Systematics of the Neotropical Characiform Genus *Curimata* Bosc (Pisces: Characiformes)

RICHARD P. VARI

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 474

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 474

Systematics of the Neotropical Characiform Genus *Curimata* Bosc (Pisces: Characiformes)

Richard P. Vari

SMITHSONIAN INSTITUTION PRESS
Washington, D.C.
1989

ABSTRACT

Vari, Richard P. Systematics of the Neotropical Characiform Genus *Curimata* Bosc (Pisces: Characiformes). *Smithsonian Contributions to Zoology*, number 474, 63 pages, 42 figures, 5 tables, 1989.—The genus *Curimata* Bosc (1817) is recognized as a monophyletic subunit of the family Curimatidae on the basis of a variety of synapomorphies in the gill arches, buccopharyngeal complex, and palatine arch. Derived modifications of the gill arches, hyoid apparatus, opercular apparatus, maxilla, hyomandibula, palatine arch, supraneurals, first proximal pterygiophore of the dorsal fin, pigmentation, body form, squamation, degree of development of dorsal- and caudal-fin rays, number of vertebrae, and morphometrics unite groups of species within the genus.

Curimata is redefined and twelve species are recognized in the genus. These are *Curimata cyprinoides* Linneaus (1766), distributed in the lower Río Orinoco, Atlantic drainages of the Guianas, lower Rio Amazonas and Rio Tocantins; *C. vittata* Kner (1859) of the Rio Amazonas system; *C. aspera* Günther (1868a) of the upper Rio Amazonas; *C. knerii* Steindachner (1877) of the middle and upper Rio Amazonas; *C. mivartii* Steindachner (1878) endemic to the Río Magdalena and associated rivers; *C. ocellata* Eigenmann and Eigenmann (1889) distributed in the Rio Amazonas basin; *C. macrops* Eigenmann and Eigenmann (1889) known only from the Rio Parnaiba drainage basin of northeastern Brazil; *C. cisandina* (Allen, in Eigenmann and Allen, 1942) found in the Rio Amazonas system; *C. cerasina* Vari (1984b), a Río Orinoco endemic; *C. incompta* Vari (1984b) of the Río Orinoco basin; *C. inornata*, a new species from the Rio Amazonas system; and *C. roseni*, a new species from the Rio Negro drainage basin.

Curimatus semitaeniatus of Steindachner (1917) was found to be based on a juvenile of *Curimata ocellata* Eigenmann and Eigenmann (1889) and is placed as a synonym of the latter species. *Curimata murieli* described by Allen (in Eigenmann and Allen, 1942) has as its holotype a juvenile of *Curimata vittata* Kner (1859) and the two species are considered conspecific. *Lambepiedra alleni* of Fernández-Yépez (1948) is placed as a synonym of *Curimata cisandina* Allen (in Eigenmann and Allen, 1942). *Curimatus simulatus* proposed by Eigenmann and Eigenmann (1889) is considered to be a synonym of *Curimata aspera* Günther (1868a). *Salmo edentulus* Bloch (1794), *Charax planirostris* Gray (1854), *Curimatus schomburgkii* Günther (1864), and *Curimata copei* Fowler (1906) are placed as synonyms of *Curimata cyprinoides* Linnaeus (1766). *Salmo immaculatus* Linnaeus (1758), the oldest name for the species herein termed *Curimata cyprinoides*, is not available (International Commission for Zoological Nomenclature, 1966).

Contrary to the conclusions of many earlier studies, *Semitapicis* of Eigenmann and Eigenmann (1889) is placed as a synonym of *Curimata* Bosc (1817) rather than being retained as a distinct genus. The genera *Acuticurimata* Fowler (1941), *Allenina* Fernández-Yépez (1948), *Bitricarinata* Fernández-Yépez (1948), *Bondichthys* Whitley (1953), *Lambepiedra* Fernández-Yépez (1948), *Peltapleura* Fowler (1906), and *Stupens* Whitley (1954) are also placed as synonyms of *Curimata*.

The historical zoogeography of the species of *Curimata* is discussed. The genus is hypothesized to have undergone most of its species-level divergence prior to the final uplift of the Andes. The degree of sympatry between sister clades within *Curimata* indicates that there has been a significant degree of post-vicariance dispersal within the genus.

OFFICIAL PUBLICATION DATE is handstamped in a limited number of initial copies and is recorded in the Institution's annual report, *Smithsonian Year*. SERIES COVER DESIGN: The coral *Montastrea cavernosa* (Linnaeus).

Library of Congress Cataloging-in-Publication Data
Vari, Richard P.
Systematics of the Neotropical characiform genus Curimata Bosc (Pisces: Characiformes) / Richard P. Vari.
p. cm.—(Smithsonian contributions to zoology ; no. 474)
Bibliography: p.
Includes index. Supt. of Docs. no.: SI 1.27:474
1. Curimata—Latin America—Classification. I. Title. II. Series.
QL1.S4 no. 474 [QL638.C89] 591 s–dc19 [597'.52] 89-600023 CIP

Contents

Systematics of the Neotropical Characiform Genus *Curimata* Bosc (Pisces: Characiformes)

Richard P. Vari

Introduction

Curimata Bosc is a genus of the characiform family Curimatidae whose species inhabit streams, rivers, and still waters over a major portion of lowland South American. The greatest species diversity of species of *Curimata* occurs to the east of the Andes where members of the genus are components of the fish faunas of the Río Orinoco and Rio Amazonas drainages, and also occur in the Rio Parnaiba of northeastern Brazil. One of the species of *Curimata* also inhabits the series of rivers that drain the Atlantic slopes of the Guianas in the region between the mouths of the Orinoco and Amazon Rivers. In trans-Andean South America the genus is represented by a single species in the Río Magdalena, Río Cauca, Río San Jorge and Río Sinú. *Curimata* species are unknown in the remaining Atlantic coastal drainages south of the Rio Parnaiba of northeastern Brazil, or in the midcontinental rivers to the south of the Rio Amazonas basin. In trans-Andean South America, *Curimata* is absent in the Lago Maracaibo basin, the Río Atrato of Colombia, and the series of Pacific slope rivers in Colombia, Ecuador and northern Peru that are inhabited by other genera in the Curimatidae. Where they occur, the various *Curimata* species are important components of the fish biomass in many aquatic ecosystems, and are exploited in commerical and subsistence fisheries in the cis- and trans-Andean portions of South America (Dahl, 1971:105; Goulding, 1981:39, 45, 60, 105; Santos et al., 1985:28-29).

The first curimatids referred to in the scientific literature (Linnaeus, 1758:312, 1766:514; Gronovius, 1763:123) were species of the genus *Curimata* that were described based on material probably originating in the Guianas, most likely Surinam. The intervening centuries have seen the description of a number of nominal species of *Curimata* (sensu stricto), and frequent citations of members of the genus from geographically widely scattered Neotropical freshwater localities. Nonetheless, the somewhat subtle differences between many of the nominal forms, the relative scarcity of specimens of some species in systematic collections, and the brief original descriptions and diagnoses of various taxa resulted in considerable taxonomic confusion at both the specific and supraspecific levels. Indicative of the degree of alpha-level taxonomic problems are the proportionally large number of nominal species placed into synonymy in this study, and the numerous incorrect literature citations of those species that are recognized as valid. In retrospect such difficulties are understandable since the discrimination of many nominal species can be best accomplished by the use of previously unutilized counts and measurements, or is greatly facilitated by accurate counts of vertebral elements; data and methods not readily available to earlier researchers.

The generic and suprageneric taxonomy of what is termed *Curimata* in this paper has been similarly unstable. The originally broadly inclusive genus *Curimatus* was drastically subdivided by Fernández-Yépez (1948) who distributed the then-known members of *Curimata*, in the sense of this paper, among his nominal genera *Allenina, Bitricarinata, Bondia* (preoccupied and replaced by *Bondichthys* [Whitley, 1953]), *Camposella* (preoccupied and replaced by *Stupens* [Whitley, 1954]), *Lambepiedra*, and *Pseudocurimata*. Other authors have also used *Semitapicis* Eigenmann and Eigenmann (Eigenmann, 1910), *Acuticurimata* Fowler (Fowler, 1941), *Psectrogaster* Eigenmann and Eigenmann (Allen, in Eigenmann and Allen, 1942), *Rivasella* Fernández-Yépez (Fowler, 1975) and *Cruxentina* Fernández-Yépez (Fowler, 1975) as vehicles for some mem-

---

Richard P. Vari, Department of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington D.C. 20560.

Review Chairman: James G. Mead, National Museum of Natural History, Smithsonian Institution. Reviewers: Thomas A. Munroe, National Marine Fisheries Service Systematics Laboratory; Melanie L.J. Stiassny, American Museum of Natural History; Stanley H. Weitzman, National Museum of Natural History, Smithsonian Institution.

bers of this lineage. This progressive generic level subdivision reached its apogee in a taxonomic scheme (Fernández-Yépez, 1948) incongruent with the hypothesis of the phylogenetic history of the genus and its subunits arrived at in this study. Vari (1989:57) noted a series of hypothesized derived characters that united the dozen species of *Curimata*, in the sense of the present study, into a natural subunit of the Curimatidae. Reference to the phylogenetic scheme proposed by Fernández-Yépez reveals that his system associated species of *Curimata* with numerous other species within the Curimatidae that do not share the defining characters of the genus, and which are rather more closely related to members of other lineages within the family (Vari, 1989:56–57). Fernández-Yépez also proposed numerous nominal genera, whose limits were often based on imprecise characters that were difficult, if not impossible, to interpret non-arbitrarily. The degree to which the problem of non-monophyletic taxa and imprecise generic limits pervaded Fernández-Yépez's classificatory scheme is reflected in the fact that several nominal species considered conspecific in the present study were allocated to different genera under Fernández-Yépez's classification. The various difficulties noted above, and others which will be discussed in the following sections of this paper, in association with the problems in the discrimination of many of the genera proposed by many authors, particularly Fernández-Yépez, served to emphasize the limited usefulness of many previous classificatory schemes as vehicles for conveying hypotheses of the evolutionary history of the group. Attempts to resolve those problems within the context of the previous classifications clearly demonstrated the need for a phylogenetic analysis based on shared derived characters. Such an analysis would both permit the advancement of an explicit hypotheses of phylogenetic relationships within *Curimata* and serve as a framework to evaluate the usefulness of previous hypotheses of the evolutionary relationships of the components of that genus.

This paper is the fifteenth of a series that deals with aspects of the phylogeny and taxonomy of curimatid characiforms (see Vari, 1982a,b, 1983, 1984a,b, 1987, 1988, 1989, in press a,b; Vari and Castro, 1988; Vari and Géry, 1985; Vari and Nijssen, 1986; Vari and Vari, 1989). A series of synapomorphies defining *Curimata* as a monophyletic unit were described and analyzed previously (Vari, 1989). In that same publication Vari advanced a hypothesis of generic level relationships within the Curimatidae. That study and the phylogenetically more encompassing scheme of relationships put forward by Vari (1983) provide the frameword for the outgroup analyses and polarity determinations of those characters that demonstrate discrete variability within *Curimata*. The present study has three primary objectives: first to analyze the morphological variation within the genus and propose a hypothesis of the phylogenetic relationships within *Curimata*; second, to determine the recognizable species in the genus and their distinguishing characters; and third, to delimit the geographic distribution of the recognizable species and advance a hypothesis of the zoogeographic history of the genus.

The hypothesis of evolutionary relationships within *Curimata* is derived following the principles of Phylogenetic Systematics first proposed in English by Hennig (1966) and since discussed and refined by a variety of authors (see Wiley, 1981 for a summary). In that system (alternatively termed Cladism or Cladistics), recognized taxa must be monophyletic in that they include all descendants of a hypothesized common ancestor. Monophyletic groups are defined on the basis of the most parsimonious hypothesis of relationships derivable from the distribution of shared derived (synapomorphous) characters. In keeping with the general scientific principle of parsimony, the hypothesis of the phylogenetic history of a group that necessitates the fewest ad hoc assumptions about character transformations is preferred. This does not assume that evolutionary mechanisms are necessarily always parsimonious, but only that parsimony (simplicity) is the best available working principle (Beatty and Fink, 1979; Wiley, 1981). Hypotheses of relationship derived from the common possession of primitive characters (symplesiomorphies) and phylogenetic speculations based on concepts of overall phenetic similarity or degrees of difference are useless as criteria to evaluate alternative phylogenetic hypotheses, or are incongruent with the aims of this study: the advancement of a hypothesis of the phylogenetic history of the taxa under consideration. Detailed discussions of these methodologies and their application can be found in Wiley (1981), Watrous and Wheeler (1981), and Maddison et al. (1984).

METHODS AND MATERIALS.—Measurements were made with dial calipers and data recorded to tenths of a millimeter. Counts and measurements were made on the left side of specimens whenever possible. Counts of total vertebrae were taken from radiographs, with the fused PU_1+U_1 considered a single bone, and the vertebrae incorporated into the Weberian apparatus counted as four separate elements. The numbers in parentheses that follow a particular vertebral count are the numbers of radiographed specimens with that count. In the species descriptions, subunits of the head are presented as a proportion of head length (HL). Head length itself and measurements of body parts are given as proportions of standard length (SL). In the counts of median and pelvic fins, unbranched fin rays are indicated by lower case roman numerals, and branched fin rays are indicated by arabic numerals. Counts of enlarged median prepelvic scales are inclusive of all median scales from the insertion of the pelvic fins to the anterior enlarged element. That scale is flanked by smaller scales that are diagonally continuous with the scale series that extends posterodorsally to the anterior margin of the pectoral fin. The observed range in the values of each count and measurement is presented first, followed by the value of the holotype or lectotype for a particular count or measurement, when available, in square brackets. In those cases where recognized species have junior synonyms, morphometric and meristic data are presented for the type series of all nominal species when it is available.

The "Material Examined" section of each species account is arranged in the following sequence: number of specimens examined (in parentheses, the number of specimens forming the basis for the meristic and morphometric data, and the range of standard lengths (in mm) for these specimens), collection locality of specimens, institutional abbreviation, catalog number, number of specimens in the lot (in parentheses, the number of specimens in the lot from which counts and measurements were taken if less than the total number of specimens, and the standard lengths (in mm) of those individuals). Geographic descriptors are in the sequence of country (capitalized), then state, province, department or district (italicized), followed by more specific locality data. The names of localities from which at least some of the examined specimens were previously cited in the literature are given as originally presented, followed by the current or correct name, in parentheses, if that differs.

The common names presented are those found in the literature although such terminology is not standardized across the entire range of the species. In the synonymies for each species, place names are first given as presented in the citation, followed by the presently recognized equivalent, in parentheses, if that differs. Drawings were made with a Zeiss microscopic camera lucida. Osteological preparations were cleared and counterstained for cartilage and bone.

ABBREVIATIONS.—The following abbreviations for institutions and collections are used:

AMNH	American Museum of Natural History, New York
ANSP	Academy of Natural Sciences of Philadelphia
BMNH	British Museum (Natural History), London
CAS	California Academy of Sciences, San Francisco
CAS-SU	Stanford University (now deposited at CAS)
FMNH	Field Museum of Natural History, Chicago
GC	Jacques Géry, personal collection (no register numbers)
INPA	Instituto Nacional de Pesquesas da Amazonia, Manaus
IU	Indiana University (collections dispersed to various depositories)
LACM	Los Angeles County Museum, Los Angeles
MBUCV	Museo de Biologia, Universidad Central de Venezuela, Caracas
MCZ	Museum of Comparative Zoology, Cambridge
MNHN	Muséum National d'Histoire Naturelle, Paris
MNRJ	Museu Nacional, Rio de Janiero
MZUSP	Museu de Zoologia da Universidade de São Paulo
NMNH	National Museum of Natural History, Smithsonian Institution, Washington, D.C.
NMW	Naturhistorisches Museum Wien, Vienna
NRM	Naturhistoriska Riksmuseet, Stockholm
UMMZ	University of Michigan, Museum of Zoology, Ann Arbor
USNM	Former United States National Museum, collections in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.
ZMA	Institute for Taxonomic Zoology (Zoölogisch Museum), Amsterdam
ZMUC	Kobenhaveens Universitet, Zoologisk Museum, Copenhagen

The following abbreviations are used in the figures and text.

AI	area of insertion of ligamentum primordiale
AS	anterior spur of fourth epibranchial (E$_4$)
BB$_3$	basibranchial
C	ceratobranchial (1–3)
DAS	dorsal articular surface of hyomandibula
DCE$_4$	distal cartilage of fourth epibranchial (E$_4$)
DP-E$_1$	dorsal process of first epibranchial (E$_1$)
DP-UP$_5$	dorsal process of fifth upper pharyngeal tooth plate (UP$_5$)
E	epibranchial (1–5)
ECT	ectopterygoid
H	hypobranchial (1–3)
HL	head length
LF	lateral fold of buccophyarngeal complex
LPU	lateral process of urohyal
MBS	medial bony spur of fourth epibranchial (E$_4$)
MES	mesopterygoid
MET	metapterygoid
MF	medial fold of buccopharyngeal complex
MPL	mucus producing layer of the buccopharyngeal complex
OC	opercular condyle of hyomandibula
PAL	palatine
PB	infrapharyngobranchial (1–4)
PDAS	posterodorsal articular surface of palatine
PP	posterior process of second infrapharyngobranchial (PB$_2$)
PU$_1$	first preural centrum
QU	quadrate
SF	secondary fold of buccopharyngeal complex
SL	standard length
U$_1$	first ural centrum
UGL	urohyal to gill arch ligament
UN	uncinate process
UP	upper pharyngeal tooth plate (4 or 5)
UR	urohyal
UVL	urohyal to ventral hypophyal ligament
VP-UP$_5$	ventral process of fifth infrapharyngobranchial (UP$_5$)

ACKNOWLEDGMENTS.—I am indebted to the following individuals and institutions for the loan and exchange of specimens, information, hospitality during visits to their institutions, and other assistance: the late Donn E. Rosen, Gareth Nelson, and M. Norma Feinberg (AMNH); William Smith-Vaniz and William Saul (ANSP); P. Humphry Greenwood, Gordon J. Howes, and Alwynn Wheeler (BMNH); William Eschmeyer and Pearl Sonoda (CAS); Robert K. Johnson and Donald Stewart (FMNH); Jacques Géry (GC); Michel Jégu (INPA); Camm Swift (LACM); Karl F. Liem, Melanie L.J. Stiassny, William L. Fink, and Karsten Hartel (MCZ); Antonio Machado-Allison and Francisco Mago-Leccia (MBUCV); Marie-Louise Bauchot (MNHN); Gustavo W. Nunan (MNRJ); Naércio A. Menezes, Heraldo A. Britski, and Jose Lima de Figueiredo (MZUSP); Barbara Herzig and Harald Ahnelt (NMW); Robert R. Miller and Reeve M. Bailey (UMMZ); Han Nijssen and Isäac Isbrücker (ZMA); Jorgen C. Nielsen (ZMUC); Michael Goulding, Museu Paraense "Emilio Goeldi"; Peter Bayley, Illinois Natural History Survey; and Frank McKinney, Grice Marine Biological Laboratory. Hernán Ortega, Universidad Nacional Mayor de San Marcos, collaborated in field studies in Peru and made available a number of specimens from diverse Peruvian localities. Antonio Machado-Allison and Leonides Aguana (MBUCV), Otto Castillo and his associates of the Estacion de Investigaciones Pesqueras, San Fernando de Apure, Justa Fernandez (MBUCV), and Carl Ferraris, Jr. (AMNH), provided valuable assistance in various collecting efforts in Venezuela. Susan L. Jewett (NMNH) very ably collaborated in field studies in Venezuela and Peru, and in museum research at MBUCV. Jerry A. Louton (NMNH), and Andrew G. Gerberich (NMNH) assisted in field studies in Peru. Gerberich and Ann W. Vari provided diverse assistance at NMNH. Photographs were prepared by Theophilus Britt Griswold. Ricardo M.C. Castro (Universidad de São Paulo, Ribeirão Preto) kindly provided the Portuguese translation of the "Resumo". Numerous specimens reported on in this paper were collected by the Expediçao Permanente da Amazônia under the direction of Paulo E. Vanzolini (MZUSP). Collecting activities in Peru were carried out as a collaborative project with the Instituto Veterinario de Investigaciones Tropicales y de Altura. The Consejo Nacional de Ciencia y Tecnologia of Peru, and in particular its director M. Vegas Velez greatly facilitated studies in that country.

Research associated with this study was partially supported by the Neotropical Lowland Research Program, and Venezuela Project of the International Environmental Sciences Program of the Smithsonian Institution. This paper benefitted from the comments and criticisms of Melanie L.J. Stiassny, Stanley H. Weitzman, Ricardo M.C. Castro and Thomas A. Munroe.

Character Description and Analysis

The genus *Curimata* Bosc as defined in this study has eight junior synonyms (*Semitapicis* Eigenmann and Eigenmann, *Peltapleura* Fowler, *Acuticurimata* Fowler, *Allenina* Fernández-Yépez, *Lambepiedra* Fernández-Yépez, *Bitricarinata* Fernández-Yépez, *Bondichthys* Whitley, and *Stupens* Whitley). In addition to those taxa, four other genera (*Cruxentina* Fernández-Yépez, *Psectrogaster* Eigenmann and Eigenmann, *Pseudocurimata* Fernández-Yépez, and *Rivasella* Fernández-Yépez) have also been used in association with some of the recognized species or their junior synonyms. Such multiplicity of utilized genera is noteworthy since it involved only eight of the twelve nominal species recognized as distinct in this study. The factors that lead to such a proliferation of generic level taxa within *Curimata* of the present study are difficult to fathom retrospectively since most of the species of *Curimata* can only be distinguished on the basis of differences in meristics and morphometrics, rather than via any grossly obvious external morphological modifications or distinctive external pigmentation patterns. Interestingly, *Curimata ocellata* Eigenmann and Eigenmann, the phenetically most distinctive species in the genus, was never proposed as the type species for a nominal genus, probably as a consequence of its relative scarcity in systematic collections.

Until 1876 *Curimata* (as *Curimatus*) was used as an all encompassing genus for all members of the Curimatidae. The generic subdivision of *Curimata* as defined in the present study was begun by Eigenmann and Eigenmann (1889) in their description of *Semitapicis*. Following the practice of previous researchers, those authors assumed that *Charax planirostris* Gray (= *Curimata cyprinoides* (Linnaeus)) was conspecific with *Curimata abramoides* Kner. As a consequence, the type species of *Semitapicis* (*Charax planirostris*) was mistakenly described as having the diagnostic characters of *Curimata abramoides* rather than those of *Curimata cyprinoides* of which it is actually a junior synonym (see Vari, 1984a:16 and remarks following synonymy of *Curimata* in this paper for a more detailed discussion). The description of nominal genera herein considered synonyms of *Curimata* was continued by Fowler who advanced *Peltapleura* (1906:300) and *Acuticurimata* (1941:166), and was dramatically accelerated by Fernández-Yépez (1948) who proposed five additional genera (*Allenina*, *Bitricarinata*, *Bondia*, *Camposella*, and *Lambepeidra*; two of which were preoccupied and replaced, see synonymy) for species herein placed in *Curimata*. Those five taxa were interspersed with other genera within his tribe Curimatini, which constituted one of the major branches in his "phylogenetic tree" of curimatids (Fernández-Yépez, 1948, fig. 2). The other species of *Curimata* known at that time were dispersed through other genera of the Curimatini of Fernández-Yépez. Vari (1989), in contrast, detailed a number of shared derived characters of the skeleton and soft anatomical systems that support the hypothesis of the monophyly of *Curimata*. A series of synapomorphies of those same body systems discovered during this study serve to define subunits of the genus as natural assemblages.

Shared derived characters that define *Curimata* as a monophyletic lineage were discussed by Vari (1989). In a few instances that study also detailed synapomorphies that characterize sublineages of the genus. Characters discussed in depth in that publication will only be briefly redescribed herein, and the reader is referred to that previous paper for additional information on the characters, the condition of homologs in outgroups, and polarity hypotheses. The discussion of morphological systems and synapomorphies for and within *Curimata* follows the arrangement in Vari (1989) in order to simplify comparisons and cross-references to that publication.

GILL ARCHES

The branchial baskets of the Curimatidae, its sister family the Prochilodontidae, and the Chilodontidae and Anostomidae (which together are, in turn, the sister clade to that bifamilial clade) all demonstrate numerous synapomorphies at familial and suprafamilial levels. Similar phylogenetically significant variation is, not surprisingly, also common within *Curimata*.

FOURTH EPIBRANCHIAL (E_4).—The fourth epibranchial demonstrates two modifications that are common to all species of *Curimata* and which are uniquely derived for that clade. The first of these features is the ontogenetic ventral expansion of the bony spur of the medial surface of the fourth epibranchial (MBS). In adults of *Curimata* that process has a vertically expanded area of attachment basally with the main body of E_4 (Figure 1), and the ventral margin of the spur contacts the medial margin of the fifth upper pharyngeal tooth plate (UP_5). The described elaboration of the bony spur is unique to

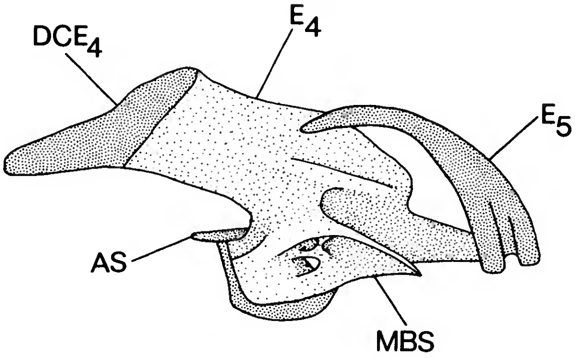

FIGURE 1.—*Curimata cyprinoides*, USNM 267964, fourth and fifth epibranchials, right side, medial view (dense patterned stippling represents cartilage).

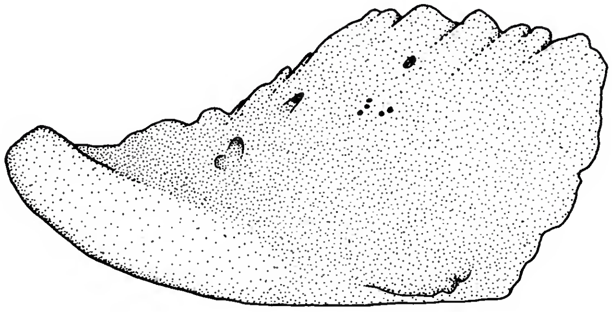

FIGURE 2.—*Curimata mivartii*, USNM 287061, fifth upper pharyngeal tooth plate, right side, ventral view, anterior to right, medial at top.

Curimata among curimatids having that process, with the mode of contact of that element with the fifth upper pharyngeal tooth plate also being limited to that genus. The overall restructuring of the medial spur and its contact with UP_5 are thus considered a synapomorphy for the members of the genus (SYNAPOMORPHY 1). The form of the medial spur in all species of *Curimata* is also unique in the family in having a distinct medial ridge along its dorsal margin, and in its pronounced overall fenestration, attributes hypothesized synapomorphous for the species of the genus (SYNAPOMORPHY 2) (see Vari, 1989, for a more detailed discussion of the spur and its derived characteristics).

The ventral portion of the main body of the fourth epibranchial, the associated ventrally expanded median bony spur described above, and the fifth upper pharyngeal tooth plate which attaches to these two processes are located distinctly medial of the vertical plane through the main body of E_4 in *Curimata* (Vari, 1989, fig. 17). That medial realignment is a derived shift from the typical placement of those structures along the vertical plane through the main body of the fourth epibranchial, and as such is hypothesized to be a synapomorphy for the genus (SYNAPOMORPHY 3) (see Vari, 1989, for a more detailed discussion of the modification).

FIFTH UPPER PHARYNGEAL TOOTHPLATE (UP_5).—Within *Curimata* the fifth upper pharyngeal tooth plate demonstrates several unique alterations that serve to define subunits of the genus. Three *Curimata* species (*mivartii, aspera,* and *cerasina*) have the fifth upper pharyngeal toothplate expanded transversely into a broad curved plate (Figure 2). The form of the widened UP_5 of these three species matches the surface of the opposing surface of the proximate portions of the fifth ceratobranchial of the lower portion of the gill arches (SYNAPOMORPHY 32). This widened form of the fifth upper pharyngeal tooth plate in this subunit of *Curimata* contrasts with the narrower form of the element in the remaining members of the genus and in most other curimatids. The single exception to that generalization involves a subunit of the genus *Steindachnerina* Fowler which also has a transversely expanded UP_5. The common occurrence of a transversely expanded fifth upper pharyngeal tooth plate in clades within both *Curimata* and *Steindachnerina* is considered to be the result of independent acquistions of such a structure in the two lineages in light of the most parsimonious hypothesis of phylogenetic relationships at the generic level put forward by Vari (1989). The hypothesis of convergence in this feature is also congruent with the proposed phylogenetic scheme within *Curimata* supported by the derived characters reported in this study (see "Synapomorphy List and Phylogenetic Reconstruction").

The sister clade within *Curimata* to the lineage characterized by a transversely widened UP_5 just described shows a totally different modification of that ossification. The fifth upper pharyngeal tooth plate in *Curimata cisandina, C. roseni,* and *C. inornata* is only moderately wide, the hypothesized primitive condition for the genus. The UP_5 in those species, however, has a well-developed process along the ventral portion of the bone. This process has the form of a curved vertical sheet extending along the lateral margin of the bone (VP-UP_5, Figures 3 and 4). When the dorsal and ventral portions of the gill arches are brought into proximity this ventral extension of UP_5 lies along the posterior margin of the fourth ceratobranchial, and corresponds in form to the associated portions of that ossification. Such an elaboration of UP_5 is neither encountered elsewhere in *Curimata* nor among the remaining groups in the Curimatidae, and is thus hypothesized to be a synapomorphy for *C. cisandina, C. roseni,* and *C. inornata* (SYNAPOMORPHY 46).

The modification of the fifth upper pharyngeal tooth plate characteristic of those three species is carried further within that clade in *C. roseni* and *C. inornata.* In all other curimatids the lateral margin of UP_5 is separated by a distinct gap from the ventral flange that forms the ventrolateral margin of the fourth epibranchial. In *Curimata roseni* and *C. inornata,* in contrast, there is an additional dorsal process on the lateral margin of UP_5 (DP-UP_5, Figure 4) which extends dorsally from the main body of the fifth upper pharyngeal tooth plate to contact the proximate portion of the fourth epibranchial (E_4) (SYNAPOMORPHY 55). This apomorphous extension of UP_5 is

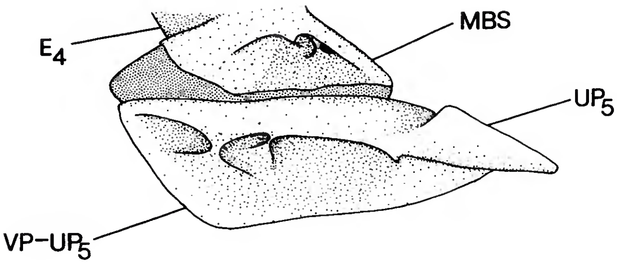

FIGURE 3.—*Curimata roseni*, USNM 268596, fifth upper pharyngeal tooth plate and ventral portion of fourth epibranchial and medial bony spur of fourth epibranchial, right side, medial view (dense patterned stippling represents cartilage).

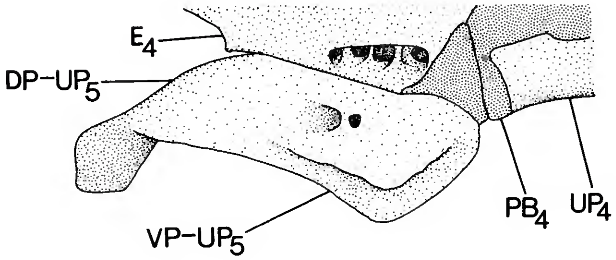

FIGURE 4.—*Curimata roseni*, USNM 268596, fifth upper pharyngeal tooth plate and proximate elements of posteromedial region of upper portions of gill arches, right side, oblique ventral view, anterior to right, ventromedial at bottom (dense patterned stippling represents cartilage).

continuous vertically with the ventral process (VP-UP_5) on that element characteristic of these two species and *C. cisandina*.

THIRD EPIBRANCHIAL (E_3).—The dorsal portion of the third gill arch is unmodified within *Curimata* with the exception of *C. aspera* and *C. cerasina*. These species have a prominent longitudinal ridge along the ventral surface of the third epibranchial. The possession of such a ridge is apomorphous relative to the transversely rounded surface of the element common to the other members of *Curimata* and most other lineages within the Curimatidae (SYNAPOMORPHY 39). As noted by Vari (1989:23) a comparable ridge on the third epibranchial also occurs in all species of *Psectrogaster* Eigenmann and Eigenmann. The common occurrence of these structures in the two lineages within the Curimatidae is hypothesized to be convergent in the context of the most parsimonious hypothesis of intrafamilial relationships (see Vari, 1989, for additional details).

SECOND EPIBRANCHIAL (E_2).—The ventral surface of the second epibranchial in characiforms typically is transversely rounded in cross-section. In *Curimata mivartii*, *C. aspera*, *C. cerasina*, *C. cisandina*, *C. inornata*, and *C. roseni* that element has an additional longitudinal ridge extending along its ventral surface, an apomorphous modification (SYNAPOMORPHY 25) relative to that in outgroups. Modifications of the second epibranchial comparable to those in *Curimata* species also occur in all species of *Psectrogaster*. The longitudinal ridges in *Psectrogaster* and within *Curimata* are considered homoplasious in the overall most parsimonious hypothesis of intrafamilial relationships (see Vari, 1989, for further details). Two of these species of *Curimata* (*aspera* and *cerasina*) with a longitudinal ridge on the ventral surface of the second epibranchial have a further derived form of the process. In those species the margin of the ridge is further developed laterally compared to that process in other species of *Curimata* bearing such a ridge. The second epibranchial ridge in *C. aspera* and *C. cerasina* is in addition uniquely folded over into a narrow horizontal shelf. The pronounced development of the ridge and the folding over of its margin are together considered a synapomorphy for these two species (SYNAPOMORPHY 40).

SECOND INFRAPHARYNGOBRANCHIAL (PB_2).—Characiforms typically have a moderately well developed cartilage-capped uncinate process on the anterolateral portion of the dorsal surface of the second infrapharyngobranchial. That process (UN, Figure 5A) contacts a corresponding cartilage-capped uncinate process on the first epibranchial. In *C. cisandina* the uncinate process of PB_2 is significantly reduced in overall size, having the form of a small residual knob. This reductive trend is carried further in *C. roseni* and *C. inornata* in which the uncinate process on the second infrapharyngobranchial is totally lacking (Figure 5B). Associated with the absence of a PB_2 uncinate process in *C. roseni* and *C. inornata* is the restructuring of the anterolateral wall of PB_2 from which the uncinate process arises in all other curimatids. That portion of PB_2 in those two species now overlaps the dorsal surface of that element (Figure 5B) rather than retaining its primitive vertical orientation.

The reduction and subsequent loss of the uncinate process of the second infrapharyngobranchial is considered a synapomorphy for the unit consisting of *C. cisandina*, *C. inornata* and *C. roseni* (SYNAPOMORPHY 47). The complete loss of the uncinate process on that element in the latter two species and the restructuring of the anterolateral portion of the bone in those taxa is, in turn, hypothesized to be a shared derived character for *C. inornata* and *C. roseni* (SYNAPOMORPHY 56).

Curimata inornata also demonstrates an autapomorphous modification of the anterior surface of PB_2. That species has a distinct posterolaterally directed, triangular projection (PP, Figure 5B) that extends to the anterolateral margin of PB_3. Such an elaboration of the second infraphyarngobranchial is not encountered elsewhere among species of the Curimatidae or examined characiforms, and is considered an autapomorphy for the species (SYNAPOMORPHY 68).

FIRST INFRAPHARYGOBRANCHIAL (PB_1).—All species of *Curimata* either have a first infrapharyngobranchial reduced to some degree or lack the bone entirely. That transition series, the reduction and loss of the first infrapharyngobrancial, is considered derived given the well developed PB_1 generalized for other species of the Curimatidae and examined characiform outgroups, and a synapomorphy for the genus (SYNAPOMOR-

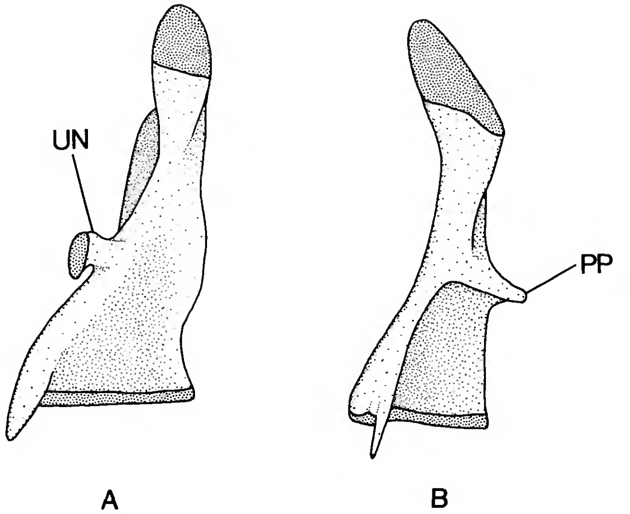

FIGURE 5.—Second infrapharyngobranchial of (A) *Curimata vittata*, USNM 229200, and (B) *Curimata inornata*, MZUSP 21392; right side, dorsal view, medial line at top (dense patterned stippling represents cartilage).

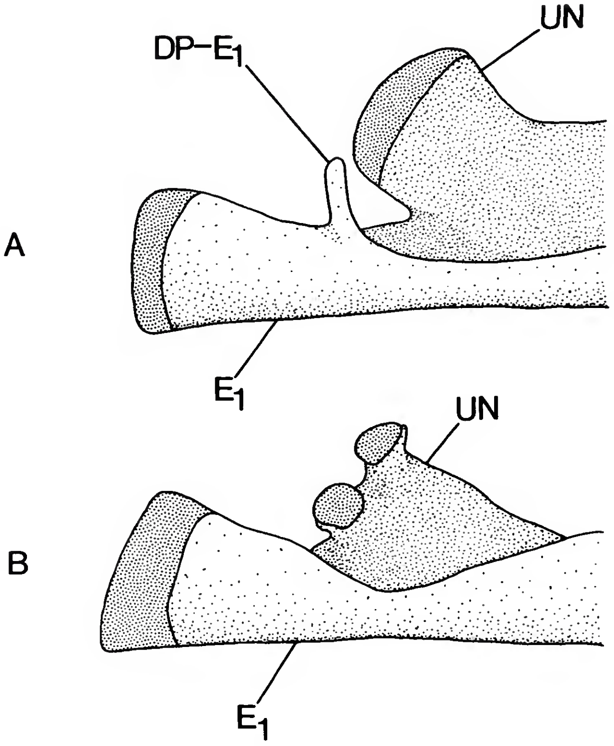

FIGURE 6.—First epibranchial of (A) *Curimata vittata*, USNM 229200, and (B) *Curimata cyprinoides*, USNM 225619; right side, anterior portion, anterior view (dense patterned stippling represents cartilage).

PHY 4). Although the first infrapharyngobranchial of *Curimata ocellata* is reduced relative to the condition in other curimatids it is nonetheless proportionally larger than the condition of the bone in other species of *Curimata* retaining the process. The more pronounced reduction or the complete loss of the first infrapharyngobranchial in the species of *Curimata* other than *C. ocellata* is hypothesized to be a synapomorphy for that clade (SYNAPOMORPHY 12). The terminal stage in the reductive series of the first infrapharyngobrancial, the complete loss of the element, is characteristic of *C. cisandina*, *C. roseni*, and *C. inornata*, another synapomorphy for that less inclusive clade (SYNAPOMORPHY 48).

FIRST EPIBRANCHIAL (E$_1$).—The form of the uncinate process of the first epibranchial is variable within *Curimata*. A relatively wide but continous cartilage cap on the E$_1$ uncinate process (UN) characterizes *C. ocellata*, *C. macrops*, and *C. vittata* (Figure 6A). Although wider than the condition in the outgroups examined, such a single cartilage cap on the uncincate process corresponds to the generalized condition of that structure for characiforms. The primitively single cartilage on the uncincate process of the first epibranchial is subdivided into two cartilage masses separated by a distinct ossified notch in *C. cyprinoides*, *C. knerii*, *C. inornata*, *C. mivartii*, *C. aspera*, *C. cerasina*, *C. cisandina*, *C. roseni*, and *C. inornata* (Figure 6B). This subdivision of the E$_1$ uncinate process in these species is considered derived in light of the single cartilage present in examined outgroups (SYNAPOMORPHY 20) (see also Vari, 1989, for a further discussion of this character in Curimatidae).

In *Curimata vittata*, which retains only a reduced PB$_1$, there is a distinct, flattened, elongate triangular process arising from the dorsal surface of the anterior margin of the first epibranchial (DP-E$_1$, Figure 6A). That dorsally directed process on E$_1$ is unique to *Curimata vittata* among examined characiforms, and thus hypothesized autapomorphous for the species (SYNAPOMORPHY 16).

