

Revision of the Indonesian and Malaysian Loaches of the Subfamily Noemacheilinae

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Abstract Nine species of the subfamily Noemacheilinae currently referred to *Noemacheilus* s.l. from Indonesia, Malaysia and Singapore are described. Kuhl and van Hasselt, in van Hasselt, 1823 are the authors of *Noemacheilus* whose type-species is *N. fasciatus* Kuhl et van Hasselt, in van Hasselt, 1823. *Modigliania* Perugia, 1893 (type-species: *M. papillosa* Perugia, 1893) and *Pogononemacheilus* Fowler, 1937 (type-species: *N. masyai* Smith, 1933) are subjective junior synonyms of *Noemacheilus*. *Noemacheilus kapuasensis* characterized by its colour pattern and *N. spiniferus* characterized by acuminate scales on the caudal peduncle, both from Borneo, are new species. *Cobitis suborbitalis* Valenciennes, 1846 is a synonym of *N. fasciatus*; *N. translineatus* Fowler, 1939 and *N. kuiperi* de Beaufort, 1939 are synonyms of *N. selangoricus* Duncker, 1904. Lectotypes are designated for *N. fasciatus*, *N. saravacensis* Boulenger, 1894, *N. olivaceus* Boulenger, 1894, *N. longipectoralis* Popta, 1904, *N. chrysolaimos* (Valenciennes, 1846) and *N. obesus* Vaillant, 1902. The five nominal species described from Sumatra (*N. jaklesi* (Bleeker, 1852), *N. pfeifferi* (Bleeker, 1853), *N. papillosa*, *N. longipinnis* Ahl, 1922 (nec Peters, 1861) and *N. dunckeri* Ahl, 1922) are still incertae sedis.

Up to 400 taxa of loaches belonging to the subfamily Noemacheilinae have already been described, with at least 200 being valid species. Until quite recently, nearly all were placed in the catch-all genus *Noemacheilus*. Recent works, especially by Banarescu and Nalbant (1964, 1966, 1968), Rita, Banarescu and Nalbant (1979), Singh et al. (1982) and Mirza, Nalbant and Banarescu (1981) have increased the number of available generic names, but without providing a phylogenetic classification. It is my intention to provide such a classification when all (or most) of the component species of the subfamily have been reviewed. It would be natural to revise the subfamily in a systematic sequence, but as this is hardly possible due to the present poor state of our knowledge, the easiest way is to revise the fauna of the various geographic areas. This first part is a revision of the Sundaic species, that is the species from Indonesia, Malaysia and Singapore. In this concept of the Sundaic area, it would have been more natural also to include Peninsular Thailand south of the Isthmus of Kra; three species occur there: *N. phuketensis* Klauswitz, 1957 which has close affinities with several Indian and Indochinese species and will be treated in cor-

relation with them; *N. masyai* Smith, 1933 is widely distributed in Western Malaysia and Thailand, but the status of Kampuchean forms is still unclear and for this reason, I decided to treat it with the Indochinese species; lastly, I have material of a third species from Phuket Island which, as I have been informed, should be described soon by Drs. Banarescu and Nalbant from another locality in Peninsular Thailand. I however decided to include both *N. masyai* and *N. phuketensis* in the key and diagnosis of the present paper.

I considered it useful to begin with the Sundaic species in order to clear the status of the type-species of *Noemacheilus*, *N. fasciatus*. This does not mean that the noemacheiline fauna of that area is now well known; this is far from being the case, and comments on the Sumatran forms will clearly illustrate this. Due to lack of freshly and well preserved material in most collections, it proved impossible to solve the problem of the identity of some nominal species and to give names to some species; for these reasons, I considered it wiser to postpone the revision of the Sumatra species to a later date.

Without judging the value of the various generic categories proposed by Banarescu and

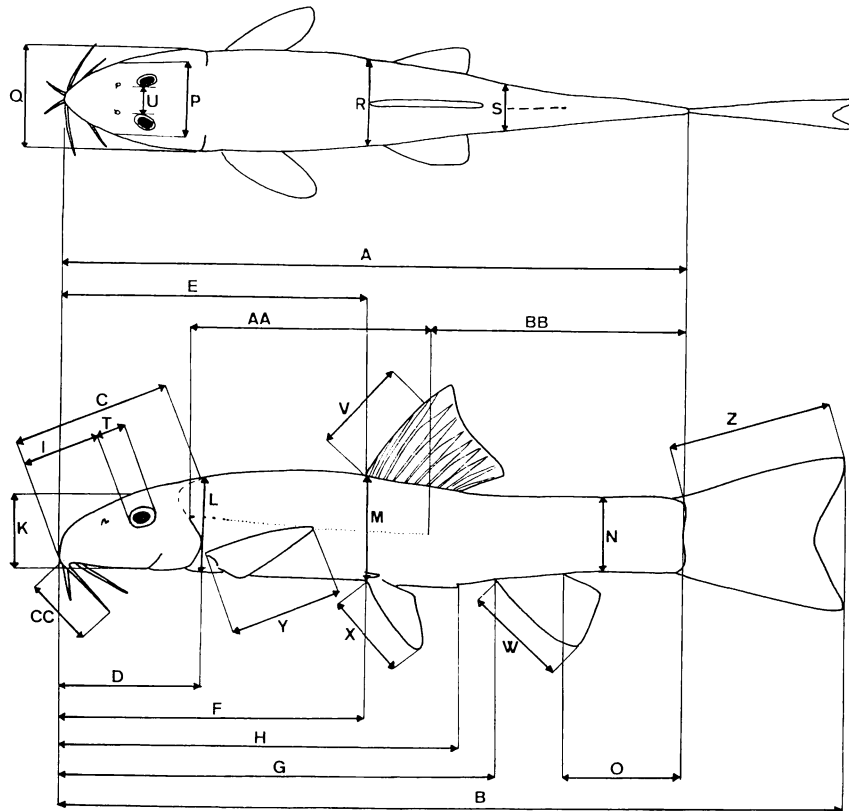


Fig. 1. Schematized noemacheiline to show the various measurements used; for explanations, see text.

Nalbant, I prefer to use *Noemacheilus* only during the whole course of the species revisions. It seemed to me more logical to first examine all the species, then establish their relationships and finally name the various lineages.

A revision of the Indochinese species and a description of the osteology of *N. fasciatus* are currently in progress.

Material and methods

The material examined belongs to the following institutions and collections: ANSP, Academy of Natural Sciences, Philadelphia; BMNH, British Museum (Natural History), London; CAS, California Academy of Sciences, San Francisco; FMNH, Field Museum of Natural History, Chicago; IRSNB, Institut Royal des Sciences Naturelles de Belgique, Bruxelles; MCZ, Museum of Comparative Zoology, Harvard; MCSNG, Museo Civico di

Storia Naturale Giacomo Doria, Genova; MHNG, Muséum d'Histoire Naturelle, Genève; MNHN, Muséum National d'Histoire Naturelle, Paris; MZB, Museum Zoologicum Bogoriense, Bogor; NMB, Naturhistorisches Museum, Basel; RMNH, Rijksmuseum van Natuurlijke Historie, Leiden; ROM, Royal Ontario Museum, Toronto; SMF, Senckenberg Museum, Frankfurt am Main; USNM, United States National Museum of Natural History, Washington; ZMA, Zoölogisch Museum, Amsterdam; ZMH, Zoologisches Museum und Zoologisches Institut, Hamburg; ZRCUS, Zoological Reference Collection, University of Singapore, Singapore. CMK is author's collection.

Measurements are taken from point to point; exceptions are explicitly signified. Standard length (SL) is measured from the tip of the snout to the extremity of the hypural complex, at mid-height of the caudal fin base (A in Fig. 1). Total length (B) is taken from the tip of the

snout to the end of longest caudal lobe. Head length is the dorsal length of head, taken from the tip of the snout to the posterior end of the occiput (C). Lateral head length (D) is from the tip of the snout to the hindmost point of opercle. Predorsal length (E) is measured from the tip of the snout to the base of the first dorsal ray; prepelvic (F) and preanal (G) lengths are measured in the same way. Preanus length (H) is taken from the tip of the snout to the anal opening. Snout length (I) is from the tip of the snout to the nearest point of the eye rim. Head height is measured at the eyes (K) and at the posterior extremity of the occiput (L). Body height (M) is taken in front of the dorsal fin. The height of the caudal peduncle (N) is taken at the narrowest part of the caudal peduncle and includes the heights of dorsal and ventral crests if there are any. Length of caudal peduncle (O) is measured from the base of the last anal ray to the extremity of the hypural complex, at lower edge of caudal base. Head width (P) is measured at the nares; maximum head width (Q) is also given, generally measured at the extremity of the opercle (exceptions are explicitly indicated). Body width is measured in front of the dorsal (R) and anal (S) fins. Eye diameter (T) is the longitudinal length of the eye. Interorbital width (U) is measured as the narrowest distance between eyes. Height of dorsal fin (V) is given as the length of the last simple dorsal ray, even if any branched ray is longer. Anal (W), pelvic (X) and pectoral fin (Y) lengths are measured from the base of first ray to the extremity of hindermost ending ray. Lengths of caudal lobes are measured from upper (Z), respectively lower, edge of caudal base to the extremity of the lobe. When length of lateral line (AA) is given, it is measured from upper edge of branchial opening to the last lateral line pit. When the length of the lacking part of lateral line (BB) is given, it is measured from the last pit to the end of the hypural complex, at mid-height of caudal base. Barbel lengths (CC) are measured from base to extremity.

