The So-called Cheirodontin Fishes of Central America with Descriptions of Two New Species (Pisces: Characidae)

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ABSTRACT

Fink, William L., and Stanley H. Weitzman. The So-called Cheirodontin Fishes of Central America with Descriptions of Two New Species (Pisces: Characidae). *Smithsonian Contributions to Zoology,* number 172, 46 pages, 26 figures, 15 tables, 1974.—The known species of Central American cheirodontin fishes, characids with a single row of premaxillary teeth, are reviewed. A key to their identification is provided. The review includes members of the genera *Cheirodon, Carlana, Phenagoniates,* and *Saccoderma.* All species are described and illustrated except for the Central American form of *Saccoderma,* which is known to us only from juveniles and may belong to an undescribed species. Two new species of *Cheirodon* are described: *C. dialepturus* from the Pacific drainages of west-central and western Panama, from eastern Cocle Province west to the Rio Coto, Costa Rica; and *C. mitopterus* from the Rio Cocle del Norte Basin, an Atlantic drainage of Central Panama.

Rhoadsia eigenmanni is placed in *Carlana,* the generic name available for the preoccupied *Carlia.* The genera *Odontostilbe, Pseudocheirodon,* and *Compsura* are synonomized with *Cheirodon,* based on reevaluation of the characters formerly used to define these genera as well as a renewed evaluation of the concept of the genus in characid fishes. Finally, some reasons are presented for considering the Cheirodontinae polyphyletic.

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Contents

The So-called Cheirodontin Fishes of Central America with Descriptions of Two New Species (Pisces: Characidae)

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Introduction

A survey of the characoid collections at the National Museum of Natural History has produced many problems of identification. One of these came to light when we examined a large number of characid specimens from Panama, collected in 1961-1962, primarily by Dr. Horace Loftin. A large percentage of the lots of so-called cheirodontins had been identified as *Compsura gorgonae* (Evermann and Goldsborough), but close examination showed that many of these belonged to two undescribed species. In an attempt to determine the relationships of the new species, all known Central American and many South American cheirodontins were examined. To clear the way for comparison with possible future discoveries in Central America and to make information available for studies of South American cheirodontins, we here present a review of all known Central American species.

Our treatment of the Central American species as cheirodontins is a matter of convenience and tradition, and it is not to be interpreted that we believe it is an expression of phylogenetic reality in the sense of Hennig (1966). In fact, we have little confidence that the Cheirodontinae (American characids with a single row of premaxillary teeth and lacking certain specializations of other characoids; see Eigenmann, 1915) constitute a group from a phylogenetic point of view. See Böhlke (1952) for comments on the possible "polyphyletic" nature of the Cheirodontinae.

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METHODS.—All measurements are straight-line distances made with dial calipers, and all are in standard length (SL) or percentages of standard length unless otherwise indicated. Standard length was measured from the anterior termination of the upper jaw (tip of snout) to the center posterior termination of the hypural fan (where the principal caudal-fin rays attach to the hypural bones). Measurements referring to the origin of the fins mean anterior (cephalad) termination of the fin base unless otherwise stated. Fin length was measured from the fin origin to the distal tip of longest ray. Head length equals the distance between the tip of the snout and the posteriormost termination of the bony opercle. (It is common to measure to the posterior termination of fleshy opercular flap; however, we find this flap to be damaged so frequently that a better measurement can be made to the bony opercular border). Snout length extends from the tip of the snout to the anteriormost bony edge of the orbit. Upper-jaw length was measured from the tip of the snout to the distalmost

termination of the maxillary bone. Eye diameter is a longitudinal measurement between bony orbital margins. Distance from eye to dorsal-fin origin is measured from posterior bony orbital margin. Caudal-peduncle length was measured from posterior termination of the anal-fin base (at the insertion of last anal-fin ray) to the center of the posterior termination of the hypural fan (end of caudal peduncle; caudal-fin origin). Caudal-peduncle depth equals the least distance between its dorsal surface and its ventral surface.

The greatest body depth extends from a point along the dorsal profile to the ventral body surface where the distance is greatest. The least bony interorbital width equals the least distance between the dorsalmost bony edges of the orbits. Lateral scales are counted as a longitudinal scale row along the midline or along the perforated lateral-line scales when these are present. Scales above the lateral line are counted from the dorsal-fin origin (not including the middorsal scale) to that scale just dorsal to the midlateral (or perforated lateral) scale row. Scales below the lateral line were counted diagonally from the anal-fin origin (not including scales of anal-fin sheath) to a scale just ventral to the midlateral scale row. Scales around the caudal peduncle were counted as the number of scale rows intersecting a vertical line or ring around the least depth of the caudal peduncle. The predorsal scales were counted beginning with the scale at the posterior termination of supraoccipital spine and continuing to the scale just anterior to the dorsal-fin origin. In some cases the predorsal scales were not counted due to a very irregular distribution. The last two dorsal-fin rays are not counted as a single ray split to the base, but as two separate rays. The last two anal-fin rays are counted as a single ray split to the base; in many instances these two rays are not completely split to the base. (This method of counting dorsal- and anal-fin rays reflects the actual anatomical relationships to the pterygiophores.) Pectoral- and pelvic-fin rays were all counted as separate rays. Gill rakers were counted on both lower and upper limbs of the first gill arch. Vertebral counts include the Weberian apparatus as four elements.