FIRST HYPOBRANCHIAL (H$_1$).—The typical form of the first hypobranchial in the Curimatidae has a broad cartilaginous articular surface along its anterior margin (Figure 7A). The overall form of the bone among curimatids is usually relatively short longitudinally. As a consequence the transverse plane through the articulation between the first hypobranchial (H$_1$) and first ceratobranchial (C$_1$) lies distinctly anterior of the transverse axis that passes through the forward limit of the ossified portion of the third basibranchial (BB$_3$), and anterior of the posterior margin of the anterolateral articular cartilage on the second hypobranchial (H$_2$) (Figure 7A). *Curimata mivartii*, *C. aspera*, *C. cerasina*, *C. cisandina*, *C. inornata*, and *C. roseni* demonstrate both a restructuring of the anterior articular surface of H$_1$, and changes in the overall form of the bone. These six species have the articular surfaces between the contralateral first hypobranchials proportionally reduced to relatively narrow cross-sections (Figures 7B and C) (SYNAPOMORPHY 26) relative both to the condition in other species of *Curimata* (Figure 7A) and among outgroups in the Curimatidae. The overall form of the first hypobranchial in these species shows a parallel lengthening in comparison to the

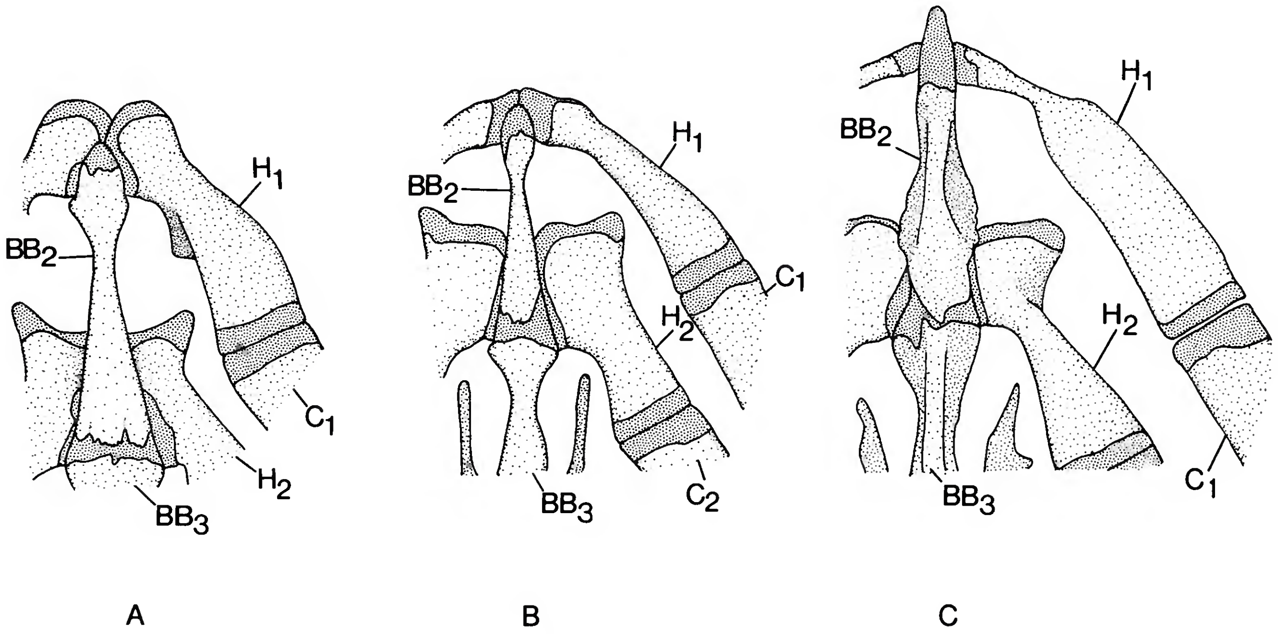

FIGURE 7.—Medial and right sections of anterior region of ventral portion of gill arches of (A) *Curimata ocellata*, MCZ 20339, (B) *Curimata mivartii*, USNM 287061, and (C) *Curimata inornata*, MZUSP 21392; dorsal view (dense patterned stippling represents cartilage).

condition in other curimatids, including species of *Potamorhina* in which the gill-arch elements are proportionally lengthened overall. As a consequence of this relative lengthening of the first hypobranchial the articulation between the first hypobranchial (H_1) and first ceratobranchial (C_1) in *Curimata mivartii, C. aspera, C. cerasina, C. cisandina, C. inornata,* and *C. roseni* is shifted posteriorly and falls slightly short of (Figure 7B) or reaches (Figure 7C) the level of the transverse line through the anterior limit of the ossified portion of the third basibranchial (BB_3). These modifications of the anterior portion of the first hypobranchial and of the overall form of that element are together considered a synapomorphy for these six species (SYNAPOMORPHY 27). The elongation of the first hypobranchial and the reduction in the relative transverse dimension of its anterior articular portion are particularly notable in the clade consisting of *C. inornata* and *C. roseni.* These terminal stages in the transition series involving the form of the first hypobranchial are considered to represent a further derived condition synapomorphous for these two species (Figure 7C) (SYNAPOMORPHY 57).

FIRST CERATOBRANCHIAL (C_1).—When viewed in lateral view, the first ceratobranchial of most curimatids is a relatively straight bone either lacking a longitudinal ridge on its dorsal surface, or having only a relatively feeble dorsal ridge. Within *Curimata* there is a transition in the form of C_1 and in the form of its dorsal margin. *Curimata mivartii, C. aspera, C. cerasina, C. cisandina, C. inornata,* and *C. roseni* have the shaft of C_1 curved ventrally in lateral view, with a moderate to well developed ridge along the anterior two-thirds of the surface of the element; hypothesized derived modifications which are together considered to be a synapomorphy for those taxa (SYNAPOMORPHY 28). *Curimata mivartii, C. aspera, C. cerasina, and C. cisandina* have a moderate curvature of the first ceratobranchial, with a distinct, although not greatly developed, dorsal ridge on the bone. In *C. inornata* and *C. roseni* the ventral flexure of C_1 is yet more pronounced, and the ridge along the dorsal surface of the bone is more highly developed, further derived conditions considered synapomorphous for these species (SYNAPOMORPHY 58).

SECOND HYPOBRANCHIAL (H_2).—The second hypobranchial is typically unelaborated along its ventral surface in curimatids. Four species of *Curimata,* in contrast, have a distinct process on the ventral surface of the anterolateral corner of the element. The process in *C. ocellata* has the form of a posteriorly directed elongate spine aligned with, and serving as the point of attachment for, the ligament extending from the second hypobranchial to the anterior portion of the vertical process on the third hypobranchial. The ventral process in *Curimata cisandina, C. inornata,* and *C. roseni* although located on this same region of the second hypobranchial, and also serving as an area of attachment for the H_2-H_3 ligament has rather the form of a triangular flange. This difference in the form of the processes raises questions about the homology of the structures in the two cited lineages. A hypothesis of the homoplasy of the processes in *C. ocellata* and in the complex formed by *C. cisandina, C. inornata,* and *C. roseni* is also congruent with the most parsimonious hypothesis of relationships within *Curimata*. The structures are thus assumed to represent independent elaborations of the second hypobranchial, and the presence of a process on the ventral surface of the anterolateral corner of the second hypobranchial is respectively considered an autapomorphy for *C. ocellata* (SYNAPOMORPHY 7), and a synapomorphy for the clade consisting of *C. cisandina, C. inornata,* and *C. roseni* (SYNAPOMORPHY 49).

SECOND CERATOBRANCHIAL (C_2).—The plesiomorphously smooth dorsal surface of the second ceratobranchial (C_2) demonstrates apomorphous elaborations of differing levels of universality within *Curimata*. All members of the genus other than *C. ocellata* have a distinct longitudinal ridge developed to some degree along the dorsal surface of the bone. This is hypothesized to be a synapomorphy for that assemblage relative to the transversely rounded dorsal profile of the element that is typical for proximate sister groups to *Curimata* and outgroups to the Curimatidae (SYNAPOMORPHY 13). Half of the species of *Curimata* (*mivartii, aspera, cerasina, cisandina, inornata,* and *roseni*) have that dorsal ridge on the second hypobranchial developed to a greater degree than in the remainder of the genus, a further derived state uniting that assemblage (SYNAPOMORPHY 29). The degree of development of the ridge is autapomorphously notably pronounced in *C. mivartii* in which it forms a distinct vertical flange (SYNAPOMORPHY 36).

THIRD HYPOBRANCHIAL (H_3).—The third hypobranchial of all members of the Curimatidae has a well developed ventral process with anterior and posterior extensions that lie within the wall of connective tissue that extends parallel to the ventral aorta (see Vari, 1989, figs. 23 and 24). The anterior portion of that ventral process of H_3 serves as the point of attachment for a ligament that extends forward to the posteromedial margin of the second hypobranchial. In both *Curimata roseni* and *C. inornata* there is developed a discrete anterolateral spur on this portion of H_3 at the point of attachment for the ligament, a unique modification for those species in the *Curimata*, and an evident synapomorphy for that species pair (SYNAPOMORPHY 59).

A moderately developed longitudinal ridge on the dorsal surface of the third hypobrancial is typical for curimatids. *Curimata mivartii, C. aspera,* and *C. cerasina* have the ridge on that element developed into a distinct vertically aligned plate-like process, a unique alteration that is considered a synapomorphy for that lineage (SYNAPOMORPHY 33).

THIRD CERATOBRANCHIAL (C_3).—Characiform outgroups to *Curimata*, including the Prochilodontidae and most members of the Curimatidae, have a transversely rounded dorsal margin or a very slight middorsal ridge on the third ceratobranchial. All members of *Curimata* have at least a discrete longitudinal ridge along the dorsal surface of the bone. A pronounced, distinctly convex ridge extending about two-thirds of the length of the bone characterizes the assemblage consisting of *C. mivartii, C. aspera, C. cerasina, C. cisandina, C. roseni,* and *C. inornata*. The convexity of the ridge is even more pronounced in *C. cisandina, C. roseni,* and *C. inornata*. These modifications are considered to represent synapomorphies at two levels of universality. The presence of a well developed convex ridge on the dorsal surface of the third ceratobranchial is hypothesized as synapomorphous for the lineage consisting of *C. mivartii, C. aspera, C. cerasina, C. cisandina, C. roseni,* and *C. inornata* (SYNAPOMORPHY 30). The greatly pronounced further development of the third ceratobranchial ridge, in turn, is considered a synapomorphy for *C. cisandina, C. roseni,* and *C. inornata* (SYNAPOMORPHY 50).

BUCCOPHARYNGEAL COMPLEX

All members of the Curimatidae, other than the species of *Curimatopsis* and *Potamorhina*, have the soft tissue layers of the dorsal portions of the oral cavity elaborated to some degree beyond the condition in those two genera and proximate outgroups to the family. This elaboration, the buccophyarngeal complex, most commonly has the form of three primary longitudinally aligned folds, a medial flap extending along the midline of the roof of the mouth, flanked on each side by a fold located on the lateral portion of that region of the oral cavity. As noted by Vari (1989:31–32), all species of *Curimata* have the three primary mouth folds expanded into large dangling flaps that extend distinctly ventrally from the roof of the oral cavity (MF and LF, Figure 8). Furthermore the buccopharyngeal complex in species of *Curimata* is also distinctive in having a number of secondary folds (SF) not found in other curimatids. Those additional folds either arise from the margins of the three primary folds, or if independent of those major flaps, are aligned parallel to them. Associated with this elaboration of the soft tissues of the roof of the mouth is a distinct layer of mucus-producing tissue (MPL, Figure 9) that presumably assists in bolus formation. The hypertrophy of the buccopharyngeal complex in the described mode is unique to the species of *Curimata* among examined Characiforms, and is considered a synapomorphy for the members of the genus (SYNAPOMORPHY 5) (see Vari, 1989:31–33, for further details on the system in the Curimatidae).

HYOID APPARATUS

UROHYAL (UR).—The urohyal within the genus *Curimata* demonstrates a number of phylogenetically informative modifications. The ossification in *Curimatopsis* and *Potamorhina*, the proximate outgroups to *Curimata* within the Curimatidae, is relatively elongate and extends distinctly posterior of the point where the medial branchiostegal rays diverge laterally. The anteroventral surface of the element in those taxa is unelaborated and the ligamentous band attaching the urohyal to the ventral portion of the gill arches inserts directly onto the ventrolateral flange of the urohyal or onto a very slightly developed process at the point of attachment. The anterior portion of the urohyal, in turn, is moderately expanded

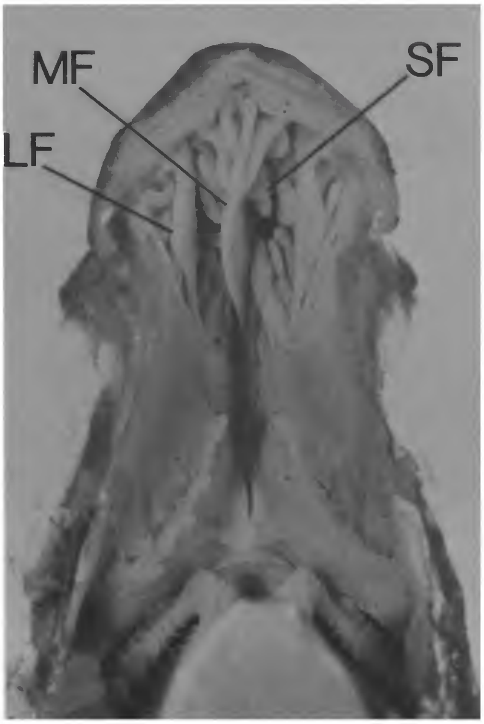

FIGURE 8.—Roof of the buccophyarngeal chamber and anterior portion of gill arches of *Curimata cyprinoides*, USNM 267963; ventral view showing buccopharyngeal complex (hyoid apparatus, ventral portion of gill arches, eyes and associated tissues removed).

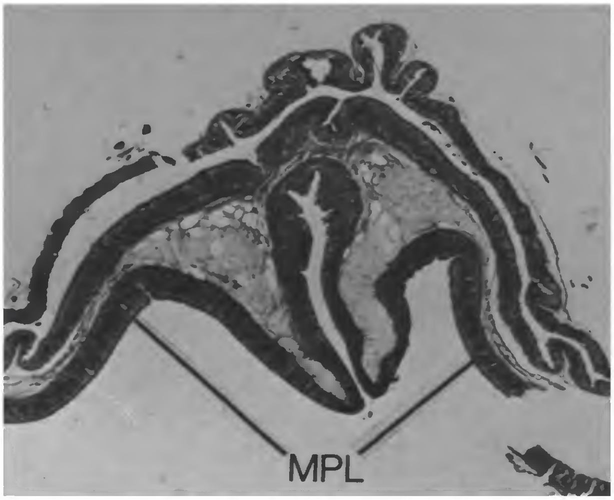

FIGURE 9.—Histological section through folds of buccopharyngeal complex of *Curimata cyprinoides*, USNM 267963, showing mucus producing surface layers.

anteriorly, with two separate concave surfaces that serve as the point of attachment for the thick ligaments that connect the urohyal to the posterior surface of the ventral hypohyal.

In *Curimata mivartii*, *C. aspera*, *C. cerasina*, *C. cisandina*, *C. inornata*, and *C. roseni* the overall length of the urohyal is relatively short. An elongate urohyal is hypothesized derived within the Curimatidae given the less horizontally developed forms of that ossification in proximate outgroups to the family. The shortened condition of the urohyal in the species of *Curimata* just cited is thus considered a derived secondary reduction (SYNAPOMORPHY 31) within the context of the overall most parsimonious hypothesis of intrafamilial relationships advanced by Vari (1989) and the intrageneric phylogeny proposed herein. Within the clade consisting of these six species the urohyal is particularly reduced in *C. inornata* and *C. roseni* in which it barely extends beyond the point where the medial branchiostegal rays diverge laterally. This further shortened form of the urohyal is considered a less inclusive apomorphy uniting those two species (SYNAPOMORPHY 60).

Three species of *Curimata* (*cisandina*, *inornata*, and *roseni*) have a definite well-developed ventral process arising from the lateral margin of the ventrolateral flange of the urohyal (LPU, Figure 10). This process serves as the point of attachment for the ligament joining the urohyal and gill arches (UGL). Such a lateral elaboration of the urohyal represents a modification not found in examined outgroups within and outside of the Curimatidae, and its possession is consequently considered a synapomorphy for the three species clade (SYNAPOMORPHY 51). Two of the species characterized by the possession of the lateral process on the urohyal (*inornata* and *roseni*) have the anterior portion of that ossifiation apomorphously expanded. The anterior portion of the urohyal in those species has the form of two large obliquely flattened processes (Figure 8). These processes, which serve as the areas of attachment for the enlarged urohyal-ventral hypophyal ligament (UVL), are unique to and considered synapomorphous for that clade (SYNAPOMORPHY 61).

BASIHYAL TOOTH-PLATE.—As noted by Vari (1989:36), the presence of a basihyal tooth-plate has a phyletically mosaic distribution in the Curimatidae; a situation exemplified by *Curimata*. The ossification is found in five species of the genus (*ocellata*, *macrops*, *cyprinoides*, *knerii*, and *inornata*) but absent in the examined specimens of the other seven species. Given the absence of the ossification in *Curimatopsis*, *Potamorhina*, and *Psectrogaster* which are the proximate outgroups to *Curimata*, the possession of a basihyal tooth plate is presumed to represent the derived condition within *Curimata*. Two alternative, equally parismonious, hypotheses exist as explanations for the distribution of the ossification within *Curimata* in the context of the most parsimonious hypothesis of intrageneric relationships. The first of these assumes the independent acquisition of the bone in each of *C. ocellata*, *C. macrops*, *C. inornata*, and in the hypothetical ancestor of *C. knerii* and *C. cyprinoides*. The second hypothesis

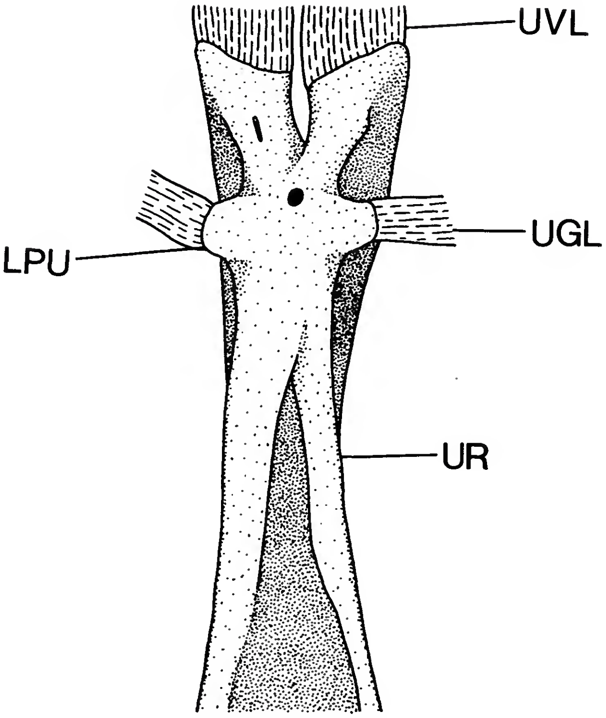

FIGURE 10.—*Curimata inornata*, MZUSP 21392, anterior section of urohyal, ventral view, anterior at top.

presumes the presence of the ossification in the ancestor of all *Curimata* species, its loss in the ancestor of the clade consisting of all *Curimata* species other than *C. ocellata* and *C. macrops*, and the secondary reacquisition of the bone in *C. inornata* and the ancestor of *C. knerii* and *C. cyprinoides*. These equally parsimonious alternatives are congruent in assuming that the presence of the ossification in *C. inornata* and in the *C. knerii-C. cyprinoides* clade is derived, albeit homoplasiously. In light of the congruence between these hypotheses the presence of a basihyal tooth-plate in those two lineages is thus considered an autapomorphy for *C. inornata* (SYNAPOMORPHY 69), and a synapomorphy for the clade formed by *C. knerii* and *C. cyprinoides* (SYNAPOMORPHY 21), respectively.

OPERCULAR APPARATUS

SUPRAPREOPERCLE.—The typical condition of the suprapreopercle in most curimatids and that found in the majority of species of *Curimata* is an elongate tube with an anteriorly concave section proximate to the anterior margin of the flange on the lateral surface of the opercle. This curvature of the supraperopercle carries that portion of the bone around the anterior margin of the laterally developed opercular flange. The degree of anterior convexity of that portion of the suprapreopercle is reduced in *C. cisandina*. In that species there is rather an increased lateral flexure of the suprapreopercle resulting from its partial shift posteriorly over the anterior portion of the opercular flange. In *C. inornata* and *C. roseni* the plesiomorphous anterior curvature of the supraperopercle proximate to the margin of the opercular flange is completely absent. The suprapreopercle instead extends directly over the anterior portion of the lateral flange of the opercle, but is much more distinctly bowed laterally than in other species of *Curimata*. These modifications of the supraperopercle are considered to represent synapomorphies at two levels of universality. The partial reduction or complete elimination of the anterior concavity of the suprapreopercle, and the migration of that portion of the bone to some degree over the anterior portion of the lateral flange on the opercle is hypothesized to be a synapomorphy for *C. cisandina*, *C. inornata*, and *C. roseni* (SYNAPOMORPHY 52). The more pronounced shift posteriorly and lateral flexure of the section of the suprapreopercle proximate to the lateral flange of the opercle, together with the elimination of the region of anterior curvature in that bone are, in turn, considered a synapomorphy for *C. roseni* and *C. inornata* (SYNAPOMORPHY 62).

MAXILLA

The form of the maxilla nearly universal in *Curimata* species and indeed in the majority of curimatid species has a relatively truncate ventral margin. That flattened border distinctly separates the anterior and posterior margins of the bone. In *C. inornata* and *C. roseni*, in contrast, the ventral portion of the maxilla is distinctly pointed with the anterior and posterior margins of the ossification in direct contact. The unique form of maxilla in those two species is consequently hypothesized to be derived (SYNAPOMORPHY 63) relative to the cited condition in outgroups. Those two species similarly have the overall profile of the main body of the maxilla vertically lengthened relative to the condition in other species of *Curimata* and outgroups in the Curimatidae, another modification hypothesized synapomorphous for the species pair (SYNAPOMORPHY 64).

HYOMANDIBULAR

The hyomandibular in species of *Curimata* is typically an angled, moderately broad element with a short, distinctly anterodorsally angled dorsal portion that articulates with the hyomandibular fossa of the cranium (Figure 11A). The longer lower portion of the hyomandibula extends along the margin of the preopercle to terminate at the level of the horizontal through the dorsal margin of the metapterygoid-quadrate foramen. Two species of *Curimata* have this phyletically widespread hyomandibular form distinctly modified. *Curimata roseni* and *C. inornata* both have hyomandibulars which are much narrower, with a less pronounced flexure at the level of the opercular condyle (OC, Figure 11B) than those found in other curimatids (Figure 11A). Correlated with the overall more slender body of the ossification in *C. roseni* and *C.*

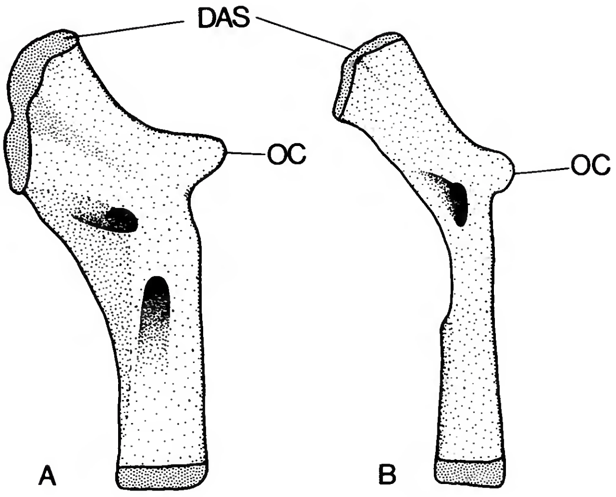

FIGURE 11.—Hyomandibular of (A) *Curimata ocellata*, MCZ 20329, and (B) *Curimata roseni*, USNM 268596; right side, medial view, anterior to left (dense patterned stippling represents cartilage).

inornata is a reduction in the relative size of the dorsal articular surface of the bone (DAS) which fits the hyomandibula fossa of the neurocranium. The overall restructuring of the hyomandibular in these two species is hypothesized as derived (SYNAPOMORPHY 65).

PALATINE ARCH

ECTOPTERYGOID (ECT).—The ectopterygoid in *Curimata* is notably modified in three different subunits of the genus. Based on the form of the ectopterygoid in curimatid outgroups the plesiomorphous condition of the bone for species of *Curimata* is hypothesized to be an anteriorly arching element with a distinctly concave anterior margin. The plesiomorphous state of the medial surface of the element is hypothesized to have a concave medial surface with a moderately developed anterodorally aligned ridge (see Vari, 1983:fig. 27). This form of the ectopterygoid is modified in divergent fashions within *Curimata*. *Curimata ocellata* has the ectopterygoid anteriorly expanded into an overall triangular bone with a nearly straight anterior margin. The posterodorsal portion of the ossification in that species is also elaborated into a discrete process that fits into a corresponding concavity on the anterior margin of the mesopterygoid (MES, Figure 12A). This marked overall reconfiguration of the anterior and posterior portions of the ectopterygoid is autapomorphous for *C. ocellata* (SYNAPOMORPHY 8).

The clade consisting of *Curimata aspera* and *C. cerasina* also has a distinctly modified ectopterygoid (Figure 12B). In those species the anterodorsal portion of the bone is expanded anteriorly into a rounded process that is separate dorsally from the ventral surface of the palatine (PAL), a derived form of the ectopterygoid not found elsewhere in the family (SYNAPOMORPHY 41). The third derived condition of the ectopterygoid among *Curimata* species characterizes *C. roseni* and *C. inornata* (Figure 12C). The overall profile of the bone from a medial view is similar to that found in outgroups in the Curimatidae. The ridge on the medial surface of the ossification is, however, developed into a very strong strut that abuts dorsally against the the ventral surface of the palatine (PAL). No such strong ridge is found in other lineages within the

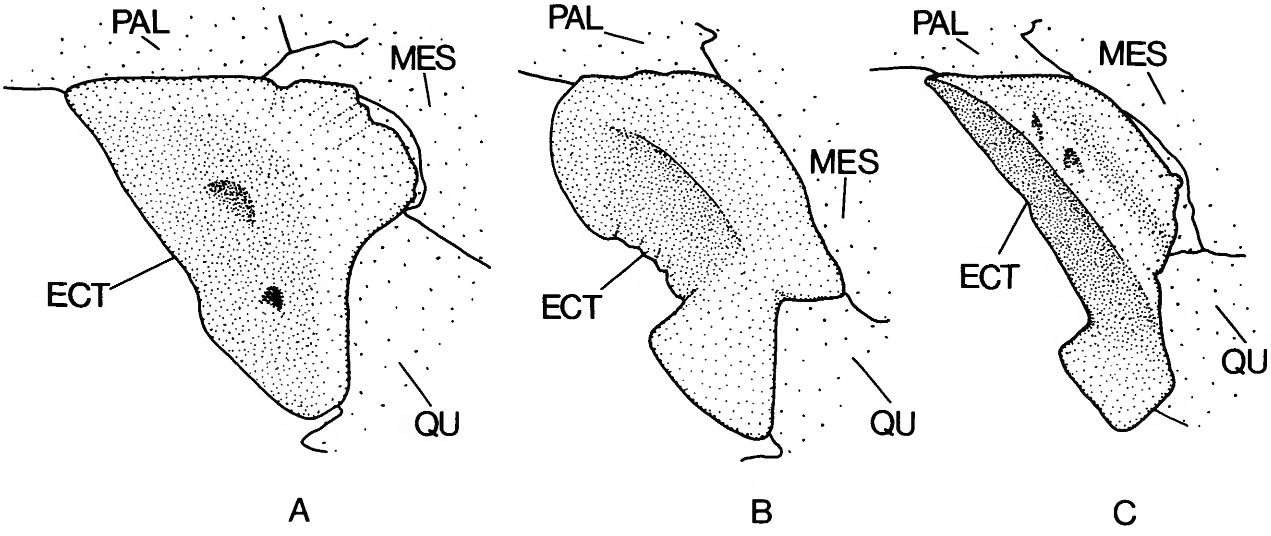

FIGURE 12.—Ectopterygoid of (A) *Curimata ocellata*, MCZ 20329, (B) *Curimata aspera*, USNM 243242, and (C) *Curimata inornata*, MZUSP 21392; right side, medial view, anterior to left, proximate portions of neighboring elements of suspensorium outlined and lightly stippled.

Curimatidae, and the possession of that feature is considered derived for *C. roseni* and *C. inornata* (SYNAPOMORPHY 66).

MESOPTERYGOID (MES).—The mesopterygoid in all species of the Curimatidae has a distinct horizontal ridge extending along the entire dorsomedial margin of the ossification. Those species of the family with a mesopterygoid-vomer ligament among curimatid outgroups have the region for the attachment of that connective tissue band well developed, but not enlarged to any significant degree or reinforced by struts (Figure 13A). Modifications of diverse components of the mesopterygoid distinguish various clades within *Curimata*.

In *Curimata mivartii*, *C. cerasina*, and *C. aspera* the posterior portion of the mesopterygoid proximal to the border with the metapterygoid is considerably thickened relative to the condition in other *Curimata* species and examined outgroups. The elaboration of that portion of the bone is hypothesized as apomorphous for these three species (SYNAPOMORPHY 34). The lineage consisting of *C. roseni* and *C. inornata* also has the mesopterygoid strengthened, but in a considerably different mode. In those two species the horizontal ridge along the dorsomedial margin of the bone is distinctly thickened, most notably anteriorly. Furthermore, in those species there is also a strong medial, vertical strut extending from the base of the process for the attachment of the mesopterygoid-vomer ligament (AI) to the ventral margin of the mesotyperygoid in the region where the latter abuts the ectopterygoid (ECT) and quadrate (QU) (Figure 13B). Although this process is analogous to the thickening of the mesopterygoid noted above in the lineage consisting of *C. mivartii*, *C. cerasina*, and *C. aspera*, the structure in *C. roseni* and *C. inornata* is more anteriorly located, and has a different overall morphology. The modifications of the horizontal ridge on the mesopterygoid and the development of the vertical strut on the medial surface of that bone in *C. roseni* and *C. inornata* are thus considered unique to that clade and synapomorphous for those species (SYNAPOMORPHY 67).

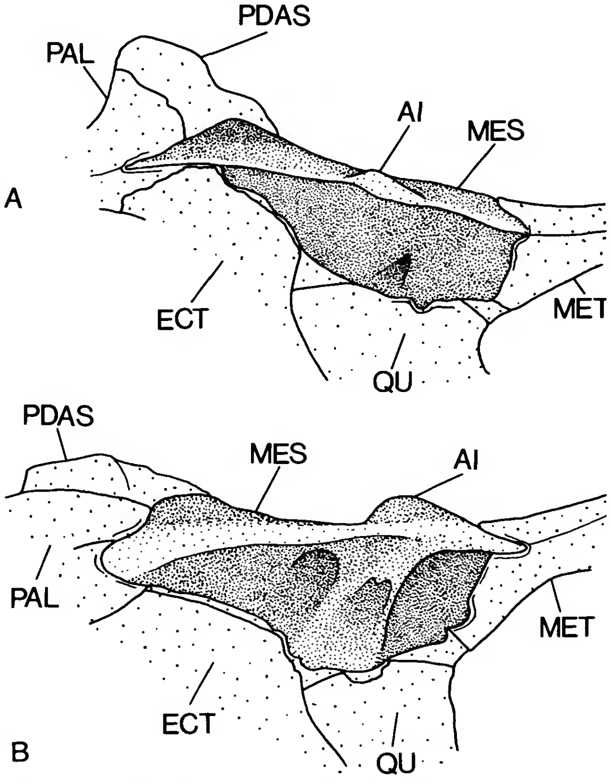

FIGURE 13.—Mesopterygoid of (A) *Curimata cyprinoides*, USNM 267964, and (B) *Curimata inornata*, MZUSP 21392; right side, medial view, anterior to left, proximate portions of neighboring elements of suspensorium outlined and lightly stippled.

METAPTERYGOID (MET).—Vari (1989:46) noted that the members of the genus *Curimata* have the ridge on the medial surface of the metapterygoid thickened anteriorly relative to the condition in the other curimatids characterized by the presence of that process. This expansion of that portion of the bone, unique to the genus, is considered a synapomorphy for the species of *Curimata* (SYNAPOMORPHY 6) (see Vari, 1989, for further details).

Within *Curimata*, three species, *C. mivartii*, *C. aspera*, and *C. cerasina*, have the anterior portion of the metapterygoid ridge thickened to a degree beyond the condition in the other species in the genus. This thickened region of the metapterygoid abuts against a similarly expanded region on the posterior portion of the mesopterygoid that serves as the area of attachment for the ligament between that element and the vomer (see above). This further thickening of the metapterygoid ridge is considered a synapomorphy for *C. mivartii*, *C. aspera*, and *C. cerasina* (SYNAPOMORPHY 35). That derived condition, in turn, is further developed in *C. cerasina* in which the anterior portion of the metapterygoid is notably thickened, a unique modification autapomorphous for the species (SYNAPOMORPHY 44). Finally, the clade formed by *C. cisandina*, *C. roseni*, and *C. inornata* is distinguished by the presence of a distinct dorsal ridge on the anterior portion of the metapterygoid (SYNAPOMORPHY 53).

SUPRANEURALS

Vari (1989) noted that the majority of species within the Curimatidae have five supraneurals, two anterior of the neural spine on the first vertebra posterior of the Weberian Apparatus, and three supraneurals interdigitating sequentially between the first and fourth neural spines. The first proximal pterygiophore of the dorsal fin, in turn, interdigitates between the fourth and fifth neural spines (see Vari, 1989, fig. 43A). That hypothesized plesiomorphous condition, common to ten of the species of *Curimata*, is modified in divergent fashions in *C. ocellata* and *C. vittata*. *Curimata ocellata* has the first proximal pterygiophore of the dorsal fin inserting between the fifth and sixth neural spines, a posterior shift in the position of that bone that is reflected in the absence of a supraneural or proximal pterygiophore between the fourth and fifth neural spines. This apomorphous shift posteriorly (SYNAPOMORPHY 9) is similar to that characteristic of species of the trans-Andean curimatid genus *Pseudocurimata* (see Vari, 1989, figs. 43B and C). The posterior shift in the position of the supraneurals in *C. ocellata* and the species of *Pseudocurimata* is hypothesized to have been independently achieved in light of the overall most parsimonious hypothesis of intrafamilial relationships (Vari, 1989).

Curimata vittata has an opposite shift in the position of the system of supraneurals and the first proximal pterygiophore of the dorsal fin. That species has four rather than five supraneurals, two anterior of the first neural spine and one element between each of the first and second, and second and third neural spines. The first proximal pterygiophore of the dorsal fin, in turn, inserts between the third and fourth neural spines. Both the reduction in the number of supraneurals and the forward shift in the position of the first proximal pterygiophore relative to the neural spines are unique to *Curimata vittata* among examined curimatids, and are considered autapomorphies for the species (SYNAPOMORPHIES 17 and 18).

PIGMENTATION

The members of the Curimatidae do not as a whole demonstrate a notable range in pigmentation patterns of the head and body. Within *Curimata* there are, however, several distinct derived pigmentation patterns which define subunits of the genus. *Curimata ocellata* has a distinct dark midlateral body stripe on the posterior portion of the body, along with a dark midlateral spot on the body in larger individuals (see Figure 15). Such a pigmentation pattern does not occur in other species of the Curimatidae, or in any members of the Prochilodontidae, and is consequently considered an autapomorphy for the species (SYNAPOMORPHY 10) (see "Color in Alcohol" under *Curimata ocellata* for a more detailed description of the pigmentation pattern).

Curimata vittata typically has a pattern of ten vertical or near vertical bars on the dorsal portion of the body in the adults (see Figure 19). Although there is some ontogenetic and geographic variation in the form and number of body bars within the species, such a pattern of pigmentation is unique to *C. vittata* both within the Curimatidae and in the sister clade to the family, the Prochilodontidae. The pattern of vertical bars is thus hypothesized to be an autapomorphy for the species (SYNAPOMORPHY 19) (see "Color in Alcohol" under *C. vittata* for a more detailed description of the pigmentation pattern).

The middorsal region of the body is typically darker than are the proximate areas in members of the Curimatidae, with the chromatophore pigmentation of the region gradually intensifying to the dorsal midline rather than demonstrating an abrupt change in intensity. Such a progressive increase in the degree of dark pigmentation characterizes all *Curimata* species with the exception of *C. cisandina, C. roseni,* and *C. inornata*. Those three species rather than having a diffuse dark middorsal region have a distinct, relatively narrow, very dark strip extending along the middorsal line from the rear of the rayed dorsal fin to the caudal peduncle. This condition is hypothesized derived given its unique nature in the family (SYNAPOMORPHY 54).

A final pigmentation character involves the life coloration in the hypothesized sister pair *C. cerasina* and *C. aspera*. These two species have a patch of bright red pigmentation on the ventral and lateral surface of the body in the region centered on the origin of the pelvic fin. Such a bright red life pigmentation in that region has not been observed or reported elsewhere in the family, and is thus hypothesized to be a synapomorphy for these two species (SYNAPOMORPHY 42).

BODY FORM AND SQUAMATION

Within the Curimatidae there is a considerable range in the degree of development of median and lateral angles in the predorsal, prepelvic and postpelvic regions of the body. Indeed Fernández-Yépez (1948) used the variation in those features as the primary diagnostic characters for a number of generic and suprageneric lineages in his classification of the Curimatidae. *Curimata* demonstrates two distinct conditions of one of these areas, the prepelvic region. *Curimata ocellata* and *C. mivartii* have transversely rounded prepelvic regions of the body whereas the remainder of the genus has a flattened prepelvic region with distinct, nearly right, lateral angles in the body wall. Such lateral angles in the body wall are not known in the Prochilodontidae, which is the sister group to the Curimatidae, and thus are judged to represent a derived character within the Curimatidae. Among curimatids such a flattened prepelvic region and the associated angles in the ventrolateral body wall occur within *Curimata, Psectrogaster,* and *Curimatella,* with the transversely concave prepelvic region of *Potamorhina pristigaster* possibly homologous with the conditions in those genera. Nonetheless overall hypotheses of relationships within the Curimatidae (Vari, 1989), within *Potamorhina* (Vari, 1984a) and that proposed for *Curimata* in this study indicate that the flattened form of prepelvic region arose independently in each of the genera. The flattened preventral region, with distinct lateral angles in the body wall is consequently considered derived within *Curimata* (SYNAPOMORPHY 14).

The distribution of the flattened prepelvic region within *Curimata* does not, however, delimit a monophyletic assemblage in the genus under the final most parsimonious hypothesis of intrageneric relationships. *Curimata mivartii*, a species with a rounded prepelvic region, is in a clade including ten other species with flattened prepelvic regions (see Figure 14). The occurrence of the transversely rounded prepelvic region in *C. mivartii* is consequently considered a derived secondary reversal in light of the overall most parsimonious hypothesis of phylogenetic relationships within *Curimata* (SYNAPOMORPHY 37).

Associated with the presence of a flattened preventral region in the majority of species of *Curimata* is an increase in the relative size of the scales on that portion of the body. The species of *Curimata* with a flattened prepelvic region have a single midventral series of enlarged scales flanked on each side by a series of similar sized scales with a distinct vertical angle that corresponds to the underlying form of the body wall. The relative enlargement of the scales in these three longitudinal series and the reconfiguration of the lateral series of scales are considered derived relative to the condition in outgroups in which the scales on the prepelvic region are neither enlarged nor angled (SYNAPOMORPHY 15). Enlarged prepelvic scales with angled lateral series on each side of the body also occur within the Curimatidae in a subunit of *Psectrogaster* and in *Curimatella*. Once again it is most parsimonious within the scheme of intrafamilial relationships proposed by Vari (1989) to hypothesize that the presence of these adaptations in those non-*Curimata* curimatids represent homoplasies. The absence of enlarged prepelvic scales with angled lateral series in *C. mivartii* is considered a derived secondary loss (SYNAPOMORPHY 38) within the overall most parsimonious hypothesis of intrageneric relationships.

Curimata ocellata is an elongate fusiform species which is phenetically very similar to and evidently mimics *Hemiodopsis semitaenitatus* (Géry, 1977b), a member of the characiform family Hemiodontidae. Such a fusiform body form is unique to *C. ocellata* within the Curimatidae, and is furthermore not approximated within the Prochilodontidae, the sister group to that family. The overall body form in *C. ocellata* is consequently hypothesized as autapomorphous (SYNAPOMORPHY 11).

MISCELLANEOUS

Several other derived characters found in body systems not yet discussed are detailed in this section.

FIN EXTENSIONS.—The anterior rays of the dorsal fin, and the dorsal and ventral rays of the caudal fin are either approximately the same length as the neighboring rays or only slightly longer than those elements in most members of the Curimatidae. The only known exceptions are *Curimata knerii* and *C. cyprinoides* in which the last unbranched and first branched dorsal-fin rays are produced into an elongate filamentous extension that extends posteriorly to, or beyond the caudal peduncle. Similarly the dorsal and ventral rays of the caudal fin are developed into elongate trailing filaments in those species. The more extensive development of these dorsal and caudal rays are considered synapomorphies for the two species given their unique nature within the family (SYNAPOMORPHIES 22 and 23).

VERTEBRAE.—The number of vertebrae among *Curimata* species inclusive of those in the Weberian complex ranges from 30 to 34, with the majority of species having 30 to 32 vertebrae. *Curimata cyprinoides* typically has 32 vertebrae, with 33 occurring in less than three percent of the specimens radiographed. A similar percentage of the examined specimens of *C. cerasina* and *C. aspera*, species usually having 32 vertebrae, were found to have 33 elements. All remaining species in the genus have 32 or fewer vertebrae with the exception of *Curimata knerii*. That species typically has 33 vertebrae, with approximately five percent of the radiographed specimens having 34 vertebrae. The higher number of vertebrae in *C. knerii* (33 or 34) is considered derived relative to the lower number of elements (30 to 32, rarely 33) typical for the other members of the genus (SYNAPOMORPHY 24).

