral count 39-40 + 12-16 = 51-55. Additional useful characters are the small eye (ca. 1.0 % SL, 7 % HL), the lower lip interrupted medially, each half triangular with only a shallow median lobe (vs. well developed in other species), not ending into a barbel-like pointed tip.

Description. - General body shape and appearance are shown in Figure 1. All specimens twisted and very soft, so that measurements are difficult to duplicate. Therefore, only the morphometric data of the holotype (39.3 mm SL) are given here: total length 109.4% SL; head length 14.8% SL; predorsal length 69.5% SL; prepelvic length 58.8% SL; preanal length 75.8

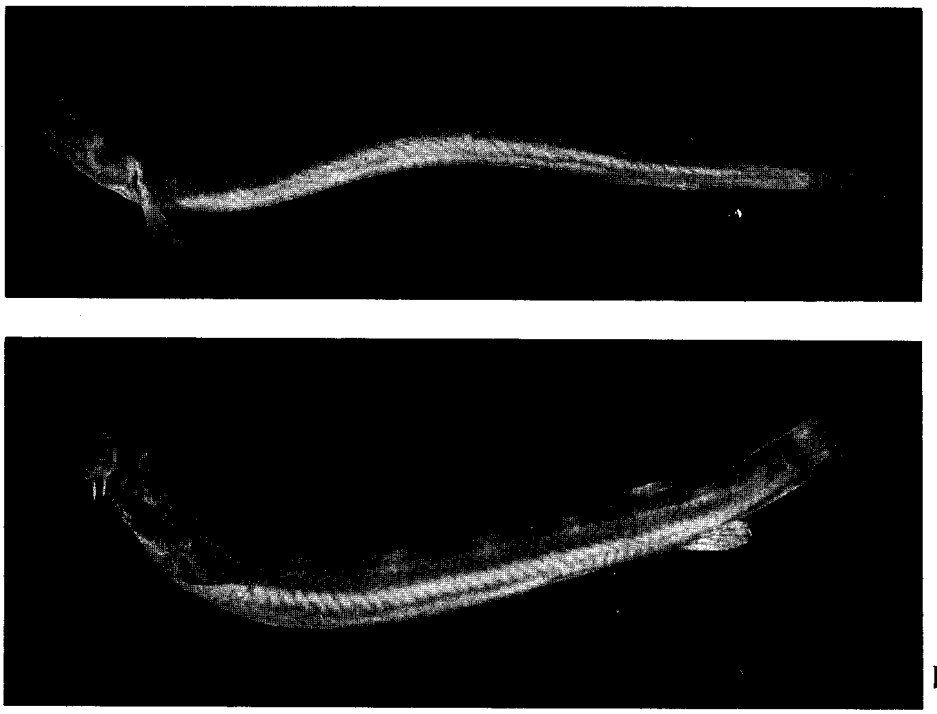


Fig. 1. *Pangio alcoides*. a, ZRC 17209, holotype, 39.3 mm SL, Rantau Abang, Terengganu; b, CMK 8242, paratype, 23.7 mm SL, Jerteh, Terengganu.

% SL; body depth at dorsal origin 9.4% SL; depth of caudal peduncle 7.6% SL; length of caudal peduncle 15.3% SL (2.0 times its depth); body width 4.1% SL; length of pelvic fin 7.6% SL; length of pectoral fin 9.2% SL; snout length 5.1 of SL, ca. 34% HL; eye diameter 1.0% SL, ca. 7% HL.

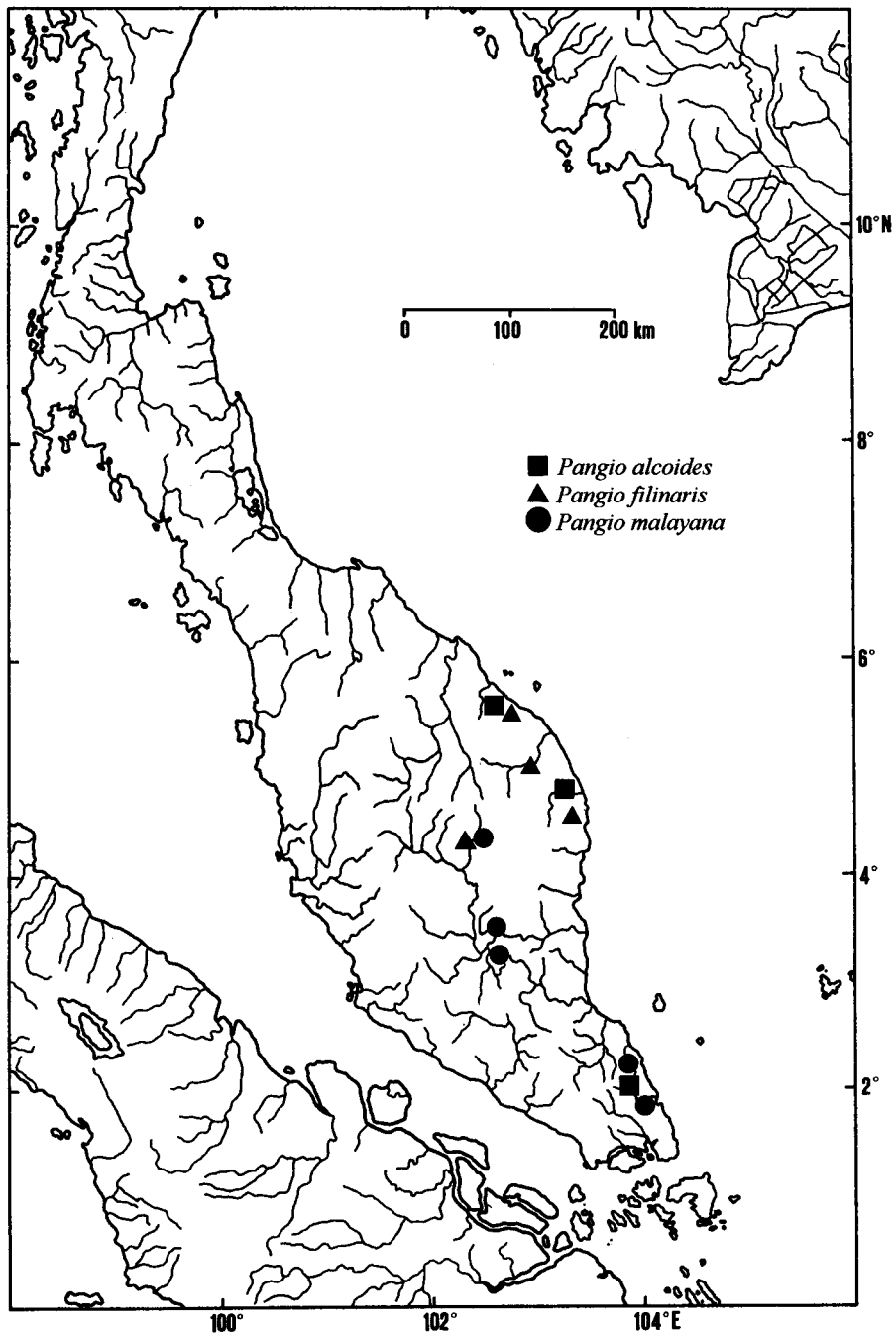


Fig. 2. Malay Peninsula showing distribution of *Pangio alcoides*, *P. filinaris* and *P. malayana*. One symbol may represent several adjacent localities. Based on examined material.

Dorsal fin with 2 rudimentary, 1 simple and 6-7 branched rays, last one split to the base; first dorsal pterygiophore inserted behind vertebrae 34-35. Pectoral fin with 11 rays; males have a much enlarged ray 2 and a somewhat enlarged ray 3. Pelvic fin with 6-7 rays, origin of first ray below vertebral centra 29-30. Anal fin inserted almost immediately behind vent, with 2 rudimentary, 1 simple and 5-6 branched rays, last one split to the base; first anal pterygiophore 39-40. Caudal fin squarish, with 8+8 principal rays (7+7 branched).

Body entirely scaled, except belly between pectoral bases. Head naked. Suborbital spine bifid, outer branch straight, inner branch sligthly curved, conspicuously longer and stronger than outer one. Three pairs of barbels, two pairs of rostral ones and one at each angle of mouth reaching about vertical of eye. Lower lip interrupted medially, each half having the appearance of a triangular flap with only a very low inner thickened lobe and not ending into a barbel-like pointed tip; margin of membrane connecting this lobe and the barbel at corner of the mouth entire. Anterior nostril at the front side of a short conical tube, reaching at most middle of eye.

Vertebrae: 39-40+12-16 = 51-55 (Table 1). Vertebrae 5 to 32-35 bear pleural ribs.

Colouration. - Dorsal half of body dark brown to blackish, belly white to yellowish. A slightly darker epaxial stripe from head to caudal base. Head yellowish brown, with a small darker spot at tip of snout, and a dark transverse line between eye and on nape, extending laterally into faint bars. Fins hyaline.

One of the Rantau Abang paratype (the smallest one) has a fainter dorsum colouration interrupted by 11 paler areas. Similarly, 2 of the 3 small paratypes from Jerteh have 7 and 8 white marks along the dorsum (Fig. 1b).

In life, general coloration was dark grey.

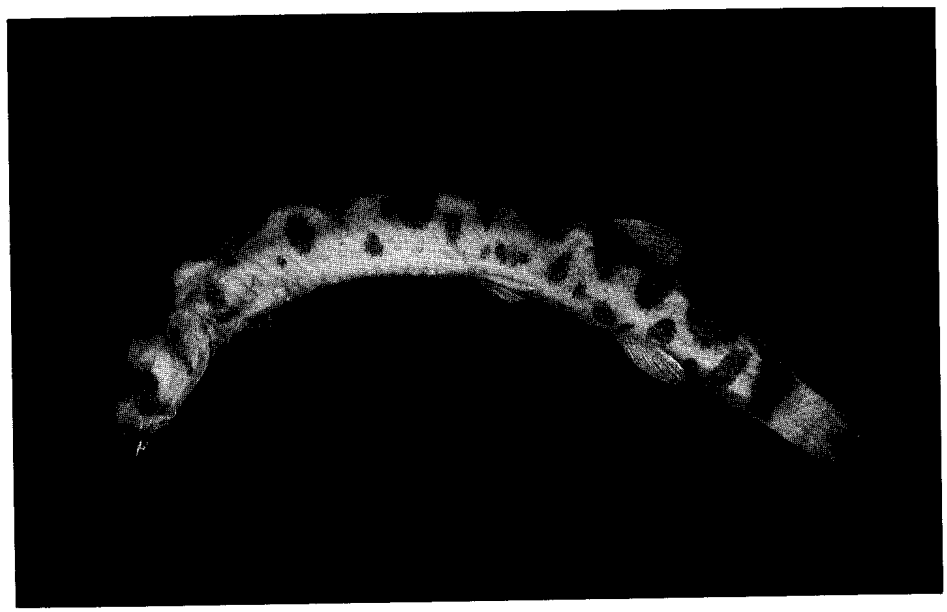
Habitat and distribution. - This species has been collected in shallow, black or brown water swamps in Terengganu and Johor (Fig. 2), in open areas.

Etymology. - The specific name is based on *Alca torda*, the small penguin, an allusion to the black dorsum and white belly of most specimens. An adjective.

Pangio alternans, new species
(Fig. 3)

Material examined. - Holotype - (30.4 mm SL), (MZB 5895), unnamed blackwater stream entering the Mahakam R. on the left side near Mujub, Mahakam R. basin, Kalimantan Timur, Borneo, 0°01'S 115°43'E, coll. M. Kottelat, 3.viii.1991 (Fig. 3a).

Paratypes - 6 ex. (25.1-27.9 mm SL), (CMK 7757), same data as holotype. — 7 ex. (18.9-36.2 mm SL), (CMK 7737), Sungei Mudjan, a tributary of Mahakam R. near Tring, Mahakam R. basin, Kalimantan Timur, Borneo, 0°04'S 115°37'E, coll. M. Kottelat, 3.viii.1991. — 24 ex. (CMK 7782,), 10 ex. (MZB 5896), 10 ex. (ZRC 35037-35046), (17.2-33.8 mm SL), Sungei Behernas, a blackwater tributary of Mahakam R. immediately upriver of Merimun, Mahakam R. basin, Kalimantan Timur, Borneo, 0°05'S 115°47'E, coll. M. Kottelat, 4.viii.1991.



a

b

Fig. 3. *Pangio alternans*, Mahakam basin, eastern Borneo. a, MZB 5895, holotype, 30.4 mm SL; b, CMK 7737, paratypes, 36.1 and 21.7 mm SL.

Diagnosis. - *Pangio alternans* is distinguished from all other congeners by its distinctive body colour pattern consisting of 6-9 irregular triangular saddles along dorsal midline alternating with a row of irregularly shaped spots on middle or lower half of body. It has less vertebrae than other members of the *kuhlii* group (32-34 + 13-15 = 45- 48, vs. 34-40 + 12-16 = 47-55).

Description. - General body shape and appearance are shown in Figure 3. All large size specimens are stongly arched, so that measurements are difficult to duplicate. Morphometric data of holotype (30.4 mm SL) are given here, only with indicative value: total length 118.1 % SL; head length 19.4 % SL; predorsal length 77.3 % SL; prepelvic length 57.9 % SL; preanal length 82.2 % SL; body depth at dorsal origin 12.8 % SL; depth of caudal peduncle 9.5 % SL; length of caudal peduncle 17.4 % SL (1.83 times its depth); body width 6.6 % SL; length of pelvic fin 7.6 % SL; length of pectoral fin 10.5 % SL; snout length 7.2 % SL, 34 % HL; eye diameter 2.6 % SL, 14 % HL.

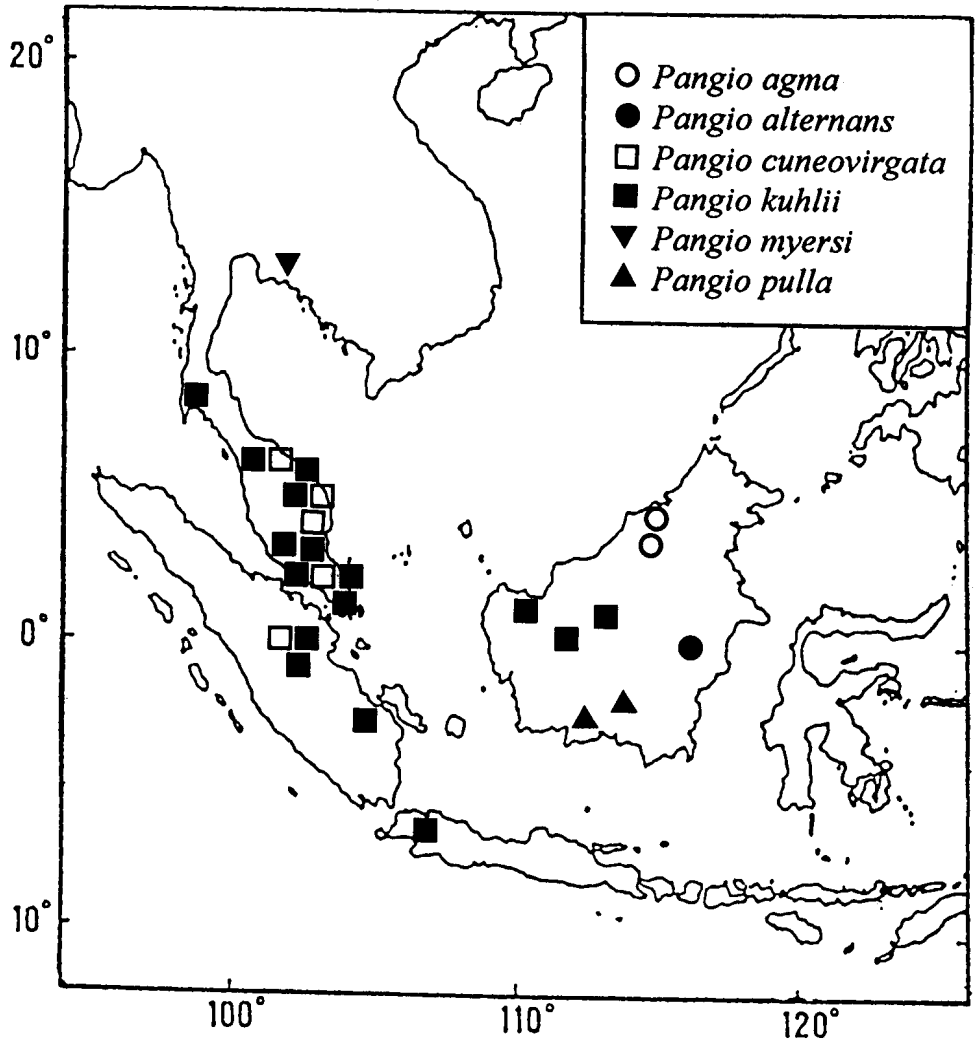


Fig. 4. Southeast Asia showing distribution of *Pangio agma*, *P. alternans*, *P. cuneovirgata*, *P. kuhlii*, *P. myersi* and *P. pulla*. One symbol may represent several adjacent localities. Based on examined material.

Dorsal fin with 2 rudimentary, 1 simple and 6 branched rays, last one split to the base. First dorsal pterygiophore inserted behind neural spine of vertebrae 27-29 (mode 28). Pectoral fin with 10-11 rays. Second ray of largest specimen (CMK 7737, 36.2 mm SL, presumptive male) about thrice thicker than other rays. Pelvic fin with 7 rays, origin of first ray below vertebral centra 22-23. Anal fin inserted almost immediately behind vent, with 2 rudimentary, 1 simple and 5 branched rays, last one split to the base; first anal pterygiophore inserted behind hemal spine of vertebrae 32-34. Caudal emarginate, fin with 8+8 principal rays (7+7 branched).

Body entirely scaled, except belly between pectoral bases. Head naked. Suborbital spine bifid, outer branch straight, inner branch slightly curved, longer and stronger than outer one. Three pairs of barbels, two pairs of rostral ones and one at each angle of mouth reaching slighthly behind eye. Lower lip interrupted medially, each half with an inner thickened lobe, not ending in a barbel-like pointed tip; margin of membrane connecting this lobe and the barbel at corner of the mouth fringed entire or with 1 or 2 shallow notches. Anterior nostril at the tip of a short conical tube, not barbel-like.

Vertebrae: 32-34+13-15 = 45-48 (Table 1). Vertebrae 5 to 23 with pleural ribs.

Colouration. - Body light greyish white, with 6-9 black irregular triangular saddles along mid-dorsal line, usually alternating with irregular spots along midlateral line. Additional spots may be present along ventral midline or low on the sides on caudal peduncle, or, more seldomly, whole body. These elements may be variously fused. In some specimens these bars may be vertically partially split and lighter coloured in the middle (Fig. 3). Three black bars on head, one on snout tip, one through eye and one on nape and opercle; dorsally, this last bar extends posteriorly to form a saddle on dorsal midline. Fins hyaline. In small specimens (less than 20-25 mm SL), the bars are quite regularly triangular and the alternating spots are either faint or missing.

In life, the background colour was white to light pinkish white and the saddles were black or dark brown.

Habitat. - *Pangio alternans* has been collected in black water streams under forest cover with quite swift current. The swift current is most likely not perennial for this habitat as it seems to have been caused by a strong lowering of the water level in the Kapuas mainstream which in turn was responsible for draining dry most of its tributaries. As a result, those tributaries which still had water were very swift and had eroded a deep and very narrow channel in what seems to be their usual bed. As the year the specimens were obtained the water level was reportedly extremely low, it is not know if the observed conditions are repeated every year. Under forest cover, the stream bed was cut through thick alternating deposits of leave litter and sediments. The specimens were obtained by placing a dipnet along the edge of the stream and tramping on the shores or by pulling both sediment and leaves into the dipnet and washing them. Other species obtained this way are: *Pangio shelfordii* (Popta, 1903), *Acanthopsoides molobrion* Siebert, 1991, *Lepidocephalichthys pristes* Roberts, 1989, *Barbucca diabolica* Roberts, 1989, a new *Vaillantella*, and a new genus and species of Chaudhuriidae (unpublished data).

