qQ
11
C17X
NH
v.14

The Freshwater Fishes of Western Borneo (Kalimantan Barat, Indonesia)

QL671.5
C2C23
v.14
1989
NH

The Freshwater Fishes of Western Borneo (Kalimantan Barat, Indonesia)

By

Tyson R. Roberts

Published by
California Academy of Sciences

Natural History
Museum
& Aquarium

San Francisco
1989

SMITHSONIAN
OCT 26 1989
LIBRARIES

Memoirs of the California Academy of Sciences Number 14

SCIENTIFIC PUBLICATIONS COMMITTEE:

Daphne Fautin, *Scientific Editor*
Frank Almeda
Luis Baptista
Wojciech Pulawski
Frank Talbot
Sheridan Warrick

Date submitted for publication: November 29, 1984
Date accepted for publication: July 23, 1985

Published by the California Academy of Sciences.

Copyright © 1989 by California Academy of Sciences. All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, included photocopying, recording, or any information storage or retrieval system, without permission in writing from the publisher.

Library of Congress Catalog Card Number 88-70981
ISBN 0-940228-21-1

Cover Illustration: *Acantophthalmus superbus*

The Freshwater Fishes of Western Borneo (Kalimantan Barat, Indonesia)

By

Tyson R. Roberts

Department of Ichthyology, California Academy of Sciences, San Francisco, California 94118

Table of Contents

Abstract: This monograph on the freshwater fishes of western Borneo or Kalimantan Barat, Indonesia, is based on the extensive collections made during the author's ichthyological survey of the Kapuas River basin in 1976, as well as on material from earlier collections deposited in European museums. The ichthyofauna includes about 290 species belonging to 120 genera and 40 families. One new family of catfishes (Parakysidae), three new genera (*Hypergastromyzon* in Homalopteridae, *Barbucca* in Cobitidae, and *Paradoxodacna* in Chandidae), and 25 new species (belonging in the families Cyprinidae, Homalopteridae, Cobitidae, Belontiidae, and Mastacembelidae) are described. Among the new taxa are *Pectenocypris balaena*, a small *Rasbora*-like cyprinid with over 200 gill rakers on the first gill arch, which feeds on unicellular phytoplankton; *Lepidocephalus spectrum*, the first blind cobitid from a nonsubterranean habitat; *Hypergastromyzon humilis*, a highly specialized gastromyzontin homalopterid; and *Paradoxodacna piratica*, a scale-eating chandid with remarkable dentition. Original observations on feeding habits and reproduction are reported for various species. Scanning electron micrographs reveal the unciliferous quality of the lips of 7 of the 13 species of the herbivorous cyprinid genus *Osteochilus* known from western Borneo. The ant-eating habits of the endemic freshwater halfbeak genus *Hemirhamphodon* are reported for the first time, together with observations on its poorly known internal fertilization and viviparity. Oral-brooding is reported in *Parambassis apogonoides*, the first member of the percoid family Chandidae in which such parental care has been observed.

The introduction includes general remarks on the freshwater ichthyofauna of western Borneo and its geographical distribution; a brief historical sketch of East Indian ichthyology, with particular reference to freshwater fishes of western Borneo; an essay on reproductive biology of freshwater fishes in western Borneo; and a detailed description of collecting localities of the 1976 Kapuas survey. The systematic account includes a brief introductory statement for each family, formal synonymies for almost all included genera and species, identification keys for some groups, comparative morphological and meristic data for many groups, detailed information on food habits and reproductive biology for some species, and geographical distribution for all species for which reliable information is available. The monograph is extensively illustrated with black-and-white photographs and line drawings. The literature cited provides a nearly complete bibliography for systematic study of Bornean freshwater fishes to the end of 1984.

Introduction

The ichthyological significance of western Borneo or Kalimantan Barat and its largest river, the Kapuas, lies in the geographical and hydrographic history of Sundaland and the drainage basin of the ancient Central or North Sunda River (hereafter referred to simply as the Sunda River). Today, with ocean levels only 8 m below the highest ever reached, Sundaland is sundered by the shallow South China Sea into the separate lands of the Malay Peninsula, Sumatra, Borneo, and Java. The freshwater hydrographic systems of these lands are now entirely separate. During much of the Cenozoic and the Pleistocene Ice Age Maxima, however, the oceans were 60–80 m lower than they are today. Under such conditions the continental land of the Malay Peninsula, Sumatra, Borneo, and Java was connected. During Pleistocene times its extensive lowlands presumably were entirely covered with tropical evergreen rain forest similar to that now found in much of the area. Low-lying but nearly continuous mountain ranges near the peripheral and southerly limits of Sundaland provided the watershed for the vast Sunda River. The Sunda River incorporated all or nearly all of the drainage area of eastern and southwestern Malay Peninsula, northern Sumatra, western and southwestern Borneo, and northwestern Java. It represents the only great equatorial river system of the Asian continent, somewhat smaller than, but otherwise comparable to, the Amazon and Congo basins. Like the equatorial river systems of South America and Africa, the Sunda River basin became populated by an extremely rich and largely endemic ichthyofauna. The Sunda drainage appears to have been an important evolutionary center for many fish groups, most notably the ostariophysan families Cyprinidae, Gyrinocheilidae, Homalopteridae, Cobitidae, Bagridae, Pangasiidae, and Siluridae, and the non-ostariophysan suborder Anabantoidea. All of these groups have endemic genera and more or less numerous endemic species in Sundaland, and the distribution of a large proportion of them is today restricted to rivers that formerly were part of the unified Sunda drainage. The significance of western Borneo's Kapuas river is that it is the largest and probably has the richest ichthyofauna of any of the modern rivers derived from the Sunda drainage. The Sunda drainage was last unified during the period 26,000 to 6,000 ybp. During this period a preponderance of the Sunda drainage fishes probably were widely or generally distributed in what is now the Malay Peninsula, Sumatra, western Borneo, Java, and the shallow floor of the intervening South China Sea. The present high levels of identical freshwater fish species now inhabiting these lands presumably is primarily due to dispersal events initiated 26,000 ybp and interrupted 6,000 ybp.

The richness of the Kapuas ichthyofauna was not fully appreciated until recently and even now many species probably remain to be discovered. Prior to 1976 there had been only four major ichthyological surveys of the Kapuas, these and other efforts resulting in a known freshwater ichthyofauna of approximately 150 species (many incorrectly identified). In 1976, sponsored by the Smithsonian Tropical Research Institute, Indonesian National Research Council, and Museum Zoologicum Bogorense, I undertook a comprehensive ichthyological survey of the Kapuas resulting in collection of some 260 freshwater fish species.

Subsequently I visited museums in Europe, examining and reidentifying significant portions of all but one of the important Kapuas collections previously made. These studies, reported herein, have resulted in a presently known freshwater ichthyofauna of western Borneo of about 290 species, a large proportion known only from within the hydrographic limits of the Sunda River drainage.

Excluded from the present account are exotic fish species introduced into western Borneo for aquaculture or other reasons. In Kalimantan Barat, in 1976, I heard that a number of exotic species had been introduced as pondfish, but have no documentation of this. Iwamatsu et al. (1982) reported the ricefish *Oryzias javanicus* (Bleeker, 1854) from Pontianak. The habitat is described simply as a "stream," width 1 m, depth 20–30 cm at Pontianak, and the specimens were collected in 1978. *Oryzias* has not been reported previously from the Kapuas or anywhere else in Borneo. Its occurrence in Pontianak presumably is due to introduction for mosquito control.

Some species found in western Borneo do extend into adjacent areas, especially southern and eastern Borneo and Thailand, but the Chao Phrya and Mekong ichthyofaunas are largely distinct from the Sunda ichthyofauna. Very few of the Sunda species occur in India, almost none in China. Of the approximately 40 or so species reportedly shared by Borneo and India (see Jayaram 1982), only about five or six appear to be correctly identified. It is doubtful that more than one or two species are shared

by Borneo and China. At taxonomic levels above the species level, however, biogeographic relationships are much more complex; the fishes of Borneo show numerous phylogenetic relationships with those of the Mekong and India, and some with those of China.

Kapuas fishes exhibit many of the kinds of adaptations associated with the richest tropical freshwater ichthyofaunas. There are numerous small or minute species, including the tiny salmoniform *Sundasalanx minor* and sexually dimorphic *Rasbora axelrodi*, males of which rival the Amazonian neon tetras in their striking red and blue coloration. Many species are secretive and apparently rare, especially among the catfishes, some of which are camouflaged like dead leaves. Some have highly specialized feeding habits, including ant-eating halfbeaks, and a scale-eating chandid, and, perhaps most unexpectedly, a small *Rasbora*-like phytoplanktonophagous cyprinid with over 200 elongate gill rakers on the first gill arch (*Pectenocypris balaena*). There are also two large midwater piscivores highly specialized for lunging upwards at prey, the cyprinid *Macrochirichthys* and silurid *Belodontichthys*. Reproductive behavior of Kapuas fishes, although many have not been studied in this respect, is extraordinarily diverse. At least 10 species in six families are oral-brooders, and many others have specialized modes of reproduction. The large lowland rivers, such as the mainstream of the Kapuas and its major tributaries, are inhabited by more than 100 fish species; small to moderately large lowland forest tributaries have up to 40 species, and highland streams of comparable size probably somewhat fewer species. As in the richest freshwater ichthyofaunas in other areas, there is little overlap in the kinds of fish species inhabiting the large lowland riverine habitats, smaller lowland tributaries, and montane tributaries. An idea of species composition of fish communities in these habitats can be gained by consulting the species lists accompanying collecting localities of the 1976 Kapuas ichthyological survey (pp. 13–20).

Some of the fishes discovered in 1976 have already been reported upon. Thus, Leonard J. V. Compagno kindly joined me in revising the very poorly known freshwater stingrays or Dasyatidae of southeast Asia and in describing *Himantura signifer*, the first freshwater species of stingray known from Borneo (Compagno and Roberts 1982). Another 1976 Kapuas discovery is *Sundasalanx minor*, representing a new family as well as a new genus and species (Roberts 1981). *Sundasalanx* are the tiniest and most tropical members of that large order of lower teleosts the Salmoniformes, which includes our northern salmon and trout. The existence of a salmoniform fish in Borneo was totally unexpected. The skeleton of *Sundasalanx* is largely cartilaginous and such bones as are present do not stain well or at all with alizarin. In order to study its osteology, specimens were prepared using the new alcian–alizarin technique for counterstaining bone and cartilage. In reality, alcian stains some kinds of bone that do not stain with alizarin, as well as cartilage. These osteological studies confirmed the suspected relationship of *Sundasalanx* to their nearest relatives, the Salangidae of Korea, Japan, and China, and also revealed unique characteristics justifying their recognition as a distinct family, Sundasalangidae. A monograph describing and comparing the skeletal anatomy of all of the salangoid fishes and revising their classification has been published (Roberts 1984).

Other papers published in preparation for the present monograph include the description of *Thryssocypris smaragdinus*, a new genus and species of compressed, emerald-green Cyprinidae, superficially resembling an anchovy (Roberts and Kottelat 1984) and several generic revisions. The revisions concern the mountain stream loach genus *Gastromyzon* (with descriptions of three new species from the Kapuas) (Roberts 1982*d*); the catfish genera *Bagarius* (Roberts 1983), *Chaca* (Roberts 1982*b*), and *Wallago* (Roberts 1982*c*); the spiny eel genus *Macrognathus* (Roberts 1980); and the previously monotypic pufferfish genus *Chonerhinos* (with descriptions of two new species from the Kapuas) (Roberts 1982*e*). The results of these studies are incorporated into the present monograph, but the individual papers should be consulted for additional information.

Attention should also be called to a paper on unculi (Roberts 1982*a*), unicellular horny projections on the lips, fins, and other epidermal features of ostariophysan fishes. Unculi represent one of the key adaptive features of the Ostariophysi (including carps, loaches, and catfishes) and are ideally suited for observation with scanning electron microscopy. Unculiferous structures in Kapuas species of *Cyclocheilichthys, Osteochilus, Paracrossochilus, Gastromyzon,* and *Bagarius* are illustrated and discussed in the paper cited; additional observations on the diversity of the highly specialized unculiferous lips of *Osteochilus* are presented herein. My most recent observations of unculi, done with the scanning electron microscopy facility of the California Academy of Sciences, but as yet unpublished, reveal the unculiferous nature of the extraordinarily specialized ostracophilous larvae in members of the Eurasian cyprinid subfamily Rhodeinae, and the presence of filamentous algae and other food items on unculiferous portions of the lips of the Chinese mountain stream loach *Pseudogastromyzon myersi* Herre, 1932. For a full discussion of the adaptive and evolutionary significance of unculi in adult ostariophysans see Roberts (1982*a*).

The approximately 7,000 specimens of 263 fish species obtained by the Kapuas survey of 1976 have been deposited in 18 museums and research institutions in Europe, North America, Indonesia, and Thailand. In many instances, specimens of species that are rare, poorly known, or difficult to identify have been placed in museums that have primary type specimens of the same or closely related species.

The main series of specimens, including holotypes of all new species and the 1st, 9th, and 10th specimen in every series of 10 specimens, is deposited in the Museum Zoologicum Bogorense (Bogor, Indonesia) and bears catalog numbers MZB 3000–4005. The next most important series, including paratypes of nearly all new species, are deposited in the California Academy of Sciences and the Smithsonian Institution (catalog numbers CAS 49181–513, 53049, USNM 218069–74, 218603, 229492, 230152–362). The other institutions which have received material are the Academy of Natural Sciences of Philadelphia (ANSP 152021–2), American Museum of Natural History (AMNH 41578–9, 48878–9, 48918–42), British Museum (Natural History) (BMNH 1978.1.10:1–4, 1979.3.21:145–152, 1981.4.13: 20–26, 1981.11.16:1, 1982.3.29:1–255), Field Museum of Natural History (94193–255), Institut Royal des Sciences Naturelles, Brussels (IRSNB 631–2, 19726–51), Kasetsart University Museum of Fisheries, Bangkok (KUMF 2848–60), Muséum d'Histoire Naturelle de Geneve (MHNG 2087.3–5), Muséum National d'Histoire Naturelle, Paris (MNHN 1982-650–724), Museum of Comparative Zoology (MCZ 57598–9, 58339–53), Museum of Zoology, University of Michigan (UMMZ 209852–930), National Inland Fisheries Institute, Bangkok (NIFI, col-

lection uncatalogued), Rijksmuseum van Natuurlijke Historie, Leiden (RMNH 28822–924), Royal Ontario Museum (ROM 37406, 38599–625), Zoological Museum, Amsterdam (ZMA 116.516–549), and Zoologisches Museum und Institut, Hamburg (ZMH 6475–76).

One of my aims in writing this monograph has been to point out numerous areas for further investigation. More species will surely be found in the Kapuas, and much systematic work remains to be done on the species already found there. Enough is known about the biology of the fishes to indicate that their food habits and modes of reproduction are extremely diverse, but for most of the species basic biological information is still lacking. For example, very little is known about fruit- and seed-eating fishes in the Kapuas. Whether the Kapuas fishes and flooded forest plain species have coevolved and interact to the extent found by Michael Goulding in the Amazon basin is unknown and perhaps doubtful. The Kapuas clearly does not have such a diverse array of large fruit- and seed-eating fishes as the Amazon, but those that are present may be important in dispersing the seeds of ecologically dominant plant species which play an important role in fish ecology. Readers interested in this topic should consult Goulding (1980). The cyprinid genera *Leptobarbus* and *Puntioplites,* the catfish genus *Pangasius,* and the giant goramy (*Osphronemus goramy*) are probably the most important fruit- and seed-eaters in the Kapuas.

Another phenomenon of potential ecological significance about which little is known in the Kapuas is fish migration. Migrations evidently do occur, but their direction, extent, biological significance, and even the species involved are virtually unknown. According to fishermen interviewed in 1976, large ikan tapah (*Wallago leerii*) formerly migrated in large numbers in the Kapuas mainstream, but their numbers have declined due to intensive gill-netting. There may have been a primary migration related to reproduction or some other seasonal activity of ikan tapah, or perhaps it was a secondary or adventitious migration enabling them to feed upon migratory prey species. Another large fish species suspected of migratory activity in the Kapuas mainstream is ikan pachil, *Cosmochilus falcifer.*

Acknowledgments

The decision to undertake an ichthyological survey of the Kapuas originated in a discussion with Ira Rubinoff, Director of the Smithsonian Tropical Research Institute, at the Museum of Comparative Zoology toward the end of 1974. Support for travel to Indonesia and for the survey was provided by the Office of the Assistant Secretary for Science of the Smithsonian Institution. This was facilitated and coordinated by David Challinor, Ross Simons, and Rita Jordan. The work in Indonesia was done in cooperation with the Museum Zoologicum Bogorense and with the permission of the Indonesian Science Research Council (Lembaga Ilmu Pengatahuan Indonesia). I am greatly indebted to Didin Sastrapradja, Sjamsiah Achmad, Sampurno Kadarsan, and Adisoemarto Soenartono for their sympathetic support. Soetikno Woerjoatmodjo of the Museum Zoologicum Bogorense accompanied and assisted me during the first half of the Kapuas survey.

The research was done mainly at the Tiburon Center for Environmental Studies of San Francisco State University and in the Department of Ichthyology of the California Academy of Sciences. I especially wish to thank Dean James Kelley, Ken Carpenter, Erwin Siebel, and Curtis O. David for facilitating my work at Tiburon, and George C. Lindsay, Frank Talbot, William N. Eschmeyer, and Tomio Iwamoto for their understanding and assistance at the California Academy of Sciences. Additional research was done at the Rijksmuseum van Natuurlijke Historie, Zoologisch Museum Amsterdam, Zoologisches Institut und Museum Hamburg, Muséum National d'Histoire Naturelle, Naturhistorisches Museum Wien, and British Museum (Natural History). Specimens were borrowed for study from these as well as a number of other institutions, including the Field Museum of Natural History, Museum of Zoology of the University of Michigan, and the Smithsonian Institution. I am grateful to the following colleagues for their assistance: Marinus Boeseman, Lipke Holthuis, Martien van Oijen, Peter van Helsdingen (Leiden); Han Nijssen (Amsterdam); Alfred Post, Matthias Stehman (Hamburg); Marie-Louise Bauchot (Paris); Harald Anhelt, Rainer Hacker (Vienna); Oliver Crimmen, Gordon Howes, Alwyne Wheeler, Peter Whitehead (London); Donald J. Stewart (Chicago); Reeve M. Bailey, Robert R. Miller, Walter Rainboth (Ann Arbor); and Susan Jewett (Washington, D.C.).

Many persons responded to my requests for information, reprints, bibliographic assistance, and so forth. I am especially grateful to colleagues who assisted in identification of species belonging to groups with which they were working: Thosaporn Wongratana (Clupeidae and Engraulidae), Jaranthada Karnasuta (*Osteochilus*), Walter Rainboth (*Puntius, Tor*), Maurice Kottelat (*Nemacheilus*), C. E. Dawson (Syngnathidae), Douglas Hoese (Gobiidae), and Donn E. Rosen (Synbranchidae). Generic citations and method of typification were reviewed with William N. Eschmeyer using his "Genera of Fishes" database at the California Academy of Sciences. Technical assistance at the California Academy of Sciences (including radiography and cataloging) was provided by Charles Ruark, Michael Hearn, and David Catania. Bibliographic assistance was provided by Ray Brian, Doris Cantou, Lillian Dempster, James Jackson, Ruth Opper, Lesley Segedy (California Academy of Sciences); Ingrid Radkey (University of California at Berkeley); Jack Marquardt (Smithsonian); and Verlejean Parker and Robert R. Rofen (Kordon Corporation, Hayward, California). Most of the photographs were prepared by Alphonse Coleman in the Photography Lab of the Museum of Comparative Zoology. Other photographs were kindly provided by Martin R. Brittan, W. I. Follett, Orrin Moon, Robert R. Rofen, Edward S. Ross, and Lloyd Ulberg. Scanning electron micrographs were prepared in the SEM Lab of the National Museum of Natural History by Susann Braden and Mary-Jaques Mann. The manuscript was typed by Francis Bertetta and reviewed by Reeve M. Bailey, William N. Eschmeyer, John Lundberg, and Lynne Parenti.

Support for study of the material obtained by the 1976 Kapuas survey and of material from earlier collections was provided by the National Science Foundation under Grant DEB77-24759. This publication is funded by National Science Foundation Grant BFR8612812. The Foundation provides awards for research in the sciences and engineering. The awardee is wholly responsible for the conduct of such research and preparation of the results for publication. The Foundation, therefore, does not assume responsibility for such findings or their interpretation. Any opinions, findings, conclusions, or recommendations expressed in

this publication are those of the author and do not necessarily reflect the views of the National Science Foundation.

History of East Indian Ichthyology, with Particular Reference to Freshwater Fishes of Borneo

The present narrative on ichthyological collecting and systematic research in the East Indies has been written because 1) such background is essential to systematists who have to study historical collections, manuscripts, and publications; 2) the subject is inherently interesting and worthwhile, particularly in that it reveals the importance of individual contributions; and 3) in the course of my museum visits and systematic investigations significant new information came to light concerning some of the events in this history. As in other branches of systematic biology, knowledge of East Indian freshwater fishes accumulated not steadily, evenly, and as a matter of course, but slowly and unevenly, and only with great individual efforts and sacrifices. The persons in this history should be memorialized, not least for the inspiration this may provide to future generations of workers.

Before proceeding to the narrative, I wish to point out that some of the important contributions could have been described at greater length, and that some minor episodes have been included but others omitted, so that this is by no means a complete history of our topic. Only a relatively small amount of research time has been devoted to this essay; no doubt it could have been greatly enriched by reference to archival materials especially in Leiden, Paris, and Vienna.

The history of East Indian or Indonesian ichthyology begins with Johan or Johannes Nieuhof (c. 1610–1672), who in 1653–1662 represented the Nederlandsche Oost-Indische Compagnie on an exploratory and diplomatic mission to the East Indies and China. The extensively illustrated folio report of this mission was first published in Dutch and French in 1665, and shortly thereafter in German, Latin, and English. It includes relatively detailed accounts of the people, towns, industries, agriculture, and natural productions of China and Indonesia. Some 43 East Indian species of fishes are named and briefly described, and nearly all of them are illustrated. This fish material was incorporated as an Appendix to Willughby's *De Historia Piscium* (1686). Nieuhof's work stands not only as the first but almost as the sole contribution to knowledge of freshwater East Indian fishes for more than a century and a half (158 years). It is therefore of interest to inquire more closely as to the actual species he discovered. To my knowledge there is no review of the subject. Nieuhof apparently did not bring any fish specimens back to Europe, or if so they probably were lost long ago, but all or almost all of the families, most of the genera, and many of the actual species can be recognized from his figures, some of which were identified by Cuvier and Valenciennes and many others by Bleeker. The great majority of the species are marine and will not be discussed further here. Five species, however, are freshwater (or estuarine and freshwater in one instance) and are of particular interest. These are Nieuhof's "Penne Visch'," "Wit Visch," "Bont-ael" or "Negen-oogen," "Kabos" or "Aelquabben'" and "Vijfoogen," or "Vyf Oogh."

The "Penne Visch'" was identified by Bleeker (1862–63:60) as *Aspidobagrus* (=*Mystus*) *gulio*, a species described from the Ganges by Hamilton-Buchanan (1822) and generally considered to be widely distributed along the coasts, in estuaries, and in river mouths, from India to southeast Asia including the Greater Sunda Islands. My observations, however, indicate that at least two species are involved; I therefore agree with Bleeker's generic identification but consider the species tentative. The "Wit Visch" was identified by Bleeker (1862–63:84) as *Callichrous* (=*Ompok*) *bimaculatus* and I concur. The excellent figure of the "Bont-ael" was identified by Valenciennes in Cuvier and Valenciennes (1839:387) as his new species *Clarias nieuhofi*. The generic identification is unquestionably correct but the species probably cannot be confirmed. The "Kabos" was identified by Bleeker (1862: 103) as *Clarias melanoderma* (=*Clarias meladerma*), but this is clearly in error. Although deficient in details, the figure strongly resembles a *Channa* or snakehead. This identification is supported by Nieuhof's vernacular name, a spelling variant of ikan gabus, the Indonesian name usually applied to *Channa striata*. Although crude, the figure of "Vyf Oogh" is based unmistakably on *Macrognathus aculeatus*. This highly specialized genus and species is indicated by the very elongate rostrum, anterior portion of dorsal fin consisting of about 13 separate sharp spines, and base of soft dorsal fin with a row of large, well-defined, and evenly spaced "eye-spots" or ocelli.

In summary, the identities of the five freshwater fishes reported by Johan Nieuhof insofar as they can be reasonably inferred are *Mystus* cf. *gulio*, *Ompok bimaculatus*, *Clarias* sp., *Channa* cf. *striata*, and *Macrognathus aculeatus*. These are almost certainly the earliest published illustrations of these species. That of *Clarias* probably is the earliest illustration of the family Clariidae (see Valenciennes *in* Cuvier and Valenciennes 1840: 359). That of *Macrognathus aculeatus* considerably antedates the earliest published (1718) and unpublished (1715) accounts and figures of Mastacembelidae cited by Sufi (1956). Most of Nieuhof's fishes were collected in or near Batavia (M. Boeseman, L. Holthuis, pers. comm., July 1984).

The seventeenth and eighteenth centuries saw a great flowering of private natural history cabinets in Europe. This led to a flourishing market for natural curiosities in centers such as London and Amsterdam. Many cabinets obtained specimens or illustrations of East Indian zoological material, most of it never recorded and subsequently lost. There were exceptions, however, some of them notable. In 1704 Michael Valentini of Frankfort published some illustrations of East Indian fishes obtained for his Naturkammer; an enlarged second edition appeared in 1714 (neither edition seen by me). In 1715 Cornelis de Vlaming, an official of the Dutch East Indies Company, and Samuel Fallours, a physician stationed in Amboina, returned to Holland with a very large number of illustrations of East Indian fishes and other marine life. A large, two volume work based on their materials was published in Amsterdam in 1718 by Louis Renard. This contains 459 "crudely drawn and barbarously colored figures" of East Indian fishes, crabs, etc. Several editions and reissues of this work with amendments and additions appeared. Francis Valentijn, a Dutch Protestant missionary stationed in the East Indies in 1685–94 and 1706–14, published a five-volume description of the Orient in 1724–26. The third volume contains descriptions and figures of 528 fishes of Amboina. The authors of these works and their collaborators were not ichthyologists or even biologists, and the artists who prepared the illustrations had not been suitably trained. Nevertheless, the large number of species and the variety of their color

and form, even crudely portrayed, served to proclaim the extraordinary ichthyological richness of the East Indies.

The beginning of modern systematic knowledge of nearly all groups of organisms in the East Indies is intimately related to the founding of the Rijksmuseum van Natuurlijke Historie in Leiden and of the Natuurkundige Commissie voor Nederlandsche Indie in 1820. The guiding light of both organizations was Coenraad Jacob Temminck, the Rijksmuseum's director from 1820 to 1858. A considerable number of young and capable naturalists, mainly from Holland and Germany and most with university education, were recruited by the Natuurkundige Commissie to obtain biological materials in the East Indies for systematic studies. They were usually instructed to make general collections, but many also pursued their individual interests. Unfortunately, during this early period medical knowledge and facilities were inadequate to cope with diseases in the East Indies, and most of the Natuurkundig Commissie's recruits died within a short time (usuallly one to four years) after undertaking fieldwork. Despite individual tragedies, the collections they made almost always arrived intact at the Rijksmuseum, and Temminck saw to it that they were promptly reported on by that museum's systematists or by systematists at other institutions.

Modern knowledge of East Indian fishes begins with Heinrich Kuhl and Johan Coenraad van Hasselt. After completing studies at the University of Groningen and receiving appointments in the Natuurkundige Commissie for the Dutch East Indies, they arrived in Batavia (Jakarta) in December 1820. They traveled widely in western Java, collecting plants as well as animals. Manuscript descriptions and illustrations were made for many species, which they presumably intended to publish upon returning to Holland, but such was not to be. Kuhl died after only nine months in Java, van Hasselt after two years and nine months. The sickness which caused their deaths has not been identified, but malaria, amoebic dysentery, or yellow fever, or perhaps a combination of these diseases, could have been responsible. Kuhl was only 25 when he died, van Hasselt 26. They are buried in the cemetery of the Botanic Gardens at Bogor (Buitenzorg).

Kuhl and van Hasselt's collections and manuscripts arrived safely at the Rijksmuseum van Natuurlijke Historie and were soon reported upon by various systematists. (Several East Indian plants, especially palms, and many fishes have been named after them.) The job of reporting on the fishes fell to the great French ichthyologists George Cuvier and Achille Valenciennes at the Muséum National d'Histoire Naturelle. Before he died, van Hasselt wrote two long letters to Temminck, providing an overall impression of the ichthyological discoveries. The letters contained manuscript latinized names for many new genera and species, some with no descriptions at all, others accompanied by very brief remarks on morphology, but none with what van Hasselt himself would have regarded as a publishable scientific description. Temminck published the two letters in the *Algemeene Konst- en Letter-Bode* (1823). Shortly thereafter a French translation appeared in Ferussac's *Bulletin des Sciences Naturelles et de Geologie.* Although many or perhaps all of the fish names in the letters are based on specimens that arrived in Leiden, and some of those specimens apparently were accompanied with labels bearing the manuscript names, presumably none of the specimens were labeled specifically as types by van Hasselt. Many of the fish names were written on the fish illustrations, which had been prepared in Java, but the illustrations were not published in the *Algemeene Konst- en Letter-Bode* or in Ferussac's journal; so far as I know none of the illustrations has ever been published. An English translation of the letters, prepared with M. Boeseman, was published by Alfred (1961).

The full extent of the ichthyological discoveries made by Kuhl and van Hasselt cannot be judged from van Hasselt's ichthyological letters because many species they obtained are not mentioned. This became evident to me while going through the volumes of Cuvier and Valenciennes's *Histoire Naturelle des Poissons,* in which Kuhl and van Hasselt's material is more fully reported upon. Cuvier and Valenciennes retained many manuscript names coined by Kuhl and van Hasselt (occasionally modifying the original spelling) but rejected many others, including some of those published in the *Algemeene Konst- en Letter-Bode.* They invariably cited Kuhl and van Hasselt as the authors of these names, even though it is clear in nearly every instance that Cuvier and Valenciennes drafted the descriptions themselves. Kuhl and van Hasselt manuscript names published for the first time by Cuvier and Valenciennes are attributable either to Cuvier, or to Valenciennes, in Cuvier and Valenciennes, not to Kuhl and van Hasselt. For the names published in the *Algemeene Konst- en Letter-Bode* (1823), the situation is complicated. A fair number of them are outright nomina nuda; the original descriptions of some of these date from the volume of Cuvier and Valenciennes in which they first appeared, while others remain unpublished and it is unknown which species they represent. A few species described in the van Hasselt letters (1823) are so distinct that even the brief original description is perhaps adequate for their recognition, for example, *Dermogenys pusillus* and *Acantopsis dialuzona.* For most of the names published in 1823, however, a strong case can be made for rejecting them as nomina nuda or dubia, and in most instances rejection is in the best interest of nomenclatural stability. Recognition of any of the 1823 names poses serious problems either of identification or typification at generic or species levels. Holotypes cannot be identified for any of the species. It seems to me that Cuvier and Valenciennes, Bleeker, and other ichthyologists of the time did all that they could to give credit to Kuhl and van Hasselt and to preserve their memory, by recognizing their manuscript names and attributing original authorship to them. This unfortunately led to considerable nomenclatural instability, because some authors uncritically accepted names rejected by others. Chief offender among recent authors is H. M. Smith (*in* Smith 1945 and in earlier papers), who recognized a number of Kuhl and van Hasselt names which earlier workers, equally or more familiar with their work and the historical circumstances, had chosen not to recognize. A case in point is provided by the genus *Labiobarbus* and the species *L. lipocheilus* and *L. leptocheilus* of van Hasselt in Kuhl and van Hasselt (1823). These are unquestionably nomina nuda, as Smith himself presumably would have recognized had he consulted the *Algemeene Konst- en Letter-Bode.* Of the relatively few names that can or should be accepted, it should be noted that the original spellings of the genera currently known as *Acanthophthalmus* and *Acanthopsis* are *Acantophthalmus* and *Acantopsis,* and that these spellings undoubtedly were intentional and therefore must be used according to ICZN. Although *Noemacheilus* Kuhl and van Hasselt, 1823, has been accepted by some authors, it has been rejected by others. It can be subjectively defined as a nomen nudum, and, because of the difficulty in determining

its generic type species, I have rejected it in favor of *Nemacheilus* Bleeker, 1863, with the originally designated type species *Cobitis fasciatus* Valenciennes in Cuvier and Valenciennes, 1846. This seems to be clearly in the best interest of nomenclatural stability as well as in accord with ICZN. A more perplexing problem arises from *Acantophthalmus* van Hasselt, 1823. This name is also subjectively definable as a nomen nudum, but its rejection would lead to generic name changes for numerous Asian loaches. The resulting confusion and opposing viewpoints probably could not be resolved except by petition to the International Commission of Zoological Nomenclature. These and other nomenclatural problems posed by van Hasselt (1823) are taken up more fully in the systematic accounts of the taxa involved.

The specimens obtained by Kuhl and van Hasselt, including the type specimens of many new species described by Cuvier and Valenciennes, are deposited in the Rijksmuseum van Natuurlijke Historie and in the Muséum National d'Histoire Naturelle. Their original illustrations of Javanese fishes were consulted in preparing descriptions for the *Histoire Naturelle des Poissons* but were never published. At least 32 species reported herein from western Borneo were first discovered by Heinrich Kuhl and Johan Coenraad van Hasselt in Java.

In 1826 the Natuurkundige Commissie sent Heinrich Boie, Heinrich Cristian Macklot, and Salomon Müller to the East Indies. Boie, a herpetologist, died in Buitenzorg not long after his arrival. His collections and manuscripts were reported upon by his older brother Friedrich Boie, who remained in Holland. Macklot collected in Java, New Guinea, and Timor; his collections and manuscripts were lost in a fire during the Chinese revolt in Poerwakarta, Java, in May 1834, and he was murdered there a few days later. Salomon Müller was perhaps the most fortunate and therefore the most successful of the Commissie's zoological recruits. It is said that Müller was a waiter in a bar in Heidelberg in 1823 when he overheard Boie and Macklot discussing their forthcoming trip to the Indies. The three young men became close friends, and the Natuurkundige Commissie, presumably persuaded by Boie and Macklot, gave Müller an appointment. Müller collected in Java (1826–28, 1829–32, 1836), Celebes (1828), Amboina (1828), southwest New Guinea (1828–29), and Samauw (1828). The holotype of the earliest freshwater fish discovered in New Guinea, *Arius leptaspis* Bleeker, 1863, was collected by Müller, but his most important zoological discoveries were made in Borneo in 1836, when he ascended the Doeson or Barito River as far as Moara Teweh. There he found the long-snouted piscivorous crocodilian *Tomistoma schlegeli* (van der Hoeven and de Vries, 1838) and the bony-tongue fish *Scleropages formosus* (Müller and Schlegel, 1844). According to Popta (1906:270), Müller collected nearly 100 species of fishes in Borneo; these are deposited in the Rijksmuseum but their identifications have not been reported.

In 1843 Johann Jacob Heckel, the first member of the nineteenth century ichthyological triumvirate of the Naturhistorisches Museum Wien (Heckel, Kner, Steindachner), published his "Fische Syriens," one of the most remarkable papers in the history of ichthyology. The full title of this paper is "Abbildungen und Beschreibungen der Fische Syriens, nebst einer neuen Classification und Characteristik sämmtlicher Gattungen der Cyprinen." Into its 109 closely written pages Heckel packed an original classification and synopsis of all known cyprinoid fishes, the first comprehensive descriptive account of cyprinoid pharyngeal teeth, and a detailed systematic account of all fishes known from Syria. The account of cyprinoid fishes includes descriptions of the first freshwater fishes known from Borneo: *Cyrene festiva*, *Cyrene ocellata*, and *Barbus carassioides*. The first two of these were well described and are valid species of the genus *Dangila*. The third, for which Heckel gave only a brief diagnosis, has not been identified previously but is here tentatively referred to the genus *Puntioplites*. The only collection of Bornean freshwater fishes of record at this early date is that of Salomon Müller from the Barito or Doeson. In going through accession records of the Naturhistorisches Museum Wien, I found early records for three additional freshwater species from Borneo (no additional locality information): *Helostoma temminckii* (1839 and 1842), *Scatophagus argus* (1839), and *Tetraodon fluviatilis* (1840). Either these specimens and those of the cyprinids described by Heckel were part of Müller's Barito collection or they represent some other early Bornean collection of which there is no published record.

The second earliest known collection of Bornean freshwater fishes was made by geologist Carl Schwaner, another member of the Natuurkundig Commissie who died young. Schwaner was charged with investigating the coal beds of Borneo. In 1843–47 he explored the Barito, Mahakam, Kahajan, and Kapuas basins. He was perhaps the first explorer to traverse the Barito-Mahakam and Kahajan-Kapuas watersheds. The latter traverse was done in the vicinity of Mount Raja, at 2,279 m, the second highest peak in Borneo (the highest, at 4,102 m, is Mount Kinabalu in the northeastern corner of the island). Schwaner then descended the Melawi River and the Kapuas mainstream to Pontianak. A collection of some 40 species of Bornean fishes (all from the Barito?) made by him is deposited in the Rijksmuseum (Popta 1906:271–272), but again their identifications have not been reported. The mountain ranges forming the watershed between the Kapuas and the rivers of southern Borneo are named after him. The fishes of the Schwaner Mountains, including Mount Raja, are still almost entirely unknown.

In 1851 Ida Pfeiffer left Vienna on her second voyage around the world. This time she traveled to London, the East Indies, and the United States. From Kuching, against the advice of Rajah James Brooke, she ascended the Batang Lupar, transversed the Lupar-Kapuas watershed and discovered the Kapuas Lake District. Pfeiffer then descended the Kapuas River to Pontianak, where a collection of freshwater fishes was obtained. This collection, or at least part of it, was presented to Bleeker, whom she met in Batavia. Bleeker (1852*b*) identified 16 species from this collection (half marine, half freshwater). In the Naturhistorisches Museum Wien I found accession records of two additional Bornean freshwater fishes collected by her, *Amblyrhynchichthys truncatus* and *Leptobarbus hoevenii*, both described by Bleeker one year prior to her visit. For additional information concerning Ida Pfeiffer and her exploration of Borneo see Pfeiffer (1856) and Lebzeller (1910).

By far the most important contributions to East Indian ichthyology are those of Pieter Bleeker (1819–1878). Bleeker's bibliography comprises some 730 items, 520 on fishes, including numerous monographs of substantial length. At a time when it was difficult to stay alive in the East Indies, he remained for 18 years, amassing a personal collection of some 2,500 fish species, over 1,100 of which he described as new, and published some 270 papers on systematic ichthyology. This work was accom-

plished in addition to official duties as surgeon and medical officer in the Dutch East Indian army and other substantial non-ichthyological activities.

During his lengthy sojourn in the East Indies (1842–1860), Bleeker organized or assisted societies and initiated and edited journals which served as the main stimuli for scientific activities in the East Indies, notably the Koninklijke Natuurkundige Vereenigung in Nederlandsch Indië. Military and civil associates sent a steady stream of fish collections from throughout the Dutch East Indian islands to Bleeker; reports on such collections were promptly presented at meetings of the scientific societies in Batavia and printed in their journals. In 1860 Bleeker returned to Holland (retiring from military service in 1863) to continue his ichthyological work and care for his ailing wife, whom he survived by one year. From 1860 until the end of his life in 1878 Bleeker published continuously. The text and illustrations of his monumental opus, the *Atlas Ichthyologique des Indes Orientales Néerlandaises,* were completed during this period. The first fascicles of the *Atlas* were published in 1862. By 1878 all but the last fascicle of text for the first nine volumes and all of the plates for the first 10 of the projected 14 or 15 volumes had been published (the uncompleted text of volume 9 ends in the middle of the description of *Pristolepis fasciata*). The remaining plates for volumes 11–14 were finally published (without text) in 1984 (Bleeker 1984).

It is largely due to the efforts of Marinus Boeseman of the Rijksmuseum van Natuurlijke Historie that the plates for volumes 11–14 of the *Atlas* are now published, that many of Bleeker's works have been reprinted (including the first three volumes of the *Atlas*), and that the basic facts about Bleeker's life and the fate of his ichthyological collections (including the type specimens of his new species) are readily available. Readers may wish to consult Boeseman's English translation of Bleeker's fascinating autobiography (Bleeker 1973), and his Introduction to the plates of volumes 11–14 of the *Atlas* (in Bleeker 1984). I have also consulted the manuscript of an unpublished paper on Bleeker's life and collections prepared by Robert R. Rofen with the help of Boeseman and Lipke Holthuis (Rofen, ms).

Despite repeated efforts, Bleeker never received a salaried appointment from any museum. A great deal of his time and energy was devoted to raising funds for his ichthyological collections and publications. Bleeker's fish specimens were his personal property until he disposed of them, and specimens remained in his possession in Batavia and in Holland for varying periods of time before they were deposited in museums. The overall history of Bleeker's collections is now fairly well known. Bleeker material is scattered in at least a dozen museums, but with very few exceptions his type specimens are deposited either in the British Museum (Natural History), or, as a result of public auction of Bleeker's effects after his death, in the Rijksmuseum van Natuurlijke Historie. Unfortunately, some of the types probably have been lost or were not identified as types, and some non-type specimens have been incorrectly labeled as types. It seems that at least some of the material Bleeker assembled in Batavia did not reach Europe.

The main facts of Bleeker's life are recounted in his autobiography. In 1840 and again in 1841, before departing for Batavia, Bleeker applied to the Rijksmuseum van Natuurlijke Historie for an appointment. The reason for his rejection has been unclear and might be revealed by consulting archival material in Leiden. Perhaps it was due to his youth and humble origins. Certainly this very brief summary does not do justice to Pieter Bleeker, an extraordinary man who surmounted great obstacles to achieve what he did, and whose greatness and humanity found expression in a wide range of non-ichthyological endeavors.

Of the 290 species of freshwater fishes now known from western Borneo, no fewer than 123 were originally described by Bleeker, mainly from specimens collected by his associates in Sumatra or southeastern Borneo (particularly Banjarmasin). Bleeker named many of these species after the persons who collected them; their names and position are recorded in Bleeker's *Atlas* and other works. Bleeker received specimens of only about 60 species of freshwater fishes from western Borneo (mainly Sambas and Pontianak), somewhat of a colonial backwater during his time. From 1850 to 1860 Bleeker published 13 papers on freshwater fishes of Borneo. His principal collaborators in obtaining specimens of freshwater fishes from that island, all doctors or medical officers, were C. Helfrich (Barito and Kahajan), J. Wolff and M. A. Feldmann (Barito), J. Einthoven and A. J. Andresen (Sambas), and M. J. N. Stevens, E. F. J. van Kappen, A. H. Thepass, and D. Sigal (Kapuas).

Researchers on systematics of Indo-Pacific fishes are indebted to Max Weber and Lieven F. de Beaufort for bringing so much information together in their great faunal work, *The Fishes of the Indo-Australian Archipelago* (which unfortunately ceased publication, although nearly completed, with volume 12). The first volume of this work comprises a nearly complete bibliography of the ichthyological publications of P. Bleeker, numbered from 1 to 500, together with indices to the principal geographical localities and to the genera and species. Without these tools it would be very difficult to work with the Bleeker literature. A number of libraries, including that of the Department of Ichthyology of the California Academy of Sciences, have utilized Weber and de Beaufort's numbering system for filing their Bleeker papers; the numbers are given (in brackets) after each Bleeker item in the literature cited herein.

In working with systematics of East Indian fishes one is frequently confronted by problems requiring examination of Bleeker type specimens. In numerous instances, including rare species of which Bleeker obtained only a single specimen or a single lot of specimens, identification of the holotype or of the syntypes presents no problems. In many instances, however, due to the exigencies of circumstance, Bleeker's type specimens were placed in the same jar with more or less numerous (and likewise unlabeled) non-type specimens, often from widespread East Indian localities. There is also a distinct possibility that some of his types were destroyed or lost in the East Indies. Sometimes Bleeker types can be recognized by pencil marks on the scales, a method used by Bleeker to facilitate scale counts. (Bleeker presumably had a proper dissecting scope for his ichthyological researches in Holland after 1860, but it may be that he lacked such a facility for all or most of the time during his stay in the East Indies.) Some ichthyologists have avoided the issue of dealing with Bleeker type specimens by regarding the plates in the *Atlas* as equivalent to types or at least based on types. This practice is unsound, since it is known that in many instances non-type specimens in better condition were utilized in the preparation of the plates. Due to the great amount of painstaking work involved and limited resources available for such a task,

the Bleeker material deposited in the Rijksmuseum has never been thoroughly revised. In some instances lectotypes or neotypes may have to be designated for Bleeker species, but this should only be done after careful study by persons thoroughly familiar with the history of Bleeker's material. In revising the supposedly monotypic freshwater pufferfish *Chonerhinos* (Roberts 1982*e*) I found that Borneo was inhabited by five species which had been lumped under *Chonerhinos modestus* (Bleeker, 1852). As Bleeker's holotype could not be positively identified, a neotype was designated for it. This was only done after the revision of the genus had been completed, all Bleeker material of *Chonerhinos* had been examined, and I had consulted with M. Boeseman. The only other Bleeker species for which I have designated a neotype is *Mystus micracanthus* (herein). Additional examples of Bornean freshwater fishes for which difficulties have been encountered in locating or identifying Bleeker type specimens include *Misgurnus barbatuloides* (see comments under *Lepidocephalichthys hasselti*) and *Glyptothorax platypogonoides*.

Eduard von Martens (1831–1904), one of the most productive malacologists in the second half of the nineteenth century, represented the Berlin Museum on the Preussische Ost-Asien Expedition in 1860. After one year he left the expedition vessel *Thetis* and remained in Asia for three years on his own. He visited Japan, China, the Philippines, Thailand, Singapore, Sumatra, Java, Celebes, Molukkas, Timor, and western Borneo before returning to Berlin in 1864. Although primarily interested in terrestrial and freshwater mollusks, von Martens made extensive collections of other groups including fishes. His outstanding zoological discovery is the Yangtze paddlefish *Psephurus gladius* (Martens, 1861). In March–June 1863 he collected some 90 species of freshwater fishes along the west coast of Borneo at Sinkawang, Seminis, Lumar, and Benkayang and in the interior of the Kapuas basin at Pontianak, Mandhor, Pulo Matjan (=Pulau Matjang), Danau Sriang, Selimbouw (=Selimbau), and Sintang. These collections were identified in Berlin by Wilhelm Carl Peters. Only two new species were described, the pipefish *Syngnathus* (=*Doryichthys*) *martensii* and the snakehead *Ophiocephalus vagus* (a junior synonym of *Channa striata*). All of the Asian fishes collected by von Martens and identified by Peters are listed with their localities in the official account of the Preussische Ost-Asien Expedition (Martens 1876). Peters was a very competent ichthyologist but his research was mainly on freshwater fishes of east Africa and evidently he was not very familiar with species from southeast Asia. The collections, apparently intact, are now kept in the Zoologische Museum of the Universiteit Alexander von Humboldt in East Berlin (H. J. Paepke, pers. comm., June 1981). It seems that none of the Bornean specimens of Eduard von Martens have been critically reexamined since their original identification.

A little known episode in the ichthyological history of Borneo concerns collections made in the Barito basin by Dr. H. Breitenstein. A German, Breitenstein served as regimental physician in the Dutch East Indian army in the Netherlands East Indies for 21 years. In 1880 he was stationed for some 18 months at Moara Teweh, at the junction of the Barito and Teweh rivers, then perhaps the most remote administrative post in the interior of Borneo. He sent anthropological and zoological collections to Europe. His fishes, all freshwater species obtained in the vicinity of Moara Teweh, were purchased for the Naturhistorisches Museum Wien by Franz Steindachner. After retiring Breitenstein published a fascinating memoir on his experiences in the Dutch East Indies, filled with anthropological and medical observations, but with only a passing mention of fishes and fish collecting (Breitenstein 1899). Steindachner (1881*a*, *b*) described two new genera and species collected by Breitenstein, the cyprinid *Parachela breitensteini* and the very strange and highly specialized akysid *Breitensteinia insignis*. Many other species were identified by Steindachner but never reported upon. During a visit to the NHW in September 1982, with the assistance of Harald Ahnelt and the late Rainer Hacker, I was able to locate accession records for the following 38 species collected by Breitenstein (as identified by Steindachner, with modern equivalents in some instances): Cyprinidae: *Balantiocheilos melanopterus, Barbichthys laevis, Barbus* (*Capoeta*) *sumatranus* (=*Puntius sumatranus*), *Barynotus* (=*Cyclocheilichthys*) *microlepis, Chela* (=*Macrochirichthys*) *macrochir, Dangila fasciata, Epalzeorhynchos kalopterum, Luciosoma trinema, Osteocheilus vittatus, Parachela breitensteini, Rasbora argyrotaenia, Thynnichthys thynnoides*. Cobitidae: *Acanthopsis choirorhynchus, Botia hymenophysa, B. macracantha*. Siluridae: *Callichrous macronema* (=*Ompok hypophthalmus*), *Wallago leerii*. Pangasiidae: *Lais hexanema, Pangasius micronema*. Bagridae: *Bagrichthys hypselopterus, Bagroides melapterus, Macrones* (=*Mystus*) *nemurus, Macrones* (=*Mystus*) *nigriceps*. Akysidae: *Breitensteinia insignis*. Polynemidae: *Polynemus multifilis*. Pristolepidae: *Catopra fasciata* (=*Pristolepis fasciatus*), *C. grootii* (=*P. fasciatus*?). Toxotidae: *Toxotes microlepis*. Syngnathidae: *Doryichthys boaja*. Channidae: *Ophiocephalus* (=*Channa*) *lucius, Ophiocephalus* (=*Channa*) *marulioides, Ophiocephalus* (=*Channa*) *micropeltes, Ophiocephalus striatus* (=*Channa striata*). Anabantidae: *Anabas oligolepis* (=*testudineus*?), *Betta pugnax*. Gobiidae: *Boleophthalmus boddaerti*. Tetraodontidae: *Tetraodon palembangensis, Xenopterus* (=*Chonerhinos*) *modestus*. It is possible that this is only a partial list of the species obtained by Breitenstein. During my visit I examined four of the actual lots of specimens: *Botia hymenophysa, Breitensteinia insignis* (holotype), *Polynemus multifilis*, and *Xenopterus* (or *Chonerhinos*) *modestus*. My observations indicate that *Botia hymenophysa* (otherwise unknown from the Barito) is correctly identified; that the species reported from western Borneo and Sumatra as *Breitensteinia insignis* may represent one or more undescribed species; and that the Barito is inhabited by two species of *Chonerhinos*, *C. modestus* and *C. nefastus*. It seems likely that knowledge of other Bornean fish species and their distribution could be similarly enhanced by examining other specimens collected by Breitenstein. Ichthyologists look forward to the day when the great collections of the Naturhistorisches Museum Wien will again be available for examination. Our esteemed friend and colleague Rainer Hacker was working to make this possible, and we can only hope that his untimely death will not signify an end to the project he began.

In 1884, according to collection records in Vienna, Franz Steindachner purchased a small collection of Kapuas fishes from one Fritz Grabowski. At least four species were included: *Chela hypophthalmus, Cyclocheilichthys apogon, Leptobarbus hoevenii*, and *Chaca bankanensis*. These specimens apparently were never reported on; the collector presumably was zoologist Friederich Grabowsky, who traveled extensively in Borneo in 1881–84 including over four months in the Kapuas basin. He subsequently held professional positions in Breslau and Brunswick.

The last decade of the nineteenth century witnessed a re-

markable burst of ichthyological exploration of the Kapuas basin, greatly increasing knowledge of its fishes. Civil mining engineer, biologist, and explorer Maurice Chaper traveled to western Borneo in November 1890–January 1891, making a valuable fish collection in the Upper Kapuas and two of its tributaries, the Knapei and Sebruang. This collection, deposited in the Muséum National d'Histoire Naturelle, comprised some 500 specimens of about 100 species and was reported upon by Leon Vaillant. From examining selected portions I learned that Vaillant underestimated the number of species and overlooked or misidentified several that were undescribed. Although Vaillant described three species from Chaper's material as new, two of these are junior synonyms of species described by Bleeker. Vaillant believed that Chaper's material did not contain many new species (Vaillant 1893*a*:55), but in fairness it should be noted that prior to Chaper's collections the Paris museum did not have any material of freshwater fishes from Borneo. Among the undescribed fishes collected by Chaper are the minute noodlefish *Sundasalanx* (mistaken for young needlefish), the remarkably specialized scale-eating chandid *Paradoxodacna piratica* (described herein), the belontiid *Sphaerichthys vaillanti,* and the pufferfish *Chonerhinos amabilis.* One specimen of the cyprinid genus *Rasbora* and one of the bagrid genus *Leiocassis* collected by Chaper have not been identified to species and may represent species still undescribed. If one of these does prove to be new, it would be fitting to name it after Maurice Chaper, for the only Bornean fish species named after him, *Diastotomycter chaperi* Vaillant, 1893, is a junior synonym of *Hemisilurus heterorhynchus* Bleeker, 1853. Chaper has left two accounts of his travels in western Borneo (Chaper 1894*a, b*).

Within three years of Chaper's Kapuas exploration, the Society for the Advancement of Natural History Exploration in the Dutch Colonies (Maatschappij ter Bevorderung van het Natuurkundig Onderzoek der Nederlandsche Koloniën) sponsored an important series of scientific expeditions to central Borneo. These expeditions were in the field in 1893–94, 1896–97, and 1898–1900. General accounts were published by Molengraaff (1895), Büttikofer (1897), and Nieuwenhuis (1900, 1904–07); zoological results appeared mainly in the *Notes from the Leyden Museum* (1897–1906). Zoologist J. Büttikofer collected fishes as well as birds, mammals, and other animals in the Kapuas basin. Anton Willem Nieuwenhuis, medical doctor, undertook ethnographic and anthropological studies and collected fishes in the Kapuas and Mahakam basins. Geologist Gustaaf Molengraaff was the first scientist to describe the history of the river systems submerged by the South China Sea and to point out the significance of this history for distribution of freshwater fishes in the area (Molengraaff 1921; Molengraaff and Weber 1921). The important fish collections, deposited in the Rijksmuseum van Natuurlijke Historie in Leiden, were reported on by Vaillant (1902) and Canna M. L. Popta (1903, 1905, 1906). In her final compilation of the freshwater fishes of central Borneo, Popta indicated some 173 species from the Kapuas and 97 from the Mahakam. About 35 of her Kapuas species are redundant, so that the true number of species known from there at that time is closer to 140. The names in the Mahakam list are not redundant; little further ichthyological exploration of the Mahakam, the second largest river basin in Borneo, has been undertaken, and the total number of species now known from there is only a little more than 100. Hardenberg (1935*b*) listed 39 species of freshwater fishes from the lower Mahakam, but many of his identifications are doubtful and the disposition of the specimens is unknown. The headwaters of the Mahakam and Kapuas evidently share a number of fish species, but Mahakam ichthyofauna is too poorly known to permit a worthwhile comparison of species composition in the two basins.

A digression is needed here concerning ichthyological exploration in northern Borneo (including Sarawak) and the Malay Peninsula. Despite Rajah James Brookes's keen interest in natural history, ichthyological knowledge in the British possessions of Borneo lagged far behind that in the Dutch territories, a condition which has not been rectified. One of the earliest freshwater fishes described from northern Borneo is the remarkably specialized mountain stream loach *Gastromyzon borneensis* Günther, 1874. The first five specimens of *Gastromyzon,* collected in Labuan (now part of Sabah), were purchased from their collector by Albert Günther of the British Museum (Natural History) for £1.00 (according to a pencil note apparently in Günther's hand in the register of vertebrate accessions). Not until a recent revision of the genus (Roberts 1982*d*) was it realized that the type-series of *G. borneensis* includes two very distinct species, and that northern Borneo is inhabited by no fewer than eight species of *Gastromyzon.* As late as 1896 only about 60 species of freshwater fishes were known from all of northern Borneo (Bartlett 1896). This number was moderately increased by small collections of fishes made by C. Hose, A. Everett, R. Hanitsch, and others and reported on by G. A. Boulenger (1894, 1899) and C. T. Regan (1906, 1913*b*) of the British Museum (Natural History), and by Willy Kükenthal's collection of 32 species from the Baram reported upon by F. Steindachner (1901). In recent years Robert F. Inger of the Field Museum of Natural History, Eugene K. Balon of the University of Guelph, and Antony Lelek of the Senckenberg Museum and their associates have made extensive collections in the Rejang and Baram but little of this material has been reported upon. Extensive collections of fresh- and brackish water fishes from northeastern Borneo (including the Kinabatangan) have been reported upon (Inger and Chin 1962) so that this somewhat impoverished area is relatively well known. The freshwater fishes of the Malay Peninsula, which one might suppose would be well known systematically, are poorly known. The first substantial contribution to knowledge of freshwater fishes of the Peninsula is by Georg Duncker (1904), with about 100 species, including 14 described as new. In this paper Duncker announced the discovery of some remarkable cyprinodont-like fishes, but it fell to Regan (1913*b*, 1916) to give the first formal descriptions of the family Phallostethidae. These small or tiny fishes, in which males have a highly specialized subcephalic copulatory organ, or priapium, are now known from the Philippines, Thailand, Sumatra, and northern Borneo as well as the Malay Peninsula, but have not been found in the rest of Borneo or in Java. Despite papers by Alfred, Herre, Herre and Myers, Hora, Hora and Gupta, and Tweedie much more ichthyological collecting and museum study will be needed for the freshwater fishes of the Malay Peninsula to become well known. A checklist of marine and freshwater fishes of the Peninsula by Fowler (1938) is useful for its bibliography. The recent account of the freshwater fishes of the Malay Peninsula by Mohsin and Ambak (1983) is concerned primarily with ecology but includes some distribution records of systematic interest.

Returning to events in western Borneo, H. A. Lorentz visited the Kapuas in 1911, obtaining a small fish collection which was

deposited in the Zoological Museum of Amsterdam. This material is reported on in Weber and de Beaufort's *Fishes of the Indo-Australian Archipelago*. Fisheries biologist J. F. D. Hardenberg published a series of papers on marine, estuarine, and freshwater fishes of the Dutch East Indies from 1930 to 1948, including several on freshwater fishes from western Borneo. Unfortunately Hardenberg's identifications are not very reliable, and the disposition of most of the specimens reported on in his papers is unknown. A few Hardenberg specimens are deposited in Amsterdam. The validity or identification of three of the new species he described from western Borneo (*Rasbora beauforti*, *Pangasius hoeksi*, and *Ompok weberi*) is problematical. The type specimens of these nominal species are not deposited in Amsterdam, Leiden, or Bogor; my letters concerning them addressed to the Director of the Marine Fisheries Institute at Den Pasar in Jakarta have not been answered. A group of Japanese fisheries biologists reported on some 109 species obtained during a survey of the middle Kapuas in 1978 (Imaki et al. 1978); these specimens are deposited in the Tokyo University of Agriculture. In 1983 Pier Georgio Bianco of the Universita degli Studi dell'Aquila collected about 1,000 specimens from a tributary of the upper Kapuas; the Cyprinidae he obtained have been reported upon (Bănărescu and Bianco 1984).

Reproductive Adaptations in Freshwater Fishes of Borneo

Virtually every reproductive adaptation known in vertebrates has been found in fishes. An ecological classification of the modes of reproduction in tropical freshwater fishes (with Bornean examples) is as follows:

I. Reproduction continuous
   A. viviparity (*Hemirhamphodon*)
   B. oviparity
      1. spawning partial
         a. fertilization external (*Chaca*?)
         b. fertilization internal (Phallostethidae)
      2. spawning total (*Calamiana* sp.)

II. Reproduction periodic
   A. viviparity (*Himantura*)
   B. oviparity
      1. spawning partial (some *Osteochilus*?)
      2. spawning total (*Cosmochilus*?)

This simple classification does not account for all physiological and behavioral adaptations involved in fish reproduction. The viviparous or live-bearing categories could be further divided into so-called "ovoviviparity" (yolk nutrition) and "true viviparity" (maternal nutrition); for a critical discussion of this distinction in teleosts see Wourms (1981). While of considerable interest from the standpoints of developmental and evolutionary biology, it is relatively unimportant ecologically whether young internally developed receive nutrition from the yolk or more directly from the mother (in fact both sources of nutrition are maternal); the essential point is that free-living young emerge from the mother. A more important consideration ecologically is the matter of parental care, and this is also of much interest to behaviorists and evolutionary biologists. Parental care is a fundamental aspect of the reproductive biology of many oviparous fishes, and possibly of many viviparous forms as well. This is particularly true of tropical freshwater fishes.

The main kinds of behavioral parental care found in fishes are as follows (adapted with substantial modification from Blumer 1982):

1. Nesting (including nest building, nest maintenance, egg burying).
2. Guarding (agonistic and other protective behavior directed mainly against potential predators on eggs and fry, including coiling body around eggs or fry).
3. Cleaning (removal of foreign matter from eggs, fry, or spawning site; removal of dead eggs or fry).
4. Aerating (fanning eggs or fry with fins or forcing water currents over them through mouth or gills; similar actions may be involved separately or simultaneously in cleaning).
5. Oral transport (carrying one or a few individual eggs or fry for a short period, possibly a fixed action response, in which the primary object is to transport eggs; examples include placing spawn in nest, returning lost eggs or fry to nest).
6. Oral brooding (carrying an entire clutch of eggs or fry in mouth for more or less prolonged periods).
7. External brooding (carrying eggs or fry attached to body or in special brood pouches).
8. Provision of food (see discussion below).

Eggs and larvae of fishes are currently receiving long-overdue attention. Substantial surveys of marine fish larvae have been published (e.g., Leis and Rennis 1984, on Indo-Pacific coral reef fishes) and others are in preparation. A detailed classification of the "reproductive guilds" of fishes, based mainly on larval adaptations, was proposed by Kryzhanovsky (1949). This classification has been translated into English, with extensive emendations and commentary, by Balon (1975, 1981). With notable exceptions, the information on freshwater fishes available to these authors came mainly from the temperate regions of North America and Eurasia. Svensson (1933) made numerous observations on larval fishes in the Gambia River of west Africa, but comparable observations have not been made for other tropical rivers, and no truly broad survey of tropical freshwater fish larvae exists. The eggs and larvae of the great majority of southeast Asian and particularly Bornean freshwater fishes are entirely unknown. Highly specialized mountain stream fishes such as *Gastromyzon* and peculiar catfishes including Chacidae, Sisoridae, Akysidae, and Parakysidae are likely candidates for distinctive larval adaptations, but their larvae have never been observed.

Observations of any kind on reproductive biology are available only for a few of the freshwater fishes of western Borneo. This is especially true of the two largest groups, carps and catfishes. More is known about those with "advanced" parental care, especially the anabantoids, many of which are oral-brooders or bubble-nesters and have been studied in aquaria (the single most important reference to the reproductive and other behavior of these fishes is Forselius 1957). Western Borneo is peculiar in that it has the most diverse assemblage of oral-brooding fishes found anywhere on earth, involving at least 11 species in six families. This is truly remarkable when it is recalled that the total number of fish families known to practice oral-brooding is only 11. Anabantoid oral-brooders of western Borneo include Channidae (*Channa orientalis*), Belontiidae (*Betta pugnax*, *Sphaerichthys*), and Luciocephalidae; non-anabantoid oral-brooders are Osteoglossidae, Ariidae, and Chandidae. The last family was not previously known to have any species with oral-brooding, but this behavior occurs in the Bornean species *Par-*

ambassis apogonoides, in which a male has been observed with nearly 100 young of two age classes in its mouth (reported herein). In addition to oral-brooders, western Borneo has four species of the freshwater syngnathid (pipefish) genus *Doryichthys,* in which the males (as in all members of the family) carry the developing young in an abdominal brood pouch, a viviparous freshwater elasmobranch (*Himantura signifer*), and four species of viviparous freshwater halfbeaks (Hemiramphidae).

While it has not been possible for me to make original observations on reproductive biology for all families of freshwater fishes inhabiting western Borneo, I have tried to identify and document significant or unusual phenomena and to point out worthwhile areas of investigation. Some interesting generalizations or hypotheses have emerged fom this process. A number of notions currently prevalent concerning reproductive biology of freshwater fishes will need to be reconsidered as more groups and species are investigated from tropical regions, especially where the ichthyofauna is exceptionally rich and diverse. There has been almost no study of the very numerous species that are small or very small, or of those that are rare. Small fishes do not have the same reproductive modes as the few relatively large species that have been most studied. The phenomenon of "rarity" or very low population density is poorly studied, but is prevalent in the richest tropical ichthyofaunas, such as that of western Borneo, and here again the modes of reproduction are not or are not likely to be the same as those of better known species. Consideration of reproductive modes in secondary as opposed to primary freshwater fishes should yield further insights.

Freshwater fishes of at least some secondary freshwater families tend to have more "advanced" forms of reproduction and parental behavior than closely related marine species. This is particularly true in rich tropical ichthyofaunas dominated by primary freshwater fishes. The outstanding southeast Asian example of this tendency is provided by the family Hemiramphidae, in which the numerous marine species are all pelagophiles, spawning large numbers of eggs which develop offshore, while the somewhat less numerous freshwater species all have internal fertilization and are mostly viviparous. In *Hemirhamphodon pogonognathus* sexually mature females are almost invariably pregnant, apparently producing one or a few relatively large young every few days until the end of their lives. Further examples are provided by Chandidae, Gobiidae, and Tetraodontidae. One of the five endemic freshwater chandids in western Borneo is an oral-brooder, the only known member of the family with such behavior. At least some and perhaps all of the marine species are pelagophiles with relatively small eggs. Parental behavior in other freshwater chandids is unknown; as of now there is no indication that they are also oral-brooders. Western Borneo has three species of the southeast Asian freshwater tetraodontid genus *Chonerhinos,* all of which produce ovarian eggs 1.5–2.0 mm in diameter (Roberts 1982*e*). This is far larger than the eggs observed in Indo-Pacific coral reef tetraodontids, which are demersal and under 1.0 mm (Leis and Rennis 1984:244). No other information on reproduction in *Chonerhinos* is available; egg size and other aspects of reproductive biology are unknown for the freshwater species of *Tetraodon* inhabiting western Borneo.

So far as I have been able to determine, there are no diadromous fishes inhabiting the Kapuas River. This is in marked contrast to the situation in the Fly River, the largest river in the Australian region, where endemic freshwater species of numerous secondary freshwater families live in the total absence of primary freshwater fishes. In the Fly large species belonging to no fewer than eight secondary freshwater families have been positively or probably identified as diadromous, migrating to brackish or marine environments for spawning (Roberts 1978). Of these eight families, only two—Engraulidae and Datnioididae—occur in the Kapuas, and they are represented by non-diadromous species. Comparisons of the taxonomic composition of secondary freshwater fishes in the Fly, Kapuas, and other large tropical rivers with different ichthyofaunas and consideration of the meager information available on their reproductive biology leads to the hypothesis that fishes with diadromous life histories generally do not survive where primary freshwater fishes are dominant (Roberts 1978:15–21).

The widespread notion that all fishes must have a reproductive "season" is contradicted repeatedly by species in many groups inhabiting large rivers in the "evergreen" equatorial rain forests. In the largest tropical rivers with the richest ichthyofaunas, including the Amazon, Congo, and Kapuas, fishes reproducing throughout the year appear to be particularly numerous. Most information available on reproductive periodicity in such rivers has come from relatively few commercially important species, mainly large forms, reproductively atypical of the ichthyofaunas as a whole. Even some large tropical species of commercial importance may breed continuously, e.g., piranhas (*Serrasalmus*), loricariid catfishes (*Hypostomus* sp.), air-breathing catfishes (Callichthyidae, Clariidae), and many Cichlidae. As more groups with small and rare or otherwise unusual species are examined, it seems likely that specialized reproductive adaptations will be found, and that many will have non-seasonal or continuous reproduction. Examples or probable examples from Borneo include species of such diverse families as Cyprinidae, Chacidae, Hemiramphidae, Syngnathidae, Mastacembelidae, Channidae, Belontiidae, Luciocephalidae, and Tetraodontidae. In all of these families one or more species have been observed in which mature females tend to be reproductively active regardless of the time of year. In most instances very small juveniles have also been found whenever the species was moderately abundant and extensive collections of small fishes were made. Some observations are presented here, and more information can be found scattered in the systematic account of this monograph (e.g., under *Rasbora axelrodi, R. bankanensis, Betta dimidiata, Calamiana* sp.). Some species of *Mastacembelus,* especially the large *M. erythrotaenia,* evidently have highly restricted reproductive periods, since the young are unknown or very rarely collected, and even large females are rarely gravid. A notable exception, however, is provided by *M. maculatus.* In this relatively small species, large samples usually include gravid females. Very small *Mastacembelus* collected in the Malay Peninsula and western Borneo usually belong to *M. maculatus.* Females have a darkly pigmented, elongate, tubular genital papilla which I tentatively identify as an ovipositor, but oviposition and other aspects of reproductive behavior have not been observed. A similar genital papilla occurs in the closely related species *M. guentheri* of India but is otherwise unknown in Mastacembelidae. More observations are needed, but the freshwater pipefishes of the genus *Doryichthys* are probably reproductively active at all times. Syngnathidae as a group evidently have continuous ovulation, each ovary producing a unicellular layer of follicles of gradually increasing size (see Wallace

and Selman 1981:334–335, fig. 14c). While ovulation is interrupted for prolonged periods in pipefishes in temperate regions, tropical species might continuously produce synchronous clutches of eggs without interruption for long periods. It seems fairly clear from numerous accounts that various oral-brooding and bubble-nesting anabantoids breed throughout the year. Extensive observations are reported herein indicating that the viviparous halfbeak *Hemiramphodon pogonognathus* bears live young throughout the annual cycle and that its reproduction continues uninterruptedly for long periods (presumably until the end of life). For the great majority of fishes in western Borneo, however, many of which are smaller than any of those discussed here, no information is available concerning frequency or timing of reproduction. Based on the information available on some of the small and very small species, reproduction probably occurs throughout the year in many of them, unless terminated by food scarcity or other unfavorable conditions. In my opinion, considering tropical freshwater fishes as a whole, it is generally inappropriate to speak of "reproductive seasons." Many of the large, highly migratory species with marked reproductive periodicity are total spawners, undergoing massive spawning in response to environmental cues or triggers within a very short period of time which hardly constitutes a "season." At the other extreme, numerous statements like "reproductive season March–October" are suspect; they are often based on inadequate information, and often do not correspond to any recognized seasonal phenomena of an ecological or climatological nature. In many instances it might be more appropriate to think rather in terms of "interrupted reproduction" or a "nonreproductive season." Probably it would be best to dispense with the notion of seasonality altogether and instead look for factors such as resource availability (mates, food, spawning sites) and other parameters which affect reproductive activities. For a critical review and new approaches to the study of reproductive periodicity in tropical freshwater fishes see Kirschbaum (1984).

Extensive comparative studies have not been done on the gonads of tropical freshwater fishes, and surprisingly little information is available about their gametes. Students of fecundity have assumed that ecological and life history parameters are directly related to fecundity. It is commonly taken for granted that in oviparous species all eggs produced are spawned, and that all eggs spawned are fertilized, but neither assumption is justified. I suspect that in some highly fecund fishes, only a portion of the eggs produced may be spawned, and that the proportion fertilized varies greatly depending on many factors. Internal fertilization occurs in all viviparous (including ovoviviparous) fishes, but the extent of internal or "oviducal" fertilization among oviparous fishes is unknown; it may be more widespread than realized. An advantage of oviducal fertilization, apart from insuring fertilization, is that it may permit temporal separation of mating and spawning. Thus mating can occur whenever sexually active males and females come together, and spawning can occur intermittently over a long period after they have separated. Oviducal fertilization, documented in the oviparous Neotropical catfish family Auchenipteridae (von Ihering 1937), is possibly widespread among catfishes.

Many catfishes have males with an elongate genital papilla, the significance of which is unknown. An even more widely distributed characteristic of male catfishes is possession of lobate testes. These first came to my attention while studying the west African amphiliid *Amphilius atesuensis* Boulenger, 1904, mature males of which have an elongate genital papilla. Since then I have found lobate testes in one or more species representing 18 of the 32 families of catfishes currently recognized. These families are Amblycipitidae, Bagridae (*Bagrichthys, Leiocassis, Mystus*), Pimelodidae, Ictaluridae, Cranoglanidae, Olyridae, Schilbeidae (*Pseudeutropius brachypopterus*), Pangasiidae, Mochokidae, Auchenipteridae, Ageneiosidae, Cetopsidae, Amphiliidae, Sisoridae (*Bagarius, Glyptothorax*), Akysidae (all genera), Parakysidae, Clariidae, Heteropneustidae, and Plotosidae. Lobate testes have not been observed in Ariidae or any of the South American loricarioid families (many of which have been examined), or in any other ostariophysans. The morphological peculiarity of catfish testes has received little attention. Lobate testes were reported, apparently for the first time, in the South American auchenipterid *Trachycorystes galeatus* (Linnaeus, 1758), by von Ihering (1937); in this species males have an enlarged genital papilla attached to the modified anterior portion of the anal fin, and fertilization is internal ("oviducal"). Whether internal fertilization occurs in some or many other catfishes is unknown. It may be significant that males of catfishes living in mountain streams often have a particularly long genital papilla (e.g., Astroblepidae), but this does not necessarily indicate it is employed as an intromittent organ. A few other reports of catfish lobate testes have come to my attention: Sundaraj (1958) for *Heteropneustes fossilis* (Bloch, 1797); Nawar (1959) for *Clarias lazera* Valenciennes *in* Cuvier and Valenciennes, 1840*a*; Sneed and Clemens (1964) for Ictaluridae; and Tilak and Hussain (1973) for *Glyptothorax brevipinnis* Hora, 1923. In catfishes both testes are usually well developed. The number of lobes is typically 20–30 for each testis, but in many instances they number in the hundreds. The lobes generally are elongate and tapered, but may be threadlike, globose, or otherwise modified; *Pangasius pangasius* (Hamilton-Buchanan, 1822) has multilocular lobes. The lobes may become so hypertrophied that the abdomen of a ripe male is nearly as distended as that of a gravid female. Lobe formation may begin long before sexual maturity. The disposition of the lobes, which may be obvious or obscured in adults, is usually (invariably?) lateral. In many instances size and superficial morphology of the lobes is identical for the entire length of the testes, but in others the anterior and posterior lobes may be strongly differentiated (e.g., in *Trachycorystes*, Clariidae, Heteropneustidae, and Ictaluridae). In such instances the anterior lobe are reportedly seminiferous and the posterior lobes non-seminiferous. In *Trachycorystes* the posterior lobes secrete a gelatinous substance interpreted as an "oviducal plug" (von Ihering 1937), but which is probably a spermozeugma. In a few catfishes I have observed amber or orangish concretions at the posterior end of the testes (e.g., in *Pseudeutropius brachypopterus*), but thus far I have not found similar concretions in the oviduct of females. For a review of spermozeugma and spermatophores in teleosts see Nielsen et al. (1968).

One area in which field observations of parental behavior is likely to provide new information is parental food supply for the young. Observers should watch for the following possible kinds of behavior:

a) ectodermal feeding (production of ectodermal secretions fed upon by fry);
b) egg feeding (mother provides eggs fed upon by fry);
c) regurgitation (parents regurgitate food for fry to feed upon);

d) fecal feeding (parents facilitate feeding of fry on fecal matter);
e) other forms of food provisioning (including killing or disabling prey fed upon by fry).

Ectodermal feeding is well documented in a few tropical freshwater fishes (e.g., the South American cichlids of the genus *Symphysodon*) but is as yet unknown in those of Borneo. Most catfishes (including many in Borneo) have pectoral glands which discharge a copious milk- or mucus-like substance through an axillary pore, but there is no evidence as yet that this substance is fed upon by the young (see observations on pectoral glands of *Pangasius* herein). The literature on reproductive and feeding behavior of fishes is replete with references to oophagy or egg-eating: fish eggs are preyed upon by conspecifics as well as a vast array of vertebrate and invertebrate heterospecifics. Many fishes guard the eggs to protect them from predation. In many instances, however, one or both parents will feed upon their own eggs. Intrauterine oophagy is now well documented in viviparous sharks of the family Isuridae. Egg feeding behavior should be watched for in species with free-living fry. If the egg-eating opportunity arises as a result of maternal behavior, it would constitute a form of parental care. So far as I am aware, there is no direct evidence of parental feeding by regurgitation or fecal supplying in fishes. Fecal feeding is very important in fishes generally, and conceivably may be involved in parental care. Observations of gut contents in young of the ant-eating hemiramphid *Hemirhamphodon pogonognathus* (q.v.) indicate that parental regurgitation or defecation may be involved. Other forms of parental food provisioning probably do occur. I suspect that killing of "excess" prey by large individuals of the snakehead *Channa micropeltes* (Smith 1945; herein) represents parental food supplying, and that similar behavior occurs in other large predatory fishes with protracted parental care. Finally, it should be noted that parental food supplying involving regurgitation, feces, or killed or disabled prey might provide important learning experiences for the young.

To summarize, no observations on reproduction are available for the majority of taxa of freshwater fishes in Borneo. Enough is known to indicate that their reproductive biology is diverse and that exciting discoveries await investigators with access to the fauna. Reproduction of the relatively few large species is generally different from that of the numerous small and very small species and should not be regarded as typical. Continuous or nearly continuous reproduction appears to be widespread. Periodic reproduction is poorly documented and not well understood.

Collecting Localities of the Kapuas Ichthyological Survey of 1976

Fieldwork in western Borneo (Kalimantan Barat) from 10 July through 23 August 1976 resulted in 55 collections from diverse freshwater habitats almost exclusively within the Kapuas River basin. These collections are designated Kapuas 1976-1 through 55 (Fig. 1). It should be noted that Kapuas 1976-19, 52, and 53 were obtained from fish markets at Sintang, Pontianak, and Kampong Djunkat, respectively, and that Kapuas 1976-4 through 7 were made in small coastal drainages (including the Mempawah) immediately N of the Kapuas basin. The rest are from habitats within the Kapuas basin.

Localities of the Kapuas survey of 1976 (Fig. 2, 3) were plotted in the field on series TPC topographic maps (scale 1:500,000, edition 2-GSGS). Distances and coordinates were subsequently calculated and Figure 1 prepared from the same maps. All place names employed in the locality descriptions are indicated on these maps.

Kapuas 1976-1. Small forest stream and man-made ditch, 2–3 m wide and 1 m deep, flowing into Sungai Sepatah, a tributary to Sungai Mandor; 24 km NE of Pontianak. Lat. 0°07.5′N, long. 109°30′E. Current moderately swift. Rotenone. 10 July.

Puntius pentazona, Rasbora cephalotaenia, R. dusonensis, R. einthoveni, R. pauciperforata, Stigmatogobius sp., *Betta anabatoides, B. taeniata, Channa lucius.*

Kapuas 1976-2. Man-made canal, 1–2 m wide and 20 cm–1 m deep, flowing into Sungai Landok; 5 km E of Pontianak. Lat. 0°01′S, long. 109°23′E. Current sluggish to nil. Push net, dip nets. 10 July.

Rasbora dusonensis, Brachygobius doriae, Mugilogobius spp., *Channa striata.*

Kapuas 1976-3. Sungai Durian, tidal creek 2–6 m wide and 10 cm–1 m deep (low tide), flowing directly into Kapuas Ketchil; 7–8 km E of Pontianak. Lat. 0°01′N, long. 109°16′E. Current moderate, pH 6. Push net, dip nets. 13 July.

Rasbora dusonensis, Dermogenys cf. *orientalis, Doryichthys doekhatoides, Butis gymnopomus, Brachygobius doriae, Mugilogobius* sp., *Pseudogobiopsis* sp., *Stigmatogobius brocki.*

Kapuas 1976-4. Small stream tributary to Sungai Penju, a small coastal drainage; about 43 km NW of Pontianak and 8 km SW of Andjongan. Lat. 0°18.5′N, long. 109°07′E. Current moderate, water brownish tinted, pH 4.5–5. Push net, dip nets. 13 July.

Puntius rhomboocellatus, Rasbora pauciperforata, Neohomaloptera johorensis, Belontia hasseltii, Betta taeniata, Parosphromenus deissneri, P. parvulus, Sphaerichthys osphromenoides.

Kapuas 1976-5 (Fig. 2a). Sungai Kepayang, 3–8 m wide and maximum 2 m deep, flowing into Sungai Penju; about 44 km NW of Pontianak and 7 km SW of Andjongan. Lat. 0°19′N, long. 109°08′E. Current moderate, water dark brown tinted, blackish when viewed from above, 27°C, pH 4.5–5. Push net; rotenone and dip nets. 13 July.

Osteochilus spilurus, Puntius rhomboocellatus, Rasbora agilis, R. axelrodi, R. pauciperforata, Kryptopterus macrocephalus, Hemirhamphodon pogonognathus, Stigmatogobius brocki, Betta taeniata, Parosphromenus deissneri, P. parvulus, Sphaerichthys osphromenoides.

Kapuas 1976-6. Sungai Paklehung, a low-lying forested hill-stream tributary to Sungai Mempawah, 5 m wide and 1 m deep; 48 km NNW from Pontianak, 9 km NE of Andjongan, and 1–3 km upstream from Toho. Elevation less than 100 m. Lat. 0°24.5′N, long. 109°13.5′E. Current moderately swift; water clear to slightly turbid, 25°C, pH 7; bottom with boulders, cobbles, and coarse gravel grading to fine sand. Rotenone. 13 July.

Crossocheilus oblongus, Cyclocheilichthys armatus, Hampala macrolepidota, Lobocheilus hispidus, Osteochilus enneaporos, Osteochilus hasselti, O. waandersii, Paracrossochilus vittatus, Puntius binotatus, P. lateristriga, Rasbora caudimaculata, R. myersi, R. sarawakensis, Homaloptera nebulosa, Acantophthalmus shelfordi, Mystus nemurus, Silurichthys hasselti, Clarias leiacanthus, Hemirhamphodon phaiosoma, Betta pugnax, Mastacembelus maculatus.

Kapuas 1976-7. Sungai Sekilap, tributary to Sungai Mem-

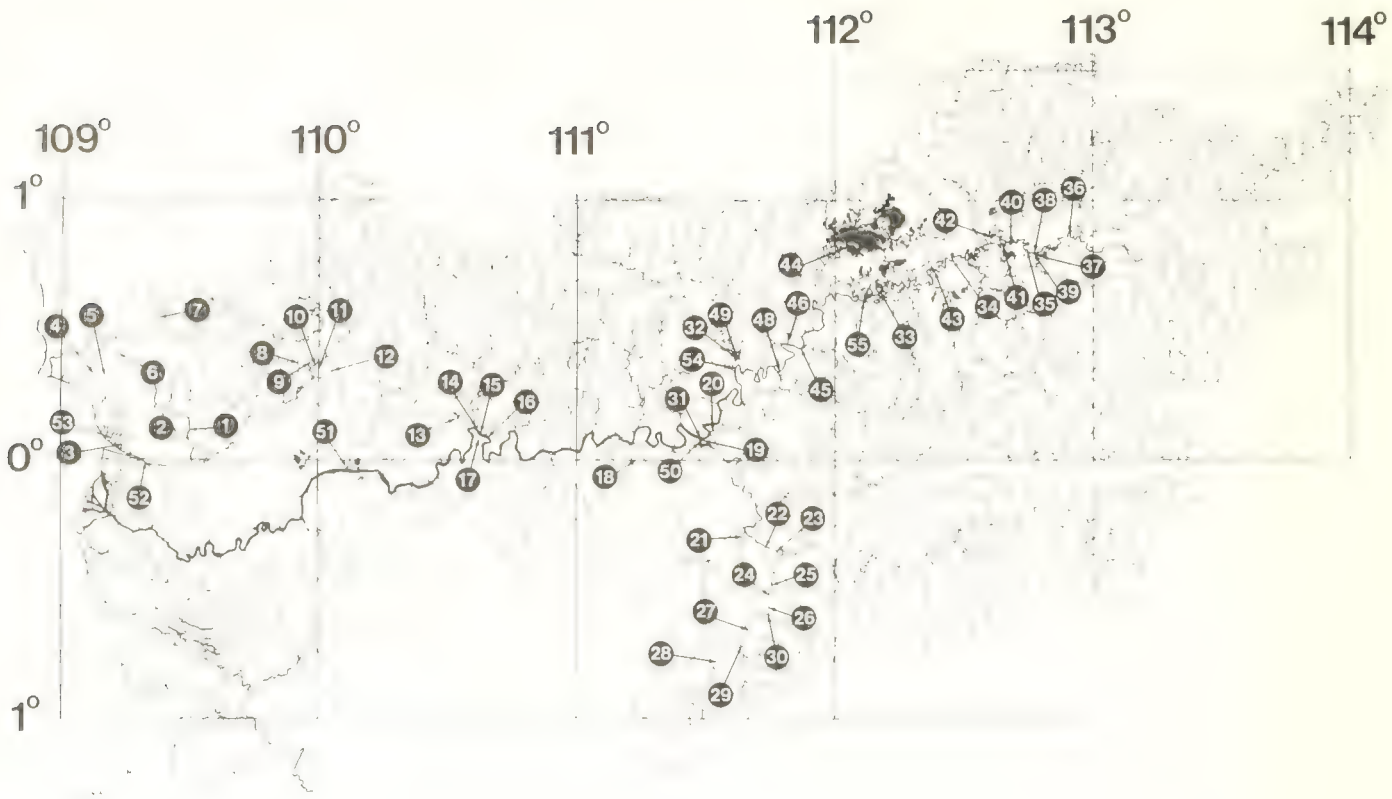

FIGURE 1. Drainage network of Kapuas and Mempawah rivers, with collecting localities of Kapuas survey of 1976

pawah; about 64 km N of Pontianak and 38 km by road NE of Andjongan. Lat. 0°33.5′N, long. 109°22.5′E. Water temp. 24°C, pH 7. Rotenone. 14 July.

Chela maassi, Cyclocheilichthys apogon, Osteochilus hasselti, Puntius anchisporus, P. binotatus, Rasbora agilis, R. bankanensis, R. brittani, R. pauciperforata, Acantophthalmus shelfordi, Nemacheilus selangoricus, Hemirhamphodon pogonognathus, Doryichthys martensii, Pristolepis fasciata, Brachygobius xanthomelas, Betta taeniata, Parosphromenus deissneri, Mastacembelus maculatus.

Kapuas 1976-8, Sungai Kenyatan, shaded forest tributary to Sungai Landak, 3–7 m wide and 1.5 m deep; about 65 km NE of Pontianak and 27 km by road W of Ngabang. Lat. 0°24′N, long. 109°44.5′E. Current slow, water turbid, brownish, 27°C, pH 6–6.5. Rotenone. 14 July.

Cyclocheilichthys apogon, Osteochilus hasselti, O. spilurus, Oxygaster hypophthalmus, Rasbora agilis, R. bankanensis, R. cephalotaenia, Homaloptera nebulosa, Acantophthalmus shelfordi, Nemacheilus saravacensis, N. selangoricus, Mystus micracanthus, M. nigriceps, Kryptopterus macrocephalus, Silurichthys phaiosoma, Hemirhamphodon pogonognathus, Xenentodon canciloides, Gymnochanda filamentosa, Nandus nebulosus, Pristolepis fasciata, Betta taeniata, Parosphromenus deissneri, Luciocephalus pulcher, Channa lucius, Macrognathus aculeatus, Mastacembelus maculatus.

Kapuas 1976-9. Sungai Landak at Ngabang, large river about 50 m wide; 83 km ENE of Pontianak. Lat. 0°23.5′N, long. 109°53′E. Current moderate, water turbid, 26°C, pH 7.5; bottom coarse sand to gravel. Seine at night. 15 July.

Clupeichthys bleekeri, Cyclocheilichthys heteronema, Oxygaster hypopththalmus, Puntius bramoides, Rasbora bankanensis, R. trilineata, Acantopsis choirorhynchos, Kryptopterus minor (type locality), *Laides hexanema, Xenentodon canciloides, Chonerhinos amabilis* (type locality).

Kapuas 1976-10. Sungai Belantian, 20–30 m wide and 1–2 m deep; 87 km ENE of Pontianak and 6 km by road E of Ngabang. Lat. 0°22′N, long. 109°59.5′E. Current swift; water clear with brownish tint, 25°C, pH 7.5; bottom sand or gravel with some cobblestones, branches and logs. Push net and cast net. 15 July.

Cyclocheilichthys armatus, Rasbora agilis, R. bankanensis, R. brittani, R. pauciperforata, Homaloptera ogilviei, H. tweediei, Acanthopsoides gracilis, Nemacheilus selangoricus, Acrochordonichthys cf. *melanogaster, Hemirhamphodon pogonognathus, Doryichthys martensii.*

Kapuas 1976-11. Swampy, densely overgrown ditch, 1–2 m wide and 1 m deep, 87 km ENE of Pontianak, 7 km by road E of Ngabang. Lat. 0°22′N, long. 110°00′E. Current sluggish or nil; water 26°C, pH 6. Push net. 15 July.

Puntius pentazona, Rasbora einthovenii, Rasbora pauciperforata, Hemirhamphodon pogonognathus, Luciocephalus pulcher.

Kapuas 1976-12. Small forested stream, 2–4 m wide and 20–50 cm deep, 91 km ENE of Pontianak and 17 km by road E of Ngabang. Lat. 0°19.5′N, long. 110°05.5′E. Current moderately swift; water clear, slightly brownish, 25°C, pH 6.5; bottom gravel or sand, with rocks, logs, and leaf litter. Push net, rotenone. 15 July.

Rasbora sarawakensis, R. sumatrana, Acantophthalmus shelfordi, Nemacheilus selangoricus, Glyptothorax major, Hemirhamphodon phaiosoma.

Kapuas 1976-13. Sungai Engkonis, small forest stream 2–4 m wide and 1 m deep, 13 km WNW of Sanggau. Lat. 0°10′N, long. 110°28′E. Current moderate; water turbid, 25°C, pH 6. Push net. 15 July.

Osteochilus hasseltii, Rasbora bankanensis, R. sarawakensis, Homaloptera tweediei, Acantophthalmus shelfordi, Hemirhamphodon sp., *Doryichthys martensii, Nandus nebulosus, Mugilogobius* sp., *Betta pugnax, Luciocephalus pulcher, Channa lucius, Mastacembelus notophthalmus* (type locality).

Kapuas 1976-14. Kapuas mainstream and mouth of Sungai Sekayam at Sanggau. Lat. 0°07′N, long. 110°35′E. Current moderate; water turbid. Kapuas mainstream 26°C, pH 6.5; Sekayam mouth 25°C, pH 7.5. Cast net, floating gill nets, seine. 17 July.

Clupeichthys bleekeri, Clupeoides hypselosoma, Lycothrissa crocodilus, Crossocheilus cobitis, C. oblongus, Cyclocheilichthys armatus, Dangila fasciata, D. lineata, Epalzeorhynchos kalopterum, Lobocheilus sp., *Luciosoma spilopleura, Oxygaster hypophthalmus, Puntioplites bulu, P. waandersi, Puntius bramoides, Rasbora borneensis, R. dusonensis, R. myersi, Homaloptera tweediei, Ellopostoma megalomycter, Kryptopterus bicirrhis, K. cryptopterus, K. schilbeides, Laides hexanema, Chanda apogonoides, C. wolffii, Paradoxodacna piratica* (type locality), *Toxotes microlepis, Brachygobius xanthomelas, Osphromenus goramy, Cynoglossus kapuasensis, Achiroides melanorhynchus, Tetraodon leiurus.*

Kapuas 1976-15. Sungai Engkayas where it flows into right side of Kapuas mainstream about 2 km upstream from Sanggau. Lat. 0°07.5′N, long. 110°36′E. Water clear, brown tinted, 27°C, pH 7.5; bottom leaf litter and logs. Rotenone. 16 July.

Clupeichthys bleekeri, Lycothrissa crocodilus, Balantiocheilos melanopterus, Cyclocheilichthys heteronema, Dangila lineata, Epalzeorhynchos kalopterum, Leptobarbus hoevenii, Lobocheilus sp., *Osteochilus microcephalus, Oxygaster hypophthalmus, Puntioplites bulu, Puntius bramoides, Rasbora dusonensis, R. myersi, Rasbora* sp., *Thynnichthys polylepis, Ellopostoma megalomycter, Mystus nemurus, Chanda apogonoides, Toxotes microlepis, Osphromenus goramy.*

Kapuas 1976-16. Sungai Tekam, small forest stream, where it enters right side of Kapuas mainstream about 5–6 km upstream from Sanggau. Lat. 0°06.5′N, long. 110°37′N. Water 25°C, pH 6.5. Rotenone. 16 July.

Cyclocheilichthys apogon, Dangila fasciata, Eirmotus octozona, Epalzeorhynchos kalopterum, Luciosoma trinema, Osteochilus borneensis, O. microcephalus, O. spilurus, O. waandersii, Oxygaster anomalura, Puntius anchisporus, P. eugrammis, P. pentazona, Rasbora agilis, R. argyrotaenia, R. borneensis, R. dorsiocellata, R. trilineata, Homaloptera tweediei, Acantophthalmus semicinctus, A. shelfordi, A. superbus (type locality), *Lepidocephalichthys pristes* (type locality), *Vaillantella euepiptera, Mystus micracanthus, Mystus nemurus, Silurichthys sanguineus* (type locality), *Wallago leerii, Chaca bankanensis, Hemirhamphodon pogonognathus, Doryichthys boaja, Doryichthys deokhatoides, Monopterus albus, Nandus nebulosus; Oxyeleotris marmorata, Brachygobius xanthomelas, Calamiana* sp., *Belontia hasseltii, Betta dimidiata* (type locality), *Betta pugnax, Sphaerichthys vaillanti, Trichogaster leerii, T. trichopterus, Helostoma temminckii, Macrognathus aculeatus, Mastacembelus erythrotaenia, Achiroides* sp.

Kapuas 1976-17. Several small forest streams where they flow into Kapuas mainstream within 10 km upstream from Sanggau. Lat. 0°06–07′N, long. 110°35–38′E. Water 24°C, pH 6–6.5. Rotenone. 16–17 July.

Cyclocheilichthys apogon, Eirmotus octozona, Luciosoma setigerum, Osteochilus borneensis, O. intermedius, O. kahajanensis, O. microcephalus, O. spilurus, Oxygaster anomalura, Pectenocypris balaena (type locality), *Puntius rhomboocellatus, Rasbora agilis, R. argyrotaenia, R. bankanensis, Acantophthalmus semicinctus, A. shelfordi, A. superbus* (type locality), *Lepidocephalichthys pristes* (type locality), *Vaillantella euepiptera, Mystus micracanthus, M. nemurus, Glyptothorax major, Clarias leiacanthus, Hemirhamphodon pogonognathus, Doryichthys deokhatoides, Monopterus albus, Eleotris melanosoma, Oxyeleotris marmorata, Brachygobius xanthomelas, Betta dimidiata* (type locality), *B. pugnax, Trichogaster leerii, Luciocephalus pulcher, Macrognathus aculeatus, Mastacembelus maculatus.*

Kapuas 1976-18. Small swampy stream about 30 km W of Sintang on road from Sanggau to Sintang. Approx. lat. 0°00′, long. 111°14′E. Push net. 18 July.

Eirmotus octozona, Puntius eugrammus, Lepidocephalichthys pristes (type locality).

Kapuas 1976-19. Fish market at Sintang. 19 July–1 August.

Himantura signifer (type locality), *Notopterus borneensis, Scleropages formosus, Lycothrissa crocodilus, Amblyrhynchichthys truncatus, Barbichthys laevis, Cosomochilus falcifer, Dangila festiva, Morulius chrysophekadion, Osteochilus microcephalus, O. schlegeli, O. triporos, Oxygaster hypophthalmus, Botia macracantha, Bagrichthys hypselopterus, B. macropterus, Bagroides melapterus, Mystus micracanthus, M. nigriceps, M. olyroides* (type locality), *Belodontichthys dinema, Ceratoglanis scleronema, Hemisilurus heterorhynchos, H. moolenburghi, Kryptopterus apogon, K. bicirrhis, K. cryptopterus, K. limpok, Pangasius humeralis* (type locality), *P. lithostoma* (type locality), *P. nasutus, P. polyuranodon, Bagarius yarrelli, Chaca bankanensis, Arius melanochir, A. stormii, Chanda macrolepis, C. wolffii, Datnioides microlepis, Pristolepis fasciata, Polynemus macrophthalmus, P. multifilis, Oxyeleotris marmorata, Trichogaster leerii, Osphromenus goramy, Channa lucius, Cynoglossus kapuasensis, Tetraodon palembangensis.*

Kapuas 1976-20. Lower part of Sungai Kebian, a large forested stream flowing into Kapuas mainstream 5 km upstream from confluence of Sungai Melawi. Lat. 0°07′N, long. 111°32′E. Current swift; water clear, tinted dark brown, pH 5.5 Local fishermen using "jermal." 19 July–1 August.

Notopterus borneensis, Balantiocheilos melanopterus, Barbichthys laevis, Cyclocheilichthys janthochir, Dangila ocellata, Leptobarbus hoevenii, Luciosoma setigerum, L. trinema, Macrochirichthys macrochir, Osteochilus melanopleura, O. triporos, Oxygaster oxygastroides, Puntioplites bulu, Puntius eugrammus, Thynnichthys polylepis, Leiocassis micropogon, Mystus nigriceps, Ompok hypophthalmus, Pseudeutropius brachypopterus, Chanda macrolepis, Datnioides microlepis, Trichogaster leerii, Channa marulioides, C. pleurophthalmus.

Kapuas 1976-21. Sungai Belimbing, large forested stream 30 m wide and 2 m deep, 46 km SSE of Sintang and 15 km by road WNW of Nangapinoh. Lat. 0°18.5′S, long. 111°38.5′E.

FIGURE 2. Kapuas survey of 1976. Habitats. a, Sungai Kepayang (Kapuas 1976-5); b, lowland forest stream (Kapuas 1976-37); c–d, Danau Piam (Kapuas 1976-32)

Water clear, little or no brown tint. Push net in finely divided roots of large tree underneath overhanging bank and in riffles. 20 July.

Cyclocheilichthys armatus, Osteochilus microcephalus, Rasbora agilis, Acantophthalmus anguillaris, A. shelfordi, Acanthopsoides gracilis, Vaillantella euepiptera, Leiocassis armatus, Mystus nemurus, Doryichthys martensii, Mastacembelus notophthalmus (type locality), *M. unicolor.*

Kapuas 1976-22. Sungai Melawi and mouth of Sungai Pinoh at Nangapinoh. Lat. 0°19.5′S, long. 111°44′E. Current moderate to strong; water clear to slightly turbid; Melawi mainstream 28°C, pH 7.5, Pinoh near mouth 28°C, pH 7–7.5. Seine daytime and night. 21 and 26 July.

Clupeichthys bleekeri, Cyclocheilichthys armatus, Luciosoma spilopleura, Rasbora bankanensis, Homaloptera zollingeri, Acantopsis choirorhynchos, Acanthopsoides gracilis, Botia macracantha, Ellopostoma megalomycter, Kryptopterus minor (type locality), *K. cryptopterus, Xenentodon canciloides, Doryichthys martensii, Gymnochanda filamentosa.*

Kapuas 1976-23. Sungai Serundung, small forested stream flowing into Sungai Melawi mainstream 1–2 km upstream from Nangapinoh. Lat. 0°20′S, long. 111°45.5′E. Local fishermen. 21 July.

Rasbora kalochroma, R. pauciperforata, Betta anabatoides.

Kapuas 1976-24. Mainstream of Sungai Pinoh 20–60 km upstream from Nangapinoh. Lat. 0°27.5–41.5′S, long. 111°39–45.5′E. Current swift; water clear, 24–25°C, pH 7.5; bottom with gravel, cobbles, or large rocks. Cast nets. 22–26 July.

Crossocheilus cobitis, C. oblongus, Cyclocheilichthys repasson, Epalzeorhynchos kalopterum, Garra borneensis, Hampala bimaculata, Luciosoma setigerum, Mystacoleucus marginatus, Osteochilus enneaporos, Paracrossochilus acerus, P. vittatus, Puntius collingwoodi, Rasbora bankanensis, R. elegans, R. myersi, R. sarawakensis, R. volzi, Schismatorhynchos heterorhynchos, Tor tambroides, Gastromyzon contractus (type locality) *G. fasciatus, G. ridens* (type locality), *Nemacheilus kapuasensis* (type locality), *Mystus nemurus, Glyptothorax platypogon, G. platypogonoides, Doryichthys martensii, Pristolepis fasciata, Osphromenus goramy, Mastacembelus maculatus, M. unicolor, Chonerhinos amabilis* (type locality).

Kapuas 1976-25. Sungai Tebelian, small forest stream 3–4 m wide and 50 cm deep, where it flows into Sungai Pinoh, 19 km of S Nangapinoh. Lat. 0°30′S, long. 111°45′E. Current moderately swift; water clear, not tinted, 24°C, pH 7.5; bottom sand or gravel with cobblestones, logs. Rotenone. 22 July.

Cyclocheilichthys armatus, Garra borneensis, Hampala bimaculata, Osteochilus enneaporos, Paracrossochilus vittatus, Puntius binotatus, P. lateristriga, Rasbora bankanensis, R. elegans, R. ennealepis (type locality), *R. sarawakensis, R. volzi, Tor tambroides, Gastromyzon contractus* (type locality), *G. fasciatus, Homaloptera nebulosa, Acanthopsoides gracilis, Nemacheilus selangoricus, Nemacheilus kapuasensis* (type locali-

ty), *Mystus nemurus, Hemirhamphodon phaiosoma, Doryichthys martensii, Mastacembelus maculatus, M. unicolor.*

Kapuas 1976-26. Sungai Sekumpai, a small forest stream 3–4 m wide and 50 cm deep, where it flows into Sungai Pinoh, 19 km S of Nangapinoh. Lat. 0°32′S, long. 111°39.5′E. Water clear, 25°C, pH 7.5. Rotenone. 22 July.

Paracrossochilus vittatus, Rasbora elegans, R. ennealepis (type locality) *R. sarawakensis, Gastromyzon fasciatus, Homaloptera nebulosa, Nemacheilus kapuasensis* (type locality), *Silurichthys hasselti, Hemirhamphodon phaiosoma.*

Kapuas 1976-27 (Fig. 3c). Rocky channel in mainstream of Sungai Pinoh, 37 km S of Nangapinoh. Lat. 0°39.5′S, long. 111°40′E. Current swift; water clear, 25°C, pH 7.5. Rotenone, cast net. 24 July.

Barilius borneensis (type locality), *Crossocheilus cobitis, C. oblongus, Epalzeorhynchos kalopterum, Hampala macrolepidota, Mystacoleucus marginatus, Osteochilus enneaporos, O. microcephalus, Paracrossochilus vittatus, Puntius collingwoodi, Rasbora bankanensis, Rasbora* cf. *ennealepis, Schismatorhynchos heterorhynchos, Gyrinocheilus pustulosus, Gastromyzon contractus* (type locality), *G. fasciatus, Homaloptera nebulosa, H. ophiolepis, H. stephensoni, H. zollingeri, Botia reversa* (type locality), *Nemacheilus maculiceps* (type locality), *Nemacheilus kapuasensis, Leiocassis micropogon, Mystus nemurus, Glyptothorax platypogon, Pristolepis fasciata, Mastacembelus unicolor.*

Kapuas 1976-28. Small forested streams flowing into Sungai Pinoh near village of Ribang-Rabing, about 55 km SSE of Nangapinoh and 2 km NE of Kotabahru. Lat. 0°47′S, long. 111°33′E. Push net; most fishes caught by villagers using herbigenous ichthyocides. 24 July.

Cyclocheilichthys apogon, Osteochilus kappenii, Rasbora bankanensis, R. sarawakensis, Leiocassis micropogon, Mystus nemurus, Kryptopterus sp., *Doryichthys martensii, Pristolepis fasciata, Mastacembelus maculatus, M. notophthalmus* (type locality).

Kapuas 1976-29 (Fig. 3a). Rocky channel in mainstream of Sungai Pinoh at Nanga Saian, 45 km S of Nangapinoh. Lat. 0°43′S, long. 111°38.5′E. Current moderate; water tinted dark brown, 25°C, pH 7. Rotenone. 26 July.

Crossocheilus cobitis, Epalzeorhynchos kalopterum, Osteochilus enneaporos, O. microcephalus, Paracrossochilus acerus, P. vittatus, Rasbora bankanensis, Schismatorhynchos heterorhynchos, Tor tambroides, Homaloptera nebulosa, H. stephensoni, H. zollingeri, Acantophthalmus oblongus, Botia macracantha, Nemacheilus maculiceps, Nemacheilus kapuasensis, Vaillantella maassi, Mystus nemurus, M. wyckii, Kryptopterus minor (type locality), *Doryichthys martensii, Osphromenus goramy, Mastacembelus unicolor.*

Kapuas 1976-30. Sungai Tamang, small forested stream with rocky bottom flowing into Sungai Pinoh opposite mouth of Sungai Kelawai. Lat. and long. uncertain due to irreconcilable map sources, approx. 0°35′S, 111°44′E. 26 July.

Cyclocheilichthys armatus, Luciosoma setigerum, Paracrossochilus vittatus, Puntius lateristriga, Rasbora volzi, Rasbora sp., *Tor tambra, Gastromyzon fasciatus, Homaloptera nebulosa, H. orthogoniata, Hypergastromyzon humilis* (type locality), *Mystus nemurus, Glyptothorax platypogon, Clarias leiacanthus, Hemirhamphodon phaiosoma, Betta anabatoides, Channa orientalis, Mastacembelus maculatus.*

Kapuas 1976-31 (Fig. 3d). Bar in mouth of Sungai Melawi at Sintang. Lat. 0°35′S, long. 111°29′E. Bottom gently sloping, fine sand to coarse gravel. Seine at night. 29 July.

Crossocheilus cobitis, C. oblongus, Dangila ocellata, Luciosoma spilopleura, Osteochilus microcephalus, Puntius bramoides, Rasbora bankanensis, R. borneensis, R. myersi, R. trilineata, Bagarius yarrelli, Akysis pseudobagarius (type locality), *Clarias leiacanthus, Paradoxodacna piratica* (type locality).

Kapuas 1976-32 (Fig. 2c, d). Danau Piam near Ketungau, 38 km NNE of Sintang. Lat. 0°23.5′N, long. 111°37.5′E. Water 26°C, pH 5.5–6. Seine, cast net, rotenone. 5–6 August.

Cyclocheilichthys armatus, C. janthochir, Leptobarbus melanopterus, Osteochilus spilurus, Oxygaster hypophthalmus, O. oxygastroides, Pectenocypris balaena (type locality), *Puntius lineatus, P. rhomboocellatus, Rasbora dorsiocellata, R. myersi, R. pauciperforata, R. subtilis* (type locality), *Homaloptera stephensoni, Lepidocephalichthys pristes, Mystus micracanthus, Ompok eugeneiatus, Pseudeutropius brachypopterus, P. moolenburghae, Xenentodon canciloides, Betta dimidiata* (type locality), *Sphaerichthys vaillanti, Trichogaster leerii, Channa pleurophthalma, Cynoglossus waandersi.*

Kapuas 1976-33. Kapuas mainstream, Danau Mawan, and "Danau Bahru" near Kampong Nibung, about 100 km NE of Sintang and 7 km NE of Selimbau. Lat. 0°39′N, long. 112°10.5′E. Kapuas mainstream 26°C, pH 5.5–6, Danau Mawan 33–34°C, pH 8–9.5. Many specimens caught by fishermen of Nibung using cast nets and life nets; seine at night; gill nets. 5–7 August.

Clupeichthys bleekeri, Lycothrissa crocodilus, Setipinna melanochir, Sundasalanx microps (type locality), *Amblyrhynchichthys truncatus, Barbichthys laevis, Cyclocheilichthys heteronema, C. repasson, Cyclocheilichthys* sp., *Dangila ocellata, Epalzeorhynchos kalopterum, Hampala macrolepidota, Luciosoma trinema, Osteochilus borneensis, O. microcephalus, Oxygaster hypophthalmus, Puntioplites bulu, P. waandersi, Puntius bramoides, Rasbora bankanensis, R. borneensis, R. myersi, Rasbora* sp., *Rasborichthys helfrichii, Rohteichthys microlepis, Thynnichthys polylepis, T. thynnoides, Acanthopsoides gracilis, Botia macracantha, Mystus micracanthus, M. nigriceps, Kryptopterus bicirrhis, K. cryptopterus, K. lais, K. micronema, K. schilbeides, Ompok hypophthalmus, Pseudeutropius brachypopterus, P. moolenburghae, Xenentodon canciloides, Channa apogonoides, C. macrolepis, Paradoxodacna piratica* (type locality), *Toxotes microlepis, Polynemus multifilis, Trichogaster leerii, Helostoma temminckii, Osphronemus goramy, Macrognathus aculeatus, M. erythrotaenia, Achiroides melanorhynchus, Chonerhinos amabilis* (type locality), *C. nefastus* (type locality).

Kapuas 1976-34. Kapuas mainstream 53 km W of Putussibau. Lat. 0°46.5′N, long. 112°27.5′E. Water 26°C, pH 6.5. Seine, gill nets. 6–7 August.

Cyclocheilichthys heteronema, C. microlepis, Dangila lineata, D. ocellata, Kalimantania lawak, Oxygaster hypophthalmus, O. oxygastroides, Puntioplites bulu, Puntius bramoides, Rasbora myersi, Mystus nigriceps, Kryptopterus bicirrhis, Paradoxodacna piratica (type locality), *Cynoglossus waandersi, Chonerhinos amabilis* (type locality), *C. nefastus* (type locality).

Kapuas 1976-35. Kapuas mainstream about 23 km WSW of Putussibau. Lat. 0°48′N, long. 112°45′E. Water 25°C, pH 7–7.5. Seine, gill nets. 8–9 August.

Notopterus borneensis, Clupeichthys bleekeri, Lycothrissa crocodilus, Crossocheilus oblongus, Cyclocheilichthys heteronema, Dangila lineata, Osteochilus microcephalus, Oxygaster hy-

FIGURE 3 Kapuas survey of 1976. Habitats. a, Sungai Pinoh at Nanga Saran (Kapuas 1976-29); b, Sungai Pinoh (Kapuas 1976-27); c, Sungai Tawang (Kapuas 1976-44); d, Kapuas mainstream at Sintang, gravel bar in mouth of Sungai Melawi at upper left (Kapuas 1976-31).

pophthalmus, Rasbora bankanensis, Acantopsis choirohynchos, Channa apogonoides, Chonerhinos amabilis (type locality), *C. nefastus* (type locality).

Kapuas 1976-36. Kapuas mainstream, 6 km W of Putussibau. Lat. 0°50.5′N, long. 112°52′E. Seine. 9 August.

Cyclocheilichthys repasson, Epalzeorhynchos kalopterum, Osteochilus waandersi, Rasbora bankanensis, R. myersi, Thryssocypris smaragdinus (type locality), *Acantopsis choirorhynchos, Botia hymenophysa, Mystus micracanthus, Chanda apogonoides, Chonerhinos amabilis* (type locality).

Kapuas 1976-37 (Fig. 2b). Small forested stream, 3–5 m wide and 1 m deep, where it flows into Sungai Mandai 2–3 upstream from its confluence with Kapuas mainstream, 17 km WSW of Putussibau. Lat. 0°47′N, long. 112°48′E. Current weak, water dark brown, turbid, 30°C, pH 6; bottom with logs and leaf litter. Rotenone. 10 August.

Barbichthys laevis, Chela maassi, Cyclocheilichthys apogon, C. heteronema, Dangila fasciata, D. lineata, Osteochilus kappeni, O. microcephalus, O. spilurus, Oxygaster anomalura, O. hypophthalmus, Puntius anchisporus, P. bramoides, P. endecanalis (type locality), *Rasbora bankanensis, R. brittani, R. myersi, R. trilineata, Homaloptera tweediei, Acantophthalmus shelfordi, Acanthopsoides gracilis, Barbucca diabolica* (type locality), *Ellopostoma megalomycter, Nemacheilus selangoricus, Vaillantella euepiptera, Mystus micracanthus, Hemirhamphodon pogonognathus, Xenentodon canciloides, Pristolepis fasciata, Betta pugnax, Osphonemus goramy, Achiroides melanorhynchus, Chonerhinos amabilis* (type locality).

Kapuas 1976-38. Mouth of Sungai Mandai, 17 km WSW of Putussibau. Lat. 0°48′N, long. 112°47′E. Current swift, water dark brown, slightly turbid. Hook and line. 10 August.

Kryptopterus limpok.

Kapuas 1976-39. Sungai Mandai Ketchil near its confluence with Kapuas mainstream, 18 km WSW of Putussibau. Lat. 0°48′N, long. 112°47′E. Rotenone. 11 August.

Cyclocheilichthys repasson, Dangila fasciata, D. lineata, D. ocellata, Osteochilus kahajanensis, O. microcephalus, O. waandersi, Oxygaster anomalura, Puntius anchisporus, P. endecanalis (type locality), *Rasbora bankanensis, R. brittani, R. myersi, R. sumatrana, R. trilineata, Homaloptera tweediei, Acantophthalmus semicinctus, A. shelfordi, Acanthopsoides gracilis, Barbucca diabolica* (type locality), *Nemacheilus selangoricus, Vaillantella euepiptera, Leiocassis armatus, Mystus micracanthus, Ompok sabanus, Parakysis anomalopteryx* (type locality), *Hemirhamphodon pogonognathus, Xenentodon canciloides, Nandus nebulosus, Calamiana* sp., *Betta dimidiata* (type locality), *Betta pugnax, Channa lucius, Macrognathus aculeatus, Achiroides leucorhynchus, Chonerhinos nefastus* (type locality).

Kapuas 1976-40. Kapuas mainstream near Telokabik, 29 km W of Putussibau. Lat. 0°50.5′N, long. 112°40′E. Rotenone. 11 August.

Oxygaster hypophthalmus, Puntius bramoides, Rasbora bankanensis, R. borneensis, R. subtilis (type locality), *Arius melanochir, Dorychthys boaja, Achiroides leucorhynchus, A. melanorhynchus, Chonerhinos nefastus* (type locality).

Kapuas 1976-41. Oxbow Lake at Nangaembaluh with direct

connection to Kapuas mainstream; 31 km W of Putussibau. Lat. 0°50′N, long. 112°39′E. Local fishermen. 12 August.

Lycothrissa crocodilus, Cyclocheilichthys heteronema, Oxygaster hypophthalmus, Rasborichthys helfrichii, Thynnichthys polylepis.

Kapuas 1976-42. Sungai Seriang, forest tributary of Sungai Palin, 5–10 m wide and 2 m deep, 37 km W of Putussibau and 3–5 km up Sungai Palin from Kapuas mainstream. Approx. lat. 0°51.5′N, long. 112°36′E. Current swift; water clear, reddish-brown tinted, 30°C, pH 6.5; many trees fallen across and into stream, bottom sand. Rotenone. 12 August.

Chela maassi, Crossocheilus sp., *Cyclocheilichthys apogon, Osteochilus intermedius, O. spilurus, O. triporos, Rasbora argyrotaenia, R. bankanensis, R. brittani, R. dorsiocellata, R. trilineata, Barbucca diabolica* (type locality), *Lepidocephalichthys pristes* (type locality), *Nemacheilus selangoricus, Vaillantella euepiptera, Leiocassis myersi* (type locality), *Mystus micracanthus, M. nemurus, Ompok hypophthalmus, Silurichthys phaiosoma, Parakysis anomalopteryx* (type locality), *Chaca bankanensis, Xenentodon canciloides, Calamiana* sp., *Betta dimidiata* (type locality), *Betta pugnax, Trichogaster leerii, Macrognathus aculeatus, Mastacembelus maculatus, Achiroides leucorhynchus.*

Kapuas 1976-43. Small oxbow lake completely cut off from Kapuas mainstream opposite Empangau, 124 km NE of Sintang. Lat. 0°44′N, long. 112°23′E. Water clear, dark brown, 30°C, pH 6–6.5; bottom mud, with many tree branches. Rotenone. 13 August.

Scleropages formosus, Chela maassi, Cyclocheilichthys repasson, Dangila ocellata, Epalzeorhynchos kalopterum, Osteochilus intermedius, O. keppeni, O. microcephalus, Puntius anchisporus, P. endecanalis (type locality), *Rasbora agilis, R. argyrotaenia, R. brittani, R. dorsiocellata, Acanthopsoides gracilis, Mystus micracanthus, M. nigriceps, Nandus nebulosus, Pristolepis fasciata, Betta dimidiata* (type locality), *Sphaerichthys vaillanti, Trichogaster leerii, Helostoma temminckii, Channa striata.*

Kapuas 1976-44. Sungai Tawang near Danau Pengembung. Lat. 0°48′N, long. 112°03′E. Current slow; water turbid, cafe-au-lait, 26°C, pH 6 (early morning). Local fishermen, cast nets and "jermal." 14–15 August.

Lycothrissa crocodilus, Amblyrhynchichthys truncatus, Balantiocheilos melanopterus, Barbichthys laevis, Cyclocheilichthys apogon, C. armatus, C. heteronema, C. microlepis, Dangila ocellata, Leptobarbus hoevenii, Lobocheilus sp., *Macrochirichthys macrochir, Osteochilus schlegeli, Oxygaster hypophthalmus, O. oxygastroides, Puntioplites bulu, Puntius anchisporus, Rohteichthys microlepis, Bagrichthys hypselopterus, Mystus micracanthus, M. nigriceps, Kryptopterus bicirrhis, K. micronema, Ompok eugeneiatus, O. hypophthalmus, Pseudeutropius brachypopterus, P. moolenburghae, Xenentodon canciloides, Chanda wolffii, Paradoxodacna piratica* (type locality), *Polynemus multifilis, Oxyeleotris marmorata, Trichogaster leerii, Achiroides melanorhynchus, Chonerhinos nefastus* (type locality), *Tetraodon palembangensis.*

Kapuas 1976-45. Kapuas mainstream 58 km NE of Sintang and 1 km downstream from Sebruang. Lat. 0°25.5′N, long. 111°52.5′E. Current moderate; water very turbid, cafe-au-lait, 28°C, pH 6.5; bottom probably muddy, but with numerous large rocks or boulders. Rotenone. 16 August.

Notopterus borneensis, Osteochilus microcephalus, Puntioplites bulu, Rasbora borneensis, Botia macracantha, Lepidocephalus spectrum (type locality), *Nemacheilus lactogeneus* (type locality), *Nemacheilus* cf. *longipectoralis, Vaillantella maassi, Bagrichthys macropterus, B. micranodus* (type locality), *Mystus wyckii, Kryptopterus bicirrhis, Breitensteinia* cf. *insignis, Chanda apogonoides, Toxotes microlepis.*

Kapuas 1976-46. Sungai Gentu, small forest stream, near where it flows into Kapuas mainstream, 55 km NE of Sintang. Lat. 0°27′N, long. 111°49′E. Current swift; water clear, brown tinted, 25°C, pH 6–6.5; bottom sand, many trees fallen across stream. Rotenone. 16 August.

Osteochilus microcephalus, O. spilurus, Rasbora argyrotaenia, R. bankanensis, R. dorsiocellata, R. trilineata, Barbucca diabolica (type locality), *Vaillantella euepiptera, Leiocassis myersi* (type locality), *Mystus nemurus, Wallago leerii, Pseudeutropius moolenburghae, Hemirhamphodon pogonognathus, Xenentodon canciloides, Nandus nebulosus, Calamiana* sp., *Betta dimidiata* (type locality), *Mastacembelus maculatus.*

Kapuas 1976-47. Small forest stream flowing into Kapuas mainstream NE of Gunung Setunggul, 53 km SW of Sintang and 10 km NW of Silat. Lat. 0°24′N, long. 111°51′E. Current moderately swift; water clear, brown tinted, 26°C, pH 6.5. Rotenone. 16 August.

Osteochilus intermedius, O. microcephalus, O. spilurus, O. waandersi, Rasbora agilis, R. argyrotaenia, R. bankanensis, R. dorsiocellata, R. trilineata, Homaloptera tweediei, Acanthophthalmus oblongus, A. semicinctus, Barbucca diabolica (type locality), *Lepidocephalichthys pristes* (type locality), *Nemacheilus selangoricus, Vaillantella euepiptera, Leiocassis myersi* (type locality), *Glyptothorax major, Parakysis anomalopteryx* (type locality), *Chaca bankanensis, Xenentodon canciloides, Gymnochanda filamentosa, Nandus nebulosus, Pristolepis fasciata, Oxyeleotris marmorata, Brachygobius xanthomelas, Calamania* sp., *Betta dimidiata* (type locality), *Macrognathus aculeatus, Mastacembelus maculatus, Achiroides melanorhynchus.*

Kapuas 1976-48. Kapuas mainstream opposite Silat, rocky area on left bank. Lat. 0°20.5′N, long. 111°47′E. Current swift; water very turbid, cafe-au-lait, 30°C, pH 6.5. Rotenone. 17 August.

Lepidocephalus spectrum (type locality), *Bagroides melapterus, Mystus wyckfii, Hemisilurus heterorhynchos, Arius melanochir, Polynemus multifilis, Achiroides melanorhynchus, Cynoglossus waandersi, Chonerhinos modestus.*

Kapuas 1976-49. Sungai Djentawang, forest stream 5–10 m wide and 3–4 m deep near Ketungau, 37–38 km NNE of Sintang. Lat. 0°23′N, long. 111°37.5′E. Current swift; water clear, dark brown, 30°C, pH 6. Rotenone. 17 August.

Balantiocheilos melanopterus, Cyclocheilichthys armatus, C. heteronema, C. janthochir, Dangila ocellata, Leptobarbus hoevenii, L. melanopterus, Luciosoma trinema, Macrochirichthys macrochir, Osteochilus melanopleura, O. triporos, Oxygaster hypophthalmus, O. oxygastroides, Puntioplites bulu, Thynnichthys polylepis, Bagrichthys micranodus (type locality), *Chanda macrolepis.*

Kapuas 1976-50. Rocky ledge in middle of Sungai Melawi near confluence with Kapuas mainstream, about 0.5 km upstream from Sintang. Lat. 0°04.5′N, long. 111°28′E. Current swift; water clear or slightly turbid, dark brown. Rotenone. 18 August.

Luciosoma spilopleura, Rasbora borneensis, Homaloptera ophiolepis, Lepidocephalus spectrum (type locality), *Nemacheilus maculiceps* (type locality), *Vaillantella maassi, Mystus wyckii, Chanda apogonoides, Achiroides melanorhynchus.*

Kapuas 1976-51. Small forest stream, 3–5 m wide and 50 cm deep, about 1 km up Sungai Tajan from Tajan, 87 km E of Pontianak. Lat. 0°02'S, long. 110°07'E. Current sluggish; water moderately turbid, dark brown, 28°C, pH 6.5; bottom mud, with leaf litter and logs. Rotenone. 22 August.

Eirmotus octozona, Osteochilus spilurus, Rasbora agilis, R. argyrotaenia, R. bankanensis, R. dorsiocellata, R. dusonensis, Acantophthalmus semicinctus, A. superbus (type locality), *Acanthopsoides gracilis, Nemacheilus selangoricus, Mystus micracanthus, Clarias melanoderma, Hemirhamphodon pogonognathus, Xenentodon canciloides, Doryichthys deokhatoides, Nandus nebulosus, Oxyeleotris urophthalmoides, Pseudogobius* sp., *Betta dimidiata* (type locality), *Betta pugnax, Parosphromenus deissneri, Trichigaster leerii, Channa lucius, Macrognathus aculeatus, Mastacembelus maculatus, Tetraodon palembangensis.*

Kapuas 1976-52. Pontianak fish market. Specimens from a single catch, said to be from Sungai Kapuas Ketchil. 23 August.

Setipinna melanochir, Cosmochilus falcifer, Chanda wolffii.

Kapuas 1976-53. Market at Kampong Djungkat (near mouth of Sungai Kapuas Ketchil, 17 km WNW of Pontianak). 13 July.

Coilia coomansi, Amblyrhynchichthys truncatus.

Kapuas 1976-54. Kapuas mainstream and Sungai Ketungau near Ketungau. Obtained from local fishermen by fisheries officer Ponejo. July–August.

Himantura signifer (type locality), *Amblyrhynchichthys truncatus, Cyclocheilichthys microlepis, Achiroides melanorhynchus, Cynoglossus kapuasensis.*

Kapuas 1976-55. Kapuas mainstream at Selimbau, 92 km NE of Sintang. Lat. 0°36.5'N, long. 112°07'E. Water turbid, 26°C, pH 6.5. Dip netting at night with flashlight from floating house. 4 August.

Crossocheilus oblongus, Rasbora bankanensis, R. borneensis, R. sp., *Kryptopterus minor* (type locality), *K. lais, Achiroides melanorhynchus.*

Systematic Account

The present account includes all species of freshwater fishes known from western Borneo or Kalimantan Barat. The only other region of Borneo for which a monographic study of the freshwater ichthyofauna is available is northeastern Borneo (Inger and Chin 1962). In recent years material has been collected from the Rejang and Baram basins which should provide the basis for a reasonably comprehensive report on the freshwater fishes of northern Borneo or Sarawak. The fishes of eastern and southern Borneo (Kalimantan Timor and Selatan) have not been sufficiently collected to make a modern synthesis worthwhile; they are known chiefly through the researches of Bleeker, Vaillant (1902), and Popta (1906). Thus the present work requires two sequels to provide a reasonably thorough systematic account of the freshwater fishes of the entire island of Borneo: one on the fishes of northern Borneo, for which a great deal of material has been collected and is deposited in North American museums; and one on southern and eastern Borneo, for which extensive field surveys need to be conducted in areas still poorly known or completely unexplored ichthyologically.

While it has not been possible for me to provide an account of the freshwater fishes of all of Borneo, western Borneo is ichthyologically the richest part of the island and probably includes at least half of all Bornean freshwater fish species. I have examined western Bornean material of almost every species reported or known from there, and the basis for inclusion of each species is indicated clearly. Some species have been incorrectly reported from western Borneo by previous authors; I have attempted to correct all such errors by examining and reidentifying the actual specimens involved. Type specimens of many species have been examined in order to verify identifications, and a great deal of extralimital material has been examined to differentiate species, investigate systematic problems including geographical variation, and verify distributions.

Before proceeding to the factual systematic accounts of taxa, a number of features should be drawn to the reader's attention.

Classification.—The formal taxonomic categories utilized herein are mainly family, genus, and species. Subfamilies or other categories are occasionally discussed, especially when I have new information concerning their classification or when they are relevant to biogeography. Categories above family level are rarely discussed or employed herein, but there is one important exception I wish to emphasize. This is especially relevant to students of fish evolution and distribution in southeast Asia, and has effected the sequential listing of families employed herein. Sundaland has apparently been the main evolutionary center of the labyrinth fishes or anabantoids, or at least a very important late evolutionary center for the group. Contrary to Berg (1940) and the long-held opinions of Liem (1963 et seq.), I believe that the snakehead family Channidae (formerly Ophicephalidae or Ophiocephalidae) and the pike-like family Luciocephalidae are integral parts of the anabantoid radiation. I have long held this view concerning Luciocephalidae and discussed it with Liem on several occasions while we were colleagues at Harvard; he recently placed Luciocephalidae within Anabantoidea (Lauder and Liem 1983). The full extension of the extraordinarily protrusible jaws of Luciocephalidae, observed by me on living specimens in Malaysia in 1970 and communicated to Liem, has been reported by Lauder and Liem (1981). On the other hand, Liem has maintained steadfastly that snakeheads are not anabantoids without proposing a well defined alternative hypothesis of their relationships. At the time of our discussions of Luciocephalidae I had not given serious consideration to the problem of snakehead relationships. Having now reviewed the biology and examined radiographs and osteological preparations of many anabantoids and Channidae, I feel the best available hypothesis is that snakeheads are anabantoids. The functional significance of the posterior extension of the swim bladder present in all anabantoids may be to provide an adjustable counterpoise to the airbubble in the suprapharyngeal respiratory organ (W. C. Freihofer, pers. comm.). I predict that evidence supporting the broad phyletic relationships among anabantoids outlined here will accumulate in proportion to comparative observations on their morphology, development, physiology, and behavior. The recent observation that *Channa striata* is an oral-brooder (Ettrich 1982) is relevant. I suggest that this is further evidence of the anabantoid relationships of Channidae, and that detailed observations of its oral-brooding and comparisons with oral-brooding in other fishes will bear this out. The distinctive spawning embrace characteristic of numerous anabantoids apparently also occurs in *Channa.*

A few additional comments concerning recognition of families

and their sequential arrangement should be noted. The entire external body surface of Sisoridae and Akysidae is covered by specialized unculiferous plaques which appear to be basically identical and have not been observed in any other catfishes (Roberts 1982*a*), indicating that the two families are closely related. Perhaps Akysidae (comprising three genera which undoubtedly form a monophyletic unit) should be placed as a subfamily of Sisoridae, but for now it is retained as a separate family. *Parakysis,* a Sundaic genus hitherto placed in Akysidae, seems not closely related to Akysidae or any other family; due to an extraordinary number of unique specializations and no known uniquely shared specializations with any other family, it is placed in a new family of its own, Parakysidae. *Ellopostoma,* a Sundaic genus of previously doubtful family relationships (Roberts 1972; Nelson 1984) is referred to Cobitidae. This peculiar and highly specialized genus cannot be placed in any of the four currently recognized cobitid subfamilies, and further observations on its osteology and biology should be made. The rather generalized percoid *Datnioides,* traditionally placed in the tripletail family Lobotidae, is recognized as the sole genus in the family Datnioididae. Datnioididae superficially resembles the leaf-fishes or Nandidae and may be related to them but is much more generalized. There seems to be no valid evidence in support of its relationship to Lobotidae.

Workers familiar with systematics of Asian freshwater fishes will find classification at the genus level presented here is generally conservative. In particular several large "traditional" or "catch-all" genera are employed which almost certainly are polyphyletic. Some of them may in fact include several genera; such are *Barilius, Puntius, Rasbora, Nemacheilus, Mystus,* and *Arius.* For all of these, additional genera have been proposed or recognized by various authors, but most are poorly defined or based on such superficial characters that it does not seem worthwhile to recognize them at present. In some instances what may be distinct genera have been recognized and reasonably well defined, but many species are so poorly known that they cannot be assigned to these genera. Thus, Howes (1980) recently split *Rasbora* into *Rasbora* and *Parluciosoma* but was able to assign only a few of the species involved to each genus. The situation in *Rasbora* is further complicated because it may include additional groups which should be recognized as separate genera (see discussion of *Rasbora axelrodi* herein). Thus it seems the most reasonable course is to leave all of the species in *Rasbora* until a more definitive study has been completed.

A similar situation exists in *Mystus,* which Bleeker (1862) split into four genera we probably should recognize. But morphological study of many poorly known species will be needed before these genera can be defined adequately and most species assigned to them, and the problem of generic typification of *Mystus* itself has to be resolved. *Arius* probably represents the most challenging problem of generic classification posed by any large group of catfishes. Some specialized or very distinctive ariids have been placed in separate genera, but a large number of species are morphologically generalized or poorly known and attempts to distinguish them generically from *Arius* have very little scientific basis. Thus the genera *Cephalocassis* and *Hemiarius* proposed by Bleeker for the species *Arius melanochir* and *Arius stormii* are not recognized because adequate generic definitions cannot be provided for them at this time. I have tried to list all of the subjective generic synonyms or at least all of those relevant to southeast Asia for each traditional or catch-all genus employed herein.

Generic Typification.—Virtually any systematic decision involving a genus requires a knowledge of its type species. In studying Asian freshwater fishes I have repeatedly found that secondary statements in the literature regarding type species are untrustworthy. Statements about type species that do not include the nature of type species determination and the relevant page references simply cannot be relied upon, and in any case cannot be verified readily.

In order to clarify the systematic status of genera, and to minimize confusion and needless duplication of effort by other workers, I have documented the type species of every genus insofar as practical. The following methods of type species determination or fixation are recognized: original designation, monotypy, absolute tautonymy, and subsequent designation (including subsequent monotypy and type species selection by the ICZN). Workers unfamiliar with these procedures should consult the latest edition of the Code. I am happy to report that type species have been determined for nearly all included genera. The most notable exception is that of *Mystus* Scopoli, 1777, typification of which probably will require formal action by the ICZN. In documenting generic typification, especially of older names and junior synonyms, it is difficult not to overlook key references. This is especially so for fixation by subsequent designation, the references to which are often obscure. In such instances it is particularly important to cite the relevant page references. I hope that I have made few errors of omission of this sort, but in any event the statements herein are documented so that they can be readily checked.

Failure to take type species into account can lead to unfortunate lapses. Thus numerous Asian loaches referred to *Lepidocephalus* are not congeneric with its type species. The loaches in question should be referred to *Lepidocephalichthys.*

The utility of systematically oriented anatomical studies (such as that on cobitid genera by Sawada 1982) could be significantly enhanced by including observations on type species of as many genera as possible. Such observations immediately place the anatomical observations on a sounder taxonomic basis and are helpful to other workers concerned with defining the genera.

Synonymies.—Generic and species synonymies presented include primary nomenclatural references (i.e., original publications of senior and junior objective and subjective synonyms), especially when directly relevant to the systematics of fishes in Borneo. In addition important re-identifications or locality records have been included in many synonymies, especially when necessary to document inclusion or exclusion of a particular species in the western Borneo ichthyofauna. This is particularly true for poorly known species or for the few species of which western Bornean specimens have not been examined by me.

Keys.—Keys have been provided for many groups, including the important food fishes *Cyclocheilichthys* and *Osteochilus,* recently revised by my Thai colleagues Suebsin Sontirat and Jaranthada Karnasuta, respectively, in their unpublished Ph.D. dissertations. I originally intended to include keys for all of the larger and more difficult groups but exigencies of time and practical considerations forestalled this plan. Nevertheless the information provided herein, supplemented with a few references should facilitate identification of all freshwater fish species known from western Borneo.

DISTRIBUTION.—Information on species distribution is given in the material examined, in summary descriptions under the heading Distributions or as brief statements in the body of the species account, and in selected instances, on distribution maps. In many instances extralimital material has been examined for the express purpose of verifying or adding to information on species distributions. The information given under the heading Distribution comes largely from the literature. For Thailand I have consulted Smith (1945) and for Indonesia Weber and de Beaufort's *Fishes of the Indo-Australian Archipelago*. It should be noted that most of the distributional information in Weber and de Beaufort cannot be verified by re-examination of specimens because it is based on Bleeker's locality records for which documented specimens are unavailable. I have tried to utilize this information judiciously, but workers should be alert to its shortcomings. For many species it seems to me that many or most locality records may be based upon misidentifications, and therefore I have not attempted a summary statement of their distribution. The maps of species distribution, on the other hand, are based on information regarded as reliable. *Scleropages formosus* could hardly be confused with any other species; due to its presumed status as an endangered species a special effort has been made to obtain all available information on its distribution. The distribution maps of *Cyclocheilichthys* and *Doryichthys* are based mainly on information provided by my colleagues Suebsin Sontirat and C. E. Dawson, who have revised the species involved. The rest of the distribution maps are based almost entirely on material examined by me.

The work of Volz (1907) contains numerous potentially valuable locality records of freshwater fishes in Sumatra. Some of his material (e.g., the holotype of *Bagarius lica*) is deposited in the Bern Natural History Museum and perhaps elsewhere in Europe, but many—perhaps most—of his locality records seem to be based on sight identifications in the field. Until the material basis for Volz's localities can be examined it seems best to ignore them.

MERISTIC AND OTHER MORPHOLOGICAL DATA.—Observations have been made on many genera or species-groups extending into adjacent areas of southeast Asia, Burma, and India in efforts to elucidate species problems. For several of the larger and more complex groups extensive meristic data, including vertebral counts obtained from radiographs, are presented. This should facilitate future systematic study of such difficult groups as *Rasbora, Mystus, Kryptopterus, Mastacembelus,* and others. Very little of such data has been recorded previously. I have not found gill raker or vertebral counts previously recorded for any species of *Rasbora* or for most of the Sundaland catfishes. Some authors (e.g., Sufi 1956, for Mastacembelidae) have recorded valuable meristic data on Asian freshwater fishes without indicating the source of the specimens from which it was taken, thus greatly diminishing the utility of their data. In the present account the source of the specimens from which meristic and other data has been taken is directly stated or can be readily deduced. Data from type specimens are invariably presented separately, rather than lumped with data from non-types.

REMARKS ON COUNTS AND MEASUREMENTS.—Counts and measurements used herein generally are those of Hubbs and Lagler (1947), and conform to their definitions. The standard measure of size, except in Dasyatidae, is standard length, and proportional measurements (unless otherwise stated) are expressed as times in standard length. The standard measure of size in Dasyatidae is disc width (at widest point). For specimens under 100 mm, standard length is given to the nearest 0.1 mm; in specimens of 100 mm or more, to the nearest mm. Relatively few new measurements have been used. One of these is humeral spine (=postcleithral process of Lundberg) length in catfishes, measured from base of pectoral fin spine to tip of humeral process. Body width, especially useful in catfishes, is measured at widest point across the pectoral girdle. Only a few new or unfamiliar counts are used, most of them self-explanatory. "Transdorsal scale rows," used in Cyprinidae, refers to the maximum number of scale rows on the anterior part of the body lying dorsal to the lateral line scale row of either side. I find vertebral counts helpful in various groups, and it is often important to indicate the number of abdominal and caudal vertebrae as well as the total number of vertebrate. I define the division between abdominal and caudal vertebrae as the relationship of the hemal spines to the anal fin pterygiophores. The first caudal vertebra is that with its hemal spine posterior to the anteriormost anal fin pterygiophores. All vertebrae anterior to this (including those of the Weberian complex) are abdominal. This method obviously will not work for fish without an anal fin, but I have found it works well with all fish groups herein for which vertebral data were taken. In some groups, especially catfishes and mastacembelids, the vertebral column is often anomalous (with complex or multiple central fusions). Specimens with abnormal vertebral columns should be omitted from the data base. This is particularly a problem in Mastacembelidae, in which fin-ray as well as vertebral counts may be distorted by abnormality which may not be externally evident. Thus, all fin-ray and vertebral counts presented herein for Mastacembelidae are based on specimens with normal vertebral columns.

Dasyatidae

Dasyatidae (whiptailed stingrays) comprises about six genera and 40 species. The great majority of the species are restricted to marine or marine and estuarine habitats, but the Indo-west Pacific *Hypolophus sephen* (Forskål 1775) frequently enters fresh water, sometimes ascending rivers for hundreds of kilometers, and two genera—*Dasyatis* and *Himantura*—are represented by endemic freshwater species. A detailed account of southeast Asian freshwater Dasyatidae is given by Compagno and Roberts (1982). A single freshwater species of *Himantura,* discovered during the Kapuas survey of 1976, is known from western Borneo.

Dasyatidae appears to be the only family of cartilaginous fishes or Elasmobranchii present in the fresh waters of western Borneo. No sharks or sawfishes have been reported from the Kapuas, and fishermen I interviewed in 1976 unanimously indicated their absence.

Himantura Müller and Henle, 1837

Himantura Müller and Henle, 1837:400 (type species *Raja uarnak* Forskål, 1775, by subsequent designation of Garman 1913:375)

Himantura differs from all other dasyatids in having a long slender tail without dorsal or ventral tail folds.

FIGURE 4 *Himantura signifer*, Kapuas 1976-19. Left, 312 mm male (MNHN 1981-1342, paratype); right, 294 mm female (MZB 3004, holotype)

Himantura signifer Compagno and Roberts, 1982
(Figure 4)

Himantura signifer Compagno and Roberts, 1982:333 (type locality mouth of Sungai Ketungau near Kapuas mainstream)

MATERIAL EXAMINED.—Thailand: Chao Phrya, Nakornsawan prov., 263 mm disc width adult male (KUMF 2862). Western Borneo: Kapuas 1976-54, 294 mm disc width (MZB 30304, holotype); Kapuas 1976-19, 6: 278–382 mm disc width (BMNH 1981.11.16.1, CAS 48777, MNHN 1981-1342, MZB 3005, RMNH 28800, USNM 229492, paratypes).

A species of *Himantura* with a relatively oval disc and distinctive brown and white coloration: overall color of dorsal surfaces of disc, pelvic fins, and tail base light brown or tan; dorsal surface of disc and pelvic fins with a narrow milk-white peripheral margin; sides of tail base and tail posterior to sting milk-white; more or less well defined milk-white spots immediately in front of each eye and behind each spiracle; ventral surfaces uniformly pale or white. Tooth rows in upper/lower jaws 35–45/38–46. Total pectoral fin radials 109–116.

DISTRIBUTION.—Western Borneo (Kapuas); tentatively identified from Thailand (Chao Phrya), Malay Peninsula (Perak R.), and Sumatra (Indragiri) (see Compagno and Roberts 1982:336). Apparently restricted to fresh water.

Osteoglossidae

The bony tongue or osteoglossomorph family Osteoglossidae comprises four genera, *Osteoglossum* and *Arapaima* in South America, *Heterotis* in Africa, and *Scleropages* in southeast Asia and the Australian region.

Scleropages Günther, 1864

Scleropages Günther, 1864:196 (type species *Scleropages leichardti* Günther, 1864, by monotypy)
Delsmania Fowler, 1934:243 (type species *Osteoglossum formosum* Müller and Schlegel, 1844, by original designation and monotypy)

Scleropages includes two species in the Australian region (Lake 1971) and one species in southeast Asia (including western Borneo).

Scleropages formosus (Müller and Schlegel, 1844)
(Figure 5)

Osteoglossum formosum Müller and Schlegel, 1844:1 (type locality Barito River)
Scleropages formosus Weber and de Beaufort, 1913:13

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 300 mm (MZB 3010) Kapuas 1976-43, 2: 148–279 mm (CAS 49182, USNM 218603)

This southeast Asian species of *Scleropages* is readily distinguished from the two species of the Australian region by its much larger scales, of which there are only 21–24 in a lateral series (instead of about 35).

DISTRIBUTION (Fig. 6).—Thailand (southeast). Kampuche[illegible] (southwest). Southern Vietnam. Malay Peninsula. Sumat[illegible] Borneo (Sarawak, Sambas, Kapuas, Barito, Mahakam). Banka

FIGURE 5. *Scleropages formosus*. Kapuas 1976-43, 148 mm (CAS 49182).

Notopteridae

The osteoglossomorph family Notopteridae or featherfins comprises three genera, *Papyrocranus* and *Xenomystus* in tropical Africa, *Notopterus* in India and southeast Asia.

Notopterus Lacepède, 1800

Notopterus Lacepède, 1800:190 (type species *Gymnotus notopterus* Pallas, 1769, by absolute tautonymy)
Chitala Fowler, 1934*a*:244 (type species *Mystus chitala* Hamilton-Buchanan, 1822, by original designation and absolute tautonymy)

Notopterus borneensis Bleeker, 1851

Notopterus borneensis Bleeker, 1851*c*:437 (type locality Sambas)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 283 mm (MZB 3006); Kapuas 1976-20, 2: 247–248 mm (CAS 49181, MZB 3007); Kapuas 1976-35, 329 mm (MZB 3008); Kapuas 1976-45, 172 mm (MZB 3009)

The southeast Asian species of *Notopterus* are poorly known; the entire genus will have to be revised before they can be properly identified and their distributions worked out. There seems to be only one species in western Borneo.

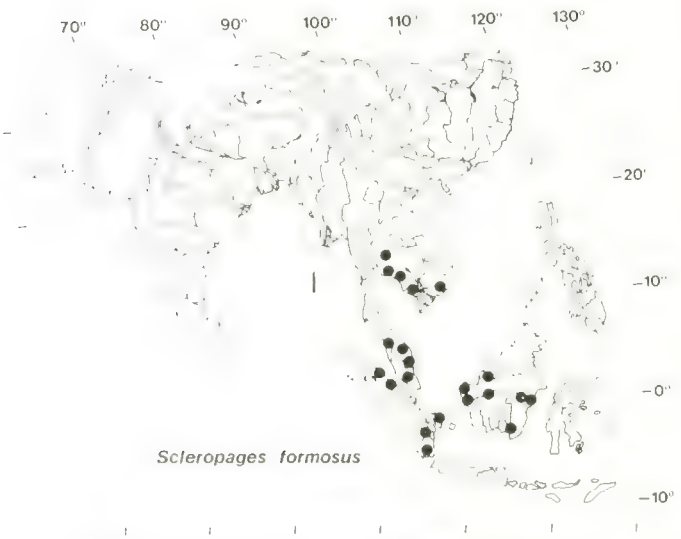

FIGURE 6. *Scleropages formosus*. Geographical distribution

Clupeidae

Apparently only two species of herrings occur in the fresh waters of western Borneo, *Clupeichthys bleekeri* and *Clupeoides hypselosoma*. Both belong to Pellonulinae, a predominantly freshwater subfamily with endemic species or genera in mainland southeast Asia, southern India and Sri Lanka, Madagascar, southeast Africa, and tropical west Africa (including the Zaire or Congo basin, where the subfamily is most diverse).

Clupeichthys Bleeker, 1855

Clupeichthys Bleeker, 1855*b*:274 (type species *Clupeichthys goniognathus* Bleeker, 1855, by monotypy)

Distinguished from all other clupeid genera in southeast Asia by having a divided anal fin. Two species known, both apparently restricted to fresh water.

Clupeichthys bleekeri Hardenberg, 1936

(Figure 7)

Clupeoides pseudopterus Vaillant, 1893:100 (nec Bleeker, 1852; Kapuas, Knapei).
Clupeichthys goniognathus Vaillant, 1902:31 (nec Bleeker, 1855; Kapuas).
Corica (*Clupeichthys*) *goniognathus* Weber and de Beaufort, 1913:55 (pro parte; fig. 21, Kapuas 4)
Clupeichthys bleekeri Hardenberg, 1936:229 (type locality middle course of Kapuas)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-9, 28: 38.4–61.0 mm (CAS 49183, MZB 3011); Kapuas 1976-14, 41: 22.0–60.6 mm (AMNH 48878, BMNH 1979.3.21.145–152, FMNH 94193, MZB 3012); Kapuas 1976-15, 28: 22.2–40.0 mm (CAS 49508, IRSNB 19726, MNHN 1982-650, MZB 3013); Kapuas 1976-22, 13: 52.2–60.8 mm (MZB 3014, ROM 38625); Kapuas 1976-33, 9: 11.7–40.1 mm (MZB 3015, UMMZ 209884); Kapuas 1976-35, 34: 34.3–71.7 mm (CAS 49184, MZB 3016, USNM 230152); Kapuas basin, Mendalan River, 26.3 mm (ZMA 100.949); Kapuas basin, Poetoes Sibau, 6: 44.2–69.0 mm (ZMA 100.948, 100.952)

Clupeichthys bleekeri differs from *C. goniognathus*, its only congener, in lacking a dusky longitudinal stripe on the body and having a somewhat longer pectoral axillary scale (T. Wongratana, pers. comm.).

DISTRIBUTION.—Borneo (Kapuas, Pamangkat in southern Borneo; T. Wongratana, pers. comm.).