Lengths expressed in % of head length (HL) are meant as % of dorsal length of head.

In anal and dorsal fins, ray counts are given in the following sequence: simple rays/branched rays. For pelvic and pectoral fins, all rays are

counted together. Caudal fin rays are indicated in the following way: upper branched rays+lower branched rays. Lateral line (L.1.) count is the number of pits along lateral line. Pores of the infra-orbital sensory canal are indicated in the following way: post-orbital pores+sub-orbital and pre-orbital pores (Fig. 2). Examined and figured scales have been taken between dorsal fin and lateral line. Vertebrae counts include four Weberian ossicles and the hypural complex.

In the descriptions of colour patterns, a bar is always a vertical marking and a stripe a longitudinal one.

Steyskal (1980) showed that the Greek grammar necessitates that the family name hitherto spelt Cobitidae (among 71 other names of the family-group in fishes) should in fact be spelled Cobitididae. This appears to be correct according to the International Code of Zoological Nomenclature. But I think that systematic research of old Greek or Latin roots of any name is a time consuming process somewhat in contradiction with the principle of stability (as it necessitates a lot of modifications) and universality of nomenclature (as it is not self-evident that a non-occidental scientist has the necessary back-ground in old Greek and Latin for discussing these problems; the time is past when classical studies are a prerequisite for scientific and medical research). By chance, according to Article 29(d) of the International Code of Zoological Nomenclature, most of the old spelling must be retained if the correct spelling is introduced after 1961. This is the case for Cobitidae.

I would also agree with Fletscher (1981) about the futility of bringing the genders of generic and specific names into agreement, but as the International Code of Zoological Nomenclature still requires it, I will do it so far as my "empiric" knowledge of old forgotten languages allows (as in *fasciatus*—*fasciatum*—*fasciata*) but I will not make any further efforts in this direction that would simply be useless elitism and pedantism.

I became aware of Sawada's (1982) work long after this paper was completed. I actually have not yet made any opinion about his transferring the subfamily Noemacheilinae from the Cobitidae to the Homalopteridae.

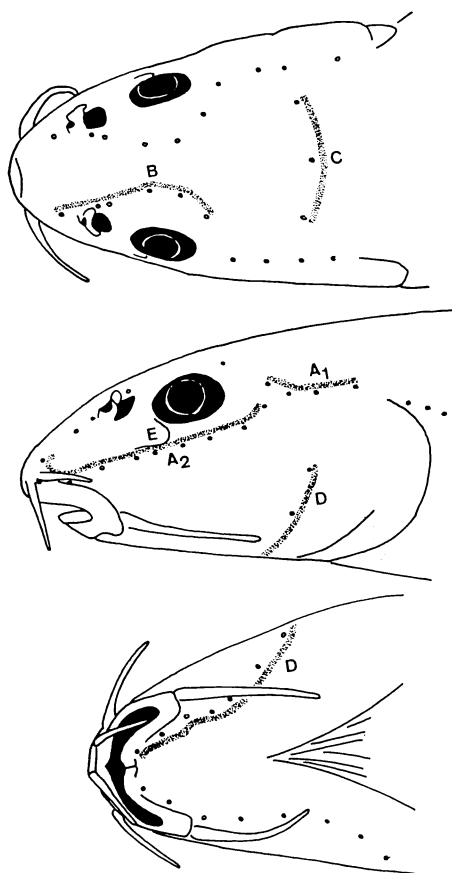


Fig. 2. Head of a noemacheiline showing suborbital flaplet (E) and the head sensory pores. Shaded area represents the approximate courses of the canals; A₁ + A₂, infraorbital pores; B, supraorbital pores; C, occipital pores; D, mandibulo-opercular pores.

Noemacheiline characteristics

Although, as stated in the introduction, it is my intention to discuss the phylogenetic relationships and to describe and define the different lineages of noemacheilines after the species revisions, I consider it useful to begin with a short description of their general outer morphology.

Noemacheilines are cobitids of very small to small (3–20 cm) size. The body is elongated, with a rounded or compressed section. The belly is flat or rounded. Head length is usually somewhat equal to body depth. The head has a rounded or depressed section. The eyes are

situated somewhat in the center of head, on the top of the head; they are occasionally to be seen from below. Eye shape is usually elliptical, occasionally circular. In some species, there is a subocular flaplet in males (Fig. 2). There are two pairs of nares, usually close together. The posterior one is a hole or a longitudinal slit; the anterior one is furnished with a kind of valve which may be more or less developed into a barbel; it is pierced at the anterior side of the valve or at the extremity of the tube-like modified valve.

The mouth is in a ventral position. Its shape varies from a transversal to horse-shoe-shaped slit. It is bordered by an anterior and a posterior lips, which may be smooth, furrowed or papillated. The anterior one is continuous and a groove is always present in front of it. The posterior one nearly always exhibits a longitudinal median slit. The groove posterior to it is interrupted in the middle. The lips are continuous around the corner of the mouth and may or not be closely adnate to the jaws. Both jaws are covered by a horny sheath (Roberts, 1982a). A beak-like modification of the anterior extremity of the premaxillary, the *processus dentiformis* (Rendahl, 1944), if often present. There are two pairs of rostral barbels at the tip of the snout and one pair of maxillary ones at the corner of the mouth.

The dorsal fin is implanted halfway between snout tip and caudal base. It has four single rays and 7–18 branched ones, the simple ones often being enclosed in a fatty epidermis. The longest dorsal ray usually is the first or second branched one. The supero-posterior edge of the fin may be concave, straight or convex.

The pectoral fins are just behind the branchial opening. They are usually in a horizontal position. The first ray is simple and there are 7–15 branched ones. They may or may not reach pelvic fins. The pelvic fins are situated approximately under the origin of dorsal fin. They may or may not reach the anus or the anal fin. The first ray is simple and is followed by six branched ones and one small simple one. The hind border of pelvic and pectoral fins may be straight, rounded or with prolongations at the extremities of the rays.

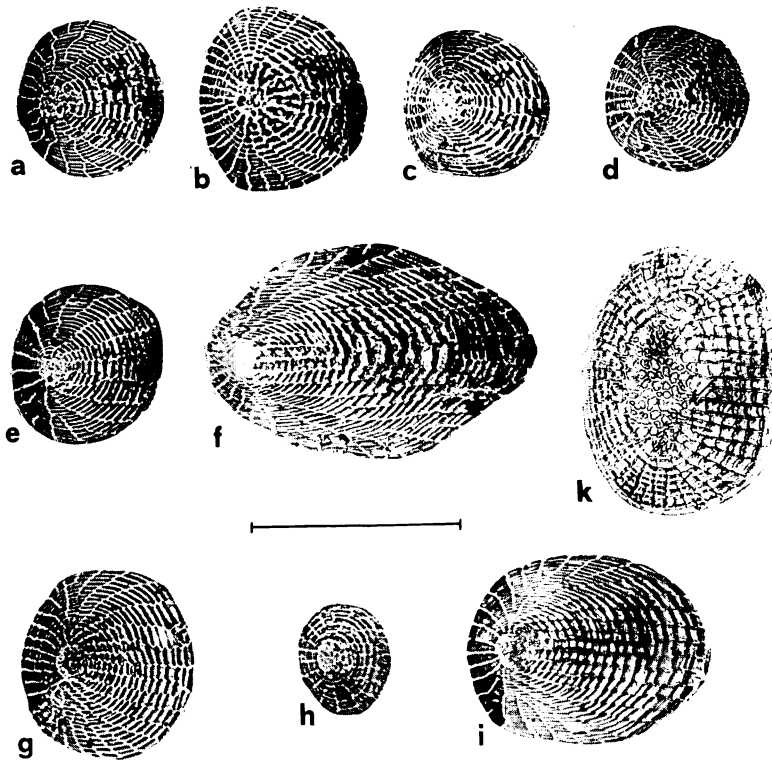


Fig. 3. Scales of Sundaic *Noemacheilus*. a, *N. fasciatus*; b, *N. kapuasensis*; c, *N. longipectoralis*; d, *N. saravacensis*; e-f, *N. chrysolaimos* (e, below dorsal fin; f, above lateral line); g, *N. selangoricus*; h, *N. spiniferus*; i, *N. olivaceus*; k, *N. obesus*. Scale bar indicates 0.1 mm.

The anal fin has three simple and five or six branched rays, the longest usually being the first branched one. It may occasionally reach caudal fin. The caudal fin may be rounded, emarginated, forked, the lobes may be equal or subequal, the upper or the lower the longer. It has up to 17 branched rays. Above and below there is one (occasionally two) articulated simple ray and several rudimentary ones. These may be hidden in a ventral and a dorsal adipose crests (sometimes called ridges or keels) which may be more or less developed (they are often non-existent in very old alcohol preserved specimens). The caudal peduncle may be very short and deep to long and slender.

The sensory canals include the lateral line and the head canals. The lateral line may be complete, incomplete or absent. The first three to six pores (on the air bladder capsule) are widely spaced. The head canals may be named as follows (Fig. 2): a) the infraorbital

canal is connected with the lateral line and consists of three to four pores between the upper edge of branchial opening and eye and a variable number of pores below and in front of eye; it reaches the base of the outer rostral barbel and has an anterior ramification which nearly reaches up to the nostrils; b) the supra-orbital canal generally consists of a series of pores above the eye and three above the naris; c) the occipital canal consists of a median pore at the posterior extremity of supraoccipital bone and one lateral pore on each side; d) the mandibulo-opercular canal follows the anterior edge of the operculum and ends at the foremost point of groove posterior to lower lip (in part after Lekander, 1949).

