Rec. West. Aust. Mus. Suppl. no. 34

A review of the freshwater fork-tailed catfishes (Pisces: Ariidae) of northern New Guinea, with descriptions of two new species

Patricia J. Kailola*

Abstract

The ariid catfish of northern New Guinea are reviewed and the genus *Arius* Valenciennes and subgenus *Brustiarius* Herre are diagnosed. Three New Guinea species, *Hemipimelodus velutinus* Weber, *H. taylori* Roberts and *H. macrorhynchus* Weber are transferred to *Arius* Valenciennes, and a replacement name *A. robertsi,* is proposed for *A. taylori,* preoccupied. The five northern New Guinea species represented are *Arius (Brustiarius) nox* Herre, *A.(B.) solidus* Herre, *A. velutinus* (Weber) and two new species of *Arius* Valenciennes. Synonymies and diagnoses are based on examination of types, biological and osteological data, and study of large series of material. *Arius utarus* sp. nov. is closely related to *A. leptaspis* (Bleeker) of southern New Guinea. It differs from all other ariids in northern New Guinea by a combination of characters including a broad mouth, rough head shield, long barbels and a palatal dentition consisting of four groups of teeth traversing the front of the palate; and from *A. leptaspis* by the number of trunk vertebrae, head size, caudal peduncle length and several other relative body parts. *A. coatesi* sp. nov. attains a large size and is distinguished by several characteristics, particularly its short barbels, small eye and constant palatal dentition of two tooth patches. All species appear to be endemic to the major river basins of northern New Guinea, i.e. the Mamberamo, Idenburg, Sepik and Ramu Rivers. Diagnoses, descriptions, illustrations and some biological data are provided for the new taxa. A dichotomous key to the five species also is given.

Introduction

The Ariidae is distributed in tropical and subtropical fresh, brackish and marine waters and includes about 130 species. Although almost circumglobal in distribution, few members exhibit a wide geographical range. The ariids are economically important wherever they occur and some taxa are aquacultured. Their low fecundity, large ova and practice of oral incubation by the male parent distinguish these fishes from other siluroid families.

Thirty-four ariid taxa inhabit the waters of Australia and New Guinea (Kailola, in prep.). Only five species, all marine, are also distributed outside the region (*Arius thalassinus* Rüppell, *A. bilineatus* Valenciennes, *A. argyropleuron* Valenciennes, *A. polystaphylodon* Bleeker and *A. nella* (Valenciennes). The present paper is concerned with some of the remainder: a group of species inhabiting the rivers and lakes of central New Guinea north of the main cordillera.

* Department of Zoology, University of Adelaide, GPO Box 498, Adelaide, South Australia 5001.

Hemipimelodus velutinus Weber (1908) was the first ariid described from northern New Guinea freshwaters and was based on 31 specimens collected from Lake Sentani and adjacent rivers in Irian Jaya. Weber also recorded *A. leptaspis* (Bleeker) from the north. Herre (1935) described four more species collected during the Crane-Pacific Expedition (*Arius solidus, Arius nox* [both in the subgenus *Brustiarius*], *A. kanganamanensis* [a synonym of *A. solidus*], *Hemipimelodus papillifer* [a synonym of *A. velutinus*]). Lastly, Nichols (1940) named two additional species collected from the Idenburg River during the 1938-39 New Guinea Archbold Expedition (*Arius microstomus* and *Hemipimelodus bernhardi* [both synonyms of *A. solidus*]).

Few fish samples from the Sepik, Ramu, Idenburg and Mamberamo River systems were available to ichthyologists until six years ago, when extensive fresh water surveys undertaken by G.R. Allen (Western Australian Museum) and colleagues, and by David C. Coates (formerly of Department of Fisheries & Marine Resources, P.N.G.), produced many more specimens. In addition, information on fishes collected during the 1954-55 Rikjsmuseum van Natuurlijke Historie (Leiden) Expedition to west New Guinea was published by Allen and Boeseman (1982).

Uncertain nomenclature has hampered attempts to determine the biology of the commercially and ecologically important ariids (at Angoram on the lower Sepik River, ariids regularly constitute 50% by weight of native fish landings): satisfactory comparison of specimens with species descriptions proved inadequate. The cause of this uncertainty, and its resolution, are addressed in this paper.

Materials and Methods

Counts and measurements follow Hubbs and Lagler (1958) with the exception of premaxillary tooth band length and width, "interdorsal" fin space, occipital process breadth and length, maxillary barbel length, and free vertebral count which follow Kailola (1983). Counts of fin elements and gill rakers were made using a needle probe; measurements were made with dial calipers to the nearest 0.1mm and, for very large specimens, with a ruler graduated in millimetres. Vertebral counts (number posterior to the anterior fused complex, and including the hypural), were made from radiographs and cleared and stained specimens (prepared using the techniques of Taylor [1967] and Dingerkus and Uhler [1977]). Bone nomenclature follows Fink and Fink (1981) and Grande (1987).

Where the range of counts and proportional measurements for the new species differ from those of the holotype, they are indicated in parentheses. Any allometric growth in these catfish was usually exhibited by the eye (relatively larger in juveniles) and barbels (relatively longer in juveniles) and are reflected in higher standard deviations of the means (see Tables).

Only first usage of names are stated in species synonymies.

In order to assess the number of taxa represented in the material (other than of *A. coatesi* sp. nov. and *A. nox*), bivariate scatter plots were prepared. Specimens of the morphologically similar species *A. leptaspis* and *A. utarus* sp. nov. were then characterised within a stepwise discriminant function analysis (BMDP software package, programme 7M; Dixon *et al.* 1985). A simple data description was subsequently prepared for each species (BMDP, 1D; Dixon *et al.* 1985).

Table 1. Localities and their co-ordinates from which material has been examined.

Locality	Degrees South	Degrees East
Aiome	05°09′	144°44′
Ambot, Kerame River	04°20′	144°10′
Angoram	04°04′40″	144°04′
Annanberg	04°54′	144°38′
Arso River	02°56′	140°45′
Bernhard Camp	03°30′	139°00′
Bewani River	02°57′	140°50′
Bunapas Station	04°14′40″	144°41′
Chambri Lakes	04°17′	143°08′
Danau Biru (Lake Holmes)	02°29′	138°00′
Idenberg River	02°54′	138°27′
Jimmi River NE Mt Hagen	05°30′	144°25′
Kabarao	04°14′	143°21′
Kambaramba	04°09′	144°00′
Kanganaman	04°12′	143°17′
Keram	04°25′	144°15′
Koragu	04°05′	143°08′
Kwatit R./Sepik R. junction	04°05′	143°06′
Magendo 2	04°06′	144°04′
Malu	04°15′	142°52′
Mamberamo River	03°00′	138°00′
lower Mamberamo River	01°26′	137°53′
Marienberg	03°55′	144°15′
Moaif River	02°25′	140°02′
Murik Lakes	03°47′	144°17′
Murui/Marui	04°05′	143°00′
Nyourangai	near Kanganaman	
Mt. Otto	05°29′	150°25′
Pagwi	04°06′	143°06′
Pioniersbivak	02°15′	138°00′
Prauwenbivak	03°12′	138°50′
lower Ramu River	04°06′	144°40′
Lake Sentani	02°35′	140°32′
Tami River entrance	02°50′	140°55′
Tami River nr Holtekang	02°41′	140°51′
Tami River	02°36′	140°55′
Tawarin River	02°28′	139°45′
Timbunke	04°11′	143°32′
Zenap/Tsenap	04°14′	142°19′
Zirken village, Ramu R.	04°02′	144°41′

Abbreviations used in the text and tables are: SL - standard length; D - dorsal fin; P - pectoral fin; A - anal fin; V - ventral (pelvic) fin; C - caudal fin; HL - head length; GR - gill rakers; caud. - caudal; dist. - distance; interorb. - interorbital; l - length; occip. - occipital; premax. - premaxillary; w. - width; stn - collecting station; C&S - cleared and stained specimen; LHS - left hand side; RHS - right hand side.

The following institutions hold material referred to in this paper: Academy of Natural Sciences, Philadelphia (AMNH); American Museum of Natural History, New York (AMNH); Australian Museum, Sydney (AMS); California Academy of Sciences, San Francisco (CAS); Ian S.R. Munro collection, CSIRO, Hobart (CSIRO); Field Museum of Natural History, Chicago (FMNH); Department of Fisheries & Marine Resources, Kanudi, Port Moresby (KFRS); Naturhistoriska Riksmuseet, Stockholm (NHRM); Naturhistorisches Museum, Vienna (NMW); Queensland Museum, Brisbane (QM); Rijksmuseum van Natuurlijke Historie, Leiden (RMNH); South Australian Museum, Adelaide (SAMA); National Museum of Natural History, Smithsonian Institution, Washington (USNM); Western Australian Museum, Perth (WAM); Zoological Museum, University of Amsterdam (ZMA) and Zoological Survey of India, Calcutta (ZSI).

The collecting method of specimens for which I have data was by rotenone, gill net and seine net. The co-ordinates of collecting localities are stated in Table 1.

Systematics

Genus *Arius* Valenciennes

Arius Valenciennes, 1840:53 (type-species, *Pimelodus arius* Hamilton-Buchanan, 1822, by absolute tautonomy)

Ariodes Müller & Troschel, 1849:6 (type-species, *Bagrus (Ariodes) arenarius* Müller & Troschel, 1849, by subsequent designation).

Genidens Castelnau, 1855:33 (type-species, *Bagrus genidens* Valenciennes, 1849, by absolute tautonomy)

Guiritinga Bleeker, 1858:62,67 (type-species, *Pimelodus commersonii* Lacepède, 1803, by monotypy)

Ariopsis Gill, 1862:56 (type-species, *Arius milberti* Valenciennes, 1840, by monotypy)

Pseudarius Bleeker, 1862:8,35 (type-species, *Pimelodus arius* Hamilton-Buchanan, 1822, by original designation)

Neoarius Castelnau, 1878:237 (type-species, *Arius curtisii* Castelnau, 1878, by monotypy)

Brustiarius Herre, 1935:388 (type-species, *Arius (Brustiarius) nox* Herre, 1935, by original designation)

Pararius Whitley, 1940:409 (type-species, *Arius proximus* Ogilby, 1898, by original designation)

Diagnosis

Moderately elongate and posteriorly compressed. Head shield and posterior cleithral process granular, rugose or almost smooth. Occipital process touches basal bone of first dorsal spine. Mouth arched or transverse and inferior to

terminal, lips varying from fleshy to tightly applied. Nostrils on each side of snout close together, posterior one valved. Eye lateral or dorsolateral, orbital margin more or less free. Three pairs of simple barbels around mouth: maxillary, mandibulary and mental. Dorsal fin with two spines - first reduced, second strong and serrated - and 7 branched rays. Pectoral fin placed low on side, with strong, serrated spine and 8-12 branched rays. Adipose fin short or moderate, situated above or extending beyond anal fin, its outer margin well-curved or truncate. Anal fin with 14-33 rays; fin margin truncate or concave. Ventral (=pelvic) fin with 6 branched rays. Caudal fin deeply forked, lobes tapered, with 7 + 8 principal rays and numerous procurrent rays associated with each lobe. Lateral line inflected upward or bifurcate at caudal base. Gill membranes connected below isthmus, posterior membrane margin strongly or weakly concave; gill openings wide to restricted. Branchiostegal rays 5-7. Premaxillary and mandibular teeth very small to moderate, slender or conical, sharp and depressible; forming 4-25 irregular series in band along each jaw. Palatal dentition present or absent: when present, teeth conical and sharp, or peglike, or molariform and globular, and grouped into one, two or four patches. Rakers along anterior and usually posterior face of all gill arches, sometimes absent from posterior of first and second arches. Small pore in axil of pectoral fin. Swimbladder ovate or cardiform, internally divided by a transverse septum, smaller septae intersecting posterior section. Gonads bilobate. Mesethmoid front margin excavated; dorsomedian cranial fontanel long; lateral ethmoid often distinct; additional pterygoid bone between autopalatine and metapterygoid; vomerine tooth plates when present, firmly attached to vomer; other tooth plates on palate free from any bone; infraorbital series of four bones; fontanel usually present between pterotic, supracleithrum and extrascapular bones; first pharyngobranchial elongate, reduced or absent. Complex vertebral centrum of four plus one, two or three vertebrae, the last one, two or three bearing ribs; secondary hypurapophysis well-developed; hypurals 1 + 2, 3 + 4 either or both fused in pairs; trunk vertebrae 9-15, haemal vertebrae 4-8, caudal vertebrae 26-33; cushy pad developed on inner ventral rays of sexually mature females.