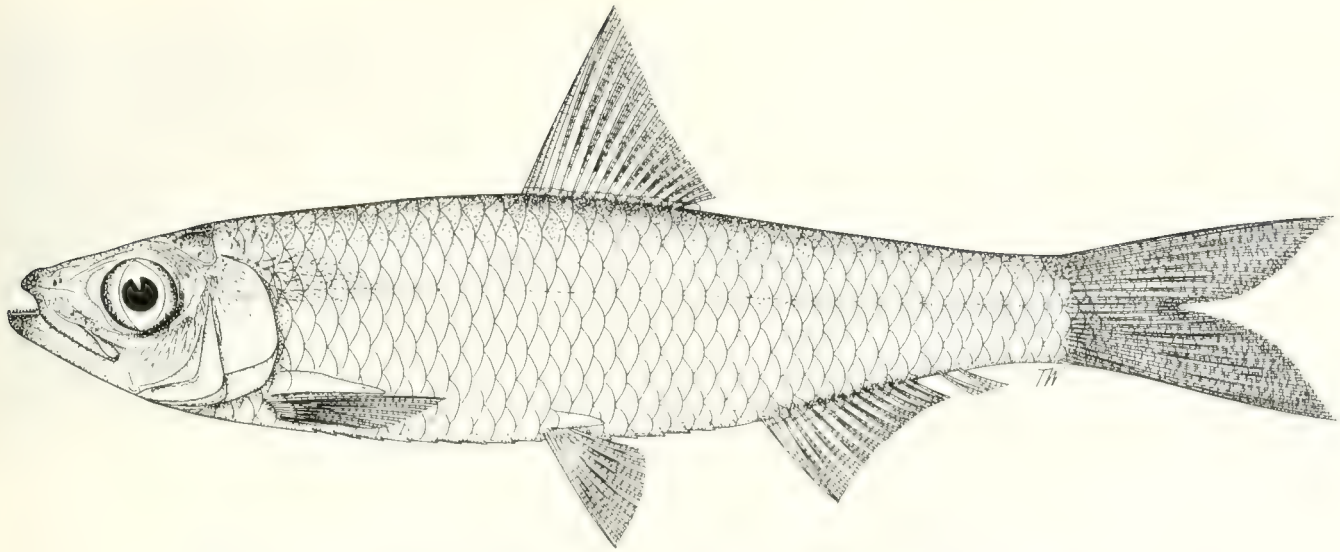

FIGURE 7. *Clupeichthys bleekeri*. Kapuas 1976-14, 58.0 mm (BMNH 1979.3.21.145, drawn by T. Wongratana).

Clupeoides Bleeker, 1851

Clupeoides Bleeker, 1851*c*:274 (type species *Clupeoides borneensis* Bleeker, 1851, by monotypy).

Clupeoides hypselosoma Bleeker, 1866

(Figure 8)

Clupeoides hypselosoma Bleeker, 1866*b*:293 (type locality "Bandjermassing, in fluviis").

Clupea (*Clupeoides*) *potamophilus* Bleeker, 1866–72:101 (proposed as substitute name for *Clupeoides hypelosoma*, regarded as preoccupied by *Harengula* (or *Clupea*) *hypselosoma* Bleeker, 1855). See Whitehead et al. (1966:76).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-42, 24.2 mm (MZB 3017). Southern Borneo: Bandjermassing, 41.5 mm (BMNH 1867.11.28.35, 57 mm total length, holotype).

This species previously was known only from the holotype; identification of the single specimen obtained in 1976 was made by T. Wongratana. For a redescription of the holotype see Whitehead et al. (1966:74).

DISTRIBUTION.—Borneo (Kapuas, Barito).

Engraulidae

The Engraulidae (comprising the anchovies) is represented by two freshwater species in western Borneo: *Lycothrissa crocodilus* and *Setipinna melanochir*. Additional species, such as *Coilia coomansi* Hardenberg, 1934 and *Setipinna breviceps* (Cantor 1850) evidently occur in the mouth and lower reaches of the Kapuas River but are not actually known from freshwater habitats and are therefore excluded from the present account.

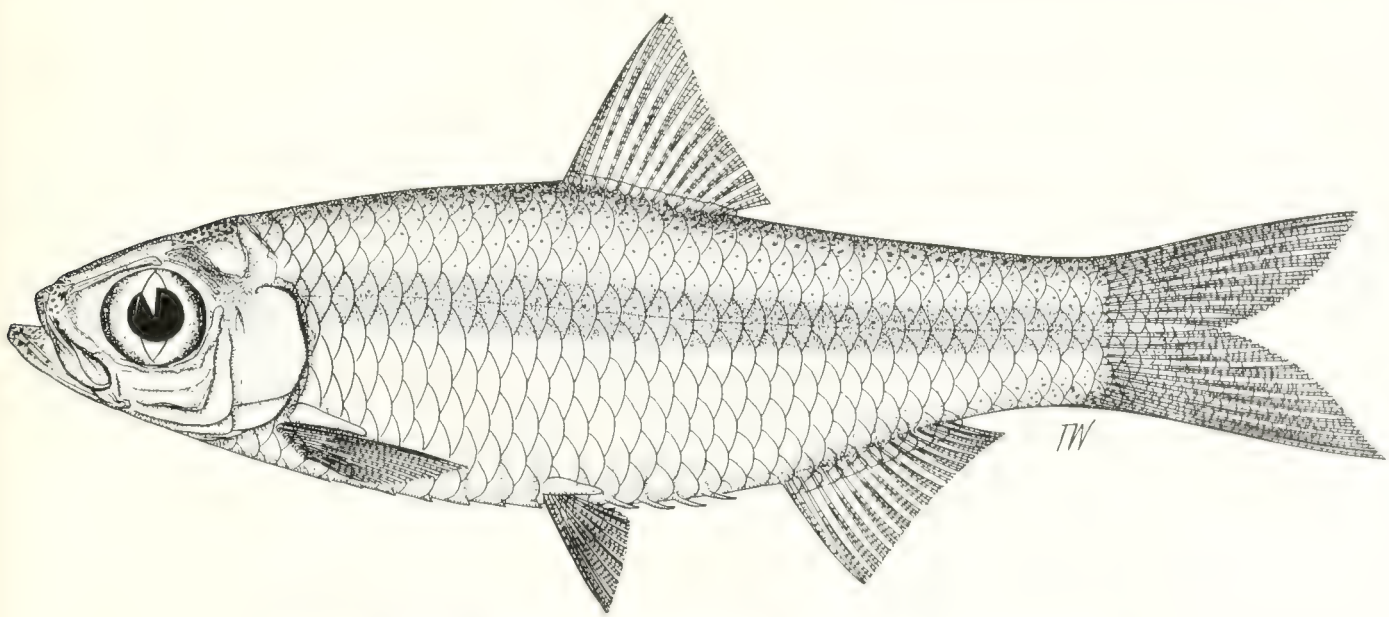

FIGURE 8. *Clupeoides hypselosoma*. Bandjermassing, 42.0 mm (BMNH 1867.11.28.35, holotype).

FIGURE 9 *Lycothrissa crocodilus*. Kapuas 1976-41, 147 mm (MZB 3024)

Lycothrissa Günther, 1868

Lycothrissa Günther, 1868:385, 399 (type species *Engraulis crocodilus* Bleeker, 1851, by monotypy)

Lycothrissa is distinguished from all other southeast Asian engraulids by its enlarged caniniform jaw teeth. A single species, restricted to fresh water.

Lycothrissa crocodilus (Bleeker, 1851)

(Figure 9)

Engraulis crocodilus Bleeker, 1851*a*:15 (type locality "Banjermassing, in fluviis")
Lycothrissa crocodilus Bleeker, 1866–72:125

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-14, 4: 93.6–148 mm (CAS 49185, MZB 3019); Kapuas 1976-15, 141 mm (MZB 3020); Kapuas 1976-19, 144 mm (MZB 3021); Kapuas 1976-33, 4: 117–172 mm (AMNH 48879, MZB 3022, USNM 230153); Kapuas 1976-35, 119 mm (MZB 3023); Kapuas 1976-41 147 mm (MZB 3024); Kapuas 1976-44, 2: 117–170 mm (MZB 3025, USNM 209911)

DISTRIBUTION.—Thailand. Sumatra (Banjuasin, Palembang, Djambi). Borneo (Kapuas, Sinkawang, Barito).

Setipinna Swainson, 1839

Setipinna Swainson, 1839:186, 292 (type species *Setipinna megalura* Swainson, 1839=*Clupea phasa* Hamilton-Buchanan, 1822, by subsequent designation of Swain 1882:280; see Whitehead et al. 1966:128)
Telara Günther, 1868*a*:400 (type species *Clupea telara* Hamilton-Buchanan, 1822=*Clupea phasa* Hamilton-Buchanan, 1822, by absolute tautonymy)
Heterothrissa Günther, 1868*a*:385, 401 (type species *Engraulis breviceps* Cantor, 1850, by monotypy)

Setipinna melanochir (Bleeker, 1849)

(Figure 10)

Engraulis melanochir Bleeker, 1849:13 (type locality "in Freto madurae prope Kammal et Surabaya")
Coilia melanochir Bleeker 1855:418
Setipinna melanochir Bleeker 1866–72:136

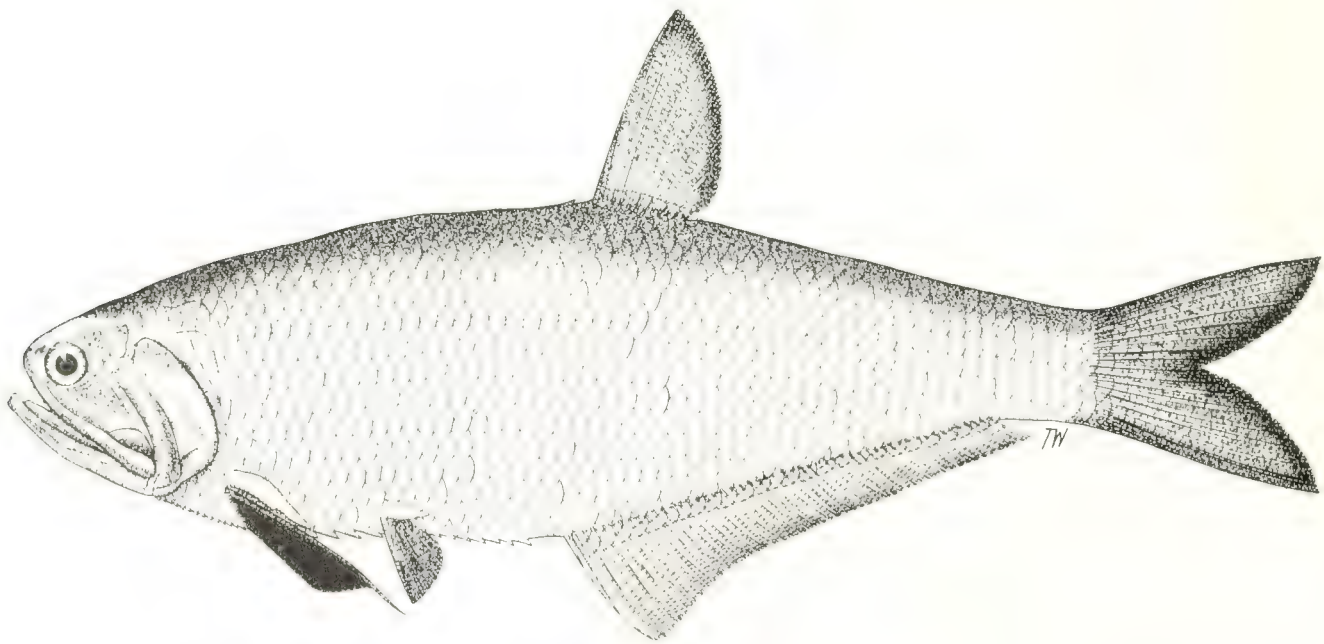

FIGURE 10 *Setipinna melanochir*. Gulf of Thailand, 153 mm (BMNH 1966.3.8.72, drawn by T. Wongratana)

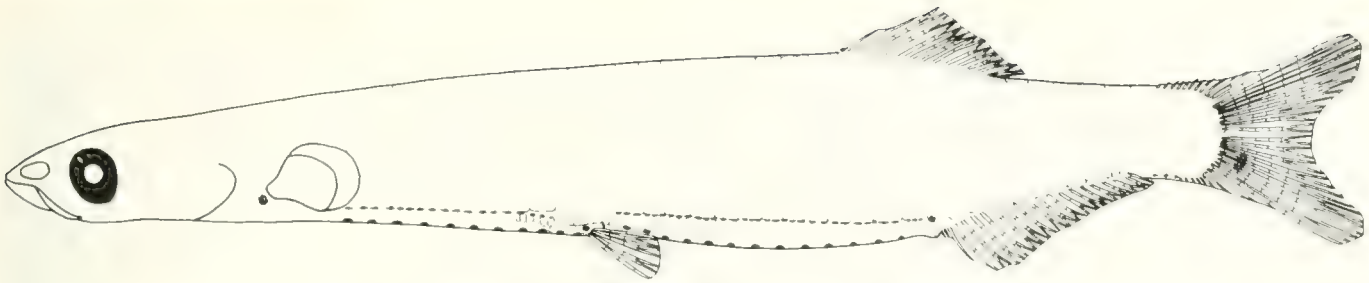

FIGURE 11. *Sundasalanx microps*. Kapuas 1976-33, 17.0 mm (CAS 44220, paratype).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-33, 159 mm (MZB 3026); Kapuas 1976-52, 101 mm (MZB 3027).

DISTRIBUTION.—Widely distributed in brackish and fresh water in Thailand, Malay Peninsula, Sumatra, and Java.

Sundasalangidae

Although first collected in the Kapuas River by Maurice Chaper in 1890, and more recently in the Mekong River along the Thai–Laos border and in the Malay Peninsula, these minute transparent fishes were not recognized as taxonomically distinct until my study of Kapuas specimens demonstrated that they are sexually mature and constitute a separate family related to the east Asian noodlefishes or Salangidae (Roberts 1981, 1984).

With both sexes ripe at 14.6 mm, the largest known specimen only 23.4 mm, Sundasalangidae are by far the smallest known salmoniforms. They differ from adult Salangidae in having a median pectoral girdle, pectoral fins without segmented rays, hypobranchials 1–3 evidently fused to basibranchials 1–3 instead of separate, pelvic fins with 5 instead of 7 rays, adipose fin absent, males without anal scales or enlarged anal fin, and total vertebrae only 37–43 (versus 48–77). A detailed account of the skeletal anatomy and systematics of Sundasalangidae and Salangidae has been published (Roberts 1984).

The family comprises a single genus with two or more species from Thailand, the Malay Peninsula, and Borneo.

Sundasalanx Roberts, 1981

Sundasalanx Roberts, 1981:297 (type species *Sundasalanx praecox* Roberts, 1981, by original description).

Sundasalanx microps Roberts, 1981

(Figure 11)

Sundasalanx microps Roberts, 1981:300 (type locality Kapuas River mainstream at Kampong Nibung, about 7 km NE of Selimbau)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-33, 35: 14.6–19.9 mm (CAS 44220, MZB 3000–3001, USNM 227793, holotype and paratypes).

DISTRIBUTION.—*Sundasalanx microps* is reported only from the Kapuas, but further study may show that it is more widely distributed. *Sundasalanx* (including undetermined species) also occurs in the Malay Peninsula and Mekong basin but is not yet known from Sumatra.

Sundasalanx sp. undet.

?*Belone caudimaculata* Vaillant, 1893:110–112, pl. 2, fig. 4 (Kapuas).
Sundasalanx sp. undet. Roberts, 1981:300

MATERIAL EXAMINED.—Western Borneo: Kapuas, 27: 18.8–23.4 mm (MNHN 1891-596).

Although these specimens were presumably collected near the type locality of *S. microps* (see Roberts 1981:302), they have much larger eyes, fewer maxillary teeth, and perhaps slightly more vertebrae (about 42–45 instead of 41–43).

Cyprinidae

Cyprinidae, comprising the carps or minnows, is the dominant family of freshwater fishes in Asia and includes more genera and species than any other family of freshwater fishes. About one-third of all freshwater fishes in western Borneo belong to this family. Many genera and most species found in western Borneo are endemic to southeast Asia, and many species are known only from Sundaland or the Kapuas basin. All cyprinids have toothless oral jaws but well-toothed pharyngeal jaws with 1–3 rows of large teeth. Despite lack of jaw teeth, diversity of feeding habits is very great. Among the new cyprinids discovered in the Kapuas in 1976 are *Thryssocypris smaragdinus*, an insectivorous new genus and species that looks remarkably like an anchovy, and *Pectenocypris balaena*, a small phytoplanktonophage with over 200 gill rakers on its first gill arch.

Albulichthys Bleeker, 1859

Albulichthys Bleeker, 1859*a*:153 (type species *Systomus albuloides* Bleeker, 1855, by monotypy)

Albulichthys, with a small mouth and numerous tuberculate gill rakers forming a complex lattice-work, seems closely related to *Amblyrhynchichthys*, *Kalimantania*, and *Puntioplites* (see accounts of these genera below). It differs most obviously from these genera in its rounded and relatively elongate snout, terete body form, and relatively small dorsal and anal fins. Body subcylindrical, snout obtusely rounded. Hyaline eyelid very well developed. Small rostral and maxillary barbels present. Lateral line complete. Scales in lateral series 36–38, predorsal scales 14, transdorsal scales 11, circumpeduncular scales 16. Scales with 6–11 parallel radii. Dorsal fin with last simple ray very slender, almost flexible, very weakly serrated; branched dorsal-fin rays 8; branched anal-fin rays 5. Pectoral-fin rays 17–19, pelvic 10. An elongate pelvic axillary scale. Pharyngeal teeth compressed with longitudinally grooved masticatory surface, 4,3,2/2,3,4 (Weber and de Beaufort 1916:107; Chevey 1932, fig. 2). Total gill rakers on first arch 22+27=49. Vertebrae 22+12=34 (three Kapuas specimens).

A single species restricted to southeast Asia.

FIGURE 12 *Albulichthys albuloides*. Kapuas 1976-52, 98.0 mm (CAS 49186).

Albulichthys albuloides (Bleeker, 1855)

(Figure 12)

Systomus albuloides Bleeker, 1855*d*:425 (type locality "Pontianak, in flumine Kapuas")
Albulichthys albuloides Bleeker, 1860*a*:306
Albulichthys Krempfi Pellegrin and Chevey, 1927:304 (type locality Pnom-Penh); Chevey, 1932:26, pl. 6

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-52, 6: 71.2–98.0 mm (CAS 49186, MZB 3028, USNM 230154)

Pellegrin and Chevey (1927) and Chevey (1932) distinguished their Mekong basin *A. krempfi* from *A. albuloides* on the basis of its having a larger eye, more truncate snout, dorsal fin less elevated, last simple dorsal-fin ray more feebly ossified, caudal peduncle more slender, and caudal-fin lobes more rounded. It would appear that these supposed differences were deduced from the only published figure of *A. albuloides* (Bleeker 1863, reproduced by Weber and de Beaufort 1916, fig. 47) rather than on actual specimens of *A. albuloides* from Indonesia. This figure portrays the snout too sharp and dorsal fin too high. The other differences also seem to be non-existent or insignificant. Kapuas specimens of *A. albuloides* agree very well with the descriptions and both figures of *A. krempfi* and I conclude they are the same species.

DISTRIBUTION.—Laos, Vietnam, Kampuchea (Mekong basin, Tonle Sap), Thailand (Mekong, Chao Phrya; Smith 1945). Sumatra (Palembang). Borneo (Kapuas, Kahajan, Barito?).

Amblyrhynchichthys Bleeker, 1859

Amblyrhynchichthys Bleeker, 1859*a*:153 (type species *Barbus truncatus* Bleeker, 1851, by monotypy)

This monotypic genus and species is immediately recognized by its blunt, concave snout; anteriorly situated nostrils; and small, distinctively shaped jaws. Hyaline eyelid well developed. Gill membranes broadly joined to flat, broad isthmus. Last simple dorsal-fin ray snout and serrate, branched dorsal-fin rays 9. Branched anal-fin rays 5. Lateral line complete. Scales with strongly convergent radii lateral scale series 36; predorsal scales

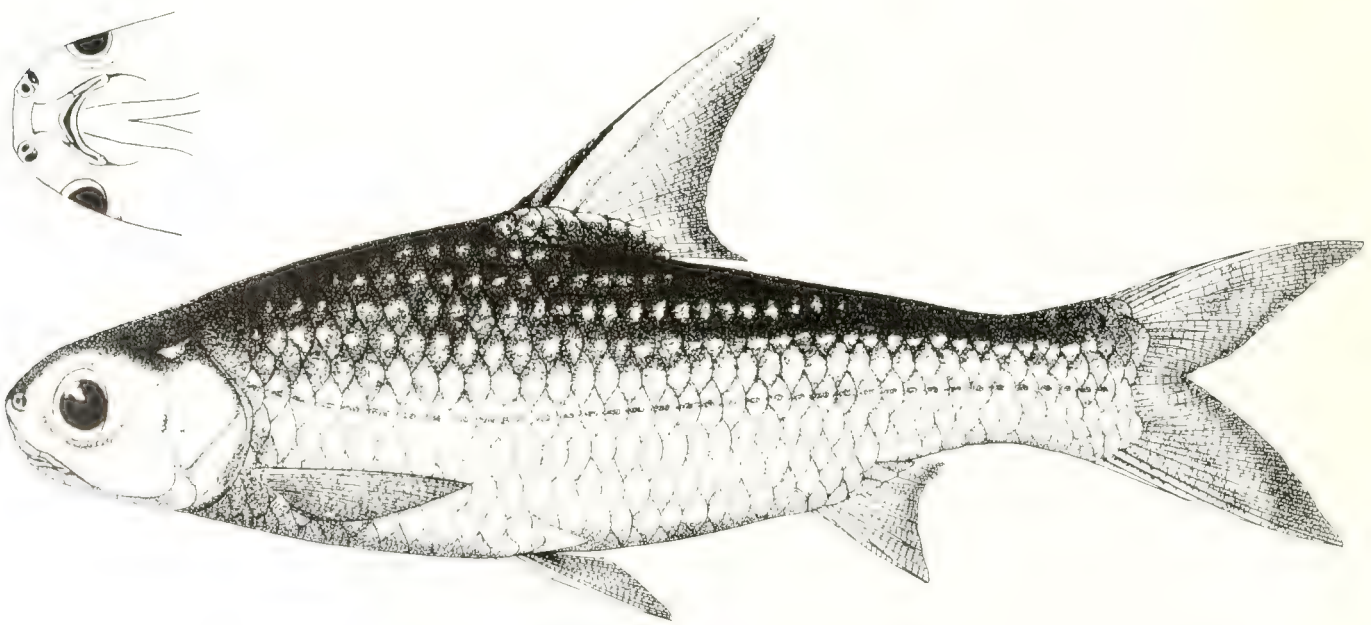

FIGURE 13 *Amblyrhynchichthys truncatus*. Kapuas, Bunut (after Weber and de Beaufort 1916, fig. 46).

FIGURE 14. *Balantiocheilos melanopterus* Kapuas 1976-49, 113 mm (MZB 3037).

13; transdorsal scales 11; circumpeduncular scales 16. Gill rakers on first arch 10–13+27–29=39–40. Vertebrae 21–22+12–13=34 (in three Kapuas specimens).

The only other nominal species referred to *Amblyrhynchichthys, A. altus* Vaillant, 1893, is a synonym of *Puntioplites lawak*, type species of the monotypic genus *Kalimantania* Bănărescu, 1980.

Amblyrhynchichthys truncatus (Bleeker, 1851)

(Figure 13)

Barbus truncatus Bleeker, 1851*a*:13 (type locality Banjermassing, in fluviis).
Amblyrhynchichthys truncatus Bleeker, 1859*a*:153.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 169 mm (MZB 3029); Kapuas 1976-33, 3: 36.3–107 mm (MZB 3030, USNM 230155); Kapuas 1976-44, 6: 93.8–147 mm (CAS 49187, MZB 3031, UMMZ 209912); Kapuas 1976-53, 91.0 mm (MZB 3032); Kapuas 1976-54, 206 mm (MZB 3033)

DISTRIBUTION.—Thailand (Menam Pasak, Meklong, Chao Phrya, Mekong, Tapi). Sumatra (Palembang, Djambi). Borneo (Kapuas, Barito).

Balantiocheilos Bleeker, 1859

Balantiocheilos Bleeker, 1859*a*:149 (type species *Barbus melanopterus* Bleeker, 1851, by monotypy).

This monotypic genus is readily identified by its lip morphology and fin coloration.

Rostral and maxillary barbels present but small; anterior margin of rostral barbel joined by a frenum to rostal cap. Rostral cap fleshy, deeply incised. Upper and lower lips thick and fleshy, their external surface with deep longitudinal or transverse grooves; lower lip posteriorly prolonged to form a deeply incised lobe with an <-shaped posterior border. Isthmus at point of posterior origin of incision of lower lip with a complementary <-shaped vertical incision; apex of isthmus posteriorly incised to form a small trapezoidal dermal wedge. This is conceivably homologous with a similarly shaped, somewhat larger dermal wedge bearing hypertrophied cutaneous papillae on the isthmus of *Cyclocheilichthys*. Last unbranched dorsal-fin ray moderately enlarged and strongly serrate. Distal margins of dorsal, anal, caudal, and pelvic fins with wide falcate marginal black bands; basal portion of caudal and sometimes other fins yellow. Gill rakers 7+10=17 (very short). Vertebrae 21+12=33 (three Kapuas specimens).

Balantiocheilos melanopterus (Bleeker, 1851)

(Figure 14)

Barbus melanopterus Bleeker, 1851*a*:11 (type locality Bandjermassing).
Balantiocheilos melanopterus Bleeker, 1859*a*:149.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-15, 81.8 mm (MZB 3034); Kapuas 1976-20, 4: 83.7–133 mm (CAS 49188, MZB 3035); Kapuas 1976-44, 117 mm (MZB 3036); Kapuas 1976-49, 2: 87.9–113 mm (MZB 3037, USNM 230156)

DISTRIBUTION.—Thailand (Mekong, Chao Phrya). Malay Peninsula (Perak). Sumatra (Palembang, Djambi, Kwantan R.). Borneo (Kapuas, Kahajan, Barito, Mahakam).

Barbichthys Bleeker, 1859

Barbichthys Bleeker, 1859*a*:147 (type species *Barbus laevis* Valenciennes *in* Cuvier and Valenciennes, 1842, by monotypy)

This southeast Asian genus has a distinctively shaped head and mouth, numerous morphologically specialized gill rakers, and perhaps the most highly modified oral and pharyngeal epithelia of any cyprinoid. Its relationships to other cyprinids are unknown.

Mouth broad, subterminal. Rostral cap expanded posteriorly dorsal and ventral to rostral barbel, reaching corner of mouth, deeply incised, its posterior margin entire. Rostral barbel moderately elongate, lying (when adpressed) in shallow longitudinal groove on external surface of rostral cap. Maxillary barbel present. Upper lip similar to rostral cap, its margin entire and broadly continuous at corners of mouth with lower lip. Lower lip thin, moderately long, deeply incised posteriorly. Upper and especially lower lips with a few irregularly placed flat tubercles of variable size near corner of mouth. A ventrally directed median papilla or barbel-like flap arising from lower lip at symphysis

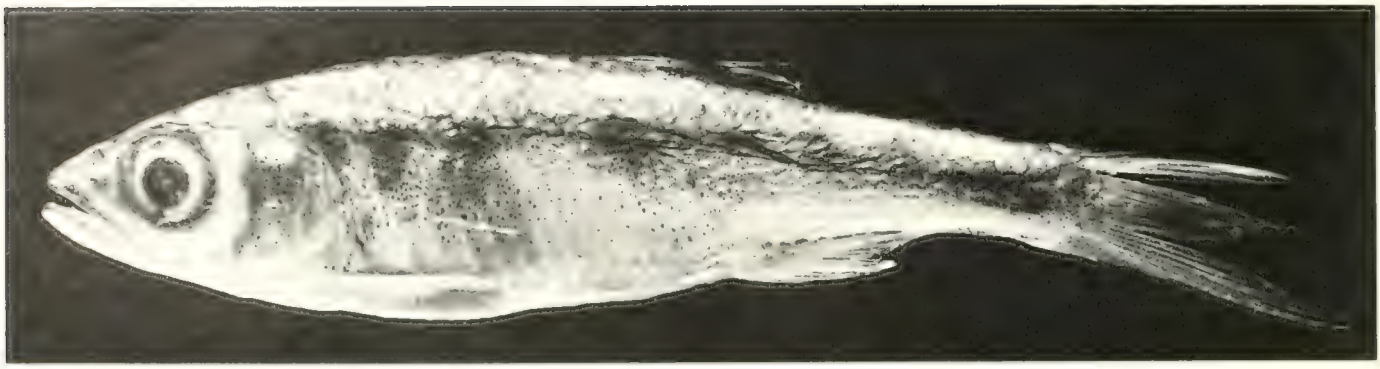

FIGURE 15 *Barilius borneensis*. Kapuas 1976-27, 38.0 mm (MZB 3043, holotype).

of lower jaw. Upper and lower horny jaw sheaths absent or rudimentary. Oral roof covered with large wrinkled folds or pleats, the largest longitudinally median, the others arranged at varying angles. Pharyngeal roof strongly arched, the apex of the arch forming a steep, narrow, median longitudinal groove and its eaves a pair of almost vertically oriented, thickened lateral pads or cushions opposed to the raker bearing portions of the gill arches. Each lateral pharyngeal pad with about eight elevated longtudinal rows of fingerlike papillae or fimbriae. In smaller specimens the fimbriae are simple and similar in size and shape to the uniformly distributed fimbriae on the median pharyngeal cushion of *Dangila*. In the largest specimens examined (to 193 mm), the fimbriae are multifid, each with 5–6 fingerlike projections which may themselves bear minute projections.

Total gill rakers on first arch 36–48, their number apparently subject to little or no increase within size range of specimens examined. Rakers moderately large and fleshy, with numerous small fimbriate projections, those of successive arches interposing to form a highly complex lattice-work somewhat similar to that of the *Albulichthys–Puntioplites* group of southeast Asian cyprinids.

Lateral line complete. Scales with moderately numerous parallel radii; lateral scales 36–38, transdorsal 11, predorsal 13–14. Last simple dorsal-fin ray non-serrate, branched dorsal-fin rays 8. Branched anal-fin rays 5. Pharyngeal teeth 2,4,5/5,4,2. Body silvery. Middle and dorsal fin with diagonal black band, upper and lower caudal-fin lobes with longitudinal submarginal black bands. Vertebrae 23+11=34 (two Kapuas specimens). A single species is recognized.

Barbichthys laevis (Valenciennes, 1842)

Barbus laevis Valenciennes *in* Cuvier and Valenciennes, 1842:192 (type locality Buitenzorg and Sarayevi, Java)
Barbus brachynemus Bleeker, 1850:18 (type locality Surabaya, in flumine Kalimas). See Bleeker 1860*a*:209
Barbus goburoides Bleeker, 1852*d*:592 (type locality Palembang, in fluviis). See Bleeker (1860*a*:209)
Barbichthys laevis Bleeker, 1859*a*:147; 1860*a*:209
Barbichthys laevis var. *sumatranus* Volz, 1904:478
Barbichthys nitidus Sauvage, 1878:9 (type locality Indo-Chine)
Barbichthys laevis nitidus Bănărescu, 1980:98

MATERIAL EXAMINED.—Malay Peninsula: Perak, Chenderoh Dam, 5: 138–193 mm (CAS-SU 34659). Western Borneo: Kapuas 1976-19, 5: 99.0–137 mm (CAS 49189, MZB 3038, USNM 230157); Kapuas 1976-20, 85.2 mm (MZB 3039); Kapuas 1976-33, 106 mm (MZB 3040); Kapuas 1976-37, 110 mm (MZB 3041). Kapuas 1976-44, 110 mm (MZB 3042)

DISTRIBUTION.—Thailand (Mekong, Chao Phrya, Patani). Malay Peninsula. Sumatra (Lampong, Pangahuang, Lahat, Palembang, Kwantan R., Kampar R., Indragiri, Djambi). Borneo (Kapuas, Barito, Mahakam). Java (Batavia, Tangerong, Rankasbetong, Lebak, Buitenzorg, Parongkalong, Brantas R., Surabaya, Gempal).

Barilius Hamilton-Buchanan, 1822

Barilius Hamilton-Buchanan, 1822:266, 384 (type species *Cyprinus barila* Hamilton-Buchanan, 1822, by subsequent designation of Bleeker, 1863*b*:203)
Opsarius McClelland, 1839:295, 413 (type species *Cyprinus* (*Barilius*) *barila* Hamilton-Buchanan, 1822, by subsequent designation of Bleeker, 1863:203).
Pachystomus Heckel, 1843:1038 (type species *Cyprinus* (*Barilius*) *shacra* Hamilton-Buchanan, 1822, by subsequent designation of Bleeker, 1863*b*:203; preoccupied by *Pachystomus* Latreille, 1809, Diptera)
Opsaridium Peters, 1854:783 (type species *Leuciscus zambezensis* Peters, 1854, by monotypy)
Shacra Bleeker, 1860*a*:431 (type species *Pachystomus schagra* Heckel, 1843=*Cyprinus* (*Barilius*) *shacra* Hamilton-Buchanan, 1822, by absolute tautonymy)
Bendelisis Bleeker, 1860*a*:431 (type species *Cyprinus* (*Barilius*) *bendelisis* Hamilton-Buchanan 1822, by absolute tautonymy and monotypy)
Bola Günther, 1868:293 (type species *Cyprinus* (*Barilius*) *bola* Hamilton-Buchanan, 1822, by absolute tautonymy; preoccupied by *Bola* Hamilton-Buchanan, 1822, Sciaenidae)
Raiamas Jordan, 1919:344 (replacement name for *Bola* Günther, 1868). For current status see Howes (1980, 1983)
Sagittabarilius Fowler, 1936:293 (type species *Barilius salmolucius* Nichols and Griscom, 1917, by original designation and monotypy)
Illodanio Smith, 1945:100 (type species *Danio* (*Allodanio*) *ponticulus* Smith, 1945, by original designation and monotypy)
Chedrus Swainson, 1839:285 (type species *Chedrus grayi* Swainson, 1839=*Cyprinus* (*Barilius*) *chedra* Hamilton-Buchanan 1822=*Cyprinus* (*Barilius*) *bendelisis* Hamilton-Buchanan, 1822, by monotypy)

The genus *Barilius* has not been reported previously from Indonesia. A single specimen of an undescribed species was obtained during the Kapuas survey of 1976.

Barilius borneensis new species

(Figure 15)

HOLOTYPE.—MZB 3043, 38.0 mm, rocky channel in mainstream of Sungai Pinoh, 37 km S of Nangapinoh (Kapuas 1976-27)

A *Barilius* with short rostral barbel but no maxillary barbel; gill rakers very short, 1+1+6=8; lateral line scales about 39, predorsal about 15, transdorsal about 15, circumpeduncular about 15 (numerous scales missing); dorsal-fin rays ii9, anal-fin rays iii7, pectoral-fin rays 14, pelvic-fin rays 8; vertebrae 19+19=38.

Horizontal diameter of eye 11.5, head length 3.4, length rostral barbel one-third of eye diameter, body depth 4.1, caudal peduncle depth 10.7. Lateral line sloping gently downwards behind head, separated from pelvic-fin origin by about 2½ and from anal fin by 2 scale rows.

Tubercles apparently absent on body and fins, but well developed on head, especially on ventral surface of mandible; ventrolateral surface of mandible with 3–4 irregular longitudinal rows of conical tubercles with crowns laterally directed, ventromedian surface of mandible with 2–3 irregular longitudinal rows of similar but somewhat smaller tubercles with crowns ventrally directed; scattered fine tubercles near tip of snout.

Side of body from immediately behind head to end of caudal peduncle with about 10 midlateral marks, more distinct anteriorly but all dusky and poorly defined; anterior 4–5 marks vertically elongate, posterior marks becoming progressively more horizontal and indistinct; posterior marks superimposed on a dusky longitudinal stripe (most distinct on caudal peduncle) extending about from a vertical below dorsal-fin origin to caudal-fin base. Dorsal-fin rays darkly pigmented near distal margin of fin, forming a slightly oblique dark longitudinal stripe across entire fin. Pectoral, pelvic, and anal fins unpigmented or with only a few inconspicuous melanophores along some fin rays. Caudal fin with numerous fine melanophores along fin rays; tip of lower caudal fin lobe slightly darkened.

Barilius borneensis is apparently most similar to *Barilius ponticulus* (Smith, 1945), and *B. nanensis* Smith, 1945, described from mountain streams in the Mekong basin of northern Thailand. The two nominal Thai species *B. ponticulus* and *B. nanensis* (probably conspecific with each other) have body-shape, fin positions, body and dorsal-fin coloration similar to those of *B. borneensis* but differ in having fewer scales in the lateral series (31–33 instead of about 39), 10 instead of only 7 branched anal-fin rays, and maxillary as well as rostral barbels present.

Etymology.—The name *borneensis* refers to the geographical origin of this species, the only member of the genus known from Borneo.

Chela Hamilton-Buchanan, 1822

Chela Hamilton-Buchanan, 1822:258, 383 (proposed as subgenus of *Cyprinus*: type species *Cyprinus cachius* Hamilton-Buchanan, 1822, by subsequent designation of Bleeker, 1863e:264).
Laubuca Bleeker, 1859–60c:438 (type species *Cyprinus laubuca* Hamilton-Buchanan, 1822, by absolute tautonymy).
Cachius Günther, 1868:339 (type species *Cyprinus cachius* Hamilton-Buchanan, 1822, by absolute tautonymy).
Allochela Silas, 1958:64, 87 (type species *Chela fasciata* Silas, 1958, by original designation; proposed as subgenus of *Chela*).
Neochela Silas, 1958:64, 93 (type species *Laubuca dadyburjori* [emended from misspelling *dadiburjori*] Menon, 1952, by original designation and monotypy). Proposed as a subgenus of *Chela*
Malayochela Bănărescu, 1968:59 (type species *Eustira maassi* Weber and de Beaufort, 1912, by monotypy).

Chela, as revised by Silas (1958), comprises 6–7 species distributed in the Indian subcontinent, mainland southeast Asia west of the Mekong basin, the Malay Peninsula, Sumatra, and Borneo (Silas 1958; Bănărescu 1968).

Chela maassi (Weber and de Beaufort, 1912)

Chela megalolepis Vaillant, 1893:91 (in part; misidentified from Kapuas; see Bănărescu 1968:61).
Haplochetlus panchax Vaillant, 1902:15 (Pontianak; misidentification).
Chela acinaces Duncker, 1904:183 (Muar River; see Bănărescu 1968).
Eustira maassi Weber and de Beaufort, 1912:531 (type locality Gunung Sahilan on Kampar River, Sumatra).
Laubuca (*Eustira*) *maassi* Weber and de Beaufort, 1916:49.
Chela (*Allochela*) *maassi* Silas, 1958:91.
Chela (*Malayochela*) *maassi* Bănărescu, 1968:59.
?*Chela* (*Malayochela*) cf. *maassi* Kottelat, 1982:420 (Mentaya basin).

Material Examined.—Malay Peninsula: Pahang, Tasek Bera, 35.8 mm (CAS 47619). Western Borneo: Kapuas 1976-7, 33.5 mm (MZB 3044); Kapuas 1976-37, 3, 28.5–34.5 mm (MZB 3045, ROM 38610); Kapuas 1976-42, 12, 22.0–33.1 mm (CAS 49190, MZB 3046, USNM 230158); Kapuas 1976-43, 35.3 mm (MZB 3047).

Diagnosis.—A comparatively slender-bodied *Chela*, depth about 3.3, with a dark median longitudinal stripe, lateral line scales 28–34, predorsal scales 20–21, and branched anal-fin rays 10–11. Pharyngeal teeth in two rows, 4–5,2–3/4–5,2–3 (Bănărescu 1968). It is the only *Chela* species known from Borneo.

Distribution.—Malay Peninsula (Muar, Pahang). Sumatra (Kampar). Borneo (Kapuas).

Cosmochilus Sauvage, 1878

Cosmochilus Sauvage, 1878:240 (type species *Cosmochilus harmandi* Sauvage, 1878, by monotypy)

Diagnosis.—Large, deep-bodied and laterally compressed; dorsal fin large and falcate, with 4 simple and 8–9 branched rays; last simple dorsal-fin ray greatly enlarged, its posterior border more or less strongly serrated for its entire length; anal fin relatively small, with 3 simple and 5–6 branched rays; head relatively small, compressed; snout truncate, without enlarged tubercles or pores; mouth small and inferior, its opening transverse; rostral and maxillary barbels large and relatively elongate; lips moderately thick, entirely covered with large, contiguous papillae; horny jaw sheaths transverse, moderately thick but with relatively weak cutting edge; gill rakers fleshy, relatively unspecialized, 15–18 on first gill arch; pharyngeal teeth triserial, morphologically generalized for Cyprinidae, usually 1,3,5/5,3,1 or 2,3,5/5,3,2; lateral line almost perfectly straight; each lateral line tubule with a short ventroposterior branch terminating in small pore on exposed portion of posterior shield; scales in lateral line series 35–48; circumpeduncular scales 16–18; scales oblong, with relatively huge posterior shields; radii of posterior shield strongly convergent; radii of anterior shield frequently conjoined or bifurcate; vertebrae 35–43.

In addition to *C. harmandi* from the Chao Phrya and Mekong, the genus includes a species from the Lancang-jiang or Mekong in Yunnan Province, China, described by Chu and Roberts (1985), and one species from Borneo.

Cosmochilus falcifer Regan, 1906

Cosmochilus falcifer Regan, 1906:66 (type locality Baram River)

Material Examined.—Kapuas 1976-19, 316 mm (MZB 3048); Kapuas 1976-52, 143 mm (MZB 3409).

Life color of *C. falcifer* has not been reported previously. The fresh 316 mm specimen caught in the Kapuas and photographed in the market at Sintang had overall color white or milk-white especially ventrolaterally and ventrally; dorsolaterally and dorsally distinctly brownish or violaceous brown; posterior margins of scales, especially on upper parts of body, with broad dark

margins; dorsal surface of head faintly yellowish and entire gill cover distinctly yellow; iris and ventral portion of head milk-white; entire dorsal fin rosy pink or faintly orangish except black at tip; pectoral fin white, pelvic white or pinkish; anal and caudal fins dusky, caudal very dark, its posterior margin almost black.

Fishermen at Sintang, where large individuals of this species are frequently marketed, informed me that they are familiar only with full-grown or nearly full-grown adults. The only small individual (143 mm) I observed in 1976 was purchased at the market in Pontianak.

DISTRIBUTION.—Sarawak (Baram, Rejang). Western Borneo (Kapuas).

Crossocheilus Kuhl and van Hasselt, 1823

Crossocheilus Kuhl and van Hasselt *in* van Hasselt, 1823:132 (type species *Crossocheilus oblongus* Kuhl and von Hasselt *in* van Hasselt, 1823, by monotypy).
Crossocheilos Bleeker, 1853:525 (unwarranted spelling emendation).
Crossochilus Günther, 1868:73 (unwarranted spelling emendation)

It is debatable whether the brief original account of the new genus and species *Crossocheilus oblongus in* van Hasselt, 1823, qualifies as a valid description. It is tentatively accepted as valid because it mentions one taxonomic character ("mouth opening downwards in the form of a parallelogram") and because its recognition is in keeping with most current practice and seemingly will not be contrary to nomenclatural stability. The earliest unquestionably valid description of the genus is by Bleeker (1853); that of the generic type species is by Valenciennes in Cuvier and Valenciennes (1842).

Rostral cap very thick, its margin fimbriate. Rostral lobe present between rostral barbel and sublacrimal groove. Sublacrimal groove extending from origin of rostral lobe to behind rictus of jaws. Upper lip well developed, continued in a fold at corner of mouth, its entire margin uniserially papillate. Jaws somewhat narrow, horny jaw sheaths present but not greatly thickened, without sharp cutting edge. Lower lip fleshy, fitting into a shallow depression on horny sheath of lower jaw (as in *Epalzeorhynchos*), its anteroventral margin with several rows of lobate papillae. Rostral and maxillary or rostral barbels only present. Males with dorsal surface of posterior half of first 8 or more pectoral-fin rays covered for their whole length with numerous close-set fine breeding tubercles.

Key to *Crossocheilus* of western Borneo

1a Rostral and maxillary barbels present; mouth relatively narrow; rostral cap with 14–15 fimbriae; upper lip relatively thick, with large marginal papillae; papillae on lower lip relatively large . . . . . *C. cobitis*

1b Rostral barbels only present; mouth relatively wide; rostral cap with about 18–23 fimbriae; upper lip thin, with very small marginal papillae; papillae on lower lip relatively small, rounded 2

2a Body with midlateral longitudinal stripe relatively pale, its margins poorly defined, ending in a small round spot at base of middle caudal-fin rays . . . . . *C. oblongus*

2b Body with midlateral longitudinal line very dark (black), its margins sharply defined, extending two-thirds of length nearly to end of middle caudal-fin rays before ending abruptly . . . . . *C.* sp. undet.

Crossocheilus cobitis (Bleeker, 1853)

(Figure 16)

Lobocheilos cobitis Bleeker, 1853*f*:523 (type locality Padang, Sumatra and Batavia, Java)
Crossocheilos (*Crossocheilichthys*) *cobitis* Bleeker, 1860*a*:125.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-14, 34.0 mm (MZB 3050); Kapuas 1976-24, 3: 66.6–94.3 (CAS 49191, MZB 3051); Kapuas 1976-26, 5: 70.3–99.8 mm (BMNH 1982.3.29.1, MNHN 1982-651, MZB 3052, RMNH 28822); Kapuas 1976-29, 2: 63.9–76.1 mm (MZB 3053, USNM 230159); Kapuas 1976-31, 2: 34.8–45.1 mm (MZB 3054, USNM 230160).

DISTRIBUTION.—Sumatra (Padang). Borneo (Kapuas, Mahakam). Java (Batavia, Surabaya).

Crossocheilus oblongus Kuhl and van Hasselt, 1823

(Figure 16)

Crossocheilus Oblongus Kuhl and van Hasselt *in* van Hasselt, 1823:132 (type locality Java).
Labeo oblongus Valenciennes *in* Cuvier and Valenciennes, 1842:357.
Crossochilus oblongus Popta, 1906:120.
Epalzeorhynchus siamensis Smith, 1931:20, fig. 9 (Tapi Stream, near Nakon Sritamarat, Peninsular Thailand). See below.
Epalzeorhynchus kalliurus Inger and Chin, 1962:99, fig. 46 (nec *Epalzeorhynchus kalliurus* Smith, 1945?) (Kinabatangan)

MATERIAL EXAMINED.—Peninsular Thailand: Pattani R., 3: 46.2–111 mm (NIFI uncat.). Malay Peninsula: Perak, Batang Padang, 5: 93.8–113 mm (CAS-SU 39348); Perak, Plus R., 97.8 mm (CAS-SU 68638); Pahang, Benas R., 3: 81.1–95.0 mm (CAS-SU 34667). Western Borneo: Kapuas 1976-6, 66.3 mm (MZB 3055); Kapuas 1976-14, 7: 40.5–48.6 mm (CAS 49192, MNHN 1982-652, MZB 3056, RMNH 28823); Kapuas 1976-24, 102 mm (MZB 3057); Kapuas 1976-27, 62.5 mm (MZB 3058); Kapuas 1976-31, 54.9 mm (MZB 3059); Kapuas 1976-35, 2: 42.3–49.0 mm (BMNH 1982.3.29.2, MZB 3060); Kapuas 1976-55, 4: 31.0–39.7 mm (MZB 3061, USNM 230161).

DISTRIBUTION.—Peninsular Thailand (Tapi). Malay Peninsula (Perak, Pahang). Sumatra (Padang, Lahat-Enim, Palembang, Taluk, Upper Langkat, Deli). Borneo (Kapuas, Mahakam, Kinabatangan?). Java (Bantam, Batavia, Butenzorg, Tjampea, Lebak, Tjandjur, Parongkalong, Surabaya, Ngantang).

Crossocheilus species undetermined

(Figure 16)

?*Crossochilus oblongus* var. *nigriloba* Popta, 1904:200 (type locality Bo R., Mahakam basin)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-42, 4: 42.9–50.9 mm (CAS 49193, MZB 3062).

The four juvenile specimens of *Crossocheilus* under consideration are quite distinct from juveniles of *C. cobitis* and *C. oblongus* of similar size obtained by the Kapuas survey of 1976, and do not seem identifiable with any recognized species in the genus. In having rostral barbels only they agree with *C. oblongus* rather than *C. cobitis*; in having the midlateral longitudinal black stripe extending well onto the middle portion of the caudal fin (more on the lower lobe than on the upper) they differ from both of these species and call to mind the series of three larger specimens 119–139 (RMNH 7589) from the Mahakam described as *C. oblongus* var. *nigriloba* by Popta (1904; see also Popta 1906:120, pl. 8, fig. 27). In these Mahakam specimens, which I have not examined, the midlateral longitudinal stripe is darker and more sharply defined than in *C. oblongus*, and it extends on the middle caudal fin and particularly over the lower

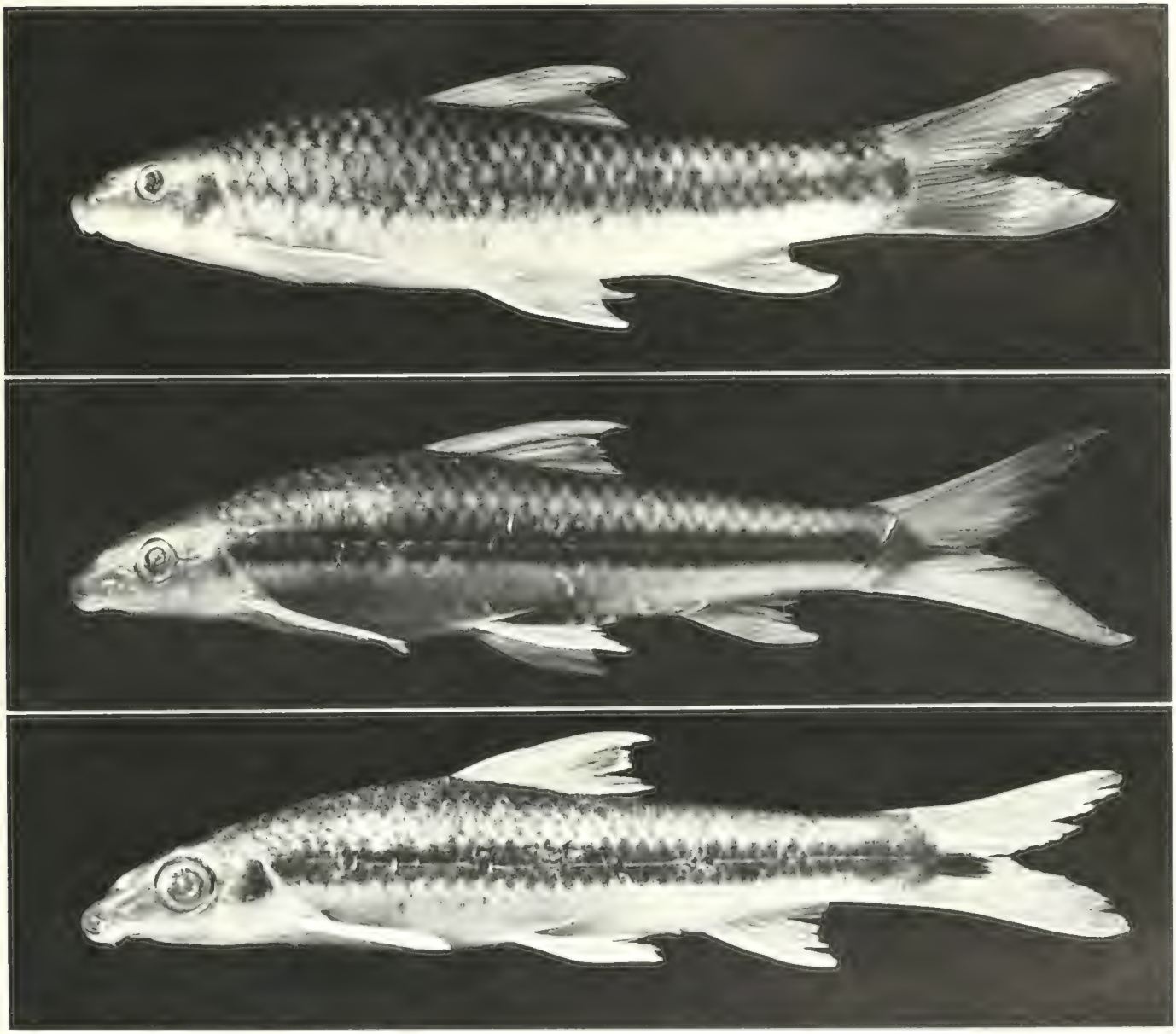

FIGURE 16. *Crossocheilus.* Above, *C. cobitis,* Kapuas 1976-27, 99.8 mm (MZB 3052); middle, *C. oblongus,* Kapuas 1976-6, 66.3 mm (MZB 3055); below, *C.* sp. undet., Kapuas 1976-42, 50.9 mm (MZB 3062).

caudal-fin lobe much more extensively but in a manner suggestive of these Kapuas juveniles.

Cyclocheilichthys Bleeker, 1859

Cyclocheilichthys Bleeker, 1859*a*:148 (type species *Barbus enoplus* Bleeker, 1850, by subsequent designation of Bleeker, 1863*b*:199).

Siaja Bleeker, 1859*a*:149 (type species *Capoeta microlepis* Bleeker, 1851, by subsequent designation of Bleeker, 1863*b*:199 [not *Capoeta siaja* Bleeker, 1851, a nomen nudum not validated until Bleeker, 1860*a*].

Anematichthys Bleeker, 1859*a*:149 (type species *Barbus apogon* Valenciennes *in* Cuvier and Valenciennes, 1842, by subsequent designation of Bleeker, 1863*b*: 199).

Oxybarbus Vaillant, 1893:83 (type species *Barbus heteronema* Bleeker, 1853, by monotypy).

Neobarynotus Bănărescu, 1980:475 (type species *Capoeta microlepis* Bleeker, 1851, by monotypy). Objective synonym of *Siaja* Bleeker, 1859; also, see present account of *Cyclocheilichthys microlepis*

NOMENCLATURAL NOTE.—Bleeker (1859*a*) indicated *Siaja* and *Anematichthys* as subgenera of his new genus *Cyclocheilichthys.* Although he did not define the subgenera he referred two or more described species to each of them.

Bleeker (1860*a*) treated five species in *Siaja* and four in *Anematichthys.* So far as I have been able to determine a type species has not been previously designated for *Anematichthys* prior to Bleeker (1863*b*).

This southeast Asian genus includes nine species, seven of which occur in western Borneo. Four of these, *C. enoplos, heteronema, janthochir,* and *microlepis,* are very distinct and cannot be confused with any other species. The remaining three, *C. apogon, armatus,* and *repasson,* are very similar and difficult to distinguish. They are apparently closely related to each other they share a distinctive color pattern not found in other species

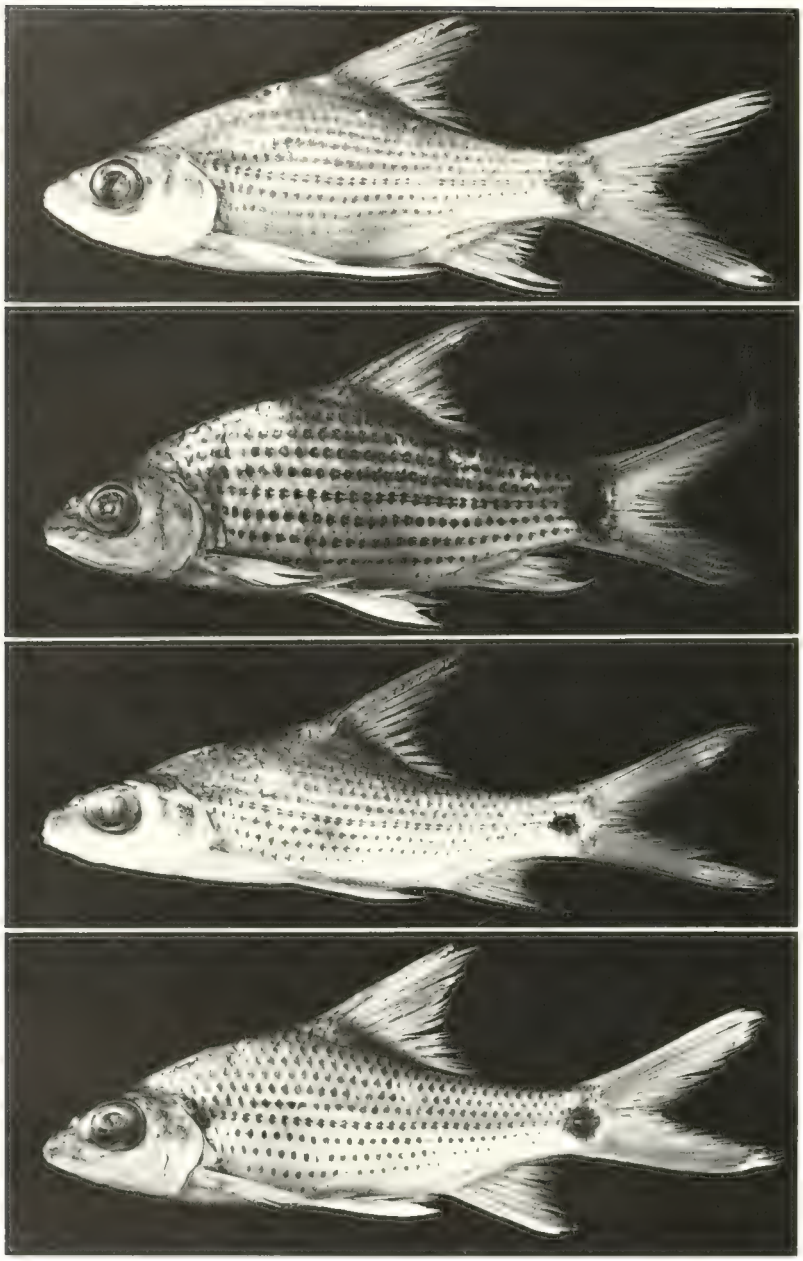

FIGURE 17 *Cyclocheilichthys*. a, *C. apogon*, Kapuas 1976-37, 63.6 mm (MZB 3068); b, *C. armatus*, Kapuas 1976-30, 78.0 mm (MZB 3077); c, *C. armatus*, Kapuas 1976-32, 78.5 mm (CAS 49198); d, *C. armatus*, Kapuas 1976-49, 78.4 mm (MZB 3080)

The characters used to separate them in the following key may not always work. In preparing the present account I have drawn freely on the unpublished doctoral dissertation of Sontirat (1976).

Key to *Cyclocheilichthys* of western Borneo

1a Middle of caudal peduncle with a large, round, dark or dusky spot; body with about 9–11 thin longitudinal stripes formed by small round spots centered on scales 2

1b Caudal peduncle without spot; body without thin longitudinal stripes or with only a single longitudinal stripe on lateral line scale row 3

2a Circumpeduncular scales 16 4

2b Circumpeduncular scales usually 20 ..... *C. repasson*

3a Barbels absent ..... *C. apogon*

3b Maxillary barbel present; rostral barbel sometimes present ..... *C. armatus*

4a Barbels present 5

4b Barbels absent 6

5a Barbels multifid; last simple dorsal-fin ray slender, not greatly enlarged; lateral line tubes simple ..... *C. heteronema*

5b Barbels simple; last simple dorsal-fin ray enormously enlarged and stout; lateral line tubes usually bifid ..... *C. enoplos*

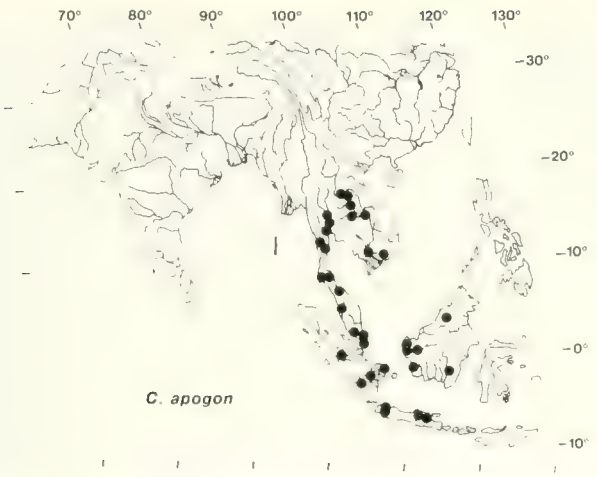

FIGURE 18. *Cyclocheilichthys apogon*. Geographical distribution (after Sontirat 1976).

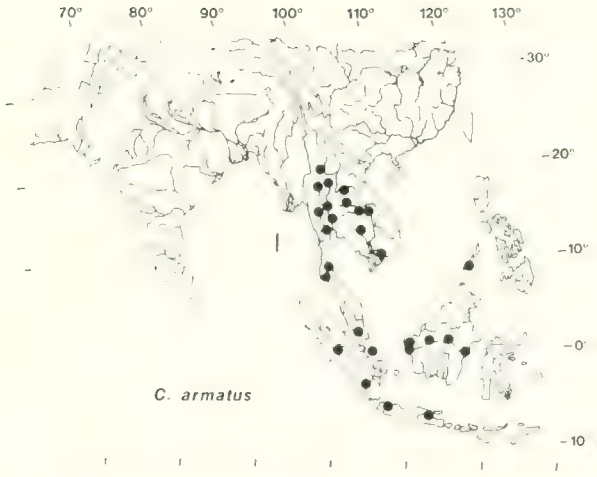

FIGURE 19. *Cyclocheilichthys armatus*. Geographical distribution (after Sontirat 1976).

6a Dorsal-fin rays 10–11; lateral line scales 32–33; a longitudinal line composed of spots centered on lateral line scales ..... *C. janthochir*

6b Dorsal-fin rays 18–22; lateral line scales 55–59; no longitudinal line(s) on body ..... *C. microlepis*

Cyclocheilichthys apogon (Valenciennes, 1842)

(Figure 17)

Barbus apogon Valenciennes *in* Cuvier and Valenciennes, 1842:392 (type locality Java).
Systomus apogon Bleeker, 1851*i*:428–429.
Systomus apogonoides Bleeker, 1855*c*:410 (type locality Java).
Cyclocheilichthys (*Anematichthys*) *apogon* Bleeker, 1859*a*:149; 1860*a*:378.
Cyclocheilichthys (*Anematichthys*) *apogonides* Bleeker, 1859*a*:149; 1860*a*:379.
Cyclocheilichthys rubripinnis Fowler, 1934*c*:343–344, fig. 7 (type locality Ban Thuang Luang, Thailand).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-7, 3: 18.9–28.7 mm (MZB 3063); Kapuas 1976-8, 5: 16.7–52.0 mm (MZB 3064, USNM 230162); Kapuas 176-16, 3: 84.0–100 mm (CAS 49194, MZB 3065); Kapuas 1976-17, 4: 41.0–99.1 mm (CAS 49195, MZB 3066); Kapuas 1976-28, 30.7 mm (MZB 3068); Kapuas 1976-37, 63.6 mm (MZB 3068); Kapuas 1976-42, 53.5 mm (MZB 3069); Kapuas 1976-44, 2: 72.3–79.2 mm (MZB 3070, USNM 230163).

DISTRIBUTION (Fig. 18).—*Cyclocheilichthys apogon* is widely distributed in Thailand, Malay Peninsula, Sumatra, Borneo, and Java.

Cyclocheilichthys armatus (Valenciennes, 1842)

(Figure 17)

Barbus armatus Valenciennes *in* Cuvier and Valenciennes, 1842:163 (type locality Java).
Barbus valenciennesii Bleeker, 1850:17 (type locality Surabaya, in flumine kalimas).
Capoeta siaja Bleeker, 1851*i*:432 (nomen nudum).
Capoeta deventeri Bleeker, 1855*c*:413 (type locality Java, Grati).
Cyclocheilichthys (*Siaja*) *siaja* Bleeker 1859*a*:149 (nomen nudum).
Cyclocheilichthys (*Siaja*) *Deventeri* Bleeker, 1859*a*:148; 1860*a*:365, 375.
Cyclocheilichthys (*Cyclocheilichthys*) *armatus* Bleeker, 1860*a*:364, 368.
Cyclocheilichthys (*Siaja*) *siaja* Bleeker, 1860*a*:365, 374 (type locality western Borneo, Sumatra).
?*Barbus lineatus* Popta, 1905:171 (type locality Bo River, Mahakam basin; preoccupied by *Barbus lineatus* Duncker, 1904). See Sontirat (1976).
?*Barbus Fowlerii* Popta, 1906:218 (replacement name for *Barbus lineatus* Popta, 1905).
?*Cyclocheilichthys lineatus* Weber and de Beaufort, 1916:162. See Sontirat (1976).
Cyclocheilichthys dezwaani Weber and de Beaufort *in* Maass, 1912:525 (type locality Solok and Lake Singkarah, Sumatra).
Cyclocheilichthys tapiensis Smith, 1931:11 (type locality Tapi River, peninsular Thailand). See Sontirat (1976).
Cyclocheilichthys mekongensis Fowler, 1937:187, fig. 126, 127 (type locality Kemarat=Mekong basin). See Sontirat (1976).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-6, 2: 51.6–59.0 mm (CAS 49196, MZB 3071); Kapuas 1976-10, 60.0 mm (MZB 3072); Kapuas 1976-14, 2: 29.3–35.7 mm (MZB 3073); Kapuas 1976-21, 19.0 mm (MZB 3074); Kapuas 1976-22, 4: 46.5–56.7 mm (CAS 49197, MZB 3075); Kapuas 1976-25, 80.3 mm (MZB 3076); Kapuas 1976-30, 78.0 mm (MZB 3077); Kapuas 1976-32, 8: 45.4–78.5 mm (CAS 49198, MZB 3078, USNM 230164); Kapuas 1976-44, 45: 52.8–113 mm (AMNH 48918, BMNH 1982.3.29.3–5, CAS 49199, FMNH 94194, IRSNB 19727, MNHH 1982-653, MZB 3079, ROM 38612, UMMZ 209913, USNM 230165); Kapuas 1976-49, 78.4 mm (MZB 3080). Philippines: Palawan Isd., west coast Iwahig River (CAS 53949).

DISTRIBUTION (Fig. 19).—This species is widely distributed in Thailand, Malay Peninsula, Sumatra, Borneo, and Java. It is also known from the single specimen reported above from Palawan; this represents the only known record of the genus *Cyclocheilichthys* in the Philippines. The specimen, collected by Robert B. Fox in 1963, was found by me among unidentified material in the Bureau of Fisheries and Aquatic Resources in Intramuros, Manila, in 1975. It is curious that *C. armatus* has not been found in northern Borneo.

Cyclocheilichthys enoplos (Bleeker, 1850)

Barbus enoplos Bleeker, 1850:16 (type locality Surabaya, in flumine Kalimas).
Capoeta enoplos Bleeker, 1851*i*:431 (description of specimen from Sambas)
Barbus macracanthus Bleeker, 1853*f*:516–517 (type locality Palembang)
Cyclocheilichthys (*Cyclocheilichthys*) *enoplos* Bleeker, 1859*a*:148; 1860*a*:366
Cyclocheilichthys (*Cyclocheilichthys*) *macracanthus* Bleeker, 1859*a*:149; 1860*a*:367.
Cyclocheilichthys dumerili Sauvage, 1881:182 (type locality Bangkok)
Barbus enoploides Tirant, 1885:157 (type locality "Thu-dau-mot"). See Sontirat (1976).

MATERIAL EXAMINED.—None.

Last simple dorsal-fin ray greatly enlarged and very stout, and lateral line tubules usually bifid (rather than simple). Lateral line scales 35–37; circumferential scales 26–27; circumpedun-

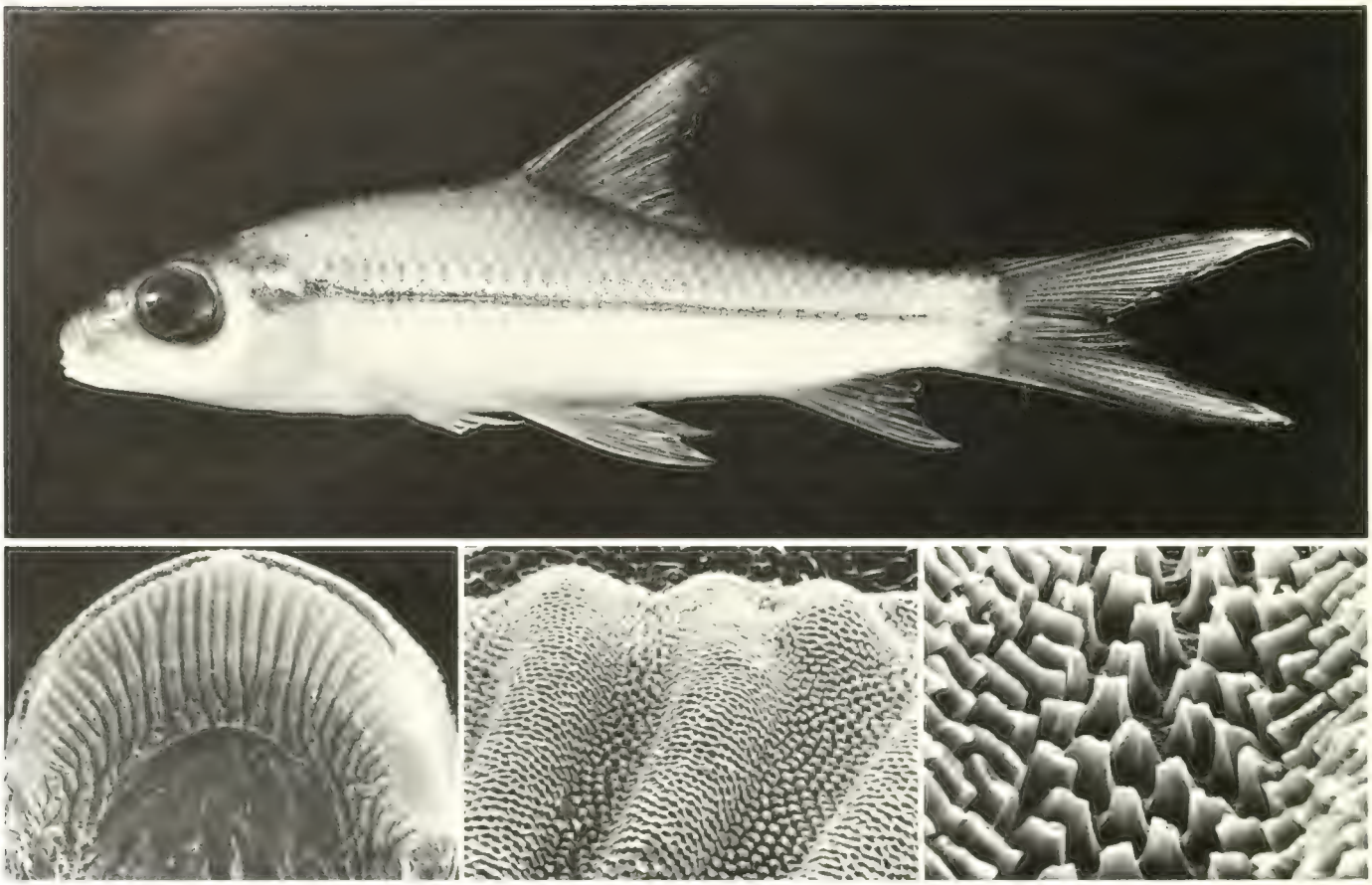

FIGURE 20. *Cyclocheilichthys janthochir*. Above, Kapuas 1976-32, 59.4 mm (MZB 4002); below, unculiferous upper lip, Kapuas 1976-49, 76.8 mm (CAS 44180).

cular scales 16. Gill rakers on first arch 15–20; vertebrae 36–37.

DISTRIBUTION.—Laos. Kampuchea. Vietnam (Mekong basin). Thailand (Mekong, Chao Phrya, Meklong, Pasak). Borneo (Sambas). Sumatra (Palembang). Java (Surabaja, Ngawi). The only Borneo record is that of Bleeker (1852:431–432). Apparently unknown from Malay Peninsula.

Cyclocheilichthys heteronema (Bleeker, 1853)

Barbus heteronema Bleeker, 1853*c*:446 (type locality Sambas, in fluviis)
Cyclocheilichthys (Siata) heteronema Bleeker, 1859*a*:149; 1860*a*:377
Oxybarbus heteronema Vaillant, 1893:83

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-9, 5: 46.9–63.0 mm (AMNH 48919, BMNH 1982.3.29.6–7, MZB 3081); Kapuas 1976-15, 20: 42.9–88.3 mm (CAS 49200, FMNH 94195, IRSNB 19728, MCZ 58339, MZB 3082) Kapuas 1976-33, 6: 46.6–83.0 mm (MNHN 1982-654, MZB 3083, CAS 349509); Kapuas 1976-34, 5: 40.7–57.6 mm (MZB 3084, RMNH 28824); Kapuas 1976-35, 7: 51.8–71.2 mm (MZB 3085, ROM 38607, UMMZ 209892); Kapuas 1976-37, 8: 60.2–73.1 mm (MZB 3086, USNM 230166), Kapuas 1976-41, 41.5 mm (MZB 3087) Kapuas 1976-44, 4: 55.1–69.8 mm (MZB 3088, ZMA 116.516). Kapuas 1976-49, 4: 49.6–78.2 mm (MZB 3089, CAS 49201)

Differs from all other *Cyclocheilichthys* in having maxillary barbel multifid instead of simple. Rostral barbel absent. Lateral line scales 32–34. Circumferential scales 11/2/13=26; circumpeduncular scales 16. Gill rakers on first arch 8–12. Total vertebrae 33–35.

DISTRIBUTION.—Thailand (Tale Noi, Pattani; Smith 1945:142–143). Malay Peninsula (Muar Johore, Kuala Pilah, Negri Sembilan; Herre and Myers 1937:61). Western Borneo (Sambas, Kapuas).

Cyclocheilichthys janthochir (Bleeker, 1853)

(Figure 20)

Systomus janthochir Bleeker, 1853*c*:448 (type locality Kapuas River)
Cyclocheilichthys (Anematichthys) janthochir Bleeker, 1859*a*:149; 1860*a*:381

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-20, 9: 100–119 mm (BMNH 1982.3.29.8, FMNH 94196, KUMF 2848, MNHN 1982-655, MZB 3090, RMNH 28825, UMMZ 209862); Kapuas 1976-32, 59.4 mm (MZB 4002); Kapuas 1976-49, 8: 67.9–78.2 mm (CAS 44180, KUMF 2849, MZB 3091, USNM 230167)

Barbels absent; circumpeduncular scales 16; circumferential scales 12/2/13=27. Lateral line scales 32–33. Last simple dorsal-fin ray stiffened and finely serrate, but very slender. Coloration unique for the genus: live fish with body white laterally and ventrally, with bluish reflections dorsally; a thin black mid-longitudinal line straddling lateral line canal; dorsal and caudal fins carmine red, with blackish margins; other fins colorless. Gill rakers 11. Vertebrae 22+11=33 (3, Kapuas).

DISTRIBUTION.—Borneo (Kapuas; southern Borneo, Kottelat 1982).

Cyclocheilichthys microlepis (Bleeker, 1851)

(Figure 21)

Capoeta microlepis Bleeker, 1851*b*:206 (type locality Bandjermassing)
Cyclocheilichthys (Siaja) microlepis Bleeker, 1859*a*:149; 1860*a*:371
Barynotus microlepis Günther, 1868:61
Neobarynotus microlepis Bănărescu, 1980:477

FIGURE 21. *Cyclocheilichthys microlepis*. Kapuas 1976-54, 256 mm (MZB 3094)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-34, 332 mm (MZB 3092); Kapuas 1976-44, 3: 112–144 mm (CAS 49202, MZB 3093, USNM 230168).

Differs from all other *Cyclocheilichthys* in having 18–22 dorsal-fin rays (vs. only 11–13) and lateral line scales 55–59 (vs. 30–40). Circumferential scales about 13/2/18=33. Circumpeduncular scales 22. Last simple dorsal-fin ray stiffened and finely serrate but very slender. Gill rakers on first arch 10. Vertebrae 22+12=34.

DISTRIBUTION.—Sumatra (Palembang, Djambi). Borneo (Kapuas, Barito).

Cyclocheilichthys repasson (Bleeker, 1853)

Barbus repasson Bleeker, 1853*b*:295 (type locality Pangabuang, Lampong province, Sumatra)
Cyclocheilichthys (*Cyclocheilichthys*) *repasson* Bleeker, 1859*a*:149; 1860*a*:370
Cyclocheilichthys megalops Fowler, 1905:483 (type locality Baram River). See Sontirat (1976)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-24, 102 mm (MZB 3095). Kapuas 1976-33, 128 mm (MZB 3096); Kapuas 1976-36, 61.7 mm (MZB 3097). Kapuas 1976-39, 85.5 mm (MZB 3098); Kapuas 1976-43, 47.9 mm (MZB 3099)

DISTRIBUTION (Fig. 22).—Vietnam, Laos, and Kampuchea (Mekong); Thailand (Mekong, Chao Phrya, Meklong, Pattani, Tale Sap); Malay Peninsula (Perak). Sumatra (Lake Singarah; Moesi R.). Borneo (Baram, Kapuas, Mahakam?).

Dangila Valenciennes, 1842

Labiobarbus van Hasselt, 1823:132 (unidentifiable)
Dangila Valenciennes *in* Cuvier and Valenciennes, 1842:229 (type species *Dangila leptocheila*=*Dangila cuvieri* Valenciennes *in* Cuvier and Valenciennes, 1842, by subsequent designation of Bleeker, 1863*b*:193)
Cyrene Heckel, 1843:1024 (type species not designated)

Most authors, following Cuvier and Valenciennes (1842), have recognized *Dangila*. Smith (1945:221), however, unwilling to accept its rejection, employed *Labiobarbus*. Inger and Chin (1962: 94) acknowledged Smith's claim of priority for *Labiobarbus* but treated it as a nomen oblitum and retained *Dangila*. Ichthyologists of the last century (including Bleeker) obviously knew about the "priority" of *Labiobarbus* but set it aside in favor of *Dangila*. The paragraph in van Hasselt (1823:132) treating *Labiobarbus* reads as follows:

> Het genus *Labiobarbus* Mihi bestaat mit Labiones met 4 barbillons, met eene dorsal vin, waarvan de 2de straal niet getand is, vereenigt dus de karakteren van *Labio*, en *barbus*, waarom ik den naam Labiobarbus het aangenomen. De namen *L. Leptocheilus* M. en *Lipocheilus* M. anderschieden de twee specien, die beide bij Batavia in de rivier gevonden worden, en onder mij afgebeeld zijn.
>
> The genus *Labiobarbus* Mihi consists of Labiones with 4 small barbels, with a single dorsal fin of which the second ray is not serrated and thus combines the characters of *Labio* and *barbus*, wherefore I adopted the name Labiobarbus. The names *L. Leptocheilus* M. and *Lipocheilus* M. distinguish the two species which were both found in the river near Batavia and figured under me (after Alfred 1961)

Many, perhaps most, members of the family Cyprinidae and subfamily Labeoinae have 4 barbels and the dorsal fin without a serrated ray; the identities of the two species mentioned by van Hasselt are known only because of the subsequent publication by Valenciennes (1842) of descriptions based on the original figures referred to by van Hasselt. Valenciennes used the species names originally proposed by van Hasselt, but coined the new generic name *Dangila*, presumably to avoid confusion or synonymy with *Labeobarbus* Rüppell, 1836, which he treated in the same volume.

The names *Labiobarbus*, *L. leptocheilus*, and *L. lipocheilus* of

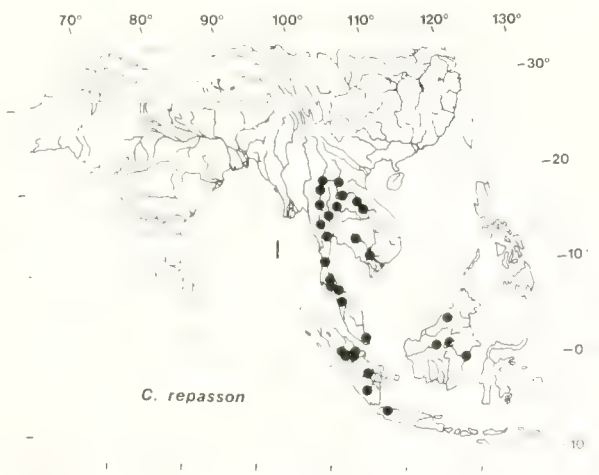

FIGURE 22. *Cyclocheilichthys repasson*. Geographical distribution (after Sontirat 1976)

van Hasselt, 1823 are regarded as unidentifiable and best forgotten.

Dorsal fin with 21–30 branched rays, last simple ray slender, flexible, and non-serrate. Two pairs of barbels, both moderately elongate. Gill rakers on first arch 38–47. Soft roof of mouth swollen, covered with hundreds of macroscopic villi, and fitting snugly against raker-bearing portions of gill arches. Scales in lateral series 39–68. Pharyngeal teeth 3,3,5/5,3,3 (Heckel 1843: 34) or 2,3–4,5/5,3–4,2 (Beaufort 1916:113).

Dangila cuvieri Valenciennes, 1842

?*Labiobarbus leptocheilus* van Hasselt, 1823:132 (unidentifiable).
Dangila Cuvieri Valenciennes *in* Cuvier and Valenciennes, 1842:230 (type locality Batavia?)
Dangila leptocheila Valenciennes *in* Cuvier and Valenciennes, 1842:234 (type locality Java).
Dangila koedjem Popta, 1904:192 (type locality "le Boelit"=?Sungai Bulit, Kapuas basin, at 0°48'N, 113°44'E)
Dangila rosea Popta, 1904:193 (type locality "le Bō", Mahakam basin).
Labiobarbus leptocheilus Smith, 1948:227

Material Examined.—None

Dangila fasciata Bleeker, 1853

Dangila fasciata Bleeker, 1853*b*:297 (type locality Pangabuang, Lampong Prov.).
Dangila taeniata Günther, 1868:38 (unwarranted substitute name).

Material Examined.—Western Borneo: Kapuas 1976-14, 37.1 mm (MZB 3101); Kapuas 1976-16, 5: 47.1–77.1 mm (CAS 49204, MZB 3102, USNM 230169); Kapuas 1976-37, 80.6 mm (MZB 3103); Kapuas 1976-39, 2: 63.0–68.6 mm (MZB 3104, UMMZ 209897)

Dangila festiva (Heckel, 1843)

Cyrene festiva Heckel, 1843:1025 (type locality Borneo).
Dangila festiva Bleeker, 1857*a*:16 (Kahajan)
Dangila festiva var. *stercus-muscarum* Vaillant, 1902:87 (type locality "Pontianak"; "Smitau, rivière Sibau")

Material Examined.—Western Borneo: Kapuas 1976-19, 172 mm (MZB 3105).

Distribution.—Malay Peninsula (Pahang, Selangor, Johore). Borneo (Kapuas, Kahajan, Barito).

Dangila lineata Sauvage, 1878

Dangila lineata Sauvage, 1878:237 (type locality Stung-Strang, Laos).
Labiobarbus lineatus Smith, 1945:223

Material Examined.—Western Borneo: Kapuas 1976-14, 2: 72.6–84.3 mm (CAS 49205, MZB 3106); Kapuas 1976-15, 67.1 mm (MZB 3107); Kapuas 1976-34, 4: 69.6–78.8 mm (MNHN 1982-656, MZB 3108, USNM 230170); Kapuas 1976-35, 2: 79.7–80.4 mm (CAS 49206, MZB 3109); Kapuas 1976-37, 72.6 m (MZB 3110); Kapuas 1976-39, 72.9 mm (MZB 3111)

Distribution.—Laos. Thailand (Mekong, Chao Phrya, Tapi, Rayong). Malay Peninsula. Borneo (Kapuas).

Dangila ocellata (Heckel, 1843)

Cyrene ocellata Heckel, 1843:1025 (type locality Borneo)
Dangila microlepis Bleeker, 1852*d*:595 (type locality Palembang). See Bleeker (1860*a*:195)
Dangila ocellata Bleeker, 1860*a*:194

Material Examined.—Western Borneo: Kapuas 1976-20, 6: 63.7–110 mm (AMNH 48920, BMNH 1982.3.29.9, CAS 49207, FMNH 94197, MZB 3112); Kapuas 1976-31, 58.1 mm (MZB 3113); Kapuas 1976-33, 2: 81.9–93.0 mm (MNHN 1982-657, MZB 3114); Kapuas 1976-34, 2: 114–120 mm (IRSNB 19729, MZB 3115); Kapuas 1976-39, 97.3 mm (MZB 3116); Kapuas 1976-43, 3: 47.4–54.5 (MZB 3117, UMMZ 209914, USNM 230171); Kapuas 1976-44, 90.3 mm (MZB 3118); Kapuas 1976-49, 67.7 mm (MZB 3119).

Lateral line scales 65–68 (30–53 in all other *Dangila*).

Body plain except for a black spot surrounded by a light colored ring (yellow in life?) on shoulder and a plain black spot on middle of caudal peduncle.

Distribution.—Sumatra (Pangabuang, Palembang, Lahat, Lematang Enim, Gunung Sahilan, Sungei Mahe, Danau Sialong Lotong, Kwantan R., Indrajiri, Djambi). Borneo (Kapuas, Kahajan, Mahakam).

Eirmotus Schultz, 1959

Eirmotus Schultz, 1959:10 (type species *Eirmotus octozona* Schultz, 1959, by monotypy)

Small cyprinids (largest known specimen of only known species 33 mm) with several longitudinal and transverse rows of cephalic cutaneous papillae; barbels absent; lateral line incomplete, with only 5–6 pored scales anteriorly; scales relatively larger than in any other southeast Asian cyprinid, lateral scale series 20, predorsal scales 7, circumpeduncular scales 8. Dorsal-fin rays 8, last simple ray serrate. Anal-fin branched rays 5. Pharyngeal teeth unknown. Gill rakers absent or extremely reduced. Vertebrae 15+15–16=30–31.

Eirmotus, Oreichthys, and *Cyclocheilichthys* are the only southeast Asian cyprinid genera with parallel rows of enlarged cephalic cutaneous papillae. Whether they are closely related (perhaps forming a monophyletic group) or independently derived from cyprinid genera lacking papillae is an open question. It is noteworthy that numerous species of tropical African "*Barbus*" (sometimes placed in separate genera on this account) have parallel rows of enlarged cephalic cutaneous papillae which are at least superficially very similar to those observed in these Asian genera.

Eirmotus octozona Schultz, 1959

(Figure 23)

Eirmotus octozona Schultz, 1959:11 (type locality, possibly erroneous, Bung Borapet, Thailand; described from aquarium specimens).

Material Examined.—Western Borneo: Kapuas 1975-16 (CAS 49208, MZB 3120, USNM 230172); Kapuas 1976-17, 32.1 (MZB 3121); Kapuas 1976-18, 2: 19.8–19.9 mm (CAS 49209, MZB 3122); Kapuas 1976-51, 25.4 mm (MZB 3123).

The color pattern of this species, while somewhat similar to that of some *Puntius* (including *P. endecanalis,* with which it occurs sympatrically) is quite distinctive. It includes all of the vertical bars found in the species of *Puntius* with barred color patterns, but in addition there are usually one or more midlateral roundish spots between the bars, and separate midventral spots on the belly, straddling the pelvic-fin base (and extending onto the pelvic fins), and on the caudal peduncle. Separate midventral spots are not found in any other cyprinid in western Borneo.

Distribution.—Thailand? (Bung Borapet?). Borneo (Kapuas; southern Borneo, Kottelat 1982).

Epalzeorhynchos Bleeker, 1855

Epalzeorhynchos Bleeker, 1855*b*:258, 270 (type species *Barbus kalopterus* by monotypy).
Epalzeorhynchus Bleeker, 1860*a*:118 (unjustified spelling emendation).

FIGURE 23. *Eirmotus octozona*. Kapuas 1976-17, 32.1 mm (MZB 3121)

Epalzeorhynchos belongs to a group of Asian genera (including *Crossocheilus* and *Paracrossochilus*) which have the upper jaw entirely covered by a greatly enlarged fimbriate rostral cap. It differs from all other genera in having a large fleshy rostral papilla ("moveable lateral lobe") between rostral barbel and sublacrimal groove. Posteriorly directed distal tip of rostral papilla almost invariably with a single large sharply pointed tubercle; additional tubercles sometimes on other parts of rostral papilla. Sublacrimal groove extending from origin of rostral papilla to behind rictus of jaws. Upper lip absent or vestigial. Horny jaw sheaths with straight or gently curved and broad margins with sharp cutting edges. Lower lip a broad, non-papillose fleshy lobe lying in concavity on ventral surface of lower horny jaw sheath. Rostral and maxillary barbels well developed; rostral barbels black, often in sharp contrast to rostral cap; maxillary barbels pale.

The rostral cap and papilla and other features of the mouth and snout of *E. kalopterum* are illustrated by Weber and de Beaufort (1916, fig. 94). Their illustration erroneously depicts the middle portion of the rostral cap with a horizontal groove extending between the rostral barbels. The rostral cap is entire in all species of *Epalzeorhynchos*.

Epalzeorhynchos is closely related to *Crossocheilus*, which differs from it in having a well developed upper lip (fimbriate), somewhat narrower jaws, and numerous papillae on lower lip, as well as in lacking a discrete rostral papilla. In *Crossocheilus* as in *Epalzeorhynchos* there is a well developed sublacrimal groove, and lying between its anterior portion and the rostral barbel is a round rostral lobe similar to the free rostral papilla of *Epalzeorhynchos*.

The essential diagnostic features of the genus were clearly recognized by Bleeker (1855).

This genus, which is being studied by J. Karnasuta, comprises at least four species, including *Labeo bicolor* Smith, 1934, and *Labeo frenatus* (with which *Labeo munensis* Smith, 1934 and *Labeo erythrurus* Fowler, 1934 are synonymous), both from Thailand (R. M. Bailey and J. Karnasuta, pers. comm.), as well as the more widely distributed type species, *E. kalopterum*, the only species known from Borneo.

Epalzeorhynchos kalopterum (Bleeker, 1850)

Barbus kalopterus Bleeker, 1850:13 (type locality Banjermassing, in fluviis)
Epalzeorhynchos kalopterus Bleeker, 1855*b*:270
Epalzeorhynchus kallopterus Bleeker, 1860*a*:118 (unjustified spelling emendation)

MATERIAL EXAMINED.—Malay Peninsula: Johore, near Kulai, 204: 20.2–45.6 mm (CAS-SU 39350). Western Borneo: Kapuas 1976-14, 3: 52.7–72.1 mm (AMNH 48291, BMNH 1982.3.29.10, MZB 3124); Kapuas 1976-15, 3: 52.8–55.5 mm (CAS 49210, MZB 3125); Kapuas 1976-16, 3: 46.1–64.5 mm (FMNH 94198, IRSNB 19730, MZB 3126); Kapuas 1976-24, 113 mm (MZB 3127); Kapuas 1976-27, 121 mm (MZB 3128); Kapuas 1976-29, 6: 63.0–92.5 mm (MCZ 58340 MNHN 1982-658, MZB 3129, RMNH 28826, ROM 38608); Kapuas 1976-33 4: 55.2–74.0 mm (MZB 3130, CAS 49211, UMMZ 209885); Kapuas 1976-36 71.9 mm (MZB 3131); Kapuas 1976-43, 4: 41.1–60.5 mm (MZB 3132, USNM 230173, ZMA 116.517)

NOTE As the gender of *Epalzeorhynchos* is neuter, the correct spelling of the species name is *kalopterum* (R. M. Bailey, pers. comm.)

This handsome species is distinguished from all congeners by its very distinctive coloration. Side of body with a broad longitudinal black stripe with sharply defined very straight margins, continued less distinctly to snout-tip and on middle caudal-fin rays to end of caudal fin. A broad longitudinal stripe above midlateral stripe and entire body below pale greyish or white. Dorsal surface of body with dark pigmentation with a sharply defined straight ventral border. Middle of dorsal, pelvic, and anal fins with a black scythe-shaped mark.

Sexual dichromatism and dimorphism apparently absent. Coloration as described above and rostral papilla with terminal or distal tubercle fully developed in smallest specimens examined of both males and females.

DISTRIBUTION.—Peninsular Thailand (Tapi R.; Smith 1945

264). Malay Peninsula (Johore). Sumatra (Palembang, Lahat, Batang Hari, Kwantan R.). Borneo (Kapuas, Kahajan, Barito).

Garra Hamilton-Buchanan, 1822

Garra Hamilton-Buchanan, 1822:343, 393 (type species *Cyprinus* (*Garra*) *lamta* Hamilton-Buchanan, 1822, by subsequent designation of Bleeker, 1863*b*:192).
Platycara McClelland, 1839:947 (type species *Platycara nasuta* McClelland, 1839, by subsequent designation of Jordan, 1919:195).
Discognathus Heckel, 1843:1027 (type species *Discognathus variabilis* Heckel, 1843, by subsequent designation of Bleeker, 1863*b*:192). See Hora, 1921:648.
Lissorhynchus Bleeker, 1859–60*c*:422; 1860*a*:85–86 (as *Lissorhynchus* on p. 86) (type species *Platycara lissorhynchus* McClelland, 1839, by absolute tautonymy).
Discognathichthys Bleeker, 1859–60*c*:423; 1860*a*:128 (type species *Discognathus variabilis* Heckel, 1843, by subsequent designation of Bleeker 1860*a*:128).
Parapsilorhynchus Hora, 1921:13 (type species *Psilorhynchus tentaculatus* Annandale, 1919, by original designation)
Discolabeo Fowler, 1937:210 (type species *Discolabeo fisheri* Fowler, 1937, by original designation and monotypy).

Menon (1964:187) and Jayaram (1981) stated that *Cyprinus lamta* Hamilton-Buchanan, 1822 is type species of *Garra* Hamilton-Buchanan, 1822 by monotypy. Reference to the original publication, Hamilton-Buchanan (1822:343–349, 393–394), however, shows that no fewer than seven species were included in this "subgenus" *Garra* (only one with a question mark). *Cyprinus lamta*, the first species mentioned, seems to be the only species indicated as type species by subsequent authors, of whom Bleeker (1863*b*) apparently is the earliest.

Rostral cap with unculiferous fimbriate margin. Upper lip varying from well developed with unculiferous fimbriate margin to vestigial or absent. Horny jaw sheaths of both jaws well developed. Lower lip with tuberculate anterior margin, enormously expanded and incised posteriorly to form a thick callous pad or mental adhesive disc; ventroposterior margin of adhesive disc with unculiferous tubercles.

Rostral and maxillary barbels present, rostral barbels only present, or both absent. In some species the mental adhesive disc is weakly developed, vestigial, or perhaps even absent; this, coupled with ontogenetic changes associated with the mental disc (see Hora 1921) and the highly variable timing of its appearance, has contributed to considerable systematic confusion at the genus as well as species level. It seems likely that all species of African and Asian Labeoinae with a mental adhesive disc belong to this one genus. Menon (1964) recognized 34 species in his revision of the genus.

A rostral cap with unculiferous fimbriae similar to that of *Garra* is found in *Crossocheilus*, *Epalzeorhynchos*, and *Paracrossochilus*. *Garra* differs from these and all other Bornean cyprinid genera in having a mental disc (missing in very young fish). The posterior border of the disc is heavily papillose. The fringes of the rostral cap and papillae of the mental disc are heavily unculiferous (Roberts 1982*a*) and presumably function in rasping food from rocky substrate as well as adhesion in the swift-flowing mountain streams typically inhabited by *Garra*. Only a single species is known from Borneo, and the genus is unknown from Sumatra and Java.

Garra borneensis (Vaillant, 1902)

Discognathus borneensis Vaillant, 1902:91 (type locality Bluu River, Mahakam basin)
Garra borneensis Fowler, 1905:482

Material Examined.—Western Borneo: Kapuas 1976-24, 6: 46.0–69.8 mm (BMNH 1982.3.29.11–12, CAS 49212, MZB 3133); Kapuas 1976-25, 8: 49.7–109 mm (FMNH 94199, MNHN 1982-659, MZB 3134, RMNH 28827, UMMZ 209867, USNM 230174).

This is the only species of *Garra* known from Indonesia: according to Menon (1964), it is closely related to *G. taeniata* Smith, 1931 from Thailand.

Distribution.—Borneo (Baram, Kapuas, Mahakam, Kinabatangan, Tempasuk). (Tempasuk is a small coastal drainage flowing N from the W side of Mt. Kinabalu.)

Hampala Bleeker, 1859–60

Hampala Kuhl and van Hasselt *in* van Hasselt, 1823:132 (nomen nudum).
Hampala Bleeker, 1859–60*c*:430; 1860*a*:275, 307–311 (type species *Hampala macrolepidota* van Hasselt, 1823=*Capoeta macrolepidota* Valenciennes *in* Cuvier and Valenciennes, 1842, by subsequent designation of Bleeker, 1863*b*:200).

Superficially similar to *Puntius* but with a characteristically pointed snout not seen in any member of that genus, and attaining greater size (to 70 cm total length). Pharyngeal teeth usually in three rows, 1,3,5/5,3,1, cochleariform.

Hampala bimaculata (Popta, 1905)

Barbus hampal var. *bimaculata* Popta, 1905:173 (type locality le Bŏ, Mahakam basin)
Hampala bimaculata Weber and de Beaufort, 1916:146.

Material Examined.—Western Borneo: Kapuas 1976-24, 71.2 mm (MZB 3135); Kapuas 1976-25, 2: 123–124 mm (CAS 49213, MZB 3136).

For a discussion of this taxon, its geographical distribution and relationship to *Hampala macrolepidota*, see Inger and Chin (1962:78–82).

Hampala macrolepidota Valenciennes, 1842

Hampala macrolepidota Kuhl and van Hasselt, *in* van Hasselt, 1823:132 (nomen nudum).
Capoeta macrolepidota Valenciennes *in* Cuvier and Valenciennes, 1842:280 (type locality Java).

Material Examined.—Western Borneo: Kapuas 1976-6, 4: 37.6–58.4 mm (CAS 49214, MZB 3137); Kapuas 1976-27, 3: 31.5–78.3 mm (MZB 3138, USNM 230175); Kapuas 1976-33, 123 mm (MZB 3139).

Juvenile *H. macrolepidota* exhibit a temporary color phase with 5 of the 6 vertical bars found in some vertically barred *Puntius* species (only the post-anal bar is absent); Taki and Kawamoto (1977, fig. 3).

Kalimantania Bănărescu, 1980

Kalimantania Bănărescu, 1980:471 (type species *Systomus lawak* Bleeker, 1855, by monotypy)

As discussed above, this genus appears to be closely related to *Albulichthys*, *Amblyrhynchichthys*, and *Puntioplites*. It is perhaps closest to *Amblyrhynchichthys*, from which it differs in having snout less truncate and nostrils not so far anterior, gill rakers much fewer, scales with divergent rather than convergent radii, and last simple anal-fin ray greatly enlarged ("spinified"). It differs from all of its presumed close relatives in having 7 instead of only 5 branched anal-fin rays.

Kalimantania lawak (Bleeker, 1855)

Systomus lawak Bleeker, 1855*c*:411 (type locality "Batavia, in flumine Tjiliwong; Surabaja, in flumine Kalimas")
Barbus lawak Günther, 1868:149

Amblyrhynchichthys altus Vaillant, 1893*a*:59 (type locality Kapuas). See Bănărescu (1980), and below.
Puntius lawak Weber and de Beaufort, 1916:203.
Puntioplites lawak Bănărescu, 1978:116.
Kalimantania lawak Bănărescu, 1980:475.

Material Examined.—Western Borneo: Kapuas, 77.0 mm (MNHN 1891:355, holotype of *A. altus*); Kapuas 1976-34, 2: 39.3–40.1 mm (CAS 49253, MZB 3268). Java: Tjiliwong River, Batavia or Kalimas River, Surabaya, 59.7 mm (BMNH 1866.5.2.203, syntype).

The holotype of *Amblyrhynchichthys altus* has dorsal-fin rays iii(or iv)8-1/2, anal-fin rays iii7-1/2. Last simple anal-fin ray stout, spine-like, deeply concave posteriorly with sharp lateral edges, non-serrate. Scales with striae parallel or slightly divergent, lateral series 34 or 35, transverse scales 8/1/6, predorsal about 13, and circumpeduncular 16. Gill rakers on first arch 26. Coloration largely silvery on head and body; no vertical streak marks as in *Puntioplites bulu*. A few days after examining this holotype in Paris, I examined the syntype of *B. lawak* in London, and concluded that they are conspecific. The BMNH syntype has 7-1/2 branched anal-fin rays and 23 gill rakers on first arch.

Distribution.—Apparently known only from western Borneo (Kapuas) and Java. Records from Sumatra (and Riouw?) (Weber and de Beaufort 1916:204) are based on misidentified *Puntioplites waandersi* according to Bănărescu (1978:116).

Leptobarbus Bleeker, 1859–60

Leptobarbus Bleeker, 1859–60*c*:435; 1859*a*:285, 432 (type species *Barbus Hoevenii* Bleeker, 1851, by monotypy)
Filirasbora Fowler, 1937:172 (type species *Filirasbora rubripinna* Fowler, 1937, by monotypy=*Leptobarbus hoevenii* Bleeker, 1851).

In general appearance like a very heavy-set *Rasbora* but with rostral and maxillary barbels well developed, longer than eye diameter; top of head broad and flat; lower jaw without symphyseal knob. Last simple dorsal-fin ray non-serrate. Lateral line complete, curved downward but slightly, lateral line scales 34–38; transdorsal 9–11; circumpeduncular 14–15. Gill rakers on first arch 14–17. Pharyngeal teeth cochleariform with crenulate margins, in three rows, 2,3,5/5,3,2.

Four species, all but *L. hoevenii* confined to Borneo. The two species found in the Kapuas differ strikingly in coloration.

Key to *Leptobarbus*

1a Transdorsal scales 9 ..... *L. hoevenii*
1b Transdorsal scales 10–11 2
2a Caudal-fin lobes with submarginal longitudinal black stripes (Kapuas) ..... *L. melanopterus*
2b Caudal fin dusky or plain 3
3a Body with a narrow, black, mid-lateral zig-zag stripe (northern and eastern Borneo) *L. melanotaenia* Boulenger, 1894
3b Body plain (northern Borneo) ..... *L. hosii* Regan, 1906

Leptobarbus hoevenii (Bleeker, 1851)

Barbus Hoevenii Bleeker, 1851*h*:207 (type locality Bandjermassing, in fluviis).
Leptobarbus Hoevenii Bleeker, 1860*a*:433.
Filirasbora rubripinna Fowler, 1937:172 (type locality Kemrat, Siam). See remarks by Bailey *in* Böhlke (1984:90).

Material Examined.—Kapuas 1976-15, 10: 18.6–36.3 mm (CAS 49215, MZB 3140); Kapuas 1976-20, 3: 91.6–136 mm (FMNH 94200, MNHN 1982-660, MZB 3141); Kapuas 1976-44, 3: 81.2–158 mm (MZB 3142, RMNH 28828, UMMZ 209915); Kapuas 1976-49, 3: 77.3–109 mm (CAS 49216, MZB 3143, USNM 230176).

In life, pelvic and anal fins blood-red; other fins dusky or colorless.

Distribution.—Thailand (Mekong, Chao Phrya). Sumatra (Palembang, Indragiri, Kwantan, Taluk, Danau Sialong Lotong, Djambi, Bagan Api Api). Borneo (Baram?, Kapuas, Barito, Kahajan, Pengaron, Mahakam).

Leptobarbus melanopterus Weber and de Beaufort, 1916

Leptobarbus melanopterus Weber and de Beaufort, 1916:97 (type locality Kapuas R. at Selimbau).

Material Examined.—Western Borneo: Kapuas 1976-32, 3: 66.1–71.1 mm (MZB 3144, USNM 230177); Kapuas 1976-49, 4: 120–131 mm (CAS 44179, MZB 3145, ZMA 116.518).

In life, caudal fin deep magenta or purple with black submarginal longitudinal stripes on each lobe; other fins dusky or pale, colorless.

Distribution.—Known only from the Kapuas.

Lobocheilos Bleeker, 1853

Lobocheilus Kuhl and van Hasselt *in* van Hasselt, 1823:132 (nomen nudum).
Lobocheilos Bleeker, 1853*f*:520 (type species *Lobocheilus falcifer* Kuhl and van Hasselt *in* van Hasselt, 1823=*Labeo falcifer* Valenciennes *in* Cuvier and Valenciennes, 1842, by subsequent designation of Bleeker, 1863:194).
Gobionichthys Bleeker, 1859*a*:145 (type species uncertain).

A genus of Labeoinae with rostral cap greatly thickened, its margin entire; upper lip also greatly thickened, its margin entire. Sublacrimal groove extending from rostral barbel (when present) to beyond rictus of jaws. Inner margin of upper lip with a valve-like transverse flap. No separate upper horny jaw sheath. Lower horny jaw sheath enormously expanded, its dorsal portion extending as a convex pad into roof of mouth, its ventral portion with a broad, nearly straight, sharp-edged, heavily cornified wedge. Lower lip fleshy, deeply incised, connected to ventral surface of lower jaw by a pair of large internal freni. Short rostral and maxillary or maxillary barbels only present.

The species of *Lobocheilos* need systematic revision. More information is needed about ontogenetic changes in coloration and other characters, and the numerous nominal species described from Thailand by Fowler (1934, 1935, 1937, 1939) should be compared with each other and with the species known from Indonesia.

Lobocheilos bo (Popta, 1904)

(Figure 24 below)

Tylognathus bo Popta, 1904:199 (type locality Bo R., Kapuas basin).
Lobocheilus bo Smith, 1945:239.

Material Examined.—Western Borneo: Kapuas 1976-14, 5: 59.8–71.6 mm (CAS 49218, MZB 3147); Kapuas 1976-15, 7: 17.9–22.2 mm (CAS 49219, MZB 3148); Kapuas 1976-40, 23.9 mm (MZB 3149).

Distribution.—Borneo (Kapuas, Mahakam; also north Borneo according to Inger and Chin 1962).

Lobocheilos hispidus Valenciennes, 1842

(Figure 24 above)

Labeo hispidus Valenciennes *in* Cuvier and Valenciennes, 1842:356 (type locality Buitenzorg).

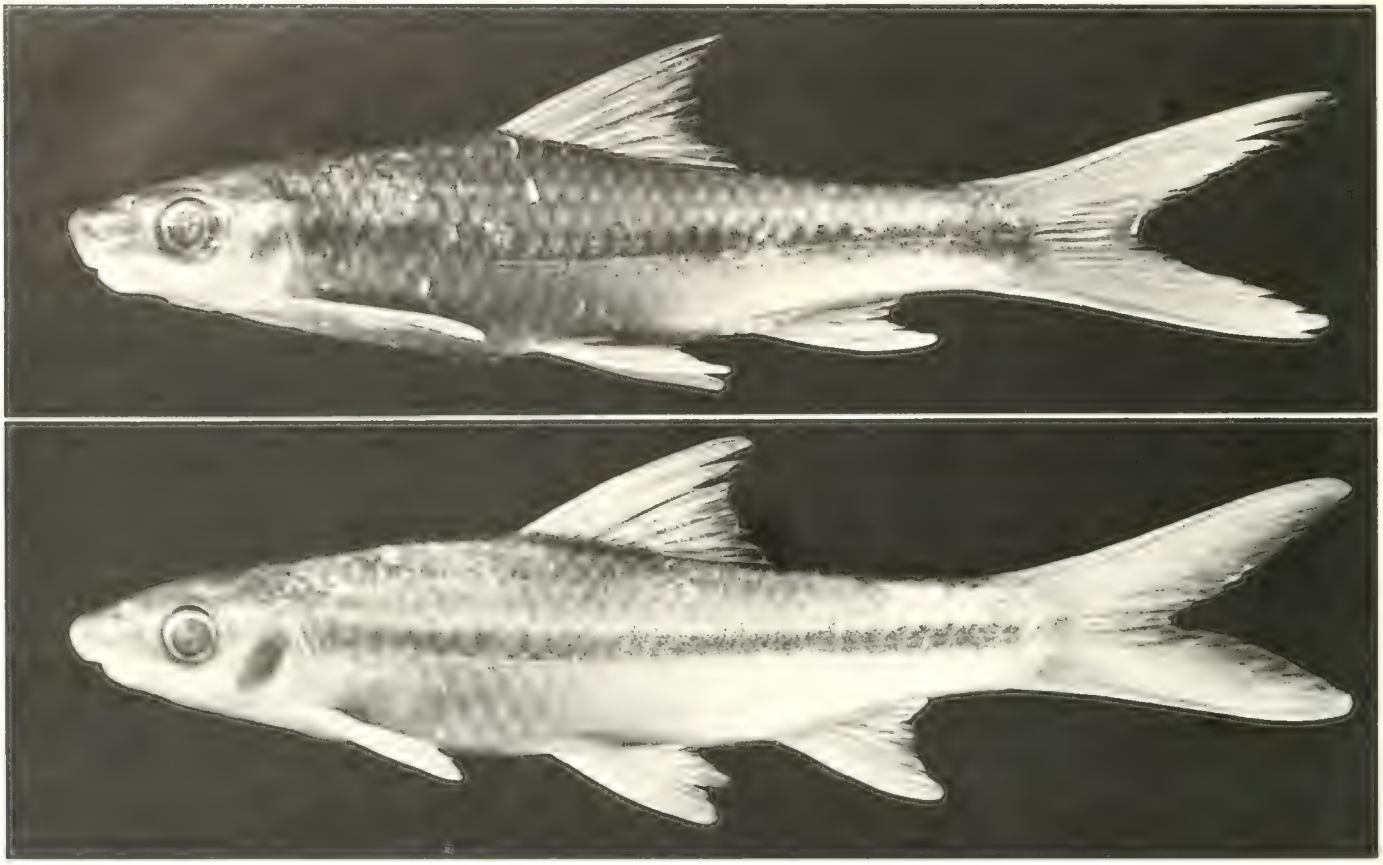

FIGURE 24. *Lobochelus*. Above, *L. hispidus*, Kapuas 1976-6, 60.7 mm (CAS 49217); below, *L. bo*, Kapuas 1976-14, 65.7 mm (MZB 3147).

Chondrostoma hipochelos Valenciennes *in* Cuvier and Valenciennes, 1844:400 (type locality Java)
Gobio javanicus Bleeker, 1857*b*:358 (type locality Batavia, in fluviis)
Lobochelus (*Gobiomichthys*) *javanicus* Bleeker, 1859*a*:145
Lobochelus (*Gobiomichthys*) *hipochelus* Bleeker, 1860*a*:154
Tylognathus hispidus Günther, 1868*a*:66
Lobochelus hispidus Fowler, 1905:483

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-6, 8: 55.9–99.3 mm (CAS 49217, MNHN 1982-661, MZB 3146, USNM 230178)

DISTRIBUTION.—Borneo (Baram, Kapuas, Mahakam). Java.

Luciosoma Bleeker, 1855

Luciosoma Bleeker, 1855*b*:263 (type species *Barbus setigerus* Valenciennes *in* Cuvier and Valenciennes, 1842, by subsequent designation of Bleeker, 1863*b* 204)
Trimematichthys Bleeker, 1860*a*:283, 412, 416 (proposed as subgenus of *Luciosoma*; type species *Leuciscus trinema* Bleeker, 1852, by monotypy)

DIAGNOSIS.—An entomophagous bariliin genus with body elongate, subcylindrical or moderately compressed; head pointed; snout elongate, with two (sometimes three?) obliquely oriented, S-curved shallow grooves (open lateral line canals?) between anterior nostril and middle of snout; mouth obliquely ascending, with a long, wide gape, extending posteriorly well beyond anterior margin of eye; lower jaw with a moderately large symphyseal knob fitting into concavity behind tip of upper jaw; upper and lower lips with transverse ridges for their entire length, ridges separated by deep but narrow grooves, with oral ends more or less free (lobate); a single pair of rostral barbels and of maxillary barbels (absent or weakly developed in one species); gill rakers short, widely set, 1–3+9–11=11–13; pharyngeal teeth uncinate, in three rows, 4–5,4,2/2,4,4–5; lateral line complete; scales in lateral series 36–47, predorsal 20–24, transdorsal 11, circumpeduncular 12–14; dorsal-fin rays ii7-1/2, anal iii6-1/2, pectoral i14–16, pelvic i8; side of body with a longitudinal row of more or less evenly spaced roundish or vertically elongate oval spots; middle of dorsal and anal fin sometimes with a thin dark horizontal mark; both caudal-fin lobes with dark submarginal (never diagonal) band (sometimes absent in two species); vertebrae 22–25+16–18=39–43.

For osteological characters see Howes (1980). Relationships of *Luciosoma* are discussed below under *L. spilopleura*.

Luciosoma is widely distributed in Thailand (Mekong, Chao Phrya), Malay Peninsula, Sumatra, Borneo, and Java. There are five species, three in western Borneo.

Key to *Luciosoma* of western Borneo

1a Head moderately pointed; numerous close-set tubercles in a broad semi-circle on snout-tip and on entire ventrolateral surface of mandible; pelvic and anal fins without filamentous extension (pelvic fin sometimes with a very short prolongation of simple ray); body with a row of vertically elongate roundish or oval spots extending to base of caudal fin and continued as solid horizontal stripe on middle rays of caudal fin; upper and lower lobes of

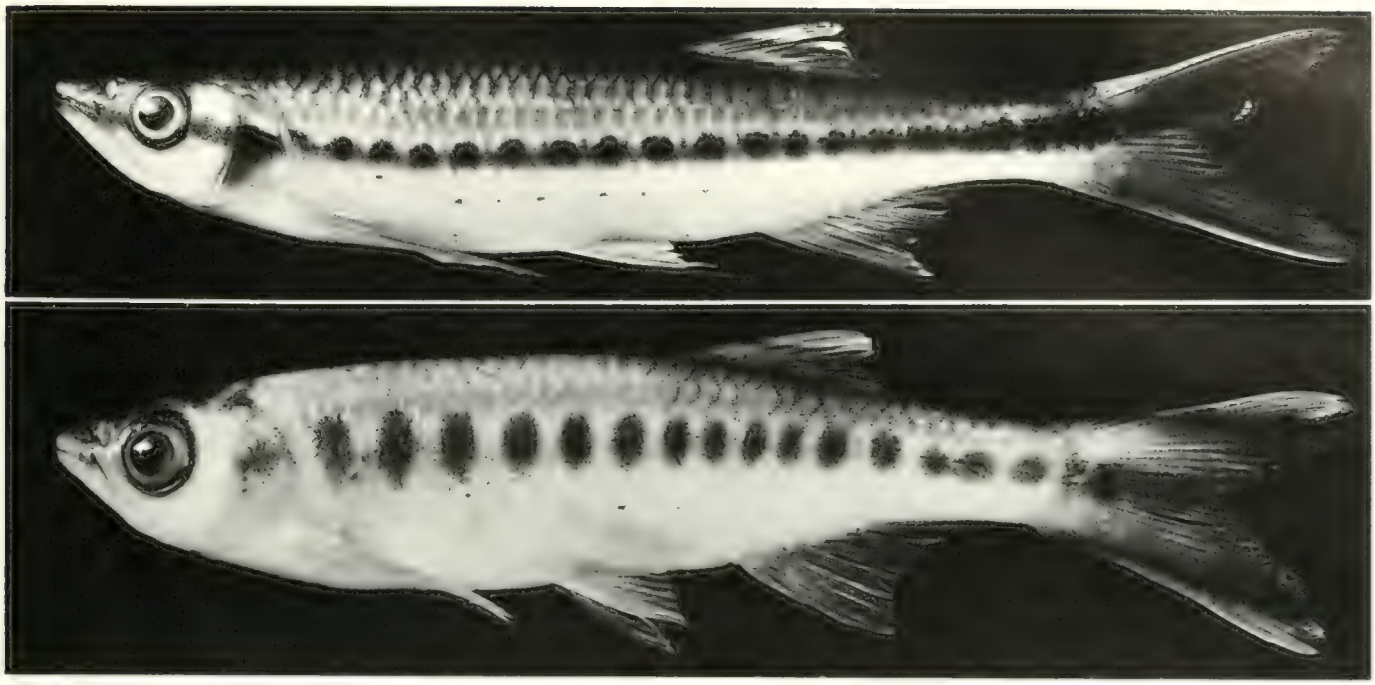

FIGURE 25. *Luciosoma*. Above, *L. setigerum*, Kapuas 1976-24, 102 mm (MZB 3152), below, *L. spilopleura*, Kapuas 1976-31, 45.5 mm (USNM 230183).

caudal fin with submarginal stripe originating on dorsal and ventral margin of caudal peduncle ..... *L. spilopleura*

1b Head strongly pointed; tubercles entirely absent; pelvic and sometimes anal fin with long filamentous extension; body with row of roundish spots extending to caudal peduncle and continued as solid bar on caudal peduncle and submarginal stripe on upper caudal fin lobe; lower caudal fin lobe with submarginal band originating on lower half of caudal fin base; middle caudal fin rays colorless 2

2a Rostral and maxillary barbels well developed, length to twice as much as eye diamater ..... *L. setigerum*

2b Barbels absent or vestigial in adults, sometimes present but very small in young ..... *L. trinema*

Luciosoma setigerum Valenciennes, 1842

(Figure 25 above)

Barbus setigerus Valenciennes *in* Cuvier and Valenciennes, 1842:203 (type locality "rivière Pebak à Java")

Barbus podonemus Bleeker, 1850:18 (type locality "Surabaya, in flumine Kalimas"). See Bleeker (1855*b*:264)

Luciosoma setigerum Bleeker, 1855*b*:264

Luciosoma Weberi Popta, 1905:177 (type locality "le Boelit, affluent du Bongam"=Mahakam basin). See Weber and de Beaufort (1916:88)

Luciosoma trinema Herre and Myers, 1937:58 (Perak, River Plus; misidentification)

MATERIAL EXAMINED.—Malay Peninsula: Perak, Plus R., 3: 140–170 mm (CAS-SU 31168–69; previously identified as *L. trinema*); Negri Sembilan, Kuala Pilah, 119 mm (CAS-SU 31167). Western Borneo: Kapuas 1976-17, 6: 31.9–119 mm (CAS 49220, MNHN 1982-662, MZB 3150, USNM 230182); Kapuas 1976-20, 157 mm (MZB 3151); Kapuas 1976-24, 102 mm (MZB 3152); Kapuas 1976-30, 121 mm (MZB 3153)

See remarks under *L. trinema*.

DISTRIBUTION.—Malay Peninsula (Perak, Pahang, Malacca, Negri Sembilan). Sumatra (Solok, Sidjungdjung, Lahat, Batang Hari, Musi R.). Borneo (Kapuas). Java (Batavia, Bekassi, Rankasbetong, Lebak, Kediri, Surabaya, Gempol).

Luciosoma spilopleura Bleeker, 1855

(Figure 25 below)

Luciosoma spilopleura Bleeker, 1855*b*:265 (type locality "Lahat, in fluviis"=Musi basin, Palembang)

MATERIALS EXAMINED.—Sumatra: Lahat, 81.9 mm (BMNH 1866.5.2.97, holotype). Western Borneo: Kapuas 1976-14, 6: 28.6–49.8 mm (BMNH 1982.3.29.13, CAS 49221, MZB 3154, RMNH 28829); Kapuas 1976-22, 47.7 mm (MZB 3155). Kapuas 1976-31, 4: 37.6–45.5 mm (MZB 3156, UMMZ 209879, USNM 230183). Kapuas 1976-50, 67.8 (MZB 3157)

DIAGNOSIS.—Evidently a relatively small species, largest specimen 81.9 mm (all other *Luciosoma* attaining 135 mm or much more); neither pelvic nor anal fin with long filamentous extensions, pelvic fin sometimes with short prolongation of outermost ray (pelvic and sometimes anal fin with long filaments in all other *Luciosoma*); snout moderately pointed (strongly pointed in all other *Luciosoma*); numerous moderately large, close-set tubercles present in semicircle on snout-tip between nostrils, tip of chin, and ventrolateral surface of mandibles (tubercles absent in all other *Luciosoma* except *L. pellegrinii* Popta, 1905, in which their distribution is like that in *L. spilopleura*); body with continuous lateral row of 16–18 vertically elongate oval or roundish spots continued to caudal-fin base; caudal fin with horizontal submarginal bars on each lobe and middle rays with a dark stripe continuous with body spots; vertebrae 39–41.

The following observations are from the 67.8 mm Kapuas specimen: head 3.7; snout 11.1; eye diameter 16.1; rostral barbel almost twice as long as eye diameter, length 8.9; maxillary barbel about half as long, 15.8; gill rakers 2+10=12; scales in lateral series about 39, predorsal 23, transdorsal 11, circumpeduncular 13; dorsal-fin rays ii7-1/2, anal iii6-1/2, pectoral i14, pelvic i8

dorsal-fin origin much nearer hypural fan than snout-tip, predorsal length 1.6; pectoral fin reaching to or slightly beyond pelvic-fin origin, length 4.1; pelvic-fin origin somewhat anterior to vertical through dorsal-fin origin, prepelvic length 3.7; pelvic-fin length 5.7; anal-fin origin below middle of dorsal-fin base.

Luciosoma spilopleura is known only from Bleeker's holotype from Lahat, Sumatra and 12 specimens obtained by the Kapuas survey of 1976. It differs in several respects from other species of *Luciosoma* and may be the most generalized or primitive member of its genus. Further study of the species might well contribute to a reassessment of the relationships of *Luciosoma*.

Relationships of *Luciosoma*.—In my view *Luciosoma* may be more closely related to *Barilius* (sensu lato) than to any other Cyprinidae. This is contrary to the opinion of Howes, who excludes *Luciosoma* from his "bariliine assemblage" and places it in a "luciosomine assemblage" with *Parluciosoma* (*Rasbora*, partim) and *Megarasbora*. I think *Luciosoma* is not so closely related to *Rasbora*. Readers are referred to the discussion of osteological characters by Howes (1980, especially pp. 180–184), particularly those concerning the ethmoid region. I have not studied these fishes osteologically and have not prepared a critical discussion of this aspect. It should be noted, however, that the osteological observations available are based on relatively few species, and that osteological examination of *L. spilopleura* could be particularly rewarding. Two general considerations bear noting: the elongate jaws of all *Luciosoma* and well developed rostral and maxillary barbels of *Luciosoma* except *L. trinema* strongly resemble the more or less elongate jaws of all *Barilius* and well developed rostral and maxillary barbels of many *Barilius*. In contrast, all *Rasbora* have relatively short jaws and lack both pairs of barbels (maxillary barbels weakly developed in *Megarasbora*). Three specific features of *L. spilopleura* indicative of relationships to *Barilius* rather than to *Rasbora* are as follows: 1) Bariliins as a group, *Barilius* particularly, are tuberculate, many species having tubercles on snout and mandible more or less comparable to those of *L. spilopleura* and *L. pellegrinii*. Tubercles are absent or but weakly developed on the snout and mandible of *Rasbora* (including *Parluciosoma*) and *Megarasbora* (mandibular tubercles of "*Rasbora*" *axelrodi* are highly specialized and may indicate this species is misidentified generically). 2) Coloration of *Luciosoma* and especially *L. spilopleura* agrees in general and in detail with coloration found in Bariliinae including *Barilius* (sensu lato) but not in *Rasbora* or any other Cyprinidae. I refer to the continuous lateral row of spots on the body, a primitive color feature of most African and Asian species of *Barilius* and of all *Luciosoma*. In most *Luciosoma* the spots tend to be round, but in *L. spilopleura*, as in *Barilius* usually, they are vertically elongate. Submarginal bands on caudal fin, present in three species of *Luciosoma* and several *Barilius*, are found in relatively few cyprinids and are absent in all species of *Rasbora* and *Megarasbora*. (Several *Rasbora* have a diagonal mark across distal portion of each caudal-fin lobe.) 3) The shape of the compressed and moderately pointed head of *L. spilopleura* is very much like that in various *Barilius* and less like the shape observed in nearly all *Rasbora* (this distinction is admittedly somewhat subjective).

Distribution.—Sumatra (Lahat, upper Musi basin). Western Borneo (Kapuas). Records of *L. spilopleura* from north Borneo by Weber and de Beaufort (1916:89) presumably are all based on *Luciosoma pellegrinii* Popta, 1905, a species found in north, northeast and west Borneo (including Mahakam basin); see Inger and Chin (1962:62).

In the Kapuas basin *L. spilopleura* was collected only in high gradient rivers with rocky, stony or gravel bottoms, whereas *L. setigerum* and *L. trinema* were found in the Kapuas mainstream and low gradient tributaries with logs and leaf-litter on the bottom.

Luciosoma trinema (Bleeker, 1852)

Leuciscus trinema Bleeker, 1852*d*:600 (type locality "Palembang, in fluviis"). *Luciosoma* (*Trinematichthys*) *trinema* Bleeker, 1860*a*:413, 416.

Material Examined.—Sarawak: 2: 122–135 mm (CAS-SU 31170); western Borneo: Kapuas 1976-16, 68.5 mm (MZB 3158); Kapuas 1976-20, 2: 141–152 mm (CAS 49222, MZB 3159); Kapuas 1976-33, 84.6 mm (MZB 3160); Kapuas 1976-49, 63.6 mm (MZB 3161).

Remarks.—*L. trinema* and *L. setigerum* are very closely related. They share a unique feature of coloration, i.e., union of spots on side of body with solid submarginal band on upper caudal fin lobe. Apart from presence or absence of barbels (which may be present but reduced in size in juvenile *L. trinema*), there seems to be almost no way to tell them apart. Reported distinctions between *L. setigerum* and *L. trinema* (other than barbels) do not hold up under closer examination. For example, Howes (1980:171) reported "modal number of vertebrae" in *L. setigerum* as 43 (4+21+17+1) and in *L. trinema* as 39 (4+18+16+1). This suggests a clear difference between the species. But Howes did not indicate number of specimens examined in determining his modes, and they may not have been numerous. *L. setigerum* have vertebrae 23–25+17–18=41(2), 42(2), 43(2), and *L. trinema* 23–25+16–18=40(6), 41(1), 43(2). Weber and de Beaufort (1916:87–88) reported scales in transverse series 3-1/2/1/4 in *L. trinema* and 5-1/2-6/1/4 in *L. setigerum*; I find 5-1/2/1/2-1/2 in both species. Perhaps *L. trinema* and *L. setigerum* are morphological varieties of one species; the problem merits further study.

Distribution.—Sumatra (Palembang, Kwantan R., Upper Langkat, Batang Hari). Borneo (Kapuas, Baram). Presence of *L. trinema* in Malay Peninsula is unconfirmed; a record from the River Plus, Perak (Herre and Myers 1937:58) is based on *L. setigerum*.

Macrochirichthys Bleeker, 1859

Macrochirichthys Bleeker, 1859*a*:155 (type species *Leuciscus uranoscopus* Bleeker, 1851=*Leuciscus macrochirus* Valenciennes *in* Cuvier and Valenciennes, 1844, by monotypy; second species doubtfully included).

Body extremely elongate, highly compressed. Barbels absent. No hyaline eyelid. Jaws strongly upturned, nearly vertical. Mandibular symphysis strongly uncinate. Gill rakers rudimentary, pharyngeal teeth in two rows, usually 4,4/4,4. Pectoral fin greatly enlarged, falcate, with 17 rays. Pelvic fin small, with 8 rays. Dorsal fin with 8 rays, anal with 25–28, both set far back. Lateral line complete, slightly curved downwards; scales in lateral line series 120–130.

I tentatively regard this genus as comprising a single species.

Macrochirichthys macrochirus (Valenciennes, 1844)

(Figure 26)

Leuciscus macrochirus Valenciennes *in* Cuvier and Valenciennes, 1844:348 (type locality Java).

FIGURE 26. *Macrochirichthys macrochirus*. Kapuas 1976-20, 212 mm (CAS 49223).

Leuciscus uranoscopus Bleeker, 1851*a*:314 (type locality "Banjermassing, in fluviis")
Macrochirichthys uranoscopus Bleeker, 1860*a*:476
Macrochirichthys??=*Leuciscus macrochirus* Bleeker, 1860*a*:477
Macrochirichthys snyderi Fowler, 1905:487, fig. 7 (type locality Baram)
Macrochirichthys laosensis Fowler, 1934*b*:112 (type locality Mekong at Chiengsen)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-20, 10: 134–221 mm (BMNH 1978.1.10:1–4, CAS 49223, MZB 3162, USNM 230184); Kapuas 1976-44, 166 mm (MZB 3163); Kapuas 1976-49, 2: 132–168 mm (MZB 3164, UMMZ 209925)

DIAGNOSIS.—See generic diagnosis above.

Weber and de Beaufort (1916:54) noted a total length of over 500 mm for this species. One I observed in a fisherman's catch in 1976 was about 1 m total length.

DISTRIBUTION.—Laos. Cambodia. Vietnam (Mekong). Thailand (Mekong, Chao Phrya, Tapi, Tale Sap, Tale Noi). Sumatra (Palembang, Batang Hari, Danau Sialong Iotong). Borneo (Kapuas, Kahajan, Pengaron, Barito, Mahakam, Baram). Java.

Morulius Hamilton-Buchanan, 1822

Morulius Hamilton-Buchanan, 1822:331, 391 (type species *Cyprinus* (*Morulius*) *morala* Hamilton-Buchanan, 1822, by subsequent designation of Bleeker, 1863*b* 195)

Morulius chrysophekadion (Bleeker, 1850)

Rohita chrysophekadion Bleeker, 1850:20 (type locality Surabaya)
Rohita cyanomelas Bleeker, 1852*d*:597 (type locality Palembang)
Rohita polyporos Bleeker, 1853*f*:519 (type locality Moarah Kompeh, Sumatrae orientalis; Batavia).
Rohita koilogeneion Bleeker, 1857*b*:359 (type locality Batavia)
Chrysophekadion polyporos Bleeker, 1859*a*:145
Morulius chrysophekadion Bleeker, 1860*a*:188
Labeo chrysophekadion Günther, 1868*a*:52.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 2: 170–319 mm (CAS 49224, MZB 3165).

Mystacoleucus Günther, 1868

Mystacoleucus Günther, 1868:206 (type species *Capoeta padangensis* Bleeker, 1852, by original designation and monotypy)
Acanthonotus Tickell *in* Day, 1888:807 (type species *Acanthonotus argenteus* Tickell *in* Day, 1888, by monotypy). Preoccupied by *Acanthonotus* Bloch, 1795; *Acanthonotus* Gray, 1831
Matsya Day, 1889:292 (replacement name for *Acanthonotus* Tickell *in* Day, 1888)

Mystacoleucus marginatus (Valenciennes, 1842)

(Figure 27)

Barbus obtusirostris van Hasselt, 1823:132 (nomen nudum)
Barbus marginatus Valenciennes *in* Cuvier and Valenciennes, 1842:164 (type locality "rivière de Tjicanigui," Java)
Barbus obtusirostris Valenciennes *in* Cuvier and Valenciennes, 1842:167 (type locality Buitenzorg)
Mystacoleucus marginatus Smith, 1931:185

MATERIAL EXAMINED.—Malay Peninsula: Tapah, Perak, 8: 66.6–94.1 mm (CAS-SU 39356). Western Borneo: Kapuas 1976-24, 29: 39.0–79.4 mm (AMNH 48922, BMNH 1982.3.29.14–16, CAS 49225, FMNH 94201, IRSNB 19731, MCZ 58341, MZB 3166); Kapuas 1976-27, 35: 45.7–80.8 mm (MNHN 1982-663, MZB 3167, NIFI uncat., RMNH 28830, ROM 38614, UMMZ 209869, USNM 230185, ZMA 116.519). Java: Buitenzorg, 3: 77.1–98.4 mm (CAS-SU 20485)

Osteochilus Günther, 1868

Deplocheilos van Hasselt, 1823 (nomen nudum)
Diplocheilichthys Bleeker, 1860*a*:142 (type species *Lobocheilos pleurotaenia* Bleeker, 1855, by monotypy; nomen oblitum)
Diplocheilos Bleeker, 1860*a*:139 (as subgenus of *Labeo*; type species *Labeo rohitoides* Bleeker, 1857 *Lobochilos pleurotaenia* Bleeker, 1855, by monotypy nomen oblitum)
Osteochilus Günther, 1868:40 (type species *Rohita melanopleura* Bleeker, 1852, by subsequent designation of Jordan, 1919:351)

Lips large, everted, sucker-like, covered with more or less elongate folds or plicae bearing numerous unicellular keratinous projections or unculi (Roberts 1982*a*). Pharyngeal teeth in three rows 2,4,5/5,4,2. Scales 27–53.

The genus includes some 23 species in Burma, Thailand, southern China, the Malay Peninsula, Sumatra, Borneo, and Java. Many are important food fishes. Borneo is inhabited by 20 species, 13 of which have been found in the Kapuas. One species, *O. kappeni*, is known only from the Kapuas. The extensive material of *Osteochilus* obtained from the Kapuas in 1976 has been identified by me and by Jaranthada Karnasuta, who studied most of the specimens in connection with his doctoral dissertation on systematics of *Osteochilus* (Karnasuta 1981). Much of the information presented here is based on Karnasuta (1981).

FIGURE 27 *Mystacoleucus marginatus*. Kapuas 1976-27, 70.5 mm (MZB 3167).

Osteochilus may be divided into three groups based on length and shape of the longest folds or plicae on the greatly expanded lateral portion of the upper lip. The groups are also partly distinguished by the distribution of unicellular keratinous projections or unculi and taste buds on the plicae, and by the size and shape of the unculi. The groups seem to represent species adapted to similar feeding ecology or habitat rather than species which are phyletically related.

The three groups may be outlined as follows: 1) Endomorphs: Main plicae on lateral portions of upper lip divided into more or less numerous oval or mound-shaped sections. Unculi and taste buds tend to be mixed together. Unculi low-lying, polygonal, to 4–18 μm long, usually present in furrows between plicae as well as on plicae. This includes the largest and most deep-bodied members of the genus (endomorphs). Generally inhabit lakes and large rivers with slow current. Absent from mountain streams. *Osteochilus borneensis, O. hasselti, O. melanopleura, O. schlegeli.* Maximum standard length 224–366 mm. This group includes some of the most important freshwater food fishes of southeast Asia. *Osteochilus melanopleura* is especially noteworthy for its upturned mouth; in all other *Osteochilus* the mouth is subinferior or inferior. It is also the largest species.

2) Mesomorphs: Main plicae on lateral portions of upper lips all divided into at least two or three elongate, ridge-like segments. Taste buds generally distributed along anterior margin of unculiferous apex of plicae. Unculi intermediate in size, frequently expanded distally, to 16–24 μm long, generally weakly developed or absent from furrows. More or less intermediate in size and body depth. Maximum standard length 120–205 mm. Mainly inhabit lowland rivers of moderate gradient. *Osteochilus kappeni, O. triporus,* and *O. waandersi.*

3) Ectomorphs: Main plicae on lateral portions of upper lip forming very long, high, unbroken ridges. Unculi confined to summit of ridges, taste buds generally form well defined rows parallel to unculiferous portions of ridges. Unculi relatively large, to 20–27 μm long, elongate. Maximum standard length 75–225 mm. Tend to inhabit smaller forest streams and mountain streams with relatively strong current. *Osteochilus enneaporus, intermedius, kahajanensis, microcephalus, pleurotaenia* and *spilurus.* In this group *O. pleurotaenia* and *O. spilurus* are particularly noteworthy. *Osteochilus pleurotaenia* apparently has the largest lips of any *Osteochilus* and its mouth is strongly inferior. The habitat is not well known, but from the localities recorded I suspect it inhabits large mountain streams and probably prefers swift currents. *Osteochilus spilurus,* attaining a maximum standard length of only about 75 mm, is by far the smallest species of *Osteochilus.* Some populations apparently mature at much smaller sizes, and the largest adults in such populations may attain only about half this length.

The above divisions can be extended to include the rest of the species of *Osteochilus* which are not found in western Borneo. The quality of the plicae is readily observable with a dissecting microscope or in most instances with the unaided eye. The unculi, however, are best observed by scanning electron microscopy, and thus far such observations have been made only for *O. borneensis, enneaporus, hasselti, intermedius, melanopleura, microcephalus, sarawakensis, triporus,* and *waandersi* (Karnasuta 1981, and herein).

The different types of lips in *Osteochilus* cannot yet be correlated with differences in feeding behavior or food. *Osteochilus,* like other Labeoinae, probably feed on aufwuchs. Species of forest streams presumably feed on aufwuchs growing on submerged tree trunks or logs and roots, those of mountain streams on epilithic aufwuchs. Scanning electron micrographs of the lips of a 58.5 mm *O. hasselti* (Fig. 30) reveal numerous straight fragments of about 4–28 μm which may possibly be chopped up bits of filamentous algae. These pieces appear to be cut off at right angles at both ends. Examination of the stomach contents of the same specimen with a compound light microscope reveals large numbers of fragments from 1.0 μm to 1.5 mm, many of which are segments of filamentous algae with 2–11 cells. Even more abundant are irregular masses of apparently organic material, at least some of it possibly from higher plants. More information could certainly be gleaned from examining stomach contents of more specimens, but field and laboratory study of live fish would be much more profitable.

Key to *Osteochilus* from western Borneo

1a	Lateral line scales 45–53; dorsal-fin rays 20–23	2
1b	Lateral line scales 27–35; dorsal-fin rays 14–21	3

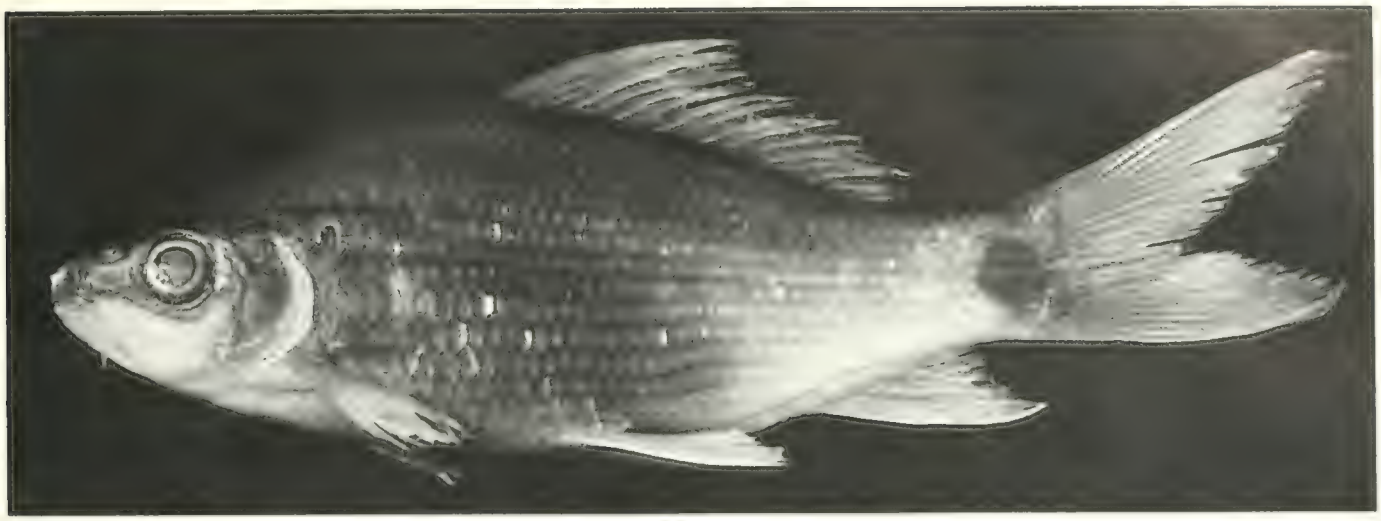

FIGURE 28. *Osteochilus borneensis*. Kapuas 1976-16, 84.9 mm (CAS 49226).

2a Mouth upturned; snout non-tuberculate; a large dark vertical mark on body above pectoral fin; gill rakers 27–35; circumferential scales 22–23/2/23–24 ..... *O. melanopleura*

2b Mouth inferior; snout with three large tubercles; no mark on body above pectoral fin; gill rakers 20–25; circumferential scales 17–19/12/17–20 ..... *O. borneensis*

3a Circumpeduncular scales 20 ..... *O. schlegeli*

3b Circumpeduncular scales 12–16 4

4a Large, round, peduncular spot 5

4b No large, round peduncular spot 8

5a Lateral line scales 27–29; circumferential scales 9/2/11 ..... *O. spilurus*

5b Lateral line scales 29–35; circumferential scales more than 9/2/11 6

6a Two large tubercles on snout; lateral plicae of upper lip long and undivided ..... *O. kahajanensis*

6b No tubercles on snout; lateral plicae of upper lip short, divided in two or three 7

7a Circumferential scales 13/2/15; spots on sides weak or indistinct ..... *O. kappeni*

7b Circumferential scales 11/2/13; spots on sides darker and more distinct ..... *O. hasselti*

8a Midlateral stripe 9

8b No midlateral stripe 12

9a Midlateral stripe continued on middle caudal-fin rays to end of caudal fin ..... *O. waandersii*

9b Midlateral stripe stopping more or less abruptly at base of caudal fin 10

10a Gill rakers 27–35 ..... *O. microcephalus*

10b Gill rakers 40–60 11

11a Snout non-tuberculate or with numerous fine tubercles; sides of body with little or no pigmentation except median longitudinal stripe ..... *O. pleurotaenia*

11b Snout with 1 or 3 tubercles; sides of body heavily pigmented, so that median longitudinal stripe is obscured (particularly anteriorly) ..... *O. enneaporus*

12a No rows of spots on scales; no dark mark on base of anterior portion of dorsal fin ..... *O. intermedius*

12b Body with several longitudinal rows of spots on exposed portion of scales; a large dark mark on base of anterior portion of dorsal fin 13

13a Plicae on lateral portion of upper lip undivided; no tubercles on snout; upper and lower lobes of caudal fin with thin dark margins ..... *O. intermedius*

13b Plicae on lateral portion of upper lip divided into two or three; snout with three tubercles; caudal fin with darkened margins ..... *O. triporus*

Osteochilus borneensis (Bleeker, 1857)

(Figure 28)

Rohita borneensis Bleeker, 1857*a*:17 (type locality Kapuas River at Pontianak)
Osteochilus borneensis Günther, 1868*a*:41

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-16, 2: 66.3–84.9 mm (CAS 49226, MZB 3168); Kapuas 1976-17, 2: 57.2–82.1 mm (MZB 3169, NIFI uncat.); Kapuas 1976-33, 70.4 mm (MZB 3170)

Endomorph. Body depth 3.3–3.8. Dorsal-fin rays 20–23, pectoral 15–16. Scales in lateral series 41–49, circumferential 17–19/2/17–20, circumpeduncular 22–24. Gill rakers 28–31. Mouth subinferior. Lateral plicae of upper lips irregularly arranged, short, mound-shaped. A large, dark round circumpeduncular spot. Body with about 15–17 faint longitudinal stripes. Fins dusky or plain. Maximum standard length 282 mm.

DISTRIBUTION.—Sumatra (Djambi). Borneo (Kapuas basin only).

Osteochilus enneaporus (Bleeker, 1852)

(Figure 29)

Rohita enneaporos Bleeker, 1852*d*:596 (type locality Padang, Sumatra)
Osteochilus vittatus Günther, 1868*a*:44 (in part)
Osteochilus vittatoides Popta, 1904:195 (type locality Howong River, Mahakam basin, eastern Borneo). See Karnasuta (1981)
Osteochilus scapularis Fowler, 1939:69, fig. 17–18 (type locality Trang, southern Thailand). See Karnasuta (1981)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-6, 7: 62.0–1[illegible] 49227, MZB 3171, NIFI uncat., USNM 230186); Kapuas 1976-24, 86.3 mm (MZB 3172); Kapuas 1976-25, 2: 50.0–61.8 mm (BMNH 1982.3.29.17, MZB 3173); Kapuas 1976-27, 6: 52.9–105 mm (FMNH 94202, MNHN 1982-[illegible] MZB

FIGURE 29 *Osteochilus enneaporus*. Above, Kapuas 1976-6, 121 mm (CAS 49227); below, unculiferous lips, Kapuas 1976-6, 82.7 mm (CAS 49227).

3174, RMNH 28831, ROM 38616); Kapuas 1976-29, 4: 72.3–136 mm (MZB 3175, UMMZ 209874, USNM 230187)

Ectomorph. Body depth 2.9–3.4. Dorsal-fin rays 15–18, pectoral 15–16. Scales in lateral series 31–32, circumferential 11/2/13, circumpeduncular 16. Gill rakers 40–60. Snout tubercles 1 or 3 (if 3, median tubercle largest). Median lateral stripe on body, usually distinct on posterior half of body, obscured by dark melanin. Lateral surface of upper lip with long undivided plicae. Maximum standard length 192 mm.

Osteochilus hasselti (Valenciennes, 1842)

(Figure 30)

Rohita hasselti Valenciennes *in* Cuvier and Valenciennes, 1842:209 (type locality Java)
Rohita rostellatus Valenciennes *in* Cuvier and Valenciennes, 1842:250 (type locality Rangoon, Burma)
Rohita (Rohita) kuhli Bleeker, 1860*a*:177 (type locality Palembang, Sumatra)
Osteochilus hasselti Günther, 1868*a*:41
Osteochilus kuhlii Günther, 1868*a*:43
Osteochilus neilli Day, 1870:99 (type locality Sittang River, Burma)
Osteochilus duostigma Fowler, 1937:182, fig. 121 (type locality Kemarat, northeastern Thailand)
Osteochilus hasselti tweediei Menon, 1954:12, fig. 3 (type locality Kuala Tahan, Pahang, Malay Peninsula)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-6, 5: 45.5–96.0 mm (CAS 49228, MZB 3176); Kapuas 1976-7, 43.5 mm (MZB 3177); Kapuas 1976-8, 9: 56.4–95.2 mm (MNHN 1982-665, MZB 3178, NIFI uncat., RMNH 28832, USNM 230188); Kapuas 1976-13, 96.3 mm (MZB 3179)

Endomorph. Body deep, 3.3–4.1. Dorsal-fin rays 16–21, pectoral 14–16. Scale in lateral series 30–33, circumferential 11/2/13, circumpeduncular 16. Gill rakers 27–35. No tubercles on snout. Lateral plicae of upper lip short, moundlike. Sides of body with about 9 longitudinal rows of close-set round spots. A large circumpeduncular spot. Fins plain. Maximum standard length 224 mm.

Osteochilus intermedius Weber and de Beaufort, 1916

(Figure 31)

Osteochilus intermedius Weber and de Beaufort, 1916:133–134 (type locality Djambi, Sumatra, and Kapuas River at Putus Sibau)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-17, 2: 66.4–69.8 mm (CAS 44182, MZB 3180); Kapuas 1976-42, 4: 56.4–64.2 mm (MZB 3181, NIFI uncat., RMNH 28833, USNM 230129); Kapuas 1976-43, 3: 46.7–49.9 mm (MZB 3182, CAS 49229); Kapuas 1976-47, 46.4 mm (MZB 3183)

Weber and de Beaufort (1916:133) gave only a summary description of this species and expressed doubt as to its distinctness. Hardenberg (1936) suggested it is only a variety of *O. triporus*. Karnasuta and I find that it is a distinct species, different in many respects from *O. triporus*, which appears to be its closest relative.

Ectomorph. Body slender, compressed. Dorsal-fin rays 17–18, pectoral 14–15. Scales in lateral series 30–32, circumferential 9/2/13, circumpeduncular 16. Gill rakers 39–49.