The scales may be present or absent, normal or rudimentary, superficial or hidden in the skin. The foremost ones are very often hidden and they are usually absent in the portion of the lateral line corresponding to the air-bladder

capsule, the lateral line perforating scales only after 6–10 pores. The scales are circular or elliptical, with some radiae and circuli leaving a free focal area which may be central or eccentric and of variable size (Fig. 3). A few species exhibit acuminate scales, that is scales with a posterior process (Fig. 23). The extremity of this process bears a tubercle.

The colour pattern generally (but not exclusively) consists of dark bars on a light background. Very constant characteristics in some species are the black markings at the base of the caudal fin (usually a more or less dissociated thin bar) and dorsal fin (one or two spots in the anterior half). Recent field and underwater observations in Thailand lead me to believe that red and reflecting patches on the head, back, caudal peduncle and base of dorsal fin may play an important role in species recognition. These may also prove useful for the systematist but most of these markings disappear in preserved specimens. They should be noted in living specimens. They are better seen when the specimens are placed in a shaded environment.

Roberts (1982b) emphasizes the role that uncini may have played in the evolution and speciation of Ostariophysi. Unfortunately, I received this paper too late to include data about uncini in the species descriptions.

Characteristics I found of interesting diagnostic value are: shape of anterior nostril, number of branched caudal and dorsal rays, presence of acuminate scales on the caudal peduncle, shape of the caudal peduncle, position of the anus, shape of the caudal fin and length of the lateral line. The best characteristics are in fact the colour pattern and the distribution. While collecting noemacheilines, one should be careful to have them fixed immediately, so that the colour pattern is well preserved.

Noemacheilus Kuhl et van Hasselt
in van Hasselt

Noemacheilus Kuhl and van Hasselt in van Hasselt, 1823: 132 (type-species: *Noemacheilus fasciatus* Kuhl et van Hasselt, 1823, by monotypy).

Noemacheilus was first used by van Hasselt (1823: 132) under the spelling *Naunacheilus* in a listing of the fishes he and Kuhl collected in

Java. This first mention does not include any description, diagnoses or indication. On the following page, he wrote: "*Noemacheilus* Nob. because of its flat maxillae approaches the genus *Poecilia* Schn., the Sundanese call it Jalaer, it lives around Buitenzorg and in our drawing the species is named *fasciatus* Nob." (translation by Dr. Martien J. P. van Oijen; a slightly different translation in Alfred, 1961b). This is an extract of a letter received and published by Temminck. It was not intended to be a description and most probably not even to be published. But in this form, both *Noemacheilus* and *N. fasciatus* must be considered as described, even if the description is very short and even if it is only by reading subsequent authors (Agassiz, 1835; Valenciennes in Cuvier and Valenciennes, 1846) that it might be understood that the "flat maxillae" is the "smooth sub-orbital" of these authors, a character in fact shared with all Ostariophysi, except Cobitinae and Botiinae. These names are generally credited to van Hasselt alone, but the clear mention "*Noemacheilus* Nob." shows that Kuhl and van Hasselt co-authored them before Kuhl's death.

A French translation of van Hasselt's letter (1824) has also been published (by Valenciennes, according to Alfred, 1961b).

Etymology. νῆμα (*néma*) (Gr.): thread; χείλος (*cheilos*) (Gr.): lip; allusion to the six filamentous barbels around mouth. Gender: masculine, as shown by the case-ending of the epithet specific name, *fasciatus*, used by van Hasselt (1823), Valenciennes (1846) and Bleeker (1863a, b).

**Key to the species of *Noemacheilus* s.l.
occurring in Indonesia, Malaysia,
Singapore and Thailand (south of
the Isthmus of Kra)***

1. 15 branched caudal rays; an ocellus on upper posterior part of caudal peduncle or on upper part of caudal fin base; Phuket Island, Peninsular Thailand.
..... *N. phuketensis*
16–17 branched caudal rays; no ocellus

* Characteristics of the colour patterns should be checked on several well preserved and coloured whole adult specimens.

- on caudal base or on caudal peduncle... 2
2. No acuminate scales on caudal peduncle... 3
 4–10 acuminate scales (Fig. 21) above and below lateral line on caudal peduncle... 10
3. Anterior naris pierced in the front side of a valve which ends in a filament at least as long as rest of valve; caudal fin rounded, truncate or forked, if forked, caudal lobes subequal, median caudal rays less than 1.3 times in upper lobe... 4
 Anterior naris valve not ending in a filament; caudal forked, median caudal rays more than 1.3 times in upper lobe... 5
4. 16 branched caudal rays; caudal truncate; incomplete lateral line; nasal tentacle more than two times eye diameter; E. Borneo... *N. obesus*
 17 branched caudal rays; caudal forked; complete lateral line; nasal tentacle less than two times eye diameter; N. Borneo... *N. olivaceus*
5. 16 (17 in the Kapuas material) branched caudal rays; 9–10 branched dorsal rays; colour pattern consisting of some 13–17 irregular dark blotches along lateral line (Fig. 9); W. Borneo... *N. saravacensis*
 17 branched caudal rays; 8–9 branched dorsal rays; colour pattern consisting of regular bar beginning on dorsal profile... 6
6. Anterior naris at the extremity of a tube-like valve (Fig. 13b)... 7
 Anterior naris pierced in the front side of a non-modified valve (Fig. 17c)... 8
7. Eye diameter 6–8% SL, 25–35% HL; HL 21–22% SL; lateral length of head 23–26% SL; N. Borneo... *N. longipectoralis*
 Eye diameter 4–6% SL, 20–32% HL; HL 16–20% SL; lateral length of head 20–25% SL; Java... *N. chrysolaimos*
8. Caudal peduncle 1.3–1.5 times longer than deep; W. Borneo... *N. kapuasensis*
 Caudal peduncle 1.5–1.9 times longer than deep... 9
9. Caudal lobes subequal; eye diameter 3–5% SL, 19–26% HL; saddles on the back approximately as long as high; Java, S. Sumatra... *N. fasciatus*
 Upper caudal lobe distinctly longer; eye diameter 4.5–6% SL, 22–23% HL; saddles on the back distinctly higher than long; Malay Peninsula, Thailand... *N. masyai*
10. Colour pattern: 10–13 dark bars, somewhat wider than interspaces, their middle area being sometimes lighter brown than the margin; these bars are not very regular, they usually are wider on dorsal mid-line and on lateral line than in between; dorsal head length 21–23% SL; process of acuminate scales as long as rest of scale, its base width approximately one-half of scale width (Fig. 21a); W. Borneo... *N. spiniferus*
 Colour pattern: 8–12 dark bars, wider than interspaces, the middle area of the bars being often lighter brown than the margin or as light as the background, the bar then being vertically split into two thin bars (Fig. 23); these bars are very regular; dorsal length of head 18–22% SL; process of acuminate scales shorter than rest of scale, its base width approximately one-fourth to one-third of scale width; Malay Peninsula, Billiton, N. E. Borneo... *N. selangoricus*
- Noemacheilus obesus* Vaillant
 (Figs. 3k, 4, 5, 6)
- Nemacheilus obesus* Vaillant, 1902: 134 (original



Fig. 4. *Noemacheilus obesus*, RMNH 7644, 52.2 mm SL.

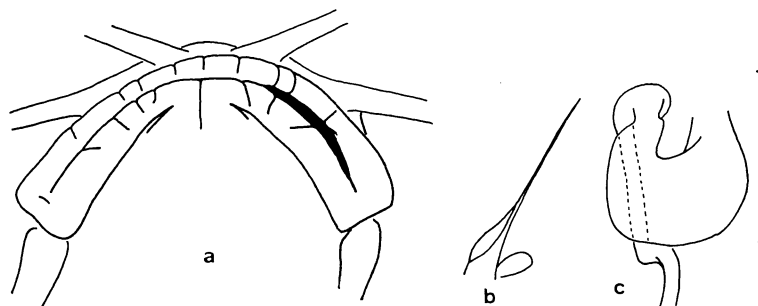


Fig. 5. *Noemacheilus obesus*, RMNH 7644, 82.3 mm SL. a, mouth; b, left naris; c, stomach. Scale bar indicates 7 mm.

description; fig.; type-locality: Bloecoe River).

Nemachilus obesus: Popta, 1906: 202 (citation; Howong, Long Bluu, Bo and Kajan Rivers).

Elxis obesus: Weber and de Beaufort, 1916: 35 (fig.), 36 (redescription).

Lefua obesus: Banarescu and Nalbant, 1964: 160 (discussion).

Oreonectes obesus: Banarescu and Nalbant, 1968: 329 (discussion); Rita, Nalbant and Banarescu, 1979: 185 (new unnamed subgenus).

Material examined. RMNH 7780, lectotype (present designation), 77.6 mm SL; Borneo: Kalimantan Timor: Upper Mahakam, Bloecoe River; Nieuwenhuis, 1896-1897. RMNH 28982, 1 ex., paralectotype, 47.9 mm SL; same data. RMNH 7644, 19 ex., 42.6-84.8 mm SL; Borneo: Kalimantan Timor: Upper Mahakam, Bo River; Nieuwenhuis, V-VIII 1900. RMNH 28980, 2 ex., 51.5-52.0 mm SL; same data; cleared, alizarin stained.