Distribution. - *Pangio alternans* is presently known only from the middle Mahakam basin, eastern Borneo (Fig. 4).

Etymology. - From the Latin *alternare*, to do one thing and then another, by extension to alternate; an allusion to the alternating saddles and blotches. Treated as a noun in apposition.

Pangio anguillaris (Vaillant, 1902)

(Fig. 5)

Acanthophthalmus anguillaris Vaillant, 1902: 151 (type locality: Borneo: 'shores of the Kapuas (Sintang ?)'; holotype: RMNH).

Acanthophthalmus vermicularis Weber & de Beaufort, 1916: 34 (type locality: Sumatra: River Kampar Kiri; holotype: ZMA 100.260).

Cobitophis perakensis Herre, 1940: 8 (type locality: Malaysia: Perak: lake above Chenderoh Dam; holotype: CAS 33004).

Material examined. - MALAYSIA: PERAK: 3 ex. (ZRC 1442), paratypes of *Cobitophis perakensis*, Chenderoh Dam, coll. A. W. C. T. Herre & M. W. F. Tweedie, iii.1937.

PAHANG: 1 ex. (ZRC 35023), Sungei Salan at Jerantut, coll. J. Cramphorn, 24.ii.1993. — 1 ex. (ZRC 35030), same data. — 10 ex.; (ZRC 34884-34893), same locality, coll. J. Cramphorn & J. Davies, 5.xi.1992. — 3 ex. (ZRC 35026-35028), Sungei Tekam at Jerantut, coll. J. Cramphorn, 26.ii.1993. — 2 ex. (ZRC 35031-35032), Sungei Jenput at Maran, coll. J. Cramphorn, 17.x.1992. — 8 ex. (ZRC 34946-34953), same data, 16.x.1992.

Diagnosis. - A species of *Pangio* with a very elongated body (depth 14-18 times in SL; Weber & de Beaufort, 1916: 35), more vertebrae than any other known species (50-52+19-20 = 69-71 [Roberts, 1989], vs. 31-49+12-18 = 45-67), 7+7 principal caudal rays (6+6 branched), sides with a faint, dusky mid-lateral stripe and upper half of body either uniformly brown or finely marked with small brown dots, cheeks naked and no nasal barbels.

Distribution. - *Pangio anguillaris* is known from the Chao Phraya and lower Mekong basins in Thailand, Laos, Cambodia and Viet Nam, the Malay Peninsula, Sumatra and Borneo (Fig. 6). In the Malay Peninsula, it has been recorded from the Pahang and Perak drainages. A detailed comparison of material from different areas might show that more than one species is involved.

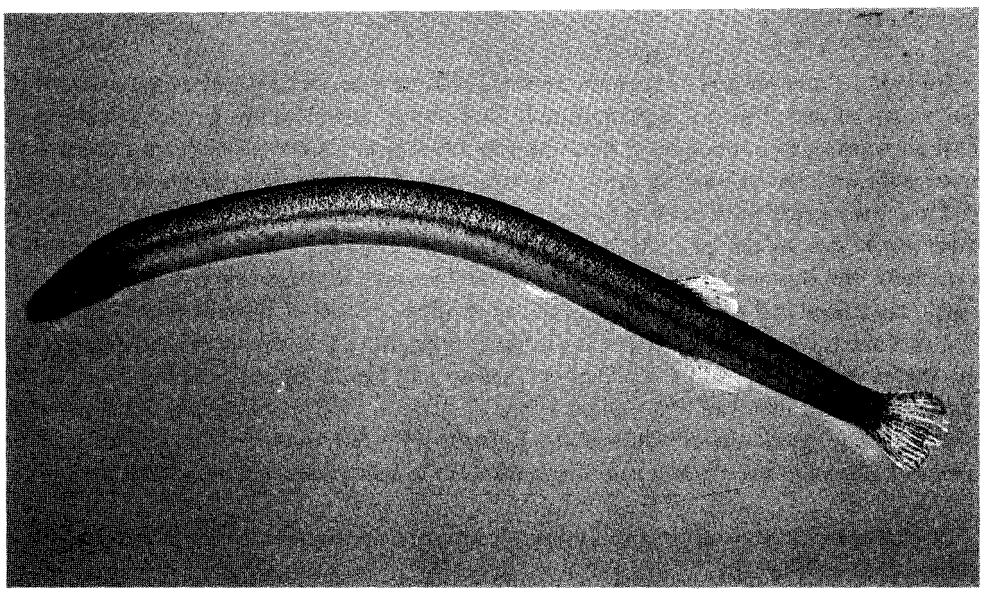


Fig. 5. *Pangio anguillaris*, CMK 5123, 39.7 mm SL, Nan basin, northern Thailand.

***Pangio cuneovirgata* (Raut, 1957)**
(Fig. 7)

Acanthophthalmus cuneovirgatus Raut, 1957: 30 (type locality: unknown, possibly "Jahore/Hinterindien"; holotype: ZMB 21332).

? *Acanthophthalmus robiginosus* Raut, 1957: 31 (type locality: stream Tjipaja-en and tributaries near Rangkas-Betong village, Bantean area, West Java; holotype: ZMB 21334).

Material examined. - MALAYSIA: JOHOR: 4 ex. (ZRC 2064 (i-iv)), Sg. Machap, 8th mile on Ayer Itam - Johor Bahru road, coll. C. K. Quek, 28.ix.1967. — 1 ex. (ZRC 8414), Kulai oil palm estate, 25 miles from Johor Bahru, coll. E. R. Alfred, 7.ii.1958. — 4 ex. (ZRC 28178-28181), Sungei Mupor, Kota Tinggi, coll. P. K. L. Ng & K. K. Lim, 15.x.1992. — 1 ex. (ZRC 2045 (iv)), Sungei Sedili, west of Gunung Sumalayang, coll. C. K. Quek, 22.ii.1968. — 1 ex. (CMK 8500), Sungei Ambat, 61 km from Kota Tinggi on road to Mersing, coll. M. Kottelat, P. K. L. Ng *et al.*, 24.vii.1992. — 7 ex. (CMK 7903), aquarium specimens said to be from Johor.

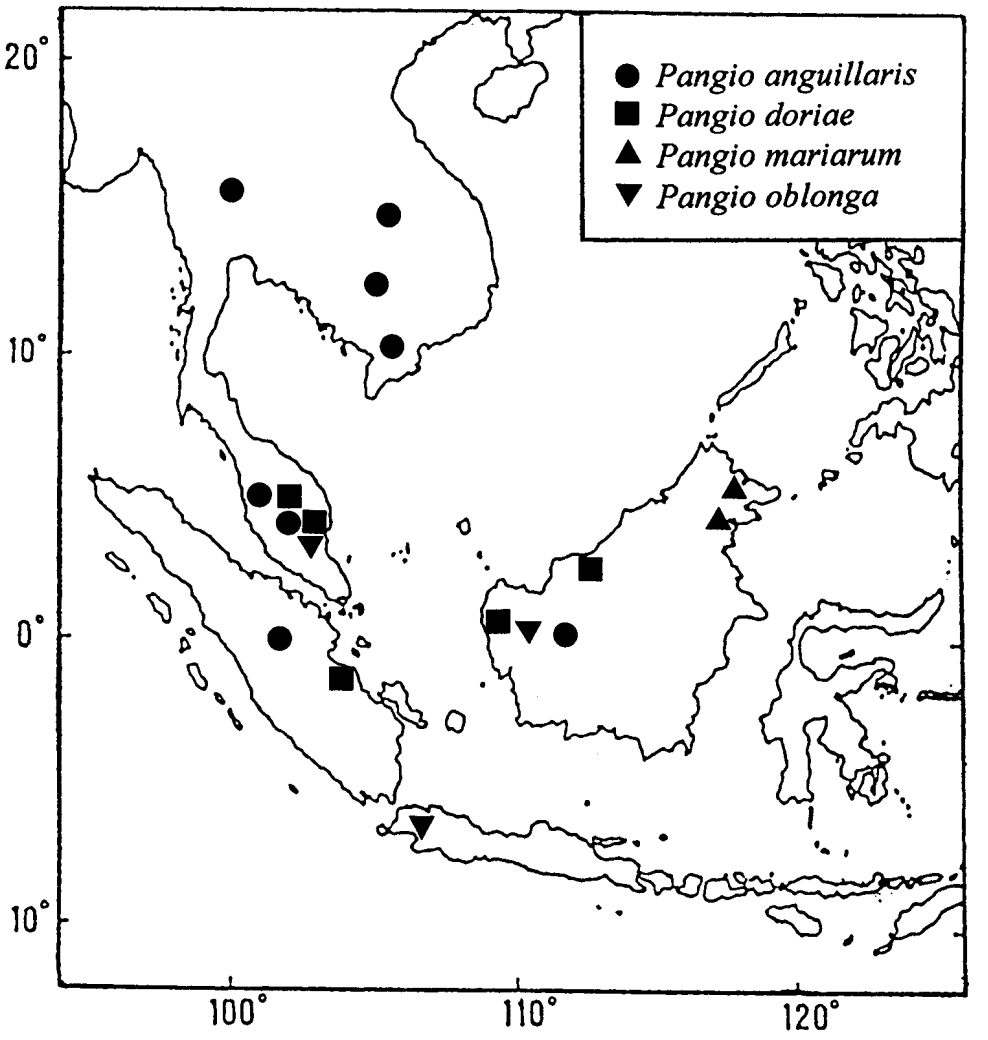


Fig. 6. Southeast Asia showing distribution of *Pangio anguillaris*, *P. doriae*, *P. mariarum* and *P. oblonga*. One symbol may represent several adjacent localities. Based on examined material; distribution of *P. anguillaris* partly based on literature.

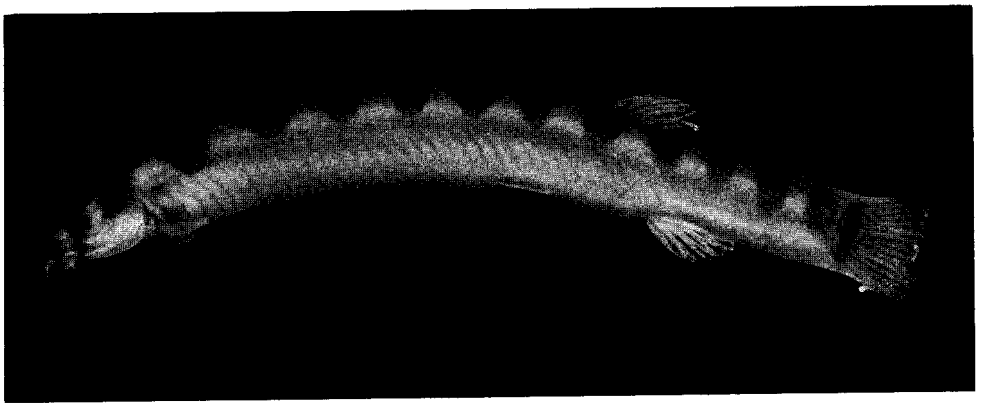


Fig. 7. *Pangio cuneovirgata*, CMK 8500, 36.0 mm SL, Sungei Ambat, Johor..

PAHANG: 1 ex. (ZRC 24724), 1 ex. (CMK 8447), stream behind Hindu temple immediately W of Kuantan-Segamat road with Kuantan-Kuala Lumpur road, Gambang, 3°42'22"N 103°07'00"E, coll. M. Kottelat, P. K. L. Ng *et al.*, 23.vii.1992. — 8 ex. (ZRC 28429-28438), 8 ex. (CMK 8104), same data, 10.iii.1992. — 1 ex. (ZRC 18461), about 25 km from Kuantan along road to Maran, coll. P. K. L. Ng *et al.*, 20.x.1991.

TERENGGANU: 1 ex. (ZRC 2053), Sg. Tok Dor at Kg. Tok Dor, coll. C. K. Quek, 4.viii.1966. — 11 ex. (ZRC 2060), Sg. Trengganu at Kuala Brang, coll. E. R. Alfred, 8.viii.1965. — 1 ex. (ZRC 24549), km 6 on Kuala Brang - Kuala Terengganu road, coll. T. H. T. Tan & D. S. L. Chung, 3-5.viii.1992.

THAILAND: 1 ex. (CMK 5134), km 8, road from Ruso to Sisa Khon, a tributary of Mae Nam saiburi at Ban Ba Khon, Khlong Wi, Narathiwat Prov., coll. S. Lumlertdacha, M. Kottelat & T. R. Roberts, 30.iii.1985.

SUMATRA: 13 ex. (CMK 8292), 3 ex. (ZRC 21019-21021), Sungei Paku, 54.3 km after bridge over North branch of Kampar, road from Pekanbaru to Renggat, Kampar Kiri basin, Riau, coll. M. Kottelat & R. Dudley, 4.iv.1992.

Diagnosis. - *Pangio cuneovirgata* is distinguished from all congeners with a barred colour pattern by having the anterior nostril pierced at the anterior base of a long nasal barbel (see figure 18). From the somewhat similar looking *P. kuhlii* it is at all sizes easily distinguished by the shape of the caudal (truncate, vs. emarginate; see figure 17) and by details of colouration: its colour pattern consists of 7-13 short saddles restricted to the dorsal half of body (vs. 6-10 bars extending downward onto lower half of body) and a black blotch at caudal fin base (vs. none; see figure 17); the caudal is hyaline, without marking (vs. black blotch extending over proximal half of caudal fin); a dark epaxial stripe is conspicuous in life as well as in preserved specimens (vs. absent). In freshly preserved specimens, the belly is white and the dorsal half of the body has an olive yellow background colouration (vs. background uniformly rosy to whitish).

Remarks. - We tentatively follow Burridge (1992) in considering *P. robiginosa* as a junior synonym of *P. cuneovirgata*, although we disagree with several points of her argument and predict that, once fresh material becomes available, *P. robiginosa* will turn out to be a valid species. Burridge (p. 178) stated that Raut had not indicated how his *P. robiginosa* was distinct of his *P. cuneovirgata*. Actually, Raut (1957: 32) had stated (our translation): "The difference [of *P. robiginosa*] from [*P.*] *cuneovirgat*[*a*] consists in the following characters (see photographs !): number of bars, pattern of the bars, colouration, body depth, position of anal in relation to

position of dorsal (in [*P.*] *cuneovirgat*[*a*] shortly behind, in the present species under end of base of dorsal)". Most of the reported differences (anal origin; black, vs. brown saddles; body depth 7.6-8.0, vs. 7.0-7.25 times in SL) apparently are not significant. The number of bars (13-17, vs. 16-22) is probably not significant too, but the pattern shown on Raut's photograph of *P. robiginosa* is not exhibited by any specimen of *P. cuneovirgata* we have examined or collected. Fresh collections of large series of Javanese material is needed to clear the identity of *P. robiginosa*. In the Javanese specimens, the bars extend to lower half of body while they are reaching at most midline in the Malayan and Sumatran specimens. Burridge's conclusion (1992: 178) that "in accordance with the variation in color pattern displayed in [*P.*] *kuhlii*, [*P.*] *robiginos*[*a*] is clearly only a colour variation of [*P.*] *cuneovirgat*[*a*]" seems premature. Her *P. kuhlii* actually is a mixture of three species (see below for comments on *P. malayana* and *P. myersi*, both of which she included in the synonymy of *P. kuhlii*). Additionally, this kind of reasoning does not make much sense as variation of a character in a species cannot be accepted as a priori evidence that the same character exhibits the same variability in related taxa.

If treated as synonyms, *P. robiginosa* and *P. cuneovirgata* are simultaneous synonyms and the first revisor's action has priority to decide which name has to be used. Burridge (1992: 177) selected *P. cuneovirgata* as the valid name. So be it. It must be noted however that while the type locality of *P. robiginosa* is quite precisely known, the type locality of *P. cuneovirgata* is unknown and Raut's mention of "Jahore/Hinterindien" [= Johor, Far East !] is based only on suppositions as is clear from his statement (our translation): "For both types [holotype and paratype]: collected in Jahore/Far East (the animals are regularly imported together with the species [*P.*] *semicinct*[*a*], which according to data [at least second hand information] from Dr. W. Ladiges - Hamburg and A[ndreas] Werner - München are collected in the vicinity of Singapore, in Jahore". We believe that the selection of the valid name associated with precise locality data (i. e. *P. robiginosa*) would have been more judicious.

Notes on biology. - This species reaches a maximum known size of 37.8 mm SL (ZRC 18461). It occurs sympatrically and syntopically with *P. kuhlii* in the Malay Peninsula (pers. obs.), Sumatra (pers. obs.) and Java (Raut, 1957: 33). It has been collected among submerged vegetation along shores of stream with moderate current and clear and relatively cold water. No habitat segregation could be observed between *P. kuhlii* and *P. cuneovirgata* in localities where they occur syntopically.

Distribution. - The distribution of *P. cuneovirgata* includes the Malay Peninsula from Narathiwat (Thailand) to Johor, Sumatra (Riau) and West Java (Fig. 4).

Pangio doriae (Perugia, 1892)
(Fig. 8)

Eucirrhichthys doriae Perugia, 1892: 1009 (type locality: Sarawak; syntypes: MCSNG 9231 [2], ZMA 114.898 [1]).

Material examined. - MALAYSIA: PAHANG: 1 ex. (ZRC 1455), Kuala Tahan, coll. C. S. Ogilvie, 1949. — 2 ex. (ZRC 1456), Kuala Tahan, coll. M. W. F. Tweedie, iii.1955. - 4 ex. (ZRC 1465), Kuala Tahan, coll. M. W. F. Tweedie, iii.1955. - 15 ex. (ZRC 1487), Sg. Tahan, coll. J. R. Hendrickson, 26.vii.1962. — 2 ex. (ZRC 14293-14294), Sg. Keniam at Kuala Perkai, coll. K. Lim & K. Whooley, 2.iv.1991. — 5 ex. (ZRC 34894-34898), Sungei Salan at Jerantut, coll. J. Cramphorn & J. Davies, 5.xi. 1992. — 2 ex. (ZRC 35024- 35025), same locality, coll. J. Cramphorn, 24.ii.1993. — 1 ex. (ZRC 35029), same data;

SUMATRA: 7 ex. (ZRC 29161-29167), aquarium specimens obtained from Jambi.

BORNEO: 2 ex. (syntypes), (MCSNG 9231), Sarawak. — 1 ex. (CMK 6700), Sungai Mandor at Mandor, Kalimantan Barat, 0°19'N 109°20'E, coll. M. Kottelat *et al.*, 22.iv.1990.

Diagnosis. - A species of *Pangio* with a very elongated body (depth 16-21 times in SL), more vertebrae than most other known species (46-49 + 15-18 = 62-67; cf. Table 1), plain brown body with a faint, dusky midlateral stripe. It is distinguished from the similarly looking *P. anguillaris* by the presence of a nasal barbel (vs. absence), the presence of cheek scales (vs absence) and vertebral count (46-49 + 15-18, vs. 50-52 + 19-20 = 69-71).

Remarks. - Kottelat (1989: 13) and Roberts (1989: 97) have commented that *P. doriae* might be a possible synonym of *P. anguillaris*. Examination of some of the syntypes of *P. doriae* and recently collected material has now shown that they represent a distinct species.