Pending further study, other nominal taxa may be allocated to the synonymy of *Arius* Valenciennes.

Remaining genera of the Ariidae are distinguished from *Arius* Valenciennes by having any of the following characters or combination of characters: bilobed, spatulate, cusped, molariform or caniniform teeth in jaws; mandibular pores distinct; barbel complement other than 6; maxillary barbel stiffened and/or it, first pectoral and first dorsal rays much extended and osseous; margin of orbit not free; infraorbitals other than 4; teeth present on parasphenoid; branchiostegal rays other than 5 or 6; gill opening restricted; mesethmoid front margin straight or convex; lateral ethmoid remarkably produced posteriorly or elevated into a hump; lateral ethmoid-frontal fontanel absent or extremely large; mesethmoid or frontal bones pneumatosed; dorsomedian cranial fontanel expanded

posteriorly; no posterolateral fontanel; epiotic (?=epioccipital) present in skull roof; supraoccipital much expanded; supraneural present between supraoccipital and first nuchal plate; first nuchal plate enlarged; laminar (="superficial") bone arched posteromedially, aorta and principal nerves entering skull ventrad to fused vertebrae; aortic canal incomplete; subvertebral cone strongly elevated or scarcely developed; swimbladder not cardiform, ovate, nor with smooth exterior walls; vertebral number reduced (trunk, haemal) or increased (caudal); caudal vertebrae enlarged or elongated; gonad single or paired and contiguous, sharing a common median wall; a convoluted or no pad on inner ventral ray of sexually mature female; lateral line bifurcate at tail base; rays of ventral and caudal fins with reduced dentae.

I recognise five freshwater species of *Arius* Valenciennes from northern New Guinea: *velutinus* Weber 1908, *nox* Herre 1935, *solidus* Herre 1935, *utarus* sp. nov. and *coatesi* sp. nov. Having examined representatives of *Arius arius*, including type specimens of *Pseudarius arius* Bleeker, 1862, I am convinced of the validity of referring these species to that genus.

Key to the species of *Arius* from northern New Guinea

Adipose fin small, above posterior third of anal, its base 4-9.5 (mean 6.6) per cent SL; eye 4-7.3 (mean 5.4) per cent SL; lips thin, closely applied. Fin spines thin, pectoral with 8-10 rays. Variable development of the palate teeth (absent, to covering most of palate), but usually in a "butterfly"-shaped patch, with the vomerine patches the larger; body very dark in hue (subgenus *Brustiarius*) 2

Adipose fin moderate, above middle of anal, 6.4-14.5 (mean 9.5) per cent SL; eye 2.7-6 (mean 3.8) per cent SL; lips moderately well-developed. Fin spines moderately stout, pectoral with 10-12 rays. Palate dentition of one, two or four distinct oval patches, or absent 3

Total GR on first arch more than 50 (mean 60.6) ..... *nox* Herre

Total GR on first arch 19-30 (mean 23.1) ..... *solidus* Herre

Palate teeth in four distinct, equal-sized oval patches transversely arranged; mouth broad, 45-56 (mean 50.4) per cent HL; internostril distance 30-39 (mean 35.1) per cent HL; head shield granular, extensive; vertical series of golden spots on sides of body in life ..... *utarus* sp. nov.

Palate teeth not as above; mouth narrower, 30-46 (mean 40.3) per cent HL; internostril distance 21-31 (mean 28.1) per cent HL 4

Maxillary barbel short, 9-10.2 (mean 9.5) per cent SL; eye small, 8.4-11 (mean 9.5) per cent HL; single, oval patch of fine teeth on each side of palate.....*coatesi* sp. nov.

Maxillary barbel 16-32 (mean 24.8) per cent SL; eye moderate, 10-24 (mean 15.5) per cent HL; palate naked or (rarely) with one or two small oval patches of fine teeth.....*velutinus* Weber

Subgenus *Brustiarius* Herre

Diagnosis

Forktailed catfishes less than 300mm SL in the genus *Arius* Valenciennes differing from other ariids by the combination of the following characters: 1) 19-67 slender and long gill rakers on first gill arch; 2) adipose fin small (length of base 1.9-4 in base of dorsal fin) and situated above posterior of anal; 3) swimbladder plump and rounded-ovate, its margin smooth; 4) caudal lobes slender; 5) very dark body pigmentation, including dusky gill rakers; 6) teeth very small, sharp and curved or blunt and conical; 7) labile expression of palatal dentition (solid plate of fine teeth, "butterfly"-shaped[1] cluster, 4 transverse-situated groups of teeth, or none); 8) thin cranial bones; 9) expanded, thin mesethmoid notched at anterior margin; 10) lateral ethmoid strongly underturned laterally; 11) few, irregular series of teeth in jaws; 12) long, outer frontal extension to lateral ethmoid with large space between it and medial cranial bones; 13) branchial elements long and slender; 14) first pharyngobranchial much reduced; 15) uncinate process from third epibranchial fused or in very close contact with second epibranchial; 16) two reduced, parasphenoid wings; 17) subvertebral cone low; 18) cleithrum thin, extending well forward; 19) neural spine of penultimate centrum reduced.

Remarks

Two northern New Guinea species belong in this subgenus: *Arius nox* Herre and *Arius solidus* Herre. The subgeneric status of the remaining ariid species in northern New Guinea is presently unclear.

Arius (Brustiarius) nox Herre, 1935

(Figure 1; Tables 6, 7)

Arius (Brustiarius) nox Herre, 1935:388 (partim) (Nyourangai, Sepik River)
Tachysurus nox - Fowler, 1949:52 (partim)
Brustiarius nox - Munro, 1958:123 (partim)

---

[1] Refer to figure 3.

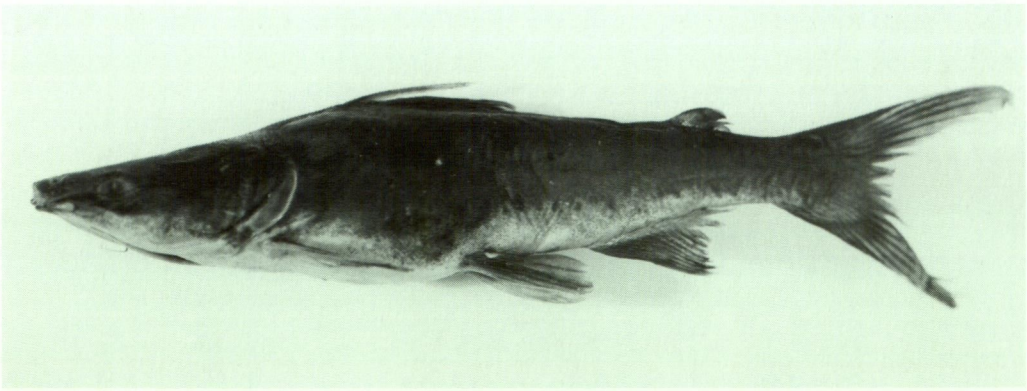

Figure 1. *Arius (Brustiarius) nox.* WAM P.27837-003, 222mm SL. Lateral view.

Diagnosis

Palate always with fine, conical teeth either grouped into four distinct patches lying across front of palate or into a "butterfly"-shaped patch; posterior aspect of first two gill arches with none to twelve rakers; 18-21 anal rays; 8-9 pectoral rays; 56-67 rakers on first gill arch; 44-46 vertebral centra posterior to complex centrum, of which 9-10 are trunk centra. Fin spines thin; barbels rounded in cross-section, maxillary 22-30 per cent SL; adipose fin base 4-7.5 per cent SL; head rather low, height 13-36 per cent SL; snout short, 8-12 per cent SL; eye 4-6 per cent SL. Caudal fin deeply forked, lobes slender. Fresh colouration blackish brown or charcoal with bluish sheen above, distinctly countershaded white or yellowish below; fins generally dark; barbels black.

Arius (B.) nox is most similar to *A. (B.) solidus*. The two can primarily be distinguished on the number of gill rakers (56-57, cf 19-30 in *A. (B.) solidus*). *A. (B.) nox* also has modally fewer pectoral rays (8-9) and trunk vertebrae (9-10) (cf 8-10, 10-12 respectively in *A. (B.) solidus*).

Distribution

Arius (B.) nox has been collected only in fresh waters of the Sepik and Ramu River systems of north-central New Guinea.

Remarks

Roberts (1978) had surmised that *A. (B.) nox* and *A. (B.) solidus* (and *H. bernhardi* Nichols) are closely related, sharing features such as increase in gill rakers, thinning of the upper jaw and anterior portion of the cranium.

Two of Herre's paratypes belong to *A. solidus* Herre because they have total GR counts (first arch) of 28 (CAS(SU) 24451) and 26 (FMNH 17200). The total GR count of the remaining paratype series ranges from 51 to 60. Although Herre's gill raker count for this species is therefore erroneous, any other discrepancies (colouration, general morphology) produced by inclusion of these two *solidus*

Herre specimens in the type series have been masked by the close morphological similarity of both taxa.

Roberts (1978) and D. Coates (pers. comm.) compared *A. nox* with *Nedystoma dayi* (Ramsay & Ogilby, 1887), a species present in southern New Guinea. Roberts (1978) concluded that the large, paired folds of skin hanging from the posterior of the palate in *A. nox* must function very effectively in separating out vermiform dipteran larvae from mud; and *A. nox* has a peculiar double "pad" hanging from the upper limb of the first gill arch which would function in a similar manner. D. Coates (pers. comm.) observed that this species usually directs its barbels forward.

Material examined

FMNH 17196, (1), 176mm SL, Nyourangai, Sepik River, 22 May 1929, Crane Pacific Expedition, collected by A.W. Herre (=PARATYPE); FMNH 17197, (1), 174mm SL, same data (=PARATYPE); FMNH 17198, (1), 208mm SL, Kanganaman, Sepik River, 15 May 1929, Crane Pacific Expedition, collected by A.W. Herre (=PARATYPE); FMNH 17199, (1), 163mm SL, same data (=PARATYPE); KFRS F.5518-03, (2), 102 and 264mm SL, Angoram, Sepik River, January 1982, collected by D. Coates; WAM P.28225-001, (15), 87-238mm SL, Sepik River, date not stated, collected by D. Coates (two specimens C&S); WAM P.27837-003, (2), 215 and 222mm SL, Chambri Lakes, 21 October 1982, collected by G.R. Allen and D. Coates; AMS I.27407-001, (2), 180 and 282mm SL, Angoram, Sepik River, January 1982, collected by D.C. Coates; WAM P.27846-004, (1), 131mm SL, 8km downstream from Pagwi, 27 October 1982, collected by G.R. Allen and D. Coates; QM I.25056, (2), 206 and 271mm SL, Angoram, Sepik River, October 1981, collected by D. Coates; NHRM A88 1981428.4230, (1), 169mm SL, same data; UMMZ 214018, (2), 183.5 and 192mm SL, same data; WAM P.28223-001, (5), 97-200mm SL, Sepik River, 1982, collected by D. Coates; AMS I.27407-002, (1), 192mm SL, Angoram, Sepik River, January 1982, collected by D. Coates, (C&S); KFRS F.5467-02, (5), SL not noted, Regene roundwater near Bunapas, Ramu River, October 1987.