Diagnosis. *Noemacheilus obesus* is easily distinguished from any other Sundaic noemacheiline by its anterior naris valve which is modified into a long and slender filament, at least two times as long as the eye. A somewhat filamentous valve is present in *N. olivaceus*, but it is hardly as long as the eye. Moreover, *N. obesus* has 16 branched caudal rays (vs. 17 in *N. olivaceus*), an incomplete lateral line (vs. complete), a truncate caudal fin (vs. forked) and 7 branched dorsal rays (vs. 8).

Description. Morphometric and meristic data are given on Table 1. A noemacheiline with a rather massive general appearance. The head and the anterior part of body are depressed and the caudal peduncle is slightly laterally flattened. The pectoral fins reach approximately halfway between their base and the base of the pelvic fins. The pelvic fins nearly reach

the anus which lies approximately one eye diameter in front of the anal. The anal fin does not reach the caudal fin. The caudal peduncle bears well developed dorsal and ventral crests. The caudal fin is truncated and the dorsal fin has a convex supero-posterior edge. Vertebrae 36.

The body and the belly are completely covered with embedded scales. The scales have a large vertically elongated ovoid focal area. The scales immediately below the dorsal fin are nearly circular; the height of the scales increases as the scales approach the lateral line (Fig. 3k). There are 3+13 infraorbital, 5 supra-orbital, 3 occipital and 9 mandibulo-opercular pores on the head sensory canals.

The head is broad and the eyes are upturned. The anterior naris is pierced in the front side of a barbel-like valve, some 2-3 eye diameters in length (Fig. 5b). Both lips, but especially the posterior one, are thick with some deep irregularly set furrows. There is a marked median incision in the posterior lip (Fig. 5a). The processus dentiformis is well formed. The maxillary barbels reach the branchial opening, the outer rostral barbels reach the middle of the postorbital area of head and the inner rostral ones reach the base of the maxillary ones. The digestive duct has a slight bend immediately below the stomachic dilatation (Fig. 5c); this structure should be checked in freshly preserved specimens, the intestine of the examined ones being not very well fixed. A dissected female (52.4 mm SL) contained ovulae, 1.3 mm in diameter.

There is apparently no sexual dimorphism.

Table 1. *Noemacheilus obesus* and *N. olivaceus*. Morphometric and meristic data.

	<i>N. obesus</i>						<i>N. olivaceus</i>					
	Lecto- type	Range	\bar{x}	Lecto- type	Range	\bar{x}	Lecto- type	Range	\bar{x}	Lecto- type	Range	\bar{x}
		% of SL			% of HL			% of SL			% of HL	
Lateral length of head	22.8	22.8–25.1	23.9	130	112–130	119	22.4	21.7–24.5	22.9	130	111–130	121
Dorsal length of head	17.5	17.5–21.7	20.4				17.2	17.2–20.7	19.0			
Predorsal length	55.3	54.8–59.4	56.8				51.4	48.1–52.4	50.2			
Prepelvic length	52.7	52.7–57.7	55.1				52.0	49.2–53.1	51.0			
Preanal length	75.0	75.0–80.8	77.3				77.6	75.3–81.3	77.1			
Pre-anus length	71.3	71.3–78.1	73.5				67.3	63.2–68.9	66.3			
Head height (at eye)	10.2	9.2–11.8	10.3	58	44–59	51	9.1	8.0–10.6	9.0	53	41–55	48
Body height (at nape)	12.2	11.9–14.4	13.1	70	60–70	64	8.6	8.6–12.8	11.3	50	50–65	60
Body height (at dorsal origin)	17.7	15.9–18.8	17.1	101	75–101	84	16.5	14.3–17.7	15.8	96	74–103	84
Height of caudal peduncle	14.3	11.2–15.0	13.6	82	54–86	67	12.3	11.4–13.3	12.5	72	61–73	66
Length of caudal peduncle	15.9	13.8–17.2	15.2	90	57–91	75	15.7	14.7–17.7	16.2	91	76–109	86
Snout length	8.4	7.5–10.4	9.3	48	39–53	45	8.3	6.5–9.4	8.2	48	35–48	43
Head width (at nares)	12.2	10.8–15.2	12.4	70	51–76	62	9.4	7.7–11.1	9.3	55	40–57	49
Maximum head width	17.9	16.1–20.6	17.8	102	73–103	88	14.0	11.4–16.8	13.8	81	64–84	73
Body width (at dorsal origin)	11.3	10.3–12.0	11.0	65	46–65	54	11.3	9.2–12.1	10.6	66	47–66	56
Body width (at anal origin)	7.7	6.6–8.0	7.4	44	30–44	37	7.4	5.7–7.4	6.7	43	30–43	35
Eye diameter	2.6	2.6–4.3	3.4	16	13–20	17	4.7	4.0–5.2	4.6	28	21–28	24
Interorbital width	9.5	8.6–10.4	9.4	54	40–54	46	6.4	5.7–8.2	7.1	37	31–42	37
Height of dorsal fin	11.3	10.2–14.8	12.7	65	53–71	62	17.3	13.6–21.2	16.5	101	74–102	87
Length of upper caudal lobe	—	19.9–23.8	21.7	—	89–116	106	25.6	22.5–28.8	24.7	149	119–149	131
Length of lower caudal lobe	20.6	20.2–22.7	21.2	118	87–118	104	24.4	23.2–27.6	25.1	142	120–151	133
Length of median caudal ray	—	18.5–22.0	20.6	—	85–113	99	20.2	17.5–24.6	21.3	118	93–130	112
Length of anal fin	16.1	15.2–17.9	16.7	92	66–92	82	15.5	15.5–19.8	17.8	90	86–106	94
Length of pelvic fin	18.4	15.7–21.2	17.9	105	73–105	88	16.7	15.9–18.2	16.9	97	81–99	89
Length of pectoral fin	21.5	16.1–21.5	19.7	123	77–123	97	18.0	15.6–23.5	19.8	105	81–118	104
Caudal peduncle: length/height	1.11	0.89–1.29	1.12				1.27	1.15–1.53	1.30			
Dorsal fin rays (simple/branched)	4/7	4/7					4/8	4/8				
Caudal fin rays	8+8	8+8					9+8	9+8				
Anal fin rays (simple/branched)	3/5	3/5					3/5	3/5				
Ventral fin rays	8	8					8	8				
Pectoral fin rays	13	12–14					12	12–13				
Lateral-line pores	35	22–44	32.6				112	86–112	96.3			

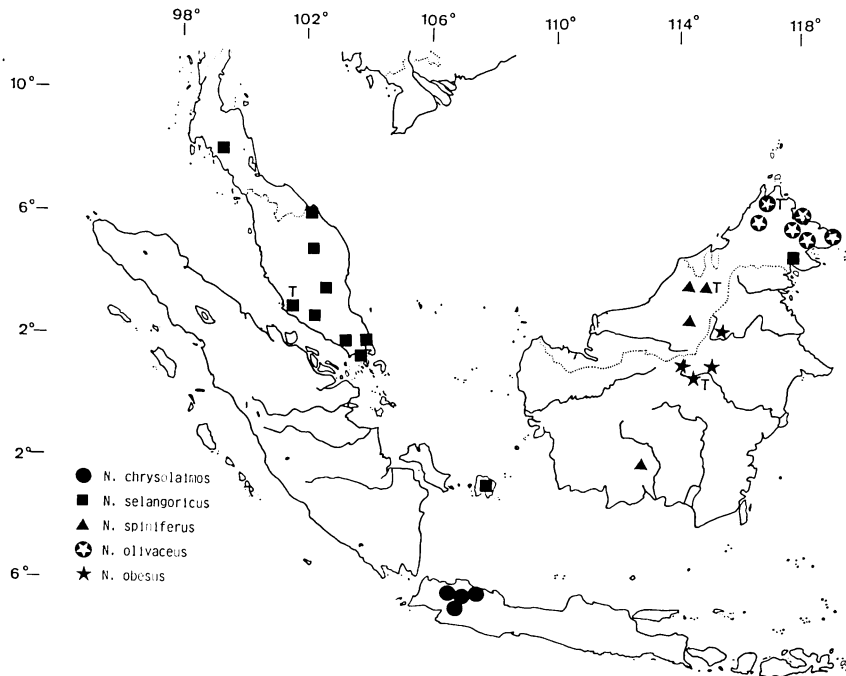


Fig. 6. Distribution of *Noemacheilus chrysolaimos*, *N. selangoricus*, *N. spiniferus*, *N. olivaceus* and *N. obesus*. T, type localities.

Colour pattern: The body has 9–13 black bars, thinner than the interspaces, wider on the back than on the sides, extending below as far as the level of the pectoral fins. They are generally hindwards directed. Some seem to be grouped in twos. Not all bars have the same height and the anterior ones are generally wider than the posterior ones. In the larger specimens, the bars show a tendency to fade or to be lighter coloured medianly. There are no distinct colour marks on the head. There is a black spot at the base of the branched rays and on the proximal fourth of the simple rays of dorsal fin; there is a dark area at midlength of each branched ray. There is a nearly complete dark bar at the base of the caudal fin; it is absent only on the dorsal adipose crest. The other fins are not marked.

Distribution. The Upper Mahakam, Kalimantan Timor (Fig. 6).