No tubercles on snout. Plicae on ventral portion of upper lip undivided. Dorsal fin with a large but indistinct dark spot anteriorly; otherwise dusky. Dorsal-fin margin nearly straight. Pe-

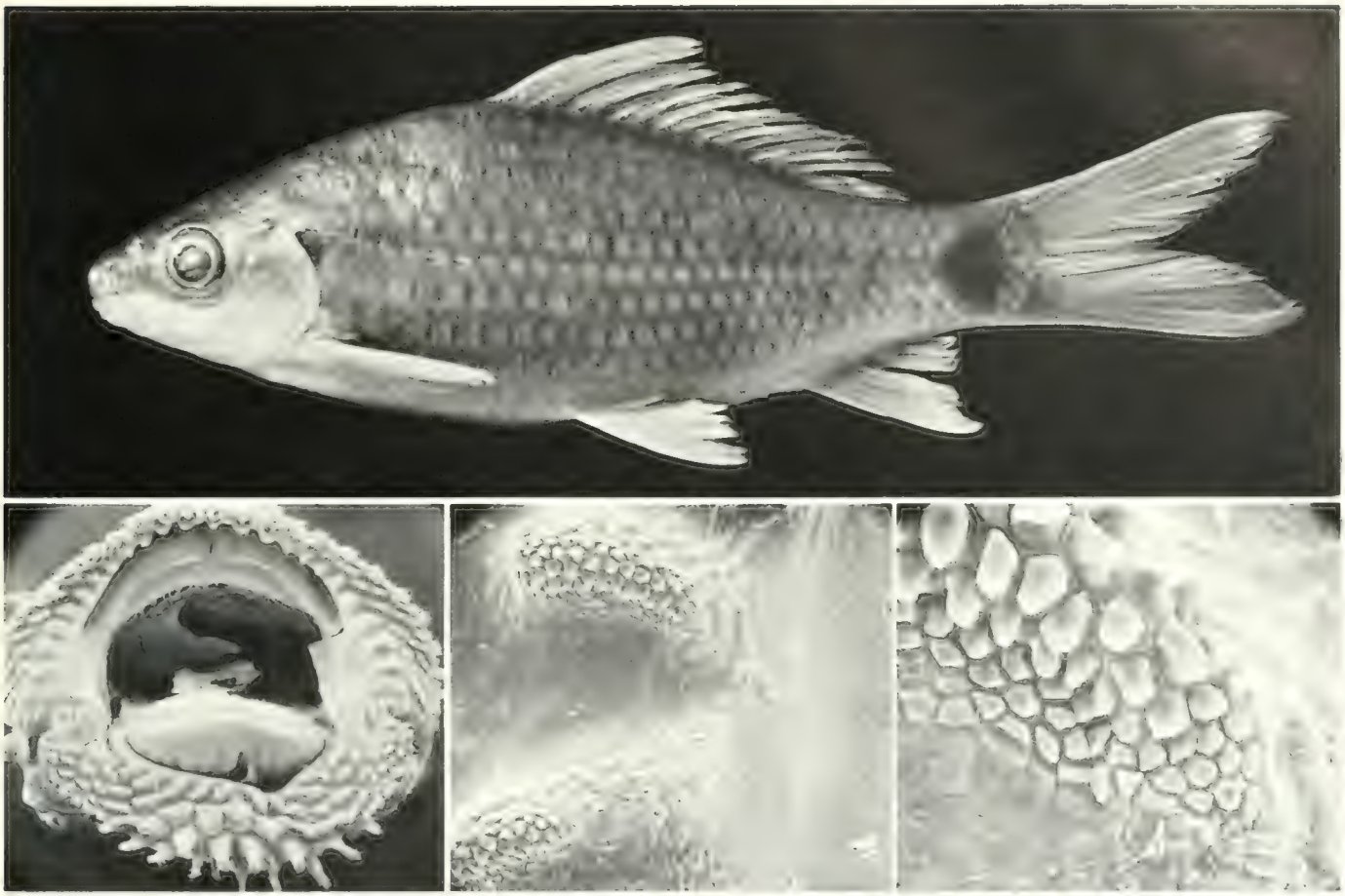

FIGURE 30. *Osteochilus hasselti*. Above, Kapuas 1976-8, 95.2 mm (USNM 230188); below, unculiferous lips, Kapuas 1976-6, 58.5 mm (CAS 49228).

duncular spot absent. Upper and lower lobes of caudal fin with a diffuse, thin, longitudinal band extending from procurrent rays to end of uppermost and lowermost caudal fin rays (absent in *O. triporus*). Side of body with six rows of dark spots, one on lateral line scale row, two on the two scale rows above lateral line and three on the three scale rows below lateral line; row of spots on lateral line scales noticeably fainter than other rows (rows of spots on lateral line equally distinct in *O. triporus*). Maximum standard length 154 mm.

DISTRIBUTION.—Sumatra (Djambi; Batang Hari). Borneo (Kapuas basin only).

Osteochilus kahajanensis (Bleeker, 1857)
(Figure 32)

Rohita kahajanensis Bleeker, 1857*a*:18 (type locality Kahajan River)
Osteochilus kahajanensis Günther, 1868*a*:44.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-17, 78.3 mm (MZB 3184); Kapuas 1976-39, 62.8 mm (MZB 3185)

Endomorph. Body depth 3.2–3.9. Dorsal-fin rays 19–21. Scales in lateral series 31–32, circumferential 11/2/13, circumpeduncular 16. Gill rakers 33–46. Differs from all other *Osteochilus* in having two large tubercles on snout (instead of 0,1,3, or numerous small tubercles). A diffuse or poorly defined median longitudinal stripe. Ventral surface of upper lip with moderately long undivided plicae. Maximum standard length 220 mm.

Osteochilus kappenii (Bleeker, 1857)
(Figure 33)

Rohita kappenii Bleeker, 1857*a*:19 (type locality Kapuas River at Pontianak)
Osteochilus kappenii Günther, 1868*a*:42
Osteochilus brevicauda Weber and de Beaufort, 1916:138 (type locality Kapuas River at Putus Sibau and Putus Genting). See Karnasuta (1981)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-28, 3: 46.5–79.8 mm (CAS 49230, MZB 3186, NIFI uncat.); Kapuas 1976-37, 2: 65.2–65.9 mm (MZB 3187, USNM 230190); Kapuas 1976-43, 50.5 mm (MZB 3188)

Mesomorph. Body compressed, depth 3.5–4.5. Dorsal-fin rays 19–21, pectoral 15. Lateral line scales 31–33, circumferential 13/2/15, circumpeduncular 16. Gill rakers 26–34. Lateral plicae of upper lip short, each divided into two or three. About nine rows of indistinct spots on sides of body (spots darker and more distinct in *O. hasselti*). A large circumpeduncular spot. Fins plain. Maximum standard length 175 mm.

This rare species of restricted distribution is very similar to the common and very widely distributed *O. hasselti*. They can be separated by the circumferential scale count (13/2/15 in *O. kappeni* vs. 11/2/13 in *O. hasselti*), as well as the less distinct spots in *O. kappeni*.

This species may be endemic to the Kapuas. Identification of specimens reported from Djambi, Sumatra, as *O. kappeni* (Weber and de Beaufort, 1916:138) should be checked. A record from the Baram River (Fowler 1905) seems likely to be based on *O. kahajanensis* (Karnasuta 1981).

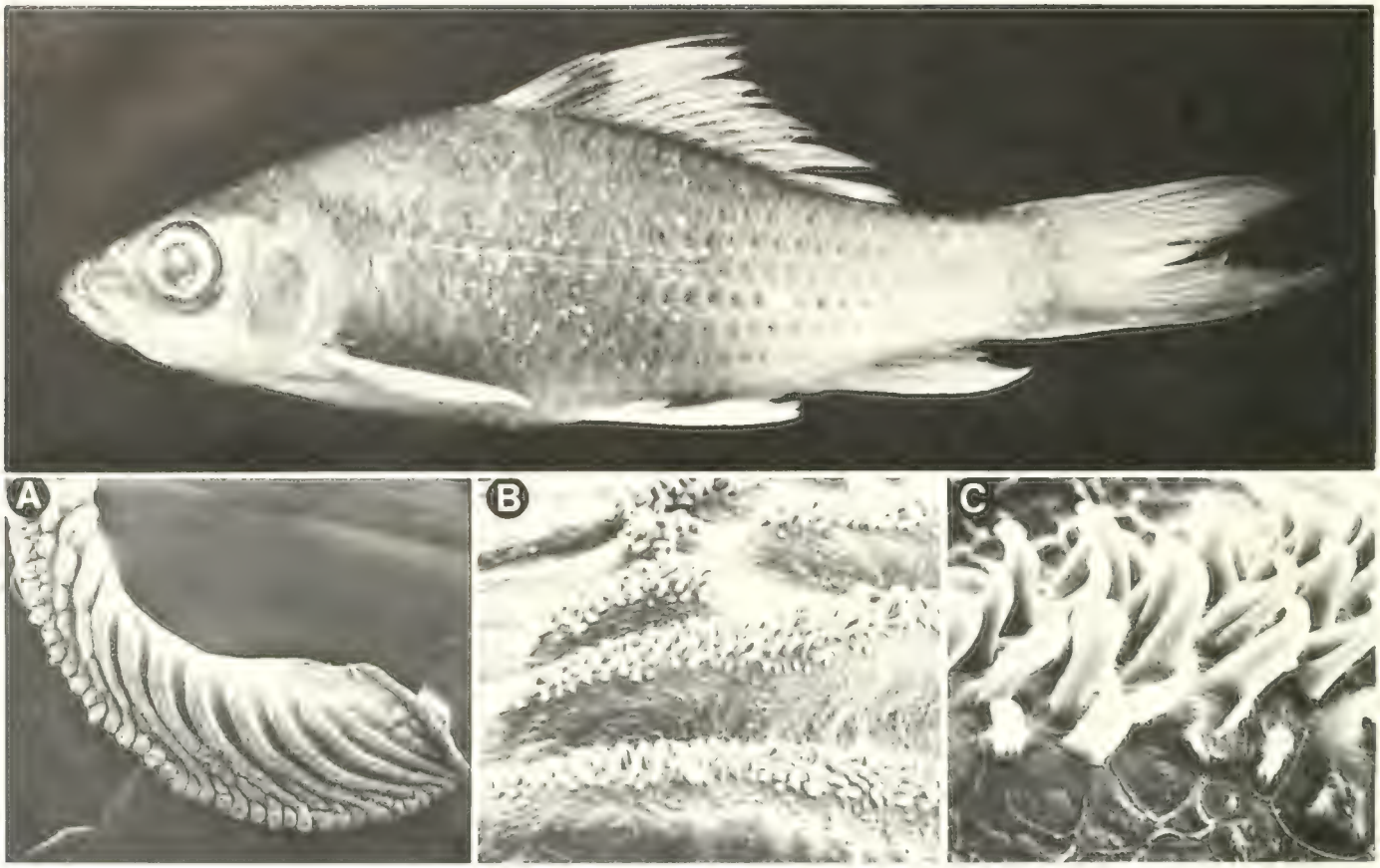

FIGURE 31. *Osteochilus intermedius*. Above, Kapuas 1976-43, 49.9 mm (CAS 49229); below, unculiferous lips, Kapuas 1976-17, 69.8 mm (CAS 44182).

Osteochilus melanopleurus (Bleeker, 1852)
(Figure 34)

Rohita melanopleura Bleeker, 1852*b*:430 (type locality Bandjermassing, Borneo, and Palembang, Sumatra).
Osteochilus melanopleurus Günther, 1868*a*:40.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-20, 3: 83.5–137 mm (CAS 49231, MZB 3189, USNM 230191); Kapuas 1976-49, 2: 72.8–119 mm (CAS 49232, MZB 3190)

Immediately distinguished from all other *Osteochilus* by its upturned mouth, and by the large size of the vertical dark bar on body above pectoral fin.

Endomorph. Body depth 3.1–4.1. Dorsal-fin rays 20–22, pec-

FIGURE 32. *Osteochilus kahajanensis*. Kapuas 1976-39, 62.8 mm (MZB 3185)

FIGURE 33. *Osteochilus kappenii.* Kapuas 1976-43, 50.5 mm (MZB 3188).

toral 17–18. Lateral line scales 41–53, circumferential 22–23/2/23–24, circumpeduncular 22–24. Gill rakers 25–40 or more (number increasing with growth). Lateral plicae of upper lip irregularly arranged, mound-shaped. Fins and body otherwise plain. Maximum standard length 366 mm.

DISTRIBUTION.—Mekong basin (Laos, Kampuchea, southern Vietnam, and Thailand). Malay Peninsula (Chenderoh Dam, Perak; Kalantan). Sumatra (Djambi, Palembang, Mandan R. at Siak). Borneo (Kapuas, Baram). Thailand (Tapi R., Meklong R., Menam Mun, Chao Phrya, Meyom at Lampang).

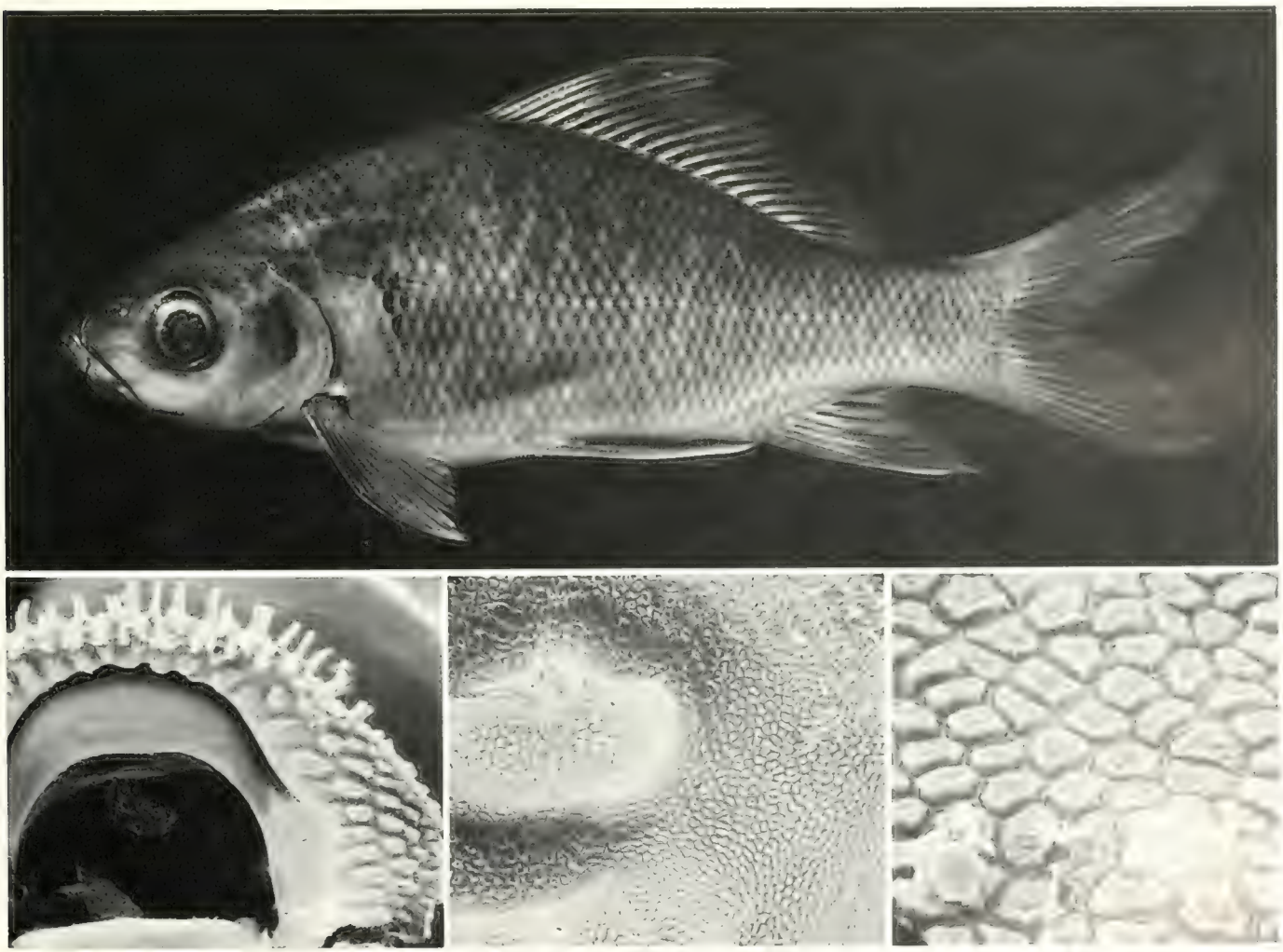

FIGURE 34. *Osteochilus melanopleurus.* Above, Kapuas 1976-49, 119 mm (MZB 3190); below, unculiferous lips, Kapuas 1976-49, 72.8 mm (CAS 49232).

FIGURE 35.—*Osteochilus microcephalus*. Kapuas 1976-45, 70.4 mm (MZB 3204).

Osteochilus microcephalus (Valenciennes, 1842)

(Figure 35)

Rohita microcephalus Valenciennes *in* Cuvier and Valenciennes, 1842:275 (type locality Bantam River, Java)
Rohita brachynotoperus Bleeker, 1855*b*:266 (type locality Lahat, Sumatra)
Rohita vittata Bleeker, 1860*a*:178 (type locality Java, Sumatra, and Borneo)
Osteochilus microcephalus Günther 1868*a*:43
Osteochilus brachynotopterus Günther 1868*a*:43
Osteochilus vittatus Günther 1868*a*:44

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-15, 3: 36.0–44.1 mm (BMNH 1982.3.29.18–19, MZB 3191); Kapuas 1976-16, 3: 47.0–53.5 mm (CAS 49233, MZB 3192); Kapuas 1976-17, 2: 55.6–61.5 mm (FMNH 94203, MZB 3193); Kapuas 1976-19, 73.1 mm (MZB 3194); Kapuas 1976-21, 3: 24.7–28.1 mm (MZB 3195); Kapuas 1976-27, 2: 93.8–115 mm (IRSNB 19732, MZB 3196). Kapuas 1976-29, 3: 87.9–99.5 mm (MCZ 58342, MZB 3197); Kapuas 1976-31, 5: 39.6–100 mm (MZB 3198, CAS 49234); Kapuas 1976-33, 61.0 mm (MZB 3199); Kapuas 1976-35, 5: 53.8–77.6 mm (MZB 3200, MNHN 1982-666); Kapuas 1976-37, 8: 44.4–60.3 mm (MZB 3201, RMNH 28834, UMMZ 209893, USNM 230192); Kapuas 1976-39, 59.1 mm, MZB 3202); Kapuas 1976-43, 7: 34.7–43.8 mm (MZB 3203, USNM 230193, ZMA 116.250); Kapuas 1976-45, 70.4 mm (MZB 3204); Kapuas 1976-46, 43.3 mm (MZB 3205); Kapuas 1976-47, 34.8 mm (MZB 3206)

Ectomorph. Body depth 2.8–3.7. Dorsal-fin rays 14–17, pectoral 14–16. Lateral line scales 32–33, circumferential 11/2/13, circumpeduncular 16. Gill rakers 27–35. Snout tubercles 0, 1 or 3. Midlateral stripe from gill opening to end of caudal peduncle. Mouth subinferior. Ventral surface of upper lip with moderately long undivided plicae. Maximum standard length 140 mm.

DISTRIBUTION.—Laos, Kampuchea, and probably southern Vietnam (Mekong basin). Thailand (Mekong, Chao Phrya, Kwai Yai R., Pattani R. at Yala). Sarawak (Niah R., Baram R.). Borneo (Kapuas, Barito R.). Malay Peninsula (Tahan R., Pahang; Sadili R., Johore). Sumatra (Djambi, Moesi, Singkarak, Sockadana, Sindjungdjung, Palembang).

Osteochilus pleurotaenia (Bleeker, 1855) new combination

Lobochilus pleurotaenia Bleeker 1855*b*:267 (type locality Lahat, Sumatra)
Lobochilus rohitoides Bleeker 1857*b*:363 (type locality Krawang, Batavia, Java)
Diplocheilichthys pleurotaenia Bleeker 1860*a*:143 (description of *Diplocheilichthys* with *Lobochilus pleurotaenia* as type species)
Labeo (*Diplocheilos*) *rohitoides* Bleeker, 1860*a*:139
Labeo pleurotaenia Günther, 1868*a*:58
Osteochilus jentinki Popta, 1904:194 (type locality Bongon River=Mahakam Basin, eastern Borneo)

MATERIAL EXAMINED.—Western Borneo (Kapuas R. at Putussibau), 3, and Nangaraun, Mandai R., Kapuas basin, 2 (RMNH 1683–86)

Ectomorph. Body slender, depth 2.5–3.0. Dorsal-fin rays 14–15, pectoral 16–17. Lateral line scales 30–31, circumferential 11/1/13, circumpeduncular 16. Mouth strongly inferior, lips perhaps larger than in any other species of *Osteochilus*. Ventral portion of upper lip with plicae long and undivided. Snout nontuberculate or with numerous fine tubercles. Gill rakers 40–60. Juveniles with median longitudinal stripe from gill cover to base of caudal fin (disappears with growth). Maximum standard length 225 mm.

This is the only species of *Osteochilus* known from the Kapuas basin not obtained during the Kapuas survey of 1976. J. Karnasuta and I independently examined material in Europe and came to the conclusion that it belongs in *Osteochilus*. The synonymy presented here is from Karnasuta (1981).

DISTRIBUTION.—Sumatra (Lahat, Moesi R.). Borneo (Kapuas, Mahakam). Java (Krawang, Batavia).

Osteochilus schlegeli (Bleeker, 1851)

(Figure 36)

Rohita schlegeli Bleeker, 1851*c*:432 (type locality Bandjermassing).
Osteochilus schlegeli Günther, 1868*a*:42

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 125 mm (MZB 3207); Kapuas 1976-44, 102 mm (MZB 3208)

Endomorph. Body deep, 3.4–4.3. Dorsal-fin rays 16–18. Lateral line scales 32–33, circumferential 13/2/15, circumpeduncular 20. Gill rakers 24–30. Lateral plicae of upper lip mound-shaped, irregularly positioned. Body and fins usually plain, except juveniles usually have a vertical black blotch on side of body above pectoral fin, and some specimens have a large black spot on anterior base of dorsal fin. Maximum standard length 313 mm.

DISTRIBUTION.—Thailand (lower Chao Phrya, Meklong R.). Sumatra (Djambi, Batang Hari, Palembang). Borneo (Kapuas).

FIGURE 36. *Osteochilus schlegeli*. Kapuas 1976-19, 125 mm (CAS 49235).

Osteochilus spilurus (Bleeker, 1851)
(Figure 37)

Dangila spilurus Bleeker, 1851*c*:272 (type locality Bandjermassing, Borneo).
Rohita oligolepis Bleeker, 1853*d*:191 (type locality Marawang, Banka).
Osteochilus oligolepis Günther, 1868*a*:45.
Osteochilus spilurus Günther, 1868*a*:45

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-5, 2: 18.8–39.2 mm (CAS 49235, MZB 3209); Kapuas 1976-8, 2: 46.8–48.5 mm (CAS 49236, MZB 3210); Kapuas 1976-16, 3: 13.0–58.0 mm (CAS 49237, MZB 3211); Kapuas 1976-17, 2: 53.3–68.0 mm (CAS 49238, MZB 3212); Kapuas 1976-32, 6: 22.1–28.7 mm (MZB 3213, USNM 230194); Kapuas 1976-37, 39.9 mm (MZB 3214); Kapuas 1976-42, 49: 24.8–42.7 mm (AMNH 48923, BMNH 1982.3.29.20–23, CAS 49510, IRSNB 19733, MCZ 58343, MNHN 1982-667, MZB 3215, NIFI uncat., RMNH

FIGURE 37. *Osteochilus spilurus*. Above, Kapuas 1976-5, 39.2 mm (CAS 49235); below, unculiferous lips, Kapuas 1976-42, 42.1 mm (CAS 49236)

FIGURE 38. *Osteochilus triporos* Above, Kapuas 1976-49, 66.6 mm (MZB 3222); below, unculiferous lips, Kapuas 1976-42, 79.0 mm (USNM 230197).

28835, ROM 38611); Kapuas 1976-46, 22: 25.2–49.1 mm (MZB 3216, UMMZ 209920, USNM 230195); Kapuas 1976-47, 5: 25.4–29.7 mm (MZB 3217, USNM 230196); Kapuas 1976-51, 7: 22.4–34.7 mm (CAS 49239, MZB 3218)

Ectomorph. Body moderately deep, 3.1–3.5. Dorsal-fin rays 14–15, pectoral 13–14. Lateral line scales 27–29, circumferential 9/2/11, circumpeduncular 16. Gill rakers 25–28. A round dark spot on caudal peduncle. Ventral surface of lip with moderately long undivided plicae. Maximum standard length 75 mm.

DISTRIBUTION.—Southern Malay Peninsula. Southern Sumatra. Western and southern Borneo. Java. Banka. Billiton.

Osteochilus triporos (Bleeker, 1852)

(Figure 38)

Rohita triporos Bleeker, 1852*e*:598 (type locality Palembang, Sumatra)
Osteochilus triporus Günther, 1868*a*:44

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 6: 78.9–116 mm (BMNH 1982.3.29.24, CAS 49240, RMNH 94204, MZB 3219); Kapuas 1976-20, 4: 66.4–113 mm (MZB 3220, MNHN 1982-668, RMNH 28836); Kapuas 1976-42, 6: 71.6–84.8 mm (MZB 3221, UMMZ 209905, USNM 230197); Kapuas 1976-49, 66.6 mm (MZB 3222)

Mesomorph. Body elongate, slender, 2.6–3.5. Dorsal-fin rays 15–16. Lateral line scales 29–30, circumferential 11/2/11–13, circumpeduncular 13. Ventral part of lip with long plicae divided into two or three parts. Gill rakers 27–32. Snout tubercles 3, middle one largest. Long plicae on ventral portion of upper lip divided into two or three parts. A large, round, dark spot near base of anterior portion of dorsal fin, followed by a straight row of smaller round spots on interradial membranes. Sides of body with about 8 rows of dusky round spots centered on anterior exposed portion of scales. Peduncular spot absent. Dorsal fin margin strongly falcate.

DISTRIBUTION.—Sumatra (Palembang, Gunung Sahilan). Borneo (Kapuas).

Osteochilus waandersii (Bleeker, 1852)

(Figure 39)

Rohita waandersii Bleeker, 1852*g*:733 (type locality Toboali, Banka).
Osteochilus waandersii Günther, 1868*a*:43

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-6, 7: 53.2–65.8 mm (CAS 49241, MZB 3223, USNM 230198); Kapuas 1976-16, 3: 46.8–58.5 mm (MZB 3224, UMMZ 209857); Kapuas 1976-36, 77.0 mm (MZB 3225); Kapuas 1976-39, 46.0 mm (MZB 3226); Kapuas 1976-47, 44.3 mm (MZB 3227)

Mesomorph. Body depth 3.0–3.4. Dorsal-fin rays 16–17. Pectoral-fin rays 15–17. Lateral line scales 32–33. Circumferential scales 11/2/13. Circumpeduncular scales 16. Gill rakers 40–60. Snout tubercle 1 or 3; if 3, median tubercle largest. Median lateral stripe from posterior border of eye (or from gill opening to end of caudal fin). Maximum standard length 205 mm.

DISTRIBUTION.—Central Thailand (Khao Phanom Bencha, Trang, Old Cheing Sen, Punnang Star, Yala, Chanthaburi, Pakjong, Menam Mun, Kanjanburi, Surathani, Chumporn, Kao Saming R., Trod). Malay Peninsula (Tahan R., Jelai R., Negri Sembilan, Pahang R., Mawai, Johore, Bukit Merah, Perak). Sumatra (Deli, Sockadana, Singkrah Lake, river at Solak, Sidjoengdjoeng, Patang). Western Borneo (Kapuas). Java. Banka (Tobali Province).

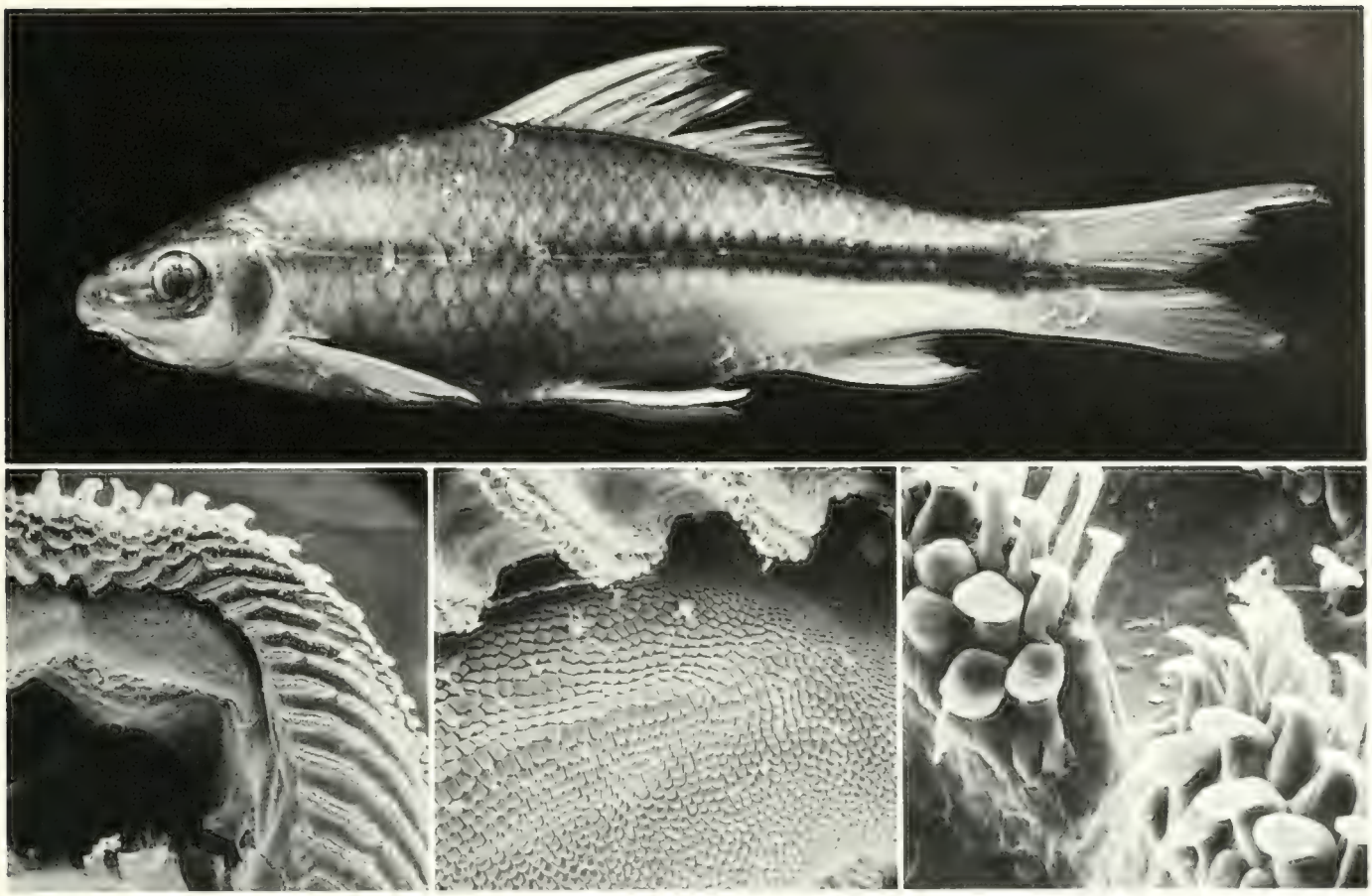

FIGURE 39. *Osteochilus waandersii*. Above, Kapuas 1976-36, 77.0 mm (MZB 3225); below, unculiferous lips, Kapuas 1976-6, 65.6 mm (USNM 230198).

Oxygaster of Günther, 1868

Oxygaster van Hasselt, 1823:133 (nomen dubium)
Oxygaster Günther 1868:332 (included species *Cyprinus* or *Leuciscus oxygaster* Valenciennes *in* Cuvier and Valenciennes, 1844:349). Proposed as a "section" of *Chela* Hamilton-Buchanan, 1822

The first ichthyologist to recognize *Oxygaster* van Hasselt, 1823 as a valid taxon subsequent to its original publication as a nomen dubium is Günther (1868). The entire original account reads as follows:

> *Oxygaster* Mihi, onderscheiden vooral door eene mesvormige carina aan de buiksvlakte, is misschienten enregte door mij onder de Cyprinaceen gesteld, waarom ik nader hierop zal terugkomen; *Anomalura* heb ik als species naam onder de Tafel geschreven.
>
> *Oxygaster* Mihi, especially distinguished by a knife-like keel on the abdominal surface, is perhaps incorrectly placed in the Cyprines by me, for which reason I will come back to this later on. I have written *Anomalura* as the species name under the figure (after Alfred 1961)

As it stands, this description of *Oxygaster anomalura* could refer to *Macrochirichthys macrochirus*, also present in Java and obtained by Kuhl and van Hasselt (see Cuvier and Valenciennes 1844:348) although not mentioned by van Hasselt (1823). There is no mention of specimens or locality, only of a figure that has never been published, and even reason to doubt that the fish in question belongs to Cyprinidae. Its identity is known only because of the account published by Valenciennes, based on a specimen obtained by Kuhl and van Hasselt at Batavia.

Although some authors (e.g., Smith 1945; Bănărescu 1971) have recognized *Oxygaster* van Hasselt, 1823, it is best if *Oxygaster* and *O. anomalura* of van Hasselt are treated as nomina dubia.

Oxygaster was rejected as a distinct genus by Valenciennes in Cuvier and Valenciennes (1844), who treated it as a synonym of *Leuciscus* Valenciennes in Cuvier and Valenciennes, 1844, by Bleeker (1860*a*:469, 1863*e*:264) and Weber and de Beaufort (1916:52), who treated it as a synonym of *Chela* Hamilton-Buchanan, 1822. The statement by Smith (1945:74–75) that "Bleeker 1863 [314] made *Chela cachius* of Hamilton the genotype" of *Oxygaster* van Hasselt is in error. Bleeker (1863*b*: 264) placed *Oxygaster* as a synonym of *Chela* and indicated *Cyprinus* (*Chela*) *cachia* Hamilton-Buchanan as type species of *Chela*; he did not indicate any type species for *Oxygaster*.

Oxygaster hypophthalmus (Bleeker, 1860)

(Figure 40)

Chela hypophthalmus Bleeker, 1860*a*:471 (type locality Palembang, in fluviis)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-8, 41.0–50.9 mm (BMNH 1982.3.29.26–28, CAS 49244, MZB 3232); Kapuas 1976-9, 15: 40.3–51.2 mm (FMNH 94206, MNHN 1982-670, MZB 3233, USNM 230199); Kapuas 1976-14, 2: 42.5–110 mm (CAS 49245, MZB 3234); Kapuas 1976-15, 45.3 mm (MZB 3235); Kapuas 1976-19, 65.0 mm (MZB 3236); Kapuas 1976-32, 57.0 mm (MZB 3237); Kapuas 1976-33, 6: 28.4–65.1 mm (MZB 3238, UMMZ 209886); Kapuas 1976-34, 12: 27.7–61.4 mm (CAS 49246, MZB 3239); Kapuas 1976-35, 8: 43.8–65.3 mm (MZB 3240, USNM 230200); Kapuas 1976-37, 8: 42.6–50.3 mm (AMNH

FIGURE 40 *Oxygaster*. Above, *O. oxygastroides*, Kapuas 1976-32, 63.2 mm (CAS 49427); middle, *O. hypophthalmus*, Kapuas 1976-41, 117 mm (MZB 3243); below, *O. hypophthalmus*, Kapuas 1976-32, 57.0 mm (MZB 3237).

48924, MZB 3241); Kapuas 1976-40, 45.6 mm (MZB 3242); Kapuas 1976-41, 2 103–117 mm (MZB 3243, ROM 38603); Kapuas 1976-44, 54.5 mm (MZB 3244); Kapuas 1976-49, 2: 81.9–92.3 mm (MZB 3245, ZMA 116.521).

DISTRIBUTION.—Southern Malay Peninsula. Central and northeastern Sumatra (Palembang, Kampar R.; Indragiri; Weber and de Beaufort 1916:52). Western Borneo and Sarawak.

Oxygaster oxygaster (Valenciennes, 1844) new combination

Oxygaster anomalura van Hasselt, 1823:133 (nomen dubium)
Cyprinus oxygaster Valenciennes *in* Cuvier and Valenciennes, 1844:349 (type locality Batavia)
Leuciscus oxygaster Bleeker, 1853*e*:453
Chela anomalurus Bleeker, 1860*a*:473
Chela oxygaster Weber and de Beaufort, 1916

FIGURE 41. *Paracrossochilus vittatus*. Kapuas 1976-24, 58.0 mm (NIFI).

MATERIAL EXAMINED.—Malay Peninsula: Kota Tinggi, Johore, 5: 89.7–104 mm (CAS-SU 34665). Western Borneo: Kapuas 1976-16, 7: 64.7–85.4 mm (BMNH 1982.3.29.25, CAS 49242, FMNH 94205, MNHN 1982-669, MZB 3228); Kapuas 1976-17, 83.7 mm (MZB 3229); Kapuas 1976-37, 2: 64.4–81.7 mm (CAS 49243, MZB 3231, UMMZ 209898).

NOMENCLATURAL NOTE.—Alternation of usage has characterized this taxon, as it has other names published by van Hasselt (1823), because of the difficulty in deciding whether van Hasselt's name has validity.

DISTRIBUTION.—Malay Peninsula (Malacca). Sumatra (Pangabuang, Palembang, Lake Tidor, Selapian R., Upper Langkat, Wampu R., Deli). Borneo (Kapuas, Baram, Pengaron R.).

Oxygaster oxygastroides (Bleeker, 1852)

(Figure 40)

Leuciscus oxygastroides Bleeker, 1852*b*:431 (type locality Sumatra, Borneo, and Java).
Chela oxygastroides Bleeker, 1860*a*:472.
Chela megalolepis Günther, 1868*a*:337 (unwarranted replacement name).
Oxygaster oxygastroides Fowler, 1935*a*:110.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-20, 2: 117–131 mm (BMNH 1982.3.29.29, MZB 3246); Kapuas 1976-32, 4: 55.1–83.7 mm (CAS 49247, MZB 3247); Kapuas 1976-34, 109 mm (MZB 3248); Kapuas 1976-44, 5: 70.2–128 mm (MNHN 1982-671, MZB 3249, UMMZ 209916, USNM 230201); Kapuas 1976-49, 111 mm (MZB 3250)

DISTRIBUTION.—Thailand (Mekong; Chao Phrya, Klong Sao Tong, Nakon Sritamarat, Tale Sap, Tale Noi, Krabi; Smith 1945). Malay Peninsula. Sumatra (Palembang, Lahat, Lake Tidor, Batang Hari). Borneo (Kapuas, Sambas, Prabukarta, Makaham, Upper Riko). Java (Batavia, Krawang, Lake Kamodjing near Tjihampeh, Kediri, Tulung Agung).

Paracrossochilus Popta, 1904

Paracrossochilus Popta, 1904:200 (type species *Paracrossochilus bicornis* Popta, 1904=*Crossochilus vittatus* Boulenger, 1894, by monotypy).

Rostral cap thick, completely covering upper jaw, with fimbriate margin. Lateral lobes of upper lip apparently present (papillose), but entire transverse or median portion of upper lip absent or vestigial. Horny jaw sheaths well developed. Lower lip fleshy, entirely covered with papillae. Rostral and maxillary barbels present. Circumpeduncular scales 8–9.

Endemic to Borneo; only two species known.

Paracrossochilus acerus Inger and Chin, 1962

Paracrossochilus acerus Inger and Chin, 1962:100, fig. 47 (type locality Sungei Dapu, Baleh River, Rejang basin, Sarawak)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-24, 33: 45.8–75.7 mm (AMNH 48925, BMNH 1982.3.29.30–31, CAS 44178, FMNH 94207, MNHN 1982-672, MZB 3251, NIFI uncat., ROM 38615); Kapuas 1976-29, 6: 20.7–33.0 mm (MZB 3252, UMMZ 209875, USNM 230202)

DISTRIBUTION.—Borneo (Rejang, Kapuas).

Paracrossochilus vittatus (Boulenger, 1894)

(Figure 41)

Crossochilus vittatus Boulenger, 1894:247 (type locality Senah, Poeh, and Tagora Rivers, Sarawak)
Paracrossochilus bicornis Popta, 1904:201 (type locality le Howong, Mahakam basin). See Weber and de Beaufort (1916:227).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-6, 10: 31.9–49.5 mm, AMNH 48926, BMNH 1982.3.29.32–35, MZB 3253); Kapuas 1976-24, 27: 44.7–62.7 mm (FMNH 94208, IRSNB 19734, MCZ 58344, MZB 3254, NIFI uncat.); Kapuas 1976-25, 7: 34.3–74.8 mm (CAS 49248, MZB 3255); Kapuas 1976-26, 5: 32.8–52.4 mm (CAS 49249, MZB 3256); Kapuas 1976-27, 21: 19.8–63.4 mm (CAS 49250, MNHN 1982-673, MZB 3257); Kapuas 1976-29, 27: 20.7–56.7 mm (MZB 3258, ROM 38599, UMMZ 209876, USNM 230203, ZMA 116.522); Kapuas 1976-30, 21: 26.7–71.7 mm (CAS 53049, MZB 3259, USNM 230204).

Pectenocypris Kottelat, 1982

Pectenocypris Kottelat, 1982:421 (type species *Pectenocypris korthausae* Kottelat, 1982, by original designation and monotypy)

DIAGNOSIS.—Small, slender *Rasbora*-like cyprinids distinguished from all other genera by extraordinarily elongate and numerous gill rakers; pharyngeal teeth expanded, bladelike, with incised crowns, in a single row (3/3); upper endentulous limb of pharyngeal bone (usually simple in cyprinids) with strongly divergent, strutlike anteromedian and anterolateral processes.

Jaws moderately upturned and short, extending posteriorly to about midway between snout-tip and anterior margin of eye. Dorsal surface of head flat. Abdominal keel absent. Scales moderately large, 26–33 in lateral series, 11–13 predorsal, 8 transverse, 11–14 circumpeduncular; lateral line incomplete, with 5–10 pored scales anteriorly. Dorsal-fin origin directly above pelvic-fin origin. Dorsal-fin rays ii7, anal iii5, pectoral 13, pelvic 8–9. Total gill rakers on first gill arch from 90 to over 200. Total

FIGURE 42 *Pectenocypris balaena*. Kapuas 1976-32, 32.3 mm ripe female (MZB 4006, holotype).

vertebrae 31–32 (present observations) or 36 (Kottelat 1982). Largest known specimen 34.9 mm.

Known only from the type species recently discovered in southeast Borneo and an undescribed species obtained during the Kapuas survey of 1976.

Pectenocypris balaena new species

(Figure 42)

HOLOTYPE.—MZB 4006, 32.3 mm, Danau Piam near Ketungau, 38 km NNE of Sintang, 5–6 August 1976 (Kapuas 1976-32)

PARATYPES.—BMNH 1982.3.29.107–108, CAS 49307, MZB 3423, USNM 230238, ZMA 116.531, 25: 20.0–34.9 mm, collected with holotype: MZB 3422, 26.6 mm, small forest streams flowing into Kapuas mainstream within 10 km upriver of Sanggau, 16–17 July 1976 (Kapuas 1976-17). Two specimens, 27.4–30.1 mm, cleared and stained with alcian blue–alizarin (CAS 49307)

DIAGNOSIS.—*Pectenocypris balaena* differs from its only congener, *P. korthausae*, in its even more elongate and numerous gill rakers, sharper or more slender snout, somewhat more slender caudal peduncle, and coloration. In many other respects the two species are closely similar and they are undoubtedly congeneric.

Counts of gill rakers in two alcohol specimens of *P. balaena* examined under water are about 40+115=155 in a 23.6 mm specimen and 45+135=180 in a 28.9 mm specimen. These counts are possibly somewhat too low due to the minute size of the gill rakers at the ends of the upper and lower limits of the gill arch. A count of 64+148=212 rakers was obtained from a 30.1 mm cleared specimen stained with alcian blue–alizarin. Kottelat (1982) reported gill rakers 20+75=95 in a specimen of *P. korthausae* (standard length not indicated) and I find about 22+75=97 in a 21.8 mm paratype of this species (CAS 50488). The unusual condition of the pharyngeal bone and pharyngeal teeth appears to be very similar in *P. balaena* and *P. korthausae* (Kottelat 1982, fig. 1).

Lower jaw distinctly projecting beyond upper (jaws equal or lower jaw extending very slightly beyond upper in *P. korthausae*). Snout 12.4–13.0 (14.7–17.9 in *P. korthausae*). Eye 12.0–12.7, interorbital width 11.5–12.1. Head 3.3–3.5 (3.5–4.3 in *P. korthausae*). Depth caudal peduncle 10.2–10.7 (9.6–12.0 in *P. korthausae*). Pored scales in lateral series 5–8. Vertebrae 16–17+15=31(1), 32(1).

Coloration in life not recorded. Preserved specimens with a narrow but conspicuous midlateral longitudinal stripe extending from snout-tip, across middle of gill cover and length of body. The stripe is nearly continuous but is interrupted for a short distance on the posterior (membranous) portion of the gill cover and body immediately underlying this part of the gill cover. It ends abruptly at the base of the caudal fin. In some specimens there is a small dark area at the very end of the stripe but none has a large oval spot on caudal-fin base like *P. korthausae*. Side of body below midlateral stripe almost entirely free of melanophores. All fins colorless or plain except for some fine melanophores narrowly aligned along fin ray margins. Dorsal surface of head and body with numerous melanophores which form a regular pattern covering all of scales except their posterior margins. A thin midaxial streak on posterior half of body above or along dorsal margin of midlateral stripe (midaxial streak extending entire body length in *P. korthausae*). Ventral surface of head and entire abdomen to anal-fin origin free of melanophores. A median dorsal stripe from occiput to dorsal-fin origin; a dark stripe along base of anal fin on either side continuous as a median ventral stripe on caudal peduncle.

FOOD HABITS (Table 1).—An analysis of the gut contents of one specimen of *P. balaena* from Kapuas 1976-32 was made by Albert Mahood, who also took the photomicrographs of phytoplankton (Fig. 43). From Table 1 it can be seen that nearly all of the food items range in size from 4 to 40 μm (longest dimension). The principal food both in number of items and in biomass visually estimated is *Peridinium* of 16–18 μm (apparently a single species), which account for 122 or more than one-fourth of the total food items and roughly half of the biomass. It is interesting that several *Peridinium* have intact chloroplasts (Fig. 43b), indicating they had been ingested in living condition. Other true phytoplankters are the unicellular Chlorophyceae (including *Tetraedron*, of which three species are present) and presumably the numerous but very small unicellular Chlorophyta. The diatoms, on the other hand, are not typical phytoplankton but rather forms usually associated with bottom sediments. These, as well as the pollen? and nearly all other unidentified and miscellaneous items encountered, judging from their small size, may well be "tychoplanktonic" or "chance plankton." They account for about one-third of the food items. It is noteworthy that the brown round things identified as pollen? (see Fig. 43i, typical of many observed) constitute a substantial item both in terms of numbers present and biomass visually estimated. The two nematodes may be parasites. Gut contents of two additional fish specimens from Kapuas 1976-32 cursorily examined also consist largely of *Peridinium*.

Dustin Chivers and I have examined the gut contents of one of the paratypes of *P. korthausae* (CAS 50488, 21.0 mm). Its gut contents consist mainly of large numbers of the dissociated valves, furculae, and antennae of a single species of Cladocera

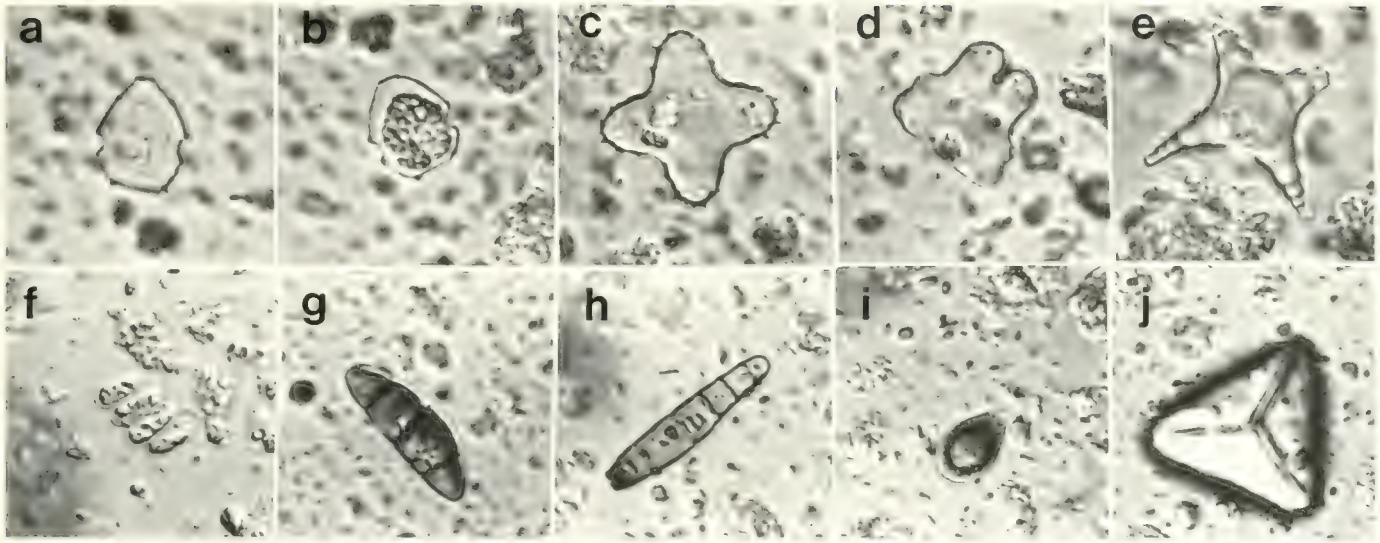

FIGURE 43. Phytoplankton from gut of *Pectenocypris balaena* (Kapuas 1976-32). a–b, *Peridinium* (18 and 16 μm); c, *Tetraedron* (29 μm); d, *Euastrum* (22 μm); e, *Staurastrum* (38 μm); f, *Scenedesmus* (16 μm); g–h, fungi? (29 and 34 μm); i, pollen? (15 μm); j, triangular unicellular plant? (30 μm).

(valves 216 × 108 μm, regularly loculose), together with a large amount of loose granular or flocculent material which appears to be the partially digested soft parts of the cladoceran. Also present are a few diatoms, which may have been ingested by the cladoceran, and a single slender oligochaete (910 × 40 μm, with about 10 very elongate segments). No other food items observed.

TABLE 1. *PECTENOCYPRIS BALAENA*. Gut contents (Kapuas 1976-32).

	μm	n
Chlorophyta		
unicellular, round	4–6	119
Chlorophyceae		
Tetraedron	29–42	51
Euastrum	22	8
Cosmarium	48	1
Staurastrum	38	1
Scenedesmaceae		
Scenedesmus	16	4
filamentous	169	1
filamentous	33	1
Chrysophyta		
Bacillariophyceae (diatoms)		
Pinnularia	36	10
Eunotia		1
Navicula	22	1
Pyrophyta (dinoflagellates)		
Dinophyceae		
Peridinium	16–18	122
Unidentified and miscellaneous		
brown, round (pollen?)	9–28	83
brown, 4–6 uniserial, thick-walled cells (fungi?)	18–29	14
ovoid, bipartite	12–18	25
oval, clear	21	6
triangular unicellular plant?	30	1
sponge spicule	213	1
higher plant	48	1
"claw" (copepod?)		1
"antenna" (copepod?)		1
nematodes		2
Total number of items		455

RELATIONSHIPS OF *PECTENOCYPRIS*.—Under "relationships" Kottelat (1982) stated: "The depressed and somewhat expanded ethmoid is typical of chelines, but unlike that group, the kinethmoid is rod-shaped and not triangular. In overall appearance, the fish most closely resembles *Inlecypris* (see Howes 1980*b*). It appears to have a 'generalized' cheline morphology with a highly specialized branchial arch; the pharyngeal bone being unlike that known in any other cyprinid." In examining both species of *Pectenocypris* I have been struck by their resemblance to *Rasbora* and particularly to such species as *R. subtilis* which resembles *Pectenocypris* in its relatively small size, slender body, and relatively small, upturned mouth. While it does not have the extraordinary specializations of the branchial arches and pharyngeal bones of *Pectenocypris*, *R. subtilis* does have relatively elongate and numerous gill rakers for a species of *Rasbora*.

DISTRIBUTION.—*Pectenocypris balaena* is known only from the Kapuas.

ETYMOLOGY.—The name *balaena*, also the scientific name of the baleen whale, refers to the numerous gill rakers of this species.

Puntioplites Smith, 1929

Puntioplites Smith, 1929:11 (type species *Puntius proctozysron* Bleeker, 1865, by original designation).
Adamacypris Fowler, 1934:125 (type species *Puntius proctozysron* Bleeker, 1865, by original designation).

Puntioplites has been revised by Bănărescu (1978) and by Taki and Katsuyama (1979).

Superficially similar to some of the species currently included in *Puntius*, but with last simple anal-fin ray greatly thickened ("spinified"), its posterior border smooth or serrate; gill rakers 25–42; scales with parallel striae. Barbels absent. Body very deep. Lateral line complete, lateral line scales 35–38, circumpeduncular 16–20. Last simple dorsal-fin ray strong and serrate;

anal-fin branched rays invariably 5? (at least some reported counts of 6 include the last half-ray counted as 1 [Bănărescu 1978:116]). Pelvic fin with 9 branched rays. Pharyngeal teeth in three rows, usually 2,3,4/4,3,2. Vertebrae 33–35.

Key to *Puntioplites* of western Borneo

1a Circumpeduncular scales usually 16 (rarely 18); scales on side of body with variably darkened ellipsoidal marks parallel to their anterior borders, scales with darkest marks forming a series of thin, wedge-shaped vertical bars *P. bulu*

1b Circumpeduncular scales 20; scales without ellipsoidal marks, coloration on side of body uniform *P. waandersi*

Puntioplites bulu (Bleeker, 1851)

Systomus bulu Beeker, 1851*h*:207 (type locality Bandjermassing, in fluviis).
Barbus bulu Günther, 1868*a*:149.
Puntius bulu Weber and de Beaufort, 1916:199
Puntioplites bulu Bănărescu, 1978:117

Material Examined.—Malay Peninsula: Perak, Telok Anson, 111 mm (CAS-SU 31094); Perak, Chenderoh Dam, 3: 155–187 mm (CAS-SU 34720). Western Borneo: Kapuas 1976-14, 17: 20.8–47.6 mm (AMNH 48927, CAS 49251, MCZ 58345, MZB 3260); Kapuas 1976-15: 24.3–48.5 mm (CAS 55328, FMNH 94209, MNHN 1982-674, MZB 3261); Kapuas 1976-20, 3: 72.6–103 mm (CAS 49252, MZB 3262); Kapuas 1976-33, 2: 48.5–56.3 mm (MZB 3263, USNM 230205); Kapuas 1976-34, 43.2 mm (MZB 3264); Kapuas 1976-44, 96.9 mm (MZB 3265); Kapuas 1976-45, 3: 21.2–89.5 mm (MZB 3266, RMNH 28838; Kapuas 1976-49, 3: 58.3–80.7 mm (MZB 3267, USNM 230206).

Distribution.—Sumatra (Palembang, Lahat, Ringat, Danau Sialong Lotong). Borneo (Baram?, Kapuas, Kahajan, Barito, Kinabatangan). Also reported, perhaps incorrectly, from southern part of Indochinese Peninsula (Taki and Katsuyama 1979: 260).

Puntioplites waandersi (Bleeker, 1858–59)

Systomus Waandersi Bleeker, 1858–59*f*:358 (type locality Ngawi, Java)
Puntius (*Puntius*) *Waandersi* Bleeker, 1863–64:110
Barbus waandersi Günther, 1868*a*:149
?*Barbus proctozysron* Volz, 1904:477 (Kwantan R., Sumatra)
Puntius nini Weber and de Beaufort, 1916:202 (type locality Bunut, Kapuas). See Bănărescu (1978:116).
Systomus (*Puntius*) *bulu* Bleeker, 1863–64:110.
Puntius lawak Weber and de Beaufort, 1916:204 (partim; specimens from Djambi and Riouw?). See Bănărescu (1978:16)
Puntioplites falcatus Smith, 1929:11–12 (type locality Mekong). See Taki and Katsuyama (1979:263)
Puntioplites waandersi Bănărescu, 1978:116

Material Examined.—Western Borneo: Kapuas 1976-14, 2: 31.7–82.0 mm (CAS 49254, MZB 3269); Kapuas 1976-33, 3: 38.3–112 mm (FMNH 94210, MZB 3270, USNM 230207)

Distribution.—Thailand (middle Mekong). Sumatra (Djambi, Kwantan?, Palembang, Indragiri). Borneo (Kapuas, Mahakam, Kota Bangun). Java (Ngawi).

Taki and Katsuyama (1979) reported samples from the middle Mekong of Thailand which they identify as *P. waandersi*. These have consistently fewer gill rakers and differ in some minor respects from *P. waandersi* from the East Indies but are otherwise closely similar to *P. waandersi* from Borneo. They regard the middle Mekong population as a relict population, and suggest that absence of the species elsewhere in continental southeast Asia may be due to the widespread occurrence there of *P. protozysron* (a species absent from the East Indies). If this Mekong population represents a distinct species, the name *Puntioplites falcatus* Smith, 1929 is available for it.

Puntius Hamilton-Buchanan, 1822

Puntius Hamilton-Buchanan, 1822:310 (type species *Cyprinus sophore* Hamilton-Buchanan, 1822, by subsequent designation of Bleeker, 1863*b*:199).
Barbodes Bleeker, 1860*a*:275, 313 (type species *Systomus* (*Barbodes*) *belinka* Bleeker, 1860, by subsequent designation of Bleeker, 1863*b*:200).

The attempt by Smith (1945:165) to designate the virtual tautonym *Cyprinus puntio* Hamilton-Buchanan, 1822 as generic type species of *Puntius* in place of *C. sophore* is invalid according to the current ICZN.

Puntius as currently understood comprises numerous species and may be polyphyletic. Barbels variable, rostral and maxillary, maxillary only, or absent. Dorsal fin with last simple ray serrate or entire, branched rays usually 8. Anal fin with last simple ray entire, branched rays usually 5 (sometimes 6, 8 in one species). Lateral line complete or incomplete, lateral line scales 17–36. Cephalic cutaneous papillae minute or absent. Pharyngeal teeth in three rows, usually 2,3,5/5,3,2. Color pattern extremely variable, many species with up to six very regularly placed vertical bars. Young often with color pattern radically different from adults. Maximum adult size 30 cm or more (*P. schwanenfeldii*) but most species less than 100 mm.

Puntius anchisporus (Vaillant, 1902)

Barbus (*Puntius*) *Sumatranus* Martens, 1876:402, pl. 11, fig. 2 (Bengkayang, Mandhor, and Danau Sriang).
Barbus sumatranus Vaillant, 1893:82 (Kapuas).
Barbus anchisporus Vaillant, 1902:96, fig. 27 (type locality Kapuas).
Puntius anchisporus Weber and de Beaufort, 1916:190.
Puntius pulcher Rendahl, 1922:203 (type locality Bulungan, northeast Borneo). See Alfred (1964:138)

Material Examined.—Western Borneo: Kapuas 1976-7, 4: 17.4–21.7 mm (CAS 49255, MZB 3271); Kapuas 1976-16, 5: 30.2–35.1 mm (MZB 3272, USNM 230208); Kapuas 1976-37, 15: 32.3–42.8 mm (FMNH 94211, MZB 3273, MNHN 1982-675, UMMZ 209894); Kapuas 1976-39, 40.1 mm (MZB 3274); Kapuas 1976-43, 26.9 mm (MZB 3275); Kapuas 1976-44, 40.0 mm (MZB 3276).

Body deeper than in any other vertically barred *Puntius*, depth less than 2 (depth more than 2 in other species); dorsal bar absent; lateral line complete. Parietal fontanel closed.

The color pattern of *P. anchisporus* is virtually identical to that of *P. tetrazona* from Sumatra which differs from it in having an incomplete lateral line as well as a more elongate body (Alfred 1964).

Distribution.—Known only from Borneo (Kapuas, Mahakam, Bulungan).

Puntius binotatus (Valenciennes, 1842)

Barbus maculatus van Hasselt, 1823:132 (nomen nudum).
Barbus binotatus Valenciennes *in* Cuvier and Valenciennes, 1842:168 (type locality Java)
Barbus maculatus Valenciennes *in* Cuvier and Valenciennes, 1842:195 (type locality Buitenzorg)
Barbus oresigenes Bleeker, 1850:17 (type locality Java). See Bleeker (1860*a*:348).
Barbus blutonensis Bleeker, 1852*a*:96 (type locality Billiton). See Bleeker (1860*a*: 348)
Barbus kusanensis Bleeker, 1852*b*:429 (type locality Prabukarta, Kusan River, southeast Borneo). See Bleeker (1860*a*:348)

Barbus polyspilos Bleeker, 1857*b*:351 (type locality "Perdana, Tjibiliong, provinciae Bantam Java occidentalis, in fluviis").
Systomus (*Barbodes*) *maculatus* Bleeker, 1860*a*:346.
Systomus (*Barbodes*) *goniosoma* Bleeker, 1860:349 (type locality Benkuelen, Sumatra).
Barbus goniosoma Vaillant, 1893:81 (Kapuas).
Barbus palavanensis Boulenger, 1895:186 (type locality Palawan). See Weber and de Beaufort (1916:189), and below.
Barbus quinquemaculatus Seale and Bean, 1907:229 (type locality "near Zamboanga").
?*Barbodes hemictenus* Jordan and Richardson, 1907:241, fig. 5 (type locality Mindoro). See below.
Barbus ivis Seale, 1909:494, pl. 1 (type locality Balabac Isd., Philippines).
Barbus elongatus Seale, 1910:265 (type locality Sandakan; preoccupied by *Barbus elongatus* Rüppell, 1837).
Barbus maculatus v. *hagenii* Popta, 1911:9 (type locality Lombok).
Puntius binotatus Weber and de Beaufort, 1916:186.
Barbus binotatus var. *palavanensis* Herre, 1924:292.
Barbodes sealei Herre, 1933 (replacement name for *Barbus elongatus* Seale, 1910). See below.
Puntius sibukensis Fowler, 1940:799, fig. 25 (type locality Silimpopon R., Sibuko Bay, Borneo). See below.
Puntius binotatus banksi Herre, 1940:31 (type locality Kuching, Sarawak, by subsequent restriction of Böhlke, 1953:37). See below.

Material Examined.—Malay Peninsula: Singapore, 75: 12.8–79.4 mm (CAS-SU 31089). Western Borneo: Kapuas 1976-6, 5: 37.1–85.3 mm (CAS 49256, MNHN 1982-676, MZB 3277); Kapuas 1976-7, 18.0 mm (MZB 3278); Kapuas 1976-25, 2: 45.6–54.6 mm (MZB 3279, USNM 230209). Sarawak: 18 mi E of Kuching, 22: 37.3–65.7 mm (CAS-SU 33900, 33903, holotype and paratypes of *P. binotatus banksi*). Northern Borneo: Balung R., Tawau, 29: 16.1–64.7 mm (CAS-SU 33604); Sandakan, 143: 22.6–114 mm (CAS-SU 27805). Java: Buitenzorg, 47: 16.7–72.6 (CAS-SU 20483). Palawan: Malatgau R., 5: 34.5–62.2 mm (CAS-SU 61641). Malabo, 2: 26.7–27.5 mm (CAS-SU 61640). Culion: stream flowing into Halsey Harbor, 35: 40.5–145 mm (CAS-SU 27622). Mindoro: 4: 77.5–93.0 mm (CAS-SU 20213, 20443, types of *P. hemictenus*); Tarogin R., 133: 19.7–52.2 mm (CAS-SU 61643); Hacienda Waterous, Mangarin, 112: 10.7–66.1 mm (CAS-SU 38099); 536: 18.5–100 mm (CAS-SU 61644). Basilan: Burakan R., 10: 45.4–61.1 mm (CAS-SU 23762). Mindanao: Marata Bogan, Lanao Prov., 139. 24.2–87.4 mm (CAS-SU 38098).

Parietal fontanel closed. Rostral and maxillary barbels well developed, both usually longer than eye diameter. Lateral line complete; scales in lateral series 23–27, predorsal 8–9, transdorsal 9, circumpeduncular 12. Last simple dorsal-fin ray finely serrate; dorsal-fin branched rays 8; anal-fin branched rays 5. Large adults often immaculate or with two round spots, one at base of dorsal-fin origin, the other in middle of caudal peduncle. Juveniles usually and adults sometimes with 2–4 midlateral round spots, variable in position. For further discussion of color pattern see below. Attains 145 mm, but adults in most populations are under 100 mm.

This is the most widely distributed and perhaps most variable species of *Puntius* in southeast Asia. It occurs from sea level to at least 2,000 m, and is commonly found below waterfalls in isolated mountain streams and on small islands inhabited by few other freshwater fishes. It exhibits great geographical variation in body depth and especially in coloration. Samples from Malay Peninsula, Borneo, and Java (and Sumatra?) exhibit relatively little variation; the greatest variation apparently occurs in the Philippine Islands; some Philippine *Puntius* regarded as distinct species, such as *P. hemictenus* of Mindoro, may be only geographical variants of this species. *Puntius binotatus* has been regarded as the parent stock for all of the endemic genera and species of cyprinids in Lake Lanao and on the Lanao Plateau of Mindanao (Herre 1955).

Large adults typically have the body with a dull golden sheen and two small round black spots, one at the base of the dorsal-fin origin, the other in the middle of the caudal peduncle. Sometimes these spots may be accentuated, especially the anterior spot, which may extend dorsally onto the dorsal fin, or ventrally as a vertical bar on the dorsal half of the body. In some specimens, particularly longer preserved specimens, the spots may be very faint or absent. Young individuals have an irregularly spaced series of four or more dark round midlateral spots and a spot at base of the anal fin, which variably disappear with growth. Sometimes the spots are joined in a nearly continuous midlateral stripe; in large adults the midlateral stripe is faint or absent. Frequently in young fish the dorsal and caudal spots may be joined by a vertical bar to a midlateral spot; this condition is occasionally encountered in adults in some localities. In some specimens it forms a large more or less triangular blotch with ventrally directed apex (Inger and Chin 1962, fig. 32). In others it forms a slender vertical bar; *P. binotatus banski* from Sarawak is based on this color variety, which also occurs in the Kapuas, Singapore, and Johore.

Puntius hemictenus is endemic to Mindoro and is perhaps the only cyprinid species on that island (see Herre 1955). I have examined the type specimens (four large adults) and three large series all including numerous small young (material listed above under *P. binotatus*) and conclude that it is either a valid species closely related to *P. binotatus* or a geographical race of *P. binotatus* characterized by young without midlateral spots. Jordan and Richardson's figure of the holotype depicts a very dark midlateral stripe extending from head to base of tail and incorporating the peduncular spot, but in the holotype as in other large adults from Mindoro I find that the midlateral stripe is faint and only the peduncular spot very dark. Juveniles from Mindoro invariably have small dorsal and peduncular spots; those in one sample (CAS-SU 38099) also have small anal spots. None of the juveniles examined exhibits the midlateral spots which occur, so far as I am aware, in juveniles (and sometimes adults) of *P. binotatus* from throughout its range.

Juveniles and adults of *P. binotatus* from many Philippine localities (including Palawan and Mindanao) tend to have two large midlateral spots (in addition to the peduncular spot) of relatively constant position, one below the dorsal-fin origin and the other above the anal-fin origin. The midpeduncular spot tends to be equally large and vertically oval, rather than round or horizontally oval. Such characteristics are not met with elsewhere except in northeastern Borneo (Tawau, Sandakan). For additional information on color variation in the Philippines, see Fowler (1941:790–795, figs. 20–23); for other Philippine *Puntius* and their distribution see Herre (1955). *Puntius sealei* (=*Puntius elongatus* Seale and *P. sibukensis* Fowler), here placed as a synonym of *P. binotatus*, is based on specimens with this type of color pattern from northeastern Borneo.

Distribution.—Thailand (see Smith 1945, for specific localities). Malay Peninsula. Sumatra. Borneo (Prabukarta, Bangkajang, Kuching, Kapuas, Tawau, Sandakan, Kinatabangan). Java. Nias. Bangka. Billiton. Bali. Lombok. Philippines (Balabac, Palawan, Culion, Busuanga, Tawi Tawi, Sulu province, Basilan, "all Mindanao except Lanao Plateau," Herre 1955: 123). Mindoro? (See discussion of *P. hemictenus* above.)

Puntius bramoides (Valenciennes, 1842)

Barbus bramoides Valenciennes *in* Cuvier and Valenciennes, 1842:160 (type locality Java)

FIGURE 44 *Puntius collingwoodii*. Kapuas 1976-27, 55.7 mm (MZB 3288).

Puntius (*Barbodes*) *bramoides* Bleeker, 1863–64:95
See Weber and de Beaufort (1916:195) for extensive synonymy

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-9, 2: 29.2–50.4 mm (CAS 49257, MZB 3280); Kapuas 1976-14, 11: 18.7–54.6 mm (FMNH 94212, MZB 3281, MNHN 1982-677); Kapuas 1976-15, 376: 7.8–50.1 mm (CAS 49258, MZB 3282); Kapuas 76-31, 7: 20.4–36.8 mm (MZB 3283, USNM 230210); Kapuas 1976-33, 3: 33.8–44.0 mm (MZB 3284, UMMZ 209888); Kapuas 1976-34, 2 23.3–27.8 mm (MZB 3285, CAS 49259); Kapuas 1976-37, 5: 21.5–34.5 mm (MZB 3286, USNM 230211); Kapuas 1976-40, 42.5 mm (MZB 3991)

A moderately deep-bodied and compressed *Puntius*; caudal fin deeply forked, with pointed lobes bearing submarginal longitudinal stripes of equal intensity. Parietal fontanel closed. Rostral and maxillary barbels well developed, somewhat longer than eye diameter. Lateral line complete. Lateral scale series 34, predorsal scales 13, transdorsal scales 16, scales between lateral line and pelvic fin origin 3-1/2. Last simple dorsal-fin ray moderately stout, serrate. Total gill rakers on first arch 9.

This species superficially resembles and is perhaps closely related to two others found in western Borneo, *P. collingwoodii* and *P. schwanenfeldii*.

DISTRIBUTION.—Thailand (Mekong, Chao Phrya). Malay Peninsula (Tembeling R., Pahang; Bukit Merah, Perak). Borneo (Baram, Kapuas, Barito, Mahakam). Java (Batavia, Tjibitong, Tandjong Oost, Buitenzorg, Tjampea, Tjikao, Parongkalong, Kuningan, Banjumas, Ngawi, Surabaya, Kediri). Unknown from Sumatra?

Puntius collingwoodii (Günther, 1868)

(Figure 44)

Barbus collingwoodii Günther, 1868*a*:483 (type locality Sarawak)
Barbus strigatus Vaillant, 1902:98 (not of Boulenger; Kapuas)
Barbus Boulengeri Popta, 1905:172 (type locality Bongan, Howang, and Bo rivers, Kapuas and Mahakam basins)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-24, 5: 43.1–71.7 mm (CAS 49260, MZB 3287, BMNH 1982.3.29.36–37); Kapuas 1976-27, 3: 39.1–55.7 mm (MZB 3288, UMMZ 209870)

A *Puntius* with compressed body and slender caudal peduncle; caudal-fin lobes with submarginal longitudinal stripes, that of lower lobe distinctly darker. Last simple dorsal-fin ray moderately stout, serrate. Lateral line complete. Lateral scale series 34, predorsal 15, transdorsal 13, circumpeduncular 16. Parietal fontanel closed. Rostral and maxillary barbels well developed, about as long as eye diameter. Total gill rakers on first arch 9.

DISTRIBUTION.—Borneo (Sarawak, Baram, Tinjar, Senah, Kapuas, Mahakam, Tempasuk R., Kota Belud).

Puntius endecanalis new species

(Figure 45)

HOLOTYPE.—MZB 4003, 48.2 mm, small forest stream where it flows into Sungai Mandai 2–3 km upstream from its confluence with Kapuas mainstream, 17 km WSW of Putussibau (Kapuas 1976-37)

PARATYPES.—BMNH 1982.3.29.38–39, CAS 49261, FMNH 94213, MNHN 1982-678, MZB 3289, RMNH 28840, UMMZ 209895, 16: 29.1–47.8 mm, same locality as holotype; MZB 3290, ZMA 116.523, 2: 34.6–36.2 mm, Sungai Mandai Ketchil near its confluence with Kapuas mainstream, 18 km WSW of Putussibau (Kapuas 1976-39); MZB 3291, USNM 230212, 4: 28.4–33.5 mm, small oxbow lake cut off from Kapuas mainstream opposite Empangau, 124 km NE of Sintang (Kapuas 1976-43)

DIAGNOSIS.—A *Puntius* with 8 (or rarely 7) branched anal rays and a distinctive color pattern of six bars on the head and body. All other *Puntius* have 5 (occasionally 6) branched anal-fin rays, and in the few species with a color pattern of six bars the shape, extent, and position of the bars differs from that in the new species. [Note: According to R. M. Bailey (pers. comm., Nov. 1984), *Puntius gonionotus* usually has 6 branched anal rays and *P. altus* often has 6.]

Dorsal profile from snout-tip to dorsal-fin origin straight. Parietal fontanel open. Rostral and maxillary barbels present. Maxillary barbel well developed, its length from two-thirds to slightly more than eye diameter. Rostral barbel relatively weakly developed, much thinner than maxillary barbel and about one-third as long. Gill rakers very short, 1+6=7 in several specimens. Pharyngeal teeth (examined in two specimens 45.8 and 47.8 mm) uncinate, in three rows, 2,3,4/4,3,2; tooth 4 in row 3 (innermost row) greatly enlarged; teeth 1–3 in row 3 usually bicuspid, with a small but well formed minor cusp projecting from shoulder and especially prominent on teeth 2–3. Pharyngeal bone (ceratobranchial 5) elongate and relatively slender compared to other *Puntius* (cf. Taki et al. 1978), its dorsal limb evenly curved medially, dorsal angle absent.

Dorsal-fin rays iv8-1/2. Last simple dorsal-fin ray with basal two-thirds bearing 12–22 serrae, distal one-third without serrae

FIGURE 45. *Puntius endecanalis.* Kapuas 1976-37, 48.2 mm (MZB 4003, holotype).

and relatively slender (some, perhaps most, *Puntius* have last simple dorsal-fin ray serrate to its tip). Anal-fin rays usually iii8-1/2 (iii8-1/2 in 22, iii7-1/2 in 1). Pectoral-fin rays 15–16, pelvic 8–9. Lateral line complete. Pored scales in lateral series 24–27. Scale rows between dorsal fin and lateral line 5–6, between lateral line and pelvic fin 3. Predorsal scales 9–11, circumpeduncular 12. Proportional measurements very uniform throughout type series, 48.2 mm holotype and five paratypes 29.1–46.7 mm from Kapuas 1976-37 with head length 3.1–3.2; snout 9.9–10.6; eye 9.1–10.2; interorbital width 11.4–11.9; maxillary barbel 8.9–13.4; body depth 2.6–2.8; caudal peduncle depth 7.1–7.5.

Color in life pale whitish with six black bars; fins generally colorless, except where bars extend from body onto basal portion of dorsal and anal fins near their origin; some specimens with a concentration of melanophores along serrated portion of third dorsal-fin ray. Color pattern in preserved specimens (29.1–48.2 mm) is very uniform; all have six bars on head and body. These bars correspond to the orbital, pectoral, subdorsal, supraanal, postanal, and caudal markings that are variably developed in many species of *Puntius.*

The orbital bar is complete dorsally, forming a broad, posteriorly directed, chevron-shaped mark on the posterior part of head and anterior portion of nape; the inverted portion of the chevron lies over the posterior half of the parietal fontanel, while skin overlying the anterior half of the fontanel is pale whitish; ventrally orbital bar continues as a short poorly defined vertical mark below middle of eye. The pectoral bar is complete dorsally; its dorsal half (above lateral line) is vertically oriented, while its ventral half slants slightly posteriorly and ends abruptly about midway between and on a level with pectoral- and pelvic-fin origins. The subdorsal bar is complete dorsally (extending onto basal portion of anteriormost 3–4 dorsal-fin rays), vertically oriented, and very short, extending only 3–4 scale rows below dorsal-fin origin. The supraanal mark is complete dorsally and ventrally, and vertically oriented; dorsally it lies on and immediately posterior to last anal-fin ray, and onto basal portion of last anal-fin ray; ventrally it extends a short distance onto anal fin near its origin. The postanal and the caudal bars are complete (joined both dorsally and ventrally with corresponding bars of opposite side of body), vertically oriented, and (especially caudal bar) somewhat more slender than other bars. In some specimens midlateral portion of postanal bar is expanded into a round spot, but in all specimens postanal bar is continuous (i.e., round spot is not isolated). There is no separate nuchal mark; it is either absent or has become part of chevron-shaped mark formed by dorsal junction of orbital bars. There is also no separate anal-basal mark; it is either absent or amalgamated with ventral portion of supraanal bar. There is a dark round spot on dorsum of snout anterior to eyes, and dark pigmentation on anterior margin of rostral flap (overlying upper lip); these marks have not been noted in other *Puntius.*

The nomenclature of bars or marks used here is that of Taki et al. (1978), who recognized seven types of barred color patterns (A–G) in the 23 species of *Puntius* they studied. The color pattern of *P. endecanalis* does not correspond to any of these types. It is closest to their type C, defined as having cross-bars or roundish blotches in pectoral, subdorsal, supraanal, and caudal positions, and sometimes an orbital mark. *Puntius endecanalis* has all of these marks, and also a postanal bar. Thus its barred pattern seems to have all of the vertical marks recognized in *Puntius.*

DISTRIBUTION.—*Puntius endecanalis* is known only from the type series of 23 specimens collected in the Kapuas in 1976.

The only other *Puntius* species with a full complement of six black marks on the head and body apparently are the southeast Asian *P. foerschi* Kottelat, 1982, *P. pentazona,* and *P. rhomboocellatus.* These three species all occur in Borneo; they are very similar to each other but not to *P. endecanalis.* These three species agree with each other but differ from *P. endecanalis* in shape of dorsal-fin base, morphology of simple dorsal-fin rays, shape of snout and orbit, and in the shape, position, and extent of black marks on head and body. The fleshy portion of the dorsal-fin base in the three species is strongly elevated or convex and covered by two scale rows rather than one as in *P. endecanalis* and most other *Puntius* species in which the dorsal-

FIGURE 46 *Puntius*. Above, *P. eugrammus*, Kapuas 1976-16, 48.6 mm (CAS 49262); below, *P. lineatus*, Kapuas 1976-32, 34.4 mm (CAS 49266)

fin base is not so elevated. The last or fourth simple dorsal-fin ray is serrate and relatively thick for its whole length; its anterior proximal portion is deeply incised and intimately overlain by the posterolaterally projecting margins of the third simple dorsal-fin ray which is strongly concave posteriorly (in *P. endecanalis* fourth dorsal-fin ray not strongly incised near base, third dorsal-fin ray not notably concave posteriorly). At least in *P. pentazona* and *P. rhomboocellatus* the orbital bars are not complete dorsally but extend dorsally only to lateral margin of parietal fontanel (condition of orbital bars unknown in *P. foerschi*). In all three species the subdorsal bar extends farther ventrally, the supraanal bar lies farther posterior (especially relative to dorsal fin) than in *P. endecanalis*, and there usually is a well developed isolated spot near base of last dorsal-fin rays.

ETYMOLOGY.—The name *endecanalis* (Latin) refers to the characteristic number of anal-fin rays in this species.

Puntius eugrammus Silas, 1956

(Figure 46)

Barbus fasciatus Bleeker, 1853*d*:190 (not of Jerdon, 1849; type locality "Marawang, in fluviis [Banka]; Moara Kompeh, Sumatrae orientalis, in fluviis")
Systomus (*Barbodes*) *fasciatus* Bleeker, 1860*a*:344
Puntius (*Barbodes*) *fasciatus* Bleeker, 1863–64:103
Barbus fasciatus, Bleeker: (var. *Chaperi*) Vaillant, 1902:13 (nomen nudum)
Puntius eugrammus Silas, 1956:194 (replacement name for *Barbus* (=*Puntius*) *fasciatus* Bleeker, 1853, preoccupied by *Cirrhinus* (=*Puntius*) *fasciatus* Jerdon, 1849)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-16, 3: 37.1–48.6 mm (CAS 49262, MZB 3292); Kapuas 1976-18, 2: 18.8–19.2 mm (CAS 49263, MZB 3293); Kapuas 1976-20, 6: 76.1–88.1 mm (CAS 49264, MZB 3294, USNM 230213).

A moderately large *Puntius*, attaining 100 mm, with long barbels; adults with 4–6 dark longitudinal stripes on side of body. Parietal fontanel open.

Individuals of this species undergo a remarkable color change as they grow (Taki 1978, fig. 4c–e; pers. obs.). Young of 18–20 mm have five broad vertical bars and no indication of the longitudinal stripes characteristic of adults. In young of about 25 mm the vertical bars start to break up and become replaced by longitudinal stripes, of which the midlateral is first to appear. By 50 mm the change in color pattern is complete.

DISTRIBUTION.—Sumatra. Borneo (Kapuas, Mahakam, Barito, Akar?). Banka.

Puntius everetti Boulenger, 1894

Barbus tetrazona Vaillant, 1893:81 (not of Bleeker, 1855; Kapuas). Re-identification by Alfred 1964:140
Barbus Everetti Boulenger, 1894:248 (type locality Poeh, Sarawak)
Puntius everetti Weber and de Beaufort, 1916:180; Imaki et al. 1978:14, pl. 6 (small rivers near Sanggau, Kapuas basin)

MATERIAL EXAMINED.—None

This species was not obtained during the Kapuas survey of 1976. It is included here on the basis of identifications of Kapuas

specimens by Alfred (1964) (MNHN 1891.352–3) and Imaki et al. (1978).

Puntius lateristriga (Valenciennes, 1842)

Barbus lateristriga Valenciennes *in* Cuvier and Valenciennes, 1842:161 (type locality Java).
Systomus (Barbodes) lateristriga Bleeker, 1860*a*:342.
Puntius lateristriga Weber and de Beaufort, 1916:179.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-6, 13: 23.5–60.3 mm (CAS 49265, FMNH 94214, MNHN 1982-679, MZB 3295); Kapuas 1976-25, 2: 42.0–53.7 mm (MZB 3296, RMNH 28841); Kapuas 1976-30, 7: 25.8–92.4 mm (MZB 3297, ROM 38619, UMMZ 209877, USNM 230214).

A moderately large (to 150 mm), heavy-set or chunky, moderately deep-bodied *Puntius*; predorsal profile increasingly steep with growth; body generally with two broad vertical bars in anterior half and a broad midlateral longitudinal stripe on posterior half; on an overall background color of light lemon yellow in life. Often a roundish black spot above anal-fin origin. Lateral line complete, lateral scales 23.

Geographical variation in color pattern in Malay Peninsula has been described by Tweedie (1961).

DISTRIBUTION.—Peninsular Thailand. Malay Peninsula (Tweedie 1961), Sumatra (numerous localities cited by Weber and de Beaufort 1916). Borneo (Bangkajang, Seminis, Lumar, Sadong, Senah, Kapuas). Java (Batavia, Buitenzorg, Tjampea, Sadingwetan, Tjipanas). Banka. Billiton. Singkep.

Usually inhabits clear mountain streams strewn with rocks and boulders; frequently found below waterfalls.

Puntius lineatus (Duncker, 1904) new combination
(Figure 46)

Barbus lineatus Duncker, 1904:180 (type locality Muar River at Tubing tinggi).

MATERIAL EXAMINED.—Malay Peninsula: Tasek Berah, Pahang, 2: 39.2–41.9 mm (CAS-SU 31097). Western Borneo: Kapuas 1976-32, 6: 29.9–38.5 mm (CAS 49266, MZB 3298, USNM 230215).

This very distinctive species seems not to have been reported or recognized since its original description, perhaps because Duncker (1904:180) suggested that it might be only a geographical race or variety of *P. fasciatus* (=*P. eugrammus*). Its linear color pattern, with 5–6 longitudinal stripes on the body, is strikingly similar to that of *P. eugrammus* but in other respects the two species are so different as to indicate they are not very closely related.

Puntius lineatus, the largest known specimen of which is a sexually mature female of only 41.9 mm, evidently is a much smaller species than the somewhat heavier-bodied *P. eugrammus*, which attains at least 100 mm. In *P. lineatus* the rostral barbels are absent and the maxillary barbels are absent (according to Duncker) or relatively short, their length less than half eye diameter (material examined); both pairs of barbels are very well developed in *P. eugrammus*, as long or longer than eye diameter. *Puntius lineatus* has gill rakers on first gill arch moderately elongate, 18–19; in *P. eugrammus* they are very weakly developed, 10. Parietal fontanel open. There is no indication that *P. lineatus* ever exhibits a vertically barred color pattern or goes through anything like the complex and protracted change in color pattern from vertical bars to longitudinal stripes observed in *P. eugrammus* at 18–50 mm. The 39.2 mm specimen of *P. lineatus* from Pahang is apparently a sexually mature male; the dorsal surface of the first four pectoral-fin rays is densely covered with fine breeding tubercles. The 41.9 mm specimen from the same collection is a female with ripening ovaries and non-tuberculate pectoral fins. Breeding tubercles have not been observed on the pectoral fins of sexually mature *P. eugrammus* males.

DISTRIBUTION.—Malay Peninsula. Kapuas.

Puntius pentazona (Boulenger, 1894)

Barbus pentazona Boulenger, 1894:248 (type locality Baram R.).
Barbus (Barbodes) hexazona Weber and de Beaufort, 1912:527, pl. 11, fig. 2 (type locality Taluk and Gunung Sahilan, Sumatra). See Alfred (1963).
Puntius pentazona Weber and de Beaufort, 1916:182 (pro parte).
Puntius hexazona Weber and de Beaufort, 1916:181, fig. 73.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-1, 34.8 mm (MZB 3299); Kapuas 1976-11, 8: 19.4–34.9 mm (BMNH 1982.3.29.40–41, CAS 49267, MZB 3300, USNM 230216); Kapuas 1976-16, 23.9 mm (MZB 3301).

This species has the maximum complement of six vertical bars seen in *Puntius*. In naming it "*pentazona*" Boulenger did not consider the vertical bar on the head. Alfred (1963) recognized two subspecies, based on the presence of a round black spot at the base of the dorsal-fin termination (the nominal subspecies, *P. pentazona pentazona*, from Sarawak) or its absence (*P. pentazona johorensis* (Duncker, 1904), from the Malay Peninsula and Sumatra). On this basis the Kapuas material is referable to the latter subspecies.

DISTRIBUTION.—Malay Peninsula (Malacca, Muar R., Johore, Singapore, Selangor, Perak, Trengganu, Alfred 1963). Sumatra (Gunung Sahilan; Indragiri, Rawang, Djambi; Taluk). Borneo (Baram, Akah, Saribas, Sibu; Alfred 1963; Kapuas).

Puntius rhomboocellatus Koumans, 1950

Puntius rhomboocellatus Koumans, 1950:189 (type locality about 15 km from Bandjermasin in a canal along the highway from Oelin to Bandjermasin).
Barbus tetrazona Bleeker, 1857*a*:14 (nec Bleeker 1855; type locality River Kahajan, Borneo)
Puntius (Barbodes) tetrazona Bleeker, 1863–64
Barbus kahajani Hoedeman, 1956:288 (replacement name for *Barbus tetrazona* Bleeker, 1857)
For discussion of synonymy see Alfred (1964:139–140).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-4, 2: 29.6–31.7 mm (MZB 3302, ZMA 116.524); Kapuas 1976-5, 6: 17.0–32.0 mm (CAS 49268, MZB 3303, USNM 230217); Kapuas 1976-17, 21.7 mm (MZB 3304); Kapuas 1976-32, 21.9 mm (MZB 3305).

A *Puntius* very similar and apparently closely related to *P. pentazona* but with the predorsal, dorsal, and anal bars expanded to form "ocellate rhombi," the dorsal and sometimes predorsal bars not extending ventrally so far as in *P. pentazona*. Color pattern of the Kapuas specimens agrees well with that of the holotype of *P. rhomboocellatus* (Alfred 1964, fig. 1e), although they have the central portion of rhombi less pronouncedly pale. A midventral dark spot between pelvic-fin bases (not extending onto pelvic fins) (absent in *P. pentazona*). Parietal fontanel open. Lateral line complete, lateral line scales 24–25; predorsal scales 9–10; transdorsal scales 9; circumpeduncular scales 12. Complete scale rows between dorsal-fin origin and lateral line 4 (5 in *P. pentazona*). Total gill rakers on first arch 10.

DISTRIBUTION.—Borneo (Kapuas, Barito, Kahajan). See Alfred (1964).

Puntius schwanenfeldii (Bleeker, 1853)

Barbus Schwanenfeldii Bleeker, 1853*f*:517 (type locality Sumatra).
Systomus (Barbodes) Schwanefeldi Bleeker, 1860*a*:323.
Puntius (Barbodes) Schwanefeldi Bleeker, 1863–64:94 (unwarranted change of spelling)
Barbus Schwanefeldi var. *rubra* Vaillant, 1902:95 (type locality Mahakam River at Tepoe)
Puntius schwanefeldi Weber and de Beaufort, 1916:178
Puntius schwanenfeldii Smith, 1945:190

MATERIAL EXAMINED.—Malay Peninsula: Singapore, 25: 23.9–69.2 mm (CAS-SU 34717)

A very deep-bodied and large (to 350 mm total length) *Puntius*; body at all sizes without marks; dorsal fin with a large black blotch anteriorly, upper and lower lobes of caudal fin with dark submarginal longitudinal bands. Large individuals silvery or golden yellow in life, with dorsal fin red and caudal fin orange or blood-red (Smith 1945:190).

Specimens from Singapore have lateral line scales 33–34, transdorsal 14–15, predorsal 13–14, circumpeduncular 16–17, and total gill rakers on first arch 9, short. Hardenberg (1936) reported 18–20 circumpeduncular scales in Kapuas specimens.

Although no specimens of this species were obtained during the Kapuas survey of 1976, a large individual was seen in a fisherman's catch on the Sungai Pinoh near its confluence with the Melawi; it has been reported from the Kapuas by Bleeker (1863), Vaillant (1893, 1902), Hardenberg (1936), and Imaki et al. (1978).

DISTRIBUTION.—Thailand (Mekong, Meklong, Tachin, Chao Phrya, Chantabun, Sikuk, Tapi, Tale Sap, Tale Noi, Patani). Malay Peninsula (Malacca). Sumatra (Padang, Solok, Lake Singkarah, Padang Pandjang, Pajakombo, Lake Manindjari, Kwantan or Indragiri, Si Djungdjung, Taluk, Ringat, Kampar R., Lamatang ilir R., Musi, Kompeh, Pangabuang). Borneo (Baram, Kapuas, Mahakam).

Rasbora Bleeker, 1859–60

Rasbora Bleeker, 1859–60*c*:435 (type species *Cyprinus rasbora* Hamilton-Buchanan, 1822, by absolute tautonymy)
Parluciosoma Howes, 1980:183, 194 (type species *Leuciscus argyrotaenia* Bleeker, 1850, by original designation)

Barbels absent; jaws small, oblique; lower jaw with an upwardly projecting symphyseal knob fitting into a concavity in upper lip when mouth is closed; gill rakers 6–22; pharyngeal teeth in three rows, elongate, uncinate, typically 2,4,5,/5,4,2. Lateral scale rows 21–44, predorsal scales 9–17; dorsal fin usually with 8 (rarely 9) branched rays, its origin over or slightly posterior to a vertical through pelvic-fin origin; anal-fin branched rays usually 5 (rarely 6).

As currently understood, *Rasbora* comprises some 55 species and is distributed throughout the Indian subcontinent, southern China, and continental southeast Asia (including Sumatra, Borneo, and Java). Somewhat less than half of the species are known from western Borneo (many of them recorded herein for the first time). It is likely that the species thus grouped together are polyphyletic; they probably could and perhaps should be placed in two or more separate genera. Howes (1980:194) proposed a new genus *Parluciosoma*, and referred to it the southeast Asian species *R. argyrotaenia, cephalotaenia, dusonensis* and *volzi*, as well as the Indian *R. daniconius*. It is evident that, if *Parluciosoma* is recognized, it will include additional southeast Asian species such as *R. myersi*, etc. Until the generic assignment of a number of species has been more thoroughly investigated, it seems best to refer to all of them as *Rasbora*. For further information see the revision of *Rasbora* by Brittan (1954, 1972).

The best guide to identification of species of *Rasbora* is Brittan (1954, 1972). The reprint edition of 1972 includes a series of color photographic plates with some new information, but the basic text is identical with that in the original work. The main change of concern here (incorporated in the figure legends of the added plates) is that the species earlier known as *R. taeniata* Ahl, 1922 is identified as *R. agilis*. The original description of *R. taeniata* is based on a poorly preserved immature specimen that is now lost, and I agree with Brittan that it should be regarded as a nomen dubium. A number of species have been described subsequently to 1972, notably *R. axelrodi* and *R. brittani* but are readily identifiable. Brittan did not include information on gill raker counts which I find helpful in distinguishing certain species. Counts for all species I have been able to examine are presented in Table 2. Morphologically similar species with different gill raker counts include the western Bornean *R. agilis* and *R. pauciperforata*; *R. bankanensis* and *R. ennealepis*; and *R. subtilis* and *R. trilineata*.

Rasbora beauforti, known only from the Kumai River in southwest Borneo, may also have to be treated as a nomen dubium unless type specimens can be located. I have not been able to locate the types of any of the four new species including this *Rasbora* described by Hardenberg (1938). They are not deposited in Amsterdam or Leiden, and my attempts to locate them elsewhere have been unsuccessful. *Rasbora borneensis*, placed as a synonym of R. *argyrotaenia* by Weber and de Beaufort (1916) and not recognized subsequently, is a very distinct species here reported from the Kapuas basin for the first time. So far as I have been able to determine, reports of *R. leptosoma* Bleeker, 1855 from the Kapuas are based on misidentified *R. argyrotaenia* or other species; the only specimens of this distinctive species known to me are Bleeker's types from Lahat, Sumatra.

The Kapuas survey of 1976 obtained 22 species of *Rasbora*, of which *R. ennealepis* and *R. subtilis* are described as new. Further exploration in western Borneo undoubtedly will uncover additional species.

Rasbora agilis Ahl, 1937

Rasbora agilis Ahl, 1937:113 (type locality "Sumatra"; described from aquarium specimen)
Rasbora taeniata Brittan, 1949, 1954

MATERIAL EXAMINED.—Malay Peninsula: Trengganu, Merchang, 10: 24.2–37.1 mm (CAS-SU 47237). Western Borneo: Kapuas 1976-5, 10: 26.5–34.1 mm (BMNH 1982.3.29.42–44, FMNH 94215, MZB 3306); Kapuas 1976-7, 8: 24.2–31.0 mm (CAS 49269, MZB 3307); Kapuas 1976-8, 16: 13.4–33.4 mm (FMNH 94216, IRSNB 19735, MZB 3308); Kapuas 1976-10, 7: 16.7–25.8 mm (MCZ 58346, MZB 3309); Kapuas 1976-16, 12: 21.2–25.2 mm (MNHN 1982-680, MZB 3310, RMNH 28842); Kapuas 1976-17, 3: 19.2–27.8 mm (MZB 3311, ROM 38624); Kapuas 1976-21, 17.6 mm (MZB 3992); Kapuas 1976-43, 2: 29.4–35.5 mm (MZB 3312, UMMZ 209909); Kapuas 1976-47, 21.2 mm (MZB 3993); Kapuas 1976-51, 4: 23.7–26.2 mm (MZB 3313, USNM 230218)

A slender *Rasbora* with a very high, pointed dorsal fin, elongate caudal peduncle and deeply forked caudal fin. Live specimens are largely translucent and often colorless except for the

FIGURE 47 *Rasbora axelrodi*. Kapuas 1975-5. Above, 18.9 mm male (MZB 3320); below, 19.0 mm female (MZB 3320)

opaque white abdomen and continuous black lateral stripe running just below horizontal septum. Lateral line incomplete, with only 2–6 pored scales anteriorly. Lateral line scales 29–33, predorsal 12–14, circumpeduncular 12.

According to M. Brittan (pers. comm.), this species was incorrectly identified in Brittan (1949, 1954) as *R. taeniata* Ahl, 1922, based on an aquarium specimen supposedly from Sumatra. The identity of *R. taeniata* is unknown; its holotype, like that of *R. agilis*, was deposited in the Berlin Museum, and may have been destroyed. For further discussion see Brittan (1949).

DISTRIBUTION.—Malay Peninsula (Johore). Sumatra? (records based on aquarium specimens). Borneo (Kapuas). Billiton.

Rasbora argyrotaenia (Bleeker, 1850)

Leuciscus argyrotaenia Bleeker, 1850:21 (type locality Java)
Rasbora argyrotaenia Bleeker, 1860*a*:448

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-16, 8: 31.7–50.8 mm (AMNH 48928, CAS 49270, MZB 3314); Kapuas 1976-17, 26: 29.4–49.8 mm (BMNH 1982.3.29.45–49, FMNH 94217, IRSNB 19736, MZC 58347, MZB 3315); Kapuas 1976-42, 6: 49.7–52.6 mm (MZB 3316, NIFI uncat., RMNH 28843); Kapuas 1976-43, 4: 39.0–46.7 mm (MZB 3317, ROM 38621); Kapuas 1976-46, 9: 32.2–52.4 mm (MZB 3318, UMMZ 209921); Kapuas 1976-47, 36.7 mm (MZB 3994); Kapuas 1976-51, 11: 40.5–59.2 mm (MZB 3319, USNM 230219, ZMA 116.325)

For information about this common, widely distributed, and variable species, of which several subspecies and races have been described, see Brittan (1954, 1972).

Rasbora axelrodi Brittan, 1976

(Figures 47, 48)

Rasbora axelrodi Brittan, 1976:94 (type locality Sumatra?; described from aquarium specimens)

MATERIAL EXAMINED.—Sumatra?: 3: 14.8–18.2 mm (CAS-SU 36685–6, holotype and paratypes); western Borneo: Kapuas 1976-5, 77: 7.3–19.3 mm (BMNH 1982.3.29.50–54, CAS 49271, FMNH 94218, IRSNB 19737, MCZ 58348, MNHN 1982-681, MZB 3320, RMNH 28844, UMMZ 209853, USNM 230220)

DIAGNOSIS.—A very small *Rasbora*-like cyprinid, possibly related to Danioninae, differing from all other *Rasbora* in its sexual dimorphism and sexual dichromatism. Largest specimen 19.3 mm. Head relatively blunt, body moderately deep, caudal peduncle slender. Lateral line absent (i.e., without tube- or pore-bearing scales); lateral scales 32, predorsal 12, circumpeduncular 12. Dorsal fin with 6 branched rays, anal with 5. In life, large

TABLE 2. FREQUENCIES OF GILL RAKER COUNTS IN *RASBORA*

R. agilis	
Malay P., Trengganu (CAS-SU 47237)	2–3+11–14=14(4), 15(3), 16(1)
Kapuas 1976-7	1–2+12–13=14(4), 15(1)
R. agyrotaenia	
Kapuas 1976-16, 42	2–4+10–12=12(1), 13(2), 15(1), 16(1)
R. axelrodi	
Kapuas 1976-5	0–1+6–7=6(1), 7(1), 8(1)
R. bankanensis	
Kapuas 1976-9	1–3+8–10=10(2), 11(7), 12?(1)
Kapuas 1976-27	1–2+8–10–9(2), 10(7), 11(4), 12(3)
Kapuas 1976-29	2+9=11(1)
R. borapetensis (Smith, 1934)	
Bangkok (CAS-SU 44396)	2–3+10–11=12(2), 13(2), 14(1)
R. borneensis	
Kapuas 1976-14	2–3+9–10=11(1), 12(3), 13(2)
R. brittani	
Malay P. (CAS-SU 35615, paratypes)	1–3+7–9=9(3), 10(1), 11(1), 12(1)
Kapuas 1976-10	1+8=9(1)
R. caudimaculata	
Malay P., Johore (CAS-SU 34644)	2–3+9–11=12(1), 13(2)
Kapuas 1976-6	3+8=11(1)
R. cavera (Jerdon, 1849)	
Sri Lanka (CAS-SU 16505, 16507)	3–5+14–17=17(3), 18(2), 19(1), 20(4), 21(1)
R. cephalotaenia	
Kapuas 1976-8	2+9=11(1)
R. daniconius (Hamilton-Buchanan, 1822)	
Nepal, Chitawan Valley (CAS 50344)	2–4+8–12=11(1), 13(2), 14(1), 15(1)
Sri Lanka (CAS 52417)	2–3+8–9=11(3)
Burma, Irrawaddy (CAS 44957)	2–3+9–12=11(1), 12(2), 13(3), 15(1)
R. dorsiocellata	
Malay P., Pahang (CAS-SU 47281)	0–3+6–9=9(3), 10(4), 12(1)
Kapuas 1976-51	2–3+8–10=11(2), 13?(1)
R. dusonensis	
Malay P., Perak (CAS-SU 15344)	3+10=13(2)
Kapuas 1976-1, 14	2–3+10–11=12(3), 13(1), 14(1)
R. einthoveni	
Kapuas 1976-1	1–2+8–9=9(1), 10(1), 11(1)
R. elanga (Hamilton-Buchanan, 1822)	
Calcutta (CAS-SU 47239)	2+10=12(1)
R. elegans	
Kapuas 1976-24, 25	2–3+9–10=12(3), 13(1)
Bungaran Isd. (CAS-SU 15328)	2+10–11=12(1), 13(1)
R. ennealepis	
Kapuas 1976-25 (paratypes)	1+7–8=8(6), 9(3)
Kapuas 1976-26 (paratypes)	1–2+7–8=8(3), 9(2)
R. cf. *ennealepis*	
Kapuas 1976-27	0–1+7–8=8(8), 9(2), 10(1)
R. heteromorpha Duncker, 1904	
Malay P., Johore (CAS-SU 31203)	1–2+7–8=8(1), 9(3), 19(1)
R. hubbsi Brittan, 1954	
N. Borneo (CAS-SU 17478, paratypes)	2–3+8–10=10(5), 12(2)
R. jacobsoni Weber and de Beaufort, 1916	
Sumatra, Harau (CAS-SU 15331)	2+7=9(1)
R. kalochroma	
Kapuas 1976-23	2+8–10(2)

TABLE 2. CONTINUED.

R. maculata Duncker, 1904	
Malay P., Johore (CAS-SU 39386)	0–1+6–8=7?(2), 8(1), 9(1)
R. meinkeni de Beaufort, 1931	
Sumatra (CAS-SU 15333)	3+13=16(1)
R. myersi	
Kapuas (CAS-SU 17345, paratypes)	3+12=15(2)
Kapuas 1976-14, 24	2–4+10–12=13(1), 14(3)
R. pauciperforata	
Sumatra, G. Sahilan (CAS-SU 15335, paratypes)	1–2+9–10=11(2), 12(2)
Kapuas 1976-4	1–2+9–10=10(1), 11(2)
R. philippina Günther, 1880	
Mindanao, Lanao Prov. (CAS-SU 38108)	3–4+11–12=14(2), 15(1), 16(2)
R. rasbora (Hamilton-Buchanan, 1822)	
India, Uttarbagh (CAS-SU 34622)	3+9–10=12(1), 13(2)
R. reticulata Weber and de Beaufort, 1915	
Nias Isd. (CAS-SU 15336, paratype)	2+8=10
R. rutteni Weber and de Beaufort, 1916	
Borneo, Sungei Wain (CAS-SU 15338, paratype)	1+7=8
R. sarawakensis	
Sarawak, Kuching (CAS-SU 33567, paratypes)	1–2+7–8=8(1), 9(2)
Kapuas 1976-6, 30	1–2+7–10=8(4), 9(5), 10(1), 11(1), 12(1)
R. semilineata Weber and de Beaufort, 1916	
N. Borneo (CAS-SU 47259)	1–2+9–10=11(6), 12(4)
R. stieneri Nichols and Pope, 1927	
Canton (CAS-SU 28748)	2–3+8–9=11(2), 12(2)
Hong Kong (CAS-SU 31630)	2–3+9–11=12(2), 13(3)
Hainan (CAS-SU 31799)	3+10=13(1)
R. subtilis	
Kapuas 1976-32, 40 (types)	4–5+15–18=19?(1), 20(1), 21(4), 22(1)
R. tawarensis Weber and de Beaufort, 1916	
Sumatra, L. tawar (CAS-SU 15340, paratype)	5+15=20(1)
R. trilineata	
Kapuas 1976-16, 37	2–5+9–13=12(2), 13(3), 14(4), 15(1), 16(2)
Malay P., Johore (CAS-SU 47235)	2–3+10=12(2), 13(1)
Thailand, Rayong R. (CAS 44434)	3–4+11–12=14(3), 15(5)
R. tubbi Brittan, 1954	
Brunei (CAS-SU 48406)	1–3+8–10=10(4), 11(4), 12(8)
R. urophthalma Ahl, 1922	
Saigon? (CAS-SU 17357)	1+8=9?(1)
R. vaterifloris Deraniyagala, 1930	
Sri Lanka (CAS-SU 15004, CAS 52414)	1–2+8–9=9(1), 11(1)
R. volzi	
Sarawak, Kuching (CAS-SU 33592)	2+9–10=11(3), 12(1)
Kapuas 1976-24	2+10=12(1)

Kapuas males with a pale blue longitudinal stripe extending on dorsolateral portion of body; abdomen wine-red. Preserved males exhibit a dark longitudinal stripe in place of the blue coloration of live specimens. This stripe is absent in females, which are less colorful in life than males. The anterior margin of the anal fin may be milky-white in large males. The precise differences of live coloration in Kapuas males and females is not known, since they were not sexed while alive, and many of both sexes were juveniles without fully developed coloration. Brittan (1976:92) provides a color photograph of a live specimen, presumably male, with a green or emerald green longitudinal stripe dorsolaterally and the abdomen and fins of a more nearly carmine-red color.

My largest female, 19.0, apparently gravid (perhaps partially spent?), contained 33 eggs of about 0.7 mm. I suspect that reproduction is year round or continuous unless interrupted by unfavorable conditions.

REMARKS ON RELATIONSHIPS.—*Rasbora axelrodi* differs strikingly from all other species assigned to *Rasbora* in having "permanent" sexual dichromatism and extensive development of large, specialized tubercles in the male. So far as I am aware, no other *Rasbora* exhibit permanent or even temporary sexual

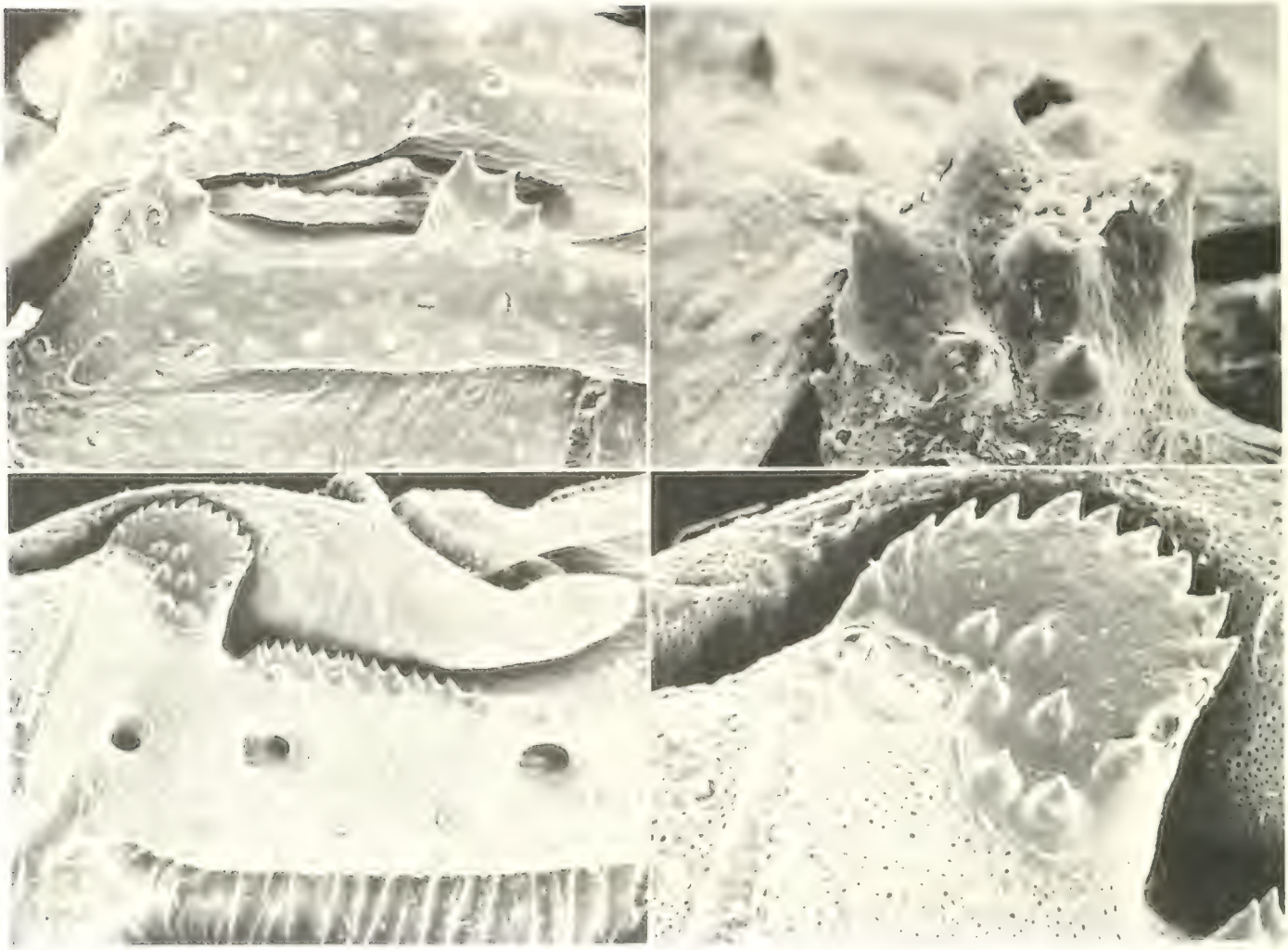

FIGURE 48. Specialized tubercles on ventral surface of mandible. Above, *Rasbora axelrodi*, Kapuas 1976-5, 17.4 mm male (CAS 49271); below, *Brachydanio rerio*, Nepal, Reu River, 29.2 mm gravid female (CAS 50284)

dichromatism or tuberculation comparable to that of *R. axelrodi*. As sexual maturity is attained, males of *R. axelrodi* develop increasingly bright coloration and heavy tuberculation, highly unusual for such a small species. Males develop relatively large tubercles on head, cheeks and shoulder region, those on opercle and overlying "pseudotympanum" in vertical rows (Fig. 47). The largest and most striking tubercles, however, occur on ventral surface of mandibles, on the lateral margins of two pairs of peculiar tubercle-bearing platforms (Fig. 48); comparable mandibular tuberculiferous structures have not been observed in any other *Rasbora* but are characteristic of both sexes in some of the smaller species of the cyprinid subfamily Danioinae, including *Brachydanio rerio* (Hamilton-Buchanan, 1822) (Fig. 48). This observation suggests that *Rasbora axelrodi* may belong to Danioinae, a subfamily otherwise unknown from Borneo.

DISTRIBUTION.—Known with certainty only from the Mempawah basin of western Borneo (Kapuas 1976-5).

Rasbora bankanensis (Bleeker, 1853)

(Figure 49)

Leuciscus bankanensis Bleeker, 1853*d*:192 (type locality Banka)
Rasbora bankanensis Bleeker, 1860*a*:454

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-7, 3: 12.9–14.0 mm (MZB 3321); Kapuas 1976-8, 49: 8.0–27.3 mm (AMNH 48929, BMNH 1982.3.29.55–64, CAS 49272, MZB 3322); Kapuas 1976-9, 46: 30.7–45.1 mm (CAS 49273, FMNH 94219, IRSNB 19738, MCZ 58349, MZB 3323); Kapuas 1976-10, 58: 10.7–49.0 mm (MNHN 1982-682, MZB 3324, RMNH 28845, ROM 38618, UMMZ 209854); Kapuas 1976-13, 13: 11.8–24.0 mm (MZB 3325, USNM 230221); Kapuas 1976-17, 15.2 mm (MZB 3995); Kapuas 1976-22, 6: 36.3–48.9 mm (MZB 3326, USNM 230222); Kapuas 1976-24, 13: 24.1–48.4 mm (MZB 3327, ZMA 116.526); Kapuas 1976-25, 23.7 mm (MZB 3328); Kapuas 1976-27, 27: 24.0–61.4 mm (CAS 49274, MZB 3329); Kapuas 1976-28, 21.0 mm (MZB 3330); Kapuas 1976-29, 2: 46.3–52.6 mm (CAS 49275, MZB 3331); Kapuas 1976-31, 2: 30.8–39.0 (MZB 3332); Kapuas 1976-33, 27.9 mm (MZB 3333); Kapuas 1976-35, 2: 31.9–34.2 mm (MZB 3334, RMNH 28846); Kapuas 1976-36, 6: 26.9–42.8 mm (AMNH 48930, MZB 3335); Kapuas 1976-37, 9: 14.1–20.9 mm (CAS 49276, MZB 3336); Kapuas 1976-39, 11: 16.5–20.1 mm (MZB 3337, UMMZ 209899); Kapuas 1976-40, 2: 28.0–33.8 mm (MZB 3338); Kapuas 1976-42, 4: 14.5–26.2 mm (MZB 3339, ROM 38605); Kapuas 1976-46, 2: 23.7–25.3 mm (MZB 3340); Kapuas 1976-47, 3: 16.0–19.7 mm (MZB 3341); Kapuas 1976-51, 24: 12.0–20.0 mm (CAS 49277, MZB 3342); Kapuas 1976-55, 17: 18.1–23.5 mm (MZB 3343, USNM 230223)

This is the most ubiquitous fish species in the collections obtained by the Kapuas survey of 1976. It is represented in 24 of the 55 collections. A large proportion of the samples include small or very small juveniles. Juveniles as well as adults of this bluish-silvery species are distinguished by usually having black

FIGURE 49. *Rasbora bankanensis*. Above, Kapuas 1976-10, 48.4 mm (MZB 3324); below, Kapuas 1976-29, 52.6 mm (CAS 49275).

pigment on the distal end of the anteriormost enlarged anal-fin rays. Lateral line complete, lateral scales series 25–28; transdorsal scales 9, predorsal 10–12, usually 11, circumpeduncular 12.

DISTRIBUTION.—Malay Peninsula (Perak, Johore, Muar R., Singapore). Sumatra (Moesi). Borneo (Kapuas). Banka (Marawang).

Rasbora beauforti Hardenberg, 1937, species inquirenda

Rasbora beauforti Hardenberg, 1937:10 (type locality Kumai River, southwest Borneo)
Rasbora beauforti Brittan, 1954:173 (summarized from Hardenberg 1938)

MATERIAL EXAMINED.—None

This species is known only from Hardenberg's account; he did not indicate the disposition of type specimens and I have not been able to find them despite considerable correspondence. It seems clear that they are not in Holland (H. Nijssen, M. Boeseman, M. van Oijen, pers. comm., 1982–83) or in Bogor (Soetikno, pers. comm., 1983). I have not been able to identify positively any specimens as *R. beauforti* and, if type specimens cannot be located, would be inclined to regard it as a nomen dubium. The original description (no figures) reads as follows:

> D.I.8; A.2.5.; P.I.12; V.I.7; L.r. 28–29; L.l. incomplete, consisting of 10 scales only; L.v. (before ventrals) 4-1/2-1-2-1/2
>
> Oblong. Height about 4 in length, 5 in length with caudal. Head about one in height. Eye 3 in head, about equal to snout. Cleft of mouth rather strongly descending, not reaching vertical through front-border of eye. Origin of dorsal behind the middle between end of snout and origin of caudal, opposite to end of incomplete lateral line, 12 scales from occiput. Dorsal nearer to ventrals than to anal, its height somewhat shorter than head. Pectorals as long as head without snout, ventrals somewhat shorter. Longest ray of anal as long as postorbital part of head and half eye. Longest ray of caudal about as long as head. Caudal peduncle surrounded by 12 scales. Colouration of formolspecies [sic] dark, brownish above, much lighter below. A conspicuous dark band along the sides, beginning on tip of snout and ending on caudal, running through the eye. This band is narrowest on the head and on the caudal fin. The black band is separated from the brownish back by a light streak. The first 12–13 scales in this streak have a blackish hindborder. Fins more or less pigmented, especially the dorsal and the caudal. Some specimens have the tip of the ventrals and of the anal blackish.
>
> Many specimens from the Kumai-river, south-west Borneo. May 1931. Longest specimen 44 mm. Named in honour of Prof. Dr. L. F de Beaufort from Amsterdam

Rasbora borneensis Bleeker, 1860

(Figure 50)

Rasbora borneensis Bleeker, 1860*a*:450 (type locality Bandjermassin in fluviis)
Genus and species undet. Kottelat, 1982:434, fig. 56 (Mentaya basin)

MATERIAL EXAMINED.—Southern Borneo: Bandjermassin, 48.9 mm (BMNH 1866.5.2.155, syntype, 62.5 mm total length) and RMNH 7497, 56.4 mm (RMNH 7497, syntype, 74.0 mm total length); Kuala Kuaya, Sampit area, Mentaya basin, 72.6 mm (CAS 53054). Western Borneo: Kapuas 1976-14, 21: 13.0–53.5 mm (BMNH 1982.3.29.65–68, CAS 49278, MZB 3344); Kapuas 1976-16, 52.2 mm

FIGURE 50 *Rasbora borneensis*. Kapuas 1976-31, 50.3 mm (MZB 3346)

(MZB 3345); Kapuas 1976-31, 50.3 mm (MZB 3346); Kapuas 1976-33, 72.8 mm (MZB 3347); Kapuas 1976-40, 25.4 mm (MZB 3348); Kapuas 1976-45, 7: 29.7–71.0 mm (MZB 3349, RMNH 28847, USNM 230224); Kapuas 1976-50, 40.5 mm (MZB 3350); Kapuas 1976-55, 6: 17.0–23.6 mm (MZB 3351, UMMZ 209930)

This very distinctive species, known until now only from two syntypes obtained at Bandjermasin, has not been recognized by any ichthyologist subsequent to Bleeker. Weber and de Beaufort (1916:61) placed it as a synonym of *Rasbora argyrotaenia* without comment, as did Brittan (1954:108) but with a question mark. It is apparently related to *R. argyrotaenia* and *R. leptosoma* but differs from them and their other relatives in having a relatively small head and distinctive coloration.

Head length 4.2–4.5 (vs. 3.4 in *R. argyrotaenia*). Lateral line complete, scales in lateral series 30–33. Predorsal scales 15–16, transdorsal 9, curcumpeduncular 14. Pale straw-colored in life. Narrow middorsal stripe from occiput to caudal fin (wider in *R. argyrotaenia*). Thin, straight longitudinal dark streak overlying or just above horizontal septum; broad longitudinal stripe faint, most evident on posterior half of body. Scales on dorsal and dorsolateral positions of body densely covered with extremely fine, numerous melanophores except distally, where there is a submarginal clear area followed by a marginal band of large melanophores (as in *R. argyrotaenia*). Large melanophores on gill cover and on ventrolateral portion of anterior half of body form the most noticeable feature of coloration in these areas. Distal margin of caudal fin dusky; fins otherwise colorless. Some specimens (males?) with scattered small tubercles extensively distributed on dorsolateral portion of body posterior to dorsal fin. Total gill rakers on first arch 12–13.

A description and photograph of the 72.6 mm specimen from Mentaya is given by Kottelat (1982). This specimen is similar to Kapuas specimens in most respects, but melanophores on its gill cover and ventrolateral portion of anterior half of body are much finer, and broad longitudinal stripe, although faint, is better developed and more evident on anterior half of body.

DISTRIBUTION.—Known only from Borneo (Kapuas, Mentaya, Barito).

Rasbora brittani Axelrod, 1976

Rasbora brittani Axelrod, 1976:94 (type locality Johore River)

MATERIAL EXAMINED.—Malay Peninsula: Johore River, 7: 31–36 mm (CAS 35615, paratypes). Western Borneo: Kapuas 1976-7, 11: 9.9–14.7 mm (BMNH 1982.3.29.69–75, MZB 3352); Kapuas 1976-10, 26: 11.7–15.3 mm (CAS 49279, FMNH 94220, MZB 3353, USNM 230225); Kapuas 1976-37, 23.2 mm (MZB 3354); Kapuas 1976-39, 2: 16.5–17.6 mm (MZB 3355, RMNH 28848); Kapuas 1976-42, 16.1 mm (MZB 3996); Kapuas 1976-43, 5: 16.6–22.4 mm (MZB 3356, UMMZ 209910)

A relatively small *Rasbora*, attaining 50 mm but most specimens smaller, rather similar to *R. argyrotaenia* in body shape and fin conformation, with pointed head, moderately slender body and caudal peduncle. Lateral line incomplete, with about nine pored scales anteriorly; lateral scales 31–34, predorsal 15, circumpeduncular 12. No lateral stripe. A small round spot in middle of caudal peduncle (absent in all other Kapuas *Rasbora*). In live specimens this spot may have bright orange or reddish-orange areas above and below it (Axelrod 1976:96–98); such coloration was not observed in Kapuas specimens, most of which came from silty water and may have been blanched.

Rasbora caudimaculata Volz, 1903

Rasbora caudimaculata Volz, 1903:559 (type locality Semangus or upper Moesi River, Palembang Residency, Sumatra)

Rasbora dorsimaculata Herre, 1940:9 (type locality brook 16 miles east Kuching, Sarawak)

For additional synonymy see Brittan (1954, 1972)

MATERIAL EXAMINED.—Malay Peninsula: Johore, Mawai Dist., 5: 33.4–85.8 mm (CAS-SU 34644); Sarawak: brook 16 km E of Kuching, 27.2 mm (CAS SU 33021, holotype of *R. dorsimaculata*); western Borneo: Kapuas 1976-6, 101 mm (MZB 3357)

Some juveniles at about 30 mm exhibit a black mark at the tip of the longest dorsal-fin rays not seen in large specimens.

DISTRIBUTION.—Thailand? (see Brittan 1954, 1972). Malay Peninsula (Johore). Sumatra (Moesi). Borneo (Sarawak, Kapuas).

Rasbora cephalotaenia (Bleeker, 1852)

Leuciscus cephalotaenia Bleeker, 1852*a*:97 (type locality Tjirutjup River, Billiton).

Rasbora cephalotaenia Bleeker, 1860*a*:438

Rasbora tornieri Ahl, 1922:32 (type locality central Sumatra). See Brittan (1954, 1972)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-1, 60.6 mm (MZB 3358); Kapuas 1976-8, 2: 63.3–67.2 mm (CAS 49280, MZB 3359)

A moderately elongate, heavy-bodied *Rasbora* with complete lateral line, lateral scale series 30–32, predorsal scales 12–13, total scales above lateral line 7, circumpeduncular scales 12. Attains at least 93 mm. Distinguished from all other species by its very distinctive color pattern of four punctuated longitudinal

FIGURE 51. *Rasbora ennealepis*. Kapuas 1976-26, 38.0 mm (MZB 3997, holotype).

stripes, two dark and two light, forming by spots on scales. The two dark stripes, nearly midlateral, are continued anteriorly and posteriorly as a single solid stripe extending from snout-tip through eye and across gill cover, and on middle caudal-fin rays to end of caudal fin. A vertically elongate oval peduncular spot straddles the dark stripes where they unite at the caudal-fin base. The upper punctuated light stripe extends from the upper corner of the gill cover to the base of the uppermost principal caudal-fin rays. The lower light stripe extends from pectoral-fin base to base of last anal-fin ray.

DISTRIBUTION.—Malay Peninsula (Singapore, Johore). Sumatra (Gunung Sahilan, Taluk, Semangus R., Palembang, Moesi. Borneo (Baram, Kapuas). Banka. Billiton.

Rasbora dorsiocellata Duncker, 1904

Rasbora dorsiocellata Duncker, 1904:183, pl 1, fig. 2 (type locality Malay Peninsula)

MATERIAL EXAMINED.—Malay Peninsula: Pahang, Tasek Bera, 11: 28.5–36.7 mm (CAS-SU 47281); western Borneo: Kapuas 1976-16, 2: 21.6–24.4 mm (AMNH 48931, MZB 3360); Kapuas 1976-32, 24: 14.3–21.3 mm (BMNH 1982.3.29.76–78, FMNH 94221, ZMH 6475, MNHN 1982-683, MZB 3361, USNM 230226); Kapuas 1976-42, 8: 17.1–22.4 mm (MZB 3362, UMMZ 209906); Kapuas 1976-43, 25.2 mm (MZB 3363); Kapuas 1976-46, 5: 17.8–24.6 mm (MZB 3364, RMNH 28849); Kapuas 1976-47, 2: 21.2–22.7 mm (MZB 3365, ROM 38620); Kapuas 1976-51, 11: 18.1–28.8 mm (CAS 49281, MZB 3366)

A small *Rasbora* distinguished by a dark round spot in the middle of its dorsal fin. Lateral line highly variable, from about six perforated scales only to complete (Brittan 1954, 1972). Lateral line scales 25–30, transdorsal 7, predorsal 12, circumpeduncular 12. A 30.8 mm presumed male from Tasek Bera is markedly tuberculate, with numerous fine tubercles on posterior half of opercle and on ventral surface of branchiostegal membranes.

DISTRIBUTION.—Malay Peninsula (Pahang, Muar, Negri Sembilan, Johore). Borneo (Kapuas).

Rasbora dusonensis Bleeker, 1851

Rasbora dusonensis Bleeker, 1851*a*:14 (type locality Duson or Barito River at Bandjermassing).

MATERIAL EXAMINED.—Sarawak: Rejang basin, SNHM, numerous uncatalogued specimens recently collected by Anthony Lelek; western Borneo: Kapuas 1976-1, 10: 30.1–50.2 mm (BMNH 1982.3.29.79–80, CAS 49282, MZB 3367, ROM 38606); Kapuas 1976-2, 19.3 mm (MZB 3368); Kapuas 1976-3, 4: 16.9–29.5 mm (FMNH 94222, MZB 3369); Kapuas 1976-14, 6: 56.6–86.8 mm (CAS 49283, MNHN 1982-684, MZB 3370, RMNH 28850, UMMZ 209856); Kapuas 1976-15, 71.9 mm (MZB 33671); Kapuas 1976-51, 3: 72.4–88.6 mm (MZB 3372, USNM 230227)

A large *Rasbora* with subtle but distinctive coloration permitting identification of juveniles as well as adults: thin midaxial streak very distinct on posterior half of body; a sharply delimited dusky midlateral longitudinal stripe of fine melanophores extending uninterruptedly from posterior margin of eye and across gill cover to caudal-fin base; a sharply delimited pale longitudinal stripe of about equal width immediately dorsal to dusky midlateral stripe. Fins clear or dusky, without discrete marks. Lateral line complete, lateral scale series 33–35; transdorsal scales 9, predorsal 13–15, circumpeduncular 14.

DISTRIBUTION.—Malay Peninsula (Perak). Sumatra (Moesi). Borneo (Rejang, Kapuas, Barito). Thailand? (see Brittan 1954, 1972:122).

Rasbora einthovenii (Bleeker, 1851)

Leuciscus einthovenii Bleeker, 1851*c*:434 (type locality Sambas)
Rasbora einthoveni Bleeker, 1859*a*:154

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-1, 13: 15.9–40.1 mm (CAS 49284, MZB 3373, ROM 38609); Kapuas 1976-11, 9: 31.34–42.3 mm (CAS 49285, MZB 3374, RMNH 28851, USNM 230228)

Distinguished from all other species of *Rasbora* by a solid dark longitudinal stripe from snout-tip to end of middle caudal-fin rays, with portion on body and especially on caudal peduncle lying just below midline of body.

DISTRIBUTION.—Malay Peninsula (Johore, Singapore). Sumatra (Bagan Api Api, Gunung Sahilan, Siboga). Borneo (Sambas, Kapuas, Bungaran, Brunei, Labuan, Sandakan).

Rasbora elegans Volz, 1903

Rasbora elegans Volz, 1903:558 (type locality Palembang, Sumatra)
Rasbora lateristriata Weber and de Beaufort, 1916:78

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-24, 2: 67.2–77.7 mm (CAS 49286, MZB 3375); Kapuas 1976-25, 10: 31.6–85.6 mm (CAS 49287, MHNG 2087.3–5, MZB 3376); Kapuas 1976-26, 4: 37.2–76.3 mm (MZB 3377, USNM 230229)

Rasbora ennealepis new species

(Figure 51)

HOLOTYPE.—MZB 3997, 38.0 mm, Sungai Sekumpai, a small forest tributary of the Sungai Pinoh 23 km S of Nangapinoh (Kapuas 1976-26)

PARATYPES.—CAS 49288 and MZB 3378, 5: 26.9–38.2 mm, same data as holotype; BMNH 1982.3.29.81–82, CAS 49289, MZB 3379, RMNH 28852, USNM 230230, 14: 26.2–44.9 mm, Sungai Tebelian, small forest tributary of Sungai Pinoh 19 km S of Nangapinoh (Kapuas 1976-25)

This species is similar to *R. bankanensis*, from which it differs in having only 8–9 instead of 9–12 gill rakers (Table 2) and in details of coloration and squamation. Lateral line complete, lateral scale rows 24–25 (vs. 25–28 in *R. bankanensis*); transdorsal scales 9, predorsal usually 9, rarely 10 (vs. 10–12, usually 11), circumpeduncular 10 (vs. 12); scales with striae few and broadly divergent (vs. scales with striae relatively numerous and nearly parallel). Sides of body with strongly reticulated color pattern (absent or weakly evident in *R. bankanensis*); anal fin without a noticeable concentration of dark pigment near distal end of enlarged anterior fin rays (usually present in *R. bankanensis*); and striae of scales pigmented (striae without pigmentation in *R. bankanensis*).

Rasbora ennealepis is slightly less elongate than *R. bankanensis*, with a slightly narrower caudal peduncle and perhaps a slightly larger eye, although no attempt has been made to quantify these differences. The two species are also similar in color pattern except for the differences pointed out above. Like *R. bankanensis*, *R. ennealepis* has a complete midaxial streak, a broad midlateral stripe better defined on posterior half of body, a well defined, complete dorsomedial streak or stripe, a supraanal streak continuous with a midventral peduncular streak, and melanophores along cleithrum somewhat concentrated to form a poorly defined humeral mark underlying posterior margin of gill cover.

In addition to the type specimens listed above, one lot of 13 specimens 31.9–47.2 mm from Kapuas 1976-26 (CAS 49290, MZB 3380) apparently belongs to *R. ennealepis*. These tend to have 10 or 11 predorsal scales and lighter coloration but in other respects are similar to the type specimens. Consideration has been given to the possibility that the differences seen between *R. ennealepis* and *R. bankanensis* merely reflect ecophenotypic variation of *R. bankanensis*. This hypothesis is weakened by the observation that *R. bankanensis* from mountain tributaries of the Sungai Pinoh do seem to differ in intensity of coloration and in subtle alterations of body form in ways that may indeed reflect ecophenotypic variation but are readily distinguishable from all of the specimens of *R. ennealepis* which is known only from mountain tributaries of the Sungai Pinoh.

ETYMOLOGY.—The name *ennealepis* (Greek) refers to the characteristic number of predorsal scales seen in this species.

Rasbora kalochroma (Bleeker, 1850)

Leuciscus kalochroma Bleeker, 1850:272 (type locality Bandjermassing)
Rasbora kalochroma Bleeker, 1859*a*:154

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-23, 5: 28.1–39.5 mm (CAS 49291, MZB 3381, USNM 230231)

Two large dark blotches on side of body, one above pectoral fin and one centered over anal-fin origin, distinguish this species from all other *Rasbora*. Dorsal-fin origin slightly posterior to a vertical through anal-fin origin. Lateral line complete, lateral line scale series 29–32; predorsal scales 11–12; circumpeduncular scales 12. Largest known specimen 59 mm.

DISTRIBUTION.—Malay Peninsula (Johore, Trengganu). Sumatra (Gunung Sahilan, rivers Kamperkiri, Kwantan, Rokan). Borneo (Kuching, Sadong, Sambas, Kapuas). Banka. Billiton.

Rasbora myersi Brittan, 1954

(Figure 52)

Rasbora myersi Brittan, 1954:117, fig. 25 (type locality Kapuas River at Potoes Sibau)

For synonymy see Brittan (1954, 1972:117–118).

MATERIAL EXAMINED.—Western Borneo: Kapuas River at Poetoes Sibau, CAS-SU 17342, 71 mm (holotype) and CAS-SU 17343, 3: 66–70 mm (paratypes); Kapuas 1976-6, 85.0 mm (MZB 3998); Kapuas 1976-14, 4: 51.6–74.3 mm (CAS 49292, MZB 3382); Kapuas 1976-15, 11: 34.5–71.5 mm (AMNH 48932, BMNH 1982.3.29.83–86, MZB 3383); Kapuas 1976-24, 4: 75.4–81.8 mm (CAS 49293, MZB 3384, ROM 38623); Kapuas 1976-31, 8: 50.3–72.3 mm (FMNH 94223, IRSNB 19739, MZB 3385); Kapuas 1976-32, 2: 49.7–58.9 mm (CAS 49294, MZB 3386); Kapuas 1976-33, 6: 66.5–72.2 mm (MCZ 58350, MZB 3387); Kapuas 1976-34, 54.2 mm (MZB 3388); Kapuas 1976-36, 4: 39.6–65.5 mm (MZB 3389, MNHN 1982-685); Kapuas 1976-37, 15: 41.9–83.5 mm (KUMF 2850, MZB 3390, RMNH 28853, ZMA 116.527); Kapuas 1976-39, 11: 50.0–79.5 mm (MZB 3391, UMMZ 209900, USNM 230232)

Rasbora cf. **myersi** Brittan, 1954 (immature)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-15, 233: 8.7–16.9 mm (CAS 49309, MZB 3425); Kapuas 1976-33, 16: 7.8–19.7 mm (CAS 49310, MZB 3426); Kapuas 1976-55, 7: 13.4–13.9 mm (MZB 3427, USNM 230239).

Material obtained during the Kapuas survey of 1976 includes three lots of small, immature *Rasbora*, apparently conspecific, which might be *R. myersi*. The largest of these specimens, 19.7 mm, apparently has a complete lateral line, and about 14–15 predorsal scales; its color pattern is generalized and rather plain, with midlateral stripe and axial streak complete, scales on dorsal portion of body with melanophores on exposed portions forming a reticulate pattern, and no distinctive or unusual markings. Kapuas species most likely to be the adults include *R. argyrotaenia, caudimaculata, dusonensis, elegans, myersi,* and *volzi*. I tentatively identify them as *R. myersi*, of which the smallest specimen otherwise examined is 34.5 mm, because of close similarity in overall morphology and color pattern.

Rasbora pauciperforata Weber and de Beaufort, 1916

Rasbora pauciperforata Weber and de Beaufort, 1916:78, fig. 28 (type locality Sumatra, Gunung Sahilan and Deli)

MATERIAL EXAMINED.—Sumatra: Gunung Sahilan, 4: 25.4–27.6 mm (CAS-SU 15335 paratypes). Western Borneo: Kapuas 1976-1, 29: 25.5–32.5 mm (AMNH 48933, BMNH 1982.3.29.87–97, MZB 3392); Kapuas 1976-6, 19: 14.1–34.1 mm (CAS 49295, MZB 3393); Kapuas 1976-5, 29: 12.0–34.2 mm (FMNH 94224, IRSNB 19740, KUMF 2851, MZB 3394); Kapuas 1976-7, 23: 8.6–22.5 mm (CAS 49296, MZB 3395); Kapuas 1976-10, 24.4 mm (MZB 3396); Kapuas 1976-11, 20: 20.6–34.0 mm (MZB 3397, MNHN 1982-686, RMNH 28854, ROM 38613); Kapuas 1976-23, 26.6 mm (MZB 3398); Kapuas 1976-32, 65: 15.3–22.9 mm (CAS 49297, MZB 3399, UMMZ 209880, USNM 230233, ZMA 116.528).

A small, slender, colorful *Rasbora* with a sharp snout, narrow caudal peduncle, and two well marked longitudinal stripes. Lateral line incomplete, with 5–10 pored scales. Lateral scale series 30–34; transdorsal scales 7, predorsal 13–14, circumpeduncular 12. Gill rakers 10–12. Largest specimen 34.1 mm.

DISTRIBUTION.—Malay Peninsula (Johore). Sumatra (Gunung Sahilan, Deli). Western Borneo (Kapuas). Billiton.

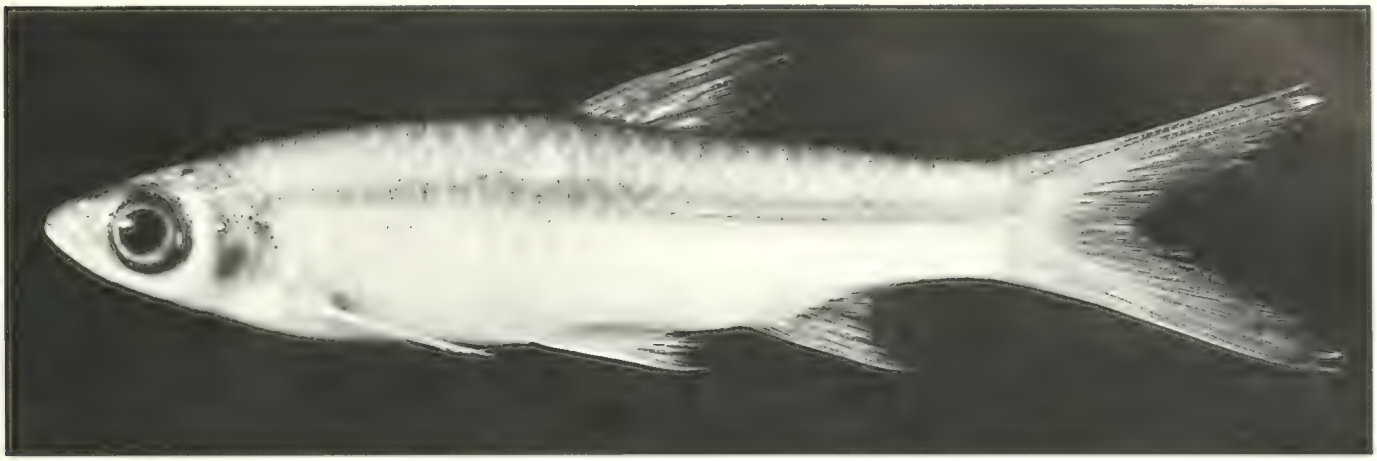

FIGURE 52. *Rasbora myersi*. Kapuas 1976-37, 58.7 mm (MZB 3390).

Rasbora sarawakensis, Brittan, 1951

(Figure 53)

Rasbora sarawakensis Brittan, 1951:1 (type locality brook 16 miles east of Kuching)

MATERIAL EXAMINED.—Sarawak: brook 16 miles east of Kuching, 10: 18–38 mm (CAS-SU 15375, 33567, holotype and paratypes); Rejang River, 3: 34–38 mm (CAS-SU 33593, paratypes). Western Borneo: Kapuas 1976-6, 37: 17.7–42.4 mm (AMNH 48934, BMNH 1982.3.29.98–101, CAS 49298, FMNH 94225, IRSNB 19741, MZB 3400); Kapuas 1976-12, 7: 12.6–38.4 mm (MZB 3401, MNHN 1982-687); Kapuas 1976-13, 3: 14.0–19.7 mm (CAS 49299, MZB 3402); Kapuas 1976-24, 43.8 mm (MZB 3403); Kapuas 1976-25, 6: 26.2–36.0 mm (MZB 3404, RMNH 28855); Kapuas 1976-26, 7: 19.0–42.5 mm (MZB 3405, ROM 38600, UMMZ 209868); Kapuas 1976-30, 28: 19.0–47.5 mm (CAS 49300, MZB 3406, UMMZ 209873, USNM 230234, ZMA 116.529)

A relatively stout-bodied *Rasbora* with a large, pointed head, distinguished from all other species by its distinctive very intense lateral longitudinal stripe, basally darkened dorsal fin, and scale markings. It differs from all other species except *R. rutteni* Weber and de Beaufort, 1916 in having numerous close-set multicellular horny tubercles (so-called breeding tubercles) extending in a narrow dorsomedial band on the posterior portion of caudal peduncle and dorsal margins of upper procurrent and uppermost principal caudal-fin rays. These tubercles are present in all of the material examined, although they are best developed in the largest specimens (female as well as male). Lateral line complete, lateral line scales 24–26; predorsal 11; circumpeduncular 12.

It is apparently very closely related to *R. rutteni* Weber and de Beaufort, 1916, which differs from it in having a relatively rounded snout, 26–29 lateral line scales, and the dark lateral stripe markedly lighter anteriorly (rather than of equal intensity for its entire length) (Brittan 1951:3).

DISTRIBUTION.—Sarawak (Rejang basin; Kuching). Western Borneo (Kapuas).

Rasbora subtilis new species

(Figure 54)

HOLOTYPE.—MZB 3407, 39.9 mm, ripening female, Danau Piam near Ketungau, 38 km NNE of Sintang, 29 July 1976 (Kapuas 1976-32)

PARATYPES.—CAS 49301, 36.0 mm, collected with holotype; CAS 49302, MZB 3408, USNM 230235, 5: 27.9–34.3 mm, Kapuas mainstream near Telokabik, 29 km W of Putussibau, 11 August 1976 (Kapuas 1976-40)

DIAGNOSIS.—A slender, compressed *Rasbora* with incomplete lateral line and a diagonal black bar near tip of each caudal-fin lobe; gill rakers and scales exceptionally numerous. Largest known specimen 39.9 mm. Gill rakers 19–22 (more than in any other *Rasbora* except a few relatively large, heavy-bodied species; Table 2). Scales in lateral series about 34–36, pored scales 8–10, predorsal 14–17, transdorsal 13 (9–11 in nearly all other *Rasbora*), circumpeduncular 14–16 (fewer in nearly all other *Rasbora*). Pharyngeal teeth elongate, slender, nearly straight, and conical or slightly uncinate, apparently 2,3,5/5,3,2.

The following observations are based on the 39.9 mm holotype and 36.0 mm paratype from Danau Piam (paratypes from Kapuas mainstream in poor condition, apparently emaciated): head length 3.7–3.8, width at middle of gill covers 8.2–8.6; snout 13.8–14.2; eye 12.0–12.1; bony interorbital width 12.5–12.9; body depth at dorsal-fin origin 5.9–6.1, width 11.2–11.4; dorsal-fin origin nearer caudal-fin base than snout-tip, predorsal length 1.9–2.0; pelvic-fin origin somewhat anterior to vertical through dorsal-fin origin, prepelvic length 2.1; height of last simple dorsal-fin ray 4.6–4.8; pectoral fin failing to reach pelvic-fin origin by a distance about equal to one-half eye diameter, pectoral fin length 4.9–5.3; pelvic fin failing to reach anal-fin origin by about same distance or somewhat less, pelvic fin length 5.7–6.2; caudal fin deeply forked, length upper lobe 3.1.

Color in life, observed at Danau Piam: "body bluish green, caudal fin yellow with a diagonal black bar near tip of each lobe." Preserved specimens have body lightly pigmented, with a narrow midlateral stripe and nearly coextensive axial streak on posteriormost one-half or two-thirds; midlateral stripe terminating in a small, horizontally elongate, basicaudal spot, sometimes very poorly defined; scales on dorsal half of body with fine melanophores forming a faint reticulate pattern; dorsomedian longitudinal stripe absent or nearly absent, perhaps represented by a few moderately large and irregularly spaced melanophores; middle of abdomen with three or four longitudinal rows of scattered, moderately large melanophores; base of anal fin with large melanophores forming a nearly coextensive anal bar, continuous with ventromedian longitudinal stripe on caudal peduncle; all fins except caudal colorless.

Rasbora subtilis resembles *R. trilineata* and they presumably are closely related. *R. trilineata* is somewhat heavier-bodied,

FIGURE 53 *Rasbora sarawakensis*. Kapuas 1976-24, 43.8 mm (MZB 3404)

with fewer gill rakers and scales, and a well developed dorsomedian stripe.

DISTRIBUTION.—Known only from the Kapuas.

ETYMOLOGY.—The name *subtilis* refers to the slender form and delicate coloration of this species.

Rasbora trilineata Steindachner, 1870

Rasbora trilineata Steindachner, 1870:673 (type locality Pengulon Patie, Johore, note pl. 3, fig. 3)

Rasbora stigmatura Fowler, 1934*c*:341, fig. 5 (type locality Krat, southeast Thailand)

MATERIAL EXAMINED.—Thailand: Rayong River, 24: 15.0–32.4 mm (CAS 44434) Malay Peninsula: Johore, Kota Tinggi, 3: 46.8–53.8 mm (CAS-SU 47235); Johore, Ayer Hitam, 36.0 mm (CAS-SU 15343); Johore, Pengulon Patie (NMW 51458–61, including syntypes of *R. trilineata*; see discussion below). Western Borneo: Kapuas 1976-9, 13: 43.2–57.8 mm (AMNH 48935, BMNH 1982.3.29.102–106, MZB 3411); Kapuas 1976-16, 5: 30.7–39.7 mm (CAS 49304, MZB 3412); Kapuas 1976-31, 3: 46.1–58.8 mm (FMNH 94226, MZB 3413); Kapuas 1976-37, 33: 34.0–55.5 mm (CAS 49305, IRSNB 19742, KUMF 2852, MNHN 1982-688, MZB 3414); Kapuas 1976-39, 11: 35.5–58.7 mm (MZB 3415, RMNH 28856, ROM 38604); Kapuas 1976-42, 4: 36.3–56.5 mm (MZB 3416, UMMZ 209907). Kapuas 1976-46, 7: 33.7–45.9 mm (MZB 3417, USNM 230236); Kapuas 1976-47, 2: 35.5–40.6 mm (MZB 3418, ZMA 116.530)

A relatively light-bodied, slender *Rasbora* with matching dark diagonal submarginal bars toward end of upper and lower caudal-fin lobes; in life these bars often accentuated by milk-white pigmentation. Supra-anal pigment heavy elongate streak lying along entire anal-fin base with scale and fin-ray counts similar to heavier-bodied species such as *R. caudimaculata*. Lateral line complete. Lateral scale series 29–32, transdorsal scales 9, predorsal 12–13, circumpeduncular 12. Gill rakers on first arch 3+12=15. Largest known specimens 60 mm.

Syntypes of *R. trilineata* are not based upon the same species. The description seems to be based mainly or entirely on *R. trilineata* auctorum, but the figure is of a color variety of *R. sumatrana* (similar to the variety from Sungei Gunong Goa, Perak; Brittan 1954, fig. 1f). The syntypes have not been critically re-examined since their original description, and this has led to doubts as to the identity of the species described by Steindachner (Brittan 1954:83). The NMW possesses four lots (NMW 51458–61) labeled as syntypes of *R. trilineata*. These lots were located by Dr. R. Hacker and Mr. H. Ahnelt for me to examine during a visit to Vienna in September 1982. My identifications are as follows:

NMW 51458, 12: 24.3–35.5 mm (all in good condition)=*Oxygaster*.

NMW 51459, 35: 15.0–33.5 mm, separated into two sublots:

FIGURE 54 *Rasbora subtilis*. Kapuas 1976-32, 39.9 mm ripe female (MZB 3407, holotype).

FIGURE 55. *Rasbora volzi*. Kapuas 1976-24, 75.6 mm (CAS 49306).

a) 24: 15.0–31.3 mm (in a vial, all badly dried, twisted and stuck together, apparently never sorted or studied)=several *Thynnichthys*, four *R. sumatrana*, four *R. trilineata*, one *Aplocheilus*, and b) 11: 20.0–33.5 mm (mounted on a glass plate, but now all badly dried). About six are *R. trilineata*, some still showing black submarginal bars with milky-white on the caudal fin. These specimens must have been in good condition orginally or they would not have been mounted so carefully; Steindachner's description of the diagnostic caudal-fin coloration presumably was based on these specimens. Of the five other specimens of this mounted series, at least one has a well marked peduncular spot and seems to be *R. sumatrana*.