HEAD WIDTH.—A single morphometric feature involving the width of the interorbital region serves to define a subunit of *Curimata*. The width of the interorbital region of the head is 0.46 to 0.52 of head length (HL) in *Curimata aspera* and 0.53 to 0.57 of HL in *C. cerasina*. This contrasts with an intraorbital width of 0.45 of HL or less in the vast majority of curimatids. The increased width of the head in *C. cerasina* and *C. aspera* together is considered a synapomorphy for that species pair (SYNAPOMORPHY 43). The very wide interorbital space of *C. cerasina* is, in turn, hypothesized as autapomorphous for that species (SYNAPOMORPHY 45).

Synapomorphy List and Phylogenetic Reconstruction

The preceeding section of the discussion detailed the series of shared derived characters in a variety of body systems common to the members of *Curimata* or to subunits of that genus. Vari (1989) has discussed the relationships of *Curimata* within the Curimatidae and the reader is referred to that study for further details on, and analysis of, the various character systems that contained information useful for the phylogenetic delimitation of *Curimata*, and in the phyletic placement of the genus within the Curimatidae.

In the following discussion the shared derived characters congruent with a hypothesis of the monophyly of the genus *Curimata* will only be listed in brief since those synapomorphies were discussed in greater detail in an earlier publication (Vari, 1989). The enumeration of the shared derived characters defining *Curimata* is followed by a listing of the less universal apomorphies that characterize the clades and species within the genus. Various authors have proposed diverse schemes as vehicles for conveying information on phylogenetic hypotheses within a classification. A subset of these methodologies involve the proposal of a name for each clade defined by shared derived characters. Formal nomenclatural recognition in this study is rather given only to the genus and the contained species. That nomenclatural system is used since the formal recognition of supraspecific taxa for all the clades in *Curimata* consisting of two or more species would necessitate the proposal and utilization of a series of at least eight additional taxa within the genus, a number that would increase if the two trichotomies in the present hypothesis of relationships were resolved to dichotomies by future studies. The resultant proliferation of subgeneric taxa in *Curimata* would, at best, only marginally clarify the following discussion, and indeed

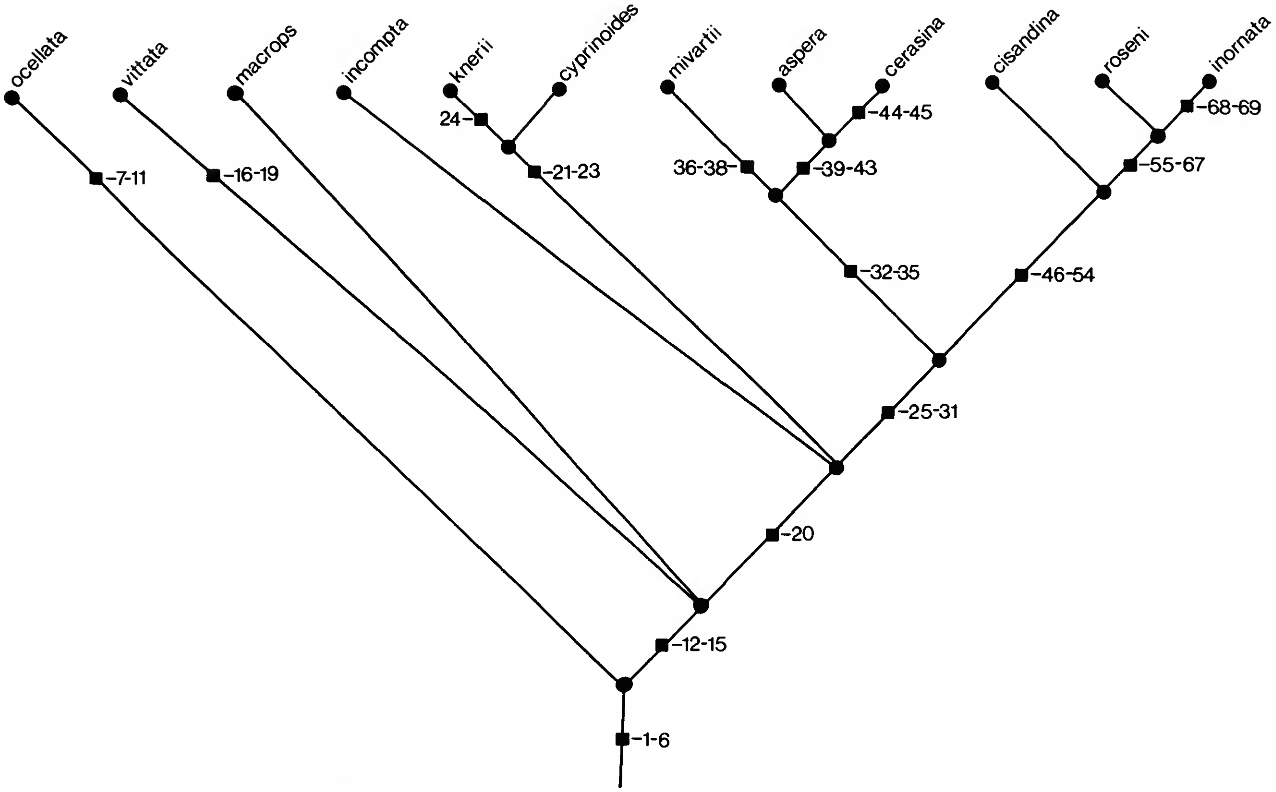

FIGURE 14.—Cladogram of the most parsimonious hypothesis of relationships for the species of the genus *Curimata*. The numbered synapomorphies of the figure correspond to those of the text (see "Synapomorphy List and Phylogenetic Reconstruction").

would more likely obfuscate the presentation. Such subgeneric taxa are thus not utilized. Although the proposed scheme of relationships within *Curimata* cannot as a consequence be directly retrieved from the classification, that phylogenetic hypothesis is discussed in detail in the following section, and is presently visually in Figure 14.

Characters pertinent to questions of suprageneric relationships within the Curimatidae are not discussed unless they represent homoplasies within the family that are common to *Curimata* or one of its subunits, and an outgroup in the Curimatidae. Such characters are typically discussed in greater detail in Vari (1989:59–62).

Subsequent to the reconstruction of the most parsimonious hypothesis of phylogenetic relationships within *Curimata* there is a discussion of the homoplasious characters within the genus, that is those derived attributes that have a phylogenetic distribution incongruent with the arrived at most parsimonious hypothesis of relationships. These characters are typically homoplasies between a subunit of *Curimata* on the one hand and another species or a supraspecific clade within the Curimatidae on the other. Less commonly the homoplasies involve two subgroups within *Curimata*. The discussion of the homoplasies in conjunction with the phylogenetic reconstruction provides the basis for the evaluation of the efficacy of previous classificatory schemes as indicators of the phylogenetic history of the genus, its suprageneric groupings and contained species.

The most parsimonious phylogenetic hypothesis for species relationships within *Curimata* incorporating the synapomorphies described above is presented in Figure 14. That hypothesis was first derived by a manual construction of the phylogenetic scheme. The parsimony of that scheme was confirmed by the use of David L. Swofford's numeric algorithm PAUP (Phylogenetic Analysis Using Parsimony, version 2.4, 1985). Derived characters unique to a single species (autapomorphies) were not included in the analysis. The data on 39 polarized characters with two to four character states was analyzed using the branch and bound option of PAUP which is guaranteed to find the most parsimonious trees. The analysis resulted in nine equally parsimonious trees with consistency indices of 0.900. These trees have identical topologies, with the differences between them being in the sequence of presentation of the clades at the two trichotomies in the final phylogeny. These trees are thus identical in terms of the phylogenetic hypothesis they represent and equivalent to the scheme of relationships in Figure 14.

The apomorphous characters defining the genus *Curimata*, the supraspecific clades, and species within the genus are numbered sequentially. The numbering of characters in the following text and the immediately preceeding section on "Character Description and Analysis" corresponds to the numbered synapomorphies of Figure 14. That numbering procedure is utilized to simplify the vizualization of the distribution of characters at all phylogenetic levels. It furthermore readily permits cross-reference of the preceeding character descriptions and analyses with the phylogenetic reconstruction in this section.

Vari (1989:57) listed six characters as synapomorphies for the members of *Curimata*. Those characters are listed below and were discussed briefly under "Character Description and Analysis". The reader is referred to the earlier publication for further information on the characters, the condition(s) in the examined outgroups and the phylogenetic distribution of the different characters.

The discovered synapomorphies described by Vari (1989) for the members of the genus *Curimata:*

1. The ontogenetic reconfiguration of the medial spur on the fourth epibranchial (E_4) into a ventrally expanded, fenestrated process contacting the fifth upper pharyngeal tooth plate (UP_5).
2. The development of a median shelf on the dorsal margin of the medial spur on the fourth epibranchial (E_4), and the associated pronounced fenestration of that spur.
3. The medial shift of the medial spur and ventral articular process of the fourth epibranchial (E_4), and of the associated fifth upper pharyngeal tooth plate (UP_5).
4. The reduction to some degree to complete loss of the first infrapharygobranchial (PB_1).
5. The elaboration of the three primary folds of the buccopharyngeal complex into large vertical flaps, and the development of numerous parallel secondary folds on the roof of the buccal cavity.
6. The thickened anteromedial portion of the metapterygoid.

Within the hypothesized monophyletic assemblage defined by characters 1 to 6, two lineages are, in turn, defined by less universal apomorphies. The first lineage consists of a single species, *Curimata ocellata*, and the second clade contains eleven species (*vittata, macrops, knerii, cyprinoides, incompta, mivartii, aspera, cerasina, cisandina, roseni,* and *inornata*). The less speciose lineage containing *C. ocellata* is defined by the following derived characters:

7. The posteriorly directed elongate spine on the ventral surface of the anterodorsal corner of the second hypobranchial (H_2).
8. The expansion of the ectopterygoid into a large overall triangular element, with a posterodorsally expanded process fitting into a corresponding notch on the anterior margin of the mesopterygoid.
9. The posterior shift of the region of interdigitation of the first proximal pterygiophore of the dorsal fin relative to the neural spines of the anterior vertebrae.
10. The distinctive pigmentation pattern of a midlateral stripe on the posterior portion of the body, with a dark midlateral body spot present in adults.
11. The elongate fusiform shape of the body.

The elongate body form and distinctive pigmentation pattern of *Curimata ocellata* are evidently mimetic with those features in some hemiodontids, in particular various species of *Hemiodopsis* with which it schools (see Géry, 1977a).

The more inclusive clade consisting of the other eleven species of *Curimata* is delimited by the following synapomorphies:

12. The pronounced reduction or total loss of the first infrapharyngobranchial (PB_1).
13. A slightly developed to pronounced longitudinal ridge on the dorsal surface of the second ceratobranchial (C_2).
14. The distinct flattened prepelvic region of the body with discrete, nearly right, lateral angles in the body wall (secondarily absent in *C. mivartii*).
15. The enlarged series of midventral scales in the prepelvic region and the flanking series of enlarged scales that have a discrete angle correponding to the angle in the underlying body wall (secondarily absent in *C. mivartii*).

At this point in the phylogeny there exists a trichotomy that has not been resolved with the evidence from the examined characters. Those three clades are as follows: first, *Curimata vittata*; second, *C. macrops*; and third, the lineage consisting of *C. knerii, C. cyprinoides, C. incompta, C. mivartii, C. aspera, C. cerasina, C. cisandina, C. roseni,* and *C. inornata*. These clades are discussed sequentially, with the order of presentation not indicative of any hypothesis of relationships.

Curimata vittata, a distinctively pigmented species widely distributed through the Rio Amazonas basin, has the following autapomorphies:

16. The flattened, elongate triangular process on the dorsal surface of the anterior margin of the first epibranchial (E_1).
17. The reduction to four supraneurals from the five in other *Curimata* species.
18. The anterior shift of the point of interdigitation of the first proximal pterygiophore of the dorsal fin to between the fourth and fifth neural spines, and the reduction to four supraneurals.
19. The distinctive pigmentation pattern in the adults of a series of vertical bars on the dorsal portion of the body.

Curimata macrops, the second component of the trichotomy, is unique in the genus in being endemic to the rivers of northeastern Brazil. No autapomorphies to characterize the species were discovered during this study.

The next lineage in *Curimata*, involved in this trichotomy, consists of nine species (*knerii, cyprinoides, incompta, mivartii, aspera, cerasina, cisandina, roseni,* and *inornata*). The discovered synapomorphy for the assemblage is as follows:

20. The subdivision of the cartilage cap on the uncinate process of the first epibranchial (E_1) into two smaller cartilages.

Once again the intrageneric phylogeny within the assemblage defined by character 20 has been only resolved to the level of a trichotomy. The three components of the trichotomy are *C. incompta*, the clade consisting of *C. knerii* and *C. cyprinoides*, and the lineage formed by *C. mivartii, C. aspera, C. cerasina, C. cisandina, C. roseni,* and *C. inornata*. These three clades are discussed consecutively, with the order of presentation not indicative of any hypothesis of relationships.

Curimata incompta, the first element of the trichotomy, achieves the smallest known adult body size in the genus, and is a Río Orinoco basin endemic. It is not known to be characterized by any autapomorphies.

The two species forming the next lineage in this trichotomy, *Curimata knerii* and *C. cyprinoides*, are very similar allopatric forms that share the following synapomorphies:

21. The possession of a basihyal tooth-plate.
22. The filamentous anterior rays of the dorsal fin.
23. The elongate dorsal and ventral rays of the caudal fin.

Curimata knerii, a species of the middle and upper portions of the Rio Amazonas system, is characterized by the following autapomorphy:

24. An increase to 33 or 34 vertebrae.

No autapomorphies are known to delimit *Curimata cyprinoides*, an inhabitant of the lower Rio Amazonas and the Atlantic drainages of the Guianas between the Amazon and the Orinoco Rivers.

The six *Curimata* species of the next clade involved in the trichotomy (*mivartii, aspera, cerasina, cisandina, roseni,* and *inornata*) have in common a number of shared derived characters, most notably involving the gill arches and associated body systems. The discovered synapomorphies for the clade are as follows:

25. The longitudinal ridge on the ventral surface of the second epibranchial (E_2).
26. The reduction in the relative size of the anterior articular surface of the first hypobranchial (H_1).
27. The relative lengthening of the first hypobranchial (H_1).
28. The moderate to pronounced curvature of the shaft of the first ceratobranchial (C_1).
29. A moderately to well-developed longitudinal ridge on the dorsal surface of the second ceratobranchial (C_2).
30. The pronounced distinctly convex longitudinal ridge extending along approximately two-thirds of the length of the dorsal surface of the third ceratobranchial (C_3).
31. The reduction in the relative length of the urohyal.

Within the clade defined by characters 25 to 30 there occur two less inclusive lineages, each consisting of three species, and both delimited by a series of synapomorphies. These clades are *C. mivartii, C. aspera,* and *C. cerasina* on the one hand, and *C. cisandina, C. roseni,* and *C. inornata* on the other.

The first of these clades, the lineage consisting of *C. mivartii, C. aspera,* and *C. cerasina*, is defined by the following synapomorphies:

32. The transverse widening of the fifth upper pharyngeal tooth plate (UP_5) into a broad plate.
33. The highly convex longitudinal ridge on the dorsal surface of the third hypobranchial (H_3).
34. The thickening of the mesopterygoid proximate and posterior to the process for the attachment of the ligament extending between the mesopterygoid and vomer.
35. The pronounced thickening of the anterior portion of the ridge on the medial surface of the metapterygoid.

Within this grouping of species, *C. mivartii* is definable by three autapomorphies, and the clade consisting of *C. aspera* and *C. cerasina* by a larger series of synapomorphies.

Curimata mivartii, a Río Magdalena basin endemic, which achieves the largest known body size in the family, is also the only member of the genus found in trans-Andean South America. The autapomorphies for *C. mivartii* are the following:

36. The greatly developed longitudinal ridge on the dorsal surface of the second ceratobranchial (C_2).
37. The secondary reacquisition of a transversely rounded prepelvic region of the body, and the secondary loss of the lateral angles in the body wall.
38. The secondary absence of the enlarged scales on the prepelvic region of the body, and the reacquisition of flattened rather than distinctly angled scales along the anterolateral border of that region.

Synapomorphies defining the clade formed by *C. aspera* and *C. cerasina:*

39. The longitudinal ridge along the ventral surface of the third epibranchial (E_3).
40. The elaboration of the ventral longitudinal ridge of the second epibranchial (E_2), and the folding over of its distal portion into a horizontal shelf.
41. The expansion of the anterodorsal portion of the ectopterygoid into a discrete rounded process separate from the ventral margin of the palatine.
42. The bright red coloration on the ventral surface of the body in life.
43. The widened interorbital region of the head.

Curimata aspera, an inhabitant of the upper Rio Amazonas basin, is not known to be characterized by any autapomorphies.

Curimata cerasina, a Río Orinoco basin endemic, is characterized by the following autapomorphies:

44. The very highly developed thickening of the anteromedial portion of the metapterygoid.
45. The extremely wide interorbital region of the head.

The sister clade to the lineage consisting of *C. mivartii, C. aspera,* and *C. cerasina* is formed by *C. cisandina, C. roseni,* and *C. inornata.* An extensive series of characters define the clade consisting of *C. cisandina, C. roseni,* and *C. inornata:*

46. The development of a strong ventral process having the form of a curved vertical sheet on the fifth upper pharyngeal tooth plate (UP_5).
47. The reduction or loss of the uncinate process on the second infrapharygobranchial (PB_2).
48. The loss of the first infrapharygobranchial (PB_1).
49. The triangular, anteriorly directed process on the ventral surface of the anterolateral corner of the second hypobranchial (H_2).
50. The very pronounced longitudinal ridge on the dorsal surface of the third ceratobranchial (C_3).
51. The distinct process on the ventrolateral margin of the urohyal serving as a point of attachment for the ligament joining the urohyal and gill arches.
52. The reduction or elimination of the anterior flexure in the supraperopercle proximate to the anterior of the flange on the lateral surface of the opercle, and the partial or complete migration of the suprapreopercle over the anterior portion of the flange.
53. The distinct dorsal ridge on the anterior portion of the metapterygoid.
54. The discrete black middorsal stripe extending from the rear of the rayed dorsal fin to beyond the adipose dorsal fin.

The two less inclusive clades within this three species lineage are *C. cisandina* on the one hand and the species pair consisting of *C. roseni* and *C. inornata* on the other.

No autapomorphies for *Curimata cisandina,* a species inhabiting the middle and upper portions of the Rio Amazonas basin, were discovered during this study.

The last species pair in the family, *Curimata roseni* and *C. inornata,* in contrast, shares numerous derived characters:

55. The dorsal flange on the dorsolateral margin of the fifth upper pharyngeal tooth plate (UP_5) that abuts the corresponding process of the fourth epibranchial (E_4).
56. The loss of the uncinate process on the second infrapharygobranchial (PB_2) and the restructuring of the anterior portion of that bone resulting in its overlapping the margin of the first epibranchial (E_1).
57. The very pronounced relative lengthening of the first hypobranchial (H_1).
58. The pronounced curvature of the shaft of the first ceratobranchial (C_1).
59. The discrete anterolateral spur on the anteroventral process of the third hypobranchial (H_3).
60. The pronounced reduction in the relative length of the urohyal which barely extends posterior of the point where the medial branchiostegal rays diverge laterally.
61. The expansion of the anterior portion of the urohyal into two large processes on which the urohyal to ventral hypohyal ligament attaches.
62. The elimination of the anterior convexity in the supraperopercle proximate to the lateral flange of the opercle and the complete migration of that section of the bone over the anterior portion of the lateral flange.
63. The ventrally acute margin of the maxilla.
64. The relative elongation of the maxilla.
65. The slender hyomandibular with a reduced dorsal articular surface.
66. The development of a very strong ridge on the medial surface of the ectopterygoid.
67. The pronounced thickening of the horizontal ridge along the posteromedial margin of the mesopterygoid and the development of a well developed vertical strut extending from the process for the attachment of the mesopterygoid-vomer ligament to the ventral margin of the mesopterygoid.

Curimata roseni, an Amazon basin species, is not known to be characterized by any autapomorphies.

The last species of the genus to be discussed, *Curimata inornata,* a form that is widely distributed in the middle and lower Amazon basin, in contrast, possesses the following autapomorphies:

68. The posterolaterally directed triangular projection along the anterior portion of the second infrapharygobranchial (PB_2) that extends to the anterolateral margin of the third infrapharygobranchial (PB_3).
69. The possession of a basihyal tooth-plate.

Convergent Characters

Homoplasy, the common occurrence of shared derived characters in lineages that do not constitute a monophyletic group in the overall most parsimonious phylogeny, is a factor typical of the majority of hypotheses of relationships. Distinctions have been made previously between convergencies and parallelisms on the basis of concepts of degrees of relative phylogenetic relationships between the involved taxa. Although the distinction may be valid genetically, it is, however, not possible to distinguish these classes of homoplasies in practice when examining morphological characters. All such homoplasious features are as a result referred to as convergencies in this discussion.

The overall most parismonious hypothesis of relationships within *Curimata* and the results reported on by Vari (1989) necessitate a hypotheses of the independent acquisition of a subset of shared derived characters either between components of *Curimata* or between a subunit of *Curimata* and another lineage within the Curimatidae.

Only one such convergent character, the common occurrence of a basihyal toothplate in *Curimata inornata* and the clade formed by *C. knerii* and *C. cyprinoides*, was found within *Curimata*. The absence of a flattened prepelvic region of the body with associated enlarged scales in *C. mivartii* and *C. ocellata* would at first appear to represent a second intrageneric homoplasy. The morphology of that region in those two species is, however, most parsimoniously considered to represent a secondary reversal to the plesiomorphous condition in *C. mivartii* within the overall scheme of intrafamilial and intrageneric relationships.

Convergences between a subunit of *Curimata* and outgroups within the Curimatidae are much more common. Such homoplasies discovered during this study are as follows, listed by synapomorphy number (see also "Character Description and Analysis" and "Synapomorphy List and Phylogenetic Reconstruction"):

5. The elaboration of the buccopharyngeal complex in *Curimata* and the majority of species within *Steindachnerina*.
9. The posterior position of the interdigitation of the first proximal pterygiophores of the dorsal fin with the proximate neural spines in *C. ocellata* and all species of *Pseudocurimata*.
14. The flattened prepelvic region of the body in all *Curimata* species other than *C. mivartii* and *C. ocellata* and subunits of *Curimatella* and *Psectrogaster*.
15. The angled lateral series of scales on the prepelvic region of the body in all *Curimata* species other than *C. mivartii* and *C. ocellata*, and subunits of *Curimatella* and *Psectrogaster*.
20. The subdivision of the uncinate process of the first epibranchial in *C. incompta, C. cyprinoides, C. knerii, C. mivartii, C. inornata, C. roseni, C. cisandina, C. aspera*, and *C. cerasina* on the one hand, and all species of *Potamorhina* on the other.
25. The well developed ventral longitudinal ridges on the second epibranchial in *C. mivartii, C. inornata, C. roseni, C. cisandina, C. aspera*, and *C. cerasina*, and all species of *Psectrogaster*.
33. The longitudinal ridge along the dorsal surface of the third ceratobranchial in *C. mivartii, C. inornata, C. roseni, C. cisandina, C. aspera*, and *C. cerasina*, and all species of *Psectrogaster*.
39. The well developed ventral longitudinal ridges on the third epibranchial in *C. aspera* and *C. cerasina*, and all species of *Psectrogaster*.

Convergences 5, 9, and 20 involve unique patterns of homoplasy between subunits of *Curimata* and curimatid outgroups and obviously must be considered convergent in light of the much more numerous synapomorphies within the Curimatidae noted by Vari (1989:52–59) and given the apomorphous defining features for *Curimata* noted in the previous section. Furthermore as noted in Vari (1989) the elaborations of the buccopharyngeal complex (5) and the subdivision of the uncinate process on the first epibranchial (20) differ in various details between *Curimata* and outgroups within the Curimatidae, and may not represent homologous and thus homoplasious characters. Repeated patterns of homoplasy occur between components of *Curimata* on the one hand and *Psectrogaster* on the other (25, 33, 39). These features involve different levels of inclusiveness within *Curimata* and thus provide internally equivocal data on possible relationships between the involved taxa. Furthermore the most parsimonious hypothesis of relationships within the family indicates that these features, although derived, do not define a monophyletic unit among curimatids. The characters common to some species of *Curimata* and subunits of *Curimatella* and *Psectrogaster* (14, 15) are evidently identical, but again are hypothesized as homoplasious for reasons of parsimony.

Comparisons with Previous Classifications

The concept of the genus *Curimata* applied in previous classifications has varied remarkably, with the genus as defined in the present study inconsistent to differing degrees with all earlier taxonomic schemes. Eigenmann (1910:420–422) used a broadly defined *Curimata* which incorporated approximately 71% of the 66 nominal species of the Curimatidae that had been described to that date. Fernández-Yépez (1948) in his drastic subdivision of the family restricted *Curimata* to two species, *C. cyprinoides* and *C. knerii*, with the other 87 species that he recognized in that revision divided among 26 other genera. The remainder of the nominal species placed in *Curimata* in the present study were apportioned by Fernández-Yépez among six other genera, one of which (*Semitapicis* Eigenmann and Eigenmann) predated his study, and six of which (*Allenina, Bitricarinata, Bondia* (replaced by *Bondichthys* (Whitley, 1953), *Camposella* (replaced by *Stupens* (Whitley, 1954)), *Lambepiedra*, and *Pseudocurimata*) were described by Fernández-Yépez (1948) in that publication.

As discussed by Vari (1989) neither the nearly totally inclusive concept of *Curimata* used by Eigenmann nor the highly subdivided classification proposed by Fernández-Yépez represent to any significant degree the natural lineages within the Curimatidae. Eigenmann's definition of *Curimata* resulted in a large genus consisting of all curimatid species not assigned to the other externally more distinctive genera within his system. As a consequence his *Curimata* was diagnosed by the common possession of primitive features, and did not constitute a natural assemblage. Although Fernández-Yépez's drastically restricted *Curimata* (*kneri* and *cyprinoides*) is a natural lineage according to the findings of the present study (see Figure 14), the genus *Curimata*, as defined herein, does not form a discrete lineage within the "phylogenetic tree" proposed by Fernández-Yépez (1948, fig. 2). Rather the species of *Curimata* of the present study are intermingled with species of other curimatid lineages within the tribe Curimatini of Fernández-Yépez (see Vari, 1989).

To a considerable degree these differences between the results of the present study and Vari (1989) on the one hand and those of Fernández-Yépez on the other are a consequence of the dependence by Fernández-Yépez on a few characters (e.g., the flattened prepelvic region of the body) which have been found to demonstrate a high degree of homoplasy within the family when evaluated within the framework of a phylogenetic hypothesis based on information from multiple body systems. The possible difficulties with the limitation of a phylogenetic analysis to a restricted data set in general and with those specific features used by Fernández-Yépez in particular, are not apparent until more extensive series of characters drawn from numerous body systems are examined.

The problems with the classifications of Eigenmann and Fernández-Yépez are typical of those in most classifications of the Curimatidae—the separation of externally distinctive taxa into their own genera and subgenera. The remaining species in such systems were lumped together in taxa defined solely by the absence of the features characteristic of more externally distinctive species. Such residual assemblages are as a consequence typically defined on primitive features. Although the resultant groupings may form monophyletic lineages, it was not possible to recognize them as such on the basis of then available data. More often such groupings have been subsequently found to represent unnatural conglomerates of species, the situation typical of many genera recognized in previous classifications of the Curimatidae.

Genus *Curimata* Bosc, 1817

Curimata Bosc, 1817:9 [type species *Salmo edentulus* Bloch, 1794 (= *Salmo cyprinoides* Linnaeus, 1766), designated by International Commission on Zoological Nomenclature, Opinion 772, 1966].

Semitapicis Eigenmann and Eigenmann, 1889:417 [type species *Charax planirostris* Gray, 1854 (= *Salmo cyprinoides* Linneaus, 1766), designated by Eigenmann, 1910:422; proposed as a subgenus].

Peltapleura Fowler, 1906:300 [type species *Salmo cyprinoides* Linnaeus, 1766, by original designation; proposed as a subgenus].

Acuticurimata Fowler, 1941:166 [type species *Curimata macrops* Eigenmann and Eigenmann, 1889, by original designation].

Allenina Fernández-Yépez, 1948:39 [type species *Curimata murieli* Allen, in Eigenmann and Allen, 1942 (= *Curimatus vittatus* Kner, 1859), by original designation].

Lambepiedra Fernández-Yépez, 1948:62 [type species *Lambepiedra alleni* Fernández-Yépez, 1948:62 (= *Psectrogaster cisandina* Allen, in Eigenmann and Allen, 1942), by original designation].

Bitricarinata Fernández-Yépez, 1948:64 [type species *Curimatus schomburgkii* Günther, 1864 (= *Salmo cyprinoides* Linneaus, 1766), by original designation].

Bondichthys Whitley, 1953:134 [type species *Curimatus mivartii* Steindachner, 1878, by original designation; replacement for *Bondia* Fernández-Yépez, 1948:66, preoccupied in Lepidoptera].

Stupens Whitley, 1954:30 [type species *Curimatus simulatus* Eigenmann and Eigenmann, 1889 (= *Curimatus asper* Günther, 1868a), by original designation; replacement for *Camposichthys* Whitley, 1953:134 preoccupied in fishes; *Camposichthys*, replacement for *Camposella* Fernández-Yépez, 1948:60, preoccupied in Diptera].

DIAGNOSIS.—*Curimata* is a morphologically diverse assemblage of curimatids typically of moderate maximum body size, with the maximum known standard lengths for the species of the genus ranging from 112 to 225 mm. The genus is characterized by a series of shared derived characters most notably of the gill arches and buccopharyngeal complex (see characters 1 to 6 of "Synapomorphy List and Phylogenetic Reconstruction").

Dorsal-fin rays ii,8–10 or iii,8–9, anteriormost dorsal-fin rays elongate in some species, sometimes extending to or beyond tip of upper lobe of caudal fin; anal-fin rays ii,7–12 or iii,7–11; pectoral-fin rays 13 to 18; pelvic-fin rays i,7–9; adipose fin always present. Pored lateral-line scales from supracleithrum to hypural joint range from 43 to 76; sensory canals in lateral-line scales straight or slightly divergent. Scale margins smooth to markedly ctenoid; ctenii more developed on ventral portions of body, particularly anterior of pelvic fin. Number of scales in a transverse series from origin of rayed dorsal fin to lateral line 11 to 19; number of scales in a transverse series from origin of anal fin to lateral line 7 to 15. Total vertebrae 30 to 34.

REMARKS.—In a previous paper Vari (1984a:13–16) discussed the identity of *Charax* 378 of Gronovius (1763:123) which Gray (1854:154) made available as *Charax planirostris*. Eigenmann and Eigenmann (1889:417) placed the latter species in the subgenus *Semitapicis*, and Eigenmann (1910:422) subsequently specifically designated *C. planirostris* as the type species of *Semitapicis*. Vari (1984a:13–16) noted that the association of *Charax* 378 of Gronovius, the *Charax planirostris* of Gray, with the other species placed in *Semitapicis* by most authors, was based on a series of assumptions by researchers commencing with Günther (1864:290, 293). Those assumptions lead to a hypothesis of the conspecificity of *Charax planirostris* and *Curimata abramoides* Kner (1859). A reappraisal of the original description of *Charax* 378 and the Gronovius manuscript illustration of the species in the Library of the British Museum (Natural History) indicates that *Charax* 378 (= *planirostris*) is not conspecific with *Curimata abramoides*. That information furthermore supports the hypothesis that *Charax planirostris* is not most closely related to the other nominal species placed in *Semitapicis* by various authors from Eigenmann and Eigenmann (1889) to Braga and Azpelicueta (1983). The available evidence (Vari, 1984a:13–16) rather indicates that *Charax planirostris* is properly asssigned to the genus *Curimata* as defined in this study. Within *Curimata*, *C. planirostris* is considered a synonym of *C. cyprinoides* as first proposed by Linnaeus (1766:514) who placed *Charax* 378 into the synonymy of his *Salmo cyprinoides* (see also Vari, 1984a:16, and "Remarks" under *Curimata cyprinoides*). *Semitapicis*, with a type species of *Charax planirostris*, is as a consequence considered a junior synonym of *Curimata*.

Fowler (1906, 1941) and Fernández-Yépez (1948) proposed a number of additional genera and subgenera for various species or species groups within *Curimata* as defined herein.

Two of the genera advanced by Fernández-Yépez (*Bondia, Camposella*) were later found by Whitley (1953, 1954) to be preoccupied and were replaced with alternative names (*Bondichthys* and *Stupens* respectively). Of the generic names available in this assemblage, nearly half either have *Curimata cyprinoides* as the designated type species (*Bitricarinata*) or have type species that are considered to be synonyms of *Curimata cyprinoides* in the present paper (*Curimata, Semitapicis,* and *Peltapleura*). The continued recognition of the remaining available genera (*Acuticurimata, Allenina, Stupens, Lambepiedra,* and *Bondichthys*) in this monophyletic lineage would, given the topology of the proposed phylogenetic tree, necessitate the description of several new genera in order to satisfy the criterion that all recognized taxa be monophyletic. Such a further generic subdivision, which would create a number of additional monotypic genera, would only complicate the already involved nomenclature of the clade. Furthermore such an expansion in the number of genera without a simultanaeous proposal of a series of nested taxa indicative of relationships of lineages between the generic and specific levels would still fail to identify supraspecific clades at subgeneric levels. The definition of such supraspecific taxa within the clade would require the advancement of a minimum of four additional names. That more complex taxonomy together with the numerous genera in such a system although allowing the hypothesis of relationships to be derived directly from the classification would at the same time be very cumbersome. The taxonomically simpler and distinctly less complicated alternative of a single all encompassing genus, *Curimata* is judged preferable and is the procedure followed herein.

Key to the Species of *Curimata*

1. Body elongate, greatest body depth 0.22–0.27 of standard length (SL); a distinct, dark, midlateral spot extends between the 38th and 45th scales of lateral line; spot in juveniles continuous with midlateral body stripe that extends to base of caudal fin; a band of black pigment on dorsal rays of lower lobe of caudal fin (middle and lower Rio Amazonas basin, upper Río Orinoco . . . . **C. ocellata**

Body moderately to distinctly deep, greatest body depth 0.30–0.45 of SL; no large dark midlateral spot or stripe on posterior of body, or if stripe present, species also has vertical bars or vertical series of spots of dorsal portion of body; caudal fin lacks distinct band of dark pigmentation on dorsal rays of lower lobe . . . 2

2. Branched anal-fin rays 7 to 9 3

Branched anal-fin rays 10 to 12 8

3. Eight to 11 dark vertical bars on dorsal portion of body, bars in some individuals subdivided into vertically aligned series of spots; a longitudinal dark midside stripe sometimes present (Rio Amazonas basin, upper Río Orinoco) . . . . **C. vittata**

Body without dark vertical bars or midside stripe 4

4. Greatest body depth 0.34–0.39 of SL 5

Greatest body depth 0.40–0.48 of SL 6

5. Interorbital width less than distance from tip of snout to anterior margin of opening in adipose eyelid; length of postorbital portion of head 0.32–0.37 of head length (HL); snout length 0.31–0.36 of HL; eye width 0.32–0.39 of HL (middle portion of Rio Amazonas basin) . . . . **C. inornata,** new species

Interorbital width greater than distance from tip of snout to anterior margin of opening in adipose eyelid; length of postorbital portion of head 0.38–0.42 of HL; snout length 0.28–0.32 of HL; eye width 0.29–0.33 of HL (Río Orinoco basin) . . . . **C. incompta**

6. Anteriormost rays of dorsal fin not filamentous; 31 vertebrae; 12 to 14 enlarged median scales along prepelvic region to origin of pelvic fins (Rio Amazonas drainage basin) . . . . **C. roseni,** new species

Anteriormost rays of dorsal fin distinctly filamentous, tips of elongate dorsal-fin rays often reaching tip of dorsal lobe of caudal fin; typically 32 to 34 vertebrae (very rarely 31); 15 to 17 enlarged median scales along prepelvic region to origin of pelvic fins 7

7. Lateral line scales to hypural joint 46 to 56; typically 32 vertebrae, very rarely 31 or 33 (Río Orinoco delta, Atlantic drainages of the Guianas, lower Rio Amazonas and Rio Tocantins) . . . . **C. cyprinoides**

   Lateral line scales to hypural joint 56 to 63. 33 or 34 vertebrae (middle and upper Rio Amazonas basin) . . . . **C. knerii**

8. Lateral line scales to hypural joint 57 to 76; scales above lateral line to origin of rayed dorsal fin 16 to 19 9

   Lateral line scales to hypural joint 43 to 54; scales above lateral line to origin of rayed dorsal fin 12 to 16 10

9. Prepelvic region margined laterally with distinct longitudinal angles in body wall. Midventral scale series of prepelvic region distinct, enlarged; flanked by a distinct series of scales that conform in shape to lateral angles of prepelvic region (Northeastern Brazil: Rio Poti and Rio Parnaiba) . . . . **C. macrops**

   Prepelvic region transversely rounded, no distinct lateral angles in body wall; scale series of prepelvic region irregularly arranged, not enlarged (Colombia: Río Magdalena, Río Cauca, Río San Jorge, Río Sinu) . . . . **C. mivartii**

10. Width of interorbital region of head 0.40–0.45 of head length (HL); vertebrae usually 31, rarely 32 (Rio Negro, middle and upper Rio Solimões) . . . . **C. cisandina**

    Width of interorbital region of head 0.46–0.57 of HL; vertebrae 32 or 33, rarely 31 11

11. Width of interorbital region of head 0.46–0.52 of HL; gape width 0.27–0.36 of HL; lateral surface of body relatively flat (middle and upper Rio Amazonas) . . . . **C. aspera**

    Width of interorbital region of head 0.53–0.57 in HL; gape width 0.35–0.40 of HL; body robust, sides of body curved laterally (Río Orinoco basin) . . . . **C. cerasina**

Curimata ocellata Eigenmann and Eigenmann

Figures 15, 16, 17

Curimatus ocellatus Eigenmann and Eigenmann, 1889:427 [type locality: Brazil, Rio Xingu]; 1891:47 [reference].—Eigenmann, 1910:422 [reference].

Curimatus semitaeniatus Steindachner, 1917:18 [type locality: Brazil, Rio Negro, Moura].—Fernández-Yépez, 1948:73 [reference].

Pseudocurimata ocellata.—Fernández-Yépez, 1948:46 [assignment to *Pseudocurimata*].—Fowler, 1975:373 [reference].

Curimata ocellata.—Fowler, 1950:288 [reference].—Géry, 1977b:105, fig. 3 [redescription, mimicry of hemiodontids].—Goulding et al., 1988:139 [Brazil, Rio Negro, Ilha Buiu-Açu; food habits].—Vari, 1989, tables 2, 3 [phylogenetic relationships].

Curimata semitaeniata.—Fowler, 1950:292 [reference]; 1975:369 [reference].—Géry, 1977a:103, figs. 1, 2 [redescription, mimicry of hemiodontids].

DIAGNOSIS.—The elongate body form and distinctive coloration pattern of *Curimata ocellata*, which are similar to those of various hemiodontids (see Figure 15 and Géry, 1977a, figs. 1–3), are unique to this species within the Curimatidae. *Curimata ocellata* is further distinguishable in the genus by its slender body (greatest body depth 0.22–0.27 of SL, in contrast to 0.30–0.46 of SL for other *Curimata* species), the possession of a dark midlateral spot on the body, and a broad stripe of pigmentation on the dorsal rays of the ventral lobe of the caudal fin, attributes absent in other species of the genus.

DESCRIPTION.—Body markedly elongate, robust, more so in larger specimens. Dorsal profile of head slightly convex. Dorsal profile of body slightly convex from rear of head to origin of rayed dorsal fin; straight and very slightly posteroventrally slanted at base of rayed dorsal fin, gently convex from base of last dorsal-fin ray to caudal peduncle. Dorsal surface of body with an indistinct median keel immediately anterior to rayed dorsal fin, smoothly rounded transversely posterior to fin. Ventral profile of body gently curved from tip of lower jaw to caudal peduncle. Prepelvic region transversely rounded anteriorly, indistinctly flattened in region immediately anterior to origin of pelvic fins; no discrete midventral series of scales or enlargement of scales in ventral prepelvic region. Postpelvic region transversely rounded.

Greatest body depth at origin of rayed dorsal fin, depth 0.22–0.28 [0.27]; snout tip to origin of rayed dorsal fin 0.48–0.51 [0.49]; snout tip to origin of anal fin 0.79–0.85 [0.81]; snout tip to origin of pelvic fin 0.52–0.56 [0.52]; snout tip to anus 0.76–0.79 [0.76]; origin of rayed dorsal fin to hypural joint 0.52–0.55 [0.53]. Rayed dorsal fin pointed, anteriormost rays approximately 3 times length of ultimate ray. Pectoral fin pointed; length of pectoral fin 0.15–0.17 [0.16], extends approximately one-half distance to origin of pelvic fin. Pelvic fin pointed, length of pelvic fin 0.16–0.18 [0.16], reaches one-half distance to origin of anal fin. Caudal fin forked. Adipose fin well developed, relatively elongate.

FIGURE 15.—*Curimata ocellata*, USNM 267973, 160.3 mm SL; Brazil, Amazonas, Rio Marauiá.