Arius (Brustiarius) solidus Herre, 1935: new combination

(Figures 2, 3; Tables 6, 7)

Arius solidus Herre, 1935:385 (Timbunke, Sepik River)
Arius kanganamensis Herre, 1935:387 (Kanganaman, Sepik River)
Arius microstomus Nichols, 1940:2 (Bernhard Camp, Idenburg River)
Hemipimelodus bernhardi Nichols, 1940:3 (Bernhard Camp, Idenburg River)
Tachysurus kanganamensis - Fowler, 1949:52
Tachysurus solidus - Fowler, 1949:52
Netuma microstomus - Munro, 1958:122
Netuma mircostoma - Munro, 1967:82 (emend.)

Diagnosis

Palate either with fine, conical teeth across the front of the palate in four distinct patches, in a "butterfly"-shape, in a very large, single patch; or palate naked. Posterior aspect of first two gill arches smooth, with none to ten low rakers; 17-19 anal rays; 8-10 pectoral rays; 19-30 rakers on first gill arch; 44-48 vertebral centra posterior to the complex centrum of which 10-12 are trunk centra.

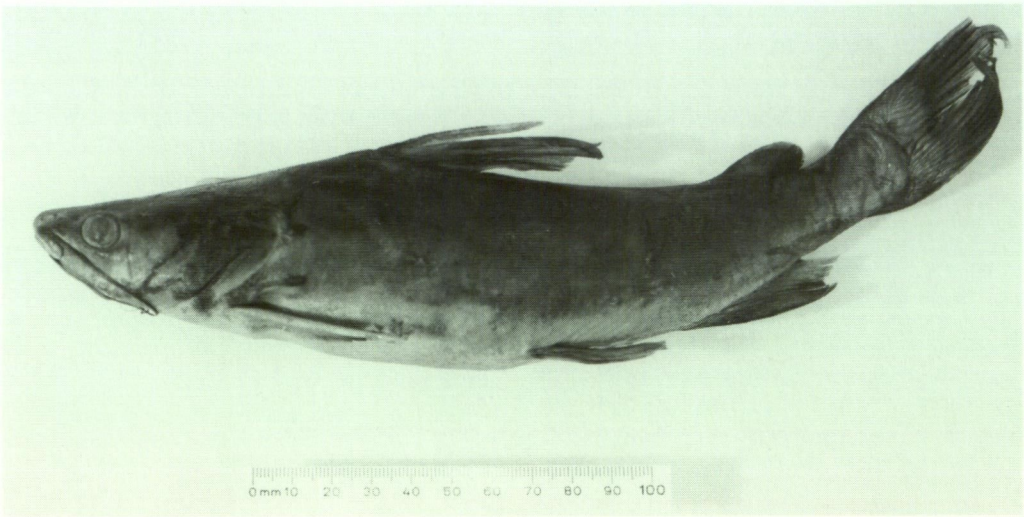

Figure 2. *Arius (Brustiarius) solidus.* WAM P.27837-002, 222mm SL. Lateral view.

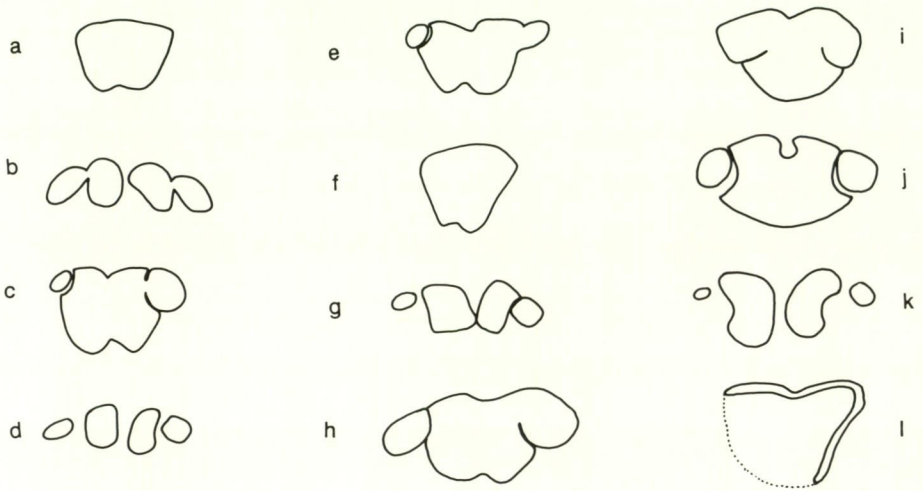

Figure 3. Palatal dentition in specimens of *A. (B.) solidus* of various SL's: a) 74mm; b) 80mm; c) 101mm; d) 114mm; e) 150mm; f) 197mm; g) 195mm; h) 242mm; i) 230mm; j) 260mm; k) 270mm; l) 247mm (dotted line indicates extent of tooth plate and solid line, spread of teeth). Three specimens (109, 138, 173mm SL) lacked palatal teeth. Drawings not to scale.

Adipose fin base 4.4-9.4 per cent SL; eye moderately large, 4-7.3 per cent SL; maxillary barbels thin, 23-36 per cent SL. Dorsal head shield rugose. Caudal fin moderately long and tapered. Fresh colouration dark bluish brown, fins dark.

A. (B.) solidus is most similar to *A. (B.) nox*, from which it can easily be distinguished by the number of gill rakers (more than 50 on first arch of *A. (B.) nox*). The statistical analyses failed to show significant differences between individuals originally determined as *A. kanganamanensis* Herre, *A. microstomus* Nichols, *Hemipimelodus bernhardi* Nichols and *A. solidus*.

Distribution

Known from the four major river systems in central-northern New Guinea and associated lesser fresh waters.

Remarks

The highly labile nature of the palatal dentition in this species has engendered considerable confusion for both systematists and fisheries workers conducting ecological studies. Not only is the degree of dental development independent of size (figure 3), but the teeth are differently shaped: from conical with blunt tips to sharply pointed and curved.

Material examined

FMNH 17204, (1 specimen), 154mm SL, Kanganaman, Sepik River, 15 May 1929, Crane Pacific Expedition, collected by A.W. Herre (=PARATYPE of *A. solidus*); FMNH 17203, (1), 175mm SL, same data (=PARATYPE of *A. solidus*); FMNH 17206, (1), 185mm SL, same data (=PARATYPE of *A. solidus*); FMNH 17205, (1), 150mm SL, same data (=PARATYPE of *A. solidus*); FMNH 17202, (1), 189mm SL, Timbunke, Sepik River, 17 May 1929, Crane Pacific Expedition, collected by A.W. Herre (=PARATYPE of *A. solidus*); FMNH 17207, (1), 197mm SL, Nyourangai, Sepik River, 22 May 1929, Crane Pacific Expedition, collected by A.W. Herre (=PARATYPE of *A. solidus*); FMNH 17208, (1), 185mm SL, same data (=PARATYPE of *A. solidus*); AMNH 20929, (1), 74mm SL, Bernhard Camp, Idenburg River, May 1939, collected by R. Archbold and W.B. Richardson (=PARATYPE of *A. microstomus*); FMNH 17200, (1), 149mm SL, Kanganaman, Sepik River, 15 May 1929, collected by A.W. Herre (=PARATYPE of *A. nox*); AMNH 15040, (3), 108.5, 138 and 173mm SL, Bernhard Camp, Idenburg River, May 1939, collected by R. Archbold and W.B. Richardson (=PARATYPES of *H. bernhardi*); KFRS F02815, (4), 138, 138, 145 and 195mm SL (one 138mm specimen C&S), Ammanberg, Ramu River, 17 December 1970, collected by L. Vargu; WAM P.27837-002, (2), 101 and 222m SL, Chambri Lakes, 21 October 1982, collected by G.R. Allen and D. Coates; KFRS F.5518-01, (1), 143mm SL, Angoram, Sepik River, January 1982, collected by D. Coates; AMS I.27408-002, (1), 206mm SL, Angoram, Sepik River, 1982, collected by D. Coates (C&S); CAS 60487, (1) 145mm SL, same data; AMS I.27408-001, (2), 155 and 260mm SL, same data; ZMA 116.458, (1), 270mm SL, Pioniersbivak, Mamberamo River, 19 December 1920, Nieuw Guinea Expedition of 1920, collected by W.C. van Heurn; KFRS F. 5517-03, (1), 242mm SL, Keram, Chambri Lakes, 17 April 1980, collected by A. Richards, C. Brooks and K. Makeu; WAM P.27846-003, (3) 140, 141 and 147mm SL, 8km downstream from Pagwi, Sepik River, 27 October 1982, collected by G.R. Allen and D. Coates; WAM P.27846-002 (in part), (2), 99 and 127mm SL, same data; KFRS F.5518-02, (1), 171.5mm SL, Angoram, Sepik River, January 1982, collected by D. Coates; QM I.25057, (2) 230 and 247mm SL, Angoram, Sepik River, 1981?, collected by D. Coates (both C&S); QM I.25055, (3), 165.5, 230 and 242mm SL, Angoram, Sepik River, 1981?, collected by D. Coates; NHRM A88 1982405.4228, (2), 112 and 127mm SL, Magendo 2, Sepik River floodplain, 8 October 1982, collected by D. Coates; BMNH unreg., (2), 100.5 and 130.5mm SL, same data; QM I.25058, (3), 87, 90 and 118.5mm SL, same data; KFRS F.5519-01, (3), 89, 109 and 114mm SL, same data; MNHN 1988-804, (2), 80 and 108mm SL, same data; NTM S.12350-001, (2), 85

and 110mm SL, same data; AMS I.27409-001, (4), 81, 113, 168 and 176mm SL, same data, (all C&S); USNM 288560, (59), 52-82 (mean 67.6)mm SL, same data.

Arius utarus sp. nov.

(Figures 4, 6a; Tables 2, 3)

Hemipimelodus velutinus - Weber, 1908:225 (partim)
Arius leptaspis - Weber, 1908:227 (partim)
Tachysurus leptaspis - Fowler, 1928:62 (partim)
Hexanematichthys leptaspis - Munro, 1958:123 (partim)
Arius sp. "C" - Allen & Boeseman, 1982:74,99

Holotype

AMS I.25406-001, 270mm SL, Murik Lakes, New Guinea, May 1980, collected by J. Campbell.