Etymology. *obesus* (Lat.): fatty.

Noemacheilus olivaceus Boulenger

(Figs. 3i, 6, 7, 8)

Nemachilus olivaceus Boulenger, 1894: 250 (original

description; type-locality: Bongon); Weber and de Beaufort, 1916:41 (redescription); Inger and Chin, 1962: 125 (fig.; ecology; Deramakot, Sungei Tabalin Besat, Tambisan Island, Sungei Edam, Brakakis, Sungei Sapagaya, Sungei Tawan); Gosse, 1972: 2 (Kinabalu National Park).

Material examined. Borneo: Sabah. BMNH 1893. 5. 30: 63, lectotype (present designation), 59.4 mm SL; Bongon (6°33'N, 116°47'E); Everett. BMNH 1893. 5. 30: 64–67, 4 ex., paralectotypes, 60.0–67.2 mm SL; same data. IRSNB 17549, 2 ex., 49.7–55.3 mm SL; affluent of Sungai Langanan (affluent of Makadau, affluent of Bandau), between Hot Spring and Ranau (5°56'N, 116°43'E), 510 m; Leopold III and Gosse, 8X 1971. IRSNB 17550, 18 ex., 25–35 mm TL; Sungai Pangakatan (Liwagu drainage) near Ranau, 630 m; same data. FMNH 44801, 1 ex., 41.0 mm SL; Lahad Datu distr.; Sungei Edam (5°02'N, 118°20'E); Tubb, 7 VIII 1948. FMNH 44802, 1 ex., 40.0 mm SL; Lahad Datu distr.: Tambisan Island (5°29'N, 119°08'E); Tubb, 15 VIII 1948. FMNH 51796, 4 ex., 53.0–58.4 mm SL; Sandakan distr.: tributary of Sungei Edam (5°02'N, 118°20'E) in rapids; Inger, 26 VII 1950. FMNH 68157, 1 ex., 30.7 mm SL; Jesselton distr.: Ranau; Chin, 24 IV 1953. FMNH 68168, 44 ex., 19.3–57.3 mm SL; Kinabatangan distr.: Deramakot (5°18'N, 117°33'E) tributary of Sungei Kinabatangan:

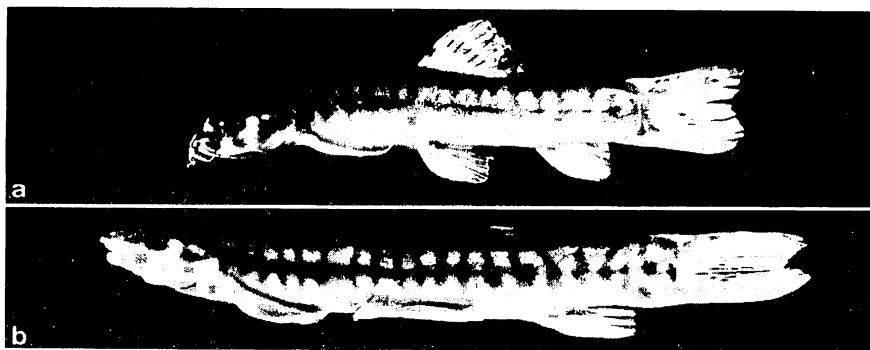


Fig. 7. *Noemacheilus olivaceus*. a, IRSNB 17549, 55.3 mm SL; b, FMNH 68168, 68.5 mm SL.

Inger and Chin, 2 V 1956. FMNH 68169, 4 ex., 39.2–46.8 mm SL; same data, 28 IV 1956. FMNH 68170, 56 ex., 18.7–27.4 mm SL; same data, 25 IV 1956. FMNH 68171, 3 ex., 35.7–42.5 mm SL; same data, 3 V 1956. FMNH 68172, 1 ex., 19.7 mm SL; same data, 21 IV 1956. FMNH 68173, 1 ex., 21.5 mm SL; same data, 27 IV 1956. FMNH 68174, 9 ex., 32.7–49.7 mm SL; same data, 8 VI 1956. FMNH 68175, 9 ex., 21.2–45.0 mm SL; same data, 2–3 V 1956. FMNH 68176, 20 ex., 16.8–43.1 mm SL; same data, 6 V 1956. FMNH 68177, 4 ex., 36.9–46.8 mm SL; same data, 2 V 1956.

Diagnosis. *Noemacheilus olivaceus* occurs in Sabah and may be recognized from the other Sundaic noemacheilines by the combination of the following characters: anterior naris pierced in the front side of a valve which is posteriorly prolonged in a barbel-like filament (this shape of the valve is shared with *N. obesus* only) less than two times eye diameter; no acuminate scales on caudal peduncle (present in *N. selangoricus* and *N. spiniferus*); a complete lateral line (incomplete in *N. obesus*, *N. phuketensis* and occasionally *N. chrysolaimos* and *N. saravacensis*); 17 branched caudal rays (15 in *N. phuketensis*, 16 in *N. obesus*, *N. saravacensis* and *N. chrysolaimos*); a slightly forked caudal fin, the upper lobe being 1.1–1.3 times longer than median rays (1.5–2.4 in *N. selangoricus*, 1.3–1.9 in *N. chrysolaimos*, 1.4–1.7 in *N. longipectoralis*, 1.4–1.8 in *N. kapuasensis*, 1.5–2.1 in *N. fasciatus*, 1.6–2.4 in *N. masyai*; the caudal fin is truncated or rounded in *N. obesus* and *N. phuketensis*).

Description. Meristic and morphometric data are given on Table 1. The body is moderately elongated, with a regular height and

an anteriorly circular and posteriorly laterally compressed section. The pectoral fins nearly reach the base of the pelvic fins. There is a small axillary lobe at the base of the pelvic fins. The pelvic fins are inserted under third simple to first branched dorsal rays; they nearly reach the anus, which lies approximately 2.0–2.5 eye diameters in front of the anal fin. The anal fin does not reach the caudal fin base. There is a well marked dorsal keel on the caudal peduncle. The caudal fin is emarginated and the supero-posterior edge of the dorsal fin is slightly convex. Vertebrae 36.

The body and the belly are completely covered with embedded scales, all of the same size. The scales have a very small (approximately one-tenth of the length of the scale) eccentric focal area (Fig. 3i). The lateral line is complete. There are 9 mandibulo-opercular, 4+11 infraorbital, 5 supraorbital and 3 occipital pores on the head sensory canals.

The anterior nostril is pierced in the front side of a very short tube-like modified valve (Fig. 8b); the tip of the posterior side of the tube is often produced in a very short filament. The mouth is arched, its gape being somewhat 2.0–2.5 times wider than long. Both lips are relatively thin and slightly furrowed. There is a wide median incision on the lower lip (Fig. 8a). The maxillary barbels reach the posterior half of postorbital area of head, the inner rostral ones reach beyond the posterior rim of the eye and the outer rostral ones reach the branchial opening. The digestive duct has a loop immediately below the stomachic dilatation (Fig. 8c).

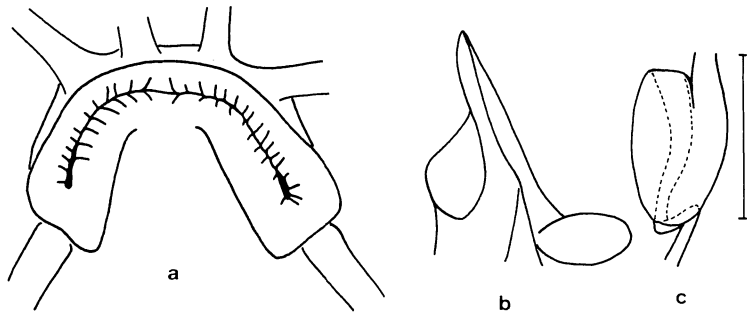


Fig. 8. *Noemacheilus olivaceus*, IRSNB 17549, 55.3 mm SL. a, mouth; b, left naris; c, stomach of FMNH 68172, 45.2 mm SL. Scale bar indicates 4 mm.

Sexual dimorphism: Females have a suborbital flaplet and the second pectoral ray is slightly thickened.

Colour pattern: The body is yellowish-brown with 12–17 dark bars which are thinner than the interspaces. The bars are somewhat irregular, some being directed obliquely hindwards or incomplete. There is a thin black band between the eyes, one on the nape, a dark spot around each naris, a dark vertical bar under each eye, followed by a light yellow area and a dark brown blotch on the opercle.

There is a dark spot at one-third of height of the last simple dorsal ray. The tip of this ray is also dark. There are two rows of spots on the dorsal rays, not very well marked. There are two rows of spots on the anal fin rays. The spots on the caudal rays form 2–3 irregular bars.

The juveniles have the same colour pattern, the body is lighter yellow and there are no marks on the fins.

Distribution. *Noemacheilus olivaceus* is known from Sabah only (Fig. 6).

Etymology. *olivaceus* (Lat.): olive coloured.

Noemacheilus saravacensis Boulenger

(Figs. 3d, 9, 10, 11)

Nemachilus saravacensis Boulenger, 1894: 251 (original description; type locality: Senah).

Nemachilus fasciatus: Weber and de Beaufort, 1916: 40 (citation in synonymy).