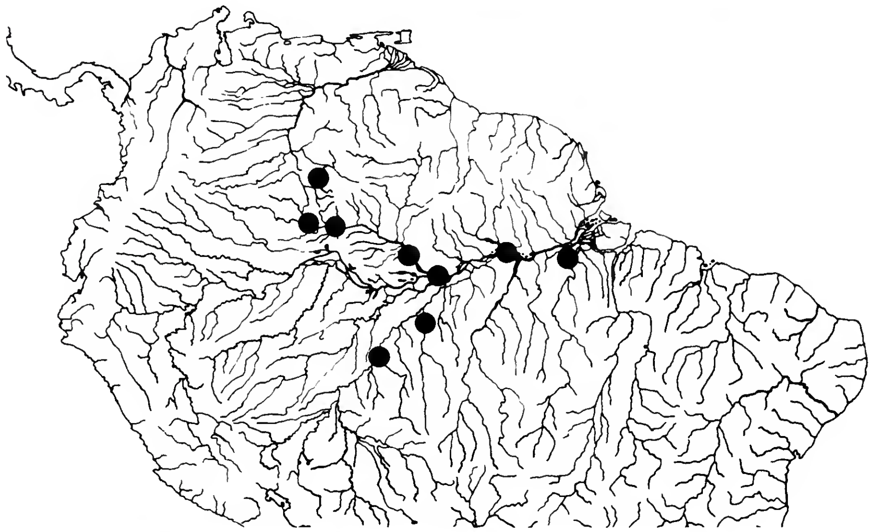

FIGURE 16.—Geographic distribution of *Curimata ocellata* (some symbols represent more than one collecting locality or lot of specimens).

Anal fin emarginate, anteriormost branched rays 2.0–2.5 times length of ultimate ray. Caudal peduncle depth 0.09–0.10 [0.10].

Head distinctly pointed, head length 0.27–0.31 [0.28]; upper jaw slightly longer, mouth slightly subterminal, lower jaw distinctly triangular anteriorly in ventral view; snout length 0.31–0.36 [0.33]; nostrils of each side of head very close, anterior circular, posterior crescent shaped with aperture closed by thin flap of skin that separates nares; orbital diameter 0.23–0.28 [0.24]; adipose eyelid present, more developed in larger specimens, with a vertically ovoid opening over middle of eye; length of postorbital portion of head 0.40–0.44 [0.40]; gape width 0.19–0.25 [0.20]; interorbital region smoothly rounded, width 0.36–0.43 [0.36].

Pored lateral-line scales from supracleithrum to hypural joint 59 to 70 [66]; all scales of lateral-line pored, canals in some scales diverge slightly dorsally and ventrally in larger specimens, otherwise straight; 5 to 8 series of scales extend beyond hypural joint onto caudal-fin base; 11 to 14 [13] scales in transverse series from origin of rayed dorsal fin to lateral line, 8 to 10 [9] scales in transverse series from lateral line to origin of anal fin.

Dorsal-fin rays ii,8–10 or iii,9 (ii,8, ii,10 and iii,9 rare) [ii,9]; anal-fin rays ii,7–8 or iii,7 [ii,7]; pectoral-fin rays 14 to 18 [16]; pelvic-fin rays i,9–10 [i,10].

Total vertebrae 31 (15).

COLOR IN ALCOHOL.—Overall coloration in specimens that retain guanine on scales is silvery-golden; darker on dorsal portions of head and body, with a discrete middorsal band between rear of head and caudal peduncle. Juveniles with a longitudinal midside stripe that starts at about lateral-line scale 36 to 40. Stripe extends posteriorly along lateral line to base of caudal fin, continues across dorsalmost portion of lower lobe of caudal fin. Anteriormost portion of midside stripe most intensely pigmented, forming a distinct spot 3 to 5 scales in longitudinal extent. Darker anterior section of lateral band becomes increasingly less continguous with posterior portion of stripe in larger specimens. Larger specimens retain dark midlateral spot but with midlateral stripe of body less heavily pigmented, and masked in specimens that retain guanine on scales. Caudal fin of juveniles and adults with a distinct dusky band across dorsal rays of ventral lobe of caudal fin and a less heavily pigmented band across middle rays of dorsal lobe of fin. Other fins hyaline.

DISTRIBUTION.—Rio Amazonas and possibly upper Río

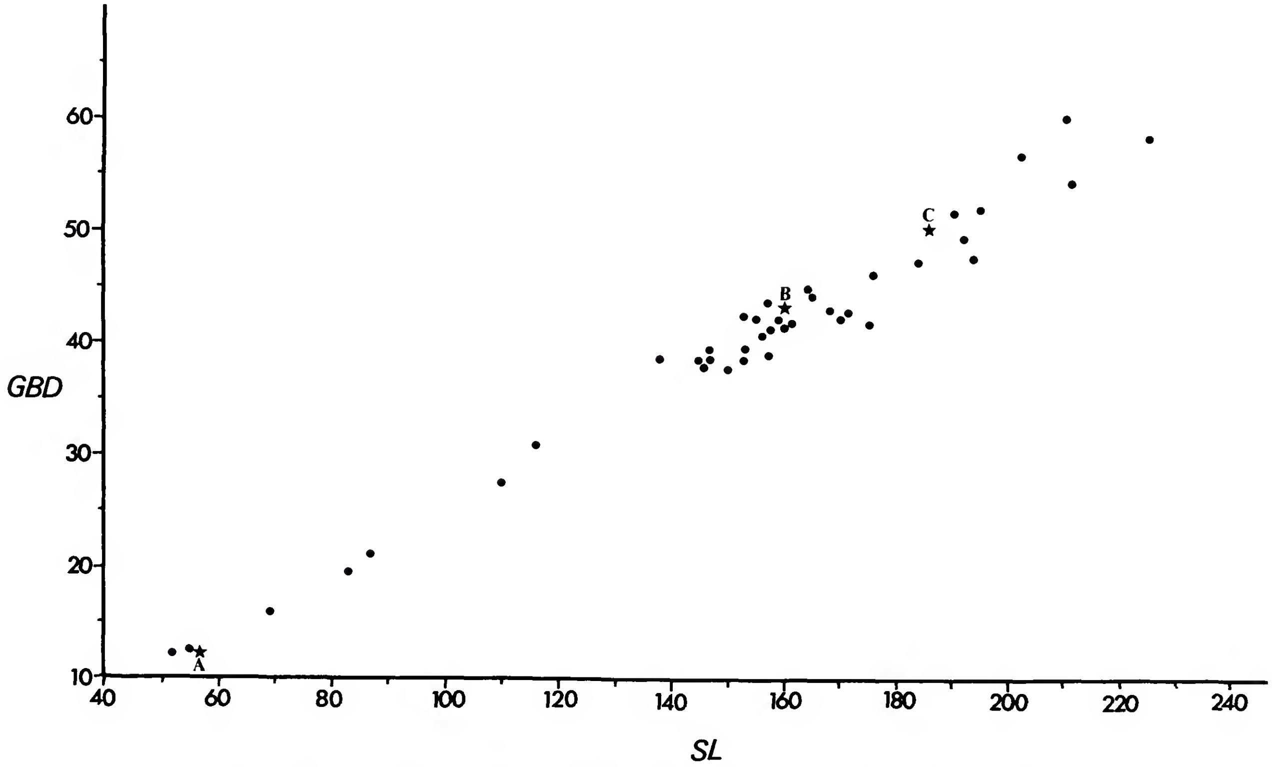

FIGURE 17.—Plot of greatest body depth (GBD) against standard length (SL), both in millimeters, for examined specimens of *Curimata ocellata*: A, holotype of *Curimatus semitaeniatus* Steindachner (based on information in original species description); B, lectotype of *Curimatus ocellatus* Eigenmann and Eigenmann (MCZ 20339); C, paralectotype of *Curimatus ocellatus* (MCZ 60884) (some dots represent more than one data point).

Orinoco drainage systems (see "Remarks") (Figure 16).

LIFE HISTORY.—Goulding et al. (1988:139) report that *Curimata ocellata* is a detritus feeder in the central portions of the Rio Negro.

REMARKS.—Eigenmann and Eigenmann (1889:427) described *Curimatus ocellatus* based on three specimens collected by "Senhor Vinhas" from an unspecified locality on the Rio Xingu. The collector was a resident of Porto do Moz in the lower Xingu (Dick, 1977) and the specimens probably were collected in that portion of the river basin. A 160.0 mm SL syntype (MCZ 20339) is designated as the lectotype. The two remaining syntypes (MCZ 60884), therefore become paralectotypes.

Steindachner's (1917:18) original description of *Curimatus semitaeniatus* was based on a unspecified number of specimens from "Moura, near the junction of the Rio Branco and Rio Negro" [my translation]. No portion of the syntypic series could be located in the holdings of the Naturhistorisches Museum, Wien (Vienna).

Steindachner (1917:18), in his original description of *Curimatus semitaeniatus*, did not mention Eigenmann and Eigenmann's (1889:427) species *C. ocellatus* despite the notable similarities between the two nominal forms. More recently Géry (1977b:103–106) discussed the apparent mimicry of both nominal species with various species of hemiodontids, without explicitly discussing the characters that purportedly distinguished *C. ocellata* from *C. semitaeniata*. Although the body depths differ between the type series of *C. ocellata* (0.27 of SL) and the value reported by Steindachner for *C. semitaeniata* (0.23 of SL), this difference is evidently a consequence of allometric increase in body depth combined with the different sizes of the involved type specimens (160–183 mm SL for *C. ocellatus* vs. 53 mm SL for *C. semitaeniatus*). Examination of a larger series of specimens fails to reveal any discontinuity in relative body depths between the nominal forms over that size range (Table 1, Figure 17). Similarly the differing degrees of continuity between the midlateral spot on the body and the midside stripe on the posterior portion of the body between the two type series also represent evidently ontogenetically variable characters (see "Color in Alcohol," above). Some slight differences occur between the proportions cited by Steindachner for his material of *Curimatus semitaeniatus* and examined specimens of *C. ocellata*. These involve the distance from the origin of the rayed dorsal fin to the hypural joint, pelvic fin length, and interorbital width (Table 1). Steindachner's measurements were less exact

TABLE 1.—Morphometrics and meristics of (A) lectotype of *Curimata ocellata*, MCZ 20339, (B) paralectotype of *C. ocellata*, MCZ 60884, (C) syntypes of *Curimatus semitaeniatus* (data from Steindachner, 1917), and (D) ranges for all specimens of *Curimata ocellata* from which counts and measurements were taken. (Standard length is expressed in mm; measurements 1 to 10 are proportions of standard length; 11 to 14 are proportions of head length; dash indicates missing data.)

Character	A	B	C	D
		MORPHOMETRICS		
Standard Length	160.0	183.0	53.0	55.9–225.3
1. Greatest body depth	0.27	0.27	0.23	0.22–0.28
2. Snout to dorsal-fin origin	0.49	0.51	—	0.48–0.51
3. Snout to anal-fin origin	0.81	0.83	—	0.79–0.85
4. Snout to pelvic-fin origin	0.52	0.53	—	0.52–0.56
5. Snout to anus	0.76	0.79	—	0.76–0.79
6. Origin of rayed dorsal fin to hypural joint	0.53	0.52	0.50	0.52–0.55
7. Pectoral fin length	0.16	0.17	—	0.15–0.17
8. Pelvic fin length	0.16	0.17	0.15	0.16–0.18
9. Caudal peduncle depth	0.10	0.10	0.09	0.09–0.10
10. Head length	0.28	0.28	0.30	0.27–0.31
11. Snout length	0.33	0.33	0.31	0.31–0.36
12. Orbital diameter	0.24	0.23	0.25	0.23–0.28
13. Postorbital length	0.40	0.43	~0.50	0.40–0.44
14. Interorbital width	0.36	0.40	0.32	0.36–0.40
		MERISTICS		
Lateral line scales	66	70	66	59–70
Scale rows between dorsal-fin origin and lateral line	13	12	12	11–14
Scale rows between anal-fin origin and lateral line	9	9	9	8–10
Branched dorsal-fin rays	9	9	9	8–10
Branched anal-fin rays	7	7	7	7–8
Total pectoral-fin rays	16	16	—	14–18
Branched pelvic-fin rays	10	10	—	9–10
Vertebrae	31	31	—	31

than those used in this study, and it possible that the differences between his specimens and those examined in this study are a consequence of that factor. It is also possible that the differences between the samples are the result of differing methods of taking measurements. The latter seems likely since no specimens with values in the cited features comparable to those given by Steindachner for *Curimatus semitaeniatus* have been discovered among the material from the Rio Negro, the type region of that species. In light of this situation and in the absence of any specimens agreeing with the original description of *Curimatus semitaeniatus*, that species is placed as a synonym of *Curimata ocellata*.

All specimens of *Curimata ocellata* examined during this study originated in the Rio Amazonas basin with the exception of three individuals in the holdings of the Museum National d'Histoire Naturelle, Paris. That lot, collected by Chaffanjon, has an imprecise collection locality of "upper Río Orinoco". The specimens presumably originated in the Río Atabapo, a black water stream along the Venezuelan-Colombian border (see Collette, 1966:11). Chaffanjon's collections from that river have been the basis for a number of species decriptions by Pellegrin (1903, 1908, 1909, 1912) and Collette (1966). Although the Río Atabapo is a portion of the Río Orinoco basin, the black acidic waters characteristic of that river are typical of those of the Río Negro in which *C. ocellata* is widespread, rather than the white, sediment laden waters characteristic of the main Río Orinoco. Examination of large series of curimatids from the main portion of the upper Río Orinoco have failed to reveal *C. ocellata* in that portion of the river basin.

MATERIAL EXAMINED.—52 (46, 55.9–225.3).

BRAZIL. *Pará*: Rio Xingu, MCZ 20339, 1 (160.0, lectotype of *Curimatus ocellatus*); MCZ 60884, 2 (1, 183.0, paralectotypes of *Curimatus ocellatus*; one specimen previously cleared and stained; out of MCZ 20339). Óbidos, MCZ 19815, 1 (55.9). Lago Jacupá, Oriximiná, MZUSP 8198, 1 (81.5). Rio Trombetas, Lago de Cruz Alto, INPA TROMB-07, 7 (138.2–202.0). *Amazonas*: Rio Negro?, GC, 2 (63.7–70.3). Rio Negro, Bucuri, CAS 41731, 2 (79.7–87.1). Lago Tupe off Rio Negro, INPA NEG-34, 1 (187.0). Lago das Papunhas, 7 km east of Humaita, GC, 1 (164.2). Rio Negro, Saõ Gabriel de Cachoeira, USNM 267974, 3 (192.0–210.3). Rio Marauiá, near mouth, USNM 267972, 3. Rio Marauiá, Cachoeira do Bicho-acu, USNM 267973, 2 (158.1–159.9); MZUSP 29530, 1. Rio Canumã, 12 (152.4–183.5). Lago Central along Rio Negro between Rio Camaraú and Rio Apeau, MZUSP 21057, 1 (57.6). Rio Uatumá, INPA UAT-278, 2 (170.2–182.1); INPA UAT-178, 3 (178.1–192.0). Rio Uatamá, Poco do Nazare, INPA UAT-258, 3 (179.9–225.3). *Mato Grosso:* no specific locality, MNRJ 5095, 1.

VENEZUELA. *Amazonas*: Río Orinoco (? Río Atabapo. see "Remarks," above), MNHN 87-771, 3 (110.1–143.2).

Curimata vittata Kner

FIGURES 18, 19, 20

Curimatus vittatus Kner, 1859:139, fig. 1 [type locality: Bolivia: Río Guaporé; Brazil: Rio Negro].—Günther, 1864:292 [copied from Kner, 1859].—Eigenmann and Eigenmann, 1889:427 [Lake Hyanuary, Teffe (= Tefé)]; 1891:7 [reference].—Pellegrin, 1909:148 [Brazil: Rio Negro, Tonantins].—Eigenmann, 1910:422 [reference].—Steindachner, 1917:19 [Brazil: mouth of the Rio Negro, Rio Branco at Boa Vista, Rio Tocantins at Cameta].

Curimata murieli Allen, in Eigenmann and Allen, 1942:298, pl. 14: fig. 1 [type locality: Peru: Río Ucayali, Contamana].—Fowler, 1945:118 [copied].—1950:287, fig. 345 [reference].

Allenina murieli.—Fernández-Yépez, 1948:39, fig. 18 [designation as type species of *Allenina*].—Fowler, 1975:365 [reference].

Bitricarinata vittata.—Fernández-Yépez, 1948:65 [assignment to *Bitricarinata*].—Fowler, 1975:366 [references in part; not tentative synonymization of *Curimatus bolivarcensis* (= *bolivarensis*) Steindachner, 1910 with *Curimatus vittatus*].

Curimata vittata.—Fowler, 1950:293, fig. 355 [reference].—Géry, 1977b:230, 232 [in key, figure].—Goulding, 1981:39, 45, 60, 105, fig. 37 [fisheries, common name, migration].—Ortega and Vari, 1986:11 [Peru; common name].—Goulding et al., 1988:132, 134, 135, 140 [Brazil, Rio Negro system, Anavilhanas, Rio Marauiá, Rio Urubaxi, Ilha Tamaquare; habitat preferences and diet].—Vari, 1988:333, fig. 10 [distribution]; 1989, tables 2, 3 [phylogenetic relationships].

DIAGNOSIS.—The distinctive pattern of 8 to 10 vertical or near vertical dark bars on the dorsal portion of the body (Figures 18, 19) is unique to *Curimata vittata* within *Curimata* and the Curimatidae. Among *Curimata* species, the combination of a greatest body depth 0.30–0.39 in SL, and 8 or 9 branched anal-fin rays further distinguish *C. vittata* from all species other than *C. incompta. Curimata incompta* lacks the distinctive pigmentation pattern of *C. vittata*. The two forms are also separable by the 30 or 31 vertebrae of *C. incompta* which contrasts with the 32 vertebrae of *Curimata vittata*.

DESCRIPTION.—Body moderately elongate, relatively robust, more so in specimens over 90 mm SL. Dorsal profile of head nearly straight, somewhat more convex anterior to vertical through anterior margin of eye. Dorsal profile of body smoothly convex from rear of head to origin of dorsal fin; straight or slightly convex, and posteroventrally slanted at base of dorsal fin; straight or gently convex from base of last dorsal-fin ray to caudal peduncle. Dorsal body surface with an indistinct median keel anterior to rayed dorsal fin, smoothly rounded transversely posterior to fin. Ventral body profile gently curved from tip of lower jaw to origin of pelvic fin, somewhat more convex from that point to caudal peduncle, particularly at base of anal fin. Prepelvic region flattened, margined laterally by distinct, nearly right, longitudinal angles that extend from anteroventral margin of pectoral girdle to point of origin of pelvic fins. Flattened prepelvic region with a median series of enlarged scales, flanked on each side by a series of enlarged scales that conform in shape to lateral angle of body wall. A well developed midventral keel posterior to pelvic fin origin. Well developed median keel posterior to pelvic-fin origin with secondary obtuse angle in body wall approximately two scales dorsal of ventral midline on each side of postpelvic region of body.

Greatest body depth at origin of rayed dorsal fin, depth 0.30–0.39 [0.37]; snout tip to origin of rayed dorsal fin 0.47–0.54 [0.49]; snout tip to origin of anal fin 0.78–0.84 [0.83]; snout tip to origin of pelvic fin 0.51–0.57 [0.54]; snout tip to anus 0.72–0.80 [0.76]; origin of rayed dorsal fin to hypural joint 0.52–0.61 [0.58]. Rayed dorsal fin pointed, less so with increasing age; anteriormost branched rays somewhat filiform, 4.0–6.7 times length of ultimate ray. Pectoral fin pointed; length of pectoral fin 0.18–0.24 [0.18], extends distinctly beyond vertical through origin of pelvic fin in smaller adults, barely to or short of that line in largest specimens examined, particularly in individuals from Río Guaporé basin. Pelvic fin pointed, length of pelvic fin 0.18–0.26 [0.22], reaches anus in young adults, falls somewhat short of that point in larger specimens. Caudal fin forked; more so in juveniles.

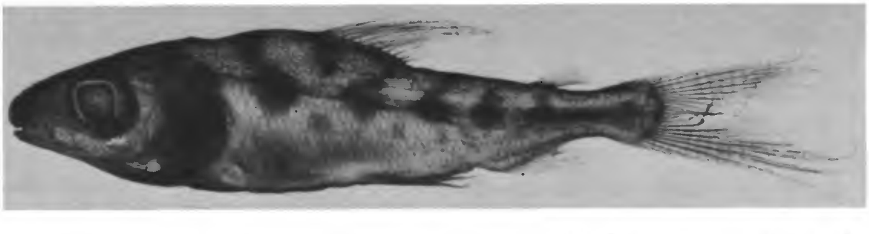

FIGURE 18.—*Curimata vittata*, USNM 269914, juvenile, 37.1 mm SL; Venezuela, Territorio Federal Amazonas, Río Negro.

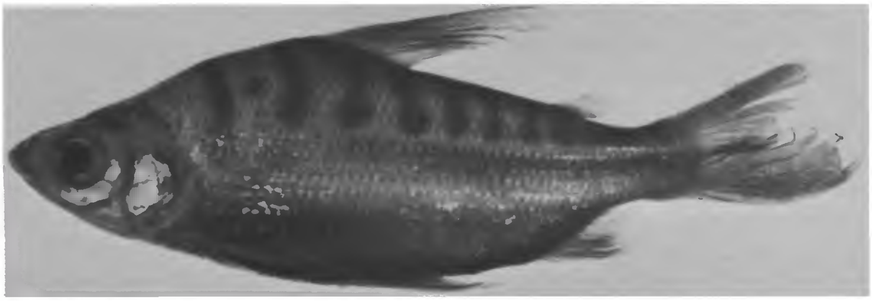

FIGURE 19.—*Curimata vittata*, USNM 242131, adult, 165.5 mm SL; Brazil, Amazonas, Rio Tefé, Jurupari.

Adipose fin well developed. Anal fin emarginate, anteriormost branched rays 2.3–3.2 times length of ultimate ray. Caudal peduncle depth 0.11–0.13 [0.11].

Head distinctly pointed, head length 0.26–0.36 [0.32]; jaws equal, mouth inferior, upper jaw distinctly longer; snout length 0.27–0.33 [0.30]; nostrils of each side of head very close, anterior circular, posterior crescent shaped, only partially closed by thin flap of skin that separates nares; orbital diameter 0.28–0.35 [0.30]; adipose eyelid present, more developed in adults, with a vertically ovoid opening over middle of eye; length of postorbital portion of head 0.39–0.46 [0.41]; gape wide, width 0.26–0.35 [0.31], lower jaw distinctly triangular anteriorly; interorbital region flat, width 0.42–0.49 [0.44].

Pored lateral-line scales from supracleithrum to hypural joint 48 to 61 [52]; all scales of lateral-line pored, canals in scales irregularly diverge dorsally and ventrally; 4 to 7 series of scales extend beyond hypural joint onto caudal fin base; 12 to 16 [13] scales in transverse series from origin of rayed dorsal fin to lateral line, 8 to 10 [8] scales in transverse series from lateral line to origin of anal fin. Scale margins very weakly ctenoid.

Dorsal-fin rays ii,9 [ii,9]; anal-fin rays ii,7–9 or iii,8 [ii,8]; pectoral-fin rays 14 to 16 [15]; pelvic-fin rays i,9–10 [i,9].

Total vertebrae 32 (20).

COLOR IN LIFE.—Overall coloration bright silvery, darker dorsally. Vertical bars on body apparent in juveniles, somewhat to distinctly masked by guanine on scales in adults.

COLOR IN ALCOHOL.—Specimens that retain guanine on scales silvery, overall coloration darker on dorsal portions of head and body. Specimens that lack guanine on scales yellowish-tan to brown. Adults with ten vertical bars along dorsal half of body, bars of each side in contact along dorsal midline. First bar runs obliquely posteroventrally from posterodorsal margin of head to posterdorsal margin of opercle. Second bar extends posteroventrally from midway along nape to reach or fall slightly short of lateral line. Remaining bars vertical or nearly so. Third bar commences at insertion of rayed

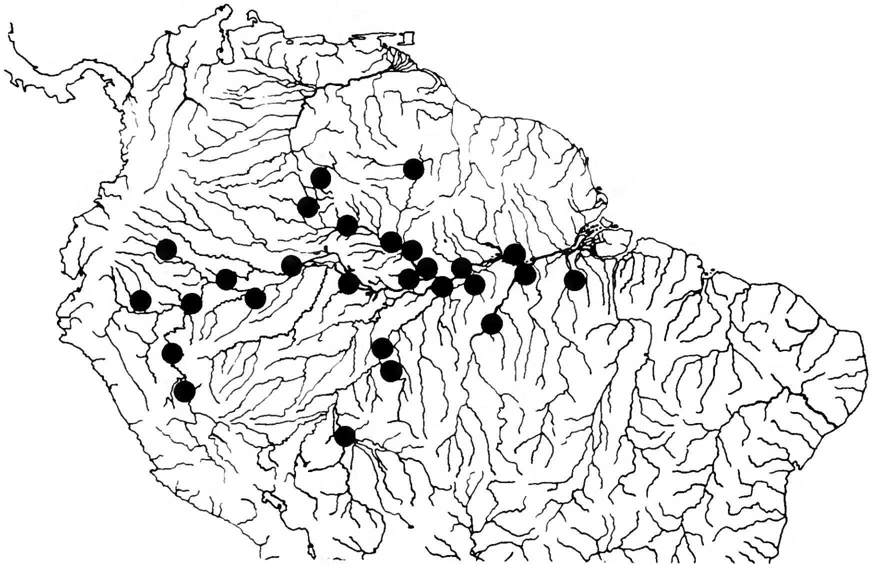

FIGURE 20.—Geographic distribution of *Curimata vittata* (some symbols represent more than one collecting locality or lot of specimens).

dorsal fin and extends to about four scales above lateral line. Fourth bar begins midway along base of rayed dorsal fin, fifth at posterior of base of that fin. Sixth through eighth bars located between rayed and adipose dorsal fins. Ninth bar at posterior of base of adipose fin. Tenth bar on caudal peduncle, sometimes followed posteriorly by another bar on caudal peduncle at base of fin rays of upper lobe of caudal fin. Form of bars somewhat variable. Some populations with bars variably broken into two large spots, or three or four smaller spots arranged in vertical or near vertical patterns. An irregular longitudinal stripe along lateral line; pigmentation of stripe less pronounced than that of bars. Anterior portion of stripe somewhat irregular, anteriormost section sometimes confluent with second vertical bar. Both bars and stripe less apparent in specimens retaining guanine on scales, particularly larger specimens in which bars are nearly totally masked by guanine.

Number of bars in juveniles eight to ten, with ontogenetic subdivision of some bars resulting in ten bars in adults. Each bar in smaller juveniles extends from dorsal midline to somewhat ventral of lateral line. Ventralmost portions of bars become detached from dorsal sections ontogenetically and subsequently expand horizontally to coalesce into dark midside stripe found in adults.

No prominent pigmentation pattern on fins; rays of all fins, particularly caudal and rayed dorsal outlined by series of small chromatophores. Similar pigmentation present, but less pronounced on other fins.

DISTRIBUTION.—Rio Amazonas and possibly upper Río Orinoco drainage basins (see "Remarks") (Figure 20).

COMMON NAME.—Brazil: Roncador (Kner, 1859; Goulding, 1981); Peru: Yahuarachi (Ortega and Vari, 1986:11).

LIFE HISTORY.—Goulding et al. (1988:132, 134, 135, 140) report that *Curimatus vitatta* feeds mainly on detritus. The species occurs in a variety of habitats within the Rio Negro basin, most notably beaches, swamps, and lakes on the center of islands in the main river channel.

REMARKS.—In his original species description, Kner (1859:139) listed type specimens of *Curimatus vittatus* from the Río Guaporé and Rio Negro collected by Natterer. No Natterer specimens from the latter region could be located in the collections of the Naturhistorisches Museum, Vienna; however, three specimens collected by that collector in the Río Guaporé (NMW 16363, 68805) were found in the holdings of that institution. A 164.5 mm SL syntype of *Curimatus vittatus* (NMW 68805.1) is evidently the individual illustrated by Kner and is designated as the lectotype. The remaining syntypes of the species (NMW 16363, 68805.2) therefore become paralectotypes.

Allen, in Eigenmann and Allen, 1942:298) in his original description of *Curimata murieli* compared his species to *C. simulata* and C. *asper*, other nominal members of the same species complex. The holotype of *C. murieli* (CAS 57148, formerly IU 17853), however, has proved to be a juvenile of *Curimata vitatta* (Table 2). Allen was evidently misled in his comparative studies by his failure to note the presence of *C. vittata* in western Amazonian South America although Kner (1859:139) originally cited the species from the Rio Guaporé of the Rio Madeira system.

Fowler (1975:366) questionably listed *Curimatus bolivarcensis* (= *bolivarensis*) of Steindachner (1910:265) as a synonym of *Bitricarinata* (= *Curimata*) *vittata*. Examination of the type series of *Curimatus bolivarensis* has shown that the nominal species is distinct from *Curimata vittata*, and is more closely related to species of the lineage recognized by Vari as *Curimatella* (see Vari, 1989, tables 2 and 3).

The examined material of *Curimata vittata* demonstrates a considerable variation in body depth and relative fin lengths across its range. Examined individuals from the Río Guaporé have relatively shallower bodies and shorter paired fins than those from the central portions of the Amazon basin. These differences are not, however, discrete between populations, but rather appear to vary across the species range. The available material is not sufficient to determine whether the geographic variation demonstrates any definite pattern.

A single specimen of *Curimata vittata* in the Museum National d'Histoire Naturelle, Paris has an indefinite locality of Río Orinoco and was evidently collected by Chaffanjon. The specimen presumably originated in the Río Atabapo, a black water stream along the Venezulan-Colombian border (see Collette, 1966:11; and "Remarks" under *C. ocellata*). Although the Río Atabapo is a portion of the Río Orinoco basin, the black acidic waters characteristic of that river are similar to those of the Río Negro, contrary to the white, sediment laden waters of the main Río Orinoco. No other specimen of *Curimata vittata* from the main white water portion of the Río Orinoco basin has been found in the extensive series of curimatids studied from that system.

MATERIAL EXAMINED.—194 specimens (61, 33.9–187.0 mm SL).

BRAZIL. *Pará*: Santarem market, CAS uncat., 1 (130.0); CAS uncat., 2 (134.5–149.4); CAS uncat., 1 (127.0); CAS uncat., 1 (164.4). Rio Tapajós, Itaituba, USNM 268019, 8. Tocantins, NMW 68803, 1. Rio Trombetas, Oriximiná, MZUSP 5416, 3. Rio Trombetas, Cumina, USNM 268017, 2. Rio Xingu, Belo Monte, USNM 268016, 1. *Amazonas*: Lago Hyanuary (= Januari), MCZ 27409, 1 (110.0); MZUSP 6859, 2 (108.5–109.1). Rio Solimões, GC, 5 (3, 71.0–89.7). Rio Negro near Manaus, GC, 1 (84.3); MZUSP 6683, 17 (5, 78.5–90.1); MZUSP 6113, 1. Manaus, MNHN 09-87-88, 2; MNHN 09-103, 1; MZUSP 9575, 1. Rio Negro, Cucui at border with Colombia, USNM 267316, 1 (83.3); CAS-SU 64164, 2 (48.7–50.2). Rio Negro, Darara, USNM 267330, 1 (62.0). Rio Negro, Marauia, USNM 267319, 4. Rio Negro, Ilha de Tamaraquar (Tapuruquara), USNM 267340, 10. Mouth of the Rio Marauia, MZUSP uncat, 2. Rio Negro, Arirara, MZUSP uncat, 1. Rio Negro, Paraná de Jacare, USNM 267332, 3; MZUSP uncat, 1. Rio Negro, Anavilhanas, Lago do Prato, USNM 268018, 1. Rio Canumã, MZUSP 7042, 5 (93.5–141.0). Rio Jauaperi, MZUSP 21051, 1; MZUSP 21153, 2; MZUSP 21148, 1. Igarapé do Rio Marau, municipio de Maués, MZUSP

TABLE 2.—Morphometrics and meristics of (A) lectotype of *Curimata vittata*, NMW 68805.1, (B) paralectotypes of *C. vittata* (NMW 16363, 68805.2), (C) holotype of *C. murieli* (CAS 57148), and (D) range of all specimens of *C. vittata* from which counts and measurements were taken. (Standard length is expressed in mm; measurements 1 to 10 are proportions of standard length; 11 to 14 are proportions of head length; dash indicates missing data.)

Character	A	B	C	D
	MORPHOMETRICS			
Standard Length	164.5	180.0–187.0	67.7	33.9–187.8
1. Greatest body depth	0.37	0.34–0.36	0.33	0.30–0.39
2. Snout to dorsal-fin origin	0.49	0.49–0.49	0.51	0.47–0.54
3. Snout to anal-fin origin	0.83	0.81–0.84	0.79	0.78–0.84
4. Snout to pelvic-fin origin	0.54	0.53–0.57	0.54	0.51–0.57
5. Snout to anus	0.76	0.77–0.79	0.72	0.72–0.80
6. Origin of rayed dorsal fin to hypural joint	0.58	0.61	0.56	0.52–0.61
7. Pectoral fin length	0.18	0.18	0.21	0.18–0.24
8. Pelvic fin length	0.22	0.18–0.24	—	0.18–0.26
9. Caudal peduncle depth	0.11	0.11	0.11	0.11–0.13
10. Head length	0.32	0.30	0.35	0.26–0.36
11. Snout length	0.30	0.30–0.33	0.29	0.27–0.33
12. Orbital diameter	0.30	0.28–0.31	0.32	0.28–0.35
13. Postorbital length	0.41	0.40–0.41	0.44	0.39–0.45
14. Interorbital width	0.44	0.48	0.43	0.43–0.49
	MERISTICS			
Lateral line scales	52	58–60	50	48–61
Scale rows between dorsal-fin origin and lateral line	13	14–16	13	12–16
Scale rows between anal-fin origin and lateral line	8	9–10	8	8–10
Branched dorsal-fin rays	9	9	9	9
Branched anal-fin rays	8	8	9	7–9
Total pectoral-fin rays	15	15	15	14–16
Branched pelvic-fin rays	9	9	9	9–10
Vertebrae	32	32	32	32

7320, 3. Lago Manacapuru, MZUSP 5875, 1. Igarapé Tarumãzinha, MZUSP 6785, 7 (128.0–142.1). Paraná de Janauacá, USNM 229200, 5 (2, 74.9–95.2). Lago Janauacá, MZUSP 2158, 1. Rio Uatumá, INPA UAT-072, 1; INPA UAT-73, 1; INPA UAT-201, 1. Rio Solimões between Manaus and Tefé, GC, 6 (3, 145.1–150.6). Teffe (= Tefé), MCZ 20251, 2 (1, 183.0). Rio Tefé, Jurupari, USNM 242131, 2. Rio Tefé, USNM 242132, 9. Rio Tonantins, MNHN 09-235-237, 3. Rio Maderia, 7 km from Humaitá, GC, 1 (159.2). Rio Machado, Santo Antonio, Lago do Mucuium, MZUSP 29566, 15. *Roramia*: Rio Branco, Boa Vista, NMW 68804, 1. *Rondonia*: Rio Guaporé, Lagoa Santa 15 km above Costa Marques, INPA POLO-070, 3.

ECUADOR. *Napo Pastaza*: Lago Jatuncocha, BMNH 1970.4.3.82, 1 (173.5).

COLOMBIA. *Amazonas*: Leticia, GC, 1. Río Amazonas 30 km upstream from Leticia, MCZ uncat., 1 (33.9).

VENEZUELA. *Territorio Federal Amazonas*: Río Orinoco (? Río Atabapo, see "Remarks," above), MNHN 87-677, 1. Río Negro near Santa Lucia, USNM 269914, 5.

PERU. *Loreto*: Pevas, MNRJ 4103, 9. Río Ampiyacu, CAS-SU 64236, 2 (30.8–35.2). Yaguasyacu near Pebas, CAS-SU 17247, 11 (63.5–110.2). Contamana, CAS 57148, 1 (67.7, holotype of *Curimata murieli*, formerly IU 17853). Tipischa Santa Elena (Río Tigre), MZUSP 15236, 1. Río Mazán upstream of Puerto Alegre, NRM SOK/1984332.4051, 2. Río Pastaza basin, Lago Rimachi, MZUSP 15235, 1. *Ucayali*: Cashibococha, Pucallpa, MZUSP 26307, 3; MZUSP 26308, 2.

BOLIVIA. *Beni*: Río Guaporé, NMW 16363, 1 (180.0, paralectotype of *Curimatus vittatus*); NMW 68805.1, 1 (164.5, lectotype of *Curimatus vittatus*); NMW 68805.2, 1 (187.0, paralectotype of *Curimatus vittatus*). Río Beni, Laguna Pintado, 5 km S Río Itenez, 4 km SW Costa Marques, Brazil, AMNH 37705, 2 (128.3–132.0).

Curimata inornata, new species

FIGURES 21, 22, 23

Curimata A.—Vari, 1984b:34–35 (Amazon River basin); 1988, fig 10 [phylogenetic biogeography]; 1989, tables 2, 3 [phylogenetic relationships].

DIAGNOSIS.—The possession of 31 vertebrae, a body depth 0.34–0.38 of SL, 7 to 9 branched anal rays, and the absence of any marked body pigmentation patterns distinguish *Curimata inornata* from all other members of the genus with the exception of *C. incompta*. The interorbital distance in *C. inornata* is less than the distance from the tip of the snout to the anterior margin of the opening in the adipose eyelid. In *C. incompata* the interorbital distance is greater than that from the snout to the eyelid margin. The species also differ in the relative length of the postorbital portion of the head (0.32–0.37 of HL in *C. inornata* vs. 0.39–0.46 in *C. incompta*, Figure 22) orbital diameter (0.32–0.39 of HL vs. 0.29–0.33), and snout length (0.31–0.36 of HL vs. 0.28–0.32). A large series of internal characters also distinguish the species (see "Synapomorphy List and Phylogenetic Reconstruction").

DESCRIPTION.—Body moderately elongate, somewhat compressed. Dorsal profile of head straight or very slightly convex. Dorsal profile of body slightly convex from rear of head to origin of rayed dorsal fin; straight and posteroventrally slanted at base of dorsal fin, gently convex from base of last dorsal-fin ray to caudal peduncle. Dorsal surface of body with an indistinct median keel anterior to rayed dorsal fin, smoothly rounded transversely posterior to fin. Ventral profile of body gently curved from tip of lower jaw to caudal peduncle, convexity more pronounced posterior to pelvic fin origin. Prepelvic region flattened, margined laterally by distinct, nearly right, angles in body wall. Prepelvic region with a median series of enlarged scales flanked on each side by a series of enlarged scales that conform in shape to lateral angle of body. Well developed median keel posterior to pelvic fin origin, with secondary obtuse angle in body wall about two scales dorsal of ventral midline on each side of postpelvic portion of body.

Greatest body depth at origin of rayed dorsal fin, depth 0.34–0.40 [0.38]; snout tip to origin of rayed dorsal fin 0.49–0.54 [0.50]; snout tip to origin of anal fin 0.80–0.87 [0.80]; snout tip to origin of pelvic fin 0.52–0.59 [0.53]; snout tip to anus 0.76–0.84 [0.77]; origin of rayed dorsal fin to hypural joint 0.53–0.59 [0.58]. Rayed dorsal fin pointed, anteriormost rays somewhat lengthened in some individuals, 3.0–4.5 times length of ultimate ray. Pectoral fin pointed; length of pectoral fin 0.18–0.24 [0.20], extends three-quarters distance to vertical through origin of pelvic fin. Pelvic fin pointed, length of pelvic fin 0.18–0.24 [0.20], reaches one-half to three-quarters distance to origin of anal fin. Caudal fin forked. Adipose fin well developed. Anal fin emarginate, anteriormost branched rays approximately three times length of ultimate ray. Caudal peduncle depth 0.10–0.12 [0.11].

Head distinctly pointed, head length 0.30–0.33 [0.31]; upper jaw very much longer, mouth distinctly inferior, snout length 0.31–0.37 [0.35]; nostrils of each side of head very close, anterior circular, posterior crescent shaped with aperture closed by thin flap of skin separating nares; eye large, orbital diameter 0.32–0.39 [0.33]; adipose eyelid well-developed, particularly anteriorly, with vertically ovoid opening over center of eye; length of postorbital portion of head 0.32–0.37 [0.35]; gape width 0.24–0.30 [0.27]; interorbital width 0.39–0.44 [0.42].

Pored lateral-line scales from supracleithrum to hypural joint 47 to 56 [55]; all scales of lateral-line pored, canals in scales straight or slightly divergent; 4 to 7 series of scales extend beyond hypural joint onto caudal fin base; 12 to 15 [13] scales in a transverse series from origin of rayed dorsal fin to lateral line; 7 to 9 [8] scales in a transverse series from the lateral line to origin of anal fin. Median series of enlarged prepelvic scales 14 to 16.

Dorsal-fin rays ii,8–9 or iii,8–9 [ii,9]; anal-fin rays ii,7–9 or iii,7–8 [ii,8]; pectoral-fin rays 13 to 16 [15]; pelvic-fin rays i,8–9 [i,9].

Total vertebrae 31 (56), 32(3).