The tooth figures were drawn from cleared and stained specimens.

Specimens were selected to reflect the size range exhibited at each collection locality.

In the descriptions, for each meristic character, the range is given, followed by the mode; for each morphometric character, the range is given. In some descriptions, for morphometric characters, juveniles and adults are separated by a semicolon. In the "Material Examined" sections, an asterisk placed before a collection number indicates that the lot was used in the subsequent description. Morphometric and meristic data are presented in Tables 1–15; specimens included in tables are noted following "Material Examined" under each species. In tables, underscored numbers indicate holotype meristics. Specimens damaged such that counts or measurements for a given character were not possible account for variation in number of specimens in tables and descriptions. Following the locality citation, Dr. Loftin's collection stations (see Loftin, 1965) have been cross-referenced with his station numbers (HL) and river basin numbers (P or A) in parentheses. P stands for Pacific drainage and A for Atlantic drainage. IAH stands for Inter American Highway.

Material was examined from collections in the National Museum of Natural History (formerly in United States National Museum: USNM), Washington, D.C., including material from the Battelle Laboratory (BNW) through the Smithsonian Oceanographic Sorting Center; Field Museum of Natural History, Chicago (FMNH); California Academy of Sciences, San Francisco (CAS); Stanford University (CAS[SU]), and Indiana University, (CAS[IUM]), both collections now at California Academy of Sciences, San Francisco; Los Angeles County Museum (LACM); Museum of Comparative Zoology, Harvard University, Cambridge (MCZ); Academy of Natural Sciences of Philadelphia, (ANSP); University of Michigan Museum of Zoology (UMMZ); and Gulf Coast Research Laboratory, Ocean Springs, Miss. (GCRL). We wish to thank Reeve M. Bailey (UMMZ), James E. Böhlke (ANSP), C. E. Dawson (GCRL), William Eschmeyer (CAS), Tyson Roberts and Mrs. M. Dick (MCZ), and Loren P. Woods (FMNH) for loan of specimens in their care. C. E. Dawson loaned Los Angeles County Museum material that was formerly deposited in the University of Miami Ichthyological Museum (UMIM) and is now at the Gulf Coast Research Laboratory. We are grateful to J. D. McPhail and R. L. Dressler for providing freshly preserved

specimens and color descriptions from life of two species and to W. A. Bussing for providing live specimens of two species. George S. Myers provided a helpful and illuminating discussion of Central American characids. James E. Böhlke, J. D. McPhail, Reeve M. Bailey, Robert H. Gibbs, Jr., and W. A. Bussing read the manuscript and offered valuable suggestions.

Artificial Key to the Species of the So-called Cheirodontin Characids of Central America

1. Anal fin with less than 40 branched rays. Dorsal-fin origin anterior to anal-fin origin. Teeth usually with 5 or more cusps 2
   Anal fin with more than 40 branched rays. Dorsal-fin origin posterior to anal-fin origin. Teeth tricuspid ..... ***Phenagoniates macrolepis*** (Meek and Hildebrand)
2. Anal fin with 15–23 branched rays. Scales below midlateral scale series 3–6 3
   Anal fin with 28–30 branched rays. Scale rows below midlateral scale series 7–8 ..... ***Carlana eigenmanni*** (Meek)
3. Modified caudal scales when present not elongate, not passing far onto lower caudal-fin lobe. Dentary teeth with 5–10 narrow cusps (Figure 2) 4
   Modified caudal scales elongate, passing well into lower caudal-fin lobe (Figure 26). Dentary teeth with 6–8 broad triangular cusps forming slightly rounded cutting edge (Figure 25) ..... ***Saccoderma*** species
4. Premaxillary teeth approximately symmetrical, anterior or median and posterior or lateral cutting edges about equidistant from tooth base (Figure 2). Dentary teeth with 5–10 cusps, with middle cusp of tooth largest, forming a rounded cutting edge. Caudal peduncle or caudal fin with modified scales[1] 5
   Premaxillary teeth asymmetrical, with anterior or median cutting edge beginning closer to tooth base than posterior cutting edge (median one or two teeth may be symmetrical) (see Figure 13). Dentary teeth with 6–8 cusps, lacking an elongate middle cusp, forming an even cutting edge. No modified caudal scales 7
5. Modified caudal scales not forming "pouches," consisting of two irregular ventral rows of small terminal peduncle scales and several scales extending slightly onto middle caudal-fin rays 6
   Modified caudal scales forming three obvious "pouches" (Figure 10) ..... ***Cheirodon gorgonae*** Evermann and Goldsborough
6. Recurved bony hooks present on upper (dorsal) fin rays of lower (ventral) caudal-fin lobe of males. Branched pectoral-fin rays 10–11, usually 10. Unbranched pelvic ray not filamentous in either sex ..... ***Cheirodon dialepturus,*** new species
   No recurved bony hooks on lower caudal-fin lobe. Branched pectoral-fin rays 11–12, usually 11. Unbranched pelvic-fin ray filamentous in males ..... ***Cheirodon mitopterus,*** new species
7. Branched anal-fin rays 17–22 ($\bar{x}$ = 19.6). Dentary with about 7 broad multicuspid and 2–3 smaller conical teeth. Gill rakers 17–20 ($\bar{x}$ = 18.0). Lateral line usually incomplete ..... ***Cheirodon affinis*** (Meek and Hildebrand)
   Branched anal-fin rays 21–23 ($\bar{x}$ = 22.1). Dentary with about 8–9 broad multicuspid teeth and usually 2–3 smaller conical teeth. Gill rakers 19–21 ($\bar{x}$ = 20.4). Lateral line usually complete ..... ***Cheirodon terrabae*** (Bussing)