Specimens similar to *P. doriae* from Sumatra (ZRC 29161-29167) are more slender than the Malayan and Borneo ones (body depth 17.2-22.3 times in SL, vs.15.1-20.6 in the specimens we examined), and have 8+8 principal caudal rays (vs. 7+7, including syntypes).

Distribution. - *Pangio doriae* is known from Sarawak and from the Kapuas basin in Western Kalimantan, Borneo, from the Batang Hari basin in Sumatra and from the Malay Peninsula (Fig. 6).

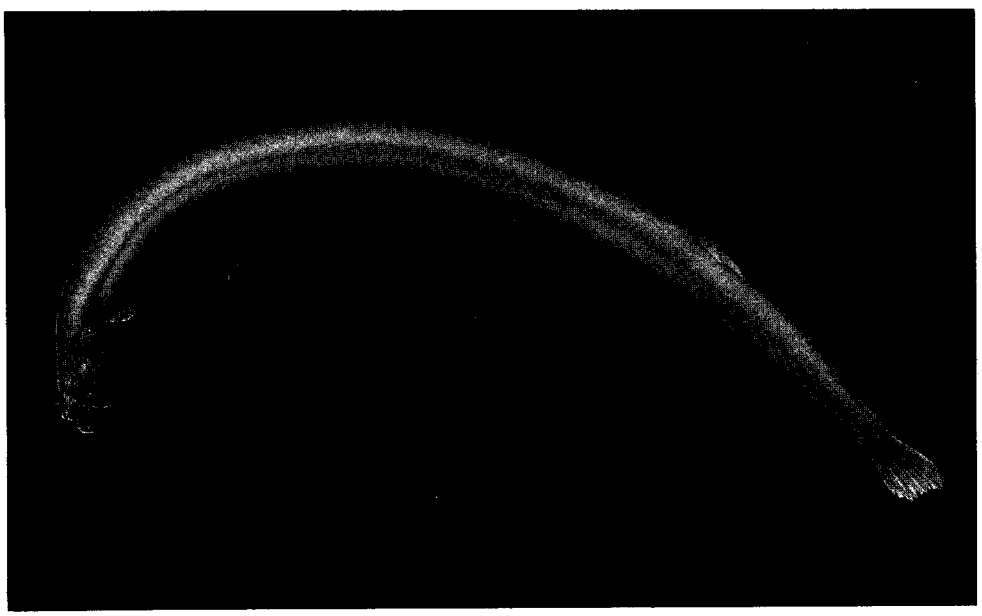


Fig. 8. *Pangio doriae*, CMK 6700, 66.4 mm SL, Kapuas basin, western Borneo.

***Pangio filinaris*, new species**
(Fig. 9)

Material examined. - Holotype - female (34.4 mm SL), (ZRC 34915), Sungai Tersat, a tributary of Sungai Terengganu, immediately downriver of Sekayu Waterfall Park, Terengganu, Malaysia, 4°57'51"N 102°57'45"E, coll. M. Kottelat, P. K. L. Ng *et al.*, 18-19.iii.1992 (Fig. 11).

Paratypes - 21 ex. (ZRC 34916-34936), 22 ex. (CMK 8201), (15.1-36.3 mm SL), same data as holotype. — 9 ex. (ZRC 34937-34945), 8 ex. (CMK 9756), (17.1-32.3 mm SL), north of Ayer Puteh, about 121 km on road from Kuantan to Kuala Terengganu, 4°24'14"N 103°15'46"E, coll. M. Kottelat & P. K. L. Ng *et al.*, 17.iii.1992. — 1 ex. (17.5 mm SL), (ZRC 9505), Sungei Tok Dor, Terengganu, Malaysia, 4.viii.1966. — 1 ex. (28.2 mm SL), (ZRC 24550), 6 km off Kuala Brang on road to Kuala Terengganu, Terengganu, Malaysia, coll. T. H. T. Tan & D. S. L. Chung, 3-5.viii.1992. — 5 ex. (34.8-38.4 mm SL), (ZRC 657), Kuala Tahan, Pahang, Malaysia, coll. M. W. F. Tweedie, iv.1940.

Diagnosis. - *Pangio filinaris* is distinguished from its congeners with plain body in having the anterior nostril pierced at the anterior base of a nasal barbel, a relatively deep body (depth 8.0-9.6 times in SL), and 33-36+12-14 = 45-49 vertebrae.

Description. - General body shape and appearance are shown in Figure 9. Most large size specimens are twisted or arched, so that measurements are difficult to duplicate. Morphometric data of holotype (34.4 mm SL) are given here, with indicative value only: total length 11.9 % SL; head length 15.4 % SL; predorsal length 70.6 % SL; prepelvic length 56.1 % SL; preanal length 80.2 % SL; body depth at dorsal origin 11.9 % SL; depth of caudal peduncle 8.7 % SL; length of caudal peduncle 16.0 % SL (1.83 times its depth); body width 7.6 % SL; length of pelvic fin 5.8 % SL; length of pectoral fin 7.6 % SL; snout length 5.87 % SL, 38 % HL; eye diameter 1.5 % SL, 9 % HL.

Dorsal fin with 2 rudimentary, 1 simple and 6 branched rays, last one split to the base; first dorsal pterygiophore inserted behind neural spine of vertebrae 28-29. Pectoral fin with 8 rays; second ray much thicker and third rays slightly thicker in males. Pelvic fin with 5 rays, origin of first ray below vertebral centra 24-27. Anal fin inserted almost immediately behind vent, with

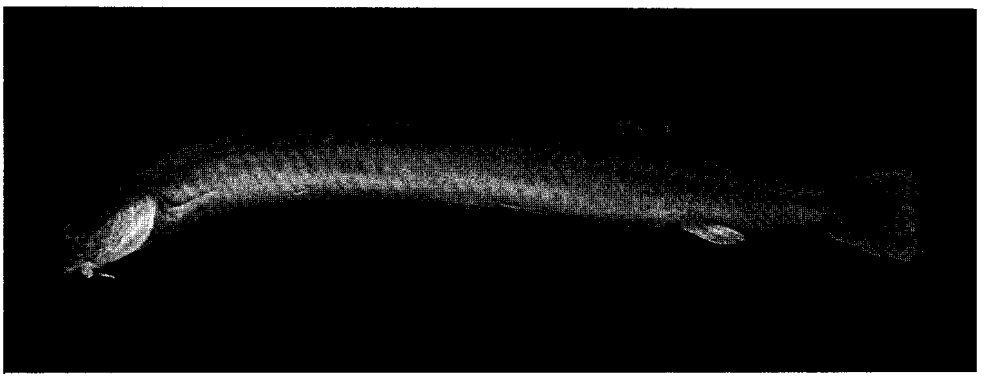


Fig. 9. *Pangio filinaris*, holotype, ZRC 34915, 34.4 mm SL; Sekayu, Terengganu.

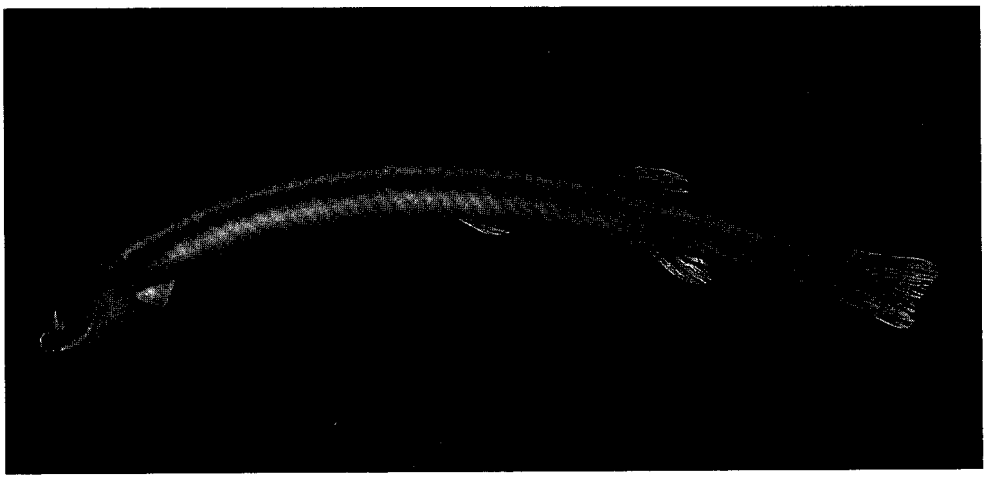


Fig. 10. *Pangio mariarum*, CMK 9557, 56.9 mm SL, Sebuku basin, eastern Borneo.

2 rudimentary, 1 simple and 5 branched rays, last one split to the base; first anal pterygiophore inserted behind hemal spine of vertebrae 33-35. Caudal fin emarginate, with 8+8 principal rays (7+7 branched).

Body entirely scaled, except belly between pectoral bases. Head naked. Suborbital spine bifid, outer branch straight, inner branch slightly curved, stronger and about twice longer than outer one. Three pairs of barbels, two pairs of rostral ones and one at each angle of mouth reaching about vertical of posterior margin of eye. Lower lip interrupted medially, each half fleshy and slightly folded, with an inner thickened lobe not ending in a barbel-like pointed tip; margin of membrane connecting this lobe and the barbel at corner of the mouth entire. Anterior nostril at the front side of a barbel reaching about to middle of eye.

Vertebrae: 33-36+12-14 = 45-49 (Table 1); vertebrae 5 to 29-30 with pleural ribs.

Colouration. - Body and head dull brown, yellowish on lower half, sometime with a faint blackish midlateral stripe from head to caudal base, usually ending in a triangular blotch over hypural complex. Caudal grey, dorsal with a faint longitudinal rows of grey spots on rays, about at midlength. Other fins hyaline.

Small specimens (less than about 25 mm SL) are grayish, the midlateral stripe is more obvious and there is usually a paler area above it on the whole length.

Life colour dull reddish brown.

Remarks. - It seems that this species has occasionally been exported for the aquarium trade. It is apparently the species reported occasionally in aquarium literature as *P. mariarum* (or *P. mariae*). This identification is probably based on the brown colouration and the presence of a nasal barbel. *Pangio filinaris* is distinguished from *P. mariarum* (Fig. 10), hitherto known only from northern Borneo, by a smaller size (up to 35 mm SL, vs. 68), deeper body (body depth 8.0-9.6 times in SL, vs. 10.8-13.5 in the material we examined [8-12 according to Inger & Chin,

1962: 119]), pectoral of male not curled upwards (vs. curled upwards), fewer pelvic rays (5, vs. 6) and slightly less vertebrae (33-36 + 12- 14 = 45-49, vs. 34-37 + 13-15 = 49-51; Table 1).

Distribution. - *Pangio filinaris* is presently known from the Pahang basin and Terengganu, Malaysia (Fig. 2). A wider distribution in the Malay Peninsula is expected, and its presence in Sumatra is not excluded.

Etymology. - From the Latin *filum*, thread, and *naris*, nostril. An allusion to the anterior nostril whose rim is modified into a barbel. A noun in apposition.

Pangio incognito, new species
(Fig. 11)

Material examined. - Holotype - (28.3 mm SL), (ZRC 34913), km 42 on road from Lindu to Kuching, west of Sungei Stinggang, Sarawak, Borneo, coll. M. Kottelat, K. Lim, P. Ng & C. Leh, 3.vii.1992 (Fig. 11).

Paratypes - 2 ex. (ZRC 34910-34911), 2 ex. (SM uncat.), 2 ex. (CMK 9735), (25.4-29.9 mm SL), same data.

Diagnosis. - *Pangio incognito* is distinguished from its congeners with marked body by the following combination of characters: body markings very irregular, more or less restricted to upper half of body; a faint longitudinal stripe of superficial pigments along lateral line; median lobe of lower lip extended into a barbel; anterior nostril not modified into a nasal barbel; 32+13-14 = 45-46 vertebrae.

Description. - General body shape and appearance are shown in Figure 11. Morphometric data of the holotype (28.3 mm SL) and 4 of the largest specimens (25.7-29.9 mm SL): total length 111.7-113.9 % SL; head length 18.3-20.6 % SL; predorsal length 66.1-70.0 % SL; prepelvic length 55.6-58.0 % SL; preanal length 77.8-80.6 % SL; body depth at dorsal origin 9.5-10.6 % SL; depth of caudal peduncle 7.0-8.4 % SL; length of caudal peduncle 16.3-19.7 % SL (2.00-2.70 times its depth); body width 6.2-6.9 % SL; length of pelvic fin 7.4-9.2 % SL; length of pectoral fin 5.4-8.8 % SL; snout length 7.0-7.4 % SL, 36-40 % HL; eye diameter 2.3-2.9 % SL, 12-15 % HL.

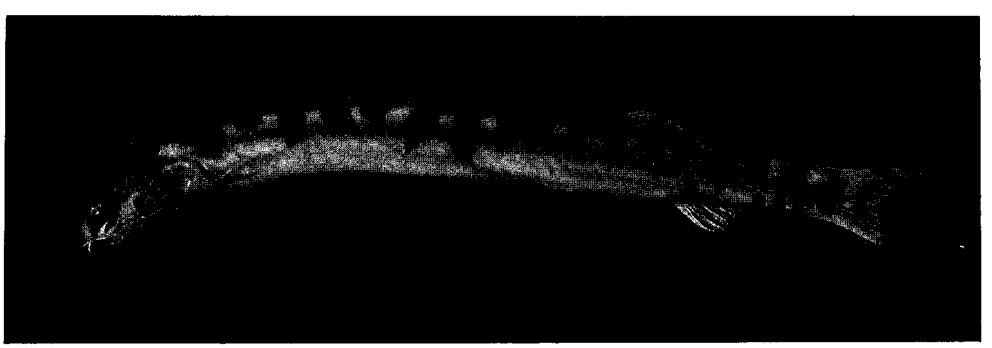


Fig. 11. *Pangio incognito*, holotype, ZRC 34913, 28.3 mm SL, Sarawak.

Dorsal fin with 2 rudimentary, 1 simple and 6 branched rays, last one split to the base; first dorsal pterygiophore inserted behind neural spine of vertebrae 25-27. Pectoral fin with 8-9 rays; no sexual dimorphism observed. Pelvic fin with 7 rays, origin of first ray below vertebral centra 22-23. Anal fin inserted almost immediately behind vent, with 2 rudimentary, 1 simple and 5 branched rays, last one split to the base; first anal pterygiophore interted behind hemal spine of vertebra 32. Caudal fin emarginate, with 8+8 (3), 8+7 (1) and 7+7 (1) principal rays (6-7 + 6-7 branched).

Body entirely scaled, except belly between pectoral bases. Head naked. Suborbital spine bifid, outer branch straight, inner branch sligthgly curved, stronger and about 1.5 times longer than outer one. Three pairs of barbels, two pairs of rostral ones and one at each angle of mouth reaching vertical of anterior margin of eye. Lower lip interrupted medially, each half with an inner thickened lobe ending in a barbel-like pointed tip; margin of membrane connecting this lobe and the barbel at corner of the mouth straight with a few irregular, fine crenulations. Anterior nostril not modified into a nasal barbel.

Vertebrae: 32 + 13-14 = 45-46 (Table 1). Vertebrae 5 to 23-24 with pleural ribs.

Colouration. - Body with 13-17 very irregular bars or saddles, usually restricted to upper half of body. The space between bars is somewhat narrower than the bars. A series of small blotches sometime present in the lower half of caudal peduncle and along anal-fin base. A narrow and faint series of irregularly set superficial pigments along lateral line. A dark ovale blotch at base of caudal fin. A fine black spot at upper extremity of pectoral-fin base. Head with at leasst two very irregular blotches.

Anal, pectoral and pelvic fins hyaline. Caudal fin with pigments on the rays forming 2 irregular vertical rows. Dorsal fin with a few irregularly set pigments on the rays.

Remarks. - *Pangio incognito* was not recognized in the field but was first 'discovered' while examining radiographs. In a series of 16 *Pangio* (ZRC 35059-35063, CMK 8404) then identified as *P. shelfordii* we noted that 5 had vertebral counts of 35 + 14-15 = 49-50 (see Table 1), agreeing with other population of the species, while 5 had 32 + 13-14 = 45-46 suggesting they are a different species (the remaining specimens could not be x-rayed due to twisted body). A detailed comparison of the two series revealed other differences: in *P. incognito* the pelvic-fin origin is below the vertebral centra 22-23 (vs. 25 in syntopic specimens of *P. shelfordii*), the first dorsal pterygiophore is inserted behind neural spine of vertebrae 25-27 (vs. 28-29), the colour pattern is consituted of 13-17 small very irregular bars not extending below lateral line (vs. large irregular intense blotches extending low on the sides) with a faint series of superficial pigments along lateral line (vs. no fine line of superficial pigment, but often an intense dark, deep laying epaxial stripe is present), head length 18.3-20.6 % SL (vs. 14.6-17.1), preanal length 77.1-80.6 % SL (vs. 74.3-77.8).

Compared to juvenile *P. shelfordii* of similar size, *P. incognito* is distinguished by the colour pattern on the head. *Pangio shelfordii* has three distinct bars on the head, which is particularly obvious in specimens of the *muraeniformis* and *shelfordii* colour forms, and fainter in the Sumatra colour form (no juveniles are available of the upper Kapuas colour form). In *P. incognito*, there are two very irregular and fainter blotches, the anterior one on the snout apparently corresponding to the anterior bar of *P. shelfordii* and the posterior one on the opercle corresponding to the two posterior ones of *P. shelfordii* (Fig. 12).

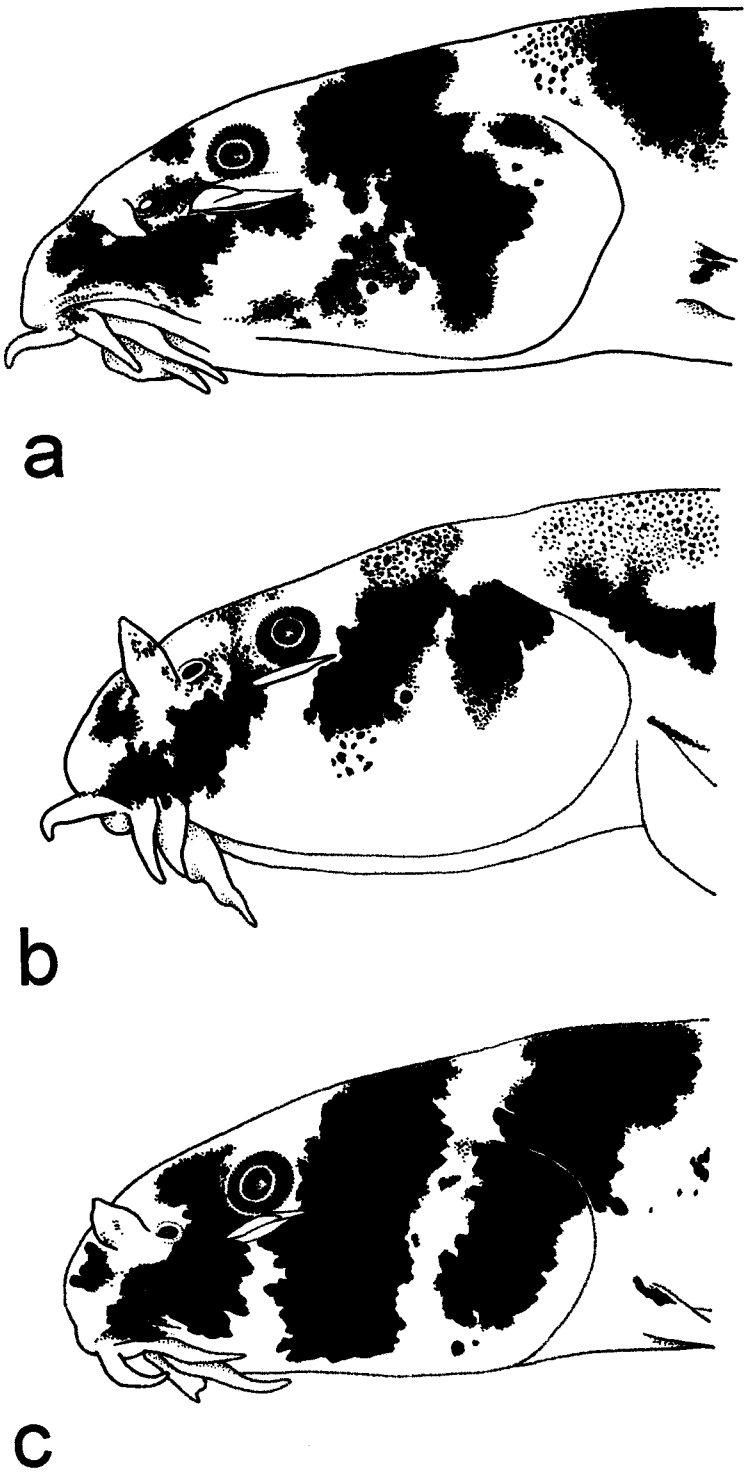


Fig. 12. Head markings of: a,*Pangio incognito*, ZRC 34910-34911, 28.5 mm SL; b, *P. shelfordii*, ZRC 30799-30814, 26.0 mm SL, Banka; c, *P. shelfordii*, ZRC 25650-25655, 26.2 mm SL, Johor.