COLOR IN ALCOHOL.—Specimens that retain guanine on scales silvery, darker on dorsal portions of head and body. Specimens that lack guanine on scales tannish-brown to brown,

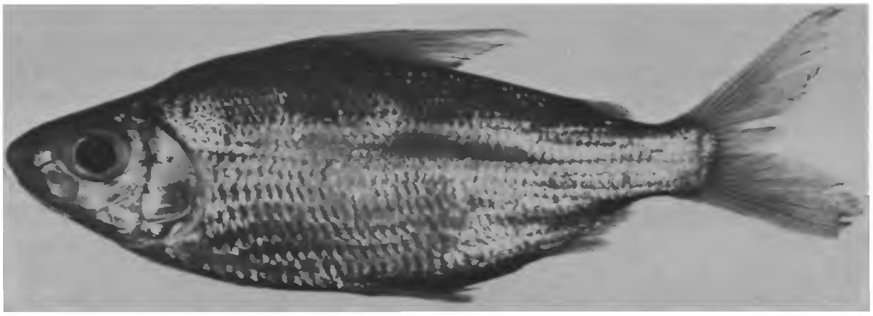

FIGURE 21.—*Curimata inornata*, new species, holotype, MZUSP 28648, 127.0 mm SL; Brazil, Pará, Rio Tapajós, Itaituba, edge of river channel.

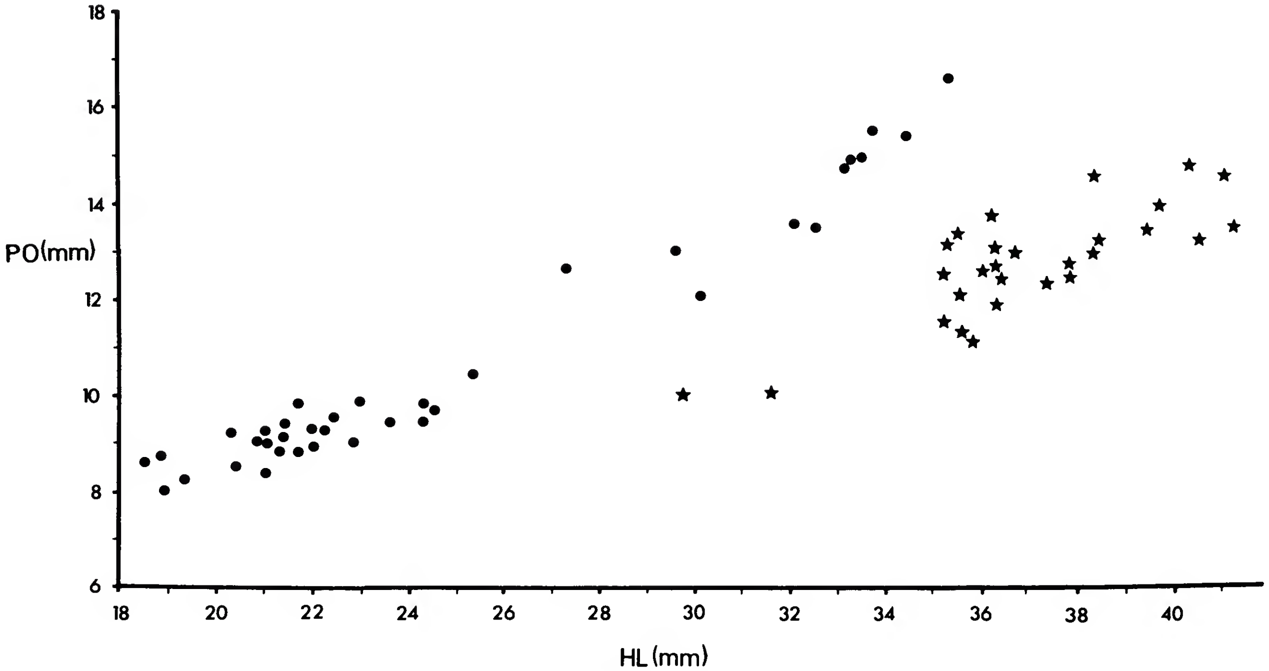

FIGURE 22.—Plot of postorbital bony length of head (PO) against head length (HL), both in millimeters, for *Curimata inornata* (stars) and *Curimata incompta* (dots) (some symbols represent more than one data point).

darker dorsally. Distinct dark middorsal band extends from posterior of insertion of last dorsal-fin ray to insertion of dorsalmost caudal-fin ray. Rayed and adipose dorsal fins and caudal fins dusky. Rays of those fins outlined by a series of small chromatophores. Other fins hyaline or only slightly dusky.

DISTRIBUTION.—Middle and lower portions of the Rio Amazonas basin (Figure 23).

ETYMOLOGY.—The specific epithet is *inornata* from the Latin for unadorned, in reference to the plain body, head, and fin pigmentation of the species.

MATERIAL EXAMINED.—341 specimens (73, 92.1–132.3).

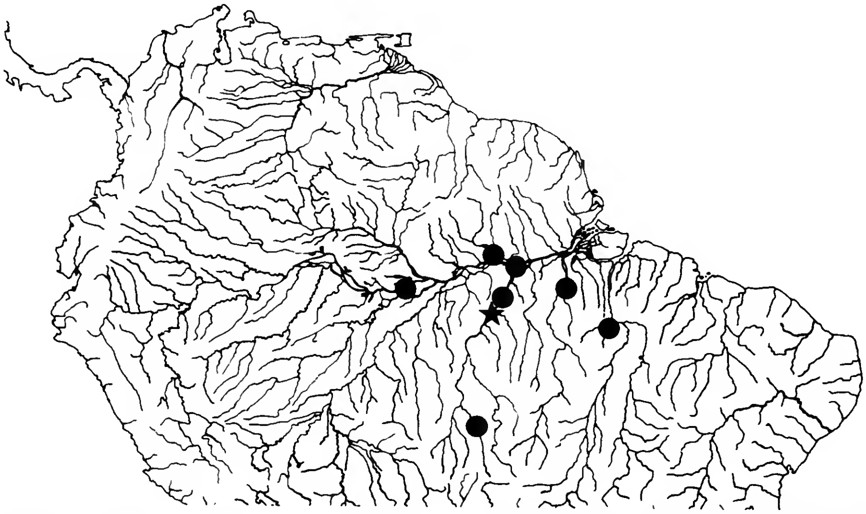

FIGURE 23.—Geographic distribution of *Curimata inornata* (star = holotype locality; some symbols represent more than one collecting locality or lot of specimens).

HOLOTYPE.—BRAZIL. *Pará*: Rio Tapajós, Itaituba, edge of river channel (approx. 4°17'S, 55°59'W), MZUSP 28648, 127.0 mm SL, collected by M. Goulding, Sep–Oct 1983.

PARATYPES.—BRAZIL. *Pará*: Same locality as holotype: 23 specimens: MZUSP 28649, 5 (117.3–136.5); AMNH 55629, 2 (126.3–129.3); BMNH 1984.11.8:7–8, 2 (122.8–129.0); ANSP 153667, 2 (124.5–128.1); MCZ 61406, 2 (124.0–127.7); CAS 55892, 2 (121.7–127.5); USNM 267994, 8 (118.3–135.3). Rio Xingu, Belo Monte, edge of river channel (approx. 3°05'S, 51°46'W), MZUSP 28650, 5 (126.1–135.6); USNM 267993, 10 (104.6–138.2), collected by M. Goulding, Jul–Aug 1983. São Luís, Rio Tapajos (approx. 4°25'S, 50°15'W), collected by the Expediçao Permanente da Amazonas under the direction of P. Vanzolini, 4–8 Sep 1970; 19 specimens: MZUSP 21392, 9 (113.0–138.1), USNM 268597, 5 (115.7–131.7); AMNH 55630, 1 (111.8); BMNH 1984.11.8:6, 1 (119.8); CAS 55893, 1 (114.0); ANSP 153668, 1 (116.2). Oriximiná, Lago Paru (approx. 1°45'S, 55°52'W), MZUSP 5592, 1 (117.9) collected by Expediçao Permanente de Amazonas, 1967. *Mato Grosso*. Rio Arinos, Pôrto dos Gauchos (approx. 11°29'S, 57°22'W), USNM 267966, 1 (133.8), collected by M. Goulding, 19 Aug 1984.

The following specimens were examined, but are not part of the type series. BRAZIL. *Pará:* Rio Tapajos, Alter de Chão, MZUSP 9528, 1 (119.1). Rio Tapajós, Maloquina near Itaituba, MZUSP 21410, 3 (117.7–124.0); MZUSP 21900, 1 (131.8). Rio Tapajós near Porto Flexal, MZUSP 24478, 1 (132.3). Rio Tapajós, Itaituba, MZUSP 29534, 220 (taken with holotype). Rio Trombetas, Reserva Biológica de Trombetas, MZUSP 15857, 5 (92.1–118.5). Rio Trombetas, Oriximiná, MZUSP 5419, 1 (102.6); MZUSP 5420, 1 (110.9). Rio Xingu, Belo Monte, MZUSP 32263, 43. Rio Itacaiunas, Caldeirao, MZUSP 29535, 4. *Amazonas*: Rio Solimões, Coari, MZUSP 20920, 1 (121.8).

Curimata incompta Vari

FIGURES 22, 24, 25

Curimata incompta Vari, 1984b:34, fig. 4 [type locality: Venezuela, Río Meta near Puerto Paez]; 1989, tables 2, 3 [phylogenetic relationships]

DIAGNOSIS.—The combination of 8 or 9 branched anal-fin rays and a greatest body depth 0.34–0.39 of SL distinguish *Curimata incompta* from all *Curimata* species other than *C. vittata* and *C. inornata*. The lack of any pronounced vertical pigmentation pattern on the dorsal surface of the body and the possession of 30 or 31 vertebrae readily separates *C. incompta* from *C. vittata* which has a characteristic pattern of vertical bars on the dorsal surface of the body and 32 vertebrae. *Curimata incompta* has an interorbital width that is greater than the distance from the tip of the snout to the anterior margin of the opening in the adipose eyelid. In *C. inornata* the interorbital width is less than the distance from the snout to the eyelid margin. The species also differ in the length of the postorbital portion of the head (0.39–0.46 of HL in *C. incompta* vs. 0.32–0.37 in *Curimata inornata*, Figure 22), horizontal width of the orbit (0.29–0.33 of HL vs. 0.32–0.39), and snout length (0-28-0.32 of HL vs. 0.31–0.36).

DESCRIPTION.—Body moderately elongate, robust, more so in larger specimens. Dorsal profile of head straight or very slightly concave. Dorsal profile of body slightly convex from rear of head to origin of rayed dorsal fin; straight and posteroventrally slanted at base of dorsal fin, gently convex from base of last dorsal-fin ray to caudal peduncle, particularly in larger specimens. Dorsal surface of body with an indistinct median keel anterior to rayed dorsal fin, smoothly rounded transversely posterior to fin. Ventral body profile gently curved from tip of lower jaw to caudal peduncle. Prepelvic region flattened, margined laterally by distinct, nearly right, angles in body wall that extend from level of vertical through origin of pectoral fin to origin of pelvic fins. A median series of enlarged scales in prepelvic region flanked on each side by a series of enlarged scales that conform in shape to lateral angle of prepelvic region of body. Well developed median keel posterior to pelvic fin origin with secondary obtuse angle in body wall two scales dorsal of ventral midline on each side of postpelvic portion of body.

Greatest body depth at origin of rayed dorsal fin, depth 0.34–0.39 [0.36]; snout tip to origin of rayed dorsal fin 0.50–0.53 [0.50]; snout tip to origin of anal fin 0.78–0.83 [0.81]; snout tip to origin of pelvic fin 0.52–0.57 [0.54]; snout tip to anus 0.75–0.80 [0.77]; origin of rayed dorsal fin to hypural joint 0.54–0.58 [0.57]. Rayed dorsal fin pointed, anteriormost rays 4.7–5.8 times length of ultimate ray. Pectoral fin pointed; length of pectoral fin 0.18–0.22 [0.21], extends to vertical through origin of pelvic fin in smaller specimens, falls short of that line in largest specimens examined. Pelvic fin pointed, length of pelvic fin 0.20–0.25 [0.22], reaches three-quarters of distance to origin of anal fin in smaller specimens, somewhat less in larger individuals. Caudal fin forked. Adipose fin well developed. Anal fin emarginate, anteriormost branched rays approximately twice length of ultimate ray. Caudal peduncle depth 0.10–0.12 [0.11].

Head distinctly pointed in profile, head length 0.31–0.36 [0.31]; upper jaw longer, mouth inferior; snout length 0.28–0.32 [0.31]; nostrils very close, anterior circular, posterior crescent shaped with aperture closed by thin flap of skin that separates nares; orbital diameter 0.29–0.33 [0.32]; adipose eyelid present, with a vertically ovoid opening over center of eye; length of postorbital portion of head 0.39–0.46 [0.46]; gape width 0.28–0.34 [0.28]; interorbital width 0.40–0.45 [0.45].

Pored lateral-line scales from supracleithrum to hypural joint 52 to 58 [55]; all scales of lateral-line pored, canals in scales straight in smaller specimens, diverging somewhat dorsally or ventrally in adults; 5 to 8 series of scales extend beyond hypural joint onto caudal fin base; 13 to 15 [13] scales in transverse series from origin of rayed dorsal fin to lateral line; 8 to 10 [9] scales in transverse series from the lateral line to origin of anal fin; 13 to 16 [14] enlarged scales in a midventral series anterior to origin of pelvic fins; scale margins weakly

FIGURE 24.—*Curimata incompta*, USNM 273308, 81.2 mm SL; Venezuela, Estado Bolivar, cãno off Río Orinoco at El Burro.

ctenoid, ctenii more developed in larger individuals, particularly on ventral portion of body.

Rayed dorsal-fin rays ii,9 or iii,8 (iii,8 rare) [ii,9]; anal-fin rays ii,8–9 or iii,8–9 (when three unbranched rays present, first very short) [iii,8]; pectoral-fin rays 13 to 15 [14]; pelvic-fin rays i,8–9 [i,9].

Total vertebrae 30 (2), 31 (56).

COLOR IN LIFE.—Overall coloration bright silvery, slightly darker dorsally; median and paired fins without any pronounced pigmentation.

COLOR IN ALCOHOL.—Overall coloration in formalin preserved specimens lacking guanine on scales yellowish to tannish-brown, darker on dorsal portions of head and body. Myomere margins along lateral midline outlined by series of small chromatophores. Distal margin of caudal and rayed dorsal fins dusky.

DISTRIBUTION.—Río Orinoco drainage basin (Figure 25).

MATERIAL EXAMINED.—59 specimens (57, 43.7–112.0 mm SL).

VENEZUELA. *Apure*: Río Meta near Puerto Paez, MBUCV V-5991, 1 (112.8, holotype of *Curimata incompta*); MBUCV V-14026, 3 (103.7–107.9, paratypes of *C. incompta*); USNM 257083, 1 (104.8, paratype of *C. incompta*). *Territorio Federal Amazonas*. Río Orinoco, Raudales de Ature upstream of Puerto Ayacucho, USNM 269991, 1. *Bolivar*: Canõ draining into Río Orinoco slightly north of El Burro, USNM 273308, 2. Laguna between Palua and Ciudad Bolivar, MBUCV V-13213, 1 (56.3,, paratype of *C. incompta*). Laguna La Ceiba and discharge channel into Río Orinoco, Los Castillos de Guyana, MBUCV V-6700, 5 (86.8–103.0). Río Orinoco just down-

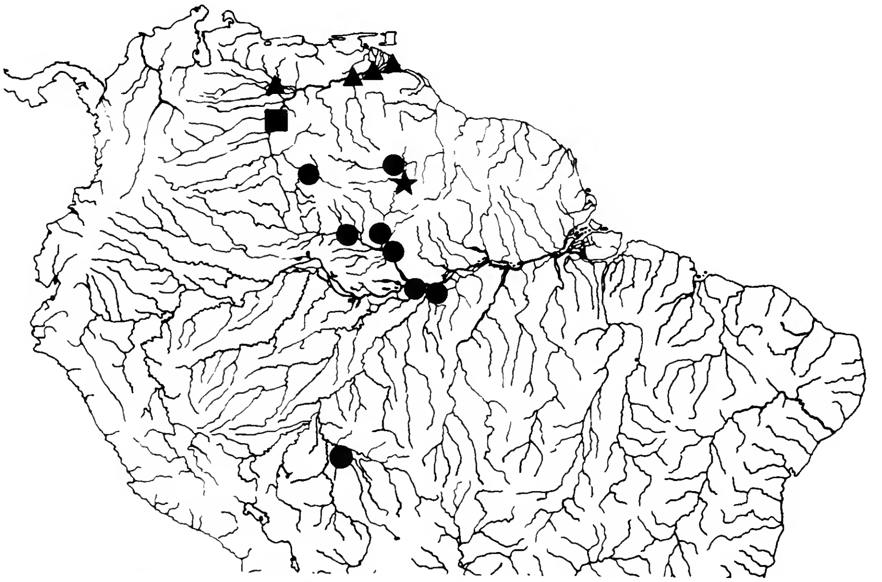

FIGURE 25.—Geographic distribution of *Curimata incompta* (square = holotype locality, triangles = sites of other collections) and *Curimata roseni* (star = holotype locality, filled circles = sites of other collections) (some symbols represent more than one collecting locality or lot of specimens).

stream of San Felix, USNM 236557, 1 (94.6, paratype of *C. incompta*). *Monagas*: Canõ Guarguapo system, USNM 236559, 5 (51.5–74.7, paratypes of *C. incompta*); MBUCV V-13093, 2 (49.8–57.7, paratypes of *C. incompta*). Río Orinoco, inlet below Barrancas, 1 (64.8, paratype of *C. incompta*). Cocos Island, Río Orinoco opposite Los Castillos de Guyana, USNM 236551, 1 (43.7, paratype of *C. incompta*). Isla Tapatapa at Los Castillos, USNM 236558, 1 (51.5, paratype of *C. incompta*). Canõ between Río Orinoco and Laguna Guatero, near Barrancas, USNM 236553, 7 (58.7–72.0, paratypes of *C. incompta*, 2 specimens cleared and counterstained for bone and cartilage); FMNH 94590, 1 (61.7, paratype of *C. incompta*); LACM 43350-1, 1 (68.7, paratype of *C. incompta*). *Territorio Federal Delta Amacuro*: Mouth of canõ on Isla Tortola, USNM 236555, 2, (66.1–72.8, paratypes of *C. incompta*). Lagoon west of Canõ Araguaito, USNM 236560, 1 (53.0, paratype of *C. incompta*); MBUCV V-13125, 2 (55.0–62.6, paratypes of *C. incompta*). Stream off Río Orinoco, USNM 236556, 4 (43.8–57.3, paratypes of *C. incompta*). Canõ Paloma system, USNM 236554, 5 (57.9–61.5, paratypes of *C. incompta*); AMNH 54627, 2 (63.4–64.7, paratypes of *C. incompta*); BMNH 1983.3.1:5–6, 2 (55.9–59.7, paratypes of *C. incompta*); ANSP 150914, 2 (55.0–57.5, paratypes of *C. incompta*); FMNH 94589, 2 (52.0–59.3, paratypes of *C. incompta*); CAS 52168, 2 (52.2–59.8, paratypes of *C. incompta*); LACM 43297-1, 2 (52.9–60.0, paratypes of *C. incompta*.

***Curimata roseni*, new species**

FIGURES 25, 26, 27

Curimatus knerii.—Steindachner, 1882:135 [in part, Brazil: Rio Branco].
Curimata B.—Vari, 1988, fig. 10 [phylogenetic biogeography]; 1989, table 2 [phylogenetic relationships].

DIAGNOSIS.—The combination of 7 to 9 branched anal rays, a body depth 0.40–0.48 of SL, and the absence of any pronounced pigmentation pattern on the body distinguishes *Curimata roseni* from all other *Curimata* species with the exception of *C. cyprinoides* and *C. knerii*. *Curimata roseni* is distinguishable from those species in having the anteriormost rays of the dorsal fin only moderately developed and in having 31 vertebrae. *Curimata knerii* and *C. cyprinoides* have greatly developed, filiform anteriormost rays of the dorsal fin that reach in some individuals to the tip of the fin rays of the dorsal lobe of the caudal fin, and have 32 to 34 vertebrae. Numerous internal characters also distinguish *C. roseni* from those species (see "Synapomorphy List and Phylogenetic Reconstruction").

DESCRIPTION.—Body moderately elongate, somewhat compressed. Dorsal profile of head straight. Dorsal profile of body slightly convex from rear of head to origin of rayed dorsal fin; straight or slightly convex, posteroventrally slanted at base of dorsal fin, gently convex from base of last dorsal-fin ray to caudal peduncle, convexity more pronounced in larger specimens. Dorsal surface of body with an indistinct median keel anterior to rayed dorsal fin, smoothly rounded transversely posterior to fin. Ventral profile of body gently curved from tip of lower jaw to caudal peduncle, convexity more pronounced posteriorly. Prepelvic region flattened, margined laterally by distinct, nearly right, angles in body wall. Prepelvic region with a median series of enlarged scales flanked on each side by series of enlarged scales that conform in shape to lateral angle of body. Distinct median keel posterior to origin of pelvic fin, with secondary obtuse keel about two scales dorsal of ventral midline on each side of postpelvic portion of body.

Greatest body depth at origin of rayed dorsal fin, specimens above 110 mm SL usually with proportionally deeper bodies, depth 0.40–0.48 [0.46]; snout tip to origin of rayed dorsal fin 0.49–0.55 [0.54]; snout tip to origin of anal fin 0.79–0.88 [0.86]; snout tip to origin of pelvic fin 0.53–0.60 [0.59]; snout tip to anus 0.77–0.84 [0.83]; origin of rayed dorsal fin to hypural joint 0.54–0.59 [0.57]. Rayed dorsal fin pointed, anteriormost rays more developed, somewhat filiform in males, posterior margin of fin concave, anteriormost rays 4.5–5.3 times length of ultimate ray; anteriormost dorsal-fin rays less developed in juveniles and females, 3.5–4.3 times length of ultimate ray. Pectoral fin pointed; length of pectoral fin 0.19–0.22 [0.20], extends to or slightly beyond vertical through origin of pelvic fin. Pelvic fin pointed, length of pelvic fin 0.22–0.26 [0.25], reaches approximately three-quarters of distance to origin of anal fin. Caudal fin forked. Adipose fin well developed. Anal fin emarginate, more so in males, anteriormost branched rays in males 2.5–3.7 times length of ultimate ray. Caudal peduncle depth 0.12–0.14 [0.13]. Dorsal and ventral rays of caudal fin sometimes somewhat developed, but not elongate.

Head pointed, head length 0.30–0.35 [0.31]; upper jaw longer; mouth inferior, lower jaw margin obtusely triangular from ventral view; snout length 0.29–0.35 [0.33]; nostrils of each side of head very close, anterior circular, posterior crescent shaped with aperture closed by thin flap of skin separating nares; orbital diameter 0.31–0.38 [0.33]; adipose eyelid present, with a vertically ovoid opening over center of eye; length of postorbital portion of head 0.34–0.40 [0.36]; gape width 0.26–0.34 [0.32]; interorbital width 0.40–0.46 [0.46].

Pored lateral-line scales from supracleithrum to hypural joint 43 to 55 [54]; all scales of lateral-line pored, canals in scales straight; 4 to 7 series of scales extend beyond hypural joint onto caudal fin base; 12 to 14 [13] scales in a transverse series from origin of rayed dorsal fin to lateral line, 7 to 9 [9] scales in a transverse series from the lateral line to origin of anal fin; scale margins smooth over most of body, ctenii poorly developed ventrally. Median series of enlarged prepelvic scales 12 to 14.

Dorsal-fin rays ii or iii,9 [ii,9]; anal-fin rays ii,7–9 or iii,8–9 [ii,8]; pectoral-fin rays 13 to 16 [15]; pelvic-fin rays i,8–10 [i,9].

Total vertebrae 31 (63)

COLOR IN ALCOHOL.—Overall coloration silvery or golden, darker on dorsal portions of head and body. Middorsal line

FIGURE 26.—*Curimata roseni*, new species, holotype, MZUSP 28651, 131.8 mm SL; Brazil, Roraima, Rio Branco, Cachoeira do Bem Querer.

between rear of rayed dorsal fin and upper portion of caudal peduncle very dark. Dorsal margin and distal portion of rayed dorsal fin dusky.

DISTRIBUTION.—Rio Negro and upper Rio Madeira drainage basins (Figure 25).

ETYMOLOGY.—This species is named for Donn E. Rosen, teacher, friend, and colleague, who first introduced me to the fascinations of systematic research and who originally directed my interests to the study of characiform fishes.

REMARKS.—Steindachner (1882:135) reported *Curimatus knerii* from various Amazonian localities including the Rio Branco. No specimens of that species from that drainage system have been found during the present study, and one specimen which served, at least in part, as the basis for the *C. kneri* citation from the Rio Branco (NMW 68858) has proved to be *C. roseni*.

Other than for a single lot of two specimens (USNM 287593), all the cited material of *Curimata roseni* originated in the Rio Negro basin or portions of the Rio Amazonas system proximate to the mouth of the Rio Negro. The single lot from the upper Rio Madeira system falls within the ranges of meristic and morphometric values for the Rio Negro specimens, although the greatest body depth of the two Bolivian specimens (Figure 27) is not quite as deep as specimens of comparable size from the Rio Negro system. Additional material from intervening portions of the Rio Madeira system is necessary to determine whether that difference is significant or merely represents geographic variation.

MATERIAL EXAMINED.—56 specimens (48, 67.2–144.3).

HOLOTYPE.—BRAZIL. *Roraima*: Rio Branco, Cachoeira do Bem Querer, cataract pool (approx. 2°50'N, 60°43'W), M. Goulding, 8 Jan 1984, MZUSP 28651, (131.8).

PARATYPES.—BRAZIL. *Roraima*: Same collection data as holotype, 14 specimens: MZUSP 28652, 4 (114.2–133.7); USNM 267995, 7 (108.0–144.3); ANSP 153669, 1 (119.9); AMNH 55631, 2 (117.8–126.2). Rio Branco, Marara, USNM 267349, 3 (96.8–106.0). Rio Branco, 160 km from its mouth, GC, 3 (94.8–103.7); USNM 268595, 1 (90.3). Rio Branco, Boa Vista (approx. 2°49'N, 61°40'W), USNM 267350, 4 (83.8–92.6); BMNH 1984.8.23:1, 1 (97.9). Rio Xeruini, MZUSP , 2 (92.0–93.0). Rio Uraricoera near Ilha Maracá (approx. 3°25'N, 61°40'W), MZUSP 21183, 1 (110.9). *Amazonas*: Rio Negro, Mandiquié, M. Goulding, 8 Oct 1979, 7 specimens: MZUSP 28653, 3 (91.7–92.4); USNM 268596, 3, (90.7–96.7, 1 specimen cleared and counterstained for cartilage and bone); AMNH 55559, 1 (93.7). Rio Canumã,

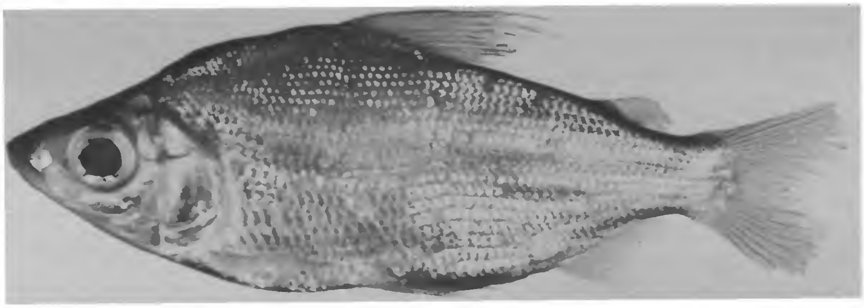

FIGURE 27.—*Curimata roseni*, new species, USNM 287593, 107.9 mm SL; Bolivia, Beni, Itenez (Londra).

MZUSP 7044, 1 (96.7).

GUYANA. *Rupununi*: Manari and Papari Rivers, BMNH 1972.7.27:417–419, 3 (104.3–127.0).

The following specimens were examined but are not part of the type series: BRAZIL. *Amazonas*: Lago Janauacá, MZUSP 21697, 1 (107.3). Lower Rio Jauaperi, MZUSP 21149, 1 (86.2); MZUSP 21155, 1 (82.0). *Roraima*: Rio Branco, NMW 68858, 1 (89.9). Rio Branco, Bem Querer, NMW 66828, 1 (67.2); MZUSP 29542, 3. Rio Branco, Boa Vista, NMW 68822, 1; NMW 67011, 1.

VENEZUELA. *Amazonas*: Upper Río Orinoco, Tamatama, CAS 56607, 1 (80.8). Bifurcation of the upper Río Orinoco, USNM 267325, 1 (76.3). Río Casiquiare, Curare, CAS-SU 56812, 1.

BOLIVIA. *Beni*: Itenez (Londra) and Río Blanco, USNM 287593, 2.

Curimata cyprinoides (Linnaeus)

FIGURES 28, 29, 30

Salmo immaculatus Linnaeus, 1758:312 [type locality: America]; 1766:513 [on Linnaeus, 1758].—Walbaum, 1792:82 [America].—International Commission of Zoological Nomenclature, 1966:41–45 [suppressed for the purposes of the Law of Priority].—Fernholm and Wheeler, 1983:215 [holotype depository].

Charax 378.—Gronovius, 1763:123 [America].

Salmo cyprinoides Linnaeus, 1766:514 [type locality: Surinam].

Salmo Cyprinoides.—Bonaterre, 1788:169 [America].

Salmo edentulus Bloch, 1794, pl. 380 [type locality: Surinam].—Bloch and Schneider, 1801:412 [Surinam].—International Commission of Zoological Nomenclature, 1966:41 [designated as type-species of *Curimata* Bosc, 1817].

Characinus cyprinoides.—Lacépède, 1803:270–274 [*Salmo edentulus* and *Salmone carpeau* placed in synonymy].

Anodus cyprinoides.—Müller and Troschel, 1845:7 [Guiana].

Curimatus cyprinoides.—Müller and Troschel, 1848:63 [British Guiana (= Guyana)].—Valenciennes, in Cuvier and Valenciennes, 1849:7 [Amazon, Surinam, Essequibo, Cayenne].—Kner, 1859:143 [in part, Surinam, not mouth of Rio Negro citation].—Günther, 1864:290 [Brazil: Pará, Rio Capin (= Capim)].—Eigenmann and Eigenmann, 1889:429 [Brazil: Pará]; 1891:481 [reference].—Ulrey, 1895:259 [Brazil: Rio Tocantins].—Vaillant, 1899:154 [French Guiana, Carsevenne River].—Eigenmann, 1910:422 [reference].—Fowler, 1914:229 [British Guiana (= Guyana): Rupununi River].—Puyo, 1949:119 [French Guiana, biology]. [Not Cope, 1872:258, 291; Steindachner, 1882:134; Fowler, 1906:300, 1913:517, 1913:518, 1915:262.]

Charax planirostris Gray 1854:154 [type locality: Rivers of South America; based on *Charax* 378, Gronovius, 1763].

?*Curimatus ciprinoides*.—Castelnau, 1855:57 [error in spelling, Amazon].

Curimatus schomburgkii Günther, 1864:291 [type locality: British Guiana (= Guyana): Demerara].—Eigenmann and Eigenmann, 1889:431 [Surinam].—Eigenmann, 1910:422 [reference].—Cockerell, 1914:94 [scale anatomy].—Mago-Leccia, 1970:75 [Venezuela].—Fernholm and Wheeler, 1983:215 [equated with *Salmo immaculatus* Linnaeus, 1758].

Curimatus planirostris.—Günther, 1864:293 [in part, not *Curimatus abramoides* synonymy or geographic distribution].—Eigenmann and Eigenmann, 1889:431 [references in part, not cited specimens]; 1891:48 [reference in part, not *C. abramoides* synonymy].

Curimata copei Fowler, 1906:301, fig. 7 [type locality: Surinam].—Fowler, 1919:130 [Surinam].—Géry, 1977b:230 [Surinam]

Curimata schomburgkii.—Fowler, 1906:303, fig. 8 [Surinam]; 1919:130 [Surinam]; 1931:407 [Venezuela, Guanoco].—Schultz, 1944:250 [reference, Venezuela].—Fowler, 1950:292, fig. 351 [reference in part, not Rio Negro citation].

Curimatus kneri.—Eigenmann and Bean, 1907:667 [Amazon].

Curimatus knerii.—Eigenmann and Ogle, 1907:4 [Brazil: Pará].

Curimatus Schomburgki.—Pellegrin, 1909:148 [Brazil: Pará].

Semitapicis planirostris.—Eigenmann 1910:422 [in part, not *C. abramoides* synonymy or cited distribution].—Fowler, 1950:302 [reference in part, not fig. 363 or *C. abramoides* synonymy]; 1975:375 [reference in part]. [Not Fernández-Yépez, 1948].

Curimatus copei.—Eigenmann, 1910:422 [reference].—Fernández-Yépez, 1948:73 [reference; possible assignment to *Cruxentina*].

Curimatus schomburgki.—Eigenmann, 1912:266, pl. 35, fig. 1 [British Guiana (= Guyana): Wismar, Lama Stop-Off, Koreabo Rubber Plantation, Issororo, Morawhanna, Mora Passage, Maduni, Christianburg].—Starks, 1913:13 [Brazil: Pará; possible synonymy with *Salmo cyprinoides* Linnaeus, 1766].—Caporiacco, 1935:61 [British Guiana (= Guyana): Demerara].

Curimata cyprinoides.—Eigenmann and Allen, 1942:295 [reference in part, not Peruvian citations].—Fowler, 1942:208 [reference in part, not Peruvian citations]; 1945:115 [reference in part, not Peruvian citations]; 1950:281, fig. 340, 341 [references in part]; 1975:369 [reference].—Géry, 1977a:230 [lower Amazon].—Santos et al., 1985:28–29 [Brazil, Rio Tocantins; common name; life history].—Vari, 1988, fig.5 [distribution]; 1989, tables 2, 3 [phylogenetic relationships]. [Not Fowler, 1940:253, 1941:166].

Bitricarinata schombourgki.—Fernández-Yépez, 1948:64, fig. 34 [designation as type species of *Bitricarinata*].

Bitricarinata schomburgkii.—Fowler, 1975:366 [reference].

Cruxentina copei.—Fowler, 1975:367 [reference].

Curimata cyprinoides schomburgki.—Géry, 1977a:230 [placement of *Curimatus schomburgkii* Günther as a subspecies of *Salmo cyprinoides* Linnaeus; Guianas].

DIAGNOSIS.—The combination of a body depth 0.40–0.47 of SL, 7 to 9 branched anal rays, and the lack of any marked body pigmentation patterns distinguishes *Curimata cyprinoides* from other members of the genus with the exception of *C. knerii* and *C. roseni*. *Curimata cyprinoides* has 46 to 56 lateral line scales from the supracleithrum to the hypural joint, 15 to 17 enlarged median prepelvic scales, and 32 (very rarely 31 or 33) vertebrae. This contrasts with 31 vertebrae and 12 to 14 enlarged median prepelvic scales in *Curimata roseni*, and 33 or 34 vertebrae and 56 to 63 lateral-line scales in *C. knerii*. *Curimata cyprinoides* and *C. roseni* also differ in numerous internal characters (see "Synapomorphy List and Phylogenetic Reconstruction"). *Curimata cyprinoides* and *C. knerii* although having somewhat overlapping lateral-line counts, demonstrate significantly different modal values for that meristic value (Figure 29).

DESCRIPTION.—Body moderately elongate, somewhat compressed. Dorsal profile of head straight or slightly convex in small specimens, straight or slightly concave in larger individuals. Dorsal profile of body distinctly curved from rear of head to origin of rayed dorsal fin; straight or slightly posteroventrally slanted at base of dorsal fin; gently convex from base of last dorsal-fin ray to caudal peduncle. Dorsal body surface with an indistinct median keel anterior to rayed dorsal fin, smoothly rounded transversely posterior to fin. Ventral body profile slightly convex from tip of lower jaw to region ventral of middle of pectoral fin, convexity increased from that point to origin of pelvic fin, gently sigmoid from

FIGURE 28.—*Curimata cyprinoides*, USNM 225214, 149.8 mm SL; Surinam, Nickerie District, Corantijn River at Matapi.

there to caudal peduncle. Prepelvic region flattened, margined laterally by distinct, nearly right, angles in body wall, prepelvic region with median series of enlarged scales flanked on each side by series of enlarged scales that conform in shape to lateral angle of body. Well developed median keel posterior to pelvic fin origin, with secondary obtuse angle in body wall about two scales dorsal of ventral midline on each side of postventral portion of body.

Greatest body depth at origin of rayed dorsal fin, depth 0.40–0.47; snout tip to origin of rayed dorsal fin 0.48–0.55; snout tip to origin of anal fin 0.79–0.85; snout tip to origin of pelvic fin 0.53–0.59; snout tip to anus 0.76–0.82; origin of rayed dorsal fin to hypural joint 0.53–0.60. Rayed dorsal fin pointed, anteriormost rays in some individuals reaching to tip of dorsal lobe of caudal fin. Pectoral fin pointed; length of pectoral fin 0.18–0.24, extends three-quarters distance to vertical through origin of pelvic fin. Pelvic fin pointed, length of pelvic fin 0.20–0.28, reaches three quarters distance to origin of anal fin. Caudal fin forked, dorsalmost and ventralmost principal fin rays moderately filiform in some individuals. Adipose fin well developed. Anal fin emarginate, anteriormost branched rays 3.5–4.6 times length of ultimate fin ray. Caudal peduncle depth 0.11–0.13.

Head distinctly pointed, head length 0.30–0.36; upper jaw longer, mouth inferior; snout length 0.28–0.34; nostrils very close, anterior circular, posterior crescent shaped with aperture closed by thin flap of skin separating nares; eye large, orbital diameter 0.31–0.37; adipose eyelid well-developed, particularly in larger individuals, with vertically ovoid opening over center of eye; length of postorbital portion of head 0.34–0.42; gape width 0.27–0.34; interorbital width 0.35–0.43.

Pored lateral-line scales from supracleithrum to hypural joint 46 to 56; all scales of lateral-line pored, canals in scales straight or somewhat divergent; 4 to 8 series of scales extend beyond hypural joint onto caudal fin base; 13 to 16 scales in transverse series from origin of rayed dorsal fin to lateral line; 7 to 10 scales in transverse series from the lateral line to origin of anal fin. Median series of enlarged prepelvic scales 15 to 17.

Dorsal-fin rays ii,8–10; anal-fin rays ii,8–9 or iii,7–9; pectoral-fin rays 13 to 16; pelvic-fin rays i,8 or 9 (i,8 relatively rare).

Total vertebrae 31 (7), 32 (101), 33 (3).

COLOR IN ALCOHOL.—Overall coloration in specimens that retain guanine on scales golden or silvery-golden, darker on dorsal portions of head and body. Specimens that lack guanine on scales yellowish-tan to brown, darker on dorsal portions of head and body. No pronounced markings on head or body. Middorsal region from rear of head to upper caudal peduncle with obscure dark band. Rayed dorsal and caudal fins dusky, with series of small chromatophores outlining fin rays. Individuals under 30 mm SL with distinct black blotch on distal half of anterior rays of dorsal fin. Anteriormost anal fin rays and dorsalmost rays of pectoral fin with chormatophores along margins; other portions of fins hyaline. Pelvics hyaline or with some chromatophores along fin-ray margins in larger specimens. Adipose fin dusky.

DISTRIBUTION.—Lower Río Orinoco, Atlantic drainages of the Guianas, lower Rio Amazonas (Figure 30).

COMMON NAME.—Brazil: Branquiha-baiaõ (Santos et al., 1985:28).

LIFE HISTORY.—Santos et al. (1985:28–29) report that this species is one of the most common and abundant species along the Rio Tocantins system of eastern Brazil. The species is cited by those authors as eating organic detritus, benthic organisms and periphyton. Sexual maturity occurs at approximately 13 cm (?SL), with breeding taking place in that basin between November and January.

REMARKS.—The first use of the specific name *cyprinoides* (in *Salmo cyprinoides* Linnaeus, 1766) is predated by that of *Salmo immaculatus* (Linnaeus, 1758), a form considered conspecific in this work (Table 3). *Salmo immaculatus*, described in 1758, was not definitely recognized as a curimatid until a recent paper by Fernholm and Wheeler (1983:215), and was not cited in a systematic study in the nearly two centuries that passed between Walbaum's brief reference (1792) and the paper by Fernholm and Wheeler (1983:215) who equated that species with *Curimatus schomburgkii* Günther (1864:291). The International Commission on Zoological Nomenclature (1966:41–

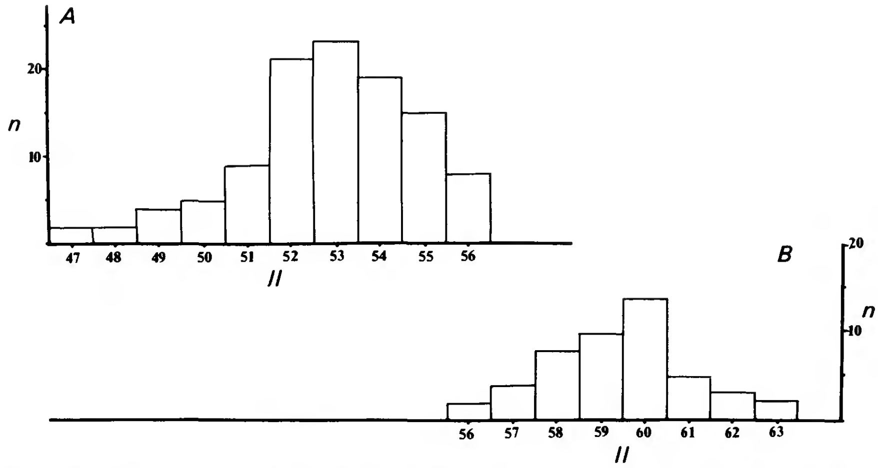

FIGURE 29.—Histograms of number of pored lateral-line scales to the hypural joint (ll) against number of specimens (n) for *Curimata cyprinoides* (A) and *Curimata kneri* (B).