Material examined. Borneo: Sarawak. BMNH 1893. 2. 6: 277, lectotype (present designation), 43.7 mm SL; Senah (1°11'N, 110°15'E); Everett. BMNH 1893. 2. 6: 278–280, 3 ex., paralectotypes, 35.5–44.5 mm SL; same data. MHNG 2155.29, 2 ex., 27.2–34.3 mm SL; Rian Kayo (Sungai Sarawak Kiri, some 24 km south of Kuching (1°32'N, 110°20'E)); Nagy, 1980. BMNH 1932. 8. 9: 29, 2 ex., 27.0–33.8 mm SL; Lejok River, Tinjar River (see Harrison, 1933); Oxford Univ. Exped., 1932. ZRCUS 664, 3 ex., 27.9–35.7 mm SL; Kampong Pangkalan Kuap, Bt. Stigang, 7 miles south of Kuching; Lim, 20 I 1969. CAS-SU 32597, 3 ex., 30.2–37.5 mm SL; Kuching; Herre, 16 II 1937. Kalimantan Barat. MZB 3561, 1 ex., 35.4 mm SL; Kapuas River basin, Sungai Keniyatan, tributary to Sungai Landak, 6.5 km NE of Pontianak (0°02'S, 109°20'E); Roberts, 14 VII 1976.

Diagnosis. *Noemacheilus saravacensis* occurs in Sarawak and in the Kapuas basin and may be

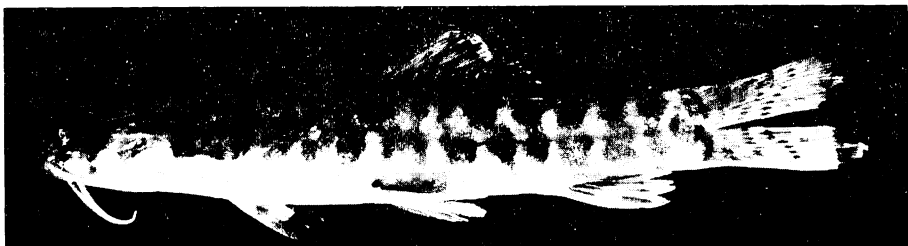


Fig. 9. *Noemacheilus saravacensis*, ZRCUS 664, 35.7 mm SL.

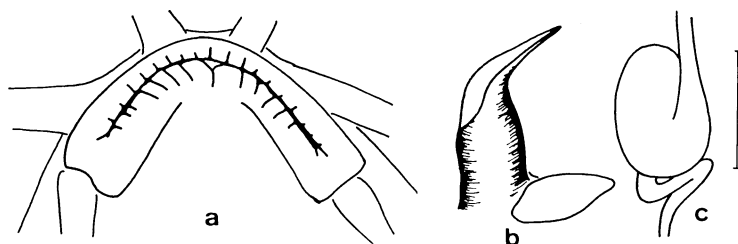


Fig. 10. *Noemacheilus saravacensis*, MHNG 2155.29, 34.3 mm SL. a, mouth; b, left naris; c, stomach. Scale bar indicates 4 mm.

distinguished from any other Sundaic noemacheiline by the combination of the following characters: usually 16 branched caudal rays (15 in *N. phuketensis* and 17 in all other species except *N. obesus* and occasionally *N. chrysolaimos*); (9–)10 branched dorsal rays (7 in *N. obesus*, 8–9 in all other species); a complete lateral line (incomplete in *N. phuketensis*, *N. obesus* and occasionally *N. chrysolaimos*); no acuminate scales on the caudal peduncle (present in *N. selangoricus* and *N. spiniferus*); anterior nostril at the extremity of an obliquely cut tube-like modified valve (valve not modified in *N. fasciatus*, *N. masyai* and *N. kapuasensis*, barbel-like in *N. olivaceus* and *N. obesus*). From the possibly nearby *N. longipectoralis*, it is easily distinguished by its shorter lateral length of head (20–23% SL vs. 23–26), shorter dorsal length of head (18–21% SL vs. 21–22), smaller eye diameter (27–31% HL vs. 29–40), less deeply forked caudal fin (upper lobe 1.1–1.5 times longer than median rays vs. 1.4–1.7).

Description. Morphometric and meristic data are given on Table 2. The body is elongated, its height slowly increasing up to the insertion of the dorsal fin; the sides are laterally flattened. The pectoral fins do not reach the base of the pelvic fins. There is an axillary lobe at the base of the pelvic fins. The pelvic fins are inserted under first to third branched dorsal rays; they nearly reach the anus, which lies approximately 1.5–2.0 eye diameters in front of the anal fin. The caudal fin is forked; its lobes are subequal, the upper one being 1.3–1.5 times longer than the median rays. The supero-posterior edge of the dorsal fin is convex. Vertebrae 33–34.

The body and the belly are completely covered by scales which are slightly embedded in the

anterior area. The scales are nearly circular, with a small (less than one-fifth of scale diameter) eccentric focal area (Fig. 3d). They all have the same size, only the ones on the caudal peduncle along the lateral line are more elongated. There are no tubercles on these elongated scales. The lateral line is usually complete (see discussion below). There are 8 mandibulo-opercular, 4+11 infraorbital, 5 supraorbital and 3 occipital pores on the head sensory canals.

The anterior naris is pierced at the extremity of a small obliquely cut tube and is posteriorly prolonged by a short point (Fig. 10b). The mouth is arched, its gape being approximately two times wider than long. Both lips are feebly pleated, the lower one has a deep median incision and 2–4 deep lateral furrows (Fig. 10a). The processus dentiformis is well developed. The maxillary and outer rostral barbels reach the middle of the postorbital length of the head, the inner rostral ones reach as far back as the posterior edge of eye. The digestive duct forms a loop closely below the stomachic dilatation (Fig. 10c).

Sexual dimorphism: Of all the examined material, a single 27.9 mm SL (ZRCUS 664) specimen exhibits a suborbital flaplet. It is supposed to be a male.

Colour pattern: The body is yellowish-brown with approximately 13–17 irregular blotches along the lateral line. Some of these blotches extend up to the dorsal mid-line and the ones on the caudal peduncle down to the ventral profile. There is a small dark spot at the extremity of the lateral line or a thin black bar at the base of the caudal fin, interrupted in its middle. There are 15–18 dark transverse bands on the dorsal profile (including on the

Table 2. *Noemacheilus longipectoralis* and *N. saravacensis*. Morphometric and meristic data.

	<i>N. longipectoralis</i>					<i>N. saravacensis</i>										
	Lecto- type	Paratypes % of SL		FMNH 80680 80681	Lecto- type	Paratypes % of HL		FMNH 80680 80681	Lecto- type	Range % of SL	\bar{x}	Lecto- type	Range % of HL	\bar{x}		
Standard length (mm)	33.8	30.3	37.0	32.8	37.3											
Lateral length of head	23.1	25.1	25.4	25.9	24.7	107	121	121	118	118	21.6	20.0-27.4	23.6	122	110-128	118
Dorsal length of head	21.6	20.8	21.1	22.0	20.9						17.6	17.6-23.7	20.0			
Predorsal length	46.2	48.5	50.5	50.0	47.5						49.0	46.4-52.7	50.2			
Prepelvic length	48.8	51.5	50.5	54.3	52.3						49.4	47.3-53.7	51.3			
Preanal length	77.8	74.3	76.8	77.1	76.7						77.3	75.5-80.0	78.7			
Pre-anus length	65.4	66.0	65.7	71.3	69.7						69.1	68.3-77.3	70.7			
Head height (at eye)	10.4	11.2	10.5	11.6	10.7	48	54	50	53	51	8.4	8.4-10.9	9.7	47	43- 56	49
Body height (at nape)	11.8	12.2	12.2	12.2	12.9	55	59	58	56	62	10.9	11.0-16.0	12.0	62	52- 70	60
Body height (at dorsal origin)	14.8	13.9	14.6	14.9	15.8	69	67	69	68	76	16.0	11.4-18.3	17.0	91	75- 98	81
Height of caudal peduncle	11.0	9.6	10.3	12.2	12.9	51	46	49	56	62	11.4	9.6-14.6	11.5	65	47- 67	58
Length of caudal peduncle	14.5	13.9	14.6	14.9	13.4	67	67	69	68	64	14.6	10.9-18.7	14.8	83	58- 84	74
Snout length	8.6	8.3	8.7	8.5	8.9	40	40	41	39	42	7.2	7.0- 9.1	8.2	41	38- 44	41
Head width (at nares)	8.3	8.9	8.7	9.2	8.0	38	43	41	42	39	6.3	6.3-11.3	9.2		44- 53	47
Maximum head width	13.3	14.9	12.7	12.2	12.9	62	71	60	56	62	12.3	12.3-16.2	14.2	70	60- 80	72
Body width (at dorsal origin)	9.8	9.6	10.0	10.0	10.7	45	46	47	46	51	12.1	9.2-14.4	11.6	68	45- 78	55
Body width (at anal origin)	6.2	5.9	6.2	7.6	7.5	29	29	30	35	36	7.9	5.5-10.5	7.2	45	27- 45	38
Eye diameter	6.2	7.6	7.6	7.3	6.2	29	37	40	33	30	4.9	4.9- 7.0	5.9	28	27- 33	30
Interorbital width	6.5	5.9	7.3	5.5	5.4	30	29	35	25	26	6.3	5.9- 8.5	7.2	26	26- 45	37
Height of dorsal fin	16.9	18.2	18.9	18.3	19.6	78	87	90	83	94	17.4	17.4-21.3	18.4	99	73-106	95
Length of upper caudal lobe	26.0	31.4	30.0	29.0	29.2	121	151	142	132	140	27.4	24.1-33.5	28.7	155	102-178	147
Length of lower caudal lobe	25.2	30.4	29.5	28.1	28.7	116	146	140	128	137	25.5	22.6-31.4	27.0	145	95-152	138
Length of median caudal ray	18.6	18.8	20.0	18.0	17.2	86	91	95	82	82	18.3	17.2-24.1	20.6	104	84-134	105
Length of anal fin	16.9	17.5	18.7	18.0	17.7	78	84	89	82	85	14.6	12.1-21.2	20.6	83	62-114	89
Length of pelvic fin	16.3	17.5	16.0	17.4	16.9	75	84	76	79	81	16.2	15.1-20.3	17.4	92	67-102	86
Length of pectoral fin	28.1	22.1	33.8	21.0	23.6	130	106	160	96	113	19.0	16.7-25.7	21.6	108	90-136	110
Caudal peduncle: length/height	1.32	1.44	1.42	1.23	1.04						1.29	0.94-1.37	1.24			
Dorsal fin rays (simple/branched)	/9	/9	4/9	4/9	4/9							4/9-10				
Caudal fin rays	9+8	9+8	9+8	9+8	9+8							8+8				
Anal fin rays (simple/branched)	3/5	3/5	3/5	3/5	3/5							3/5				
Ventral fin rays	8	8	8	8	8							8				
Pectoral fin rays	—	11	11	12	12							12				
Lateral-line pores	96	92	89	85	88						84	80-86	82			