[1] Modified caudal peduncle scales may be difficult to see in *C. dialepturus* and *C. mitopterus;* the scales are easily damaged.

Cheirodon Girard

Cheirodon Girard, 1854:199 [type-species *Cheirodon pisciculus* Girard, 1854, by monotypy].

Odontostilbe Cope, 1870:566 [type-species *Odontostilbe fugitiva* Cope, 1870, by monotypy].

Compsura Eigenmann, 1915:60 [type-species *Compsura heterura* Eigenmann, 1915, by original designation and monotypy].

Pseudocheirodon Meek and Hildebrand, 1916:275 [type-species *Pseudocheirodon affinis* Meek and Hildebrand, 1916, by original designation and monotypy].

The generic referral below of five species of Central American "cheirodontins" to *Cheirodon* needs explanation. The two new species described here as new, plus reexamination of other Central

American "cheirodontins," has forced a reconsideration of the generic validity of *Odontostilbe, Compsura,* and *Pseudocheirodon.*

One species herein described as new, *Cheirodon mitopterus,* could be referred to the genus *Odontostilbe* Cope (1870) because it has a complete lateral line. Cope described *Odontostilbe* for *O. fugitiva* Cope (1870) because at that time it was the only known characid with a single row of premaxillary teeth and a complete lateral line. Géry (1972:71) has most recently defined *Odontostilbe* and implied in his discussion that it differs from *Cheirodon* only in the possession of a complete lateral line. We can no longer accept the possession of a complete versus incomplete lateral line as a valid generic character separating *Cheirodon* and *Odontostilbe* because some specimens of two of the species of *Cheirodon* treated here, *C. dialepturus* (new species) and *C. affinis* (Meek and Hildebrand), have complete and others have incomplete lateral lines. *Cheirodon dialepturus* usually tends to have an incomplete lateral line, but some population samples usually have a complete lateral line. Specimens of most population samples of *C. affinis* tend to have an incomplete lateral line, but some samples have all or nearly all of the specimens with a full row of 33 perforated lateral-line scales. In view of the demonstrated lability of the lateral-line length, we see no reason to recognize the genus *Odontostilbe,* and therefore consider it a synonym *of Cheirodon.* See below under *Cheirodon dialepturus, C. affinis,* and *C. terrabae* (Bussing), for a more complete discussion of lateral-line variation.

Compsura has been defined as a "cheirodontin" with modified scales associated with one or more well-developed pouches on the lower caudal-fin lobe. In addition, the known species have teeth with symmetrically arranged cusps, each tooth having an enlarged median cusp. Retrorse hooks are present on the anal- and pelvic-fin rays in males and the lower (ventral) caudal-fin rays are without hooks. This definition fits both *C. heterura* Eigenmann, the type-species of the genus, from eastern Brazil (Rio San Francisco and Rio Itapicuru) and the fish heretofore known as *C. gorgonae* (Evermann and Goldsborough), with a limited distribution in central Panama (see below for collection records). The wide geographical separation of these two species, nearly 3,000 miles, strains credulity that they must be one another's closest relatives as indicated by their common generic status.

If the characters used to define *Compsura* are labile ones appearing more or less at random among small characids, convergence of characters would seem a better hypothesis than one of close relationship to explain the similarities of these two species separated by such a wide geographical distance. The only character in the definition above that has not been demonstrated to be labile at the species level is the caudal-fin squamation. Even here, in view of the possible independent appearance and perhaps even lability of the caudal region in several of the so-called "glandulocaudins" (Weitzman and Thomerson, 1970) and the fact that subtle modifications in scale structure occur in other species of *Cheirodon* (see accounts of *C. mitopterus* and *C. dialepturus* below), we do not believe that the caudal glands and associated scales in characoids are necessarily useful in determining generic relationships.

Accordingly, the holotype (FMNH 57825) and several other specimens of *Compsura heterura* (FMNH 57827, 57828) have been examined and compared with *C. gorgonae* to determine whether the two are truly congeneric and the caudal scales are similar enough that convergence would seem unlikely. None of the *C. heterura* specimens available have all the caudal scales present (some have been dried in the past and are quite damaged), but an approximate reconstruction of the caudal-scale configuration was made (Figure 11). The figure of the caudal fin in Eigenmann (1915:61) apparently is not accurate in that some of the scales are misrepresented or missing. The modified caudal scales are not identically arranged in the two species under consideration as may be seen by comparing Figures 10 and 11. In *C. heterura* the scales are more elongate and associated with a single large pouch on the ventral part of the caudal peduncle. A modified scale covers a large area of the base of the dorsal caudal-fine lobe. In *C. gorgonae* there is a series of 3 layers of scales, each associated with its own pouch, all in relation to the ventral part of the caudal peduncle. There is little modification in the scales above the midline in *C. gorgonae.* No attempt was made by histological methods to determine whether glandular tissue is associated with the pouches in either species, but glandular tissue is not obvious to gross inspec-

tion. Eigenmann (1915) indicated that only males of *C. heterura* possess modified scales, whereas we found these scales in both sexes of *C. gorgonae.* All specimens of *C. heterura* examined by us were males, except for 2 small juveniles, 1 of which had enlarged scales on the caudal peduncle.