45) ruled that *immaculatus* of Linnaeus (1958) is suppressed for the purposes of the Law of Priority. *Curimata cyprinoides* is consequently used in this study.

The specimen or specimens that served as the basis for Linnaeus' description (1766) of *Salmo cyprinoides* are not known to be extant in the holdings of the Swedish Museum of Natural History (Fernholm and Wheeler, 1983), the Linnean Society, London (Wheeler, 1985), or any other repository known to contain types of Linnaeus' species (A. Wheeler, pers. commun.).

Gronovius' *Charax* 378 (1763:123) and *Charax planirostris*, the species based on it that was subsequently made available by Gray (1854:154), are tentatively considered as synonyms of *Curimata cyprinoides*. Neither the original Gronovius description, nor the manuscript illustration of the species by Gronovius now in the British Museum (Natural History) (see Vari, 1984a, fig. 7) permit a definite identification of the species. Nontheless the overall body form, positions of the fins, and body and head proportions of the specimen in the illustration agree with those of a juvenile of *Curimata cyprinoides*. Furthermore it is likely that the specimens available to Gronovius originated in northeastern South

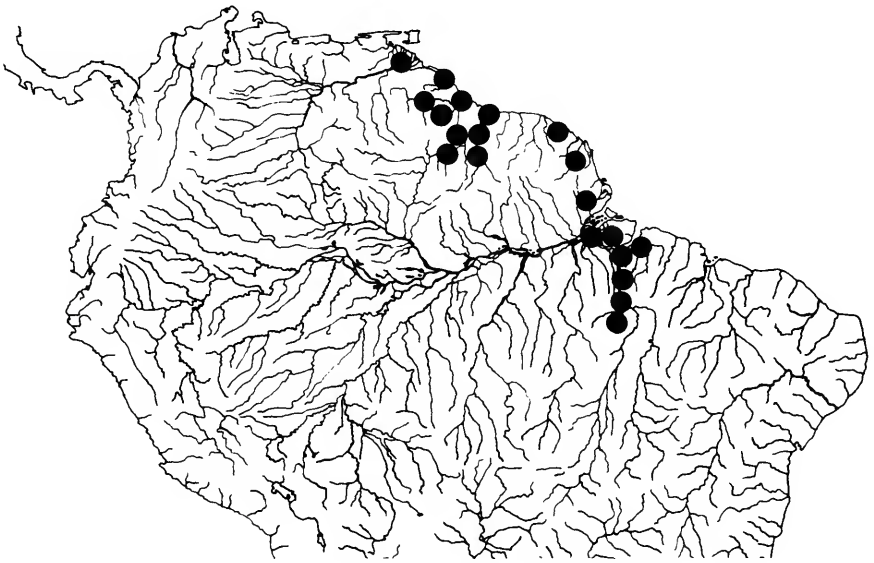

FIGURE 30.—Geographic distribution of *Curimata cyprinoides* (some symbols represent more than one collecting locality or lot of specimens).

TABLE 3.—Morphometrics and meristics of (A) holotype of *Salmo immaculatus*, NRM LP 76, (B) lectotype and paralectotypes of *Curimatus schomburgkii*, BMNH 1978.9.12:2 and BMNH 1862.12.15:68, (C) holotype of *Curimata copei*, ANSP 8201, and (D) range of all specimens of *Curimata cyprinoides* from which counts and measurements were taken (holotype of *C. cyprinoides* not known to be extant). (Standard length is expressed in mm; measurements 1 to 10 are proportions of standard length; 11 to 14 are proportions of head length; dash indicates missing data; questionmark indicates damaged specimen.)

Character	A	B	C	D
		MORPHOMETRICS		
Standard Length	51.7	62.6–108.5	100.0	40.5–212.9
1. Greatest body depth	0.42	0.41–0.46	0.41	0.40–0.47
2. Snout to dorsal-fin origin	0.52	0.48–0.52	0.51	0.48–0.55
3. Snout to anal-fin origin	0.84	0.82	0.81	0.79–0.85
4. Snout to pelvic-fin origin	0.56	0.53–0.56	0.53	0.53–0.59
5. Snout to anus	0.79	0.78–0.80	0.77	0.76–0.82
6. Origin of rayed dorsal fin to hypural joint	0.58	0.57–0.60	0.60	0.53–0.60
7. Pectoral fin length	–	0.20–0.24	–	0.18–0.24
8. Pelvic fin length	–	0.22–0.25	–	0.20–0.28
9. Caudal peduncle depth	0.13	0.12–0.13	0.13	0.11–0.13
10. Head length	0.35	0.32–0.35	0.34	0.30–0.36
11. Snout length	0.30	0.29–0.32	0.30	0.28–0.34
12. Orbital diameter	0.33	0.30–0.35	0.34	0.31–0.37
13. Postorbital length	0.42	0.39–0.41	0.40	0.34–0.42
14. Interorbital width	0.42	0.40–0.42	0.41	0.35–0.43
		MERISTICS		
Lateral line scales	53	53–54	49?	46–56
Scale rows between dorsal-fin origin and lateral line	16	14	14?	13–16
Scale rows between anal-fin origin and lateral line	10	9	8	7–10
Branched dorsal-fin rays	9	8–9	9	8–10
Branched anal-fin rays	9	9	9	7–9
Total pectoral-fin rays	13?	15	15	13–16
Branched pelvic-fin rays	9	9	9	8–9
Vertebrae	–	32	32	31–33

America, a region of the continent that was one of the first to be sampled for fishes. Such is the case with other Gronovius species such as *Plecostomus* no. 69 (Gronovius, 1754:26–27) which is conspecific with *Loricaria cataphracta* Linneaus, the distribution of which (Isbrücker, 1981:58–66) is very similar to that of *Curimatus cyprinoides*.

The synonymy of *Charax planirostris* into *Curimata cyprinoides* is congruent with the action of Linnaeus (1766:514) who placed *Charax* 378 as a synonym of his *Salmo* (= *Curimata*) *cyprinoides*. It contrasts with the practice initiated by Günther (1864) that placed *Charax planirostris* as the senior synonym of *Curimatus abramoides* of Kner (1859:142). That synonymy also diverges from previous associations of *Charax planirostris* (as *Semitapicis planirostris*) with elements of the multispecific assemblage defined as *Potamorhina* by Vari (1984a) (see Vari, 1984a:13–16, for a discussion of the basis for these actions).

Günther (1864:291) noted the similarity of his *Curimatus schomburgkii* from Guyana and *C. cyprinoides* (Linnaeus) originally described from Surinam, but did not elaborate on the perceived differences between the nominal forms that lead him to describe a new species. Starks (1913:13) although identifying material from Pará, Brazil as *Curimatus schomburgkii*, nonetheless noted that his material seemed identical to British Guiana (= Guyana) specimens and should be probably referred to as *Curimatus cyprinoides* (Linnaeus). The meristic and morphometric values listed for *C. schomburgkii* fall within the range of *C. cyprinoides* (Table 3) and a re-examination of the majority of the type series of *C. schomburgkii* fails to reveal any basis for a continued recognition of the latter species as distinct. It is consequently placed into the synonymy of *C. cyprinoides*.

Curimatus schomburgkii was described by Günther (1864:291) from a series of specimens collected in British Guiana (= Guyana). The single specimen (BMNH 1978.9.12:2) presented by Schomburgk (specimen "a" of Günther [1864:292]) is designated as the lectotype of the species. The remaining specimens thus become paralectotypes. Of these, two specimens (the "specimen d" purchased from Scrivener (BMNH 1848.7.1.35) that was cited by Günther (1864:291), and the dried skin referred to by that author (his "specimen c," BMNH uncatalogued) were examined and their conspecificity with the lectotype confirmed. Günther's specimens "b" and "e" were not located in the holdings of the BMNH. Additional Scrivener specimens from British Guyana (BMNH 1862.12.15:68, 2 specimens), although presumably available to Günther, do not appear to have been referred to by that author in the original description of the species.

More recently Fowler (1906:301) described another nominal species from Surinam, *Curimata copei*. The holotype of the species (ANSP 8201) is in very poor condition and was already damaged when examined by Fowler as indicated by the incomplete fins in the original illustration and the uncertainty on Fowler's part as to the number of scales in the lateral line. Fowler noted the similarity of his *C. copei* to *C. schomburgkii* (= *C. cyprinoides* in this study) but distinguished the two species on the basis of the more anteriorly gibbous profile of the body in *C. copei*. A radiographic plate of the holotype of the latter species has revealed that the marked gibbosity is the function of a postmortem break in the vertebral column and the dorsal displacement of the posterior portion of the body in the very soft specimen. No character has been found to distinguish *C. copei* from *C. cyprinoides* (Table 3), and the species are consequently considered conspecific.

Curimata cyprinoides has been cited from a broad geographic range including the middle and upper Rio Amazonas basin and the rivers of eastern Brazil; areas beyond the distribution range recognized in this study. Cope (1872:291) listed *Curimatus cyprinoides* from the Rio Solimões; an identification subsequently modified by Fowler (1906:305) to *Psectrogaster ciliatus* (Müller and Troschel). In actuality, the specimens in question (ANSP 8208-9) are *Psectrogaster amazonica* Eigenmann and Eigenmann. Steindachner (1882:134) reported *Curimatus cyprinoides* from the Rio Puti (= Poti) of eastern Brazil based on Thayer Expedition material. Eigenmann and Eigenmann (1889:413) suggested the the record was a misidentification of their species *Psectrogaster rhomboides*, a hypothesis confirmed by an examination of the specimens reported on by Steindachner (NMW 66885, 66938).

Fowler (1913:517) cited *Curimatus cyprinoides* as an element of the Rio Madeira ichthyofauna based on two specimens (ANSP 39551-2) which have on examination been found to be *Psectrogaster amazonica* Eigenmann and Eigenmann. The poor condition of the 18 *Psectrogaster* juveniles (ANSP 39353-70) from the same region that Fowler (1913:518) equated with *C. crypinoides* has prevented a definitive reidentification. The specimens are tentatively considered to be *Psectrogaster amazonica*.

More recently Fowler (1941:166) reported *Curimata cyprinoides* from a variety of localities in the state of Ceará and Piauhy (= Piauí), Brazil. The specimens are actually a mixture of *Psectrogaster rhomboides* Eigenmann and Eigenmann (ANSP 81892, 81934, 81936, 81937) and *P. saguiru* Fowler (ANSP 88590). The same author reported *C. cyprinoides* from the Río Ucayali basin (1940:253). Reexamination of the cited individuals (ANSP 88600) has shown them to be *Psectrogaster rutiloides* Kner and *Curimata aspera* (Günther).

Géry (1977b:230) recognized *Curimata cyprinoides* from the lower Amazon and a distinct subspecies *C. cyprinoides schomburgki* from the Guianas. Both nominal forms have type localities in the Guianas (Surinam and Guyana respectively) rendering such a geographic subdivision untenable. Neither have any geographically correlated differences between the Guianan and lower Amazonian populations been discovered in this study. That author also considered *Curimata falcata* Eigenmann and Eigenmann to be a member of his *C. cyprinoides* species group. The former species is not closely related to *C. cyprinoides*, nor does it have the shared derived characters unique to *Curimata*. Its phylogenetic relationships, rather, lie with species of *Psectrogaster* (see Vari, 1989, tables 2,3).

A notable degree of variation in overall body form exists in this species acrosss its range, a situation that might be expected in such a geographically wideranging form. Specimens from the southerly portions of the species range typically have more slender bodies with smoother body profiles. No discrete differences subdividing the species have been found, and further research is necessary to determine the significance, if any, of this variation.

MATERIAL EXAMINED.—2843 specimens (93, 40.5–212.9).

"AMERICA." NRM LP 76, 1 (51.7, holotype of *Salmo immaculatus* Linnaeus).

VENEZUELA. *Territorio Federal Delta Amacuro*: Río Arature, USNM 267327, 1. Lower Río Orinoco, USNM 267331, 1: USNM 267327, 2. *Monagas*; Río Morichal Largo, Canõ Pavon, upriver of bridge at El Silencio, MBUCV V-15261, 1; MBUCV V-15262, 4.

GUYANA. No specific locality, BMNH 1978.9.12:2, 1 (108.5, lectotype of *Curimatus schomburgkii*); BMNH 1862.12.15:68, 2 (62.6–120.3, paralectotypes of *Curimatus schomburgkii*); BMNH 1959.3.17:95, 1. *Essequibo:* Manari, BMNH 1972.7.27:417–419, 3 (1,127.3). Morabelli, Essequibo River, BMNH 1972.10.17:3258–3259, 2 (1, 56.3). Cuyuni River near Kartabo, AMNH 51634, 4; AMNH 51635, 1. Mazaruni River, BMNH 1934.9.12:343–347, 5 (2, 92.0–109.3). Georgetown, USNM 267242, 1. Georgetown, Botanic Gardens, BMNH 1974.5.22:503–504, 2 (172.9–175.1). Koreabo Rubber Plantation, AMNH 7089, 3; BMNH 1911.10.31:192--195, 4 (52.0–90.6); USNM 66144, 3 (57.4–83.9); USNM 267333, 1; MCZ 30045, 1 (86.2). Lama Stop-Off, MCZ 30049, 1 (111.5); USNM 66143, 1 (120.0); USNM 267333, 1; BMNH 1911.10.31:190–191, 2 (1, 132.1). Morawhanna, USNM 267343, 2 (52.0–57.9). Hyde Park River, BMNH 1922.3.29:8, 1. Potaro River, AMNH 4469, 3.

SURINAM. no specific locality, ANSP 8201, 1 (approx. 100.0, holotype of *Curimata copei*); MCZ 792, 1 (176.2). *Nickerie*: Corantijn River, BMNH 1981.6.9:820. Corantijn River, Koekwie Creek, USNM 267321, 1; USNM 267351, 1.

Corantijn River, Matapi, USNM 225214, 24 (9, 132.2–164.1). Corantijn River, Makilikabroe, USNM 225619, 4 (79.2–113.9). Corantijn River, Camp MacClemmen, USNM 226158, 1 (170.2). Corantijn River, USNM 225403, 2 (116.2–122.5); USNM 225230, 2; USNM 225256, 2; USNM 225188, 7; USNM 225616, 1; USNM 225186, 2; USNM 225618, 1; Dalibana Creek, USNM 225250, 1. *Morawijne*: Morawijne River, 30 km S of Albina, ZMA 106.169, 43. Saramaca River, 14 km from mouth, ZMA 105.575, 15. *Brokopondo*: Dateke Kreek, approx. 1.5 km S of Brokopondo, ZMA 107.475, 3.

FRENCH GUIANA. Oyapock River below Santo Antonio, BMNH 1926.3.2:586–591, 6 (3, 115.7–200.5). Approuague River, Inery Creek, BMNH 1926.3.2:592–594, 3 (40.5–66.5). Mahury River near Cayanne, USNM 220351, 153 (10, 56.1–75.9).

BRAZIL. *Amapá*: Cupixi, MZUSP 32254, 3. Rio Araguari, Ferreira Gomes, MZUSP 32282, 1892; USNM 267964, 3 (110.5–163.4). Rio Amapá, Cachoeira Grande, MZUSP 32253, 512; USNM 267962, 15 (5, 122.0–212.9). *Pará*: no specific locality, BMNH 1898.10.11:7, 1; MCZ 794, 2 (77.3–93.4); AMNH 3769, 5 (66.7–131.3); USNM 34576, 2 (88.5–94.7). Marajo Island, BMNH 1923.8.11:4, 1 (157.0). Belém, Rio Guamá, MZUSP 20789, 1 (65.0). Rio Capim, BMNH 1849.11.8:55–56, 2 (138.1–164.5). Rio Capim, Vila Santana, MZUSP 21232, 7 (2, 111.2–112.7); MZUSP 21199, 4 (2, 150.0–167.5); MZUSP 21198, 3 (1, 146.3). Igarapé Sororoca, Furo de Panaquera, MZUSP 21244, 1 (131.4). Rio Tocantins, Lagoa near Jatobal, MZUSP 21319, 8. Mouth of Rio Tocantins, Parana Sammuma, MZUSP 21250, 8 (4, 110.2–121.1). Vicinity of Vila Maiauatá, MZUSP 21235, 7 (3, 65.7–70.7); MZUSP 21237, 1 (64.0); MZUSP 21236, 5. Rio Tocantins near Tucuruí, MZUSP 21293, 1; MZUSP 21327, 1. Igarape Coelho, mouth of Rio Tocantins, MZUSP 21245, 6. Rio Itacaiunas, Cachoeira do Calderiao, USNM 267961, 5 (2, 101.1–153.8); MZUSP 32252, 14. Rio Guajara, MNRJ 2800, 4.

Curimata knerii Steindachner

FIGURES 29, 31, 32

Curimatus knerii Steindachner, 1877:83 [type locality: Tefé]; 1882:135 [in part, Tefé, mouth of Rio Negro; not Rio Branco and Surinam].—Eigenmann and Eigenmann, 1889:428 [Brazil: Montalegre (= Monte Alegre), Porto do Moz, Rio Negro, Tonantins, Lake Hyanuary (= Lago Januari)]; 1891:47 [reference].—Eigenmann, 1910:422 [reference]. [Not Eigenmann and Ogle, 1907:4].

Curimatus macrops.—Eigenmann and Eigenmann, 1889:430 [one specimen from San Paolo (= Saõ Paulo de Olivença)].

Curimata knerii.—Fernández-Yépez, 1948:38, fig. 17 [reference].—Fowler, 1950:286 [references in part, not Surinam records]; 1975:369 [reference].—Goulding et al., 1988:132 [Brazil, Rio Negro, Anavilhanas; detritivory].—Vari, 1989, tables 2, 3 [phylogenetic relationships].

Curimata kneri.—Géry, 1977b:230 [in key, Rio Negro].—Ortega and Vari, 1986:11 [Peru; common name].—Bayley, 1988:131 [Brazil, Rio Amazonas, near Manaus; detritivory, growth rates].

DIAGNOSIS.—The combination of a body depth 0.40–0.47 of SL, 7 to 9 branched anal-fin rays, and the lack of any marked body pigmentation pattern distinguishes *Curimata knerii* from all other members of the genus with the exception of *C. cyprinoides* and *C. roseni*. *Curimata knerii* has 33 or 34 vertebrae, 56 to 63 pored lateral-line scales, and 15 to 17 enlarged median prepelvic scales. This contrasts with 31 vertebrae and 12 to 24 enlarged median prepelvic scales in *Curimata roseni* and typically 32, rarely 31 or 33, vertebrae and 46 to 56 lateral-line scales in *C. cyprinoides*. *Curimata knerii* and *C. cyprinoides* have overlapping lateral-line counts, but demonstrate significantly different modal values for that meristic value (Figure 29).

DESCRIPTION.—Body moderately elongate, somewhat compressed. Dorsal profile of head straight or very slightly concave in smaller individuals, straight in larger specimens. Dorsal profile of body distinctly curved from rear of head to origin of rayed dorsal fin; straight or slightly convex, posteroventrally slanted at base of dorsal fin, gently convex from base of last dorsal-fin ray to caudal peduncle. Dorsal body surface with an indistinct median keel anterior to rayed dorsal fin, smoothly rounded transversely posterior to fin. Ventral body profile nearly straight from tip of lower jaw to region of vertical through middle of pectoral fin, more convex from that point to origin of pelvic fin, then somewhat sigmoid to caudal peduncle. Prepelvic region flattened, margined laterally by distinct, nearly right, angles in body wall. Prepelvic region with median series of enlarged scales flanked on each side by series of enlarged scales that conform in shape to lateral angle of body. Well developed median keel posterior to pelvic fin origin with secondary obtuse angle in body about two scales dorsal of ventral midline on each side of postventral portion of body.

Greatest body depth at origin of rayed dorsal fin, depth 0.38–0.44 [0.41]; snout tip to origin of rayed dorsal fin 0.48–0.53 [0.51]; snout tip to origin of anal fin 0.79–0.84 [0.82]; snout tip to origin of pelvic fin 0.52–0.56 [0.52]; snout tip to anus 0.75–0.80 [0.79]; origin of rayed dorsal fin to hypural joint 0.54–0.60 [0.60]. Rayed dorsal fin pointed, anteriormost rays filiform in some individuals, reaching to tip of dorsal rays of dorsal lobe of caudal fin. Pectoral fin pointed; length of pectoral fin 0.19–0.24 [0.22], extends to or slightly short of vertical through origin of pelvic fin in smaller adults, falls short of that line in largest specimens examined. Pelvic fin pointed, length of pelvic fin 0.19–0.26 [0.23], reaches three-quarters of distance to origin of anal fin. Caudal fin forked. Adipose fin well developed. Anal fin emarginate, anteriormost branched rays three to four times length of ultimate ray. Caudal peduncle depth 0.11–0.13 [0.12].

Head distinctly pointed, head length 0.28–0.33 [0.30]; upper jaw longer, mouth inferior; snout length 0.26–0.34 [0.30]; nostrils of each side of head very close, anterior circular, posterior crescent shaped with aperture closed by thin flap of skin that separates nares; eye relatively large, orbital diameter 0.29–0.35 [0.30]; adipose eyelid well-developed, particularly in larger specimens, with vertically ovoid opening over center of eye; length of postorbital portion of head 0.38–0.43 [0.42];

FIGURE 31.—*Curimata kneri*, USNM 258654, 134.3 mm SL; Brazil, Amazonas, vicinity of Manaus.

gape width 0.27–0.34 [0.27]; interorbital width 0.42–0.48 [0.44].

Pored lateral-line scales from supracleithrum to hypural joint 56 to 63 [59]; all scales of lateral-line pored, canals in scales straight; 5 to 8 series of scales extend beyond hypural joint onto caudal fin base; 14 to 16 [15] scales in transverse series from origin of rayed dorsal fin to lateral line; 9 to 11 [9] scales in transverse series from the lateral line to origin of anal fin. Median series of enlarged prepelvic scales 15 to 17.

Dorsal-fin rays ii or iii,9 [ii,9]; anal-fin rays ii,7–9 or iii,8–9 [ii,8]; pectoral-fin rays 13 to 17 [15]; pelvic-fin rays i,8 or 9 (i,8 rare) [i,9].

Total vertebrae 33 (59), 34 (3).

COLOR IN ALCOHOL.—Overall coloration in specimens that retain guanine on scales silvery or silvery-golden, darker on dorsal portions of head and body. Specimens that lack guanine on scales tan to tannish-brown, darker dorsally. No pronounced pigmentation pattern on body and head. Middorsal region from rear of head to upper caudal peduncle with obscure dark band. Rayed and adipose dorsal fins, and caudal fin dusky. Small chromatophores outline fin rays, particularly elongate anteriormost dorsal-fin rays. Anteriormost rays of anal fin and dorsalmost rays of pectoral fin somewhat dusky.

DISTRIBUTION.—Middle and upper portions of Rio Amazonas drainage basin (Figure 32).

COMMON NAME.—In Peru: "yahuarachi" (Ortega and Vari, 1986:11).

LIFE HISTORY.—Goulding et al. (1988:132) report that this

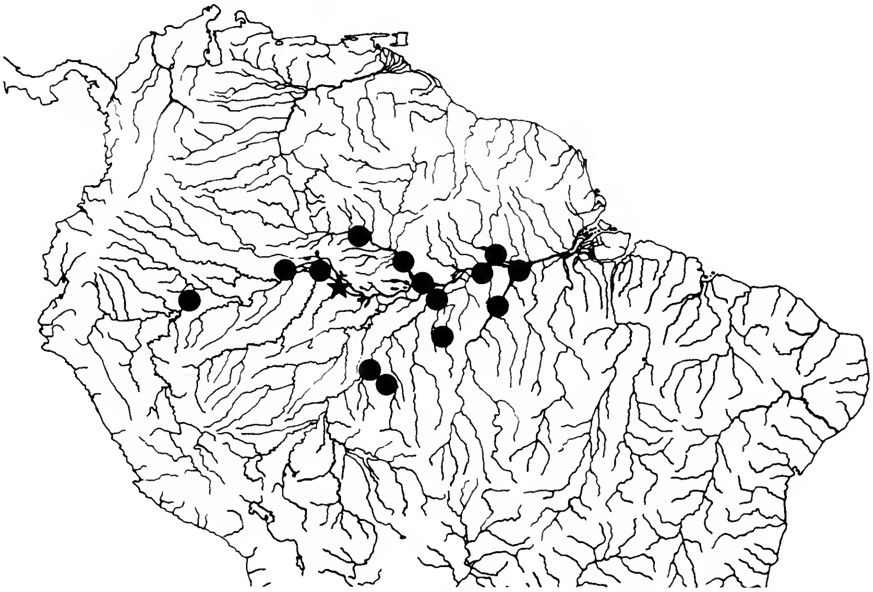

FIGURE 32.—Geographic distribution of *Curimata kneri* (star = lectotype locality; some symbols represent more than one collecting locality or lot of specimens).

species is a detritivore. Bayley (1988:131) provides various data on growth rates and detritivory in the species.

REMARKS.—Steindachner (1882:135) reported *Curimatus knerii* from the Rio Branco and Surinam. The former citation is based, at least in part, on material of *Curimata roseni* (NMW 68858), and the latter on specimens of *C. cyprinoides*. Eigenmann and Bean (1907:667) and Eigenmann and Ogle (1907:4) reported *Curimata knerii* from the lower Amazon River. Examination of the specimens in question (USNM 34697, 52540) has shown that they are actually *C. cyprinoides*. Eigenmann and Eigenmann (1889:430) tentatively associated specimens from San Paolo (= Saõ Paulo de Olivença) with their species, *C. macrops*, which is considered to be endemic to northeastern Brazil in the present study. One of the specimens (MCZ 60887) is rather *Curimata knerii*.

MATERIAL EXAMINED.—153 specimens (50, 51.4–177.3).

BRAZIL. *Pará*: Santarem, CAS 41727, 1 (113.2). Santarem, Rio Tapajós, MZUSP 5718, 30 (5, 116.3–126.7). Rio Tapajós, MZUSP 25590, 1. Rio Tapajós, Alter de Chaõ, MZUSP 9528, 1 (118.7). Rio Tapajós, Maloquinha, MZUSP 21398, 3; MZUSP 21404, 5, (3, 138.0–169.0). Rio Tapajós, Barreririnha, MZUSP 21242, 3 (125.2–166.1). Rio Trombetas, Oriximiná, MZUSP 5421, 35 (5, 104.0–123.4). Lago Jacupá, Oriximiná, MZUSP 5514, 2. Lago Paru, Oriximiná, MZUSP 5594, 1. Rio Trombetas, USNM 267960, 10. Monte Alegre, MCZ 20199, 1 (128.5). *Amazonas*: Vicinity of Tefé, MNW 68685, 1 (177.3, holotype of *Curimatus knerii*). Canumá, MZUSP 7043, 2 (150.7–152.6). Manaus, MCZ 30920, 1 (155.7). Vicinity of Manaus, USNM 258654, 1 (134.3); MZUSP 6685, 5 (70.3–145.3). Lake Hyanuary (= Lago Januari), MCZ 27404, 1. Ilha da Marchantaria, USNM 229181, 6 (2, 51.4–70.0). Lago Janauacá, MZUSP 21564, 1. Lago Murumuru, Janauacá, USNM 267335. Lago do Castanho, Janauacá, USNM 267338, 3. Rio Negro, MCZ 793, 1. Rio Negro above Manaus, MZUSP 6132, 12 (4, 104.3–124.7). Igarapé Jaraqui along Rio Negro, MZUSP 6183, 1 (139.8). Rio Negro, Anavilhanas, USNM 267971, 3 (149.8–206.8). Rio Livramento, MCZ 34132, 1 (131.5); AMNH 12710, 1 (135.1). Lago Puraquequara, mouth of Rio Puraquequara, MZUSP 6086, 7. Boca do Lago Jose Açu, Parintins MZUSP 7633, 1 (97.6). Igarapé Manduaçu, NW of Fonte Boa, MZUSP 20967, 2 (110.4–135.5). Rio Solimões above mouth of Rio Jutai, MZUSP 20993, 1 (114.3). San Paolo (= Saõ Paulo de Olivença), MCZ 60887, 1. Tonantins, MCZ 20195, 2. Rio Aripuana, INPA AR-36, 1. *Rondonia*: Rio Machado. Lago do Paraiso, USNM 220350, 2 (161.7–170.3). Rio Madeira, Calama, USNM 267336, 1 (85.7).

PERU. *Loreto*: Iquitos, MZUSP 15230, 1 (111.5); MZUSP 15237, 1 (118.3).

Curimata macrops Eigenmann and Eigenmann

FIGURES 33, 34

Curimatus macrops Eigenmann and Eigenmann, 1889:429 [type locality: Rio Puty (= Poti), San Gonçallo (= Saõ Gonçalo); not specimens questionably listed from San Paolo (= Saõ Paulo de Olivença].—Eigenmann, 1910:422 [reference].—Fernández-Yépez, 1948:72 [reference].

Acuticurimata macrops.—Fowler, 1941:166, fig. 78 [Ceará: Forteleza (= Fortaleza); Piauhy (= Piauí): Therezina (= Teresina)]; 1950:276, fig. 335 [citation].

Rivasella macrops.—Fowler, 1975:374 [reference].

Curimata macrops.—Géry, 1977b:230 [in key, not Sao Paulo citation].—Vari, 1989, tables 2, 3 [phylogenetic relationships].

DIAGNOSIS.—*Curimata macrops* can be distinguished from all other members of the genus with the exception of *C. mivartii* by the combination of 10 to 12 branched anal-fin rays, and 57 to 67 pored lateral-line scales to the hypural joint. *Curimata macrops* is separable from *C. mivartii* by its deeper body (0.37–0.42 of SL vs. 0.33–0.39), overall body form, and the presence in the prepelvic region of distinct, nearly right, lateral angles in the body wall and a discrete midventral series of enlarged scales. In *C. mivartii*, in contrast, the prepelvic region in transversely rounded and the scales on that region are neither enlarged nor arranged in discrete longitudinal series.

DESCRIPTION.—Body moderately elongate, somewhat compressed. Dorsal profile of head straight. Dorsal profile of body slightly convex from rear of head to origin of rayed dorsal fin in juveniles, distinctly convex in larger specimens; straight and posteroventrally slanted at base of dorsal fin, gently convex from base of last dorsal-fin ray to caudal peduncle. Dorsal surface of body with an indistinct median keel anterior to rayed dorsal fin, smoothly rounded transversely posterior to fin. Ventral body profile gently curved from tip of lower jaw to caudal peduncle. Prepelvic region distinctly flattened, margined laterally by obtuse longitudinal angles in body wall; prepelvic region with median series of enlarged scales flanked on either side by series of enlarged scales that conform in shape to lateral angles in body wall. Well developed median keel posterior to pelvic fin insertion with secondary, obtuse lateral angles in body wall three scales dorsal of ventral midline on each side of postpelvic portion of body.

Greatest body depth at origin of rayed dorsal fin, depth 0.37–0.42 [0.42]; snout tip to origin of rayed dorsal fin 0.49–0.54 [0.52]; snout tip to origin of anal fin 0.76–0.81 [0.78]; snout tip to origin of pelvic fin 0.52–0.55 [0.52]; snout tip to anus 0.72–0.77 [0.76]; origin of rayed dorsal fin to hypural joint 0.53–0.57 [0.57]. Rayed dorsal fin pointed, less so with increasing age; anteriormost rays 3.2–4.3 times length of ultimate ray. Pectoral fin pointed; length of pectoral fin 0.19–0.24 [0.21], extends to or slightly beyond vertical through origin of pelvic fin. Pelvic fin pointed, length of pelvic fin 0.21–0.23 [0.21], reaches three-quarters of distance to origin of anal fin. Caudal fin forked. Adipose fin well developed. Anal fin emarginate, anteriormost branched rays twice length of ultimate ray. Caudal peduncle depth 0.11–0.12 [0.12].

Head distinctly pointed, head length 0.31–0.36 [0.33]; upper jaw longer; mouth inferior; lower jaw obtusely triangular anteriorly; snout length 0.26–0.30 [0.29]; nostrils of each side of head very close, anterior circular, posterior crescent shaped with aperture closed by thin flap of skin that separates nares; orbital diameter 0.29–0.32 [0.30]; adipose eyelid present,

FIGURE 33.—*Curimata macrops*, USNM 258769, 113.2 mm SL; Brazil, Piaui, São Gonçalo.

moderately developed, with vertically ovoid opening over middle of eye; length of postorbital portion of head 0.39–0.44 [0.43]; gape width 0.25–0.30 [0.25]; interorbital width 0.37–0.41 [0.39].

Pored lateral-line scales from supracleithrum to hypural joint 57 to 67 [65]; all scales of lateral-line pored, canals in scales straight; 5 to 8 series of scales extend beyond hypural joint onto caudal-fin base; 16 to 19 [17] scales in transverse series from origin of rayed dorsal fin to lateral line, 10 to 12 [12] scales in transverse series from the lateral line to origin of anal fin. Scales somewhat ctenoid along ventral portion of body.

Rayed dorsal-fin rays ii,9–10 [ii,9]; anal-fin rays ii,10–12 or iii,10–11 [ii,10]; pectoral-fin rays 14 to 16 [15]; pelvic-fin rays i,7–9 [i,9].

Total vertebrae 32 (15).

COLOR IN ALCOHOL.—Overall coloration in specimens which retain guanine on scales is silvery-golden; darker on dorsal portions of head and body. Specimens lacking guanine on scales tan to brown with scattered small chromatophores over dorsal portion of body. No distinct pigmentation pattern on head, body or fins. Rays of caudal and rayed dorsal fin outlined by series of small chromatophores.

DISTRIBUTION.—Rio Parnaiba drainage basin (Figure 34).

REMARKS.—Eigenmann and Eigenmann (1889:429) described *Curimatus macrops* from a series of species collected in the Rio Parnaiba drainage basin. A 109.0 mm SL specimen from the Rio Poti (MCZ 20309) is selected as the lectotype. The remaining specimens (USNM 120249, MCZ 20301, 20302, 20305, 20311) thus become paralectotypes.

In their original description of *Curimatus macrops*, Eigenmann and Eigenmann (1889:430) questionably equated some specimens from San Paolo (= São Paulo de Olivença) on the Rio Solimões with *C. macrops*. Examination of the specimens in question (MCZ 20221) has shown that they are not *C.*

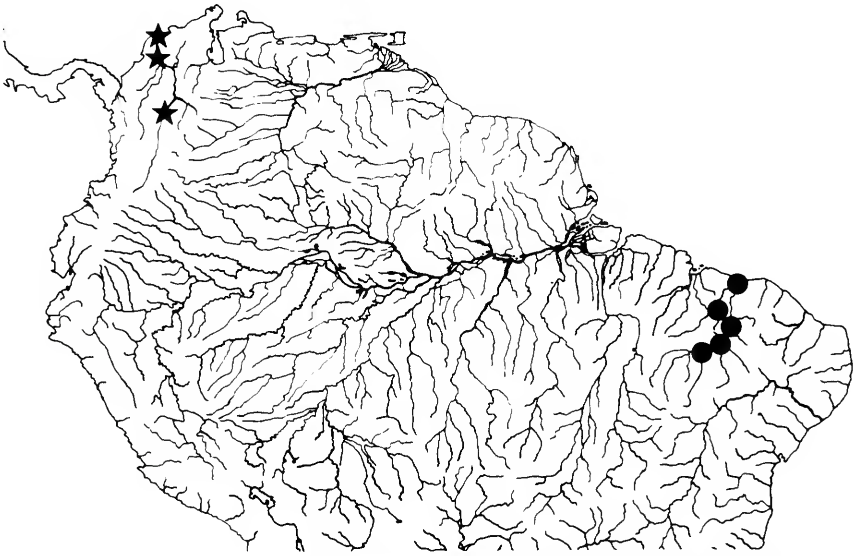

FIGURE 34.—Geographic distribution of *Curimata macrops* (filled circles) and *Curimata mivartii* (stars) (some symbols represent more than one collecting locality or lot of specimens).

macrops, but rather *C. cisandina* (MCZ 20221) and *C. kneri* (MCZ 60887; out of MCZ 20221)

MATERIAL EXAMINED.—120 specimens (41, 55.4–175.6mm SL).

BRAZIL. *Piauí*: Rio Puty (= Poti). MCZ 20305, 11 (4, 117.7–128.3, paralectotypes of *Curimatus macrops*); MCZ 20302, 1 (133.1, paralectotype of *Curimatus macrops*); MCZ 20301, 10 (4, 141.1–141.5, paralectotypes of *Curimatus macrops*); MCZ 20309, 1 (109.0, lectotype of *Curimatus macrops*); NMW 68905, 3 (100.3–123.9); NMW 68878, 3; NMW 68879, 4; NMW 68880, 4; NMW 68881, 4; NMW 68882, 3. San Gonçallo (= Saõ Gonçalo), USNM 120249, 3 (124.5–151.0, paralectotypes of *Curimatus macrops*); MCZ 20311, 5 (113.5–175.6, paralectotypes of *Curimatus macrops*). Teresina, NMW 66901, 4 (115.7–119.3); USNM 258769, 4 (109.6–128.0); NMW 66891, 4; NMW 66899, 4; NMW 66900, 4; NMW 66903, 4; NMW 68904, 4; NMW 68884, 1; NMW 68883, 1; MZUSP 5095, 2. Rio Parnaiba near Buriti dos Lopes, MCZ 46801, 11 (3, 66.4–70.4); MCZ 46799, 6 (3, 64.3–73.4). Rio Parnaiba at Floriana, USNM 267317, 3. *Maranhão*: Rio Parnaiba basin, Engenho de Aqua, NMW 68826, 1 (106.9); NMW 68875, 5; NMW 68877, 5. Rio Parnaiba, USNM 267341, 5 (55.4–77.3).

Curimata mivartii Steindachner

FIGURES 34, 35

Curimatus Mivartii Steindachner, 1878:48, pl. 13, fig. 1 [type locality: Río Magdalena]; 1880:67 [Río Cauca].

Curimatus mivartii.—Eigenmann and Eigenmann, 1889:426 [reference].—Eigenmann, 1910:422 [reference]; 1920a:16 [Río Magadalena drainage system]; 1920b:30 [Río Magdalena].—Dahl, 1971:105 [Colombia: Río Magdalena, lower Río Cauca, Río San Jorge, Río Sinu].

Curimatus mivarti.—Steindachner, 1902:142 [Colombia, Río Lebrija].—Eigenmann, 1922:107 [lower Río Magdalena drainage basin, Soplaviento, Calamar, Calamar Cienega, Penãs Blancas, Cienega de Puerto Berrio, Hunda, Girardot].—Nielson, 1974:48 [paralectotype depository].

Acuticurimata mivartii.—Miles, 1947:130 [Río Magdalena].—Dahl, 1955:17 [Río Ure, San Jorge District, Colombia].

Bondia mivartii.—Fernáandez-Yépez, 1948:66, fig. 35 [designation as type species of *Bondia*, *Bondia* preoccupied in Lepidoptera, replaced by *Bondichthys* Whitley, 1953:134].—Fowler, 1975:365 [reference].

Bondichthys mivarti.—Whitley, 1954:134 [assignment to *Bondichthys*].

Curimata (Acuticurimata) mivartii.—Dahl, Medem, Henao, 1963:42 [Colombia, Río San Jorge].—Dahl, 1971:105 (Colombia; maximum length, common name, use in fisheries).

Curimata mivartii.—Vari, 1988:343, fig. 12 [phylogenetic biogeography]; 1989, tables 2, 3 [phylogenetic relationships].

DIAGNOSIS.—*Curimata mivartii* is distinguishable from all other members of the genus with the exception of *C. macrops* in its possession of 10 or 11 branched anal-fin rays, and 63 to 76 pored lateral-line scales to the hypural joint. *Curimata mivartii* is separable from *C. macrops* in overall form of the body, by its greatest body depth (0.33–0.39 of SL vs. 0.37–0.42 of SL), and in having a transversely rounded prepelvic region without distinct longitudinal series of enlarged scales. In *C. macrops*, in contrast, the prepelvic region is flattened and has a median series of enlarged scales flanked on each side by a comparable sized series of scales that conform in shape to the lateral angles of the prepelvic region of the body.

DESCRIPTION.—Body relatively elongate, somewhat compressed. Dorsal profile of head straight. Dorsal profile of body slightly convex from rear of head to origin of rayed dorsal fin; straight and posteroventrally slanted at base of dorsal fin, straight or very slightly convex from base of last dorsal-fin ray to caudal peduncle. Dorsal surface of body with median keel anterior to rayed dorsal fin, smoothly rounded transversely posterior to fin. Ventral profile of body gently curved from tip of lower jaw to vertical through origin of pectoral fin, flattened or slightly convex from that point to anus, somewhat sigmoid from anus to caudal peduncle. Prepelvic region not distinctly flattened, scales irregularly arranged, without distinct median series of scales, prepelvic scales not enlarged. Well developed median keel posterior to pelvic fin origin.