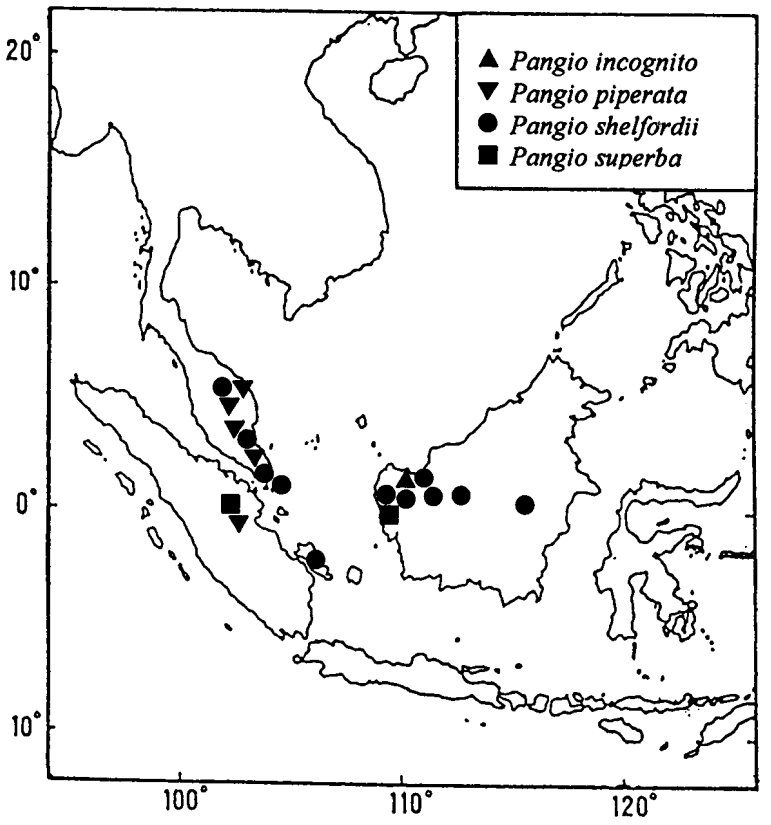


Fig. 13. Southeast Asia showing distribution of *Pangio incognito*, *P. piperata*, *P. shelfordii* and *P. superba*. One symbol may represent several adjacent localities. Based on examined material; distribution of *P. superba* partly based on literature.

Distribution. - *Pangio incognito* is presently known only from the type series collected in 1992 in southern Sarawak, west of Kuching (Fig. 13).

Etymology. - From the Italian *incognito* meaning unknown; by extension meaning unrecognized. A noun in apposition.

Pangio kuhlii (Valenciennes, 1846)

(Fig. 14)

Acantophthalmus fasciatus van Hasselt, 1823: 133 (nomen nudum).

Acanthophthalmus fasciatus van Hasselt, 1824: 377 (nomen nudum).

Cobitis kuhlii Valenciennes, in Cuvier & Valenciennes, 1846: 77 (type locality: Java: Krawang; neotype: RMNH 2688, designated by Burridge, 1992: 182).

Acanthophthalmus fasciatus Bleeker, 1860: 74 (type locality: Java: Krawang; neotype: RMNH 2688, by present designation).

? *Acanthophthalmus semicinctus* Fraser-Brunner, 1940: 172 (type locality: Malaysia: Johor: Mawai; holotype: BMNH 1938.12.1:113).

? *Acanthopthalmus kuhlii sumatranus* Fraser-Brunner, 1940: 175 (type locality: Sumatra: Lahat; holotype: BMNH 1866.5.2:41).

Material examined. - SINGAPORE: 5 ex. (ZRC 1187), Sg. Seletar, W. of Seletar Reservoir, coll. E. R. Alfred, 8.iv.1963. — 1 ex. (ZRC 3213), stream along Mandai Road, coll. A. K. Tham, 1964. — 2 ex. (ZRC 7692-7693), Mandai, coll. C. F. Lim.

MALAYSIA: JOHOR: 1 ex. (ZRC 491), Sg. Sedili W. of Gunung Sumalayang, coll. E. R. Alfred, 1.vi.1968. — 41 ex. (ZRC 1474), 11th mile on Kota Tinggi - Mawai road, coll. E. R. Alfred, 15.i.1958. — 3 ex. (ZRC 2045), Sg. Sedili, W. of Gunung Sumalayang, coll. C. K. Quek, 22.ii.1968. — 48 ex. (ZRC 2049), Sg. Semalok, Mawai, coll. E. R. Alfred, 4.x.1967. — 1 ex. (ZRC 8414), Kulai, 25 mls. from Johor Bahru, coll. E. R. Alfred, 7.ii.1958. — 1 ex. (ZRC 2050), Sg. Mupor, Mawai, coll. E. R. Alfred, 4.x.1967. — 1 ex. (ZRC 2065), Sg. Machap, 8th mile on Ayer Itam - Johor Bahru road, coll. C. K. Quek, 28.ix.1967. — 27 ex. (ZRC 1441), Mawai District, coll. A. W. C. T. Herre & M. W. F. Tweedie, ii.1937. — 1 ex. (ZRC 4798), [aquarium material] 1940. — 7 ex. (ZRC 11072-11078), Kulai, coll. P. K. L. Ng *et al.*, 9.xi.1989. — 3 ex. (ZRC 11857-11859), Sg. Mupor, coll. E. R. Alfred, 21.ii.1971. — 4 ex. (CMK 7380), Sg. Mupor, about km 15 on road from Kota Tinggi to Mersing, 103°56'E 1°52'N, coll. M. Kottelat & K. Lim, 22.i.1991. — 2 ex. (ZRC 13989-13990), eastern foothills of Gunung Panti, Kota Tinggi, coll. P. K. L. Ng & S. T. Quek, 20.ix.1990. — 5 ex. (CMK 7425), northeastern foothills on Gunung Panti, about 16 km N of Kota Tinggi, 1°50'N 103°54'E, coll. M. Kottelat, P. K. L. Ng, K. K. P. Lim, 21.i.1991. — 3 ex. (ZRC 14323-14325), streams along Kluang Mersing road, coll. P. K. L. Ng, v.1985. — 21 ex. (CMK 8510), pool ca. 50-55 km from Kota Tinggi on road to Mersing, coll. M. Kottelat, P. K. L. Ng *et al.*, 24.vii.1992. — 78 ex. (ZRC 14537-14614), Layang-Layang, coll. P. K. L. Ng *et al.*, 6.ii.1991. — 1 ex. (ZRC 16931), 5 ex. (CMK 7856), stream along road between Mawai and junction with Kota Tinggi-Desaru road, 25 km before junction, coll. P. K. L. Ng & M. Kottelat, 14.viii.1991. — 9 ex. (ZRC 16997-17005), streams along Mawai - Tg. Sedili road, coll. P. K. L. Ng & M. Kottelat, 14.viii.1991. — 81 ex. (CMK 7820), stream at about km 3 on Mawai-Tandjung Sedili road, coll. M. Kottelat & P. K. L. Ng, 14.viii.1991. — 3 ex. (CMK 8498), Sungei Ambat, 61 km from Kota Tinggi on road to Mersing, coll. M. Kottelat, P. K. L. Ng *et al.*, 24.vii.1992. — 1 ex. (ZRC 17743), Sg. Semberong, 6 km from Kluang, coll. K. Yong, 13.iv.1990. — 2 ex. (ZRC 17745-17746), Kulai, P. K. L. Ng, ix.1989. — 3 ex. (ZRC uncat.), streams along Ayer Itam - Kluang road, coll. K. Lim & P. G. Lee, 23.v.1991. — 1 ex. (CMK 8536), Sungei Labis, 15 km from Labis on road to Muar, Sungei Muar basin, coll. M. Kottelat, K. K. P. Lim *et al.*, 26.vii.1992.

PAHANG: 1 ex. (ZRC 1458), Kuala Tahan, coll. C. S. Ogilvie, 1949. — 1 ex. (ZRC 1460), Kuala Tahan, coll. C. S. Ogilvie, 1950. — 1 ex. (ZRC 2077), Tasek Chini, coll. RAF Changi, 22..viii.1967. — 17 ex. (ZRC 17686-17702), stream at about 25 km to Kuantan on Kuantan - Maran road, coll. P. K. L. Ng *et al.*, 20.x.1991. — 26 ex. (ZRC 17703-17728), about 200 m S. W. of 33 km stone to Kuantan on Segamat - Kuantan Highway, coll. P. K. L. Ng *et al.*, 20.x.1991. — 14 ex. (ZRC 17729-17742), about 500 m. before 10 km stone on road from Kuantan to Gambang (near Kg. Mahkota), coll. P. K. L. Ng *et al.*, 20.x.1991. — 66 ex. (CMK 8103), stream behind Hindu temple, immediately W of junction of Kuantan-Segamat road with Kuantan-Kuala Lumpur road, Gambang, coll. M. Kottelat, P. K. L. Ng *et al.*, 10.iii.1992. — 5 ex. (CMK 8446), same data, 23.vii.1992.

SELANGOR: 19 ex. (ZRC 1485), Batu Tiga, 2nd mile Kuala Lumpur - Sg. Buloh road, coll. P. Y. Berry, 19.vi.1960. — 38 ex. (ZRC 1486), Batu Tiga, 2nd mile Kuala Lumpur - Sg. Buloh road, coll. P. Y. Berry, 7.xii.1963. — 19 ex. (ZRC 2057), 2nd mile Kg. Batu Tiga - Subang road, coll. E. R. Alfred, 5.vi.1966. — 1 ex. (ZRC 2058), 2nd mile Kg. Batu Tiga to Subang road, coll. E. R. Alfred, 5.vi. 1966. — 3 ex. (ZRC 2068), 11th mile Rawang - Kuala Selangor road, coll. A. J. Berry, 29.v.1964. — 32 ex. (ZRC 17317-17348), 32 km stone on Rawang - Kuala Selangor road, coll. P. K. L. Ng *et al.*, 24.viii.1991.

TERENGGANU: 3 ex. (CMK 8202), Sungai Tersat, a tributary of Sungai Terengganu, immediately downriver of Sekayu Waterfall Park, 4°57'51"N 102°57'45"E, coll. M. Kottelat, P. K. L. Ng *et al.*, 18-19.iii.1992. — 12 ex. (ZRC 1459), Kuala Brang, coll. M. W. F. Tweedie, viii.1950. — 6 ex. (ZRC 2062), Rantau Abang, coll. C. K. Quek, 16.viii.1966. — 19 ex. (ZRC 34954-34972), 24 ex. (CMK 8152), swamp at km 56 on road from Kuala Terengganu to Kuantan, north of Rantau Abang, coll. M. Kottelat, P. K. L. Ng *et al.*, 18.iii.1992. — 65 ex. (CMK 8203), stream at about km 6 on Kuala Brang-Kuala Terengganu road, 5°04'25"N 103°03'20"E, coll. M. Kottelat, P. K. L. Ng *et al.*, 19.iii.1992. — 7 ex. (ZRC 2073), Sg.

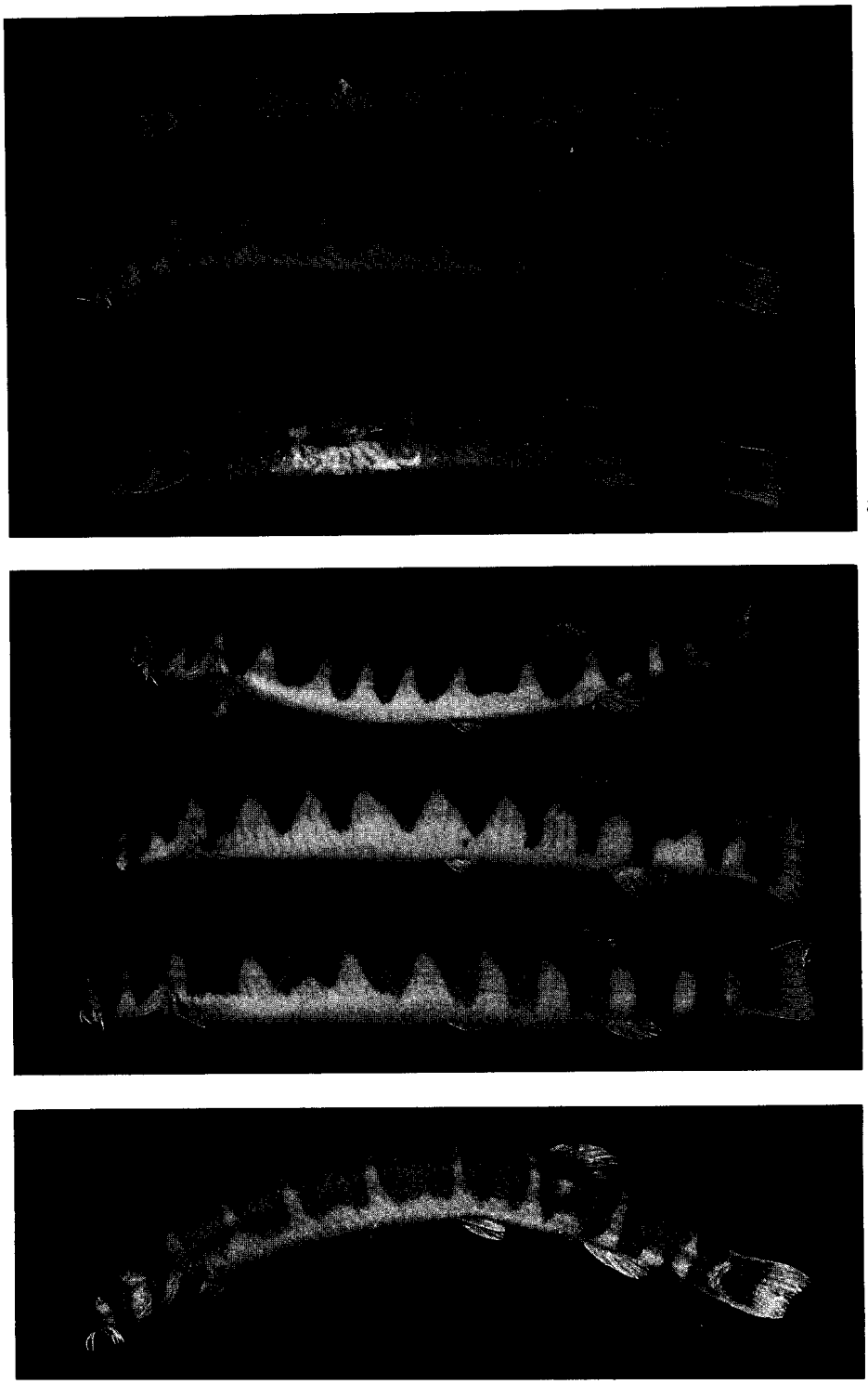
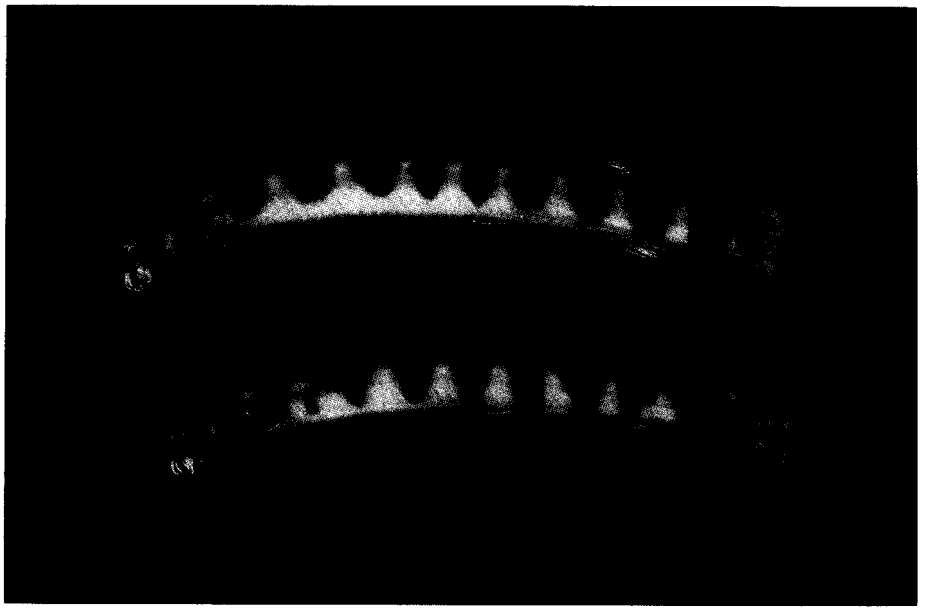
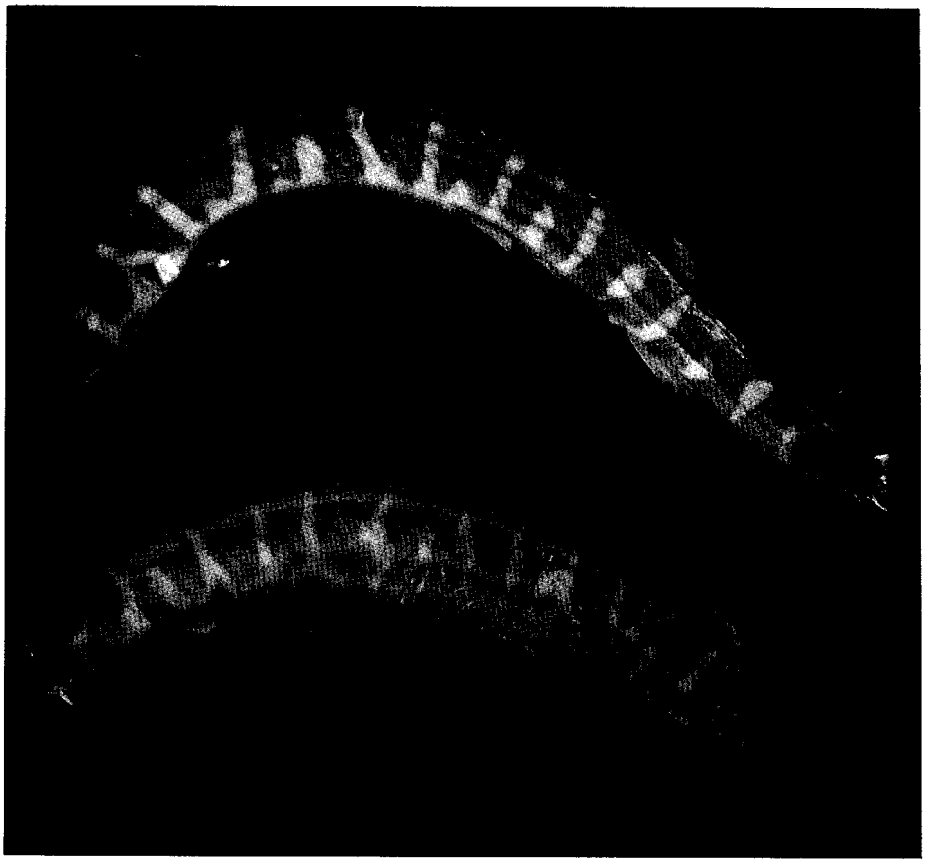


Fig. 14 a-c. *Pangio kuhlii*. a, CMK 7820, 38.3, 50.1 and 47.6 mm SL, Mawai, Johor; b, CMK 8498, 50.8, 55.9 and 59.9 mm SL, Sungei Ambat, Johor; c, CMK 6036, 47.2 mm SL, Palembang, Sumatra.



d



e

Fig. 14 d-e. *Pangio kuhlii*. d, CMK 8371, 45.2 and 40.8 mm SL, Sungei Jaguh, Sarawak; e, ZRC 674-675, 44.8 and 40.0 mm SL, Bogor, Java.