Thus the principal character that separates these two fishes, *C. heterura* and *C. gorgonae,* from members of the genus *Cheirodon* appears to be very different in each species and likely developed independently in both. The remaining characters supplementally defining *Compsura* appear to us to be labile characters appearing here and there in the species of small characids, and although they have, in various combinations, been used to help define genera, their use in defining relationships is open to question. If one wishes to refer *C. heterura* to a genus separate from *Cheirodon* because of its caudal structure, the same should be done for *C. gorgonae,* and since the caudal structure is different in the two species, they would have to be placed in separate genera. In view of the difficulty of using caudal structures as generic characters within the so-called glandulocaudins, and the subtle but certainly evident caudal-fin variation and modification in other members of the genus *Cheirodon,* we are here considering both *C. heterura* and *C. gorgonae* as members of the genus *Cheirodon* pending a full investigation of caudal scale and pouch structure in characid fishes.

Two of the species here referred to *Cheirodon*—*C. affinis* and *C. terrabae*—could be placed in the genus *Pseudocheirodon* Meek and Hildebrand (*C. affinis* is the type-species of the genus). Bussing (1967) and López (1972) accepted *Pseudocheirodon* as valid because of an even cutting edge of the dentary teeth, lack of fin hooks, and low number of "interhemals" (ventral procurrent caudal-fin rays) as compared with the rounded cutting edge of the dentary teeth, presence of anal-fin hooks, and enlarged, numerous (up to 20) ventral procurrent caudal-fin rays in *Cheirodon.* These characters as treated by Bussing need some comment. We have found anal-fin hooks in *C. affinis* and *C. terrabae.* As pointed out by Böhlke (1954), the number and size of ventral procurrent caudal-fin rays vary greatly in *Cheirodon,* and we believe it to be a labile character that should not be used as a generic character for this group of fishes. Bussing also felt hesitant about using ventral procurrent caudal-fin rays as a generic character.

The remaining character, an even cutting edge in each dentary tooth in *Pseudocheirodon,* versus an enlarged median or central cusp and a rounded cutting edge in each dentary tooth in all other species of *Cheirodon* does not seem valid. We find that some specimens of at least *C. affinis* (the type-species of *Pseudocheirodon*) have somewhat enlarged median central cusps on the dentary teeth, approaching some undescribed species of *Cheirodon* from northern South America, which tend to have a relatively small central median cusp. The character as recorded for *Pseudocheirodon* is not sharply different from that found in some species of *Cheirodon,* and all the characters so far noted that might separate *Pseudocheirodon* from *Cheirodon* appear to grade between the two nominal genera.

In our key we have separated *C. affinis* and *C. terrabae* from other Central American species of *Cheirodon* on the basis of an asymmetrical cutting edge of the premaxillary teeth. This character is useful in the key on a local geographical basis; however, since several other species of *Cheirodon* from elsewhere have asymmetrical teeth, some subtly so, some obviously so, we believe that this character is labile and useless at the generic level.

Cheirodon dialepturus, new species

FIGURES 1–5

Compsura gorgonae (not Evermann and Goldsborough).—Nelson, K., 1964:62 [in part, listed], 71, fig. 3*a* [caudal morphology figured], 74 [in part, identity of specimens discussed], 129 [in part, discussion of possible relationship with the Glandulocaudini].—Bussing, 1967:211 [listed], 214 [in part, compared with *Pseudocheirodon*], 241, fig. 1 [photograph].—López, 1972:93–129 [in part, compared with *C. affinis* and *C. terrabae;* variation of several characters; distribution], 121, fig. 5 [photograph].

MATERIAL EXAMINED

(All specimens from Panama except as noted)

*USNM 208524, holotype, a male 28.0 mm: Veraguas Province, Rio San Pedro basin, creek at bridge 12 mi W of Santiago on Road to Sona, H Loftin, E. Tyson, R. Yerger, 28 Jan. 1962. (HL-105; P16-9).

*USNM 208523, paratypes, with same data as holotype; 144 specimens 20.1–30.0 mm (3 cleared and stained).

*ZMA 112.473, paratypes, with same data as holotype; 2 specimens 26.3–26.5 mm.

FIGURE 1.—*Cheirodon dialepturus*, new species, holotype, USNM 208524, male, 28.0 mm; Panama, Veraguas Province, Rio San Pedro basin, creek at bridge 12 miles west of Santiago on road to Sona, collected 28 January 1962 by H. Loftin, E. Tyson, and R. Yerger.