Paratypes

QM I.21674, (1 specimen), 294mm SL, Murik Lakes, May 1980, collected by J. Campbell; AMS I.25406-002, (2) 242 and 284.5mm SL, same data; SAMA F.6254, (1), 175.5mm SL, Keram, Sepik River, May 1980, collected by A. Richards (C&S); WAM P.28224-001, (1), 252.5mm SL, Angoram, Sepik River, July 1982, collected by D. Coates; RMNH28814, (1), 88mm SL, Tami River entrance, 1954, collected by M. Boeseman; CSIRO C.3532, (1), 122mm SL, Sepik River at Murui, 2 May 1954, collector unrecorded; CAS (SU)68631, (1), 198mm SL, Sepik River at Kanganaman, 15 May "1927" (?=1929), collected by A.W. Herre; CAS (SU)28204, (1), 218mm SL, Malu, Sepik River, 16 May 1929, collected by A.W. Herre; CAS (SU)68882, (1), 198mm SL, Kerame River at Ambot, 25 May 1929, collected by A.W. Herre; ZMA 116.459, (1), 250mm SL, Pioniersbivak, Mamberamo River, Nieuw Guinea Expedition of 1920-21, 5 January 1921, collected by W.C. van Heurn; ZMA 116.460, (1), 267mm SL, Prauwenbivak, Idenburg River, Nieuw Guinea Expedition of 1920, 18 September 1920, collected by W.C. van Heurn; RMNH 8001, (1), 149mm SL, outlet of Tami River, 12 May 1903, collected by L.F. de Beaufort, (=SYNTYPE of *Hemipimelodus velutinus* Weber); CAS 13482, (2), 215 and 280mm SL, Sepik River, 1929, collected by A.W. Herre; CAS 13481, (1), 380mm SL, Sepik River, 1929, collected by A.W. Herre; WAM P.27846-001, (4), 97, 109, 116 and 133mm SL, 8km downstream from Pagwi, Sepik River, 27 October 1982, collected by G.R. Allen and D. Coates; WAM P.27847-010, (7), 84, 101, 104, 113, 115, 118 and 118mm SL, Kwatit River at junction with Sepik River, 28 October 1982, collected by G.R. Allen and D. Coates; KFRS F.5517-01 (2), 297 and 325mm SL, Keram, Sepik River, 17 April 1980, collected by A. Richards, C. Brooks and K. Makeu; NTM S.11904-001, (2), 252 and 258mm SL, Angoram, Sepik River, 1981, collected by D. Coates.

Diagnosis

Fine teeth in four isolated, oval patches across front of palate; usually no rakers on posterior aspect of first two gill arches; 18-22 anal rays; 9-10 pectoral rays; 45-48 vertebral centra posterior to complex centrum, of which 10-12 are trunk vertebrae; 13-22 rakers along first gill arch. Maxillary barbel 28-50 (mean 36) per cent SL; mouth broad, gape 46-56 (mean 50.4) per cent HL; jaws strong. Dorsal head shield rough, with granules extending forward along midline; occipital process oblong or broadly triangular. Body compressed and tapered distally, caudal peduncle shallow, its depth 6-8.4 (mean 7.3) per cent SL. Fresh colouration dark blue to olive, vertical series of golden spots arranged along upper sides.

A. utarus sp. nov. is most similar to *A. leptaspis* (Bleeker, 1862). The two species differ in the number of trunk vertebrae (13-15 in *A. leptaspis*), eye position (more dorsad in *A. utarus* sp. nov. than *A. leptaspis* of similar size) and thickness of head skin (thicker in *A. leptaspis*). *A. utarus* sp. nov. also can be distinguished by the combination of smaller head (27-31 (mean 29.5) per cent SL cf 28-36 (mean 31.2) in *A. leptaspis*), shallower caudal peduncle (1.8-2.8 [mean 2.2] in peduncle length cf 1.4-2.3 [mean 1.8] in *A. leptaspis*), longer anal base (15-20 [mean 17] per cent SL cf 12-18.5 [mean 15]), longer band of premaxillary teeth (5.5-10 [mean 7.6] in its width cf 5.3-16 [mean 9.2] and broader occipital process (16-25 [mean 20.5] per cent HL cf 12-25 [mean 16.7]).

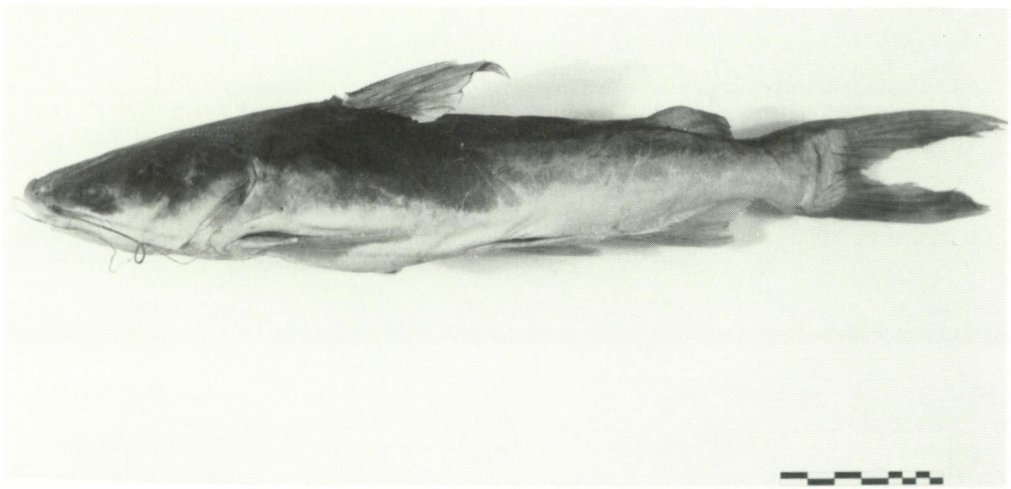

Figure 4. *Arius utarus* paratype. AMS I.25406-002, 284.5mm SL. Lateral view.

Description

The range, mean and standard deviation of meristics and selected proportions are presented in Tables 2 and 3.

D I,7. A 18 (18-22). P I,10 (I,9-10). V 6. C i,6 + 7,i. GR (first arch) 16 (13-22) of which 5 (4-7) rakers on upper limb. GR (last arch) 18 (16-21). Number of free vertebral centra posterior to complex vertebra - (45-48), total vertebrae 53-55: 10-12 trunk, 6-7 haemal, 28-31 caudal (5 specimens). Branchiostegals 6.

Body slender and robust; depressed anteriorly, well compressed posteriorly. Predorsal profile almost straight, slightly convex at nape. Snout rounded, slightly pointed in small juveniles; short, crescentic groove present on snout midline in juveniles. Mouth broad and curved, subterminal; jaws strong, slightly upturned at medial symphysis. Lips moderately fleshy, especially in juveniles, forming muscular lobe at corners of mouth; inner lip margin scalloped or crenulate. Nostrils ovate, anterior nostril usually directly in front of posterior one, which

can be concealed by skin flap. Eye rounded or ovate, situated dorsolaterally and visible from above, mid-head length opposite or up to one eye diameter posterior to, hind margin of eye. Orbit free from head skin. Gill opening wide; membranes meeting well anteriorly at a right angle and attached to isthmus and with free, broad margin.

Teeth in jaws and palate rather small: slender and curved, tips sharp: depressible and embedded in soft tissue. Jaw teeth in narrow band: premaxillary with 4-8 irregular series; mandibulary with 4-6 irregular series, divided by narrow diastema at symphysis. Four ovate patches of many teeth arranged across front of palate, each patch separated from its neighbour by narrow but distinct gap. Palate mostly smooth; broad velum between premaxillary and palatal teeth; usually two low, muscular ridges of tissue lying obliquely at rear of palate.

Head shield often obscured by thick skin in juveniles, exposed in adults: heavy and extensive, of many coarse granules arranged in series or scattered in patches, from above anterior of eye to origin of gill opening and over occipital process. Dorsomedian head groove short and lanceolate, extending from between nostrils to distance of one eye diameter behind eye in adults, longer and narrower posteriorly in juveniles, not reaching occipital process base. Process broad, oblong or triangular, with median keel of juveniles becoming flattened in adults, and, adjacent, a crescentic, granular predorsal plate. Many fine, tiny papillae scattered

Table 2. Meristics and relative body proportions* of *Arius utarus*. (*Ratios could not be computed if character is damaged or missing on a specimen) n=sample size; SD=standard deviation.

Character	Holotype	For all type specimens		
		n	range	mean	SD
SL (mm)	270	32	84-380	194.5	83.3
HL in SL	3.2	32	3.2-3.7	3.4	0.2
eye l. in HL	8.3	32	5.4-8.6	7.1	1.0
eye l. in snout l.	3.2	32	2.0-3.3	2.7	0.4
eye l. in bony interorb. width	3.0	32	1.8-3.4	2.5	0.5
occip. proc. width in proc. l.	1.2	32	1.0-3.4	1.5	0.4
D.spine l. in HL	1.4	30	1.3-2.0	1.5	0.2
P.spine l. in HL	1.3	28	1.1-1.6	1.4	0.1
adipose fin base l. in D.fin base l.	1.9	32	0.8-1.9	1.2	0.2
adipose fin base l. in interdorsal space	4.4	32	2.1-4.7	3.0	0.7
caudal peduncle depth in its l.	2.3	32	1.8-2.8	2.2	0.2
predorsal l. in SL	2.6	32	2.6-2.9	2.7	0.1
longest barbel in SL	3.5	32	2.0-3.6	2.8	0.4
head ht. in head width	1.6	32	1.2-1.7	1.4	0.1
l. premax. tooth band in its width	7.9	31	5.5-10.1	7.6	1.2
count of A. fin rays	18	32	18-22	19.6	1.0
count of P. fin rays	10	32	9-10	9.8	0.4
total GR (first arch)	16	30	13-22	17.7	1.8
total GR (last arch)	18	28	16-21	19.5	1.3

Table 3. Percent of HL and SL for *Arius utarus*.

Character	Holotype	For all type specimens		
Per cent of HL		n	range	mean	SD
head height	45	32	45-63	54	4.8
head w.	71	32	67-82	75	3.9
eye l.	12	32	12-18	14	2.1
mouth gape	50	32	46-56	50	3.1
internostr. distance	36	32	30-39	35	2.3
snout l.	39	32	34-40	37	1.4
longest barbel l.	91	32	90-177	125	22.8
bony interorb. w.	36	32	31-40	35	2.4
occipital process l.	27	32	24-72	30	8.2
occipital process w.	22	32	16-25	21	2.0
Per cent of SL					
HL	31	32	27-32	29	1.4
head height	14	32	14-18	16	1.0
head width	22	32	20-25	22	1.4
eye l.	4	32	4-5	4	0.5
mouth gape	16	32	13-17	15	1.3
internostr. distance	11	32	8-12	10	1.0
snout l.	12	32	10-13	11	0.8
longest barbel l.	29	32	28-50	36	5.5
bony interorb. w.	11	32	9-12	10	1.0
occipital process l.	9	32	7-21	9	2.3
predorsal l.	39	32	34-39	37	1.3
D.fin base l.	12	32	8-14	11	0.9
interdorsal l.	28	32	24-32	28	2.0
adipose fin base l.	6	32	6-12	9	1.5
anal fin base l.	16	32	15-20	17	1.3
caudal peduncle depth	7	32	6-8	7	0.4
caudal peduncle l.	16	32	14-19	16	1.2
pectoral spine l.	24	28	19-24	21	1.5
dorsal spine l.	22	30	16-22	19	1.7

over anterior half of head in mature males and some juvenile specimens; sides of head slightly venulose. Humeral process smooth and striate, granular in larger fish; well-ossified anteroventrally, with acute triangular shaft extending to 1-3 length of pectoral spine. Axillary pore tiny, rounded.

Barbels moderately flattened. Maxillary barbel extending to or beyond last dorsal ray in juveniles, no further than tip of humeral process in adults; mandibulary barbel extending to below pectoral base or as far as mid-dorsal base (juveniles); mental barbel attains lower head margin or pectoral spine base (adults).

Gill rakers slender, stiff and somewhat acute, one half as long as filaments. Usually no rakers along posterior aspect of first and second arches (holotype and one paratype have one raker on first arch, two paratypes have 2 and 3 rakers

on second arch), 15 (14-22; mean 18.6) along posterior aspect of third arch. Smaller fish have low, crenulate flap of tissue posterodorsally on second arch and may also have 3-5 series of low papillae along backs of first two arches.