NMW 51460, 7: 38.8–46.5 mm=*R. sumatrana* and 1: 42.2 mm=*R. trilineata*. All of the *R. sumatrana* are relatively deep-bodied with a peduncular spot. The 42.2 mm specimen of *R. trilineata* has the slender narrow body typical of *R. trilineata* and lacks the peduncular spot. It is in good condition except that the distal two-thirds of its caudal fin is broken off, and thus the caudal-fin coloration diagnostic for the species cannot be observed.

NMW 51461, 3: 49.8–70.1 mm=*R. sumatrana*. All with round peduncular spot; largest with black coloration extending to tip of caudal-fin lobes, obviously not the caudal-fin coloration described by Steindachner.

In conclusion, of the four presumed lots of syntypes of *R. trilineata*, only NMW 51459–60 include *R. trilineata* auctorum. NMW 51458, containing only *Oxygaster*, and NMW 51461, *R. sumatrana*, should no longer be considered syntypes of *R. trilineata*. A lectotype could be designated from NMW 51459 or 51460, but due to the poor condition of the specimens there seems to be little advantage in choosing one of them for this purpose. Should future studies indicate a need for type selection, the wisest course probably would be to designate a neotype from a well preserved series of fresh specimens collected at or near the type locality. For the time being I can only affirm that Steindachner's syntypes (NMW 51459–60) include specimens of *R. trilineata* sensu Brittan, 1954. Under the present ICZN, however, the correct procedure would be to select a lectotype from the type series.

Rasbora volzi Popta, 1905

(Figure 55)

Rasbora volzi Popta, 1905:175 (type locality Bongan and Howong rivers, Kapuas and Mahakam basins).

Rasbora volzi var. *fasciata* Popta, 1905:176 (type locality Kajan River). See Brittan (1954, 1972:61–73).

MATERIAL EXAMINED.—Sarawak: 16 miles E of Kuching, 12: 37.0–72.0 mm (CAS-SU 33592). Western Borneo: Kapuas 1976-24, 2: 70.3–74.2 mm (CAS 49306, MZB 3419); Kapuas 1976-25, 2: 49.7–50.3 mm (MZB 3420, USNM 230237); Kapuas 1976-30, 3: 25.6–88.7 mm (CAS 49308, MZB 3421).

The two smallest Kapuas specimens, Kapuas 1976-30, 25.6–25.7 mm, differ from other Kapuas specimens examined in having midlateral stripe and bar on anal-fin base very dark and well defined; midlateral stripe extending uninterrupted full length of body, notably expanded ventrally in anterior half. Such pattern is observed in adults as well as juveniles of *R. volzi* (or *R. volzi fasciata*) from Kajan River, east Borneo (Popta 1906, pl. 9, fig. 34) and Sarawak (present observations; Brittan 1954, 1972:61–63, fig. 8), although midlateral stripe tends to be interrupted in posterior half of body. In larger Kapuas specimens examined midlateral stripe and anal bar very faint; at least in 74.2 mm specimen from Kapuas 1976-24 (CAS 49306), lateral stripe uninterrupted, and slightly but distinctly expanded ventrally in anterior half of body.

Rasbora species undetermined

Rasbora leptosoma (nec Bleeker) Vaillant, 1902:89 (Kapuas, in part, MNHN 1891-376 only).

MATERIAL EXAMINED.—Western Borneo: Kapuas, Sebroeang, 46.5 mm (MNHN 1891-376, originally identified as *R. leptosoma*, subsequently reidentified as *R pauciperforata*)

As indicated above, the true *R. leptosoma* is known only from Bleeker's type specimens from Lahat, Sumatra. Most of the Kapuas specimens identified as *R. leptosoma* by Vaillant have been identified as other species of *Rasbora*, but the present specimen is an exception. It may be briefly described as follows: lateral line incomplete, each side of body with about nine pore-bearing scales; lateral scale series about 34, predorsal scales 15, transdorsal 11, circumpeduncular 12; head length 3.5; eye diameter 11.6, body depth 4.7, caudal peduncle depth 9.5 (much deeper than in *R. pauciperforata*); dark lateral stripe (badly faded) continuous from opercle to caudal-fin base; axial streak extending from middle of body to end of hypural plate.

Rasborichthys Bleeker, 1859

Rasborichthys Bleeker, 1859*a*:155 (type species *Leuciscus Heltrichii* Bleeker, 185 ` by monotypy)

FIGURE 56 *Rasborichthys helfrichii*. Kapuas 1976-41, 80.8 mm (MZB 3429).

A Sundaic cyprinid genus with a narrow, sharp-snouted head; elongate subcylindrical or fusiform body, with a median keel extending between pelvic and anal fins; gill rakers numerous and very elongate or lanceolate, 9–10+32–35=41–45. Dorsal-fin branched rays 7, anal 17–19. Hyaline eyelid very well developed, extending anteriorly from snout to in front of nostrils and posteriorly almost onto gill cover. Jaws terminal, lips thin. Pharyngeal teeth in three rows 1,3,5/5,3,1. Lateral line complete, slightly decurved anteriorly but otherwise nearly straight. Lateral scale series about 60, predorsal scales 25, transdorsal 18, circumpeduncular about 28, scales between lateral line and pelvic-fin origin 5-1/2. Vertebrae 23–24+19–20=42(3), 43(3). The genus comprises a single species.

Rasborichthys helfrichii (Bleeker, 1857)

(Figure 56)

Leuciscus Helfrichii Bleeker, 1857*a*:15 (type locality Kahajan River)
Rasborichthys Helfrichii Bleeker, 1859*a*:155; 1860*a*:456

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-33, 21: 77.1–93.8 mm (BMNH 1982.3.29.109–10, CAS 49311, MNHN 1982-689, MZB 3428, RMNH 28857, UMMZ 209889); Kapuas 1976-41, 13: 76.7–92.8 mm (AMNH 48936, FMNH 94227, MZB 3429, USNM 230240, ZMA 116.532)

DISTRIBUTION.—Sumatra (Batang Hari). Borneo (Kapuas, Kahajan).

Rohteichthys Bleeker, 1860

Rohteichthys Bleeker 1860*a*:395 (type species *Barbus microlepis* Bleeker, 1850, by monotypy)

Body moderately deep, strongly compressed. Dorsal profile strongly sloped, head concave above eyes. Abdomen anterior to pelvic fins flattened, posterior to pelvic fins strongly compressed or cultrate, with a well developed midventral membranous keel. Last simple dorsal-fin ray stout and heavily serrate; dorsal-fin branched rays 8, anal-fin branched rays 5. Lateral line complete, nearly straight, midlateral. Scales without radii; lateral scales 68–72, transdorsal 27, predorsal about 35, circumpeduncular 33. Vertebrae 18+15=33 (2, Kapuas). Body and fins plain except for a large dark midpeduncular spot.

Mouth terminal, moderately upturned. Jaws narrow, moderately elongate. Barbels absent. Rostral cap thin, deeply incised, its anterior margin straight. Lips thin. No discrete horny jaw sheaths. Mandibular symphyseal knob weakly developed. Sublacrimal groove deeply incised. Adipose eyelid weakly developed. Gill rakers moderately long, bony, 2–3+11=13–14 on first arch. Pharyngeal teeth uncinate, in three rows, 2,3,5/5,3,2.

Relationships of *Rohteichthys* have not been discussed since Bleeker (1860:397) compared it to *Rohtee* (now *Osteobrama*) *vigorsi*, to which it is perhaps closely related. It also seems to be a close relative of *Cyclocheilichthys*. The numerous specialized rows of hypertrophied cephalic cutaneous papillae, not previously noted in *Rohteichthys*, are virtually identical in the two genera. *Rohteichthys* has numerous transverse rows of papillae on the dorsal surface of the head from snout-tip to occiput, transverse rows on the isthmus between the mandibular rami, vertical and longitudinal rows on the cheek and mandibular regions, vertical rows on the opercle, and oblique rows on the subopercle, all as in *Cyclocheilichthys*. The intermandibular pad is relatively elongate in *Rohteichthys* and not so sharply incised but is otherwise similar to the papillose intermandibular pad of *Cyclocheilichthys*. Other unusual or specialized characters shared with *Cyclocheilichthys* include the unusually straight lateral line and overall similarity of head and body form (including concave head, and abdomen flat anteriorly but strongly compressed posteriorly). In overall morphology *Rohteichthys* is remarkably similar to deep-bodied species of *Cyclocheilichthys* such as *C. repasson*. The morphology of the pharyngeal jaws and teeth of *Rohteichthys* (Weber and de Beaufort, 1916; fig. 42) is virtually identical to that of *Cyclocheilichthys* (op. cit., fig. 66). It differs from *Cyclocheilichthys* in having the snout more pointed and the jaws upturned and terminal (rather than subterminal) and the cultrate portion of the abdomen with a well developed membranous keel (entirely absent in all species of *Cyclocheilichthys*). Only one species of *Rohteichthys* is known.

Rohteichthys microlepis (Bleeker, 1850)

(Figure 57)

Barbus microlepis Bleeker, 1850:12 (type locality Banjermassing, in fluviis).
Systomus microlepis Bleeker, 1851*f*:160
Rohtee microlepis, Bleeker, 1860*a*:396

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-33, 4: 90.2–97.2 mm (CAS 49312, MZB 3430, RMNH 28858); Kapuas 1976-44, 3: 107–146 mm (MZB 3431, USNM 230241)

DISTRIBUTION.—Sumatra (Palembang, Lahat, Djambi). Borneo (Kapuas, Barito).

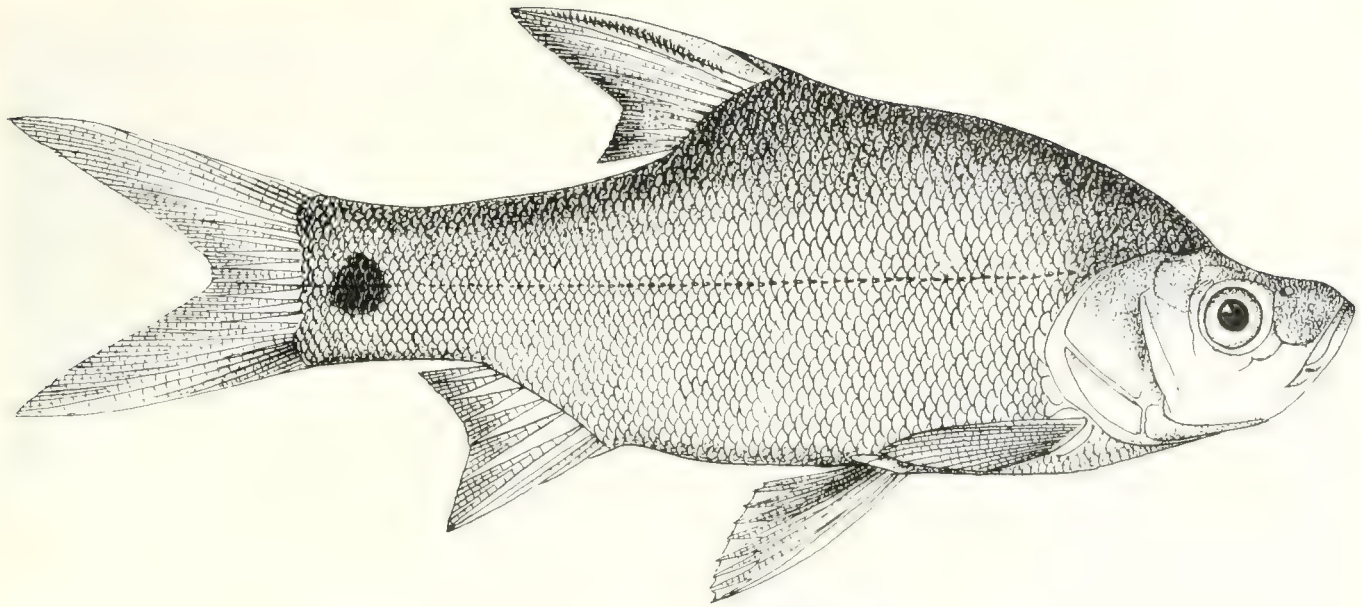

FIGURE 57. *Rohteichthys microlepis*. Sumatra (after Weber and de Beaufort 1916, fig. 41).

Schismatorhynchos Bleeker, 1855

Schismatorhynchos Bleeker, 1855*b*:258, 269 (type species *Lobocheilos heterorhynchus* Bleeker, 1853, by monotypy).

Juveniles and adults of both sexes with a large, deeply undercut and heavily tuberculate secondary rostrum. Rostral cap and upper lip similar to those of *Lobocheilos*: rostral cap thick, its margin entire, with a deep subrostral groove; upper lip almost as thick as rostral cap, its margin entire; no separate upper horny jaw sheath. Horny sheath of lower jaw enormous, but not so thickened or as strongly projecting dorsally as in *Lobocheilos*, the margin strongly curved and with a very thin, flexible cornified cutting or scraping edge. Lower lip fleshy, but not thick or deeply incised, as in *Lobocheilos*, and its free anterior margin weakly fimbriate. Palate with delicate, ventrally projecting, longitudinally crenulate lobes. Short rostral and maxillary barbels present.

A well developed secondary rostrum occurs in only two other cyprinoid genera, both Asian. It is characteristic of several species of *Garra* (including *G. gotyla*) and one of *Gastromyzon* (*G. borneensis*). It is lacking in the *Gastromyzon* and *Garra* known from western Borneo. In all three of these Asian genera the secondary rostrum generally is evident in juveniles long before sexual maturity, and tends to be well developed in both sexes; the relationship of sex to development of secondary rostrum is not well understood; sometimes it seems to be somewhat larger in males, but in other instances it may be larger in females (e.g., some *Garra*). The secondary rostrum and portion of the snout underlying and in front or to the side of it tend to be heavily tuberculate. The function of the tuberculate snout in these fishes is not well understood, but it is probably involved with inter- as well as intra-specific territorial behavior, non-sexual as well as sexual.

Schismatorhynchos comprises two species, *S. heterorhynchus* and *S. nukta* (sometimes placed in a separate genus, *Nukta*); the latter occurs in southern India.

Schismatorhynchos heterorhynchos (Bleeker, 1853)

(Figure 58)

Lobocheilos heterorhynchos Bleeker, 1853*f*:524 (type locality Solok, in fluviis)
Schismatorhynchos lobocheiloides Bleeker, 1855*b*:259, 260 (unwarranted substitution of species name)
Schismatorhynchos heterorhynchos Bleeker, 1860*a*:131 (unwarranted spelling emendation)
Tylognathus heterorhynchus Günther, 1868*a*:67.

MATERIAL EXAMINED.—Sumatra: Batu Sanghar, 136 mm (CAS-SU 8077). Western Borneo: Kapuas 1976-24, 2: 62.6–87.9 mm (MZB 3432, RMNH 28859); Kapuas 1976-27, 6: 83.9–105 mm (CAS 49313, MZB 3433, USNM 230242); Kapuas 1976-29, 88.0 mm (MZB 3434)

DISTRIBUTION.—Sumatra (Solok, Lahat, Batu Sanghar). Borneo (Kapuas, Mahakam, Kinabatangan).

Thryssocypris Roberts and Kottelat, 1984

Thryssocypris Roberts and Kottelat, 1984:142 (type species *Thryssocypris smaragdinus* Roberts and Kottelat, 1984, by original designation)

Small, insectivorous, anchovy-like cyprinids with strongly compressed head and body, beaklike snout, no barbels. Differs from most other cyprinid genera in western Borneo in having pharyngeal teeth in two rows. For other diagnostic features and osteological description see Roberts and Kottelat (1984).

Relationships of *Thryssocypris* to other cyprinids are unknown. Two species, one in the Kapuas and one in the Mekong.

Thryssocypris smaragdinus Roberts and Kottelat, 1984

(Figure 59)

Thryssocypris smaragdinus Roberts and Kottelat, 1984:146 (type locality Kapuas)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-36, MZB 3435, 49.4 mm holotype) and CAS 49314, USNM 230243, 4: 46.8–54.0 mm (paratypes)

This species is known only from the type specimens collected in the mainstream of the upper Kapuas River.

FIGURE 58. *Schismatorhynchos heterorhynchos*. Kapuas 1976-29, 88.0 mm (MZB 3434).

Thynnichthys Bleeker, 1859

Thynnichthys Bleeker, 1859*a*:153 (type species *Leuciscus thynnoides* Bleeker, 1852, by subsequent designation of Bleeker, 1863*b*:201)

Body somewhat heavy-set, more or less finely scaled. Lateral line complete. Dorsal fin with 8–10 branched rays, anal with 5. Head broad with large gill covers. Mouth terminal, broad. Premaxillae, maxillae, and lower jaw very thinly covered with skin; no discrete rostral cap, lips, or horny jaw sheaths. Premaxillae moderately protrusible. Barbels absent. Gill rakers confined to uppermost portions of trailing edge of first gill arch and of leading and trailing edges of arches 2–4; leading edge of first gill arch rakerless. Pharyngeal pad anteriorly with broad longitudinal sulci opposed to long rakerless portions of lower limbs of gill arches, posteriorly with complex epithelial folds or convolutions opposed to raker-bearing portions of arches. Pharyngeal teeth with a flat, oblong crown, in three rows wedged together, 4–5,3–4,2–3/2–3,3–4,4–5 (Weber and de Beaufort 1916:121).

Thynnichthys comprises several species in southeast Asia and India. Two species are known from western Borneo, and one from eastern Borneo. They are most readily distinguished by differences in scale counts.

Key to *Thynnichthys* of Borneo

1a Lateral line scales 47; scales between lateral line and dorsal fin 11 ..... *T. vaillanti* Weber and de Beaufort, 1916

1b Lateral line scales 56–61; scales between lateral line and dorsal fin 12–13 ..... *T. thynnoides*

1c Lateral line scales 65–75; scales between lateral line and dorsal fin 16–17 ..... *T. polylepis*

Thynnichthys polylepis Bleeker, 1860

(Figure 60)

Thynnichthys polylepis Bleeker, 1859*a*:154 (nomen nudum); 1860:407 (type locality Palembang, Sumatra, and Pontianak, Borneo)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-15, 105 mm (MZB 3436); Kapuas 1976-20, 7: 72.9–96.0 mm (CAS 49315, MZB 3437); Kapuas 1976-33, 5: 69.7–115 mm (MZB 3438, USNM 230244); Kapuas 1976-41, 2: 102–103 mm (MZB 3439, RMNH 28860); Kapuas 1976-49, 62.3 mm (MZB 3440)

DISTRIBUTION.—Sumatra (Palembang; Danau Sialong Iotong). Borneo (Kapuas).

Thynnichthys thynnoides (Bleeker, 1852)

Leuciscus thynnoides Bleeker, 1852*e*:599 (type locality Palembang, in fluviis)
Thynnichthys thynnoides Bleeker, 1859*a*:153, 1860*a*:408

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-33, 7: 119–158 mm (CAS 49316, MZB 3441, RMNH 28861, USNM 230245)

DISTRIBUTION.—Thailand (Mekong, Chao Phrya, Tale Sap, Tale Noi, Patani R.). Malay Peninsula (Perak, Pahang). Sumatra (Palembang, Djambi, Kampar R., Gunung Sahilan, Kwantan R., Danau Sialong Iotong). Borneo (Kapuas).

Tor Gray, 1833

Tor Gray, 1833:96 (type species *Cyprinus tor* Hamilton-Buchanan, 1822, by absolute tautonymy)

Tor cf. **tambra** (Valenciennes, 1842)

Barbus tambra Valenciennes *in* Cuvier and Valenciennes, 1842:190 (type locality "environs de Buitenzorg," Java)

FIGURE 59. *Thryssocypris smaragdinus*. Kapuas 1976-36, 49.4 mm (MZB 3435, holotype)

FIGURE 60. *Thynnichthys polylepis*. Kapuas 1976-41, 102 mm (MZB 3439).

Labeobarbus tambra Bleeker, 1857*b*:355
?*Puntius streeteri* Myers, 1927:1 (type locality Baloi River, Rejang basin, Sarawak).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-30, 105 mm (MZB 3442).

The single specimen of this species obtained by the Kapuas survey of 1976 has been examined by Walter Rainboth. He has tentatively identified it with *Puntius streeteri*, a probable synonym of *Tor tambra*.

Tor tambroides Bleeker, 1854

(Figure 61)

Labeobarbus tambroides Bleeker, 1854*a*:92 (type locality numerous places in western Sumatra and western Java)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-24, 8: 37.1–84.6 mm (CAS 49317, MZB 3443, USNM 230246); Kapuas 1976-25, 4: 65.0–90.5 mm (RMNH 28862, MZB 3444); Kapuas 1976-29, 8: 15.9–29.4 mm (CAS 49318, MZB 3445)

Gyrinocheilidae

The extraordinarily specialized southeast Asian mountain stream fishes assigned to *Gyrinocheilus*, the sole genus comprising the family Gyrinocheilidae, are very poorly known morphologically and systematically. Their unique specialization is a spiracle-like opening at the upper limit of the gill cover by means of which the gills are ventilated during long periods while the heavily treaded sucker-like lips are expanded and attached to the rocky or stony substrate thus occluding the oral respiratory current. The algae-feeding *Gyrinocheilus* are also the only cyprinoids in which the pharyngeal teeth are absent (young specimens should be examined to see if they also lack the teeth).

Gyrinocheilus superficially at least resembles the cyprinid subfamily Labeoinae, but no osteological or other studies have been done to determine its relationships. The thick, expandable lips are covered with numerous parallel rows of large, close-set, square or rectangular papillae. Similar labial papillae do not occur in any African, Indian, or southeast Asian cyprinids but do occur in *Semilabeo* Peters, 1880 (with *Pseudogyrinocheilus* Fang, 1933, a junior synonym), the species of which are endemic to southern China (where *Gyrinocheilus* is unknown). *Semilabeo* lacks the spiracle-like specialization but otherwise closely resembles *Gyrinocheilus*. They probably are closely related.

Gyrinocheilus Vaillant, 1902

Gyrinocheilus Vaillant, 1902:107 (type species *Gyrinocheilus pustulosus* Vaillant, 1902, by monotypy)

Gyrinocheilus includes several poorly known species in Thailand (especially the Mekong) and Sumatra badly in need of systematic study. A single species is known from western Borneo.

Gyrinocheilus pustulosus Vaillant, 1902

(Figure 62)

Gyrinocheilus pustulosus Vaillant, 1902:111 (type locality "embouchure du Raoen, haut-Sibau," Kapuas)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-27, 299 mm gravid female (MZB 3446)

Gyrinocheilus pustulosus seems to be the largest gyrinocheilid. The very numerous almost parallel rows of close-set breeding tubercles covering almost the entire side of the head has been observed only in this species. My 299 mm gravid female is very similar in all respects to Vaillant's illustration of one of the type specimens (reproduced here as Fig. 62).

DISTRIBUTION.—Known only from the Kapuas.

Homalopteridae

Homalopteridae, as currently understood, constitutes a large and diverse family of loach-like fishes widely distributed from India to China and in the main islands of Sundaland. The main concentrations of species, however, occur in southern China and on Borneo. Nearly all of the species are adapted to living on the bottom of swift-flowing mountain streams or in riffles of lowland streams, and some are among the most highly specialized of cyprinoids. All are characterized by more or less enlarged and horizontally flattened paired fins, and there is a strong tendency for increased numbers of pectoral- and pelvic-fin rays. In several of the most specialized taxa of China and Borneo the greatly enlarged pelvic fins are united to each other posteriorly, a condition otherwise unknown in lower teleosts.

The more specialized homalopterids are poor swimmers but have evolved new modes of creeping and crawling locomotion (Wickler 1971). In all homalopterids the ventral surface of the

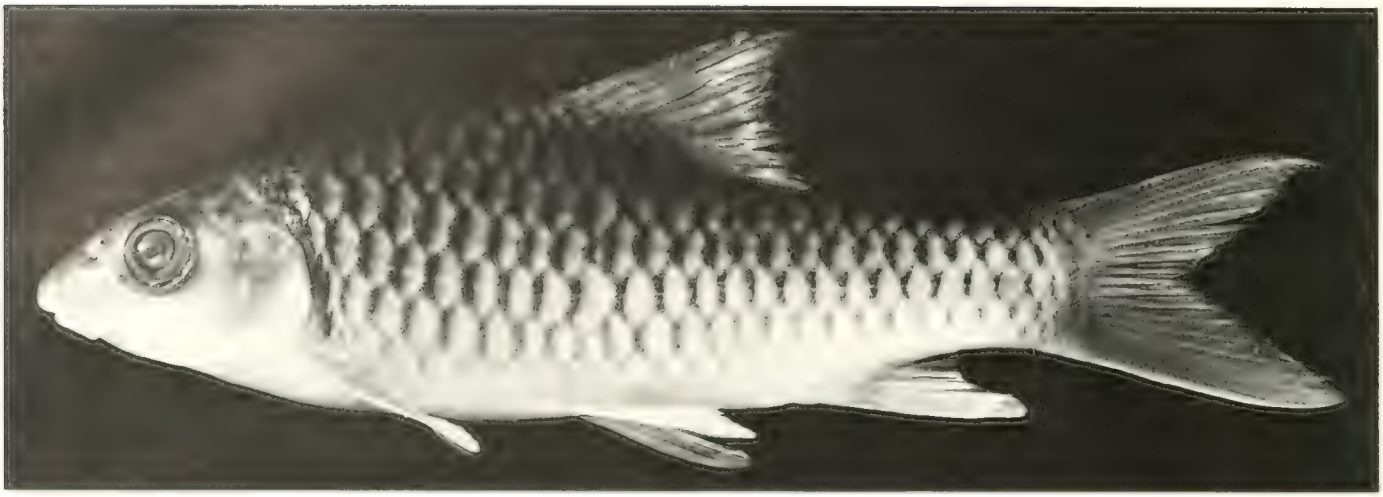

FIGURE 61 *Tor tambroides*. Kapuas 1976-24, 84.6 mm (CAS 49317)

anteriormost rays in the pectoral and pelvic fins bear large adhesive or frictional pads; these pads are unculiferous, as observed in numerous Chinese species by Chang (1945) and in several Bornean species by me (Roberts 1982*a*). In at least one Chinese species, *Pseudogastromyzon myersi* Herre, 1932, the lips bear specialized unculiferous ridges employed in feeding upon filamentous algae and associated food items (Roberts, unpublished observation).

Higher classification of Homalopteridae is in an unsatisfactory state. There is evidence that the two subfamilies currently recognized, Homalopterinae and Gastromyzontinae, are unnatural assemblages, and that it may well be that Homalopteridae itself is polyphyletic. Current concepts of the subfamilies originated with Hora (1932), who recognized Homalopterinae chiefly on the basis of having two or more simple rays in the pectoral and pelvic fins, while Gastromyzontinae have only one

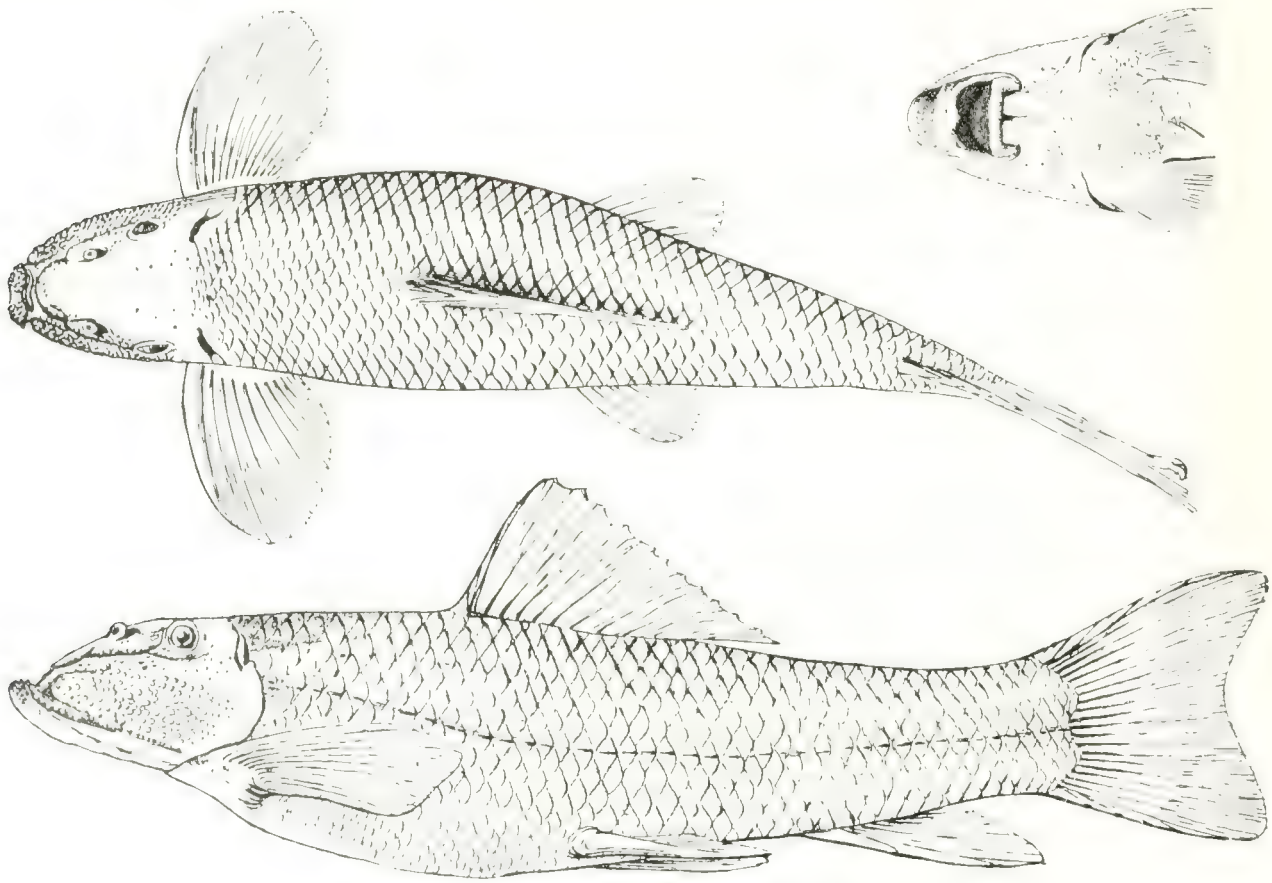

FIGURE 62 *Gyrinocheilus pustulosus*. Kapuas (after Vaillant 1902:112)

simple ray in each fin. Indeed, for the Bornean taxa, this simple distinction does not seem to result in a natural classification into two subfamilies. Thus, Bornean Homalopterinae comprises only species of *Homaloptera* and of its close relative, the monotypic *Neohomaloptera* (*Homaloptera* is by far the most speciose homalopterid genus, with about 40 species). Bornean Gastromyzontinae, although morphologically diverse, also appear to represent a monophyletic group. Problems arise, however, in attempts to integrate the numerous Chinese genera and species into this classification, as has been done by Hora (1932), Chang (1945), Silas (1953), and Chen (1980). In my opinion none of the Chinese species is congeneric with Bornean species, and the species from the two areas probably do not even belong in the same subfamily.

One of the most striking differences between Bornean Homalopterinae and Gastromyzontinae and the Chinese taxa currently assigned to these subfamilies concerns the enlarged rib which is ligamentously attached to the pelvic-fin girdle in the vicinity of the origin of the anteriormost pelvic-fin ray. This enlarged rib supposedly distinguishes Homalopteridae from Cobitidae, in which it is lacking. In Bornean Homalopterinae, so far as known, the enlarged rib is born on the 10th vertebra, while in Bornean Gastromyzontinae it is born on the 12th vertebra (Table 3). This provides an additional distinction between Bornean members of the two subfamilies and suggests that we are in fact dealing with two monophyletic lines in Borneo. It is of interest that the relatively generalized *Glaniopsis,* some of the species of which superficially at least resemble the cobitid subfamily Nemacheilinae, appears on this basis to be part of the Bornean Gastromyzontinae. An apparently unique character shared by several Bornean Gastromyzontinae involves the nature of the tuberculation in the males. In all or almost all Bornean Homalopteridae, in mature males the dorsal surface of the anteriormost pectoral-fin rays bears large pads of fine, close-set multicellular horny tubercles. In addition, males of Bornean Gastromyzontinae may have uniserial rows of fine, multicellular tubercles on the snout, cheek, or gill cover, or on the body immediately above the base of the pectoral fin. Such "comb-like" or "ctenoid" tuberculation occurs in *Gastromyzon ctenocephalus* Roberts, 1982, *Neogastromyzon pauciradiatus* Inger and Chin, 1961, *Protomyzon griswoldi,* and an undescribed species of *Hypergastromyzon* from the Lupar basin, Sarawak (pers. obs.) but has not been found in any Chinese species.

The constant position of the enlarged rib and distinctive nature of the male tuberculation set Bornean Gastromyzontinae apart from Chinese species. Some of the more generalized Chinese homalopterids lack the enlarged rib (*Crossostoma, Formosania, Vannemania*); in others it is present on the 10th or on the 11th vertebra, but has not been observed on the 12th (Table 3). Another character suggesting that Bornean and Chinese Gastromyzontinae are not so closely related involves the suprapelvic flap in those forms with greatly enlarged pelvic fins. In the Bornean forms (*Gastromyzon, Hypergastromyzon, Neogastromyzon*) the suprapelvic flap is continuous anteriorly with a flat lateral extension of the body wall which forms the ventrolateral abdominal margin. In Chinese taxa the flap arises directly from the dorsal surface of the pelvic fin.

The Kapuas survey of 1976 resulted in discovery of several new Gastromyzontinae. Most of these belong in *Gastromyzon* and have been described already (Roberts 1982*d*); in addition, an undescribed genus and species is reported herein (*Hypergastromyzon humilis*). These discoveries bring the total known homalopterid genera to about 43 and the species to over 160. A synopsis of homalopterids is provided by Silas (1953).

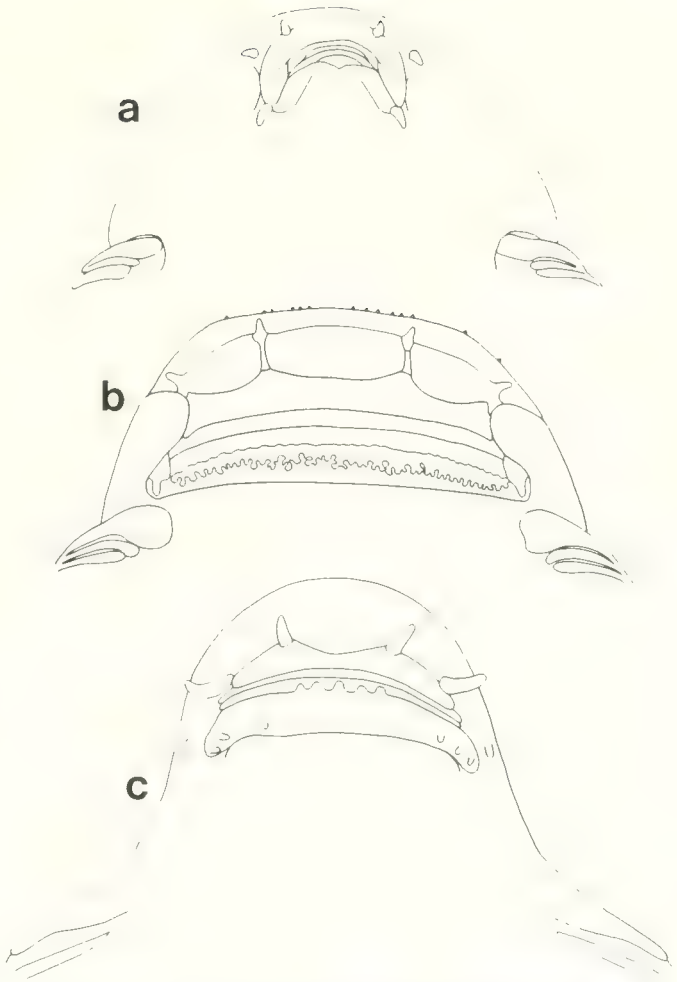

FIGURE 63. Mouthparts of Bornean Gastromyzontinae. a, *Hypergastromyzon*; b, *Gastromyzon*; c, *Neogastromyzon*

Key to Homalopteridae of western Borneo

1a Pectoral fins with 22–31 rays, a single unbranched ray anteriorly; pelvic fins united posteriorly, each with 18–24 rays (Gastromyzontinae) 2

1b Pectoral fin with 11–17 rays, with at least two unbranched rays anteriorly; pelvic fins separate, each with 7–11 rays (Homalopterinae) 7

2a Mouth broad, almost as wide as head; cutting edge of horny jaw sheaths straight (Fig. 63b, c) 3

2b Mouth narrow, less than one-third as wide as head; cutting edge of horny jaw sheaths curved (Fig. 63a) *Hypogastromyzon humilis*

3a Head width at least 5; sublacrimal groove absent; rostral and maxillary barbels project from posterior margin of rostral cap (Fig. 63c); adhesive pad of anteriormost pectoral-fin ray with anterior margin continuous with skin of abdomen *Neogastromyzon nieuwenhuisi*

TABLE 3. VERTEBRAL CHARACTERS OF HOMALOPTERIDAE SENSU LATO. For definition of vertebral counts see p. 22.

	Vertebral counts	Vertebra bearing enlarged rib
Homalopterinae		
Homaloptera nebulosa		
Kapuas 1976-6 (CAS 49323)	20+11=31(4) 21+10=31(1)	10(5)
Homaloptera ophiolepis		
Kapuas 1976-27 (CAS 49325)	22+14=36(2)	10(2)
Homaloptera orthogoniata		
Kapuas 1976-30 (CAS 49326)	21+10=31(1)	10(1)
Homaloptera stephensoni		
Kapuas 1976-32 (MZB 3479)	21+11=32(1)	10(1)
Mahakam (RMNH 7633, holotype)	21+11=32(1)	10(1)
Homaloptera tweediei		
Kapuas 1976-13 (CAS 49327)	19+12=31(1) 20+11=31(2)	10(3)
Homaloptera zollingeri		
Kapuas 1976-29 (CAS 49331)	22+11=33(1)	10(1)
Neohomaloptera johorensis		
Malay Peninsula (CAS-SU 66426)	21+11(2)	10(2)
Gastromyzontinae		
Gastromyzon borneensis		
Baram R. (CAS 53177)	24+9=33(1) 24+10=34(1) 25+10=35(1)	12(3)
Gastromyzon contractus		
Kapuas 1976-24 (CAS 44186)	22+9=31(2) 22+10=32(2)	12(3)
Gastromyzon fasciatus		
Baram R. (CAS 53175)	23+10=33(2)	12(2)
Gastromyzon ridens		
Kapuas 1976-24 (CAS 49322)	24+9=33(2)	12(2)
Glaniopsis hanitschi Boulenger, 1899		
Mt. Kinabalu (CAS 53185)	25+11=36(6)	12(6)
Glaniopsis multiradiata Roberts, 1982		
Baram basin (CAS 53179, paratypes)	24+12=36(1) 25+11=36(7) 26+10=36(1) 25+12=37(6)	12(15)
Hypergastromyzon humilis		
Kapuas 1976-30 (CAS 49333, MZB 3480, types)	24+8=32(2) 25+8=33(1)	12(2)
"*Hypergastromyzon*" sp.		
Batang Ai, Lupar basin (uncat.)	22+9=31(3)	12(3)
Neogastromyzon nieuwenhuisi		
Batang Ai, Lupar basin (CAS 53173)	22+8=30(1) 22+9=31(2)	12(3)
Parhomaloptera microstoma (Boulenger, 1899)		
Rejang basin (FMNH 68134)	26+10=36(2) 27+9=36(3)	12(5)
Protomyzon aphelocheilus Inger and Chin, 1962		
Sungei Kaingeran, N. Borneo (FMNH 68167)	25+10=35(1) 25+11=36(1) 26+10=36(3) 27+9=36(1)	12(6)
Protomyzon borneensis Hora and Jayaram, 1951		
Sungei Kaingeran, N. Borneo (FMNH 68186)	24+9=33(4) 25+8=33(1)	12(5)

TABLE 3. CONTINUED.

	Vertebral counts	Vertebra bearing enlarged rib
Protomyzon griswoldi (Hora and Jayaram, 1951)		
Keningau, N. Borneo (FMNH 68133)	24+9=33(6)	12(6)
Protomyzon whiteheadi (Vaillant, 1893)		
Ranau District, N. Borneo (FMNH 68139)	23+10=33(1) 24+9=33(5)	12(6)
Chinese		
Beaufortia leveretti (Nichols and Pope, 1927)		
Hainan (CAS-SU 32570)	24+9=33(1)	11(1)
Formosania lacustre		
Formosa (CAS-SU 18255)	24+13=37(1) 25+13=38(1)	none(2)
Hemimyzon formosanus (Boulenger, 1894)		
Formosa (CAS-SU 49364)	25+12=37(1)	10(1)
Liniparhomaloptera disparis (Lin, 1934)		
Hong Kong (CAS-SU 32589)	24+11=35(1) 25+10=35(2)	none(3)
Pseudogastromyzon fasciatus (Sauvage, 1878)		
Kiangsi (CAS-SU 39644)	27+12=39(1) 28+12=40(1) 29+11=40(1)	11(3)
Sinogastromyzon sanhoensis Fang, 1931		
China (CAS-SU 27502)	23+13=36(1)	10(1)
Sinohomaloptera hoffmanni (Herre, 1938)		
Hainan (CAS-SU 33002, 33003, types)	21+12=33(2)	10(2)
Sinohomaloptera yaotanensis Fang, 1931		
China (CAS-SU 27503)	23+13=36(1)	10(1)

3b Head width at most 4; sublacrimal groove present; rostral and maxillary barbels project from anterior margin of rostral cap (Fig. 63b); adhesive pad of anteriormost pectoral-fin ray with anterior margin free from abdomen (*Gastromyzon*) 4

4a Sublacrimal groove extending dorsally onto side of head ..... *G. ridens*

4b Sublacrimal groove confined to ventral surface of head 5

5a Postoral pouch present ..... *G. fasciatus*

5b Postoral pouch absent 6

6a Subopercular groove present; abdomen scaleless ..... *G. contractus*

6b Subopercular groove absent; specimens over 40 mm with abdomen at least partially covered with scales ..... *G. lepidogaster*

7a A pair of small maxillary barbels at each corner of mouth; pectoral-fin rays 12–13; pelvic-fin rays 7 ..... *Neohomaloptera johorensis*

7b A single small maxillary barbel at each corner of mouth; pectoral-fin rays 13–17; pelvic-fin rays 8–10 (*Homaloptera*) 8

8a Pectoral fin falls considerably short of pelvic fin 9

8b Pectoral fin reaches or overlaps pelvic fin 12

9a Body compressed (deeper than wide), scales 56–67 10

9b Body cylindrical or depressed, scales 45–48 11

10a Scales 56–61, not keeled; eye 4.5–7 in head ..... *H. ogilvici*

10b Scales 63–67, keeled; eye 10–12 in head ..... *H. orthogoniata*

11a Body cylindrical, body and fins uniformly dark brown or blackish ..... *H. zollingeri*

11b Body depressed, dorsal surface of body with faint round marks, paired fins strongly barred ..... *H. ophiolepis*

12a Pectoral fin reaching pelvic fin; scales 46–51, carinate ..... *H.* cf. *stephensoni*

12b Pectoral fin overlapping pelvic fin; scales 32–40, noncarinate 13

13a Lateral line scales 30–32; transverse scales 4-1/2-5-1/2/4-1/2-5-1/2 ..... *H. tweediei*

13b Lateral line scales 36–40; transverse scales 6-6-1/2/6-6-1/2 ..... *H. nebulosa*

Gastromyzon Günther, 1874

Gastromyzon Günther, 1874:454 (type species *Gastromyzon borneensis* Günther, 1874, by monotypy)

Lepidoglanis Vaillant, 1889:81 (type species *Lepidoglanis monticola* Vaillant, 1889, by monotypy)

DIAGNOSIS.—*Gastromyzon* differs from all other Gastromyzontinae in having a sublacrimal groove between lacrimal bone and rostral cap, and rostral and maxillary barbels projecting from anterior (rather than posterior) margin of rostral cap. Pec-

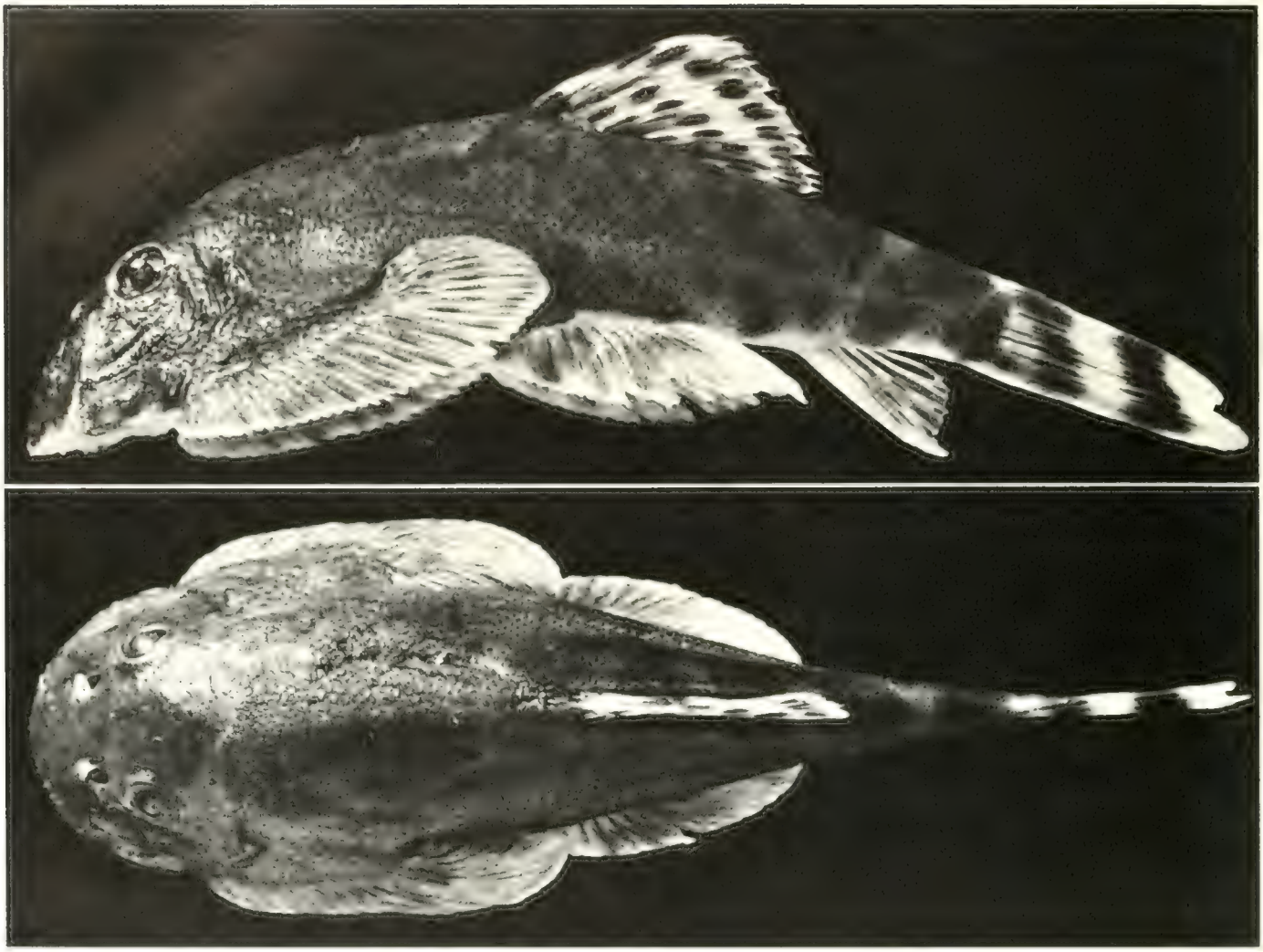

FIGURE 64 *Gastromyzon contractus*. Kapuas 1976-25, 34.4 mm (MZB 3447, holotype)

toral fin with 23–31 rays. Pelvic fins, united posteriorly, with 18–25 rays.

In my revision of *Gastromyzon* the number of species was increased from four to nine, including three new species discovered in the Kapuas basin (Roberts 1982*d*). Descriptions and figures of all of the species are given in the revision. The genus is restricted to Borneo.

Gastromyzon contractus Roberts, 1982

(Figure 64)

Gastromyzon contractus Roberts, 1982*d*:504, fig. 6 (type locality Sungai Tebelian, a tributary of Sungai Pinoh, 19 km upstream from Nangapinoh, Kapuas basin)

MATERIAL EXAMINED.—Western Borneo, Kapuas basin (holotype and paratypes): Kapuas 1976-24, 17: 29.1–36.9 mm (BMNH 1982.3.29.111–112, CAS 44186, MNHN 1982-690, MZB 3448, RMNH 28863, USNM 230247, paratypes); Kapuas 1976-25, 30.2–34.4 mm (MZB 3447, holotype, CAS 49319, paratype); Kapuas 1976-27, 2: 25.9–29.8 mm (CAS 49320, MZB 3449, paratypes).

Apparently the smallest *Gastromyzon* (largest specimen 36.9 mm), differing from all other species in having pelvic fin and dorsal fin (when depressed) reaching to or beyond level of anal-fin origin (depressed dorsal fin not reaching level of anal-fin origin, and pelvic fin reaching at most to anal fin in all other *Gastromyzon*). Sexually mature males develop dense patches of minute breeding tubercles on dorsal surface of first 8–10 branched pectoral-fin rays (Roberts 1982*d*, fig. 2).

Known only from Kapuas basin.

Gastromyzon fasciatus Inger and Chin, 1961

(Figure 65)

Gastromyzon fasciatus Inger and Chin, 1961:173 (type locality Sungai Dapu, Baleh River, Rajang basin, Sarawak)

MATERIAL EXAMINED.—Sarawak: Baleh R., 6: 48.1–65.9 mm (BMNH 1960.12.30.1, FMNH 68115 and 68120; paratypes); Truson R., Lawas, 70.4 mm (FMNH 45852); Pa Brayong, Truson R., 2: 64.9–70.5 mm (FMNH 45853); Akah R., Meligong, 3: 44.1–51.0 mm (FMNH 68583); Sadong R., 45.1 mm (CAS-SU 32378); Arur Dalam, Padapur R., Baram basin, 6: 38.6–69.3 mm (IRSNB 19725). North Borneo: Sungai Kaingeran, Tambunan, 5: 20.6–46.5 mm (FMNH 68128); Parutan R., Tambunan, 4: 17.2–32.8 mm (FMNH uncat.). Kapuas basin: Kapuas 1976-24, 59.0 mm (MZB 3450); Kapuas 1976-25, 56.0 mm (MZB 3451); Kapuas 1976-26, 44.7 mm (MZB 3452); Kapuas 1976-27, 24.5 mm (MZB 3453); Kapuas 1976-30, 3: 39.5–57.5 mm (CAS 49321, MZB 3454, USNM 230248); Bongan, 4: 22.5–54.1 mm (RMNH 7636). Mahakam basin: Bo, 2: 53.2–56.8 mm (RMNH 7638); Bluu or Bloeoe, 2: 39.2–54.3 mm (RMNH 7794).

In life the nearly black or bluish-black coloration of the body and fins with thin, pale or almost white bars or stripes made

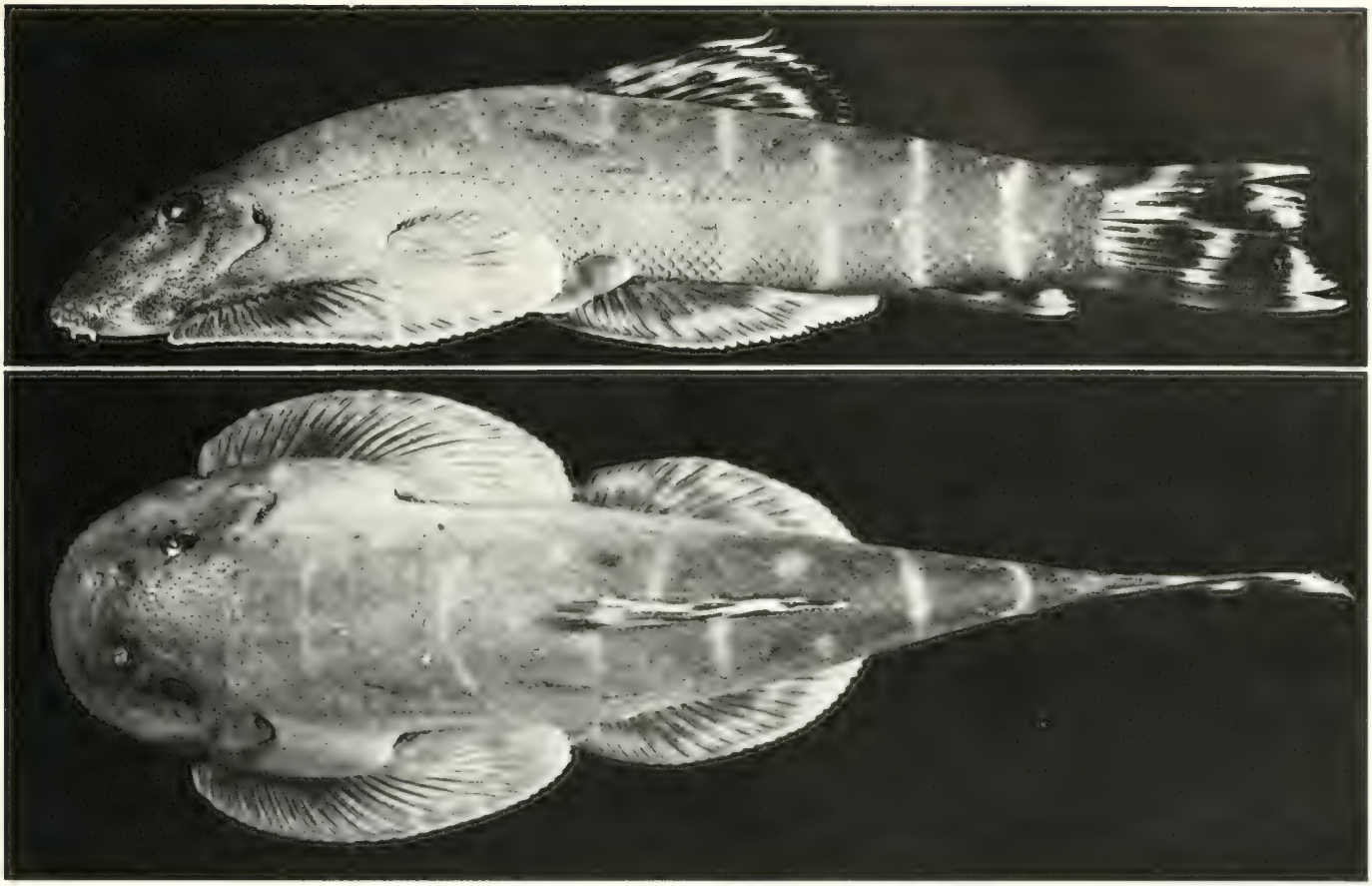

FIGURE 65. *Gastromyzon fasciatus.* Kapuas 1976-24, 59.0 mm (MZB 3450).

this species stand out from all the others of the genus *Gastromyzon* encountered in the Kapuas. Predorsal scales 40–55; gill opening angular and subopercular groove present (gill opening vertical and subopercular groove absent in most other *Gastromyzon*).

DISTRIBUTION (Fig. 66).—Northern Borneo (Kapuas, Mahakam).

Gastromyzon lepidogaster Roberts, 1982

Gastromyzon lepidogaster Roberts, 1982*d*:509, fig. 9, 10 (type locality sources of Mengalong River, Beaufort District, north Borneo)

MATERIAL EXAMINED.—Western Borneo: Bongan, 72.3 mm (RMNH uncat.) North Borneo: Kajan basin, Mahakam basin. See Roberts (1982*d*:509).

REMARK.—This species is characterized by having the abdomen of specimens over 40 mm more or less extensively covered by minute scales (Roberts 1982*d*, fig. 9). The abdomen is scaleless in all other *Gastromyzon* except *G. megalepis* Roberts, 1982 (from the Rajang basin), some specimens of which have a few relatively large scales on the posterior part of the abdomen between the pelvic fins. In the holotype and some other specimens of *G. lepidogaster* virtually the entire abdomen is covered with fine scales. In specimens from the Mahakam and Kapuas basins scales are confined to about the posterior half of the abdomen. Color in life unknown.

DISTRIBUTION (Fig. 66).—Northern Borneo (Kapuas, Mahakam).

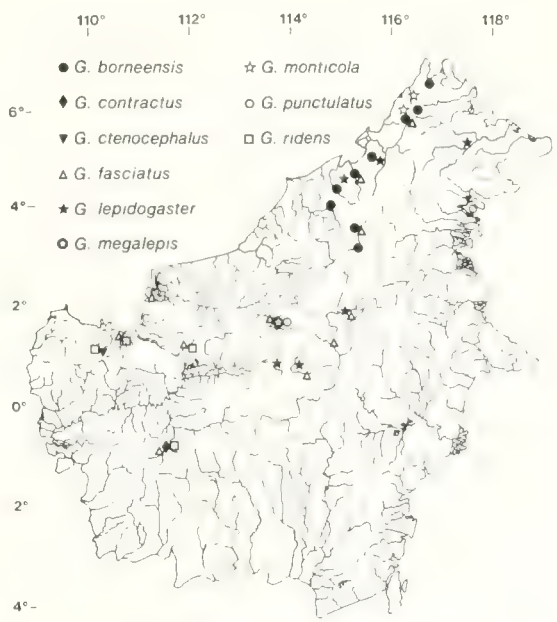

FIGURE 66. *Gastromyzon.* Geographical distribution

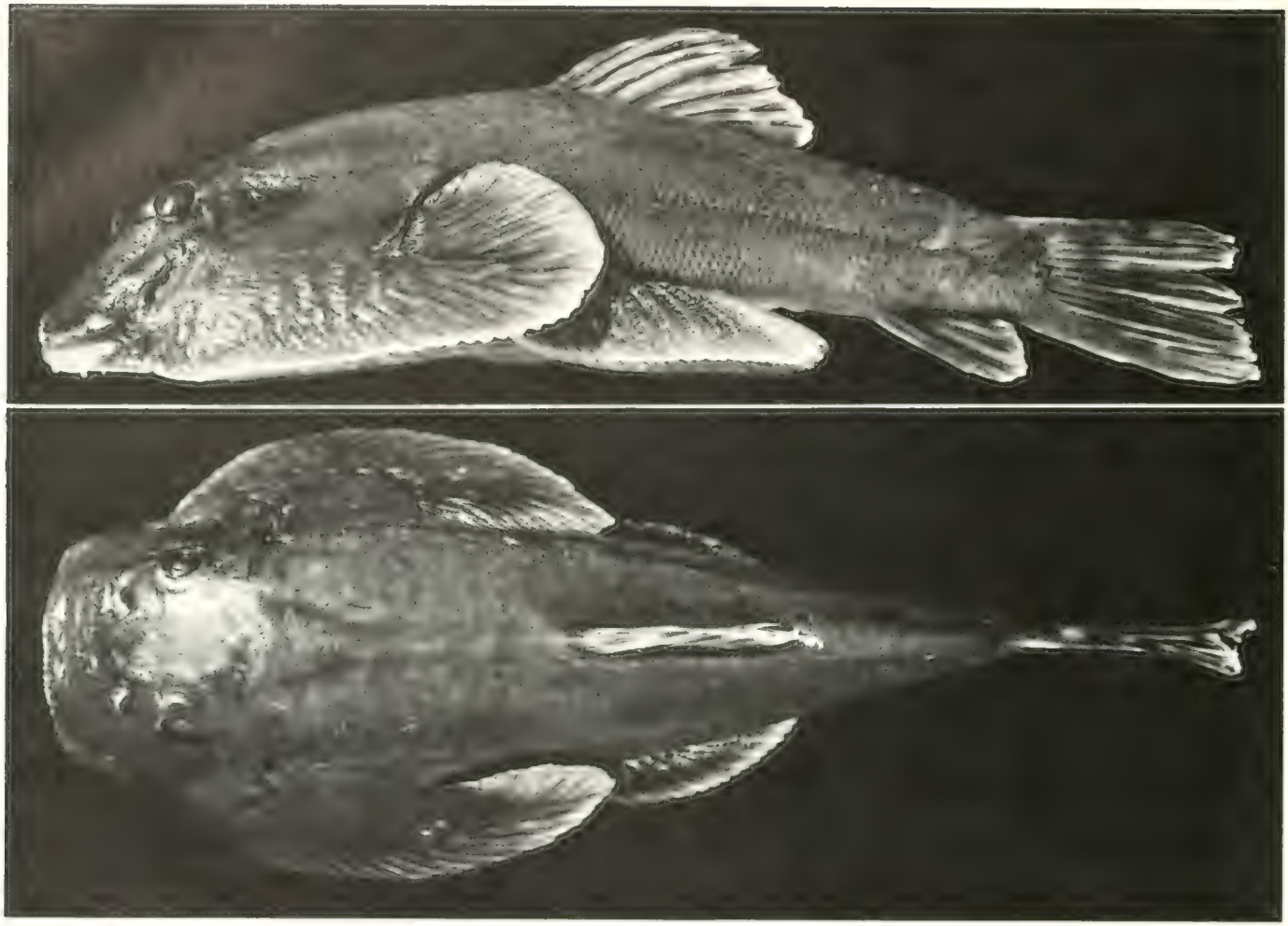

FIGURE 67 *Gastromyzon ridens* Kapuas 1976-24, 50.0 mm (MZB 3455, holotype)

Gastromyzon ridens Roberts, 1982

(Figure 67)

Gastromyzon ridens Roberts, 1982*d*:515, fig. 14 (type locality Sungai Pinoh, Kapuas basin)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-24, 9: 24.3–50.0 mm (BMNH 1982.3.29.113, CAS 49322, FMNH 94228, MNHN 1982-691, RMNH 28864, USNM 230249; holotype and paratypes). Sarawak: Senah, 6: 35.4–48.6 mm (BMNH 1893.3.6.270–275, paratypes); Sadong River, 9: 21.2–36.5 mm (CAS-SU 32378). In addition, I recently identified numerous specimens of this species from the Batang Ai, a high gradient tributary of the Batang Lupar in Sarawak collected by Joan Cramphorn (BMNH)

Gastromyzon ridens differs from all other members of its genus in having the sublacrimal groove extending well onto the side of the head, which gives it a very distinctive appearance (a laughing expression, hence the name *ridens*). This character is well marked even in the smallest specimens examined.

DISTRIBUTION (Fig. 66).—Sarawak and western Borneo.

Homaloptera Hoeven, 1833

Homaloptera van Hasselt *in* Kuhl and van Hasselt 1823:133 (nomen nudum)
Homaloptera Hoeven, 1833:211 (type species *Homaloptera ocellata* Hoeven, 1833, by monotypy). Original publication not seen; see discussion by Hora (1932:274–276)
Helgia Vinciguerra, 1890:330 (type species *Homaloptera bilineata* Blyth, 1860, by monotypy)
Homalopteroides Fowler, 1905:476 (type species *Homaloptera wassinkii* Bleeker, 1853, by original designation and monotypy)
Choprata Prashad and Mukerji, 1929:188 (type species *Choprata rupicola* Prashad and Mukerji, 1929, by original designation and monotypy)
Homalopterula Fowler, 1940:379 (type species *Homalopterula ripleyi* Fowler, 1940, by original designation and monotypy). See Silas (1953:188)

Homaloptera nebulosa Alfred, 1969

(Figure 68)

Homaloptera nebulosa Alfred, 1969:227, pl. 1, fig. 304 (type locality "River Sok, Kampong Sok, Kelantan," Malay Peninsula)

MATERIAL EXAMINED.—Malay Peninsula: River Sok, Kampong Sok, Kelantan, 21.8 mm (CAS-SU 66428, paratype). Western Borneo: Kapuas 1976-6, 5: 19.7–33.5 mm (CAS 49323, MZB 3456); Kapuas 1976-8, 25.1 mm (MZB 3457); Kapuas 1976-25, 3: 29.9–31.8 mm (BMNH 1982.3.29.114–115, MZB 3458); Kapuas 1976-26, 7: 28.2–33.7 mm (FMNH 94229, MNHN 1982-692, MZB 3459, RMNH 28865); Kapuas 1976-27, 3: 30.5–32.3 mm (MZB 3460, UMMZ 209871); Kapuas 1976-29, 4: 34.9–35.9 mm (CAS 49324, MZB 3461); Kapuas 1976-30, 8: 26.8–34.9 mm (MZB 3462, USNM 230250, ZMA 116.533)

This species has been known until now only from the holotype and four paratypes, 22.3–24.5 mm. Thus the Kapuas specimens represent a substantial increase in maximum known standard length (to 35.9 mm) as well as the first record for Borneo.

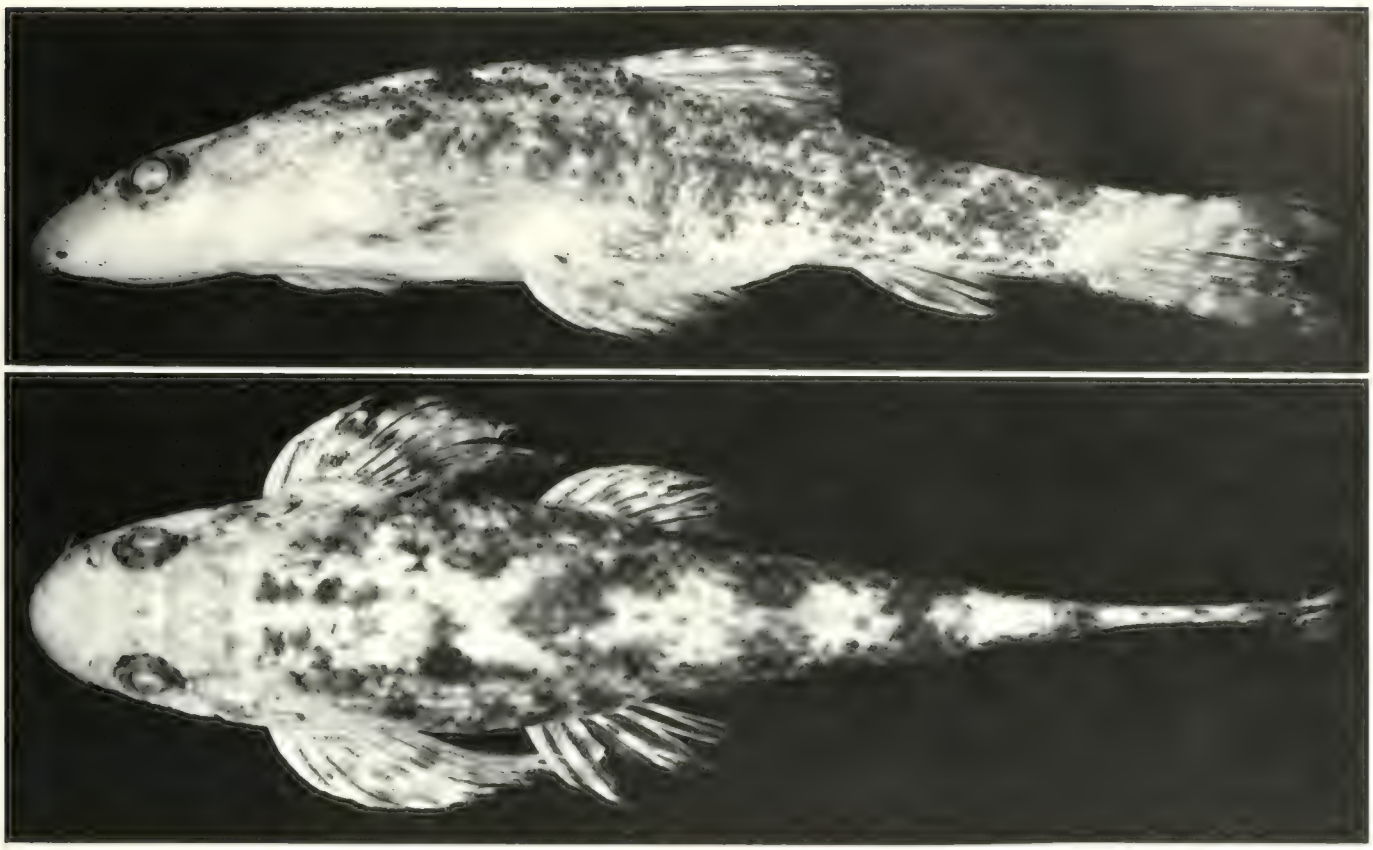

FIGURE 68. *Homaloptera nebulosa*. Kapuas 1976-6, 31.8 mm (CAS 49323)

Homaloptera ogilviei Alfred, 1967

Homaloptera ogilviei Alfred, 1967:587, fig. 1, 2 (type locality Telai River, Negri Sembilan, Malay Peninsula)

MATERIAL EXAMINED.—Malay Peninsula: River Jelai, Negri Sembilan, Malay Peninsula, 2: 26.4–28.5 (CAS-SU 66421, non-types). Western Borneo: Kapuas 1976-10, 26.6 mm (MZB 3463).

Body compressed (deeper than wide), eye diameter 4.5–7 in head, scales carinate, 56–61, caudal peduncle slender (depth 15–16), body with a dark vertical bar continuing onto anterior portion of dorsal fin; paired fins (especially pectoral) almost vertically oriented (versus almost horizontally in all or most other *Homaloptera*).

The peculiar orientation of the paired fins may be related to the tendency of this species to stay in vegetation (Alfred 1969) rather than on rock or gravelly bottom like most other *Homaloptera*.

DISTRIBUTION.—Known only from the Malay Peninsula (Negri Sembilan, Trengganu, Johore, Pahang, Perak [Alfred 1969: 220] and the Kapuas).

Homaloptera ophiolepis Bleeker, 1853

(Figure 69)

Homaloptera ophiolepis Bleeker, 1853*a*:157, 160 (type locality "Bandong, in fluviis")

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-27, 4 62.8–111 mm (CAS 49325, MZB 3464, RMNH 28866). Kapuas 1976-50, 2 36.9–39.0 mm (MZB 3465, USNM 230251)

DISTRIBUTION.—Sumatra (Lahat). Borneo (Kapuas, Mahakam). Java (Bandung, Parongkalong).

Homaloptera orthogoniata Vaillant, 1902

Homaloptera bilineata Boulenger, 1894:251 (not of Blyth; Baram River, Sarawak) See Weber and de Beaufort (1916:15–17)

Homaloptera orthogoniata Vaillant, 1902:122, fig. 33–35 (type locality "embouchure du Raoen" [Kapuas])

MATERIAL EXAMINED.—Malay Peninsula: Perak, Tapah Fisheries Station, 2 83.8–97.2 mm, CAS-SU 39390; River Tahan, King George V National Park, Chegar Sireh, 56.4 mm, CAS-SU 66423. Western Borneo: Kapuas 1976-30, 2 52.1–54.7 mm (CAS 49326, MZB 3466)

Perhaps the most ornate species of Homalopterinae. The thin, dark longitudinal stripe through the eye and a similar vertical stripe extending below it are present in all specimens examined. In some, stripes are emphasized by a thin pale area surrounding them. In larger specimens the three saddle-like marks on the dorsal surface of the body may break up or be augmented by smaller ventrolateral marks.

In life the darker marks on the fins and body of the Kapuas specimens were a rich reddish brown, the lighter areas a rich tan. This species is perhaps most closely related to *Homaloptera erythrorhina* Valenciennes in Cuvier and Valenciennes, 1846, which has similarly compressed body, fine carinate scales, and small eyes but coloration consisting of a series of five round spots confined on its dorsal surface and a well defined bar across the middle of the dorsal fin. *H. erythrorhina* is known from Sumatra and Java (Weber and de Beaufort 1916).

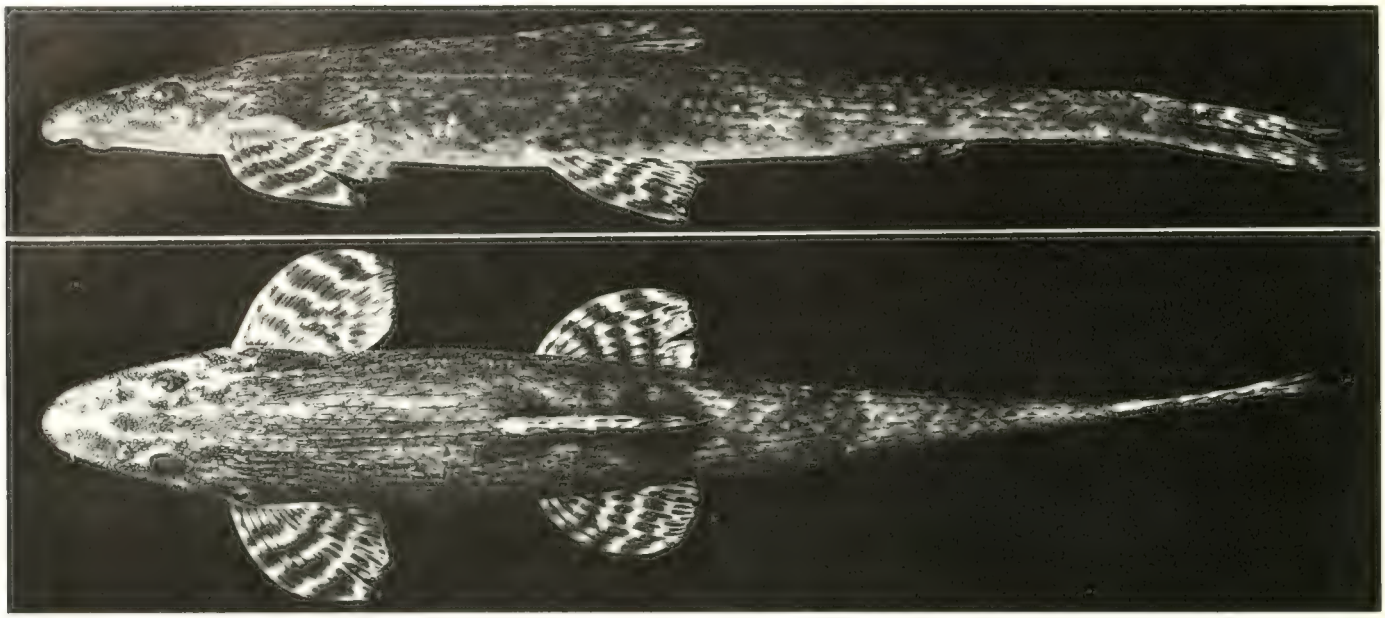

FIGURE 69 *Homaloptera ophiolepis*. Kapuas 1976-27, 111 mm (CAS 49325).

DISTRIBUTION.—Malay Peninsula (Perak, Pahang, Negri Sembilan, Johore; Alfred 1969). Sarawak (Baram). Borneo (Kapuas, Mahakam).

Homaloptera cf. **stephensoni** Hora, 1932

(Figure 70)

Homaloptera stephensoni Hora, 1932:281 (type locality upper Mahakam River, Borneo)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-27, 17: 37.0–53.9 mm (BMNH 1982.3.29.119–110, CAS 49332, MNHN 1982-694, MZB 3477, RMNH 28869); Kapuas 1976-29, 6: 38.6–57.2 mm (MZB 3478, USNM 230254); Kapuas 1976-32, 57.5 mm (MZB 3479). Eastern Borneo: upper Mahakam River, 48.2 mm (RMNH 633, holotype of *H. stephensoni*)

DIAGNOSIS.—A *Homaloptera* with head short; snout moderately pointed; head and anterior portion of body feebly depressed, ventral surface broad and flattened; scales on dorsum and sides moderately carinate; lateral line pored scales 44–52; pectoral fins, not overlapping pelvic fins when body is straight, with 5 simple and 11–12 branched rays; pelvic fins with 2 simple and 8 branched rays; dorsal-fin origin about equidistant between snout-tip and caudal-fin base or slightly closer to snout-tip; caudal peduncle elongate; caudal fin narrow, with pointed lobes, lower lobe longer than upper; dorsal surface of body with 5 round spots, sides with 7–8 elongate blotches (sometimes partially fused, especially anteriorly); total vertebrae 32.

The following description is based on the 48.2 mm holotype, a gravid female, and the 11 largest specimens from the Kapuas, 46.7–57.5 mm (information on Kapuas specimens in parentheses): head length 4.2 (3.9–4.4); snout moderately elongated and pointed, length 8.7 (8.3–9.2); horizontal diameter of eye about equal to interorbital width, 18.9 (18.3–21.3); body depth 6.5 (7.2–9.7); length 7.4 (6.3–7.5), depth 16.1 (15.1–17.6); lateral line scales 44 (46–52); predorsal 17 (19–22); circumpeduncular about 10 (12–14); dorsal-fin origin about midway between snout-tip and base of caudal fin, distinctly posterior to a vertical line through pelvic-fin origin; dorsal-fin branched rays 7; pectoral-fin simple rays 5 and branched rays 11–12; dorsum with 5 dark oval blotches, second centered on dorsal-fin origin, and sides with 7–8 dark elongate blotches centered on lateral line; vertebrae 21+11=32 in single Kapuas specimen radiographed.

The holotype of *H. stephensoni* has a deeper body and slightly fewer scales than the Kapuas specimens; also its snout appears to be slightly shorter, more rounded, and downturned (Hora 1932, pl. 11, fig. 1). These differences lead me to suppose that they might not be the same species. The deep body of the holotype of *H. stephensoni* is at least partly due to its being a gravid female; a gravid 57.2 mm female from the Kapuas has the body depth distinctly less (7.2 vs. 6.5). In both of these specimens the maximum size of the eggs is about 0.5 mm. In other respects, however, the Kapuas specimens are very similar to the Mahakam holotype and I tentatively conclude that they are conspecific.

DISTRIBUTION.—Borneo (Kapuas, Mahakam).

Homaloptera tweediei Herre, 1940

Homaloptera tweediei Herre, 1940*a*:7–8, pl. 1 (type locality "a shallow rapid creek in the Mawai district, Johore, about 40 miles north of Singapore")

MATERIAL EXAMINED.—Malay Peninsula: Mawai district, Johore, 3: 23.0–26.0 mm (CAS-SU 33012, 33013; holotype and paratypes). Western Borneo: Kapuas 1976-10, 2: 17.0–17.7 mm (BMNH 1982.3.29.116, MZB 3467); Kapuas 1976-13, 4: 17.7–20.7 mm (CAS 49327, MZB 3468); Kapuas 1976-14, 21.9 mm (MZB 3469); Kapuas 1976-16, 11.3 mm (MZB 3470); Kapuas 1976-37, 2: 16.0–16.3 mm (CAS 49328, MZB 3471); Kapuas 1976-39, 23: 12.5–17.5 mm (MNHN 1982-693, MZB 3472, RMNH 28867, UMMZ 209903, USNM 230252, ZMA 116.534); Kapuas 1976-47, 2: 20.1–20.3 mm (CAS 49329, MZB 3473)

This is probably the smallest species of *Homaloptera*. Alfred (1969:225–227) reported 82 specimens from nine localities in the Malay Peninsula of 14.4–30.0 mm; the species evidently attains sexual maturity at standard lengths of 20 mm or less. The Kapuas material includes 35 specimens from seven localities; the largest of these is only 21.9 mm, and a large majority are under 20 mm.

DISTRIBUTION.—Malay Peninsula. Borneo (Kapuas).

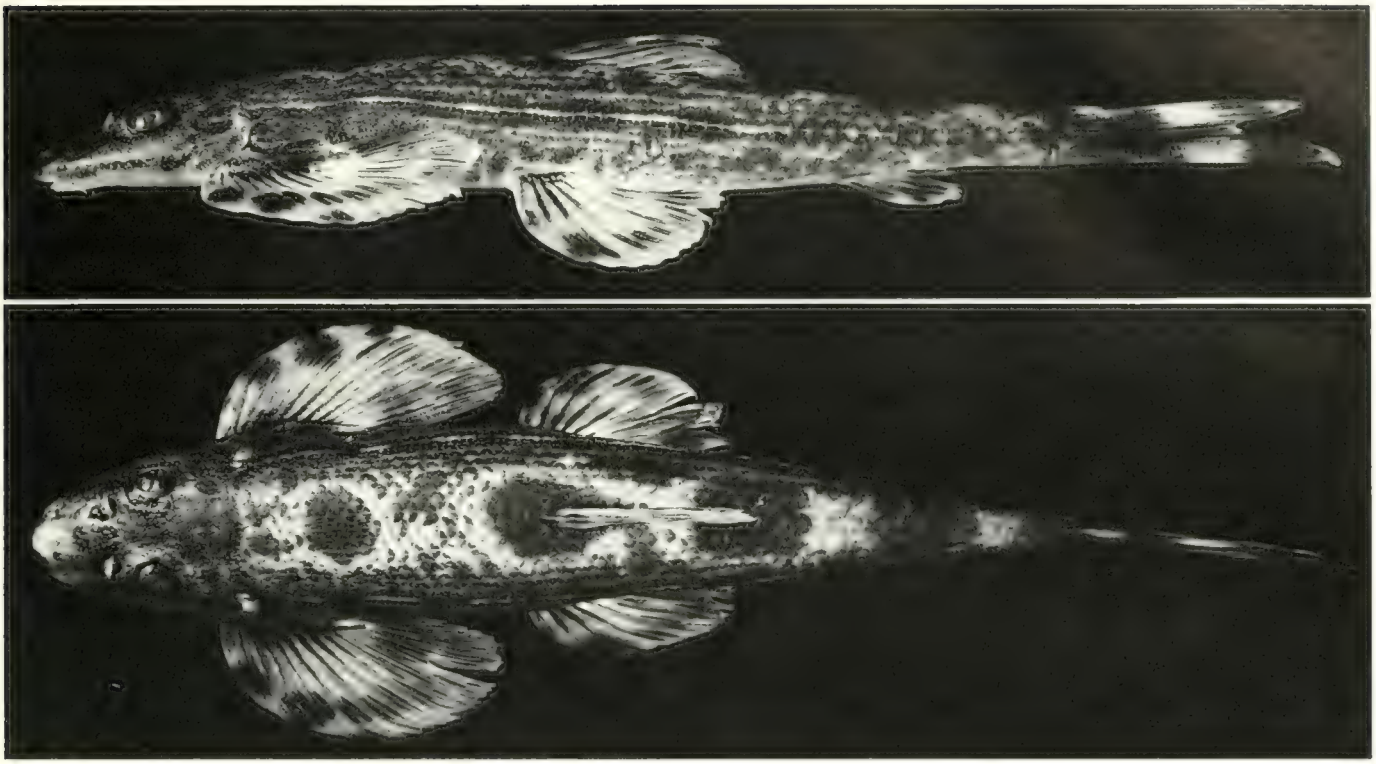

FIGURE 70. *Homaloptera* cf. *stephensoni*. Kapuas 1976-32, 57.5 mm (MZB 3479).

Homaloptera zollingeri Bleeker, 1853

(Figure 71)

Homaloptera javanica van Hasselt *in* Kuhl and van Hasselt, 1823:133 (nomen nudum)

Homaloptera Zollingeri Bleeker, 1853*a*:159 (type locality "Batavia, Bandong, in fluviis")

?*Homaloptera nigra* Alfred, 1969:217 (type locality Tahan River, Pahang, Malay Peninsula)

MATERIAL EXAMINED.—Malay Peninsula: River Tahan, Pahang, 2: 45.6–58.3 mm (CAS-SU 66424, paratypes *H. nigra*). Western Borneo: Kapuas 1976-22, 6 35.6–40.5 mm (CAS 49330, MZB 3474); Kapuas 1976-27, 8: 56.0–79.5 mm (BMNH 1982.3.29.117–118, CAS 44185, MZB 3475, RMNH 28868, USNM 230253); Kapuas 1976-29, 2: 59.4–68.5 mm (MZB 3476, CAS 49331)

The differences between *H. nigra* and *H. zollingeri* indicated by Alfred are rather slight; with the limited material at hand I am unable to decide whether they are distinct species.

DISTRIBUTION.—Thailand (Bangpakong). Malay Peninsula (Perak, Pahang, Johore). Sumatra (Lahat). Borneo (Kapuas). Java (Bandung, Batavia).

Hypergastromyzon new genus

TYPE SPECIES.—*Hypergastromyzon humilis* new species

DIAGNOSIS.—A gastromyzontin with head and body moderately broad and very strongly depressed; pectoral and pelvic fins greatly enlarged; pectoral-fin origin below eye; pelvic fins completely joined posteriorly; mouth small, about one-third as wide as head, with horny jaw sheaths strongly curved; three pairs of very short barbels, two rostral and one maxillary; rostral cap largely fused to or indistinguishable from upper lip except around base of rostral barbels; lower lip with medial groove well developed posterolaterally but interrupted anteromedially (Fig. 63a); snout broadly rounded in dorsal view, strongly acuminate viewed from the side; gill opening vertical, very small, above middle of pectoral-fin base; subopercular groove absent; base of first pectoral-fin ray separated from head by a deep groove or skin fold parallel to anterior margin of ray on ventral surface of head and continuing dorsally on head to behind base of ray (Fig. 63a); suprapelvic flap originating immediately behind pectoral-fin base and continuing as a free flap above anterior third of pelvic-fin base, but entirely free from pelvic fin itself; abdomen entirely scaleless. Pectoral fin separated from head by a deep groove extending ventrally to pectoral fin parallel to anterior margin of first pectoral-fin ray and dorsally to pelvic fin to origin of first branched pectoral-fin ray. Dorsal surface of fleshy pectoral-fin base scaleless.

The only other described Bornean gastromyzontins with greatly expanded pectoral and pelvic fins and completely joined pelvic fins are *Gastromyzon* and *Neogastromyzon*; the other genera have pectoral and pelvic fins much smaller, with far fewer rays, and pelvic fins widely separated. *Gastromyzon* and *Neogastromyzon* agree with each other and differ from *Hypergastromyzon* in having a broad mouth nearly as wide as the head, with horny jaw sheaths nearly straight transversely and a broad rostral cap separated from upper lip by a deep rostral groove. The shape of the head is very different and body depth much greater in these genera than in *Hypergastromyzon*. *Hypergastromyzon* superficially resembles the Chinese gastromyzontin genus *Beaufortia* Hora, 1932. *Beaufortia* has a narrow mouth as in *Hypergastromyzon* but differs in having origin of first pectoral-fin ray flush with surface of head dorsally and ventrally (rather than separated from head by a deep groove or fold of skin), supra-

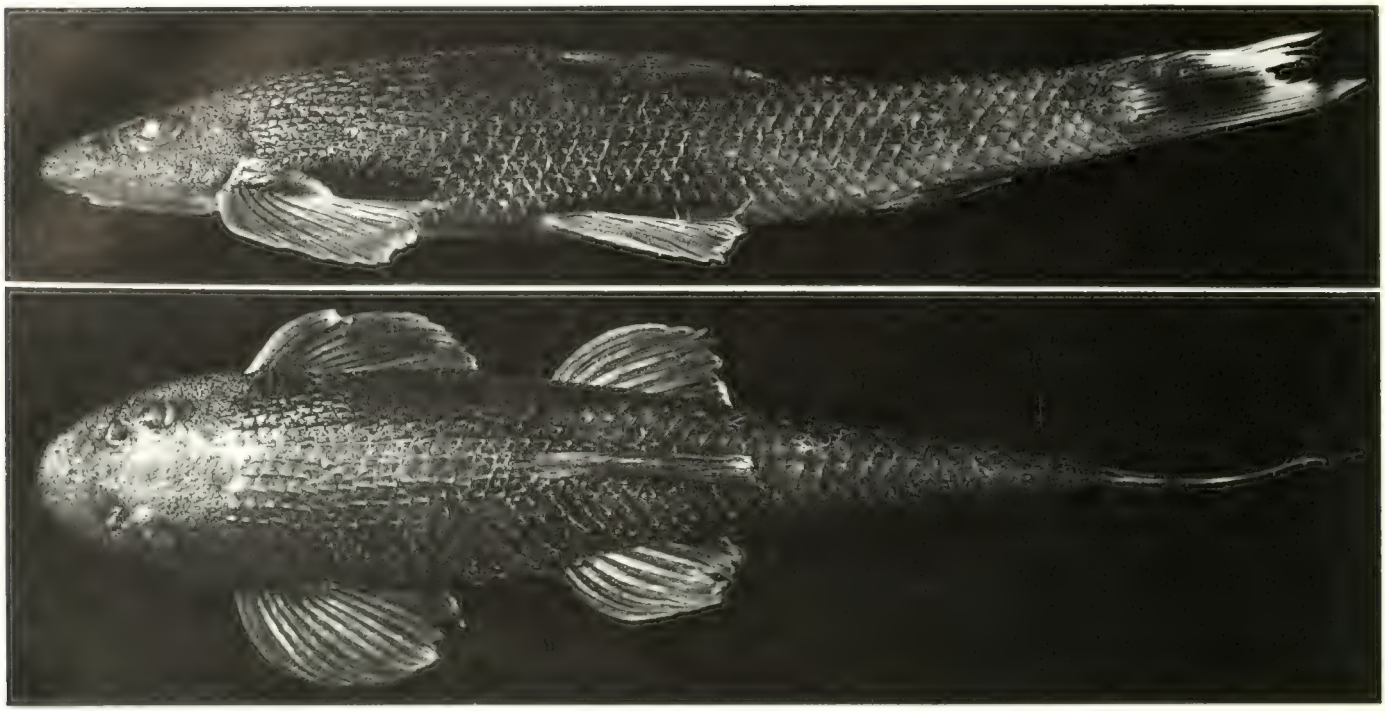

FIGURE 71 *Homaloptera zollingeri*. Kapuas 1976-27, 71.3 mm (MZB 3475).

pelvic flap originating near middle of pelvic fin and strongly attached to pelvic fin (rather than originating just behind pectoral-fin base and entirely free from pelvic fin), pelvic fins incompletely joined posteriorly, and free margin of rostral cap lobose. These characters suggest that *Beaufortia* is more closely related to other Chinese genera than to *Hypergastromyzon* or any of the Bornean genera.

Hypergastromyzon is known only from two specimens of an undescribed species obtained by the Kapuas survey of 1976.

ETYMOLOGY.—*Hypergastromyzon* (masculine), from Greek *hyper* and *Gastromyzon*.

Hypergastromyzon humilis new species

(Figures 63a, 72)

HOLOTYPE.—MZB 3480, 35.7 mm (probably subadult female), Sungei Tamang, small forest stream with rocky bottom flowing into Sungai Pinoh opposite mouth of Sungei Kelawai (Kapuas 1976-30)

PARATYPE.—CAS 49333, 37.5 mm (probably subadult female), collected with holotype

Head length 4.0–4.2, width (measured just in front of pectoral-fin origin) 4.1–4.4; snout 8.7–8.8; eye 15.9–18.8; interorbital width 13.7–14.2; gill opening small, about equal to eye diameter, 16.3–18.3; mouth width 15.6–16.6; length of all barbels one-fourth or less of eye diameter; greatest depth body 7.5–9.3; least depth caudal peduncle 13.2–14.2; pectoral fin originating below middle of eye, length 2.5; pelvic fin originating well in advance of vertical through dorsal-fin origin, length 3.4; anal fin small, widely separated from pelvic fin, length 7.9–8.5; distance between posterior margin of pelvic fin and anal-fin origin 9.9–14.2.

Pored scales in lateral series about 56; scale rows between dorsal fin and lateral line 11–12, between lateral line and pelvic fin 6; predorsal scales (very irregular) approximately 30–42; circumpeduncular 18–20. Anterior third of body with scale row immediately above lateral line and all scale rows below it considerably larger than scales more dorsally situated; this difference in scale size diminishes toward mid-body, and in posterior half of body all scales are nearly equal in size. Dorsal body surface entirely scaled except fleshy pectoral-fin base below gill opening and adjacent to pectoral fin and dorsolateral margin and free portion of suprapelvic flap which are scaleless. Abdomen entirely scaleless.

Dorsal-fin rays iii7 (last ray simple); anal-fin rays ii4 (last ray simple). Pectoral-fin rays i28–30 (last 3–4 rays entirely divided to base, last ray sometimes simple). Pelvic-fin rays i18–19. Pelvic-fin membranes entirely united posteriorly. Posteriormost part of pectoral-fin membrane with a single straight ray which appears to be median but actually originates from left or right pelvic fin (pelvic fin contributing this ray with one more ray than pelvic fin of opposite side). Ventral surface of anteriormost 11–12 pectoral- and 8 pelvic-fin rays with thick adhesive pads.

Dorsal surface of head and most of body above pectoral fins with small, widely spaced and almost uniformly distributed tubercles; posterior portion of body with a few very small scattered tubercles. Dorsal surface of pectoral fin with a single row of 1–6 tubercles superficially similar to those on head and anterior portion of body including pectoral-fin base; first and generally largest tubercle lying at or near base of ray, others diminishing in size and confined to basal half of ray. Dorsal surface of some pelvic-fin rays with single row of very small tubercles. The general nature and distribution of tubercles in the holotype and paratype suggests they are females; males of most Bornean gastromyzontins have densely packed rows of numerous tubercles on the pectoral fin, and some have peculiar comb-shaped or ctenoid tubercles on the cheek or pectoral-fin base, neither of which occur in these specimens.

Dorsal surface of head with numerous small dark round spots.

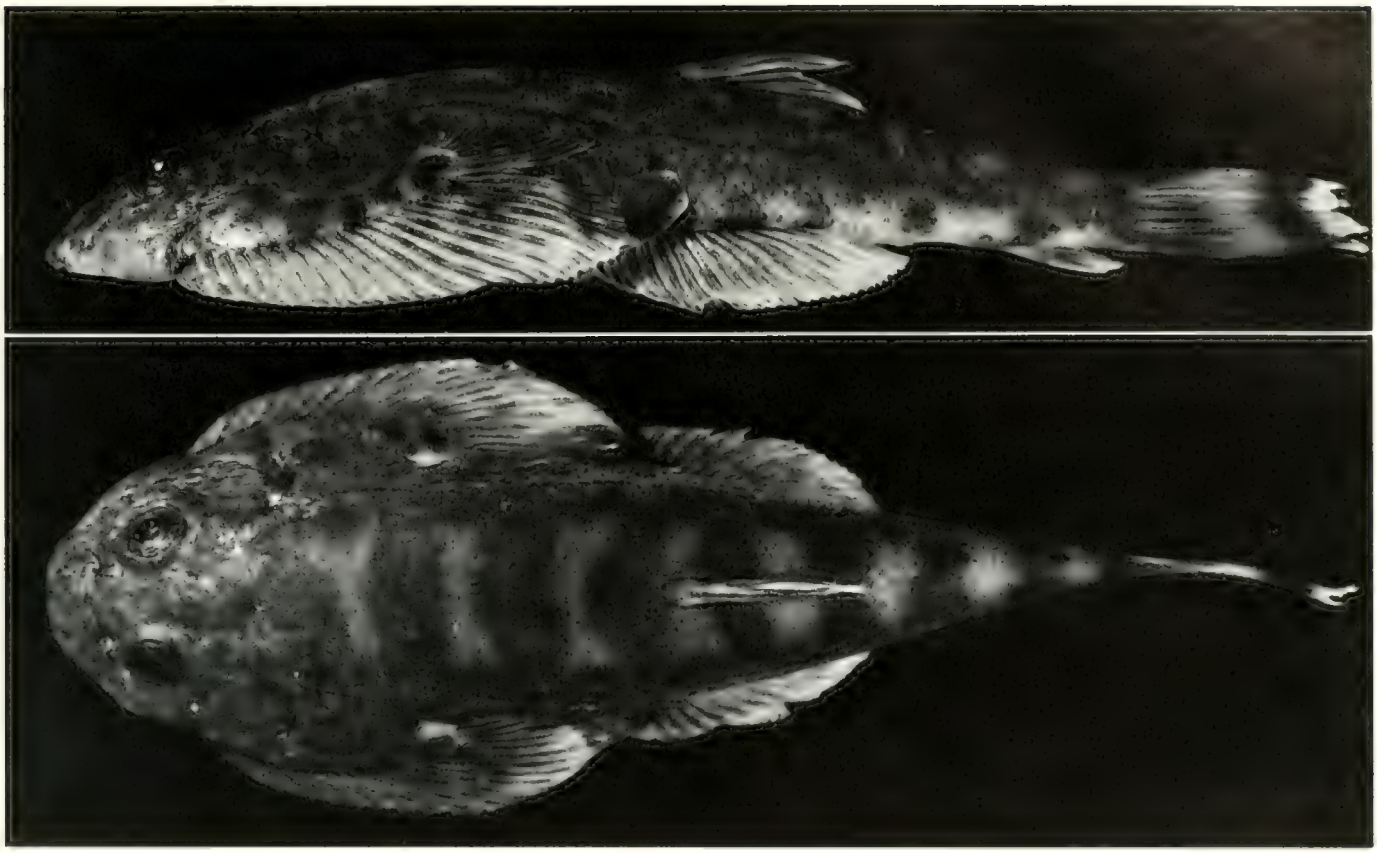

FIGURE 72. *Hypergastromyzon humilis*. Kapuas 1976-30, 35.7 mm (MZB 3480, holotype).

Dorsal surface of body with nine regularly spaced, broad transverse dark bars alternating with pale intervals, superficially similar to coloration of *Homaloptera* and very different from that in other Bornean gastromyzontins. Pectoral, pelvic, and anal fins with faint broad bands; caudal fin with two widely spaced dark vertical marks separated by a pale interval with fine melanophores; dorsal-fin rays uniformly covered with fine melanophores but interradial membranes without melanophores and dorsal fin relatively lacking color pattern.

DISTRIBUTION.—Kapuas.

ETYMOLOGY.—The name *humilis* (Latin, on the ground, low) refers to the depressed body form of this species.

Neogastromyzon Popta, 1905

Neogastromyzon Popta, 1905:180 (type species *Neogastromyzon nieuwenhuisii* Popta, 1905, by monotypy).

DIAGNOSIS.—Gastromyzontins with mouth opening broad, almost as wide as head; pelvic fins united posteriorly, each with 15–22 rays. Superficially similar to *Gastromyzon* but differing from that genus in having no sublacrimal groove; rostral and maxillary barbels projecting from posterior margin of rostral cap (the primitive condition) rather than from its anterior margin; and a narrower, more elongate body.

Neogastromyzon comprises two species known mainly from northern Borneo. A single specimen has been collected in the Kapuas basin.

Neogastromyzon nieuwenhuisii Popta, 1905

Gastromyzon borneensis Vaillant, 1902:18 (nec Günther; Haut-Sibau, Kapuas)
Neogastromyzon nieuwenhuisii Popta, 1905:181 (type locality Howong River, Mahakam basin)
Gastromyzon nieuwenhuisi Weber and de Beaufort, 1916:4.

MATERIAL EXAMINED.—Western Borneo: "Silau" [=Sibau, upper Kapuas], 20.3 mm (RMNH 7795). Sarawak: Sadong R., 29.3 mm (CAS-SU 68827); Batang Ai, Batang Lupar basin, 6: 34.5–38.9 mm (CAS 53172–53173)

The 20.3 mm specimen from Sibau here identified as *N. nieuwenhuisii* represents the only known specimen of *Neogastromyzon* from the Kapuas basin. It has 23 pectoral- and 20 pelvic-fin rays. Inger and Chin (1961) reported a large number of specimens from the Rajang basin, Sarawak. The specimens reported above from the Sadong and Lupar represent the first records for these basins.

The only other species in the genus is *N. pauciradiatus* (Inger and Chin 1961), from the Rejang basin, characterized by only 15–16 pelvic-fin rays (vs. 18–21 in *N. nieuwenhuisii*).

DISTRIBUTION.—Sarawak, Kapuas, Mahakam.

Neohomaloptera Herre, 1944

Neohomaloptera Herre, 1944:51 (type species *Homaloptera* (*Neohomaloptera*) *johorensis* Herre, 1944, by original designation and monotypy, proposed as subgenus).

Neohomaloptera, among the smallest Homalopteridae, is distinguished from all other genera by having two maxillary barbels

instead of only one at each corner of mouth. Superficially it resembles some of the smaller species of *Homaloptera*. Unlike *Homaloptera*, most of which live in mountain streams or in riffles in lowland streams, *Neohomaloptera* tends to be found in vegetation in slow-flowing lowland streams or swampy areas.

Neohomaloptera johorensis (Herre, 1944)

Homaloptera (*Neohomaloptera*) *johorensis* Herre, 1944:51 (type locality brook near Simpang Rengam, Johore, Malay Peninsula).
Neohomaloptera johorensis Silas, 1953:203

Material Examined.—Malay Peninsula: brook near Simpang Rengam, Johore, 2: 18.0–20.5 mm (CAS-SU 39840–39841, holotype and paratype); River Sarong Buaya, Johore, 2: 18.7–20.3 mm (CAS-SU 66426). Western Borneo: Kapuas 1976-4, 17.5 mm (MZB 3481)

This is apparently the smallest species of Homalopterinae. Alfred (1969:223) reported 52 specimens from the Malay Peninsula, the largest only 23.7 mm. It differs from all other members of the subfamily by its low pectoral-fin ray counts and in having two maxillary barbels on each side instead of only one. Its scale counts, 31–37, are lower than those of all other species except *H. tweediei*, which has 32–36.

Distribution.—Malay Peninsula (Johore). Western Borneo (Kapuas).

Cobitidae

This family has more species than any other Eurasian freshwater fish family except Cyprinidae. Loaches are perhaps more diverse in the Kapuas than anywhere else. All four cobitid subfamilies currently recognized are present: Botiinae (one genus and three species); Cobitinae (five genera and 12 species), Nemacheilinae (two genera and seven species), and Vaillantellinae (one genus and two species). In addition, the strange cobitid *Ellopostoma megalomycter*, which does not seem to fit into any of these subfamilies, is known only from the Kapuas.

A number of cobitid genera, especially in the subfamily Cobitinae, are poorly defined and difficult to distinguish. Most of the southeast Asian genera and species have not been studied osteologically and in a number of instances adequate generic diagnoses are unavailable.

Apparently all genera of Cobitinae are characterized by sexual dimorphism in which the pectoral fins of males are enlarged and otherwise modified. The pectoral-fin ray most highly modified may be either the second (first branched) ray or the innermost (medial) ray. One new species from the Kapuas has males with bony serrations on the second pectoral-fin ray, a specialization previously unreported. Other males with modified pectoral-fin rays bearing variously shaped bony projections or multicellular keratinous tubercles (breeding tubercles). As this sexual dimorphism has not been well studied, an effort has been made to record it here and describe some of the interspecific differences that occur.

Blind loaches have been reported from caves in Iran, Iraq, and China, but the blind *Lepidocephalus spectrum* described herein is the first known blind loach that lives in a normal riverine habitat.

The number of species known in the family Cobitidae has grown enormously since Linnaeus (1758) published his account of the "genus" *Cobitis* with five species. Van Hasselt (1823) reported the discovery of five new species in Java, some of which occur also in Borneo, and made one of the earliest efforts to split the Linnaean genus *Cobitis*. Van Hasselt's names pose some serious nomenclatural problems which I have attempted to resolve in the following account. Bleeker, Vaillant, Fowler, and others have described additional new genera and species from the East Indies or Indonesia and Borneo, and additional taxa undoubtedly remain to be discovered there. In the present account one genus and six species are described as new. Another new species discovered during the Kapuas survey of 1976, *Nemacheilus kapuasensis*, has been described by Kottelat (1984).

It appears that information on vertebral number is helpful in distinguishing various genera and species of loaches. Data on vertebral counts of loaches from southeast Asia and elsewhere are presented in Table 4. Abdominal and caudal as well as total counts are given, which is much more informative than total counts only. The table shows that *Lepidocephalichthys* and *Nemacheilus* have characteristic vertebral formulae exhibited by most or at least many of the species. The similarity of the vertebral counts or formulae of *Acanthopsoides gracilis* and *Acantopsis choirorhynchus* may indicate that they are in fact closely related, as suggested by their superficially similar appearance. Phyletic isolation of *Barbucca*, *Ellopostoma*, *Lepidocephalus*, and *Vaillantella* is supported by their distinctive vertebral formulae. *Barbucca*, possibly the smallest nemacheilin loach, has the lowest vertebral counts known in Cobitidae.

Acanthopsoides Fowler, 1934

Acanthopsoides Fowler, 1934*b*:103 (type species *Acanthopsoides gracilis* Fowler, 1934, by original designation and monotypy).

Diagnosis.—Superficially similar to *Acantopsis*, but snout less elongate, suborbital spine only slightly anterior to eye, and dorsal fin with only 8–9 rays, its origin posterior to a vertical through pelvic-fin origin. Vertebrae 40–42.

A single known species.

Acanthopsoides gracilis Fowler, 1934

Acanthopsoides gracilis Fowler, 1934*b*:103, fig. 55 (type locality "Chien Mai, North Siam" [Mekong basin])

Material Examined.—Western Borneo: Kapuas 1976-10, 3: 27.6–44.8 mm (CAS 49342, MZB 3506); Kapuas 1976-21, 26.9 mm (MZB 3507); Kapuas 1976-22, 7: 34.8–46.0 mm (CAS 49343, MZB 3508); Kapuas 1976-25, 45.0 mm (MZB 3509); Kapuas 1976-33, 28.3 mm (MZB 3510); Kapuas 1976-37, 42: 25.5–42.3 mm (BMNH 1982.3.29.127–131, CAS 49512, FMNH 94232, IRSNB 19744, KUMF 2853, MZB 3511); Kapuas 1976-39, 78: 21.6–44.1 mm (ANSP 152021, CAS 49344, MNHN 1982-697, MZB 3512, RMNH 28873, UMMZ 209902, USNM 230261, ZMA 116.536); Kapuas 1976-43, 2: 23.2–35.5 mm (CAS 49345, MZB 3513); Kapuas 1976-51, 2: 26.1–27.8 mm (CAS 49346, MZB 3514).

Acanthopsoides gracilis occurs sympatrically with *Acantopsis*, and has sometimes been mistaken for its young, although the two are readily distinguishable. The largest recorded *A. gracilis* is only 54 mm. *Acantopsis* attain at least 225 mm.

Sexual dimorphism has not been reported previously. The series of 42 specimens from Kapuas 1976-37 comprises 13 males 25.5–28.3 mm and 29 females 33.0–42.3 mm. Males have enlarged, upcurved pectoral fins, with the second ray about three times thicker than the others. On the distal third of the second ray, the branched portions of the ray each bear a single irregular row of minute breeding tubercles. Such a clear-cut difference in male–female body size is unusual for Cobitinae, and may not

be typical of this species. The sample from Kapuas 1976-25 consists of a single much larger male (45.0 mm) with a similarly modified second pectoral-fin ray.

DISTRIBUTION.—Thailand (Mekong). Borneo (Kapuas).

Acantophthalmus van Hasselt, 1823

Acantophthalmus van Hasselt, 1823:133 (type species *Acantophthalmus fasciatus* van Hasselt, 1823=*Cobitis kuhlii* Valenciennes *in* Cuvier and Valenciennes, 1846, by subsequent designation of Bleeker, 1863*c*:38).

Acanthophthalmus Bleeker, 1858–59*e*:304, 1860*a*:73 (unwarranted change in spelling).

Pangio Blyth, 1860:169 (type species *Cobitis pangia* Hamilton-Buchanan, 1822, by monotypy).

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

?*Eucirrhichthys* Perugia, 1892:1009 (type species *Eucirrhichthys doriae* Perugia, 1892, by monotypy). See Remark under *Acantophthalmus anguillaris* below.

NOMENCLATURAL NOTE.—In attempting to determine the original authority, type species designation, and proper spelling of this genus one has to deal with *Acantophthalmus* van Hasselt (1823:133) which has been variously misquoted, misinterpreted, or overlooked by others. This represents one of the most difficult of the nomenclatural problems posed by the publication of van Hasselt (1823). It is perhaps well to recall here that his account was never intended for publication; it does not represent his efforts at formal description, but merely an attempt to explain in a private letter to Temminck the extent and nature of the Javanese fish collections obtained by Kuhl and him.

The paragraph in which *Acantophthalmus* is treated may be cited in full:

> *Cobitis Octocirrhus* Tab. nostra, Irivroet Zunda, Kitjaerae heeft, met de *Cobitis taenia* Linn., dat gemeen, dat hij onder het oog eenen beweegbaren doorn heeft; dit teeken komt mij voor een gewigtig te zijn, als verschiedenen karakteren in de genera der Cyprinïden door Cuv. opgesteld, en zou alzoo als eenen afdelling van Cobitis, den naam *Acantophthalmus* verdienen. De zonderlin structuur der luchtblaas, is geheel die der Cobiten en hij leeft als deze in kleine beken; ik reken tot dezen *Acantophthalmus* nog 2 specien, die zich alleen onterschieden door eene meer afterwaarts geplaatse dorsaal-vin. Zij dragen in de teekening de namen *fasciatus* en *Javanicus* Mihi Rambockassang beide in het Zundasche.

An English translation of this paragraph, prepared with the help of M. Boeseman, was published by Alfred (1961:86), and may also be quoted here:

> *Cobitis Octocirrhus* Tab. nostra, Irivroet in Sundanese, Kitjaerae has, in common with *Cobitis taenia* Linn. a moveable spine below the eye; this character seems to me to be as important as various characters in the genera of Cyprines erected by Cuv., and as a section of Cobitis would consequently deserve the name *Acantophthalmus*. The unusual structure of the air-bladder is exactly as that of the Cobites and it lives just like these in small brooks. To this *Acantophthalmus* I reckon another 2 species which distinguish themselves solely by a more backwardly placed dorsal fin. In the drawing they bear the names *fasciatus* and *Javanicus* Mihi both Rambockassang in the Sunda region.

Alfred did not analyze the nomenclatural significance of this paragraph, nor has anyone else to my knowledge. The name *Acantophthalmus* occurs in two other places in van Hasselt (1823), always with the same spelling, but without nomenclaturally significant remarks. The nomenclatural status of *Acantophthalmus, A. fasciatus, A. javanicus*, and *Cobitis octocirrhus* of van Hasselt (1823) must all rest solely on this one paragraph. No taxonomic character(s) are given to validate any of the three new species: *Cobitis octocirrhus* is not distinguished from *Cobitis taenia* Linnaeus, and *Acantophthalmus fasciatus* and *A. javanicus* are not distinguished from each other. Had the figures referred to by van Hasselt been published, they undoubtedly would have sufficed for species recognition.

The status of *Acantophthalmus* van Hasselt (1823) may now be considered. Van Hasselt undoubtedly intended it to include the three new species from Java as well as the European *Cobitis taenia* Linnaeus, 1758, but not the other species placed in *Cobitis* by Linnaeus (*anableps, barbatulus, fossilis*). The character of a subocular spine was in fact recorded by Linnaeus, but was used by him only to distinguish *C. taenia* ("Cobitis aculeo bifurco infra utrumque oculum") from the other four species of his *Cobitis* which all lack the spine. We know now that the spine occurs in the majority of species in the large subfamily Cobitinae and in all species of Botiinae.

So far as I have been able to determine, a valid type species has never been designated for *Acantophthalmus*. Bleeker (1863: 38) designated *Acantophthalmus fasciatus* van Hasselt, 1823 as type species, but this is a nomen nudum. It is believed that *Cobitis kuhlii* Valenciennes, 1846 in fact represents the original *A. fasciatus*. Under "*Acanthophthalmus* [sic] van Hasselt" Jordan (1917:116) stated "type *Acanthophthalmus fasciatus* van Hasselt is unavailable (Code, Article 12)." There is no discussion of the nomenclatural history of the genus *Acantophthalmus* and no mention of a type species in the important paper on the species of the genus by Fraser-Brunner (1940).

A strict interpretation of the Code would seem to require that *Cobitis taenia* Linnaeus be recognized as type species of *Acantophthalmus*, since it is the only one of the species included by van Hasselt which is nomenclaturally available. Since *C. taenia* is the type species of *Cobitis, Acantophthalmus* would become a junior objective synonym of *Cobitis*.

The original spellings *Acantophthalmus* and *Acantopsis* by van Hasselt clearly were intentional. Both names appear repeatedly with no change in spelling. It should be pointed out that numerous systematists have regarded "acanto" as a correct Latinization (e.g., *Hypacantus* Rafinesque, 1809; *Acantophis* Berthold, 1827; *Acantoceras* Pavlov, 1892). In numerous instances, in fact, earlier names spelled with "acantho" subsequently were corrected to "acanto" (see Neave 1939:12). Thus while nearly all subsequent authors have used the spellings *Acanthophthalmus* and *Acanthopsis* for these genera, it seems that this is not permissible according to the present Code. Similar problems arise in names in which "opisto" and "opistho" have been used interchangeably. It seems that the best way to resolve such duality in spelling, at least in most instances, is to adhere to the original spelling, as is done here with *Acantophthalmus* and *Acantopsis*.

Acanthophthalmus Bleeker, 1859, automatically takes the same type species as *Acantophthalmus* van Hasselt, 1823 (Code, Article 67(i)(ii)).

Two Bornean species placed until now in this genus, *A. lorentzi* Weber and de Beaufort, 1916, and *A. sandakanus* Inger and Chin, 1962, are herein referred to *Leptocephalichthys*.

Acantophthalmus anguillaris Vaillant, 1902

Acanthophthalmis anguillaris Vaillant, 1902:151 (type locality Kapuas)

Acanthophthalmus vermicularis Weber and de Beaufort, 1916:34 (type locality

TABLE 4. FREQUENCIES OF VERTEBRAL COUNTS IN COBITIDAE. For definition of vertebral counts see p. 22.

Acanthopsoides gracilis	
Kapuas 1976-22	27–28+12–14=40(2), 41(3), 42(1)
Acantophthalmus anguillaris	
Perak (paratypes *C. perakensis*)	50+19–20=69(2), 70(1)
Kapuas 1976-21	50–52+19=69(1), 70(1), 71(1)
Acantophthalmus muraeniformis de Beaufort, 1933	
Singapore (CAS-SU 32602, paratype)	33+15=48?(1)
Johore (CAS-SU 32601)	34–35+14–16=49(1), 50(5)
Acantophthalmus myersi Harry, 1949	
SE Thailand (CAS-SU 14888, paratype)	35+13=48(1)
Acantophthalmus oblongus	
Kapuas 1976-29	33–35+12=45(1), 46(8), 47(2)
Acantophthalmus pangia (H.-B., 1822)	
Nepal, Chitawan (CAS 50180)	50(1)
Acantophthalmus cf. *pangia*	
Burma, Mitkyina (CAS-SU 32618)	40+14–15=54(1), 55(1)
Acantophthalmus semicinctus	
Johore (CAS-SU 32611)	34–37+12–15=46(1), 48(1), 49(4), 50(2), 51(1)
Kapuas 1976-17	33–35+13–14=46(1), 47(1), 48(9), 49(2)
Acantophthalmus shelfordi	
Kapuas 1976-16	34–36+14–15=49(1), 49(3), 50(1)
Acantophthalmus superbus	
Kapuas 1976-17, paratypes	35–36+15–16=50(1), 51(2), 52(1)
Acantopsis choirorhynchos	
Kapuas 1976-35	28–29+13–14=42(2)
Acantopsis lachnostoma Rutter, 1897	
S. China, Swatow (CAS-SU 1812, holotype)	29+15=44(1)
Barbucca diabolica	
Kapuas 1976-37, paratypes	19–20+8–9=28(7), 29(6)
Botia hymenophysa	
Kapuas 1976-36, 39	20–21+12–13=33(6)
Botia macracantha	
Kapuas 1976-19	19–20+10–11=30(3)
Botia reversa	
Sumatra, paratypes	20–21+12–14=33(3), 34(1)
Kapuas 1976-27, 29, paratypes	21–22+12–13=33(5), 34(4)
Mahakam, paratypes	20–21+12–13=33(3)
Ellopostoma megalomycter	
Kapuas 1976-14	24–25+9=33(1), 34(1)
Lepidocephalichthys guntea (H.-B., 1822)	
Nepal (CAS 50532)	24–25+11=35(1), 36(3)
Lepidocephalichthys hasselti	
W. Java (CAS-SU 20499, 24094, UMMZ 155673)	24–25+11–12=35(1), 36(4)
Lepidocephalichthys lorentzi	
Kapuas (ZMA 103.259, holotype, ZMA 116.551)	25–26+11–12=36(1), 37(1), 38(1)
Lepidocephalichthys pristes	
Kapuas 1976-16, 42, paratypes	23–24+9–10=33(4), 34(1)
Lepidocephalichthys sandakanensis (Inger and Chin, 1962)	
N. Borneo, Sandakan (CAS-SU 49967, paratypes)	23–25+11–13=35(1), 36(4)
Lepidocephalus macrochir	
Kapuas (RMNH 7783, holotype *L. pallens*)	28+15=43(1)
Lepidocephalus spectrum	
Kapuas 1976-48, paratypes	28+14–15=42(1), 43(1)
Nemacheilus fasciatus (Val. *in* Cuv. and Val., 1846)	

TABLE 4. CONTINUED.

Java, Buitzenzorg (CAS-SU 20498)	20–23+12–13=33(1), 34(10), 35(4)
Nemacheilus kapuasensis	
Kapuas 1976-29	22+11–13=33(1), 34(6), 35(1)
Nemacheilus lactogeneus	
Kapuas 1976-45, types	24+14=38(2)
Nemacheilus maculiceps	
Kapuas 1976-27, paratypes	20–22+11–13=33(5), 34(4)
Nemacheilus saravacensis	
Kapuas 1976-8	22+12=34(1)
Nemacheilus selangoricus	
Kapuas 1976-39	21–22+11–12=33(10), 34(10)
Nemacheilus cf. *longipectoralis*	
Kapuas 1976-45	23+12=35(1)
Vaillantella euepiptera	
Kapuas 1976-37	33–35+19–21=52(2), 53(2), 54(2)
Vaillantella maassi	
Pahang, R. Tahan (CAS-SU 50180, paratypes *V. flavofasciata*)	39–40+20=59(1), 60(1)
Kapuas 1976-29, 50	38+19=57(2)

"Sumatra, river Kampar kiri"). See Smith (1945:302), Inger and Chin (1962: 119–120), and below.

?*Eucirrhichthys doriae* Perugia, 1892:1009 (type locality Sarawak). See Tweedie (1956), and below.

Cobitophis anguillaris Myers, 1927:4.

Cobitophis perakensis Herre, 1940*a*:8 (type locality lake above Chenderoh Dam, Perak, Malay Peninsula). See Hora (1941*a*:49–51), Tweedie (1956:57), and below.

MATERIAL EXAMINED.—Malay Peninsula: 4: 46.1–60.5 mm, lake above Chenderoh Dam, Perak (CAS-SU 33004–5, holotype and paratypes of *Cobitophis perakensis*). Western Borneo: Kapuas 1976-21, 3: 70.2-76.8 mm (CAS 49334, MZB 3482, USNM 230255)

DIAGNOSIS.—By far the most elongate *Acantophthalmus*, with body depth 14 or more and vertebrae 69–71 (versus body depth 10 or less and vertebrae 45–55 in all other species).

The three Kapuas specimens of this species are two males, 71.0–76.8 mm, and a female, 70.2 mm. The males have large upturned pectoral fins, much larger, about twice as long as those of the female, and with the second fin ray greatly thickened. A faint, dusky midlateral stripe runs length of body, the upper portion of which is covered with fine, more or less uniformly distributed spots. In the female, anal-fin origin directly below base of last dorsal-fin ray; in the two males it is below the base of the second or third from last dorsal-fin ray. Principal caudal rays 8+8(2), 8+7(1). Female pectoral-fin rays 8; anal-fin rays 1,6; pelvic-fin rays 6. Male pectoral-fin rays 7 or 8; anal-fin rays 2,6; pelvic-fin rays 6. All four specimens in the type series of *C. perakensis* (SU 33004–5, 46.1–60.5 mm SL) appear to be females (or immature males) with small pectoral fins; the origin of the anal fin varies in position from below about the fourth to the second from last dorsal-fin ray.

Myers (1927) distinguished *Cobitophis* (type species *Acantophthalmus anguillaris* Vaillant) from *Acantophthalmus* on the basis of its having an extremely attenuated, anguilliform body, and some part of the anal fin under the dorsal fin. Myers included *Acantophthalmus vermicularis* Weber and de Beaufort (1916: 34) from Kampar Kiri R., Sumatra, in *Cobitophis*. A third species, *C. perakensis* Herre (1940:8) was described from Chenderoh Dam, Perak, Malay Peninsula. In these species the body depth is reported as 14.3–18 in standard length, whereas in other *Acantophthalmus* known at the time of Myers' description, it is about 7–10.

CONCLUSION.—*Acantophthalmus anguillaris* and *A. perakensis* are identical. Females of *A. anguillaris* from the Kapuas agree closely with the entirely female type series of *A. perakensis* in relative position of dorsal and anal fins and in body depth, the only characters cited to differentiate the species by Herre, and I have not found any other significant differences between them. *A. vermicularis*, based on a single 70 mm specimen, possibly a male, is probably also a junior synonym of *A. anguillaris*; it is described as having "last dorsal ray above first anal ray."

REMARK.—If the synonymy is correct, *A. anguillaris* includes individuals with and without more or less elongate barbels. The head or cheeks are usually scaleless, so far as observed or reported. *Eucirrhichthys doriae* Perugia, 1892:1009 (Weber and de Beaufort 1916:27, fig. 10), from Sarawak has a long nasal barbel and head extensively scaled, but is otherwise similar to *A. anguillaris*. Since nasal barbels and head squamation occur repeatedly in Cobitinae they can be regarded as primitive characters for the group, and their presence or absence should not be used to define genera. It seems probable that *E. doriae* is congeneric and possible that it is conspecific with *A. anguillaris*.

DISTRIBUTION.—Malay Peninsula (Tahang, Kelantan, Perak) (Hora 1941). Sumatra (Kampar Kiri River). Western Borneo (Kapuas). Sarawak? North Borneo (Tawan district) (Inger and Chin 1962). Thailand (Fowler 1934).

Acantophthalmus oblongus (Valenciennes, 1846)
new combination

(Figure 73)

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

Cobitis oblonga Valenciennes *in* Cuvier and Valenciennes, 1846:76 (type locality Java; description based on van Hasselt's unpublished figure of *A. javanicus*).

Acanthophthalmus javanicus Bleeker, 1860:75.

FIGURE 73 *Icantophthalmus oblongus*. Kapuas 1976-29, 62.6 mm male (CAS 49335).

?*Acanthophthalmus mariae* Inger and Chin, 1962:118, fig. 56 (Kinabatangan R at Deramakot)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-29, 15: 49.4–62.6 mm (CAS 49335, MZB 3483, RMNH 28870, USNM 230256); Kapuas 1976-47, 39.2 mm (MZB 3484)

Acantophthalmus oblongus and the extremely elongate *A. anguillaris* are perhaps the only plain colored *Acantophthalmus* in the East Indies. Specimens from Borneo, Sumatra (Weber and de Beaufort 1916:32) and Java should be compared to determine whether they are in fact conspecific. Weber and de Beaufort (1916:31) placed this species as synonym of *Acanthophthalmus pangia*, a plain colored species from Burma and India, but they apparently are not identical. This is the first record of *A. oblongus* from Borneo. Most of the Kapuas specimens were uniformly dark brown in life; a few were pale tan or gray.

In sexually mature males the pectoral fin is enlarged, due mainly to the elongation and widening of the second ray. The lepidotrichia of this ray are very numerous and broad, and the distal half of its dorsal surface is covered with a patch of hundreds of small, densely packed tubercles.

DISTRIBUTION.—If the synonymy given here is correct, the species is distributed in Java, western Borneo, Sumatra, and probably, eastern Malay Peninsula (for the latter see *A. pangia in* Hora 1941:47).

Acantophthalmus semicinctus Fraser-Brunner, 1940

Icanthophthalmus semicinctus Fraser-Brunner, 1940:172 (type locality Mawai district, Johore, and Malacca, Malay Peninsula)

MATERIAL EXAMINED.—Malay Peninsula: Johore, Mawai district, A. W. Herre, 27 February 1937, 38: 24.7–53.8 mm (CAS-SU 32611, non-types, but probably part of the series from which holotype was drawn); Johore, 5 miles north of Kota Tinggi, 4: 35.3–49.8 mm (CAS-SU 32612); Johore, near Kulai, 3: 48.6–52.5 mm (CAS-SU 39392); Johore, Kota Tinggi, 8: 23.7–52.5 mm (CAS-SU 39391); Malacca, Lake Chin Chin Jasin, 1: 55.7 mm (CAS-SU 31078). Western Borneo: Kapuas 1976-16, 3: 41.3–48.9 mm (BMNH 1982.3.29.121–2, MZB 3485); Kapuas 1976-17, 17: 33.3–51.0 mm (CAS 49336, FMNH 94230, MZB 3486, RMNH 28871, UMMZ 209858); Kapuas 1976-39, 25.5 mm (MZB 3487); Kapuas 1976-47, 4: 40.1–48.0 mm (MNHN 1982-695, MZB 3488); Kapuas 1976-51, 7: 24.7–42.9 mm (MZB 3489, USNM 230257)

DIAGNOSIS.—Until now this species has been known only from the southern Malay Peninsula.

In *A. semicinctus* the pale marks on the dorsal surface of the body are usually entirely transverse (usually complete but sometimes partial), or transverse alternating with small round spots (never longitudinal). When these spots are oval (i.e., elongated), they are oriented transversely.

In two 52.5 mm males from Kota Tinggi the pectoral fin is greatly enlarged and upcurved. The second ray is thickened. The skin on the dorsal surface of the branches of the second pectoral-fin ray is greatly thickened, and in the depression thus created between the branches lies a series of about 15 transverse, extremely regular, tightly seried rows of elongate breeding tubercles.

None has a separate row of smaller marks ventral to the marks covering the dorsal surface of the body.

Acantophthalmus shelfordi Popta, 1903

Icanthophthalmus shelfordi Popta, 1903:231 (type locality Sarawak, river near Kuching)

MATERIAL EXAMINED.—Western Borneo: MZB 3490, 45.2 mm, Kapuas 1976-6; MZB 3491, 31.8 mm, Kapuas 1976-7; BMNH 1982.3.29.123–126 and MZB 3492 (1), 5: 31.4–52.3 mm; Kapuas 1976-8; CAS 49337 (6) and MZB 3493 (1), 7: 30.2–46.2 mm, Kapuas 1976-12; MZB 3494, 33.3 mm, Kapuas 1976-13; FMNH 94231 (4) and MZB 3495 (1), 5: 44.2–51.0 mm, Kapuas 1976-16; IRSNB 19743 (3) and MZB 3496 (1), 4: 30.3–53.8 mm, Kapuas 1976-17; MZB 3497, 26.8 mm, Kapuas 1976-21; MZB 3502, 31.7 mm, Kapuas 1976-37; CAS 49338 (8), MNHN 1982-696 (4), MZB 3498 (10), RMNH 28872 (4), UMMZ 209901 (4), USNM 230258 (4), and ZMA 116.535 (4), 38: 24.0–52.6 mm, Kapuas 1976-39.

This species has an extremely variable color pattern.

DISTRIBUTION.—Malay Peninsula, Sarawak, Kapuas.

Acantophthalmus superbus new species

(Figure 74)

HOLOTYPE.—MZB 3499, 51.5 mm, Kapuas basin, small forest stream about 1 km up Sungai Tajan from Tajan, 87 km E of Pontianak (Kapuas 1976-51)

PARATYPES.—CAS 49339, 3: 32.7–34.6 mm, collected with holotype; MZB 3500 (1) and USNM 230259 (2), 3: 42.5–47.1 mm, Sungai Tekam near Kapuas mainstream 5–6 km upstream from Sanggau (Kapuas 1976-16); CAS 49340 (3) and MZB 3501 (1), 4: 48.1–57.1 mm, several small forest streams near Kapuas mainstream within 10 km upstream of Sanggau (Kapuas 1976-17)

DIAGNOSIS.—Distinguished from all other *Acantophthalmus* by its distinctive coloration.

All specimens have a row of about 10–11 dark saddlelike marks on head and body; in smaller specimens all of the marks tend to be discrete or but narrowly joined, while in larger specimens those on the body tend to be at least partly joined. In specimens of all sizes the dark marks are totally or partially separated at the dorsal midline by a pale area; in small specimens

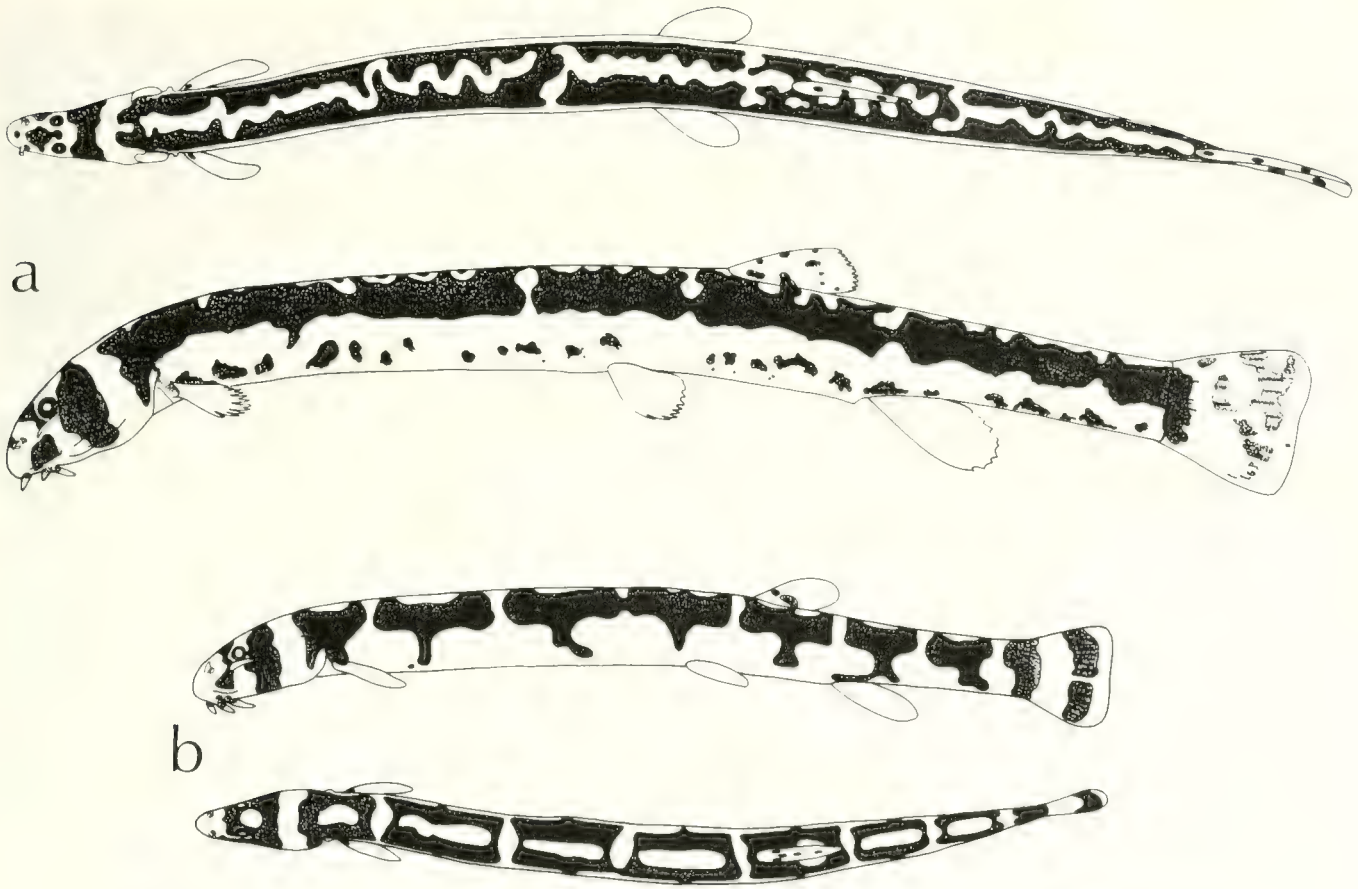

FIGURE 74. *Acantophthalmus superbus*. Kapuas 1976-51. a, 51.5 mm (MZB 3499, holotype); b, 34.2 mm (CAS 49339, paratype).

the pale area tends to form a series of short, separate longitudinal stripes and transverse bars; in larger specimens it is more variable, but generally more continuous, and may form a serpentine middorsal stripe (Fig. 74). In live specimens the dark areas are purple or magenta, and the pale areas, below as well as above the dark ones, are orange. All other species of *Acantophthalmus* known from the Kapuas are relatively drab. *A. superbus* tends to have more vertebrae than other *Acantophthalmus* from the Kapuas except *A. anguillaris* (Table 4).

ETYMOLOGY.—The name *superbus* (Latin) refers to the beautiful coloration of this species.

Acantopsis van Hasselt, 1823

Acantopsis van Hasselt, 1823:133 (type species *Acantopsis dialuzona* van Hasselt, 1823, by monotypy).
Acanthopsis Bleeker 1858–59*e*:303 (unwarranted emendation)
As pointed out by Alfred (1961:86), the description of *Acantopsis* given by van Hasselt appears to be sufficient for its recognition.
NOTE.—Concerning the spelling of *Acantopsis* see note under *Acantophthalmus*

DIAGNOSIS.—Distinguished from other Cobitinae by its greatly elongated head and snout, dorsally situated eyes, and suborbital spine entirely far anterior to eye (instead of below eye, or rarely, slightly anterior to it). Dorsal fin with 10–13 rays, its origin anterior to vertical through pelvic-fin origin. Caudal fin forked or deeply emarginate. Vertebrae 40–44.

Acantopsis choirorhynchos (Bleeker, 1854)

Cobitis choirorhynchos Bleeker, 1854*a*:95 (type locality Sumatra, Palembang "ubi confluunt flumina Lamantang et Enim").
Acanthopsis choirorhynchos Bleeker, 1860*a*:66

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-9, 111 mm (MZB 3503), Kapuas 1976-22, 93.2 mm (CAS 44184); Kapuas 1976-35, 4: 84.2–113 mm (CAS 49341, MZB 3504); Kapuas 1976-36, 2: 70.2–75.7 mm (MZB 3505, USNM 230260)

Following Smith (1945:296) and Alfred (1961), I tentatively treat *A. choirorhynchos* as distinct from *A. dialuzona*. Further study of the species of *Acantopsis* is needed.

In sexually mature males of *A. choirorhynchos* the pectoral and pelvic fins are greatly enlarged; the second pectoral-fin ray is greatly thickened, with hundreds of tubercles on its dorsal surface and thousands of unicellular horny projections or unculi on its ventral surface (Roberts 1982*a*:66, fig. 12e, 14).

Chen (1981:22) placed *Acantopsis lachnostoma* Rutter, 1897 as a junior synonym of *A. choirorhynchos*, thus extending the range of this species to southern China. I have examined the holotype of *A. lachnostoma* (CAS-SU 1812, 127 mm ripe female from Swatow, Kwangtung Prov.) and compared it directly with two Kapuas specimens of *A. choirorhynchos* 96–101 mm. The two taxa are congeneric but not conspecific. *Acantopsis lachnostoma* has the large, elongate head, dorsally situated eyes, suborbital spine anterior to eye, and oral cavity lined with villus-like papillae diagnostic of the genus *Acantopsis*. On the other hand the head is somewhat shorter, snout less pointed, caudal

FIGURE 75 *Barbucca diabolica*. Kapuas 1976-37, 23.2 mm ripe female (MZB 3536, holotype).

peduncle much deeper, dorsal-fin rays fewer, and vertebrae apparently more numerous than in *A. choirorhynchos* or any other member of *Acantopsis*. The holotype of *A. lachnostoma* has head 4.7, caudal peduncle depth 13.1, dorsal-fin rays iii7-1/2, and vertebrae 29+15=44 (vs. head 3.8, caudal peduncle depth 22.3–23.0, dorsal-fin rays iii10-1/2 and vertebrae 28+14=42 in Kapuas *A. choirorhynchos*). It seems that *A. lachnostoma* is a valid species endemic to southern China; it may be the most primitive species of *Acantopsis*.

DISTRIBUTION.—The systematics of *Acantopsis* is too poorly known to make meaningful statements about species distributions.

Barbucca new genus

TYPE SPECIES.—*Barbucca diabolica* new species.

DIAGNOSIS.—Related to *Nemacheilus* but distinguished by its smaller size; foreshortened body and large, broadly overlapped paired fins; peculiarly truncate snout and downturned jaws; labial in addition to rostral and maxillary barbels; fewer fin rays; fewer vertebrae; and unusual tuberculation.

Largest specimen, a gravid female (eggs to 0.25 mm diameter) only 23.2 mm (all other Nemacheilinae attaining more than 30 mm?); lower lips with bulbous posterolateral paired thickenings giving rise to moderately elongate labial barbels posteromedial to maxillary barbels; horny jaw sheaths very large; fin-ray counts almost invariable, dorsal-fin rays usually iii–iv8 (not 8-1/2), and ii–iii5, pectoral i10, and pelvic i6; caudal fin truncate, principal rays 9+9; pectoral- and pelvic-fin axial flaps absent; vertebrae 28–29 (all other Cobitidae with 30 or more vertebrae, *Nemacheilus* with 32–42; see Table 4).

Breeding tubercles on caudal peduncle exceptionally large, present in both sexes, about 6–8 in an irregular row on lower half of body extending immediately in front of and above anal-fin base (peduncular tubercles, characteristic of most Sundaic *Nemacheilus*, usually present in male sex only, generally associated with dorsolateral portion of caudal peduncle nearer caudal than anal fin). Some specimens of both sexes with one or two moderately large tubercles on gill cover near posterior margin. Mature males invariably with a very distinctive, slightly concave, or hook-shaped patch of numerous very small, close-set tubercles extending below and posterior to middle of eye (comparable tubercles unknown in any other cobitids). Subocular fleshy papilla absent (present in males of most Sundaic *Nemacheilus*). No other sexual dimorphism observed.

ETYMOLOGY.—*Barbucca* (feminine), from Latin *barba* (beard) and *bucca* (cheek), in reference to the tuberculate cheek patch in males.

Barbucca diabolica new species

(Figure 75)

HOLOTYPE.—MZB 3536, 23.2 mm, gravid female, small forested stream where it flows into Sungai Mandai 2–3 km upstream from confluence with Kapuas mainstream, 17 km WSW of Putussibau, 10 August 1976 (Kapuas 1976-37).

PARATYPES.—BMNH 1982.3.29.132–134, CAS 49354, FMNH 94233, MNHN 1982.698, MZB 3537, 29: 17.5–22.3 mm, collected with holotype; MZB 3538, RMNH 28876, 4: 15.6–20.6 mm, Sungai Mandai Ketchil near its confluence with Kapuas mainstream, 18 km WSW of Putussibau, 11 August 1976 (Kapuas 1976-39); MZB 3539, USNM 230268, 9: 17.6–20.6 mm, Sungai Seriang, forested tributary of Sungai Palin, 37 km W of Putussibau, 12 August 1976 (Kapuas 1976-42); MZB 3540, 22.2 mm, Sungai Gentu, near where it flows into Kapuas mainstream, 55 km NE of Sintang, 16 August 1976 (Kapuas 1976-46); MZB 3541, ZMA 116.537, 4: 14.8–17.9 mm, small forest stream flowing into Kapuas mainstream NE of Gunung Setunggul, 53 km NW of Sintang and 10 km NW of Silat, 16 August 1976 (Kapuas 1976-47); CAS 52591, 21.2 mm, Malay Peninsula, Johore, J. Vierke, ca. 1978.

The most distinctive characteristics of the species are given in the generic diagnosis. It may be further characterized as follows (proportional measurements from holotype): head length 3.6; eye large, diameter 13.2; interorbital space broad, about equal to eye, 12.9; snout 8.3; medial and lateral rostral barbels relatively thick but short, their length much less than eye diameter; maxillary barbel moderately elongate, extending posteriorly to below middle of eye, its length slightly greater than eye diameter; pectoral fin broadly overlapping pelvic fin, its length 3.8; pelvic fin length 4.3; origin of dorsal fin slightly nearer snout-tip than caudal-fin base, predorsal length 2.1; body width (at pectoral-fin origin) 5.3, depth (at dorsal-fin origin) 5.9; depth caudal peduncle 9.3, length 8.9. Scales relatively large and thin, deeply embedded and difficult to count especially anteriorly and dorsally, more exposed and slightly larger on posteriormost part of body, approximately 45–50 in lateral series.

Body with six broad dark vertical bands (rich brown in life)

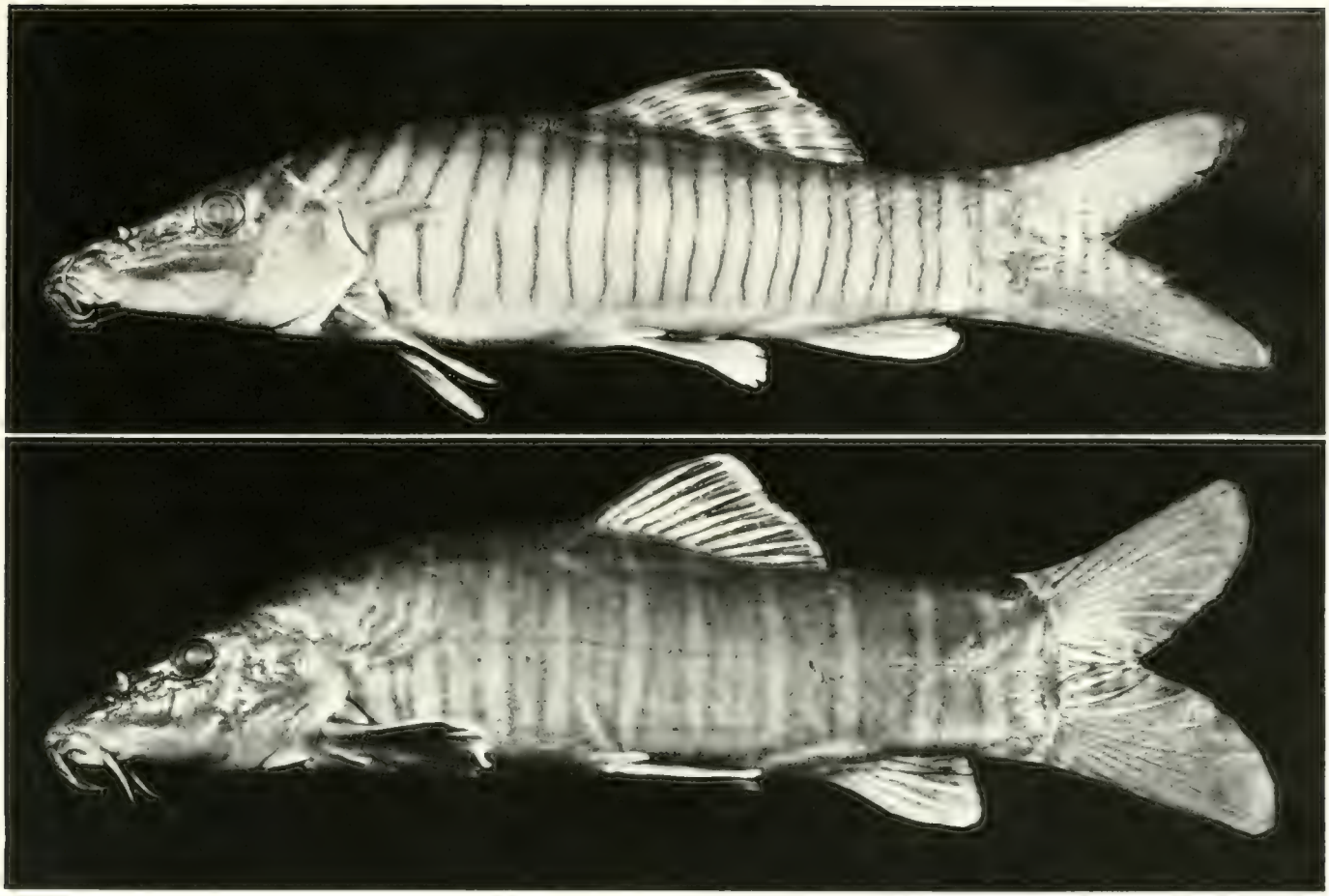

FIGURE 76. *Botia*. Above, *B. hymenophysa*, Kapuas 1976-39, 80.5 mm (MZB 3516); below, *B. reversa*, Kapuas 1976-27, 87.6 mm (MZB 3521, holotype).

separated by narrow, slightly oblique pale vertical bands (golden in life); dorsal and anal fins colorless; basal half or two-thirds of caudal fin with broad vertical bars; thin vertical uniserial rows of melanophores overlapping lepidotrichial joints of fin rays; pectoral and pelvic fins with dark basal marks on dorsal surface but otherwise colorless. In live specimens the eyes shined bright red, recalling the tapetum lucidum of nocturnal higher vertebrates, a feature looked for but not observed in any other Kapuas cobitids.

NOTE.—The existence of this species first came to my attention during a visit to the Raffles Museum in 1972, when Dr. Eric Alfred kindly showed me a single specimen he had collected in Johore (present disposition of this specimen is unknown, but a second specimen from Johore, CAS 52591, was collected by Dr. Jorg Vierke).

ETYMOLOGY.—The name *diabolica* alludes to the glowing red eyes and spiked tail characteristic of the species.

DISTRIBUTION.—Malay Peninsula (Johore). Western Borneo (Kapuas).

Botia Gray, 1831

Botia Gray, 1831:8 (type species *Botia almorhae* Gray 1831, by monotypy).
Hymenphysa McClelland, 1839:443 (type species not designated).
Syncrossus Blyth, 1860:166 (type species *Syncrossus berdmorei* Blyth, 1860, by monotypy).
Hymenophysa Bleeker, 1858–59*e*:303; Günther, 1868*a*:366 (unwarranted spelling emendation of *Hymenphysa* McClelland, 1839).

Botia hymenophysa (Bleeker, 1852)

(Figure 76)

Cobitis hymenophysa Bleeker, 1852*d*:602 (type locality Palembang, in fluviis).
Hymenophysa MacClellandi Bleeker, 1858–59*f*:358 (unwarranted substitute name for *Cobitis hymenophysa*).
Botia hymenophysa Bleeker, 1863–64:6.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-36, 4: 95.3–148 mm (CAS 49347, MZB 3515, RMNH 28874); Kapuas 1976-39, 2: 80.5–84.8 mm (MZB 3516, USNM 230262). Southeastern Borneo: Moara-Teweh, Barito-Flüss, 2: 85.0–126 mm (NMW 48528).

DIAGNOSIS.—A *Botia* with complex vertical bars consisting of alternating pale and dark bands separated by darker thin vertical streaks; as pale bands generally somewhat wider than dark ones, effect is 12–14 pale bands with very dark margins on a slightly dark background. Dorsal-fin branched rays 12-1/2 or 13-1/2.

Fin rays of all fins without melanophores except where traversed by features of color pattern; dorsal fin with a solid dark submarginal blotch on uppermost portion of last unbranched and first three branched rays and their interradial membranes. Rest of dorsal fin with about six evenly spaced oblique dusky bands breaking up into spots on interradial membranes and fin rays; middle portion of caudal fin with 5–6 narrow vertical dusky bands of fine melanophores; pectoral, pelvic, and anal fins clear or with relatively few fine melanophores on interradial membranes.