*BMNH 1973.2.161; 3–4, paratypes, with same data as holotype; 2 specimens 25.8–28.8 mm.

*FMNH 71702, paratypes, with same data as holotype; 2 specimens 27.4–29.6 mm.

*CAS 16060, paratypes, with same data as holotype; 2 specimens 28.3–30.0 mm.

*MCZ 49067, paratypes, with same data as holotype; 2 specimens 26.6–28.3 mm.

*ANSP 121989, paratypes, with same data as holotype; 2 specimens 28.4–29.3 mm.

*USNM 208525, Veraguas Province, Rio San Pedro basin, Rio Cobre at bridge on new IAH section from Santiago, H. Loftin, E. Tyson, R. Condon, 4 Jan. 1962; 16 specimens 24.9–30.7 mm (HL–92; P17–3).

*USNM 208522, Chiriqui Province, creek 5 mi W of David on IAH, H. Loftin and E. Tyson, 2 Dec. 1961; 94 specimens 18.8–33.0 mm (2 specimens cleared and stained) (HL–72; P21–10).

USNM 208552, Cocle Province, Rio Grande basin, creek of Rio Cocle about 5 mi N of Penonome on road to La Pintada, H. Loftin, 23 Mar. 1962; 17 specimens 14.8–29.7 mm (HL–134; P10–1).

USNM 208531, Cocle Province, Rio Hato basin, creek about 3 mi W of Rio Hato at bridge on IAH, H. Loftin and E. Tyson, 14 Oct. 1961; 7 specimens 16.5–27.0 mm (HL–16; P9–18).

USNM 208528, Cocle Province, Rio Grande basin, creek at bridge on IAH about 5 mi E of Nata, H. Loftin and E. Tyson, 15 Oct. 1961; 18 specimens 19.7–26.3 mm (HL–22; P10–4).

USNM 208538, Cocle Province, creek on IAH about 3 mi E of Davisa, H. Loftin and E. Tyson, 15 Oct. 1961; 8 specimens 16.0–18.9 mm (HL–25; P11–3).

USNM 208509, Veraguas Province, Rio Santa Maria basin, creek 1 mi S of Rio Santa Maria bridge on San Francisco road, H. Loftin, 14 Jan. 1962; 20 specimens 17.2–22.3 mm (1 cleared and stained) (HL–97; P11–13).

USNM 208536, Veraguas Province, Rio San Pedro basin, creek at bridge about 20 mi W of Santiago on Sona road, H. Loftin and E. Tyson, 28 Oct. 1961; 56 specimens 16.8–27.3 mm (HL–40; P16–12).

USNM 208526, Veraguas Province, Rio San Pedro basin, creek about 21 mi W of Santiago on Sona road, H. Loftin and E. Tyson, 28 Oct. 1961; 3 specimens 26.4–27.3 mm (HL–41; P16–13).

USNM 208512, Veraguas Province, Rio San Pablo basin, creek 2 mi W of Rio San Pablo bridge on new IAH section from Santiago, H. Loftin, E. Tyson, R. Condon, 4 Jan. 1962; 17 specimens 26.4–28.9 mm (2 cleared and stained) (HL–91; P17–1).

USNM 208532, Chiriqui Province, backwater of Rio San Felix by bridge on IAH (new section), H. Loftin and E. Tyson, 18 Nov. 1961; 61 specimens 17.2–26.2 mm (HL–63; P20–7).

USNM 208537, Chiriqui Province, creek on IAH (new section) less than one-fourth mile from San Felix bridge, H. Loftin and E. Tyson, 18 Nov. 1961; 93 specimens 22.3–31.3 mm (HL–62; P20–8).

USNM 208527, Chiriqui Province, Rio Chorcha at bridge on IAH E of town of Chiriqui, H. Loftin and E. Tyson, 1 Dec. 1961; 95 specimens 27.9–32.2 mm (HL–71; P20–17).

USNM 208535, Chiriqui Province, Rio Esti, about 1 mi N of Gualaca, H. Loftin and E. Tyson, 16 Dec. 1961; 10 specimens 23.1–34.3 mm (HL–80; P21–1).

USNM 208510, Chiriqui Province, Creek 15 mi W of Concepcion on IAH, H. Loftin and E. Tyson, 2 Dec. 1961; 17 specimens 25.0–30.0 mm (2 cleared and stained) (HL–77; P22–1).

USNM 208508, Chiriqui Province, 1.45 mi E of Calle Segunde este, La Concepcion on IAH, R. H. Goodyear, 16 Apr. 1969; 17 specimens 27.1–30.1 mm (2 cleared and stained).

USNM 208511, Panama Province, Rio Corona at bridge on IAH 3 mi E of San Carlos. H. Loftin and E. Hislop, 11 Mar. 1962; 14 specimens 27.8–30.0 mm (2 cleared and stained) (HL–127; P9–10).

USNM 208530, Panama Province, Rio Las Lajas at bridge on IAH E of San Carlos, H. Loftin, 24 Mar. 1962; 2 specimens 30.4–31.8 mm (HL–136; P9–6).

USNM 208533, Comoro del Baru Province, large irrigation canal by road 8 mi N of Puerto Armuelles, H. Loftin and E. Tyson, 15 Apr. 1962; 5 specimens 28.1–29.7 mm (HL–148; P23–1).