Greatest body depth at origin of rayed dorsal fin, depth 0.33–0.39 [0.36]; snout tip to origin of rayed dorsal fin 0.47–0.52 [0.50]; snout tip to origin of anal fin 0.75–0.81 [0.78]; snout tip to origin of pelvic fin 0.47–0.51 [0.49]; snout tip to anus 0.73–0.78 [0.75]; origin of rayed dorsal fin to hypural joint 0.54–0.66 [0.57]. Rayed dorsal fin pointed, less so with increasing age; anteriormost rays 3.5–4.1 times length of ultimate ray. Pectoral fin pointed; length of pectoral fin 0.17–0.22 [0.22], extends to or slightly beyond vertical through origin of pelvic fin in smaller adults, falls somewhat short of

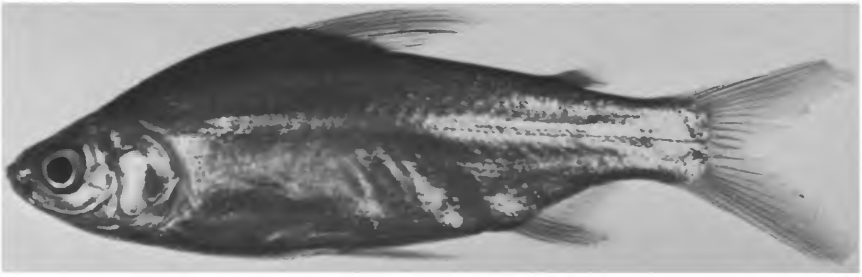

FIGURE 35.—*Curimata mivartii*, USNM 79195, 130.8 mm SL; Colombia, Atlantico, Barranquilla.

that line in largest specimens examined. Pelvic fin pointed, length of pelvic fin 0.19–0.27 [0.27], reaches to or falls slightly short of anus. Caudal fin forked. Adipose fin well developed. Anal fin margin very emarginate, anteriormost branched rays approximately three times length of ultimate ray. Caudal peduncle depth 0.12–0.13 [0.13].

Head distinctly pointed, head length 0.29–0.34 [0.31]; upper jaw longer; mouth inferior, lower jaw distinctly triangular anteriorly; snout length 0.26–0.32 [0.26]; nostrils of each side of head very close, anterior circular, posterior crescent shaped with aperture closed by thin flap of skin that separates nares; orbital diameter 0.24–0.31 [0.27]; adipose eyelid present, with a vertically ovoid opening over middle of eye; length of postorbital portion of head 0.44–0.50 [0.46]; gape width 0.24–0.30 [0.24]; interorbital width 0.40–0.44 [0.40].

Pored lateral-line scales from supracleithrum to hypural joint 63 to 76 [66]; all scales of lateral-line pored, canals in scales straight, 4 to 7 series of scales extend beyond hypural joint onto caudal fin base; 16 to 18 [18] scales in transverse series from origin of rayed dorsal fin to lateral line, 11 to 15 [14] scales in transverse series from the lateral line to origin of anal fin.

Dorsal-fin rays ii,9 or iii,9 [ii,9]; anal-fin rays ii,10–11 or iii,10 [iii,10]; pectoral-fin rays 14 to 17 [17]; pelvic-fin rays i,9 [i,9].

Total vertebrae 32 (9).

COLOR IN ALCOHOL.—Overall coloration of specimens retaining guanine on scales silvery, darker on dorsal portions of head and body. No pronounced pigmentation pattern on head or body. Membranes of caudal and rayed dorsal fins with numerous small chromatophores, particularly between middle rays of caudal fin.

COMMON NAMES.—Colombia: vizcana, cachaca, sardina (Dahl, 1971:105)

DISTRIBUTION.—Río Magdalena, Río Cauca, Río San Jorge, Río Sinu (Figure 34).

REMARKS.—Steindachner (1878:48) described *Curimatus Mivartii* from a syntypic series of unspecified size collected in the Río Magdalena. A 118.1 mm SL specimen (NMW 68759.1) is designated as the lectotype. The remaining known syntypic specimens (NMW 68759.2, NMW 68760, ZMUC 88) thus become paralectotypes.

MATERIAL EXAMINED.—29 specimens (18, 44.7–246.0).

COLOMBIA. Río Magdalena. NMW 68759.1, 1 (118.1, lectotype of *Curimatus Mivartii*); NMW 68759.2, 1 (132.2, paralectotype of *Curimatus Mivartii*); NMW 68760, 3 (126.4–137.1, paralectotypes of *Curimatus Mivartii*); ZMUC 88, 1 (104.0, paralectotype of *Curimatus Mivartii*); NMW 68758, 2; NRM 7068, 1. Mouth of Río Magdalena, NMW 68757, 4. Río Cauca, NMW 68767, 1. Río Magdalena, Cienega La Biga, perto de San Pablo, MZUSP 36689, 2 (183.2–193.1). *Atlantico*: Barranquilla, BMNH 1947.7.1.128–132, 6 (3, 156.3–246.0); BMNH 1900.1.30.38, 1 (157.0). Calamar, USNM 79195, 3 (124.2–129.5); AMNH 7075, 2 (127.9–129.3). *Antioquia*: Peñas Blancas, USNM 267329, 1 (98.3).

Curimata cisandina (Allen)

FIGURES 36, 37

Curimatus macrops.—Eigenmann and Eigenmann, 1889:429 [in part, two non-type specimens from San Paolo (= São Paulo de Olivença)].

Curimatus simulatus.—Eigenmann and Eigenmann, 1889:430 [in part, specimens cited as distinctive from Fonteboa (= Fonte Boa), Brazil].

Psectrogaster cisandinus Allen, in Eigenmann and Allen, 1942:290, pl. 14: fig. 3 [type locality: Peru, Iquitos].—Fowler, 1945:120 [copied]; 1950:301, fig. 362 [reference].

Camposella cisandina.—Fernández-Yépez, 1948:61 [assignment to *Camposella*].—Fowler, 1975:367 [reference].

Lambepiedra alleni Fernández-Yépez, 1948:62, fig. 33 [type locality: Peru: Lago Cashiboya; designation as type species of *Lambepiedra*].

Curimata cisandina.—Géry, 1977b:230 [in key].—Ortega and Vari, 1986:11 [Peru; common name].—Vari, 1989, tables 2, 3 [phylogenetic relationships].

DIAGNOSIS.—The combination of 10 to 12 branched anal fin rays, and 45 to 52 pored lateral-line scales to the hypural joint distinguishes *Curimata cisandina* from all members of this genus with the exception of *C. aspera* and *C. cerasina*. *Curimata cisandina* is separable from those species in having an interorbital width 0.40–0.45 of SL, and most typically 31 vertebrae. In *C. aspera* and *C. cerasina* the interorbital widths are 0.46 of HL or greater, and the vertebral count is typically 32 or 33, rarely 31. *Curimata cisandina* also differs from *C. aspera* and *C. cerasina* in numerous internal characters (see "Synapomorphy List and Phylogenetic Reconstruction").

DESCRIPTION.—Body moderately elongate and compressed. Dorsal profile of head straight or very slightly concave. Dorsal profile of body distinctly convex from rear of head to origin of rayed dorsal fin, more so in larger specimens; straight or somewhat convex and posteroventrally slanted at base of dorsal fin, convex from base of last dorsal-fin ray to caudal peduncle, particularly in larger specimens. Dorsal surface of body with median keel anterior to rayed dorsal fin, smoothly rounded transversely posterior to fin. Ventral profile of body gently curved from tip of lower jaw to caudal peduncle, more convex posteriorly. Prepelvic region flattened, margined laterally by distinct, nearly right, angles in body wall; prepelvic region with median series of enlarged scales flanked on each side by series of enlarged scales that conform in shape to lateral angles of body. Distinct median keel posterior to pelvic fin insertion with secondary obtuse angle in body wall about two scales dorsal of ventral midline on each side of postpelvic portion of body.

Greatest body depth at origin of rayed dorsal fin, depth 0.38–0.44 [0.42]; snout tip to origin of rayed dorsal fin 0.50–0.54 [0.51]; snout tip to origin of anal fin 0.78–0.83 [0.79]; snout tip to origin of pelvic fin 0.50–0.58 [0.52]; snout tip to anus 0.75–0.79 [0.76]; origin of rayed dorsal fin to hypural joint 0.55–0.59 [0.57]. Rayed dorsal fin pointed, less so with increasing age; anteriormost rays 3.7–4.7 times length of ultimate ray. Pectoral fin pointed; length of pectoral fin 0.20–0.23, extends to or slightly beyond vertical through origin of pelvic fin. Pelvic fin pointed, length of pelvic fin 0.22–0.27, reaches approximately two-thirds to three-quarters distance to

FIGURE 36.—*Curimata cisandina*, USNM 267323, 84.5 mm SL; Brazil, Roraima, Rio Branco.

origin of anal fin. Caudal fin forked. Adipose fin well developed. Anal fin emarginate, anteriormost branched rays twice length of ultimate ray. Caudal peduncle depth 0.11–0.13 [0.12].

Head distinctly pointed, head length 0.31–0.37 [0.31]; upper jaw longer; mouth inferior; lower jaw triangular in ventral view; snout length 0.30–0.35 [0.34]; nostrils of each side of head very close, anterior circular, posterior crescent shaped with aperture closed by thin flap of skin that separates nares; orbital diameter 0.30–0.35 [0.31]; adipose eyelid present, with vertically ovoid opening over center of eye; length of postorbital portion of head 0.36–0.41 [0.38]; gape width 0.24–0.31 [0.30]; interorbital width 0.40–0.45 [0.42].

Pored lateral-line scales from supracleithrum to hypural joint 44 to 52 [49]; all scales of lateral-line pored, canals in scales straight; 4 to 8 series of scales extend beyond hypural joint onto caudal fin base; 12 to 15 [15] scales in transverse series from origin of rayed dorsal fin to lateral line, 7 to 9 [9] scales in transverse series from lateral line to origin of anal fin; scale margins slightly ctenoid, more so ventrally.

Dorsal-fin rays ii,9 [ii,9]; anal-fin rays ii,10–12 or iii,10 [ii,12]; pectoral-fin rays 14 to 16 [14]; pelvic-fin rays i,8–9 [i,8].

Total vertebrae 30 (1), 31 (58), 32 (1).

COLOR IN LIFE.—Overall coloration bright silvery, median and paired fins with slight reddish tint.

COLOR IN ALCOHOL.—Overall coloration of specimens retaining guanine on scales golden or silvery golden, darker on dorsal portions of head and body. Specimens lacking guanine on scales tannish-brown to brown. Middorsal line quite

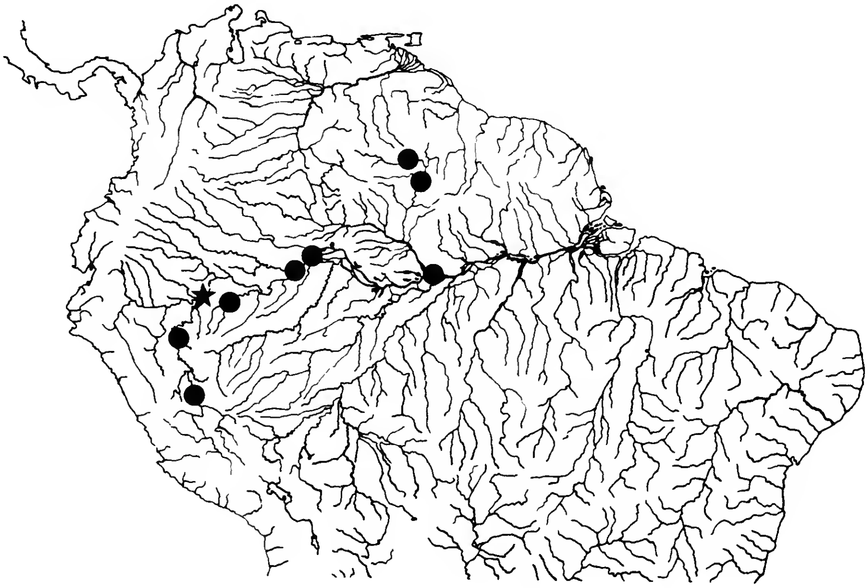

FIGURE 37.—Geographic distribution of *Curimata cisandina* (star = holotype locality; some symbols represent more than one collecting locality or lot of specimens).

TABLE 4.—Morphometrics and meristics of (A) holotype of *Curimata cisandina*, USNM 167834, formerly IU 17850, (B) holotype of *Lambepiedra alleni*, CAS 57144, and (C) range for all specimens of *Curimata cisandina* from which counts and measurements were taken. (Standard length is expressed in mm; measurements 1 to 10 are proportions of standard length; 11 to 14 are proportions of head length; dash indicates missing data.)

Character	A	B	C
		MORPHOMETRICS	
Standard Length	121.5	80.9	55.5–121.5
1. Greatest Body depth	0.42	0.41	0.38–0.44
2. Snout to dorsal-fin origin	0.51	0.52	0.50–0.54
3. Snout to anal-fin origin	0.79	0.80	0.78–0.83
4. Snout to pelvic-fin origin	0.52	0.56	0.50–0.58
5. Snout to anus	0.76	0.75	0.75–0.79
6. Origin of rayed dorsal fin to hypural joint	0.57	0.56	0.55–0.59
7. Pectoral fin length	—	0.22	0.20–0.23
8. Pelvic fin length	—	0.25	0.22–0.27
9. Caudal peduncle depth	0.12	0.12	0.11–0.13
10. Head length	0.31	0.34	0.31–0.37
11. Snout length	0.34	0.34	0.30–0.35
12. Orbital diameter	0.31	0.33	0.30–0.35
13. Postorbital length	0.38	0.36	0.36–0.41
14. Interorbital width	0.42	0.42	0.40–0.45
		MERISTICS	
Lateral line scales	49	50	44–52
Scale rows between dorsal-fin origin and lateral line	15	14	12–15
Scale rows between anal-fin origin and lateral line	9	8	7–9
Branched dorsal-fin rays	9	9	9
Branched anal-fin rays	12	10	10–12
Total pectoral-fin rays	14	15	14–16
Branched pelvic-fin rays	8	9	8–9
Vertebrae	31	31	30–32

dark from rear of rayed dorsal fin to upper portion of caudal peduncle. Anterior margin and distal portions of rayed dorsal fin dusky.

DISTRIBUTION.—Rio Branco and Rio Solimões (Figure 37).

COMMON NAME.—Peru: Julilla (Ortega and Vari, 1986:11).

REMARKS.—Allen (in Eigenmann and Allen, 1942:290) first described *Psectrogaster cisandinus* based on eight specimens collected at four localities. It is questionable whether Allen had IU 15842 available when finishing his description of *P. cisandinus* since the collection data for that material presented in the publication is incomplete and I have been unable to locate the lot in the depositories known to contain the specimens reported on by Eigenmann and Allen. In the text Allen states that of the three specimens in IU 17850 collected at Iquitos, "the largest [is] the type". In the same work, the caption to plate XIV, figure 3 lists another specimen (IU 15834) from the Río Paranapura as the "type". The explicit designation in the text, which furthermore has page priority, is considered the correct type citation.

An examination of the holotype and other available specimens listed by Allen shows that his material of *Psectrogaster cisandinus* consists of three species. The holotype (IU 15850, now USNM 167384), the two specimens from Lago Cashiboya (IU 17851, originally two specimens, one specimen later made the holotype of *Lambepeidra alleni* Fernández-Yépez (now CAS 57144), the other now USNM 167805), and one of the two specimens listed from the Río Nanay, Iquitos (IU 15837, now USNM 167803) are *Curimata cisandina*. The two other specimens collected with the type (IU 15834, now USNM 167834) at Iquitos are actually an individual of *Psectrogaster amazonica* (USNM 268199) and a specimen of *Curimata aspera* (USNM 268200). The single specimen from the Río Paranapura (IU 15834, now UMMZ 185271) is *Curimata aspera*.

Fernández-Yépez (1948:62) described *Lambepiedra alleni* from a single specimen from Lago Cashiboya (IU 17851) previously identified by Allen (in Eigenmann and Allen, 1942:290) as *Psectrogaster cisandinus*. The purported differences in mouth position cited by Fernández-Yépez (1948: key following p. 16) as distinguishing the two nominal species are not apparent in the types. Neither has any other meristic or morphometric difference been found to distinguish the two nominal species (Table 4). *Lambepiedra alleni* is consequently placed into synonymy of *Curimata cisandina*.

In their description of *Curimatus simulatus* Eigenmann and Eigenmann (1889:430) noted that part of the syntypic series from Fonteboa (= Fonte Boa) differed from the remaining specimens in that series both in body form and other characters. A re-examination has shown that the three distinctive specimens in the material examined by the Eigenmanns (MCZ 60886) are actually *Curimata cisandina*. In the same publication, those authors questionably associated some specimens from San Paolo (= Saõ Paulo de Olivença) in the Rio Amazonas basin with their species, *C. macrops*, an endemic of the rivers of northeastern Brazil. Three of the specimens (MCZ 20221) are actually *C. cisandina*.

MATERIAL EXAMINED.—85 specimens (42, 55.5–121.5)

BRAZIL. *Roraima*: Rio Branco, USNM 267323, 1. Rio Branco at Bem Querrer, USNM 267352, 28 (15, 55.5–71.4); NMW 68862, 1. Rio Uraraicoera, opposite Ilha de Maraca, USNM 267956, 4 (112.7–127.9); MZUSP 32256, 10. Rio Branco, Marara, MZUSP 28723, 6. *Amazonas*: Ilha da Marchantaria, USNM 229171, 2 (84.9–89.2). USNM 267328, 1 (86.2). Fonteboa (= Fonte Boa), MCZ 60886, 3 (103.5–113.8, paralectotypes of *Curimatus simulatus*; out of MCZ 20198); MZUSP 21032, 4 (98.2–107.2). Rio Solimões near mouth of Rio Jutai, MZUSP 20991, 1 (97.8); MZUSP 21015, 2 (98.8–99.0). Vicinity of Manaus, MZUSP 28722, 4 (2, 81.4–98.3). San Paolo (= Saõ Paulo de Olivença), MCZ 20221, 3. Hyavary (= Rio Javari), MCZ 20233, 1.

PERU. *Loreto*: Iquitos, Río Nanay, USNM 167803 (formerly IU 17851), 2 (89.3–89.7, paratypes of *Psectrogaster cisandinus*); USNM 167834 (formerly IU 17850), 1 (121.5, holotype of *Psectrogaster cisandinus*). Río Nanay near Llanchama Cocha, NRM SOK/1984324.4055, 1. Río Nanay near Quebrada Agua Negra, NRM SOK/1984326.4044, 3. Río Itaya, lower portions, USNM 280425, 1. Lago Cashiboya (near Contamana), USNM 167805 (formerly IU 17851 in part, paratype of *Psectrogaster cisandinus*), 1 (84.5); CAS 57144, 1 (80.9, holotype of *Lambepiedra alleni*, paratype of *Psectrogaster cisandinus*, formerly IU 17851). *Ucayali*: Río Yavari, near Petropolis, USNM 261437, 1. Río Ucayali, Masisea, USNM 261483, 2 (87.2–97.4). Masisea, USNM 261472, 1 (113.7).

Curimata aspera Günther

FIGURES 38, 39, 40

Curimatus asper Günther, 1868a:243, fig. 8 [type locality: Río Huallaga and

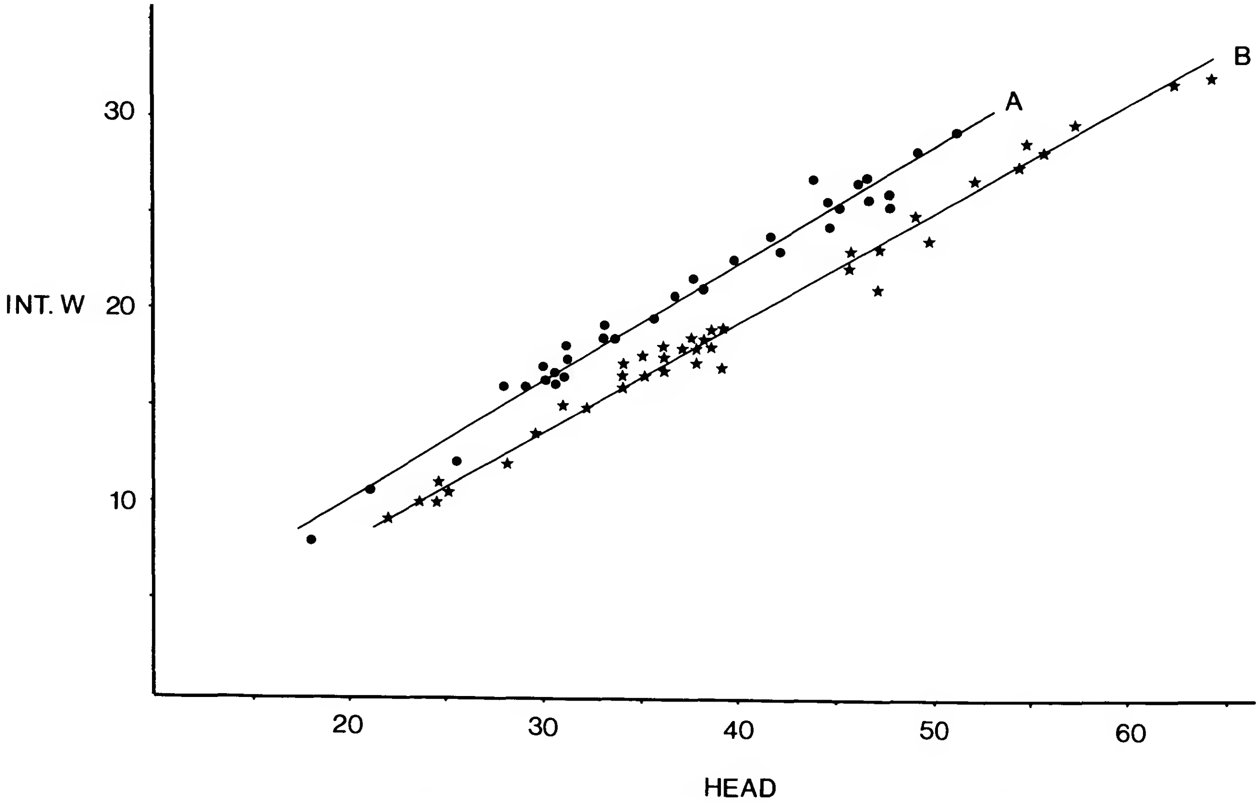

FIGURE 38.—Plot of interorbital width (INT. W) against head length (HEAD), both in millimetres, for examined specimens of *Curimata cerasina* (A) and *Curimata aspera* (B), with regression lines for each species (some symbols represent more than one specimen).

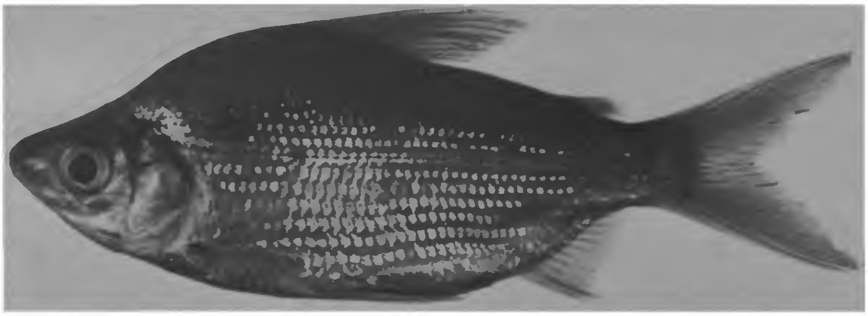

FIGURE 39.—*Curimata aspera*, AMNH 35682, 96.7 MM SL; Peru, Ucayali, Río Ucayali.

Xeberos (= Jeberos)]; 1868b:478 [on 1868a].—Eigenmann and Eigenmann, 1889:426 [reference]; 1891:47 [reference].—Eigenmann, 1910:422 [reference].—Vari, 1989, tables 2, 3 [phylogenetic relationships].

Curimatus simulatus Eigenmann and Eigenmann, 1889:430 [type locality: Brazil, Tonantins, Fonteboa (= Fonte Boa]; 1891:48 [reference].—Eigenmann, 1910:422 [reference].

Curimata aspera.—Fowler, 1942:208 [reference].—Eigenmann and Allen, 1942:293 [Peru: Gosulimacocha].—Fowler, 1945:278 [literature compilation].—1950:278, fig. 336 [reference].—Géry, 1977a:230 [in key].—Ortega and Vari, 1986:11 [Peru; common name].—Vari, 1989, tables 2, 3 [phylogenetic relationships].

Psectrogaster cisandinus.—Allen, in Eigenmann and Allen, 1942:290 [in part, specimen from Río Paranapura, Peru].

Curimata simulata.—Eigenmann and Allen, 1942:298 [Peru: Lago Sanango].—Fowler, 1945:118 [copied]; 1950:292 [reference].—Géry, 1977b:230 [in key].

Camposella simulata.—Fernández-Yépez, 1948:60, fig. 32 [designated as type species of *Camposella*; *Camposella* preoccupied in Diptera, replaced with *Camposichthys*, Whitley, 1953:134].—Fowler, 1975:367 [reference].

Bitricarinata aspera.—Fernández-Yépez, 1948:65 [assignment to *Bitricarinata*].—Fowler, 1975:366 [reference in part, not placement of *Curimatus alburnus caudimaculatus* Pellegrin, 1909, *Lepipinna immaculata* Fernández-Yépez, 1948, and *Curimatus alburnus lineatus* Eigenmann and Eigenmann, 1889 as subspecies].

Camposichthys simulatus.—Whitley, 1953:134 [designation as type species of *Camposichthys*, replacement for *Camposella* preoccupied in Diptera; *Camposichthys* preocupied in fishes, replaced with *Stupens*, Whitley 1954:30].

Stupens simulatus.—Whitley, 1954:30 [designation as type species of *Stupens*, replacement for *Camposichthys* preoccupied in fishes].

DIAGNOSIS.—The 10 or 11 branched anal-fin rays and 44 to 54 pored lateral-line scales to the hypural joint in *Curimata aspera* distinguish it from all other members of the genus with the exception of *C. cisandina* and *C. cerasina*. The interborbital width (0.46–0.52 of HL) in *C. aspera* separates it from both C. *cisandina* (0.40–0.45) and *C. cerasina* (0.53–0.57) (see Figure 38). *Curimata aspera* is further distinguishable from *C. cisandina* in having a more rotund body, in typically having 32 vertebrae contrary to the 31 that characterize the latter species, and in numerous internal characters (see "Synapomorphy List and Phylogenetic Reconstruction"). *Curimata aspera* can additionally be distinguished from *C. cerasina* by differences in gape width (0.27–0.35 versus 0.35–0.40) and in the more rotund body of *C. cerasina*.

DESCRIPTION.—Body moderately elongate, somewhat compressed, more so in larger specimens. Dorsal profile of head straight or very slightly concave over orbit. Dorsal profile of body distinctly convex from rear of head to origin of rayed dorsal fin; straight and posteroventrally slanted at base of dorsal fin, gently convex from base of last dorsal-fin ray to caudal peduncle, convexity more pronounced in larger specimens. Dorsal surface of body with indistinct median keel anterior to rayed dorsal fin, smoothly rounded transversely posterior to fin. Ventral profile of body gently curved from tip of lower jaw to caudal peduncle, more convex posteriorly. Prepelvic region flattened, margined laterally with distinct, nearly right, angles in bvody wall that extend from level of vertical through origin of pectoral fin to origin of pelvic fins. Prepelvic region with median series of enlarged scales, median scale series flanked on each side by series of enlarged scales that conform in shape to lateral angle of body. Well developed median keel posterior to pelvic fin origin with secondary obtuse angle in body wall about two scales dorsal of ventral midline on each side of postpelvic portion of body.

Greatest body depth at origin of rayed dorsal fin, depth 0.38–0.44 [0.39]; snout tip to origin of rayed dorsal fin 0.50–0.54 [0.52]; snout tip to origin of anal fin 0.76–0.83 [0.80]; snout tip to origin of pelvic fin 0.50–0.54 [0.50]; snout tip to anus 0.70–0.78 [0.76]; origin of rayed dorsal fin to hypural joint 0.54–0.60 [0.58]. Rayed dorsal fin pointed, anteriormost rays 3.5–4.2 times length of ultimate ray. Pectoral fin pointed; length of pectoral fin 0.21–0.26 [0.23], extends to or slightly beyond vertical through origin of pelvic fin in smaller adults. Pelvic fin pointed, length of pelvic fin 0.25–0.31 [0.27], reaches three-quarters of distance to origin of anal fin. Caudal fin forked. Adipose fin well developed. Anal fin emarginate, anteriormost branched rays 2.5–3.2 times length of ultimate ray. Caudal peduncle depth 0.12–0.14 [0.13].

Head obtusely pointed, wide, head length 0.31–0.36 [0.31]; upper jaw longer; mouth inferior; lower jaw rounded in ventral view; snout length 0.28–0.36 [0.33]; nostrils of each side of head very close, anterior circular, posterior crescent shaped with aperture nearly closed by flap of skin separating nares; orbital diameter 0.28–0.33 [0.31]; adipose eyelid well-developed, with vertically ovoid opening over center of eye; length of postorbital portion of head 0.36–0.44 [0.42]; gape

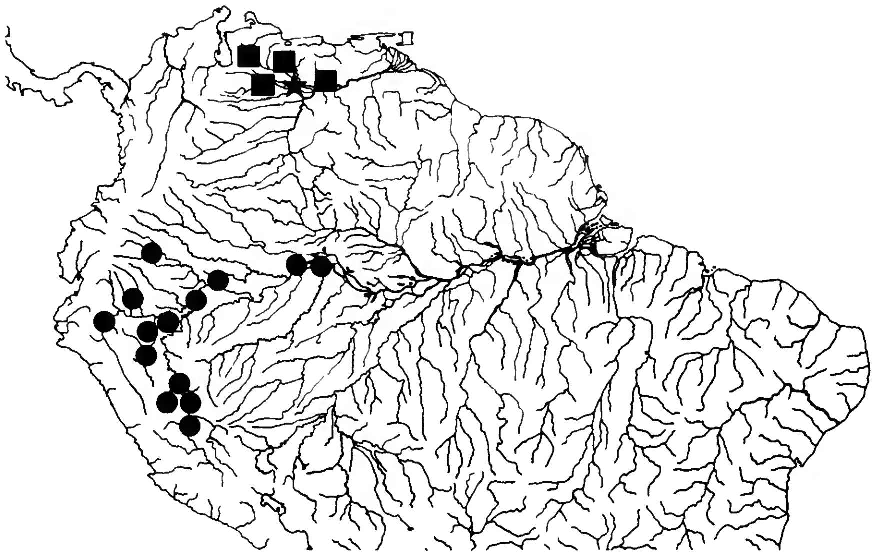

FIGURE 40.—Geographic distribution of *Curimata aspera* (filled circles) and *Curimata cerasina* (star = holotype locality, squares = sites of other collections) (some symbols represent more than one collecting locality or lot of specimens).

width 0.27–0.36 [0.28]; interorbital region wide, width 0.46–0.52 [0.49].

Pored lateral-line scales from supracleithrum to hypural joint 43 to 54 [46]; all scales of lateral-line pored, canals in scales straight, 5 to 8 series of scales extend beyond hypural joint onto caudal fin base; 13 to 16 [14] scales in transverse series from origin of rayed dorsal fin to lateral line; 8 to 10 [9] scales in transverse series from lateral line to origin of anal fin; scales slightly ctenoid, particularly ventrally.

Dorsal-fin rays ii,8–10 [ii,9]; anal-fin rays ii,10–11 or iii,10–11 [ii,10]; pectoral-fin rays 13 to 16 [15]; pelvic-fin rays i,9–10 [i,9].

Total vertebrae 31 (2), 32 (37), 33 (2).

COLOR IN LIFE.—Overall body coloration bright silver. Belly and pelvic fins red (H. Ortega, pers. comm.)

COLOR IN ALCOHOL.—Specimens that retain guanine on scales golden or silvery-golden, darker on dorsal portions of head and body. Specimens that lack guanine on scales yellowish to light brown. No pronounced pigmentation pattern on head or body. Dorsal- and caudal-fin rays outlined by series of small chromatophores. Proximal two-thirds of rayed dorsal fin very dusky in some individuals. Comparable pigmentation present, but less developed, on paired fins and anterior portion of anal fin in some specimens.

DISTRIBUTION.—Upper portion of the Rio Amazonas drainage basin (Figure 40).

COMMON NAME.—Peru: Chio-chio (Ortega and Vari, 1986:11).

REMARKS.—Günther (1868a:243) described *Curimatus asper* from four specimens collected by Bartlett on the Río Huallaga and at Xeberos. The smallest specimen of the two individuals from the Huallaga is actually a specimen of *Psectrogaster rutiloides* (Kner) (BMNH 1867.6.13:85). One of the two other syntypes from that locality (124.1 mm SL) is designated the lectotype of *Curimatus aspera* (BMNH 1867.6.13:83). The remaining specimens from the Huallaga (BMNH 1867.13:84–85) and the specimen from Xeberos (= Jeberos) (BMNH 1867.6.13:48) thus become paralectotypes of that species. The type series of *Psectrogaster cisandinus* of Allen (in Eigenmann and Allen, 1942:290) contains two species in addition to that nominal species. The single specimen reported on from Río Paranapura (UMMZ 185271, formerly IU 15834) is actually *Curimata aspera,* as is one of the specimens from Iquitos (USNM 268200, formerly IU 17850, see also "Remarks" under *C. cisandina*).

Eigenmann and Eigenmann (1889:415 and 417) in their revision of the then-known species of curimatids separated their nominal species *Curimatus simulatus* from Günther's *C. aspera* at the third major couplet in their key. *Curimata aspera* was supposedly characterized by a "Postventral region rounded or with an obtuse median keel" whereas *C. simulata* was described as having the "Postventral region trenchent." An examination of the type series of both species has not revealed any difference between the specimens in the form of the postpelvic region. Neither has any other difference between the nominal species been noted in pigmentation, meristics or morphometrics (Table 5) that justifies the continued recognition of a distinct *Curimatus simulatus.*

The original description of *Curimatus simulatus* by Eigenmann and Eigenmann (1889:430) was based on three specimens from Tonantins and five from Fonteboa (= Fonte Boa). Those authors noted that three of the specimens from the

TABLE 5.—Morphometrics and meristics of (A) lectotype of *Curimata aspera*, BMNH 1867.6.13:83, (B) paralectotypes of *C. aspera*, BMNH 1867.6.13: 48 and 84, (C) lectotype of *Curimatus simulatus*, MCZ 20198, (D) paralectotypes of *C. simulatus*, MCZ 20194 and 69885, and (E) all specimens of *Curimata aspera* from which counts and measurements were taken. (Standard length is expressed in mm; measurements 1 to 10 are proportions of standard length; 11 to 14 are proportions of head length; dash indicates missing data.)

Character	A	B	C	D	E
			MORPHOMETRICS		
Standard Length	124.0	121.5–144.5	104.3	109.1–115.4	46.2–212.4
1. Greatest body depth	0.39	0.38–0.39	0.43	0.40–0.43	0.38–0.44
2. Snout to dorsal-fin origin	0.52	0.50–0.52	0.52	0.52–0.54	0.50–0.54
3. Snout to anal-fin origin	0.80	0.76–0.81	0.81	0.76–0.81	0.76–0.83
4. Snout to pelvic-fin origin	0.50	0.50–0.53	0.52	0.50–0.52	0.50–0.54
5. Snout to anus	0.76	0.74–0.76	0.77	0.73–0.78	0.70–0.78
6. Origin of rayed dorsal fin to hypural joint	0.58	0.57–0.58	0.60	0.58–0.60	0.54–0.60
7. Pectoral fin length	0.23	—	0.26	0.23–0.24	0.21–0.26
8. Pelvic fin length	0.27	—	0.30	0.25–0.29	0.25–0.31
9. Caudal peduncle depth	0.13	0.12–0.13	0.14	0.13	0.12–0.14
10. Head length	0.31	0.32–0.33	0.33	0.31–0.33	0.31–0.36
11. Snout length	0.33	0.32	0.32	0.31–0.32	0.28–0.36
12. Orbital diameter	0.31	0.30–0.31	0.29	0.28–0.29	0.28–0.33
13. Postorbital length	0.42	0.42–0.44	0.44	0.42–0.43	0.36–0.44
14. Interorbital width	0.47	0.47–0.48	0.47	0.46–0.47	0.46–0.52
			MERISTICS		
Lateral line scales	46	45–46	44	44–49	43–54
Scale rows between dorsal-fin origin and lateral line	14	14–15	14	13–16	13–16
Scale rows between anal-fin origin and lateral line	9	9–10	10	9–10	8–10
Branched dorsal-fin rays	9	9	9	9	8–10
Branched anal-fin rays	10	10–11	10	9–10	10–11
Total pectoral-fin rays	15	15–16	15	14–16	13–16
Branched pelvic-fin rays	9	9	9	9	9–10
Vertebrae	32	32–33	32	32	31–3

latter locality differed from the remaining syntypes in body form and certain other characters. A re-examination of the three cited individuals has shown that they are actually *Curimata cisandina* (MCZ 60886; out of MCZ 20198). One of the two remaining syntypes of *C. simulatus* from Fonte Boa (a 104.3 mm SL specimen, MCZ 20198) is designated as the lectotype of the species. The remaining syntypes from that locality (MCZ 60885; out of MCZ 20198) and the specimens from the Tonantins (MCZ 20194) thus become paralectotypes of the species.

Fowler (1975:366) recognized four taxa within what he termed *Bitricarinata aspera*. Those were *B. aspera* itself, *B. aspera caudimaculata* (based on *Curimatus alburnus caudimaculatus* Pellegrin [1909:150]), *B. aspera immaculata* (based on *Lepipinna immaculata* Fernández-Yépez [1948:27]), and *B. aspera lineatus* (based on *Curimatus alburnus lineatus* Eigenmann and Eigenmann [1889:419]). No explanation was provided for this significant shift in the taxonomy of these taxa. Examination of the types of all of the species has shown that none of the three nominal subspecies incorporated into *Curimata aspera* by Fowler is conspecific with that species, and indeed that all of those proposed subspecies are actually more closely related to species of the lineage recognized by Vari (1989, tables 2, 3) as *Curimatella*.

MATERIAL EXAMINED.—57 specimens (50, 46.2–212.4).

BRAZIL. *Amazonas*: Tonantins, MCZ 20194, 3 (112.2–115.4, paralectotypes of *Curimatus simulatus*). Fonteboa (= Fonte Boa). MCZ 20198, 1 (104.3, lectotype of *Curimatus simulatus*); MCZ 69885, 1 (109.1, paralectotype of *Curimatus simulatus*; out of MCZ 20198).

PERU. *Loreto*: Río Huallaga, BMNH 1867.6.13:83, 1 (124.0, lectotype of *Curimatus asper*); BMNH 1867.6.13:84, 1 (144.5, paralectotype of *Curimatus asper*). Xeberos (= Jeberos), BMNH 1867.6.13:48, 1 (121.5, paralectotype of *Curimatus asper*). Río Amazonas, USNM 267345, 1 (103.8). Río Paranapura, UMMZ 185271 (formerly IU 15834), 1 (116.9, paratype of *Psectrogaster cisandinus*). Río Gálvez, upstream of Colonia Angamos, NRM SOK/1984312.4057, 2. Iquitos, USNM 268200, 1 (paratype of *Psectrogaster cisandinus*, formerly IU 17850). Río Marona, USNM 267526, 1 (149.7).

Cocha Agujal, Iquitos, MZUSP 15240, 1 (120.7). Río Corrientes, MZUSP 15239, 1 (160.7); MZUSP 15242, 1 (157.4). Río Ampiyacu near Pebas, USNM 267332, 1 (114.7); SU 36591, 1 (145.0). Lago Sanango, IU 15821, 1 (144.0); USNM 267320 (? formerly IU 15821), 1 (123.4). Pevas, MNRJ 4104, 1. Río Putomayo, El Estrecho, NRM SOK/1986295.5288, 1. *Ucayali*: Iparia National Forest, BMNH 1969.7.15.42, 1 (126.8). Río Ucayali, Betel, AMNH uncat., 2 (58.3–66.1). Río Ucayali, AMNH 35682, 1 (96.7). Río Ucayali, Pucallpa, USNM 261394, 2 (70.1–73.1). Río Neshuya at Pucallpa-Huanuco Road, USNM 261408, 2 (46.2–47.0), USNM 261398, 1 (128.0). Río Tamaya, USNM 243242, 3 (85.7–102.4). Río Tamaya near Masisea, USNM 261466, 1 (102.8). Masisea, USNM 261470, 2 (102.0–111.7). Pucallpa, Romainecocha, MZUSP 26450, 3 (103.3–115.2). Lago Jarinococha, BMNH 1977.3.10.168–169, 2 (70.1–84.3). *Amazonas*: La Poza, LACM 36318-9, 1. *Huanuco*: Río Pachitea near Tournavista, ANSP 119891, 1 (180.3).

ECUADOR. *Napo Pastaza*: Río Aguarico at Santa Cecilia, ANSP 130464, 1 (212.4). Río Napo at Coca, MCZ 51878, 5 (179.4–221.4). Mouth of Río Pañayacu, ANSP 137615, 6 (5, 113.2–125.6).

Curimata cerasina Vari

FIGURES 38, 40, 41

Curimatus schomburgkii.—Mago-Leccia, 1967:254 [Venezuela: Llanos of Río Orinoco basin].

Curimata sp.—Roman, 1983:97 [Venezuela: Río Orinoco basin; common name].

Curimata cerasina Vari, 1984b:30, fig. 1 [type locality: Venezuela, San Fernando de Apure].—Machado-Allison, 1987:48, 68, 72, 93–95 [fecundity, breeding, development], Machado-Allison et al., in Machado-Allison, 1987:135 [common name].—Vari, 1989, tables 2, 3 [phylogenetic relationships].

DIAGNOSIS.—*Curimata cerasina* can be distinguished from other species of *Curimata*, and indeed all other curimatids by the very wide interorbital region which is 0.53–0.58 of HL in contrast to 0.36–0.52 for all other species of *Curimata*. Only *Curimata aspera*, a species endemic to the Rio Amazonas basin, has an interorbital width (0.46–0.52) approaching, although distinct from, that of *C. cerasina* (see Figure 38). Differences in gape width (0.27–0.35 in *C. aspera* vs. 0.35–0.40 for *C. cerasina*) and the more robust body of *C. cerasina* further separate these forms.