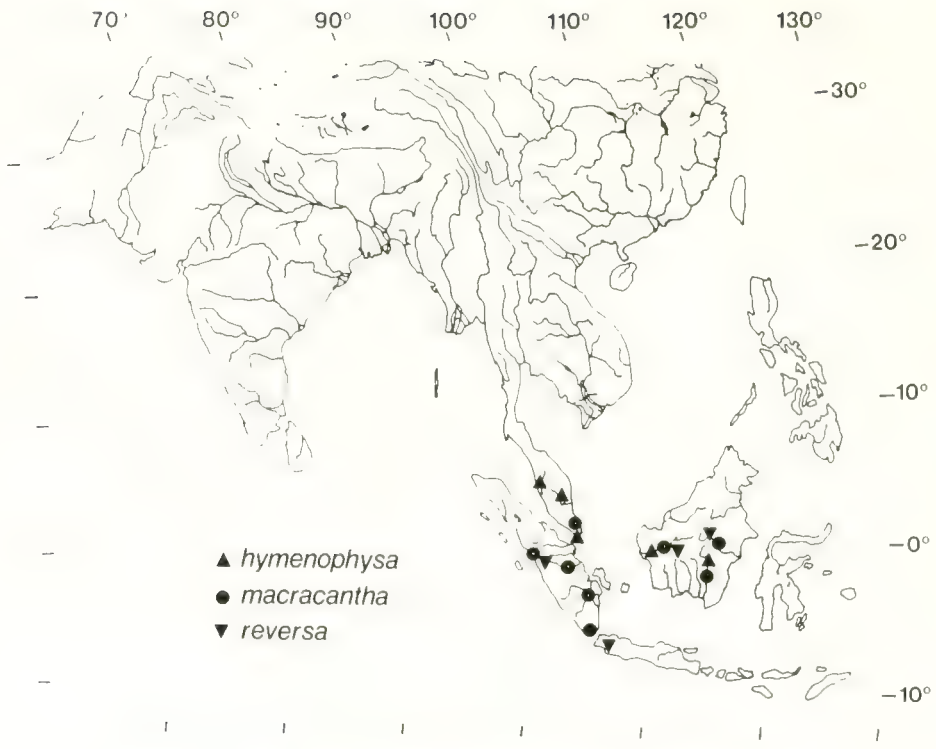

FIGURE 77. *Botia*. Geographical distribution of the three species found in Borneo.

Proportional measurements on two specimens 98.5–124 mm from Kapuas 1976-36 (CAS 49347) are head 3.1; snout 5.4–5.7; eye 21.9–23.8; body depth 4.2; body width 8.1–10.05; depth of caudal peduncle 6.3–6.5; predorsal length 1.7. Kapuas specimens have dorsal branched rays 12-1/2(5) or 13-1/2(1); pectoral rays 15(1), 16(1); pelvic rays 8(2). The 124 mm specimen, a male, has pectoral fins with dorsal surface of distal one-half of first 6–7 rays with 2–3 rows of about 6 tubercles each across each lepidotrich. No other sexual dimorphism observed.

DISTRIBUTION (Fig. 77).—Sumatra, Borneo, Java. Although frequently reported from the Mekong basin and other parts of Thailand and the Malay Peninsula, there are no confirmed records of this species from mainland Asia. At least some records of *B. hymenophysa* from Indochina and the Mekong basin are based on *Botia helodes* Sauvage, 1876. Specimens reported from the Malay Peninsula (Weber and de Beaufort 1916:24; Mohsin and Ambak 1983:117) should be reexamined to confirm their identity. Some Bornean and Sumatran records are based on *B. reversa* new species.

Botia macracantha (Bleeker, 1852)

Cobitis macracanthus Bleeker, 1852*d*:603 (type locality "Palembang et in flumine Kwanten, Sumatrae occidentalis")
Hymenophysa macracanthus Bleeker, 1860*a*:62
Botia macracantha Bleeker, 1863–64:5

DIAGNOSIS.—Distinguished from all other *Botia* by having 8 barbels instead of 6 and enormously enlarged suborbital spines. Branched dorsal-fin rays 8. Total vertebrae 30. Yellowish brown or orange with three broad vertical bars, the first bar passing obliquely through the eye and suborbital spine sheath.

DISTRIBUTION.—Malay Peninsula (Johore). Sumatra (Telok Betong; rivers Pangabuang, Musi, Kwanten; Batang Hari, Lake Manindjau). Borneo (Barito, Kahajan, Kapuas, Bangan, Mahakam). Unknown from Java and northern Borneo.

Botia reversa new species
(Figure 76)

Hymenophysa hymenophysa Fowler, 1904:500 (record based entirely or partly on *B. reversa* from Batu Sanghar)

HOLOTYPE.—MZB 3521, 87.6 mm, Kapuas basin, rocky channel in mainstream of Sungai Pinoh, 37 km S of Nangapinoh (Kapuas 1976-27).

PARATYPES.—CAS 49349, 4: 85.8–101 mm, collected with the holotype; MZB 3522 (1) and USNM 230264 (3), 4: 90.7–103 mm, Kapuas basin, rocky channel in mainstream of Sungai Pinoh at Nanga Saian, 45 km S of Nangapinoh (Kapuas 1976-29); RMNH 7651, 2: 71.0–75.1 mm, Mahakam basin, Long Bluu; RMNH 28042, 97.2 mm, upper Mahakam; CAS-SU 8008, 4: 62.6–75.0 mm, Batu Sanghar, Tanah Datar, Padangsche Bovenland (elevation 1,500–3,000 feet), Sumatra (note: additional specimens from this collection should be at ANSP); UMMZ 155675, 2: 65.5–95.7 mm, Tjisokan, Java

DIAGNOSIS.—A *Botia* with complex vertical bars apparently most closely related to *B. hymenophysa* from which it differs in having a shorter snout, slightly more robust body, 9–11 instead of 12–13 branched dorsal-fin rays, a slightly deeper caudal peduncle and shorter caudal fin, and a strikingly different color pattern which in at least some respects is the reverse of that in *B. hymenophysa*.

The holotype and 17 paratypes of *B. reversa* may be further characterized as follows (condition of paratypes in parentheses): head length 3.0 (2.9–3.4); snout 6.2 (5.7–6.7); eye 23.1 (21.8–25.8); suborbital spine extending posteriorly to below middle of eye; body depth 3.9 (3.8–4.6); body width 8.2 (6.9–9.6, greatest in gravid females); depth of caudal peduncle 5.6 (5.3–6.2); predorsal length 1.8 (1.75–1.85).

Frequencies of fin rays are as follows: dorsal-fin branched rays 9(5), 10(12), 11(1); pectoral-fin rays 13(2), 14(10), 15(4), 16(2);

pelvic-fin rays 8(18). A 103 mm Kapuas male has 1–2 rows of 2–3 tubercles across each lepidotrich on middle portion of pectoral-fin rays 3–5. No other sexual dimorphism observed.

Body with about 12 complex vertical bars consisting of alternating pale and dark bands separated by darker thin vertical streaks; as dark bands generally somewhat wider than pale ones, effect is of 12–13 dark bands with very dark margins on a pale background (reverse of pattern seen in *B. hymenophysa*).

Fin rays of all fins but especially of dorsal and pectoral fins more or less densely covered for their entire length or all but their tips by fine melanophores; most specimens with interradial membranes of dorsal, pectoral, pelvic, and anal fins largely or entirely clear except for fine melanophores on portions of interradial membrane immediately adjacent to fin rays; dorsal fin of some specimens with faint longitudinal stripes broken up into spots, faintly visible in middle of interradial membranes and somewhat darker where they overlie fin rays; only two specimens with a vertical black mark near tip of dorsal fin between last unbranched and first branched ray; basal half of caudal fin with four narrow vertical faint dark stripes (sometimes broken up into spots).

While the number of complex vertical bars is about the same in *B. reversa* and *B. hymenophysa*, in *B. reversa* the impression gained is of somewhat wider dark bars separated by pale interspaces while in *B. hymenophysa* the reverse is true. The two species presumably are closely related and it is reasonable to hypothesize that one of them has undergone at least a partial color pattern reversal in its evolution. A curious feature of the reversal is that in *B. reversa* fine melanophores are concentrated in the segmental or lepidotrichial joints of virtually all fin rays, whereas in *B. hymenophysa* the joints are devoid of melanophores or have very few of them.

Distribution (Fig. 77).—Known only from the Kapuas and Mahakam rivers of Borneo (mountain stream tributaries), Java and Sumatra. A note with the specimens from Sumatra indicates they were taken at 1,500–3,000 feet. It apparently does not occur sympatrically with the lowland species *B. hymenophysa*.

Etymology.—The name *reversa* (Latin) refers to the "reversed" color pattern of this species compared to that of *B. hymenophysa*.

Ellopostoma Vaillant, 1902

Ellopostoma Vaillant, 1902:145 (type species *Aperioptus megalomycter* Vaillant, 1902, by monotypy).

Diagnosis.—Distinguished from all other cobitids by its oblique, squared-off snout (shaped mainly by enormously expanded maxillae); mouth highly protrusible; a single pair of well developed maxillary barbels; ceratobranchial 5 with about 30 conical teeth in a single row; suborbital spine absent; dorsal fin elongate, with 18–19 rays, its origin far in advance of a vertical through pelvic-fin origin; pectoral fins not sexually dimorphic; vertebrae 33–34.

It can now be affirmed that *Ellopostoma* is a member of the family Cobitidae. In addition to the single row of ceratobranchial teeth, it has three branchiostegal rays and a Weberian apparatus with large lateral capsules of very spongy bone. The protrusible jaws, while highly modified, are basically similar to those of cyprinoids or cobitoids. Basihyal bone Y-shaped, as in many Cobitidae. On the other hand, relationships of *Ellopostoma* to other cobitids are unclear, and it clearly cannot be readily assigned to any of the subfamilies of Cobitidae currently recognized.

The genus was known only from the Kapuas basin, but recently has been found in the Tapi basin in peninsular Thailand (M. Kottelat, pers. comm.). Only one species is described.

Ellopostoma megalomycter (Vaillant, 1902)

(Figure 78)

Aperioptus megalomycter Vaillant, 1902:3145 (type locality "Kapuas"=Sintang?).
Ellopostoma megalomycter Weber and de Beaufort, 1916:237; Roberts, 1973 (redescription of type specimens).

Material Examined.—Western Borneo: Kapuas 1976-14, 17: 39.9–48.8 mm (BMNH 1981.4.13.20–26, CAS 49350, MZB 3523, RMNH 28875); Kapuas 1976-15, 41.5 mm (MZB 3524); Kapuas 1976-22, 45.7 mm (MZB 3525); Kapuas 1976-37, 11: 38.5–45.8 mm (CAS 49351, MZB 3526).

Lepidocephalichthys Bleeker, 1863

Lepidocephalichthys Bleeker, 1863*c*:35, 38, 42 (type species *Cobitis hasselti* (Valenciennes *in* Cuvier and Valenciennes, 1846, by original designation).
Platacanthus Day, 1865:296 (type species *Platacanthus agrensis* Day, 1865, by monotypy)

Diagnosis.—Lower lip deeply divided into posteriorly projecting lobes, each lobe bearing two or three short barbel-like projections. Dorsal-fin rays 7–9, anal-fin rays 6–7, pectoral-fin rays 8–9, pelvic-fin rays 7–8. Pectoral fins of mature males highly modified. Vertebrae 34–38.

This genus appears to be very widely distributed. The species, perhaps most numerous in India, are poorly known. Two Bornean species previously placed in *Acantophthalmus* have been studied by me and are here referred to *Lepidocephalichthys* for the first time: *L. lorentzi* (Weber and de Beaufort, 1916), known only from the Kapuas, and *L. sandakanus* (Inger and Chin, 1962), known only from the Kinabatangan basin in northern Borneo. *L. sandakanus* resembles *Acantophthalmus* in having the dorsal-fin origin very far posterior, about midway between verticals through the pelvic- and anal-fin origins (Inger and Chin 1962, fig. 54e), and vertebral formula (Table 4). For *L. lorentzi* see below.

Lepidocephalichthys hasselti (Valenciennes, 1846)

Cobitis Hasselti Valenciennes *in* Cuvier and Valenciennes, 1846:74 (type locality Java)
?*Cobitis barbatuloides* Bleeker 1851*i*:435 (type locality "Sambas, in fluviis")
Lepidocephalichthys Hasseltii Bleeker, 1860*a*:71
?*Cobitichthys barbatuloides* Bleeker, 1860*d*:21 ("Sambas, Pontianak")
Lepidocephalichthys Hasseltii Bleeker, 1863*c*:35.
?*Misgurnus barbatuloides* Bleeker, 1863–64:13.

This species, known from Java and Sumatra, has not been reported previously from Borneo. Its inclusion here is based on published accounts of the holotype and only known specimen of *Cobitis barbatuloides* which is apparently lost. Its generic identity is dubious. According to Bleeker the holotype was in such poor condition that he was unsure whether it had 8 or 10 barbels. The published accounts, including a figure presumably based on the holotype (Bleeker 1863–64, pl. 103, fig. 1) suggest that *C. barbatuloides* belongs in *Lepidocephalichthys*. It differs from the species known from Borneo in having the dorsal-fin origin almost directly above that of the pelvic fin. In this and

FIGURE 78. *Ellopostoma megalomycter.* Kapuas 1976-14, 48.8 mm (CAS 49530).

other respects it agrees with *L. hasselti.* Its status presumably will remain unresolved until the holotype is found or more specimens are collected from Borneo.

Alfred (1961:33) reported on a specimen presumed to be the holotype of *Cobitis barbatuloides,* RMNH 4960, supposedly collected at Sambas by J. Einthoven. I have examined this dried, badly damaged and completely discolored alcoholic specimen and conclude that it is too small to be the holotype. Much of the head is missing and all of the fins are reduced to stumps; the mouth and barbels are absent; a small detached piece of the head with an eye was found in the bottom of the jar. The standard length is probably about 33.0 mm, and at most 33.5 mm. Making a generous allowance for the missing portions of its head and tail, the total length could not be more than 42.5 mm (the caudal fin of a 34. 8 mm *L. hasselti* is only 8.8 mm long). The total length of Bleeker's holotype was 46 mm. If specimens identifiable with *Cobitis barbatuloides* become available and it proves to be a distinct species, it should be redescribed and a neotype should be designated.

Lepidocephalichthys lorentzi (Weber and de Beaufort, 1916) new combination

(Figure 79)

Icanthophthalmus lorentzi Weber and de Beaufort, 1916:32–33, fig. 12 (type locality "Borneo, upper Kapuas"; "Poetes Sibau" or Putussibau according to label in bottle)

MATERIAL EXAMINED.—Western Borneo: upper Kapuas at Putussibau, 32.3 mm (ZMA 103.259, holotype) and 2: 31.6–32.3 mm (ZMA 116.551, non-types)

This species apparently is known only from the female holotype and two additional specimens (male and female non-types) collected together with the holotype but previously unrecorded.

DIAGNOSIS.—A *Lepidocephalichthys* with dorsal-fin origin distinctly posterior to vertical through pelvic-fin origin. Mature males with innermost pectoral-fin ray bladelike (enlarged and hardened); second ray of pectoral fin unmodified.

Although the bottle label for the three specimens examined indicates they are syntypes, the original description appears to be based on a single specimen and ends with the statement "Length 40 mm [type in the Zoological Museum of Amsterdam]." The two largest specimens, a male and a female, are both 32.3 mm SL; the female is about 39.4 mm and the male 39.7 mm TL. Although the female is only about 39.4 mm TL and the male about 39.7 mm TL and thus slightly closer to the 40 mm indicated for the holotype, the figure accompanying the original description agrees closely with the female in the straight condition of the body, details of color pattern, and much shorter pectoral fin. I therefore conclude that the 32.3 mm SL female can be positively identified as the holotype and have indicated it as such above.

The male is similar to the two females in all respects except pectoral-fin morphology. All three specimens have one simple and seven branched pectoral-fin rays (not 1,8 as stated in the original description), but in the male the pectoral fin is substantially larger and its rays are modified. The outermost branched ray is markedly thicker than the other rays but does

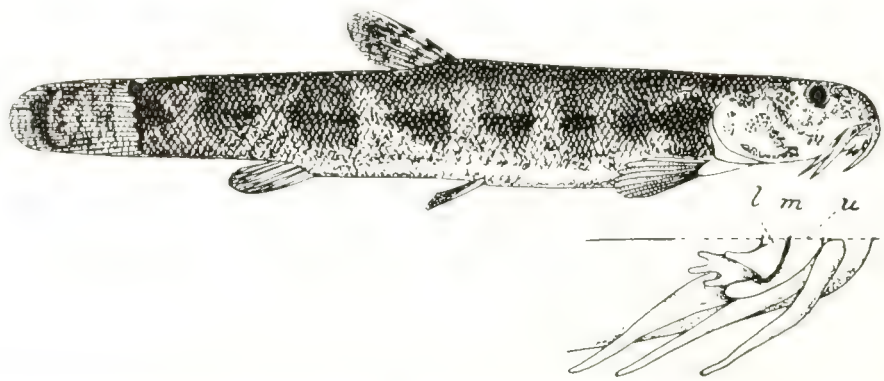

FIGURE 79. *Lepidocephalichthys lorentzi.* Kapuas, Putussibau, 32.3 mm female (ZMA 103.259, holotype, after Weber and de Beaufort 1916)

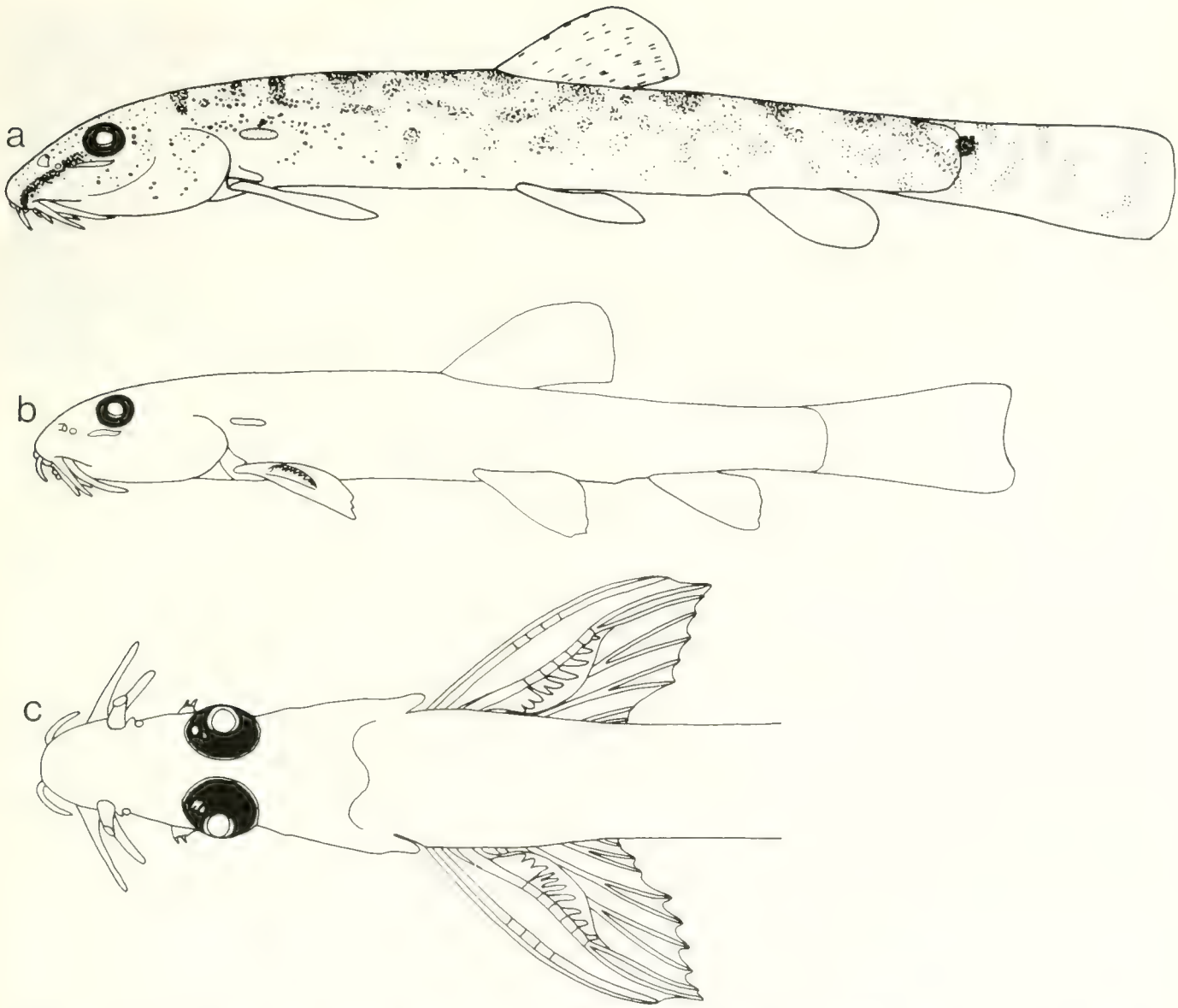

FIGURE 80. *Lepidocephalichthys pristes*. a, Kapuas 1976-47, 30.9 mm female (USNM 230266, paratype); b–c, Kapuas 1976-18, 24.5 mm male (MZB 3527, holotype).

not appear to be otherwise modified, while the innermost two pectoral rays are thickened for their basal half and bear the so-called "lamina circularis," consisting mainly of a flange-like bony projection from the middle of the dorsal surface of next to last ray. In all three specimens the dorsal-fin origin lies posterior to a vertical line through the base of the pelvic fins.

Lepidocephalichthys pristes new species

(Figure 80)

HOLOTYPE.—MZB 3527, 24.5 mm male, small swampy stream about 30 km W of Sintang on road from Sanggau to Sintang (Kapuas 1976-18).

PARATYPES.—CAS 49352 (3), MZB 3528 (1), 4: 20.4–39.2 mm, Sungai Tekam, where it enters right side of Kapuas mainstream about 5–6 km upstream from Sunggau (Kapuas 1976-16); MZB 3529, 25.8 mm, small forest streams flowing into Kapuas mainstream within 10 km upstream of Sanggau (Kapuas 1976-17); MZB 3530 (1), USNM 230265 (1), 2: 27.6–32.7 mm, Danau Piam near Ketungau (Kapuas 1976-32); MZB 3531, 37.9 mm, Sungai Seriang, 37 km W of Putussibau (Kapuas 1976-42); MZB 3532 (1), USNM 230266 (1), 2: 23.6–30.9 mm, small forest stream flowing into Kapuas mainstream near Gunung Setunggul (Kapuas 1976-47); MCZ 56064, 2: 30.1–30.8 mm, Lundu (coll. H. W. Smith, no date or additional information).

DIAGNOSIS.—Dorsal fin usually with 7 branched rays (8 in one paratype from Lundu), its origin well in advance of a vertical through pelvic-fin origin; pectoral fin of sexually mature males with inner margin of enlarged second ray bearing 8–11 medially directed serrae (spinelike projections of enlarged lepidotrichia), caudal fin weakly rounded, truncate, or slightly concave (not forked). Total vertebrae 33–34.

DISTRIBUTION.—Western Borneo (Lundu, Kapuas).

ETYMOLOGY.—The name *pristes*, a noun in apposition (Greek, saw) refers to the serrate pectoral-fin ray observed in males of this species.

FIGURE 81. *Lepidocephalus spectrum*. Kapuas 1976-50, 74.7 mm (MZB 3533, holotype).

Lepidocephalus Bleeker, 1858–59

Lepidocephalus Bleeker, 1858–59*c*:303 (type species *Cobitis macrochir* Bleeker, 1854, by subsequent designation of Bleeker, 1863*c*:35).

DIAGNOSIS.—Superficially similar to *Acantophthalmus* but with a much deeper body, depth 5–6 in standard length; vertebrae 42–43.

Only two species known, the type species with eyes, and a closely related undescribed species without eyes discovered during the Kapuas survey of 1976.

Lepidocephalus macrochir (Bleeker, 1854)

Cobitis macrochir Bleeker, 1854*a*:97 (type locality Sumatra orientalis, provinc Palembang, ubi confluunt flum. Lamatang et Enim; Surakarta, Javae centralis, in flumine Pepeh).
Lepidocephalus macrochir Bleeker, 1860*a*:70.
Lepidocephalichthys pallens Vaillant, 1902:154 (type locality Kapuas).
Lepidocephalus pallens Weber and de Beaufort, 1916:28.
Acanthophthalmus pahangensis de Beaufort, 1933:31 (type locality Mentakab, Pahang River, Malay Peninsula). See Hora (1941*a*:55–56).

MATERIAL EXAMINED.—Western Borneo: Kapuas, 43.0 mm (RMNH 7783, holotype *L. pallens*). Bleeker collection, locality unknown, 76.5 mm (BMNH 1866.5.2.55, syntype *L. macrochir*).

The only Kapuas specimen of *L. macrochir* (RMNH 7783, holotype of *L. pallens*) has dorsal-fin rays iii8, anal ii6, pectoral i10, pelvics i6; about 34 scale rows between dorsal-fin origin and lateral line; dorsal portion of head, cheek and opercle covered with fine scales. One of the distinctions used by Weber and de Beaufort (1916:28) to differentiate *L. pallens* and *L. macrochir*, pectoral-fin shape, is related to sexual dimorphism; in males the second pectoral-fin ray becomes greatly elongated. Two dark spots on the caudal-fin base of the holotype of *L. pallens* mentioned and figured by Vaillant are present only on one side of the body and are probably artifacts (dirt?).

DISTRIBUTION.—Malay Peninsula (Pahang). Sumatra (Palembang). Western Borneo (Kapuas). Java (Pepeh R. at Surakarta).

Lepidocephalus spectrum new species

(Figure 81)

HOLOTYPE.—MZB 3533, 74.7 mm, rocky ledge in middle of Sungai Melawi near confluence with Kapuas mainstream, about 0.5 km upstream from Sintang (Kapuas 1976-50).

PARATYPES.—MZB 3534, 53.3 mm, Kapuas mainstream 58 km NE of Sintang and 1 km downstream from Sebruang (Kapuas 1976-45); CAS 49353 (2), MZB 3535 (1), and USNM 230267 (1), 4: 38.7–59.8 mm, Kapuas mainstream opposite Silat (Kapuas 1976-48).

DIAGNOSIS.—Superficially similar to its only congener, *L. macrochir*, but without eyes.

Body entirely creamy or pinkish white in life. A small, shallow depression above suborbital spine in area normally occupied by eye; no sign of superficial or underlying eyeball or visual pigment. Lateral line complete, straight, with about 90 short pore-bearing tubules. Scales minute, embedded in thick skin and not readily countable or observable.

DISTRIBUTION.—Kapuas.

ETYMOLOGY.—The name *spectrum* (Latin) refers to the ghastly or ghostlike character of this species.

Nemacheilus Bleeker, 1863

Noemacheilus Kuhl and van Hasselt *in* van Hasselt, 1823:133 (unidentifiable).
Nemacheilus Bleeker, 1863*c*:34–36 (type species *Cobitis fasciatus* Valenciennes *in* Cuvier and Valenciennes, 1846, by subsequent designation of Jordan, 1917:116).
Modigliania Perugia, 1893:246 (type species *Modigliana papillosa* Perugia, 1893 = ?*Nemacheilus fasciatus*, by monotypy).

In terms of number of species and frequency of citation, this is by far the most important of the fish genera first recognized by Kuhl and van Hasselt. Its original description has been variously attributed to Kuhl and van Hasselt (or van Hasselt) and to Bleeker, frequently without following the original spelling of either author. Bleeker himself has contributed at least two unwarranted spelling variants (*Nematocheilus* and *Nemachilus*), and others have contributed *Nemacheilos* and *Noemachilus*. Thus it is particularly desirable to determine the correct original authorship and valid spelling.

The statement by Weber and de Beaufort (1916:38) that *Nemachilus* [sic] van Hasselt, 1823:133 is "without description" is not precisely correct, but the genus could not possibly be identified from van Hasselt's account, which may be quoted in its entirety: "*Noemacheilus* Nob. nadert door platte maxillen het genus *Poecilia* Schn., de Zundanezen noemen hem Jelaer, hij leeft bij Buitenzorg en de species heeft in onze teekening den nam *fasciatus* Nob." [In other words, *Noemacheilus* Nobis, i.e., of Kuhl and van Hasselt (as opposed to Mihi, of van Hasselt alone), is distinguished by flat maxillae (or upper jaw parts) like those of *Poecilia* Schneider in Bloch and Schneider, its Sundanese name is Jelaer, and it is found at Buitenzorg (near Jakarta

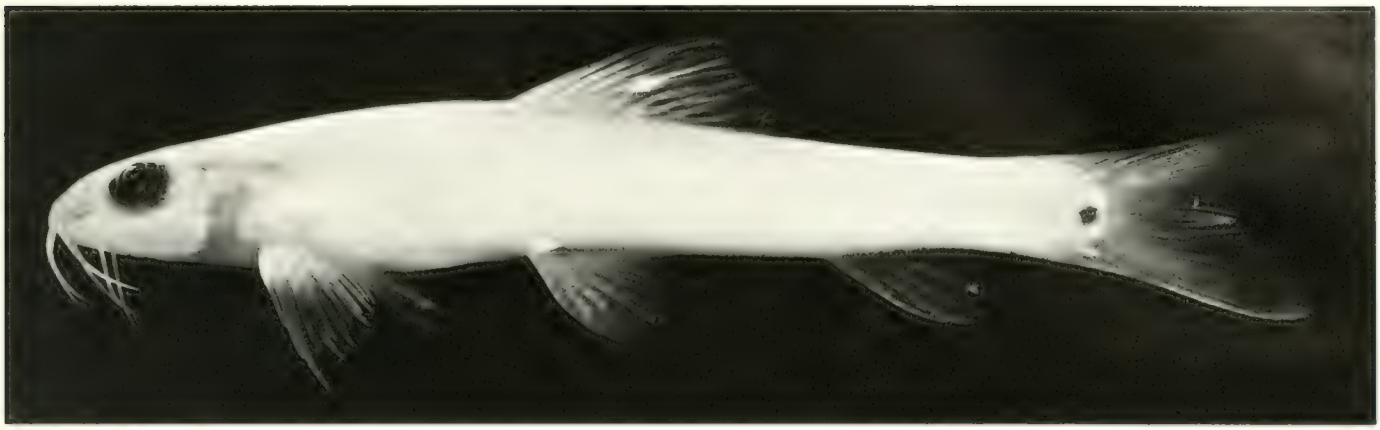

FIGURE 82. *Nemacheilus lactogeneus*. Kapuas 1976-45, 48.1 mm male (MZB 3542, holotype).

or Bogor); and in our figure of it the species bears the name *fasciatus*.] But the figure was not published. Only one taxonomic character is mentioned, i.e., the shape of the maxillae, and without a figure the description is too subjective to be useful. Kuhl and van Hasselt's figures and specimens of Javanese loaches were later studied by Valenciennes, and consequently the identity of *N. fasciatus* and the others became known. In the case of *N. fasciatus*, Valenciennes published an excellent description and fine illustration of one of the specimens but chose not to recognize *Noemacheilus*, placing the species instead in *Cobitis*. It remained for Bleeker (1863) to recognize the genus. Bleeker (1863:37) designated *Noemacheilus fasciatus* van Hasselt, 1823 as type species but it is unidentifiable. The earliest valid type species designation appears to be by Jordan (1917).

Six species of *Nemacheilus* occur in western Borneo. Three of these were discovered during the Kapuas survey of 1976; one has been described already (Kottelat 1984), and the other two are described herein.

Nemacheilus, like all Nemacheilinae, lacks a subocular spine, but in many species sexually mature males develop a large, posteriorly directed subocular papilla immediately below the anteroventral margin of the eye. The papilla was discovered by Perugia (1893) who, not recognizing it as sexually dimorphic, regarded it as diagnostic of his new genus and species *Modiglianiania papillosa* (type locality Lake Toba, Sumatra). Weber and de Beaufort (1916:40–41), reported the absence of the papilla in type specimens of *M. papillosa* they examined and referred the species to *N. fasciatus*. I have examined a series of *N. fasciatus* from Buitenzorg, the type locality (CAS-SU 20498, 20: 23.0–49.3 mm) and confirmed that males do have a subocular papilla. Other species of the genus in which males with a subocular papilla have been examined by me include *N. beavani*, *N. kapuasensis*, *N. saravacensis*, *N. longipectoralis*, and *N. selangoricus*.

Nemacheilus kapuasensis Kottelat, 1984

Nemacheilus kapuasensis Kottelat, 1984:244 (type locality Kapuas)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-24, 4: 51.5–54.9 mm (BMNH 1982.3.29.139–141, MZB 3556); Kapuas 1976-25, 31: 38.7–56.3 mm (FMNH 94235, IRSNB 19745, KUMF 2855, MZB 3557, MNHN 1982-700); Kapuas 1976-26, 3: 32.3–55.9 mm (MZB 3558, RMNH 28880); Kapuas 1976-27, 23: 32.3–59.1 mm (MZB 3559, UMMZ 209872, USNM 230271); Kapuas 1976-29, 42: 41.7–55.6 mm (MZB 3560, 4004–5, CAS 47378, 49360 [including holotype and 31 paratypes of *N. kapuasensis*]).

DISTRIBUTION.—Borneo (Kapuas, Rejang).

Nemacheilus lactogeneus new species

(Figure 82)

HOLOTYPE.—MZB 3542, 48.1 mm, Kapuas mainstream 58 km NE of Sintang and 1 km downstream from Sebruang, 16 August 1976 (Kapuas 1976-45)

PARATYPE.—CAS 49355, 44.6 mm, collected with holotype.

DIAGNOSIS.—A morphologically generalized *Nemacheilus* similar to *N. fasciatus* in body proportions and in most other respects but slightly more elongate (with 38 vertebrae instead of 33–36 as in other Sundaic *Nemacheilus*); color in life milky-white, without vertical marks or bars on fins or body in live or preserved specimens (vertical marks or bars characteristic of all other Sundaic nemacheilins); upper half to two-thirds of body nearly uniformly covered with very fine, faint melanophores, lower part of body without melanophores; barbels and fins without melanophores or with very fine faint melanophores along inner surface of outer rostral barbel and on elongate anterior-most dorsal-fin rays; caudal-fin base with a dark, subdermal, midlateral oval spot.

Holotype and paratype (immature males?) with small, fleshy fingerlike subocular flaps and weakly developed tubercles on posterior margin of peduncular scales; head 4.3–4.4; snout 11.7–12.8; eye 18.9–19.8; interorbital width 15.4–17.2; barbels elongate; inner rostral barbel 11.5–12.9, outer rostral barbel 7.1–7.4, extending posteriorly beyond hind border of eye and slightly farther than maxillary barbel; maxillary barbel 10.9–12.4; body depth 6.4–6.8, width 8.0–8.4; caudal peduncle depth 11.2–11.7, length 5.8–6.5. Dorsal fin with 9-1/2 branched rays; length of first branched dorsal-fin ray 11.2–11.7; pectoral fin length 4.3–4.7; pectoral-fin rays i12–13, unbranched outermost ray with short filamentous extension nearly reaching pelvic-fin origin, branched rays with shorter extensions; pelvic fin length 6.9; pelvic-fin rays i7; caudal fin moderately forked, lobes about equal. Scales very small, difficult to count, about 160 in lateral series, 50 predorsal, 50 circumpeduncular.

DISTRIBUTION.—Known only from the Kapuas type specimens.

ETYMOLOGY.—The name *lactogeneus* (Latin) refers to the milk-white coloration of this species observed in life.

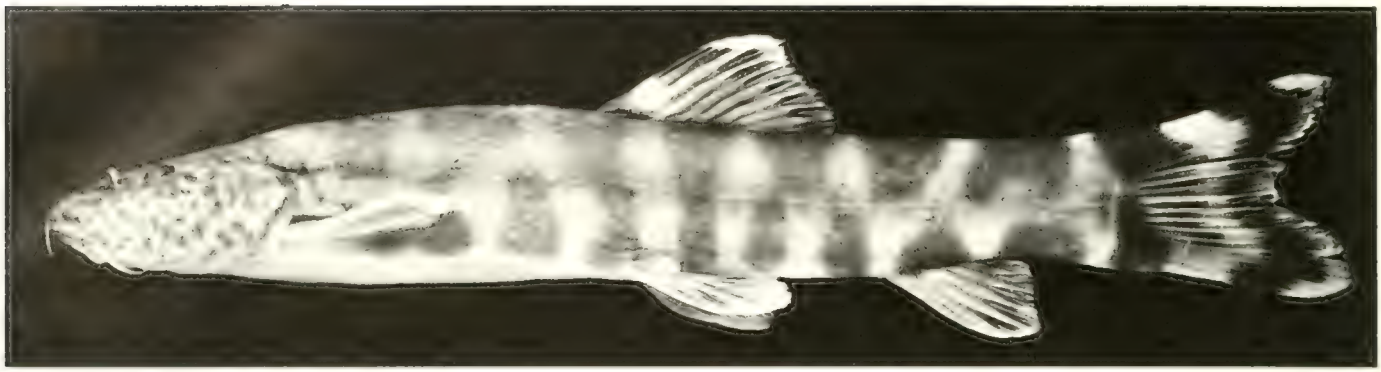

FIGURE 83.—*Nemacheilus maculiceps*. Kapuas 1976-27, 78.9 mm (MZB 3543, holotype).

Nemacheilus cf. **longipectoralis** Popta, 1905

Noemacheilus longipectoralis Popta, 1905:182 (type locality upper Mahakam)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-45, 1: 37.6 mm (MZB 4007).

Nemacheilus maculiceps new species

(Figure 83)

HOLOTYPE.—MZB 3543, 78.9 mm immature male, rocky channel in mainstream of Sungai Pinoh, 37 km S of Nangapinoh, 24 July 1976 (Kapuas 1976-27).

PARATYPES.—BMNH 1982.3.29.135, CAS 49356, RMNH 28878, USNM 230269, 7: 48.5–99.7 mm, collected with holotype; MZB 3544, 116 mm, rocky channel in mainstream of Sungai Pinoh at Nanga Saian, 45 km S of Nangapinoh, 26 July 1976 (Kapuas 1976-29); CAS 49357, MZB 3545, 4: 25.1–29.9 mm, rocky ledge in middle of Sungai Melawi near confluence with Kapuas mainstream, about 0.5 km upstream from Sintang, 18 August 1976 (Kapuas 1976-50).

DIAGNOSIS.—A large, heavy-bodied *Nemacheilus* with small eyes and very fine scales; largest specimen, a gravid female, 116 mm; head elongate, somewhat dorsoventrally depressed (head laterally compressed in most Sundaic nemacheilines); larger specimens with cheeks projecting laterally well beyond eyes; entire dorsal, lateral, and sometimes ventral surface of head (including lips, rostral barbels, gill cover, and sometimes branchiostegal membranes) with numerous moderately large dark maculae or vermiculae; dorsal-fin rays iv8-1/2 (dorsal-fin branched rays almost invariably 9-1/2 in other Sundaic *Nemacheilus*); dorsal-fin origin relatively posterior, only slightly nearer to snout-tip than to caudal fin base (dorsal-fin origin usually much closer to snout-tip in other *Nemacheilus*); pectoral and pelvic fins widely separated (pectoral fin extending posteriorly to or beyond pelvic-fin origin in all other Bornean *Nemacheilus*); males without digitiform subocular flap (present in all other Sundaic *Nemacheilus*?). Scales in lateral series about 215, in transverse series 50, circumpeduncular 70. Dorsal surface of head relatively flat and evenly sloped anteroposteriorly; head length 3.5–3.9; eye horizontally oval, diameter 29–38 (strong negative allometry); interorbital width 14.5–17.2; barbels moderately elongate; rostral barbels with bases approximate; inner rostral barbel length 18–25, outer 13.9–16.8; maxillary barbel extending posteriorly to beyond hind margin of eye, its length 13.0–16.8; nasal valve with a short barbel-like process dorsally; posterior nostril narrowing to a slit posteriorly (posterior nostril round or slightly oval, usually not narrowing to a slit posteriorly in other *Nemacheilus* examined); conformation of lips and horny jaw sheaths as in generalized *Nemacheilus* including *N. fasciatus*; upper lip relatively smooth, without papillae or marked transverse furrows; lower lip interrupted medially; horny jaw sheaths moderately developed, lower without processus dentiformis; body stout, subcylindrical, width at pectoral-fin origin 5.6–7.5, depth at dorsal-fin origin 5.6–6.7; height of first branched dorsal-fin ray 5.8–7.1; pectoral and pelvic fins widely separated, pelvic-fin origin distinctly posterior to vertical through dorsal-fin origin; posterior margin of pectoral fin rounded or lobate, without fringes due to freely projecting ray tips seen in many *Nemacheilus*); pectoral-fin length 4.8–6.0, pelvic 6.0–7.5; pectoral-fin rays i10–12, pelvic i7. Pectoral and pelvic fins with fleshy axillary flaps arising above fin origin; caudal peduncle compressed, short, and very deep, depth 7.5–9.0, without dorsal or ventral keel; caudal fin moderately forked, lobes rounded, lower somewhat larger than upper; principal caudal-fin rays 10+9; vertebrae 20–22+11–13=33–34.

Larger specimens with about nine evenly spaced, dark, wavy vertical bars or blotches on dorsal and lateral surface of body and two similar vertical bars on caudal fin; in some specimens bars vertically complete, in others broken into separate portions on dorsal and ventral half of body (especially posteriorly). Abdomen pale or whitish (covered with fine scales which may be embedded in skin or secretion-covered and difficult to detect). Dorsal, anal, pectoral and caudal fins with fin rays generally dusky except near tips which are plain; interradial membranes nearly plain; anterior margin of dorsal fin dusky; no dark spot on base of dorsal fin near origin. Smaller specimens may have a broad, dark midlateral longitudinal stripe on body; this is absent in all specimens above 70 mm. Largest males, apparently immature, 23.0–78.9 mm, with a single row of small breeding tubercles on dorsal surface of outermost three pectoral-fin rays. No other secondary sexual dimorphism observed.

DISTRIBUTION.—Known only from the Kapuas.

ETYMOLOGY.—The name *maculiceps* (Latin) refers to the spotted head of this species.

Nemacheilus saravacensis Boulenger, 1894

Nemacheilus saravacensis Boulenger, 1894:251 (type locality Senah, Sarawak)

MATERIAL EXAMINED.—Kapuas 1976-8, 36.0 mm (MZB 3561).

The identification of the single specimen of this species obtained during the Kapuas survey of 1976 was verified by M. Kottelat. It is male, with a subocular papilla, single rows of

FIGURE 84. *Vaillantella*. Above, *V. euepiptera*, Kapuas 1976-37, 83.0 mm (CAS 49362); below, *V. maassi*, Kapuas 1976-29, 97.7 mm (MZB 3570).

small breeding tubercles on the dorsal surface of the pectoral-fin rays, and weak tuberculation near middle of caudal peduncle.

DISTRIBUTION.—Sarawak, Mempawah.

Nemacheilus selangoricus Duncker, 1904

Nemacheilus selangoricus Duncker, 1904:175 (type locality "Umgegend von Kuala Lumpur")

MATERIAL EXAMINED.—Malay Peninsula: Perak, Plus R., Lasat, 40.6 mm (CAS-SU 31080); Johore, Kota Tinggi, 8: 27.5–38.3 mm (CAS-SU 39396); Johore, Simpang Rengam, 11: 42.8–55.4 mm (CAS-SU 39397); Singapore, Mandai Road, 4: 37.8–54.7 mm (CAS-SU 32598); Singapore, 20: 25.8–50.5 mm (CAS-SU 31081) Northeast Borneo: Balung R., 10: 18.2–39.7 mm (CAS-SU 33609). Western Borneo: Kapuas 1976-7, 20.2 mm (AMNH 48937, MZB 3547); Kapuas 1976-10, 4 17.3–23.0 mm (BMNH 1982.3.29.136–138, MZB 3548); Kapuas 1976-12, 30.7 mm (MZB 3549); Kapuas 1976-25, 4: 37.9–45.8 mm (CAS 49358, MZB 3550); Kapuas 1976-37, 11: 25.0–31.4 mm (FMNH 94234, MZB 3551); Kapuas 1976-39, 68: 15.5–50.4 mm (CAS 49359, HZM 6476, KUMF 2854, MCZ 58351, MNHN 1982-699, MZB 3552, RMNH 28879, ROM 38602); Kapuas 1976-42, 15: 22.5–37.8 mm (MZB 3553, USNM 230270); Kapuas 1976-47, 8: 25.0–37.6 mm (MZB 3554, UMMZ 209922); Kapuas 1976-51, 4: 21.0–38.8 mm (MZB 3555, ZMA 116.737)

DIAGNOSIS (modified from Hora 1941).—Body with about 12–14 sharply demarcated light vertical bands set off by dark pigment. Dorsal fin with a very dark round spot near its origin and three irregular rows of lighter spots. A dark suborbital spot. Barbels very long, almost reaching gill openings.

This is perhaps the commonest species of *Nemacheilus* in the Malay Peninsula. Herre (1940:34) previously reported the specimens from the Balung River as *N. selangoricus* but this identification was questioned by Hora (1941:59). Having compared these specimens with those from the Kapuas and the Malay Peninsula I find them closely similar and consider that they are all *N. selangoricus*.

DISTRIBUTION.—Malay Peninsula. Northern Borneo (Kapuas).

Vaillantella Fowler, 1905

Vaillantella Fowler, 1905:474 (type species *Nemacheilus euepipterus* Vaillant, 1902, by original designation and monotypy).

DIAGNOSIS.—Distinguished from all other loaches by its extraordinarily elongate dorsal fin, with 59–73 rays, and by the deeply forked caudal fin with its greatly elongated upper lobe. Principal caudal-fin rays 10+9. Vertebrae 57–60. Secondary sexual dimorphism unknown. For a detailed characterization see Nalbant and Bănărescu (1977, especially pp. 100–101).

The genus comprises only two species; both occur in the Kapuas basin, but in different habitats: *V. euepiptera* in lowland streams and *V. maassi* in highland streams.

Vaillantella euepiptera (Vaillant, 1902)

(Figure 84 above)

Nemacheilus euepipterus Vaillant, 1902:137 (type locality "Pontianak, Kapoeas (Sintang)")
Vaillantella euepipterus Weber and de Beaufort, 1916:37
Vaillantella euepiptera Nalbant and Bănărescu, 1977:101

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-16, 22: 30.2–81.0 mm (AMNH 48938, BMNH 1892.3.29.142–144, CAS 49361, MZB 3562); Kapuas 1976-17, 4: 36.3–73.0 mm (FMNH 94236, MZB 3563); Kapuas 1976-21, 2: 44.7–70.5 mm (IRSNB 19746, MZB 3564); Kapuas 1976-37, 25: 48.8–120 mm (CAS 49362, MNHN 1982-701, MZB 3565, RMNH 28881); Kapuas 1976-39, 35: 36.7–82.8 mm (MZB 3566, UMMZ 209904, USNM 230272); Kapuas 1976-42, 5 56.9–79.7 mm (MZB 3567, MZB 116.538); Kapuas 1976-46, 55.1 mm (MZB 3568); Kapuas 1976-47, 5: 50.9–80.2 mm (CAS 49363, MZB 3569)

DIAGNOSIS.—Differs from its only congener in having anal fin with only 7 rays (vs. 12–15 in *V. maassi*), and in its coloration.

DISTRIBUTION.—Kapuas.

Vaillantella maassi Weber and de Beaufort, 1916

(Figure 84 below)

Vaillantella maassi Weber and de Beaufort, 1916:38, fig. 18 (type locality Goenoeng Sahilan on Kampar kiri River, Sumatra)
Vaillantella flavofasciata Tweedie, 1956:59, pl. 6b (type locality River Tahan, near Kuala Tahan, Pahang, Malay Peninsula)

MATERIAL EXAMINED.—Malay Peninsula: River Tahan near Kuala Tahan, Pahang, 2: 97.2–125 mm (CAS-SU 50180, paratypes of *V. flavofasciata*). Western Borneo: Kapuas 1976-29, 2: 97.7–129 mm (CAS 49364, MZB 3570); Kapuas 1976-45, 6: 44.6–77.3 mm (BMNH 1982.3.29.145, MZB 3571, UMMZ 209917, USNM 230273); Kapuas 1976-50, 3: 67.2–76.2 mm (CAS 49365, MZB 3572 ZMA 116.539)

DIAGNOSIS.—See under *V. euepiptera*.

Until now this species has been known only from the holotypes of *V. maassi*, the type series of *V. flavofasciata*, and a

single specimen from the Kapuas River at Sintang identified by Nalbant and Bănărescu (1977:101). These authors did not examine the types of *V. flavofasciata* and maintained it as a valid species. I have compared one of the paratypes with my Kapuas specimens and consider them conspecific.

DISTRIBUTION.—Sumatra (Kampar kiri River). Malay Peninsula (Pahang). Borneo (Kapuas).

Ariidae

The "sea catfishes" or Ariidae, all or almost all species of which produce relatively small numbers of large eggs that are carried through hatching in the male's mouth, include a number of species endemic to fresh water. In large rivers of western Borneo occur three distinctive freshwater species which apparently are not closely related to each other, and their relationships to marine ariids or to freshwater ariids of other areas (such as New Guinea and Australia) is obscure. These are *Arius melanochir, A. stormii,* and *Hemipimelodus borneensis.*

Specimens of three additional ariid species have been recorded from Pontianak: *Arius argyropleuron* Valenciennes *in* Cuvier and Valenciennes, 1840, *A. oetik* (Bleeker, 1846), and *Batrachocephalus mino* (Hamilton-Buchanan, 1822). These are primarily marine or estuarine; their occurrence in fresh water is unconfirmed and likely to be limited to areas of tidal influence and the lowermost courses of large rivers near the sea or estuaries.

Arius Valenciennes, 1840

Arius Valenciennes *in* Cuvier and Valenciennes, 1840:53 (type species *Pimelodus arius* Hamilton-Buchanan, 1822, by absolute tautonymy; see Wheeler and Baddokwaya 1981:769)

Cephalocassis Bleeker, 1858*c*:98 (type species *Cephalocassis melanochir* Bleeker, 1858, by subsequent designation of Bleeker, 1863*a*:91)

Hexanematichthys Bleeker, 1858*c*:126 (type species *Bagrus sundaicus* Valenciennes *in* Cuvier and Valenciennes, 1839, by monotypy)

Hemiarius Bleeker, 1863*a*:90 (type species *Cephalocassis stormii* Bleeker, 1858, by monotypy)

The synonymy presented here includes only names relevant to systematics of freshwater ariids found in western Borneo.

Arius has always been a catch-all for large numbers of catfishes with poorly known relationships. As originally conceived by Valenciennes it was nearly Linnaean in scope and included species now assigned to Auchenipteridae, Bagridae, and Diplomystidae as well as Ariidae.

The name *Tachysurus* Lacepède, 1803 (type species *Tachysurus sinensis* Lacepède, 1803) continues to be regarded by some authors as a valid senior synonym of *Arius* Valenciennes. This nomenclatural problem is discussed in detail by Wheeler and Baddokwaya (1981). Their findings and conclusions, with which I agree, may be briefly summarized: 1) the original painting upon which *Tachysurus sinensis* was based apparently is no longer available; 2) the engraving of the painting and original description by Lacepède (1803) are obviously based on some kind of catfish but cannot be identified with specimens of any known species or genus or even with the family Ariidae as presently understood (sensu Regan 1911); 3) *Tachysurus sinensis* Lacepède, 1803, appears to be an unrecognizable siluriform fish from fresh water in China. Although Wheeler and Baddokwaya do not employ the term, *Tachysurus sinensis* (and *Tachysurus*) is a nomen dubium.

As currently understood *Arius* contains a large number of species from Central and South America, Africa, Asia, and the Australian region; presumably several genera are involved. Some of these already have received names, but anatomical or other information for diagnosing these genera and deciding which species should be assigned to them simply does not exist.

The type species *Arius arius* is not well known; it was long regarded as a junior synonym of *Arius gagora* (Hamilton-Buchanan, 1822) but is recognized as a distinct species in Jayaram (1982) and other recent works on Indian Ariidae.

Arius melanochir Bleeker, 1852

(Figure 85 below)

Arius melanochir Bleeker, 1852*d*:590 (type locality Palembang, in fluviis).
Cephalocassis melanochir Bleeker, 1858*c*:103.
Arius melanochir Günther, 1864:161

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 11: 125–250 mm (CAS 49426, MZB 3713, USNM 230311); Kapuas 1976-40, 222 mm (MZB 3714); Kapuas 1976-48, 3: 60.6–91.6 mm (BMNH 1982.3.29.193, MZB 3715, RMNH 28908)

DISTRIBUTION.—Sumatra (Palembang, Djambi). Borneo (Kapuas).

Arius stormii Bleeker, 1858

(Figure 85 above)

Cephalocassis Stormii Bleeker, 1858*c*:246 (type locality Sumatra, Palembang, in flumine Mussi)
Hemiarius Stormi Bleeker, 1862–63:29.
Arius stormii Günther, 1864:162.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 3: 282–405 mm (CAS 49427, MZB 3716, USNM 230312)

A moderately large ariid, attaining 500 mm, characterized by very large, exceptionally stout, and heavily serrate dorsal and pectoral-fin spines; a pointed, strongly projecting snout; large, sharp, backwardly projecting jaw teeth; premaxillary tooth band partially exposed when jaws closed; palatal teeth in two small round vomerine patches (vomerine and palatine patches on each side sometimes nearly or quite continuous; see Weber and de Beaufort 1913, fig. 117); maxillary and mental barbels moderately elongate; lateral line on head and body forming dense network of anastomosing canals.

It should be noted that Bleeker (1863) proposed the monotypic genus *Hemiarius* based on this species. Only one other species, *Arius* (*Hemiarius*) *danielsi* Regan, 1908, has been referred to *Hemiarius*, and this species is now placed in *Cochlefelis*, an unrelated carcinophagous genus endemic to large rivers in southern New Guinea and northern Australia (Roberts 1978: 45). The species *Arius* cf. *stirlingi* Ogilby, 1898 reported from the Fly River (op. cit. pp. 37–38) bears some resemblance to *A. stormii*, but they probably are not closely related.

DISTRIBUTION.—Thailand (Chao Phrya). Sumatra (Palembang, Djambi). Borneo (Kapuas, Bandjermasin). Apparently confined to fresh water (large rivers).

Hemipimelodus Bleeker, 1858

Hemipimelodus Bleeker, 1858*c*:236 (type species *Pimelodus borneensis* Bleeker, 1851, by subsequent designation of Bleeker, 1863*a*:92).

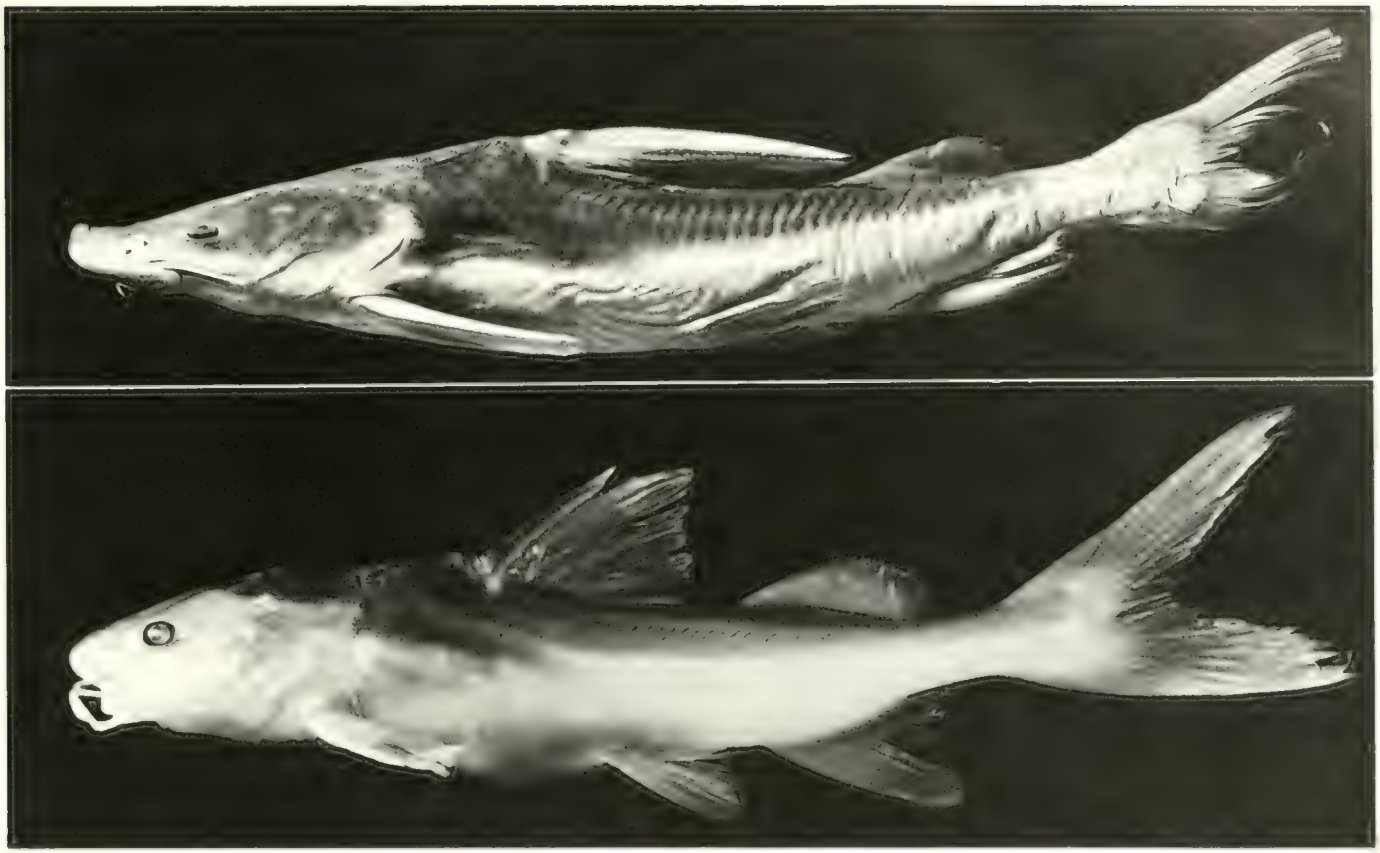

FIGURE 85. *Arius*. Above, *A. stormi*, Kapuas 1976-19, 405 mm (CAS 49427); below, *A. melanochir*, Kapuas 1976-48, 83.0 mm (MZB 3715)

Hemipimelodus borneensis (Bleeker, 1851)

Pimelodus borneensis Bleeker, 1851*i*:430 (type locality "Sambas, in fluviis")
Hemipimelodus borneensis Bleeker, 1858*c*:238

MATERIAL EXAMINED.—None

DISTRIBUTION.—Thailand (Chao Phrya, Bangpakong). Sumatra (Palembang). Borneo (Baram, Sambas, Barito).

Bagridae

The Old World family Bagridae, with about 27 genera and 205 species (Nelson 1984), includes some of the most generalized and some of the most specialized catfishes in western Borneo, such as the remarkable *Bagrichthys hypselopterus*. The generalized species, with numerous relatives in tropical Africa, India, China, and elsewhere in southeast Asia, belong to the subfamily Bagrinae. The main genus in southeast Asia is *Mystus*, with four or five species in western Borneo, including one new species obtained during the Kapuas survey of 1976. The most specialized bagrids in western Borneo, with related forms restricted to southeast Asia and China, belong to the Bagrichthyinae. A few bagrichthyins are plain or uniformly dull colored, but most of the genera and species are characterized by a highly distinctive pattern consisting of a series of offset, horizontally elongate light blotches on the upper and lower halves of the body usually separated by a pale midlateral longitudinal streak or stripe of variable width. Such coloration is shared by most species of *Bagrichthys, Bagroides, Leiocassis*, and *Pelteobagrus*. At least nine or 10 species of Bagrichthyinae occur in western Borneo, including one *Bagrichthys* and one *Leiocassis* discovered in 1976 and described herein as new.

The small, very rare and poorly known species currently identified as *Pelteobagrus ornatus* is morphologically distinctive and has an extraordinary color pattern entirely different from that of any other *Pelteobagrus* or Bagrichthyinae; its generic, subfamilial, and even familial placement are tentative.

Bagrichthys Bleeker, 1858

Bagrichthys Bleeker, 1858*c*:130 (type species *Bagrus hypselopterus* Bleeker, 1852, by monotypy)
Pseudobagrichthys Bleeker, 1862–63:9, 49 (type species *Bagroides macropterus* Bleeker, 1853, by original designation)

Bagrichthys is distinguished from all other genera of Bagridae by its elongate and laterally compressed caudal peduncle, with 13–20 peduncular vertebrae, and from all others except *Bagroides* in having upwardly (rather than downwardly) directed serrae on posterior margin of dorsal-fin spine. In addition, all species except *B. macracanthus* differ from all other bagrids in having one or both mental barbels with uniquely convoluted and papillose margins (not at all like modifications of mental barbels in mochokid catfishes to which they have been compared by some authors). Anal-fin rays 14–16; pectoral rays 8–11; pelvic rays 6. Gill rakers 2–4+3–11=5–15. Vertebrae 17–20+24–30=42–49.

Bagrichthys occur mainly in large muddy rivers such as the

FIGURE 86. *Bagrichthys macracanthus*, oral dentition. Mahakam, 92.5 mm (RMNH 7839), holotype *B. vaillanti*)

mainstream of the Kapuas and its larger tributaries, and feed almost exclusively on detritus of higher plants. The entire length or long portions of the intestine is filled with vegetable detritus in nearly every one of the four *B. hypselopterus*, one *B. macracanthus*, 25 *B. macropterus*, eight *B. micranodus*, and four *B.* sp. undet. (Mekong basin) in which I examined the gut contents. The detritus is generally loose, sometimes with silt particles but never clay. The stomach is generally empty but when full its contents are similar to those of the intestines. The only other food item observed was a single large winged insect in a 95.8 mm *B. micranodus* from Kapuas 1976-45. The intestines are convoluted but only moderately elongate for a detritivore. A 233 mm *B. hypselopterus* has intestines 330 mm long and a 105 mm *B. macropterus* intestines 190 mm long.

Species of *Bagrichthys* have been the source of much taxonomic confusion. Problems have arisen from 1) assumption of extensive late allometric changes in *B. hypselopterus*; 2) Bleeker's figure of oral dentition of *B. macropterus* in which the number of teeth is greatly exaggerated; 3) poorly understood differences in color pattern reported or observed in *Bagrichthys* sp. or spp.

The first problem has been resolved by the present finding that the unique morphology of *B. hypselopterus* is fully developed in individuals under 200 mm, that specimens of all sizes can be identified by 19–20 rather than 13–16 peduncular vertebrae (vertebrae entirely posterior to base of last anal-fin ray including hypural centrum as 1), and that *B. macracanthus* has been misidentified as young *B. hypselopterus*. The second problem has been resolved by examination of the dentition in the holotype and other specimens of *B. macropterus*. The third problem, not fully resolved, is narrowed down to color variation within *B. macracanthus* or to differences in coloration among species closely related to *B. macracanthus*. Geographical distribution of species of *Bagrichthys* is shown in Figure 88.

Key to *Bagrichthys* of Borneo

1a Mouth opening relatively large and broad; oral dentition well developed, jaws and palate with numerous exposed teeth forming well defined tooth bands (Fig. 86); dorsal-fin spine moderately to extremely elongate, with 18 or more serrae in adults 2

1b Mouth opening relatively small and narrow; oral dentition extremely reduced, jaws and palate with a few scattered teeth (sometimes apparently absent) deeply buried in soft tissue; dorsal-fin spine relatively short, with 15 or fewer serrae 3

2a Body form relatively generalized, nape and dorsal-fin base not greatly elevated; jaw teeth not notably heterodont, those of lower jaw only partially exposed from gum; gill rakers 10–14; dorsal-fin spine moderately long, with 18–29 serrae in adults; pectoral-fin rays 9; inner and outer mental barbels with straight (non-convoluted) margins; total vertebrae 42–43; caudal peduncle moderately elongate, peduncular vertebrae 14–15; upper and lower caudal-fin lobes pointed but not markedly filamentous *B. macracanthus*

2b Body form highly modified, nape and dorsal-fin base extraordinarily elevated; jaw teeth markedly heterodont, teeth of lower jaw about 1.5 times as long and much more slender than those of upper jaw, and totally exposed from gum; gill rakers 14–15; dorsal-fin spine extremely long, extending to or beyond base of caudal fin when depressed, with 60 or more serrae in large juveniles and adults; pectoral-fin rays 10–11; inner and outer mental barbels with extremely convoluted anterior margins; total vertebrae 47–49; caudal peduncle extremely elongate, peduncular vertebrae 19–20; upper and lower caudal-fin lobes with long filamentous extensions ..... *B. hypselopterus*

3a Inner and outer mental barbels strongly crenulated; attains at least 236 mm; males sexually mature at 215 mm; color in life pale brownish or tan with whitish or cream-colored light areas ..... *B. macropterus*

3b Inner mental barbel crenulated but outer mental barbel simple; largest known specimen 125 mm; males sexually mature at 95.8 mm; color in life dark brown or brownish black with whitish or cream-colored light areas *B. micranodus*

Bagrichthys hypselopterus (Bleeker, 1852)

(Figure 87)

Bagrus hypselopterus Bleeker, 1852*d*:588 (type locality Palembang, in fluviis).
Bagrichthys hypselopterus Bleeker, 1858*c*:131

MATERIAL EXAMINED.—Sumatra?: Palembang?, 253 mm, Bleeker (RMNH 6877, possible holotype); 172 mm, Bleeker (BMNH 1863.12.4.61). Western Borneo: Kapuas 1976-19, 7: 200–241 mm (CAS 49366, MZB 3573, USNM 230274); Kapuas 1976-44, 2: 184–228 mm (CAS 49367, MZB 3574)

DIAGNOSIS.—*Bagrichthys hypselopterus* is characterized by the most highly modified dorsal fin and body form of any *Bag-*

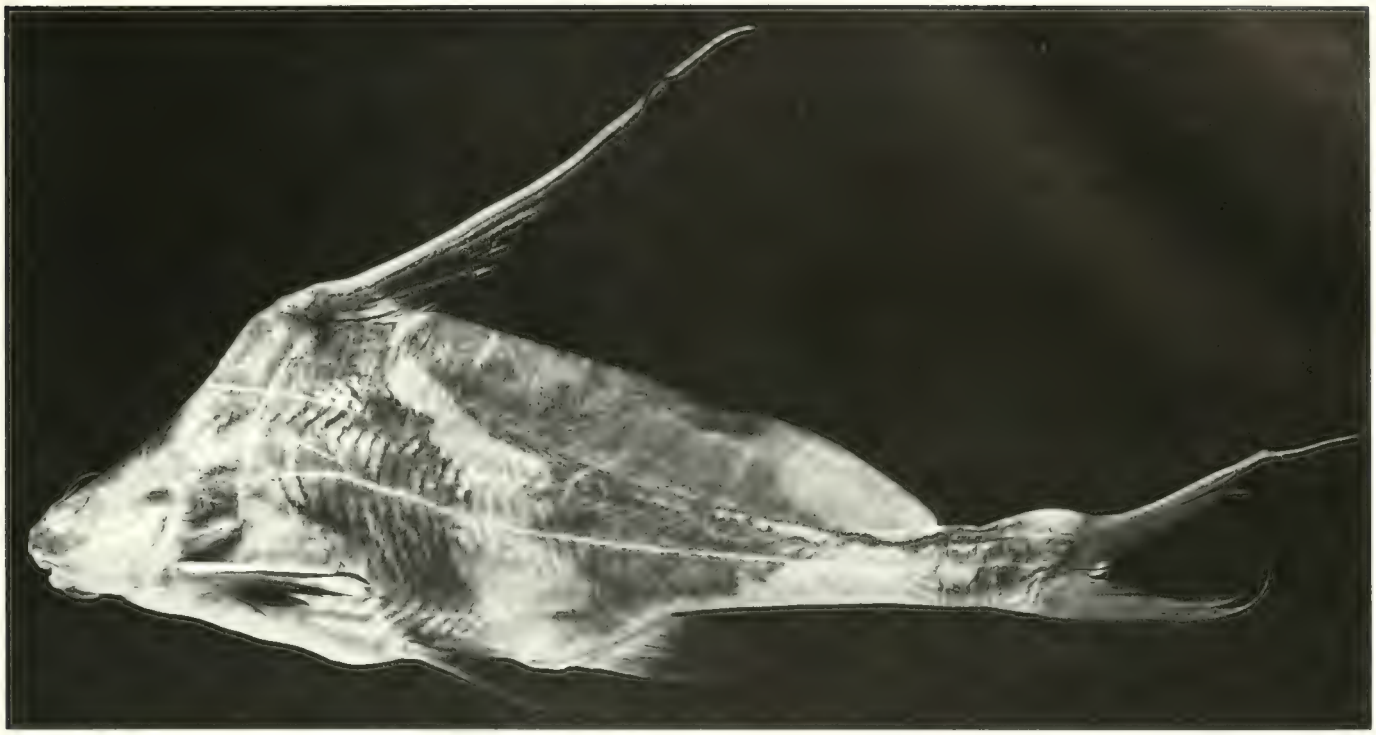

FIGURE 87. *Bagrichthys hypselopterus*. Kapuas 1976-19, 234 mm male (CAS 49366).

richthys and perhaps of any member of the family Bagridae. Anterior portion of body very compressed and deep, predorsal profile extremely steep. Dorsal fin extraordinarily elongate; dorsal-fin spine extending to or slightly beyond level of caudal-fin base when depressed, its posterior margin with up to 60 serrae. Caudal peduncle excessively elongate, about 1.5–2 times longer than in any other *Bagrichthys*. Gill rakers 14–15. Peduncular vertebrae 19–20, total vertebrae 47–49.

The 184 mm Kapuas specimen has the following: head length 6.0; eye 6.9 (much smaller than in specimens of any other species of *Bagrichthys* of comparable size); snout 19.2; mouth opening 23; gill rakers 4+11=15; dorsal-fin spine, broken near tip but still extending posteriorly when adpressed to beyond caudal-fin origin, its length 1.5; dorsal-fin spine serrae 53 (not allowing for gaps between serrae, apparently due to serrae having broken off, which would bring the count to about 60); pectoral-fin spines broken off near base; humeral process 13.3; body depth 3.3, width 7.3; caudal peduncle length 2.6, depth 17.7; nasal barbel extending posteriorly well beyond eye, length 14.8; maxillary barbel extending posteriorly to somewhat in front of pectoral-fin spine, length 7.8; both mental barbels with excessively convoluted anterior margins; outer mental barbel length 16.7, inner 25.2; upper and lower lobe of caudal fin with long filamentous extensions. The other specimens from the Kapuas are very similar in all respects to this specimen except for their larger size. Adult or subadult specimens of smaller species of *Bagrichthys* with less modified dorsal fin and body shape have been mistaken for young *B. hypselopterus* (Weber and de Beaufort 1913:346, fig. 146; Jayaram 1968:381, fig. 13; Mohsin and Ambak 1983: 125, fig. 92). The smallest known *B. hypselopterus*, 172 mm (BMNH 1863.12.4.61), is as extreme in its morphology as the largest known specimens.

Through the kindness of Han Nijssen I have been able to examine material of the *Bagrichthys* which Weber and de Beaufort (1916:346, fig. 146) mistakenly identified as young *B. hypselopterus*. These specimens, ZMA 101.457, a sexually mature male of 108 mm and two gravid females, 182–193 mm, from Batang Hari at Djambi, Sumatra, I tentatively identify as *B. macracanthus*. They have the fins black or very dark, and the body entirely or almost entirely dark brown or brownish black except for a pale or white axial streak; jaws wide, teeth in both jaws large and numerous (not heterodont); mental barbels simple (not convoluted or papillose); gill rakers 4+9–10=13(1),

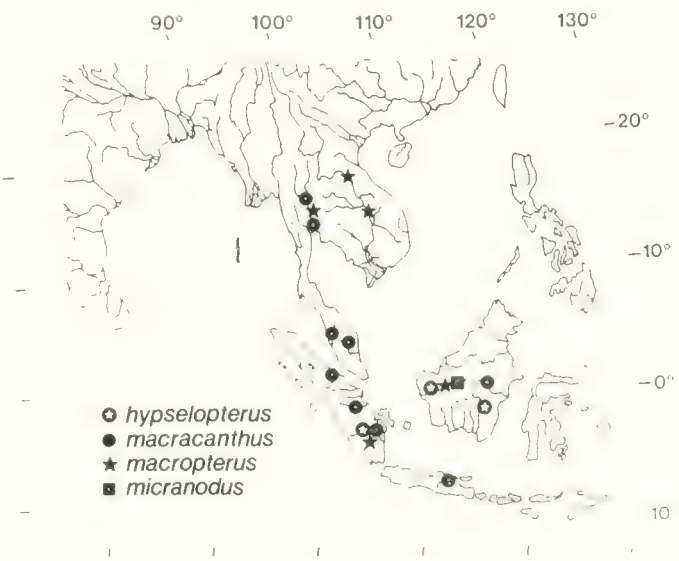

FIGURE 88. *Bagrichthys*. Geographical distribution

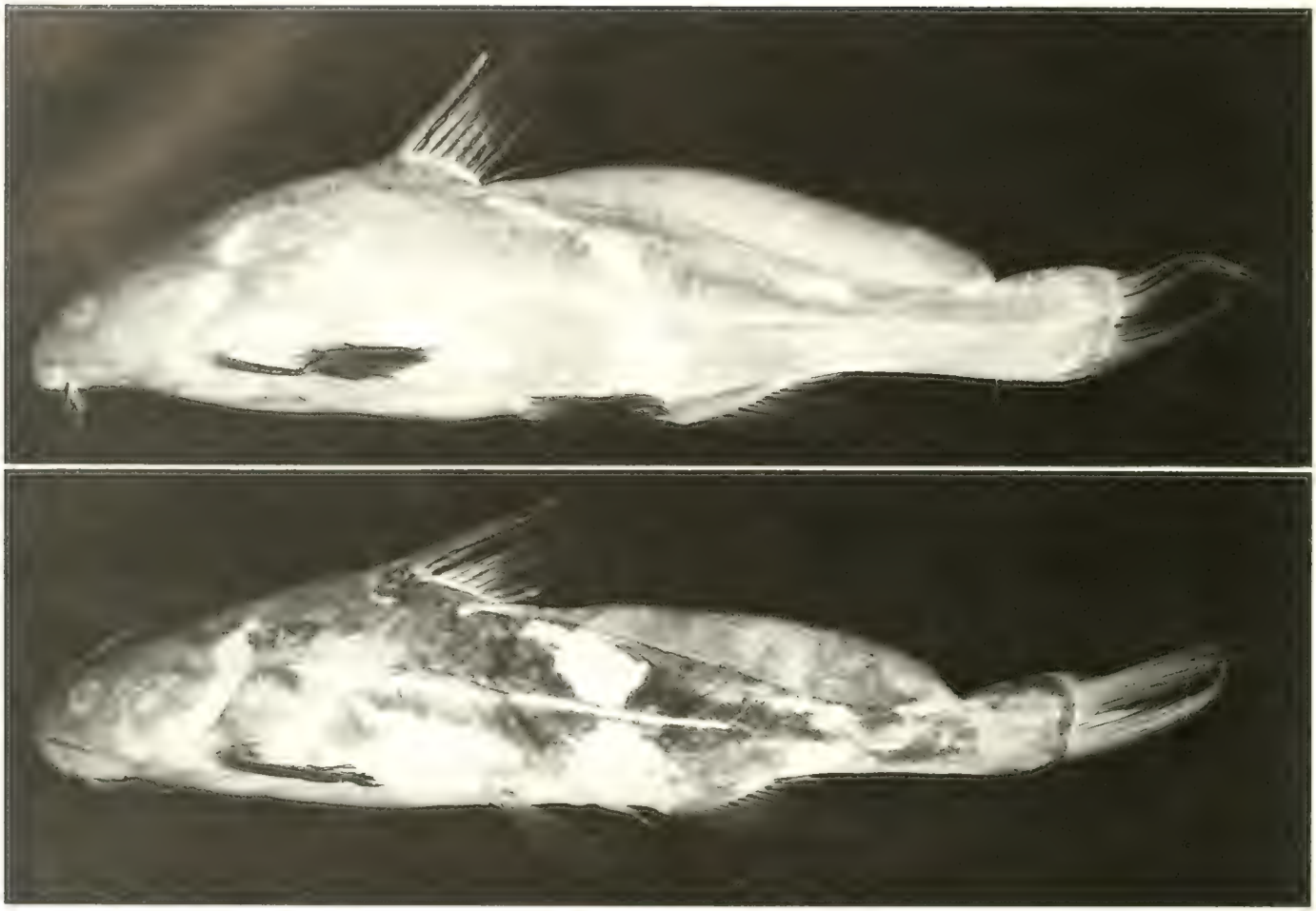

FIGURE 89. *Bagrichthys*. Above, *B. macropterus*, Kapuas 1976-45, 129 mm (MZB 3575); below, *B. micranodus*, Kapuas 1976-45, 125 mm (MZB 3578, holotype)

14(2); dorsal-fin spine broken in all three specimens, 108 mm male (dorsal spine broken near tip) with at least 23 serrae; pectoral-fin rays 9; peduncular vertebrae 14(2), 15(1); total vertebrae 18–19+24–25=43(3).

DISTRIBUTION.—Sumatra (Musi). Borneo (Kapuas, Barito?). Records from Malay Peninsula (Mohsin and Ambak 1983) and Java (Jayaram 1968) are erroneous.

Bagrichthys macropterus (Bleeker, 1853)

(Figure 89)

Bagroides macropterus Bleeker, 1853*f*:515 (type locality Muara Kompeh, Sumatra)
Pseudobagrichthys macropterus Bleeker, 1862–63:50
Bagroides macropterus Gunther, 1864:91
Bagrichthys macropterus Jayaram, 1968:380

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 4: 174–236 mm (CAS 49368, MZB 3577); Kapuas 1976-45, 27: 58.9–183 mm (BMNH 1982.3.29.146–147, FMNH 94237, IRSNB 631, KUMF 2856, MNHN 1982-702, MZB 3576, RMNH 28882, UMMZ 209918, USNM 230275, ZMA 116.540). Locality unknown (=Sumatra, Muara Kompeh?), 193 mm (RMNH 6876, probable holotype)

NOTE ON HOLOTYPE.—The 193 mm specimen (RMNH 6876) probably is the holotype from Muara Kompeh. It is still in a jar apparently supplied by Bleeker, and labelled *Pseudobagrichthys macropterus*. Only one specimen of the species is indicated in the A group of the auction catalog of Bleeker material (none in B, C, D, or E). Therefore this should be the only Bleeker specimen of *B. macropterus* in the RMNH (as it apparently is) and the holotype. The total length of about 256 mm as measured by me agrees with Bleeker's of 256 mm. The specimen has its mouth cut at rictus so it could be more readily opened, and tissue overlying the jaws has been partially removed. The upper jaw has only two minute teeth visible (one tooth on each side) and 3+1 teeth on lower jaw. The description and figure of the dentition of *B. macropterus* given by Bleeker (1862, pl. 67, fig. 2) thus seems to differ from that in the holotype and in the original description. It may be that the 1862 account is based on BMNH 1863.12.4.108, a 117 mm Bleeker specimen from Sumatra. This is apparently the only other Bleeker specimen of *B. macropterus*.

DIAGNOSIS (based on Kapuas specimens).—A *Bagrichthys* with a very small mouth opening and greatly reduced oral dentition; inner and outer mental barbels strongly crenulated; dorsal-fin spine relatively short, 5.5–7.1, with up to 14 serrae (usually 12 or fewer); body and fins with strongly defined light marks on a darker background.

The present Kapuas material includes a 215 mm sexually mature male and a 236 mm gravid female. The rest of the specimens seem to be immature. Apart from the elongate genital papilla of males, there seems to be no sexual dimorphism or dichromatism.

The following observations are based on 25 Kapuas specimens 58.5–236 mm: head length 4.0–6.0; eye 32.4–49.7; snout 10.6–18.1; width of mouth opening 36.6–56.0; width of mouth including lips 15.2–28.3; nasal barbel, invariably thin and round, extending posteriorly to eye by a distance no more than twice eye diameter, length 10.8–17.0; maxillary barbel usually failing to reach base of pectoral-fin spine, length 4.6–8.5; outer mental barbel with weakly or moderately strongly convoluted anterior margin, length 10.2–18.9; inner mental barbel with strongly convoluted anterior margin, length 20.3–39.3; dorsal-fin spine length 5.5–7.1, serrae 7–14 (increasing in number with growth); pectoral-fin spine length 5.2–6.6, serrae 13–26 (increasing in number with growth); pectoral-fin rays 8(1), 9(22), 10(1); body depth 3.7–4.7, width 5.6–6.5; caudal peduncle length 3.4–3.9, depth 11.4–14.4; gill rakers 2+5=7(2); vertebrae 45(2), 46(6); peduncular vertebrae 14–15.

In addition to the material from Sumatra and Borneo listed above, I have examined four specimens from the Mekong basin in Thailand previously identified as *B. macropterus* (UMMZ 186765, 186851, 88.8–169 mm). These are morphologically close to *B. macropterus* but have dorsolateral surfaces of head and body uniformly brown (i.e., without the highly visible pale or cream-colored blotches and midlateral stripe characteristic of Sundaic *B. macropterus*). For the present I identify them as *Bagrichthys* sp. undet. (near *B. macropterus*).

Bagrichthys micranodus new species

(Figure 89)

HOLOTYPE.—MZB 3578, 125 mm mature male, Kapuas mainstream 58 km NE of Sintang and 1 km downstream from Sebruang (Kapuas 1976-45).

PARATYPES.—BMNH 1982.3.29.148, CAS 49369, MZB 3579, USNM 230276, 8: 59.6–95.8 mm, collected with holotype; MZB 3580, 108 mm mature male, Sungai Djentawang near Ketungau, 37–38 km NNE of Sintang (Kapuas 1976-49).

DIAGNOSIS.—A *Bagrichthys* with greatly reduced oral dentition as in *B. macropterus* from which it differs in much smaller adult size, generally longer barbels with ribbon-like margins (excepting inner mental barbel), slightly longer fin spines, slightly more elongate caudal peduncle and darker coloration.

The following observations are based on the 125 mm holotype and seven paratypes 59.6–108 mm: head length 4.0–4.7; eye 27–34.5; snout 10.9–16.2; width of mouth opening 15.3–19.5; width of mouth including lips 15.3–19.5; nasal barbel in 3 largest specimens 95.8–125 mm (all males) extending posteriorly to or beyond gill opening, length 4.4–5.9, but much shorter in other specimens, length only 10.0–11.0; nasal barbels with expanded flat margins in three largest specimens; maxillary barbel extending posteriorly to or beyond base of pectoral-fin spine in all specimens, its length 3.5–5.8; outer mental barbel with simple margins, length 6.1–9.6; inner mental barbel with strongly convoluted and papillose anterior margin, length 18.8–25.2; dorsal-fin spine length 5.3–6.5, serrae 6–15 (increasing in number with growth); body depth (at dorsal-fin origin) 4.2–4.7; body width (at widest point in humeral process) 5.5–6.0; pectoral-fin spine length 4.7–5.8; pectoral spine serrae 12–22 (increasing in number with growth); pectoral-fin rays 8(3), 9(5); humeral process length 8.4–10.1; anal-fin rays 14(3), 15(3), 16(1); caudal peduncle length 3.4–3.7, depth 13.4–15.6; gill rakers 2+3–7=5(1), 6(1), 8(1), 9(1); vertebrae 19–21+25–26=45(6), 47(1); peduncular vertebrae 15(2), 16(5). Color in life overall dark brown with pale abdomen, large regularly spaced cream-colored marks on nape and side of body, and a cream-colored midlateral streak extending length of body. Color pattern generally similar to that of *B. macropterus* but nape mark generally narrower and failing to meet dorsally.

There are numerous slight differences between *B. micranodus* and *B. macropterus*. In addition to those already noted, at comparable sizes the dorsal- and pectoral-fin spines are slightly longer and generally have 2–3 more serrae in *B. macropterus*; eye and mouth tend to be slightly larger, body slightly wider.

The three largest specimens, 95.8–125 mm, are fully mature males. These have an elongate genital papilla, length 12.5–17.4, and ripe testes with dozens of villus-like projections up to 5 mm long. In all other specimens gonads weakly developed and sex not determined.

ETYMOLOGY.—The name *micranodus* (Greek) refers to the small size and virtually toothless jaws of this species.

Bagroides Bleeker, 1851

Bagroides Bleeker, 1851*h*:204 (type species *Bagroides melapterus* Bleeker, 1851, by monotypy).

DIAGNOSIS.—*Bagroides* differs from all other bagrids except *Bagrichthys* in having serrae on dorsal-fin spine retrorse rather than antrorse or absent; it differs from *Bagrichthys* in having fewer vertebrae; humeral process very large and broad-based; a relatively small adipose fin partly free from body posteriorly, and a greatly enlarged oval-shaped vomerine tooth patch with molariform rather than conical teeth. Dorsal and pectoral spines very stout, and heavily serrate; occipital process and predorsal plate very strong and in contact; anal-fin rays 19–20; vertebrae 18+21–22=39–40, peduncular vertebrae 9–10 (*Bagrichthys* with 43–48 total and 13–20 peduncular vertebrae).

Jayaram (1968) placed *Leiocassis hirsutus* Herre, 1934 (type locality Wuchow, Kwangsi province) in this otherwise monotypic genus. I have compared the 230 mm paratype (CAS-SU 13885) (same specimen examined by Jayaram) directly with a 235 mm Kapuas specimen of *B. melapterus* (CAS 49370) and conclude they are not congeneric. *Leiocassis hirsutus* differs from *Bagroides* in having head much broader anteriorly, with a wide, broadly rounded snout, relatively wide mouth and interorbital space; predorsal profile gently concave rather than gently convex; posterior margin of united branchiostegal membranes with a relatively strong median indentation; vomerine teeth in a strongly arched band; dorsal- and pectoral-fin spines relatively slender; serrae of dorsal-fin spine relatively weak (as if worn) and antrorse rather than strong and retrorse; humeral process narrow based; serrae of pectoral-fin spine much smaller and probably more than twice as numerous; adipose fin longer, with much more extensive thickened portion anteriorly; anal-fin rays 23 (first 4 rays minute); vertebrae 17+24=41. I tentatively refer Herre's species to *Leiocassis*.

Bagroides melapterus Bleeker, 1851

Bagroides melapterus Bleeker, 1851*h*:204 (type locality Bandjermassing, in fluviis)

Bagroides melanopterus Bleeker, 1852*b*:413 (unwarranted spelling change)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 4: 85.0–250 mm (CAS 49370, MZB 3581, USNM 230277); Kapuas 1976-48, 97.7 mm (MZB 3582)

DISTRIBUTION.—Sumatra (Palembang, Kwantan R., Indragiri, Djambi). Borneo (Sambas, Kapuas, Barito, Kahajan). We-

TABLE 5. MERISTIC CHARACTERS OF SOME SUNDALAND *LEIOCASSIS*. For definition of vertebral counts see p. 22.

	Gill rakers	Anal-fin rays	Pectoral-fin rays	Vertebrae
L. armatus				
Kapuas	6–8?	14–15	6	14–16+17–18=32(2), 33(2)
L. cf. *fuscus* Popta, 1904				
Johore (CAS-SU 39339)	12	12–13	6–7	17+18=35(3)
L. leiacanthus W and de B, 1912				
Johore (CAS-SU 31006)	10	15–17	7–8	16+20=36(2)
L. micropogon				
Kapuas	12	17	8	18+21=39(1)
L. myersi				
Kapuas (types)	16–18	17–18	7	16–17+26–27=43(3), 44(2)

ber and de Beaufort (1913:349) give Rajang R., but the basis for this record is unknown.

Leiocassis Bleeker, 1858

Leiocassis Bleeker, 1858*c*:59, 139 (type species *Bagrus poecilopterus* Valenciennes *in* Cuvier and Valenciennes, 1839, by subsequent designation of Bleeker, 1862–63:9)

Liocassis Günther, 1864:65 (unwarranted spelling emendation).

?*Pseudomystus* Jayaram, 1968:359 (type species *Bagrus stenomus* Valenciennes *in* Cuvier and Valenciennes, 1839, by original designation; described as subgenus of *Leiocassis*)

Although Jayaram (1968) reviewed *Leiocassis*, his work is based mainly on a survey of the literature. The only comprehensive revision of the genus is that by Regan (1913), based on relatively few specimens and comprising relatively brief descriptions without figures. Several species have been described subsequent to Regan, but it is clear from examination of museum collections that additional species remain undescribed.

It seems likely that the numerous species presently included in *Leiocassis* are of diverse phyletic relationships (i.e., polyphyletic). Jayaram (1968) divided *Leiocassis* into two subgenera, *Leiocassis* and *Pseudomystus*. Within *Pseudomystus* he recognized two groups, the "*leiacanthus* complex" with *leiacanthus, siamensis,* and *bicolor,* and the "*stenomus* complex" with *stenomus, vaillanti, inornatus, mahakamensis, fuscus, moeschii, breviceps,* and *robustus*. The "*leiacanthus* group," with only three species, may be natural, but the "*stenomus* complex" appears to be very diverse and probably polyphyletic. Jayaram (1968: 359) remarked of this group that the species resemble those of the genus *Mystus*. I have myself noted the superficial resemblance of *L. stenomus, L. mahakamensis,* and *L.* cf. *fuscus* to *Mystus* (or *Hemibagrus*) and am inclined to believe it may indicate a true relationship. In *L.* cf. *fuscus* and L. *mahakamensis* the branchiostegal membranes of the left and right sides are strongly overlapping (as in *Mystus*) whereas in all members of the subgenus *Leiocassis* and *leiacanthus* complex of *Pseudomystus,* so far as I have been able to determine, they are nonoverlapping.

Meristic characters of some Sundaland *Leiocassis* are given in Table 5.

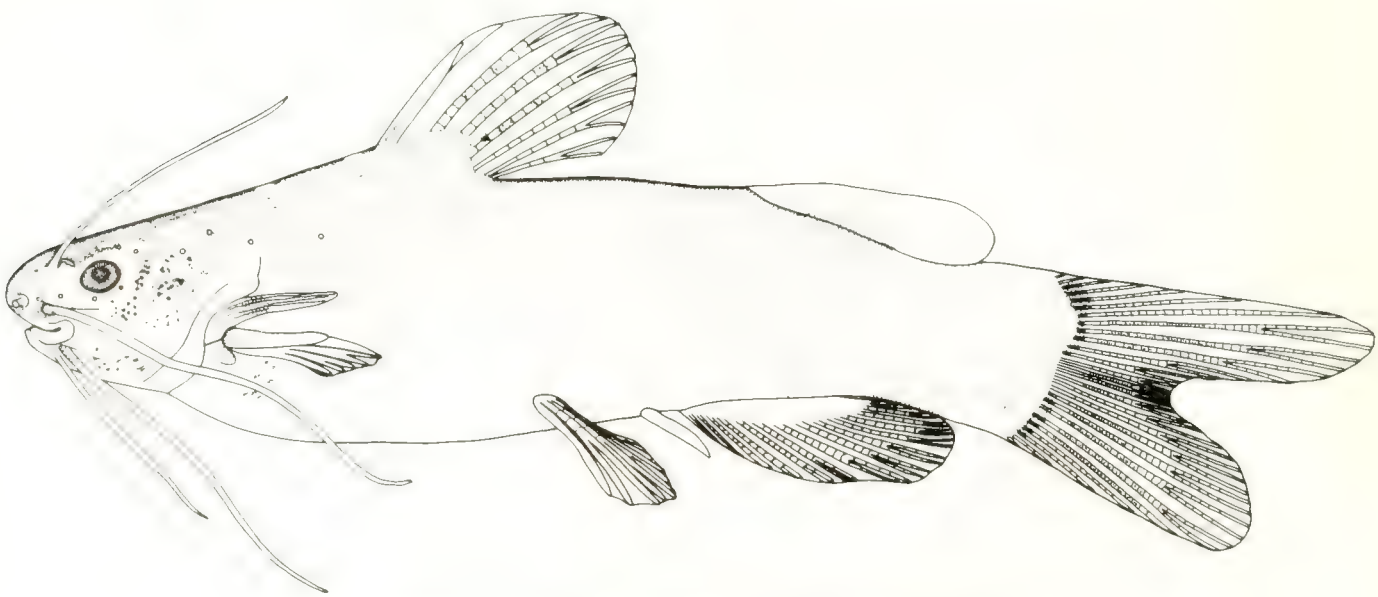

FIGURE 90 *Leiocassis armatus*. Kapuas 1976-39, 24.8 male (CAS 49427).

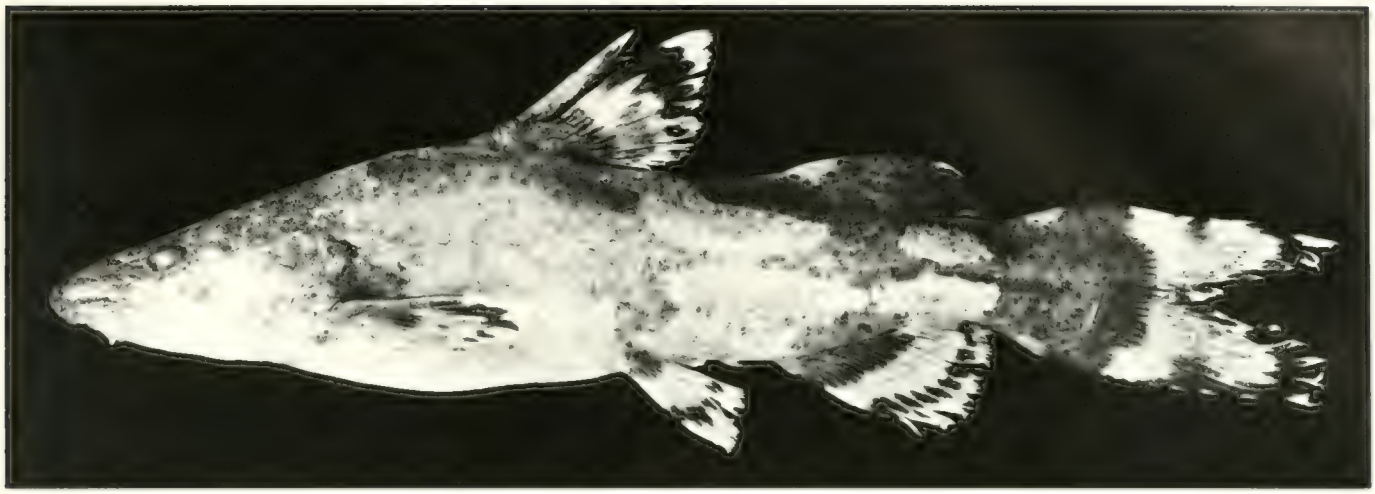

FIGURE 91 *Leiocassis micropogon*. Kapuas 1976-27, 85.2 mm (MZB 3586).

Leiocassis armatus (Vaillant, 1902) new combination
(Figure 90)

Akysis armatus Vaillant, 1902:64 (type locality Tepoe, bords du Mahakam)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-21, 7: 19.2–23.5 mm (BMNH 1982.3.29.149–150, CAS 49371, MZB 3583, RMNH 28883); Kapuas 1976-39, 11: 17.9–24.8 mm (CAS 49372, MZB 3584, USNM 230278). Eastern Borneo: Mahakam basin, Tepoe, 21.7 mm (RMNH 7844, holotype of *A. armatus*).

Direct comparison of several Kapuas specimens with the holotype and only previously known specimen of "*Akysis*" *armatus* reveals that they are identical in all respects. The species does not have the characteristic features of the family Akysidae.

Leiocassis armatus is perhaps the smallest member of the bagrid genus *Leiocassis* (largest known specimen, a sexually mature male with elongate genital papilla, 24.8 mm).

DISTRIBUTION.—Kapuas, Mahakam.

Leiocassis micropogon (Bleeker, 1852)
(Figure 91)

Bagrus micropogon Bleeker, 1852*a*:94 (type locality Blitong [=Billiton], in flumine Tjirutjup).
Leiocassis micropogon Bleeker, 1858*c*:142
?*Liocassis baramensis* Regan, 1906:67 (type locality Baram River)
?*Liocassis hosii* Regan, 1906:67 (type locality Sibu, Sarawak)
?*Liocassis merabensis* Regan, 1913:550 (type locality Merabeh, North Borneo)
?*Liocassis doriae* Regan, 1913:551 (type locality Borneo)
?*Leiocassis chaseni* de Beaufort, 1933:34 (type locality Ulu Jelai, Malay Peninsula) See Hora and Gupta (1941:25).
?*Leiocassis regani* Jayaram, 1965:9 (type locality Sadong, N. Borneo)

MATERIAL EXAMINED.—Malay Peninsula: outlet of Lake Chin-chin Jasin, Malacca, 148 mm (CAS-SU 31005). Western Borneo: Kapuas 1976-20, 2: 129–183 mm (CAS 49373, MZB 3585); Kapuas 1976-27, 85.2 mm (MZB 3586); Kapuas 1976-28, 8: 32.9–105 mm (BMNH 1982.3.29.151–152, CAS 49374, MZB 3587, RMNH 28884, USNM 230279).

Leiocassis micropogon is closely related to *L. poecilopterus* (generic type species) but differs in having a more elongate head (especially snout) and body (especially caudal peduncle). It is rather variable in such respects as relative development of occipital crest and predorsal plate, development of a posterior median projection from the vomerine or palatal toothplate, depth of caudal peduncle, and coloration (from subdued brownish with relatively indistinct mottling to relatively well defined dark marks on an orangish or yellowish background).

The 183 mm Kapuas specimen, a gravid female (CAS 49373) has head length 3.1; snout 9.4; eye more than 3 times in snout, about 3 times in interorbital space, its length 32.7; soft interorbital width 16.4; barbels uniformly thin; nasal barbel very small, length 61 (less than eye diameter); maxillary barbel extending posteriorly a little beyond eye, length 8.2; outer mental barbel 12.0 and inner 42; palatal tooth band with a broad-based short posterior median extension; branchiostegal rays 7–8?; gill rakers 3+9=12; predorsal plate elongate, separated from occipital process by a distance about equal to eye diameter; dorsal spine with 20 serrae, length 6.0; pectoral spine with 20 serrae, length 6.7; pectoral-fin rays 8; humeral process extending posteriorly as far as middle of adpressed pectoral spine, length 10.2; anal-fin rays about 14 (4 simple and 10 branched); adipose fin moderately long, with a well defined posterior insertion but thickened anteriorly with origin poorly defined, length about 5.0; caudal peduncle length 6.0, depth 13.8.

The nominal species of Regan (1906, 1913), preceded by question marks in the synonymy of *L. micropogon* presented here, are all known only from one or a few type specimens from single type localities. I examined these specimens and tentatively conclude that they represent individual or local variations of *L. micropogon*. *L. doriae* was distinguished because the 177 mm holotype and only known specimen has a vomerine or palatal tooth band with an exceptionally large median posterior projection; in other respects it appears to be identical to other large specimens of *L. micropogon* which tend to have a variably developed posterior projection. The syntypes of *L. hosii* have a more elongate or slender caudal peduncle than other specimens examined but in other respects seem indistinguishable from *L. micropogon*.

DISTRIBUTION.—Malay Peninsula. Sumatra. Borneo (Sarawak, Sambas, Kapuas). Banka. Billiton.

Leiocassis myersi new species
(Figure 92)

HOLOTYPE.—MZB 3588, 71.2 mm small forest stream flowing into Kapuas mainstream NE of Gunung Setunggul, 53 km NW of Sintang (Kapuas 1976-47)

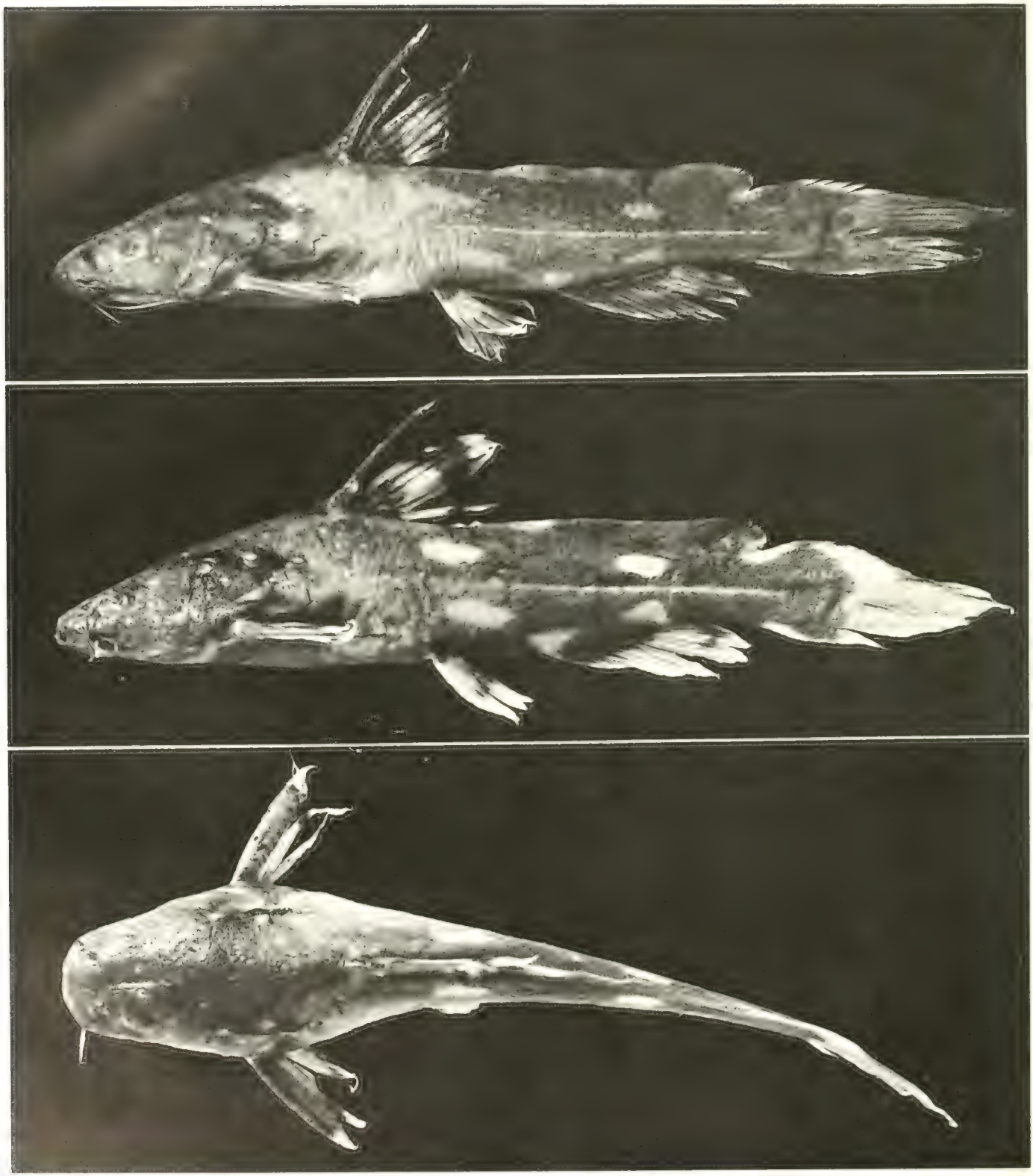

FIGURE 92 *Leiocassis myersi*, Kapuas 1976-47. Above, 71.2 mm (MZB 3588, holotype), middle and below, 46.8 mm (CAS 49375, paratype).

PARATYPES.—CAS 49375 (2), MNHN 1982-703 (1), MZB 3589 (2), USNM 302850 (3), ♀ 38.9–87.8 mm, same collection as holotype; BMNH 1982.3.29.153–154 (2), MZB 3590 (1), RMNH 28885 (1), 4 ♂ 52.8–55.9 mm, Sungai Seriang, a tributary to Sungai Palin, Kapuas basin, 37 km W of Putussibau (Kapuas 1976-42), MZB 3591, 44.9 mm, Sungai Gentu, near where it flows into Kapuas mainstream, 55 km NE of Sintang (Kapuas 1976-46).

DIAGNOSIS.—A *Leiocassis* with a relatively broad, moderately depressed head; dorsal surface of cranium rugose, exposed or covered only by a thin layer of skin which may be easily abraded off; pores of cephalic laterosensory canals relatively large and highly visible due to depigmented rims; adipose fin elongate and

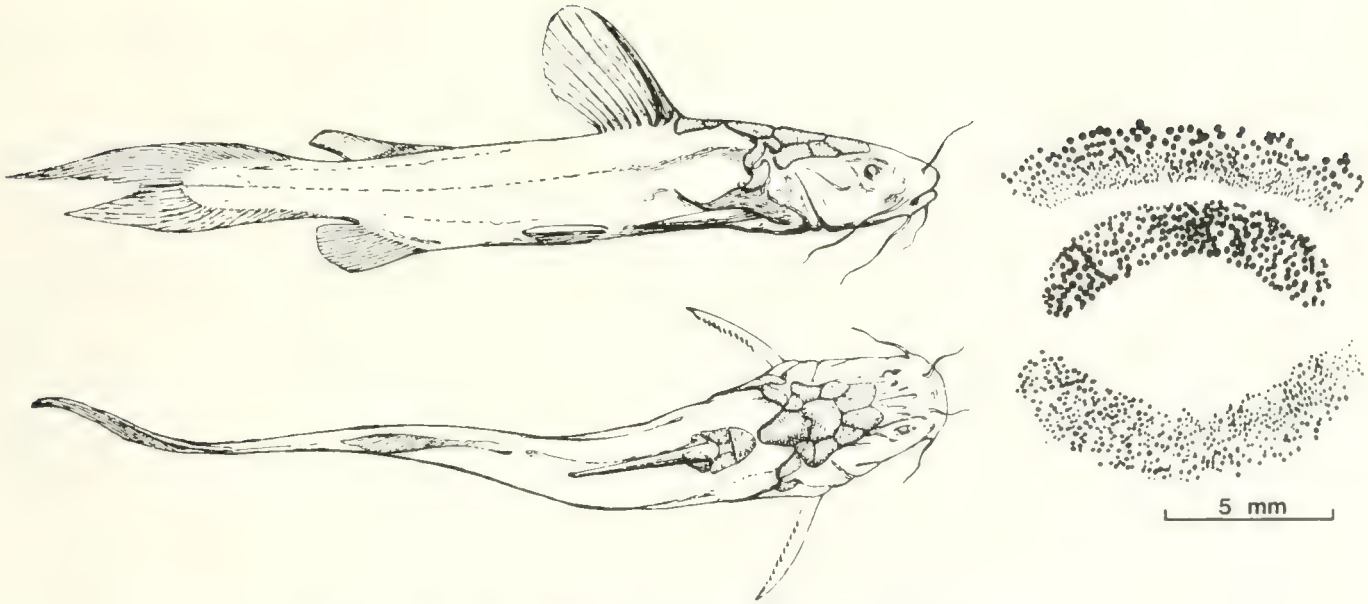

FIGURE 93. *Leiocassis vaillanti*. Kapuas, 107 mm (RMNH 7840, holotype; left, after Vaillant 1902:61)

relatively low, extending posteriorly onto anterior portion of ridge formed by upper procurrent caudal-fin rays (in all other *Leiocassis* examined adipose fin terminates posteriorly directly on dorsal surface of trunk or caudal peduncle); gill rakers 16–18; anal-fin rays 17–18; caudal-fin rays 24+8/9+16–17; vertebrae 16–17+26–27=43–44; color in life bluish-black; side of body with a thin pale or white midlateral streak, two horizontally elongate pale or white oval spots above midlateral streak and three similar oval spots below it; small pale marks at origin and termination of dorsal fin, but dorsum without pale transverse bands; rayed fins overall pale but with one or two dark transverse bands; adipose fin black with pale edges or marginal spots.

The following observations are based on the 71.2 mm holotype and four paratypes 55.1–87.8 mm: head length 3.3–3.7, gill cover elongate, extending posteriorly to above middle of humeral spine; snout broadly rounded, length 9.9–10.6; eye without free orbital rim, horizontal diameter 29.0–31.6; mouth width 9.2–10.7; interorbital space broad, slightly concave, width 13.5–14.8; occipital crest and predorsal plate rugose and moderately elongate, of equal length and similar shape, and nearly or quite meeting each other; predorsal plate length 16.0–18.7; body depth 4.9–5.5 and width 4.4–4.9; barbels thin, moderately elongate; nasal barbel extending posteriorly well beyond eye, 7.5–9.5; maxillary barbel extending almost to or slightly beyond base of pectoral-fin spine, 4.1–5.4; outer and inner mental barbels respectively 6.1–8.8 and 8.5–12.7; dorsal-fin spine moderately elongate, 5.3–6.1; adipose-fin base length 2.7–3.2 and height 16.4–20.9; pectoral-fin spine length 5.0–5.5; pectoral serrae 11–16 (increasing in number with growth); pectoral-fin rays 7; humeral process rugose, moderately elongate, 9.5–9.8; supraclavicular spine well developed, pointed distally; pelvic fin large, extending posteriorly to anal-fin origin, length 6.1–7.2;

FIGURE 94 *Leiocassis* sp. undet. Kapuas, 75.2 mm (MNHN 1891-475)

pelvic-fin rays 6; caudal fin moderately forked, with pointed lobes, upper slightly longer than lower.

DISTRIBUTION.—Known only from Kapuas.

ETYMOLOGY.—This species is named in honor of Professor George S. Myers, my teacher in ichthyology and himself a student of Asian fishes.

Leiocassis vaillanti Regan, 1913

(Figure 93)

Leiocassis moeschii Vaillant, 1902:61 (non Boulenger, 1890).
Leiocassis vaillanti Regan, 1913:549 (type locality embouchure du Raoun, Kapuas basin)

MATERIAL EXAMINED.—Western Borneo: Kapuas basin, embouchure du Raoun, 107 mm (RMNH 7840, holotype)

Leiocassis vaillanti is known only from a description and figures by Vaillant (1902:61–63, fig. 8, 9), who identified it as *L. moeschii* Boulenger, and a very brief description by Regan (1913), who recognized it as a new species, of a single specimen from the Kapuas basin. In addition to reproducing Vaillant's figures I give an illustration of the oral dentition.

This species has dorsal surface of head consisting mainly of exposed, rugose or granulated bone. As noted by Regan, the "supraclavicular" (=supracleithrum?) bone lacks the posterior spinous projection characteristic of *L. moeschii* and is in fact strongly concave where the spine would be; this condition is accurately illustrated in Vaillant's figures. The anterior margin of the exposed bony head shield lies far posterior to the level of the eyes, whereas in *L. moeschii* it is continued anteriorly as a pair of elongate projections extending in front of the eyes. *L. vaillanti* also has a broader, less pointed snout, a wider mouth, and a more elongate body than *L. moeschii*; gill rakers 3+10=13; pectoral spine with 16 strong serrae; pectoral-fin rays 8; pelvic 6; anal 16.

Leiocassis sp. undet.

(Figure 94)

Leiocassis stenomus Vaillant, 1893:73 (non Valenciennes *in* Cuvier and Valenciennes, 1839; Knapei, Kapuas basin).

MATERIAL EXAMINED.—Western Borneo: Kapuas basin, Knapei, 75.2 mm (MNHN 1891-475, specimen identified as *L. stenomus* by Vaillant). The following additional lot of Kapuas specimens, examined briefly and not directly compared with the preceding specimen, may also be the same species: RMNH 7837, 12: 20.0–70.7 mm, Sintang.

Mystus Scopoli, 1777

Mystus Scopoli, 1777:451 (type species undetermined; for discussion see Jayaram 1962)
Macrones Dumeril, 1856:484 (type species *Bagrus lamarii* Valenciennes *in* Cuvier and Valenciennes, 1839; preoccupied by *Macrones* Newman, 1841, Coleoptera).
Hemibagrus Bleeker, 1862–63:9 (type species *Bagrus nemurus* Valenciennes *in* Cuvier and Valenciennes, 1839, by original designation).
Ispidobagrus Bleeker, 1862–63:9 (type species *Bagrus gulio* Hamilton-Buchanan, 1823, by original designation and monotypy)
Hypselobagrus Bleeker, 1862–63:10, 57 (type species *Bagrus macronema* Bleeker, 1846–*Bagrus nigriceps* Valenciennes *in* Cuvier and Valenciennes, 1839, by original designation)
Heterobagrus Bleeker, 1864:355 (type species *Heterobagrus bocourti* Bleeker, 1864, by original designation and monotypy). See discussion under *Mystus nigriceps*
Aoria Jordan, 1919:341 (substitute name for *Macrones* Dumeril, 1856; preoccupied by *Aoria* Baly, 1863, Coleoptera)
Sperata Holly, 1939:143 (substitute name for *Aoria* Jordan, 1919, and therefore with same type species; Holly's designation of *Silurus vittatus* Bloch as type species is invalid).
Aorichthys Wu, 1939:131 (substitute name for *Aoria* Jordan, 1919).
Macronichthys White and Moy-Thomas, 1940:505 (substitute name for *Aoria* Jordan, 1919).

Mystus Scopoli, 1777 is a traditional or catch-all genus (revived by Fowler 1928:105 to replace the preoccupied traditional genus *Macrones* Dumeril, 1856) to which approximately 30 relatively generalized Asian bagrid species are assigned.

The nomenclatural history of *Mystus* is extremely complicated and requires further study before Jayaram's conclusions concerning its type species can be accepted.

Some species of *Mystus* (e.g., *M. nemurus*, type species of *Hemibagrus* Bleeker) are superficially extremely similar to the genus *Bagrus* (type species *Silurus docmak* Fôrskal, 1775). This African genus comprises about eight species which are morphologically relatively similar. They differ from *Mystus* in having 8–11 dorsal-fin rays rather than the generalized number (for catfishes) of 7.

Bleeker (1862–63), in characteristically bold fashion, divided *Macrones* or *Mystus* into four genera, but these are not recognized here pending further study of their morphology and determination of the type species of *Mystus* Scopoli, 1777.

Mystus micracanthus (Bleeker, 1846)

Bagrus micracanthus Bleeker, 1846*a*:151 (type locality Batavia, in fluviis).
Hypselobagrus micracanthus Bleeker, 1862–63:59.
Macrones micracanthus Günther, 1864:76
Mystus micracanthus Fowler, 1934*b*:94

MATERIAL EXAMINED.—Malay Peninsula: Perak, Telok Anson, 132 mm (CAS-SU 30988); Malacca, 57.7 mm (CAS-SU 30985); Johore, Mawai, 66.6 mm (CAS-SU 30986); Johore, Sungei Kayu, 105 mm (CAS-SU 32715); Singapore, 2: 67.6–113 mm (CAS 53308, CAS-SU 30987). Sumatra: Padang, 106 mm (CAS-SU 8014); Indragiri River, 112 mm (ZMA 119.059); Batang Hari, 6: 72.5–98.1 mm (ZMA 119.060); Gunung Sahilan, 4: 60.5–65.5 mm (ZMA 114.393); Lampong, 107 mm (RMNH 15858); Moesi River at Moera Klingi, 8: 40.7–102 mm (UMMZ 155689, 155713–4). Borneo: Kapuas 1976-8, 47.7 mm (MZB 3592); Kapuas 1976-16, 40.2 mm (MZB 3593); Kapuas 1976-17, 2: 40.4–82.0 mm (BMNH 1982.3.29.155, MZB 3594); Kapuas 1976-19, 3: 62.7–68.0 (CAS 49376, MZB 3595); Kapuas 1976-32, 4: 67.8–83.4 mm (FMNH 94238, MZB 3596); Kapuas 1976-33, 5: 60.6–90.8 mm (MZB 3597, USNM 230281); Kapuas 1976-36, 77.1 mm (MZB 3598); Kapuas 1976-37, 5: 73.8–89.5 mm (CAS 49377, MZB 3599, RMNH 28886); Kapuas 1976-39, 94.1 mm (MZB 3600); Kapuas 1976-42, 2: 73.5–84.1 mm (KUMF 2857, MZB 3601); Kapuas 1976-43, 41.1 mm (MZB 3602); Kapuas 1976-44, 60.6 mm (MZB 3603); Kapuas 1976-51, 3: 48.1–54.1 mm (MZB 3604, UMMZ 209926). Java: Batavia, 106 mm, Bleeker collection (RMNH 15847, neotype); Krawang, 111 mm (RMNH 2947); Brantas River, 78.1 mm (RMNH 5206); no precise locality, 2: 101–120 mm (RMNH 2948, 3009); Bleeker collection, no locality: 27: 62.7–122 mm (RMNH 5216).

DIAGNOSIS.—*Mystus micracanthus* is a narrow-headed, moderately large-eyed species with a very long adipose fin and very long barbels. In these respects it agrees with *M. nigriceps*, but is less elongate, with a shorter cranial fontanel and different coloration. Maxillary barbel extending posteriorly to or beyond end of caudal fin; outer mental barbel extending posteriorly to origin of pelvic fin. Color in life overall brownish. Area overlying entire tympanum moderately darkened, and caudal peduncle with a large, triangular midpeduncular spot, these two moderately darkened areas not outlined or otherwise intensified by pallid or white contiguous areas.

DESIGNATION AND DESCRIPTION OF NEOTYPE.—Bleeker did not specifically mention any specimen(s) utilized in the original description of *M. micracanthus*. The RMNH possesses a single

TABLE 6. *MYSTUS MICRACANTHUS*. Geographical variation in frequencies of gill rakers and vertebrae.

	Gill rakers																				Vertebrae				
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	36	37	38	39	40
Malay Peninsula																										
Telok Anson, 132 mm									1															1		
Malacca, 57.7 mm							1																	1		
Mawai, 66.6 mm					1																			1		
Sungei Kayu, 105 mm	1																						1			
Singapore, 67.6–113 mm			1			1																		2		
Sumatra																										
Padang, 106 mm										1														1		
Indragiri, 112 mm										1																1
Batang Hari, 98.1 mm									1																1	
Batang Hari, 72.5–77.5 mm															1	3	2					4	2			
G. Sahilan, 60.5–65.5 mm					1			2	1														1	2		
Lampong, 107 mm									1															1		
Moesi, 40.7–102 mm			1		1	1	2	1	1	2														2	4	2
Borneo																										
Kapuas, 40.2–94.1 mm				1			1	1			1		5	2	3	2		1				5	12			
Java																										
Batavia, 106 mm (neotype)								1																	1	
Krawang, 111 mm																					1					
Brantas, 78.1 mm														1										1		
"Java," 101–120 mm																					2				2	
Bleeker Col. (Java?)																										
no loc., 62.7–122 mm				1	1		1		1	3	2	2											3	3	4	
no loc., 74.3–109 mm														1	4	3	2	3	1				2	6	7	1

Bleeker specimen from Batavia, the type locality, RMNH 15857, 106 mm, with broken anal and caudal fins but otherwise in good condition. The specimen has a piece of parchment tied to it but the writing on the label is indiscernible. It may well have been the actual specimen (or at least one of those) upon which Bleeker's original description was based. The only other Bleeker specimens of *M. micracanthus* in Leiden are RMNH 5216, 27 specimens without locality data. I therefore designate RMNH 15857 as neotype. The specimen may be described as follows: head 3.8, snout 9.8, eye 16.8, bony interorbital width 11.8; cranial fontanel extending posteriorly to anterior border of supraoccipital bone; nasal barbel reaching posteriorly almost to end of head its length 5.7, maxillary barbel reaching to middle of caudal peduncle, its length 1.14; outer mental barbel 2.4, inner 3.4; dorsal-fin spine 7.1, pectoral 4.7; pectoral-fin spine with 16 serrae on posterior margin; humeral spine 9.1; body depth 4.3, width 5.0; caudal peduncle depth 10.0; adipose-fin base about 3.2; dorsal-fin rays 7-1/2, anal about 13, pectoral 9, pelvic 6; gill rakers 6+21=27; branchiostegal rays 9/9; vertebrae 21+18=39.

INTRASPECIFIC VARIATION.—*Mystus micracanthus* exhibits differences in frequencies of counts of gill rakers and vertebrae (Table 6) interpreted by me as intraspecific variation. In Sumatra one finds most specimens with relatively few gill rakers and more vertebrae, but there is one sample (from Batang Hari) with more gill rakers and few vertebrae. Specimens from the Malay Peninsula examined by me all correspond to the first type, while those from Borneo (Kapuas) correspond best to the second. This pattern suggests that two species might be involved. Specimens from the Malay Peninsula, Sumatra, and Borneo with few gill rakers and more vertebrae tend to be larger than those with more gill rakers and few vertebrae, which also suggests two species. The picture is complicated, however, by specimens from Java and from the Bleeker collections (unfortunately without locality data) in which the range of gill raker counts is very wide but vertebral counts do not differ in specimens with low and high gill raker counts. Another complication is that specimens from the Kapuas with low vertebral counts exhibit almost as great a range of gill raker counts as those from the entire range of *Mystus micracanthus*. It would be interesting to examine additional material, especially from the Malay Peninsula and Borneo (including Sarawak), to determine whether the patterns described here really exist.

NOTE ON *MYSTUS BIMACULATUS*.—*Mystus bimaculatus* Volz, 1904, was placed as a junior subjective synonym of *M. micracanthus* by Weber and de Beaufort (1913:339) and has not been recognized subsequently as a valid species. Although closely related to *M. micracanthus*, it is immediately distinguished by its striking coloration, overall chocolate brown, with a large black humeral spot (round and well defined) and a large black vertical bar on posterior portion of caudal peduncle and base of caudal fin; anterior margin of humeral spot and both margins of caudal bar set off by vertical cream or white bars. A color photograph of live *M. bimaculatus* from Djambi appears in Vogt (1979). Specimens examined by me (ZMA 119.064, 2: 38.8–39.1 mm, Bagan si api-api) have 23–24 gill rakers and only 33–35 vertebrae. The species apparently is restricted to Sumatra.

Mystus nemurus (Valenciennes, 1839)

Bagrus nemurus Valenciennes *in* Cuvier and Valenciennes, 1839:423 (type locality Java)

Bagrus Hoevenii Bleeker, 1846*a*:154 (type locality Batavia, in fluviis)

Bagrus Sieboldii Bleeker, 1846*a*:155 (type locality Batavia, in fluviis).
?*Macrones bongan* Popta, 1904:182 (type locality "le Bongan"=Kapuas basin). See below.
Macrones planiceps Vaillant, 1902:18, 20, 23 (Sibau, Raoen, Kapuas basin; Bloeoe, upper Mahakam).
Mystus nemurus Fowler, 1934*b*:95.
Mystus johorensis Herre, 1940*a*:13 (type locality Sungai Kayu, 16 miles north of Kota Tinggi, Johore). See below.
Mystus pahangensis Herre, 1940*a*:14 (type locality Sungai Garam, near Karak, Pahang). See below.
?*Macrones* (*Hemibagrus*) *filamentus* Fang and Chaux *in* Chaux and Fang, 1949: 200 (type locality Cambodge).

Material Examined.—Thailand, Chantabun, Kao Sabap, 194 mm (CAS-SU 28825). Malay Peninsula: Pahang, Sungai Garam near Karak, 196 mm (CAS-SU 33025, holotype *M. pahangensis*); Perak, Telok Anson, 2: 77.0–85.6 mm (CAS-SU 30999); Perak, Chanra Dam, 2: 216–231 mm (CAS-SU 32717); Perak, Bukit Merah, 3: 98.4–161 mm (CAS-SU 30997, 32714); Kuala Lumpur, Selangor, 3: 83.3–143 mm (CAS-SU 32716); Malacca, Lake Chin Chin, 2: 66.8–95.6 mm (CAS-SU 30996); Johore, Sungei Kayu, 208 mm (CAS-SU 33026, holotype *M. johorensis*); Johore, Sungei Kayu, 200 mm (CAS-SU 32721); Johore, Kota Tinggi, 140 mm (CAS-SU 32718); Johore, Ayer Hitam, 113 mm (CAS-SU 31000); Singapore, 147 mm (CAS-SU 31001). Western Borneo: Kapuas 1976-6, 4: 106–192 mm (BMNH 1982.3.29.156–158, MZB 3605); Kapuas 1976-15, 2: 20.6–24.6 mm (CAS 49378, MZB 3606); Kapuas 1976-16, 5: 71.3–168 mm (CAS 49379, MZB 3607, ROM 37406); Kapuas 1976-17, 2: 80.4–86.5 mm (FMNH 94239, MZB 3608); Kapuas 1976-21, 80.5 mm (MZB 3609); Kapuas 1976-24, 2: 61.9–123 mm (IRSNB 19747, MZB 3610); Kapuas 1976-25, 11: 49.8–188 mm (MNHN 1982-704, MZB 3611, RMNH 28887); Kapuas 1976-27, 5: 44.6–85.7 mm (MZB 3612, USNM 230282); Kapuas 1976-28, 2: 80.1–89.0 mm (MZB 3613, ZMA 116.541); Kapuas 1976-29, 76.7 mm (MZB 3614); Kapuas 1976-30, 6: 40.9–56.9 mm (CAS 49380, MZB 3615); Kapuas 1976-42, 99.8 mm (MZB 3616); Kapuas 1976-46, 79.1 mm (MZB 3617); Kapuas basin, Nanga Raoen, 145 mm (RMNH 7828); Kapuas basin, Sibau, 93.3 mm (RMNH 7829). Eastern Borneo: Mahakam basin, Bloeoe, 2: 63.1–84.5 mm (RMNH 7827).

Diagnosis.—*Mystus nemurus* (type species of *Hemibagrus* Bleeker, 1862) has a broad, flat head; moderately large eyes; wide interorbital space; cranium moderately rugose dorsally; cranial fontanel extending well into posterior half of supraoccipital bone, almost to base of supraoccipital crest; supraoccipital crest extending posteriorly almost to predorsal bone, barbels long, maxillary barbel extending posteriorly almost to anal-fin origin to somewhat beyond it; adipose fin large but short, originating far posterior to dorsal fin, with its dorsoposterior margin distinctly rounded and its base incised posteriorly; upper caudal-fin lobe often with a short filamentous extension; color in life overall dark brown, with a well defined, dark, thin midaxial streak extending length of body (absent in all other *Mystus*); branchiostegal rays 11–13; gill rakers 3–5+9–14=13–19; vertebrae 22–23+22–23=43–45.

The thin, dark midaxial streak, probably always present in fresh specimens, juvenile as well as adult, apparently occurs only in this species among *Mystus*. This otherwise diagnostic character may fade entirely after long periods in preservative. I have examined the holotypes (which are also the only reported specimens) of *M. pahangensis* and *M. johorensis*; both have an obvious midaxial streak and agree in all respects with *M. nemurus*.

Remarks on Related Species.—*Mystus nemurus* seems closely related to *M. planiceps* and *M. baramensis* (Regan 1906). *Mystus baramensis* is known only from northern Borneo, where it occurs sympatrically with *M. nemurus* (see Inger and Chin 1962:138–141, 202–204). As noted by Inger and Chin, *M. baramensis* differs from *M. nemurus* in coloration, adipose-fin shape, and gill raker counts. *M. baramensis* has no midaxial streak. Its adipose-fin base is more elongate.

Gill rakers vary considerably in both species, but generally are more numerous in *M. baramensis* (see Table 7 and discussion in Inger and Chin 1962). Finally, having examined several lots of both species, I find *M. baramensis* slightly stockier and less elongate, with a shorter or stouter caudal peduncle, and with its cranial roof more covered with skin and less rugose. The largest reported specimen of *M. baramensis* is only 172 mm standard length (Inger and Chin 1962), whereas *M. nemurus* has been reported to 350 mm (total length?) (Weber and de Beaufort 1913:342). Thus *M. baramensis* may be a smaller species, although limited data available (Table 7) indicate this is not reflected by marked decrease in vertebral number.

Mystus planiceps (Valenciennes *in* Cuvier and Valenciennes, 1839), type locality Java, is similar to *M. nemurus* but differs in having shorter barbels, slightly shorter snout, broader interorbital space, less rugose dorsal surface of cranium, supraoccipital process relatively short (separated from predorsal plate by a distance equal to about twice eye diameter, vs. usually less than one eye diameter in *M. nemurus*), possibly a pale rather than dark midaxial streak, and more vertebrae. Gill rakers 16–17. Vertebrae 46–49 (Table 7).

Mystus planiceps probably does not occur in Borneo, although it has been reported from northern Borneo by Boulenger (1894: 247) and Inger and Chin (1962:141), from western Borneo by Vaillant (1893:38; 1902:18, 20), and from eastern Borneo by Vaillant (1902:23). I have examined the specimens reported upon by Vaillant (1902) (RMNH 7827–29) and reidentified them as *M. nemurus*. I have also examined some of the specimens studied by Inger and Chin (1962) (FMNH 68064, 68092–93). These specimens, from the Rejang basin, differ from *M. planiceps* from Buitenzorg, Java (CAS-SU 20505) and are unlike other Bornean specimens of *Mystus* examined by me.

Distribution.—*Mystus nemurus* is common and widely distributed in Thailand (Smith 1945:386), Malay Peninsula, Sumatra, Borneo, and Java. It apparently occurs in almost every river basin in Borneo (Weber and de Beaufort 1913:342; Inger and Chin 1962).

Mystus nigriceps (Valenciennes, 1839)

Bagrus nigriceps Valenciennes *in* Cuvier and Valenciennes, 1839:412 (type locality Java).
Bagrus macronemus Bleeker, 1846*a*:150 (type locality Batavia, in fluviis).
Bagrus singaringan Bleeker, 1846*a*:150 (type locality Batavia, in fluviis).
Bagrus heterurus Bleeker, 1846*a*:151 (type locality Batavia, in fluviis).
Hypselobagrus macronema Bleeker, 1862–63:58.
Macrones nigriceps Günther, 1864:77.
Hypselobagrus nigriceps Fowler, 1905:470.
Mystus nigriceps Fowler, 1935*a*:94.
Mystus cavasius Smith, 1945:94 (in part).
Macrones cavasius von Martens, 1876:400 (Kapuas, Danau Sriang).

Material Examined.—Malay Peninsula: Malacca, 3: 44.9–76.9 mm (CAS-SU 30995); Perak near Sauk, 125 mm (CAS-SU 32720); Perak, Chandra dam, 2: 190–198 mm (CAS-SU 30992); Johore, Ayer Hitam, 87.9 mm (CAS-SU 30993); Pahang, 2: 111–132 mm (CAS-SU 30998), Singapore, 66.7 mm (CAS 20003). Western Borneo: Kapuas 1976-8, 12: 67.1–152 mm (BMNH 1982.3.29.159–160, CAS 49381, FMNH 94240, MNHN 1982-705, MZB 3618); Kapuas 1976-19, 2: 112–133 mm (MZB 3619, RMNH 28888); Kapuas 1976-20, 3: 109–119 mm (MZB 3620, UMMZ 209863); Kapuas 1976-33, 105 mm (MZB 3621); Kapuas 1976-34, 117 mm (MZB 3622); Kapuas 1976-43, 93.5 mm (MZB 3623); Kapuas 1976-44, 4: 112–127 mm (MZB 3624, USNM 230283). Java: Buitenzorg, 161 mm (CAS-SU 20492).

Diagnosis.—*M. nigriceps* is readily distinguished from other

TABLE 7. FREQUENCIES OF GILL RAKER AND VERTEBRAL COUNTS IN *MYSTUS NEMURUS* AND RELATED SPECIES.

	Gill rakers												Vertebrae						
	13	14	15	16	17	18	19	20	21	22	23	24	43	44	45	46	47	48	49
Mystus baramensis																			
Northeast Borneo																			
Kabili R. (CAS-SU 32711, -13, -19)					1	2	6	2	2				1	1		1			
Sibugal R. (CAS-SU 33738)							2						1	1					
Sandakan (Inger and Chin, 1962)			1			2	5	1											
Kalabakan (Inger and Chin, 1962)							1		3	4	3	1							
Mystus nemurus																			
Thailand																			
Kao Sabap	1																		
Singara			1																
Malay Peninsula																			
Pahang (holotype *pahangensis*)			1												1				
Telok Anson				1			1												
Bukit Merah			1		1	1									1				
Chandra Dam		1			1														
Malacca		2													1				
Kuala Lumpur	1	1	1																
Johore (holotype *johorensis*)		1													1				
Singapore				1										1					
Western Borneo																			
Kapuas 1976-16	3												1	2					
Kapuas 1976-30				1	4													5	
Mystus planiceps																			
Java																			
Buitenzorg				2	2											1	3		
Mystus cf. *planiceps*																			
Sarawak																			
Rejang R. (FMNH 68092)				1	7	7	3										4	12	2

Mystus in the Malay Peninsula and Indonesia by its long adipose fin contiguous with the dorsal fin (origin of adipose fin at a distance from dorsal fin in other species). Barbels very long, maxillary barbel sometimes extending to or beyond caudal fin. Branchiostegal rays 7–8. Gill rakers 21–25. Vertebrae 41–44 (Table 8).

Smith (1945:94) treated *M. nigriceps* as a junior synonym of *M. cavasius* (Hamilton-Buchanan, 1822). While the two species are morphologically extremely similar and undoubtedly closely related, I agree with Bleeker and with Weber and de Beaufort (1913:338) that they are distinct. The most obvious difference involves coloration. Bornean and apparently Malaysian specimens are uniformly dark brownish in life, without distinct marks on body. Specimens from Nepal are greyish in life, with a more or less well defined midlateral longitudinal stripe, sometimes also a less well defined or more diffuse longitudinal stripe ventral to the midlateral stripe, and a dark humeral spot emphasized by a white or pale area along its ventral margin. The longitudinal stripes tend to fade but not the humeral spot even in very old preserved specimens. Such coloration, longitudinal stripes and a humeral spot outlined by pale or white areas, is characteristic of several Indian species but does not occur in any Malaysian or Indonesian species. Most of these Indian species have no obvious close relatives in Malaysia and Indonesia, but *M. cavasius* constitutes an exception.

Mystus nigriceps and *M. cavasius* generally can also be distinguished by gill raker counts (Table 8). *M. nigriceps* from the Malay Peninsula and Kapuas have 22–25 rakers while most *M. cavasius* examined from Pakistan, Nepal, India, Sri Lanka, and Thailand have only 15–21. This generally clear-cut difference in gill raker counts is complicated however by samples from Bombay and Burma. The Bombay specimens (CAS-SU 35854, 8: 54.3–89.7 mm, Deolali, Bombay Presidency) have 20–24 rakers. These specimens, although somewhat faded, exhibit the typical coloration of *M. cavasius* and do not seem to differ except in gill raker counts from other samples of that species. The Burmese specimens, on the other hand, are rather distinctive and may possibly represent a species distinct from either *M. cavasius* or *M. nigriceps*.

The bagrid *Heterobagrus bocourti*, characterized by an enlarged dorsal fin with an extremely elongate non-serrate spine, has been recognized as a valid genus and species since its original description by Bleeker (1864). Bleeker made the following statement about the relationships of *Heterobagrus*: "Ce type nouveau tient le milieu entre les genres *Hypselobagrus* [type-species *Mystus nigriceps*], *Pseudobagrichthys* et *Bagrichthys*. Si l'on voyait que la tête, on n'hésiterait pas de le rapporter au *Hypselobagrus*. Si, au contraire, l'on ne tenait compte du dos et des nageoires dorsales, on ne pourrait manquer d'y voir un *Bagrichthys* [type and only included species *B. hypselopterus*]. Et si l'on n'en observait que la moitié posterieure du corps, tous les Silurologistes y verraient un *Pseudobagrichthys*." Resemblance between *Heterobagrus bocourti* and *Bagrichthys* (including *Pseudobagrichthys*) is in my opinion entirely superficial. A host of spe-

TABLE 8. *MYSTUS NIGRICEPS* AND CLOSELY RELATED SPECIES. Frequencies of gill rakers and vertebrae.

	Gill rakers												Vertebrae					
	15	16	17	18	19	20	21	22	23	24	25	26	39	40	41	42	43	44
Mystus bocourti																		
Pasak R., CAS-SU 28826	1															1		
Mystus cavasius																		
Deolali, CAS-SU 3485				2	1	2	1	2							6	2		
Bisrampur, CAS-SU 41068					1		1							3	2	2		
Tozpur, CAS-SU 41065			1															
Calcutta, CAS-SU 34859				1										1				
Hugli R., CAS-SU 41069				1	1									2				
Naraini R., CAS 50275					1								1					
Rapti R., CAS 50312			1		1									1	1			
Dudara R., CAS 50327	3	3	5	12	4	1							1	4	1			
Indus R., CAS 24246				1									1					
Pulta, CAS-SU 34850							1									1		
Yakvala, CAS-SU 30556							1									1		
Nikaveritiya, CAS-SU 30150							1								1			
Bangkok, CAS 53213					1	1	3								3	2		
Mystus near *cavasius* #1																		
Hlegu, CAS-SU 34851									1		1				1	1		
Minhla Tank, CAS 53339					1		1	1	1		1					5		
Rangoon, CAS-SU 33788									2			1			2	1		
Mystus near *cavasius* #2																		
Rangoon, CAS-SU		1											1					
Mystus nigriceps																		
Pahang, CAS-SU 30998								1			1						1	1
Telok Anson, CAS-SU 30994							1	3	1							2	1	2
Perak, Sauk, CAS-SU 32720									1							1		
Perak, Chandra, CAS-SU 30992									1	1							1	1
Malacca, CAS-SU 30995								3								2	1	
Ayer Hitam, CAS-SU 30993								1										1
Kota Tinggi, CAS-SU 39341															3	2		
Kapuas, CAS 49381									1		1					2		
Buitenzorg, CAS-SU 20492										1						1		

cialized characters of *Bagrichthys* including several modifications of the axial skeleton, well developed retrorse dorsal-fin spine serrae, convoluted and papillose barbels, and *Leiocassis*-like coloration are absent in *Heterobagrus*. On the other hand, direct comparison of specimens of *Heterobagrus* and *Mystus nigriceps* reveal they are extremely similar in virtually every respect except size of the dorsal fin and its elongate spine. I consider *Heterobagrus bocourti* a valid species congeneric with *Mystus* (or *Hypselobagrus*) *nigriceps*. For meristic data on *M. bocourti* see Table 8. The species occurs in the Chao Phrya and Mekong.

DISTRIBUTION.—*M. nigriceps* is very widely distributed in the Malay Peninsula, Sumatra, Borneo, Java; it may also occur in Thailand, but the few Thai specimens examined by me seem to be *M. cavasius*.

Popta (1906) described five new species and a new variety of *Macrones* (=*Mystus*) from the Kapuas and Mahakam basins. Weber and de Beaufort (1913:34) examined the type specimens of these taxa and placed them all in the synonymy of *M. nemurus*, but the type material should be more carefully re-examined and compared with specimens of other species. I tentatively place only *M. bongan* as a synonym of *M. nemurus*. Popta's other new species, *M. howong*, *M. bo*, and *M. kajan*, all from the Mahakam basin, may be synonyms of *M. baramensis* (Regan 1906), described from the Baram River, Sarawak. *Mystus baramensis* resembles *M. nemurus* but is less elongate, with a much shorter snout and a slightly shorter or deeper caudal peduncle, head much broader and covered with smooth skin (rather than relatively exposed and rugose dorsally, at least in larger specimens).

Mystus olyroides new species

(Figures 95, 96)

HOLOTYPE.—MZB 3625, 155 mm female with ripening ovaries, Sintang Market, July 1976 (Kapuas 1976-19), reportedly caught in Sungai Kebian (see Kapuas 1976-20)

PARATYPE.—CAS 49382, 202 mm mature male with well developed testes and moderately elongate genital papilla, obtained with holotype.

DIAGNOSIS.—A very elongate *Mystus* with a short flat head; small eyes; very long barbels; very short and weak dorsal spine; very long adipose fin; caudal fin with upper lobe elongate and lanceolate, lower lobe rounded and much shorter; gill membranes broadly overlapping, branchiostegal rays 9–11; gill rakers 14; pectoral rays 8; anal rays 13; vertebrae 24+24–25=48 or 49; body and fins without markings; color in life uniformly dark brown dorsally and laterally, abdomen dusky.

The holotype and single paratype (in parentheses) of *Mystus olyroides* may be further characterized as follows: head length 3.7 (3.9), dorsal surface covered with smooth skin; snout rounded, length 10.6 (10.9); eye small but entirely free from orbital rim, horizontal diameter 35.2 (40.4); interorbital space broad

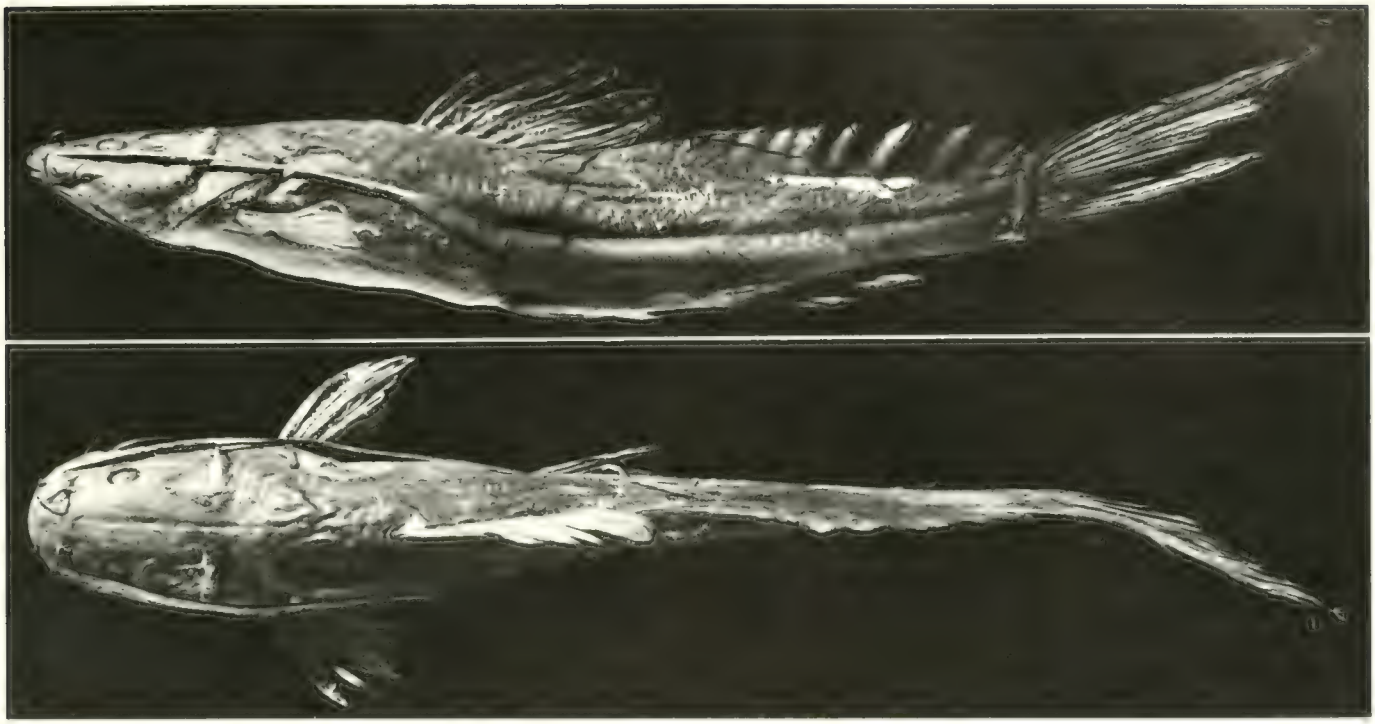

FIGURE 95. *Mystus olyroides*. Kapuas 1976-19, 155 mm (MZB 3625, holotype).

and flat, width 13.6 (13.7); mouth broad, width 8.9 (8.9); upper and lower jaw teeth and palatal teeth in slender bands of relatively generalized conformation for *Mystus*, except lateral arms of palatal tooth patch extend relatively far posteriorly (Fig. 96); gill rakers elongate, 3+1+10 (2+1+11) on first gill arch, all well developed; an unusually long portion of upper limb near origin and of lower limb near insertion without gill rakers; posterior margins of first and second gill arches without gill rakers and of third and fourth with gill rakers; barbels very elongate and thin; maxillary barbel extremely elongate, extending posteriorly to base of caudal fin (or to end of anal fin base), its length 1.0 (1.2); nasal barbel, thinner than other barbels, extending posteriorly almost to occipital crest (well past eye), its length 6.2 (9.2); outer mental barbel, slightly longer than inner, extending posteriorly nearly to end of pectoral fin, its length 2.7 (3.1); body depth 6.0 (6.5), width 5.9 (6.0); dorsal spine weak, almost flexible, and very short, length 12.0 (12.6); occipital process, overlain by thick smooth skin, apparently very short, its length about equal to eye diameter; predorsal plate greatly reduced and deeply embedded; distance between occipital process and dorsal-fin origin about 8.5 (9.3); pectoral spine short, length 8.4, with 12 well developed moderately large serrae on posterior edge (pectoral spines broken off near base on both sides of paratype); humeral spine short, length 16.5 (15.2); pelvic fin with 6 rays and large, length 6.25 (6.5) but with a relatively narrow base, width at base 36.9 (35.5); adipose fin extremely long, originating a distance about equal to eye diameter behind base of last dorsal-fin ray and extending posteriorly dorsal to caudal peduncle and onto anterior half of ridge created by upper procurrent caudal-fin rays, its length 2.2 (2.1) and maximum height 14.9 (17.7); caudal peduncle very elongate, length 4.7 (4.9) and maximum height excluding adipose fin 12.3 (13.6);

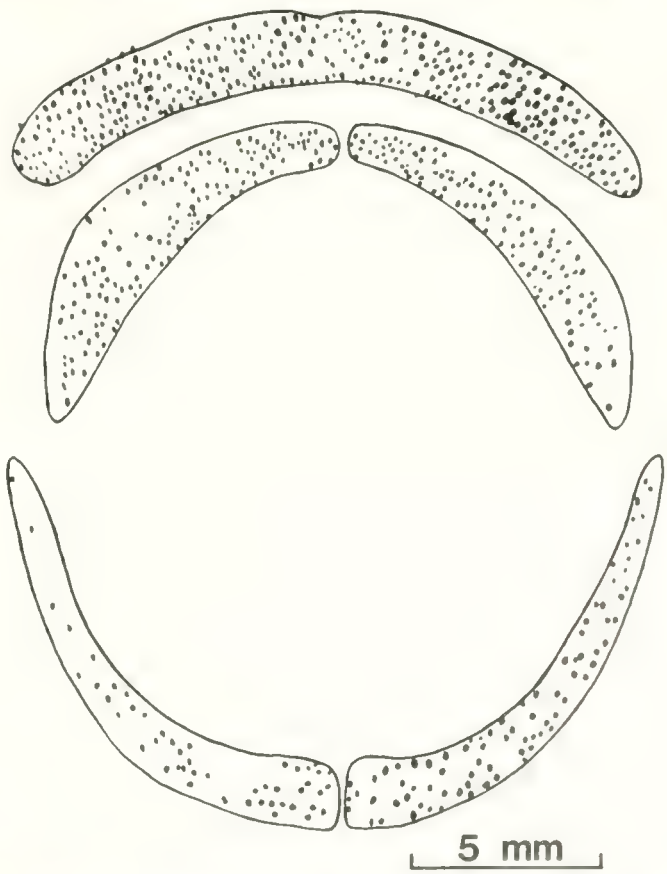

FIGURE 96. *Mystus olyroides*, oral tooth bands. Kapuas 1976-19, 202 mm (CAS 49382, paratype)

caudal fin with 9+8/9+13–14 rays; upper lobe length 2.7 (2.4); posterior swim bladder chamber of 202 mm paratype dorsoventrally flattened and oval, its narrowed posterior end well before level of pelvic origin; posterior swim bladder chamber with rigid walls; internally a rigid dorsoventrally and longitudinally complete median septum divides it into separate right and left chambers, floors of which are further complicated by a series of skinlike partial septae; head (including barbels) and body (except ventral surface) dark brown; adipose fin and fin rays of all fins brown; interradial membranes of all fins except pectoral varying from dusky to almost black; interradial membranes of pectoral fin clear.