USNM 208529, Los Santos Province, Rio La Villa basin, Rio Tebarico, about 3 mi W of Llano de Peidra, H. Loftin and E. Tyson, 30 Sept. 1961; 63 specimens 22.0–29.5 mm (HL–08; P12–1).

USNM 208534, Herrera Province, creek about 4 mi up Pese road from junction with Chitre-Divisa road, H. Loftin and E. Tyson, 21 Oct. 1961; 113 specimens 15.8–29.1 mm (HL–32; P12–3).

USNM 210990, Costa Rica; Puntarenas Province, 7 km SE of Villa Neily on IAH, M., E., and W. Bussing, 28 Feb. 1973; 4 specimens 27.9–32.6 mm.

Specimens included in description and tables include holotype, 6 male and 4 female paratypes, 6 males and 4 females each from USNM 208525 and USNM 208522.

DESCRIPTION.—Standard length of examined specimens 25.4–33.3 mm. Body elongate, compressed laterally; greatest body depth 32.2–38.3. Predorsal body profile somewhat convex with slight concavity at nape; concavity deepest at posterior termination of supraoccipital spine. Body profile between posterior dorsal-fin base termination and anterior base of adipose fin nearly straight to slightly convex, often with a slight dip at adipose fin base. Posterior to adipose fin, body profile continuous as a straight line or slight ventrally directed slope to procurrent caudal rays. Distance from eye to dorsal-fin origin 38.0–41.2; distance from dorsal-fin origin to end of caudal peduncle 51.3–54.7. Ventral body profile usually gently rounded from jaws to anus; steepest inclination ventral to jaws. Ventral body profile protrudes ventrally its greatest distance just anterior to pelvic-fin origin. Body profile along anal-fin base straight or slightly concave; between posterior anal-fin termination and procurrent caudal rays, body profile concave. In many males ventral procurrent caudal rays slightly longer than dorsal procurrent rays. Caudal-peduncle depth 12.1–15.0; peduncle length 13.9–16.5.

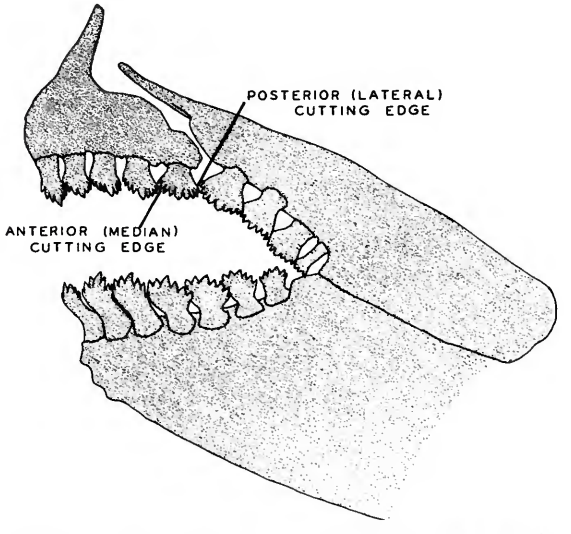

FIGURE 2.—Dentition of *Cheirodon dialepturus*, USNM 208522, female, 31.5 mm; Panama, Chiriqui Province, creek 5 miles west of David on IAH, collected 2 December 1961 by H. Loftin and E. Tyson.

Head Length 23.3–25.3. Eye diameter 8.6–10.5. Snout length 4.7–6.1. Least bony interorbital width 7.0–8.0. Maxillary relatively long, sloping ventrally and posteriorly, forming an angle of 50–60 degrees to longitudinal body axis; upper-jaw length 7.1–9.4. All teeth symmetrical, with 6–7 cusps (except the small posterior tricuspid or conical dentary teeth), with median cusps longest and at least 1 enlarged median cusp; all teeth in a single series (see Figure 2). Maxillary with 2–3, usually 3, teeth (very rarely with 4 teeth), premaxillary with 5 teeth (2 specimens with 6 on one side). Dentary with 9–11 teeth, broader than those of maxillaries, arching anteriorly and becoming smaller toward rictus, row ending in a small conical tooth. No teeth present on vomer, palatines, or pterygoids.

Fontanel moderate, that part anterior to epiphyseal bar about as long as width of fontanel posterior to bar. Gill rakers moderate, 18–21. Circumorbital bones well ossified, infraorbital 3 wide, contacting preopercle ventrally, and with a narrow naked posterior area. Infraorbital 2 not touching preopercle as indicated by López (1972) for "gorgonae" (see below concerning identity of her specimens).

Scales moderately large, cycloid, with concentric circuli, and about 4–6 radii on exposed posterior

field. Lateral line variable, with as few as 7 perforated scales to as many as 34 in some specimens (holotype with 13 perforated scales). When complete, lateral line with a ventral curve on side of body to below adipose fin, then continuing as a straight line to caudal-fin base just ventral to midline. Lateral scales 33–34, usually 33 (often irregular and difficult to count with accuracy); scales above lateral line 6 (some populations examined with 5 scales above lateral line); scales below lateral line 4 in all specimens. Predorsal scales 10–12, usually 11. Scale sheath at base of anal fin of about 5–6 scales. Axillary scale present dorsal to pelvic-fin insertion. Posterior 2 irregular layers of caudal-peduncle scales (border scales) smaller than those just anterior (Figure 3). Each of 2 or 3 posteriormost scales at midline longer than deep, these elongate scales overlapping smaller adjacent scales. All caudal-peduncle scales combined protruding slightly out over caudal fin and attaching to fin membrane. Some specimens with a complete lateral line, with an extension of lateral line onto caudal fin. Variation in exact scale arrangement present, but all specimens have elongate scales at midline.