Fin spines strong, slightly compressed, with fine or rugose striae along lateral aspect; usually short filament present at tip. Front margin of spines with transverse, granular ridges, replaced towards tip by 3-4 (dorsal) or 5-8 (pectoral) low serrae; posterior margin with 5-8 low, retrorse serrae (dorsal) or 11-16 triangular, retrorse serrae (pectoral). Dorsal spine subequal to or shorter than pectoral spine, as long as or slightly longer than postorbital head length. First ray of dorsal fin 2.6 (2.6-3.3; mean 2.9) longer than last ray. Pectoral fin low on sides, extending to or beyond vertical line from end of dorsal base. Anal fin margin slightly to well concave, longest ray 2.4 (2.4-3.2; mean 2.9) longer than last ray. Adipose fin above posterior 2/3 of anal, short-based, high and oblong in shape, its posterior margin convex. Caudal fin deeply forked, lobes broad, lower lobe subequal to upper one. Ventral fin oblong, usually reaching anal origin (males, juveniles) or to about 4th anal ray (females); sexually mature females with thick, cushy pad of tissue along upper aspect of sixth ray.

Lateral line elevated anteriorly and at tail base. Numerous branching, oblique venules emanate from line along its length, extending short distance over back and lower sides. Caudal peduncle long and compressed.

Colour when fresh: dark blue or olive above, white or cream below; bronze sheen over body; vertical series of pores from lateral line often highlighted golden. Dorsal, adipose and caudal fins brown or dark grey; other fins dusky, ventral, anal and caudal reddish brown when fish sexually mature. Maxillary barbels dark brown, other barbels paler.

Colour when preserved: very dark brown (adults), "smokey" brown or charcoal (juveniles) over upper 2/3 of body, cream or pinkish below. Maxillary barbel dark brown, other barbels cream or white. Dorsal, adipose and caudal fins mostly brown; anal and ventral brown; dorsal aspect of pectoral fins dark brown, underside of pectoral and ventral fins cream. Peritoneum pale pink or cream.

Distribution

North-central rivers of New Guinea: Mamberamo and Idenburg Rivers in the west to the Sepik River and lower Ramu River in the east.

Etymology

The specific name refers to its close morphological similarity to *Arius leptaspis* (Bleeker), a species only accurately recorded from areas south of the known range of the new species (southern New Guinea, northern Australia). "utara" means "north" in bahasa Indonesia.

Notes on biology and habitat

Arius utarus occurs in both brackish and fresh water. It eats a variety of food, including detritus, large crustaceans, insect larvae and nymphs, and fish scales.

Spawning takes place between the end of the dry season and the middle of the wet (monsoon) season. The maximum size (450mm SL) was recorded by D. Coates (pers. comm.) from sampling from 1981 to 1983.

Remarks

The characters which contributed most to an understanding of the variability between *A. leptaspis* and *A. utarus* sp. nov. are: distance between dorsal and adipose fins, pectoral ray count, type of palatal teeth, ratio of eye diameter into snout length, ratio of head height into head width, length of anal fin base as a percentage of SL, depth of caudal peduncle as a percentage of SL and length of dorsal spine as a percentage of SL. The resulting discriminant function [$Z_{A.\ leptaspis}$ = -771.916 + 0.585 (interdorsal space) + 72.168 (pectoral ray count) + -12.790 (type of palatal teeth) + 15.924 (eye diameter snout length) + 83.901 (head height head width) + 11.159 ([anal fin base SL] x 100) + 57.907 ([caudal peduncle depth SL] x 100) + -0.321 ([dorsal spine length SL] x 100); $Z_{A.\ utarus}$ sp. nov. = - 713.130 + -0.371 (interdorsal space) + 65.934 (pectoral ray count) + -5.704 (type of palatal teeth) + 40.704 (eye diameter snout length) + 72.295 (head height head width) + 13.053 ([anal fin base SL] x 100) + 45.837 ([caudal peduncle depth SL] x 100) + 1.453 ([dorsal spine length SL] x 100) - where the highest Z score determines membership] separates 100 per cent of the cases accurately in the robust jackknife classification matrix (BMDP, 7M; Dixon *et al.* 1985).

All literature references to *Arius leptaspis* (Bleeker) in northern New Guinea are based on misidentified specimens of *A. utarus*: Weber (1908) provided details of a 370mm specimen from the Moaif River, comparing it with *A. leptaspis* from southern rivers and with Bleeker's (1862) description; Weber & de Beaufort (1913) recorded the species (as *A. leptaspis*) from the Sepik and Moaif Rivers; Hase (1914) reported it from Reganbiwak (=Sepik River) and the Tami River; Hardenberg (1941) described one of two specimens from the Mamberamo River; Herre (1936) collected specimens from Ambot (on the Kerame River), Marienberg, Malu, Tsenap, Koragu and Kabero (all on the Sepik River); and Munro (1958) recorded it from Murui (Sepik River). Apparently Herre was uneasy about the determination of his material, as he wrote "co-type, *tsenapensis*" on cloth labels attached to two of his specimens (CAS(SU) 68882 from Ambot; CAS(SU) 68631 from Kanganaman). (His material from Tsenap must also have referred.) No formal description of a new species was ever published.

The 12 syntypes of *Hemipimelodus velutinus* from the Tami River mouth almost certainly represent *A. utarus*. Désoutter (1977) noted that five of the six in ZMA 112.655 have four tooth patches across the palate, as has a sixth (RMNH 8001), which I re-examined. Désoutter did not comment on the condition of the 293mm syntype in ZMA 112.655. Furthermore, there are no reliable records of *A. velutinus* from marine or brackish water, whilst the Tami River water (the source of Weber's series of included syntypes) is salty (*fide* Désoutter 1977).

The realisation that the northern populations of *"A. leptaspis"* are not conspecific with *A. leptaspis* Bleeker has effectively resolved the zoogeographic "problem" of *A. leptaspis* being the only New Guinea ariid occurring in both northern and southern rivers. This topic was discussed by Weber (1913), Munro (1964) and referred to by other authors (e.g. Herre 1936, Hardenberg 1941, Allen & Boeseman 1982).

Condition of the holotype is moderately good. The belly is slit longitudinally; the LHS mental and mandibulary barbels are damaged at the bases and the tips lost. The tips of all fin spines are missing. The membrane of both the pectoral fins are split from the spine. The dorsal membrane is split from part of the spine and between the 4th and 5th ray.

Additional non-type material examined.

WAM P.27847-009 (4), 48-51mm SL, Kwatit River at junction of Sepik River, October 1982; KFRS FO091, (2), 52 and 54.5mm SL, lower Ramu River, November 1960; KFRS FO090, (2), 49 and 59mm SL, same data; KFRS F.5470-01, (25), SL not noted, Ramu River at Bunapas Mission, October 1987.

Arius coatesi sp. nov.

(Figures 5, 6b; Tables 4, 5)

Hexanematichthys sp - Kailola, 1975:40
Hexanematichthys leptaspis - Kailola, 1975:42 (partim)

Holotype

AMS I.25405-001, 270mm SL, market at Angoram, Sepik River, New Guinea, August 1982, collected by D. Coates.

Paratypes

WAM P.28221-001, (4 specimens), 290-390mm SL, Angoram, July 1982, collected by D.C. Coates; QM 21673, (1), 375mm SL, same data as holotype; KFRS FO4108, (1), 242mm SL, Zirken village, lower Ramu River, 27 August 1972, collected by G. West; KFRS FO3995, (1), 237mm SL, Kambaramba, Sepik River, May 1972, collector unrecorded, C&S; AMS I.25405-002, (1), 450mm SL same data as holotype.

Diagnosis

A robust species of ariid with strong jaws and very rough head shield. Fine teeth in two isolated, oval patches arranged across palate; usually no rakers on posterior aspect of first two gill arches; 19-21 anal rays; 10-12 pectoral rays; 48-49 vertebral centra posterior to complex centrum, of which 13-14 are trunk centra; 13-17 rakers along first gill arch. Eye small, 8.4-11 (mean 9.5) per cent HL; mouth moderately broad, 39-46 (mean 43) per cent HL; maxillary barbels thin, 9-10 (mean 9.5) per cent SL; head height 16-21 (mean 17.4) per cent SL. Fresh colouration uniform dark blue-grey above, paler below.

A. coatesi sp. nov. is most similar to *A. augustus* Roberts, 1978 of southern rivers, with which it shares the characters of small eye, short barbels, strong

and robust head and jaws. Both species attain a large maximum size. However, *A. augustus* has an even broader mouth (50-56 per cent HL) and wider space between nostrils (40-44 per cent HL, cf 29-31 in *A. coatesi* sp. nov.), more rakers on the first gill arch (20-22), a truncate snout (tapered in *A. coatesi* sp. nov.), four patches of teeth on the palate and 51-52 free vertebral centra of which 12 are trunk centra. The short barbels and small eye distinguish *A. coatesi* sp. nov. from the other two moderately large ariids in fresh water of northern New Guinea, *A. velutinus* (Weber) and *A. utarus*.

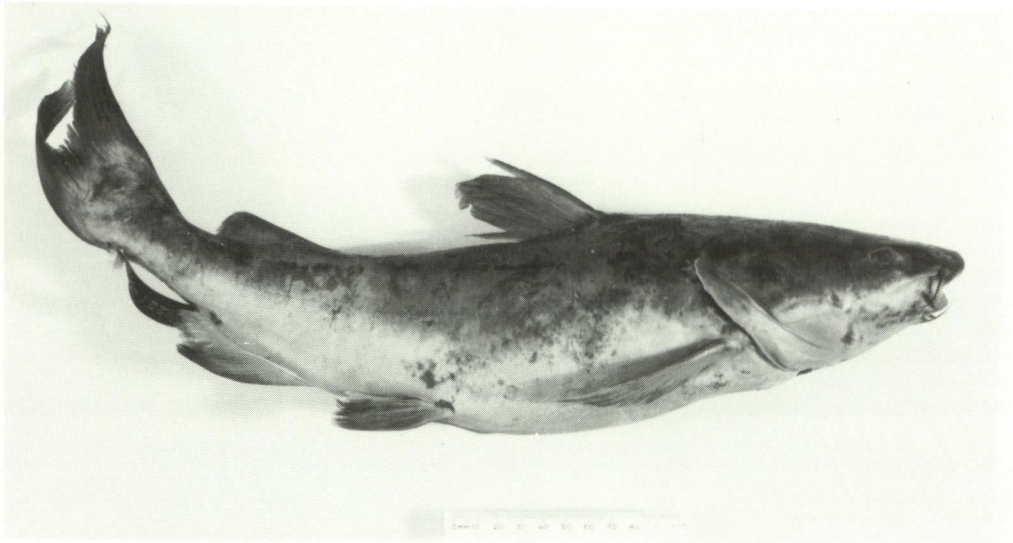

Figure 5. *Arius coatesi* paratype. WAM P.28221-001, 390mm SL. Lateral view.

Figure 6. Dental arrangement of: a) *A.utarus* (e.g. KFRS F.5517-01, 297mm SL); b) *A. coatesi* (e.g. WAM P.28221-001, 304mm SL). Drawings not to scale.

Description

The range, mean and standard deviation of meristics and selected body proportions are presented in Tables 4 and 5.

D I,7. A 20 (19-21). P I,12 (I,10-11). V 6. C i,6 + 7,i. GR (first arch) 14 (13-17), of which 6 (5-7) on upper limb. GR (last arch) 16 (15-17). Number of free vertebral centra posterior to complex vertebra - (48-49), total vertebrae 55-56: 13-14 trunk, 5 haemal, 30 caudal (2 specimens). Branchiostegals 6.

Table 4. Meristics and relative body proportions* of *Arius coatesi*. (*Ratios could not be computed if character is missing or damaged on a specimen) n=sample size; SD=standard deviation.