Trengganu at Kuala Brang, coll. C. K. Quek, 3.viii.1966. — 3 ex. (CMK 8243), pool at km 94 on road from Kuala Terengganu to Kota Bahru, S of Jerteh, 5°32'38"N 102°43'44"E, coll. M. Kottelat, P. K. L. Ng *et al.*, 19.iii.1992. — 33 ex. (ZRC 2051), Sg. Tok Dor at Kg. Tok Dor, coll. C. K. Quek, 4.viii.1966. — 1 ex. (ZRC 2082), Sg. Tok Dor at Kg. Tok Dor, coll. E. R. Alfred, 6.vii.1958. — 1 ex. (CMK 8256), small tributary of Sungai Kemia Hulu Besut, 6 km W of Kampung Keruak on road to hydro-electric station, coll. M. Kottelat, P. K. L. Ng *et al.*, 20.iii.1992. — 1 ex. (ZRC 9280), Central Trengganu, coll. B. T. Wee, 1966.

KEDAH: 1 ex. (ZRC 2078), Sg. Sari, 2.5 mile on Kg. Nerang to Kg. Padang road, Terap, coll. J. I. Furtado, 31..iii.1967.

THAILAND: 4 ex. (CMK 5477), km 2, road from Sungai Padi to Naratiwat, Naratiwat Prov., coll. S. Lumlertdacha, M. Kottelat & T. R. Roberts., 28.iii.1985. — 1 ex. (CMK 5173), Khlong Sok at Ban Khlong Sok, Tapi basin, Surat Thani Prov., 8°49'N 98°35'E, coll. S. Lumlertdacha, M. Kottelat & T. R. Roberts, 4.iv.1985. — 2 ex. (CMK 5341), km 22 on road from Phangnga to Kapong, tributary of Khlong Khao Thalu at Ban Bang Kan, Phangnga Prov., 8°33'N 98°28'E, coll. M. Kottelat, 22.iv.1985.

SUMATRA: 41 ex. (CMK 8291), 8 ex. (ZRC 21022-21029), Sungei Paku, 54.3 km after bridge over north branch of Kampar, road from Pekanbaru to Renggat, Kampar Kiri Basin, Riau, coll. M. Kottelat & R. Dudley, 4,iv.1992. — 1 ex. (CMK 9437), Tanatan, north of Pangkalankasai, Kap. Indragiri Ulu, Kecamatan Seberida, Riau, coll. A. J. Whitten, 22.ii.1992. — 3 ex. (CMK 6036), Sungei Tulangbawan, Palembang, don. D. Yuwono, vi.1988.

BORNEO: SARAWAK: 3 ex. (ZRC 35048-35050), 2 ex. (SM uncat.), 2 ex. (CMK 8371), Sungei Jaguh, road from Balai Ringin to Bandar Sri Aman, 99 km from Kuching, coll. M. Kottelat, K. K. P. Lim & C. Leh, 2.vii.1992.

BORNEO: KALIMANTAN BARAT: 10 ex. (CMK 6804), Sungai Tao, 22 km E of Sintang on road to Bukit Kelalam, coll. M. Kottelat *et al.*, 24.iv.1990. — 2 ex. (6920), right tributary of Sungai Sibau, about 3 km upstream of Putussibau, coll. M. Kottelat *et al.*, 28.iv.1990.

JAVA: 2 ex. (ZRC 674-675), Bogor, coll. Achmad, iii.1967.

Diagnosis. - *Pangio kuhlii* is distinguished by its colour pattern consisting of 6-10 bars, usually irregular, with a dark large quadrangular blotch occupying the proximal half of caudal fin; median lobe of lower lip not produced into a barbel; 34-37+12-15 = 47-51 vertebrae.

Remarks. - Burridge (1992: 181) correctly stated that Valenciennes' description of *Cobitis kuhlii* was based on one of the drawings prepared under Kuhl and van Hasselt's supervision in Java and sent by them to Leiden (Alfred, 1961; Kottelat, 1987). She reported the drawings as being lost, which is only partly true. The notes and materials used by Cuvier and Valenciennes for the preparation of the *Histoire naturelle des Poissons* are preserved in the Bibliothèque Centrale of MNHN. Among the material used for the loaches section, is a colour tracing (reproduced in Roberts, 1993) of the original drawing which MK has examined in 1982 which shows a colour pattern agreeing with the species called *P. kuhlii* here. A neotype (collected between 1826 and 1836 from an imprecise locality where the species may no longer be extant) has been designated by Burridge (1992: 182). So be it, but we question the usefulness of such a designation. We think that selection of old and poorly documented specimens as neotypes is a practice which should be discouraged whenever possible in favour of well documented localities and protected habitats. It is important that species can be recollected from their type localities in the future when it will come to check the identity of variant forms discovered by new biochemical methods, ethological observations, etc. for which museum specimens will be useless.

Van Hasselt's use of *Acantophthalmus fasciatus* (1823) and *Acanthophthalmus fasciatus* (1824) are nomina nuda. Bleeker's (1860: 74) description makes *Acanthophthalmus fasciatus* (or *Pangio fasciata*) an available name (flatly overlooked by Burridge, 1992). Bleeker based his description both on specimens he examined and on earlier literature accounts. As no holotype is explicitely designated, all the specimens he lists and those mentionned in the cited literature are syntypes. As discussed below, it is likely that more than one species of barred *Pangio* occurs (or occurred) in Java and southern Sumatra but this can only be solved through examination of large series of fresh material. In addition, *A. fasciatus* has always been considered a synonym of *C. kuhlii*. In order to simplify the case and not further complicate analysis of biological problems by strictly nomenclatural aspects, an appropriate type designation is in order to definitively make *P. fasciata* a synonym of *P. kuhlii*. We propose the following three-steps action:

1) Valenciennes (1846: 77) based his description of *Cobitis kuhlii* on a drawing sent by van Hasselt. Bleeker's description of *Acanthophthalmus fasciatus* being based in part on Valenciennes's description, the material used by Valenciennes is part of the syntype series. The specimen which has been used as a model for the drawing on which Valenciennes based his description of *C. kuhlii* is here formally designated as lectotype of *A. fasciatus*. The remaining material examined by Bleeker become paralectotypes.

2) The lectotype of *A. fasciatus* is lost (see Burridge, 1992: 181).

3) To stabilize nomenclature, we decide to designate a neotype. As there are no holotype (see above), lectotype (it is lost), syntypes (they all are now paralectotypes) or prior neotype, this is possible according to ICZN art. 75 (a). We designate RMNH 2688 as the neotype of *Acanthophthalmus fasciatus* Bleeker, 1860. This specimen had already been designated as neotype of *Cobitis kuhlii* Valenciennes, 1846 by Burridge (1992) and this makes the two names objective synonyms; *A. fasciatus* being the junior name, it cannot be used anymore.

Burridge (1992) placed *P. myersi, P. semicincta, P. sumatrana* and *P. malayana* in the synonymy of *P. kuhlii*, without providing evidence. *Pangio malayana* is considered here a valid species (see below). We tentatively agree that *P. semicincta* is a synonym of *P. kuhlii* as we are seeing no apparent difference between Burridge's Javanese neotype (but her Figure 4C is very crude) and Malayan specimens. However, we doubt that there are (were ?) only two species of barred *Pangio* in Java. The Javanese specimens illustrated as *P. k. kuhlii* by Fraser-Brunner (1940: 175, fig. 4A) and Moldenhauer (1957: 120) exhibit a colour pattern unknown in the large series of *P. kuhlii* we have examined and we suspect that they might represent a distinct species. Whether or not these and the neotype of *P. kuhlii* are conspecific will then have to be demonstrated. We are unaware of recent collections of *P. kuhlii* from Java. The only reasonably recent Javanese specimens we have been able to examine had been obtained in 1967 (ZRC 674-675; Fig. 14e). One is similar to Fraser-Brunner's figure of *P. k. sumatrana* while the other is somewhat similar to Moldenhauer's figure of *P. k. kuhlii*. More material is needed to decide if *P. kuhlii, P. sumatrana* and *P. semicincta* are conspecific or not. Our single small collection from southern Sumatra (Palembang, CMK 6036; Fig. 14c) resembles Fraser-Brunner's (1940) figure, and, like material from northern Sumatra (Riau), it does not seem distinguishable from the Malayan populations. This does not exclude the possibility that more than one large, barred eel-loach occur in southern Sumatra and Java.

Pangio myersi (Harry, 1949) is easily distinguished by its colour pattern consisting of ca. 8-11 broad, quadrangular and very regular black bars on an orange background (e. g., Smith, 1945, p. 300, fig. 62; aquarium specimen in Sterba, 1987: 216), contrasting very much with the pattern exhibited by *P. kuhlii*. The caudal fin often is entirely black or has, beside the large basal black blotches, a submarginal vertical bar which is absent in *P. kuhlii* (Fig. 15). Also, *P. myersi*, definitely known only from southeastern Thailand, apparently reaches a much larger size than *P. kuhlii* (67.2 mm SL, for wild caught specimens; aquarium specimens of *P. myersi* reach up to 100 mm SL; the largest *P. kuhlii* we have ever seen is a wild caught female, 63.0 mm SL, with distended belly (ZRC 17703-17728)).

Pangio kuhlii is apparently widely distributed on the Sunda shelf, except in Sarawak where it is replaced by *P. agma* (Burridge, 1992). This distribution pattern is shared with the halfbeak *Hemirhamphodon pogonognathus* (most of Sunda Shelf) and *H. kuekenthali* (Sarawak) (Anderson & Collette, 1991), *Rasbora cephalotaenia* (Sunda shelf) and *R. tubbi* (Brunei, northern Sarawak), *Puntius hexazona* (Sunda shelf) and *P. pentazona* (northern Borneo), and perhaps *Carinotetraodon lorteti* (Malay Peninsula) and an undescribed *Carinotetraodon* (Sarawak), and *Doryichthys boaja* (Malay Peninsula, southern Borneo) and *D. heteronema* (Sambas) (Kottelat, 1993). Burridge (1992: 184) cited only the pair *Phenacostethus posthon* (peninsular Malaysia and Thailand) and *P. trewavasae* (Baram River, Sarawak) as sharing this distribution pattern and history. The distributions might seem similar, but there are important differences between the *Pangio, Hemirhamphodon*, etc. distribution and the *Phenacostethus* one. The first group includes only strictly fresh waters species, occurring far inland and apparently widely distributed throughout the area. While *P. trewavasae* appears to be a strictly freshwater species, *P. posthon* is a coastal - estuarine species known only from along the west coast of the Malay Peninsula (Roberts, 1971; MK, pers. obs.). This is the slope not facing Sarawak. The species has recently been recorded from Riau Prov., Sumatra (Kottelat & Whitten, 1993). We doubt that this pair of estuarine and freshwater phallostethids can be considered as having the same distribution pattern as the strictly freshwater eel-loaches. But another phallostethid could be a candidate to replace *P. posthon* in this hypothesis; we have frequently collected an apparently strictly freshwater phallostethid in small forest creeks of the Malay Peninsula identified as *P. smithi* (the identification is tentative). This or a similar species also occurs far inland in Sumatra (Riau and Jambi Prov.; MK pers. obs.) and is expected to occur in Borneo too. Other North Sarawak ichthyo-geographic peculiarities include the endemic genera *Parawaous* (Watson, 1993), the silurid *Pterocryptis furnessi* (a genus otherwise unknown from the Sunda shelf), etc.

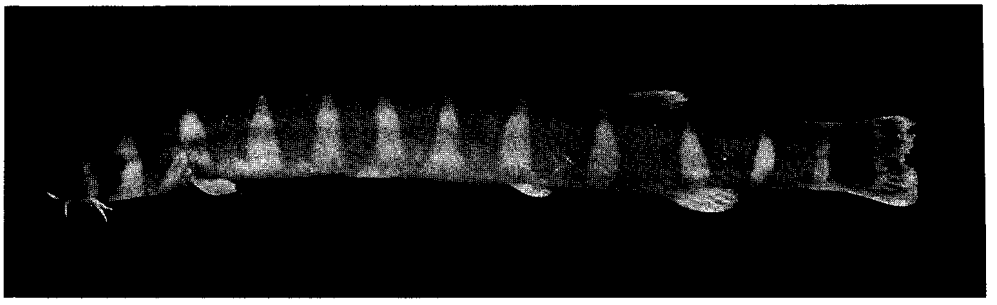


Fig. 15. *Pangio myersi*, CAS 79098, 49.8 mm SL; Chantaburi, Southeastern Thailand.

Distribution. - *Pangio kuhlii* is known from West Java, Sumatra, Kalimantan Timur and Kalimantan Barat (Borneo), and the Malay Peninsula at least as far north as Phangnga (Fig. 4). Records by Burridge (1992) from central and southeastern Thailand in our view either need confirmation or are *P. myersi*.

***Pangio malayana* (Tweedie, 1956)**
(Fig. 16)

Acanthophthalmus kuhlii malayanus Tweedie, 1956: 58 (type locality: Malaysia: Pahang: Kuala Tahan; holotype: BMNH).

Material examined. - MALAYSIA: JOHOR: 3 ex. (ZRC 2045), Sg. Sedili W. of Gunung Sumalayang, coll. C. K. Quek, 22.ii.1968. — 1 ex. (ZRC 491), same locality, coll. E. R. Alfred, 1.vi.1968. — 1 ex. (ZRC 28177), Sg. Mupor, Kota Tinggi, coll. P. K. L. Ng & K. Lim, 15.x.1992. — 3 ex. (CMK 8501), Sungei Ambat, 61 km from Kota Tinggi on road to Mersing, coll. M. Kottelat, P. K. L. Ng *et al.*, 24.vii.1992. — 1 ex. (ZRC 17744), Sg. Semberong, 6 km from Kluang, coll. K. Yong, 13.iv.1990.

PAHANG: 1 (of 2) ex. (ZRC 1444), paratypes of *Acanthophthalmus kuhlii malayanus*; near Kuala Tahan, coll. M. W. F. Tweedie, iii.1955. — 1 ex. (ZRC 28053), Tasik Bera, access stream from NE, coll. K. Lim *et al.*, 2.x.1992. — 2 ex. (ZRC 28010-28011), Sg. Bera, NE of Tasik Bera, coll. K. Lim & D. G. B. Chia, 2.x.1992. — 11 ex. (ZRC 34899-34909), Sg. Salan at Jerantut, coll. J. Davies & J. Cramphorn, 5.xi.1992.

Fig. 16. *Pangio malayana*, CMK 8501, 35.1 and 47.8 mm SL, Sungei Ambat, Johor. Right side, reversed to match present standards in fish illustration.

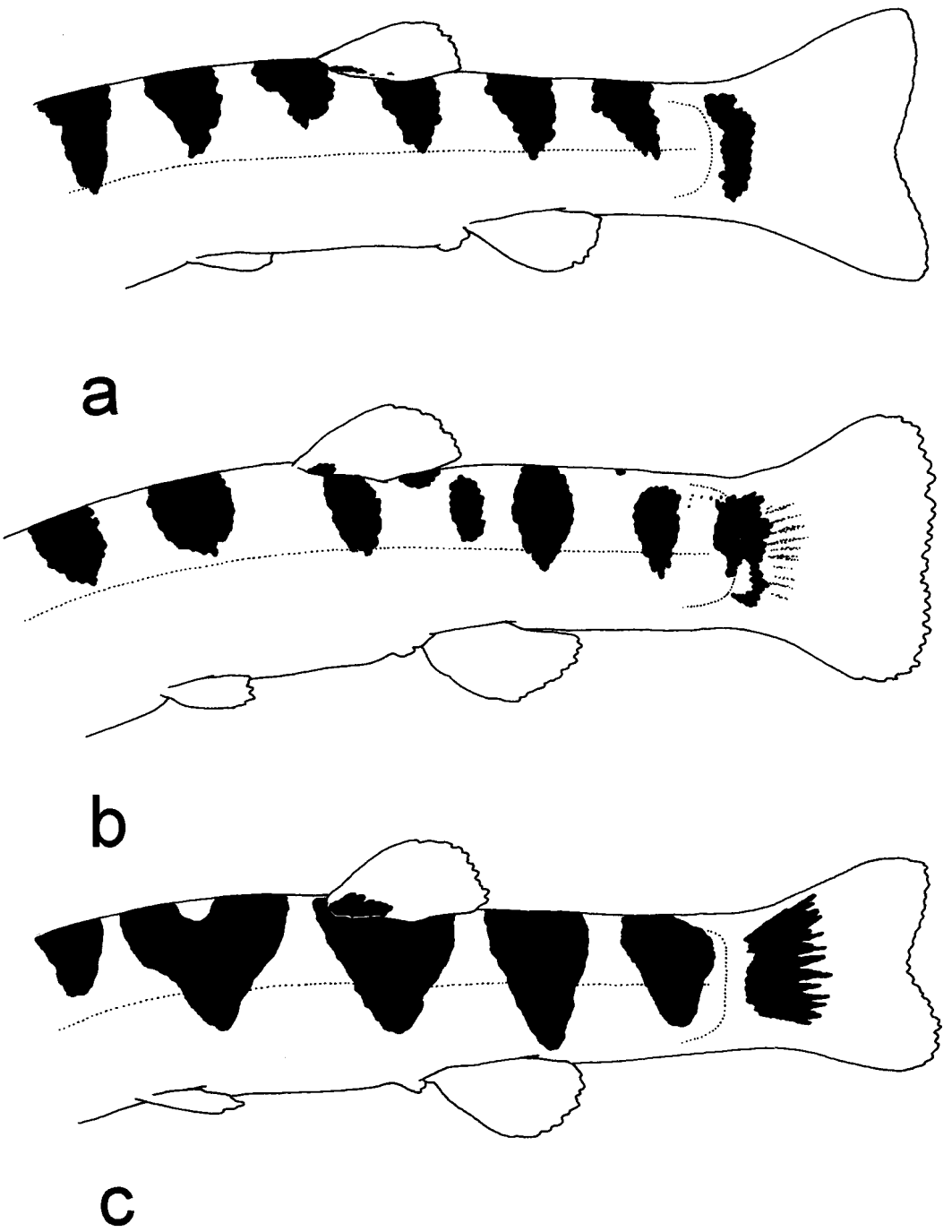


Fig. 17. Markings on posterior part of body of syntopic specimens of: a, *Pangio malayana*, ZRC 28177, 33 mm SL; b, *P. cuneovirgata*, ZRC 28178-28181, 36 mm SL; c, *P. kuhlii*, ZRC 28217-28254, 34 mm SL.