Dorsal fin with 2 unbranched rays and 8–9, usually 9, branched rays. Dorsal-fin origin anterior to anal-fin origin, posterior to pelvic-fin origin, nearer eye than caudal-fin base. Distance from tip of snout to dorsal-fin origin 50.5–55.2. Second or third ray of dorsal fin longest with posterior rays shorter, forming a slightly rounded posterior margin to fin; length of longest ray 27.3–33.8 (holotype damaged).

Anal fin with 4 unbranched rays and 16–19,

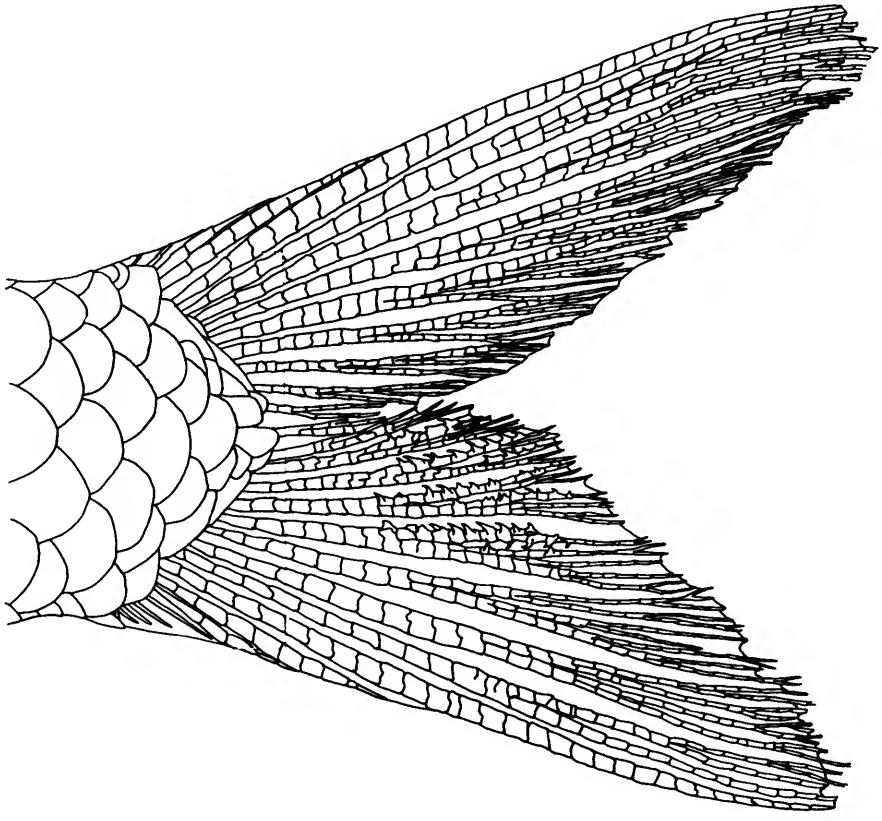

FIGURE 3.—Caudal fin and adjacent scalation of *Cheirodon dialeptura*, USNM 208552, male, 26.5 mm; Panama, Rio Grande basin, creek of Rio Cocle about 5 miles north of Penonome on road to La Pintada, collected 23 March 1962 by H. Loftin.

usually 17 or 18, branched rays. First unbranched ray not always visible except in radiographs. Origin of anal fin, posterior to midpoint of standard length, 62.1–66.4. Fourth through eighth or ninth anal rays longer, with successive posterior rays shorter, forming an abruptly protruding fin margin anteriorly and a straight margin posteriorly; this character more pronounced in females than in males. Dorsally recurved anal-fin hooks present in males only; these occur on posterior unbranched ray and on posterior branches of first through fourteenth (1 specimen), fifteenth (8 specimens, including holotype), sixteenth (5 specimens), or seventeenth (2 specimens) branched rays; only 1 hook or bilateral pair of hooks per bony ray segment; fin often fleshy around hooks. Posterior 8 or 9 branched anal-fin rays often bend slightly anteriad. Extent of area covered by anal-fin hooks and bending of posterior rays varies from population to population.

Pectoral fin with 1 unbranched ray and 9–11, usually 10, branched rays. Pectoral fins reach just anterior to or just to pelvic-fin origin. Distance from tip of snout to dorsal end of pectoral-fin base 23.4–26.8 and length of pectoral fin from base to tip of longest ray 20.8–26.2.

Pelvic fin with i,7 rays in all specimens, distal tip reaching from just anterior to just posterior to anal-fin origin. Distance from tip of snout to pelvic-fin origin 43.7–48.8; pelvic-fin length 17.9–24.2. In males, unbranched ray without hooks, first through sixth (2 specimens) or seventh (13 specimens including holotype) branched rays with antrorse hooks, usually on the ventral surface of rays. Only 1 hook present per bony ray segment.