REMARKS.—*Mystus olyroides* does not seem particularly close to any other species. In some respects it resembles "*Leiocassis*" *mahakamensis* but differs considerably from the holotype and only known specimen of that species (type locality Mahakam) in coloration, more elongate adipose fin, and rounded (rather than lanceolate) lower caudal-fin lobe. It also superficially resembles and may be related to the genus *Olyra* of India, Burma, and western Thailand, which is usually assigned to a separate family, Olyridae, but apparently is a bagrid.

DISTRIBUTION.—Kapuas.

ETYMOLOGY.—The name *olyroides* refers to the similarity of this species to members of the Asian catfish genus *Olyra* McClelland, 1842.

Mystus wolffii (Bleeker, 1851)

Bagrus Wolffii Bleeker, 1851*b*:205 (type locality Bandjermassing, in fluviis).
Hypselobagrus Wolffi Bleeker, 1862–63:58 (Bandjermassing, Pontianak, Palembang)
Macrones wolffii Günther, 1864:82

MATERIAL EXAMINED.—Peninsular Thailand: brackish lagoon near Songkhla, 7: 105–136 mm (CAS 55554). Borneo: no further locality, 3: 77.8–115 mm (RMNH 2945). Bleeker collection: locality data lost, 9: 47.8–128 mm (RMNH 6866)

The only report of this species from western Borneo apparently is that of Bleeker (1858*c*:161, 1860*d*:19) from Pontianak. The material upon which this record is based cannot be located, and neither can the holotype. Bleeker (1858*c*:161, 1862–63) indicated having 16 specimens of *M. wolffii*. The auction catalog of Bleeker's collections also indicates 16 specimens, 12 in lot A and one each in lots B–E. Lot A, which should have included the holotype, is represented by RMNH 6866 which now has only nine specimens. None of them has a total length of 131 mm as reported for the holotype.

The Bleeker specimens of *M. wolffii* (RMNH 6866) have gill rakers 6–9+18=24?(1), 25(2), 26(2), 28(2), and 29(2) and vertebrae 18–19+18–21?=37(2), 38(6), and 39?(1). The RMNH Borneo specimens agree closely in all respects observed with the Bleeker material. They have gill rakers 7–9+21–23=28(1), 29(1), and 32(1) and vertebrae 18+20=38. The CAS specimens from Thailand have been compared directly with the Bleeker and Borneo specimens and agree closely except in having more numerous gill rakers. The Thai specimens have gill rakers 9–11+29–30=39(2), 40(3), and 42(2) and vertebrae 18–19+19–20=37(3) and 38(4).

DISTRIBUTION.—Thailand: lower courses of rivers flowing into Gulf of Thailand. Sumatra (Palembang). Borneo (Pontianak, Bandjermasin). I suspect that this species is restricted to the lower courses of rivers, as indicated by Smith (1945:384), and that it may be a brackish water species. The specimens from Thailand were taken with a large number of specimens tentatively identified as *Mystus gulio* (CAS 55555). Smith indicates a published record from Malacca, on the Indian Ocean coast of the Malay Peninsula, but I have not found the source of this record. A record from the upper Mahakam by Popta (1906:253) is evidently based on a misidentified specimen examined by me and tentatively re-identified as *M. nemurus* (RMNH 7835).

Mystus wyckii (Bleeker, 1858).

Bagrus Wyckii Bleeker, 1858*c*:156 (type locality Java, in flumine Tjitarum, provinciae Preanger, prope vicum Parongkalong).
Hemibagrus Wyckii Bleeker, 1862–63:57
Macrones wyckii Günther, 1864:83.
Mystus wycki Smith, 1929:12

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-29, 4: 35.2–206 mm (CAS 49383, MZB 3626); Kapuas 1976-45, 4: 31.7–151 mm (MZB 3627, USNM 230284); Kapuas 1976-48, 2: 18.6–20.2 mm (CAS 49384, MZB 3628); Kapuas 1976-50, 2: 27.5–29.7 mm (CAS 49385, MZB 3629).

DIAGNOSIS.—A large species of *Mystus* (*Hemibagrus*) with distinctive coloration and relatively numerous vertebrae. Dorsal and lateral surfaces of head and body and all fins largely black in color but with well defined white markings on tips of pectoral and dorsal fin; leading edge of adipose and anal fins, upper and lower margins of caudal peduncle, and caudal fin (including filamentous extensions of unbranched primary caudal-fin rays); gill cover black but gill membranes pale, almost white; nasal barbel dark and mental barbels pale, but elongate maxillary barbel (extending posteriorly beyond level of pelvic-fin origin) with anterior margin white and posterior margin black; branchiostegal rays 9+8; gill rakers on first gill arch 3–4+9–10=12–14, anterior portion of lower limb rakerless near origin; vertebrae 51.

Pelteobagrus Bleeker, 1865

Pelteobagrus Bleeker, 1865*a*:9 (type species *Silurus calvarius* Basilewski, 1855=*Pimelodus fulvidraco* Richardson, 1845?)

Pelteobagrus ornatus (Duncker, 1904)

(Figure 97)

Arius sp. indet. Vaillant, 1902:71 (Le Kapoeas, ?Sintang)
Pseudobagrus ornatus Duncker, 1904:173 (type locality Muar-Flüss bei Tubing tinggi)
Pelteobagrus ornatus Jayaram, 1968:297

MATERIAL EXAMINED.—Malay Peninsula: Muar River at Tubing tinggi, 2: 24.0–25.5 mm (HZM 8654, syntypes of *P. ornatus*). Western Borneo: Kapuas basin, Sintang, 29.1 mm (RMNH 7826, previously identified as *Arius* sp. indet.).

Placement of this very small southeast Asian catfish with large eyes in either *Pseudobagrus* or *Pelteobagrus*, otherwise exclusively east Asian (China, Korea, Japan, Siberia) genera of relatively large species with small eyes, is highly tentative.

The species was known only from Duncker's two syntypes from Muar until Kottelat (1982:434) reported two specimens from southeastern Borneo. A single specimen from the Kapuas basin, unfortunately in rather poor condition, also appears to be this species. This specimen has not been compared directly to the syntypes but is apparently very similar to them in most respects: snout noticeably overhanging; horizontal diameter of eye fully 3 times in head length (eye relatively smaller in syn-

types); tooth band of upper jaw nearly straight transversely, palatal tooth band about half as wide and moderately curved; nasal barbel absent? (minute nasal barbel present in syntypes); maxillary barbel extending to pectoral-fin origin (shorter than head in syntypes); mental barbels elongate; gill rakers 4+10; dorsal-fin branched rays 6; pectoral-fin spine with 8 strong serrae; pectoral branched rays 7; total anal-fin rays 19 or 20 (22–23 in syntypes according to Jayaram 1968:297).

The extraordinary color pattern of the Kapuas specimen, identical or very similar to that of Duncker's syntypes (Fig. 97) in all respects, includes a horizontal stripe about half as wide as eye arising on side of head near snout-tip, extending laterally at mid-eye level to cover both nostrils, middle portion of gill cover, and part of cleithrum; a second stripe, about half as wide, arises near snout-tip but more dorsally and extends between eyes and onto occipital region; single roundish black spots at dorsal-fin origin, near middle of adipose-fin base, on abdomen behind each pelvic-fin base, and on anal-fin base near origins of anal-fin rays 4–7; caudal peduncle with a narrow midlateral horizontal stripe extending to middle of caudal-fin base; upper and lower halves of caudal-fin base with vertically oriented elliptical or oval dark marks.

DISTRIBUTION.—Malay Peninsula (Muar). Borneo (Kapuas; Barito basin?).

Clariidae

This distinctive air-breathing family of Africa and Asia is readily distinguished by its elongate, entirely spineless dorsal fin (sometimes extending entire length of body), elongate anal fin, and distinctive overall appearance. Head flattened; four pairs of well developed barbels; eyes small; body cylindrical, moderately to extremely elongate; arborescent air-breathing apparatus arising from gill arches 2 and 4; cleithrum with knoblike bony process projecting into gill opening; caudal fin rounded.

Clarias Scopoli, 1777

Clarias Gronovius, 1763:100 (non-binomial, not available for zoological nomenclature; Opinion 261, Official index of rejected and invalid works on zoological nomenclature, 1958).
Chlarias Scopoli, 1777:455 (misspelling of *Clarias* Gronovius, 1763; type species *Silurus anguillaris* Linnaeus, 1758, by present designation).
Clarias Cuvier, 1816:206 (type species *Silurus anguillaris* Linnaeus, 1758, by present designation).

NOMENCLATURAL NOTES.—Although portions of Scopoli are binomial, the treatment of *Chlarias* [=*Clarias*] is non-binomial and does not include any reference to a binomial taxon. From the standpoint of the genus *Clarias* it is unfortunate that Gronovius (1763) is unavailable for zoological nomenclature, since the binomial *Silurus anguillaris* is among the species listed under the genus and would therefore automatically be the type species by monotypy. The first authority to assign binomial taxa to *Clarias* is Cuvier (1816), who mentioned two species, *Silurus anguillaris* Linnaeus, 1758 and *Silurus batrachus* Bloch, 1794 [=*Silurus batrachus* Linnaeus, 1758]. Thus the generic type species must be one of these two species. In the apparent absence of subsequent designation of either *Silurus anguillaris* or *Silurus batrachus* as type species of *Clarias*, I hereby designate *Silurus anguillaris* Linnaeus, 1758 as type species of *Chlarias* [=*Clarias*] Scopoli, 1777 and of *Clarias* Cuvier, 1816.

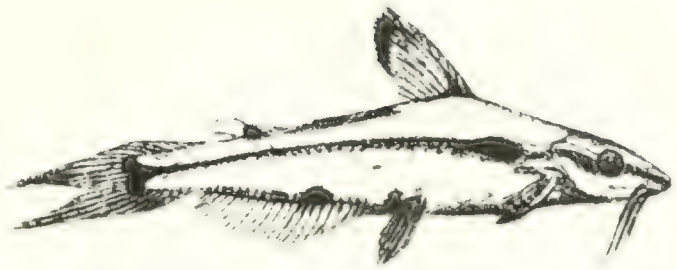

FIGURE 97. *Pelteobagrus ornatus*. Malay Peninsula, Muar River (HZM 8654, syntype; after Duncker 1904, pl. 2, fig. 13).

There is doubt as to the number of *Clarias* species in western Borneo and their identity. The survey of 1976 obtained only two species, but at least four and perhaps five species are present in the Kapuas. Weber and de Beaufort (1913) reported five species but their work is largely compiled and I have experienced difficulty identifying specimens utilizing their key, especially in distinguishing between *C. leiacanthus* and *C. teysmanni*.

Clarias cf. **batrachus** (Linnaeus, 1758)

?*Silurus batrachus* Linnaeus, 1758:305 (type locality Asia)
?*Macropteronotus magur* Hamilton-Buchanan, 1822:146 (type locality Ganges).
Clarias batrachus Bleeker, 1858*c*:343 (Sambas).
Clarias magur Vaillant, 1893:37 (listed from western Borneo).

MATERIAL EXAMINED.—Western Borneo: Kapuas basin, Smitau, 212 mm (RMNH 7799); Kapuas basin, Sintang, 2: 159–197 mm (RMNH 7800)

The species tentatively identified as *Clarias batrachus* is one of the most important food fishes in southeast Asia (especially in Thailand, where it is extensively cultured).

According to Weber and de Beaufort (1913:190) *C. batrachus* differs from other species of *Clarias* found in Borneo and Indonesia in having generally fewer dorsal- and anal-fin rays (60–76 vs. 68–106 dorsal and 47–58 vs. 52–95 anal).

Clarias leiacanthus Bleeker, 1851

Clarias leiacanthus Bleeker, 1851*i*:430 (type locality Sambas, in fluviis).
Clarias hacanthus Günther, 1864:20 (unwarranted spelling change)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-6, 4: 80.2–135 mm (CAS 49422, MZB 3704, USNM 230308); Kapuas 1976-17, 131 mm (MZB 3705); Kapuas 1976-30, 96.8 mm (MZB 3706); Kapuas 1976-31, 14.7 mm (MZB 3707).

Clarias meladerma Bleeker, 1846

Clarias meladerma Bleeker, 1846*a*:178 (type locality Batavia, in paludibus)
Clarias melasoma Bleeker, 1852*b*:427
Clarias melanoderma Bleeker, 1858*c*:341.
Clarias melanosoma Bleeker, 1858–59*a*:1

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-51, 5: 88.6–242 mm (CAS 49423, MZB 3708, USNM 230309)

NOMENCLATURAL NOTE.—Although virtually all authors subsequent to Bleeker (1858) have referred to this species as *C. melanoderma*, the original spelling of *C. meladerma* is employed here. The spelling *C. meladerma* appears twice in Bleeker's original account (Bleeker 1846*a*:178, 188) thus indicating it was intentional and not a typographical error.

Clarias meladerma is distinguished by a series of strong serrae projecting from leading edge of pectoral-fin spine. In all other

Clarias the leading edge is smooth, rough, or with a few relatively weak serrae.

Clarias nieuhofi Valenciennes, 1840

Clarias nieuhofi Valenciennes *in* Cuvier and Valenciennes, 1840:386 (type locality not indicated)
Clarias pentapterus Bleeker, 1851*h*:206 (type locality Bandjermassing).
?*Clarias jagur* von Martens, 1876:302, 399 (not of Hamilton-Buchanan, 1822; Danau Sriang, Kapuas basin). See Weber and de Beaufort (1913:194).
Clarias Nieuhofi Vaillant, 1893:63 (Kapuas basin, Knapei et Sebroeang).

MATERIAL EXAMINED.—Malay Peninsula: Tinggi, Johore, 140 mm (CAS-SU 32694). Western Borneo: Kapuas basin, Raouen R., Mandai, 2: 171–172 mm (RMNH 7685); Kapuas basin, upper Sibau R., 3: 204–230 mm (RMNH 7684); Kapuas basin, Sintang, 191 mm (RMNH 7805)

DIAGNOSIS.—*Clarias nieuhofi* differs from all other southeast Asian *Clarias* in having more numerous dorsal- and anal-fin rays (87–106 vs. 60–76 dorsal and 69–95 vs. 47–53 anal) and dorsal and anal fins united to caudal fin at least at its base (Weber and de Beaufort 1913).

Clarias teysmanni (Bleeker, 1857)

Clarias Teysmanni Bleeker, 1857*b*:344 (type locality "Tjikoppo, provinciae Buitenzorg, 900 metr. supra mare," Java). (Typographical error for *Teysmanni*.)
Clarias Teysmanni Bleeker, 1862–63:104
Clarias Teysmanni Vaillant, 1893:62 (Kapuas)

Both MNHN and RMNH have a number of lots identified as *C. teysmanni* from the Kapuas basin. I briefly examined the RMNH material but was unable to come to any firm conclusion as to the correctness of its identification or the distinctness of *C. teysmanni* from *C. leiacanthus*. Two characters utilized by Bleeker and Weber and de Beaufort to distinguish the species seem highly variable and difficult to use: shape of occipital process and distance between occipital process and dorsal-fin base. The latter can differ by 20 percent or more in the same specimen depending on whether the head is flexed dorsally or ventrally.

It may be noted in passing that substitution of "ij" for "y" is a common typographical error throughout Bleeker's publications. Thus Cyprinidae is often printed "Cijprinidae."

Encheloclarias Herre and Myers, 1937

Encheloclarias Herre and Myers, 1937:66 (type species *Heterobranchus tapeinopterus* Bleeker, 1852, by original designation and monotypy)

Encheloclarias, the only Asian clariid genus with an adipose fin, differs from African clariids with an adipose fin (*Heterobranchus, Dinotopterus*, some species of *Clarias*) in head and body shape, relationship of adipose and anal fins to caudal fin, morphology of neural spines, vertebral formula, and size. Overall form, when viewed from above, not notably tapered from head to tail; head very small, relatively short and narrow, only slightly wider than anterior part of body (in African forms with adipose fin overall form strongly tapered; head very large, much longer and broader). Adipose and anal fins broadly united to caudal fin (both fins always or almost always separate from caudal fin in African forms). Vertebrae about 16+41=57, those immediately behind Weberian apparatus relatively elongate (*Heterobranchus* with vertebrae about 23–25+34–36=57–61, those immediately behind Weberian apparatus strongly compressed) (vertebrae of Weberian apparatus difficult to count in radiographs). Largest known specimen 124 mm total length (*Heterobranchus* and *Dinotopterus* commonly reach 1 m and sometimes nearly 2 m).

Although Herre and Myers (1937) stated that the adipose fin of *Encheloclarias* is supported by "extremely weak extensions of the neural spines," this is in error. I have examined the same specimen they did, and a radiograph clearly reveals that the neural spines are confined to the body proper (i.e., do not enter the adipose fin at all). Examination of the adipose fin with transmitted light reveals fine ray-like structures (ceratotrichia?) about 4–5 times more numerous than neural spines. For further discussion and illustrations of the elongate neural spines in the adipose fin of African clariids see Teugels (1983). Detailed comparison of *Encheloclarias* and *Heterobranchus* probably will reveal additional distinctions. The size, shape, and orientation of some cranial bones apparently differ. The anterior tubular nostril of *Encheloclarias* has not been studied. Only a single species is recognized.

Encheloclarias tapeinopterus (Bleeker, 1852)

Heterobranchus tapeinopterus Bleeker, 1852*a*:732 (type locality Banka); Bleeker, 1858*c*:337 (Sambas); Weber and de Beaufort, 1913:194.
Encheloclarias tapeinopterus Herre and Myers, 1937:66 (Mawai, Johore).

MATERIAL EXAMINED.—Malay Peninsula: Mawai, Johore, 63.3 mm (CAS-SU 32004)

DISTRIBUTION.—Malay Peninsula (Johore). Western Borneo (Sambas). Report of this species from Sarawak by Weber and de Beaufort (1913:195) (copied by Herre and Myers 1937:66) apparently is based on Bleeker's record of it from Sambas, which is in western Borneo, not Sarawak.

Schilbeidae

Schilbeids are smooth-skinned catfishes with two to four pairs of usually elongate barbels (vestigial or absent in *Silonia*); large laterally or ventrolaterally directed eyes; large gill openings with branchiostegal membranes separate from isthmus; gill rakers moderately to very numerous; swim bladder with bilaterally expanded anterior chamber frequently visible through large thin-walled tympanic membrane; posterior swim bladder chamber occasionally extending posteriorly above anal-fin base; dorsal fin small, with or without a spine and up to 7 branched rays, or absent; adipose fin small and hyaline or absent; pectoral fin with a thin stiff spine usually serrate on posterior margin; anal fin long, not confluent with caudal; anal-fin rays 24–90; caudal fin deeply forked, lobes usually pointed, usually (always?) with 8/9 principal rays. Usually whitish or pearly, often with longitudinal dark stripes, a few species mottled brownish.

The family comprises about 16 genera and 40 species equally divided between Africa and Asia. Most of Asian taxa restricted to Indian subcontinent. A single genus, *Pseudeutropius*, in Indonesia. (*Laides*, sometimes placed in Schilbeidae, is arbitrarily referred to Pangasiidae in the absence of compelling evidence concerning its familial placement.)

Pseudeutropius Bleeker, 1862

Pseudeutropius Bleeker, 1862:398 (type species *Eutropius brachypopterus* Bleeker, 1858, by original designation and monotypy)

FIGURE 98. *Pseudeutropius*. Above, *P. brachypopterus*, Kapuas 1976-32, 73.8 mm (MZB 3683); below, *P. moolenburghae*, Kapuas 1976-32, 67.2 mm (MZB 3686).

Pseudeutropius brachypopterus (Bleeker, 1858)
(Figure 98 upper)

Eutropius brachypopterus Bleeker, 1858*c*:169 (type locality Sumatra, Palembang, in fluviis)
Pseudeutropius brachypopterus Bleeker, 1863*a*:107

MATERIAL EXAMINED.—Western Borneo: Kapuas (1976-20, 8: 73.2–87.8 mm (CAS 49410, MZB 3682); Kapuas 1976-32, 46: 47.8–92.3 mm (BMNH 1982.3.29.178–182, CAS 53290, FMNH 94244, MNHN 1982-711, MZB 3683, RMNH 28904, ROM 38617, UMMZ 209882, USNM 230301); Kapuas 1976-33, 8: 75.0–102 mm (CAS 49411, MZB 3684); Kapuas 1976-44, 3: 56.4–84.4 mm (MZB 3685, ZMA 116.542).

DIAGNOSIS.—Head relatively long, 3.4–3.9; barbels relatively short, extending posteriorly about to level of dorsal-fin origin; gill rakers extremely long and numerous (22+71=93 in a 102 mm specimen); anal-fin rays 31–35; vertebrae 12–13+24–26=37(5) or 38(8).

Pseudeutropius moolenburghae Weber and de Beaufort, 1913
(Figure 98 lower)

Pseudeutropius moolenburghae Weber and de Beaufort, 1913:249, fig. 100 (type locality Batang Hari, Sumatra)

MATERIAL EXAMINED.—Western Borneo: Kapuas 196-32, 95: 49.7–69.8 mm (AMNH 48939, BMNH 1982.3.29.183–187, CAS 49412, IRSNB 19748, MCZ 58353, MNHN 1982-712, MZB 3686, RMNH 28905, ROM 38622, UMMZ 209883, USNM 230302, ZMA 116.543); Kapuas 1976-33, 3: 50.8–80.3 mm (CAS 49413, MZB 3687); Kapuas 1976-44, 2: 55.3–67.0 mm (MZB 3688, USNM 230303); Kapuas 1976-46, 68.5 mm (MZB 3689)

DIAGNOSIS.—Head relatively short, 4.4–4.6; barbels relatively long, extending posteriorly to a vertical behind anterior fourth

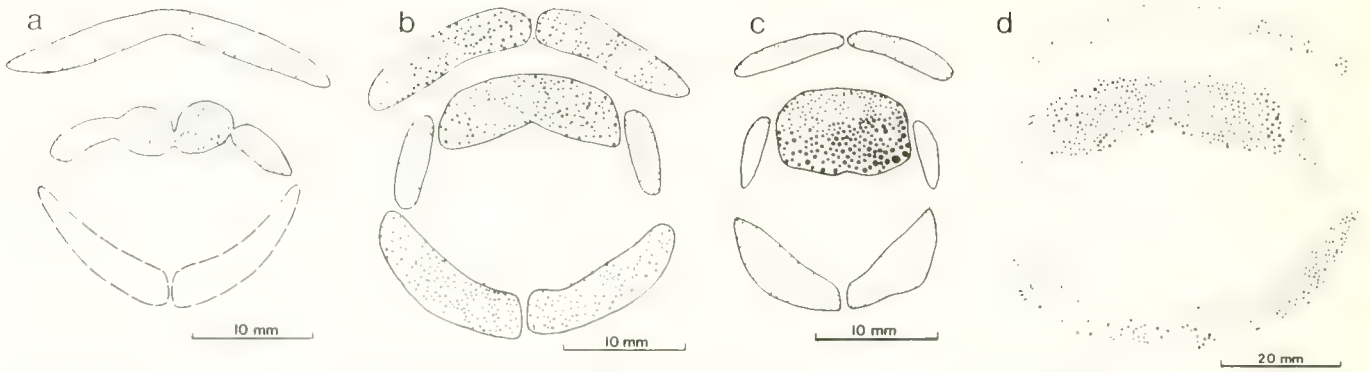

FIGURE 99 Oral dentition of Sundaland *Pangasius*. Species with complex palatal toothbands. a, *P. dezwaani* Weber and de Beaufort, 1912, Sumatra, Taluk (ZMA, holotype); b, *P. nasutus*, Kapuas 1976-19, 215 mm (CAS 49407); c, *P. polyuranodon*, Kapuas 1976-19, 227 mm (CAS 49408), d, *P. ponderosus* Herre and Myers, 1937, Malay Peninsula, Chanderoh dam, Perak, 600 mm (CAS-SU 14162, holotype)

or third of anal-fin base; gill rakers very long, 14+29–31=43–45; anal-fin rays 42–49; vertebrae 10–11+30–32=41(5) or 42(12).

Pangasiidae

Pangasiids are elongate, moderately compressed, smooth-skinned midwater catfishes of large size; mouth subterminal, moderately to very wide; maxillary barbels and a single pair of mental barbels usually present, nasal barbels and second pair of mental barbels invariably absent; dorsal- and pectoral-fin spines well developed, with serrate internal margins; dorsal fin with 7 soft rays, situated anteriorly; adipose fin well developed but with a restricted base; anal fin elongate, with 26–42 rays; caudal fin deeply forked, principal caudal rays 8+9; posterior chamber of swim bladder large, flattened and shield-shaped, with rigid walls supported by numerous internal fibrous struts; vertebrae 41–52 (*Pangasius*).

Many catfishes have paired pectoral or axial glands lying in the body wall near the pectoral-fin base and sometimes partially overlain by the humeral (or postcleithral) process. This gland is one of the specializations of siluroids that has no known homolog in other fish groups. In most catfishes each gland opens to the exterior by a single axillary pore or *porus pectoralis* lying just below the humeral process and above the origins of the innermost pectoral-fin rays. In *Pangasius* the gland is sometimes unusually large; it tends to be as long as the humeral process. In addition to a large *porus pectoralis* in the usual location, some *Pangasius* have a large number of additional pores more or less coextensive with the portion of body wall overlying the entire pectoral gland. Another peculiarity of the *pori pectorali* of *Pangasius* is that the openings are not simple, as in other catfishes, but loculose (i.e., divided into sections by internal partitions). In many catfish families, especially in South America, the secretion of the pectoral gland is milk-white or creamy and at least in some tastes like milk or cream. In *Pangasius* the secretion is clear and viscous, and tastes like mucus. In southeast Asia as in South America it is believed locally that the pectoral gland provides nourishment for the young. It is remarkable that so little is known about these glands.

The family comprises five or six genera and about 30 species, the great majority of which belong to the genus *Pangasius*. It ranges from the Indian subcontinent (including the Indus basin but not Sri Lanka), through mainland southeast Asia (including the Mekong basin), Sumatra, and Borneo. Although *Helicopha-*

FIGURE 100 *Pangasius humeralis*. Kapuas 1976-19, 389 mm (RMNH 28903, paratype).

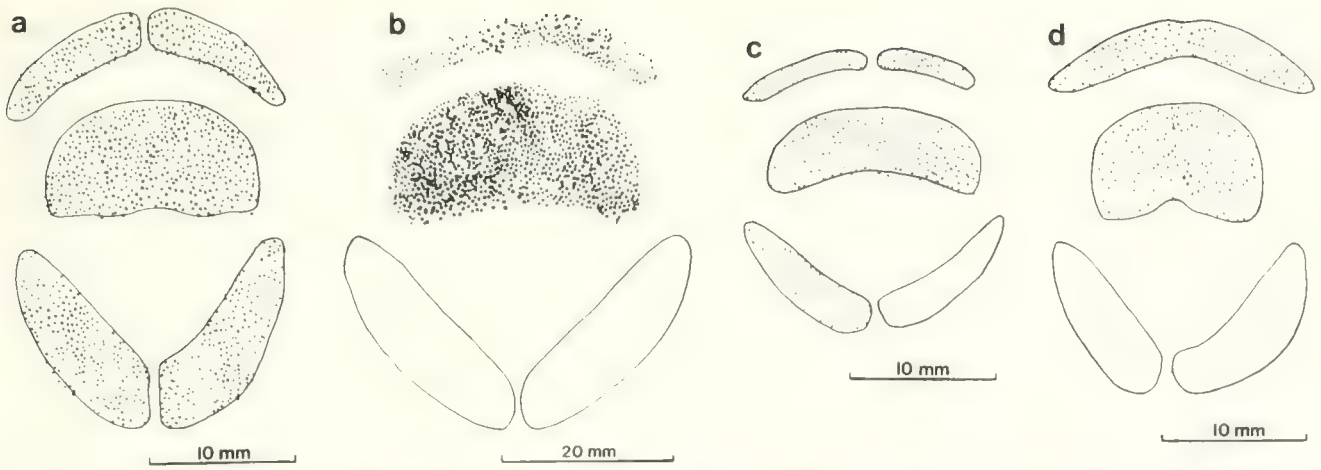

FIGURE 101. Oral dentition of Sundaland *Pangasius*. Species with simple palatal toothband. a, *P. lithostoma*, Kapuas 1976-19, 214 mm (CAS 49406, paratype); b, *P. nieuwenhuisi*, Mahakam, rivière Bo, 400 mm (RMNH 7546, holotype); c, *P. humeralis*, Kapuas 1976-19, 215 mm (CAS 49408, paratype); d, *P.* sp. undet., northeastern Borneo, Kinabatangan, 224 mm (FMNH 68041, formerly identified as *P. nieuwenhuisi*).

gus occurs in Thailand, Sumatra, and southeastern Borneo, only *Laides* and *Pangasius* are known in western Borneo.

Laides Jordan, 1919

Lais Bleeker, 1858*c*:170 (type species *Pangasius hexanema* Bleeker, 1852, by monotypy). Preoccupied by *Lais* Gistel, 1848, Tunicata.
Laides Jordan, 1919:293 (replacement name for *Lais* Bleeker, 1858).

Laides differs from all other pangasiids in having two pairs of mental barbels instead of only a single pair. Maxillary barbel elongate, reaching posteriorly to middle of body. Adipose fin minute. Anal fin with 39–42 rays. Vertebrae 44. A single species.

Laides hexanema (Bleeker, 1852)

Pangasius hexanema Bleeker, 1852*d*:588 (type locality "Palembang, Batavia, in fluviis").
Lais hexanema Bleeker, 1858*c*:171.
Pangasius longibarbis Fowler, 1934*b*:87 (type locality Mekong R. at Chieng Sen).
Laides hexanema Smith, 1945:372.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-9, 96.4 mm (MZB 3676); Kapuas 1976-14, 81.6 mm (MZB 3677). Thailand: Mekong R. at Chieng Sen, 2: 51.6–95.0 mm (ANSP 59441, 59442, holotype and paratype of *P. longibarbis*).

DISTRIBUTION.—Thailand (Mekong). Malay Peninsula. Sumatra (Palembang, Lahat, Lematang Enim, Ringat, Sidjundjung, Djambi). Borneo (Kapuas).

Pangasius Valenciennes, 1840

Pangasius Valenciennes *in* Cuvier and Valenciennes, 1840:45 (type species *Pimelodus pangasius* Hamilton-Buchanan, 1822, by monotypy and absolute tautonymy).
Pseudopangasius Bleeker, 1862:399 (type species *Pangasius polyuranodon* Bleeker, 1852, by original designation and monotypy).
Pseudolais Vaillant, 1902:51 (type species *Pseudolais tetranema* Vaillant, 1902=*Pangasius micronema* Bleeker, 1847, by monotypy). See Weber and de Beaufort (1913:261).
Neopangasius Popta, 1904:180 (type species *Neopangasius nieuwenhuisii* Popta, 1904, by monotypy).

Division of *Pangasius* into three genera based on differences in palatal dentition (*Pangasius* with two vomerine and two palatine toothplates, *Pseudopangasius* with a single vomerine and two palatine toothplates, and *Neopangasius* with a single median palatal toothplate) seems to result in artificial or non-phyletic assemblages of species and has been rejected by most authors. Nevertheless the toothplates are useful in distinguishing some species, and those of most of the *Pangasius* known from Sundaland are illustrated in Figures 99 and 101.

Pangasius humeralis new species

(Figures 100, 101c)

HOLOTYPE.—MZB 3680, 173 mm, Kapuas basin, fish market at Sintang (Kapuas 1976-19).

PARATYPES.—CAS 49408, 204 mm, RMNH 28903, 389 mm, same data as holotype.

DIAGNOSIS.—*P. humeralis* is distinguished from all other *Pangasius* in western Borneo by the very elongate humeral process which extends fully two-thirds to three-quarters of distance to end of pectoral-fin spine. Pectoral gland large, with numerous pectoral pores (14 or more) coextensive with area ventral to humeral process. Eye small. Palatal teeth in a single median patch. Gill rakers 7+0–1+12–12=19–22. Anal-fin rays 30–31. Vertebrae 19–20+28=47–48. Pectoral fins jet black. Body without distinctive markings.

P. humeralis may be further characterized as follows: snout broadly rounded, length 9.8–11.1; head length 4.2; exposed portion of eye 29–35; margin of lower jaw strongly curved, mouth width 10.2; body depth 4.3, width 4.7; predorsal length 2.6; dorsal and pectoral spines moderately strong; pectoral spine length 5.2; posterior pectoral serrae about 17, or about 29 counting rudimentary basal serrae; humeral process 6.7.

REMARKS.—The only other *Pangasius* known to me with a humeral process as long as that of *P. humeralis* is *P. nieuwenhuisi* Popta, 1904 from the Mahakam basin of eastern Borneo. This species also has palatal teeth consisting of only a median toothpatch.

Direct comparison of the 400 mm holotype of *P. nieuwenhuisi* (RMNH 7546) with the 389 mm paratype of *P. humeralis* reveals that the snout shape is very different, that of *P. nieuwenhuisi* being much more pointed; the angle subtended by

FIGURE 102 *Pangasius lithostoma*. Kapuas 1976-19, 196 mm (MZB 3678, holotype).

snout-tip and anterior border of eye is much greater in *P. nieuwenhuisii*. In other respects these two species are rather similar.

DISTRIBUTION.—Known only from the Kapuas R. of western Borneo. In addition to the three specimens obtained at the market in Sintang, the species was observed in the Sungai Mandai (Kapuas 1976-38).

ETYMOLOGY.—The name *humeralis* (Latin, shoulder) refers to the exceptionally large humeral (postcleithral) process of this species.

Pangasius lithostoma new species

(Figures 101a, 102)

HOLOTYPE.—MZB 3678, 196 mm, market at Sintang (Kapuas 1976-19)

PARATYPES.—CAS 49406, RMNH 28901, USNM 230299, 3: 181–214 mm, market at Sintang (Kapuas 1976-19)

DIAGNOSIS.—Distinguished from all other *Pangasius* by a greatly expanded and strongly convex vomerine toothplate which projects strongly downwards from the roof of the mouth like a millstone. Anal-fin rays 40–41; vertebrae 21+31=52 (in three specimens).

The holotype (and three paratypes) may be further described as follows: snout broadly rounded, length 10.7 (10.0–11.1); head length 4.2 (4.2–4.3); exposed portion of eye 32.7 (26.6–30.6); mouth opening strongly curved, width 11.7 (11.2–11.9); body depth 34.6 (4.1–4.7), width 5.8 (5.7–5.9); predorsal length 2.6 (2.5–2.6); caudal peduncle depth 12.1 (11.4–12.4); dorsal and pectoral spines moderately strong; dorsal spine length 5.8 (5.4–6.1); pectoral spine length 5.6 (5.4–6.1); pectoral serrae 16 (17–19). Humeral process exposed, extending slightly less than halfway to end of pectoral spine, its length 12.0 (12.1–12.8); pectoral pores confined to area above bases of pectoral-fin rays; gill rakers 6–8+14–19=22–26; fins dusky, body without distinctive marks.

DISTRIBUTION.—Known only from the Kapuas R. of western Borneo.

ETYMOLOGY.—The name *lithostoma* (Greek) refers to the stonelike palatal toothpatch of this species.

Pangasius micronema Bleeker, 1847

Pangasius micronema Bleeker, 1847:8 (type locality Java)
Pangasius rios Bleeker, 1851*b*:205 (type locality Bandjermassing, in fluviis)
Pangasius rios Vaillant, 1893:71 (Knapei and Sebruang, Kapuas)
Pseudolais tetranema Vaillant, 1902:52 (type locality Tepoe, bords du Mahakam)
See Weber and de Beaufort (1913:261)
Pangasius rios Vaillant, 1902:29 (Kapuas)
Pangasius rios Popta, 1906:28 (Kapuas)
?*Pangasius hoeksi* Hardenberg, 1948 (type locality Kapuas). See below

MATERIAL EXAMINED.—Malay Peninsula: Chandra or Chanderoh dam, Perak River, 7: 117–263 mm (CAS-SU 31031, 32725, 34930); Perak, 169 mm (CAS-SU 31032)

Numerous large *Pangasius*, probably this species, were observed in the fish market at Sintang during the Kapuas survey of 1976 but none was preserved.

DIAGNOSIS.—*P. micronema* is distinguished by very large eyes, greatly reduced maxillary and mental barbels, truncate snout, outline of lower jaw angular rather than rounded, and very short skin-covered humeral process.

Four specimens from the Perak River (CAS-SU 32725) have the following: snout 10.7–12.3; head 4.5–4.9; exposed portion of eye 16.8–20.5; mouth width 10.6–12.5; body depth 4.5–4.9, width 5.5–5.9; predorsal length 3.0–3.2 (intermediate between *P. polyuranodon*, 3.3, and other Kapuas *Pangasius*, 2.5–2.6); depth of caudal peduncle 11.2–12.7; dorsal and pectoral spines slender (as in *P. polyuranodon*); dorsal spine 7.0 (intact only in one specimen); pectoral spine 5.3–5.8; pectoral serrae (including rudimentary anterior serrae) about 24–30; humeral process covered with skin, extending posteriorly less than midway above pectoral spine length, its length 12.4–13.8. Pectoral pores about 1–4, tightly clustered above origin of pectoral spine.

The identity of *P. hoeksi* puzzled me until I saw specimens of *P. micronema* with very black pectoral fins. The 275 mm (total length) holotype and only known specimen of *P. hoeksi* was not illustrated and my efforts to locate it have not been successful. The original description may be quoted in its entirety:

D.II.7; A.32; P.I.13; V6.

Elongate, rather strongly compressed, dorsal profile nearly straight behind dorsal, sloping down in a straight line to snout before dorsal. Snout rounded, mouth subterminal. Height 4, head 4.5 in length. Eye 4 in head, once in snout, almost 4 in interorbital space. Pupil large. Head totally covered by soft skin. Dorsal spine (damaged) totally smooth in its lower part. Length of dorsal equal to snout and half eye. Adipose fin small, above 22 anal ray. Anal about as long as 1.5 head. Height of anal somewhat less than eye and snout. Length of pectoral equal to head. Ventrals reaching anal. Height of caudal peduncle equal to width of mouth. Maxillary barbels short, not surpassing eyes, mandibulary ones shorter.

Colouration brownish above, lighter below. Pectorals black. Caudal blackish. Other fins blackish with a black border.

One specimen with a total length of 275 mm from the Kapuas River (W. Borneo). Legit Dr B. M. Hoeks.

Of the five species of *Pangasius* known from the Kapuas this description fits only *P. micronema*. The statements about barbel length and eye size could apply only to *P. micronema* and rule out the possibility of *P. hoeksi* being identical with *P. humeralis* or *P. lithostoma*. Until the holotype is located or additional specimens are collected *P. hoeksi* should be considered a probable synonym of *P. micronema*.

DISTRIBUTION.—Sumatra (Djambi). Borneo (Kapuas, Barito, Mahakam). Java (Surakarta, Wonogiri, Kediri, Gempol, Surabaya).

Pangasius nasutus Bleeker, 1862

Pangasius nasutus Bleeker, 1862:72 (type locality Bandjermassin, in fluviis).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 7: 148–215 mm (BMNH 1982.3.29.177, CAS 49407, MZB 3679, RMNH 28902, UMMZ 209855, USNM 230300). Sumatra: Palembang, 270 mm (UMMZ 155721).

Distinguished from all other Bornean *Pangasius* by its sharply pointed snout, very small eyes, relatively stout dorsal- and pectoral-fin spines, and fewer anal-fin rays (26–30 vs. 30 or more).

Two Kapuas specimens, 148–178 mm (CAS 49407), have the following characteristics: head length 3.7–3.8; exposed portion of eye 42.3–49.4; mouth width 8.0; snout 9.1–9.4; maxillary barbel 5.3–6.1; mental barbel 7.0–8.0; predorsal length 2.6; body depth 4.3–4.6, width 4.8–4.9; depth of caudal peduncle 12.8–13.8; dorsal spine 5.7–7.0; pectoral spine 6.0–6.6; humeral process exposed, extending slightly beyond middle of pectoral spine, its length 10.9–11.2; pectoral pores 6–8, confined to area above bases of pectoral-fin rays; gill rakers 6+13=19 and 8+13=21; fins dusky; body without distinctive marks. Vertebrae in Kapuas specimens 18–20+25=43(1), 44(5), or 45(1); in Palembang specimen 18+26=44.

DISTRIBUTION.—Sumatra (Kwantan, Batu Ridial, Indragiri, Batang Hari, Djambi, Palembang). Borneo (Kapuas, Barito).

Pangasius polyuranodon Bleeker, 1852

Pangasius polyuranodon Bleeker, 1852*b*:425 (type locality Bandjermassing, in fluviis)

Pangasius juaro Bleeker, 1852*d*:589 (type locality Palembang, in fluviis).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 2: 227–294 mm (CAS 49409, MZB 3681).

This species is distinguished by its elongate body, blunt snout, large eye, distinctive palatal dentition, thin dorsal- and pectoral-fin spines, and long anal fin with relatively numerous rays (35–40). Dorsal-fin origin relatively far anterior, predorsal length 3.3 (vs. 2.5–32 in other Kapuas *Pangasius*). Palate with a large, median vomerine toothpatch with enlarged submolariform teeth and small lateral toothpatches with relatively fine conical teeth (Fig. 99c), median palatal tootpatch about 4 times as long anteroposteriorly as premaxillary toothbands (anteroposterior length of premaxillary: vomerine toothpatches from 1:1 to 1:3 in other *Pangasius*). Vertebrae 18+32=50.

The 227 mm Kapuas specimen (CAS 49409) may be described as follows: snout relatively blunt, its length 12.8; head length 5.0 (3.7–4.3 in other Kapuas *Pangasius*); eye relatively large, exposed portion 22.5 (26.6–49.4 in other Kapuas *Pangasius* except *P. micronema*); mouth opening only slightly curved, mouth width 12.8; barbels very thin; maxillary barbel length 6.6; mental barbel length 16.9; body depth 5.0, width 6.3; caudal peduncle depth 11.2; dorsal- and pectoral-fin spines relatively slender; dorsal spine length 5.7, pectoral 6.1; pectoral serrae, 32; humeral process normally covered by skin and relatively short, extending not quite to middle of pectoral spine, its length 14.4; pectoral pores confined to a small area above bases of pectoral-fin rays; gill rakers 12+17=29; no distinctive marks on body or fins.

DISTRIBUTION.—Thailand. Sumatra (Banguasin, Palembang). Borneo (Baram, Limbang, Kapuas, Barito, Mahakam). Java.

Sisoridae

Sisoridae is an exclusively Asian family of bottom-dwelling catfishes, most with more or less thickened leathery skins with specialized unculiferous tubercles or polygonal plaques (Roberts 1982*a*), typically inhabiting high-gradient lowland or mountain streams, with adults ranging in size from about 20 mm to 2 m. Many of the genera are disruptively or cryptically colored and have adhesive organs (labial or thoracic) with which they cling to the substrate. The family has its greatest diversity in the Indian subcontinent with about 17 genera and 63 species (see Jayaram 1981). The family is somewhat less abundant in China and mainland southeast Asia; in Borneo only two genera and fewer than eight species are known.

Bagarius Bleeker, 1853

Bagarius Bleeker, 1853*h*:121 (type species *Pimelodus bagarius* Hamilton-Buchanan, 1822, by monotypy and absolute tautonymy).

Bagarius differs from all other Sisoridae, and perhaps from all other catfishes, in having 1) each premaxilla evidently composed of two ossifications instead of a single ossification, and 2) dentition of lower jaw markedly heterodont, with 2–3 outer rows of relatively numerous, close-set conical teeth, and 1–2 inner rows of less numerous, widely separated, and much larger conical teeth.

For a detailed account of this south and southeast Asian sisorid genus and its three species see Roberts (1983). A single species occurs in Borneo.

Bagarius yarrelli (Sykes, 1839)

(Figure 103)

Bagrus Yarrelli Sykes, 1839:163.

Bagarius yarrelli Sykes, 1841:370 (type locality Mota Mola at Poona, India)

Bagarius lica Volz, 1903*a*:557 (type locality Moesi River at Palembang, Sumatra)

Bagarius Nieuwenhuisi Popta, 1904:190 (type locality Mahakam basin, Borneo)

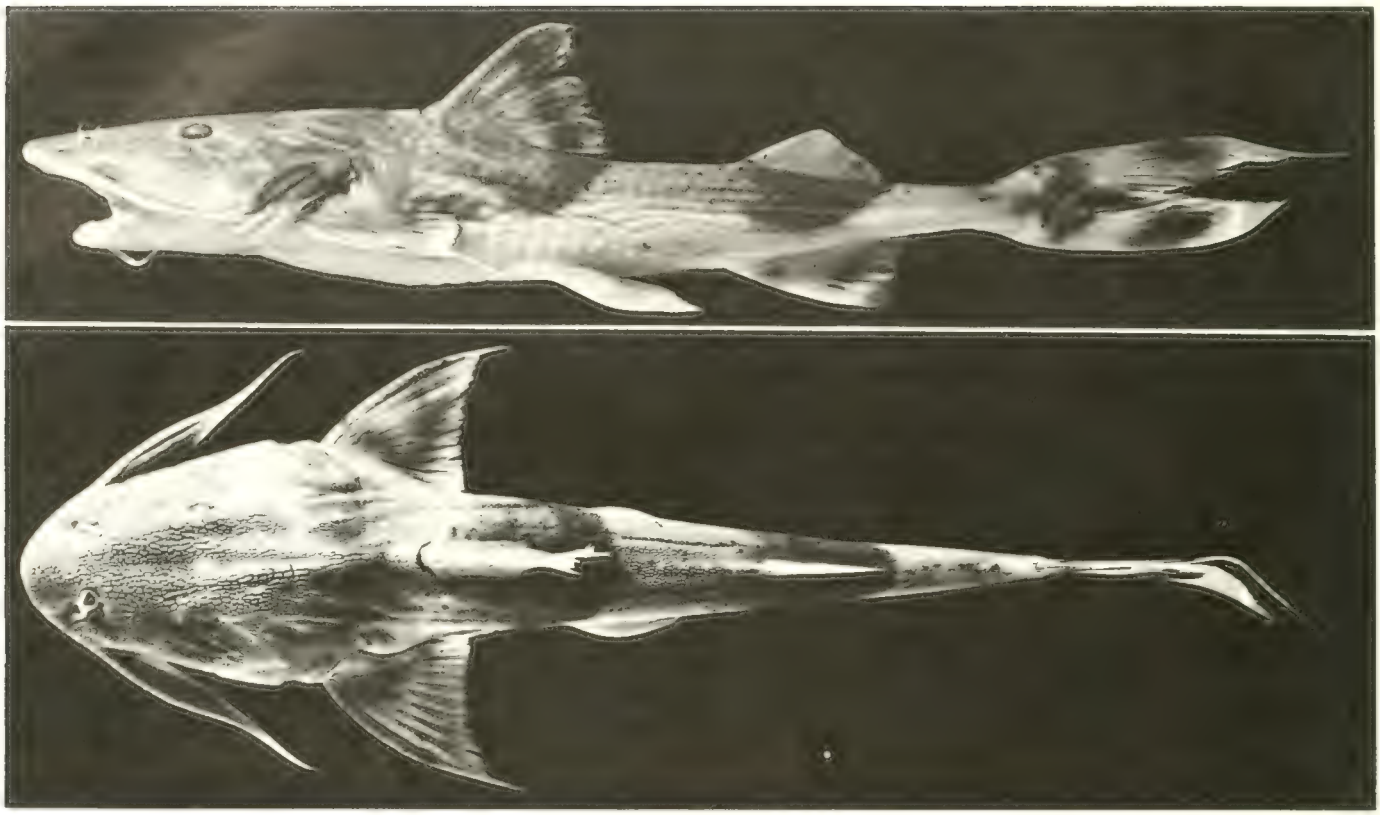

FIGURE 103.—*Bagarius yarrelli*. Kapuas 1976-31, 129 mm (MZB 3695)

MATERIAL EXAMINED.—Sumatra: Moesi River at Palembang, 410 mm (radiographs only) (BNHM VO 37T, holotype of *B. lica*). Western Borneo: Kapuas 1976-19, 2: 309–615 mm (CAS 54646, MZB 3694). Kapuas 1976-31, 2: 129–148 mm (CAS 44189, MZB 3695). Additional material examined from India, Bangladesh, Burma, Thailand, Vietnam, Sumatra, and Java is listed in Roberts (1983: 441–442).

DIAGNOSIS.—*Bagarius yarrelli*, attaining 2 m and therefore the largest member of the family Sisoridae, is distinguished from other *Bagarius* at all sizes by having pelvic-fin origin usually posterior to vertical line through base of last dorsal-fin ray; gill rakers 8–11 (vs. 6–10); pectoral-fin rays 11–14 (vs. 9–12), elongate neural spines (see Roberts 1983) 2–5, slender (vs. 4–9, distally expanded); abdominal vertebrae 21–24 (vs. 17–21); and total vertebrae 40–45 (vs. 38–42).

DISTRIBUTION.—*Bagarius yarrelli* is probably the most widely distributed freshwater catfish in Asia. It is more or less continuously distributed in the Indus and Ganges drainages, most of southern India east of the western Ghats, Burma, Thailand, Kampuchea, Vietnam (including Red River), Sumatra, western and eastern Borneo, and Java. An apparent gap in its distribution occurs in peninsular Thailand and the Malay Peninsula. Unknown from north Borneo.

Glyptothorax Blyth, 1860

Glyptothorax Blyth, 1860:154 (type species *Glyptosternon striatus* McClelland, 1842, by subsequent designation of Bleeker, 1862:13).

Glyptothorax are small to moderately large sisorids with thoracic adhesive organ consisting of unculiferous laminae arranged in a whorl and confined to abdomen immediately behind isthmus and between pectoral fins (Roberts, 1982a).

There is doubt as to the number of *Glyptothorax* species in Borneo. There may be as few as three or as many as six. Three species occur in western Borneo (including *G. platypogonoides*, hitherto known only from Sumatra). The status of *G. nieuwenhuisi* (Vaillant, 1902), *G. laak* (Popta, 1904), and *G. tiong* (Popta, 1904), placed as synonyms of *Glyptosternum* (=*Glyptothorax*) *majus* by Weber and de Beaufort (1913), needs to be reconsidered. *Akysis baramensis* Fowler, 1904, placed in *Glyptosternum* (=*Glyptothorax*) by Weber and de Beaufort (1913), is a true *Akysis*.

Glyptothorax major (Boulenger, 1894)

(Figure 104 upper)

Akysis major Boulenger, 1894:246 (type locality Senah, Tagora, and Baram rivers, Sarawak).

"*Glyptosternon platypogonoides* Vaillant, 1893:73 (Kapuas, Sebroeang). See Weber and de Beaufort (1913:267).

MATERIAL EXAMINED.—Malay Peninsula: Perak, Tapah Fisheries Station, 41: 28.8–55.4 mm (CAS-SU 39344); Perak, Batang Padang, 3: 17.5–56.7 mm (CAS-SU 39343); Pahang, Benus River, 49.5 mm (CAS-SU 32678); Selangor, Kuala Lumpur, 49.8 mm (CAS-SU 32677); Johore, Muar, 42.1 mm (CAS-SU 31003); Johore, Simpang Rengam, 4: 40.6–42.8 mm (CAS-SU 39342); Johore, Kota Tinggi, 3: 41.7–54.6 (CAS-SU 32675). Western Borneo: Kapuas 1976-12, 38.6 mm (MZB 3999); Kapuas 1976-17, 55.7 mm (MZB 4000); Kapuas 1976-47, 3: 45.9–47.6 mm (CAS 49416, MZB 4001, USNM 230305).

The identity of three nominal species of *Glyptothorax* from eastern Borneo placed as junior synonyms of *G. major* by Weber and de Beaufort (1913:267–268) requires further study. These

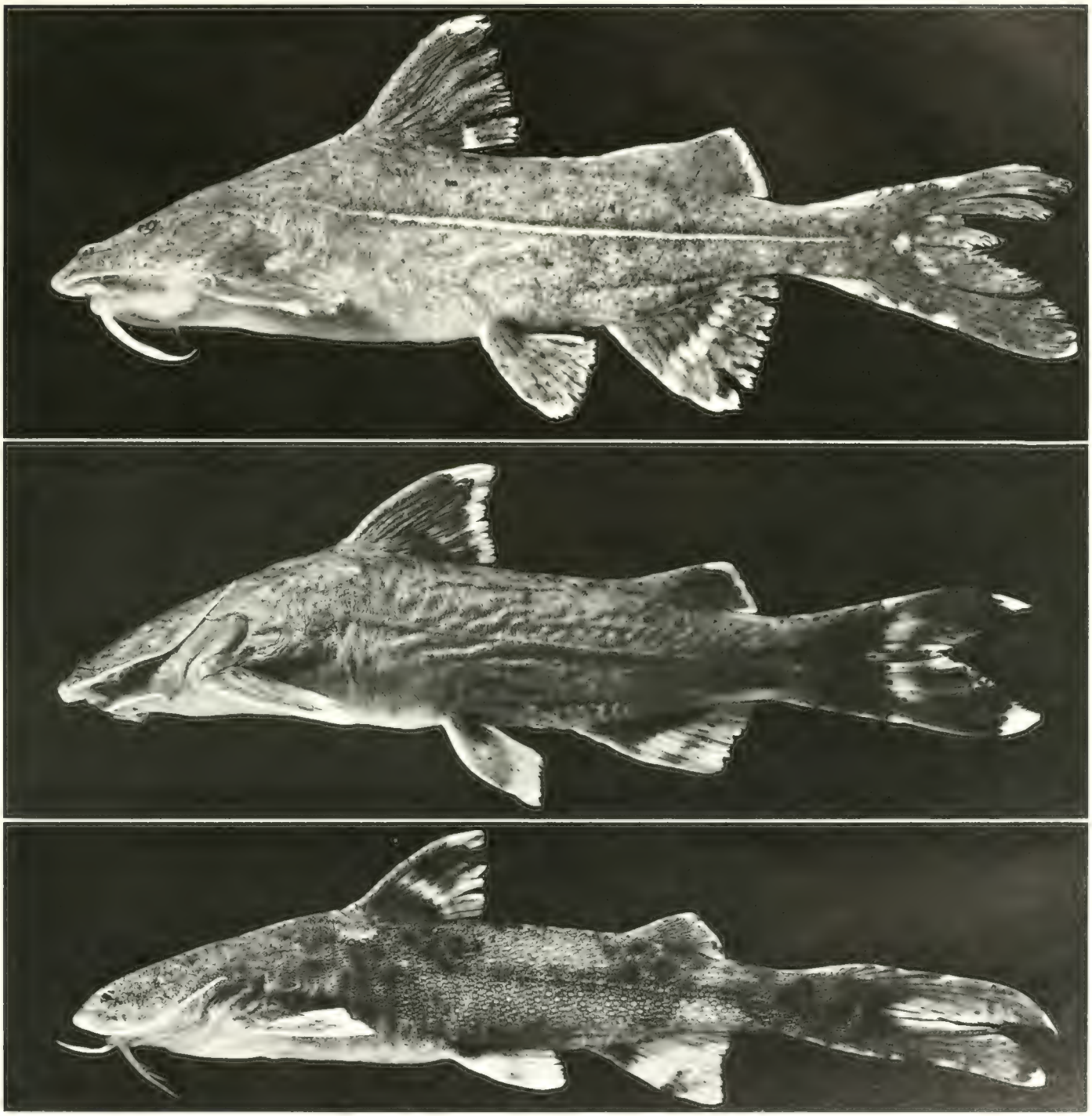

FIGURE 104. *Glyptothorax*. Above, *G. major*, Kapuas 1976-17, 55.7 mm (MZB 4000); middle, *G. platypogon*, Kapuas 1976-30, 90.7 mm (CAS 49418); below, *G. platypogonoides*, Kapuas 1976-24, 59.2 mm (CAS 49419).

are *G. laak* (Popta, 1904) and *G. nieuwenhuisi* (Vaillant, 1902) from the Mahakam and *G. tiong* (Popta, 1904) from the Kajan.

Glyptothorax platypogon (Valenciennes, 1840)

(Figure 104 middle)

Pimelodus platypogon Valenciennes *in* Cuvier and Valenciennes, 1840:152 (type locality Java).

Pimelodus cyanochloros Bleeker, 1847:11 (type locality Java). See Bleeker (1858 218).

Glyptothorax platypogon Günther, 1864:187

Glyptosternum Kükenthali Steindachner, 1901:448 (type locality Baram River)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-24, 42.2 mm (MZB 3697) Kapuas 1976-27, 16: 33.1–60.1 mm (BMNH 1982.3.29.188–189, CAS 49417, MNHN 1982-713, MZB 3698, RMNH 28906, USNM 230306). Kapuas 1976-30, 3: 31.1–90.7 mm (CAS 49418, MZB 3699)

TABLE 9 MERISTIC CHARACTERS OF AKYSIDAE. For definition of vertebral counts see p. 22.

	Gill rakers	Pectoral br. rays	Anal rays	Principal caudal rays	Vertebrae
Acrochordonichthys cf. *melanogaster*					
Kapuas	1+7=8	7	10		
Akysis baramensis					
Baram R., CAS	1+7=8		10		15–16+19=34(1), 35(1)
Akysis hendricksoni Alfred, 1966					
Pahang, CAS 48215	1+4–5=5–6	6	9–11	7+6	15+16–18=31(1), 32(1), 33(1)
Akysis cf. *macronema* Bleeker, 1860					
Vietnam, Chau Doc, CAS 53206	1+6=7	7	10–12	7+8(4)	16+19–20=35(2), 36(1)
Akysis pseudobagarius					
Kapuas, types	1+7=8	6	10	7+7(1), 6+8(2)	16+19=35(2)
Akysis variegatus					
Java, Brantas R., CAS 53055	1+6=7	6	8–9	7+7 or 7+6	14+16–18=30(1), 32(1)
Breitensteinia cf. *insignis*					
Djambi			10	6?+5	20+22=44
Kapuas	2+3–4=5–6	6	10	5+5	21+22=43

Glyptothorax platypogonoides (Bleeker, 1855)

(Figure 104 lower)

Pimelodus platypogonoides Bleeker, 1855*b*:272 (type locality Lahat, in fluviis).
Glyptosternon platypogonides Bleeker, 1858*c*:219.
Glyptothorax platypogonoides Bleeker, 1862–63:63.
Glyptosternum platypogonoides Günther, 1864:186
Bagarius bagarius Vaillant, 1902:72 (nec Hamilton-Buchanan, 1822; embouchure du Raoen=Kapuas)

MATERIAL EXAMINED.—Sumatra?: Lahat?, 4: 55.1–68.7 mm (RMNH 6912, presumed syntypes *G. platypogonoides*); Lahat?, 3: 65.5–76.0 mm (RMNH 15289). Western Borneo: Kapuas 1976-24, 4: 53.9–64.8 mm (BMNH 1982.3.29.190, CAS 49419, MZB 3700, RMNH 28907); Kapuas basin, embouchure du Raoen, 61.1 mm (RMNH 7845, originally identified as *Bagarius bagarius*)

This species illustrates well the sort of problems encountered in attempting to identify Bleeker type specimens, even in relatively simple instances where few specimens and localities are involved, and despite recent clarification of the history of Bleeker's collections. The original description of *G. platypogonoides* refers to four specimens 70 to 85 mm total length from Lahat, Sumatra. These are equivalent syntypes. In his last published reference to the species Bleeker stated: "Habit. Sumatra (Lahat), in fluviis. Longitudo 4 speciminum 70‴ ad 85‴. Je ne connais cette espèce que des rivières de la partie orientale de Sumatra." The entry for *G. platypogonoides* in the auction catalog of Bleeker's collections also indicates only four specimens (Hubrecht 1879:37). Thus there is no published indication that Bleeker had more than four specimens, or specimens from any locality other than Lahat. The four specimens in the auction catalog were all in lot A, and thus were obtained for the Rijksmuseum van Natuurlijke Historie. In Leiden I found two lots of *G. platypogonoides* collected by Bleeker, RMNH 6912, 4: 55.1–68.7 mm (total length 70.5–84.6 mm) and RMNH 15289, 3: 65.5–66.0, and 76.0 mm (total length about 85 mm for first two specimens, 97 mm for last). Collection records indicate that all seven specimens in these two lots originally had been included in RMNH 6912. The implication is that someone, at a relatively late date, chose four specimens from the lot of seven which corresponded in length with Bleeker's syntypes. The problem is further complicated by the presence of one more Bleeker specimen of *G. platypogonoides*, unfortunately now dry, in London: BMNH 1863.12.11.154, approximately 56–58 mm or total length 76–79 mm (A. Wheeler, pers. comm., June 1984). The size of this specimen indicates it may be one of the syntypes. At this late date it seems unlikely that we shall ever know which four specimens are the true syntypes, or even whether all eight Bleeker specimens are from Lahat. I have examined RMNH 6912 and 15289 and compared them directly with my Kapuas material of *G. platypogonoides*. The only other specimen of the species known to me is BMNH 1863.12.11.154 (not examined by me).

DISTRIBUTION.—Sumatra (Lahat). Western Borneo (Kapuas). So far as I have been able to determine, all records of *G. platypogonoides* from India, Burma, Thailand, and the Malay Peninsula are due to misidentification.

Akysidae

Akysids are small to minute, cryptically colored, secretive catfishes with tiny eyes, encountered singly or in small numbers and poorly represented in museum collections. All have four pairs of barbels, no palatal teeth, strong dorsal- and pectoral-fin spines, adipose fin with a long base, and tough leathery skin. The entire surface of the head (including lips and barbels and excluding only the eyes), body and fins is covered with unculiferous plaques. The basic morphological similarity of the unculiferous plaques of Akysidae and Sisoridae (as illustrated by scanning electron microscopic observations of *Acrochordonichthys* and *Bagarius*) may indicate that these two families are closely related (Roberts 1982*a*:70–72, fig. 20–22). Akysids differ from sisorids and all other catfishes in having some of the unculiferous plaques on the body greatly enlarged and arranged in longitudinal rows of fixed number and position, a median middorsal row and four lateral rows. The ventralmost lateral row may be reduced or absent in the smallest species of *Akysis*.

As here understood Akysidae comprises three genera, *Acrochordonichthys*, *Akysis*, and *Breitensteinia*, with about 15 species. The genus *Parakysis*, formerly placed in Akysidae, is assigned

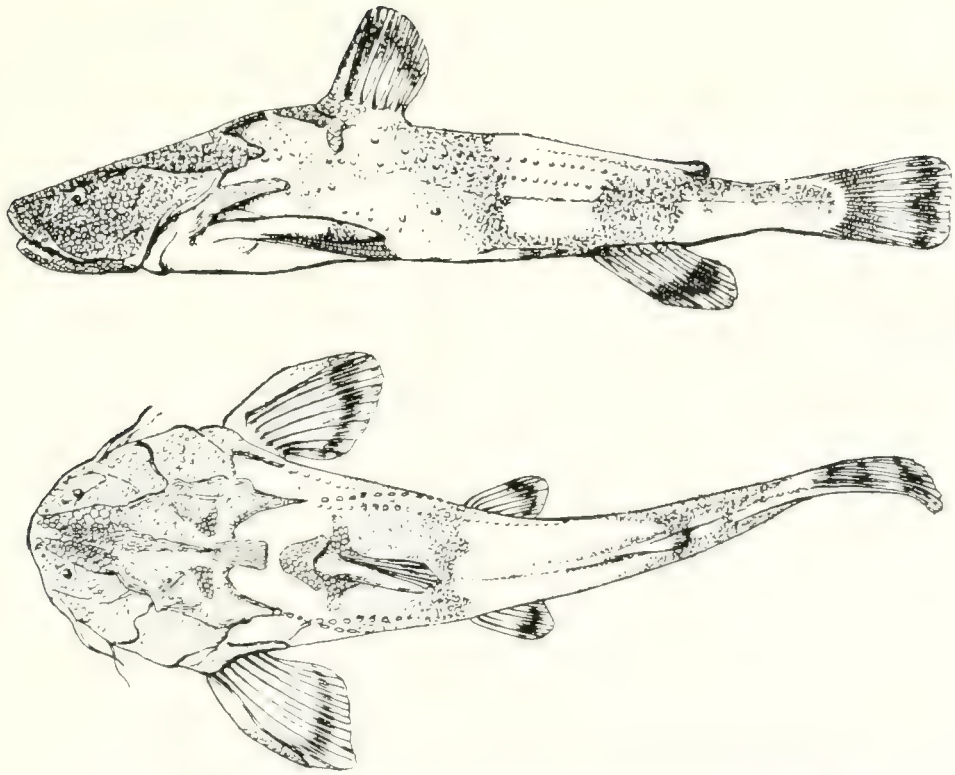

FIGURE 105. *Acrochordonichthys chamaleon*. Kapuas (RMNH, syntype; after Vaillant 1902).

to a new family Parakysidae; *Akysis armatus* Vaillant, 1902 is referred to the bagrid genus *Leiocassis* (p. 117). Meristic characters of Akysidae are given in Table 9.

Acrochordonichthys Bleeker, 1858

Acrochordonichthys Bleeker, 1858*c*:221 (type species *Acrochordonichthys platycephalus* Bleeker, 1858, by subsequent designation of Bleeker, 1863*a*:105).
Sosia Vaillant, 1902:82 (type species *Sosia chameleon* Vaillant, by monotypy).

Bleeker (1858*c*) recognized six species of *Acrochordonichthys*, all described by himself, and additional species were described by Vaillant (1902) and Popta (1904), bringing the total number of nominal species to 11. I believe that the naming of so many species is the result of failure to recognize intraspecific variation in 1) coloration, 2) sexual dimorphism, 3) development of epidermal structures, and 4) development of the supraoccipital crest. All of these problems have been exacerbated by the fact that most samples of *Acrochordonichthys* consist of a single specimen. Having examined a fair number of specimens I tentatively conclude that 1) extreme individual variation in coloration is the rule in *Acrochordonichthys*; 2) all or nearly all of the larger specimens are gravid females; smaller specimens, usually difficult to sex but presumably including mature males, tend to differ in proportions and sometimes have been taken for different species; 3) the keratinous epidermal structures (unculiferous plaques) may occasionally or periodically become greatly hypertrophied (e.g., in *A. rugosus* and *A. pachyderma*) or greatly reduced (presumably due to sloughing and renewal); and 4) as in some other catfish groups in which this character has been used, the development of the supraoccipital crest apparently is subject to considerable individual and populational variation.

As things now stand it is impossible to determine either the number of species or what names should be applied to them. Weber and de Beaufort (1913) recognized four species, placed two nominal species as junior synonyms, and listed five nominal species as doubtful. There seem to be two species in the Kapuas basin. The names and synonymies presented below are highly tentative.

Acrochordonichthys chamaleon (Vaillant, 1902)
new combination.
(Figure 105)

Sosia chamaleon Vaillant, 1902:82 (type locality Kapuas basin).

MATERIAL EXAMINED.—Western Borneo: RMNH 7848, 2: 68.5–69.5 mm, RMNH 7849, 1: slightly dried, RMNH 7851, 3: 58.0–98.4 mm, Kapuas basin (syntypes of *S. chamaleon*)

Weber and de Beaufort (1913:370) suggested that *Sosia chamaleon* is conspecific with *Acrochordonichthys melanogaster*. I consider it congeneric but not conspecific. In the four largest syntypes (RMNH 7848, 68.5–69.5 mm and RMNH 7851, 71.1–98.4 mm) the head is substantially broader than in any other *Acrochordonichthys* examined; in the 98.4 mm specimen head width is 3.0 times in standard length (head width about 4 or more in other *Acrochordonichthys*). Other features which seem to set these specimens apart from all other described species are the peculiar white coloration of anterior portion of snout, across occiput, and on gill covers; extremely short nasal barbels; and absence of tubercles on nearly the entire caudal fin (principal caudal-fin rays and interradial membranes covered for their

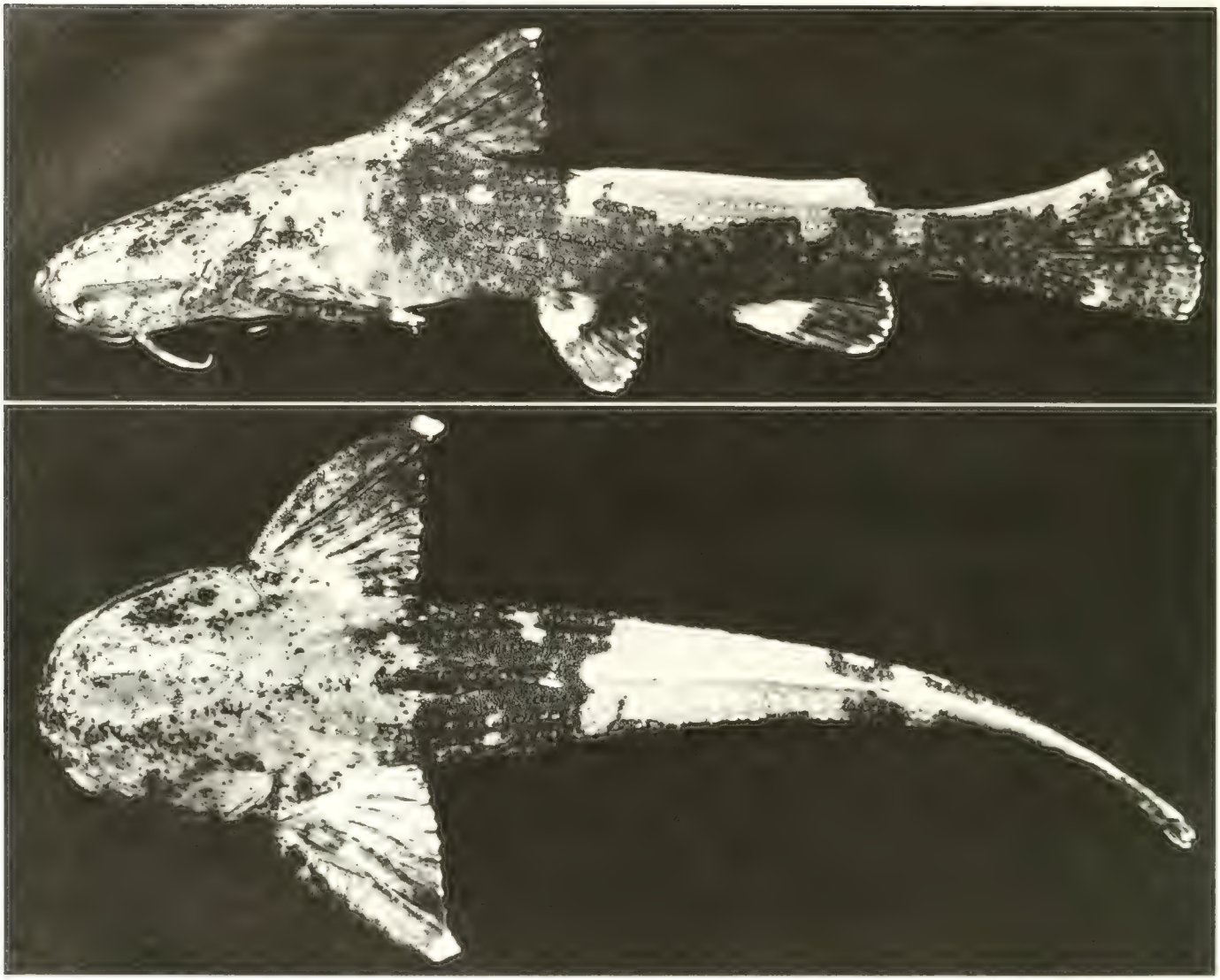

FIGURE 106 *Acrochordonichthys* cf. *melanogaster*. Kapuas 1976-10, 73.2 mm (MZB 3690)

entire length with small tubercles in all other *Acrochordonichthys* examined).

Acrochordonichthys cf. **melanogaster** (Bleeker, 1854)

(Figure 106)

?*Acrochordonichthys melanogaster* Bleeker, 1854*a*:89 (type locality Sumatrae orientalis, provinc. Palembang, ubi confluunt flumina Lamatang et Enim)

Acrochordonichthys pachyderma Vaillant, 1902:66 (type locality rivière Bloe, Kapuas basin)

Acrochordonichthys obscurus Popta, 1904:187 (type locality rivière Bongan)

Acrochordonichthys buettikoferi Popta, 1904:187 (type locality rivières Bongan and Bo)

Acrochordonichthys varius Popta, 1904:189 (type locality rivière Bo)

MATERIAL EXAMINED.—Western Borneo: RMNH 7556, 101 mm, rivière Bongan, Kapuas basin (holotype of *A. obscurus*); RMNH 7557, 126 mm, and 7558 (3) 86.8–91.5 mm, rivières Bongan et Bo, Kapuas basin (syntypes of *A. buettikoferi*). RMNH 7559, 2: 95.7–129 mm, rivière Bo, Kapuas basin (syntypes of *A. varius*) RMNH 7850, 59.0 mm, Kapuas (syntypes of *S. chamaleon*); MZB 3690, 73.2 mm, Kapuas 1976-10. Eastern Borneo: RMNH 7843, 105 mm, rivière Bloeoe Mahakam basin (holotype of *A. pachyderma*)

Akysis Bleeker, 1858

Akysis Bleeker, 1858*c*:234 (type species *Pimelodus variegatus* Bleeker, 1847, by monotypy)

The *Akysis* of Indonesia and Kalimantan in particular are poorly known. The only species of *Akysis* previously known from Borneo, *A. baramensis* Fowler, 1904, has not been recognized as an akysid since its incorrect placement in the sisorid genus *Glyptosternum* by Weber and de Beaufort (1913:265). I have examined the type specimens and find they represent a valid species of *Akysis*. The only other species of *Akysis* described or reported from Borneo, *A. armatus* Vaillant, 1902, is in fact a bagrid and is herein assigned to *Leiocassis*. The Kapuas survey of 1976 obtained a single undescribed species of *Akysis*.

Akysis pseudobagarius new species

(Figure 107)

HOLOTYPE.—MZB 3691, 48.2 mm, mature female? bar in mouth of Sungai Melawi at Sintang, 29 July 1976 (Kapuas 1976-31)

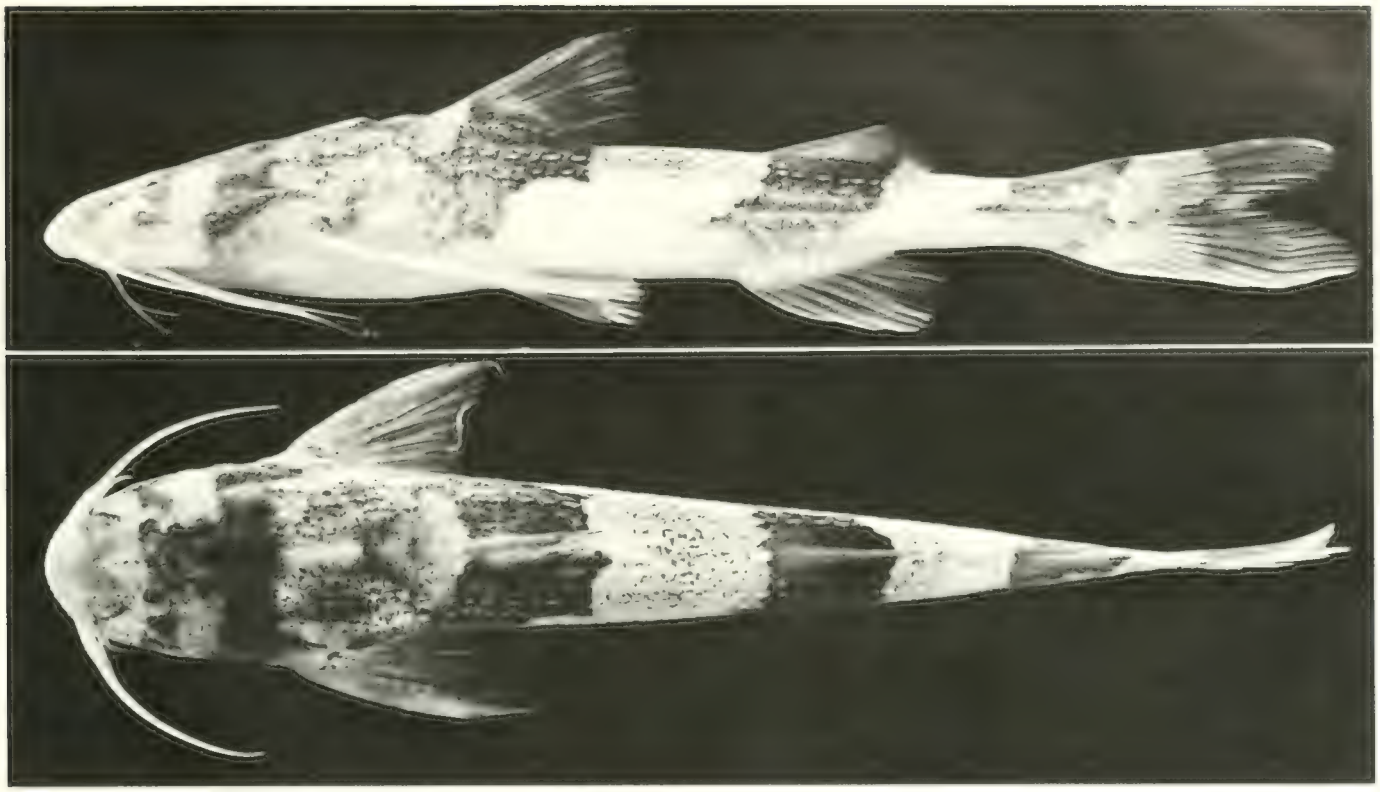

FIGURE 107. *Akysis pseudobagarius*. Kapuas 1976-31, 48.2 mm mature female (MZB 3691, holotype).

PARATYPES.—CAS 49414, MZB 3692, 2: 21.4–23.3 mm, collected with holotype; UMMZ 155702, 47.2 mm, gravid female, Sumatra, Moesi R. at Moera Klingi, A. Thienemann, 10 May 1929

DIAGNOSIS.—An *Akysis* with exceptionally narrow and elongate head and body and a color pattern of well defined brown marks and bands on a cream-colored background. Snout slightly pointed (not broadly but evenly rounded), strongly overhanging lower jaw; premaxillary tooth band entirely exposed when mouth is closed; inner margin of pectoral-fin spine with 8–9 serrae more or less evenly spaced over its entire length (even in very small specimens); vertebrae 35.

The following observations were made on the 48.2 mm Kapuas holotype and 47.2 mm Moesi River paratype (these two specimens are very similar in all respects): head 3.9–4.0; eye 39–48; interorbital space somewhat narrow, 22.4–25.4; snout 9.5–9.7; width of mouth opening 10.1–11.2; gill rakers 1+6–7=7 or 8; nasal barbel extending posteriorly almost to posterior border of eye or slightly beyond eye, length 11.2–11.3; maxillary barbel extending posteriorly just beyond base of pectoral-fin spine, 4.1–4.8; outer mental barbel extending posteriorly to middle or distal two-thirds of pectoral-fin spine, 5.4–6.0; side of body with 6 longitudinal rows of enlarged elongate epidermal tubercles or plaques (fourth row from top straddling lateral line canal); mid-dorsal row of enlarged tubercles weakly developed or absent; body depth 6.7–6.9, width 5.0–5.4; caudal peduncle length 4.7–5.1, depth 16.3–16.6; pectoral fin with short "filamentous" extension, extending posteriorly when adpressed almost to middle of pelvic fin; more posterior than anal-fin origin; anal-fin rays ii or iii7-1/2; caudal fin deeply forked, lobes equal in length but lower lobe somewhat larger than upper; principal caudal-fin rays 6+8; vertebrae 16+19=35.

The two small Kapuas paratypes, only 21.4–23.3 mm, are very similar in nearly all respects to the two large specimens described above. The eyes and barbels have nearly the same relative proportions and the color pattern, although somewhat less well marked, is also the same; even the number of pectoral-fin spine serrae is similar (8 or 9). The longitudinal rows of epidermal tubercles or plaques are very evident, although rows 3 and 6 are very weakly developed. The most striking differences seem to be that the basal membrane connecting the maxillary barbel to the check is relatively much larger, and the pectoral-fin spines proportionately longer, length 3.9–4.1.

Live *A. pseudobagarius* have a handsome pattern of rich brown marks and transverse bands and cream-colored background on dorsolateral surfaces of head and body (ventral surfaces pale, without marks). Head with a brown blotch centered on each nostril, a narrow vertical brown bar below eye, and a broad transverse brown band (complete dorsally) extending over gill cover on posteriormost part of head immediately anterior to pectoral girdle and fin; dorsal surface of body with a large but poorly defined and somewhat irregularly shaped brown blotch anterior to dorsal fin, and two small middorsal faint oval brown marks, one midway between dorsal and adipose fin, the second posterior to adipose fin; lateral surface of body with a series of three well defined and nearly equally spaced broad transverse brown bands, the first centered below dorsal fin, the second below adipose fin, and the third on posterior half of caudal peduncle. A fourth transverse brown band, similar to those on

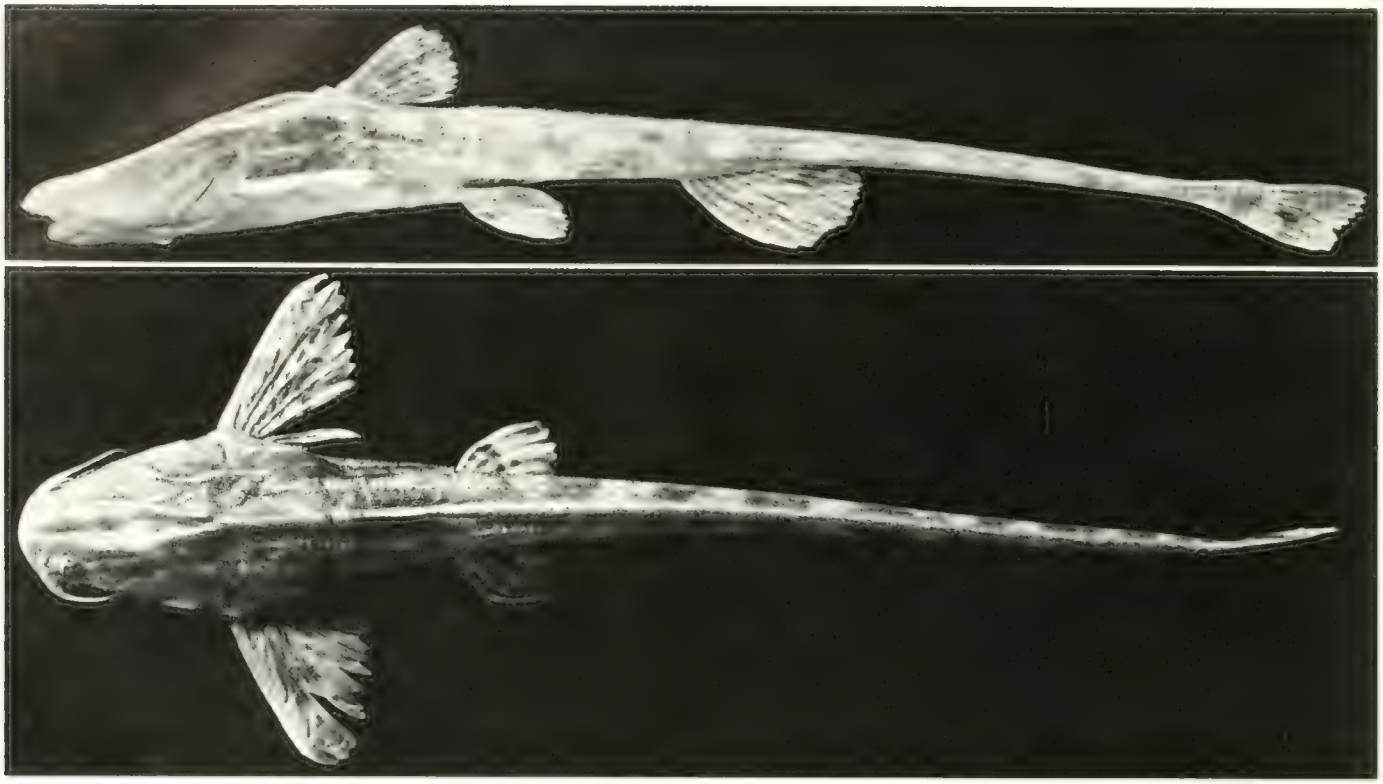

FIGURE 108. *Breitensteinia* cf. *insignis*. Kapuas 1976-45. Above, 93.0 mm (CAS 49415); below, 191 mm female (CAS 49415).

body, occurs on distal half of caudal fin. All four bands with narrow midlateral anterior prolongations. Dorsal and adipose fins with brown coloration continuous with brown bands on side of body; pectoral fin with brownish mark basally; anal fin colorless or with a narrow brown band extending across middle of posteriormost four fin rays; pelvic fins colorless; nasal barbel with faint brownish marks (not well defined), barbels otherwise entirely or almost entirely colorless.

The shape, coloration, and overall appearance of *A. pseudobagarius* is strikingly similar to that of *Bagarius* (before I examined it, the paratype from Moesi River actually had been mistaken for *Bagarius*). At Kapuas 1976-31 *A. pseudobagarius* and *Bagarius yarrelli* were collected from a single seine haul at night and compared side by side while alive. The uncanny resemblance includes color quality as well as nearly identical distribution and shape of markings on head, body and fins.

Alternating brown and cream-colored or yellowish banding comparable to that just described occur in many catfishes typically found over gravel bars or riffles. Among these are African amphiliids and mochokids, South American pimelodids, and other Asian sisorids (e.g., *Nangra* and several species of *Glyptothorax*, including *G. platypogonoides* which has also been mistaken for *Bagarius*). There is also another *Akysis*, *A. leucorhynchus* Fowler (1934:97, fig. 44, 45). This species, from the Menam Chao Phrya, probably is not closely related to *A. pseudobagarius*; it differs in having snout more truncate, interorbital space broader, posterior portion of head laterally expanded, body less elongate, and adipose fin smaller.

DISTRIBUTION.—Known only from Moesi and Kapuas rivers.

ETYMOLOGY.—The name *pseudobagarius* refers to the striking superficial (but phylogenetically false) resemblance of this species to members of the sisorid catfish genus *Bagarius*.

Breitensteinia Steindachner, 1881

Breitensteinia Steindachner, 1881*a*:213 (type species *Breitensteinia insignis* Steindachner, 1881, by monotypy)

Breitensteinia cf. **insignis** Steindachner, 1881

(Figure 108)

Breitensteinia insignis Steindachner, 1881*a*:213 (type locality Teweh=Moara Teweh, Barito River, southeast Borneo)
Breitensteinia insignis Vaillant, 1902:76, figures 16, 17 (Kapuas)

MATERIAL EXAMINED.—Sumatra: Djambi, 77.3 mm (ZMA 104.653). Western Borneo: Sintang, 176 mm female (RMNH 7847); Sanggau, 125 mm male (RMNH 16048); Kapuas 1976-45, 4: 93.0–191 mm (CAS 49415, MZB 3693, USNM 230304). Southeast Borneo: Moara Teweh, Barito-Flüss, 133 mm (NMW 55042, holotype)

The material examined represents all specimens of the genus *Breitensteinia* known to me. Through the kindness of the late Rainer Hacker I was able to examine the holotype of *B. insignis* during a visit to Vienna in October 1982. The holotype (sex undetermined) is in somewhat poor condition; perhaps it had been dead for some time before preservation. It is now faded or bleached to a uniform pale white presumably due to exhibition or storage in daylight. Although I examined specimens of *Breitensteinia* from Sumatra and Borneo before and shortly after examining the holotype, it was not possible to compare them directly. While the specimens from Sumatra and western Borneo appear to be conspecific, I am not certain that they are the same species as the holotype.

The 125 mm specimen from Sanggau is of particular interest because it is a sexually mature male; each testis has about 10 elongate, digitiform lateral processes or caeca. The 176 mm

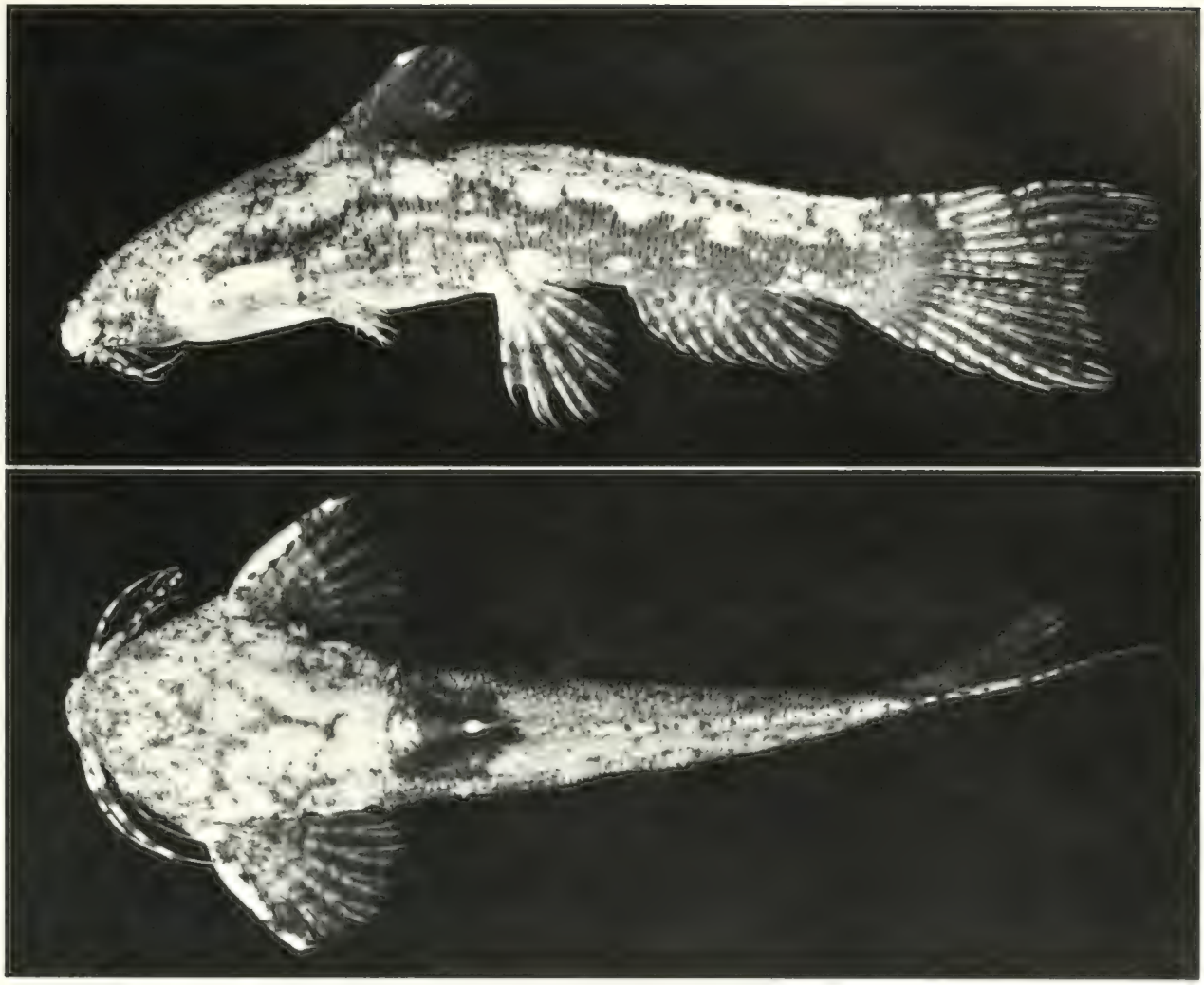

FIGURE 109. *Parakysis verrucosa*. Malay Peninsula, Pahang, 42.5 mm gravid female (USNM 266589).

specimen from Sintang and 191 mm specimen from Kapuas 1976-45 are gravid females. The gonads of other large specimens were not examined, but I suspect that they are females. Thus, the 125 mm specimen is the only known mature male of *Breitensteinia*. This specimen differs so much from the more elongate females that it could represent a different species. The characteristics of the three mature specimens of known sex are summarized in Table 9. Two specimens had small prawns in their stomach (no other food items observed).

Parakysidae new family

In 1937 A. W. Herre collected some very peculiar little catfishes in Sarawak and in the southern part of the Malay Peninsula which he subsequently described as a new genus and species of Akysidae, *Parakysis verrucosa* (Fig. 109). Presumably Herre referred *Parakysis* to Akysidae on the basis of its highly tuberculate skin, cryptic coloration, small size, superficial resemblance to *Akysis*, and occurrence in southeast Asia. He apparently did not compare the specimens of his new genus with any akysid specimens. It is possible that Herre never saw a true member of the family Akysidae: there were no specimens in the fish collection of the Stanford Natural History Museum during his time, and so far as I have been able to determine he never obtained any.

Direct comparison of *Parakysis* with the three genera of Akysidae—*Acrochordonichthys*, *Akysis*, and *Breitensteinia*—reveals little in common and numerous differences. *Parakysis* is highly specialized in several respects and does not seem closely related to any other catfishes, and therefore a new family is proposed for it.

The family Parakysidae is characterized as follows:

1. Head and body entirely covered with evenly distributed, rounded tubercles of nearly uniform size.

The tubercles of *Parakysis* exhibit no indication of organization into longitudinal rows which is such a striking characteristic of Akysidae. The rounded tubercles of *Parakysis* have not been examined with the scanning electron microscope but superficially they do not resemble the polygonal unculiferous tubercles observed in akysids and sisorids. In *Parakysis* the tubercles vary from pale to highly melanistic, while in Akysidae and Sisoridae they are generally (always?) unpigmented. At least some of the tubercles of *Parakysis* apparently have a depression (or pore?) at the summit, thus suggesting a possible sensory or secretory function absent in the poreless tubercles of Akysidae and Sisoridae.

2. Lips with transverse plicae; lower lip with a pair of anteriorly projecting lateral lobes.

The number of transverse plicae increases with growth. The largest specimen examined, a 59.8 mm *P. verrucosa*, has the main part of the upper lip with 7 complete transverse plicae and lower lip with 4 complete transverse plicae plus 4–5 plicae on each lateral lobe. The plicae superficially resemble those on the expanded lips of the cyprinid genus *Osteochilus*. In Akysidae and Sisoridae, as in catfishes generally, the lips are generally tuberculate or papillose; no other Asian catfishes with transversely plicate lips have come to my attention. The lateral lobes of the lower lip of *Parakysis* are unique.

3. Nasal, maxillary, and two pairs of mandibular or mental barbels well developed. Base of outer mandibular barbel with 0–1 and of inner mental barbel with 0–3 short accessory barbels. Maxillary barbel with a broad base originating at rictus of jaws and continuous with both upper and lower lips.

Parakysis has the full catfish complement of four pairs of barbels, with the specializations noted above which are unique. Comparable accessory mental barbels are not found in any other Asian catfishes; the highly branched mental barbels of African Mochokidae and South American Doradidae are very different from the simple accessory mental barbels of *Parakysis*. In Akysidae and Sisoridae, as in catfishes generally, base of maxillary barbel originates from or above upper lip only.

4. Gill rakers absent.

There are no gill rakers on any of the gill arches in *Parakysis*. In Akysidae gill rakers are reduced in number but are large and well developed and present on the leading edge of all arches except the last. The only other Asian catfishes as known to me in which the gill rakers are entirely absent belong to the highly specialized and unrelated family Chacidae.

5. Dorsal and pectoral spines short, stout, and non-serrate.

The dorsal-fin spine of *Parakysis* is exceptionally stout and wide for such a small catfish, much more so than the dorsal spine of any akysid or sisorid. The pectoral spine of nearly all akysids and sisorids bears large serrae on its inner margin.

6. Dorsal fin with 4, pectoral and pelvic fins with 5–6 soft rays.

In catfishes the primitive or generalized complement of dorsal-fin soft rays is 7. In small catfishes with a well developed dorsal-fin spine the number of rays is commonly reduced to 6 or 5, rarely to 4 (never fewer?). In akysids the dorsal-fin rays are usually 5.

7. Anal fin with 8–13 rays, anteriormost 3–8 rays simple and widely spaced.

The number of simple or unbranched anal-fin rays in Akysidae and Sisoridae, as in most catfishes, is usually no more than 3–5; in catfishes with up to five unbranched rays, the first 2–4 rays tend to be very close together (sometimes all based on the first anal pterygiophore). Perhaps the only Asian catfishes with numerous widely spaced simple anal-fin rays comparable to those of *Parakysis* are the members of Olyridae and Amblycipitidae.

8. Humeral (or postcleithral) process absent. Pectoral gland present, with a single pectoral pore.

The humeral process of the pectoral girdle is well developed in all Akysidae. In *Parakysis* there is a slight convexity on the posterior margin of the cleithrum near where the humeral process normally arises, but nothing like the well developed humeral process seen in nearly all Asian catfishes including Akysidae and Sisoridae.

9. Caudal fin with upper lobe moderately elongate and pointed, lower lobe shorter and rounded. Caudal fin with 3–5 upper and 3–4 lower procurrent rays and 7/6 or 7/5 principal rays.

In Akysidae the upper and lower lobes are generally similar in shape, with the lower equal to or slightly longer than upper.

In catfishes the principal caudal-fin ray formula is almost always n/n or n/n+1, with n ranging from 9 (the primitive number of catfishes, found only in *Diplomystes*) to 5. Many species have 8/9=17. The lowest principal ray count known in catfishes is 5/5=10, found in several highly specialized and unrelated genera in different families. Although no exceptions to this formula were reported in the extensive survey of catfish caudal skeletons by Lundberg and Baskin (1969), at least three genera from southeast Asia depart from the rule: *Parakysis* with 7/6 or 7/5, *Akysis hutchinsoni* with 7/6, and the silurid *Silurichthys* with 7/6, 7/5, or 7/4. Akysidae other than *A. hutchinsoni* usually have n/n or n+1 principal caudal rays (Table 9).

10. Lateral line apparently absent from side of body.

In most catfishes the lateral line is well developed on the side of the body. Akysidae have a series of lateral line pores at least on the anterior half of the body. *Acrochordonichthys* has the lateral line with 23 pores extending to a point below end of adipose fin; *Breitensteinia* has the lateral line with 27 pores extending to well beyond the anal fin. In *Akysis variegatus*, the smallest akysid, the lateral line apparently is confined to the anterior half of the body, but has 5 well developed pores. No pores or other indication of a lateral line have been observed on the body of *Parakysis*.

11. Vertebrae 16–19+11–14=30–32.

In *Parakysis* the number of abdominal vertebrae is 2–7 more than of caudal vertebrae, while the reverse is generally true in Akysidae (see Table 9).

Additional features of Parakysidae, mainly primitive or reduction characters of less help in establishing its distinctness or relationships, include the following: eyes minute, dorsal in position; teeth of upper and lower jaws generalized, disposed in narrow bands; palatal teeth absent; gill openings restricted, extending from just below to just above lateral prominence of cleithrum; isthmus broad; branchiostegal rays 5+5; anterior chamber of swim bladder with lateral lobes; adipose fin absent or represented by a long, low-lying dorsomedian ridge of almost uniform height beginning just behind dorsal fin and continuous with low ridge formed by upper procurrent caudal-fin rays; mature males with moderately elongate genital papilla.

The family Parakysidae comprises the genus *Parakysis* with two species, *P. verrucosa* from the Malay Peninsula, Sarawak, and Sumatra, and *P. anomalopteryx* new species from the Kapuas basin.

Parakysis Herre, 1940

Parakysis Herre, 1940*a*:12 (type species *Parakysis verrucosa* Herre, 1940, by monotypy)

Parakysis anomalopteryx new species

Holotype.—MZB 3702, 27.1 mm, Kapuas basin, Sungai Seriang, a forested tributary of the Sungai Palin, 37 km W of Putussibau (Kapuas 1976-42)

Paratypes.—MNHN 1982-714, 2: 23.0–24.1 mm, same collection as holotype;

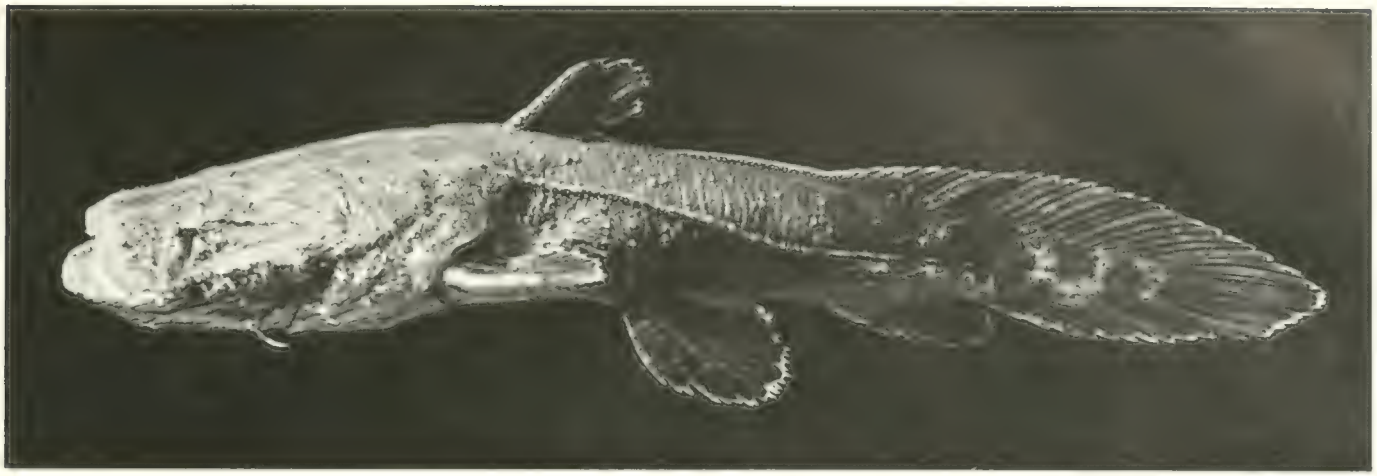

FIGURE 110 *Chaca bankanensis*. Kapuas 1976-47, 101 mm (USNM 230310).

AMNH 48940, BMNH 1982.3.29.151–192, CAS 49420, FMNH 94245, MCZ 58352, MZB 3701, 18: 19.8–34.1 mm, Kapuas basin, Sungai Mandai Ketchil near confluence with Kapuas mainstream, 18 km WSW of Putussibau (Kapuas 1976-39); CAS 49421, MZB 3703, UMMZ 209923, USNM 230307, 18: 18.5–30.4 mm, Kapuas basin, small forest stream flowing into Kapuas mainstream NE of Gunung Setunggul, 53 km NW of Sintang (Kapuas 1976-47)

DIAGNOSIS.—*P. anomalopteryx* is superficially similar to its only congener, *P. verrucosa* (Fig. 109), but differs from that species in fin ray counts, shape of upper lip, number of branches on mental barbels, and number of pores in mandibular branch of cephalic laterosensory canals. Pectoral-fin rays usually i5 (vs. i6 in *P. verrucosa*); pelvic-fin rays 5 (vs. 6); caudal-fin rays almost invariably 7/5 (vs. usually 7/6); total anal-fin rays 10–13, 5–8 simple + 3–7 branched (vs. total 8–11, 3–7 simple + 5–6 branched). Upper lip with uniform margin (vs. upper lip with a discrete median lobe between anterior nostrils projecting ventrally between lateral lobes of lower lip). Outer mandibular barbel almost invariably without branches, inner mandibular barbel almost invariably with a single branch (vs. outer mandibular barbel usually with one branch and inner with two or three branches). Mandibular laterosensory canal without a pore lateral to outer mandibular barbel (vs. with a pore).

DISTRIBUTION.—Kapuas. Its only congener, *P. verrucosa*, is known from Malay Peninsula (Pahang, Johore), Sumatra (Deli), and Sarawak.

ETYMOLOGY.—The name *anomalopteryx* refers to the unusual or "anomalous" fin ray counts characteristic of this species.

Chacidae

The south and southeast Asian angler-catfish family Chacidae is distinguished by its extraordinarily large, broad, flat head, nearly square in outline when viewed from above; mouth terminal, very broad; tongue very broad, occupying nearly entire floor of mouth; maxilla entirely included in gape; palate edentulous; gill arches greatly enlarged and elongate; gill rakers absent; gill opening moderately large, extending onto isthmus only a short distance anteroventral to pectoral fin; isthmus extremely broad; branchiostegal rays 6–8; eyes minute; three or four pairs of minute or very small barbels (nasal barbel absent in *C. chaca*); numerous cutaneous flaps or cirri on dorsolateral surface of head, sometimes also on lower lip and on body. Skin extensively granulated. Dorsal fin with a strong spine and four rays. Anal fin with 8–10 rays. Pectoral fin with a short, strongly serrated spine and 4–5 rays; pelvic fins large, with 6 rays; caudal fin rounded with 5/6 or 6/5 principal rays; upper and lower procurrent rays greatly enlarged and numerous, 18–25/8–13. Vertebrae 14–16+17–20=31–35.

A single genus, *Chaca*, with two species, *C. chaca* (Hamilton-Buchanan, 1822) in the Indian subcontinent and *C. bankanensis* in the Malay Peninsula and Indonesia. For further information on the family see Roberts (1982*b*).

Chaca Gray, 1831

Chaca Gray, 1831 (type species *Platystacus chaca* Hamilton-Buchanan, 1822, by monotypy and absolute tautonymy)

Chaca bankanensis, Bleeker, 1852

(Figure 110)

Chaca bankanensis Bleeker, 1852*c*:455 (type locality Banka, in fluviis)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-16, 4: 46.0–89.2 mm (CAS 49424, MCZ 57598, MZB 3709); Kapuas 1976-19, 164 mm (MZB 3710); Kapuas 1976-42, 2: 15.2–17.9 mm (CAS 49425, MZB 3711); Kapuas 1976-46, 3: 39.4–101 mm (MZB 3712, USNM 230310)

DISTRIBUTION.—Malay Peninsula (Johore, Perak). Sumatra (Indragiri). Borneo (Kapuas, Barito). Banka. Billiton.

Siluridae

The Eurasian Siluridae is one of the most distinctive and well defined families of catfishes. Head depressed, body compressed, skin smooth; maxillary barbels usually elongate; one or (in *Parasilurus* and *Silurus*) two pairs of mental barbels (sometimes vestigial or absent); nasal barbels invariably absent; gill openings very wide; branchiostegal membranes, more or less broadly overlapping, with 8–21 branchiostegal rays; dorsal fin spineless, with 1–8 (usually 1–4) soft rays (sometimes absent), and exhibiting a fixed position in relation to vertebral column unlike that in other catfishes (see below); anal fin very long with 41–112 rays; abdominal cavity restricted; caudal vertebrae about 3–4 times as numerous as abdominal; vertebrae 9–20+32–56=42–75.

In all silurids, including those without dorsal-fin rays, well

FIGURE 111 *Belodontichthys dinema*. Kapuas 1976-19, 296 mm (CAS 49386).

developed dorsal-fin pterygiophores articulate with neural process of vertebra 7, or, in, the three closely related genera *Hito, Parasilurus* and *Silurus*, with neural process of vertebra 8 or 9. In other catfish families dorsal-fin pterygiophores generally articulate with neural processes of several vertebrae beginning with vertebra 4 or even with vertebra 1 or 2.

The family comprises 9–10 genera and about 50 species (for systematic review see Haig 1952). The genera and species are most numerous in the Indian subcontinent, Mekong basin, and Borneo; seven genera and 21 species (two herein described as new) are known from western Borneo. Of particular interest are the highly specialized but poorly known endemic southeast Asian genera *Belodontichthys, Ceratoglanis*, and *Hemisilurus*.

Belodontichthys Bleeker, 1858

Belodontichthys Bleeker, 1858*c*:266 (type species *Belodontichthys macrochir* Bleeker, 1858=*Wallago dinema* Bleeker, 1851, by monotypy)

A highly specialized and very distinctive genus. Head and body strongly compressed; predorsal profile strongly concave from tip of strongly upturned snout to above eye, then almost perfectly straight to dorsal-fin origin; dorsal body musculature extending very far forward onto head, to above middle of eyes (as in cyprinid *Macrochirichthys*); depth of body strongly decreasing from anal-fin origin to caudal-fin base; jaws long, compressed, strongly upturned, lower jaw strongly projecting, rictus below anterior margin of eye; jaw teeth large, lancet-shaped, in three irregular rows in both jaws, teeth in outermost row somewhat smaller; vomerine teeth minute, restricted to a small patch; eyes large, lateral (not visible from below head), subcutaneous; maxillary barbels extending posteriorly to beyond level of pectoral-fin origin and almost to pelvic-fin origin; mental barbels minute, vestigial; gill openings very large; branchiostegal membranes free from isthmus with 13–15 branchiostegal rays; gill arches extremely long; gill rakers short but relatively numerous (4+29=33 in 296 mm Kapuas specimen); dorsal fin small, with 4–5 rays; anal fin long, with 88–96 rays; pectoral fin falcate and extraordinarily large, extending posteriorly well beyond level of anal-fin origin, with a basally rigid, distally flexible (i.e., nonpungent), non-serrate spine and 18–22 branched rays; cleithrum and pectoral muscles enormously expanded; humeral process absent; porus pectoralis and axillary gland absent; pelvic fin small, with 9–10 rays; caudal fin small, separate from anal fin, upper lobe slightly longer than lower with 8/9 principal and about 4/3 procurrent caudal-fin rays; vertebrae 13 or 14+53=66–67 (in one Kapuas specimen); color in life (Kapuas) iridescent greenish-blue dorsally, silvery or milky-white laterally and ventrally; attains 550 mm.

The genus comprises a single species.

Belodontichthys dinema (Bleeker, 1851)

(Figure 111)

Wallago dinema Bleeker, 1851*h*:198, 202 (type locality Banjermassin).
Belodontichthys macrochir Bleeker, 1858*c*:266 (unwarranted substitution of species name for *W. dinema*)
Belodontichthys dinema Weber and de Beaufort, 1913:204
Wallago dinema Myers, 1938:98

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 3: 193–296 mm (CAS 49386, MZB 3630, UMMZ 209859)

DISTRIBUTION.—Laos, Vietnam, Thailand (Mekong, Chao Phrya). Malay Peninsula. Sumatra (Palembang, Djambi). Borneo (Kapuas, Barito).

Ceratoglanis Myers, 1938

Ceratoglanis Myers, 1938:98 (type species *Hemisilurus scleronema* Bleeker, 1862, by original designation and monotypy)

Ceratoglanis is distinguished from all other silurids by its hook-shaped maxillary barbels (barbels permanently bent in a right angle near midlength) and more numerous anal-fin rays (103–112 vs. less than 100 in all other silurids). Vertebrae 12+51–53=63–65. In shape of head and of its inferior, transverse jaws *Ceratoglanis* strongly resembles *Hemisilurus* but its posterior nostril lies anterior to eye rather than posterior to it as in *Hemisilurus*. Vertebral counts are virtually identical in *Ceratoglanis* and *Hemisilurus*.

Ceratoglanis scleronema (Bleeker, 1862)

Hemisilurus scleronema Bleeker, 1862–63:93 (type locality Krawang, Java)
Ceratoglanis scleronema Myers, 1938:98

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 14: 226–348 mm (CAS 49387, MZB 3631, RMNH 28889, USNM 230285).

Kapuas specimens have gill rakers 2–3+11–12=13(2), 14(2), or 15(1); anal-fin rays 103–112; vertebrae 12+51–53=63(2), 64(1), 65(2).

DISTRIBUTION.—Sumatra (Djambi). Borneo (Baram, Kapuas). Java (Krawang).

Hemisilurus Bleeker, 1858

Hemisilurus Bleeker, 1858*c*:295 (type species *Wallago heterorhynchos* Bleeker, 1853, by subsequent designation of Bleeker, 1862:395).
Diastatomycter Vaillant, 1891:182 (type species *Diastatomycter chaperi* Vaillant, 1891=*Wallago heterorhynchos* Bleeker, 1853, by monotypy).

Hemisilurus are large silurids, attaining at least 80 cm (pers. obs.), distinguished from all other genera by having posterior nostril lying behind posterior margin of eye (rather than in front of eye) and in having maxillary barbel (simple, short, and thin in juveniles) becoming greatly enlarged with its distal half flattened and bearing a series of thread-like extensions in large adults. This condition of the barbels was reported by Weber and de Beaufort (1913:213, fig. 85) in a female *H. moolenburghi* presumably over 500 mm (length not stated). Haig (1952:64) assumed that the condition occurs only in females but this needs confirmation. I observed a number of very large specimens of *Hemisilurus* in the fish market at Sintang (Kapuas 1976-19), several of which had enlarged, modified maxillary barbels. It seems likely that these were *H. heterorhynchos* rather than *H. moolenburghi*; unfortunately the specimens were not obtained, and it was not possible to sex them or confirm the specific identity. The secondary growth and differentiation of the maxillary barbel apparently does not occur until fish are well over 400 mm (and presumably have attained sexual maturity). Anal-fin rays 90–98. Vertebrae 12+51–52=63–64.

Hemisilurus heterorhynchos (Bleeker, 1853)

Wallago heterorhynchos Bleeker, 1853*f*:514 (type locality Moara Kompeh, Sumatrae orientalis, in fluviis).
Hemisilurus heterorhynchus Bleeker, 1862:94.
Diastatomycter chaperi Vaillant, 1891:182 (type locality Knapei, Kapuas basin).
Hemisilurus chaperi Weber and de Beaufort, 1913:211.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 18: 215–350 mm (BMNH 1982.3.29.161–162, CAS 49388, MNHN 1982-706, MZB 3632, RMNH 28890, UMMZ 209860, USNM 230286); Kapuas 1976-48, 136 mm (MZB 3633).

Kapuas specimens have gill rakers 4+9–10=13(1) or 14(1), anal-fin rays 92–98, and vertebrae 12+51–52=63(1), 64(1).

Although Weber and de Beaufort (1913:211) and Haig (1952: 94) treat *Hemisilurus chaperi* as a valid species, it is noteworthy that Vaillant himself treated it as a junior synonym. Vaillant had not examined specimens of either *Hemisilurus heterorhynchos* or *Hemisilurus* (=*Ceratoglanis*) when the original description of his *Diastatomycter chaperi* was prepared. Later, having examined type specimens of the three nominal species, Vaillant (1902:50) concluded that they represented only two species, *H. heterorhynchos* and *H. scleronema*. It is perfectly clear from the discussion that he recognized the identity of *D. chaperi* with *H. heterorhynchos* and that the statement "*Diastatomycter Chaperi*, Vaillant=*H. scleronema*, Bleeker" is a lapsus calami.

The 19 Kapuas specimens here reported as *H. heterorhynchus* appear to represent a single species; they agree quite well with Bleeker's accounts of *H. heterorhynchos* and Vaillant's of *D. chaperi*. I therefore conclude that Vaillant was correct in recognizing the specific identity of *H. heterorhynchos* and *D. chaperi*.

DISTRIBUTION.—Sumatra (Palembang, Djambi). Borneo (Kapuas).

Hemisilurus moolenburghi Weber and de Beaufort, 1913

Hemisilurus moolenburghi Weber and de Beaufort, 1913:212 (type locality Batang Hari, Sumatra).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 308 mm (MZB 3634).

A single specimen of *Hemisilurus* obtained at the fish market in Sintang differs from all of the others obtained there in having a much smaller eye and more elongate but still very slender maxillary barbel. It thus agrees with *H. moolenburghi*, a species previously known only from the type specimens obtained in the Batang Hari, Sumatra.

Kryptopterus Bleeker, 1858

Kryptopterus Bleeker, 1858*c*:283 (type species *Kryptopterus micropus* Bleeker, 1858=*Silurius cryptopterus* Bleeker, 1851, by subsequent designation of Bleeker, 1862–63:18)
Kryptopterichthys Bleeker, 1858*c*:288 (type species *Silurus palembangensis* Bleeker, 1852=*Silurus bicirrhis* Valenciennes *in* Cuvier and Valenciennes, 1839, by subsequent designation of Bleeker, 1862–63:18)
Micronema Bleeker, 1858*c*:298 (type species *Micronema typus* Bleeker, 1858=*Silurus micronemus* Bleeker, 1846, by original designation).
Phalacronotus Bleeker, 1858*c*:302 (type species *Silurus leptonema* Bleeker, 1852, by subsequent designation of Bleeker, 1862–63:18).
Cryptopterus Günther, 1864:38 (unwarranted spelling emendation).
Cryptopterella Fowler, 1944:1 (type species *Cryptopterella beldti* Fowler, 1944=*Kryptopterichthys macrocephalus* Bleeker, 1858?).

Bleeker (1858) divided the fishes here placed in *Kryptopterus* into two tribes, Kryptopterini and Phalacronoti, each with two genera. These taxa, based mainly on reduction characters such as presence or absence of dorsal fin and mental barbels, have not been followed by subsequent authors. Kryptopterini (with *Kryptopterus* and *Kryptopterichthys*) supposedly includes one or two large species and small species which have 8–12 branchiostegal rays, while Phalacronoti (with *Micronema* and *Phalacronotus*) includes only large species with 12–17 branchiostegal rays. Whether the taxa thus recognized are phyletically valid has not been sufficiently investigated.

The genus has not been revised since Bleeker (1858*c*, 1862–63). The species are listed by Haig (1952). Counts of vertebrae, not previously given, and of gill rakers, rarely provided, appear to be characteristic or diagnostic for various species. Data on these and other meristic characters are presented in Table 10.

Kryptopterus apogon (Bleeker, 1851)

(Figure 112)

Silurus apogon Bleeker, 1851*f*:67 (type locality Bandjermassing, in fluviis)
Silurus leptonema Bleeker, 1852*d*:584 (type locality Palembang, in fluviis)
Silurus micropogon Bleeker, 1855*d*:418 (unwarranted replacement name for *Silurus apogon* Bleeker, 1851).
Phalacronotus leptonema Bleeker, 1858*c*:304.
Phalacronotus micropogon Bleeker, 1858*c*:306.
Cryptopterus micropogon Günther, 1864:43
Cryptopterus apogon Weber and de Beaufort, 1913:221
Kryptopterus apogon Smith, 1933:75

TABLE 10. MERISTIC CHARACTERS IN *KRYPTOPTERUS*. For definition of vertebral counts see p. 22.

	Gill rakers	Branch. rays	Pect. rays	Pelvic rays	Anal rays	Vertebrae	Type status
K. apogon							
Kapuas 1976-19	4+16–20(1)	16	16	9	83	14+48–49=62(1), 63(1)	
K. bicirrhis							
Pahang, Bentong	4+12–16–16(1), 19(1), 20(1)		11(3)	6(3)	63–68	11+38–49(3)	
Palembang?	5+14–16=19(3), 20(1), 21(1)	8–9	11–12		60–68		RMNH (incl. holotype *palembangensis*?)
Palembang?						11+37–48	BMNH (non-type)
Sintang		8–9	10		55–60		
Kapuas 1976-14			11		66	10+36=46	
Kapuas 1976-19	4+15–17=19(1), 21(1)	8–9	11–12	6(2)	64–66	10+37–38=47(1), 48(1)	
Kapuas 1976-33					67 or 68	10+37=47	
Kapuas 1976-34	3–4+14–16=18(1), 19(1), 20(1)	8–10	11–13	6(3)	62–63	10+37–38=47(1), 48(1)	
Kapuas 1976-44	4+16–17–20(1)21(1)	10	12–13	6(1)	59–63	10+36–37=46(2), 47(2)	
Kapuas 1976-45			11		63	10+36=46(1)	
Java	3+15=18(1)	8	11		60	10+37=47	holotype *bicirrhis*
"Amboyna"	4+16=20(1)		11?		63	10+37=47	holotype *amboinensis*
K. cryptopterus							
Chao Phrya	5+18=23	11	10	6	78	12+40=52	
Kapuas 1976-14, 33	4+14=18(1); 7+22–23=29(1), 30(1)	11–12	13–15	6	66–71	12+37–41=49(1), 50(1), 53(1)	
K. lais							
Kapuas 1976-33	4+14=18(1)	8	10	6	61	11+37=48(1)	
K. limpok							
Kapuas 1976-19	3–4+11–16=15(4), 16(1), 17(1), 20(1)	10–12	13–=15	8–9	76–85	12+45–47=57(1), 58(1), 59(1)	
K. macrocephalus							
Kapuas 1976-5	2–3+9–10–11(2), 13(2)	9–10	10(4)	6(4)	48–52	10+32–33=42(2), 43(2)	
Kapuas 1976-8	2+9=11(1)	9–10	9(2), 10(6)	6(5)	50–55	10+33–35=43(2), 44(5), 45(3)	
K. minimus							
Kapuas 1976-9	2+9–9=10(2), 11(2)	7(1), 8(3)	8(1), 9(3)	6(4)	50–60	9–10+33–35=43(1), 44(9)	
Kapuas 1976-22	2–3+9–11=11(2), 13(5)	7(5), 8(3)	8(6), 9(1)	5(6), 6(1)	46–49	9–10+33–35=43(4), 44(1), 45(3)	
Kapuas 1976-29			9		52	10+34=44(1)	
Kapuas 1976-55	1–2+9–10–10(2), 11(2), 12(3)	7(4)	8(7), 9(1)	5(5)	48–52	10–11+34–35=44(5), 45(2), 46(1)	
K. micronema							
Kapuas 1976-33	4+16=20(1)	16	16	9	83	14+48–49=62(1), 63(1)	
K. schilbeides							
Kapuas 1976-33	7–8+23=30(1), 31(1)	10–11?	11–12	6	70(2)	10+40=50(2)	

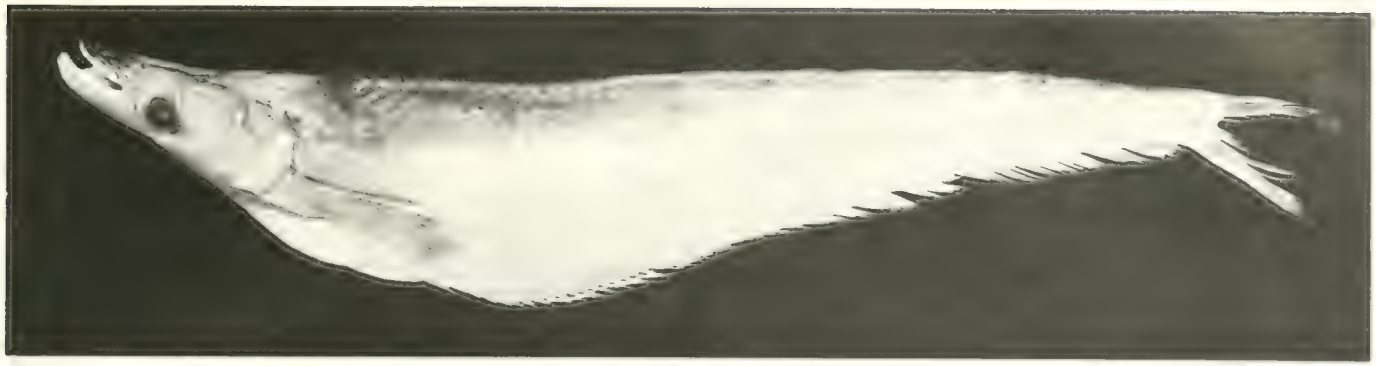

FIGURE 112. *Kryptopterus apogon*. Kapuas 1976-19, 318 mm (CAS 49389).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 4: 173–318 mm (CAS 49389, MZB 3635, RMNH 28891, USNM 230287); Sintang, 204 mm (ZMA 114.382)

DIAGNOSIS.—Probably the largest species of *Kryptopterus*, attaining a total length of 770 mm (Weber and de Beaufort 1913: 221); head more elongate than in any other *Kryptopterus*, its length 4.6–5.3 (vs. 5.5–7.4 in other species); lower jaw strongly projecting beyond upper when mouth is closed, teeth very large, those of lower jaw extending to external anterior margin of dentary; barbels greatly reduced, length of maxillary and mental barbels about 0.5–1.0 eye diameter.

Kryptopterus bicirrhis (Valenciennes, 1839)

(Figure 113)

Silurus bicirrhis Valenciennes *in* Cuvier and Valenciennes, 1839:367 (type locality Java)
Silurus palembangensis Bleeker, 1852*d*:584 (type locality Palembang, Sumatra)
Kryptopterichthys palembangensis Bleeker, 1858*c*:290.
Kryptopterichthys bicirrhis Bleeker, 1858*c*:292
Cryptopterus amboinensis Günther, 1864:40, 429 (type locality "Amboyna," erroneous).

MATERIAL EXAMINED.—Malay Peninsula: Bentong, Pahang, 3: 89.4–104 mm (CAS-SU 31980). Western Borneo: Kapuas 1976-14, 89.7 mm (MZB 3652); Kapuas 1976-19, 2: 96.1–99.3 mm (CAS 49399, MZB 3653); Kapuas 1976-33, 95.7 mm (MZB 3654); Kapuas 1976-34, 3: 93.5–125 mm (MZB 3655, RMNH 28897, USNM 230294); Kapuas 1976-44, 4: 67.4–87.8 mm (BMNH 1982.3.29.172, CAS 49400, MZB 3656); Kapuas 1976-45, 80.3 mm (MZB 3657); Sintang, 3: 60.8–78.6 (AMNH 7815). Java: 96.3 mm (MNHN 9932, holotype of *S. bicirrhis*) Locality unknown: Bleeker collection, 122 mm (BMNH 1863.12.4.101); Bleeker collection, 4: 108–143 mm (RMNH 6837, presumably including holotype of *S. palembangensis*); "Amboyna," 90.3 mm (BMNH 1855.3.24.14, holotype of *C. amboinensis*)

DIAGNOSIS.—*Kryptopterus bicirrhis* is a medium-sized species, attaining perhaps 200 mm, transparent in life, with a long maxillary barbel, mental barbels greatly reduced or absent, gill rakers 16–21, branchiostegal rays 8–10, dorsal fin well developed, pectoral-fin rays 11–13, pelvic-fin rays 6, anal-fin rays 59–68, and vertebrae 46–49.

Meristic data on this species and its synonyms are presented in Table 10.

Kryptopterus cryptopterus (Bleeker, 1851)

Silurus cryptopterus Bleeker, 1851*c*:270 (type locality Bandjermassing in fluviis)
Kryptopterus micropus Bleeker, 1858*c*:284 (unwarranted substitute name for *Silurus cryptopterus* Bleeker, 1851)
Cryptopterus micropus Günther, 1864:42
Kryptopterus cryptopterus Fowler, 1905:468

MATERIAL EXAMINED.—Thailand: Chao Phrya at Bangkok, 115 mm (CAS-SU 28829). Western Borneo: Kapuas 1976-14, 4: 98.7–124 mm (BMNH 1982.3.29.168, CAS 49393, MZB 3640); Kapuas 1976-19, 3: 117–138 mm (FMNH 94242, MNHN 1982-708, MZB 3641); Kapuas 1976-22, 126 mm (MZB 3642); Kapuas 1976-33, 9: 114–146 mm (MZB 3643, RMNH 28893, UMMZ 209890, USNM 230289, KUMF 2858)

DISTRIBUTION.—Laos, Thailand (Mekong, Chao Phrya). Malay Peninsula. Sumatra (Palembang, Djambi, Banjuasin). Borneo (Baram, Sambas, Kapuas, Bandjermasin).

Kryptopterus lais (Bleeker, 1851)

Silurus lais Bleeker, 1851*c*:428 (type locality Sambas in fluviis)
Kryptopterichthys lais Bleeker, 1858*c*:291
Cryptopterus lais Günther, 1864:62; von Martens, 1876:399 (Danau Sriang, Kapuas basin)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-33, 2: 59.3–65.5 mm (CAS 49394, MZB 3644); Kapuas 1976-55, 5: 55.8–75.7 mm (BMNH 1982.3.29.169, MNHN 1982-709, MZB 3645, RMNH 28894, USNM 230290)

DISTRIBUTION.—Borneo (Sambas, Kapuas, Kahajan, Barito).

Kryptopterus limpok (Bleeker, 1852)

Silurus limpok Bleeker, 1852*d*:583 (type locality Palembang, in fluviis)
Kryptopterus limpok Bleeker, 1858*c*:286
Cryptopterus limpok Günther, 1864:39

MATERIAL EXAMINED.—Western Borneo: Pontianak, 126 mm (RMNH 7814); Sintang, 122 mm (RMNH 7815); Kapuas, Knapei et Sebruang, 2: 217–225 mm (MNHN 1891/456–457); Kapuas 1976-19, 15: 130–241 mm (BMNH 1982.3.29.170, CAS 49395, MZB 3646, RMNH 28895, UMMZ 209861, USNM 230291); Kapuas 1976-38, 294 mm (MZB 3647)

DIAGNOSIS.—*Kryptopterus limpok* is a moderately large species, attaining 300 mm or more, immediately distinguished from all other *Kryptopterus* by its elongate mental barbel extending posteriorly to or beyond tip of pectoral fin.

Kapuas specimens of this species have gill rakers 15–20, branchiostegal rays 10–12, dorsal fin present, pectoral-fin rays 13–15, pelvic-fin rays usually 9, anal-fin rays 76–85, vertebrae 57–59.

DISTRIBUTION.—Thailand (Chao Phrya, Pasak). Malay Peninsula (Pahang). Sumatra (Batang Hari, Kwantan, Musi). Borneo (Baram, Kapuas, Kahajan, Mahakam).

Kryptopterus macrocephalus (Bleeker, 1858)

(Figure 114)

Kryptopterichthys macrocephalus Bleeker, 1858*c*:293 (type locality Sumatra?, Padang?, in fluviis)

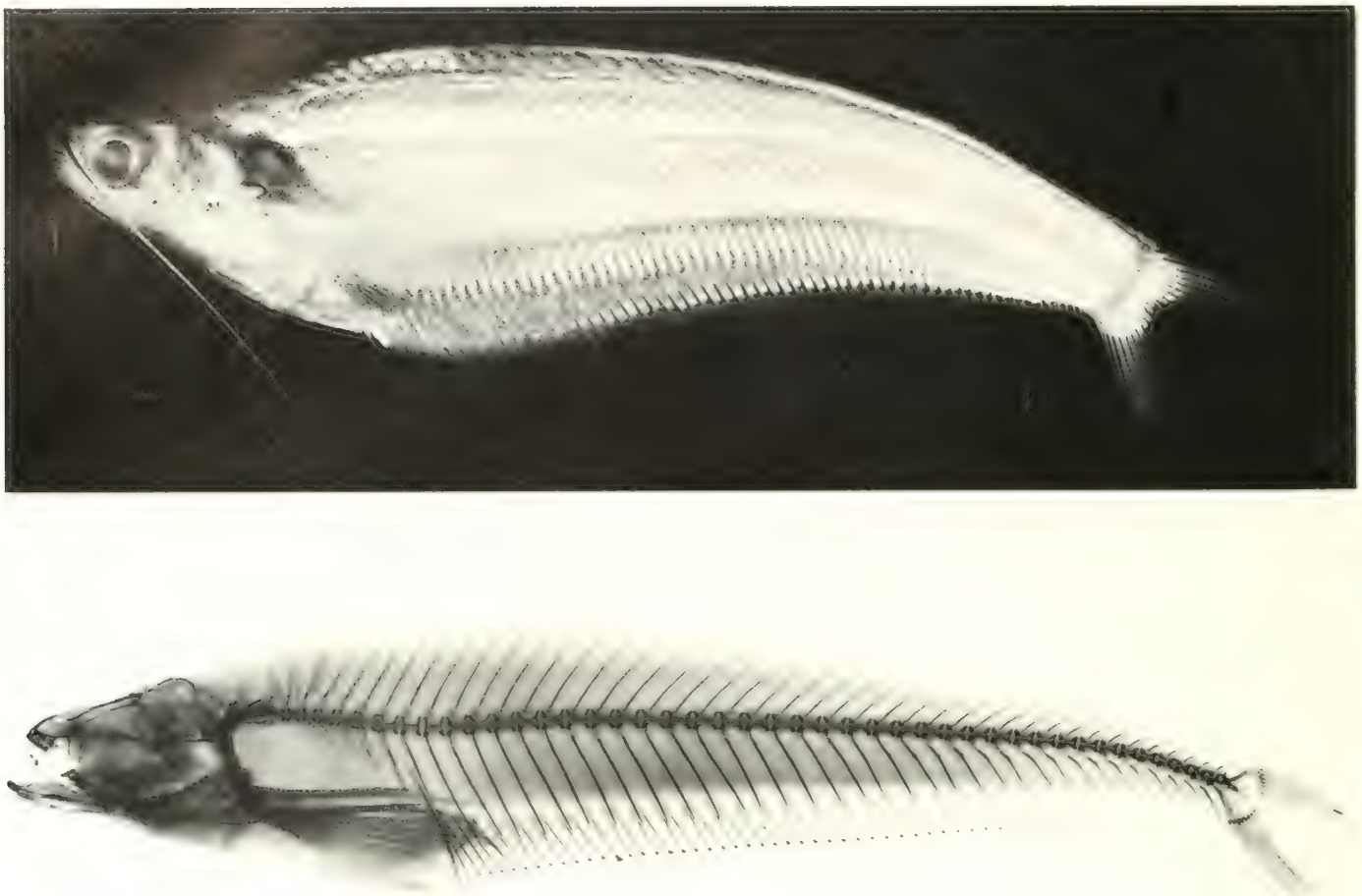

FIGURE 113 *Kryptopterus bicirrhis*. Above, Kapuas 1976-34, 93.5 mm (MZB 3655); below, Java, 96.9 mm (MNHN 9932, holotype, radiograph by Janine Abel).

Cryptopterus macrocephalus Günther, 1864:41
Cryptopterus bicirrhis Popta 1906:26 (upper Mahakam)
Kryptopterus macrocephalus Herre and Myers, 1937:67 (Malay Peninsula)
?*Cryptopterella beldti* Fowler, 1944:2 (type locality Borneo)

MATERIAL EXAMINED.—Peninsular Thailand: Singora (=Songkhla), 62.2 mm (CAS-SU 14840). Malay Peninsula: Perak, Bukit Merah, 66.0 mm (CAS-SU 31071). Sumatra: no further locality, 3: 51.5–62.4 mm (CAS-SU 31071). Sumatra?: Padang?, 96.5 mm (BMNH 1863.12.4.101, holotype?). Western Borneo: Kapuas 1976-5, 4, 50.2–58.2 mm (CAS 49396, MZB 3648); Kapuas 1976-8, 10, 33.8–50.4 mm (CAS 49397, MZB 3649, USNM 230292).

DIAGNOSIS.—*Kryptopterus macrocephalus* is distinguished from almost all other *Kryptopterus* by its strikingly striped or (alternatively) mottled coloration; small size, largest known specimen about 100 mm; long maxillary barbel, gill rakers 11–13, dorsal fin present, pectoral-fin rays 9–10, pelvic-fin rays 6, anal-fin rays 48–55, vertebrae 42–45.

Kryptopterus macrocephalus has two quite distinct color varieties, striped and mottled. The commonest variety, and the one exhibited by the holotype, is striped, with three well defined longitudinal dark stripes extending length of body. The middle stripe tends to be broadest and best defined; its dorsal margin is limited by a very dark, thin midaxial streak. In the mottled color variety the longitudinal stripes are present but are variably broken up, and the clear spaces separating them are obscured by mottling which may extend onto the anal fin. In both color varieties there is usually observed a concentration of melanophores forming a small spot at the base of each anal-fin ray, and a concentration of melanophores forming continuous thin longitudinal line or streak for the length of the anal fin about one-third of the distance from its distal margin. The dorsal surface of the head usually bears two dark broad longitudinal bars separated by a light interspace; in some specimens in which the entire dorsal surface of the head is darkened these are obscured. In the field I was inclined to believe that the striped variety (Kapuas 1976-5) and mottled variety (Kapuas 1976-8) were different species, but detailed comparisons of their color pattern and morphology leads me to conclude they are conspecific. Meristic data on these color varieties are presented in Table 10.

Cryptopterella beldti is based on an aquarium specimen from Borneo (ANSP 71571, 93 mm) which I have not examined. The color pattern, as figured by Fowler, includes several features

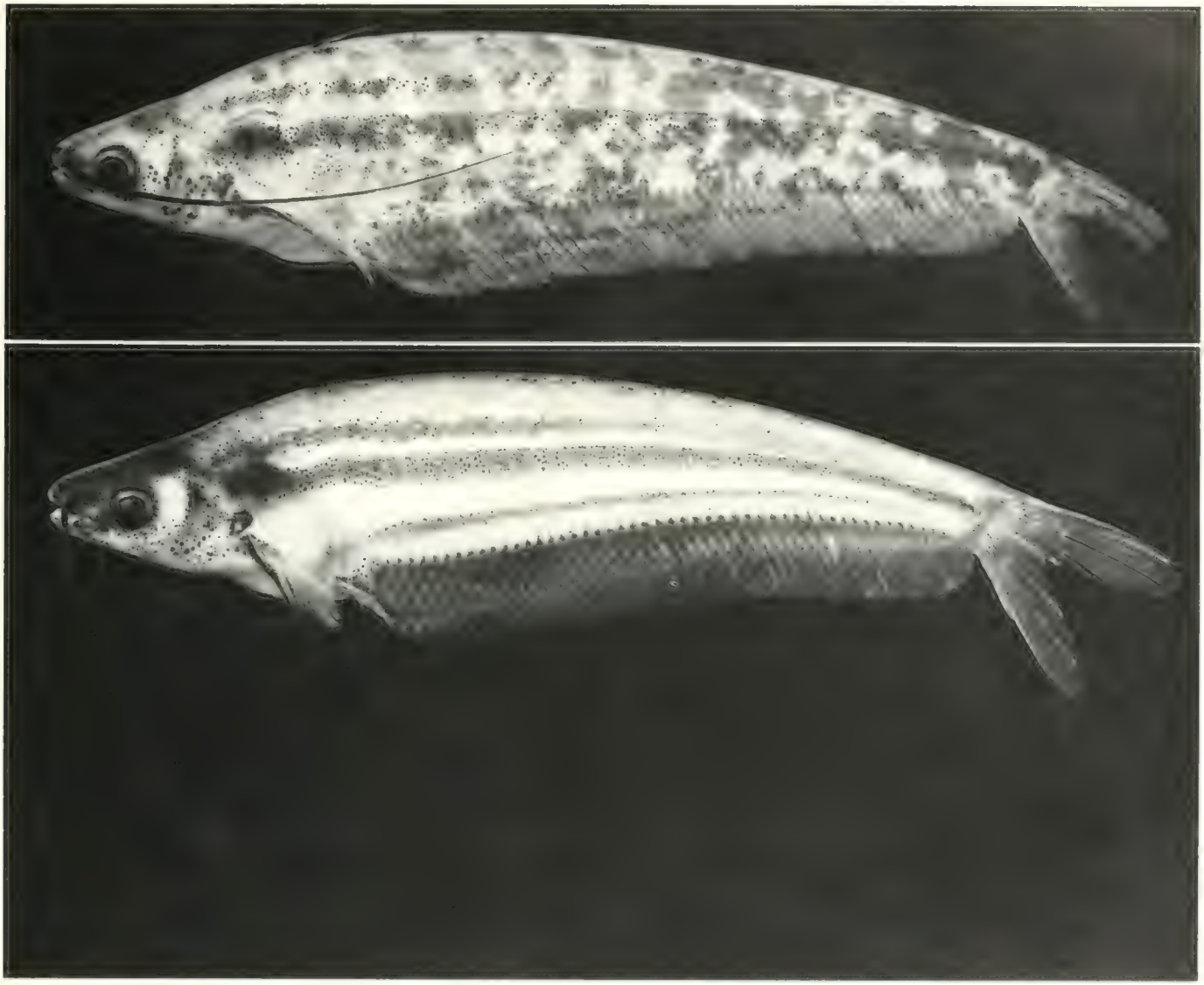

FIGURE 114. *Kryptopterus macrocephalus*. Above, Kapuas 1976-5, 54.4 mm (CAS 49396); below, Kapuas 1976-8, 50.4 mm (CAS 49397)

here considered diagnostic of *K. macrocephalus* including longitudinal stripes (albeit faint), a thin dark midaxial streak, dark spots along anal-fin base, a thin longitudinal line on anal fin one-third of distance from its distal margin, and very large round spots on dorsal surface of snout. The maxillary barbels of the specimen are abnormally short because their ends have been bitten off (W. Smith-Vaniz and E. Böhlke, pers. comm.).

DISTRIBUTION.—Peninsular Thailand (Songkhla). Malay Peninsula (Perak, Johore). Sumatra (Padang, Djambi). Borneo (Kapuas, Mahakam).

Kryptopterus micronema (Bleeker, 1846)

Silurus micronemus Bleeker, 1846*b*:289 (type locality Batavia)
Silurus phalacronotus Bleeker, 1851*b*:429 (type locality Sambas, in fluviis)
Micronema typus Bleeker, 1858*c*:300 (unwarranted replacement name for *Silurus micronemus* Bleeker, 1846)
Phalacronotus micruropterus Bleeker 1858*c*:307 (unwarranted replacement name for *Silurus phalacronotus* Bleeker, 1851)
Micronema phalacronotus Bleeker, 1859*a*:139
Cryptopterus micronema Günther, 1864:43
Kryptopterus deignani Fowler 1937:136 (type locality Mepoon, Central Siam) See Smith (1945:344)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-33, 3: 125–225 mm (CAS 49398, MZB 3650); Kapuas 1976-44, 4: 116–156 mm (BMNH 1982.3.29.171, MZB 3651, RMNH 28896, USNM 230293); Kapuas, Knapei et Sebruang, 2: 291–316 mm (MNHN 1891/452–453)

DISTRIBUTION.—Thailand (Chao Phrya). Malay Peninsula (Johore, Singapore). Sumatra (Palembang). Borneo (Baram, Sambas, Kapuas, Kahajan). Java (Batavia).

Kryptopterus minor new species

(Figure 115)

HOLOTYPE.—MZB 3638, 68.5 mm, mainstream of Sungai Pinoh at Nanga Satan, 45 km S of Nangapinoh (Kapuas 1976-29)

PARATYPES.—BMNH 1982.3.29.163–167, 4, CAS 49390, 4, FMNH 94241, 4 MNHN 1982-707, 4, MZB 3636, 13, RMNH 28892, 4, USNM 230288, 4, 41 49.8–68.0 mm, Sungai Landak at Ngabang (Kapuas 1976-9); CAS 49391, 2, MZB 3637, 1, UMMZ 209865, 4, 7: 46.3–55.2 mm Sungai Melawi and mouth of Sungai Pinoh at Nangapinoh (Kapuas 1976-22); CAS 49392 [illegible] MZB 3639 [illegible] 24.2–34.4 mm, Kapuas mainstream at Selimbau (Kapuas 1976-55)

FIGURE 115 *Kryptopterus minor*. Kapuas 1976-29, 68.5 mm (MZB 3638, paratype).

DIAGNOSIS.—*Kryptopterus minor* is a plain colored, small species (largest known specimen 68.5 mm), transparent in life, differing from all other *Kryptopterus* by having usually or always fewer gill rakers, branchiostegal rays, and pectoral- and pelvic-fin rays. Dorsal fin present; maxillary barbel elongate; mental barbels minute; gill rakers 10–13; pectoral-fin rays 8–9; pelvic 5–6, anal 46–60; vertebrae 9–10+33–35=43–46. Frequencies of meristic characters are presented in Table 10.

This species is perhaps most closely related to *K. bicirrhis*, with which I initially identified it. Although both inhabit the mainstream of the Kapuas River and its larger tributaries, and were collected mainly by night-lighting, they were not collected together on any occasion. They differ greatly in nearly all meristic characters (Table 10).

So far as I have been able to determine this species has not been previously reported under any other name. The only specimens known to me are those obtained by the Kapuas survey of 1976.

ETYMOLOGY.—The name *minor* (Latin) refers to the small size of adults of this species.

Kryptopterus schilbeides (Bleeker, 1858)

Hemisilurus schilbeides Bleeker, 1858*c*:297 (type locality Palembang, Sumatra and Bandjermassin, Borneo)
Cryptopterus schilbeides Günther 1864:41
Kryptopterus schilbeides Haig 1952:110

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-14, 2: 82.0–82.6 mm (BMNH 1982.3.29.173, MZB 3658); Kapuas 1976-33, 8: 61.4–88.6 mm (CAS 49401, MZB 3659, RMNH 28898, UMMZ 209891, USNM 230295).

DISTRIBUTION.—Sumatra (Palembang, Djambi). Borneo (Sarawak, Kapuas, Bandjermasin).

Kryptopterus sp. undet.

Cryptopterus micronema Vaillant 1902:48 (Pontianak)
Cryptopterus apogon Weber and de Beaufort 1913:221 (part)

MATERIAL EXAMINED.—Western Borneo: Pontianak, 67.9 mm (RMNH 7817 identified as *C. micronema* by Vaillant 1902).

I have not been able to identify this distinctively colored specimen. It is certainly not *K. micronema* as originally determined by Vaillant (1902), nor is it *K. apogon* as suggested by Weber and de Beaufort; it differs from both of these species in having a dorsal fin (overlooked by Vaillant) as well as fewer gill rakers and anal-fin rays. Mouth broad, lower jaw prominent; teeth large, sharp; maxillary barbel extending posteriorly to middle of eye (left side) or to its posterior border (right side); mental barbels absent?; dorsal fin present (rays broken off near base); pectoral-fin branched rays 13–14; pelvic-fin rays 8?; anal-fin rays 77? (73 reported by Vaillant); gill rakers 2+14=16; branchiostegal rays 14 or 15?; entire head, body, and anal fin strongly marbled.

Ompok Lacepède, 1803

Ompok Lacepède, 1803:49 (type species *Ompok siluroides* Lacepède, 1803=*Silurus bimaculatus* Bloch, 1797, by monotypy)
Callichrous Hamilton-Buchanan, 1822:149 (type species *Silurus (Callichrous) pabda* Hamilton-Buchanan, 1822, by subsequent designation of Bleeker, 1862:17).
Silurodes Bleeker, 1858*c*:271 (type species *Silurus hypophthalmus* Bleeker, 1846, by subsequent designation of Bleeker, 1862:177)
Pseudosilurus Bleeker, 1858*c*:275 (type species *Silurus bimaculatus* Bloch, 1797, by present designation; n.b.: designation of *Pseudosilurus* as an absolute synonym of *Callichrous* Hamilton-Buchanan, 1822 by Bleeker, 1862:17 is invalid because *Silurus (Callichrous) pabda* is not among the species included in the original account of *Pseudosilurus*)

Four species of *Ompok* occur in western Borneo. Meristic data on Bornean *Ompok* are given in Table 11.

Ompok eugeneiatus (Vaillant, 1893)

Callichrous eugeneiatus Vaillant, 1893*a*:61 (type locality Kapuas)
Silurodes eugeniatus Weber and de Beaufort, 1912:13
Ompok eugeneiatus Haig, 1952:105

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-32, 9: 76.5–94.8 mm (BMNH 1982.3.29.174, CAS 49402, MNHN 1982-710, MZB 3661, UMMZ 209881); Kapuas 1976-44, 3: 122–129 mm (MZB 3662, USNM 230296).

Ompok hypophthalmus (Bleeker, 1846)

Silurus hypophthalmus Bleeker, 1846*a*:149 (type locality Batavia)
Silurus macronema Bleeker, 1851*h*:203 (type locality Bandjermassing, in fluviis).
Silurodes hypophthalmus Bleeker, 1858*c*:272
Silurodes macronema Bleeker, 1858*c*:273
Callichrous hypophthalmus Günther, 1864:48
Callichrous macronema Günther, 1864:49
Ompok hypophthalmus Haig, 1952:105

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-20, 3: 144–177 mm (CAS 49403, MZB 3663); Kapuas 1976-32, 2: 113–125 mm (MZB 3664, RMNH 28899); Kapuas 1976-33, 190 mm (MZB 3665); Kapuas 1976-42, 140 mm (MZB 3666); Kapuas 1976-44, 2: 117–196 mm (MZB 3667, USNM 230297).

TABLE 11. MERISTIC CHARACTERS OF BORNEAN *OMPOK*. For definition of vertebral counts see p. 22.