Character	Holotype	For all type specimens			
		n	range	mean	SD
SL (mm)	270	9	237-450	320.9	72.1
HL in SL	3.4	9	3.1-3.4	3.3	0.1
eye l. in HL	9.8	9	9.3-11.9	10.6	0.8
eye l. in snout l.	3.6	9	3.1-4.4	3.8	0.4
eye l. in bony interorbital w.	3.1	9	2.7-4.4	3.5	0.5
occipital process w. in process l.	1.3	9	1.3-2.8	2.1	0.4
D.spine l. in HL	1.8	8	1.6-2	1.8	0.1
P.spine l. in HL	1.7	6	1.5-1.7	1.6	0.1
adipose fin base l. in D.fin base l.	1.1	9	1.1-1.4	1.2	0.1
adipose fin base l. in interdorsal space	3.0	9	2.7-3.7	3.1	0.4
caudal peduncle depth in its l.	1.8	9	1.8-2.4	2.1	0.2
predorsal l. in SL	2.7	9	2.5-2.7	2.6	0.06
longest barbel in SL	10.2	9	9.8-11.4	10.5	0.5
head height in head width	1.3	9	1.2-1.3	1.2	0.05
l. premaxillary tooth band in its w.	6.8	9	4.6-7.2	6.0	0.8
count of A. fin rays	20	9	19-21	19.8	0.7
count of P. fin rays	12	8	10-12	10.8	0.7
total GR (first arch)	14	9	13-17	14.7	1.1
total GR (last arch)	16	8	15-17	15.5	0.8

Body sturdy, thickset anteriorly; head broad and slightly depressed. Predorsal profile almost straight; interorbital flat. Snout moderately broad and rounded, tapered when viewed from above. Mouth slightly curved, subterminal; jaws strong; outer 1/3-1/2 premaxillary tooth band exposed when mouth closed. Lips "rubbery", thicker at corners of mouth. Nostrils ovate, anterior nostril almost directly in front of posterior one; abbreviated flap on posterior nostril. Small eye ovate or rounded, situated dorsolaterally, mid-head length 1/2-1 1/2 eye diameter behind hind margin of eye. Orbit free from head skin; lateral ethmoid somewhat prominent before eye. Gill opening wide: membranes meeting at an obtuse angle and attached to isthmus and with free, broad margin.

Teeth in jaws very small and slender with sharp tips; teeth depressible and embedded in soft tissue. Jaw teeth in broad, crescentic band: premaxillary with 8-14 irregular series; mandibulary band with 6-8 irregular series, separated at symphysis by narrow diastema. Numerous conical, sharp or blunt teeth in two widely-spaced oval patches situated anteriorly on palate. Palate smooth or with scattered, slender papillae; broad velum between premaxillary and palatal teeth; two shallow, muscular ridges of tissue at rear of palate.

Head shield partly obscured by thick, venulose skin; shield smooth anteriorly, rugose posteriorly. Low granules form clusters along lateral margin of shield and striae around median head groove (larger fish), present around base and

Table 5. Percent of HL and SL for *Arius coatesi*.

Character	Holotype	For all type specimens			
Percent of HL		n	range	mean	SD
head height	56	9	53-65	57	3.4
head w.	71	9	65-77	70	3.5
eye l.	10	9	8-11	9	0.8
mouth gape	44	9	39-46	43	2.2
internostril w.	30.5	9	29-33	30	1.4
snout l.	26	9	34-37	36	1.3
longest barbel l.	33	9	28-34	31	2.0
bony interorbital w.	32	9	29-37	33	2.4
occipital process l.	33	9	21-38	31	5.0
occipital process w.	16	9	12-17	15	1.6
Percent of SL					
HL	29	9	29-32	30.5	0.9
head height	16	9	16-21	17	1.4
head width	21	9	19-25	21.5	1.5
eye l.	3	9	3-3	3	0.2
mouth gape	13	9	12-14	13	0.9
internostril w.	9	9	8-11	9	0.6
snout l.	11	9	10-12	11	0.6
longest barbel l.	10	9	9-10	9.5	0.5
bony interorbital w.	9	9	8.5-12	10	0.9
occipital process l.	6	9	6-11	9	1.6
predorsal l.	38	9	37-40	39	0.9
D.fin base l.	10	9	10-11	10	0.4
interdorsal w.	28	9	24-30	27	2.1
adipose fin base l.	16	9	14-17	15	0.9
A.fin base l.	16	9	14-17	15	0.9
caudal peduncle depth	7	9	7-8	7	0.3
caudal peduncle l.	12	9	12-16	15	1.2
P.spine l.	17	6	17-20	19	1.2
D.spine l.	17	8	16-19	17	0.9

over occipital process in all individuals. Dorsomedian head groove flat and lanceolate, deeper posteriorly, terminating anterior to occipital process base. Process long and slightly triangular, with straight sides and low, granular median keel; predorsal plate granular. Humeral process smooth, heavily ossified anteroventrally, its oblique, triangular shaft extending to 1/3 length of pectoral spine. Axillary pore tiny, rounded.

Barbels thin, rounded in cross-section, wisp-like distally. Maxillary barbel extending no further than 1/2-1 1/2 eye diameter distance behind eye; mandibulary barbel extending to below middle or hind margin of eye; mental barbel fails to reach level of front margin of eye.

Gill rakers rigid and strong, 1/2-2/3 as long as filaments. Usually no rakers along posterior aspect of first and second arches (one and two rakers on upper

limb of second arch in two paratypes), 16 (12-17; mean 14.8) well-developed rakers along posterior aspect of third arch. Low, thick pad of tissue developed posterodorsally only on second arch. First gill arch broadly attached anteriorly by membrane to roof of branchial chamber.

Fin spines moderately compressed, short filament present at tip (all stadia); fine longitudinal striae on sides becoming granular in larger fish. Anterior margin of spines with series of sharp, transverse ridges; posterior margin with 3-12 low serrae (dorsal) or 12-18 larger, retrorse serrae (pectoral). Dorsal spine slightly shorter than pectoral, subequal to postorbital head length. First dorsal ray 2.6 (2.6-3.3; mean 2.8) longer than last ray. Pectoral fin extending to below middle of or beyond, dorsal base. Anal fin margin slightly concave, longest ray 2.3 (2.5-2.8; mean 2.6) longer than last ray. Adipose fin begins opposite 5th-7th anal ray; fin oblong, posterior margin rounded. Caudal fin deeply forked, lobes broad and well-tapered, lower lobe subequal to upper lobe. Ventral fin base moderately broad (both sexes), fins rather oblong and usually reaching anal fin origin [no mature females among my material].

Lateral line elevated anteriorly and at caudal base. Up to 20 vertical series of pores and many shorter, oblique venules diverging from line along its length. Caudal peduncle moderately compressed.

Colour when fresh: Uniform blue-grey above, paler below. Fins dusky grey.

Colour when preserved: Brown or dark grey above, mottled brown over anterior part of head and caudal peduncle; lower 1/3 of head and body pinkish white, grey or fawn, clusters of dark spots or freckles along mandible and breast. Fins tan, dorsal, anal and caudal with dark brown margin; upper aspect of pectoral fin blackish brown. Barbels dark brown; peritoneum pale grey.

Distribution

Fresh water of the Sepik and Ramu river systems, northern New Guinea.

Etymology

Named for David C. Coates (formerly of Department of Fisheries & Marine Resources, Papua New Guinea) who collected most of the type series and provided information on biology.

Notes on biology and habitat

Adults of *Arius coatesi* are present in the channels of main rivers and tributaries. The preferred habitat of juveniles is unknown. The species is an opportunistic omnivore, with a preference for crustaceans (D. Coates, pers. comm.). Spawning of *A. coatesi* probably occurs in the early to mid wet (monsoon) season. The maximum size recorded by D. Coates is 660mm SL, making this the largest ariid in northern freshwaters.

Remarks

Observed dietary preferences supplement the phenotypic differences noted in the species diagnosis between *A. coatesi* and *A. augustus*. Whereas *A. augustus*

is piscivorous (Roberts, 1978; pers. obs.), *A. coatesi* eats few fish, stomachs of specimens examined containing a variety of food items, crustaceans significant among them (D. Coates, pers. comm.). Another contrast is provided by *A. velutinus*, which feeds mainly on detritus, plant material, insects and their larvae and nymphs.

It is possible that juveniles of *A. coatesi* in collections have been misidentified as *A. velutinus*.

The condition of the holotype is moderately good. It is straight, with all the fins intact and mouth slightly agape. The LHS pectoral spine is broken off near its base and the RHS pectoral spine broken through, the outer section remaining attached to the fin rays. The abdomen is cut through between the isthmus and anus and the specimen is partly eviscerated.

Arius velutinus (Weber, 1908): new combination

(Figure 7; Tables 6, 7)

Hemipimelodus velutinus Weber, 1908:225 (partim) (Lake Sentani; Tawarin River)
Hemipimelodus papillifer Herre, 1935:390 (Timbunke, Sepik River)
Hemipimelodus sp. - Kailola, 1975:40
Hemipimelodus crassilabris - Désoutter, 1977:18 (partim)
Arius "sp. D" - Allen & Boeseman, 1982:74,99
Hemipimelodus sp - Allen & Boeseman, 1982:75

Diagnosis

Palate usually naked, rarely with one or two oval patches of fine teeth; lips usually thick; posterior aspect of first two gill arches with up to 7 short rakers on upper limb, many broad papillae (rarely rakers) on lower limb. Anal rays 17-24; pectoral rays 10-12; rakers along first gill arch 13-18; vertebral centra posterior to complex vertebra 44-46, of which 11-12 are trunk centra. Eye moderate, 10-24 (mean 15.5) per cent HL; mouth gape moderately small, 8.4-12.7 (mean 10.5) per cent SL; maxillary barbel 16-32 (mean 24.8) per cent SL; adipose fin base moderate, 7-14.5 (mean 10.3) per cent SL; maxillary tooth patch short and broad, its length 3-8.2 (mean 4.6) in its width. Dorsal head shield smooth, becoming rugose in larger fish; vertical series of papillae along length of lateral line often conspicuous. Fresh colouration bluish to blue-grey, all fins with distinct, dark margins.

A. velutinus is very similar to *Hemipimelodus taylori* Roberts, 1978 and also to *H. macrorhynchus* Weber, 1913 and *Arius latirostris* Macleay, 1884. However, *Hemipimelodus taylori* lacks rakers and or papillae on the back of the first and second gill arches (rakers and or papillae always present on these arches in *A. velutinus*), has a slightly smaller eye (mean 13.2 per cent HL) and a more rounded head shape in cross section, when compared to the moderately broad, blunt head of *A. velutinus*.

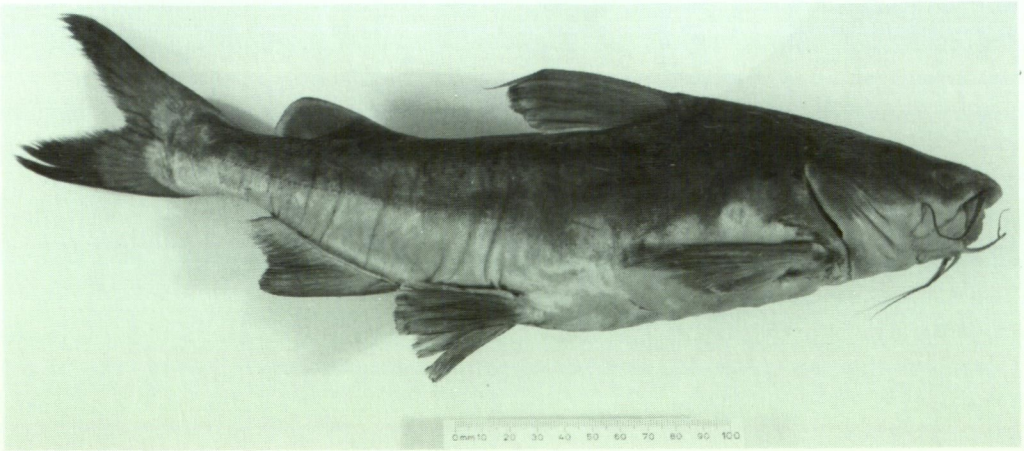

Figure 7. *Arius velutinus.* NTM S.11911-001, 303mm SL. Lateral view.