Diagnosis. - *Pangio malayana* is distinguished from the other species with a barred colour pattern by the combination of the following characters: 11-16 bars on sides of body, slightly broader than the interspaces, not reaching below lateral mid-line, except on caudal peduncle where they tend to be slightly narrower and longer; three bars on head, the one through the eye not meeting its homolog behind lower lip; greyish epaxial stripe present; a black bar at caudal base, rest of fin hyaline; caudal fin emarginate; no nasal barbel.

Remarks. - Tweedie (1956) based his description on the holotype (deposited in BMNH) and 4 paratypes of which we have examined one (ZRC 1444 [actually two specimens; the second specimen being on loan could not be examined]). The original description was not very detailed and Tweedie only compared his new subspecies with *P. kuhlii* (sensu Fraser-Brunner, 1940) from Java and Sumatra.

Burridge (1992: 173) stated that "the comparative study of the kuhli loaches from their entire range does not show distinction between populations at the species level in most instances. Therefore I propose that *A. myersi, A. semicinctus,* and *A. sumatranus*, including the nominal subspecies *A. kuhlii kuhlii, A. k. malayanus*, and *A. k. sumatranus,* are all junior synonyms of *A. kuhlii*" [sic]. She apparently had examined a single specimen (one of the paratypes ZRC 1444 which she incorrectly lists as holotype) of what we are now considering a distinct species.

We have examined 25 specimens from eight populations and we are confident that there are three species of barred eel-loaches in the Malay Peninsula. The collection we obtained on 24 July 1992 in Sungei Ambak is the best evidence as it includes *P. kuhlii* (CMK 8498; Fig. 14b), *P.*

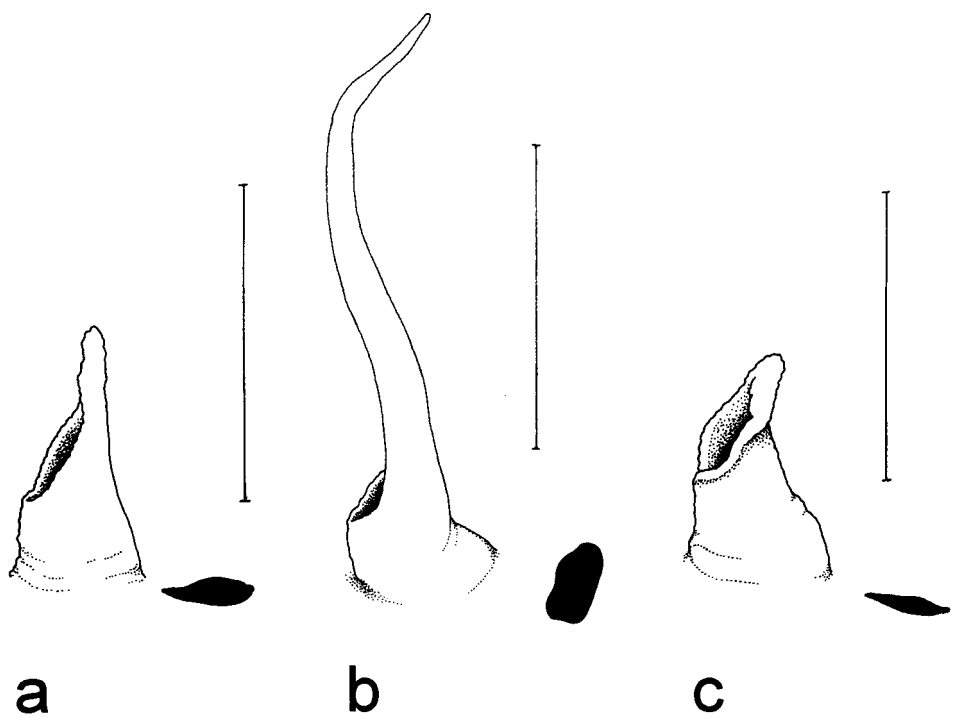


Fig. 18. Shape of nostrils of syntopic specimens of: a, *Pangio malayana*, ZRC 28177, 33 mm SL; b, *P. cuneovirgata*, ZRC 28178-28181, 36 mm SL; c, *P. kuhlii*, ZRC 28217- 28254, 35 mm SL. Scale bars 1 mm.

cuneovirgata (CMK 8500; Fig. 7) and *P. malayana* (CMK 8501; Fig. 16). Although *P. malayana* seems "intermediate" between *P. kuhlii* and *P. cuneovirgata*, we consider as unlikely the possibility of *P. malayana* being an hybrid between the two as for all characters it is identical with one or the other species but never exhibits intermediate values as is usually the case with hybrids. With *P. cuneovirgata*, it shares the bars restricted to the upper body half, the presence of the epaxial stripe, the bar at the caudal base and the hyaline caudal (Fig. 17); with *P. kuhlii*, it shares the absence of nasal barbel (Fig. 18). The number of body bars of *P. malayana* is even beyond the range of variability of both species: *Pangio kuhlii* has 6-10 bars, *P. cuneovirgata* 7-13 and *P. malayana* 10-16. *Pangio malayana* differs from both species in having the second head bars not meeting ventrally behind the lower lip (vs. meeting or almost meeting; only distinct in large size specimens). The largest known specimen is 60 mm SL (Tweedie, 1956).

Distribution. - *Pangio malayana* has been collected in forest streams in Johor and Pahang (Fig. 2). Its rare occurence in collections might be explained by a preference for large rivers or insufficient collecting. Where it has been collected in large numbers (e.g. Sg. Salan, ZRC 34899-34909), *P. kuhlii* was not present.

Pangio oblonga (Valenciennes, 1846)

(Fig. 19)

Acantophthalmus javanicus van Hasselt, 1823: 133 (nomen nudum).
Acanthophthalmus javanicus van Hasselt, 1824: 377 (nomen nudum).
Cobitis oblonga Valenciennes, in Cuvier & Valenciennes, 1846: 76 (type locality: Java: Bogor; neotype: ZRC 35047, by present designation).
Acanthophthalmus javanicus Bleeker, 1860: 75 (type locality: Java: Bogor; neotype: ZRC 35047, by present designation).

Material examined. - MALAYSIA: 2 ex. (ZRC 28437-28438), 2 ex. (CMK 8102), stream behind Hindu temple, immediately W of junction of Kuantan-Segamat road with Kuantan-Kuala Lumpur road, Gambang, Pahang, coll. M. Kottelat, P. K. L. Ng *et al.*, 10.iii.1992.

SUMATRA: 2 ex. (CMK 4610), km 25 on road from Sijungjung to Paya Kumbuh, Sumatera Barat, coll. P. G. Bianco & M. Kottelat, 3.xii.1984. — 8 ex. (CMK 9736), 3 ex. (ZRC 35051-35053), Sungei Tembesi basin near Pauh, Jambi Prov., don. D. Yuwono, iii.1993.

BORNEO: 1 ex. (CMK 6889), Kapuas mainstream at Teluk Ujung Bayur, Kalimantan Barat, 0°50'N 112°45'E, coll. M. Kottelat *et al.*, 27.iv.1990.

JAVA: 1 ex. (ZRC 35047), neotype, 1 ex. (CMK 6040), Bogor, Java, don. Vivaria Indonesia, 29.v.1988. — 11 ex. (ZRC 29150-29160), aquarium specimens from West Java.

Diagnosis. - *Pangio oblonga* is distinguished by its plain brown colouration (reddish brown in life) and its comparatively deep body (depth 7.2-7.7 times in SL); absence of nasal barbel; and 33-35 + 12- 13 = 45-47 vertebrae.

Remarks. - The description of *Cobitis oblongus* is based on a drawing prepared under Kuhl and van Hasselt's supervision in Java and sent by them to Leiden (Alfred, 1961; Kottelat, 1987). Valenciennes apparently had no other material.

Van Hasselt's use of *Acantophthalmus javanicus* (1823) and *Acanthophthalmus javanicus* (1824) are nomina nuda. Bleeker's (1860: 75) description makes *Acanthophthalmus javanicus*

(or *Pangio javanica*) an available name. Bleeker based his description both on specimens he examined and on earlier literature accounts. As no holotype is explicitely designated, all the specimens he lists and those on which the literature accounts are based are syntypes. As discussed below, it is likely that more than one species of brown *Pangio* occurs (or occurred) in Java and Sumatra. As *A. javanicus* has always been considered a synonym of *C. oblongus*, it seems desirable to have this synonymy permanently fixed by an appropriate type designation.

Valenciennes (1846: 77) based his description of *Cobitis oblongus* on a drawing sent by van Hasselt. Bleeker's description of *Acanthophthalmus javanicus* was based in part on Valenciennes's description; the material used by Valenciennes is part of the syntype series. The specimen which has been used as a model for the drawing on which Valenciennes based his description of *C. oblongus* is here formally designated as the lectotype of *A. javanicus*. The lectotype of *A. javanicus* is the holotype of *C. oblongus*, and the two species are thus objective synonyms. The holotype of *C. oblongus* (and lectotype of *A. javanicus)* is lost (see Roberts, 1993). To stabilize nomenclature, we hereby designate ZRC 35047, 53.5 mm SL (Fig. 19a), collected at the original type locality, as the neotype of *Cobitis oblongus* Valenciennes, 1846. Because *C. oblongus* and *Acanthophthalmus javanicus* Bleeker, 1860, are objective synonyms, the neotype of *C. oblongus* is also the type of *A. javanicus*.

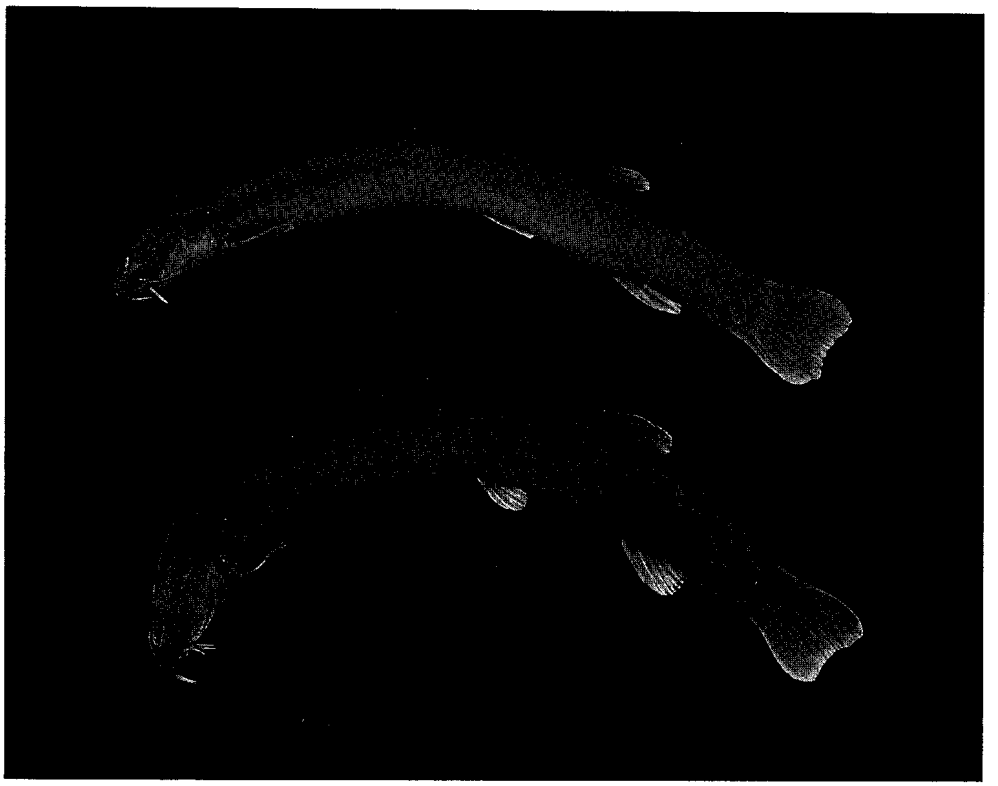


Fig. 19. *Pangio oblonga*, ZRC 35047, 53.5 (neotype) and CMK 6040, 59.7 mm SL, Bogor, Java.

Until recently a single species of brown *Pangio* has been recorded from Java and Sumatra. We herein record two other species from Sumatra (*P. piperata* and *P. shelfordii*) which often have plain brown specimens. Additional material from this area indicates that more brown species might be present and this is presently being investigated.

Distribution. - As recognized here and by Roberts (1989), *P. oblonga* is known from Java, Sumatra, Borneo and Malaysia (Fig. 6). Specimens reported under this name from Thailand and Cambodia (Kottelat, 1985, 1989) apparently represent at least one undescribed species.

***Pangio piperata*, new species**
(Fig. 20)

Acanthophthalmus muraeniformis - Hora, 1941: 51 (part), Kuala Tahan, Pahang) (non de Beaufort, 1933).

Material examined. - Holotype - female (46.1 mm SL), (ZRC 35003), stream at about km 6 on Kuala Brang - Kuala Terengganu road, Terengganu, Malaysia, 6°04'25"N 103°03'20"E, coll. M. Kottelat, P. K. L. Ng *et al.*, 19.iii.1992 (Fig. 20).

Paratypes - MALAYSIA: JOHOR: 70 ex. (27.3-44.5 mm SL), (ZRC 494), Sg. Sedili W. of Gunung Sumalayang, coll. C. K. Quek, 22.ii.1968. — 18 ex. (33.2-45.6 mm SL), (ZRC 495), Sg. Sedili W. of Gunung Sumalayang, coll. E. R. Alfred, 1.vi.1968. — 7 ex. (33.3-44.1 mm SL), (CMK 8497), Sungei Ambat, 61 km from Kota Tinggi on road to Mersing, coll. M. Kottelat, P. K. L. Ng *et al.*, 24.vii.1992. — 24 ex. (27.5-45.3 mm SL), (ZRC 28294-28317), same locality, coll. K. Lim & D. G. B. Chia, 15.x.1992. — 28 ex. (27.2-52.1 mm SL), (ZRC 28189-28216), Sg. Mupor, Kota Tinggi, coll. P. K. L. Ng & K. Lim, 15.x.1992. — 1 ex. (25.9 mm SL), (CMK 8537), 15 km from Labis on road to Muar, Sungei Labis, Sungei Muar basin, coll. M. Kottelat, K. K. P. Lim *et al.*, 26.vii.1992. — 6 ex. (30.2- 38.6 mm SL), (ZRC 23049-23054), Sg. Bong, Ulu Endau, coll. T. H. T. Tan & J. B. Tay, 5.iv.1992. — 14 ex. (ZRC 23074-23087), Sg. Anak Jasin, Ulu Endau, coll. T. H. T. Tan & J. B. Tay, 4.iv.1992.

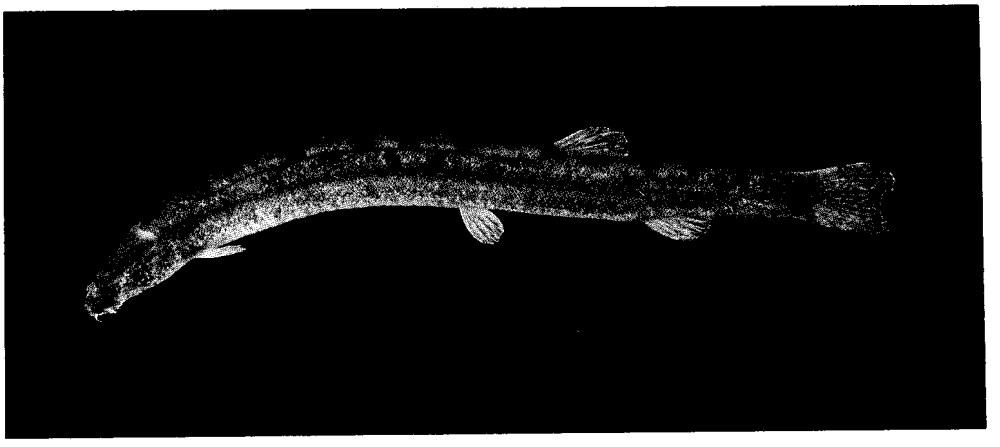


Fig. 20. *Pangio piperata*, ZRC 35003, holotype, 46.1 mm SL, Kuala Brang, Terengganu.

PAHANG: 5 ex. (39.8-45.0 mm SL), (ZRC 655 (i-v)), Kuala Tahan, coll. M. W. F. Tweedie, iv.1940. — 1 ex. (47.7 mm SL), (ZRC 8280), a western tributary of Sg. Kinchin, Ulu Kinchin, coll. P. K. L. Ng *et al.*, 14.vi.1989. — 10 ex. (ZRC 14299-14308), 4 ex. (CMK 7882), (38.7-48.8 mm SL), Sg. Keniam at Kuala Perkai, coll. K. Lim, S. Lum & K. Whooley, 2.iv.1991. — 1 ex. (32.6 mm SL), (ZRC 28013), Sg. Bera, NE of Tasik Bera, coll. K. Lim & D. G. B. Chia, 2.x.1992.

TERENGGANU: 26 ex. (21.8-48.6 mm SL), (ZRC 493), Sg. Tok Dor at Kg. Tok Dor, coll. C. K. Quek, 4.viii.1966. — 14 ex. (ZRC 35004-35017), 15 ex. (CMK 8204), (20.1-46.0 mm SL), same data as holotype. — 4 ex. (40.4-47.0 mm SL), (ZRC 24534-24537), same locality as holotype, coll. T. H. T. Tan & D. S. L. Chung, 3-5.viii. 1992. — 3 ex. (ZRC 35000-35002), 3 ex. (CMK 8200), (22.1-40.5 mm SL), Sungai Tersat, a tributary of Sungai Terengganu, immediately downriver of Sekayu Waterfall Park, 4°57'51"N 102°57'45"E, coll. M. Kottelat, P. K. L. Ng *et al.*, 18-19.iii.1992. — 4 ex. (ZRC 35018-35021), 5 ex. (CMK 8253), (32.6-46.9 mm SL), a small tributary of Sungai Kemia Hulu Besut, 6 km W of Kampung Keruak on road to hydro-electric station, coll. M. Kottelat, P. K. L. Ng *et al.*, 20.iii. 1992. — 9 ex. (ZRC 34991-34999), 9 ex. (CMK 8121), (19.0-36.8 mm SL), north of Ayer Puteh, about 121 km on road from Kuantan to Kuala Terengganu, 4°24'14"N 103°15'46"E. coll. M. Kottelat & P. K. L. Ng *et al.*, 17.iii. 1992.

SUMATRA: 3 ex. (35.5-43.1 mm SL), (CMK 8355), S. Siregar, vicinity of Seberida, Riau, 1991-1992. — 5 ex. (35.7-41.0 mm SL), (CMK 9054), Sungei Gangsal in Kecamatan Seberida, Riau, coll. A. J. Whitten, 30.xi.1991.

Diagnosis. - *Pangio piperata* is distinguished from the other species of *Pangio* by the combination of the following chracters: body slender, its depth 9.0-10.6 times in SL; absence of nasal barbel; body background whitish, finely peppered with very closely set black dots, often with a series of small black saddles along dorsal mid-line; 31-35 + 13-16 = 46-49 vertebrae.