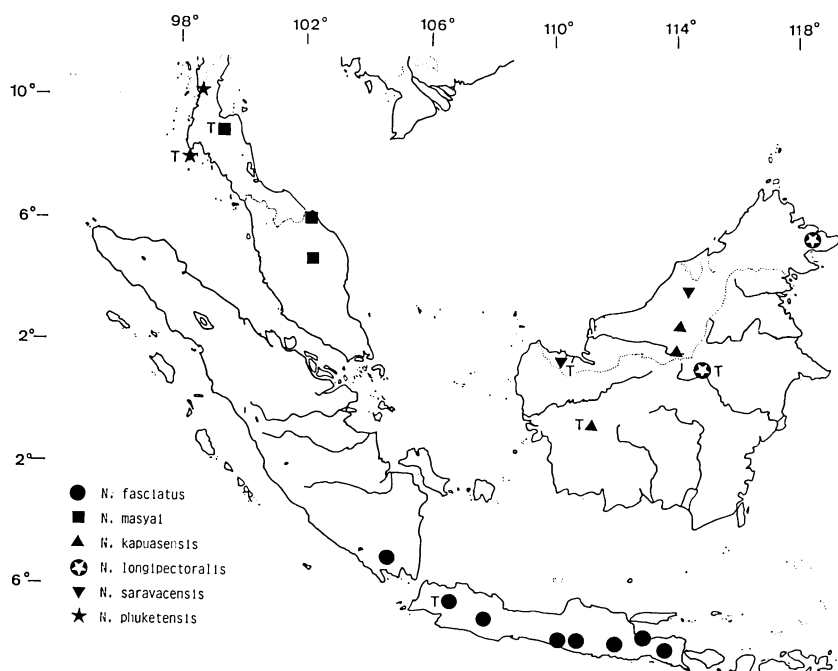


Fig. 11. Distribution of *Noemacheilus fasciatus*, *N. masyai*, *N. kapuasensis*, *N. longipectoralis*, *N. saravacensis* and *N. phuketensis*. T, type localities.

snout and between the eyes). These bars and bands may be connected. They may be lighter in their middle area. The foremost lateral line bars appear to be pairs, i.e., two very thin bars are close together. There is a dark blotch on the operculum and a dark bar below the eye. There is a dark spot at the lower fourth of first branched dorsal ray and the upper two-thirds of last simple dorsal ray is greyish. There are 2–3 more or less irregular rows of spots on this fin. There are 5–6 irregular vertical rows of spots on the caudal fin and two rows on the anal fin. These markings on the anal fin are not always present. The other fins are hyalin.

Discussion. The single specimen (MZB 3561) from the Kapuas Basin is easily distinguished from all other specimens, having 17 branched caudal rays (instead of 16) and a lateral line only reaching below the dorsal fin (instead of being complete), but it is in overall agreement with them in what concerns any other characteristics. Thus I have no hesitation in placing it in *N. saravacensis*.

Distribution. Sarawak and the Kapuas Basin in Kalimantan Barat (Fig. 11). At places,

this species occurs sympatrically with *N. spiniferus*.

Etymology. *saravacensis*: after Sarawak State.

Noemacheilus longipectoralis Popta

(Figs. 3c, 11, 12, 13)

Nemachilus longipectoralis Popta, 1904: 182 (provisionary description; type-locality: Upper Mahakam); 1906: 198 (redescription; fig.); Weber and de Beaufort, 1916: 39 (redescription).

Noemacheilus longipectoralis: Banareescu and Nalbant, 1968: 329 (synonymy).

Material examined. RMNH 9641, lectotype (present designation), 33.8 mm SL; Borneo: Kalimantan Timur: Upper Mahakam; Nieuwenhuis, X 1898. RMNH 27360, 2 ex., paralectotypes, 30.3–37.0 mm SL; same data. FMNH 80680, 1 ex., 32.8 mm SL; Borneo: Sabah: Kinabatangan distr.; Inger and Chin, 28 IV 1956. FMNH 80681, 1 ex., 37.3 mm SL; same data, 2 V 1956.

Diagnosis. *Noemacheilus longipectoralis* occurs in Eastern Borneo and may be distinguished from other Sundaic noemacheilines by the combination of the following characteristics: no acuminate scales on the caudal peduncle (present

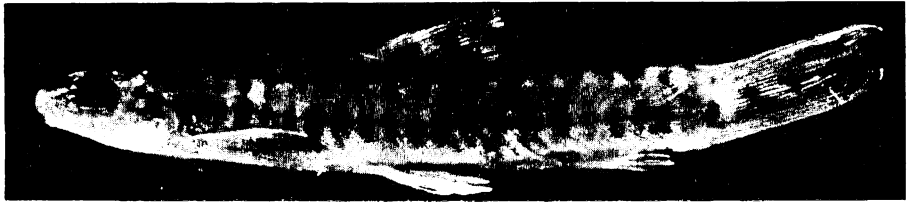


Fig. 12. *Noemacheilus longipectoralis*, FMNH 80681, 37.3 mm SL.

in *N. selangoricus* and *N. spiniferus*); anterior nostril pierced at the extremity of an obliquely cut tube (in the anterior side of a valve in *N. fasciatus*, *N. masyai* and *N. kapuasensis*; valve barbel-like in *N. obesus* and *N. olivaceus*); caudal peduncle 1.0–1.4 times longer than deep (1.5–1.9 in *N. fasciatus* and *N. masyai*); 17 branched caudal rays (15 in *N. phuketensis*, 16 in *N. obesus*, *N. saravacensis* and occasionally in *N. chrysolaimos*). See *N. saravacensis* for additional diagnostic characteristics between this and the present species.

Description. Meristic and morphometric data are given on Table 2. The body is elongated and slightly compressed. The pectoral fins reach farther than the base of pelvic fins (in FMNH material, they do not reach pelvic base). There is a small axillary lobe at the base of the pelvic fins, which are inserted under second to third branched dorsal rays; they reach the anus which lies approximately 1.5 eye diameter in front of the anal fin. The anal fin may nearly reach the base of the caudal fin. There may be a well marked adipose crest on the whole dorsal length of the caudal peduncle. The caudal fin is deeply forked, the lobes are subequal, the upper one being

1.4–1.7 times longer than the median rays. The dorsal fin has a straight supero-posterior edge. Vertebrae 36.

The body and the belly are completely covered by scales which are embedded in the anterior area only. The scales have an ovoid shape with a small (one-fifth of scale diameter) eccentric focal area (Fig. 3c). The lateral line is complete. There are 9 mandibulo-opercular, 4+11 infraorbital, 5 supraorbital and 3 occipital pores on the head sensory canals.

The anterior naris is at the extremity of a small obliquely cut tube (Fig. 13b). The mouth is arched, its gape being 1.5–2.0 times wider than long (Fig. 13a). Both lips are regularly pleated, more markedly in the anterior area of the lower lip. There is a median incision in the lower lip. The processus denticiformis is well developed. The maxillary and outer rostral barbels reach at least as far back as the middle of the postorbital length of the head. The inner rostral barbels reach below the eyes. One already dissected paralectotype (37.0 mm SL) has a damaged digestive duct which possibly had a loop at some distance after the stomachic dilatation (?), but this cannot actually be observed (Fig. 13c).

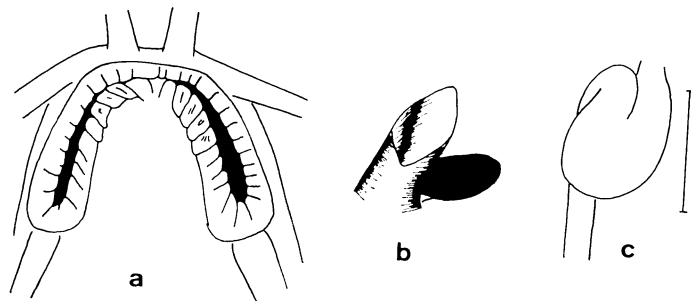


Fig. 13. *Noemacheilus longipectoralis*, lectotype. a, mouth; b, left naris; c, stomach of paralectotype, 37.0 mm SL. Scale bar indicates 3 mm.