H. macrorhynchus is distinguished from *A. velutinus* by having, among other differences, minimal lip development and narrow premaxillary tooth band (width 5.6-11.5 in its length, cf 3.1-8.2 in *A. velutinus*), a pointed snout indented near nostrils, longer barbels (2.3-3 in SL, cf 3.1-6.3 in *A. velutinus*), and different body colouration. *Arius latirostris* is distinguished from *A. velutinus* by its larger eye (1.2-3.5 [mean 1.9] in snout length, cf 1.6-4.3 [mean 2.6] for *A. velutinus*), mouth gape (36-52 per cent [mean 45) HL, cf 31-44 [mean 37] in *A. velutinus*), wider space between anterior nostrils (30-38 per cent HL, cf 21-31 in *A. velutinus*), different body colouration and head shape, and no papillae or rakers on the lower posterior limb of the first two gill arches.

My study of the type species of *Arius* Valenciennes and *Hemipimelodus* Bleeker, 1858 (type, *H. borneensis* Bleeker) has shown that *velutinus* Weber properly belongs in *Arius. Hemipimelodus taylori* Roberts and *H. macrorhynchus* Weber are likewise transferred to *Arius.* However, *A. taylori* is preoccupied in *Arius* by *A. taylori* Hildebrand, 1926 from El Salvador, central America (with which it is not conspecific) and so becomes a primary homonym. In accordance with the provisions of the International Code of Zoological Nomenclature, the New Guinea species requires a replacement name. I therefore propose *Arius robertsi* for *Hemipimlodus taylori* Roberts.

Distribution

Known from the Mamberamo, Idenburg, Ramu and Sepik Rivers and associated lesser fresh waters in north-central New Guinea.

Remarks

The statistical analyses failed to show significant differences between individuals originally determined as *Hemipimelodus papillifer* Herre and *A. velutinus* (Weber).

Table 6. Meristics and relative body proportions* of *Arius velutinus, A. (B.) nox* and *A. (B.) solidus* (*ratios could not be computed if character is damaged or missing on a specimen). n = sample size; SD = standard deviation.

Character	For all specimens											
	velutinus Weber				*nox* Herre				*solidus* Herre			
	n	range	mean	SD	n	range	mean	SD	n	range	mean	SD
SL (mm)	40	73-380	191.5	90.6	18	100-282	192	51.3	49	74-270	147.3	10.7
HL in SL	40	3.2-3.9	3.6	0.2	18	2.9-3.7	3.2	0.2	49	2.9-3.6	3.3	0.04
eye l. in HL	40	4.2-9.7	6.8	1.5	18	4.4-7.7	6.2	0.8	49	3.9-7.6	5.5	0.2
eye l. in snout l.	40	1.6-4.3	2.6	0.6	18	1.3-2.6	1.9	0.3	49	1.2-2.7	1.9	0.06
eye l. in bony interorb width	40	1.2-3.1	2.2	0.6	18	1.3-2.6	2.0	0.3	49	1.3-2.5	1.8	0.15
occip. proc. width in proc. l.	39	1.5-2.4	1.9	0.2	18	1.5-4.8	2.0	0.8	47	1.2-2.6	1.8	0.05
D. spine l. in HL	38	1.2-1.9	1.6	0.2	18	1.5-2.0	1.7	0.1	44	1.3-2.0	1.5	0.05
P. spine l. in HL	38	1.2-1.9	1.6	0.2	18	1.6-2.0	1.7	0.1	40	1.2-1.8	1.6	0.09
adipose fin base l. in D. fin base l.	40	0.8-1.6	1.2	0.2	18	1.4-2.3	1.8	0.3	48	1.1-2.9	1.6	0.15
adipose fin base l. in interdorsal space	40	1.6-4.6	2.8	0.7	18	4.3-7.5	5.6	0.9	49	3.4-6.6	4.3	0.4
caudal peduncle depth in its l.	39	1.7-2.4	2.1	0.2	18	2.1-3.2	2.6	0.3	49	0.8-3.9	2.3	0.08
predorsal l. in SL	40	2.4-2.9	2.6	0.1	18	2.5-3.0	2.7	0.1	49	2.4-2.8	2.6	0.08
longest barbel in SL	40	3.1-6.3	4.2	0.8	13	3.4-4.5	3.8	0.3	48	2.8-4.4	3.3	0.3
head height in head width	40	0.8-1.4	1.2	0.1	18	1.1-1.4	1.3	0.1	49	1.0-1.8	1.3	0.01
l. premax. tooth band in its width	37	3.1-8.2	4.6	1.0	18	5.7-10.2	8.2	1.4	48	5.2-10.9	7.7	0.3
count of A. fin rays	40	17-24	20.9	2.0	18	18-21	19.6	0.9	49	17-23	19.2	0.2
count of P. fin rays	40	10-12	10.6	0.6	18	8-9	8.8	0.4	49	8-10	9.7	0.4
total GR (first arch)	39	13-18	16.1	1.3	18	56-67	60.6	3.3	48	19-30	23.0	1.5
total GR (last arch)	38	15-19	17.3	1.1	13	48-57	51.9	2.9	48	19-30	22.3	3.8

Table 7. Percent of HL and SL for *A. velutinus, A. (B.) nox* and *A. (B.) solidus.*

Character	For all specimens											
	velutinus Weber				*nox* Herre				*solidus* Herre			
Percent of HL	n	range	mean	SD	n	range	mean	SD	n	range	mean	SD
head height	40	46-72	60	5.2	18	42-52	46	3.1	49	33-65	51	2.8
head w.	40	58-81	70	5.4	18	55-63	59	2.1	49	52-78	66	2.8
eye l.	40	10-24	15.5	3.6	18	13-23	16	2.4	49	13-26	18	0.4
mouth gape	38	31-44	37	3.0	18	33-43	37	3.0	45	31-64	42	5.0
internostr. distance	39	21-31	26	2.1	18	21-30	27	2.2	47	25-50	30	5.1
snout l.	40	33-44	38	2.3	18	27-33	31	1.8	49	31-37	34	0.1
longest barbel l.	40	54-114	88.5	15.6	13	67-103	84	8.8	48	66-120	101	8.1
bony interorb. w.	40	27.5-36	32	2.3	18	29-34	31	1.2	49	27-37	32	1.8
occipital process l.	39	28-41	34	3.4	18	23-60	28	8.2	47	23-36	30	1.2
occipital process w.	39	13-21	18	1.7	18	11-18	14	1.8	47	12-21	16	0.02
Percent of SL												
HL	40	26-32	28	1.6	18	27-34	31	1.7	49	28-34	30	0.4
head height	40	14-20	17	1.2	18	13-16	14.5	0.9	49	10-19	15.5	0.6
head width	40	16-23	20	1.7	18	16-20	18	1.0	49	17-23	20	0.6
eye l.	40	3-6	4	0.9	18	4-6	5	0.5	49	4-7	5.5	0.2
mouth gape	38	8-13	10.5	1.0	18	9-14	11	1.2	45	10-19	13	1.3
internostr. distance	39	6-9	7	0.8	18	6-10	9	1.0	47	7-15	9	1.4
snout l.	40	9-14	11	1.0	18	8-11	10	0.9	49	9-12	10	0.1
longest barbel l.	40	16-32	25	4.0	13	22-30	27	1.9	48	23-36	31	2.9
bony interorb w.	40	7-11	9	0.9	18	8-11	10	0.7	49	8-12	10	0.4
occipital process l.	39	8-11	9	0.8	18	7-18	9	2.3	47	8-11	9	0.5
predorsal l.	40	35-41	38	1.5	18	34-40	37.5	1.5	49	36-42	39	1.3
D. fin base l.	40	10-19	12	1.3	18	9-11	10	0.4	48	9-17	11	0.2
interdorsal l	40	20-33	28	2.7	18	29-33	31	1.2	49	26-35	30	0.2
adipose fin base l.	40	7-15	10	1.8	18	4-7	6	0.9	49	4-9	7	0.5
anal fin base l.	40	15-22	18	1.7	18	15-18	16	1.0	49	7-19	17	1.7
caudal peduncle depth	39	7-9	8	0.5	18	6-8	7	0.5	49	7-9	8	0.2
caudal peduncle l.	39	13-18	16	1.2	18	17-22	18	1.2	49	7-31	17	0.3
pectoral spine l.	38	15-21	18	1.8	18	15-20	18	1.2	40	17-24	19	0.7
dorsal spine l.	38	15-23	18	1.9	18	15-19	18	1.1	44	17-22	20	0.9

A robertsi is known from only three types and one other specimen (QM I.25053), all larger than 280mm SL and all collected in upper reaches of the Fly and Purari Rivers. When compared with *A. velutinus,* any consistent interspecific differences of body proportions and meristics which may exist are not readily apparent. However, although the characteristics noted (see *A. velutinus* diagnosis) presently support the retention of *A. robertsi* as a separate taxon, more material over a wider size range is needed to resolve its true status.

It can be seen from the species' description that Weber either did not base it on all of the syntypes or, that he did not examine them carefully:

a) only one count for the anal (15) and pectoral (10) fins is given, and frequently, only one ratio of body proportions. None of the 65 specimens I examined have less than 17 (mean 20.9) anal rays; and Désoutter (1977) found 17-22 (mean 19) anal rays in many of the syntypes. The pectoral count ranges from 10-12 (mean 10.6) in my material (which includes syntypes).
b) some individuals of *A. velutinus* develop one or two patches of teeth on the palate. Roberts (1978) located a patch of teeth on the palate of the 276mm SL syntype ZMA 112.654, and five specimens I examined (156-380mm SL) have palatal teeth. Désoutter observed ". . . certains spécimens, possédant des plaques de dents sur le palais . . ." (1977:12) and implied that there were more than the five examples of ZMA 112.655 and RMNH 8001 that she particularly noted as having such teeth (those specimens are all referable to *A. utarus; q.v.).* Yet *A. velutinus* was diagnosed by Weber as lacking palatal dentition.
c) Weber supposed that *A. velutinus* lacks an axillary pore. For example, in 1913 he noted its absence when discussing the relationships of another new species *Hemipimelodus macrorhynchus* Weber. Although Weber was followed by Weber & de Beaufort (1913) and Munro (1967), Smith (1945:417) recounted that, upon re-examining some typical specimens of *A. velutinus* for him, de Beaufort found that they all possess a "small slit-like pore".

Similarly, Herre (1935, 1936) overlooked the axillary pore in his descriptions of *H. papillifer;* as did Whitley (1956) when describing a 380mm SL specimen from the Jimmi River. Every individual examined by Désoutter, and I, possesses an axillary pore. (An axillary pore is also present in *A. macrorhynchus* - pers. obs.).

Portrayals of *A. velutinus* by Weber (1913:26), Herre (1936:44) and Désoutter (177:12) all accurately represent the species.

Those syntypes now recognised as belonging to *A. utarus* were all collected in brackish water of the Tami River: the remaining syntypes all came from fresh water (and see comments for *A. utarus*). Clearly, Weber confused the two species. *A. utarus* inhabits both fresh and brackish water, *A. velutinus* only fresh (e.g. D. Coates and colleagues have never collected it from brackish water [pers. comm.]).