Description. - General body shape and appearance are shown in Figure 20. Morphometric data of the holotype (46.1 mm SL) and 4 of the largest topotypes (41.9-46.0 mm SL): total length 111.8-114.8 % SL; head length 14.8-16.5 % SL; predorsal length 66.4-69.0 % SL; prepelvic length 54.0-58.2 % SL; preanal length 77.4-80.7 % SL; body depth at dorsal origin 9.4-11.1 % SL; depth of caudal peduncle 7.0-7.9 % SL; length of caudal peduncle 15.3-17.4 % SL (2.14-2.36 times it depth); body width 5.6-6.9 % SL; length of pelvic fin 6.5-10.3 % SL; length of pectoral fin 6.9-11.5 % SL; snout length 4.8-5.7 % SL, 31-37 % HL; eye diameter 2.0-2.4 % SL, 13-16 % HL.

Dorsal fin with 2 rudimentary, 1 simple and 6 branched rays, last one split to the base; first dorsal pterygiophore inserted behind neural spine of vertebrae 26-27. Pectoral fin with 7-8 rays; in males, pectoral much longer than in females, second ray thicker and slightly turned upwards at the tip, third ray slightly thicker. Pelvic fin with 7 rays, much longer in males than in females, origin of first ray below vertebral centra 23-26. Anal fin inserted almost immediately behind vent, with 2 rudimentary, 1 simple and 5 branched rays, last one split to the base; first anal pterygiophore inserted behind hemal spine of vertebrae 31-35. Caudal fin emarginate, with 8+8 principal rays (7+7 branched).

Body entirely scaled, except belly between pectoral bases. Head naked. Suborbital spine bifid, outer branch straight, inner branch slightly curved, stronger and twice longer than outer one. Three pairs of barbels, two pairs of rostral ones and one at each angle of mouth reaching at most vertical of front margin of eye. Lower lip interrupted medially, each half with an inner thickened lobe ending in a short barbel-like pointed tip; margin of membrane connecting this lobe and the barbel at corner of the mouth entire. Anterior nostril at the tip of a short conical tube.

Vertebrae: 31-35+13-16 = 46-49 (Table 1). Vertebrae 5 to 24-28 with pleural ribs.

Colouration. - Body yellowish brown, finely dotted by tiny black spots except on belly. The spots are more densely set at body midheight where they form a dark midlateral stripe (without sharp margins). On the back they are also somewhat denser and often tend to be organized into a series of middorsal dark blotches behind and especially in front of dorsal fin. A conspicuous black vertical mark at caudal fin base. A black spot at axil of pectoral. Head finely dotted as body, with a narrow, pale transverse bar on nape and one between nostrils. Dorsal, anal and caudal fins with rows of tiny black spots, denser on caudal fin. Other fins hyaline. Pectoral of males with fine dark lines along both sides of modified second ray. Colour pattern of juvenile as in adults.

In life, the body is dark reddish brown and the dots are black.

Remarks. - *Pangio piperata* was first reported by Hora (1941) who considered it as within the range of variation of *P. muraeniformis* [now *P. shelfordii*]. As discussed below, *P. shelfordii* exhibits much geographic variation in colour pattern, including in Sumatra and Borneo some populations with a colour pattern not too different from *P. piperata* (compare figures 19 and 21d-e). Undoubtedly the two species are closely related, but in the Malay Peninsula they regularly occur together and both species can be distinguished at once on the basis of the colour pattern, even in specimens as small as ca. 10 mm SL. There is no intermediate colour pattern at these localities or in this general area. Additionally, where they occur in sympatry, they can be distinguished by vertebral counts (31-35 + 13-16 = 46-49 [mode: 33+14=47] in *P. piperata*, vs. 33-36 + 14-16 = 49-51 [mode: 35+15=50] for Malayan *P. shelfordii*; see Table 1).

Habitat. - *Pangio piperata* has been collected mostly in forest streams. They are usually found in thick leaf litters, often associated with *P. shelfordii* with which they have been confused earlier.

Distribution. - *Pangio piperata* has been collected in West Malaysia from Johor to Terengganu and in Sumatra in Riau (Fig. 13).

Etymology. - A adjective based on the Latin *Piper* (pepper), meaning peppered, an allusion to the finely speckled body.

Pangio pulla, new species
(Fig. 21)

Material examined. - Holotype - female (61.4 mm SL), (ZRC 35022), blackwater stream, 28-29 km on road to Tangkiling; tributary of Sungei Rungan, Sungei Kahajan basin, heath forest NW of Palankaraya, Kalimantan Tengah, Indonesia, coll. A. Waser, R. Krummenacher & A. Monsch, 17.vii.1991 (Fig. 21a).

Paratype - female (56.0 mm SL), (CAS 80441), Sungai Ramban, swift flowing blackwater forest stream, 22 km W of Sampit on road to Pembuanghulu, Mentaya basin, Kalimantan Tengah, Indonesia, coll. G. Lucas, 11.vi.1992 (Fig. 21b).

Diagnosis. - *Pangio pulla* has 46-48 + 15-16 = 61-62 vertebrae, values shared with a group of species including *P. doriae*, and *P. anguillaris*, characterized by 62-70 vertebrae (all other named species have 45-55). From these species, *P. pulla* is distinguished by its colour pattern consisting of an almost entirely blackish brown body with some 20-25 very thin light vertical bars (vs. plain dull brown or greyish with a more or less conspicuous black longitudinal stripe) and by the absence of pelvic fins and pelvic girdle (vs. presence). It further differs from *P. doriae* which has slightly overlapping vertebral counts in having the neural spines forming an angle of

about 50-60° with the longitudinal axis of the vertebrae (vs. about 20-30° in *P. doriae*), a more massive head (head depth at nape 1.5-1.7 times in its length vs. about 2.3-2.7 [Malayan and Borneo specimens]) and a shorter nasal barbel (reaching middle of eye, vs. reaching beyond eye).

Description. - Body shape and appearance are shown in Figure 21. Morphometric data of the holotype and paratype (in brackets): total length 104.9 (107.0) % SL, head length 9.8 (12.1) % SL, predorsal length 78.2 (77.1) % SL, preanal length 83.2 (78.8) % SL, body depth (at dorsal origin) 8.6 (8.8) % SL, body width (at body midlength) 4.4 (5.4) % SL, depth of caudal peduncle 6.2 (7.5) % SL, length of caudal peduncle 15.6 (16.1) % SL (2.53 (2.14) times its depth), length of pectoral fin 5.2 (5.7) % SL, eye diameter 1.1 (1.3) % SL, 12 (10) % HL, interorbital width 1.8 (2.1) % SL, 18 (18) % HL, snout length 3.7 (3.8) % SL, 38 (31) % HL.

Dorsal fin small, rays difficult to count as they are in a very thick adipose membrane, with 2 simple and 5 branched rays, the last one split to the base; first dorsal pterygiophore inserted behind neural spine of vertebrae 44 (44). Pectoral fin small, falcate, with 1 simple and 6 (5) branched rays. Pelvic fins and pelvic girdle absent. Anal fin inserted almost immediately behind vent, with 2 simple, 4 branched rays, and one segmented but simple ray. First anal pterygiophore inserted behin hemal spine of vertebrae 48 (46). Caudal fin slightly emarginate, with 7+8 (apparently damaged) (8+8) principal rays (7+7 branched).

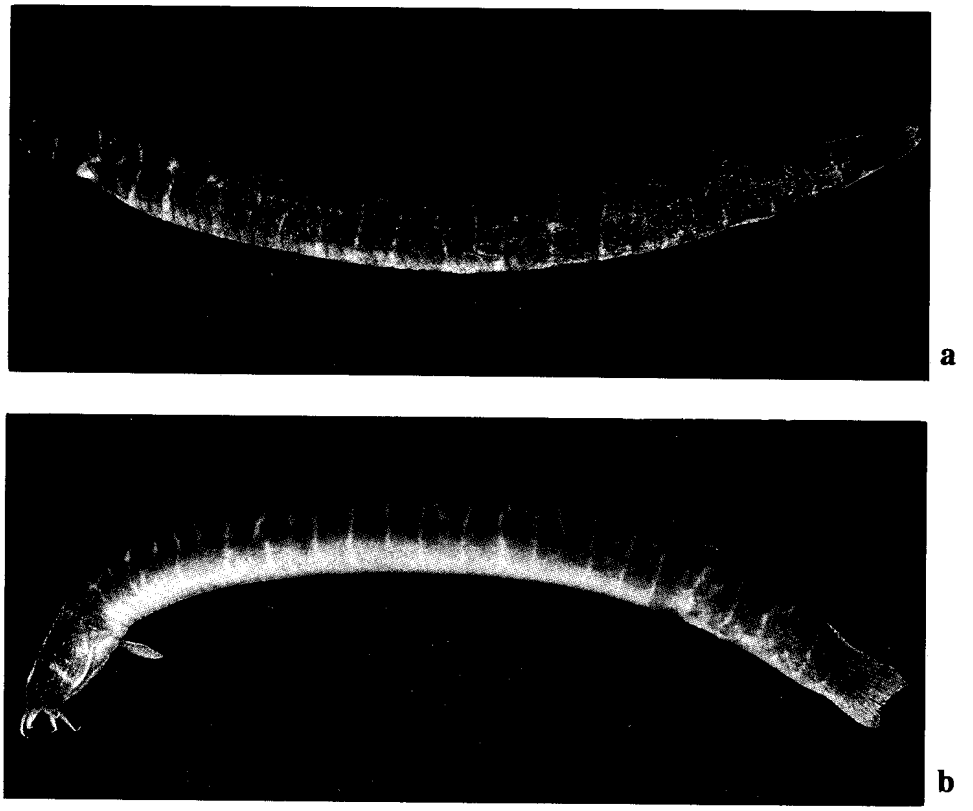


Fig. 21. *Pangio pulla*. a, ZRC 35022, holotype, 61.4 mm SL; b, CAS 80441, paratype, 56.0 mm SL; both Kalimantan Tengah, Borneo.

Body entirely covered by scales. Head naked. Suborbital spine bifid, outer prong about 1/4 to 1/3 of length of inner one. Mouth with three pairs of barbels, reaching posteriorly about to vertical of eye, and a pair of mental lobe which are fused medially on most of their length. Anterior nostril pierced in a triangular flap with an elongated point reaching about middle of eye.

Vertebrae: 48+16=62 (46+15=61) vertebrae. Vertebrae 5-32 (5-30?) bear pleural ribs.

Colouration. - Body, head and caudal fin blackish brown, belly yellowish. Body with about 20-25 very narrow vertical yellowish bars, last one on caudal fin, deliminating roughly squarish dark patches, almost all of them with a round or vertically elongated light mark in the middle. Head with a white or silvery stripe below eye and a second one along margin of operculum. Dorsal and anal fins hyaline. Pectoral fins brown in holotype, hyaline in paratype.

Habitat. - The holotype has been collected in a blackwater stream in heavily degraded heath forest, with moderately swift current and the paratype in a blackwater forest stream with swift current.

Distribution. - Presently known only from Kalimantan Tengah, Borneo (Fig. 4).

Etymology. - From the Latin *pullus*, meaning blackish brown; an allusion to the dull colouration as well as to the blackwaters it inhabits. An adjective.

***Pangio shelfordii* (Popta, 1903)**

(Fig. 22)

? *Acanthophthalmus borneensis* Boulenger, 1894: 251 (type locality: Baram River, Sarawak; syntypes: BMNH).

Acanthophthalmus shelfordii Popta, 1903: 231 (type locality: Sarawak River near Kuching; holotype: RMNH 7661).

Acanthophthalmus muraeniformis de Beaufort, 1933: 32 (type locality: Singapore: Thomson Road; syntypes: ZRC 1052 [2], ZMA 103.185 [3])

Material examined. - *A. muraeniformis* colour pattern:

SINGAPORE: 3 ex. (ZRC 1051), stream near Seletar Reservoir, coll. M. W. F. Tweedie, i.1951. — 2 ex. (ZRC 1052), syntypes of *Acanthophthalmus muraeniformis*; 3rd mile Thomson Road, coll. R. Hanitsch, 16.v. 1912. — 171 ex. (ZRC 1186), Sg. Seletar W. of Seletar Reservoir, coll. E. R. Alfred, 8.iv.1963. — 2 ex. (ZRC 5165-5166), stream along Mandai Road, coll. D. S. Johnson, 16.x.1955. — 1 ex. (ZRC 11576), Nee Soon swamp forest, coll. P. K. L. Ng & P. Yap, 28.xii.1989. — 2 ex. (ZRC 12346-12347), Nee Soon swamp forest, coll. K. Yong & P. K. L. Ng, 21.iv.1990. — 5 ex. (CMK 6031), Nee Soon rifle range, coll. M. Kottelat *et al.*, 21.v.1988.

MALAYSIA: JOHOR: 1 ex. (ZRC 1452), Mawai District, coll. M. W. F. Tweedie, iii.1938. — 1 ex. (ZRC 1453), Kota Tinggi, coll. M. W. F. Tweedie, 1938. — 2 ex. (ZRC 2047), Sg. Sedili W. of Gunung Sumalayang, coll. C. K. Quek, 22.ii. 1968. — 3 ex. (ZRC 2083), Sg. Mupor, Mawai, coll. C. K. Quek, 4.x.1967. — 4 ex. (ZRC 4881-4884), Sg. Mupor, coll. E. R. Alfred, 21.ii.1971. — 3 ex. (ZRC 5894-5896), Mawai. — 1 ex. (ZRC 8406), eastern foothills of Gunung Panti, coll. K. C. Lim & K. Lim, 25.vi.1989. — 3 ex. (CMK 7394), northeastern foothill on Gunung Panti, about 20 km N of Kota Tinggi, 103°52'E 1°53'N, coll. M. Kottelat, P. K. L. Ng & K. K. P. Lim, 22.i.1991. — 7 ex. (ZRC 28182-28188), same locality, coll. P. K. L. Ng & K. Lim, 15.x.1992. — 1 ex. (ZRC 25764), same locality, coll. P. K. L. Ng *et al.*, 24.vii.1992. — 2 ex. (ZRC 13960-13961), 10 ex. (CMK 7381), Sg. Mupor, about km 15 on road from Kota Tinggi to Mersing, 103°56'E 1°52'N, coll. M. Kottelat & K. Lim, 22.i.1991. — 2 ex.

(ZRC 13991-13992), eastern foothills of Gunung Panti, coll. P. K. L. Ng, 20.ix.1990. — 9 ex. (ZRC 14236-14334), streams along Kluang - Mersing road, coll. P. K. L. Ng, v.1985. — 3 ex. (ZRC 16932-16934), 3 ex. (CMK 7855), stream along road between Mawai and junction with Kota Tinggi-Desaru road, 25 km before junction, coll. P. K. L. Ng & M. Kottelat, 14.viii. 1991. — 11 ex. (ZRC 18781-18791), same locality, coll. P. K. L. Ng *et al.*, 22.x.1991. — 6 ex. (ZRC 28371-28376), Kota Tinggi, Mawai - Desaru road, coll. P. K. L. Ng *et al.*, 15.x.1992. — 5 ex. (ZRC 17006-17010), 5 ex. (CMK 7821), black water stream at about km 3 on road from Mawai to Tandjung Sedili, coll. P. K. L. Ng & M. Kottelat, 14.viii.1991. — 6 ex. (ZRC 21390- 21395), Sg. Selagi, 15 km from Kota Tinggi on road to Tg. Sedili, coll. P. K. L. Ng *et al.*, 22.iv.1992. — 1 ex. (ZRC 28425), Sg. Temerang, Kota Tinggi, coll. P. K. L. Ng *et al.*, 15.x.1992. — 4 ex. (CMK 8499), Sungei Ambat, 61 km from Kota Tinggi on road to Mersing, coll. M. Kottelat, P. K. L. Ng *et al.*, 24.vii.1992. — 3 ex. (ZRC 28291-28293), same locality, coll. K. Lim & D. G. B. Chia, 15.x.1992. — 6 ex. (ZRC 25650—25655), 5 ex. (CMK 8512), pool ca. 50—55 km from Kota Tinggi on road to Mersing, coll. M. Kottelat, P. K. L. Ng *et al.*, 24.vii.1992. — 5 ex. (ZRC 29053-29057), 5 ex. (CMK 9268), Gunung Pulai reservoir, coll. M. Kottelat, P. K. L. Ng *et al.*, 4.iii. 1992. — 1 ex. (ZRC 23055), Sg. Bong, Ulu Endau, coll. T. H. T. Tan & J. B. Tay, 5.iv.1992. — 3 ex. (ZRC 23071-23073), Sg. Anak Jasin, Ulu Endau, coll. T. H. T. Tan & J. B. Tay, 4.iv.1992.

PAHANG: 2 ex. (ZRC 1454), Tasek Bera, coll. M. W. F. Tweedie, x.1949. — 1 ex. (ZRC 8281), a western tributary of Sg. Kinchin, Ulu Kinchin, coll. P. K. L. Ng *et al.*, 14.vi.1989. — 11 ex. (ZRC 8282-8292), Sg. Kinchin, at confluence of Sg. Seladang, Ulu Kinchin, coll. P. K. L. Ng *et al.*, 13.vi.1989. — 3 ex. (ZRC 28054-28056), Tasik Bera, access stream from NE, coll. K. Lim *et al.*, 2.x.1992. — 4 ex. (ZRC 28014-28017), Sg. Bera, NE of Tasik Bera, coll. K. Lim & D. G. B. Chia, 2.x.1992.

SUMATRA: RIAU: 27 ex. (ZRC 33389-33415), Pulau Bintan north, 1°09'00.4"N 104°31'05.5"E, coll. T. H. T. Tan *et al.*, 12.v.1993. — 12 ex. (ZRC 34296-34307), Pulau Bintan north (1°09'34.6"N 104°31'37"E), coll. N. Sivasothi *et al.*, 13.v. 1993. — 3 ex. (ZRC 33040-33042), Pulau Bintan north, coll. N. Sivasothi *et al.*, 12.v.1993.

A. shelfordii colour pattern:

MALAYSIA: TERENGGANU: 44 ex. (ZRC 2052), Sg. Tok Dor at Kg. Tok Dor, coll. C. K. Quek, 4.viii.1966. — 1 ex. (ZRC 2061), Sg. Trengganu at Kuala Brang, coll. E. R. Alfred, 8.viii.1965. — 7 ex. (ZRC 2080), Sg. Tok Dor at Kg. Tok Dor, coll. 6..vii.1958. — 18 ex. (ZRC 34973-34990), 18 ex. (CMK 9144), stream at about km 6 on Kuala Brang to Kula Terengganu road, 5°04'25"N 103°03'20"E, coll. M. Kottelat, P. K. L. Ng *et al.*, 19.iii.1992.

BORNEO: SARAWAK: (RMNH 7661), holotype of *A. shelfordii*, coll. Kuching. — 5 ex. (ZRC 35054-35058), 5 ex. (SM uncat.), 5 ex. (CMK 8372), Sungei Jaguh, road from Balai Ringin to Bandar Sri Aman, 99 km from Kuching, coll. M. Kottelat, K. Lim, P. Ng & C. Leh, 2.vii.1992. — 5 ex. (ZRC 35059-35063), 5 ex. (CMK 8404), km 42 on road from Lindu to Kuching, west of Sungei Stinggang, coll. M. Kottelat, K. Lim, P. Ng & C. Leh, 3.vii.1992.

Upper Kapuas colour pattern:

BORNEO: KALIMANTAN BARAT: 14 ex. (CMK 6921), right tributary of Sungai Sibau, about 3 km upstream of Putussibau, coll. M. Kottelat *et al.*, 28.iv.1990.