	Branchiostegal rays	Gill rakers	Pectoral-fin rays	Pelvic-fin rays	Anal-fin rays	Vertebrae
O. eugeneiatus						
Kapuas	9–10	17–19	12–13	7(2), 8(1)	61–62	11+39–40=50(1), 51(2)
O. hypophthalmus						
Kapuas	12–13	14–15	13–14	8(1)	80–84	11+44=55(2)
O. leiacanthus						
Baram		10	13		55	9+35=44
O. sabanus						
Kinabatangan		16–20			57–64	11+37–39=48(1), 49(4), 50(1)
Kapuas	9–12	12–14	11–12	6(4), 7(1)	53–58	11+35–37=46(2), 47(5), 48(1)
O. weberi						
Kapuas, Kumai					41–47	

Ompok sabanus Inger and Chin, 1959

(Figure 116)

Ompok sabanus Inger and Chin, 1959:282 (type locality Segama River, north Borneo).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-39, 23: 57.0–75.8 mm (BMNH 1982.3.29.175–176, CAS 49404, FMNH 94243, MZB 3668, RMNH 28900). North Borneo: Kinabatangan basin, 6: 68.9–108 mm (CAS 49745, FMNH 68024, paratypes).

DISTRIBUTION.—Kapuas, Kinabatangan (northeast Borneo).

Ompok weberi (Hardenberg, 1936)

Callichrous weberi Hardenberg, 1936:232 (type locality Padang Tikarbay, western Borneo); Hardenberg, 1937:9 (Kumai River, western Borneo).
Ompok weberi Haig, 1952:106.

MATERIAL EXAMINED.—None.

Ompok weberi is known only from Hardenberg's descriptions of the 79 mm holotype from Padang Tikarbay and a 50 mm (total length) non-type specimen from the Kumai. Both specimens are presumed lost.

As described by Hardenberg it differs from all other *Ompok* in having only 41–47 anal-fin rays (vs. 53 or more). Eye covered by skin, 4 in head; maxillary barbel extending posteriorly to beyond anal-fin origin; mental barbel very short, length less than that of head; branchiostegal rays 13; pectoral-fin rays 8–9; caudal-fin lobes rounded.

Silurichthys Bleeker, 1856

Silurichthys Bleeker, 1856:417, 418 (type species *Silurus phaiosoma* Bleeker, 1851, by monotypy).

This distinctive southeast Asian genus is poorly represented in museum collections, and it is doubtful how many species should be recognized or how they may be distinguished. There are three species in the Kapuas, including one new species. Meristic data on these three species are presented in Table 12.

Silurichthys hasselti Bleeker, 1858

(Figure 117)

Silurichthys Hasseltii Bleeker, 1858*c*:270 (type locality Java, Tjisekat, in fluviis).

MATERIAL EXAMINED.—Malay Peninsula: Kota Tinggi, Johore, 4: 44.7–99.0 mm (CAS-SU 31076, 32698, 39335); western Borneo: Kapuas 1976-6, 81.5 mm (MZB 3669); Kapuas 1976-26, 83.3 mm (MZB 3670).

Silurichthys phaiosoma (Bleeker, 1851)

(Figure 118)

Silurus phaiosoma Bleeker, 1851*c*:428 (type locality Sambas, in fluviis).
Silurichthys phaiosoma Bleeker, 1858*c*:268.

MATERIAL EXAMINED.—Malay Peninsula: Telok Anson, Perak (CAS-SU 31076); western Borneo: Kapuas 1976-8, 38.4 mm (MZB 3671); Kapuas 1976-42, 70.9 mm (MZB 3672).

Silurichthys sanguineus new species

(Figure 119)

HOLOTYPE.—MZB 3673, 40.9 mm, Sungai Tekam, a small forest stream, where it enters Kapuas mainstream about 5–6 km upstream from Sanggau.

DIAGNOSIS.—A *Silurichthys* lacking pelvic fins and with only 7+4=11 principal caudal-fin rays (all other *Silurichthys* examined with 12–13 principal caudal-fin rays); head relatively shorter and body more elongate than in any other *Silurichthys*; upper lip extending posteriorly to a point behind vertical along posterior margin of eye; dorsal-fin origin far in advance of a vertical through anal-fin origin; vertebrae 13+43=56; color in life entirely blood-red or vivid purplish-red.

The holotype and only known specimen of *S. sanguineus* may be further characterized as follows: dorsal-fin rays 4; pectoral-fin rays i8; anal-fin rays 60; head length 6.3; maxillary barbel extending posteriorly to well beyond anal-fin origin, mental barbel to well beyond pectoral-fin origin; greatest body depth (at abdomen) 7.4; body depth at middle of anal fin 9.9; depth of anal fin 19.5; upper caudal-fin lobe distinctly longer than lower lobe. Specimens of *S. hasseltii* and *S. phaiosoma* of comparable size observed in life were plain colored or mottled brownish without any coloration of the vivid red color observed in *S. sanguineus*.

ETYMOLOGY.—The name *sanguineus* (Latin) refers to the blood-red color of the holotype of this species observed in life.

Wallago Bleeker, 1851

Wallago Bleeker, 1851*c*:265 (type species *Silurus mulleri* Bleeker, 1846=*Silurus attu* Bloch and Schneider, 1801, by subsequent designation of Bleeker, 1862*a*: 394).
Wallagonia Myers, 1938:98 (type species *Wallago leerii* Bleeker, 1851, by original designation).

Wallago comprises large silurids, distinguished from all other genera in southeast Asia by having a relatively large dorsal fin

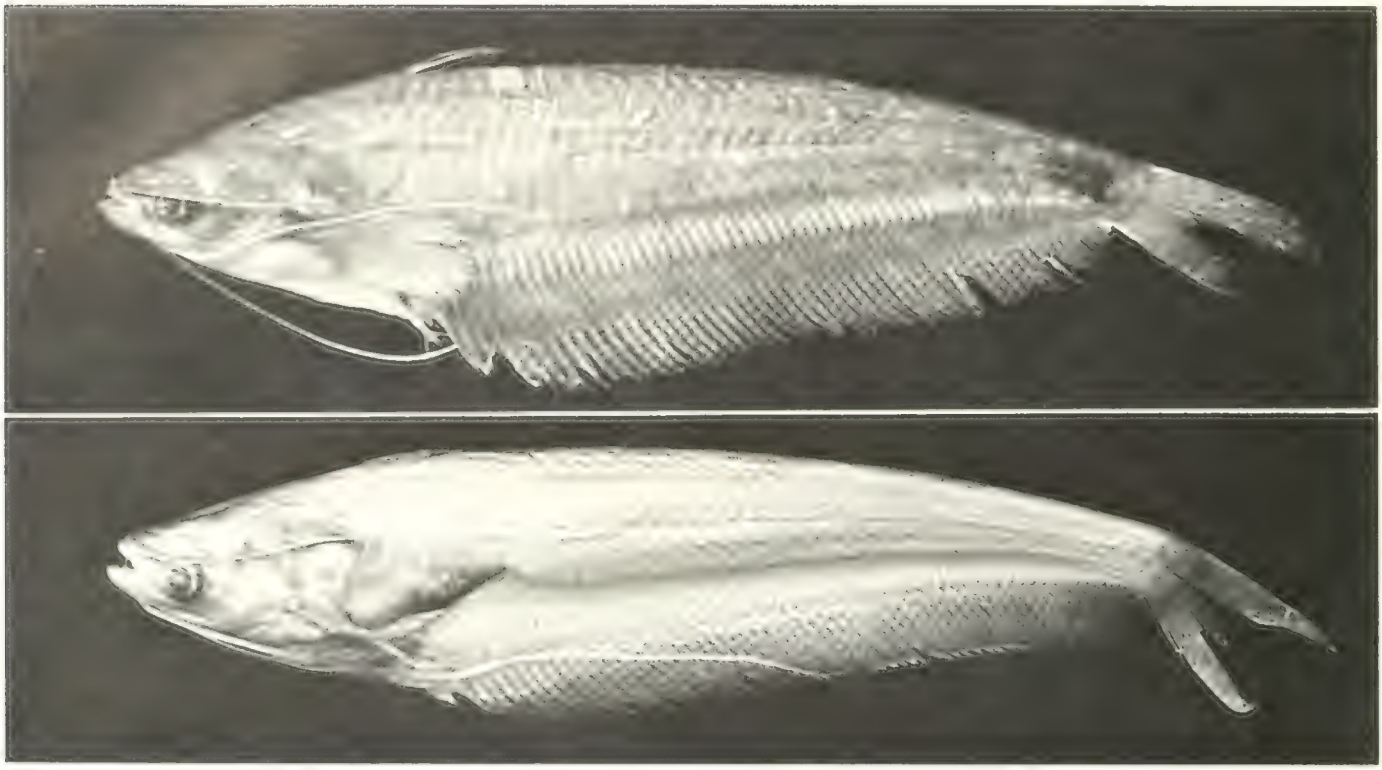

FIGURE 116.—*Ompok sabanus*. Above, Kapuas 1976-39, 73.0 mm (FMNH 94243); below, northeastern Borneo, Kinabatangan, 76.3 mm (FMNH 68024, paratype).

with 5 rays (dorsal fin smaller, usually with 4 or fewer rays, or absent altogether, in other southeast Asian silurids). Eye with free orbital rim, lying entirely above level of corner of mouth, not visible from beneath head (eye subcutaneous in all other southeast Asian silurids, lying at or below corner of mouth in *Ompok*, visible from below head in *Kryptopterus* and most other silurids); gape oblique, wide, and very long, reaching to or beyond anterior margin of eye (shorter in *Ompok* and most other silurids); branchiostegal rays 13–21; pectoral-fin rays 12–15, pelvic 8–11, anal 60–96; caudal fin deeply forked, with slightly pointed lobes, free from anal fin; principal caudal-fin rays 8/9.

Three species of *Wallago* are recognized (Roberts 1982*c*), of which only one is found in western Borneo.

Wallago leerii Bleeker, 1851

Wallago Leerii Bleeker 1851*c*:427 (type locality Sambas et Palembang, in fluviis)
Wallago nebulosus Vaillant 1902:46 (type locality Tepoe, bords du Mahakam)
See Roberts (1982*c*)
?*Wallagonia tweediei* Hora and Misra *in* Hora and Gupta, 1941:18 (type locality Kuala Tahan, Pahang). See Roberts (1982*c*)

MATERIAL EXAMINED.—Malay Peninsula: Singapore, 305 mm (CAS-SU 14839). Sumatra: Diambi, 21: 102–315 mm (ZMA 114.407). Borneo: Pleyharie River, 218 mm (RMNH 15937); Kapuas 1976-16, 2: 179–202 mm (CAS 49405, MZB 3674); Kapuas 1976-46, 175 mm (MZB 3675); Kapuas River, 321 mm (ZMA 114.400). Mahakam River, 152 mm (RMNH 7812, holotype of *W. nebulosus*).

DIAGNOSIS.—*Wallago leerii* is distinguished from all other *Wallago* by its jet black pectoral-fin membranes. Branchiostegal rays 15–18; gill rakers 12–16; anal-fin rays 64–75.

Local fishermen interviewed in 1976 indicated that *Wallago leerii* (always known to them as ikan tapah, and not confused with any other species) attains 80 kg and is the largest fish in the Kapuas. They also stated that it used to form large migratory schools in the Kapuas mainstream but that such schools had become less noticeable, which they attributed to intensive gill netting.

Belonidae

The predominantly marine and estuarine needlefishes or Belonidae include a single freshwater genus in Asia.

Xenentodon Regan, 1911

Xenentodon Regan, 1911:332 (type species *Belone cancila* Hamilton-Buchanan, 1822, by subsequent designation of Jordan, 1920:540)

Body cylindrical; jaws with large canine teeth alternating with much more numerous small conical teeth; infrapharyngobranchial bones absent or toothless except for third pair (infrapharyngobranchials two through four present and tooth-bearing in all or almost all other Belonidae except the diminutive South American *Belonion*; Collette 1966); gill rakers absent; scales very small to extremely small; lateral line placed very low on body, not forming keel on caudal peduncle; dorsal and anal fins about equal and nearly opposite each other, with 14–19 rays; caudal fin truncate or rounded; vertebrae 33–40+21–23=55–62.

The genus is widely distributed in fresh water (and brackish water?) in India, Burma, Thailand, the Malay Peninsula, Sumatra, and western Borneo but apparently is absent from northern and eastern Borneo and Java. Only two species currently are recognized but my observations indicate there are at least three.

TABLE 12. MERISTIC CHARACTERS IN *SILURICHTHYS*. For definition of vertebral counts see p. 22.

	Anal-fin rays	Principal caudal-fin rays	Vertebrae
S. hasselti			
Kota Tinggi	50–56	7+5(3), 6+6(1)	10–11+35–37=46(1), 47(2), 48(1)
Gunong Pulai	48	7+6?	11+36=47
Singapore	52		11+35=46
Kapuas	55–56	7+6(1)	10?+36–39=46?(1), 49?(1)
S. phaiosoma			
Telok Anson	55		11+38=49
Kapuas	49, 56	7+6(1)	11+38–40=49(1), 51(1)
S. sanguineus			
Kapuas	60	7+4	13+43=56

Key to *Xenentodon*

1a Dorsal-fin rays 16–18, anal-fin rays 17–19; predorsal scales more than 200, transverse scales (between dorsal- and anal-fin origins) 30–40; vertebrae 57–62 (small-scaled species) 2

1b Dorsal- and anal-fin rays 14–17; predorsal scales about 140–160, transverse scales 20–30; vertebrae 55–58 (large-scaled species) ..... *Xenentodon* sp. or spp.

2a Jaws relatively large and heavy-set, length of upper jaw 2.6–3.2 times in body length measured from anterior margin of orbit to end of hypural plate; enlarged teeth in upper jaw 9–21 (Fig. 120); dorsal-fin origin usually anterior to a vertical through anal-fin origin; a heavy-bodied species reaching 40 cm in total length ..... *X. cancila*

2b Jaws relatively slender and delicate, length of upper jaw 2.3–2.6 times in body length; enlarged teeth in upper jaw 21–32 (Fig. 120); dorsal-fin origin usually over base of second or third anal-fin ray; a smaller, more slender species apparently not exceeding 30 cm in total length ..... *X. canciloides*

The large-scaled species of *Xenentodon*, of which there may be more than one, occurs in southern India, Sri Lanka, and the Malay Peninsula, probably in brackish as well as fresh water. It apparently does not exceed about 30 cm total length. The small-scaled *X. cancila* appears to be the only species of the genus in the Ganges-Brahmaputra. It may also be widely distributed in Burma and Thailand but this requires further study. Although a large-scaled species and *X. canciloides* both occur in the Malay Peninsula, only the latter is known from western Borneo.

Xenentodon canciloides (Bleeker, 1853)

Belone canciloides Bleeker, 1853c:454 (type locality Pontianak, in flumine Kapuas; Pangaboeang, provinciae Lampong, Sumatrae austro-orientalis, in fluviis)
Mastacembelus canciloides Bleeker, 1866:223
Belone cancila von Martens, 1876:400 (Kapuas); Vaillant, 1902:31 (Kapuas)
Xenentodon canciloides Weber and de Beaufort, 1922:133

MATERIAL EXAMINED.—Malay Peninsula: Johore, Kota Tinggi, 2: 98.5–123 mm (CAS-SU 32881, 33862). Western Borneo: Kapuas 1976-8, 3: 108–245 mm (CAS 49433, MZB 3735); Kapuas 1976-9, 148 mm (MZB 3736); Kapuas 1976-22, 4: 62.4–128 mm (FMNH 94246, MZB 3737); Kapuas 1976-32, 6: 147–201 mm (MZB 3738, RMNH 28911, USNM 230315); Kapuas 1976-33, 161 mm (MZB 3739); Kapuas 1976-37, 174 mm (MZB 3740); Kapuas 1976-39, 2: 170–194 mm (BMNH 1982.3.29.203, MZB 3741); Kapuas 1976-42, 153 mm (MZB 3742); Kapuas 1976-44, 151 mm (MZB 3743); Kapuas 1976-46, 160 mm (MZB 3744); Kapuas 1976-47, 2: 69.2–103 mm (CAS 49434, MZB 3745); Kapuas 1976-51, 2 168–180 mm (MNHN 1982-715, MZB 3746)

DISTRIBUTION.—Malay Peninsula (Johore). Sumatra. Western Borneo (Kapuas).

Hemiramphidae

The circumtropical Hemiramphidae or halfbeaks comprise about 12 genera and 80 species (Nelson 1984). Three genera in

FIGURE 117. *Silurichthys hasselti*. Kapuas 1976-26, 83.3 mm (MZB 3670).

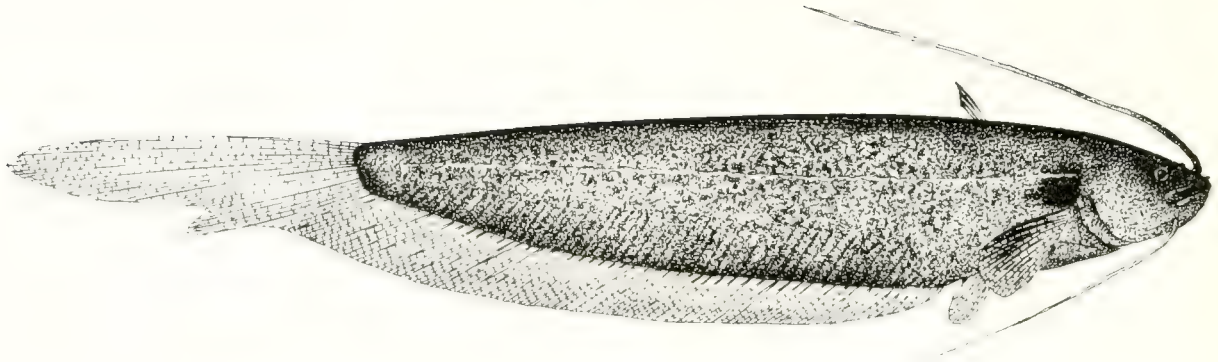

FIGURE 118. *Silurichthys phaiosoma.* Sumatra (after Weber and de Beaufort 1913, fig. 77).

southeast Asia (including Celebes) are viviparous and occur largely or exclusively in fresh water, two in western Borneo.

Dermogenys van Hasselt, 1823

Dermogenys van Hasselt *in* Kuhl and van Hasselt, 1823:131 (type species *Dermogenys pusillus* van Hasselt *in* Kuhl and van Hasselt, 1823, by monotypy).

Dermogenys, characteristic of brackish as well as freshwater habitats, is the most widely distributed of the viviparous southeast Asian halfbeaks, ranging from Burma and Thailand along the coasts of the Malay Peninsula and Greater Sunda islands to Celebes. Although *Dermogenys* occurs far inland in some places, and its distribution surrounds that of *Hemirhamphodon,* the two genera apparently never occur sympatrically. The single collection of *Dermogenys* taken by the Kapuas survey of 1976 was obtained in a tidal creek near the Kapuas mouth far from any collections of *Hemirhamphodon. Dermogenys* is unknown from the Kapuas interior. I suspect that wherever it occurs the exclusively freshwater *Hemirhamphodon* has excluded or displaced *Dermogenys.*

Dermogenys cf. **pusillus** van Hasselt *in* Kuhl and van Hasselt, 1823

Dermogenys pusillus van Hasselt *in* Kuhl and van Hasselt, 1823:131 (type locality Java)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-3, 6: 23.7–35.9 mm (CAS 49428, MZB 3717, ZMA 116.544)

Mohr (1936) revised *Dermogenys,* giving an extensive synonymy of *D. pusillus* and recording specimens of the species from numerous localities virtually coextensive with the entire range of the genus. Until *Dermogenys* can be revised again these records should be regarded with caution.

Hemirhamphodon Bleeker, 1866

Hemirhamphodon Bleeker, 1866*a*:140 (type species *Hemirhamphus phaiosoma* Bleeker, 1852, by original designation)

DIAGNOSIS.—Myrmecophagous halfbeaks with each side of beak (extended lower jaw) with two or three rows of anterolaterally directed conical teeth (beak toothless in all other hemiramphids). Beak terminating in an elongate, flexible, fleshy appendage. Scales in lateral line series about 90–100. Dorsal fin with 14–24 rays, its origin far anterior to that of anal fin. Ovoviviparous. Males with an elongate genital papilla and distinctively modified anal fin with posteriormost four rays separated from anterior rays and morphologically specialized.

Male *Hemirhamphodon* may have 1–3 minute spines projecting laterally from the posterior margin of the scales over most of their body surface. These are relatively smaller but otherwise probably comparable to the scale spines or ctenii on males of the South American freshwater belonid *Pseudotylosurus angusticeps* (see Wiley and Collette 1970:189, fig. 10f) and numerous cyprinodonts. Such "breeding contact organs" have not been reported previously in hemiramphids.

Key to *Hemirhamphodon* of western Borneo

1a Dorsal-fin origin considerably posterior to vertical line through anal-fin origin; dorsal-fin rays 14–15 *H. pogonognathus*

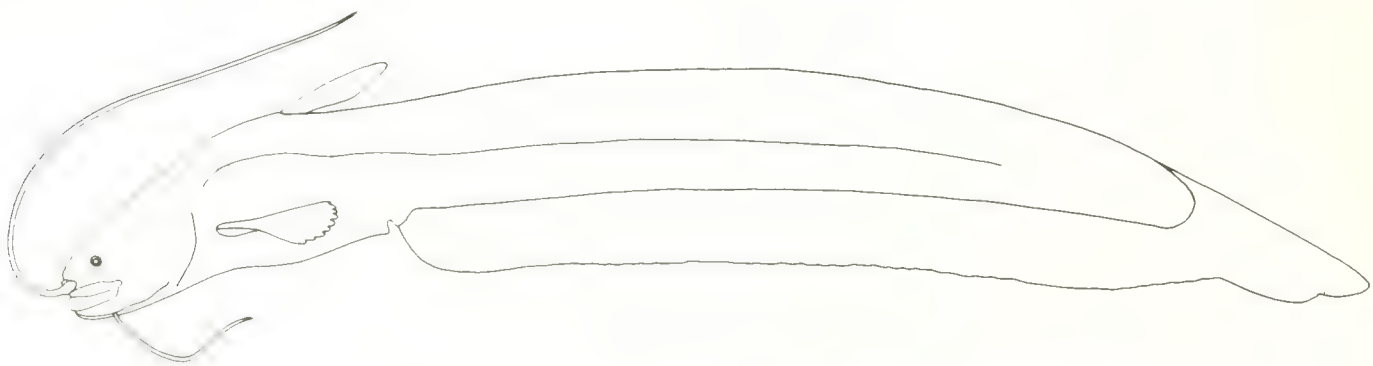

FIGURE 119 *Silurichthys sanguineus.* Kapuas 1976-16, 40.9 mm (MB 3673, holotype).

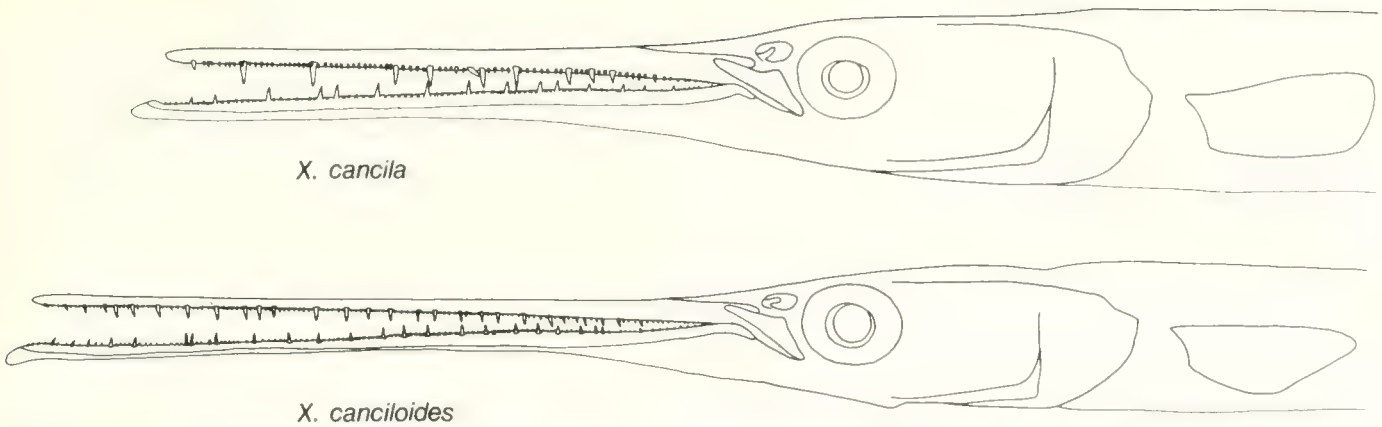

FIGURE 120. *Xenentodon*. Above, *X. cancila*, Nepal, Chitawan Valley, 111 mm (CAS 50358); below, *X. canciloides*, Kapuas 1976-22, 112 mm (FMNH 94246).

1b Dorsal-fin origin considerably anterior to vertical line through anal-fin origin; dorsal-fin rays 22–24 ..... *H. phaiosoma*

1c Dorsal-fin origin almost directly above or slightly posterior to a vertical line drawn through anal-fin origin; dorsal-fin rays 17–18 ..... *H.* sp. undet.

Hemirhamphodon phaiosoma (Bleeker, 1852)

Hemirhamphus phaiosoma Bleeker, 1852*a*:26 (type locality Billiton).
Hemirhamphodon phaiosoma Bleeker, 1866*a*:168.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-6, 13: 26.5–50.4 mm (CAS 49429, MZB 3718); Kapuas 1976-12, 8: 37.1–49.2 mm (MZB 3719, USNM 230313); Kapuas 1976-25, 6: 32.0–47.5 mm (MZB 3720, RMNH 28909); Kapuas 1976-26, 5: 26.9–48.6 mm (BMNH 1982.3.29.194–197, MZB 3721); Kapuas 1976-30, 2: 41.0–47.9 mm (MZB 3722, UMMZ 209878).

COLORATION.—Life colors of *H. phaiosoma* were recorded in the field at Kapuas 1976-12: overall body color violaceous or mauve; larger specimens usually with two (sometimes three) parallel longitudinal red streaks; smallest specimens with a single red streak; ventrolateral half of body without oval marks or blotches; dorsal, anal, and caudal fins, and gular membrane yellow with thin red margins; abdomen pale, but in some specimens with two widely spaced parallel longitudinal red streaks extending from just behind head to anal fin origin. The only other color observation for this species known to me, of specimens from Billiton Island (de Beaufort 1939:192) agrees with mine except that he noted sexual dichromatism: "Two males, 76 and 80 mm, and two females 68 and 69 mm [presumably total length]. Color of preserved specimens yellowish. The males with two narrow crimson lines, running parallel to each other along sides of body and two, the females with a faint pinkish lateral band, bordered above and below with dusky."

HABITAT.—In the Kapuas *H. phaiosoma* was found in smaller, relatively high-gradient, deeply shaded forest streams with numerous rocks and stones on the bottom.

DISTRIBUTION (Fig. 121).—Borneo (Palandok, Sadong Matang, Kapuas). Banka. Billiton. The species has been reported from Singapore but I agree with Alfred (1966) that this record is suspect. There are no other records from the Malay Peninsula.

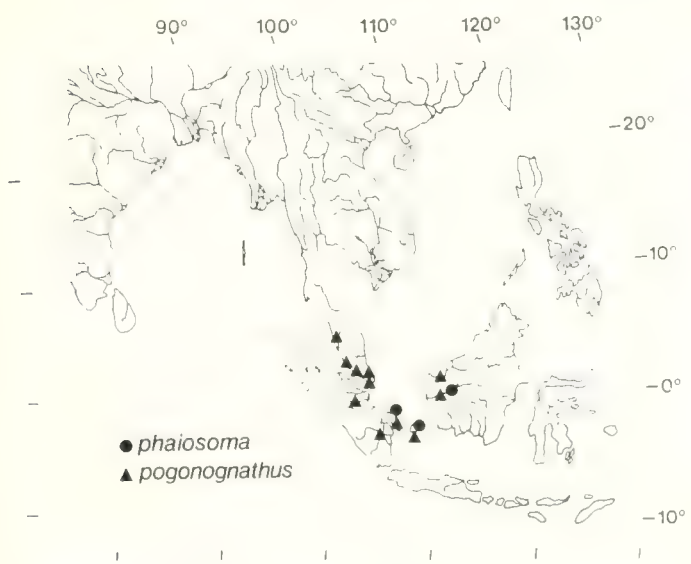

FIGURE 121. *Hemiramphodon*. Geographical distribution of two species.

Hemirhamphodon pogonognathus (Bleeker, 1853)
(Figure 122)

Hemirhamphus pogonognathus Bleeker, 1853*a*:193 (type locality Banka Is., Marawang, in fluviis)
Hemirhamphodon pogonognathus Bleeker, 1866*a*:169.
?*Hemirhamphodon kukenthali* Steindachner, 1901:450 (type locality Baram River, Sarawak). See Mohr (1936:60–61)

MATERIAL EXAMINED.—Malay Peninsula: Perak, Tapah Fisheries Station, 47.5 mm (CAS-SU 40484); Johore, Kulai, 11: 24.4–50.9 mm (CAS-SU 39417); Johore, Gunong Pulai, 64: 22.2–52.5 mm (CAS-SU 30757); Johore, Mawai district 50–60 mi N of Singapore, 6: 30.2–44.1 mm (CAS-SU 30755); Johore, Kota Tinggi, 11: 23.7–49.5 mm (CAS-SU 33619); Singapore, Mandai Road, 97: 29.0–56.4 mm (CAS-SU 33947, 33618); Singapore, 34: 26.5–49.7 mm (CAS 19994, CAS-SU 30756. Sarawak: 15–20 mi E of Kuching, 24: 27.6–63.3 mm (CAS-SU 33564). Western Borneo: Kapuas 1976-5, 9: 25.9–55.0 mm (CAS 49430, MZB 3723); Kapuas 1976-6, 37.5 mm (MZB 3724); Kapuas 1976-8, 6: 26.6–49.7 mm (BMNH 1982.3.29.198–202, MZB 3725); Kapuas 1976-10, 47.1 mm (MZB 3726); Kapuas 1976-11, 2: 25.5–25.6 mm (CAS 49513, MZB 3727); Kapuas 1976-16, 35.5 mm (MZB 3728); Kapuas 1976-17, 7: 28.0–50.6 mm (MZB 3729, RMNH 28910). Kapuas 1976-367, 3: 31.6–43.2 mm (MZB 3730, UMMZ 209896); Kapuas 1976-39, 9: 17.9–44.3 mm (MZB 3731, USNM 230314); Kapuas 1976-46, 3: 24.0–25.0 (CAS 49431, MZB 3732); Kapuas 1976-51, 3: 29.7–36.5 mm (MZB 3733 ZMA 116.545)

COLORATION.—Life colors of *H. pogonognathus* were recorded in the field at Kapuas 1976-8. Overall body color pale bluish or violaceous. No midlateral longitudinal red streak. Ventro-

FIGURE 122 *Hemirhamphodon pogonognathus*. Above, Kapuas 1976-5, 55.0 mm male (CAS 49430); below, Singapore, Mandai Road, 54.0 mm male with upper jaw transfixed by mandibles of 7.5 mm ant (CAS-SU 33947)

lateral half of body with a row of four evenly spaced, bluish or bluish-green, vertically elongate oval spots or blotches from just behind pectoral fin to just in front of anal-fin origin (spot in front of anal fin sometimes faint). Abdomen white; no abdominal red streaks. Fins colorless or dusky except for white or pale blue margin of anal fin. Gular membrane red. Color photographs of the species have been published by Brembach (1978*a*), Wickman (1981), and Hyrtl (1983). The colorations illustrated agree generally with my observations but there are some differences worth noting. Wickman's fish was collected near Kuching; its coloration is basically similar to that described above except the overall body coloration is brownish or reddish-brown and the vertically oval spots dusky or dark; a thin midlateral longitudinal reddish-brown streak present, scarcely distinguishable from overall brownish or reddish-brown body color. Caudal fin with a thin marginal coloration of pale blue and reddish flecks, otherwise plain. Opercle with two short, horizontal iridescent blue marks; gular membrane pale bluish with variably red margins. Brembach's specimens and Hyrtl's specimen are without locality data. Brembach's have overall body color iridescent greenish dorsolaterally and violaceous or pearly ventrolaterally; a thin, faintly visible midlateral longitudinal red streak; four bluish oval blotches; dorsal, anal, and caudal fins with thin pale bluish border, that of dorsal fin also flecked with red; gular membrane rosy, ventral border with a thin black margin. Hyrtl's specimen, a male, is strikingly beautiful: overall body color deep blue, somewhat violaceous ventrolaterally; midlateral red streak relatively well defined; four oval blotches rather indistinct, almost same deep blue hue as overall body color; dorsal fin with thin red marginal band; pelvic, anal, and caudal fins with pale bluish margins; fins otherwise colorless; gular membrane entirely bright scarlet.

REPRODUCTION.—It has long been known that *Hemirhamphodon* is viviparous (or ovoviviparous), producing relatively large young, but there has been little documentation of the phenomenon. Soong (1968), in an extremely brief communication, reported that in *H. pogonognathus*: 1) males grow larger than females; 2) young are born in smaller batches than in *Dermogenys pusillus*, at an average (total?) length of 11 mm; 3) duration of gestation is about 6–8 weeks; 4) individual wild populations breed synchronously but different populations breed at different times; and 5) there is no true (reproductive) seasonality. Brembach (1978*a*) reported or indicated that: 6) pregnant females carry a number of young in different stages of development; 7) young are born in rapid succession, sometimes daily; 8) the number of young produced is usually only 1 or 2 and sometimes 4 daily; 9) isolated females will generate young daily for a considerable period of time. My own observations on superfetating *H. pogonognathus* do not bear on items 3–4 but confirm or support 1–2 and 5–9. Data on males and females in

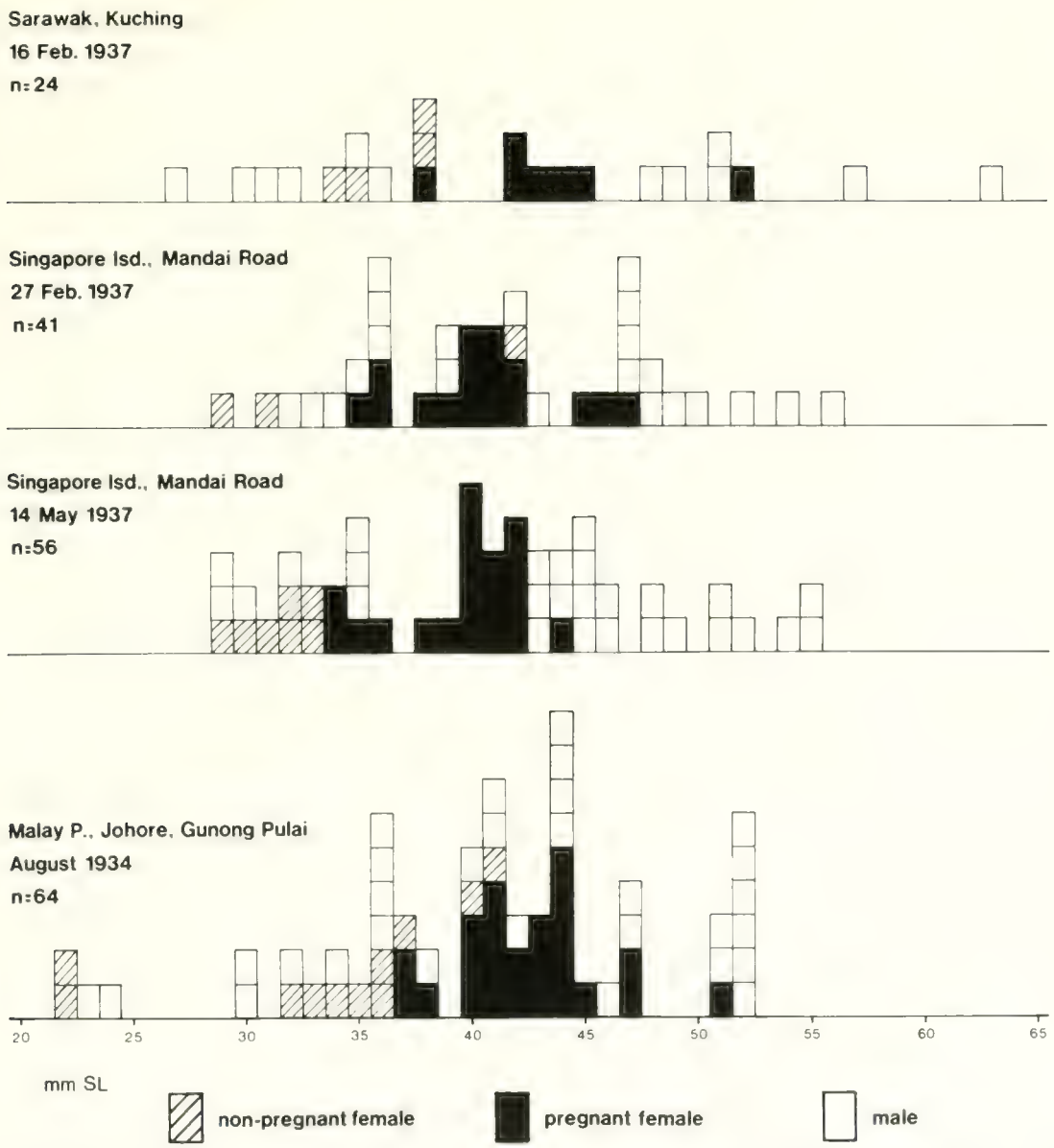

FIGURE 123. *Hemirhamphodon pogonognathus*. Length-frequency distribution of males, non-pregnant females, and pregnant females from four population samples.

four population samples of *H. pogonognathus* are presented in Figure 123. These population samples were collected in February, May, and August. Smaller samples examined were collected in January, March, July, and October. Due to the early appearance of an elongate genital papilla in males and a swollen genital region in females it is possible to determine the sex of nearly all wild-caught specimens in my samples, including the smallest which are only 22 mm. In the four largest samples the male:female ratios are 12:12, 22:19, 27:29, and 30:34 or virtually 1:1. Males grow substantially larger than females. In three of four large samples the largest males are 9–12 mm longer than the largest females; 29 of the 31 largest specimens in the four samples are males. The largest male is 63 mm and the largest female only 52 mm. Females become sexually mature by 34 mm; in all samples examined, most females above 34 mm are pregnant (60 out of 70 in four large samples) and almost all females above 38 mm are pregnant (49 of 52). From this observation it follows that reproduction occurs throughout the year; i.e., that it is basically not seasonal.

The developing young or fetuses are generally of about the same number and stage of development in the left and right ovaries. The following observations are based on the right ovary. The number of young in a single ovary varies from one to 12, but is usually 4–9. In addition there may be one to 10 or more unfertilized eggs or eggs to 2 mm in diameter in an early stage of development. The developing young are aligned in single file, each tightly wrapped around its yolk sac. Size at hatching is about 7.3–8.3 mm (the largest fetal young observed; in the smallest pregnant females the largest young are about 1 mm smaller than in the largest females). Successive young generally differ greatly in size. Standard length in mm of successive fetuses from the right ovary of several pregnant females is as follows: 37.4

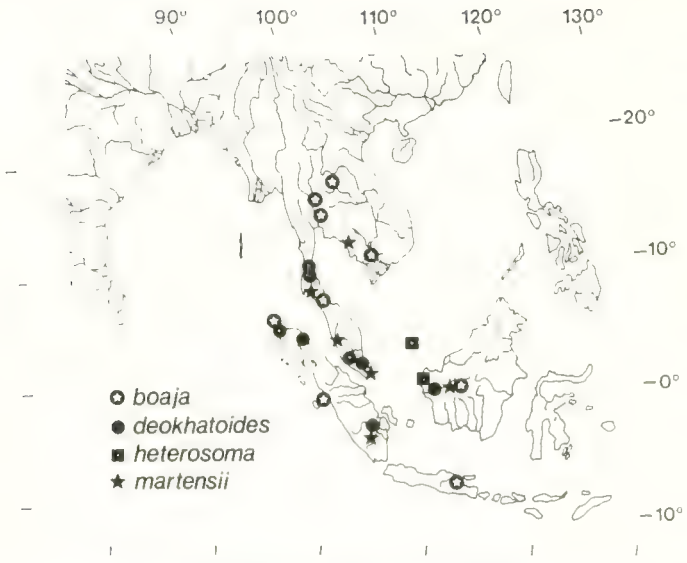

FIGURE 124. *Doryichthys*. Geographical distribution

mm female, 12 fetuses (CAS-SU 30757): 7.3, 7.3, 6.2, 5.1, 4.8, 4.8, 4.5, 3.6, 3.6, 2.8, 2.4 (plus 4 eggs 1.2–1.6 mm in early development?); 37.2 mm female, 5 fetuses (CAS-SU 33618): 6.7, 6.1, 4.2, 3.5, 1.1 + 2 eggs 1.1 mm in diameter (immature?); 41.3 mm female, 6 fetuses (CAS-SU 33618): 7.1, 6.2, 5.8, 4.6, 2.7, 1.5 mm + 7 eggs 1.2–1.6 mm in a double row; 44.5 mm female, 7 fetuses (CAS-SU 33618): 7.7, 6.8, 5.2, 4.8, 3.0, 2.5 mm + 1 egg 1.7 mm, with late cell divisions (no other eggs); 51.5 mm female, 11 fetuses (CAS-SU 30757): egg 2.1 mm (misshapen, with small white core; evidently in process of resorption), fetuses 8.3, 7.2 mm, egg 2.0 mm (very misshapen, large white core), fetuses 5.2, 5.4, 4.5, 4.5, 4.1, 3.4, 3.6, 2.8, 2.8 mm + double row of 9 eggs (6 with morula- or gastrula-like development). From these and other observations I conclude that *H. pogonognathus* exhibits an extreme form of superfetation, with each successive brood in a single ovary consisting of no more than three young and usually of only a single young. The difference in age of the young probably is due to individual fertilization of eggs by sperm stored in the female. An alternative hypothesis, that differences in fetal development are controlled by a maternal or fetal hormonal gradient in the ovary, is contraindicated by the observation of successive fetuses of identical length in pregnant females from Gunong Pulai.

In summary, data presented here on *H. pogonognathus* indicate that females become sexually active at about 34 mm, and that from then on they produce very small numbers of relatively large young (7–8 mm) at more or less regular intervals throughout the year. A pregnant female may carry up to 8 discrete broods at once. If the gestation period of 6–8 weeks given by Soong is correct, females presumably give birth at intervals as short as 2–8 days.

FOOD HABITS.—Gut contents were examined in over 30 specimens representing nearly all available collections of *H. pogonognathus*. Virtually every specimen contained at least one discrete food item. Almost all food items were terrestrial insects, sometimes too digested to be identified even to order. Nevertheless, it is clear that *H. pogonognathus* feeds almost exclusively on terrestrial insects and predominantly ants. In more than half of the specimens examined ants were the only identifiable gut contents. Several specimens have 5–6 or more ants in their guts and no other items. One specimen, a 54.0 mm male (Fig. 122) has its upper jaw transfixed by the mandibles of a 7.5 mm ant it had tried to swallow. Other insects encountered (in small numbers, usually singly) include Diptera, Coleoptera, and Orthoptera (mole-cricket). Food habits of the other species of *Hemirhamphodon* apparently are comparable to those of *H. pogonognathus*. It seems likely that the rows of antrorse conical teeth unique to the beak of *Hemirhamphodon* enable it to snag the legs of live ants which are its predominant food source.

HABITAT.—In the Kapuas basin *H. pogonognathus* was found in small low-gradient streams with abundant logs and leaf litter but no rocks or stones on the bottom.

DISTRIBUTION (Fig. 121).—Malay Peninsula (Perak, Johore, Singapore). Sumatra (Palembang, Taluk, Gunong Sahilan, Simbolong mountains). Borneo (Baram?, Kapuas). Banka. Billiton.

Hemirhamphodon sp. undet.

?*Hemirhamphodon chrysopunctatus* Brembach, 1978*b* (type locality southeast Borneo)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-13, 5: 40.1–46.8 mm (CAS 49432, MZB 3734).

A single small lot of *Hemirhamphodon* obtained in 1976 is not identifiable with either *H. phaiosoma* or *H. pogonognathus* (see Key above). It may be *H. chrysopunctatus* or an undescribed species. Color in life not recorded.

Syngnathidae

Syngnathidae (pipefishes and seahorses) are predominantly marine and brackish water inhabitants but endemic freshwater species occur in tropical west Africa, southeast Asia, and perhaps elsewhere. The southeast Asian freshwater genus *Doryichthys* comprises four species, all present in western Borneo. Their geographical distribution is shown in Figure 124.

Doryichthys Kaup, 1856

Doryichthys Kaup, 1853:233 (nomen nudum)

Doryichthys Kaup, 1856:56 (type species *Doryichthys bilineatus* Kaup, 1856=*Syngnathus deokhatoides* Bleeker, 1853; by subsequent designation of Jordan and Evermann, 1896:773)

Kaupia Smith, 1963:533 (type species *Syngnathus boaja* Bleeker, 1851, by original designation)

DIAGNOSIS.—Opercle with a single longitudinal ridge; superior trunk ridge and inferior tail ridges not confluent; caudal-fin rays typically 9. Apparently confined to fresh water.

Doryichthys obtained during the Kapuas survey of 1976 have been identified by C. E. Dawson, and some of the specimens utilized in his revision of the genus (Dawson 1981). The present account is based on this revision, to which the reader may refer for fuller information.

Key to *Doryichthys* (after Dawson 1981)

1a Trunk rings 15–20; total rings 45–53; dorsal-fin rays 27–39; principal ridges of each ring without a prominent spine 2

1b Trunk rings 22–26; total rings 56–64; dorsal-fin rays 43–

69; principal ridges of each ring with a prominent spine in adults and subadults 3
2a Trunk rings 17–20; tail rings 28–34; pectoral-fin rays 19–23; usually with large dark spots above lateral trunk ridge ..... *D. deokhatoides*
2b Trunk rings 15–17; tail rings 31–37; pectoral-fin rays 16–22 (usually 19 or less); usually with small dark spots on lateral trunk ridges ..... *D. martensii*
3a Trunk rings 22–24; dorsal-fin rays 43–65 ..... *D. boaja*
3b Trunk rings 25–26; dorsal-fin rays 65–69 ..... *D. heterosoma*

Doryichthys boaja (Bleeker, 1851)

Syngnathus boaja Bleeker, 1851*a*:16 (type locality Banjermassing, in fluviis).
Doryichthys spinosus Kaup, 1856:57, 75 (type locality Java, Borneo).
Syngnathus Jullieni Sauvage: 1874:338 (type locality Cochin China).
Syngnathus zonatus Karoli, 1882:185 (type locality Borneo).
Doryichthys heterosoma Vaillant, 1902 (misidentification of specimen from Sintang). See Dawson (1981:16).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-16, 191 mm (MZB 3002); Kapuas 1976-40, 338 mm (MZB 3003). These specimens are illustrated by Dawson (1981, fig. 6).

DISTRIBUTION (Fig. 124).—Vietnam. Thailand (Mekong, Chao Phrya, Paltani). Sumatra. Borneo (Kapuas). Java (Brantas).

Doryichthys deokhatoides (Bleeker, 1853)

Syngnathus deokhatoides Bleeker, 1853*g*:5, 11, 18 (type locality Palembang, Sumatra, and Pontianak, Borneo).
Doryichthys deokhatoides Bleeker, 1859*a*:188.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-3, 157 mm (MZB 3747); Kapuas 1976-16, 3: 112–136 mm (CAS 49435, MZB 3748, USNM 218069); Kapuas 1976-17, 2: 114–131 mm (MZB 3749, USNM 218070); Kapuas 1976-51, 106 mm (MZB 3750).

DISTRIBUTION (Fig. 124).—Peninsular Thailand. Malay Peninsula. Sumatra. Western Borneo (Kapuas).

Doryichthys heterosoma (Bleeker, 1851)

Syngnathus heterosoma Bleeker, 1851*i*:441 (type locality Sambas River, western Borneo).
Doryichthys heterosoma Günther, 1870:180.

MATERIAL EXAMINED.—None.

This species is known only from the Sambas River and the Natunas islands.

Doryichthys martensii (Peters, 1869)

Syngnathus martensii Peters, 1869:459 (type locality Pulo Matjan, Kapuas).
?*Microphis caudatus* Vaillant, 1893:62 (not of Peters, 1869; Kapuas).
Microphis ignoratus Vaillant, 1902:28, 40, fig. 1, 2 (type locality Mandai River, Kapuas).
Doryichthys (*Microphis*) *ignoratus* Popta, 1906:211.
Doryichthys Martensi Duncker, 1915:53.
Doryichthys brachyrhynchops Fowler, 1934*b*:145 (type locality Chantaboon, southeast Siam).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-7, 11: 36.5–104 mm (CAS 49436, GCRL 15759, MZB 3751, USNM 218071); Kapuas 1976-10, 2: 72.5–82.5 mm (MZB 3752, USNM 218072); Kapuas 1976-13, 54.0 mm (MZB 3753); Kapuas 1976-21, 7: 52.0–97.5 mm (CAS 49437, MZB 3754, USNM 218073); Kapuas 1976-22, 105 mm (MZB 3755); Kapuas 1976-24, 70.5 mm (MZB 3756); Kapuas 1976-25, 114 mm (MZB 3757); Kapuas 1976-28, 2: 44.0–99.0 mm (MZB 3758, USNM 218074); Kapuas 1976-29, 88.5 mm (MZB 3759).

DISTRIBUTION (Fig. 124).—Southeast Thailand. Malay Peninsula. Western Borneo (Kapuas).

Chandidae

Chandidae (also commonly referred to as Ambassidae) is one of the few families of percoid fishes which exhibit greater diversity in fresh water than in marine habitats. Seven of the eight genera currently recognized and about 21 of the approximately 41 species are confined to fresh water in Madagascar, south Asia, southeast Asia, and the Australian region (including New Guinea). A systematic review of the family is given by Fraser-Brunner (1955). The fresh waters of western Borneo are inhabited by three genera and five species; three of the species are known only from fresh water in Borneo or in Borneo and Sumatra; the fourth species is known also from the Malay Peninsula, and the fifth from Thailand. One of the species is a highly specialized new genus and species of scale-eaters discovered during the Kapuas survey of 1976. Another species is an oral brooder, the first member of the family Chandidae in which such parental care has been observed. Although generally known as glass-perches, of the species found in western Borneo, only *Gymnochanda filamentosa* is actually transparent.

Key to freshwater Chandidae of Borneo

1a Cheeks, gill cover, and body covered with scales; dorsal margin of pre-orbital bone entire or with small postero-ventrally projecting serrae; dorsal- and anal-fin branched rays 9–10, never filamentous; vertebrae 10+14–15=24–25; adults considerably larger than 33 mm 2
1b Head and body scaleless; dorsal margin of preorbital bone with 3–4 enormous dorsally projecting serrae, dorsal- and anal-fin branched rays 12–14, filamentous in males; vertebrae usually 8+17=25; largest specimen 33 mm (males and females sexually mature at much smaller size) ..... *Gymnochanda filamentosa*
2a Dorsal profile gently sloped or but moderately steep; body depth at least 2.3; second anal-fin spine only moderately enlarged; gill rakers 22 or less 3
2b Dorsal profile very steep; body depth about 2.0; second anal-fin spine enormously enlarged; gill rakers 29 ..... *Parambassis wolffii*
3a Dorsal profile gently concave at nape; cheek with fewer than 9 scale rows; dorsal preopercular margin serrate; lower jaw not strongly projecting 4
3b Dorsal profile strongly concave at nape; cheek with 9–10 scale rows; dorsal preopercular margin smooth; lower jaw strongly projecting ..... *Parambassis macrolepis*
4a Scales in lateral series 40–47; jaws about equal, or lower jaw slightly projecting; second anal-fin spine larger than third ..... *Parambassis apogonoides*
4b Scales in lateral series about 60; lower jaw much shorter than upper; second anal-fin spine about equal to or slightly shorter than third ..... *Paradoxodacna piratica*

Gymnochanda Fraser-Brunner, 1955

Gymnochanda Fraser-Brunner, 1955:210 (type species *Gymnochanda filamentosa* Fraser-Brunner, 1955, by original designation and monotypy)
Gymnochanda Boeseman, 1957:75, pl. 3 (type species *Gymnochanda filamentosa*

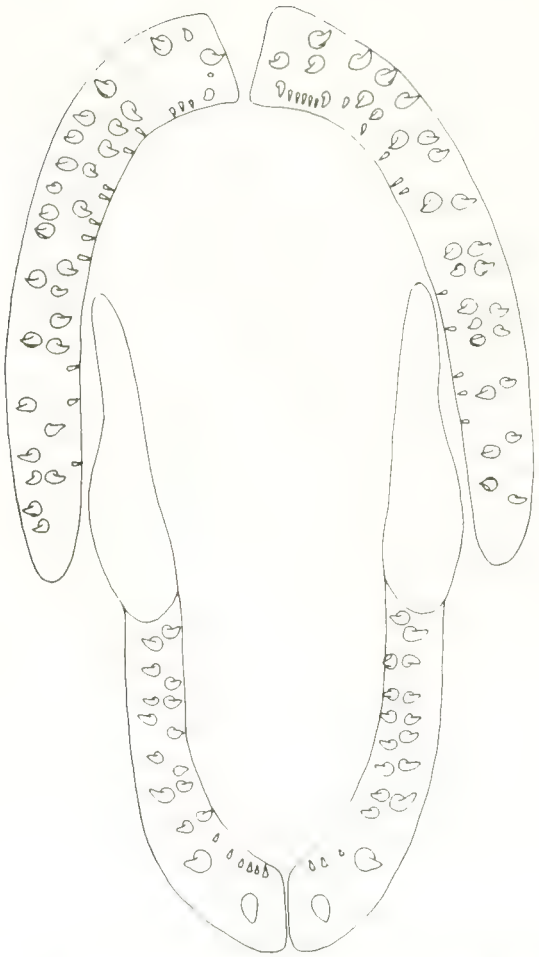

FIGURE 125. *Paradoxodacna piratica*, oral dentition. Kapuas 1976-33, 69.3 mm (CAS 49440, paratype).

Boeseman, 1957, by original designation and monotypy). N. B. Boeseman independently chose the same genus and species name for this fish.

Gymnochanda filamentosa Fraser-Brunner, 1955

Gymnochanda filamentosa Fraser-Brunner, 1955:210, fig. 4 (type locality "southern Malaya"; aquarium specimens)

Gymnochanda filamentosa Boeseman, 1957:75 (type locality "Singapore?"; aquarium specimens)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-8, 6: 9.1–23.9 mm (BMNH 1982.3.29.205–209, MZB 3767); Kapuas 1976-22, 47: 23.1–32.1 mm (AMNH 48941, CAS 49441, FMNH 94247, IRSNB 19749, MNHN 1982-716, MZB 3768, RMNH 28912, UMMZ 209866, USNM 230317, ZMA 116.546); Kapuas 1976-47, 22.7 mm (MZB 3769)

DIAGNOSIS.—Scales entirely absent. Dorsal profile strongly concave above eye; dorsal margin of preorbital bone with 3–4 enormous dorsally projecting serrae; dorsal portion of bony interorbital rim with about 10 strong posteroventrally projecting serrae. Jaws equal. Gill rakers about 16. Body transparent or translucent yellowish or yellowish-brown in life, filamentous rays of sexually mature males milk-white distally.

DISTRIBUTION.—Malay Peninsula (Johore). Western Borneo (Kapuas).

TABLE 13. COMPARISON OF THE TWO SCALE-EATING GENERA OF FRESHWATER CHANDIDAE.

Chanda	*Paradoxodacna*
Strongly prognathous	Strongly retrognathous
Preorbital ridge with a large anterior spine directed dorsoposteriorly and 9–10 smaller spines directed posterolaterally; no ventrolaterally projecting lamina	Preorbital ridge non-serrate, with a smooth-edged ventrolaterally projecting lamina
Preorbital edge smooth	Preorbital edge with 9 strong posteroventrally directed serrae
Preopercular ridge smooth excepting terminal serra	Preopercular ridge with 9 strong serrae
Lower edge of preopercle with a few irregular serrae, hind margin smooth	Lower edge and hind margin of preopercle strongly and regularly serrate
Dorsal-fin rays 15–17, anal 14–17	Dorsal-fin rays 9–10, anal 9
Cheek and gill cover scaleless, body scaleless anteriorly	Cheek, gill cover, and body fully scaled
Posterior nostril vertically oval, about twice as large as anterior nostril	Posterior nostril round, about same size as anterior nostril
Vertically elongate humeral spot	No humeral spot
Vertebrae 10+15=25 (rarely 10+16=26)	Vertebrae 10+14=24

Paradoxodacna new genus

TYPE SPECIES.—*Paradoxodacna piratica* new species.

DIAGNOSIS.—A scale-eating chandid with retrognathous jaws (lower jaw markedly shorter than upper) and highly modified teeth; upper and lower jaw with two rows of large conical teeth, outer row with crowns labially directed, inner row with crowns lingually directed; upper jaw with a separate innermost row of very small conical teeth with lingually directed teeth, and lower jaw with similar small teeth in anteriormost portion of inner tooth row (Fig. 125).

DISCUSSION.—The dentition of *Paradoxodacna* is remarkably similar to that of *Chanda* Hamilton-Buchanan, 1822, the single species of which, *C. nama* Hamilton-Buchanan, 1822, is the only other known scale-eater in the family Chandidae (pers. obs.). Because of its scale-eating habits and dentition I thought at first that *Paradoxodacna* should be placed in *Chanda* but I have rejected this hypothesis because of their numerous differences (Table 13). In short, the non-dental characters of *Paradoxodacna* suggest that its closest relatives are freshwater chandids endemic to Sumatra and Borneo, whereas the characters of *Chanda* seem to indicate that its closest relatives are other Indian freshwater chandids. The similarity of dentition in the two scale-eating genera is therefore interpreted as convergent.

ETYMOLOGY.—*Paradoxodacna* (feminine) from Greek "paradoxos" and "dakno" (bite), in reference to the extraordinary jaw teeth.

Paradoxodacna piratica new species

(Figures 125, 126)

Imbassis microlepis Vaillant, 1893:110 (in part; Kapuas)

HOLOTYPE.—MZB 3762, 41.8 mm, Kapuas mainstream and mouth of Sungai Sekayam at Sanggau (Kapuas 1976-14).

PARATYPES.—CAS 49438, 31.8 mm, same collection as holotype; CAS 49439, MZB 3763, 2: 16.5–18.9 mm, Kapuas basin, sand and gravel bar in mouth of

FIGURE 126. *Paradoxodacna piratica*. Kapuas 1976-14, 41.8 mm (MZB 3762, holotype).

Sungai Melawi at Sintang (Kapuas 1976-31); BMNH 1982.3.29.204, CAS 49440, MZB 3764, USNM 230316, 8: 19.0–69.3 mm, Kapuas mainstream near Kampong Nibung, about 100 km NE of Sintang (Kapuas 1976-33); MZB 3765, 52.9 mm, Kapuas mainstream 53 km W of Putussibau (Kapuas 1976-34); MZB 3766, 48.8 mm, Kapuas basin, Sungai Tawang near Danau Pengumbung (Kapuas 1976-44); RMNH 7890, 34.3 mm, Kapuas basin, Sintang, Büttikofer, July 1894; MNHN 1891/581–582, 585, 3: 61.7–88.6 mm, Kapuas basin, Knapei, Sebruang, Chaper, 1890 (identified as *Ambassis microlepis* by Vaillant); ZMA 112.376, 53.3 mm, Kapuas basin, Mendalan River, H. A. Lorentz, 28 June 1908.

SCALE-EATING.—*Paradoxodacna piratica* feeds predominantly on scales of Cyprinidae. Stomach contents of one large specimen from each of four localities are as follows:

Kapuas 1976-14, 31.8 mm: 20 scales about 1.0–3.0 mm long; a single aquatic larval insect head capsule about 1.5 mm long.

Kapuas 1976-33, 69.3 mm: 10 scales about 1.5 mm long, 178 scales about 2.0 mm long, and 7 scales 3.1–3.3 mm long; one small whole chandid (not young of *P. piratica*) 14.4 mm.

Kapuas 1976-34, 52.9 mm: 88 scales about 2.5–3.5 mm long, and 11 large, chevron-shaped scales (from *Cyclocheilichthys*?) 5.0–5.2 mm wide and 6.5–6.8 mm long; one aquatic larval insect head capsule about 1.5 mm long and unidentified soft animal remains, possibly all insect, amounting to about 10 per cent of total food contents.

Kapuas 1976-44, 44.8 mm: 16 scales 0.8–2.0 mm long and 49 scales 2.7–4.4 mm long; no other food items.

All or almost all of the scales seem to be from Cyprinidae, the predominant scaled fishes throughout the Kapuas basin. From the differences in size and shapes of scales it is evident that all four specimens had taken scales from at least two or three different prey, and some from two or three different prey species; scales ingested range in size from about that of the scale-eater's own scales to several times larger. Since *P. piratica* has relatively small scales, the prey probably ranged in size from slightly larger to two or three times the length of the scale-eater. In the two smallest specimens collected, 16.5–18.9 mm, the dentition is not yet modified for scale-eating; i.e., the crowns in the outer row of conical jaw teeth are curved inwards, as in juveniles and adults of non-lepidophagous chandids generally, rather than outwards as in adult *P. piratica*. The stomach of the 16.5 mm specimen was empty except for the head of a minute aquatic larval insect, and that of the 18.9 mm specimen entirely empty. In a 19.0 mm specimen the dentition is nearly fully modified for scale-eating; its stomach contained 25 copepods 0.7–0.9 mm body length and a single scale 1.0 mm long. For discussion of scale-eating fishes see Sazima (1983).

DISTRIBUTION.—Known only from the Kapuas.

ETYMOLOGY.—The name *piratica* (Latin, a sea-robber) refers to the scale-eating behavior.

Parambassis Bleeker, 1874

Parambassis Bleeker, 1874*c*:86, 102 (type species *Ambassis apogonoides* Bleeker, 1851, by original designation)

Pseudambassis Bleeker, 1874*c*:86 (type species *Chanda lala* Hamilton-Buchanan, 1822, by original designation and monotypy)

Icanthoperca Castelnau, 1878:44 (type species *Acanthoperca gulliveri* Castelnau, 1878, by monotypy)

Whitlevina Fowler and Bean, 1930:vii, 163, 334 (type species *Ambassis wolffii* Bleeker, 1850, by monotypy). Misspelled as *Whitleya*, p. 2, 148

REMARKS.—The species here placed in *Parambassis* have been placed in *Chanda* Hamilton-Buchanan, 1822 by various authors, many of whom regarded *Chanda lala* Hamilton-Buchanan, 1822 as type species of *Chanda*. The ICZN has ruled that *Chanda nama* Hamilton-Buchanan, 1822 is type species of *Chanda* (Opinion 1121, 1979). *Chanda nama* is a highly specialized scale-eater which I consider to represent a monotypic genus and species (see discussion under *Paradoxodacna*). The next available generic name for the other species formerly placed in *Chanda* is *Parambassis* Bleeker, 1874.

Parambassis apogonoides (Bleeker, 1851)

(Figure 127)

Ambassis apogonoides Bleeker 1851*h*:200 (type locality Banjermassing)

Parambassis apogonoides Bleeker 1874:103

Chanda apogonoides Fraser-Brunner, 1954:204

FIGURE 127 *Parambassis apogonoides* Kapuas 1976-14, 42.6 mm (CAS 49442).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-14, 16: 22.1–42.6 mm (BMNH 1982.3.29.210–211, CAS 49442, FMNH 94248, MZB 3770, RMNH 28913); Kapuas 1976-15, 2: 37.6–42.3 mm (MNHN 1982-717, MZB 3771); Kapuas 1976-33, 86: 3.3–51.6 mm (CAS 49443, MZB 3772); Kapuas 1976-35, 2 42.8–44.3 mm (MZB 3773, USNM 230318); Kapuas 1976-36, 54.5 mm (MZB 3774); Kapuas 1976-45, 2: 32.2–33.9 mm (MZB 3775, UMMZ 209919); Kapuas 1976-50, 4: 26.5–35.9 mm (MZB 3776, USNM 230319); Sintang, 9: 20.8–37.8 mm (RMNH 7890); Raoen embouchure, Kapuas, 58.5 mm (RMNH 7891); Kapuas Poetoes Sibau, 42.8 mm (ZMA 112.310); Kapuas, Mendalan, 62.2 mm (ZMA 112.309). Eastern Borneo: Mahakam basin, Tepoe, 2: 56.8–62.3 mm (RMNH 7889). No locality: Bleeker collection, 3: 40.5–67.1 mm (RMNH 5558) (note: this 67.1 mm specimen, now 84 mm total length, with penmarks on the lateral line scales presumably made by Bleeker, is probably the holotype [88 mm total length] from Bandjermassing)

DIAGNOSIS.—Dorsal profile moderately sloped, gently concave. Dorsal margin of preorbital bone smooth. Orbital rim with 2–3 small serrae dorsoposteriorly, otherwise smooth. Dorsal preopercular margin serrate. Second anal spine slightly larger than third. Gill rakers 21–22. Scales in lateral series 40–47. Cheek with 5 scale rows.

ORAL BROODING.—Parental care is unknown in the family Chandidae (Breder and Rosen 1966; Blumer 1982). Thus it is particularly noteworthy to report that *C. apogonoides* practices oral brooding. The orobranchial cavity of a 51.6 mm male from Kapuas 1976-33 contained 81 young of 3.3–7.0 mm. Two size classes are present, 78: 3.3–5.5 mm, slender and white, and 3: ±7.0 mm, much thicker and yellowish, presumably representing two broods. The orobranchial cavity also contained one whole larval ephemeropteran and a few small pieces of insects. The guts of this specimen contained fine black detritus, at least partly from insect remains.

There is no indication of oral brooding in the other Kapuas chandid species; a brief survey of freshwater and marine chandids from other areas in the CAS collections failed to reveal additional oral brooding species.

DISTRIBUTION.—Sumatra (Muara-Kompeh, Djambi). Borneo (Barito, Kahajan, Kapuas, Mahakam, Mendalan [=Barito?] rivers). Unknown from northern Borneo.

Parambassis macrolepis Bleeker, 1857

(Figure 128 upper)

Bogoda macrolepis Bleeker, 1857*a*:13 (type locality Pontianak, in flumine Kapuas)
Imbassis (*Bogoda*) *microlepis* von Martens, 1868:9 (Kapuas; unwarranted emendation of spelling)
Parambassis microlepis Bleeker, 1874:104
Imbassis microlepis Vaillant, 1893:110 (Kapuas)
Chanda macrolepis Fraser-Brunner, 1955:205

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 68.5 mm (MZB 3777); Kapuas 1976-20, 15: 65.6–97.5 mm (BMNH 1982.3.29.212–213, CAS 49444, FMNH 94249, MZB 3778, UMMZ 209864); Kapuas 1976-33, 4: 65.2–82.3 mm (MZB 3779, USNM 230320); Kapuas 1976-49, 2: 57.7–88.0 mm (MZB 3780, RMNM 28914); Kapuas basin, Knapei, Sebruang, 2: 57.3–65.8 mm (MNHN 1891 583–584); Kapuas basin, Sintang, 4: 77.0–98.9 mm (RMNH 7892); Kapuas basin, Boenoet, 3: 66.7–72.4 mm (ZMA 112.337)

DIAGNOSIS.—Body moderately deep. Dorsal profile strongly concave. Second anal spine larger than third. Gill rakers 17, 5 on upper limit; first 4 rakers on upper limit mound-shaped. Scales in lateral series 50–59. Cheek with 9–10 scale rows. Dorsal preopercular margin entire. Dorsal margin of preorbital bone smooth. Orbital rim non-serrate.

DISTRIBUTION.—Sumatra (Batang Hari). Borneo (Kapuas only?).

Parambassis wolffii (Bleeker, 1850)

(Figure 128 lower)

Imbassis Wolffii Bleeker, 1850:9 (type locality Banjermassin)
Imbassis robustus Günther, 1859:222 (type locality Borneo)

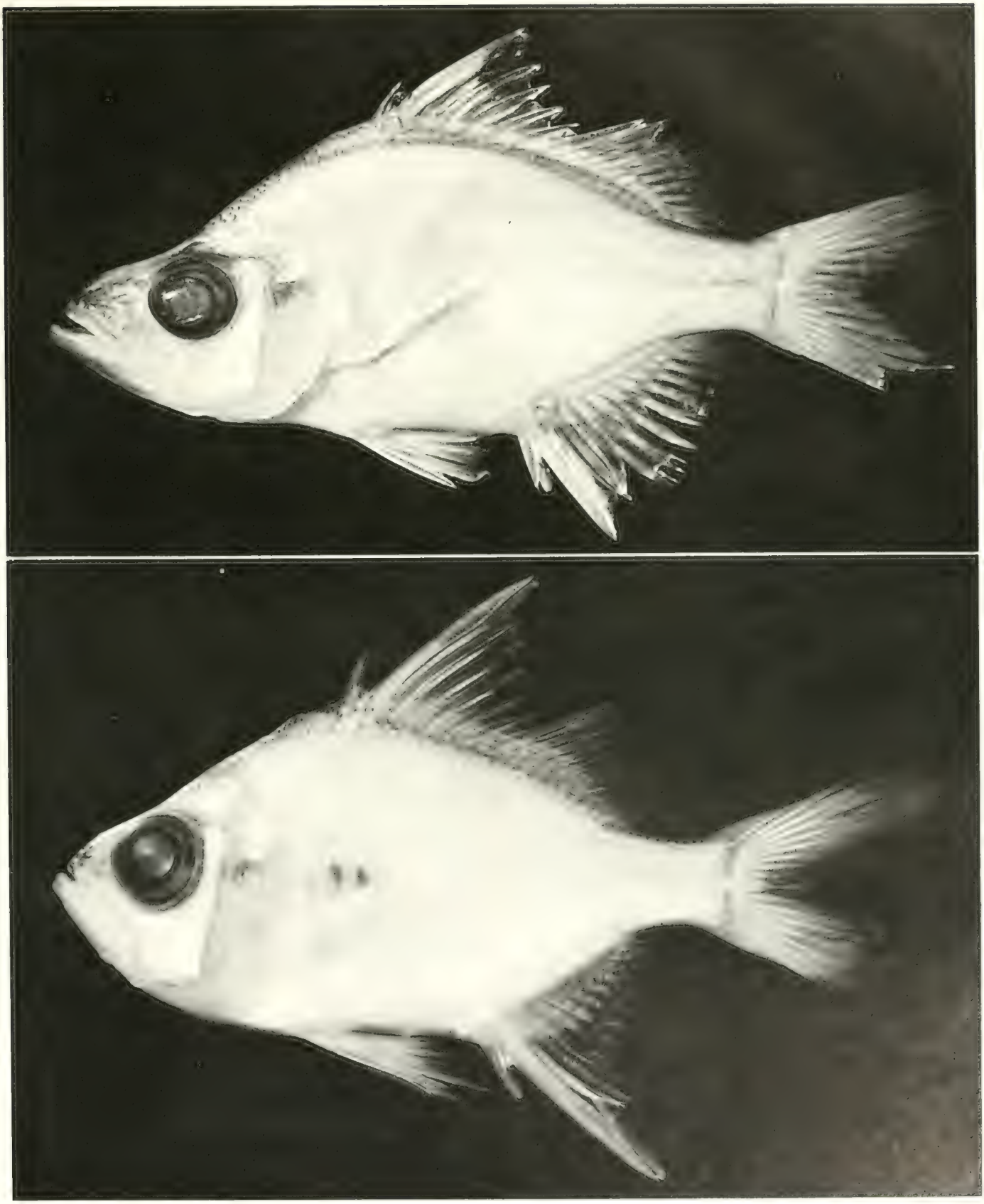

Figure 128. *Parambassis*. Above, *P. macrolepis*, Kapuas 1976-33, 82.3 mm (USNM 230320); below, *P. wolffii*, Kapuas 1976-14, 81.4 mm (CAS 49445)

Imbassis boulengeri Volz, 1903:553 (type locality "Banju asin, dem grossen Astuar an der Nordostküste der Residenz Palembang, Sumatra")
Icanthoperca wolffii Fowler, 1937:230.
Chanda wolffii Smith, 1945:482.
Parambassis wolffi Allen, 1982:166

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-14, 2: 24.8–81.4 mm (CAS 49445, MZB 3781); Kapuas 1976-19, 99.6 mm (MZB 3782); Kapuas 1976-44, 3: 97.4–118 mm (CAS 49446, MZB 3783, USNM 230321); Kapuas 1976-52, 58.7 mm (MZB 3784).

DIAGNOSIS.—Dorsal profile very steep, almost straight. Depth about twice in standard length. Second dorsal, pelvic, and second anal spines greatly enlarged. Gill rakers 29, 10 on upper limb. Scales in lateral series 43–46. Cheek with 7–8 scale rows. Dorsal preopercular margin smooth. Posterior margin of orbital rims and dorsal margin of preorbital bone with small posteriorly directed serrae.

Parambassis wolffii differs strikingly from all of the marine Chandidae and from the other freshwater chandids in India and southeast Asia. It is perhaps closely related to two New Guinean freshwater species currently known as *Parambassis gigas* and *P. confinis*.

DISTRIBUTION.—Thailand (Chao Phrya; Mekong). Sumatra (Palembang). Borneo (Baram?, Barito, Kapuas, Kahajan). (Baram record of Weber and de Beaufort [1929:402] doubtful—source unknown.)

Nandidae

Nandidae, as herein understood, is a tropical primary freshwater family comprising the traditional leaf-fish genera: *Monocirrhus* and *Polycentrus* in South America, *Afronandus* and *Polycentropsis* in west Africa, and *Nandus* in south and southeast Asia.

Nandus Valenciennes, 1831

Nandus Valenciennes *in* Cuvier and Valenciennes, 1831:481 (type species *Coius nandus* Hamilton-Buchanan, 1822, by absolute tautonymy)
Bedula Gray, 1833–34 (type species *Bedula nebulosa* Gray, 1833, by monotypy?) (Reference not seen.)

Nandus comprises two species: *N. nandus* in India, Burma, and Thailand and *N. nebulosus* in southeast Asia including the Greater Sunda Islands.

Nandus nebulosus (Gray, 1833)

Bedula nebulosus Gray, 1833, pl. 88, fig. 2 (no locality)
Nandus marmoratus Valenciennes *in* Cuvier and Valenciennes, 1831:482 (replacement name for *Coius nandus* Hamilton-Buchanan, 1822).
Nandus nebulosus Bleeker, 1852*a*:92
Nandus borneensis Steindachner, 1901:422 (type locality Baram River)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-8, 2: 16.2–37.8 mm (CAS 49449, MZB 3792); Kapuas 1976-13, 55.7 mm (MZB 3793); Kapuas 1976-16, 8: 9.6–78.8 mm (CAS 49450, MZB 3794); Kapuas 1976-17, 57.3 mm (MZB 3795); Kapuas 1976-39, 4: 37.3–48.0 mm (MZB 3796, USNM 230323); Kapuas 1976-43, 3: 24.3–69.6 mm (BMNH 1982.3.29.214–215, MZB 3797); Kapuas 1976-46, 5: 30.0–42.6 mm (CAS 49451, MZB 3798); Kapuas 1976-47, 71.7 mm (MZB 3799); Kapuas 1976-51, 4: 27.5–31.5 mm (MZB 3800, USNM 230324).

DISTRIBUTION.—Thailand (Chao Phrya, Poon Duang River, Nakon Sritamarat, Chantabun, Ban Thung Luang). Malay Peninsula (Johore, Singapore). Sumatra (Lahat, Indragiri, Danau Sialong, Taluk, Gunung Sahilan, Sungei Mahe, Laut Tador, Latong, Kwantan R., Djambi). Borneo (Baram, Kapuas, Pamangkat, Bankayan). (Not known from Java.)

Datnioididae

Datnioides comprises three or four species of morphologically generalized, deep-bodied percoids with vertically barred color patterns found in fresh and brackish water in southeast Asia and the tropical Australian region (especially New Guinea). The genus has been placed in the otherwise monotypic family Lobotidae by Jordan (1919), Weber and de Beaufort (1936), Nelson (1984), and others but there is little or no evidence in favor of this relationship and it seems untenable. Fowler (1931) recognized *Datnioides* as forming a subfamily Datnioidinae of Theraponidae, but Vari (1978:193) noted that *Datnioides* does not share diagnostic theraponid osteological characters and excluded it from that family. Johnson (1984), unaware of Fowler's use of the family-group name Datnioidinae, placed *Datnioides* along with 11 other genera as incertae sedis in an alphabetical list of 80 percoid families. Convinced that *Datnioides* does not belong in Lobotidae or Theraponidae, and without any solid evidence indicating its relationship to Nandidae or any other percoid family, I hereby recognized *Datnioides* as forming its own monotypic family.

Datnioides Bleeker, 1853

Datnioides Bleeker, 1853*c*:440 (type species *Coius polota* Hamilton-Buchanan, 1822=*Chaetodon quadrifasciatus* Sevastianov, 1809, by monotypy.

In the original description of *Datniodes* Bleeker (1853:442) indicated *Coius binotatus* Gray, 1834 and *Lobotes hexazona* Bleeker, 1851 as junior synonyms of *Datnioides polota*. As Bleeker clearly recognized *D. polota* as the only valid species of *Datnioides* it is the generic type species by monotypy.

Datnioides comprises at least three species: *D. quadrifasciatus*, supposed to be widely distributed in south and southeast Asia, tropical Australia and southern New Guinea; *D. microlepis* from southeast Asia; and *D. campbelli* Whitley, known only from the upper Sepik River of northern New Guinea (Munro 1967).

Key to *Datnioides* of southeast Asia (from Smith 1945)

1a Scales in lateral line about 70; branched dorsal rays 13–14; body and head with 8–10 dark brown cross bands some of which become confluent with age; a dark round spot on opercle ..... *D. quadrifasciatus*
1b Scales in lateral line about 105; branched dorsal rays 15–16; body and head with black cross bands, which remain distinct at all ages; no round dark spot on opercle ..... *D. microlepis*

Datnioides microlepis Bleeker, 1853

Datnoides microlepis Bleeker, 1853*c*:442 (type locality "Pontianak, in flumine Kapuas")

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 245 mm (MZB 3785); Kapuas 1976-20, 2: 151–219 mm (CAS 49447, MZB 3786).

DISTRIBUTION.—Kampuchea, Thailand (Mekong, Chao Phrya). Borneo (Kapuas). This species apparently is restricted

to fresh water, and is generally recorded much farther inland than *D. quadrifasciatus*.

Datnioides quadrifasciatus (Sevastianov, 1809)

Chaetodon quadrifasciatus Sevastianov, 1809:448 (reference not seen).
Coius polota Hamilton-Buchanan, 1822:95, 370 (type locality Ganges).
Lobotes hexazona Bleeker, 1851*a*:9 (type locality Bandermassing, in fluviis).
Datnioides polota Bleeker, 1853*e*:441.
Datnioides quadrifasciatus Bleeker, 1876–77:32.
For additional synonymy see Weber and de Beaufort (1936:462).

MATERIAL EXAMINED.—None

DISTRIBUTION.—India. Burma. Thailand. Vietnam. Sumatra. Borneo (Sarawak, Sambas, Kapuas, Kukajan, Barito). New Guinea. In brackish water in mouths of large rivers and coastal lagoons as well as in freshwater lakes and rivers above tidal influence.

Pristolepidae

As here understood, Pristolepidae includes only *Pristolepis*. Relationships of this deep-bodied and relatively generalized perchlike genus have not been satisfactorily investigated. It is perhaps related to the anabantoids, or to the so-called "protoanabantoid stock." *Pristolepis* was excluded from Badidae, which may also be related to the anabantoids or protoanabantoids, by Barlow et al. (1968). *Pristolepis* has been placed in Nandidae (e.g., by Greenwood et al. 1966) but is more generalized than typical nandids and probably is not closely related to them. It differs from nandids in having very short jaws with ascending premaxillary process not notably elongate; branchiostegal membranes united very far posteriorly and covered with scales; scales with ctenii in multiple rows instead of uniserial; and pore-bearing scales of lower lateral line series extending to middle of caudal fin. *Pristolepis* agrees with Nandidae in having the lateral line divided into separate upper and lower parts, but this character is found also in some anabantoids and most Cichlidae. *Pristolepis* has a distinctive vertebral formula, 13+12=25.

Pristolepis Jerdon, 1848

Pristolepis Jerdon, 1848:141 (type species *Pristolepis marginata* Jerdon, 1848) (reference not seen).
Catopra Bleeker, 1851*f*:65 (type species *Catopra fasciata* Bleeker, 1851, by monotypy).
Paranandus Day, 1865:130 (type species *Catopra malabarica* Günther, 1864, by monotypy).

The genus comprises three or four species and is found in southern India, Burma, Thailand, Kampuchea, the Malay Peninsula, and Asian continental islands of Indonesia; one or possibly two species in western Borneo.

Pristolepis fasciata (Bleeker, 1851)

Catopra fasciata Bleeker, 1851*f*:61, 65 (type locality Bandjermassing, in fluviis).
Catopra nandoides Bleeker, 1851*f*:61 (nomen nudum); Bleeker, 1851:172 (type locality presumably Java).
?*Catopra Grootii* Bleeker, 1852*a*:90 (type locality Billiton).
Pristolepis fasciatus Bleeker, 1876–78:80, pl. 391, fig. 4.
?*Pristolepis grootii* Bleeker, 1876–78, pl. 391, fig. 2
Catopra nandoides von Martens, 1876:394 (Kapuas).
Catopra fasciata von Martens, 1876:394 (Kapuas).
?*Catopra grooti* von Martens, 1876:394 (Kapuas).
Pristolepis fasciatus Vaillant, 1893:109 (Kapuas); 1902:32 (Kapuas).
Pristolepis fasciata Hora, 1923:177.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-6, 9: 16.7–24.7 mm (CAS 49452, MZB 3801, USNM 230325); Kapuas 1976-8, 47.0 mm (MZB 3802); Kapuas 1976-19, 2: 98.0–105 mm (CAS 49453, MZB 3803); Kapuas 1976-24, 49.6 mm (MZB 3804); Kapuas 1976-27, 59.9 mm (MZB 3805); Kapuas 1976-28, 71.0 mm (MZB 3806); Kapuas 1976-37, 61.2 mm (MZB 3807); Kapuas 1976-43, 2: 50.8–89.5 mm (MZB 3808, USNM 230326); Kapuas 1976-47, 92.0 mm (MZB 3809).

It is possible that my Kapuas material includes two species, *Pristolepis fasciata* and *Pristolepis grootii,* both of which have been reported from the Kapuas, but I have been unable to determine whether these really are distinct species. For discussion of supposed differences between them and additional synonymy see Weber and de Beaufort (1936:478–481). The account of the genus *Pristolepis* in Bleeker's Atlas is incomplete, but his figures of *P. fasciata* and *P. grootii* should be consulted (Bleeker 1877:80, pl. 391). Note that Weber and de Beaufort's figure of *Pristolepis fasciata* (Weber and de Beaufort 1936, fig. 95) resembles not *P. fasciata* but rather *P. grootii* as figured by Bleeker.

DISTRIBUTION.—Widely distributed in fresh water in Thailand, Malay Peninsula, Sumatra, Borneo (western, southern, and eastern), Java. Burma?

Toxotidae

The tropical Indo-West Pacific Toxotidae or archerfishes, renowned for the ability to knock insects off overhanging vegetation onto the water by accurately aimed jets of water forcefully ejected from their mouth, comprise a single genus with six species (Allen 1978). One species, *Toxotes jaculator,* generally occurs in brackish habitats (mainly mangrove creeks) but is sometimes encountered in pure fresh water in the lower parts of rivers and coastal streams. The other species generally go through their entire life cycle in fresh water, sometimes hundreds of miles inland.

Toxotes Cuvier, 1817

Toxotes Cuvier, 1817:338 (type species *Sciaena jaculator* Pallas, 1767, by monotypy).

Toxotes is readily distinguished from all other freshwater perciform fishes in southeast Asia by its characteristic body form and color, with a very sharp snout, single dorsal fin with 4–6 large spines and 11–14 rays lying entirely on posterior half of body, and sides with several large dark vertical bars or roundish spots on a yellowish background. The Indonesian or Malay name for *Toxotes* is ikan sumpit (blowgun fish). Three species occur in western Borneo, but only *T. microlepis* is known from fresh water in western Borneo.

Toxotes microlepis Günther, 1860

Toxotes microlepis Günther, 1860:68 (type locality Siam).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-14, 78.2 mm (MZB 3787); Kapuas 1976-15, 3: 22.5–40.3 mm (MZB 3788, USNM 230322); Kapuas 1976-19, 121 mm (MZB 3789); Kapuas 1976-33, 74.2 mm (MZB 3790); Kapuas 1976-45, 2: 70.9–76.2 mm (CAS 49448, MZB 3791)

This species is distinguished by 5 dorsal-fin spines, 6–7 bars on side of body, and scales in lateral series 42–45.

DISTRIBUTION.—Thailand (Chao Phrya, Bangpakong). Sumatra (Palembang). Borneo (Kapuas, Barito, Mahakam).

Polynemidae

The tropical and subtropical family Polynemidae or threadfins, with seven genera and about 35 species, occurs mainly in marine and brackish habitats but several species apparently are endemic to fresh water. In southeast Asia, although other genera may enter river mouths and the lower portions of rivers, the only genus with freshwater species is *Polynemus*.

Polynemus Linnaeus, 1758

Polynemus Linnaeus, 1758:317 (type species *Polynemus paradiseus* Linnaeus, 1758, by Opinion 93, 1926, ICZN)
Polistonemus Gill, 1861:277 (type species *Polynemus multifilis* Schlegel, 1845, by monotypy)

Polynemus are readily distinguished from all other freshwater fishes in southeast Asia by having the pectoral fin divided into two discrete portions, an upper portion with 12–17 rays united by fin-membrane and a ventral portion with 7–16 extremely elongate free filamentous rays. When the fish swim slowly in open water the free lower rays can be widely spread apart like the ribs of an umbrella.

There seem to be more freshwater polynemids in Borneo than anywhere else. *Polynemus macrophthalmus* and *P. multifilis* occur in the Kapuas in western Borneo and probably both occur in other Bornean rivers; they are also known from rivers in Sumatra. At least two other species are known only from rivers in Borneo: *P. hornadayi* Myers, 1936 from the Sadang R. in Sarawak, and *P. hilleri* (Fowler, 1905) from the Baram R. in Sarawak.

For keys to genera of Polynemidae and species of *Polynemus*, references to earlier literature, and additional information see Myers (1936).

Key to freshwater *Polynemus* of western Borneo

1a Lower portion of pectoral fin with 7 free rays
P. macrophthalmus
1b Lower portion of pectoral fin with 14–16 free rays
P. multifilis

Polynemus macrophthalmus Bleeker, 1858–59

Polynemus macrophthalmus Bleeker, 1858–59:10 (type locality Palembang, in ostiis fluminis Mussi)
Polynemus borneensis Vaillant, 1893:109 (Kapuas)

MATERIAL EXAMINED.—Sumatra: Batang Hari at Djambi, 3: 140–223 mm (ZMA 114.431). Western Borneo: Kapuas R. at Bunut, 164 mm (ZMA 114.432); Kapuas 1976-19, 258 mm (MZB 3810).

Color in life of the single Kapuas specimen (obtained in very fresh condition in fish market at Sintang) overall pale greyish white or dull silvery. I believe that this species may sometimes be brilliant orange or orangish-gold in life. A half-dozen fresh specimens of *Polynemus* with head, body, and fins entirely bright orange were seen by me in the market at Pontianak but were not preserved or positively identified to species. The three ZMA specimens from Sumatra, although preserved long ago, still show such coloration; I suspect this is not an artifact of preservation but due to their retention of pigmentation from life.

DISTRIBUTION.—Sumatra (Palembang, Mussi R., Djambi, Batang Hari). Borneo (Kapuas).

Polynemus multifilis Schlegel, 1843

Polynemus multifilis Schlegel, 1843 *in* Siebold, 1842–50:29 (type locality "Zuidkust van Borneo bij Banjermassing" [=Barito River?]). See also Schlegel (1848).
Polynemus quaterdecimfilis Pel, 1851:10 (type locality "littoribus meridionalibus insulae Borneo")
Polistonemus multifilis Gill, 1861:277
Trichidion multifilis Bleeker, 1865*b*:174.

MATERIAL EXAMINED.—Sumatra: Djambi, 149 mm (ZMA 114.430). Western Borneo: Kapuas R. at Bunut, 4: 156–183 mm (ZMA 114.403); Kapuas 1976-19, 6: 111–184 mm (CA 47198, MZB 3811, RMNH 28839); Kapuas 1976-33, 5: 73.5–119 mm (CAS 47199, MZB 3812); Kapuas 1976-44, 6: 88.9–138 mm (MZB 3813, USNM 230327); Kapuas 1976-48, 12: 27.0–76.7 mm (BMNH 1982.3.29.216–218, CAS 49454, MZB 3814).

The number of free pectoral-fin rays reported for this species is 14. Most of my Kapuas specimens have 15 or 16. Color in life dull white or faintly silvery.

DISTRIBUTION.—Sumatra (Djambi). Borneo (Kapuas, Barito).

Eleotridae

The Eleotridae or sleepers comprise some 40 genera and 150 species of mostly tropical, marine, brackish, and freshwater fishes. Two genera and four species occur in the fresh waters of western Borneo.

Eleotris Schneider *in* Bloch, 1801

Eleotris Schneider *in* Bloch, 1801:65 (type species *Gobius pisonis* Gmelin, 1789, by subsequent designation of ICZN, 1958, Opinion 93).

Eleotris melanosoma Bleeker, 1852

Eleotris melanosoma Bleeker, 1852*e*:705 (type locality Wahai, Ceram and Sumatra occidentalis, in mari).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-17, 111 mm (MZB 3816).

For a tentative synonymy of *E. melanosoma* see Koumans (1953:297–298). It apparently is very widely introduced in estuaries and rivers in the East Indies and Australian region; it also has been reported from Guam, Samoa, and Mindi on the Atlantic coast of the Panama Canal (Koumans 1953:298–299).

Oxyeleotris Bleeker, 1874

Oxyeleotris Bleeker, 1874*b*:294, 302 (type species *Eleotris marmorata* Bleeker, 1852, by original designation and monotypy).
?Gigantogobius Fowler, 1905:511 (type species *Gigantogobius jordani* Fowler, 1905, by original designation and monotypy). See discussion under *Oxyeleotris marmorata*

Oxyeleotris is unusual among eleotrid genera in being almost entirely restricted to fresh water. Endemic freshwater species of the genus occur in southeast Asia and others in the Australian region. Three species are known from western Borneo.

Oxyeleotris marmorata (Bleeker, 1852)

Eleotris marmorata Bleeker, 1852*b*:424 (type locality Bandjermassing et Palembang, in fluviis)
Oxyeleotris marmorata Bleeker, 1874*b*:303.
?Gigantogobius jordani Fowler, 1905:511 (type locality "Baram, Borneo").
Calleleotris platycephalus Fowler, 1934*b*:156 (type locality Bangkok).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-16, 5: 12.2–105 mm (CAS 49455, MZB 3817); Kapuas 1976-17, 2: 52.1–54.5 mm (BMNH 1982.3.29.219, MZB 3818); Kapuas 1976-19, 2: 187–189 mm (MZB 3819, RMNH 28915); Kapuas 1976-44, 137 mm (MZB 3820); Kapuas 1976-47, 4: 44.1–148 mm (MZB 3821, USNM 230328).

As pointed out by Bleeker (1877:23), *O. marmoratus* is the largest gobioid in the East Indies; it may well be the largest gobioid of all. So far as I have been able to determine it is the only freshwater gobioid in Sundaland for which specimens over 300 mm have been reported. Bleeker had specimens to 430 mm (total length) but it apparently grows even larger. Although the holotype of *Gigantogobius jordani* is still lost (Böhlke 1984:107), there seems no reason to doubt Koumans's tentative conclusion that *G. jordani* is a synonym of *O. marmorata* (Koumans 1940: 134, 1954:354). The holotype, "26 inches long" (total length?) seems to be the largest specimen of gobioid on record. Presuming that the length of 26 in. refers to total length, its standard length would have been about 540 mm (caudal fin about 17 percent of total length). The next largest gobioid specimen known to me is a 437 mm *Bunaka herwerdenii* (Weber, 1910) from the Fly River, New Guinea (Roberts 1978:11, 65).

DISTRIBUTION.—Widely distributed in fresh water in Thailand (Smith 1945:509). Malay Peninsula. Sumatra. Western and northwestern Borneo.

Koumans (1953:355) reported the occurrence of *O. marmorata* in estuaries as well as rivers and included the Philippines, Fiji, and Celebes within its range. This information is doubtful. *O. marmorata* may occur in brackish habitats within its range, but all of the well documented locality records appear to be from fresh water. Occurrence in the Philippines apparently is based on the doubtful record by Meyer (1885:30) from Laguna de Bay, Luzon (see Herre 1927:75). Herre (1953:365, 1954:729) never questioned Meyer's identification, and supposed that *O. marmorata* "no doubt is in river mouths in Balabac, Palawan, Tawi Tawi, and Cotabato Province, Mindanao." So far as I have been able to determine Herre never collected a specimen of this species in the Philippines. I suspect that reports of *O. marmorata* from Celebes and Fiji are based either on erroneous locality data or misidentification.

Oxyeleotris urophthalmus (Bleeker, 1851)

Eleotris urophthalmus Bleeker, 1851*h*:202 (type locality "Bandjermassing, in fluviis").
Oxyeleotris urophthalmus Bleeker, 1877:23

MATERIAL EXAMINED.—Borneo: Sarawak, Kuching, 5: 112–131 mm (CAS-SU 33135).

DISTRIBUTION.—Thailand? Malay Peninsula. Borneo (Sarawak, Kapuas, Kahajan, Mahakam). Celebes? New Guinea? (see Koumans 1953:356).

Oxyeleotris urophthalmoides (Bleeker, 1853)

Eleotris urophthalmoides Bleeker, 1853*b*:273 (type locality Palembang; Lacus Meninju; Sambas).
Oxyeleotris urophthalmaoides Bleeker, 1877:21, 25.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-51, 2: 56.5–114 mm (CAS 49456, MZB 3822).

DISTRIBUTION.—Sumatra. Borneo. Nias. Known only from fresh water.

Gobiidae

Gobiidae, probably the most speciose of all living fish families, is rather poorly represented in the fresh waters of western Borneo. Only eight species were encountered during the Kapuas survey of 1976. All of these were taken in freshwater habitats, but only two species, *Brachygobius xanthomelas* and *Calamiana* sp. undet., were found in the interior of the Kapuas basin living in association with a rich assortment of primary and secondary freshwater fish species. The other six were found only near the coast and in habitats greatly altered by human activity (such as canals or streams flowing through plantations) in which primary freshwater fishes were poorly represented. It is noteworthy that gobiids were found at freshwater localities in the mainstream of the Kapuas River. The number of Gobiidae could be considerably increased here by addition of species present in estuarine or brackish waters in western Borneo and likely to enter fresh water for short distances.

It is possible that some of the undetermined species referred to *Mugilogobius, Pseudogobiopsis, Pseudogobius,* and *Stigmatogobius* are undescribed. Their generic identification, for help with which I am indebted to Douglas Hoese, should be regarded as tentative.

Brachygobius Bleeker, 1874

Brachygobius Bleeker, 1874*b*:315 (type species *Gobius doriae* Günther, 1868, by original designation and monotypy)

Brachygobius (bumble-bee gobies) are short, heavy-bodied gobies with moderately large eyes; broad interorbital space; no head pores; an upturned mouth with prominent lower jaw; conical jaw teeth in 2–3 rows; scales in midlateral series 21–50; and coloration consisting of a few well defined black and yellow (sometimes orangish or cream-colored) vertical bands. *Brachygobius* differs from all or almost all other gobiid genera in having simple first ray of second dorsal fin segmented rather than unsegmented and in having first and second anal-fin rays instead of only first anal-fin ray without a medial pterygiophore (D. Hoese, pers. comm., October 1983). There are at least eight species (Inger 1958), some found in estuaries, mangroves, and tidal creeks but others (perhaps the majority) restricted to fresh water. A key to the species is provided by Inger (1958).

Brachygobius doriae (Günther, 1868)

Gobius Doriae Günther, 1868*b*:265 (type locality Sarawak)
Brachygobius doriae Hardenberg, 1936:252 (Pontianak, Padang Tikarbay, Kubu Terentang, Telok Pekadai)
Brachygobius nunus Koumans, 1941:269, 1953:194 (in part)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-2, 4: 23.2–26.5 mm (CAS 49457, MZB 3823); Kapuas 1976-3, 6: 19.9–30.7 mm (BMNH 1982.3.29.220–222, MZB 3824, USNM 230329)

Brachygobius doriae is a relatively large and particularly heavy-bodied species typically found in tidal creeks and disturbed habitats such as man-made canals. It has three light-colored vertical bands. In numerous live fish observed during the Kapuas survey of 1976 the anteriormost light-colored band was orangish and the posteriormost two bands of a decidedly lighter canary yellow. According to Hardenberg (1936:252) it feeds mainly on mosquito larvae.

DISTRIBUTION.—Borneo (Sarawak, Kapuas, coastal streams and tidal creeks in western Borneo). Perhaps much more widely distributed.

Brachygobius xanthomelas Herre, 1937

Brachygobius xanthomelas Herre, 1937:43 (type locality Mawai District, Johore). *Brachygobius nunus* Koumans, 1941:269, 1953:194 (in part).

MATERIAL EXAMINED.—Malay Peninsula: Mawai District, Johore, 11: 8.4–27.6 mm (CAS-SU 30953, 16964, holotype and paratypes of *B. xanthomelas*). Western Borneo: Kapuas 1976-7, 4: 8.3–13.6 mm (CAS 49458, MZB 3825); Kapuas 1976-14, 14.0 mm (MZB 3826); Kapuas 1976-16, 9: 11.8–16.0 mm (MZB 3827, USNM 230330); Kapuas 1976-17, 16: 12.2–14.9 mm (BMNH 1982.3.29.223–228, FMNH 94250, MZB 3828); Kapuas 1976-47, 23: 13.2–17.3 mm (CAS 49459, KUMN 2859, MZB 3829)

Brachygobius xanthomelas is a relatively small species, apparently restricted to fresh water, previously known only from the Malay Peninsula. In live specimens observed in 1976 the light bands were all pale yellow.

Calamiana Herre, 1945

Calamiana Herre, 1945:80 (type species *Calamiana magnoris* Herre, 1945, by original designation and monotypy)

Calamiana comprises several relatively small species of sexually dimorphic gobies in which the males, growing larger than females, develop extremely elongate jaws and expanded or bullate opercular regions. The systematics of the species are poorly known and it is likely that some are undescribed.

Calamiana sp. undet.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-13, 2: 15.5–16.0 mm (CAS 49461, MZB 3833); Kapuas 1976-16, 15.2 mm (MZB 3834); Kapuas 1976-39, 84: 8.1–27.8 mm (CAS 49462, MZB 3835); Kapuas 1976-42, 8: 14.0–28.5 mm (MZB 3836, USNM 230331); Kapuas 1976-46, 4: 17.8–24.0 mm (MZB 3837, USNM 230332); Kapuas 1976-47, 10: 14.5–20.2 mm (MZB 3838, USNM 230333).

Calamiana sp. differs from *C. magnoris* (Herre 1935), the only other species of *Calamiana* examined by me, in squamation and coloration. *Calamiana* sp. has scales in lateral series about 27, predorsal scales about 7, scales on abdomen as large as those on side on body; *C. magnoris* and *C. kabilia* have scales in lateral series about 30–32, predorsal scales 11–12 (*C. kabilia*) or 15 (*C. magnoris*), scales on abdomen much smaller than those on sides. *Calamiana* sp. has posterior half of dorsal fin with solid black pigment and body with 4–5 broad, broken, vertical dark marks. *Calamiana magnoris* has fins weakly spotted and body more or less uniformly covered with fine melanophores of variable size. *Calamiana kabilia* has median fins with well developed small spots in parallel rows and entire side of body with vertical streak in middle of each scale. Judging from size of specimens examined and degree of sexual dimorphism, *C.* sp. may be a smaller species. The holotype of *C. magnoris* is a male 29.7 mm with sexual dimorphism very weakly developed compared to that of my largest specimens of *C.* sp. The two type specimens of *C. kabilia* are females 32.0–36.0 mm and therefore also far larger than my largest (20.1 mm) female *C.* sp.

Calamiana sp. exhibits pronounced sexual dimorphism of the sort found in many small Indo-Pacific gobiids in which males have greatly enlarged mouths. In males of this species the jaws posteriorly extend well beyond the eye, which is rather large, while in females the jaws do not extend posteriorly even as far as to below its anterior margin. In addition, the cheeks are greatly swollen and heavily ossified or bullate, and lower jaw is very heavily ossified in males. The behavioral significance of this dimorphism, found in many species albeit usually less pronounced, seems to be unknown. As is often the case in such sexually dimorphic gobies, the more extreme examples of which live in fresh water, males are larger than females.

The CAS subset of 59 specimens from Kapuas 1976-39 (84: 8.1–27.8 mm) includes 14 males with more or less marked sexual dimorphism, 18.4–27.2 mm; 7 gravid females 16.2–19.6 (with oval eggs 0.7–1.5 mm long); 12 ripening females 15.0–20.1 mm (with eggs to 0.5 mm long); and 26 sex undetermined 8.1–18.4 mm. The largest female, 20.1 mm, has eggs 0.25 mm long. The largest gravid female, 19.6 mm has exactly 30 eggs, all 1.5 mm long. Observation of this and other females indicates that ovulation is synchronous; the full complement of eggs probably is spawned at once or over a short period of time; i.e., there is total spawning on an individual basis although by no means for populations as a whole.

Mugilogobius Smitt, 1900

Mugilogobius Smitt, 1900:522 (type species *Ctenogobius abei* Jordan and Snyder, 1901, by subsequent designation of Jordan et al., 1913:345).

Three small collections of subadult gobies were obtained in fresh water near the coast during the Kapuas survey of 1976 representing two unidentified species of *Mugilogobius*. The species of this genus are very poorly known (D. Hoese, pers. comm., 1984).

Mugilogobius sp. undet.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-2, 18.1 mm (MZB 3830).

Mugilogobius sp. undet.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-2, 5: 7.8–16.0 mm (CAS 49460, MZB 3831); Kapuas 1976-3, 20.0 mm (MZB 3832).

Pseudogobiopsis Koumans, 1935

Pseudogobiopsis Koumans, 1935:131 (type species *Gobiopsis oligactis* Bleeker, 1875, by original designation)

The Kapuas survey of 1976 obtained a small sample of gobies living in fresh water near the coast identified by D. Hoese as *Pseudogobiopsis*.

Pseudogobiopsis jurongensis (Herre, 1940) new combination

Vaimosa jurongensis Herre, 1940*a*:18 (type locality brook at Jurong, Singapore Island)

MATERIAL EXAMINED.—Malay Peninsula: Singapore Island, brook at Jurong, 23: 18.7–35.9 mm (CAS-SU 32982–3, holotype and paratypes). Western Borneo: Kapuas 1976-3, 6: 15.0–21.6 mm (CAS 49463, MZB 3839)

The Kapuas specimens are very similar to the type specimens from Singapore in almost all respects but a substantial difference in size at sexual maturity should be noted. The Kapuas specimens include a sexually mature male of 21.6 mm and a gravid female of 20.0 mm. The male has cheeks markedly expanded and jaws markedly elongate, extending posteriorly to below pos-

terior margin of eye. The female, with numerous eggs about 0.20 mm diameter, has cheeks not expanded and jaws relatively short. The type series from Singapore comprises 16 mature or maturing males, 26.9–35.9 mm, 3 gravid females, 22.9–24.3 mm; and 3 apparently immature specimens (possibly including spent females) 18.7–23.2 mm. In the males the jaws are more or less elongate, but only specimens of about 30 mm or more have jaws as elongate and cheeks almost as swollen as in the 21.6 mm Kapuas male. The three gravid females all have numerous eggs about 0.15 mm diameter, noticeably smaller than in the gravid Kapuas female.

Pseudogobius Aurich, 1938

Pseudogobius Aurich, 1938:158 (type species *Gobius javanicus* Bleeker, 1856, by original designation).

The Kapuas survey of 1976 obtained a single small goby in fresh water well inland, kindly identified by D. Hoese as a *Pseudogobius*.

Pseudogobius sp. undet.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-51, 16.8 mm (MZB 3840).

Stigmatogobius Bleeker, 1874

Stigmatogobius Bleeker, 1874*b*:323 (type species *Gobius pleurostigma* Bleeker, 1849=*Gobius sadanundio* Hamilton-Buchanan, 1822, by original designation and monotypy).

Stigmatogobius brocki (Herre, 1936)

Vaimosa brocki Herre, 1936:9 (type locality Singapore harbor).

MATERIAL EXAMINED.—Malay Peninsula: Singapore harbor (CAS-SU 30965, holotype). Western Borneo: Kapuas 1976-3, 18: 13.3–34.2 mm (CAS 49464, MZB 3841, USNM 230334); Kapuas 1976-5, 3: 10.4–27.8 mm (CAS 49465, MZB 3842).

Stigmatogobius sp. undet.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-1, 3: 23.1–26.7 mm (CAS 49466, MZB 3843).

In morphology and coloration this species strongly resembles *Stigmatogobius brocki,* but there are obvious differences. Both species have the snout relatively pointed and jaws elongate and nearly horizontal, but in *S.* sp. the snout is moderately pointed and the jaws extend posteriorly to below anterior third of eye, whereas in *S. brocki* the snout is more strongly pointed and the jaws extend posteriorly almost to below posterior border of eye. In both species a vertical dark bar extends ventrally from dorsal fin onto body and there is a triangular peduncular spot (base of triangle vertical, apex directed posteriorly), but in *S.* sp. the vertical dark bar extends well onto abdomen and the peduncular spot is very well defined and restricted to ventral half of caudal peduncle whereas in *S. brocki* the vertical bar is confined to dorsal half of body and peduncular spot less well defined, in middle of peduncle adjacent to or overlapping caudal-fin base. Finally, *S.* sp. has a dark spot in middle of anal-fin base lacking in *S. brocki* but itself lacks fine melanophores evenly covering most of body characteristic of *S. brocki.*

The small East Indian species *Vaimosa* (=*Stigmatogobius*?) *balteata* Herre, 1935 (type locality Waigeu) with a similar dark vertical bar originating on the dorsal fin, differs from *S. brocki* and *S.* sp. in having a very short truncate snout, and a large diagonal dark bar extending posteroventrally from hind border of eye across cheek and gill cover.

Channidae

Channidae or snakeheads are distinguished from other anabantoids by their elongate cylindrical bodies with long, entirely soft-rayed dorsal and anal fins, large mouth with well toothed jaws and palate, and relatively simple labyrinth organ. There are perhaps about 25 species, three in tropical Africa (perhaps constituting an endemic African genus, *Paraphiocephalus* Senna, 1924, as yet poorly characterized), the rest in Asia. All of the Asian species are placed at present in *Channa.* Some species are widely distributed, from the Indian subcontinent to southeast Asia and China, but the majority are endemic to one of these three areas. Southeast Asia has more species than any other area, and the Kapuas with nine species has more than any other river.

Apparently most snakeheads produce pelagic eggs. A nest is made in a swampy area or backwater by making a clearing amidst dense grassy vegetation. The eggs are spawned in the cleared area, float to the surface, and are guarded by one or both parents. A more or less complex system of pathways may be cleared in the grass between the nest and open water. The parents may continue to guard the young until they are 50 mm or longer, and at least in some species the young are highly gregarious and remain in close proximity. In several Asian species juveniles are brightly colored, usually with red or orange on the side of the body, sometimes set off above and below by thin longitudinal black stripes. The size at which this juvenile coloration is lost ranges from about 50 to 450 mm, depending on the species. In at least some species these brightly colored young are highly gregarious and apparently form a dense school or ball if threatened (Breder and Rosen 1966; pers. obs.). See additional remarks under *C. micropeltes.* At least one species (*Channa orientalis*) practices oral brooding (Ettrich 1982).

Channa Scopoli, 1777

Channa Gronovius, 1763:135 (non-binomial; not available for zoological nomenclature according to Opinion 86, ICZN).
Channa Scopoli, 1777:459 (type species *Channa orientalis* Bloch and Schneider, 1801, by subsequent designation or subsequent monotypy of Bloch and Schneider, 1801:lvi, 496)
Ophicephalus Bloch 1794:137 (type species *Ophicephalus punctatus* Bloch, 1794).
Ophiocephalus Hamilton-Buchanan, 1822:59 (emended spelling).
Philypnoides Bleeker, 1849:19 (type species *Philypnoides surakartensis* Bleeker, 1849=*Channa orientalis* Bloch and Schneider, 1801, by monotypy)

For nomenclatural discussion and other information on *Ophicephalus* see Myers and Shapovalov (1931).

Channa bankanensis (Bleeker, 1852)

Ophicephalus bankanensis Bleeker, 1852*f*:726 (type locality Banka)
Ophicephalus bankanensis Vaillant, 1902:13, 16 (Pontianak, Sintang).

MATERIAL EXAMINED.—Western Borneo: Pontianak, 197 mm (RMNH 7869); Sintang, 2: 104–123 mm (RMNH 7870).

The 197 mm specimen from Pontianak has dorsal-fin rays 39, anal-fin rays 29, lateral line scales 69, and rakers on first gill

arch 9; head convex dorsally; an oval black spot on opercle; pectoral fin with round white spots; dorsal surface of head with small round black spots, ventral surface of head and body with even smaller black spots; body with a faint irregular lateral band. It generally resembles the figure of *C. bankanensis* in Bleeker (1875–78, pl. 397, fig. 1).

DISTRIBUTION.—Borneo (Kapuas, Barito). Banka.

Channa lucius Cuvier, 1831

Ophicephalus lucius Cuvier *in* Cuvier and Valenciennes, 1831:416 (type locality Java)
Ophiocephalus polylepis Bleeker, 1852*e*:578 (type locality "Solok, Sumatrae occidentalis, in fluviis"). See Weber and de Beaufort (1922:327).
Ophiocephalus bistriatus Weber and de Beaufort, 1922:322 (type locality Sungei Manggar, Balikpapan; Sarawak). See Alfred (1964*b*).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-1, 105 mm (MZB 3909); Kapuas 1976-8, 22.1 mm (MZB 3910); Kapuas 1976-13, 108: 31.6–39.0 mm (CAS 49488, MZB 3911, USNM 230348); Kapuas 1976-19, 198 mm (MZB 3912); Kapuas 1976-39, 129 mm (MZB 3913); Kapuas 1976-51, 120 mm (MZB 3914).

Channa marulioides (Bleeker, 1851)

Ophicephalus marulioides Bleeker, 1851*i*:424 (type locality "Sambas, in fluviis").

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-20, 172 mm (MZB 3915)

DISTRIBUTION.—Sumatra (Deli, Djambi). Borneo (Sambas, Bankayan, Kapuas). Banka. Billiton.

Channa melanoptera (Bleeker, 1855)

Ophicephalus melanopterus Bleeker, 1855*d*:420 (type locality "Pontianak, in flumine Kapuas")

MATERIAL EXAMINED.—None

DISTRIBUTION.—Sumatra (Palembang, Indragiri, Gunung Sahilan, Djambi). Borneo (Kapuas).

Channa melasoma (Bleeker, 1851)

Ophicephalus melasoma Bleeker, 1851*i*:424 (type locality Sambas).
Ophicephalus rhodotaenia Bleeker, 1851*i*:425 (type locality Sambas). See Weber and de Beaufort (1922:319–320)
Ophicephalus mystax Bleeker, 1853*d*:188 (type locality Banka)
Ophiocephalus melanosoma Günther, 1861:473
Ophiocephalus baramensis Steindachner, 1901:3435 (type locality Baram).

MATERIAL EXAMINED.—Western Borneo: Raoen, Kapuas basin, 5: 105–178 mm (RMNH 7862)

DISTRIBUTION.—Thailand (Menam Mun). Sumatra (Palembang, Labat, Gunung Sahilan, Ringgat, Laut Tador, Langkat). Borneo (Baram, Gambas, Sadong, Kapuas, Jesselton, Tempasuk, Kinabatangan). Banka. Palawan Archipelago.

Channa micropeltes (Cuvier, 1831)

Ophicephalus micropeltes Cuvier *in* Cuvier and Valenciennes, 1831:427 (type locality Java)
Ophicephalus serpentinus Cuvier *in* Cuvier and Valenciennes, 1831:429 (type locality Siam)
Ophicephalus bivittatus Bleeker, 1845:519 (type locality Batavia)
Ophicephalus Stevensii Bleeker, 1853*c*:444 (type locality Pontianak and Moara Kempeh)
Ophiocephalus diplogramme Day, 1865*a*:36 (type locality Cochin); Day, 1865*b*: 147, pl. 10
Ophiocephalus studeri Volz, 1903*a*:553 (type locality Palembang)

MATERIAL EXAMINED.—Western Borneo: Kapuas near Putus Genteng, 183 mm (ZMA 114.391); Kapuas near Sanggau, 130 mm (RMNH 26932).

Channa micropeltes, attaining nearly a meter in length and more than 20 kg, is the largest member of the family Channidae. According to Smith (1945:474) it is very savage in guarding its nest and eggs and will even attack human beings if its nest is approached. It is also highly destructive of other fishes, consuming fishes of all kinds and sizes and killing far in excess of its actual needs. As first noted by Day (1876), this species undergoes one of the most profound color transformations of any Asian freshwater fish. Young from about 30 mm to as large as 450 mm have a pair of dark longitudinal stripes extending the length of the head and body to the end of the caudal fin. These bands are usually reported as black but in some 50–60 mm fish observed by me in Thailand they were vivid ultramarine blue. The interspace between these lines is scarlet or bright orangish-red. In larger individuals this coloration is entirely replaced. A basically similar but less colorful color change occurs in *C. striata* but at much smaller sizes.

DISTRIBUTION.—West coast of southern India (Malabar, Canara, Trichoor, mouth of Cochin R.). Burma?. Thailand. Malay Peninsula. Sumatra (Palembang, Lahat, Muara Kompeh, Gunung Sahilan, Djambi, Laut Tador, Danau Kota, Danau baru, Lake Toba). Borneo (Montrado, Sambas, Kapuas, Barito, Prabukarto). Java (Batavia, Tjibiliong, Lelles, Samarang). Banka. Billiton.

Channa orientalis Bloch and Schneider, 1801

Channa orientalis Bloch and Schneider, 1801:496, pl. 90, fig. 2 (type locality "India orientali")
Ophiocephalus gachua Hamilton-Buchanan, 1822:68, 367, pl. 21, fig. 21 (type locality ponds and ditches of Bengal).
For additional synonymy see Weber and de Beaufort (1922) and De Witt (1960).

Pectoral fins with a series of curved vertical bars, typically six in number, bar nearest fin-base often expanded into a large basal blotch. Dorsal, anal, and caudal fins sometimes dusky or dark (even black) with a thin white margin; dark portion of median fins sometimes with faint vertical bars.

Channa pleurophthalmus (Bleeker, 1851)

Ophicephalus pleurophthalmus Bleeker, 1851*c*:270 (type locality "Bandjermassing, in fluviis")
Ophicephalus urophthalmus Bleeker, 1852*d*:578 (type locality "Palembang, in fluviis"). See Bleeker (1879:49).
?*Ophicephalus spiritalis* Fowler, 1904:530 (type locality Padang). See Weber and de Beaufort (1922:324–325)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-20, 4: 159–263 mm (CAS 49489, MZB 3916, USNM 230349); Kapuas 1976-32, 127 mm (MZB 3917).

DISTRIBUTION.—Sumatra (Palembang, Djambi, Padang?). Borneo (Kapuas, Barito).

Channa striata (Bloch, 1793)

Ophicephalus striatus Bloch, 1793:141, pl. 359 (type locality Malabar)
For additional synonymy see Weber and de Beaufort (1922:317).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-2, 44.8 mm (MZB 3918); Kapuas 1976-43, 103 mm (MZB 3919).

Channa striata is a very important food fish and its range undoubtedly has been expanded by introductions. It is now

found throughout most of the East Indies, the Malay Peninsula, and Thailand, and in India, Sri Lanka, and the Philippines.

Anabantidae

The anabantoid family Anabantidae or climbing perches comprises three genera, *Ctenopoma* and *Sandelia* in Africa and *Anabas* in Asia.

Anabas Cuvier, 1816

Anabas Cuvier, 1816:339 (type species *Anthias testudineus* Bloch, 1795, by monotypy).

Anabas testudineus (Bloch, 1795)

Anthias testudineus Bloch, 1795:121 (type locality Japan, southern India).
Perca scandens Daldorff, 1797:62 (not seen by me).
Anabas testudineus Cuvier, 1816:339.
Anabas scandens Vaillant, 1902:13 (Pontianak).
For additional synonymy see Weber and de Beaufort (1922:334).

MATERIAL EXAMINED.—Western Borneo: Pontianak, 88.8 mm (RMNH 7873).

Anabas, the climbing perch, now generally regarded as comprising a single species, is exceptionally variable. Body form varies from oval and compressed to elongate and subcylindrical. Meristic variation has also been noted (e.g., Weber and de Beaufort 1922:336 on geographical variation in number of dorsal-fin spines). Further study may reveal more than one species (see Dutt and Ramaseshaiah 1980, 1983).

Anabas are among the hardiest of fishes. The suprabranchial cavity is exceptionally large and the labyrinth it contains is complexly folded. In some of the more elongate subcylindrical morphs the paired suprabranchial cavities are so greatly enlarged that they are externally evident as bulla-like swellings on the dorsal surface of the skull.

Belontiidae

The family Belontiidae, although currently recognized, probably is not distinct from the next family, Osphronemidae. As currently understood, Belontiidae is the largest and most diverse family of anabantoids, with 11 genera and more than 30 species, and is distributed throughout the Indian subcontinent, southeast Asia, and much of China. Five genera and 11 species are known from western Borneo.

The belontiid *Trichopsis vittata* (Cuvier *in* Cuvier and Valenciennes, 1831) is recorded from Sintang by Weber and de Beaufort (1922:351). Presumably this is based on the listing of its junior synonym *Osphromenus striatus* (Bleeker, 1850) from "le Kapoeas de Sintang jusque Boenoet" by Popta (1906:255). I know of no other records of this otherwise common and rather widely distributed southeast Asian species from western Borneo, and doubt that it occurs there. Popta's record presumably would have been based upon material collected by the Dutch expeditions to central Borneo of 1896–1900 and deposited in the RMNH. A recent search for this material has been unsuccessful (M. S. Hoogmoed, pers. comm., August 1984).

Belontia Myers, 1923

Belontia Myers, 1923:63 (type species *Polyacanthus hasselti* Cuvier *in* Cuvier and Valenciennes, 1831, by original designation)

This genus includes two species and has a disjunct distribution, with *B. hasselti* in the East Indies and Thailand and *B. signata* (Günther, 1861) in Sri Lanka. *B. signata* is recorded from Java by Day (1878:371) and Jayaram (1982:382) but the basis of this record is not stated; the species was not mentioned from Java by Bleeker or by Weber and de Beaufort (1922).

Belontia hasselti (Cuvier, 1831)

Polyacanthus Hasselti Cuvier *in* Cuvier and Valenciennes, 1831:353 (type locality Java).
Polyacanthus Kuhli Bleeker, 1845:520 (nomen nudum).
Polyacanthus Einthovenii Bleeker, 1851*c*:423 (type locality "Sambas, Borneo occidentalis, in fluviis")
Polyacanthus Helfrichii Bleeker, 1855*a*:162 (type locality "Bandjermasin, in fluviis")
Belontia hasselti Myers, 1923:63

MATERIAL EXAMINED.—Kapuas 1976-4, 62.5 mm (MZB 3844); Kapuas 1976-16, 3: 40.1–67.1 mm (CAS 49467, MZB 3845).

DISTRIBUTION.—Malay Peninsula (Perak, Johore, Singapore). Sumatra (numerous localities cited by Weber and de Beaufort 1922:339), Borneo (Sambas, Kapuas, Kahajan, Barito). Java.

Betta Bleeker, 1850

Betta Bleeker, 1850:12 (type species *Betta trifasciata* Bleeker, 1850=*Panchax pictum* Valenciennes *in* Cuvier and Valenciennes, 1846, by monotypy).
Micracanthus Sauvage, 1879:95 (type species *Micracanthus marchei* Sauvage, 1878=*Betta splendens* Regan, 1910, by monotypy). See Roberts (1981).
Parophiocephalus Popta, 1905:184 (type species *Parophiocephalus unimaculatus* Popta, 1905, by monotypy)
Oshimia Jordan, 1919:342 (unneeded replacement name for *Micracanthus* Sauvage, 1878, supposed by Jordan to be preoccupied by *Microcanthus* Swainson, 1839).
Pseudobetta Richter, 1981:273 (type species *Betta pugnax* Cantor, 1849, by original designation)

It has long been recognized that some species of *Betta* are oral brooders while others are bubble nesters. Whether all species fall neatly into one of these two categories is not yet known, however. Recently, Richter has proposed that the bubble nesting species should be left in the genus *Betta* and proposed a new genus, *Pseudobetta*, for the oral brooders. This is contraindicated because the type species of *Betta*, *B. picta*, is itself an oral brooder (Vierke 1981; Richter 1983). Another problem which argues against the designation of a separate genus for the substrate spawners is the probability that oral brooding and substrate spawning are not evolutionary "fixed" or stable characters in *Betta* but have been selected for repeatedly in different species. In this case generic division of *Betta* based on brood care would inevitably result in polyphyletic taxa and an unnatural classification. At least for the time being it seems best to recognize only a single genus, *Betta*, of which there seem to be about 15 species, some oral brooders and others substrate spawners.

With the notable exception of the long-jawed and very distinctively colored *B. macrostoma*, preserved specimens of *Betta* are notoriously difficult to identify to species. Some have distinctive coloration in life, but color is difficult to use because it is so changeable depending on sex, maturity, reproductive condition or "emotional" state, perhaps geographical variation, and certainly variation related to method of preservation. Meristic characters are of little help because the genus is morphologically relatively conservative, and probably because species vary geo-

TABLE 14. FREQUENCIES OF VERTEBRAL COUNTS IN *BETTA*. For definition of vertebral counts see p. 22.

	Abdominal			Caudal							Total							
	9	10	11	18	19	20	21	22	23	24	28	29	30	31	32	33	34	35
B. akarensis Regan, 1910 (Akar R., holotype)		1						1							1			
B. anabatoides Bleeker, 1850 (Kapuas 1976-23)		1	6				5	2							6	1		
B. coccina Vierke, 1979 (Djambi, types)	3					1	2					1	2					
B. dimidiata new species (Kapuas, types)		57	2		11	47	2					9	47	2				
B. foerschi Vierke, 1979 (Mentaya R., types)		3					2	1						2	1			
B. macrostoma Regan, 1910 (Brunei near Labi)		2						2							2			
B. pugnax Cantor, 1850 (Penang)		15	2		1	13	3						14	3				
B. pugnax Cantor, 1850 (Kapuas)		10		1	7	2					1	7	2					
B. cf. *taeniata* Regan, 1910 (Kapuas 1976-1)		11				11							11					
B. unimaculata (Popta, 1906) (Balung R.)			8					5	2	1						5	2	1

graphically more than generally recognized. Thus the largest and smallest species of *Betta* have almost identical counts of fin rays and scales. Species distinctions based on presence or absence of small spines in the dorsal and anal fins and the number and thickness of such spines are not so reliable as previously supposed by some workers. Differences in morphometric features such as body proportions (particularly head length and body depth) and fin shapes seem to distinguish certain species but are difficult to define objectively and may vary geographically. Vertebral counts have not been used previously in defining species, and I have gathered some data to see whether they might be helpful (Table 14). The frequencies of vertebral counts seem to be very distinctive for *B. unimaculata,* and help to distinguish *B. dimidiata* new species. In the present state of knowledge it is not possible to discuss with confidence the geographical distribution of the commoner and more widely distributed species of *Betta.* On the other hand, within single river basins, where four or more species may occur, they can usually be more or less readily distinguished by differences in color and morphology, although the species names which should be applied may be in doubt. There are four species in western Borneo.

Betta anabatoides Bleeker, 1851

(Figure 129a)

Betta anabatoides Bleeker, 1851c:269 (type locality "Bandjermassing, in fluviis").

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-1, 2: 46.8–59.6 mm (BMNH 1982.3.29.229, MZB 3846); Kapuas 1976-23, 8: 23.3–43.4 mm (CAS 49468, MZB 3847, RMNH 28916, USNM 230335); Kapuas 1976-30, 59.2 mm (MZB 3848).

Betta dimidiata new species

(Figure 130)

Betta akarensis Vierke, 1983:166 (Kapuas).

HOLOTYPE.—MZB 3849, 31.7 mm (ripening female), Kapuas basin, Sungai Seriang, 37 km W of Putussibau (Kapuas 1976-42).

PARATYPES.—CAS 49469 (9), MZB 3850 (3), 12: 22.4–30.2 mm, same locality as holotype; MZB 3851 (2), USNM 230336 (7), 9: 16.8–28.9 mm, Kapuas basin, Sungai Tekam on right side of Kapuas mainstream 5–6 km upstream from Sanggau (Kapuas 1976-16); CAS 49470 (3), MZB 3852 (1), 4: 20.9–34.3 mm, Kapuas basin, small streams flowing into Kapuas mainstream within 10 km of Sanggau (Kapuas 1976-17); BMNH 1982.3.29.230–235 (6), FMNH 94251 (6), MNHN 1982-718 (5), MZB 3853 (7), 24: 9.5–23.3 mm, Kapuas basin, Danau Piam near Ketungau, 38 km NNE of Sintang (Kapuas 1976-32); CAS 49471 (2), MZB 3854 (1), 3: 23.6–35.0 mm, Kapuas basin, Sungai Mandai Ketchil near confluence with Kapuas mainstream 18 km WSW of Putussibau (Kapuas 1976-39); MZB 3855 (1), RMNH 28917 (2), 3: 27.0–29.0 mm, Kapuas basin, small oxbow lake opposite Empangau, 124 km NE of Sintang (Kapuas 1976-43); MZB 3856 (1), USNM 230337 (5), 6: 23.0–28.5 mm, Kapuas basin, Sungai Gentu where it flows into Kapuas mainstream 55 km NE of Sintang (Kapuas 1976-46); CAS 49472 (6), MZB 3857 (1), 7: 20.7–24.8 mm, Kapuas basin, small forest stream flowing into Kapuas mainstream NE of Gunung Setunggul, 53 km NW of Sintang (Kapuas 1976-47); MZB 3858 (1), UMMZ 209927 (5), 6: 14.3–27.4 mm, Kapuas basin, small forest stream near Tajan, 87 km E of Pontianak (Kapuas 1976-51).

DIAGNOSIS.—*Betta dimidiata* is possibly the smallest species of *Betta* (largest of 75 specimens from nine samples only 35.0 mm); scales in lateral series 27–29; transverse scale rows 8–9, apparently fewer than in any other species (with no "half scales" or with at most one interposed scale on dorsal-fin base and one on anal-fin base); dorsal-fin origin opposite 11th–14th scale in lateral series; scales between eyes 2 or 3; dorsal fin with 1–3 (usually 2) and anal fin with 1–2 (usually 1) spines; total dorsal-fin elements 9–11, anal 23–27; pectoral-fin rays 12–15; vertebrae 10 (rarely 11)+19–21=29–31, with a strong mode at 30 (Table 14).

Nearly all *Betta* species have at least 11 transverse scale rows. The species nearest *B. dimidiata* in this character apparently is *Betta akarensis* Regan, 1910, which may also be its closest relative. The holotype of *B. akarensis* has 10 transverse scale rows on the body proper plus a row of sheath scales along the dorsal fin and the anal fin giving a total count of 12 if these are included; the number of scales from the gill opening to below the dorsal fin seems to be 12 or 13 (as in *B. dimidiata*), but these are difficult to count because some scales are missing on both sides (I am indebted to O. Crimmen and A. Wheeler for scale counts on the holotype of *B. akarensis*). In fin formulae and vertebral counts *B. akarensis* again differs from *B. dimidiata.* As indicated by Regan (1910:779), and confirmed by examination of radiographs, the holotype of *B. akarensis* has no dorsal-fin spines, and only a single anal-fin spine; the total number of dorsal-fin supporting elements is 8 (one less than in any specimens of *B. dimidiata*) and of anal-fin elements 28 (one more than in *B. dimidiata*); this is correlated with the scale count of 31 reported by Regan, also higher than observed in *B. dimidiata.* The number of scales between the eyes is also fewer in *B. dimidiata* than in other *Betta* I have examined, but comparative data for this character are not available for *B. akarensis* and most other species. *Betta akarensis* probably attains a larger size than *B. dimidiata*; the holotype and only known specimen is 37.0 mm.

Frequencies of vertebral counts in *B. dimidiata* are presented in Table 14. Frequencies of dorsal-fin elements are 9(25), 10(36), 11(4) and of anal-fin elements 23(3), 24(11), 25(31), 26(23),

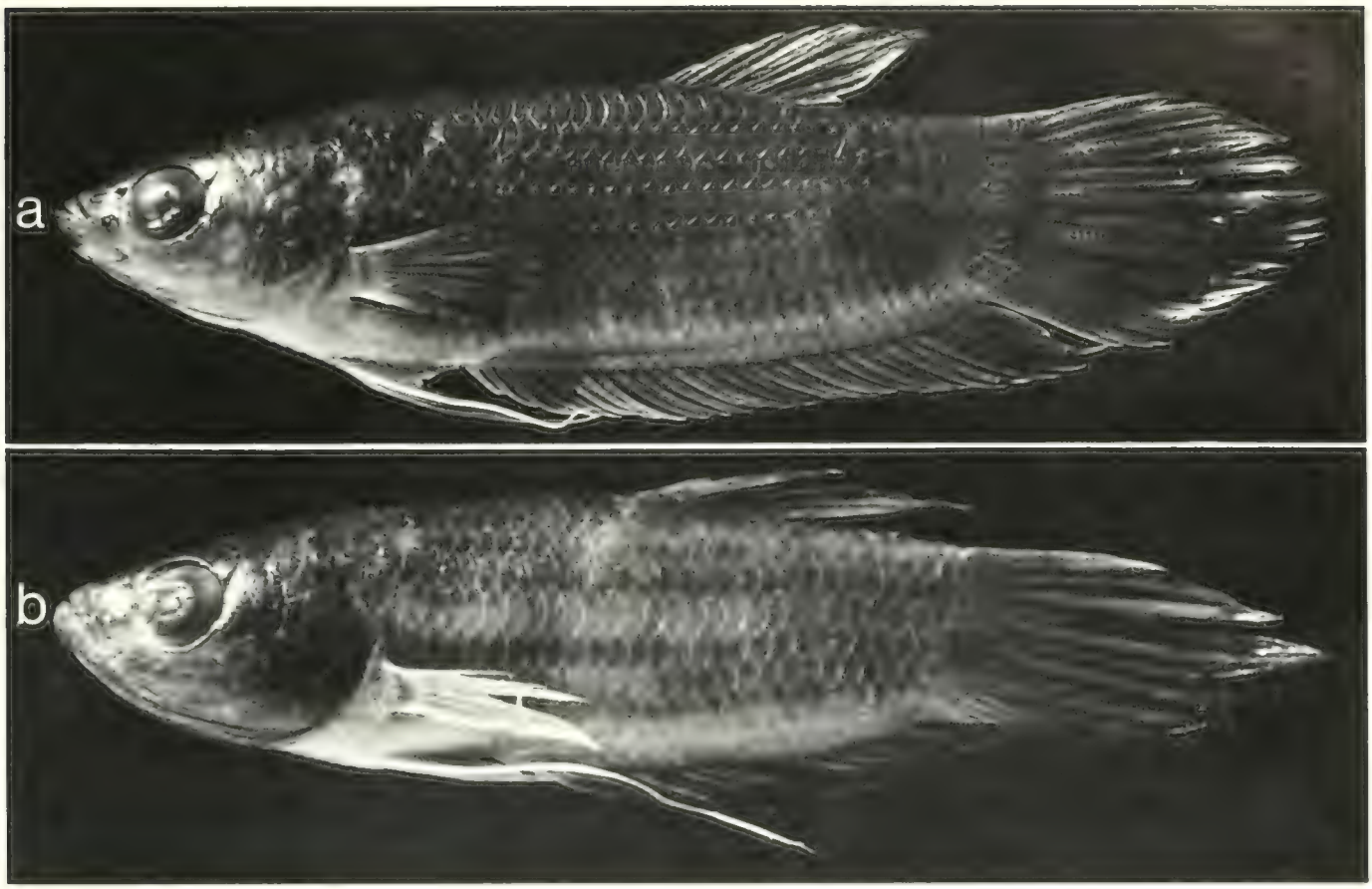

FIGURE 129. *Betta*. a, *B. anabatoides*, Kapuas 1976-1, 59.6 mm (MZB 3846); b, *B. pugnax*, Kapuas 1976-51, 46.8 mm (MZB 3866).

27(2). Head length 2.7–2.9; eye diameter 9.7–10.9; bony interorbital width 11.7–12.6; snout 11.6–14.1, mouth extending posteriorly to a point below and slightly in front of anterior margin of eye; body depth at dorsal-fin origin 4.2–4.7. Filamentous ray of pelvic fin in both sexes extending posteriorly about one-third or at most one-half of length of anal-fin base. Anal fin with filamentous termination extending to below about middle of caudal fin in both sexes. Caudal fin not notably rounded or expanded, upper rays extending slightly beyond lower rays in some specimens.

Body usually with one or sometimes two broad longitudinal dusky stripes or in some specimens (males?) with three somewhat narrower and darker longitudinal stripes. Female holotype with a single broad stripe commencing below snout-tip (continuous around chin), extending across opercular region and on ventral half of body to caudal-fin base; this stripe is narrower but better defined on head. Some specimens have a second broad longitudinal stripe beginning behind head and extending length of body; this is usually somewhat less well defined than stripe on ventral half of body. Some specimens have a longitudinal stripe on head below eye which does not extend onto body, while in a few this extends as a third narrow stripe for entire length of body. Dorsal-, anal-, and caudal-fin rays and interradial membranes with more or less numerous, uniformly distributed (crowded or contacting) and very numerous (crowding or contacting each other) chromatophores (reddish or reddish-brown in life?). Mode of brood care unknown.

ETYMOLOGY.—The name *dimidiata* (Latin, halved or diminished) refers to the small size of the species.

Betta pugnax (Cantor, 1850)

(Figure 129b)

Macropodus pugnax Cantor, 1850:1066 (type locality Pinang, Malay Peninsula).
Betta pugnax Regan, 1910:779
Pseudobetta pugnax Richter, 1981:273

MATERIAL EXAMINED.—Malay Peninsula: Pinang, 18: 27.4–63.0 mm (CAS-SU 33181). Western Borneo: Kapuas 1976-6, 2: 32.4–46.1 mm (CAS 49473, MZB 3859); Kapuas 1976-13, 32.8 mm (MZB 3860); Kapuas 1976-16, 2: 14.6–18.6 mm (CAS 49474, MZB 3861); Kapuas 1976-17, 3: 25.3–56.8 mm (BMNH 1982.3.29.236–237, MZB 3862); Kapuas 1976-37, 5: 12.7–46.4 mm (MZB 3863, USNM 230338); Kapuas 1976-39, 10: 39.2–59.8 mm (MNHN 1982-719, MZB 3864, RMNH 28918); Kapuas 1976-42, 2: 41.5–50.0 mm (MZB 3865, UMMZ 209908); Kapuas 1976-51, 2: 37.6–46.8 mm (MZB 3866, ZMA 116.547)

Comparison of the well preserved Kapuas and Pinang samples reveals their close similarity in all respects and no reason to doubt their conspecificity. In large males of this oral brooding species from Penang and from Kapuas the gill cover and entire ventral portion of head (including branchiostegal membranes) is very darkly pigmented.

Betta cf. **taeniata** Regan, 1910

Betta taeniata Regan, 1910:781 (type locality River Senah, Sarawak)
?*Betta edithae* Vierke, 1984:60 (type locality Barito Delta bei Banjarmasin)

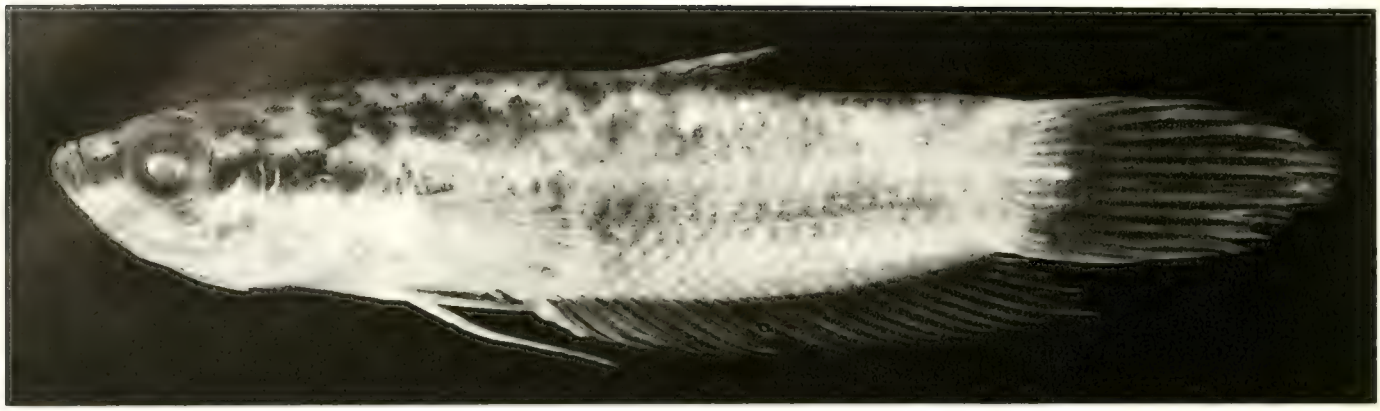

FIGURE 130 *Betta dimidiata*. Kapuas 1976-42, 31.7 mm female (MZB 3849, holotype).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-1, 31: 22.5–46.7 mm (BMNH 1982.3.29.238–241, CAS 49475, MNHN 1982-720, MZB 3867, RMNH 28919, USNM 230339); Kapuas 1976-4, 5: 17.7–31.8 mm (MZB 3868, UMMZ 209852); Kapuas 1976-5, 34.9 mm (MZB 3869); Kapuas 1976-7, 35.5 mm (MZB 3870); Kapuas 1976-8, 12: 17.3–34.2 mm (CAS 49476, MZB 3871)

This species is distinguished from other Kapuas *Betta* by having regularly punctuated dark marks on the interradial membranes of the dorsal and caudal fins (particularly marked on the latter). Most specimens have up to five interrupted longitudinal stripes on the body, the lowermost two characteristically joining or fusing together on about the posterior one-third of the body. Scales between eyes about 5.

Betta edithae is distinguished from *B. taeniata* mainly by having its anal fin with ii27–28 instead of only ii20–22 rays. My material from Kapuas 1976-1 has anal-fin rays ii26(2), ii27(3), ii28(3), ii29(3) and thus in this respect agrees with the description of *B. edithae* better than with that of *B. taeniata*. Clearly more information is needed on geographical distribution and meristic variation in these species, one or both of which must be very widely distributed.

Parosphromenus Bleeker, 1879

Parosphromenus Bleeker, 1879:19 (type species *Osphromenus deissneri* Bleeker, 1859, by monotypy)

Parosphromenus includes four species: *P. deissneri* from the Malay Peninsula, Banka, and western Borneo; *P. filamentosus* Vierke, 1981 (closely related to *P. deissneri*), from southeastern Borneo; *P. paludicola*, from the Malay Peninsula at Trengganu; and *P. parvulus* from western and southeastern Borneo. The genus presumably occurs in Sumatra but has not been reported there, presumably due to insufficient collecting of small fishes in suitable habitats. Meristic data on the species are presented in Table 15.

Parosphromenus deissneri (Bleeker, 1859)

Osphromenus Deissneri Bleeker, 1859*b*:377 (type locality Banka).
Parosphromenus Deissneri Bleeker, 1879:20

MATERIAL EXAMINED.—Malay Peninsula: Johore, 2: 20.7–26.4 mm (CAS-SU 34833); Johore, Kulai, 2: 19.8–19.9 mm (CAS-SU 39449). Western Borneo: Kapuas 1976-4, 24.7 mm (MZB 3872); Kapuas 1976-5, 12: 12.4–24.5 mm (CAS 49477, MZB 3873, USNM 230340); Kapuas 1976-7, 4: 9.3–23.0 mm (MZB 3874, RMNH 28920); Kapuas 1976-8, 3: 16.9–25.6 mm (BMNH 1982.3.29.242–243); Kapuas 1976-51, 22.6 mm (MZB 3875)

DISTRIBUTION.—Malay Peninsula (Malacca, Johore). Western Borneo (Kapuas). Banka.

Parosphromenus parvulus Vierke, 1979

(Figure 131)

Parosphromenus parvulus Vierke, 1979:247 (type locality "Mentaya-Flüss-System, 250 km nordwestlich von Banjarmasin")

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-4, 16.8 mm (MZB 3876); Kapuas 1976-5, 2: 18.9–19.6 mm (CAS 49478, MZB 3877)

TABLE 15 MERISTIC CHARACTERS IN *PAROSPHROMENUS*

	Dorsal-fin spines+rays	Anal-fin spines+rays	Scales in lateral series
P. deissneri			
Johore (CAS 34833)	11–12+7=18–19	12+10=22	27–28
Kapuas	12+6–7=18–19	11–12+9–11=21–23	28–29
Bangka (holotype, after Bleeker)	13+7=20	13+9=22	30
P. filamentosus			
SE Borneo (types, after Vierke)	12–13+6–7=19–20	11–12+10=21–22	29–30
P. paludicola			
Trengganu (types, after Tweedie)	17–18+6–7	15+7=22	30
P. parvulus			
Kapuas	10+6=16	7+12–13=19–20	26–27
Mentaya (types, after Vierke)	10–11+7=17–18	8–9+10–11=18–20	26–27

FIGURE 131 *Parosphromenus*. Above, *P. parvulus*, Kapuas 1976-4, 16.8 mm (MZB 3876); below, *P. deissneri*, Kapuas 1976-5, 21.9 mm (CAS 49477)

DISTRIBUTION.—Known only from Borneo (Kapuas, Mentaya).

Sphaerichthys Canestrini, 1860

Sphaerichthys Canestrini, 1860:707 (type species *Sphaerichthys osphromenoides* Canestrini, 1860, by monotypy)

Small, body deep, compressed. Jaws with very small, fixed teeth. Dorsal-fin spines 6–10; anal-fin spines 7–11. Pectoral-fin rays 10–12. Scales in lateral series 28–30. Preorbital and preopercle serrate, other head bones non-serrate. Lateral line vestigial or absent. Swim bladder extending almost to caudal fin, obliquely truncate posteriorly. Pelvic fin with a spine and five well developed rays; first ray sometimes very elongate. Caudal fin obliquely truncate, caudal-fin rays 7–8+7–8=14–16. Total vertebrae 25–28.

This distinctive anabantoid genus comprises four species (all present in Borneo): *S. osphromenoides, S. vaillanti, S. acrostoma* Vierke, 1979, and *S. selantanensis* Vierke, 1979 (originally described as a subspecies of *S. osphromenoides* but here treated as a full species). *S. osphromenoides* occurs in Malay Peninsula, Sumatra, and Borneo; the other three are known only from Borneo. *S. osphromenoides* and *S. vaillanti* occur in western Borneo (Kapuas) and are treated in more detail in the following pages. The key provided here includes all of the species but is based on relatively few specimens.

Key to *Sphaerichthys*

1a Body relatively deep; snout short; dorsal-fin origin almost directly above anal-fin origin; total dorsal-fin elements 15–20; anal-fin spines 7–9; total vertebrae 25–26 2

1b Body relatively elongate; snout elongate; dorsal-fin origin considerably posterior to a vertical through anal-fin origin; total dorsal-fin elements 13–15; anal-fin spines 10–11; total vertebrae 27–28 3

2a Dorsal-fin spines 8–11; no pale vertical bar extending from dorsal-fin origin to just behind pelvic-fin origin; no

pale longitudinal stripe extending length of body ..... *S. osphromenoides*

2b Dorsal-fin spines 7; pale vertical bar extending from dorsal-fin origin to just behind pelvic-fin origin; pale longitudinal line extending length of body (known only from Barito) ..... *S. selatenensis*

3a Ventral two-thirds of body with 6–8 vertical or slightly oblique dark bars; anal-fin rays 16–18 ..... *S. vaillanti*

3b Body without 6–8 dark bars; anal-fin rays 20–21 (known only from Mentaya) ..... *S. acrostoma*

Sphaerichthys osphromenoides sensu Regan, 1910

?*Sphaerichthys osphromenoides* Canestrini, 1860:707 (type locality "aus Indien").
Osphromenus malayanus Duncker, 1904:163, table 1, fig. 8 (type locality Kuala Lumpur).
Sphaerichthys osphromenoides Regan, 1910:776.

Material Examined.—Malay Peninsula: Kuala Lumpur, 3: 19.4–33.3 mm (HZM 8510, syntypes of *O. malayanus*); Simpang Rengam, Johore, 42.2 mm (CAS-SU 39451); Kulia, Johore, 18: 14.4–37.4 mm (CAS-SU 39450); Kota Tinggi, Johore, 2: 24.9–25.4 mm (CAS-SU 33864); Singapore, 22: 13.0–32.3 (CAS-SU 19993). Sumatra: Taluk, 2: 28.7–30.6 mm (ZMA 114.386); Bagan Api Api, 14: 19.9–34.9 mm (ZMA 114.385); Gunung Sahilan, 13: 10.4–28.2 mm (ZMA 114.384); Djambi, Batang Hari, 30.8 mm (ZMA 114.387). Borneo: Kapuas 1976-4, 23.9 mm (MZB 3878); Kapuas 1976-5, 5: 12.1–29.9 mm (CAS 49479, MZB 3879, USNM 230341)

Having made direct comparisons of specimens of this species with the types of *S. osphromenoides selatanensis*, I am inclined to regard the latter as a distinct species. In addition to the characters indicated in the key above, *S. selatanensis* has a thicker head, wider mouth, and blunter snout than *S. osphromenoides* of the same size.

Sphaerichthys osphromenoides carries the eggs in its mouth, as I myself once observed during fieldwork in Johore. The reproductive and parental behavior of its congeners is unknown.