Although it is clear that more than one species is present in the type series, I defer designating a lectotype from one of the syntypes I have examined pending an opportunity to determine whether any other syntypes agree closely with Weber's description and figure. The whereabouts of 26 of the *Hemipimelodus velutinus* type specimens is known, distributed between the ZMA, RMNH, ZSI, NMW and AMNH. Ten of them actually belong to *A. utarus*.

Roberts (1978) remarked that *A. velutinus* differs from its congeners in having well-developed gill rakers on the lower limb of the posterior face of the second gill arch. His conclusion is based on two syntypes in ZMA 112.654 (specimens I have not seen) which, he stated, have 14 rakers on this limb. However, gill rakers in this position were present in only five specimens I examined, and then only through a range of one to seven. Many specimens I examined have well-developed papillae on the posterior face of the anterior gill arches instead. It is possible that raker and papillae development on the second gill arch may have labile expression in this species.

Herre (1935:390) named his species in reference to the "conspicuous transverse rows of papillae from the dorsal origin to the caudal peduncle, extending downward one-half or three-fourths of the distance to the ventral surface." These papillae are apparent to a greater or lesser degree in preserved material, but are inconspicuous in fresh (large) material (D. Coates, pers. comm.).

Whitley (1956) was the first to recognise that *H. papillifer* Herre (and he supposed *H. bernhardi* Nichols) is a synonym of *A. velutinus*. Munro did not recognise it until 1967, even then referring to the taxon as *"papillifer"* instead of by the older name of *velutinus* Weber.

Désoutter (1977) misidentified Whitley's specimen of *A. velutinus* from the Jimmi River (AMS IB.3354) as *H. crassilabris* Ramsay & Ogilby.

Smith (1945) tentatively and erroneously included Fowler's (1935) *Hemipimelodus bicolor* from Bangkok in the synonymy of *A. velutinus*. I have examined the type of *H. bicolor* Fowler (ANSP 60777): it has two patches of granular teeth posteriorly on the palate and may be referable to *A. maculatus* Thunberg.

Material examined

ZMA 112.656 (in part), (2 specimens), 133 and 147.5mm SL, Tawarin River, 20 June 1903, Nieuw Guinea Expedition of 1903, collected by L.F. de Beaufort and H.A. Lorentz (=SYNTYPES of *H. velutinus*); FMNH 17212, (1), 224mm SL, Marienberg, Sepik River, 14 May 1929, collected by A.W. Herre (=PARATYPE of *H. papillifer*); WAM P.27870-003, (1), 260mm SL, Danau Biru (=Lake Holmes), lower Mamberamo River, 22 November 1982, collected by G.R. Allen; RMNH 28815, (6), 215, 230, 248, 252, 268 and 290mm SL, Southeast part of Lake Sentani near Poee, 13 November 1954, collected by M. Boeseman (215mm specimen C&S); KFRS FO2813, (1), 180mm SL, Aiome, Ramu River, 19 December 1970, collected by G. West; KFRS F0086, (1), 155mm SL, Angoram, Sepik River, September 1960, collected by S. Bucknall; RMNH 28819, (3), 232, 244 and 310mm SL, 11km from Holtekang, Tami River, 18-21 November 1954, collected by M. Boeseman, AMS IB.3354, (1), 380mm SL, Jimmi River, 20-27 July 1954, collected by E.L.G. Troughton and N. Camps; WAM P.27847-009, (9), 14-98mm SL, Kwatit River at junction with Sepik River, 28 October 1982, collected by G.R. Allen and D. Coates; WAM. P.27856-002, (5) 149, 152, 152, 156 and 158mm SL, fish market at Lake Sentani, 10 November 1982, collected by G.R. Allen (2 specimens C&S);

KFRS F.5517-02, (1), 235mm SL, Keram River, 17 April 1980, collected by A. Richards, C. Brooks and K. Makeu; AMS I.27410-001, (1), 270mm SL, fish market at Angoram, Sepik River, 1981, collected by D. Coates (C&S); NTM S.11911-001, (2), 303 and 375mm SL, same data; SMF 22005, (1), 268mm SL, Angoram, Sepik River, 1981, collected by D. Coates, SAMA F.6340, (1), 181mm SL, same data; QM I.25054, (1), 375mm SL, Sepik River, no other data; USNM 217321, (23), 47-189mm SL, Ramu River near Mt Otto, 11 February 1976, collected by T.R. Roberts; WAM P.28216-001, (5), 182-415mm SL, Sepik River, no date, collected by D. Coates.

Acknowledgements

I am indebted to Gerald R. Allen (WAM) and David C. Coates (formerly KFRS) for loan of specimens, photographs and information on fresh material. Their patience in awaiting publication of my study is much appreciated. The following persons kindly provided additional loan material and information: H. Nijssen (ZMA), R.K. Johnson and D.J. Stewart (formerly FMNH), W.N. Eschmeyer (CAS), M.N. Feinberg (AMNH), A. Richards and staff (KFRS) and M. Boeseman (RMNH). W.N. Eschmeyer also aided the presentation of a synonymy for *Arius* Valenciennes. I am indebted to staff at the Adelaide Dental School for radiography and to B.E. Pierce (statistical assistance), P. Kempster (photography) and M.J. Tyler (supervision, critical review of the manuscript) all of the Zoology Department, University of Adelaide.

References

Allen, G.R. and Boeseman, M. (1982). A collection of fishes from western New Guinea with descriptions of two new species (Gobiidae and Eleotridae). *Rec. West Aust. Mus.* 10(2):67-103.

Bleeker, P. (1858). De visschen van den Indischen Archipel beschreven en toegelicht. I. Siluri. *Act. Soc. Sc. Indo-Neerl.* 4:pp.370.

Bleeker, P. (1862). Description de trois espéces nouvelles de Siluroides de l'Inde Archipelagique. *Versl. Akad. Amsterdam.* 15:70-76.

Bleeker, P. (1862). *Atlas ichthyologique des Indes Orientales Neerlandaises, publie sous les auspices du Gouvernement colonial neerlandais.* II. Fred. Müller, Amsterdam, pp.112, pl.49-101.

Castelnau, F. de (1855). *Expedition dans les parties centrales de l'Amerique du Sud, de Rio de Janeiro à Lima, et de Lima au Para. - Zoologie. Poissons.* P. Bertrand, Paris, pp.112.

Castelnau, F. de (1878). Australian fishes. New or little known species. *Proc. Linn. Soc. N.S.W.* 2(3):225-248.

Chevey, P. (1932). Poissons des campaignes du "de Lanessan" (1925-1929). *4e Mémoire Inst. océan. Indochine:* pp.155, 50pl.

Désoutter, M. (1977). Révision du genre *Hemipimelodus* Bleeker, 1858 (Tachysuridae, Siluriformes, Pisces). *Cybium 3e Série,* 1977, 1:9-36.

Dixon, W.J. *et al* (1985). *BMDP statistical software.* W.J. Dixon *et al* (eds). University of California Press, Berkeley, California. pp.733.

Dingerkus, G. and Uhler, L.D. (1977). Enzyme clearing of alcian blue stained whole small vertebrates for demonstration of cartilage. *Stain Technol.* 52(4):229-232.

Fink, S.V. and Fink, W.L. (1981). Interrelationships of the ostariophysan fishes (Teleostei). *Zool. J. Linn. Soc.* (1981), 72:297-353.

Fowler, H.W. (1928). The fishes of Oceania. *Mem. Bernice P. Bishop Mus.* 10:pp.540.

Fowler, H.W. (1935). Zoological results of the third de Schauensee Siamese Expedition, part 1 - Fishes. *Proc. Acad. nat. Sci., Philad.* 87:67-169.

Fowler, H.W. (1949). The fishes of Oceania. Supplement 3. *Mem. Bernice P. Bishop Mus.* 12(2):37-186.

Gill, T. (1862). Catalogue of the fishes of the eastern coast of North America, from Greenland to Georgia. *Proc. Acad. nat. Sci. Philad.* 13 (1861):pp.63.

Grande, L. (1987). Redescription of †*Hypsidoris farsonensis* (Teleostei:Siluriformes), with a reassessment of its phylogenetic relationships. *J. Vertebr. Palaeont.* 7(1):24-54.

Hardenberg, J.D.F. (1941). Fishes of New Guinea. *Treubia* 18(2):217-231.

Hase, A. (1914). Die fische der Deutschen Grenzexpedition 1910 in das Kaiser-Wilhelms-Land, Neu Guinea. *Jenaische Zetschr. für Naturwiss. Jena* 51:525-548.

Herre, A.W.C.T. (1935). New fishes obtained by the Crane Pacific Expedition. *Field Mus. nat. Hist., Zool. ser.* 18(12):383-438.

Herre, A.W.C.T. (1936). Fishes of the Crane Pacific Expedition. *Publ. Field Mus. nat. Hist.* 353, *Zool. Ser.* 21:1-472.

Hubbs, C.L. and Lagler, K.R. (1958). Fishes of the Great Lakes Region. *Bull. Cranbrook Inst. Sci.* 26:pp.213.

Kailola, P.J. (1975). A catalogue of the fish reference collection at the Kanudi Fisheries Research Laboratory, Port Moresby. *Res. Bull. Dept. Ag., Stock, Fish. Port Moresby,* 16:pp.277.

Kailola, P.J. (1983). *Arius graeffei* and *Arius armiger:* valid names for two common species of Australo-Papuan fork-tailed catfishes (Pisces, Ariidae). *Trans. R. Soc. S. Aust.* 107(3/4):187-196.

Müller, J. and Troschel, F.H. (1849). *Horae ichthyologiae. Beschreibung und Abbildung neuer Fische.* Verlag von Veit & Comp., Berlin, pp.28.

Munro, I.S.R. (1958). The fishes of the New Guinea region. A check-list of the fishes of New Guinea incorporating new records of species collected by the Fisheries Survey Vessel *Fairwind* during the years 1948 to 1950. *Papua New Guin. agric. J.* 10(4):97-369.

Munro, I.S.R. (1964). Additions to the fish fauna of New Guinea. *Papua New Guin. agric. J.* 16(4):141-186.

Munro, I.S.R. (1967). *The Fishes of New Guinea.* Dept. Ag., Stock and Fish., Port Moresby, pp.650, 84pl.

Nichols, J.D.F. (1940). Results of the Archbold Expedition, no. 30. New catfishes from northern New Guinea. *Amer. Mus. Novit.* 1093:1-3.

Roberts, T.R. (1978). An ichthyological survey of the Fly River in Papua New Guinea with descriptions of new species. *Smithson. Contrib. Zool.* 281:pp.72.

Smith, H.M. (1945). The fresh water fishes of Siam or Thailand. *Bull. U.S. natn. Mus.* 188:pp.622.

Taylor, W.R. (1967). An enzyme method of clearing and staining small vertebrates. *Proc. U.S. natn. Mus.* 122 ((2596):1-17.

Valenciennes, A. (1840). *Histoire Naturelle des Poissons.* 15. by G. Cuvier and A. Valenciennes. Levrault, Paris, pp.397.

Weber, M. (1908). Süsswasserfische von New-Guinea. *Nova Guin.* 5(2):201-267.

Weber, M. (1913). Süsswasserfische aus Niederlandisch Sud-und Nord-New-Guinea. *Nova Guin.* 9(4):513-613.

Weber, M. and de Beaufort, L.F. (1913). *The fishes of the Indo-Australian Archipelago, 2.* E.J. Brill, Leiden, pp.404.

Whitley, G.P. (1940). Illustrations of some Australian fishes. *Aust. Zool.* 9(4):397-428.

Whitley, G.P. (1956). Fishes from inland New Guinea. *Rec. Aust. Mus.* 24(3):23-30.

Received 12 May 1988 Accepted 14 November 1988 Published 29 June 1990