Sexual dimorphism: Males have a well developed suborbital flaplet.

Colour pattern: Lectotype: Of the syntypes, only the lectotype retains some colour marks on a generally dark background (see illustration in Popta, 1904); the two paralectotypes are black. On the right side, there are 14 bars, the first five possibly being dissociated or lighter in the central area. These bars are thinner than the interspaces. There is a black spot at the base of the caudal fin, at the extremity of the lateral line. The dorsal fin bears a row of subdistal spots, and the caudal fin three vertical rows on its non-forked area. The upper area of the head is dark, except for the part above the fontanel.

FMNH 80681: The ground colour is brown; there are 19 vertically elongated spots along the course of the lateral line, approximately as wide as the interspaces, and 17 thin saddles on the back; some of these saddles are in contact with the spots, others alternate with them; some are forked and may touch two spots. There is a vertically elongated black spot at the posterior extremity of the lateral line, mainly in the lower half of the base of the caudal fin. The head bears a dark band between the eyes, a dark blotch on the nape, one on the opercle and one on each side of the snout. The last simple ray of the dorsal fin is greyish and there are two rows of dark markings on the branched rays of that fin. There are three vertical rows of dark markings on the caudal fin and one on the anal fin.

Discussion. I tentatively refer the two FMNH specimens to the present species. They are mainly distinguished by a greater preanus length, a smaller interorbital width and shorter pectoral fins (see Table 2). With only five specimens at hand, these differences cannot be given any significant value.

Distribution. The Upper Mahakam, Kalimantan Timor, and Eastern Sabah (Fig. 11).

Etymology. *longus* (Lat.): long; *pectoralis* (Lat.): pectoral fin.

Noemacheilus chrysolaimos (Valenciennes)

(Figs. 3e, f, 6, 14, 15)

Noemacheilus fasciatus Kuhl and van Hasselt in van Hasselt, 1823: 133 (in part); 1824: 377 (in part).

Cobitis chrysolaimos Valenciennes in Cuvier and Valenciennes, 1846: 27 (original description; fig.; type-locality: Java).

Cobitis fasciata: Bleeker, 1854: 96 (in part); 1859: 303 (in part); 1860: 78 (in part).

Nemacheilus fasciatus: Bleeker, 1863a: 366 (in part); 1863b: 41 (in part); 1863c: 7 (in part).

Nemachilus fasciatus: Günther, 1868: 349 (in part); Weber and de Beaufort, 1916: 39 (fig.), 40 (in part).

Material examined. Java. MNHN 3961, lectotype (present designation), 47.1 mm SL; Kuhl and van Hasselt. MNHN B-2972, 1 ex., paralectotype, 41.1 mm SL; same data. MZB 1374, 10 ex., 44.0–48.2 mm SL; Tjisarna, Bogor (6°34'S, 106°45'E); Jachja, 5 IV 1970. MZB uncat. (ex MZB 1372), 3 ex., 33.7–50.3 mm SL; Tjikuniri, Paku, Bogor; Wargasmita, 25 III 1970. USNM 72534, 2 ex., 44.5–48.8 mm SL; Buitenzorg (=Bogor); Bryant and Palmer, 10 III 1909. BMNH uncat., 1 ex., 49.6 mm SL; Bleeker. RMNH 17717, 25 ex., 31.9–50.1 mm SL; river by Buitenzorg; Buitendijk, III 1925–VII 1930. RMNH 28981, 2 ex., 39.6–44.3 mm SL; same data; cleared, alizarin stained. MHNG 1372.85–87, 3 ex., 35.3–44.9 mm SL; Sukabumi (6°55'S, 106°50'E); Walsh, VII 1930. ZMA 112879, 7 ex., 33.7–47.5 mm SL; Tjisaät; Bartels, 16 VII 1907. USNM 62357, 7 ex., 38.7–44.4 mm SL; Campbell. RMNH 2690, 37 ex. (very poor state); Krawang (6°15'S, 107°15'E); Müller, approximately 1830. RMNH 8950, 1 ex., 45.9 mm SL; East Indies; Bleeker, 1850–1860. ZMA 112.882, 1 ex., 29.6 mm SL; Tjibodas (6°44'S, 107°00'E); Lieftinck, 29 VI 1930. MCZ 30878, 2 ex., 38.9–49.5 mm SL; Buitenzorg; Bryant and Palmer, X 1909. MCZ 30569, 3 ex., 28.0–45.9 mm SL; Buitenzorg; Barbour, 1906–1907. ZMA 112.886, 24 ex., 22.8–50.4 mm SL; Buitenzorg; Weber, 1898–1899. ZMA uncat., 1 ex., 48.0 mm SL; no data.

Diagnosis. *Noemacheilus chrysolaimos* occurs on Java and may be distinguished from other Sundaic noemacheilines by the combination of the following characteristics: no acuminate scales on the caudal peduncle (present in *N. selangoricus* and *N. spiniferus*); anterior naris at the extremity of an obliquely cut tube-like modified valve (valve not modified in *N. fasciatus*, *N. kapuasensis* and *N. masyai*, barbel-like in *N. olivaceus* and *N. obesus*); caudal peduncle 1.1–1.5 times longer than deep (1.4–1.8 in *N. fasciatus* and *N. masyai*); usually 17 branched caudal rays (15 in *N. phuketensis*, 16 in *N. obesus* and *N. saravacensis*); eye diameter 3.8–5.7% SL (6.2–7.6 in *N. longipectoralis*, 2.6–

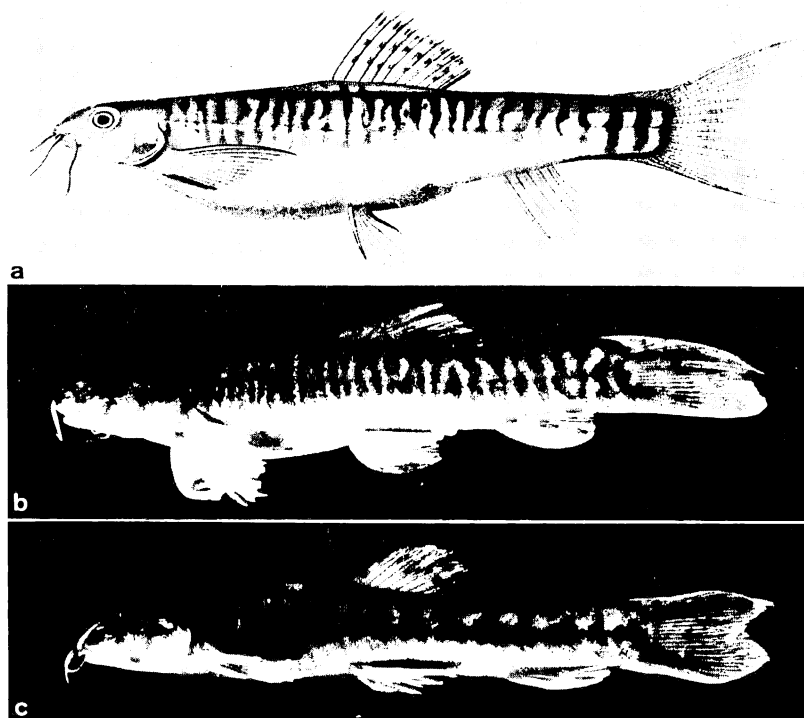


Fig. 14. *Noemacheilus chrysolaimos*. a, original illustration of Valenciennes; b-c, MZB 1374, 47.5 and 46.7 mm SL.

3.4 in *N. obesus*); a distinctive although very variable colour pattern (see below).

Description. Morphometric and meristic data are given on Table 3. The body is moderately elongated, with an anteriorly cylindrical section, somewhat laterally flattened on the caudal peduncle only. The body height is rather uniform. The pectoral fins reach nearly half-way between their own and pelvic fin bases. There is an axillary lobe at the base of pelvic fins which are inserted under last simple to third branched dorsal rays; they reach the anus which lies approximately two eye diameters in front of the anal fin. The anal fin does not reach the base of the caudal fin. There are short adipose crests on the caudal peduncle. The caudal fin is forked, its lobes are subequal, the upper one being 1.3–1.9 times longer than median rays. The supero-posterior edge of the dorsal fin is slightly concave. Vertebrae 35–36.

The body and the belly are completely covered by scales (except between the bases of the pectoral fins) which are not embedded. The

ones along the lateral line, particularly on the caudal peduncle, are distinctly longer (Fig. 3e, f). In all cases, the focal area is distinctly eccentric. The lateral line is complete but may occasionally be absent on the posterior half of the body in some localities (MZB 1374). There are 9 mandibulo-opercular, 4+11 infra-orbital, 5 supraorbital and 3 occipital pores on the head sensory canals.

The anterior naris is pierced at the extremity of an obliquely cut tube (Fig. 15b). The mouth is arched, its gape being some 1.5 times wider than long (Fig. 15a). The processus dentiformis is well marked. The anterior lip is finely crenated. The median part of the lower lip bears a few furrows. The inner rostral barbels reach below middle of the eye. The outer rostral and the maxillary barbels may reach as far back as the second half of the postorbital length of head. There is a loop in digestive duct below the stomachic dilatation (Fig. 15c).

Sexual dimorphism: Males have a sub-ocular flaplet and tubercles on upper side of the