BORNEO: KALIMANTAN TIMUR: 3 ex. (CMK 7736), Sungei Mudjan, a tributary of Mahakam R. near Tring, Mahakam R. basin, 0°04'S 115°37'E, coll. M. Kottelat, 3.viii.1991. — 1 ex. (CMK 7756), unnamed blackwater stream entering the Mahakam R. on the left side near Mujub, Mahakam R. basin, 0°01'S 115°43'E, coll. M. Kottelat, 3.viii.1991. — 2 ex. (CMK 7783), Sungei Behernas, a blackwater tributary of Mahakam R. immediately upriver of Merimun, Mahakam R. basin, 0°05'S 115°47'E, coll. M. Kottelat, 4.viii.1991.

Sumatra colour pattern:

SUMATRA: BANKA: 7 ex. ((ZRC 30941-30947), 41 km S of Koba on road to Toboali, coll. M. Kottelat *et al.*, 3.iii.1993. — 16 ex. (ZRC 30799-30814), 9 km E of Mentok on road to Pangkalinang,

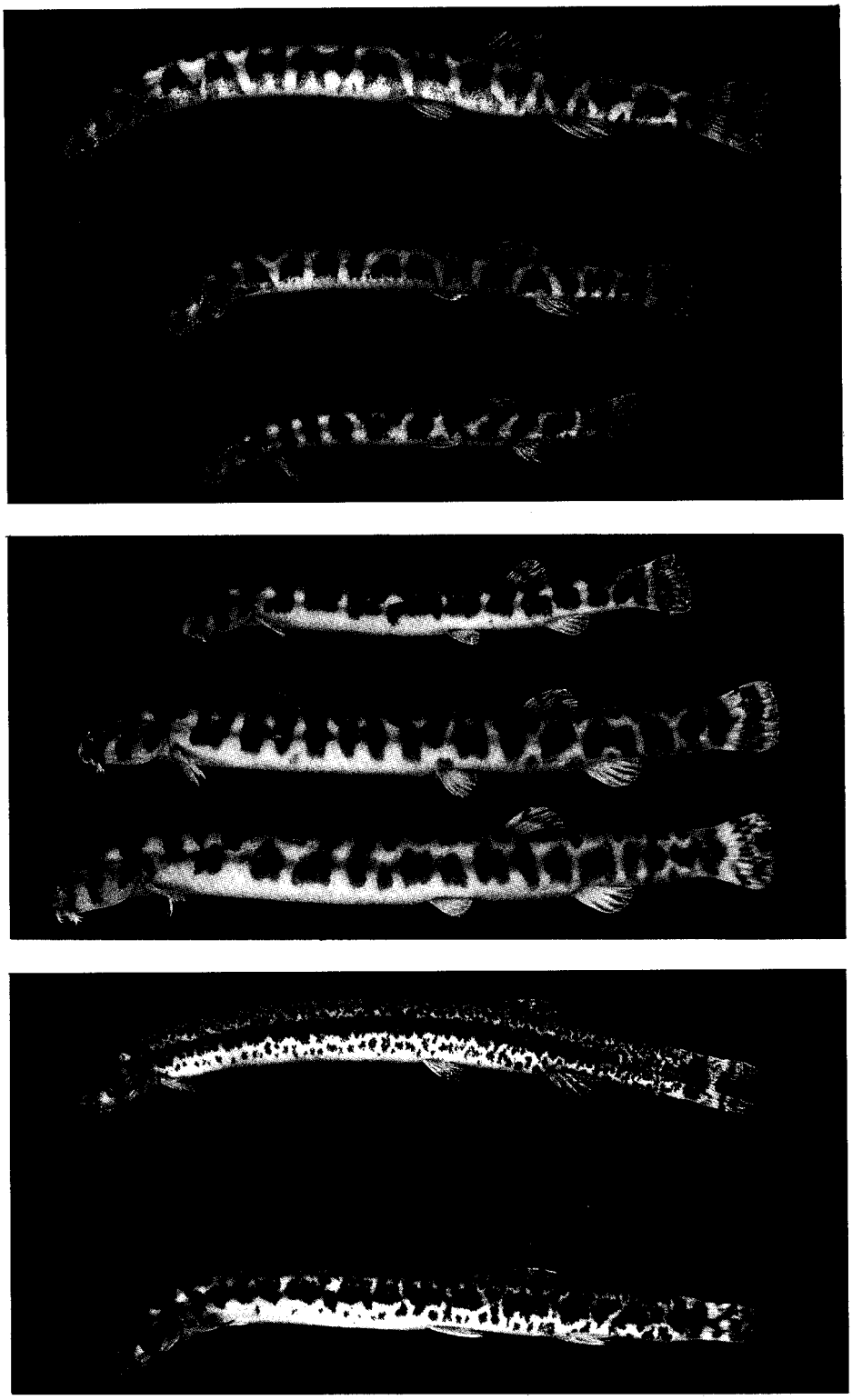


Fig. 22. a-c. *Pangio shelfordii*. a, CMK 8372, 52.6, 39.0 and 32.7 mm SL, Sungei Jaguh, Sarawak; b, CMK 9144, 36.1, 49.6 and 51.3 mm SL, Terengganu; c, CMK 7381, 49.2 and 47.2 mm SL; Sungei Mupor, Johor.

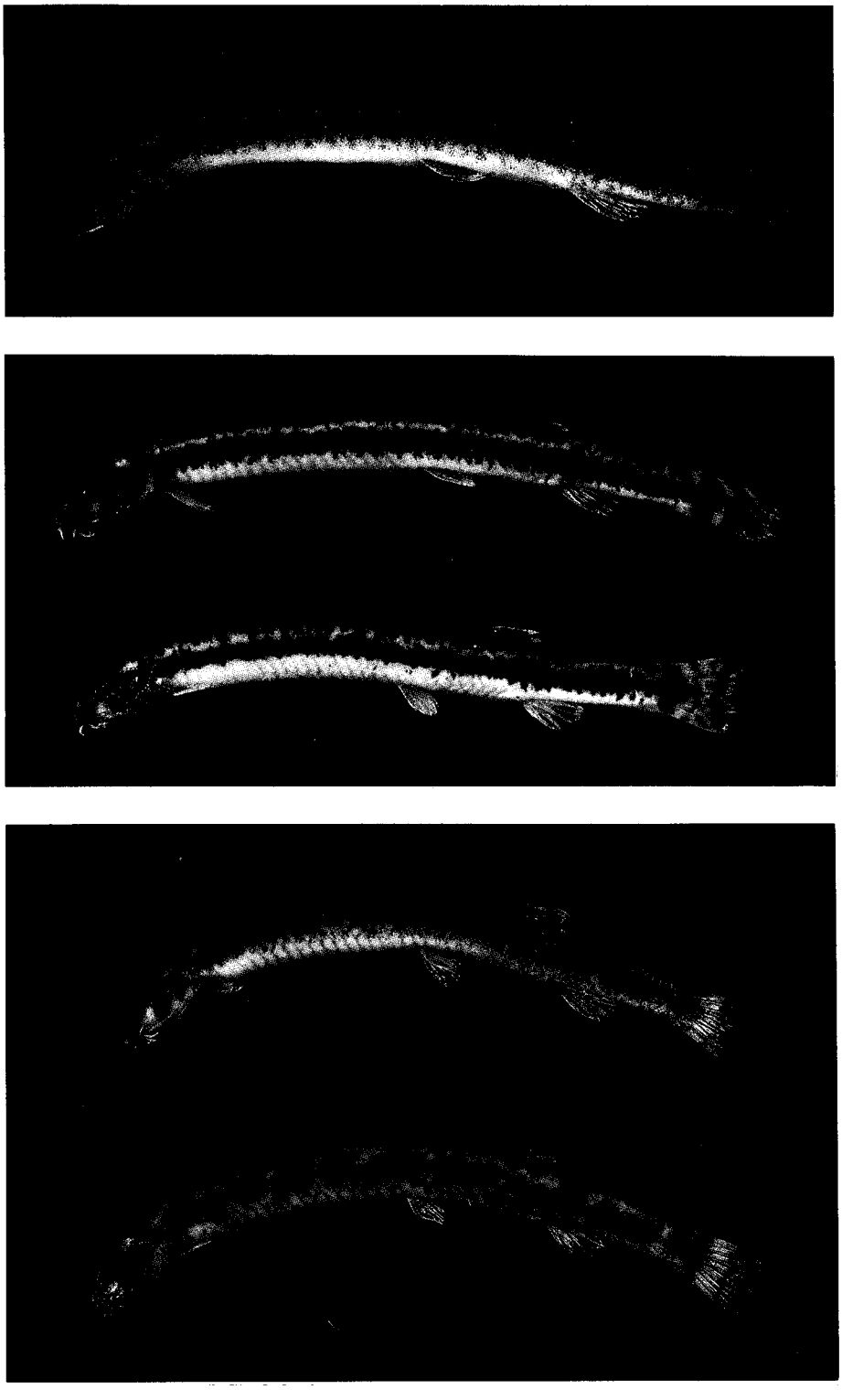


Fig. 22. d-f. *Pangio shelfordii*. d, CMK 9645, 43.1 mm SL, Banka; e, CMK 6701, 34.0 and 32.0 mm SL, Sungei Mandor, western Borneo; f, CMK 6921, 52.3 and 46.2 mm SL, Putussibau, western Borneo.

coll. M. Kottelat *et al.*, 4.iii. 1993. — 7 ex. (CMK 9645), 28 km N of Payung on road to Pangkalpinang, coll. M. Kottelat *et al.*, 5.iii.1993. — 8 ex. (CMK 9655), Mangong forest reserve, near Petingdang village, coll. T. Tan, N. Sivasothi & S. Lum, 6.iii.1993.

BORNEO: KALIMANTAN BARAT: 5 ex. (CMK 6701), Sungai Mandor at Mandor, 0°19'N 109°20'E, coll. M. Kottelat *et al.*, 22.iv.1990. — 2 ex. (CMK 6762), 11 km SE of Sanggau on road to Sintang, coll. M. Kottelat *et al.*, 23.iv.1990. — 6 ex. (CMK 6732), Insiluk, 16 km WNW from Sanggau on road to Pontianak, coll. M. Kottelat *et al.*, 23.iv.1990.

Diagnosis. - *Pangio shelfordii* as defined here, is a species with a quite variable colour pattern. In the Malay Peninsula, it is distinguished by its colour pattern consisting of a more or less conspicuous mid-lateral series of irregular blotches, sometimes forming a mid-lateral stripe; back finely mottled, with a median row of large black saddles or any intermediate pattern; a vertical black blotch at caudal base; caudal mottled; median lobe of lower lip produced into a barbel; 32-36 + 14- 16 = 46-51 vertebrae.

Remarks. - We tentatively consider that *P. shelfordii* and *P. muraeniformis* are conspecific, as first suggested by Kottelat & Whitten (1993). Further collections, especially in Borneo, might show that actually more than one species is involved. The material available to us supports the hypothesis of a single very variable and widely distributed species.

Pangio shelfordii is distinguished by having a series of black blotches on the side of the body, either connected or alternating with a somewhat similar number of black saddles along the back. In specimens from Sarawak (Fig. 22a), the lateral blotches tend to be vertically elongated and much darker at mid height of body; the back saddles are very pale and contiguous, leaving only a narrow pale line between them. Specimens from Terengganu (Fig. 22b) are very similar to the Sarawak ones, but the saddles and blotches are uniformely black and very contrasted on the yellow background; the saddles are not adjacent and leave a distinct yellow patch between them.

In specimens from Singapore and Johor (Fig. 22c), the lateral blotches are finer and form an almost contiguous black stripe along body, bordered ventrally by a row of paler, irregular blotches extending (depending of individuals), from a point between head and vertical of pelvic fin to caudal base. The back saddles are usually replaced by a median patch of small, pale brown blotches; in some specimens the saddles may still be retained, though not sharply marked. There seem to be a gradient between the Johor and Terengganu colour patterns. The distribution map (Fig. 13) shows what seems to be a distribution gap between the two patterns, but we cannot be sure if the gap is real; we certainly have not been able to catch the species in intermediate areas, which originally where peat swamp forest, an habitat where no *Pangio* is known to occur in the Malay Peninsula.

In specimens from Sumatra (Banka) the lateral blotches are completely fused in a broad lateral stripe with somewhat irregular margins (Fig. 22d). The predorsal saddles are still there in some specimens and absent in others; when present, their limits are not very contrasted; in the other specimens, the back is densely spotted. Our collections of this species from Riau only includes juveniles specimens and cannot be used for comparison of colour pattern.

A somewhat similar gradient is possibly also exhibited by the populations from the Kapuas basin, from inland to the coastal area. Specimens from near Putussibau (Fig. 22f) have a series of very irregular blotches along the sides, especially dark at mid-height; on the back, there are only few, irregularly shaped, not closely set, brown saddles. Specimens from the lower Kapuas

basin have a finely speckled brown body with a black midlateral stripe, occasionally with traces of blotches and/or saddles (Fig. 22e).

The few specimens available from the Mahakam are juveniles and subadults; they seem very similar to the upper Kapuas ones.

An alternative hypothesis would be that at least four species are involved: the Sarawak-Terengganu colour form (to which the name *P. shelfordii* should be restricted), the Johor-Singapore form (for which the name *P. muraeniformis* is available), the upper Kapuas form and the lower Kapuas-Sumatra form. The presence of intermediates between the Sarawak-Terengganu and Johor-Singapore forms lead us to consider them as conspecific. Considering the scarcity of collections from Borneo and Sumatra, a decision concerning the local forms has to wait future collections in intermediate areas. An element which could give support to the hypothesis that more than one species are involved is juvenile colouration. Specimens from Johor, Terengganu and Sarawak under about 25-30 mm SL have a color pattern formed of about 12-15 dark vertically elongated blotches, sometime forming complete bars. Specimens from Sumatra, the Kapuas and the Mahakam have a speckled back and a black midlateral stripe.

Noteworthy are interbasin similarities in colour patterns. The populations from Sarawak are most similar to those from Terengganu, a pattern parallelling what is known in the *Rasbora sumatrana* group (unpublished data). The similarity of the populations from the upper Kapuas and the Mahakam parallels the distribution of *Nanobagrus armatus*. The similarity of the lower Kapuas and Sumatra populations is expected considering their earlier hydrographic connections (see de Beaufort, 1951; Kottelat & Whitten, 1993).

Boulenger (1894) described *Acanthophthalmus borneensis* from the Baram river in Sarawak. The original description gives few useful characters. Boulenger describes the coloration as follow: 'Body colourless; three black annular bands on the head - the first on the snout, the second passing through the eyes, the third across the occiput and covering the opercles; dorsal and caudal fins black at the base'. One of the syntype is illustrated in Kottelat & Whitten (1993: pl. 29). They are not well preserved and they do not show much additional information than given by Boulenger. The three bars on the head and the oval blotch at the base of the caudal fin correspond to colour marks present in all members of *P. shelfordii* examined by us. The photograph shows remains of other pigment areas, but this is difficult to interpret. It seems very likely that *P. borneensis* is either a senior synonym of *P. shelfordii* or a closely related species. Vertebral counts of 7 syntypes overlap with those of other population, although modal values of precaudal and total vertebrae are slightly inferior (Table 1). As we have not been able to examine fresh specimens from the Baram basin, we do not wish to establish a formal synonymy at this stage.

In 1981, the first author saw aquarium specimens of unknown origin about 60 mm SL of a *Pangio* species with a completely whitish body and 3 bars on the head, a colour pattern which would fit the one described by Boulenger for *P. borneensis*.

Since its original description, *P. borneensis* has been recorded only once, by Vaillant (1902: 150) from the Kapuas basin. Vaillant's notes clearly seem to refer to *P. shelfordii* specimens.

The holotype of *P. shelfordii* had been received from the Sarawak Museum. Using data in SM registers, we visited the type locality in Kuching with Charles Leh (SM) in 1992. The stream is under profound human impact and no collection could be obtained.

Table 1. Vertebral counts of the species of *Pangio*. Note: not all specimens could be x-rayed well enough to distinguish between caudal and precaudal vertebrae so that the number of specimens for total vertebrae counts may be superior to the number of specimens for which caudal and precaudal counts are given.

	precaudal									caudal					total											
oblonga group	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**12**	**13**	**14**	**15**	**16**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	
P. pangia																				1						Roberts, 1989
P. oblonga																										
Java		2									2					2										CMK 6040
Sumatra															1	5	2									CMK 9736
Borneo		1										1					1									CMK 6889
		1	8	2						11					1	8	2									Roberts, 1989
P. mariarum			1	2	4	2					1	6	2						2	6	1					ZRC 941 (paratypes), CMK 9468
P. filinaris		1	5	4	2					1	3	8			2	7	2		3							ZRC 657, CMK 8201
***kuhlii* group**																										
P. alternans	4	15	2								12	8	1		2	10	9	1								CMK 7782, 7737, 7757
P. cuneovirgata																										
Malay Peninsula				3	2							2	3						1	4	2					ZRC 18461, CMK 7903, 8500
Sumatra																			2	2						CMK 8292
P. kuhlii																										
Malay Peninsula			3	6	16	1				1	8	16	2					5	11	11						ZRC 17703-7, CMK 7380, 7425, 7820, 8498, 8152, 8203
Borneo			7	10	2					3	4	8	4				1	4	9	5						CMK 6804, 6920, 8371
Sumatra			2	8	4	1					6	6	3					4	9	2						CMK 6036, 8291
Java						1						1									1					ZRC 674
P. alcoides								4	1	1		1	2	1							1		1	1	2	ZRC 17209-12, CMK 8511
P. agma				1							1							1								ZRC 8408
P. malayana				1	2	3					4	2							2	3	1					ZRC 2045, CMK 8501
***shelfordii* group**	**31**	**32**	**33**	**34**	**35**	**36**				**12**	**13**	**14**	**15**	**16**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**				
P. borneensis				4	2	1				1	2	4					1	5	1							BMNH (syntypes)
P. shelfordii																										
Borneo: Sarawak				2	12							9	5					1	9	5						RMNH 7661, CMK 8372, 8404
Borneo: Kapuas		1	1	1	2							2	3				2		2	1						CMK 6921
Borneo: Mahakam		1	1									2				1	1									CMK 7736, 7756
Terengganu			1	3	10	3						1	10	6					2	8	7					ZRC 2052, CMK 8203
Johor				4	10	3						4	7	3					3	10	1					CMK 7381, 7394, 8499
P. incognito		5									4	1			4	1										CMK 9735
P. piperata																										
Malay Peninsula		5	18	3	1						6	16	4	1		7	20	3	1							CMK 7882,8121, 8200, 8204, 8497, 8535
Sumatra	1	1	1								1		2			2	1									CMK 8355
P. superba																				1	2	1				Roberts, 1989
***anguillaris* group**	**46**	**47**	**48**	**49**	**50**	**51**	**52**			**15**	**16**	**17**	**18**	**19**	**20**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**
P. anguillaris																										
Malay Peninsula					3									2	1									2	1	CAS-SU 33005 (Roberts, 1989; paratypes of *C. perakensis*)
Borneo					1	1	1							3										1	1	1 Roberts , 1989
P. doriae																										
Malay Peninsula		1	5	2							4	2	2					1	3	2		2				ZRC 1487, 14293-4
Borneo	1	1	1							1	1	1					1	1	1							MCSNG 9231, CMK 6700
Sumatra	1	1	2	3						4	2	1						3	4							ZRC 29161-7
P. pulla	1		1							1	1					1	1									ZRC 35022, CAS 80441

Distribution. - *Pangio shelfordii* is known from the Malay Peninsula, where it extends from Singapore to Terengganu, from Sumatra (recorded from Banka and Riau) and Borneo (known from Sarawak and the Kapuas and Mahakam basins) (Fig. 14). It has usually been collected in brown or slightly black waters, usually among leaf litter.

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