DESCRIPTION.—Body moderately elongate, robust, more so in larger specimens, particularly females in spawning condition. Dorsal profile of head very slightly concave above orbit in smaller specimens, straight in larger individuals. Dorsal profile of body convex from rear of head to origin of rayed dorsal fin; straight and posteroventrally slanted at base of dorsal fin, gently convex from base of last dorsal-fin ray to caudal peduncle, convexity more pronounced in larger specimens. Dorsal surface of body with indistinct median keel anterior to rayed dorsal fin, smoothly rounded transversely posterior to fin. Ventral profile of body gently curved from tip of lower jaw to caudal peduncle, convexity more pronounced posteriorly. Prepelvic region flattened, margined laterally by distinct, nearly right, angles in body wall that extend from level of vertical through origin of pectoral fin to origin of pelvic fin. Median series of enlarged scales in prepelvic region flanked on each side by series of enlarged scales that conform in shape to lateral angle of prepelvic portion of body. Well developed median keel posterior to pelvic fin insertion with secondary obtuse keel about two scales dorsal of ventral midline on each side of postpelvic portion of body.

Greatest body depth at origin of rayed dorsal fin, depth 0.41–0.48 [0.44]; snout tip to origin of rayed dorsal fin 0.52–0.56 [0.53]; snout tip to origin of anal fin 0.81–0.85 [0.85]; snout tip to origin of pelvic fin 0.52–0.58 [0.54]; snout tip to anus 0.78–0.82 [0.81]; origin of rayed dorsal fin to hypural joint 0.52–0.58 [0.58]. Rayed dorsal fin pointed, anteriormost rays 3.7–5.3 times length of ultimate ray. Pectoral

FIGURE 41.—*Curimata cerasina*, paratype, USNM 257086, 125.6 mm SL; Venezuela, Estado Apure, 15 km southeast of San Fernando de Apure.

fin pointed; length of pectoral fin 0.17–0.25 [0.24], extends to or slightly beyond vertical through origin of pelvic fin. Pelvic fin pointed, length of pelvic fin 0.17–0.25 [0.24], reaches three-quarters of distance to origin of anal fin. Caudal fin forked. Adipose fin well developed. Anal fin emarginate, anteriormost branched rays 2.5–3.2 times length of ultimate ray. Caudal peduncle depth 0.12–0.15 [0.14].

Head obtusely pointed in profile, very wide; head length 0.30–0.35 [0.32] in specimens over 75 mm SL (0.37–0.38 in specimens of 45.0–55.0 mm SL); upper jaw longer, mouth inferior, teeth present in larvae, but absent in adults (Machado-Allison, 1987:72), snout length 0.32–0.39 [0.36]; nostrils of each side of head very close, anterior circular, posterior crescent shaped with aperture largely closed by flap of skin that separates nares; orbital diameter 0.25–0.32 [0.28]; adipose eyelid present, most developed anteriorly, with vertically ovoid opening over middle of eye; length of postorbital portion of head 0.39–0.46 [0.44]; gape width 0.34–0.39 [0.39], specimens under 18.0 mm SL with single series of conical teeth in each jaw, no teeth in jaws in larger specimens; interorbital region very wide, width 0.53–0.58 [0.57].

Pored lateral-line scales from supracleithrum to hypural joint 42 to 46 [45]; canals in scales straight; all scales of lateral line pored in larger specimens, individuals under 33.0 mm SL with lateral line incompletely pored, 4 to 6 series of scales extend beyond hypural joint onto caudal fin base; 13 to 15 [14] scales in transverse series from origin of rayed dorsal fin to lateral line, 8 to 11 [9] scales in transverse series from the lateral line to origin of anal fin; 12 to 15 [14] enlarged scales in midventral series anterior to insertion of pelvic fins; scales somewhat ctenoid, ctenii more developed in larger specimens, more so on ventral portion of body.

Dorsal-fin rays ii,9–10 (ii–10 rare), iii,9 [ii,9]; anal-fin rays ii,10–11, iii,10–11 [ii,11]; pectoral-fin rays 14 to 16 [15]; pelvic-fin rays i,8–9 [i,9].

Total vertebrae 31 (2), 32 (37), 33 (1).

Color in Life.—Overall body coloration bright silver. A relatively large patch of intense red pigmentation on ventral and lateral surfaces of body surrounding region of origin of pelvic fin. Red coloration extends anteriorly to vertical through origin of pectoral fin, posteriorly two-thirds of distance from origin of pelvic fin to anus, slightly further in larger specimens, and dorsally to level of horizontal through origin of pectoral fin. Pelvic fins intense red. Dorsal fin rays edged with red. Caudal and anal fin rays red distally.

Color in Alcohol.—Overall coloration in specimens that retain guanine on scales silvery or silvery-golden; darker on dorsal portions of head and body. Specimens that lack guanine on scales pale yellow to brown, darker on dorsal portions of head and body. Chromatophores more concentrated on scale centers in some specimens; darker pigmentation aligned to form faint longitudinal bands along scale series. No pronounced pigmentation pattern on head or body. Margins of median fins dusky, fin rays outlined by series of small chromatophores. Pelvics somewhat dusky in some individuals.

Distribution.—Central portions of Río Orinoco drainage basin (Figure 40).

Ecology.—*Curimata cerasina* inhabits rivers, ponds and other highly turbid still waters, typically over muddy bottoms. The species is common in the lower lying regions of the Llanos (savannahs) that are most subject to seasonal flooding (Machado-Allison, 1987:68; pers. observ.). Females with ripe ovaries were present in collections made in late March and April, with each female producing over 100,000 eggs (Machado-Allison, 1987:48, 68). The species breeds in the main channels of the watercourses in the Llanos, with juveniles of 17.0–60.0 mm SL captured in floating and emergent vegetation in late July and August. The larvae of the species feed on copepods and cladocerans utilizing oral dentition that is lost ontogenetically (Machado-Allison, 1987:72).

Common Name.—Bocachica (Roman, 1983:97), Boca chico (Machado-Allison et al., in Machado-Allison, 1987:135).

Remarks.—Mago-Leccia (1967:254) reported *Curimatus schomburgkii* from the Llanos of Venezuela. That report is apparently based on specimens of *Curimata cerasina.*

Material Examined.—96 specimens (87, 17.0–167.3 mm SL).

VENEZUELA. *Apure*: Flooded area along road from San Fernando de Apure to Arichuna, 15 km southeast of San Fernando de Apure, MBUCV V-14025, 1, (149.6, holotype of *C. cerasina)*; USNM 257086, 3 (125.6–139.8, paratypes of *C. cerasina*); AMNH 54629, 1 (133.3, paratype of *C. cerasina*). Río Arauca, La Trinidad de Arauca, MBUCV V-5364, 4 (115.8–120.2). Río Apure Viejo at San Fernando de Apure, MBUCV V-8256, 1 (54.7). Inundated region off Río Apure Viejo, Hacienda La Guamote, near San Fernando de Apure, MBUCV V-11103, 6. Boca Apurito, Río Apure, MBUCV V-9120, 1 (146.0, paratype of *C. cerasina*). Río Apure, mouth of Río Apurito near San Fernando de Apure, MBUCV V-9015, 3 (113.5–167.3, paratypes of *C. cerasina*); ANSP 150195, 1 (145.8, paratype of *C. cerasina*). Canõ el Pavoncito, Río Apure, MBUCV V-2779, 3 (101.7–111.4). Río Apure in front of airport at San Fernando de Apure, USNM 257087, 2 (151.3–160.9, paratypes of *C. cerasina*); AMNH 54628, 1 (145.1, paratype of *C. cerasina*). Río Apure, Los Boquerones, MBUCV V-635, 23 (105.1–135.8). Río Apure at junction with Río Portuguesa, MBUCV V-9334, 1 (111.7, paratype of *C. cerasina*). Canõ off Río Apurito, USNM 258258, 1. Río Arauca, USNM 257526, 2 (1 cleared and counterstained for cartilage and bone). *Guarico*: Río Tiznados, MBUCV V-2844, 1 (146.8). Laguna los Laureles between Camaguan and Canõ Falcon, MBUCV V-6607, 7 (74.7–163.9, paratype of *C. cerasina*); USNM 257085, 1 (89.3, paratype of *C. cerasina*, cleared and counterstained for cartilage and bone); CAS 52169, 2 (90.2–97.4, paratypes of *C. cerasina*); FMNH 94591, 1 (87.9, paratype of *C. cerasina*). Canõ Falcon, MBUCV V-6627, 10 (109.7–159.7). Esteros de Camaguan approximately 8 km north of Camaguan on highway from Calabozo to San Fernando de Apure, MBUCV V-5820, 1 (121.2); MBUCV

V-11845, 1 (105.4, paratype of *C. cerasina*); MBUCV V-11893, 1 (146.0). Flooded borrow pit along side of road from Calabozo to Camaguan, USNM 257088, 2 (91.7–93.6, paratypes of *C. cerasina*); BMNH 1983.3.1:8, 1 (86.0, paratype of *C. cerasina*). Río Portuguesa near La Manga, Camaguan, MBUCV V-8691, 3 (134.0–148.6, paratypes of *C. cerasina*); BMNH 1983.3.1:7, 1 (131.7, paratype of *C. cerasina*). Río Portuguesa at Camaguan, USNM 257084, 2 (85.7–97.5). Río Portuguesa, Laguna Boca Ruido, MBUCV V-5807, 3 (17.0–45.6). Río Manapire, deep pool isolated from the main river channel, La Vega near Santa Rita, MBUCV V-5743, 2 (104.3–106.7, paratypes of *C. cerasina*); MBUCV V-5731, 1 (95.7). *Portuguesa*: Canõ Maraca at bridge on road from Guanarito to Guanare MCZ 54344, 1, (88.3, paratype of *C. cerasina*). *Barinas*: Río Guanare Viejo, Boca de Tortumal, west of La Union, MBUCV V-3631, 1 (92.9).

Phylogenetic Biogeography

The species of the genus *Curimata* inhabit a significant portion of the total range of the family Curimatidae, which in turn occurs through much of South America. Such a broad geographic range in conjunction with a nearly resolved intrageneric phylogeny and detailed distributional information should provide insight into the historical biogeography of the genus, and to lesser degrees into those of the family and the lowland South American freshwater fish fauna.

Vari (1988), focusing on questions of areas of endemism of the Neotropical freshwater fish fauna and alternative hypotheses concerning the relative extent of speciation before and after the uplift of the Andes, discussed some aspects of the zoogeography of *Curimata* and the entire Curimatidae. Suprageneric topics will not, as a consequence, be detailed again in this study. Two primary questions can be addressed by the phylogenetic and distributional data at hand for *Curimata*. First, what are the historical associations of the river basins of South America inhabited by the species of *Curimata* as reflected in the hypothesized relationships of those taxa? Second, to what degree has secondary dispersal been a factor in the history of the members of the genus?

Figure 42 is an area cladogram for the species of *Curimata* in which the species names have been replaced by the areas that they inhabit, a system which simplifies the visualization of geographic distributions across the phylogenetic scheme. Although reduced area cladograms are typically used in such historical biogeographic studies I have chosen not to follow that practice since that would decrease the degree of available information relative to the second question—to what extent has dispersal been a factor in the distribution of the known species of *Curimata*?

Reference to Figure 42 shows that the historical biogeography of the genus has apparently been quite complex. The degree of complexity that we recognize is, to a considerable degree, a function of the speciation model that we are operating under. Although it is not possible to ex post facto determine with certainty the methods of speciation that occurred within *Curimata*, we can draw on available information on the ecology and behavior of the genus as a whole to evaluate the likelihood of alternative models. *Curimata* species undertake long distance spawning and feeding migrations, typically in larger schools, often through rapids and across other barriers. Although the species of *Curimata* have modifications specialized for utilizing detritus, the members of the different genera do not apparently specialize within that general food type. Such highly mobile populations and the lack of any apparent species specific specialization in diet or modes of reproduction make it difficult to conceive of *Curimata* species as undergoing either stasipatric or sympatric speciation. The limitation of *Curimata* species, and indeed all curimatids, to relatively low altitude drainage systems do, however, make them prime candidates for allopatric speciation resulting from vicariance between hydrographic systems. These factors in combination lead me to cast the following discussion within an allopatric speciation framework.

Only two species of *Curimata* do not have distributions overlapping to some degree with that of at least one congeneric. These are *C. macrops* (D) of the rivers of northeastern Brazil and *C. mivartii* (G) of the Río Magdalena system; river systems with overall limited curimatid faunas. The more typical condition for species of *Curimata* and one that is obvious in Figure 42 is the notable, often complete, sympatry between sister clades. That pattern is presumably indicative of secondary dispersal following allopatric spaciation. Such secondary sympatry obscures the underlying vicariance events that lead to speciation in the genus. Several less inclusive subunits of the genus do, however, demonstrate allopatric distributions, which are congruent with a vicariance biogeography model. These allow insight into both area relationships within the South American ichthyofauna, and into the relative timing of some of the speciation events in the Curimatidae.

The most discrete of the allopatric sister pair distributions within *Curimata* involves the three species of node 8 (G = *mivartii*; H = *aspera*; I = *cerasina*). *Curimata mivartii* of the Río Magdalena system is the sister species to the clade consisting of *C. aspera* of the western Amazon and *C. cerasina* of the Orinoco basin. This pattern of relationships is congruent with a hypothesis of a vicariance event between the Río Magdalena following temporally by a vicariance event between the Amazon and Orinoco basins. As noted by Vari (1988) this pattern of relationships and distributions is also interesting in indicating that the majority of the more encompassing speciation events of the genus (Figure 42, nodes 1–4) occurred prior to the Andean vicariance event, a pattern evidently general for the family. Additional allopatric distributions between sister species involve *C. knerii* (F) of the middle and upper Amazon and *C. cyprinoides* (G) of the Guianas and lower Amazon, and *C. roseni* (K) and *C. inornata* (L) of different subsections of the Amazon (see Figures 23 and 26) cannot, however, be similarly tied to specific geologic events at this time.

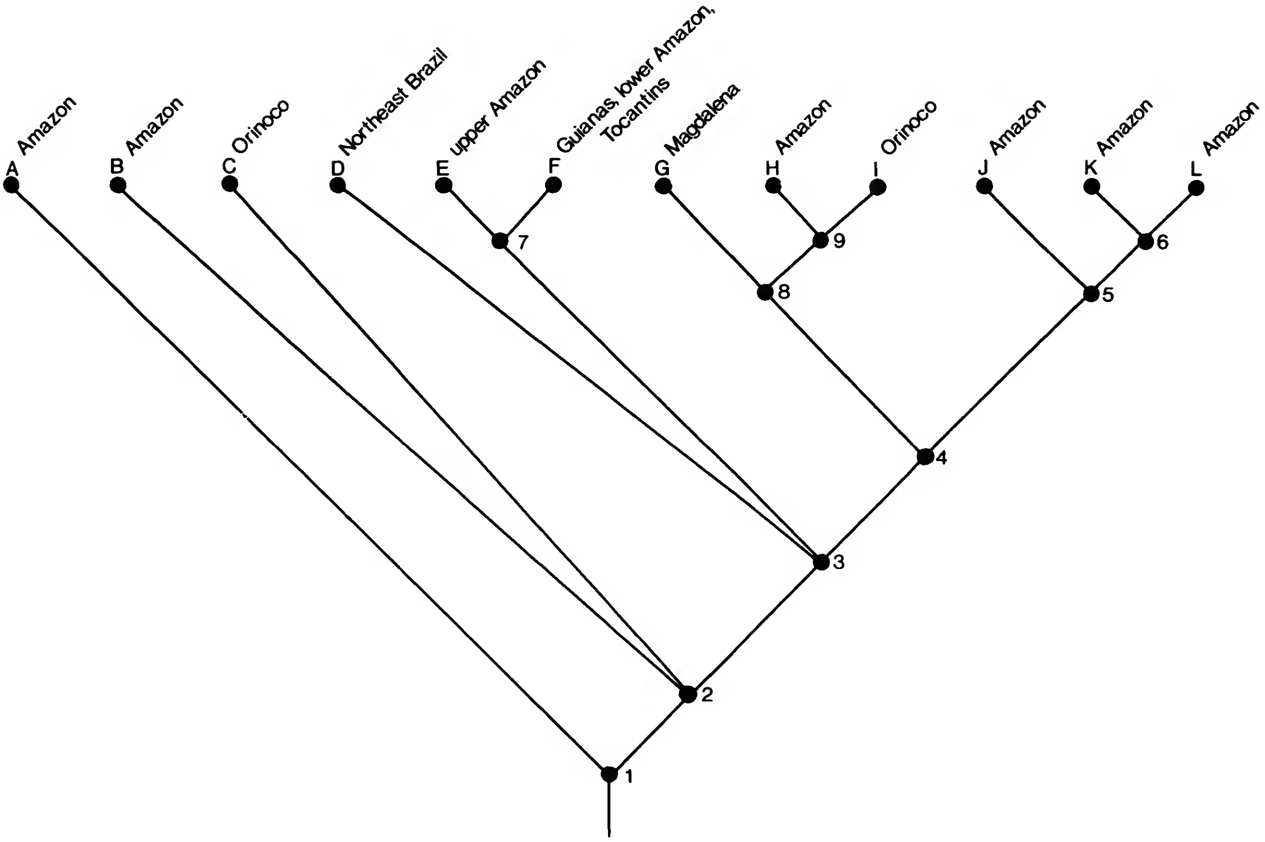

FIGURE 42.—Area cladogram of the species of *Curimata*: A, *C. ocellata*; B, *C. vittata*; C, *C. macrops*; D, *C. incompta*; E, *C. knerii*; F, *C. cyprinoides*; G, *C. mivartii*; H, *C. aspera*; I, *C. cerasina*; J, *C. cisandina*; K, *C. roseni*; L, *C. inornata*. Areas of occurrence of species noted above letters (see Figures 16, 20, 23, 25, 30, 32, 34, 37, 40 for exact details of known species distributions). Nodes numbered sequentially.

Returning to the intrageneric sympatry noted above, we find that there are repeated patterns of large scale sympatry between sequential sister groups (nodes 1–5) until we reach the terminal dichotomies within the genus (nodes 6–9). If the subdivision of the continent by the uplift of the Andes during the Miocene is correlated with the speciation event of node 8, then the speciation at nodes 1, 2, 3, and 4, which also demonstrate the largest degree of sympatry, would have predated the event. It is quite reasonable to assume that the sympatry between sister clades at those phyletically higher level nodes is correlated with the dramatic rearrangement of the hydrographic patterns in South America associated with the uplift of the Andes. The reorganization of the drainage patterns of the continent would have brought previously separated species into the same basins. The species could then have dispersed through those now conjoined systems. The lower level of sympatry or lack of distributional overlaps at nodes 6, 7, 8, and 9, in turn, could reflect the more stable hydrographic patterns that have existed following the final uplift of the Andes. Such hydrographic stability would have reduced the possibilities for secondary dispersal between drainage basins following speciation resulting from geological vicariance events.

Resumo

O gênero *Curimata* Bosc (1817) é definido como uma subunidade monofilética da família Curimatidae com base em várias sinapomorfias nos arcos branquiais, complexo buco-faringeano e arco palatino. Modificações de natureza derivada nos arcos branquiais, aparelho hióide, aparelho opercular, osso maxilar, hiomandibular, arco palatino, supraneurais, primeiro pterigióforo proximal da nadadeira dorsal, pigmentaçaõ, forma do corpo, tamanho e forma das escamas, grau de desenvolvimento dos raios das nadadeiras dorsal e caudal, número de vértebras e morfometria reunem grupos de espécies dentro do gênero.

Curimata é redefinido e doze espécies são reconhecidas no gênero. Estas são: *Curimata cyprinoides* Linnaeus (1766), distribuída no baixo rio Orinoco, drenagens atlânticas das Guianas, baixo rio Amazonas e rio Tocantins; *C. vittata* Kner (1859), do sistema do rio Amazonas; *C. aspera* Günther (1868a), do alto rio Amazonas; *C. knerii* Steindachner (1877), do médio e alto rio Amazonas; *C. mivartii* Steindachner (1878), endêmica do rio Magdalena e rios associados; *C. ocellata* Eigenmann & Eigeinmann (1889), distribuída na bacia do rio Amazonas; *C. macrops* Eigenmann & Eigenmann (1889), conhecida somente da bacia do rio Parnaíba no nordeste do Brasil; *C. cisandina* (Allen, em Eigenmann & Allen, 1942), encontrada no sistema do rio Amazonas; *C. cerasina* Vari (1984b), endêmica do rio Orinoco; *C. incompta* Vari (1984b), da bacia do rio Orinoco; *C. inornata*, uma nova espécie do sistema do rio Amazonas; e *C. roseni*, uma nova espécie da bacia do rio Negro.

Verificou-se que a espécie *Curimatus semitaeniatus* de Steindachner (1917) foi baseada em um exemplar juvenil de *Curimata ocellata* Eigenmann & Eigenmann (1889), sendo por esse motivo colocada como um sinônimo da mesma. *Curimata murieli*, descrita por Allen (em Eigenmann & Allen, 1942), tem como holótipo um exemplar juvenil de *Curimata vitata* Kner (1859), sendo a primeira espécie considerada um sinônimo júnior da última. *Lambepiedra alleni*, de Fernández-Yépez (1948), é colocada como um sinônimo de *Curimata cisandina* Allen (em Eigenmann & Allen, 1942). *Curimatus simulans*, proposto por Eigenmann & Eigenmann (1889), é considerado como um sinônimo de *Curimata aspera* Günther (1868a). *Salmo edentulus* Bloch (1794), *Charax planirostris* Gray (1854), *Curimatus schomburgkii* Günther (1864) e *Curimata copei* Fowler (1906) são colocadas como sinônimos de *Curimata cyprinoides* Linnaeus (1766). *Salmo immaculatus* Linnaeus (1758), o nome mais antigo para a espécie aqui denominada *Curimata cyprinoides*, não é disponível (Comissão Internacional de Nomenclatura Zoológica, 1966).

Contrariamente a muitos estudos anteriores, *Semitapicis* de Eigenmann & Eigenmann (1889) é colocado como um sinônimo de *Curimata* Bosc (1817), em lugar de ser mantido como um gênero distinto. Os gêneros *Acuticurimata* Fowler (1941), *Allenina* Fernández-Yépez (1948), *Bitricarinata* Fernádez-Yépez (1948), *Bondichthys* Whitley (1953), *Lambepiedra* Fernández-Yépez (1948), *Peltapleura* Fowler (1906) e *Stupens* Whitley (1954) são também considerados como sinônimos de *Curimata*.

A zoogeografia histórica das espécies de *Curimata* é discutida, apresentando-se a hipótese de que a maior parte da divergência evolutiva a nível de espécie no gênero se deu antes do levantamento final dos Andes. O grau de simpatria entre linhagens-irmãs dentro de *Curimata* indica que ocorreu uma significativa quantidade de dispersão pós-vicariância no gênero.

Literature Cited

Bayley, P.B.

1988. Factors Affecting Growth Rates of Young Tropical Floodplain Fishes: Seasonality and Density-Dependence. *Environmental Biology of Fishes*, 21(2):127–142.

Beatty, J., and W.L. Fink

1979. [Review of] *Simplicity*, by E. Sober, 1975, Oxford: Clarendon Press. *Systematic Zoology*, 28:643–651.

Bloch, M.E.

1785–1795. *Natürgeschichte der Ausländischen Fische*. 324 plates. Berlin.

Bloch, M.E., and J.G. Schneider

1801. *Systema Ichthyologiae iconibus CX Illustratum*. 584 pages. Berlin: J.G. Schneider.

Bonaterre, J.P.

1788. *Tableau encyclopédique et méthodique des trois règnes de la nature, Ichthyologie*. 215 pages. Paris.

Bosc, L.A.C.

1817. *Nouveau dictionaire d'Histoire naturelle*. 560 pages, Paris.

Braga, L., and M. Azpelicueta

1983. *Semitapicis squamoralevis* sp. nov. (Osteichthyes: Curimatidae) con consideraciones sobre el género. *Studies on Neotropical Fauna and Flora*, 18:139–150.

Caporiacco, L. di

1935. Spediziones nello Beccari nella Guiana Britannica, Pesci. *Monitore di Zoologia Italiana*, 46(3):55–70.

Castelnau, F., de

1855. *Animaux nouveaux ou rares recueillis pendant l'expedition dans les partes centrales de l'Amerique du Sud, de Rio de Janiero a Lima, et de Lima au Para, Poissons*. xii + 112 pages. Paris.

Cockerell, T.D.A.

1914. The Scales of the South American Characinid Fishes. *Annals of the Carnegie Museum*, 9:92–113.

Collette, B.B.

1966. *Belonion*, a New Genus of Fresh-water Needlefishes from South America. *American Museum Novitates*, 2274:1–22.

Cope, E.D.

1872. On the Fishes of the Ambiyacu River. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 23:250–294.

Cuvier, G., and A. Valenciennes

1849. *Histoire naturelle des poissons*. Volume 22, 395 pages, 17 plates. Paris.

Dahl, G.

1955. An Ichthyological Reconnaisance of the Sinú River. *Revista Linneana*, 1:11–19.

1971. *Los Peces del Norte de Colombia*. 391 pages. Bogota: Inderena.

Dahl, G., F. Medem, and A. Henao

1963. *El "Bocachico," Contribucion al estudio de su Biologia y de su Ambiente*. 144 pages. Departamento de Pesca de la Corporacíin Autínoma Regional de los Valles del Magdalena y del Sinu.

Dick, M.M.

1977. Stations of the Thayer Expedition to Brazil, 1865–1866. *Brevoria*, 144:1–37.

Eigenmann, C.H.

1910. Catalogue of the Freshwater Fishes of Tropical and South Temperate America. In *Report of the Princeton University Expedition to Patagonia, 1896–1899*, 3(4):375–511.

1912. The Freshwater Fishes of British Guiana, Including a Study of the Ecological Grouping of Species and the Relation of the Fauna of the Plateau to That of the Lowlands. *Memoirs of the Carnegie Museum*, 5: xii + 578 pages, 103 plates.

1920a. South America West of the Maracaibo, Orinoco, Amazon and Titicaca Basins, and the Horizontal Distribution of its Fresh-water Fishes. *Indiana University Studies*, 7(45):1–24.

1920b. The Magdalena Basin and the Horizontal and Vertical Distribution of Its Fishes. *Indiana University Studies*, 7(47):21–34.

1922. The Fishes of Western South America, Part 1. The Fresh-water Fishes of Northwestern South America, Including Colombia, Panama, and the Pacific Slopes of Ecudaor and Peru, Together with an Appendix upon the Fishes of the Rio Meta in Colombia. *Memoirs of the Carnegie Museum*, 9:1–354.

Eigenmann C.H., and W.R. Allen

1942. *Fishes of Western South America, I: The Intercordilleran and Amazonian Lowlands of Peru. II: The High Pampas, Bolivia, and Northern Chile, with a Revision of the Peruvian Gymnotidae, and of the Genus Orestias*. 494 pages, 47 figures, 22 plates. Lexington: University of Kentucky.

Eigenmann, C.H., and B.A. Bean

1907. An Account of Amazon River Fishes Collected by J.B. Steere; with a Note on *Pimelodus clarias*. *Proceedings of the United States National Museum*, 31:659–668.

Eigenmann, C.H., and R.S. Eigenmann

1889. A Revision of the Edentulous Genera of the Curimatinae. *Annals of the New York Academy of Sciences*, 4:409–440.

1891. A Catalogue of the Fresh-water Fishes of South America. *Proceedings of the United States National Museum*, 14:1–81.

Eigenmann, C.H., and F. Ogle

1907. An Annotated List of Characin Fishes in the United States National Museum and the Museum of Indiana University with Descriptions of New Species. *Proceedings of the United States National Museum*, 33:1–36.

Fernández-Yépez, A.

1948. Los Curimátidos (peces fluviales de Sur América): Catálogo descriptivo con nuevas adiciones génericas y específicas. *Boletín Taxonómico del Laboratorio de Pesquería de Caiquire*, 1:1–86, 37 figures.

Fernholm, B., and A. Wheeler

1983. Linnaean Fish Specimens in the Swedish Museum of Natural History, Stockholm. *Zoological Journal of the Linnean Society*, 78:199–286.

Fowler, H.W.

1906. Further Knowledge of Some Heterognathus Fishes, Part I. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 58:293–351, figures 1–33.

1913. Fishes from the Madeira River, Brazil. *Proceedings of the Academy of Natural Sciences of Philadephia*, 65:517–579.

1914. Fishes of the Rupununi River, British Guiana. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 66:229–284.

1915. Cold-blooded Vertebrates from Florida, the West Indies, Costa Rica, and Eastern Brazil. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 67:244–269.

1919. Notes on Tropical Fishes. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 71:128–155.

1931. Fishes Obtained by the Barber Asphalt Company in Trinidad and Venezuela in 1930. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 83:391–410.

1940. A Collection of Fishes Obtained by Mr. William C. Morrow in the Ucayali River Basin, Peru. *Proceedings of the Academy of Natural Sciences of Philadelphia,* 91:219–289.
1941. A Collection of Freshwater Fishes Obtained in Eastern Brazil by Dr. Rodolpho von Ihering. *Proceedings of Academy of Natural Sciences of Philadelphia,* 93:123–199, figures 1–104.
1942. Los Peces del Perú. *Boletin Museo de Historia Natural "Javier Prado," Lima,* 6(20):206–222.
1945. Los Peces del Perú. *Boletin Museo de Historia Natural "Javier Prado," Lima,* 7:1–298.
1950. Os peixes de áqua doce do Brasil. *Arquivos de Zoologia do Estado de São Paulo,* 6:205–401, figures 238–447.
1975. A Catalogue of World Fishes (XXIII). *Quarterly Journal of the Taiwan Museum,* 28(3):277–402.

Géry, J.
1977a. Deux nouveaux cas de mimétisme chez les poissons: Curimatidés mimétiques d'Hemiodidés (Characoïdes). *Revue Français de Aquariologie,* 4:103–106.
1977b. *Characoids of the World.* 672 pages. Neptune City: TFH Publications.

Goulding, M.
1981. Man and Fisheries on an Amazon Frontier. *In* H.J. Dumont, editor, *Developments in Hydrobiology, 4:137 pages, 37 figures. The Hague: W. Junk Publishers.*

Goulding, M., M. Leal Carvalho, and E.G. Ferreira
1988. *Rio Negro, Rich Life in Poor Water: Amazonian Diversity and Foodchain Ecology as Seen through Fish Communities.* 200 pages. The Hague: SPB Academic Publishing bv.

Gray, J.E.
1854. *Catalogue of Fish Collected and Described by L.T. Gronow, Now in the British Museum.* 196 pages. London.

Gronovius, L.T
1754. *Museum Ichthyologicum, sistens Piscium indigenenorum quorundum exoticum qui in Museo Laurenti Theodori Gronovii, etc.* 70 pages. Leiden.
1763. *Zoophylacii Gronoviani Fasciculus Primus Exhibens Animala Quadrupeda, Amphibia, atque Pisces, etc.* 136 pages. Lugduni Batavroum.

Günther, A.
1864. *Catalogue of the Fishes in the Collection of the British Museum.* Volume 5, xii + 455 pages. London.
1868a. Descriptions of Freshwater Fishes from Surinam and Brazil. *Proceedings of the Zoological Society of London,* 1868:229–247.
1868b. Diagnosis of Some New Freshwater Fishes from Surinam and Brazil in the Collection of the British Museum. *Annals and Magazine of Natural History,* series 1, 4:475–481.

Hennig, W.
1966. *Phylogenetic Systematics.* 263 pages. Urbana: University of Illinois Press.

International Commission of Zoological Nomenclature
1966. Opinion 772. *Curimata* Walbaum, 1792 (Pisces): Rejected as a Generic Name and Placed on the Official List. *Bulletin of Zoological Nomenclature,* 23(1):41–45.

Isbrücker, I.J.H.
1981. Revision of *Loricaria* Linnaeus, 1758 (Pisces, Siluriformes, Loricariidae). *Beaufortia,* 32(3):51–96.

Kner, R.
1859. Zur Familie der Characinen. III. Folge der Ichthyologischen Beiträge. *Denkschriften der Akademie der Wissenschaften, Wien,* 17:137–182, plates 1–9.

Lacépède, B.G.
1803. *Histoire naturelle des poissons.* Volume 12, 432 pages. Paris.

Linnaeus, C.
1758. *Systema Naturae.* Edition 10, volume 1, 824 pages.
1766. *Systema Naturae.* Edition 12, volume 1, 532 pages.

Machado-Allison, A.
1987. Los peces de los llanos de Venezuela, un ensayo sobre su historia natural. 144 pages. Caracas: Universidad Central de Venezuela.

Maddison, W.P., M.J. Donoghue, and D.R. Maddison
1984. Outgroup Analysis and Parsimony. *Systematic Zoology,* 33:83–103.

Mago-Leccia, F.
1967. Notas Preliminares Sobre los Peces de los Llanos de Venezuela. *Boletin de la Sociedad Venezolana de Ciencias Naturales, Caracas,* 27(112):237–263.
1970. *Lista de los peces de Venezuela.* 241 pages. Caracas: Ministerio de Agricultura y Cria.

Miles, C.
1947. *Los Peces del Río Magdalena.* 214 pages, appendix 28 pages. Bogota: Editorial El Grafico.

Müller, J., and F. Troschel
1845. *Horae Ichthyologicae, Beschreibung und Abbildung neuer Fische; Die Familie Characinen.* 40 pages. Berlin.
1848. *Reisen in British-Guiana in den Jahren 1840–1844 (Im Auftrag Sr. Majestat des Konigs von Preussen Ausgefuhrat von Richard Schomburgk. Versuch einer Fauna und Flora von British Guiana) (Fische).* 644 pages. Berlin.

Nielsen, J. G.
1974. *Fish Types in the Zoological Museum of Copenhagen.* 115 pages. Copenhagen: Zoological Museum, Universtiy of Copenhagen.

Ortega, H., and R.P. Vari
1986. Annotated Checklist of the Freshwater Fishes of Peru. *Smithsonian Contributions to Zoology,* 437:1–25.

Pellegrin, J.
1903. Description de cichlidés nouveaux de la collection du Muséum. *Bulletin Muséum d'Histoire Naturelle, Paris,* 9:120–125.
1908. Characinidés Américains nouveaux de la collection du Muséum d'Histoire Naturelle. *Bulletin du Muséum National d'Histoire Naturelle, Paris,* 14:342–347.
1909. Characinides du Bresil rapportes par M. Jobert. *Bulletin du Muséum National d'Histoire Naturelle, Paris,* 15:147–153.
1912. Description d'un poisson nouveau de l'Orénoque appartenant au genre *Xenocara. Bulletin de la Société Zoologique de France, Paris,* 37:271–272.

Puyo, J.
1949. *Poissons de la Guyane Française.* 280 pages. Paris: Librairie Larose.

Roman, B.
1983. *Los Peces de los Llanos de Venezuela. III. Las Pirañas y demas Characidos.* 205 pages. Caracas: Fundacion Cientifica Fluvial de los Llanos.

Santos, G.M., dos, M. Jégu, and B. de Merona
1985. *Catálago de peixes commercisis do baixo rio Tocantins.* 85 pages. Manaus: Electronorte.

Schultz, L.P.
1944. The Fishes of the Family Characinidae from Venezuela, with Descriptions of Seventeen New Forms. *Proceedings of the United States National Museum,* 95:235–367.

Starks, E.C.
1913. The Fishes of the Stanford Expedition to Brazil. *Leland Stanford Junior University Publications, University Series,* 1913:1–77.

Steindachner, F.
1877. Ichthyologische Beiträge (V). II. Ueber einige neue Fischarten, insebesondere Characinen und Siluroiden aud dem Amazonenstrome. *Sitzungberichte der Akademie der Wisenschaften, Wien,* 74(for 1876):49–240.
1878. Fischfauna des Magdalenen Stromes. *Denkschriften der Akademie der Wissenschaften, Wien,* 39:47–69.
1880. Zur Fischfauna des Cauca und Flüsse bei Guayaquil. *Denkschriften der Akademie der Wissenschaften, Wien,* 42:66–85.
1882. Beiträge sur Kenntniss der Flussfische Süderamerika's. *Denkschriften der Akademie der Wissenschaften, Wien,* 43:103–146.

1902. Herpetologische und ichthyologische Ergebnisse einer Reise nach Südamerika. *Denkschriften der Akademie der Wissenschaften, Wien,* 72:89–148.

1910. Notiz über einige neue Characinenarten aus dem Orinoco und dem Oberen Surinam. *Anzeiger der Akademie der Wissenschaften, Wien,* 47:265–270.

1917. Beiträge sur Kenntniss der Flussfische Süderamerika's. *Denkschriften der Akademie der Wissenschaften, Wien,* 93:15–106.

Swofford, D.L.

1985. *PAUP: Phylogenetic Analysis Using Parsimony, Version 2.4.* Champaign: Illinois Natural History Survey. [Computer program.]

Ulrey, A.B.

1895. The South American Characinidae Collected by Charles Frederick Hartt. *Annals of the New York Academy of Science,* 8:258–300.

Vaillant, L.L.

1899. Note préliminaire sur les collections ichthyologiques recueilles par M. Geay en 1897 et 1898 dans la Guyane Francaise et le Conteste Franco-Brasilien. *Bulletin de Museum d'Histoire Naturelle,* 5:154–155.

Vari, R.P.

1982a. Systematics of the Neotropical Characoid Genus *Curimatopsis* (Pisces: Characoidei). *Smithsonian Contributions to Zoology,* 373:1–28.

1982b. *Curimatopsis myersi,* a New Curimatid Characiform Fish (Pisces: Characiformes) from Paraguay. *Proceedings of the Biological Society of Washington,* 95(4):788–792.

1983. Phylogenetic Relationships of the Families Curimatidae, Prochilodontidae, Anostomidae, and Chilodontidae (Pisces: Characiformes). *Smithsonian Contributions to Zoology,* 378:1–60, 41 figures.

1984a Systematics of the Neotropical Characiform genus *Potamorhina* (Pisces: Characiformes). *Smithsonian Contributions to Zoology,* 400:1–36, 17 figures.

1984b. Two New Fish Species of the Genus *Curimata* (Pisces: Curimatidae) from Venezuela. *Acta Biologica Venezuelica,* 11(4):27–43, figures 1–6.

1987. Two New Species of Curimatid Fishes (Ostariophysi: Characiformes) from Rio Grande do Sul, Brazil. *Proceedings of the Biological Society of Washington,* 100(3):603–609.

1988. The Curimatidae, a Lowland Neotropical Fish Family (Pisces: Characiformes); Distribution, Endemism, and Phylogenetic Biogeography. *In* W.R. Heyer and P.E. Vanzolini, editors, *Neotropical Distribution Patterns: Proceedings of a 1987 Workshop,* pages 313–347, figures 1–15. Rio de Janiero: Academia Brasiliera de Ciências.

1989. A Phylogenetic Study of the Neotropical Characiform Family Curimatidae (Pisces: Ostariophysi). *Smithsonian Contributions to Zoology,* 471:1–71, 45 figures.

In press a. Systematics of the Neotropical Characiform Genus *Psectrogaster* Eigenmann and Eigenmann (Pisces: Characiformes). *Smithsonian Contributions to Zoology,* 481.

In press b. Systematics of the Neotropical Characiform Genus *Pseudocurimata* Fernández-Yépez (Pisces; Ostariophysi). *Smithsonian Contributions to Zoology,* 490.

Vari, R.P., and R.M.C. Castro

1988. *Prochilodus stigmaturus* Fowler, Reassigned to the Curimatidae from the Prochilodontidae, with Comments on Other Nominal Curimatid and Prochilodontid Species Treated by Fowler. *Copeia,* 1988(3):777–780.

Vari, R.P., and J. Géry

1985. A New Curimatid Fish (Characiformes: Curimatidae) from the Amazon Basin. *Proceedings of the Biological Society of Washington,* 94(4):1030–1034.

Vari, R.P., and H. Nijssen

1986. *Curimata punctata,* a New Uniquely Pigmented Species of Curimatid from the Marowijne River Basin of Surinam and French Guiana (Pisces, Characiformes). *Beaufortia,* 36(4):51–55.

Vari, R.P., and A.W. Vari

1989. Systematics of the *Steindachnerina hypostoma* Complex (Pisces, Ostariophysi, Curimatidae), with the Description of Three New Species. *Proceedings of the Biological Society of Washington,* 102(2):468–482.

Walbaum, J.

1792. *Petri artedi sueci genera Piscium: Ichthyologiae pars III: Emendata et aucta.* 732 pages. Grypeswaldiae.

Watrous, L.E., and W.D. Wheeler

1981. The Out-Group Comparison Method of Character Analysis. *Systematic Zoology,* 30:1–11.

Wheeler, A.

1985. The Linnaean Fish Collection in the Linnean Society of London. *Zoological Journal of the Linnean Society,* 84(1):1–76.

Whitley, G.P.

1953. Studies in Ichthyology. *Records of the Australian Museum,* 23:133–158.

1954. New Locality Records for Some Australian Fishes. *Proceedings of the Royal Society of New South Wales,* 1952–1953:23–30.

Wiley, E.O.

1981. *Phylogenetics: The Theory and Practice of Phylogenetic Systematics.* vi+439 pp. New York: John Wiley and Sons.

Index

(synonyms and page of principal discussion in italics)

✩ **U.S. GOVERNMENT PRINTING OFFICE:** 1989–202–416/60044