Important Note.—It is conceivable that Regan's identification of *Sphaerichthys osphromenoides* Canestrini, 1860 is incorrect, and that the species under consideration here should be known as *Sphaerichthys malayanus* (Duncker, 1904). Canestrini's original description may be translated as follows:

> *Sphaerichthys* mihi nov. gen. moderately long dorsal fin originating over the origin of the anal fin; anal fin longer [than dorsal] and joined with the caudal fin. First soft pelvic-fin ray only slightly elongated, the others normally developed, not rudimentary. Pectoral fins normally developed, caudal fin pointed (acuminate). Opercle entire, preopercle with spines at angle and on its horizontal margin. Subopercle and interopercle margins entire, preorbital spiny. Mouth opening small, mouth protrusible. Jaw teeth uncommonly small, barely visible; vomer and palate smooth (toothless). Head and nape covered with scales, scales of nape finely ciliate (ctenoid). Small pores on head. Lateral line consisting of a row of fine pores barely visible to the naked eye. Six gill rakers. Two nostrils on each side, nostrils separated from each other by less than their diameter. Labyrinth organ originating from some of the anterior gill arches, with dorsoanteriorly projecting leaflets (laminae)
>
> Swim bladder ("shining through") extending up to tail (tail fin?) Dorsal profile of head (stirnprofil) slightly concave. A true intermediate genus (connecting link) between *Osphromenus* and *Trichopodus*
>
> *Sphaerichthys osphromenoides* mihi
>
> Head 2-1/2 in body length (without caudal). Eye diameter 3-1/2 in head length and greatest depth of body 1-2/5 in length without caudal. Number of scales in a longitudinal row from opercle to caudal about 26, in a transverse row at the greatest depth about 12
>
> The dorsal and anal spines are laterally compressed and increasingly longer posteriorly. Judging from the strongly stained alcohol specimens the ground color is dark brown (castanienbraun), the fins except the pectoral are dark. Dorsal half of body at caudal-fin base with a dark spot. Two white cross-bars (vertical bars) on posterior half of body extending between the dorsal and anal fins, of which the first ends at the base of last three anal-fin spines and the second at base of 7th–10th anal-fin soft-rays. The lower half of the second white bar is banded (eingefasst) by two dark marks, which barely extend dorsally to the lateral line.
>
> The two specimens of this species at hand come from the Indies and their length without caudal measures not quite 1-1/2 Viennese inches and their greatest height almost 10 lines.

Regan (1909:776), without comment and without examining Canestrini's types, placed *O. malayanus* in the synonymy of *S. osphromenoides*. Duncker (1904:164) suggested that the differences between his description of *Osphromenus malayanus* and Canestrini's of *Sphaerichthys osphromenoides* might be due to racial differentiation or inaccurate observation; this probably influenced Regan. I am inclined to credit the accuracy of Canestrini's observations; now that several species of *Sphaerichthys* are known it seems likely that Canestrini's and Duncker's specimens belong to different species. The original description does not permit identification of *Sphaerichthys osphromenoides* Canestrini, 1860 with any known species. Although some parts of the description agree with *Sphaerichthys* and *S. osphromenoides* of Regan et seq., other points contradict this conclusion. The strongest of these are:

1. Dorsal-fin spines 12 (vs. 7–10).
2. Depth of body 1-2/5 in length of body without caudal (vs. more than 2).
3. Transverse scale rows 12 (vs. 14–15).

Some other seeming discrepancies should be commented upon. The expanded caudal fin is obliquely truncate, but when the caudal-fin rays are adpressed may appear to be acuminate. Canestrini's remarks seem to imply that his fish has a complete lateral line; if so, it is unlike any known species of *Sphaerichthys* sensu Regan, 1909, in which lateral line is absent or is represented by a few pored scales on the posterior half of the body.

Canestrini remarked on the possible identity of his *Sphaerichthys osphromenoides* with the poorly known "*Osphromenus notatus* K.v.H." and *Ctenops nobilis* McClelland, specimens of which were unavailable for him to examine. The former is probably based on young *Osphromenus goramy*, while the latter is a valid genus and species differing in numerous respects from the fishes under consideration (see Liem 1965). But the comparison with "*O. notatus*" with "dorsal fin 13/11" strongly suggests that the notation "D 12/7-8" for *S. osphromenoides* is not a typographical error.

The two type specimens (syntypes) of *S. osphromenoides* presumably are deposited in the Naturhistorisches Museum Wien, the ichthyological types and other material of which are temporarily unavailable for study. Mr. Harald Anhelt searched unsuccessfully in the NMW for the syntypes of *S. osphromenoides* in June 1984.

Distribution.—Malay Peninsula (Negri Sembilan, Johore). Sumatra (Bagan Api Api, Batang Hari, Djambi, Taluk, Gunung Sahilan). Borneo (Kapuas). I have seen specimens from Billiton (2: 22.4–27.5 mm, ZMA 114.388) which may also belong to this species but did not study them sufficiently to be sure of their identification. So far as I have been able to determine this is the only *Sphaerichthys* occurring outside Borneo.

Sphaerichthys vaillanti Pellegrin, 1930

Osphromenus nobilis Vaillant, 1893:102 (not of McClelland, 1844; specimens from Kapuas).
Sphaerichthys vaillanti Pellegrin, 1930:243 (type locality Kapuas).

MATERIAL EXAMINED.—Western Borneo: Kapuas, 2: 27.7–29.2 mm (MNHN 1891-510–11, syntypes); Kapuas 1976-16, 30.3 mm (MZB 3880); Kapuas 1976-32, 22.9 mm (MZB 3881); Kapuas 1976-43, 2: 27.5–27.9 mm (CAS 49480, MZB 3882).

This species is known only from the Kapuas. It is closely related to *S. acrostoma* from the Mentaya.

Trichogaster Bloch and Schneider, 1801

Trichogaster Bloch and Schneider, 1801:164 (type species *Labrus trichopterus* Pallas, 1770, by subsequent designation of Cuvier *in* Cuvier and Valenciennes, 1831:388).
For additional synonymy see Myers (1923*b*).

This southeast Asian genus comprises four species, two of which occur in western Borneo.

Trichogaster leerii (Bleeker, 1852)

Trichopus Leerii Bleeker, 1852*d*:577 (type locality Palembang, in fluviis).
Trichopodus leeri Regan, 1909:783.
Trichogaster leeri Myers 1923*b*:112.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-16, 4: 39.0–69.3 mm (CAS 49481, MZB 3883); Kapuas 1976-17, 2: 40.5–57.7 mm (BMNH 1982.3.29.244, MZB 3884); Kapuas 1976-19, 8: 63.4–72.3 mm (CAS 49482, MZB 3885); Kapuas 1976-20, 70.7 mm (MZB 3886); Kapuas 1976-32, 3: 57.5–71.2 mm (MZB 3887, RMNH 28921); Kapuas 1976-33, 2: 57.8–63.4 mm (CAS 49483, MZB 3888); Kapuas 1976-42, 3: 51.0–69.5 mm (KUMF 2860, MZB 3889); Kapuas 1976-43, 6: 36.9–75.8 mm (MZB 3890, USNM 230342); Kapuas 1976-44, 5: 55.6–73.0 mm (MZB 3891, RMNH 28922); Kapuas 1976-51, 4: 47.0–71.0 mm (MZB 3892, UMMZ 209928).

DISTRIBUTION.—Thailand (Chao Phrya). Malay Peninsula. Sumatra. Borneo (Kapuas, Barito).

Trichogaster trichopterus Pallas, 1770

Labrus trichopterus Pallas, 1770:45 (type locality not stated).
Trichogaster trichopterus Bloch and Schneider, 1801:165.
Trichopus sepat Bleeker, 1845:520 (nomen nudum).
Osphromenus siamensis Günther, 1861:385 (type locality Siam).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-16, 59.1 mm (MZB 3893).

DISTRIBUTION.—Thailand (Salwin, Chao Phrya, Mekong). Laos. Kampuchea. Vietnam. Malay Peninsula. Sumatra. Borneo (western, southern, and eastern). Java. Madura. Commonly transported alive in the general area of its distribution, so that its natural distribution is impossible to determine. Introduced into Philippines and presumably into Bali.

Osphronemidae

Osphronemidae, as currently understood, comprises a single species, the giant gouramy. Although its suprabranchial organ is especially elaborate, it probably should not be placed in a monotypic family (see remarks under Belontiidae).

Osphronemus Lacepède, 1802

Osphromenus Commerson, 1777? (unpublished manuscript).
Osphronemus Lacepède, 1802:116 (type species *Osphromenus olfax* Cuvier *in* Cuvier and Valenciennes, 1831=*Osphronemus goramy* Lacepède, 1802, by subsequent designation of Bleeker, 1879:17).
Osphromenus Cuvier *in* Cuvier and Valenciennes, 1831:377.

Osphronemus goramy Lacepède, 1802

Osphromenus olfax Commerson, ca. 1777 (unpublished manuscript name, cited by Lacepède, Cuvier, and many others).
Osphronemus goramy Lacepède, 1802:116 (type locality l'Isle de France=Mauritius, where it was introduced prior to 1770).
Osphromenus olfax Cuvier *in* Cuvier and Valenciennes, 1831:377 (unwarranted replacement name for *Osphronemus goramy* Lacepède, 1802).
Osphromenus notatus Cuvier *in* Cuvier and Valenciennes, 1831:377 (type locality Java). See Bleeker (1879:3).
Osphromenus satyrus Bleeker, 1845:519.
Osphromenus gourami Regan, 1910:774 (unwarranted spelling emendation, incorrectly attributed to Lacèpede, 1802).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-14, 26.4 mm (MZB 3897); Kapuas 1976-15, 3: 23.4–29.1 mm (CAS 49485, MZB 3898); Kapuas 1976-19, 92.4 mm (MZB 3899); Kapuas 1976-24, 44.9 mm (MZB 3900); Kapuas 1976-29, 2: 34.6–39.4 mm (MZB 3901, USNM 230345); Kapuas 1976-33, 23.6 mm (MZB 3902); Kapuas 1976-37, 34.3 mm (MZB 3903).

The scientific name of the giant gouramy has an interesting history. As pointed out by Cuvier, Commerson originally named the species *Osphromenus olfax* (from the Greek, osphromenai, and Latin olfax) because of his belief that the suprabranchial organ is an olfactory organ. Its laminated structure superficially resembles that of an olfactory organ, although its primary function undoubtedly is air-breathing. For whatever reason, Lacepède changed the name to *Osphronemus goramy*. This spelling is clearly intentional, i.e., not a typographical error or lapsus calami, and thus must stand according to the ICZN, notwithstanding Cuvier's objection to it. So far as I am aware, aerial olfaction has not been demonstrated in teleosts but it should be looked for especially in large, air-breathing species such as the giant gouramy that feed on terrestrial vegetation.

DISTRIBUTION.—Before it was widely transported and introduced in many new lands by man, *Osphronemus goramy* may have been restricted to Sumatra, Borneo, and Java. One of the most celebrated of Asian food fishes, and an important species in freshwater aquaculture in tropical Asia, the giant gouramy is found in Thailand; India (introduced by Francis Day in the second half of nineteenth century); Sri Lanka, Reunion, Mauritius, and Madagascar (introductions in eighteenth century); Australia, etc., etc. Cuvier recommended its introduction into France and French colonies.

Helostomatidae

Helostomatidae, endemic to southeast Asia, comprises a single species, the kissing gouramy. The kissing gouramy is probably the most highly specialized filter-feeding freshwater fish in Asia, with extraordinarily fine gill rakers and highly modified soft structures on its gill arches. Liem (1967*b*) described the functional anatomy of the head, including the neurocranium, jaws and suspensorium, opercular apparatus, hyoid apparatus, and pectoral girdle, but inexplicably omitted the most highly specialized and interesting functional unit, the branchial arches.

Helostoma Cuvier, 1829

Helostoma Cuvier, 1829:228 (type species *Helostoma temminckii* Cuvier, 1829 by monotypy).

Helostoma temminckii Cuvier, 1829

Helostoma Temminkii Cuvier 1829:228 (type locality "Moluques," erroneous; incorrect spelling of species name attributable to typographic error).
Helostoma Temminckii Cuvier *in* Cuvier and Valenciennes, 1831:342 (type locality indicated as Java)

Material Examined.—Western Borneo: Kapuas 1976-16, 4: 98.3–112 mm (MZB 3894, USNM 230343); Kapuas 1976-33, 74.0 mm (MZB 3895); Kapuas 1976-43, 8: 75.5–120 mm (CAS 49484, MZB 3896, USNM 230344)

Distribution.—Central Thailand (Chao Phrya). Malay Peninsula. Sumatra. Borneo (western and southern). Java.

Luciocephalidae

Overall appearance pike-like: head and body elongate, subcylindrical, dorsal and anal fins placed far back; jaws extremely elongate and protrusible. Ascending premaxillary processes extending posteriorly to behind eyes. Gular bone present (absent in all other anabantoids). Dorsal fin with 9–11 rays, anal 18–19, pectoral 15–16, pelvic i5, caudal 2+6/6+2. Anal fin bilobate, caudal rounded. First pelvic-fin ray prolonged (filamentous). Scales ctenoid; lateral scale series 40–42. Branchiostegal rays 5. Rakers on first gill arch 11. Vertebrae 19+21–22=40(3) or 41(4) (CAS 19998, Singapore). A single species.

Luciocephalus Bleeker, 1851

Diplopterus Gray, 1830, fig. 1 (type species *Diplopterus pulcher* Gray, 1830, by monotypy; preoccupied by *Diplopterus* Boie, 1826, Aves)
Luciocephalus Bleeker, 1851c:274 (replacement name for *Diplopterus* Gray, 1830).

Luciocephalus pulcher (Gray, 1830)

Diplopterus pulcher Gray, 1830, pl. 87, fig. 1 (type locality none)
Luciocephalus pulcher, 1851c:274 (Bandjermassing, in fluviis)

Material Examined.—Malay Peninsula: Singapore and immediate vicinity, 8: 33.2–121 mm (CAS 19998). Western Borneo: Kapuas 1976-8, 27.6 mm (MZB 3904); Kapuas 1976-11, 53.7 mm (MZB 3905); Kapuas 1976-13, 3: 17.7–65.8 mm (CAS 49486, MZB 3906); Kapuas 1976-17, 2: 76.3–115 mm (MZB 3907, USNM 230346)

Distribution.—Malay Peninsula (Singapore, Johore). Sumatra (Lahat, Palembang, Musi ilir, Benakat, Sungi Surikaka, Sungi Mahe, Indragiri, Laut Tador, Taluk, Gunung Sahilan, Djambi). Borneo (Baram, Bankayan, Kapuas, Kahajan, Banjarmasin). Banka. Billiton.

Mastacembelidae

Mastacembelidae (spiny eels) and the related Synbranchidae (swamp eels) are perhaps the most highly modified percomorph families which are entirely or almost entirely restricted to fresh water. Their relationships to other percomorphs are unknown. Mastacembelids occur only in tropical Africa, where there are two genera and perhaps 50 species (most in the Zaire basin including Lake Tanganyika), and in Asia. In Asia there are four genera and some 24 species.

Macrognathus and *Mastacembelus*, the genera with most of the Asian species, were revised by Sufi (1956). This otherwise very good revision is marred by lumping of data and failure to indicate specimens or localities from which data were obtained for certain species. Several valid species are lumped under *Macrognathus aculeatus* (Bloch, 1786) and *Mastacembelus armatus* (Lacepède, 1800) by Sufi. *Macrognathus* already has been revised by me (Roberts 1980); the results of this study are incorporated herein. In the present account the apparently valid species lumped under *M. armatus* are identified: *M. notophthalmus* new species, from the Malay Peninsula, Sumatra, and Borneo; *M. favus* Hora, 1923, from the Malay Peninsula and Thailand; *M. undulatus* McClelland, 1844, from southeastern China and northern Vietnam; and the true *M. armatus*, from the Indian subcontinent including Sri Lanka and Burma. Original observations on systematics and distribution are also presented for *Mastacembelus maculatus* and other species found in western Borneo. Meristic data on *Mastacembelus* are presented in Table 16. Two genera and five species occur in western Borneo.

Key to Mastacembelidae of Borneo

1a Rim of anterior nostril with six fingerlike fimbriae; dorsal-fin spines 14–31; dorsal- and anal-fin rays 48–70; total vertebrae 70–82; maximum adult size about 300 mm 2
1b Rim of anterior nostril with two fimbriae and two broad-based flaps; dorsal-fin spines 33–40; dorsal- and anal-fin rays 68–85; total vertebrae 84–95; all species probably attain 400 mm or more 4
2a Fleshy rostrum greatly enlarged, its concave ventral surface with a large series of paired bony toothplates bearing numerous fine teeth; dorsal-fin spines 14–22; body with 14–17 oblique dark bars ..... *Macrognathus aculeatus*
2b Fleshy rostrum not greatly enlarged, round in cross section, without toothplates; dorsal-fin spines 27–31; body without oblique dark bars 3
3a Dorsal-fin spines 29–31; scales relatively large, readily visible to naked eye when skin is dry, about 14–17 above lateral line and less than 200 in lateral series; sexually mature females with an elongate genital papilla ..... *Mastacembelus maculatus*
3b Dorsal-fin spines 26–28; scales relatively small, about 22–25 above lateral line and 300 in lateral series; females without elongate genital papilla (northeastern Borneo) ..... *Mastacembelus keithi*
4a Dorsal-fin spines 33–35, vertebrae 84–92; no vertical black bar below eye 5
4b Dorsal-fin spines 37–39, vertebrae 90–96; a vertical black bar usually present below eye ..... *Mastacembelus notophthalmus*
5a Caudal fin with 14–15 rays, its upper and lower rays broadly attached to dorsal and anal fins; adults with blood-red horizontal bars of variable length and distribution ..... *Mastacembelus erythrotaenia*
5b Caudal fin with 19–21 rays, more or less separated from dorsal and anal fins; no blood-red bars ..... *Mastacembelus unicolor*

Macrognathus Lacepède, 1800

Macrognathus Lacepède, 1800:9 (type species *Ophidium aculeatum* Bloch, 1786, by subsequent designation of Jordan, 1917:56).
Rynchobdella Bloch and Schneider, 1801:xliv (spelling mistake for *Rhynchobdella*)
Rhynchobdella Bloch and Schneider, 1801:478 (type species *Ophidium aculeatum* Bloch, 1786, by subsequent designation of Jordan, 1917:59).

For diagnosis, systematics, and discussion of this genus see

TABLE 16. MERISTIC CHARACTERS IN *MASTACEMBELUS*. For definition of vertebral counts see p. 22.

	Dorsal spines	Dorsal rays	Anal rays	Pect. rays	Caud. rays	Pred. vert.	Abd. vert.	Caud. vert.	Total vert.	Catalog number, type status
M. armatus										
Bengal, Ganges	37(1), 38(1), 39(1)	77–80	77–81	24–26	18–20	4	42–44	52–54	94(1), 95(1), 98(1)	MNHN 5695, 5698, 5699
Indus	36(1), 38(5)	77–82	75–83	24	18–21	5	42–44	51–53	93(1), 95(5)	CAS 24256
Chitawan	37(2), 40(1)	73–78	76–79	26	17–18	4	40–43	52–56	95(1), 96(2), 98(1)	CAS 50217
Ceylon	36(3), 37(1)	67–77	67–75		15–19	4	39	49–52	88(1), 90(1), 91(2)	CAS-SU 30192
M. dayi										
Rayong	35(3)	77–82	76–79	24	25–27	5	37–38	47–49	85(1), 86(2)	NRM NNN/19369895379, 19389995376
M. erythrotaenia										
Kuching	33–34	70	68–69	24?	14–15	5	39–41	45–46	84(1), 87(1)	CAS-SU 33717
Kapuas	35	68	68	25?	15	4?	40	47	87	CAS 49492
M. favus										
Rayong R.	33(1), 35(1)	74	71	28–29	14	4	38	49	87(1)	CAS 52670
Pahang	36	85	87	25	14	5	39	53	92	CAS-SU 39407
Perak R.	37	84	84	25	14?	4	39	51	90	CAS-SU 39408
Goh Kut	35(11), 36(4), 37(1)	77–84	77–82	28–29	12–15	4–5	38–40	50–53	89(4), 90(5), 91(7)	CAS 52675
M. guenthert										
Travancore	27(2), 28(3), 29(5)	60–68	63–70		12–14	7–8	32–33	48–51	81–84	CAS-SU 41406
M. keithi										
Segaliud R.	27	57	56	26	16	7	33	42	75	CAS-SU 33016, holotype
Kabili R.	27(2)	58	57–59	25–26	14–18	8	34	40	74(2)	CAS-SU 33017, paratypes
M. maculatus										
"Moluques"	30–31	65–66	65–66	25–27?	12–13	6	32–33	49	81(1), 82(1)	MNHN 5378, syntypes *M. maculatus*
Perak	29	59	57?	22?	12	8	33	44	77	CAS-SU 30972, holotype *M. perakensis*
Perak	29–31	52–65	56–67		11–13	7–8	33	44–47	77–80	CAS-SU 39412
Baram R.	29	61	64	24	14	8	33	44	77	ANSP 114888, holotype *M. vaillanti*
Mempawah R.	30	61	63			8	32	44	76	MZB 3951
Kapuas	29	54–56	54–55		13	6	32–33	42	74–75	CAS 49495
M. notophthalmus										
Perak	38–39	73–79	69–81	24–26	15–18	4	42–43	51–54	93–96	CAS-SU 39403–4, holotype, paratypes
Jalong	38	78	73		16	4	42	51	93	CAS-SU 39406, paratype
Mawai	38–39	73				4	42–43	50–51	93(3)	CAS-SU 35660, paratypes
Kapuas	37–39	78–86	78–85	24–26	17–18	3–4	41–43	49–52	90–94	CAS 49497, MZB 3948–50, paratypes
M. undulatus										
Hainan	34–35	72–78	73–74		14–16	5	37–38	50	87(1), 88(2)	CAS-SU 31823–4, 32852
Canton	34–36	70–72	71–75	25–26	13–16	5–6	38–39	48–50	87(2), 88(3), 89(2)	CAS-SU 24197, 25681
M. unicolor										
Batu Sanghar	34	79–82	73–73	25–26	20–22	5	39	48–50	87–89	CAS-SU 8667
Kapuas	34–35	79–90	73–86		19–21	5–6	38–39	49–52	88–91	all Kapuas specimens in material examined
Java	34	81	75		21	5	39	49	88	MNHN 5693, holotype *M. unicolor*

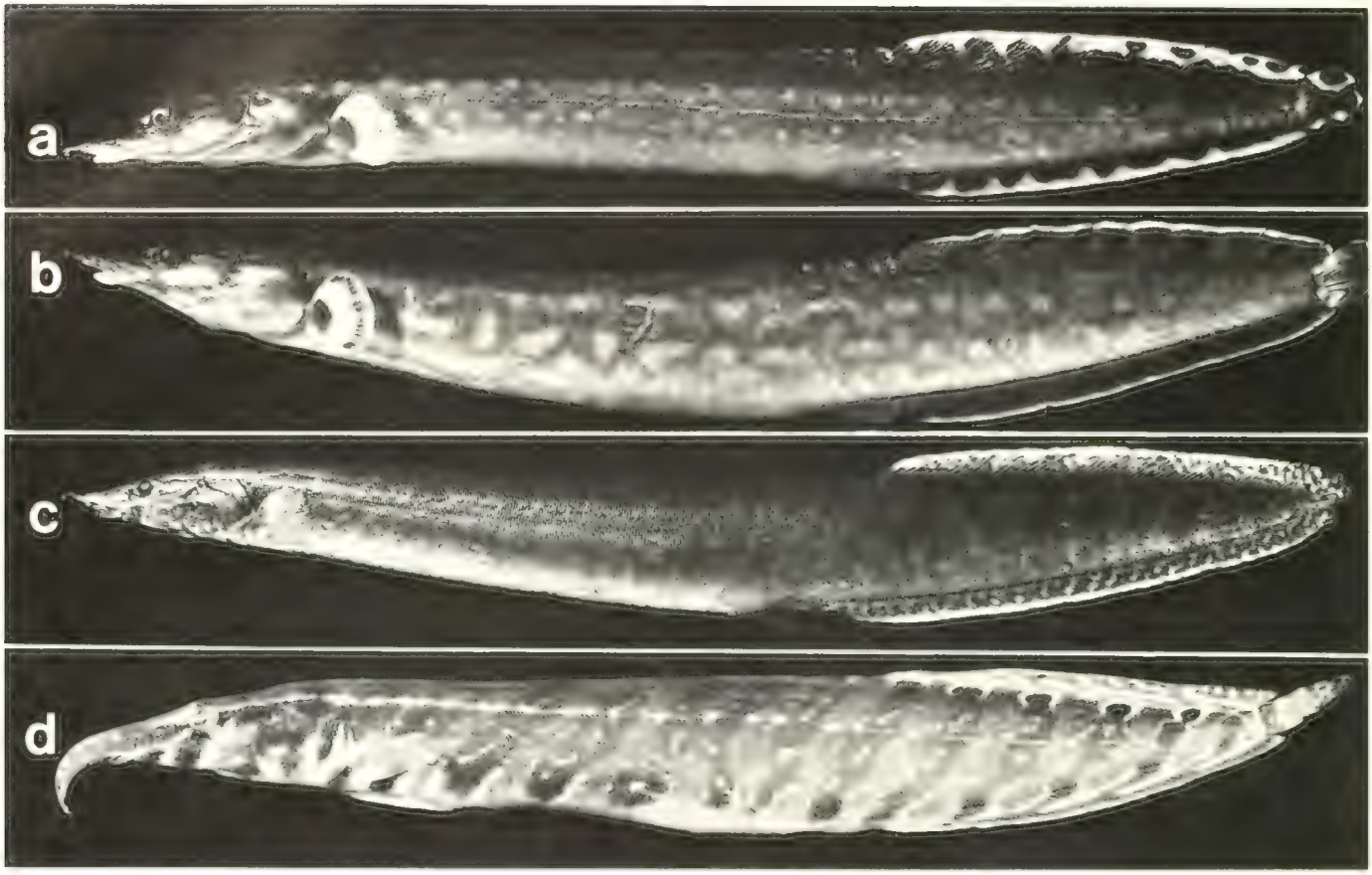

FIGURE 132 Mastacembelidae. a, *Mastacembelus unicolor*, Kapuas 1976-29, 112 mm (MZB 3947); b, *Mastacembelus unicolor*, Kapuas 1976-27, 172 mm (MZB 3946); c, *Mastacembelus maculatus*, Kapuas 1976-24, 137 mm gravid female (MAB 3935); d, *Macrognathus aculeatus*, Kapuas 1976-39, 122 mm (CAS 42591)

key above and Roberts (1980). There are at least three species, characterized by differences in coloration and meristics: *M. aral* (Bloch and Schneider, 1801) from the Indian subcontinent, including Sri Lanka and Burma; *M. siamensis* (Günther, 1861) from Thailand; and *M. aculeatus* from the Malay Peninsula, Sumatra, Borneo, and perhaps Java. Specimens from Java have distinctive coloration and may represent a fourth species.

Macrognathus aculeatus (Bloch, 1786)

(Figure 132)

Ophidium aculeatum Bloch, 1786:478 (type locality "Süssen Wasser von Ostindien")
Macrognathus aculeatus Lacepède, 1800:9
For additional synonymy see Roberts (1980)

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-8, 5: 101–226 mm (CAS 49490, MZB 3920), Kapuas 1976-16, 191 mm (MZB 3921); Kapuas 1976-17, 123 mm (MZB 3922); Kapuas 1976-27, 147 mm (MZB 3923); Kapuas 1976-33, 3: 133–165 mm (MZB 3924, USNM 230350); Kapuas 1976-39, 2: 116–122 mm (CAS 42591, MZB 3925); Kapuas 1976-42, 2: 107–108 mm (FMNH 94252, MZB 3926), Kapuas 1976-47, 2: 122–175 mm (MNHN 1982-721, MZB 3927); Kapuas 1976-51, 9: 102–127 mm (CAS 49491, MZB 3928, USNM 230351)

This species differs from all other *Macrognathus* in having 14–17 oblique dark bars on body (absent in specimens from Java); rostral toothplates 37–55, 21 in a single otherwise normal specimen (vs. 10–25 in other *Macrognathus*); and 22–29 pectoral-fin rays (18–24 in other species).

DISTRIBUTION.—Peninsular Thailand (Trang). Malay Peninsula (Tembling R.). Sumatra (Deli, Batang Hari, Lahat, Gunung Sahilan, Palembang). Borneo (Kapuas, Sambas, Kayan (?) R.). Java (northern Java east to Brantas R.).

Mastacembelus Scopoli, 1777

Mastacembelus Gronovius, 1763:133 (non-binomial, not available for zoological nomenclature)
Mastocembelus Scopoli, 1777:453 (misspelling of *Mastacembelus* Gronovius; type species *Ophidium mastacembelus* Solander *in* Russell, 1794, by absolute tautonymy)
Pararhynchobdella Bleeker, 1874*a*:368 (type species "*Rhynchobdella maculata* Rwdt."=*Mastacembelus maculatus* Cuvier *in* Cuvier and Valenciennes, 1831, by monotypy)
Bdellorhynchus Jordan and Tanaka, 1927:391 (type species *Mastacembelus maculatus* Cuvier *in* Cuvier and Valenciennes, 1831, by original designation and monotypy)

As previously pointed out (Roberts 1980), the Asian species currently assigned to the genus *Mastacembelus* can be divided into two groups on the basis of morphology of the rim of the tubular anterior nostril. *Mastacembelus* sensu stricto has rim with two fimbriae and two flaps; the other species have rim with six fimbriae. Six fimbriae also occur on rim of anterior tubular nostril in *Macrognathus*. African mastacembelids apparently all have rim with two fimbriae and two flaps. Species with six fimbriae have fewer fin spines and rays and vertebrae and smaller adults than most species with two fimbriae and two flaps.

The classification of Asian mastacembelids is being studied by R. Travers (1984 and continuing).

Mastacembelus erythrotaenia Bleeker, 1850

Mastacacemblus eatenatus Heckel, 1846?:248 (missprint for *Mastacembelus catenatus*; type locality Borneo [=Barito?]). I have been unable to consult the full text or to confirm the date of this publication.
Mastacembelus erythrotaenia Bleeker, 1850:6 (type locality Banjermassing).
Mastacembelus argus Günther, 1861:542 (type locality Siam). See Sufi (1956).

MATERIAL EXAMINED.—Sarawak: Kuching, 2: 270–317 mm (CAS-SU 33717). Western Borneo: Kapuas 1976-16, 2: 235–252 mm (CAS 49492, MZB 3929); Kapuas 1976-33, 299 mm (MZB 3930).

Mastacembelus catenatus was indicated by Bleeker (1859*a*: 107) as a possible synonym of *M. erythrotaenia*. So far as I am aware this is the only appearance of the name *M. catenatus* in print other than in the original description. If the holotype, NMW 73350, proves to be the same species as *M. erythrotaenia* the name *M. catenatus* should be treated as a nomen oblitum. The holotype is part of the Frank material from Borneo acquired by Heckel in 1839 (NMW acc. no. 1839. I. 46) which may have originally been part of the Barito collection made by Salomon Müller in 1836.

DISTRIBUTION.—Kampuchea (Mekong). Thailand (Mekong, Chao Phrya, Patalung R., Krabi). Malay Peninsula (Penang, Perak). Sumatra (Deli, Palembang, Muara Kompeh, Batang Hari, Sungei Mahi, Laut Tador, Indragiri, lower Langkat). Borneo (Baram, Kuching, Sambas, Kapuas, Bandjermasin, Balungan).

Mastacembelus maculatus Cuvier, 1831

(Figure 132)

Mastacembelus maculatus Cuvier *in* Cuvier and Valenciennes, 1831:461 (type locality "Moluques," erroneous).
Mastacembelus maculatus var. *chrysogaster* Bleeker, 1852*a*:93 (type locality Java and Sumatra).
Mastacembelus maculatus var. *dictyogaster* Bleeker, 1852*a*:93 (type locality Billiton).
?*Mastacembelus guentheri* Day, 1865*b*:37 (type locality Malabar).
Pararhynchobdella maculata Bleeker, 1874*a*:368.
Mastacembelus vaillanti Fowler, 1905:491, fig. 8 (type locality Baram R., Sarawak).
Mastacembelus perakensis Myers *in* Herre and Myers, 1937:74, pl. 7 (type locality Bukit Merah Reservoir, Perak, Malay Peninsula).
Mastacembelus billitonensis de Beaufort, 1939:194 (type locality Billiton and Wai Lima, Lampong Dist., Sumatra).

MATERIAL EXAMINED.—"Moluques": 2: 182–186 mm (MNHN 5378, syntypes *M. maculatus*). Malay Peninsula: Perak, Bukit Merah, 137 mm (CAS-SU 30972, holotype *M. perakensis*); Perak, Tapah Fisheries Station, 34 (CAS-SU 39412). Sarawak: Baram R., 143 mm (ANSP 114888, holotype *M. vaillanti*). Western Borneo: Kapuas 1976-6, 2: 33.5–115 mm (MZB 3931, 3951); Kapuas 1976-7, 2: 32.7–36.9 mm (CAS 49493, MZB 3932); Kapuas 1976-8, 68.8 mm (MZB 3933); Kapuas 1976-17, 4: 85.3–178 mm (BMNH 1982.3.29.245–7, MZB 3934); Kapuas 1976-24, 137 mm (MZB 3935); Kapuas 1976-25, 2: 77.7–233 mm (CAS 49494, MZB 3936); Kapuas 1976-28, 2: 141–178 mm (FMNH 94253, MZB 3937); Kapuas 1976-30, 5: 74.9–227 mm (MNHN 1982-722, MZB 3938, RMNH 28923); Kapuas 1976-42, 81.8 mm (MZB 3939); Kapuas 1976-46, 5: 68.2–150 mm (MZB 3940, USNM 230352); Kapuas 1976-42, 13: 92.3–172 mm (IRSNB 19750, CAS 49495, MZB 3941, UMMZ 209924); Kapuas 1976-51, 2: 92.6–176 mm (MZB 3942, ZMA 116.548).

This species is distinguished from all other mastacembelids except the south Indian *Mastacembelus guentheri* Day, 1865 in having sexually mature females with an elongate tubular genital papilla (possibly an ovipositor). Juveniles to 70 mm have an exceptionally broad pale dorsal longitudinal stripe and dorsal and anal fins clear except for a basal row of numerous round dark spots. Adults are relatively uniformly dark or somber on the sides of the body, abdomen uniformly pale or dusky or with transverse bands, fins with highly variable bands or marks.

Mastacembelus perakensis is undoubtedly a synonym of *M. maculatus*. I have compared the holotype with other specimens of this species and find them identical. Contrary to the original description, the holotype of *M. perakensis* has a subocular or preorbital spine. I have also examined the holotype of *M. vaillanti* and agree with Sufi (1956:113) that it is a synonym of *M. maculatus*. Meristic data from the type specimens of *M. maculatus*, *M. perakensis*, and *M. vaillanti* are presented in Table 16. *Mastacembelus guentheri* from southern India (and Assam?) is closely related to *M. maculatus*; perhaps they are conspecific. Sufi (1951:123) reported a 247 mm female *M. guentheri* with a large genital papilla.

DISTRIBUTION.—Thailand (without specific locality; Bleeker, 1865:174). Malay Peninsula (Perak, Singapore). Sumatra (Deli, Langkat [R.?], Lematang [R.?], [ilir], Tagora R., Petok, L. Korinchi, Lahat, Solok, Kaju Tanam, Pajakumbuk, Wai Lima, Sungei Penoh, Palembang, Kipahiang). Borneo (Kina Balu, Kahajan, Seminis, Kapuas). Java (Lebak, Bogor, Tjipanas, Tjandjur, Djasinga, Tji Barangbang, Palabuan, Kepong). Billiton.

Mastacembelus notophthalmus new species

?*Mastacembelus armatus* Volz, 1903*b*:380 (Deli, Sumatra); Volz, 1904:492 (Sumatra).
Mastacembelus armatus Weber, 1912:20 (Taluk, Sumatra); Herre, 1940:54 (Mawai District); Sufi, 1956:134 et seq. (in part; Malay Peninsula and Sumatra, fig. 31, 32); de Beaufort and Briggs, 1962:433 (in part).

HOLOTYPE.—CAS-SU 39403, 248 mm, Tapah Fisheries Station, Perak, west Malaysia, A. W. Herre, 24 October 1940.

PARATYPES.—CAS-SU 39404, 11: 54.4–251 mm, same data as holotype; CAS-SU 39402, 119 mm, Batang Padang near Tapah Fisheries Station, Perak, west Malaysia, A. W. Herre, 23 October 1940; CAS-SU 35660, 3: 55.1–78.3 mm, Mawai District, Johore, west Malaysia, A. W. Herre, February 1937; CAS-SU 39406, 257 mm, Jalong, Perak, west Malaysia, A. W. Herre, October 1940; MZB 3948, 59.1 mm, Kapuas basin, Sungai Engkonis, 13 km WNW of Sanggau (Kapuas 1976-13); CAS 49497, MZB 3949, 2: 43.6–389 mm, Kapuas basin, Sungai Belimbing, 46 km SSE of Sintang (Kapuas 1976-21); MZB 3950, 265 mm, Kapuas basin, small forested stream flowing into Sungai Pinoh near Ribang-Rabing (Kapuas 1976-28).

DIAGNOSIS.—*Mastacembelus notophthalmus* differs from all other species closely related to or previously referred to *M. armatus* in having a dark vertical bar below eye (present and well developed in all but one or two of the smaller specimens in the type series) and in having the reticulate pattern absent or very much broken up and more evident on the ventral half of the body than on the dorsal half. The dorsal half of the body is dark, with some irregular small light marks; the ventral half of the body is light with irregular small dark marks which sometimes constitute an irregular and much broken reticulate pattern. The boundary between the dark upper and lighter lower colored areas is straight and sharp. Such sharply marked "color pattern reversal" between upper and lower halves of the body occurs in some samples of *M. armatus* from southern India but is otherwise very unusual among Asian mastacembelids. The reversal does not include coloration of the fins. The dorsal and anal fins have a more or less bold pattern of sharply contrasted light and dark marks; in young the dark marks are restricted to

the base of dorsal and anal fins, but larger ones may have a continuous submarginal longitudinal black stripe connected by regularly spaced vertical bars to dark marks along the fin bases.

DISTRIBUTION.—Malay Peninsula (Perak, Johore). Sumatra. Western Borneo (Kapuas).

DISCUSSION.—In order to describe *M. notophthalmus* n. sp. it has been necessary to look into the status of *M. armatus* Lacepède, 1800 and its synonyms. As recognized by Sufi (1956), *M. armatus* is the most widely distributed and most variable species in the family Mastacembelidae, and has numerous synonyms. Most of the supposed synonyms are from the Indian subcontinent, but there are also some from China and Thailand. I tentatively consider that there are four valid species, all with entirely or almost entirely allopatric distributions. *Mastacembelus notophthalmus* is the only member of the *M. armatus* species complex occurring in Indonesia. Its range extends into the Malay Peninsula, where it approaches and possibly overlaps the southern part of the range of *M. favus*. *M. notophthalmus* and *M. favus* are sharply distinguished by meristic characters (Table 16) as well as coloration.

ETYMOLOGY.—The name *notophthalmus* (Latin, eye-mark) refers to the dark bar extending below the eye in almost all specimens of this species.

The holotype of *M. armatus*, which should be in the MNHN, was without type locality and is now lost (M. L. Bauchot, pers. comm., 10 January 1983). Hamilton-Buchanan (1822), the next author to deal with the species, reported it from the Ganges. Then, Cuvier *in* Cuvier and Valenciennes (1831), reported it from the Ganges and Bengal. Hamilton-Buchanan did not preserve specimens, but the Gangetic and Bengal specimens examined by Cuvier are preserved in Paris (MNHN 5695, 5697–8, Table 16). At the time Cuvier had Lacepède's dried holotype on hand, but based his account on the well preserved alcoholic specimens with good locality data. This species has numerous supposed synonyms from the Indian subcontinent (Sufi 1956: 134–135), some of which may represent valid species.

Mastacembelus undulatus (McClelland, 1844; type locality Chusan) seems closely related to *M. armatus* but is restricted to southern China (including Hainan) and the Red River. It is characterized by a relatively short and narrow head, small eye, scale rows above lateral line about 40 (vs. about 25 in other members of *M. armatus* complex), 5–6 predorsal vertebrae, and only 87–89 total vertebrae (Table 16).

Mastacembelus favus Hora, 1923, from Thailand and the Malay Peninsula, characterized by a relatively large fleshy head and deep body, and very bold color pattern of large reticulations equally well developed over entire body; usually 4 predorsal vertebrae and 87–90 total vertebrae.

Like *M. armatus*, *M. undulatus* has a variably developed reticulate color pattern which tends to be more evident or more regularly developed on the dorsal half of the body.

Mastacembelus unicolor Cuvier, 1831

(Figure 132)

Mastacembelus unicolor Cuvier *in* Cuvier and Valenciennes, 1831:453 (type locality Java).

MATERIAL EXAMINED.—Sumatra: Batu Sanghar, 2: 153–172 mm (CAS-SU 8667). Western Borneo: Kapuas 1976-21, 41.8 mm (MZB 3943); Kapuas 1976-24, 98.5 mm (MZB 3944); Kapuas 1976-25, 3: 82.2–104 mm (CAS 49496, MZB 3945); Kapuas 1976-27, 172 mm (MZB 3946); Kapuas 1976-29, 9: 64.2–135 mm (BMNH 1982.3.29.248–249, MNHN 1982-723, MZB 3947, USNM 230353). Java: 137 mm (MNHN 5693, holotype).

The elements of color pattern are completely obscured in the holotype of *M. unicolor*, which is uniformly darkly discolored; hence my identification of it with the present Kapuas material is based on meristics (Table 16) and morphology. The species has a distinctive color pattern, including two (sometimes three) variably developed rows of pale elongate spots on side of body, a large black spot on pectoral-fin base and usually a dark submarginal band on the pectoral fin, and a pale marginal band on the otherwise uniformly dark median fins. In juveniles dark coloration of the median fins is incomplete and restricted to large marks along the fin bases. Caudal fin narrowly joined to base of dorsal and anal fins; caudal-fin rays 19–21.

COMPARISON WITH *MASTACEMBELUS DAYI*.—Sufi (1956:128–130) placed *Mastacembelus dayi* Boulenger, 1912 (type locality Irrawaddy) as a junior synonym of *M. unicolor*. Having examined three specimens of *M. dayi* from Rangoon (NRM NNN/19369895379, 159–204 mm, and 19389995376, 306 mm) I consider it a valid species notably differing in caudal-fin ray counts (Table 16) and coloration from *M. unicolor*. The caudal fin in these three specimens is entirely or almost entirely separate from dorsal and anal fins (caudal fin joined to dorsal and anal fins near base in *M. unicolor*) and has more rays than any other *Mastacembelus* known to me, 13–15+12=25(1), 26(1), 27(1). They also have slightly fewer vertebrae than *M. unicolor* examined (Table 16), but this distinction needs confirmation by examination of more specimens. The difference in coloration involves distribution and orientation of body spots and color pattern of median fins. *M. dayi* has 3 or 4 (rather than only 2 or 3) main rows of large pale spots on side of body; the spots exhibit a strong tendency to vertical (rather than horizontal) elongation and fusion; dorsal body surface (almost or quite immaculate in *M. unicolor*) covered with pale round spots. Median fins entirely or almost entirely covered with pale spots similar to those on body, particularly large on dorsal fin; on dorsal and anal fins spots tend to oblique elongation and fusion; spots on caudal fin round, well defined and rather numerous. Although smaller juveniles of *M. dayi* have not been observed it is clear from the pattern present in adults that the fins do not undergo color change similar to that occurring in *M. unicolor*.

DISTRIBUTION.—Malay Peninsula (Tembeling R., Telom R., Pabang). Sumatra (Deli; Batu Sanghar; Laut Tador, upper Langkat, Siboga, Pajakombo, Taluk, Solok, Lake of Singkarah, Padang, Batang, Bingin Telok, Rawa R.). Borneo (Baram, Kapuas, Mahakam). Java (Jakarta, Bogor, Lebak, Tjandjur, Garut, Purworedjo Modjokerta, Surakarta, Surabaya, Brantas R.). Banka.

Synbranchidae

Synbranchidae are elongate and eel-like; without paired fins; dorsal and anal fins absent or reduced to median folds, caudal fin reduced or absent; gill membranes united, continuous around isthmus, with a single ventral gill opening. Pantropical, usually restricted to fresh water, about four genera and 15 species.

Osteology, relationships and systematics of Synbranchidae are treated by Rosen and Greenwood (1976), but some systematic problems remain. The Old World species are very poorly

known. Synbranchidae are thought to be closely related to Mastacembelidae (Travers 1984).

Monopterus Lacepède, 1800

Monopterus Lacepède, 1800:138, 139 (type species *Monopterus javanensis* Lacepède, 1800, by monotypy).
Fluta Bloch and Schneider, 1801:565 (unnecessary replacement name for *Monopterus* Lacepède, 1800).
For additional synonymy see Rosen and Greenwood (1976:57).

Monopterus albus Zuiew, 1793

Muraena alba Zuiew, 1793:299 (type locality unknown; "presumed to be Asiatic Russia" according to Rosen and Greenwood 1976:57).
Monopterus javanensis Lacepède, 1800:176 (type locality "detroit de la Sonde, auprés des cotes de l'isle de Java").
For additional synonymy see Okada (1960:718); Rosen and Greenwood (1976: 571).

Material Examined.—Western Borneo: Kapuas 1976-16, 4: 36.0–37.6 mm (AMNH 41578, MZB 3760); Kapuas 1976-17, 6: 40.7–485? mm (AMNH 41579, MZB 3761).

Synbranchidae obtained by the Kapuas survey of 1976 were kindly examined for me by D. E. Rosen and M. N. Feinberg and identified by them as *M. albus*.

Distribution.—*Monopterus albus* reportedly is widely distributed in southeast Asia (including Burma, Thailand, Sumatra, Borneo, Java, Celebes). Northern and southern China. Japan. Okinawa. Rosen and Greenwood (1976:58) suggest it may also be native to Queensland, Australia.

Soleidae

This flatfish family seems to be represented by only a single genus, *Achiroides*, in the fresh waters of western Borneo.

A doubtful exception is *Liachirus melanospilus* (Bleeker, 1854), a widely distributed southeast Asian marine species reported from Sintang by Weber and de Beaufort (1929:429). I have examined the specimens upon which this record is based (ZMA 114.433, 2: 63.3–69.9 mm, supposedly collected at Sintang by Lorentz in 1909). These were originally identified as *L. melanospilus* by Chabanaud in 1928 and their identity is not in question; the Sintang locality is probably erroneous.

Achiroides Bleeker, 1851

Achiroides Bleeker, 1851*c*:262 (name only; type species *Plagusia melanorhynchus* Bleeker, 1851, by monotypy); 1851*d*:402, 408 (generic diagnosis).

Right-handed soleids with scales feebly ctenoid on both sides; one straight lateral line on both sides; fleshy tentacles around corner of mouth and on chin on both sides (more numerous on blind side); snout not forming prominent hook; dorsal and anal fins broadly joined to caudal fin; dorsal-fin rays 49–64, anal 35–47; pectoral fin absent; pelvic fins short, rather broad-based, with 3–5 rays; caudal fin large, broadly rounded, with 16 rays, all branched; vertebrae 28–32. Largely or entirely confined to fresh water (also in brackish water according to Weber and de Beaufort 1929:181).

Achiroides leucorhynchus Bleeker, 1851

Achiroides leucorhynchus Bleeker, 1851*d*:411 (type locality Surakarta, Javae centralis, in fluviis).

A small species of *Achiroides*, largest known specimen positively identified about 50 mm; no dark pigmentation on mouth and surrounding area on blind side; dorsal-fin rays 49–53; anal-fin rays 35–37; vertebrae 28–29 (counts based on Kapuas specimens).

Distribution.—Borneo (Kapuas.) Java (Solo basin).

Identifications of *A. leucorhynchus* from peninsular Thailand, based on a 77 mm specimen with 42 anal-fin rays (Smith 1945: 440) and from the coast of Sumatra 100 miles west of Singapore, based on a 68 mm eyeless specimen (Herre and Myers 1937: 51) require confirmation. I have not located the specimens in question.

Achiroides melanorhynchus (Bleeker, 1851)

Plagusia melanorhynchus Bleeker, 1851*a*:15 (type locality Banjermassing, in fluviis).
Achiroides melanorhynchus Bleeker, 1851*c*:262 (name only).
Achiroides melanorhynchos Bleeker, 1851*d*:402.
Eurypleura melanorhyncha Kaup, 1858:100.
Synaptura melanorhyncha Günther, 1862:487.
Synaptura achira Duncker, 1904:168 (part).

Material Examined.—Western Borneo: Kapuas 1976-14, 21: 16.7–66.2 mm (AMNH 48942, CAS 49499, MZB 3956, USNM 230355); Kapuas 1976-33, 10: 21.2–112 mm (BMNH 1982.3.29.252–253, CAS 49500, FMNH 94254, MZB 3957); Kapuas 1976-37, 2: 55.3–66.1 mm (IRSNB 19751, MZB 3958); Kapuas 1976-40, 40.2 mm (MZB 3959); Kapuas 1976-44, 90.4 mm (MZB 3960); Kapuas 1976-47, 2: 34.4–39.4 mm (MNHN 1982-724, MZB 3961); Kapuas 1976-48, 95.9 mm (MZB 3962); Kapuas 1976-50, 4: 25.6–44.4 mm (MZB 3963, USNM 230356); Kapuas 1976-54, 14: 32.4–49.1 mm (CAS 49501, MZB 3964, UMMZ 209929, ZMA 116.549); Sintang, 10: 31.7–61.9 mm (RMNH 7908); Boenoet, 2: 46.6–65.8 mm (ZMA 114.358); Sintang, 5: 30.1–57.3 mm (ZMA 114.359); Poetoes Sibau, 2: 49.3–53.1 mm (ZMA 114.357).

A relatively large species of *Achiroides*, attaining well over 100 mm; dark pigmentation on mouth and surrounding area on blind side usually (always?) present; dorsal-fin rays 54–61; anal-fin rays 39–47; vertebrae 31–32 (counts based on Kapuas specimens).

Distribution.—Malay Peninsula (Singapore, Pahang). Sumatra (Palembang). Borneo (Kapuas, Barito, Mahakam).

Achiroides sp. undet.

Material Examined.—Western Borneo: Kapuas 1976-16, 61.8 mm (MZB 3965).

No dark pigmentation on mouth and surrounding area on blind side; dorsal-fin rays 64; anal-fin rays 47; vertebrae 31.

Possibly this is simply a specimen of *A. melanorhynchus* lacking the characteristic oral pigmentation and with an unusually high anal-fin ray count.

Cynoglossidae

The predominantly marine family Cynoglossidae (tongue soles) comprises three or four genera and about 140 species. A number of species of the genus *Cynoglossus* apparently occur exclusively in fresh water, and these have not been well collected. They occur mainly in west Africa and southeast Asia. In the introduction to his revision of *Cynoglossus*, Menon (1977) stated the species are marine or estuarine shallow-water burrowing forms with a few species—*C. microlepis* (Bleeker), *C. heterolepis* Weber, and *C. kapuasensis* Fowler—entering freshwater streams. This statement is misleading. *Cynoglossus heterolepis*, *C. ka-*

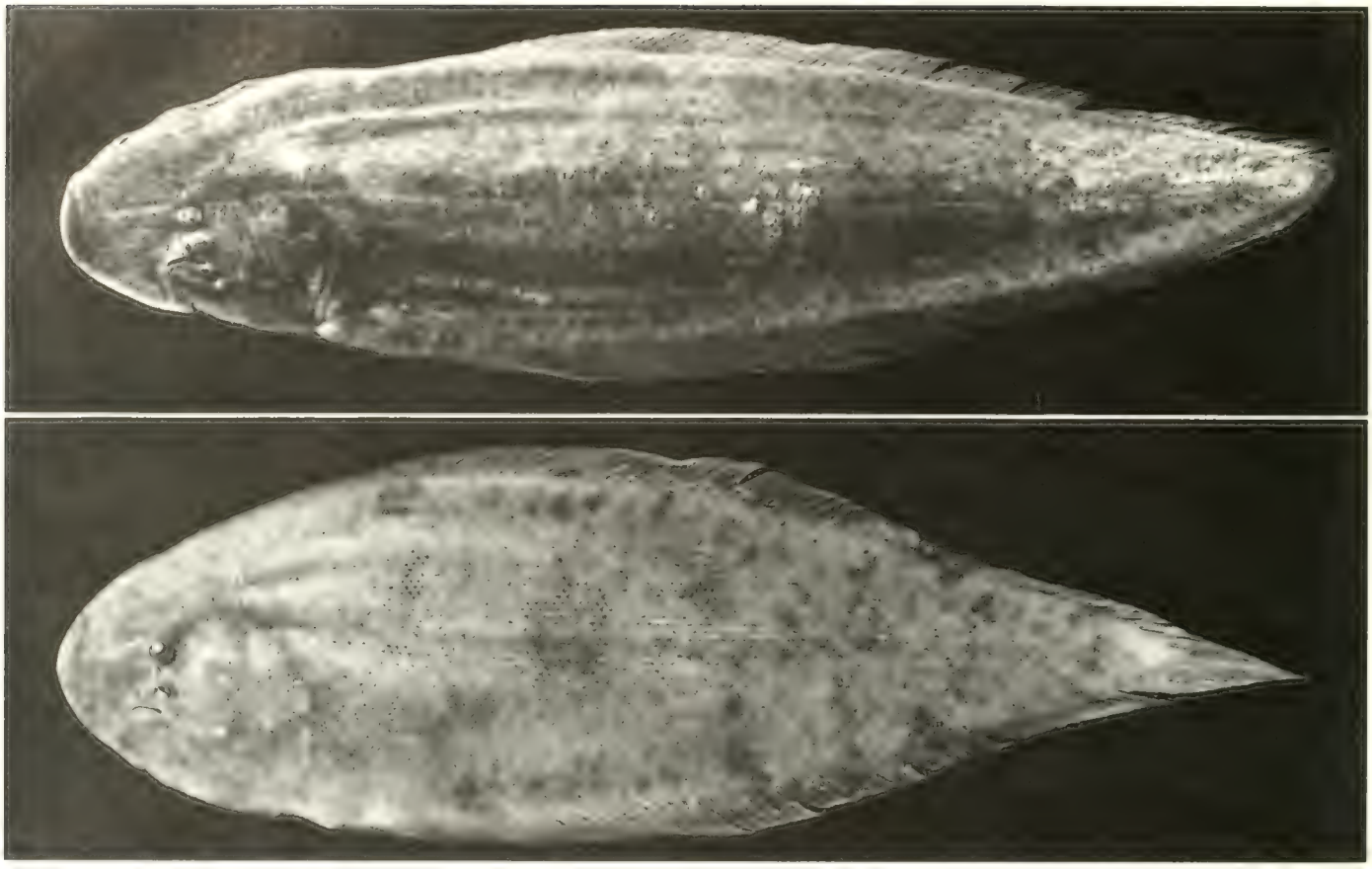

FIGURE 133. *Cynoglossus*. Upper, *C. kapuasensis*, Kapuas 1976-54, 199 mm (MZB 3968; lower, *C. waandersi*, Kapuas 1976-48, 107 mm (MZB 3971).

puasensis, and *C. waandersi*, and possibly *C. feldmanni* and *C. microlepis* are known only from fresh water, and at least the first three species probably do not occur in marine habitats. *C. heterolepis* is known only from large rivers in southern New Guinea (flowing into the shallow Gulf of Papua) which formed a single freshwater drainage during Pleistocene sea-level minima (Roberts 1978). The central or north Sunda drainage appears to have been the center of distribution for as many as four freshwater species of *Cynoglossus*. According to Menon (1977: 87) these four species are closely related to each other and to *C. heterolepis*; together with the marine species *C. semilaevis*, *C. abbreviatus*, and *C. gracilis* they form his "*heterolepis* complex." This complex is characterized by a much elongated, pointed snout, with angle of mouth nearer branchial opening than snout tip; both nostrils present; interlinear scales 15–25; eyes very small, interorbital space about equal to or somewhat greater than eye diameter; three lateral lines on eyed side, none on blind side.

Cynoglossus Hamilton-Buchanan, 1822

Cynoglossus Hamilton-Buchanan, 1822:32, 365 (type species *Cynoglossus lingua* Hamilton-Buchanan, 1822, by monotypy)
For generic synonymy see Menon (1977:16)

Cynoglossus kapuasensis Fowler, 1905

(Figure 133 upper)

Cynoglossus microlepis Vaillant, 1893:101 (nec Bleeker, 1851; "Knapei, Sebruang," Kapuas).
Cynoglossus kapuasensis Fowler, 1905:519 (type locality Kapuas).
?*Cynoglossus kapwasensis* Seale, 1910:288 (misprint for *kapuasensis*; Sandakan; marine?; probable misidentification)

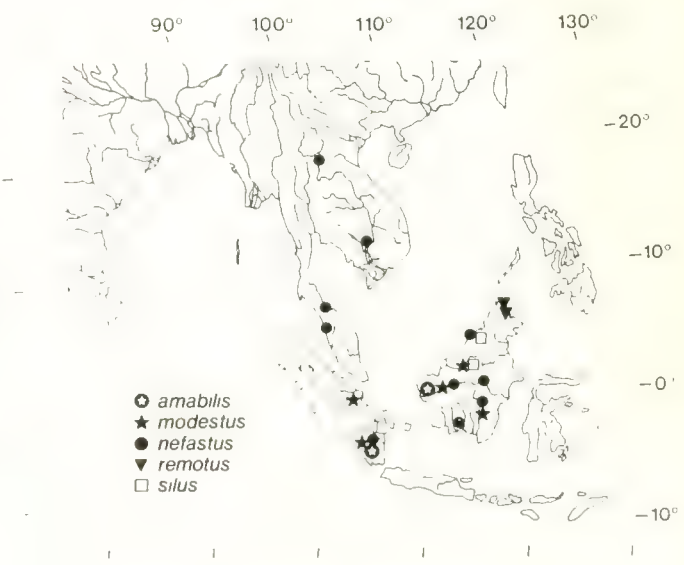

FIGURE 135. *Chonerhinos*. Geographical distribution

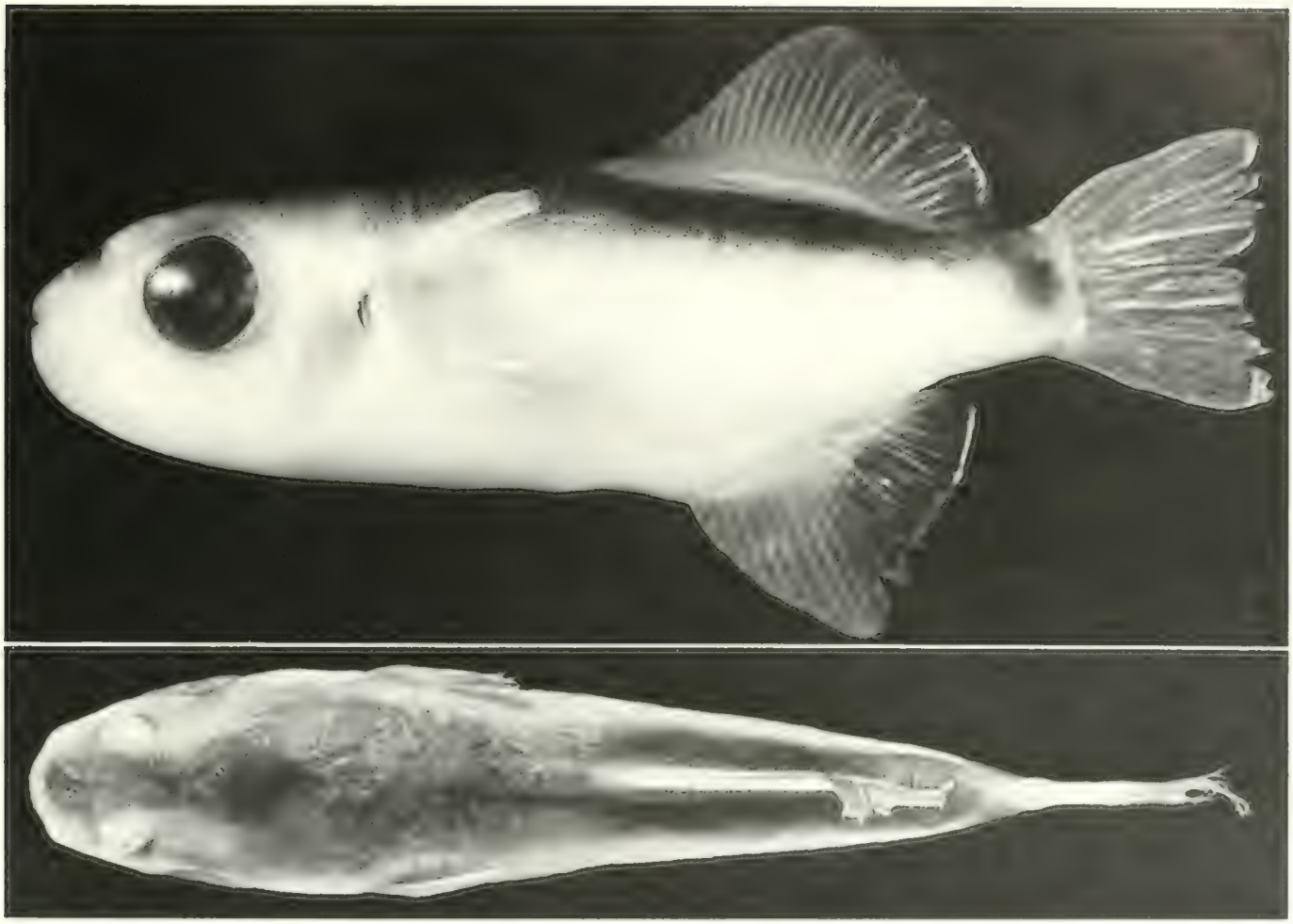

FIGURE 134. *Chonerhinos amabilis*. a, Kapuas 1976-36, 45.2 mm (MZB 3972, holotype); b, Kapuas 1976-9, 48.7 mm (MZB 3973, paratype).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-14, 52.9 mm (MZB 3966); Kapuas 1976-19, 4: 169–240 mm (ANSP 152022, CAS 49502, MZB 3967, USNM 230357); Kapuas 1976-54, 199 mm (MZB 3968); Kapuas, Knapei, Sebruang, 142 mm (MNHN 1891-489, formerly identified as *C. microlepis*).

DISTRIBUTION.—Borneo (Kapuas).

Radiographs of two of my specimens of *C. kapuasensis* reveal dorsal-fin rays 108–110, anal-fin rays 85–86, caudal-fin rays 10, and vertebrae 9+42=51.

Cynoglossus waandersi (Bleeker, 1854)

(Figure 133 lower)

Plagusia waandersi Bleeker, 1854*a*:98 (type locality Palembang, ubi confluunt flumina Lamatang et Enim).
Arelia waandersi Bleeker, 1859*a*:185
Cynoglossus waandersi Bleeker, 1866–72:31.

MATERIAL EXAMINED.—Kapuas 1976-32, 188 mm (MZB 3969); Kapuas 1976-34, 3: 102–168 mm (CAS 49503, MZB 3970, USNM 230358); Kapuas 1976-48, 107 mm (MZB 3971).

A radiograph of one of my Kapuas specimens of *C. waandersi* reveals dorsal-fin rays 95, anal-fin rays 70, caudal-fin rays 10, and vertebrae 9+34=43.

DISTRIBUTION.—Sumatra (Batang Hari, Palembang, Taluk, Gunung Sahilan, Moesi R.). Borneo (Kapuas).

Tetraodontidae

The freshwater pufferfishes of western Borneo belong to two very different genera, *Chonerhinos* and *Tetraodon*. The five species of *Chonerhinos*, exclusively freshwater and restricted to southeast Asia, have been revised by me (Roberts 1982*e*); all five occur in Borneo, three in western Borneo. The Asian freshwater species of the widely distributed *Tetraodon*, which includes numerous marine species as well, have been revised by Dekkers (1975). Three species occur in fresh water in western Borneo (Fig. 135). These revisions should be consulted for additional information.

Key to Freshwater Tetraodontidae of Western Borneo

1a Nasal organ confined to depression on snout; three lateral line canals on side of body; dorsal-fin rays 23–28; anal-fin rays 18–22; pectoral-fin rays 13–17; vertebrae 24–28; color in life almost uniformly bluish or greenish dorsally, white ventrally (*Chonerhinos*) 2

1b Nasal organ an elevated tube divided into two lips or lobes; two lateral line canals on side of body; dorsal-fin rays 12–15; anal-fin rays 10–12; pectoral-fin rays 18–24; vertebrae 19; color in life highly disruptive, with reticu-

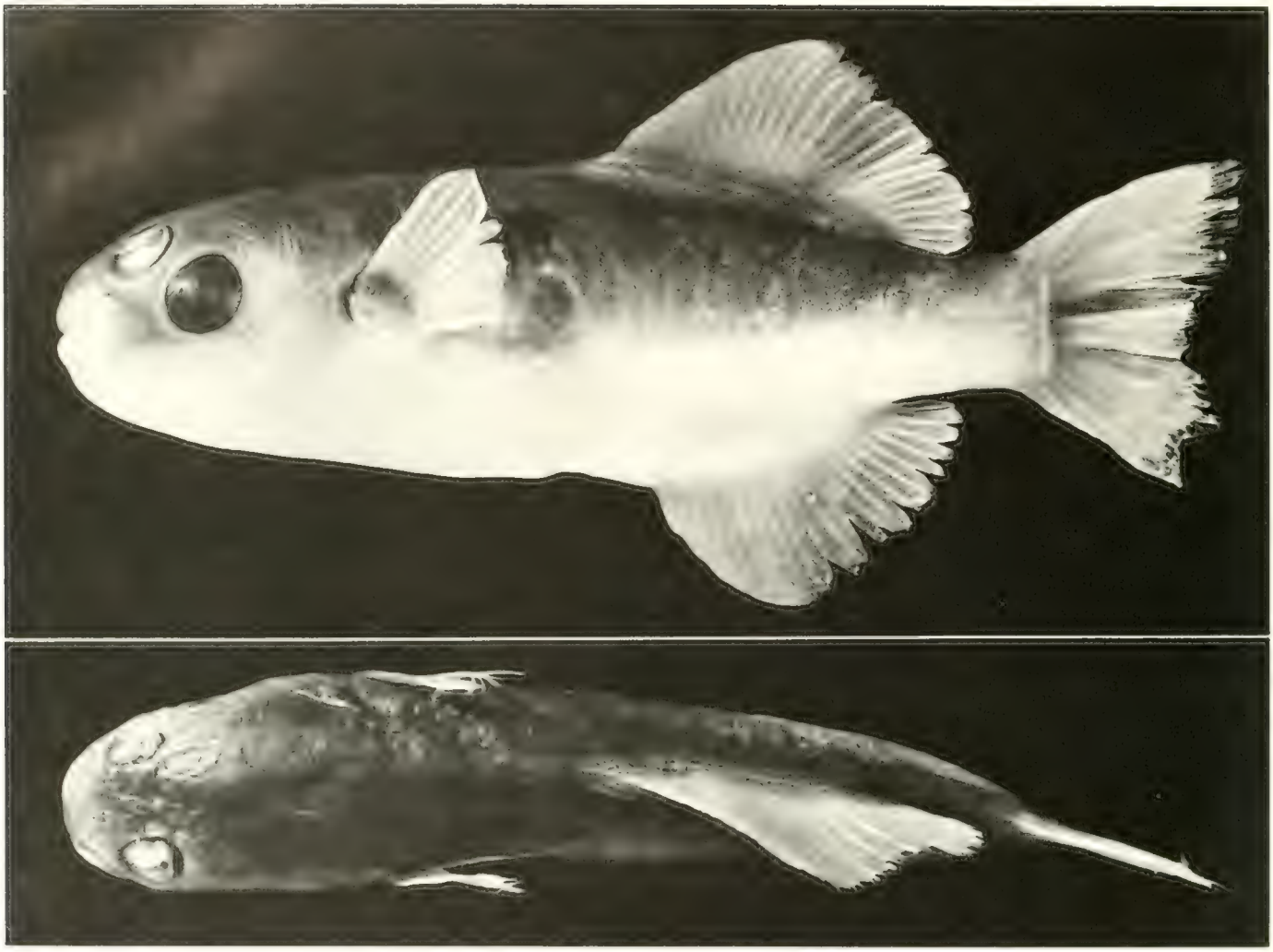

FIGURE 136 *Chonerhinos modestus*. Kapuas 1976-35, 64.6 mm (CAS 49505)

lated, spotted or ocellated pattern predominantly brownish above, off-white, grayish, yellowish, or brownish ventrally (*Tetraodon*) 4

2a Scales on side of body anterior and ventral to pectoral fin with spines directed posteriorly 3

2b Scales on side of body anterior and ventral to pectoral fin with spines directed dorsally . . . . . *C. modestus*

3a Caudal peduncle relatively deep, with a roundish dark spot in its middle; dorsal and anal fins with angulated margins; upper lip not projecting beyond lower lip; exposed portion of eye round; length of nasal organ 10.1–17.9 *C. amabilis*

3b Caudal peduncle relatively elongate, immaculate; dorsal and anal fins usually with rounded margins; upper lip usually projecting; exposed portion of eye usually horizontally oval; length of nasal organ 17.3–27.4 *C. netastus*

4a Head with flat, straight or slightly concave dorsal profile; opposed surfaces of nasal lobes never with spongy tissue; side of body with many polygonal dark spots leaving only lighter network or with wide-meshed dark network enclosing some dark rounded spots 5

4b Head with convex or rounded dorsal profile; opposed surfaces of nasal lobes often with spongy tissue in larger specimens; side of body with many dark spots and rounded blotches . . . . . *T. nigroviridis*

5a Sides and entire abdomen with very well defined dark reticulations surrounding pale areas; center of sides often with numerous ocelli in pale areas with large oval dark spots; body spines often in deep dermal pits hidden under dermal papillae . . . . . *T. palembangensis*

5b Dorsal surface and sides of body with a loose network or more open reticulated pattern; abdomen plain; ocelli absent or few on sides; body spines mostly in superficial dermal pits without papillae . . . . . *T. leiurus*

Chonerhinos Bleeker, 1854

Chonerhinos Bleeker, 1854*c*:259–260 (type species *Tetraodon naritus* Richardson, 1848, Bleeker, 1866*c*:19)

Chonerhinus Bleeker, 1865:213 (unjustified spelling change)

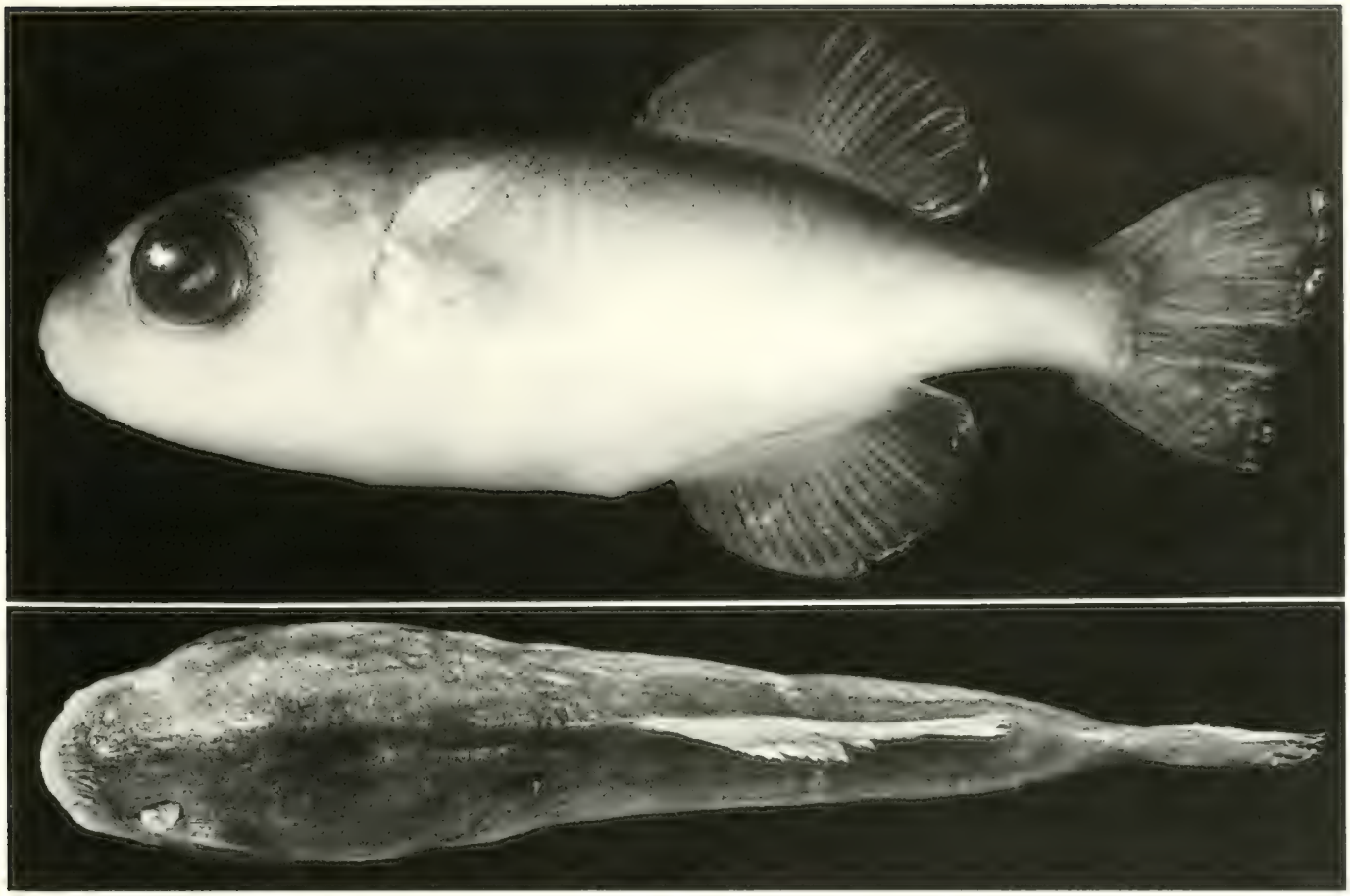

FIGURE 137. *Chonerhinos nefastus*. a, Kapuas 1976-40, 47.0 mm (MZB 3980, holotype); b, Kapuas 1976-35, 40.7 mm (MZB 3983, paratype)

Chonerhinos amabilis Roberts, 1982

(Figure 134)

Chonerhinus naritus Weber and de Beaufort, 1962:374 (specimens from Labang Hara, Soengei Serawai, Kapuas basin).

Chonerhinus modestus Vaillant, 1893, 1902 (pro parte); Popta, 1906 (pro parte); Weber and de Beaufort, 1962 (fig. 84).

Chonerhinos amabilis Roberts, 1982*e*:5 (type locality Kapuas River near Putussibau).

MATERIAL EXAMINED.—Sumatra: Moesi R. at Moera Klingi, 2: 36.2–38.3 mm (UMMZ 171708, paratypes). Western Borneo: Kapuas 1976-9, 48.7 mm (MZB 3973, paratype); Kapuas 1976-24, 41.8 mm (MZB 3974, paratype); Kapuas 1976-33, 38.3 mm (MZB 3975, paratype); Kapuas 1976-34, 2: 35.9–36.8 mm (MZB 3976, USNM 230359, paratypes); Kapuas 1976-35, 2: 35.6–46.0 mm (FMNH 94255, MZB 3977, paratypes); Kapuas 1976-36, 2: 45.0–45.2 mm (CAS 49504, paratypes, MZB 3972, holotype); 36.9 mm (MNHN 1891.216, paratype); Sintang, 2: 40.9–41.2 mm (RMNH uncat., paratypes); Raun, 4: 55.5–68.1 mm (RMNH 7935, paratypes); Soengai Serawai at Lebang Hara, 3: 56.3–70.4 mm (ZMA 108.912, paratypes).

This species feeds almost exclusively on large aquatic insect larvae (Roberts 1982*e*).

DISTRIBUTION.—Sumatra (Moesi). Western Borneo (Kapuas).

Chonerhinos modestus (Bleeker, 1850)

(Figure 136)

Tetraodon (*Arothron*) *modestus* Bleeker, 1850:16 (type locality Banjermassin).

Chonerhinos modestus Bleeker, 1854*c*:260.

MATERIAL EXAMINED.—Sumatra: Indragiri, 3: 44.7–73.5 mm (NHMB 822–824); Lahat, 3: 66.6–81.1 mm (RMNH 12004). Western Borneo: Kapuas 1976-35, 2: 64.6–106 mm (CAS 49505, MZB 3978); Kapuas 1976-48, 2: 46.8–48.4 mm (MZB 3979, USNM 230360); Kapuas at Sanggau, 78.7 mm (RMNH 26931, lectotype); Kapuas at Sanggau, 2: 49.2–59.2 mm (RMNH uncat.); Kapuas at Sintang, 3: 50.0–58.9 mm (RMNH 7934). Southern Borneo: Barito River at Moara Teweh, 2: 90.5–95.3 mm (NMW 64647). Banka Island: Muntok, 4: 52.2–97.0 mm (NMW 64646)

Chonerhinos modestus, attaining at least 106 mm and probably the largest member of its genus, feeds mainly on terrestrial insects, shrimps, seeds, and to a lesser extent on whole fish, fin rays or scales (Roberts 1982*e*).

DISTRIBUTION.—Sumatra (Lahat, Palembang). Borneo (Kapuas, Barito). Bangka Island (Muntok). This species may occur in Thailand and the Malay Peninsula but all specimens of *Chonerhinos* from these places examined by me are *C. nefastus*. The records from Barito R. and Banka are based on specimens examined in Vienna after publication of my revision.

Chonerhinos nefastus Roberts, 1982

(Figure 137)

Chonerhinos modestus D'Aubenton and Blanc, 1966:561 (Mekong basin, Kampuchea); Taki, 1974:199–200, fig. 187 (Mekong basin, Laos); Imaki et al., 1978:29, pl. 18 (Kapuas R. at Sintang)

Chonerhinos nefastus Roberts, 1982*e*:10 (type locality Kapuas R. near Putussibau)

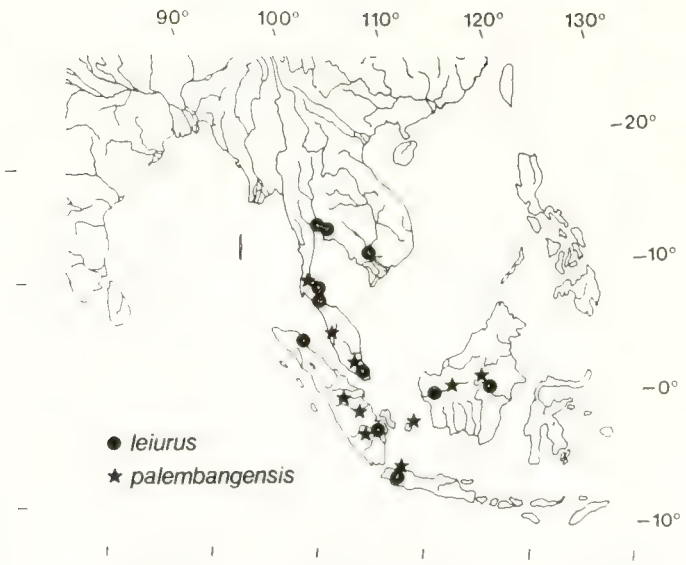

FIGURE 138. *Tetraodon*. Geographical distribution of two species found in western Borneo.

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-33, 4: 34.3–43.3 mm (CAS 49506, MZB 3981, paratypes); Kapuas 1976-34, 3: 36.6–43.7 mm (BMNH 1982.3.29.254–5, MZB 3982, paratypes); Kapuas 1976-35, 6: 32.9–60.2 mm (IRSNB 632, MZB 3983, ROM 38601, USNM 230361, paratypes); Kapuas 1976-37, 51.7 mm (MZB 3984, paratype); Kapuas 1976-39, 64.9 mm (MZB 3985, paratype); Kapuas 1976-44, 4: 36.7–57.8 mm (MZB 3980, holotype, MZB 3986, CAS 49507, paratypes). Southern Borneo: Barito R. at Moara Teweh, 39.1 mm (NMW 64645). For material examined from Kampuchea, Thailand, Malay Peninsula, Sumatra, Sarawak, and additional localities from Borneo see Roberts (1982*e*:10–11).

This species feeds largely on the fin rays and scales of other fishes (Roberts 1982*e*).

DISTRIBUTION.—Kampuchea (Mekong basin). Thailand (Mekong, Songkhla Lake). Malay Peninsula (Perak). Sumatra (Moesi R.). Borneo (Niah, Rejang, Kapuas, Mentaya, Barito, Mahakam). The record from the Barito is based on the 39.1 mm specimen from Moara Teweh reported above, examined in Vienna after publication of Roberts (1982*e*).

Tetraodon Linnaeus, 1758

Tetraodon Linnaeus, 1758:332 (type species *Tetraodon lineatus* Linnaeus, 1758, by subsequent designation of Lesson, 1830:198–199).

Tetraodon leiurus Bleeker, 1851

Tetraodon leiurus Bleeker, 1851*b*:97 (type locality Batavia, in mari et ostiis fluviorum)
Tetrodon Hilgendorfii Popta, 1905:185–186 (type locality Boh River, upper Mahakam). See Dekkers (1975).
Tetrodon Bergii Popta, 1905:186 (type locality Bongan River at Bulit, Kapuas). See Dekkers (1975)
Tetraodon cambodgiensis Chabanaud, 1923:137–140 (type locality Pnom-Penh). See Dekkers (1975).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-14, 42.8 mm (MZB 3987).

DISTRIBUTION (Fig. 138).—Kampuchea (Mekong). Thailand (Nontaburi, Bangpakong R., Thale Luang, Patalung R.). Malay Peninsula (Jahan, Sembeling). Sumatra (Pangian R., Deli, Lahat, Palembang, Padang, Solok, Sinkiarak Lake). Borneo (Kapuas, Mahakam). Java.

Although Dekkers (1975:112) indicated east Malaysia as part of its range, he did not list any specimens examined from there or include any locality records from there.

Tetraodon nigroviridis Marion de Proce, 1822

Tetraodon nigroviridis Marion de Proce, 1822:130 (type locality freshwater pool on NE coast of Sumatra).
Tetrodon simulans Cantor, 1850:1356–1357 (type locality Malay Peninsula).

MATERIAL EXAMINED.—None.

The inclusion of this species is based on identification of a 72 mm specimen (ZMA 110.211) from South Natuna Island by Dekkers (1975:125).

Tetraodon palembangensis Bleeker, 1852

Tetraodon palembangensis Bleeker, 1852*d*:21, 25, 26 (type locality Palembang).
Tetraodon pinguis Vaillant, 1902:38 (type locality Mahakam River at Tepu).

MATERIAL EXAMINED.—Western Borneo: Kapuas 1976-19, 8: 54.7–132 mm (CAS 49508, MZB 3988); Kapuas 1976-44, 6: 68.0–185 mm (MZB 3989, USNM 230362); Kapuas 1976-51, 64.5 mm (MZB 3990).

DISTRIBUTION (Fig. 138).—Laos (Mekong). Thailand (Mekong, Chao Phrya, Tale Luang, Tale Noi, Tale Sap). Malay Peninsula (Perak, Jahan R.). Sumatra (Palembang, Gunung Sahilan, Djambi R., Indragiri R.). Borneo (Kapuas, Mahakam). Java. Billiton.

LITERATURE CITED

AHL, E. 1922. Einige neue Süsswasserfische des Indo–Malayischen Archipels. Sitzb. Ges. Naturf. Fr. Berlin 1922(1–2):30–36.
——— 1937. Neue Süsswasserfische aus dem Indischen und malaiischen Gebeit. Zool. Anz. 117:113–119.
ALFRED, E. R. 1961. The Javanese fishes described by Kuhl and van Hasselt. Bull Nat. Mus. (Singapore) 30:80–88, pls. 3–8.
——— 1964*a*. Some colourful fishes of the genus *Puntius* Hamilton. Bull. Nat. Mus (Singapore) 32:135–142.
——— 1964*b*. *Channa bistriata* (Weber and de Beaufort), the young of the snake-head fish *Channa lucius* (Cuvier). Bull. Nat. Mus. (Singapore) 32:155–156
——— 1966. The fresh-water fishes of Singapore. Zool. Verh. 78. 68 pp., 8 pls.
——— 1969. The Malayan cyprinoid fishes of the family Homalopteridae. Zool. Meded. 43(18):213–237, 2 pls.
ALLEN, G. R. 1978. A review of the archerfishes (family Toxotidae). Rec. West. Aust. Mus. 6:355–378.
——— 1982. *Parambassis altipinnis*, a new species of freshwater glassfish from western New Guinea. Bull. Zool. Mus. Univ. Amst. 8(20):165–169.
AURICH, H. J. 1938. Mitteilung XXVIII der Wallacea-Expedition Woltereck. Die Gobiiden (Ordnung: Gobioidea). Int. Res. ges. Hydrobiol. Hydrogr. (Leipzig) 38:125–183.
AXELROD, H. R. 1976. *Rasbora brittani*, a new species of cyprinid fish from the Malay peninsula. Trop. Fish Hobbyist 24(6):94–98.
BALON, E. K. 1975. Reproductive guilds of fishes: a proposal and definition. J. Fish. Res. Board Can. 32:821–864.
BĂNĂRESCU, P. M. 1978. The genus *Puntioplites* Smith (Pisces, Cyprinidae). Rev. Roum. Biol. (Biol. Anim.) 23:113–118.
——— 1980*a*. Remarks on the genera *Scaphiodontichthys, Barbichthys* and *Cosmocheilus* (Pisces, Cyprinidae). Rev. Roum. Biol. (Biol. Anim.) 25:93–100.
——— 1980*b*. *Kalimantania* and *Neobarynotus*, two new Indonesian genera of minnows. Trav. Mus. Hist. nat. Grigore Antipa (Bucarest) 22:471–478.
BĂNĂRESCU, P. M. AND P. G. BIANCO. 1984. A contribution to the fishfauna of the Kapuas River, Kalimantan Barat, Indonesian Borneo: Cyprinidae. Cybium 8(1):59–70.
BARLOW, G. W., K. F. LIEM, AND W. WICKLER. 1968. Badidae, a new fish family—behavioral, osteological, and developmental evidence. J. Zool. 156:415–447.
BARTLETT, E. 1896. Fishes of Borneo and adjacent islands. Sarawak Gazette 2: 92–99, 128–136, 148–154, 186–238.
BERG, L. S. 1940. Classification of fishes, both recent and fossil. [In Russian.] Trav. Inst. Zool. Acad. Sci. URSS 5:87–345.

Bleeker, P. 1845. Bijdragen tot de geneeskundige Topographie van Batavia. Generisch overzicht der Fauna. Visschen. Nat. Geneesk. Arch. Ned. Ind. 2: 505–528 [2].
———. 1846*a*. Overzicht der Siluroiden welke te Batavia voorkomen. Nat. Geneesk. Arch. Ned. Ind. 3(2):135–184 [3].
———. 1846*b*. Siluroideorum bataviensium species nuperrime detectae. Nat. Geneesk. Arch. Ned. Ind. 3(2):284–293 [4].
———. 1847. Nieuwe bijdrage tot de kennis der Siluroiden van Java. Verh. Bat. Gen. 21(1):1–12 [7].
———. 1849. Bijdrage tot de kennis der ichthyologische fauna van het eiland Madura, met beschrijving van eenige nieuwe species. Verh. Bat. Gen. 22:1–16 [16].
———. 1850. Bijdrage tot de kennis der ichthyologische fauna van Midden-en Oost-Java, met beschrijving van eenige nieuwe species. Verh. Bat. Gen. 23:1–23 [25].
———. 1851*a*. Bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van 16 nieuwe soorten van Zoetwaterfischen. Nat. Tijds. Ned. Ind. 1:1–16 [26].
———. 1851*b*. Over drie nieuwe soorten van *Tetraodon* van den Indischen Archipel. Nat. Tijds. Ned. Ind. 1:96–97 [30].
———. 1851*c*. Nieuwe bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van eenige nieuwe soorten van zoetwatervisschen. Nat. Tijds. Ned. Ind. 1:259–275 [35].
———. 1851*d*. Over eenige nieuwe soorten van Pleuronectoiden van den Indischen Archipel. Nat. Tijds. Ned. Ind. 1:401–416 [38].
———. 1851*e*. Over eenige nieuwe soorten van *Megalops, Dussumieria, Notopterus* en *Astronesthes*. Nat. Tijds. Ned. Ind. 1:417–424 [39].
———. 1851*f*. Derde bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van eenige nieuwe soorten van zoetwaterfvisschen. Nat. Tijds. Ned. Ind. 2:57–70 [42].
———. 1851*g*. Nieuwe bijdrage tot de kennis der Percoidei, Scleroparei, Sciaenoidei, Maenoidei, Chaetodontoidei en Scomberoidei van den Sunda-Molukschen Archipel. Nat. Tijds. Ned. Ind. 2:163–179 [44].
———. 1851*h*. Vierde bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van eenige nieuwe soorten van zoetwatervisschen. Nat. Tijds. Ned. Ind. 2:193–208 [45].
——— 1851*i*. Vijfde bijdrage tot de kennis der ichthyologische fauna van Borneo, met beschrijving van eenige nieuwe soorten van zoetwatervisschen. Nat. Tijds. Ned. Ind. 2:415–442 [49].
———. 1852*a*. Bijdrage tot de kennis der ichthyologische fauna van Blitong (Billiton), met beschrijving van eenige nieuwe soorten van zoetwatervisschen. Nat. Tijds. Ned. Ind. 3:87–100 [52].
———. 1852*b*. Zesde bidrage tot de kennis der ichthyologische fauna van Borneo. Visschen van Pamangkat, Bandjermassing, Praboekarta en Sampit. Nat. Tijds. Ned. Ind. 3:407–442 [55].
———. 1852*c*. Bijdrage tot de kennis der ichthyologische fauna van het eiland Banka. Nat. Tijds. Ned. Ind. 3:443–460 [56].
———. 1852*d*. Bijdrage tot de kennis der Blootkakige visschen van den Soenda-Molukschen Archipel. Verh. Bat. Gen. 24:1–26 [62].
———. 1852*e*. Diagnostische beschrijvingen van nieuwe of wenig bekende vischsoorten van Sumatra. Tiental I–IV. Nat. Tijds. Ned. Ind. 3:569–608 [67].
———. 1852*f*. Nieuwe bijdrage tot de kennis der ichthyologische fauna van Ceram. Nat. Tijds. Ned. Ind. 3:689–714 [69].
———. 1852*g*. Nieuwe bijdrage tot de kennis der ichthyologische fauna van het eiland Banka. Nat. Tijds. Ned. Ind. 3:715–738 [70].
———. 1853*a*. Over eenige nieuwe soorten van *Homaloptera* v. Hass. (*Balitora* Gr.) van Java en Sumatra. Nat. Tijds. Ned. Ind. 4:155–164 [74].
———. 1853*b*. Diagnostische beschrijvingen van nieuwe of weining bekende vischsoorten van Sumatra. Tiental V–X. Nat. Tijds. Ned. Ind. 4:243–302 [76].
———. 1853*c*. Diagnostische beschrijvingen van nieuwe of wenig bekende vischsoorten van Batavia. Tiental I–IV. Nat. Tijds. Ned. Ind. 4:451–516 [78].
———. 1853*d*. Nalezingen op de ichthyologische fauna van het eiland Banka. Nat. Tijds. Ned. Ind. 5:175–194 [82].
———. 1853*e*. Zevende bijdrage tot de kennis der ichthyologische fauna van Borneo. Zoetwatervisschen van Sambas, Pontianak en Pengaron. Nat. Tijds. Ned. Ind. 5:427–462 [85].
———. 1853*f*. Nieuwe tientallen diagnostische beschrijvingen van nieuwe of wenig bekende vischsoorten van Sumatra. Nat. Tijds. Ned. Ind. 5:495–534 [86].
———. 1853*g*. Bijdrage tot de kennis der Troskieuwige visschen van den Indischen Archipel. Verh. Bat. Gen. 25:1–30 [89].
———. 1853*h*. Nalezingen op de ichthyologische fauna van Bengalen en Hindostan. Verh. Bat. Gen. 25:1–164 [91].
———. 1854*a*. Overzicht der ichthyologische fauna van Sumatra, met beschijving van eenige nieuwe soorten. Nat. Tijds. Ned. Ind. 7:49–108 [106].
———. 1854*b*. Visschen van de Natoena-eilanden. Nat. Tijds. Ned. Ind. 7:163–164 [108].
———. 1854*c*. Vijfde bijdrage tot de Kennis der ichthyologische fauna van Celebes. Nat. Tijds. Ned. Ind. 7:225–260 [109].
———. 1854*d*. Ichthyologische warrnemingen, gedaan op verschillende reizen in de residentie Banten. Nat. Tijds. Ned. Ind. 7:309–326 [110].
———. 1854*e*. Specierum piscium javanensium novarum vel minus cognitarum diagnoses adumbratae. Nat. Tijds. Ned. Ind. 7:415–448 [113].
———. 1855*a*. Achste bijdrage tot de kennis der ichthyologische fauna van Borneo. Zoetwatervisschen van Bandjermassin. Nat. Tijds. Ned. Ind. 8:151–168 [121].
———. 1855*b*. Nalezingen op de vischfauna van Sumatra. Visschen van Lahat en Sibogha. Nat. Tijds. Ned. Ind. 9:257–280 [136].
———. 1855*c*. Verslag van eenige vischverzamelingen van Oost-Java. Nat. Tijds. Ned. Ind. 9:391–414 [138].
———. 1855*d*. Negende bijdrage tot de kennis der ichthyologische fauna van Borneo. Zoetwatervisschen van Pontianak en Bandjermassin. Nat. Tijds. Ned. Ind. 9:415–430 [139].
———. 1856. Verslag van eenige verzamelingen van zee- en zoetwatervisschen van het eiland Banka. Nat. Tijds. Ned. Ind. 11:415–420.
———. 1857*a*. Tiende bijdrage tot de kennis der ichthyologische fauna van Borneo. Visschen van de rivieren Barito, Kahajan en Kapoeas. Act. Soc. Sci. Indo-Neerl. 2:1–21 [162].
———. 1857*b*. Descriptiones specierum piscium javanensium novarum vel minus cognitarum diagnosticae. Nat. Tijds. Ned. Ind. 13:323–368 [166].
———. 1858*a*. Zesde bijdrage tot de Kennis der vischfauna van Sumatra. Visschen van Padang, Troessan, Priaman, Siboga en Palembang. Act. Soc. Sci. Indo-Neerl. 3:1–50 [174].
———. 1858*b*. Elfde bijdrage tot de kennis der ichthyologische fauna van Borneo. Visschen van Singawang. Act. Soc. Sci. Indo-Neerl. 3:1–4 [177].
———. 1858*c*. Ichthyologiae Archipelagi Indici Prodomus, Vol. I. Siluri. Lange & Co., Batavia [189a].
———. 1858–59*a*. Zevende bijdrage tot de kennis der vischfauna van Sumatra. Acta Soc. Sci. Indo-Neerl. 5:1–12 [190].
———. 1858–59*b*. Twaalfde bijdrage tot de kennis der vischfauna van Borneo. Visschen van Sinkawang. Act. Soc. Sci. Indo-Neerl. 5:1–10 [191].
———. 1858–59*c*. Vischsoorten van Sinkawang, verzameld door J. H. Sonnemann Rebentisch. Nat. Tijd. Ned. Ind. 16:195–196 [201].
———. 1858–59*d*. *Ophiocephalus micropeltes* K. v. H. gevangen in de rivieren van westelijk Borneo en aangeboden door den heer C. M. H. Kroesen. Nat. Tijds. Ned. Inc. 16:241 [210].
———. 1858–59*e*. Over de geslachten der Cobitinen. Nat. Tijds. Ned. Ind. 16: 302–304 [220].
———. 1858–59*f*. Zoetwater visschen uit de omstreken van Ngawi, verzameld dor J. T. van Bloemen Waanders. Nat. Tijds. Ned. Ind. 16:357–358 [225].
———. 1859*a*. Enumeratio specierum piscium hucusque in Archipelago indico observatarum, adjectis habitationibus citationibusque ubi descriptiones earum recentiores reperiuntur, nec non speciebus Musei Bleekeriani Bengalensibus, Japonicis, Capensibus Tasmanicisque. Act. Soc. Sci. Indo-Neerl. 6. xxxvi + 276 pp. [233].
———. 1859*b*. Negende bijdrage tot de kennis der vischfauna van Banka. Nat. Tijds. Ned. Ind. 18:359–378 [235].
——— 1859–60*a*. Vischsoorten van Siam, verzameld door Fr. de Castelnau. Nat. Tijds. Ned. Ind. 20:101–102 [239].
———. 1859–60*b*. Zoetwatervisschen van Sintang, verzameld door A. H. Thepas. Nat. Tijds. Ned. Ind. 20:199–200 [245].
———. 1859–60*c*. Conspectus systematis Cyprinorum. Nat. Tijds. Ned. Ind. 20:421–441 [261].
———. 1860*a*. Ichthyologiae Archipelagi Indici Prodromus, Vol. II. Cyprini. Lange & Co., Batavia [265a].
———. 1860*b*. Achste bijdrage tot de Kennis der vischfauna van Sumatra. Visschen van Benkoelen, Priaman, Tandjong, Palembang en Djambi. Act. Soc. Sci. Indo-Neerl. 8:1–88 [270].
———. 1860*c*. Negende bijdrage tot de Kennis der vischfauna van Sumatra. Visschen mit de Lematang-Enim en van Benkoelen. Act. Soc. Sci. Indo-Neerl 8:1–12 [271].
———. 1860*d*. Dertiende bijdrage tot de Kennis der vischfauna van Borneo Act. Soc. Sci. Indo-Neerl. 8:1–64 [272].
———. 1862. Notice sur les genre *Parasilurus, Eutropiichthys, Pseudeutropius* et *Pseudopangasius*. Versl. Akad. Amst. 14:390–399 [299].
———. 1862–63. Atlas ichthyologique des Indes Orientales Néerlandaises. 2 Siluroides. 112 pp., pls. 49–101.
———. 1863*a*. Systema Silurorum revisum. Ned. Tijds. Dierk. 1:77–122 [306]

——— 1863*b*. Systema Cyprinoideorum revisum. Ned. Tijds. Dierk. 1:187–218 [314].
——— 1863*c*. Sur les genres de la famille des Cobitoides. Ned. Tijds. Dierk. 1:361–368; also Versl. Akad. Amst. 15:32–44 [323].
——— 1863*d*. Description de trois espèces nouvelles de Siluroides de l'Inde archipélagique. Versl. Akad. Amst. 15:70–76 [324].
——— 1863*e*. Notice sur les noms de quelques genres de la famille des Cyprinoides. Versl. Akad. Amst. 15:261–264 [329].
———. 1863–64. Atlas ichthyologique des Indes Orientales Néerlandaises. 3. Cyprins. 150 pp., pls. 102–144.
———. 1864. Notice sur la faune ichthyologique de Siam. Versl. Akad. Amst. 16:352–358 [337].
———. 1865*a*. *Rhinobagrus* et *Pelteobagrus*, deux genres nouveaux de Siluroides de Chine. Ned. Tijds. Dierk. 2:7–10 [342].
———. 1865*b*. Sixième notice sur la faune ichthyologique de Siam. Nat. Tijds. Ned. Ind. 2:171–176 [356].
——— 1865–69. Atlas ichthyologique des Indes Orientales Néerlandaises. 5. Baudroies, plectognaths. 152 pp., pls. 194–231.
——— 1865–75. Atlas ichthyologique des Indes Orientales Néerlandaises. 6. Pleuronectes, etc. 170 pp., pls. 232–278.
———. 1866*a*. Révision des Hémirhamphes de l'Inde archipélagique. Ned. Tijds. Dierk. 3:136–170 [375].
———. 1866*b*. Description de quelques espèces inédites ou peu connues de Clupeoides de l'Inde archipélagique. Ned. Tijds. Dierk. 3:293–308 [381].
——— 1866*c*. Systema Balistidorum, Ostracionidorum, Gymnodontidorumque revisum. Ned. Tijd. Dierk. 3:8–19 [367].
———. 1874*a*. Typi nonnulli generici piscium neglecti. Versl. Akad. Amst. (2)8: 367–371 [449].
——— 1874*b*. Esquisse d'un systeme naturel des Gobioides. Arch. Neer. Sci. Nat. 9:289–331 [453].
——— 1874*c*. Revision des espèces d'*Ambassis* et de *Parambassis* de l'Inde archipélagique. Nat. Verh. Holl. Maatsch. Wetensch. 2(2):83–106 [457].
——— 1875–77. Atlas ichthyologique des Indes Orientales Néerlandaises. 8. Percoides II. 156 pp., pls. 321–364.
——— 1876. Systema percarum revisum. Arch. Neerl. Sci. Nat. 1:247–288; 2: 289–340 [468].
——— 1876–78. Atlas ichthyologique des Indes Orientales Néerlandaises. 9–10. Percoides III. 80 pp., pls. 365–420.
——— 1877. Revision des especes insulindiennes de la sousfamille des Eleotriformes. Versl. Akad. Amst. (2)11:13–110 [478].
——— 1879. Memoire sur les poissons a pharyngiens labyrinthiformes de l'Inde archipélagique. Verh. Akad. Amst. 19:1–56 [498].
——— 1984. Atlas ichthyologique des Indes Orientales Néerlandaises. 11–14. 20 pp. [introduction and species index by M. Boeseman], pls. 421–575 [11 pls. missing].
Bloch, M. E. 1786. Naturgeschichte der ausländischen Fische, Berlin. 2.
——— 1795. Naturgeschichte der ausländischen Fische. Berlin. 6.
——— and J. G. Schneider. 1801. Systema ichthyologiae. Berolini. lx + 584 pp.
Blumer, L. S. 1982. A bibliography and categorization of bony fishes exhibiting parental care. Zool. J. Linn. Soc. 75(1):1–22.
Blyth, E. 1860. Report on some fishes received chiefly from the Sitang River and its tributary streams. J. Asiat. Soc. (Calcutta) 29:138–174.
Boeseman, M. 1957. On a collection of east Asian fishes. Zool. Med. 35:69–78, pl. 3.
Böhlke, E. 1984. Catalog of type specimens in the ichthyological collection of the Academy of Natural Sciences of Philadelphia. Acad. Nat. Sci. Philadelphia Spec. Publ. 14. viii + 246 pp.
Boulenger, G. A. 1894. Descriptions of new freshwater fishes from Borneo. Ann. Mag. Nat. Hist. (6)13:245–251
——— 1895. List of the freshwater fishes collected by Mr. A. Everett on Palawan and Balabac. Ann. Mag. Nat. Hist. (6)15:185–187.
——— 1899. Descriptions of two new homalopteroid fishes from Borneo. Ann. Mag. Nat. Hist. (7)4:228–229
——— 1912. A synopsis of the fishes of the genus *Mastacembelus*. J. Acad. Nat. Sci. Philadelphia (2)15:197–203.
Breder, C. M. and D. E. Rosen. 1966. Modes of reproduction in fishes. The Natural History Press, Garden City, New York. xvi + 941 pp.
Breitenstein, H. 1899. 21 Jahre in Indien. Leipzig. viii + 264 pp.
Brembach, M. 1978. *Hemirhamphodon*—der Zahnleistenhalbschnäbler. Aquar Mag. 12(10):498–503.
Brittan, M. R. 1949. Rediagnosis of the Malayan cyprinid fish *Rasbora taeniata* Ahl. Proc. Calif. Zool. Club 1:22–28.
———. 1951. New cyprinid fishes of the genus *Rasbora* from Borneo and Bungaran islands. Proc. Calif. Zool. Club 2:1–5.
——— 1954. A revision of the Indo-Malayan freshwater fish genus *Rasbora*. Philippine Inst. Sci. Tech., monogr. 3. 224 pp., 52 figs., 3 maps. [Reprinted 1972 by TFH Press.]
——— 1976. *Rasbora axelrodi*, a new cyprinid fish from Indonesia. Trop. Fish Hobbyist 25(4)[Dec. 1976]:92–98.
Büttikofer, J. 1897. Zoological results of the Dutch Scientific Expedition to Central Borneo—introduction. Notes Leyden Mus. 19:1–25, map.
Canestrini, J. 1860. Zur Systematik und Charakteristik der Anabatinen. Verh. Zool. Bot. Verein. Wien 10:697–712.
Cantor, T. 1850. Catalogue of Malayan fishes. J. Asiat. Soc. Bengal 18(1849), xii + 983–1443, 14 pls.
Castelnau, F. Count de. 1878. Notes on the fishes of the Norman River. Proc. Linn. Soc. New South Wales 3:41–51.
Chang, H. W. 1945. Comparative study on the girdles and their adjacent structures in Chinese homalopterid fishes with special reference to the adaptation to torrential stream. Sinensia 16(1–6):9–26.
Chaper, M. 1984*a*. Voyage à Borneo. Ann. Geogr. 3:371–381.
——— 1894*b*. Huit cents kilometres à l'interieur de l'ile de Borneo. Bull. Soc. Geogr. Comm. 16:266–297.
Chen, J. 1981. A study on the classification of the subfamily Cobitinae of China. Trans. Chin. Ichthyol. Soc. 1:21–31.
Chevey, P. 1932. Poissons des campagnes du "de Lanessan" (1925–1929). Trav. Inst. Oceanogr. Indochine (Saigon), Mem. 4, pt. 1. 155 pp., 50 pls.
Chu, X. L. and T. R. Roberts. 1985. *Cosmochilus cardinalis*, a new species of cyprinid fish from the Lancang-jiang or Mekong River of China. Proc. California Acad. Sci. 44(1):1–7.
Compagno, L. J. V. and T. R. Roberts. 1982. Freshwater dasyatid stingrays of Southeast Asia and New Guinea, with description of a new species. Env. Biol. Fishes 7(4):321–339.
Cuvier, G. 1816. Le règne animal distribue d'après son organisation, Vol. 2. Paris. xviii + 532 pp.
——— 1829. Le règne animal distribue d'après son organisation, Vol. 2. Paris. xvi + 406.
Cuvier, G. and A. Valenciennes. 1831. Histoire naturelle des poissons, Vol. 7. Paris–Strasbourg. xxix + 531 pp., pls. 170–208.
——— 1839. Histoire naturelle des poissons, Vol. 13. Paris–Strasbourg. xix + 505 pp., pls. 369–388.
——— 1840*a*. Histoire naturelle des poissons, Vol. 14. Paris–Strasbourg. xxii + 464 pp., pls. 389–420.
——— 1840*b*. Histoire naturelle des poissons, Vol. 15. Paris–Strasbourg. xxi + 540 pp., pls. 421–455.
——— 1842. Histoire naturelle des poissons, Vol. 16. Paris–Strasbourg. xx + 472 pp., pls. 456–487.
——— 1844. Histoire naturelle des poissons, Vol. 17. Paris–Strasbourg. xxiii + 497 pp., pls. 487–519.
——— 1846. Histoire naturelle des poissons, Vol. 18. Paris–Strasbourg. xix + 505 pp., pls. 520–533
Daldorff, D. C. de. 1797. Natural history of *Perca scandens*, nov. sp. Trans. Linn. Soc. Lond. (Zool.) 3:62–63.
d'Aubenton, F. and M. Blanc. 1966. Poissons tetraodontiformes du Cambodge. Bull. Mus. Natl. Hist. Nat. Paris (2)38:554–561.
Dawson, C. E. 1981. Review of the Indo-Pacific doryrhamphine pipefish genus *Dorychthys*. Jap. J. Ichthyol. 28:1–18.
Day, F. 1865*a*. On the fishes of Cochin, on the Malabar coast of India. Proc. Zool. Soc. Lond. 1865:286–318, 3 figs.
——— 1865*b*. The fishes of Malabar. London. xxxii + 293 pp., 20 pls.
——— 1869. On the freshwater fishes of Burma. Part 1. Proc. Zool. Soc. Lond. 1869:614–623.
——— 1888. Supplement to the fishes of India. Williams and Norgate, London.
——— 1889. Fishes *in* The fauna of British India, including Ceylon and Burma. W. T. Blanford, ed. London, Calcutta.
de Beaufort, L. F. 1933. On some new or rare species of Ostariophysi from the Malay Peninsula and a new *Betta* from Borneo. Bull. Raffles Mus. 8:31–36.
——— 1939. On a collection of freshwater fishes of the island of Billiton. Treubia 1869:614–623.
Dekkers, W. J. 1975. Review of the Asiatic freshwater puffers of the genus *Tetraodon* Linnaeus, 1758 (Pisces, Tetraodontiformes, Tetraodontidae). Bijdr. Dierk. 45:87–142.
DeWitt, H. H. 1960. A contribution to the ichthyology of Nepal. Stanford Ichthyol. Bull. 7(4):63–88.
Dumeril, A. 1856. Ichthyologie analytique ou classification des poissons, etc. Mem. Acad. Sci. Paris 27(1):1–511.

DUNCKER, G. 1904. Die Fische der malayischen Halbinsel. Mitth. Naturh. Mus. Hamburg 21:133–207, pls. 1–2.
———. 1915. Revision der Syngnathidae. Erster Teil. Mitteil. Naturh. Mus. Hamburg 32:9–120.
DUTT, S. AND M. RAMASESHAIAH. 1980. Chromosome number in *Anabas testudineus* (Bloch, 1975) [sic] and *A. oligolepis* Bleeker, 1855 (Osteichthyes: Anabantidae). Matsya 6:71–74.
———. 1983. Taxonomic and biometric studies on *Anabas testudineus* (Bloch) and *A. oligolepis* Bleeker (Osteichthyes: Anabantidae). Proc. Ind. Nat. Sci. Acad. 49B(4):317–326.
ETTRICH, G. 1982. Das Schlangenkopffisch-männchen entpuppte sich als Maulbrüter. Aquar. Mag. 16(11):650–653.
FORSELIUS, S. 1957. Studies of anabantid fishes. I–III. Zool. Bidrag. Univ. Uppsala 32:93–598.
FORSKÅL, P. 1775. Descriptiones animalium avium, amphibiorum, piscium, insectorum, vermium, quae in itinere orientali observavit. Post mortem auctoris edidit Carsten Neibuhr. Havniae. 164 pp., 43 pls., map.
FOWLER, H. W. 1904. A collection of fishes from Sumatra. J. Acad. Nat. Sci. Phila. (2)12:495–560, pls. 7–28.
——— 1905. Some fishes from Borneo. Proc. Acad. Nat. Sci. Phila. 57:455–523.
———. 1928. Further notes and descriptions of Bombay shore fishes. J. Bombay Nat. Hist. Soc. 33:100–119.
———. 1931. The fishes of the families Lobotidae, Pempheridae, Priacanthidae, Lutjanidae, Pomadasyidae, and Teraponidae, collected by the United States Bureau of Fisheries Steamer "Albatross," chiefly in Philippine seas and adjacent waters. Bull. U.S. Natl. Mus. Vol. 100. x + 388 pp.
———. 1934*a*. Description of new fishes obtained 1907 to 1910, chiefly in the Philippine Islands and adjacent seas. Proc. Acad. Nat. Sci. Phila. 85:233–367.
———. 1934*b*. Zoological results of the third de Schauensee Siamese Expedition. Part 1. Fishes. Proc. Acad. Nat. Sci. Phila. 86:67–163.
———. 1934*c*. Zoological results of the third de Schauensee Siamese Expedition. Part 5. Additional fishes. Proc. Acad. Nat. Sci. Phila. 86:335–352.
———. 1935*a*. Zoological results of the third de Schauensee Siamese Expedition. Part 6. Fishes obtained in 1934. Proc. Acad. Nat. Sci. Phila. 87:89–163.
———. 1935*b*. Zoological results of the third de Schauensee Siamese Expedition. Part 7. Fishes obtained in 1935. Proc. Acad. Nat. Sci. Phila. 87:509–513.
———. 1936. Zoological results of the George Vanderbilt African Expedition of 1934. Part III—the fresh water fishes. Proc. Acad. Nat. Sci. Phila. 88:243–335.
———. 1937. Zoological results of the third de Schauensee Siamese Expedition. Part 8. Fishes obtained in 1936. Proc. Acad. Nat. Sci. Phila. 89:125–264.
——— 1938. A list of the fishes known from Malaya. Fish. Bull. Singapore 1: 1–268.
——— 1939. Zoological results of the third de Schauensee Siamese Expedition. Part 9. Additional fishes obtained in 1936. Proc. Acad. Nat. Sci. Phila. 91:39–76.
———. 1944. A new glass catfish from Borneo (*Cryptopterella beldti*). Fish Cult. 24(1):1–2.
FOWLER, H. W. AND B. A. BEAN. 1930. The fishes of the families Amiidae, Chandidae, Duleidae, and Serranidae, obtained by the United States Bureau of Fisheries Steamer "Albatross" in 1907 to 1910, chiefly in the Philippine Islands and adjacent seas. U.S. Natl. Mus. Bull. Vol. 100, No. 1. ix + 334 pp.
FRAZER-BRUNNER, A. 1940. On some fishes of the genus *Acanthophthalmus*, with description of a new species. Ann. Mag. Nat. Hist. (11)6:170–175.
———. 1943. Notes on plectognath fishes—VIII. The classification of the suborder Tetraodontoidea, with a synopsis of the genera. Ann. Mag. Nat. Hist. (11)10:1–18.
———. 1955. A synopsis of the centropomid fishes of the subfamily Chandinae, with descriptions of a new genus and two new species. Bull. Raffles Mus. 25: 185–213.
GARMAN, S. 1912. Pisces. *In* Some Chinese vertebrates. Mem. Mus. Comp. Zool. Harvard 40:111–123.
———. 1913. The Plagiostomia (sharks, skates and rays). Mem. Mus. Comp. Zool. Harv. Vol. 36. xii + 515 pp., 77 pls.
GILL, T. N. 1861. Synopsis of the polynematoids. Proc. Acad. Nat. Sci. Phila. 13:271–282.
GOULDING, M. 1980. The fishes and the forest. Univ. California Press, Berkeley. xii + 280 pp.
GRAY, J. E. 1831. Descriptions of twelve new genera of fish discovered by Gen. Hardwicke in India, the greater part in the British Museum. Zool. Miscell. 1831: 7–10.
———. 1833–34. Illustrations of Indian zoology, chiefly selected from the collection of General Hardwicke, Vol. 2. London [not seen].
GREENWOOD, P. H., D. E. ROSEN, S. H. WEITZMAN, AND G. S. MYERS. 1966. Phyletic studies of teleostean fishes, with a provisional classification of living forms. Bull. Amer. Mus. Nat. Hist. 131(4):339–456.
GRONOVIUS, L. T. 1763. Zoophylacii Gronoviani fasciculus primus. Lugduni Batavorum. 136 pp.
GÜNTHER, A. 1860. Catalogue of the fishes in the British Museum. 2. Squamipennes, etc. xxii + 548 pp.
———. 1862. Catalogue of the fishes in the British Museum. 4. Acanthopterygii, Pharyngognathi, and Anacanthini.
———. 1864. Catalogue of the fishes in the British Museum. 5. Siluridae, etc. xxii + 455 pp.
———. 1868*a*. Catalogue of the fishes in the British Museum. 7. Heteropygii, Cyprinidae, etc. xx + 512 pp.
———. 1868*b*. Description of two new gobioid fishes from Sarawak. Ann. Mag. Nat. Hist. (4)1:264–266.
HAIG, J. 1952. Studies on the classification of the catfishes of the Oriental and Palearctic family Siluridae. Rec. Ind. Mus. 48:59–115.
HAMILTON-BUCHANAN, F. 1822. An account of the fishes found in the river Ganges and its branches. Edinburgh and London. vii + 405 pp. Atlas, 39 pls.
HARDENBERG, J. D. F. 1935*a*. Some new or rare fishes of the Indo-Australian archipelago. IV. Treubia 15:131–140.
——— 1935*b*. On a collection of fishes from Samarinda. Nat. Tijds. Ned. Ind. 95:231–239.
——— 1936. On a collection of fishes from the estuary and the lower and middle course of the River Kapuas (W. Borneo). Treubia 15:225–254.
———. 1937. Hydrological and ichthyological observations in the mouth of the Kumai-River (SW. Borneo). Treubia 16:1–14.
———. 1948. Some new or rare fishes of the Indo-Australian archipelago. VIII. Treubia 19:407–415.
HARTL, A. 1983. Halbhechte und Halbschnabelhechte Harmlose Namensverwandte unseres Hechtes aus Südostasien (Schluss). Aquar. Terrar. Zeitschrift 36(10):368–371.
HECKEL, J. J. 1843. Abbildungen und Beschreibungen der Fische Syriens, nebst einer neuen Classification und Characteristik sämmtlicher Gattungen. Pp. 993–1099 *in* Russeger's Reissen. Stuttgart, 1(2).
——— 1846? *In* Russeger's Reisen [full text not seen; see synonymy of *Mastacembelus erythrotaenia*].
HERRE, A. W. C. T. 1924. Distribution of the true fresh-water fishes in the Philippines. I. The Philippine Cyprinidae. Phil. J. Sci. 24:249–307, 2 pls.
——— 1933. A check list of fishes from Sandakan, British North Borneo. J. Pan-Pacific Res. Inst. 8(4):2–5.
——— 1936. Eleven new fishes from the Malay Peninsula. Bull. Raffles Mus. 12:5–15, pls. 2–11.
——— 1937. A contribution to the ichthyology of Malaya. Part I. Marine fishes. Bull. Raffles Mus. 13:11–53, 4 pls.
———. 1940*a*. New species of fishes from the Malay Peninsula and Borneo. Bull. Raffles Mus. 16:5–26, 20 pls.
——— 1940*b*. Additions to the fish fauna of Malaya and notes on rare or little known Malayan and Bornean fishes. Bull. Raffles Mus. 16:27–61.
——— 1944. Notes on fishes in the Zoological Museum of Stanford University. XVII. New fishes from Johore and India. Proc. Biol. Soc. Wash. 57:45–52.
——— 1945. Notes on fishes in the Zoological Museum of Stanford University. XIX. Two new Philippine gobies, with key to the genera of gobies with vomerine teeth. Proc. Biol. Soc. Wash. 58:77–82.
——— 1953. Check list of Philippine fishes. U.S. Dept. Int. Fish Wildl. Serv. Res. Rep. 20. 977 pp.
HERRE, A. W. C. T. AND G. S. MYERS. 1937. A contribution to the ichthyology of the Malay Peninsula. Bull. Raffles Mus. 13:5–75.
HOLLY, M. 1939. Zur Nomenklatur der Siluridengattung *Macrones* C. Dumeril Zool. Anz. 125:143.
HORA, S. L. 1921. Notes on fishes in the Indian Museum. I. On a new genus of fish closely resembling *Psilorhynchus*, McClelland. Rec. Ind. Mus. 22(1):13–17.
——— 1924. Zoological results of a tour in the Far East. Fish of the Tale Sap, Peninsular Siam (Part 1). Mem. Asiat. Soc. Bengal 6:461–476.
——— 1932. Classification, bionomics, and evolution of homalopterid fishes Mem. Indian Mus. 12:263–330, pls. 10–12.
——— 1941*a*. Notes on Malayan fishes in the collection of the Raffles Museum, Singapore. Parts 2 and 3. Bull. Raffles Mus. 17:44–64, pls. 5–6.
———. 1941*b*. On a small collection of fish from Perak, Federated Malay States Bull. Raffles Mus. 17:5–11, pl. 1.
HORA, S. L. AND J. C. GUPTA. 1941. Notes on Malayan fishes in the collection of the Raffles Museum, Singapore. I. Catfishes of the families Siluridae, Bagridae, Amblycepidae, Akysidae, Sisoridae, Chacidae, Schilbeidae and Clariidae. Bull Raffles Mus. 17:12–43, 2 pls.

Howes, G. J. 1979. Notes on the anatomy of the cyprinid fish *Macrochirichythys macrochirus* with a review of the subfamily Cultrinae. Bull. Br. Mus. Nat. Hist. (Zool.) 36(3):147–200.

——— 1980. The anatomy, phylogeny and classification of barbiine cyprinid fishes. Bull. Br. Mus. Nat. Hist. (Zool.) 37(3):129–198.

Hubbs, C. L. and K. F. Lagler. 1947. Fishes of the Great Lakes region. Cranbrook Inst. Sci. Bull. 26. xii + 186.

Hubrecht, A. A. W. 1879. Catalogue des collections formées et laissées par M.-P. Bleeker, de Breuk & Smits, Leiden. iv + 71 pp.

Imaki, A., A. Kawamoto, and A. Suzuki. 1978. A list of freshwater fishes collected from the Kapuas River, West Kalimantan, Indonesia. The Institute for Breeding Research, Tokyo Univ. Agric. 52 pp.

Inger, R. F. and P. K. Chin. 1959. New species of fresh-water catfishes from North Borneo. Fieldiana, Zool. 39:279–296.

——— 1961. The Bornean cyprinoid fishes of the genus *Gastromyzon* Günther. Copeia 1961:166–176.

——— 1962. The fresh-water fishes of North Borneo. Fieldiana, Zool. 45:1–268.

Iwamatsu, T., A. Imaki, A. Kawamoto, and A. Inden. 1982. On *Oryzias javanicus* collected at Jakarta, Singapore and West Kalimantan. Annot. Zool. Jap. 55(3):190–198.

Jayaram, K. C. 1962. The nomenclatural status of *Mystus, Macrones, Aoria* and other names for a genus of Asiatic siluroid fishes. Proc. First All-India Congr. Zool. 1959(2):632–635.

——— 1968. Contributions to the study of bagrid fishes (Siluroidea: Bagridae). 3. A systematic account of the Japanese, Chinese, Malayan, and Indonesian genera. Treubia 27(2–3):287–386.

——— 1982. The freshwater fishes of India, Pakistan, Bangladesh, Burma, and Sri Lanka. Zool. Surv. India (Calcutta). 475 pp., 13 pls.

Johnson, G. D. 1984. Percoidei: development and relationships. *In* H. G. Moser et al., eds., Ontogeny and systematics of fishes. Amer. Soc. Ich. Herp. Spec. Publ. 1. ix + 760 pp.

Jordan, D. S. 1919. New genera of fishes. Proc. Acad. Nat. Sci. Phila. 70:341–344.

——— 1920. Genera of fishes, part IV. Stanford Univ. Pub., Univ. Ser. i–xviii + 411–576 pp.

Jordan, D. S. and B. W. Evermann. 1896. The fishes of North and Middle America. Bull. U.S. Nat. Mus., Vol. 47, No. 1. lx + 1240 pp.

Jordon, D. S., S. Tanaka, and J. O. Snyder. 1913. A catalogue of the fishes of Japan. J. Coll. Sci. Univ. Tokyo, Vol. 33, No. 1. 497 pp.

Karnasuta, J. 1981. Revision of the southeastern Asiatic cyprinid genus *Osteochilus* Günther. Ph.D. Dissertation, Univ. Alberta, Edmonton. xiii + 374 pp.

Károli, J. 1882. Prodromus piscium Asiae orientalis a Domine Joanne Xantus annis 1868–70 collectorum. Természet. Füzetek, Budapest. Pp. 137–187.

Kaup, J. J. 1853. Uebersicht der Lophobranchier. Arch. Naturg. Berlin 19:226–234.

——— 1856. Catalogue of lophobranchiate fish in the collection of the British Museum. Taylor and Francis, London. 76 pp.

Kirschbaum, F. 1984. Reproduction of weakly electric teleosts: just another example of convergent development? Environ. Biol. Fishes 10:3–14.

Kottelat, M. 1982. A small collection of fresh-water fishes from Kalimantan, Borneo, with descriptions of one new genus and three new species of Cyprinidae. Rev. Suisse Zool. 89:419–437.

——— 1984. Revision of the Indonesian and Malaysian noemacheiline loaches. Jap. J. Ichthyol. 31(3):225–260.

Koumans, F. P. 1935. Notes on gobioid fishes. On the synonymy of some species from the Indo-Australian Archipelago. Zool. Meded. 18:121–150.

——— 1940. On a new species of *Puntius* from Borneo. Temminckia 5:189–190

——— 1953. The fishes of the Indo-Australian archipelago. 10. Gobioidea. E. J. Brill, Leiden.

Lacepède, B. 1800. Histoire naturelle des poissons. Paris 2:lxiv + 632 pp.

Lauder, G. V. and K. F. Liem. 1981. Prey capture by *Luciocephalus pulcher*: implications for models of jaw protrusion in teleost fishes. Env. Biol. Fishes 6: 257–268

——— 1983. The evolution and interrelationships of the actinopterygian fishes. Bull. Mus. Comp. Zool. 150(3):95–197.

Lebzeller, F. F. 1910. Die österreichische Weltreisende Ida Pfeiffer, 1797–1858, mit besonderer Berucksichtigung der naturwissenschaftlichen Ergebnisse ihrer Reisen. Verlag von Winkler & Wagner, Wien. 225 pp

Leis, J. M. and D. S. Rennis. 1984. The larvae of Indo-Pacific coral reef fishes. Kensington, N.S.W. and Honolulu. ix + 269 pp.

Lesson, R. P. 1830. Tétrodon. Dictionnaire classique d'Histoire naturelle 7: 198–199.

Liem, K. F. 1963. The comparative osteology and phylogeny of the Anabantoidei (Teleostei, Pisces). Illinois Biol. Monogr. 30. 149 pp.

——— 1967*a*. A morphological study of *Luciocephalus pulcher*, with notes on gular elements in other recent teleosts. J. Morph. 121:103–134.

——— 1967*b*. Functional morphology of the head of the anabantoid teleost fish *Helostoma temminckı*. J. Morph. 121(2):135–138.

Linnaeus, C. 1758. Systema naturae (10th ed.). Holmiae.

Marion de Procé. 1822. Note sur plusieurs especes nouvelles de poissons et de crustacés observées dans un voyage de France a Manilla. Bull. Soc. Philomath. Paris 1822:129–134.

Martens, E. von. 1876. Die preussischen Expedition nach Ost-Asien. Zoologische Abtheilung, Berlin 1(2):193–412.

McClelland, J. 1839. Indian Cyprinidae. Asiatic Researches (Calcutta) 19(2): 217–471, 25 pls.

Menon, A. G. K. 1954. Notes on Malayan fishes in the collection of the Raffles Museum, Singapore. Part 4. The cyprinid fishes. Bull. Raffles Mus. 25:5–26.

——— 1964. Monograph of the cyprinid fishes of the genus *Garra* Hamilton. Mem. Ind. Mus. 14(4):173–260, pls. 8–13.

——— 1977. A systematic monograph of the tongue soles of the genus *Cynoglossus* Hamilton-Buchanan (Pisces: Cynoglossidae). Smithson. Cont. Zool. 238. 129 pp.

Meyer, A. B. 1885. Catálogo de los peces recolectados en el archipiélago de las Indias Orientales durante los años 1870 a 1873. Ann. Soc. Espana Hist. Nat. Madrid 14:5–49.

Mohr, E. 1936. Hemirhamphiden-Studien IV–VI. Mitt. Zool. Mus. Berlin 21(1): 334–364.

Mohsin, A. K. M. and M. A. Ambak. 1983. Freshwater fishes of peninsular Malaysia. Penerbit Universiti Pertanian Malaysia, Kuala Lumpur. xviii + 284 pp.

Molengraaff, G. A. F. 1895. Die niederländische Expedition nach Zentral-Borneo in den Jahren 1893 und 1894. Petermanns Mitt. 41:201–208, map.

——— 1921. Modern deep sea research in the East-Indian Archipelago. Geogr. J. 57:95–121.

Molengraaff, G. A. F. and M. Weber. 1921. On the relation between the Pleistocene glacial period and the origin of the Sunda Sea (Java- and South China-Sea), and its influence on the distribution of coral reefs and on the land- and freshwater fauna. Proc. Akad. Wetens. Amsterdam 23:395–447.

Müller, J. and F. G. J. Henle. 1837. Ueber die Gattungen der Plagiostomen. Arch. Naturg. 3:394–401.

Müller, S. and H. Schlegel. 1844. Beschrijving van een' nieuwen zoetwatervisch van Borneo, *Osteoglossum formosum*. Pp. 1–28 *in* Verhandelingen over de natuurhjke geschiedenis der Nederlandsche oberzeesche bezittingen, door de Leden der Natuurkundige commissie in Indie en andere Schrijvers, Temminck, C. J.

Myers, G. S. 1923*a*. Notes on the nomenclature of certain anabantid fishes and a new generic name proposed. Copeia 118:62–63.

——— 1923*b*. Further notes on anabantids. Copeia 124:111–113.

——— 1927. *Puntius streeteri*, a new cyprinoid fish from Borneo, and *Cobitophis*, a new genus of Bornean Cobitidae. Amer. Mus. Nov. 265:1–4.

——— 1938. Notes on *Ansorgia, Clarisilurus, Wallago*, and *Ceratoglanis*, four genera of African and Indo-Malayan catfishes. Copeia 1938(2):98.

Myers, G. S. and L. Shapovalov. 1931. On the identity of *Ophicephalus* and *Channa*, two genera of labyrinth fishes. Peking Nat. Hist. Bull. 6:33–37.

Nalbant, T. T. and P. M. Bănărescu. 1977. Vaillantellinae, a new subfamily of Cobitidae. Zool. Meded. 52:99–105.

Nawar, G. 1959. Observations on the seminal vesicle of the Nile catfish *Clarias lazera*. Ann. Mag. Nat. Hist. ser. 13 2(19):444–448.

Neave, A. S. 1939. Nomenclator zoologicus. 1. Zool. Soc. Lond.

Nelson, J. S. 1984. Fishes of the world. John Wiley & Sons, Inc., New York. xviii + 523 pp.

Nielsen, J. G., A. Jesperson, and O. Munk. 1968. Spermatophores in Ophidioidea (Pisces, Percomorphi). Galathea Rep. 9:239–254, pls. 16–24.

Nieuhof, J. 1665. Het Gezantschap der Nederlandsche Oost-Indische Compagnie aan den grooten Tartarischen Cham, den tegenwoordigen Keizer van China . . . 1655–1657, etc. Amsterdam. xii, 208, 258 pp., 148 pls.

Nieuwenhuis, A. W. 1900. In Centraal Borneo. Reis von Pontianak naar Samarinda. 2 vols. E. J. Brill, Leiden.

——— 1904–07. Quer durch Borneo: Ergebnisse seiner Reisen in den Jahren 1894, 1896–97 und 1898–1900. 2 vols. E. J. Brill, Leiden.

Pel, H. S. 1851? Over eene nieuwe soorte van Polynemus (*P. macronemus*). Bijdr. Dierkunde, 1848–54 1:9–10.

PELLEGRIN, J. 1930. Description d'un anabantidé nouveau de Bornéo appartenant au genre *Sphaerichthys*. Bull. Soc. Zool. Fr. 55:242–244.

PELLEGRIN, J. AND P. CHEVEY. 1927. Poissons du Cambodge recueillis par le Dr. Krempf. Description d'un cyprinidé nouveau. Bull. Soc. Zool. Fr. 52:301–305.

PERUGIA, A. 1892. Descrizione di due nuove specie di pesci raccolti in Sarawak dai Sig. G. Doria ed O. Beccari. Ann. Mus. Civ. Storia Nat. Genova (2)12: 1007–1008.

———. 1893. Di alcuni pesci raccolti in Sumatra dal Dott. Elio Modigliani. Ann. Mus. Civ. Storia Nat. Genova (2)13:241–247.

PETERS, W. 1869. Über eine neue Nagergattung, *Chiropodomys penicillatus*, so wie über einige neue oder weniger bekannte Amphibien und Fische. Monatsber. Akad. Wiss., Berlin 1868(1869):448–460.

PFEIFFER, I. 1856. Meine zweite Weltreise. Carl Gerold's Sohn, Wien. 1. 280 pp.

POPTA, C. M. L. 1903. *Acanthophthalmus shelfordii*, n. sp. Notes Leyden Mus. 23:231–233.

———. 1904. Descriptions préliminaires des nouvelles espèces de poissons recueillies au Bornéo Central par M. le Dr. A. W. Nieuwenhuis en 1898 et en 1900. Notes Leyden Mus. 24:179–202.

———. 1905. Suite des descriptions préliminaires des nouvelles espèces de poissons recueillies au Bornéo Central par M. le Dr. A. W. Nieuwenhuis en 1898 et en 1900. Notes Leyden Mus. 25:171–186.

———. 1906. Resultats ichthyologiques des voyages scientifiques de Monsieur le Professeur Dr. A. W. Nieuwenhuis dans le centre de Bornéo (1898 et 1900). Notes Leyden Mus. 27:1–304, pls. 1–10.

———. 1911. Vorläufige Mitteilung über neue Fische von Lombok. Notes Leyden Mus. 34:9–16.

PRASHAD, B. AND D. D. MUKERJI. 1929. The fish of the Indawygi Lake and the streams of the Myitkyina district (Upper Burma). Rec. Ind. Mus. 31(3):161–223.

REGAN, C. T. 1906. Descriptions of five new freshwater fishes from Sarawak, Borneo, collected by Dr. C. Hose. Ann. Mag. Nat. Hist. (7)18:66–68.

———. 1910. Asiatic fishes of the family Anabantidae. Proc. Zool. Soc. Lond. 1909:767–787, pls. 77–79.

———. 1913*a*. A synopsis of the siluroid fishes of the genus *Liocassis*, with descriptions of new species. Ann. Mag. Nat. Hist. (8)11:547–554.

———. 1913*b*. *Phallostethus dunckeri*, a remarkable new cyprinodont fish from Johore. Ann. Mag. Nat. Hist. (8)12:548–555.

———. 1916. The morphology of the cyprinodont fishes of the subfamily Phallostethinae, with descriptions of a new genus and two new species. Proc. Lond. Zool. Soc. 1916:1–26, pls. 1–4.

REUVENS, C. L. 1895. Fresh and brackish water fishes from Sumba, Flores, Groot-Bastaard, Timor, Samaoe and Rotti. Notes Leyden Mus. 16:145–156.

RICHTER, H. J. 1981. Einführung eines neuen Gattungsnamens für die maulbrutenden Kampffische. Aquar. Terr. 28(7):272–275.

ROBERTS, T. R. 1972. An attempt to determine the systematic position of *Ellopostoma megalomycter*, an enigmatic freshwater fish from Borneo. Breviora 384:1–16.

———. 1978. An ichthyological survey of the Fly River in Papua New Guinea with descriptions of new species. Smithson. Cont. Zool. 281. 72 pp.

———. 1980. A revision of the Asian mastacembelid fish genus *Macrognathus*. Copeia 1980(3):385–391.

———. 1981. Sundasalangidae, a new family of minute, freshwater salmoniform fishes from Southeast Asia. Proc. Calif. Acad. Sci. 42(9):295–302.

———. 1982*a*. Unculi (horny projections arising from single cells), an adaptive feature of the epidermis of ostariophysan fishes. Zool. Scripta 11(1):55–76.

——— 1982*b*. A revision of the South and Southeast Asian angler-catfishes, family Chacidae. Copeia 1982(4):895–901.

———. 1982*c*. Systematics and geographical distribution of the Asian silurid catfish genus *Wallago*, with a key to the species. Copeia 1982(4):890–894.

——— 1982*d*. Revision of *Gastromyzon* and *Glaniopsis*, homalopterid fishes of Borneo, with descriptions of new species. Proc. Calif. Acad. Sci. 42(2):497–524.

———. 1982*e*. Revision of the Southeast Asian freshwater pufferfish genus *Chonerhinos* (Tetraodontidae), with descriptions of new species. Proc. Calif. Acad. Sci. 43(1):1–16.

——— 1983. Revision of the Asian sisorid catfish genus *Bagarius*, with description of a new species from the Mekong. Copeia 1983(2):435–444.

——— 1984. Skeletal anatomy, systematics, and classification of the neotenic Asian Salmoniform superfamily Salangoidea (icefishes or noodlefishes). Proc. Calif. Acad. Sci. 43(13):179–220.

ROBERTS, T. R. AND M. KOTTELAT. 1984. Description and osteology of *Thrysocypris*, a new genus of anchovylike cyprinid fishes, based on two new species from Southeast Asia. Proc. Calif. Acad. Sci. 43(11):141–158.

ROSEN, D. E. AND P. H. GREENWOOD. 1976. A fourth neotropical species of synbranchid eel and the phylogeny and systematics of synbranchiform fishes. Bull. Amer. Mus. Nat. Hist. 157:1–70.

SAUVAGE, H. E. 1874. Notices ichthyologiques. V. Sur un Syngnathe d'espèce nouvelle provenant de Cochinchine. Rev. Mag. Zool., Paris 1873(2):338–339.

——— 1878. Note sur quelques poissons d'espèces nouvelles provenant des eaux douces de l'Indochine. Bull. Soc. Philomath. Paris (2)7:233–242.

——— 1881. Recherches sur la faune ichthyologique de l'Asie et description d'espèces nouvelles de l'Indo-Chine. Nouv. Arch. Mus. Hist. Nat. Paris 4:123–194, 4 pls.

SAWADA, Y. 1982. Phylogeny and zoogeography of the superfamily Cobitoidea (Cyprinoidei, Cypriniformes). Mem. Fac. Fish. Hokkaido Univ. 28(2):65–223.

SAZIMA, I. 1983. Scale-eating in characoids and other fishes. Environ. Biol. Fishes 9(2):87–101.

SCHLEGEL, H. 1848? Beschrijving eener nieuwe soort van vischen [*Polynemus multifilis*]. Bijdr. Dierk. 1848–1852 1:9–12.

SCHULTZ, L. D. 1959. A new cyprinid fish from Siam. Trop. Fish Hobbyist 7(9)[May 1959]:9–11, 36–37.

SCOPOLI, G. A. 1777. Introductio ad historiam naturalem etc. Pragae. x + 506 pp.

SEALE, A. 1910. Fishes of Borneo, with descriptions of four new species. Phila. J. Sci. 5(D):263–288, 4 pls.

SEVASTIANOV, A. 1809. Description de quelques nouvelles espèces d'animaux, du Musée Academique. Mem. Acad. Sci. St. Petersbourg 1:443–449.

SIEBOLD, P. F. DE. 1842–50. Fauna Japonica. Pisces. Lugduni Batavorum. 345 pp., 1161 pls.

SILAS, E. G. 1953. Classification, zoogeography, and evolution of the fishes of the cyprinoid families Homalopteridae and Gastromyzonidae. Rec. Indian Mus. 50(2):173–264, pl. 5.

——— 1958. Study on cyprinid fishes of the oriental genus *Chela* Hamilton. J. Bombay Nat. Hist. Soc. 55(1):55–99, 2 pls.

SMITH, H. M. 1933. Contributions to the ichthyology of Siam. J. Siam Soc. Nat. Hist., Suppl. 9:53–87, 3 pls.

——— 1945. The freshwater fishes of Siam or Thailand. Bull. U.S. Nat. Mus. 188. xi + 622 pp., 9 pls.

SMITH, J. L. B. 1963. Fishes of the family Syngnathidae from the Red Sea and western Indian Ocean. Ichthyol. Bull. Rhodes Univ. 27:515–543.

SMITT, F. A. 1900. Preliminary notes on the arrangement of the genus *Gobius*, with an enumeration of its European species. Oefver. Svenska Vet. Akad. Forh. Stockh. 1899(6):543–555.

SNEED, K. E. AND H. P. CLEMENS. 1963. The morphology of the testes and accessory reproductive glands of the catfishes (Ictaluridae). Copeia 1963(4):606–611.

SONTIRAT, S. 1976. Revision of the southeastern Asiatic cyprinid fish genus *Cyclocheilichthys*. Ph.D. Dissertation. Univ. Michigan, Ann Arbor. 140 pp.

SOONG, M. H. H. 1968. Aspects of reproduction in halfbeaks. Malayan Nat. J. 21:33–34.

STEINDACHNER, F. 1870. Ichthyologische Notizen. X. Sitzb. Akad. Wiss. Wien 61(Abth. 1):623–642, 5 pls.

———. 1881*a*. Ichthyologische Beiträge (X). Sitzb. K. Akad. Wissensch. I Abth. 1881:179–218, pls. 1–8.

———. 1881*b*. Ichthyologische Beiträge (XI). Sitzb. K. Akad. Wissensch. I Abth. 1881:395–408, 1 pl.

——— 1901. Ergebnisse einer zoologischen Forschungsreise in den Molukken and Borneo, im Auftrage der Senckenbergfischen naturforschenden Gesellschaft ausgeführt von Dr. Willy Kükenthal, ordentl. Prof. der Zoologie an der Universität Breslau. Zweiter Teil: Wissenschaftliche Reiseergebnisse. Mit 8 Tafeln, einer Abbildung im Text und einer Kartenskizze. Fische. Abhand. Senck. Nat. Ges. Frankfurt XXV(2) 3(2):408–464, pls. 17, 18.

SUFI, S. M. K. 1956. Revision of the oriental fishes of the family Mastacembelidae. Bull. Raffles Mus. 27:93–146, pls. 13–26.

SVENSSON, G. S. O. 1933. Freshwater fishes from the Gambia River (British West Africa). Results of the Swedish expedition 1931. Kungl. Sv. Vet. Akad. Handl. 12(3):1–102.

SWAIN, J. 1882. A review of Swainson's "Genera of fishes." Proc. Acad. Nat Sci. Phila. 1882:272–284.

SWAINSON, W. 1839. The natural history and classification of fishes, amphibians and reptiles, or monocardian animals. London, 2 vols

Sykes, W. H. 1839. [Untitled: on the fishes of the Dukhun.] Proc. Zool. Soc. Lond. (1838)6:157–165.

——— 1841. The fishes of Dukhun. Trans. Zool. Soc. Lond. 2:349–378.

Taki, Y. 1974. Fishes of the Lao Mekong basin. USAID Mission to Laos, Agric. Div. vi + 232 pp.

Taki, Y. and A. Katsuyama. 1979. Differentiation and zoogeography of two species of the cyprinid genus *Puntioplites*. Jap. J. Ichthyol. 26(3):253–265.

Taki, Y., A. Katsuyama, and T. Urushido. 1978. Comparative morphology and interspecific relationships of the cyprinid genus *Puntius*. Jap. J. Ichthyol. 25:1–8

Teugels, G. G. 1983. La structure de la nageoire adipeuse dans les genres *Dinotopterus, Heterobranchus* et *Clarias* (Pisces; Siluriformes; Clariidae). Cybium 7(1):11–14.

Tilak, R. and A. Hussain. 1973. Notes on fishes of Doon Valley, Uttar Pradesh 1. Distributional and morphological studies on some glyptothoracoid fishes (Sisoridae). Rec. Zool. Surv. India 67:391–399.

Tirant, G. [1885]1929. "Notes sur les poissons de la Basse-Cochinchine et du Cambodge." *In* Excursions et Reconnaissances. Reprint. Saigon: Gouvernement Général De L'Indochine.

Travers, R. A. 1984. A review of the Mastacembeloidei, a suborder of synbranchiform teleost fishes. Part I. Anatomical descriptions. Bull. Brit. Mus. (Nat. Hist.) Zool. 46(1):1–133

Tweedie, M. W. F. 1956. Notes on Malayan freshwater fishes. 7. Cobitidae and Cyprinidae in the Raffles Museum collection. Bull. Raffles Mus. 27:56–62, pls. 5, 6.

——— 1961. Notes on Malayan fresh-water fishes 9. Regional differentiation in the colour pattern of *Puntius lateristriga* (C.&V.). Bull. Raffles Mus. 26:178–182, pls. 22, 23.

Vaas, K. F. 1952. Fisheries in the Lake District along the River Kapuas in West Borneo. Proc. Indo-Pacific Fisheries Council 1952, sec. 2(10):1–10.

Vaillant, L. 1890. Sur les poissons des eaux douces de Bornéo. Compt. Rend. Congr. Int. Zool. (Paris) 1889:81–82.

——— 1891. [Note on *Lepidoglanis*.] Bull. Soc. Philomath. Paris III(8), 1890–91. Compt. Rend. 2, p. 6.

——— 1893*a*. Sur une collection de poissons recueillie par M. Chaper, a Bornéo. Bull. Soc. Zool. Fr. 18:55–62.

——— 1893*b*. Contribution a l'étude de la faune ichthyologique de Bornéo. Nouv. Arch. Mus. Hist. Nat. Paris (3)5:23–114, 2 pls.

——— 1894. Sur la faune ichthyologique des eaux douces de Bornéo. Compt. Rend. Acad. Sci. (Paris) 118:209–211.

——— 1902. Résultats zoologiques de l'expedition scientifique néerlandaise au Bornéo Central. Notes Leyden Mus. 24:1–166, 2 pls.

van Hasselt, J. C. 1823. Uittreksel uit een' brief van Dr. J. C. van Hasselt, aan den Heer C. J. Temminck. Algemeene Konst. en Letter-Bode 1(2):315–317; 1(21):329–331; 2(35):13–133

Vari, R. P. 1978. The Terapon perches (Percoidei, Teraponidae). A cladistic analysis and taxonomic revision. Bull. Amer. Mus. Nat. Hist. 159(5):175–340.

Vierke, J. 1979*a*. Ein neuer Labyrinthfisch von Borneo—*Parosphromenus parvulus* nov. spec. Das Aquarium 13(120):247–250

——— 1979*b*. Beschreibung einer neuen Art und einer neuen Unterart aus der Gattung *Sphaerichthys* aus Borneo. Das Aquarium 13(122):339–346.

——— 1981. *Parosphromenus filamentosus* n. sp. aus SO-Borneo (Pisces: Belontiidae). Senckenbergiana Biol. 61:363–367.

——— 1983. Informationen über *Betta akarensis*, und andere neuigkeiten über maulbrütende Kampffische. Aquar. Terrar. Zeits. 36:165–169.

——— 1984. *Betta taeniata* Regan, 1910 und *Betta edithae* spec. nov., zwei Kampfische von Sud-Borneo. Das Aquarium 176:58–63.

Vinciguerra, D. 1890. Viaggio di Leonardo Fea in Birmania e regione vicini [Pesci]. Ann. Mus. Civ. Storia Nat. Genova 9(2):129–362, 5 pls.

Volz, W. 1903*a*. Neue Fische aus Sumatra. Zool. Anz. (Leipzig) 26:553–559.

——— 1903*b*. Fische von Sumatra. Zool. Jahrb. (Jena) 29:347–420, pls. 25–26.

——— 1904. Fische von Sumatra, gesammelt von Heern G. Schneider. Rev. Suisse Zool. 12:451–493.

——— 1907. Catalogue of the fishes of Sumatra. Nat. Tijds. Ned. Ind. 66:35–250

von Ihering, R. 1937. Oviducal fertilization in the South American catfish *Trachycorystes*. Copeia 1937(4):201–205.

Wallace, R. A. and K. Selman. 1981. Cellular and dynamic aspects of oocyte growth in teleosts. Amer. Zool. 21:325–343.

Weber, M. and L. F. de Beaufort. 1911. The fishes of the Indo-Australian archipelago. 1. Index to the ichthyological papers of P. Bleeker. E. J. Brill, Leiden.

——— 1912. Die Fische. *In* A. Maass, Durch Zentral-Sumatra, Leipzig 2:1–20

——— 1913. The fishes of the Indo-Australian Archipelago. 2. Malacopterygii, Myctophoidea, Ostariophysi: I. Siluroidea. E. J. Brill, Leiden.

——— 1916. The fishes of the Indo-Australian Archipelago. 3. Ostariophysi: II. Cyprinoidea, etc. E. J. Brill, Leiden.

——— 1922. The fishes of the Indo-Australian Archipelago. 4. Heteromi, etc. incl. Labyrinthici. E. J. Brill, Leiden.

Wheeler, A. and A. Baddokwaya. 1981. The generic nomenclature of the marine catfishes usually referred to the genus *Arius* (Osteichthyes, Siluriformes). J. Nat. Hist. 15:769–773.

Whitehead, P. J. P., M. Boeseman, and A. C. Wheeler. 1966. The types of Bleeker's Indo-Pacific elopoid and clupeoid fishes. Zool. Verh. 84. 159 pp., 19 pls.

Wickman, A. 1981. Net in hand in Borneo. Aquar. Pondkeeper 46(6):40–46 [40, 43, 45, 46].

Wiley, M. L. and B. B. Collette. 1970. Breeding tubercles and contact organs in fishes: their occurrence, structure and significance. Bull. Am. Mus. Nat. Hist. 143(3):143–216.

Willughby, F. 1686. De historia piscium, etc. Oxonii. 343. 30 pp., 186 pls.

Wourms, J. P. 1981. Viviparity: the maternal–fetal relationship in fishes. Amer. Zool. 21:473–515

Zuiew, B. 1793? *Gymnotus albus*, nova species. Nova Acta Acad. Petropol., 1787. 5:269–273.

Index to Genera and Species

General Index

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 01302 5986