Caudal fin with 10/9 principal caudal rays in all specimens; fin forked, not split to base. Lower lobe largest in males, with recurved hooks present on dorsal edge (occasionally ventral edge) of branches of rays 2–5 or 2–6, counting the most dorsal ray of lower lobe as number 1. These hooks often paired, similar to anal-fin hooks, with each hook of pair facing different side of fin; only 1 hook or hook pair per bony ray segment. Fin rays usually curved dorsally when hooks present. Ventral procurrent rays of males often somewhat longer than dorsal procurrent rays. In females, caudal fin symmetrical, without hooks and elongate ventral procurrent rays.

Precaudal vertebrae 15–16. Total vertebrae 32–34, usually 33.

Color in alcohol: Ground color pale brown; nape dark brown. Humeral spot variable, virtually absent in some populations, rather large in others;

FIGURE 4.—*Cheirodon dialepturus,* new species, USNM 210990, male, 32.5 mm; Costa Rica, Puntarenas Province, 7 kilometers southeast of Villa Neily on IAH, collected 28 February 1973 by Myrna, Eric, and William Bussing; specimen photographed in life.

when present, centered at "pseudotympanum." Small melanophores present on scale pockets on sides of fish, more numerous dorsally, forming reticulate pattern above midline and following myomere junctions below midline above anal fin. Some specimens with a broad dark stripe along midline, terminating in dark caudal spot, in others only caudal spot present. Small melanophores usually present along fin rays of all fins, more numerous distally on dorsal, caudal, and anal fins.

Color in life: The following description has been supplied to us by Dr. J. D. McPhail from specimens captured in the Rio Zarati, on road between Penonome and Tambo, Cocle Province: Back bronze shading to green. Scales of back outlined with black pigment and very conspicuous. Belly silver white, sides dorsal to anal fin translucent. Burnished silver lateral stripe ending at dark spot on caudal peduncle. Very conspicuous yellow pigment (shading to red in some males) above and below caudal spot. Dorsal, anal, and pelvic fins red with white tips. Caudal fin red, shading off to transparency toward fin margin.

Range: Cheirodon dialepturus is found in Pacific drainages throughout western and west-central Panama from eastern Cocle Province, west at least to Puntarenas Province of Costa Rica (see "Material Examined"). Bussing (1967) listed *C. gorgonae* from the Rio Coto drainage in eastern Costa Rica; López (1972) approximated *C. gorgonae's* range to be from the Rio Coto, throughout southern Panama, to areas of Colombia adjacent to Panama (no specimens were listed from areas east of the Canal Zone). We believe, as discussed below, that López and Bussing were referring, for the most part, to *C. dialepturus.*

COMPARISONS.—*Cheirodon dialepturus* is a distinctive species that can be separated from all other known Central American cheirodontins by the combination of the presence of antrorse hooks on the ventral caudal-fin lobe of males, and the modified scales on the caudal peduncle as shown in Figure 3.

Cheirodon dialepturus has jaw teeth similar to those of *C. gorgonae* but lacks the modified scale "pouches" of the latter. Also, the two species have

FIGURE 5.—*Cheirodon dialepturus,* new species, USNM 210990, female, 32.6 mm; Costa Rica, Puntarenas Province, 7 kilometers southeast of Villa Neily on IAH, collected 28 February 1973 by Myrna, Eric, and William Bussing; specimen photographed in life.

a different body shape (compare Figures 1 and 8). *Cheirodon dialepturus* resembles *C. mitopterus* in its possession of modified caudal-peduncle scales; however, other characters including live color pattern, fewer vertebrae (32–34, usually 33, in *C. dialepturus,* vs. 34–36, usually 35, in *C. mitopterus*), fewer pectoral rays (9–11, usually 10, in *C. dialepturus,* vs. 11–12, usually 12, in *C. mitopterus*), fewer tooth cusps (6–7 in *C. dialepturus,* vs. 7–10 in *C. mitopterus*), and presence of caudal-fin hooks (lacking in *C. mitopterus*) clearly set the two species apart. Furthermore, there are definite behavioral differences between the two forms (McPhail, personal communication). *Cheirodon dialepturus* shares the characters of caudal-fin hooks with some species of *Saccoderma* (discussed in the account of that genus) but is clearly different from those species in tooth structure and in the shape of the latter's modified caudal-fin scales. *Cheirodon dialepturus* is quite distinct from *C. affinis* and *C. terrabae* in having caudal-fin hooks, a different tooth structure, and the modified caudal scales.

There has been some confusion regarding *C. dialepturus* in the past. Loftin's collections of the species in the National Museum of Natural History are mostly labeled *"Compsura gorgonae"* or *"Pseudocheirodon affinis."* Loftin (1965) states that his cheirodontins were examined and identified by W. A. Bussing. Therefore, we assume that much of Loftin's and Bussing's (1967) *"Compsura gorgonae"* material may be *C. dialepturus.* This is substantiated by the fact that Bussing refers to the hooks on the lower caudal lobe of his specimens. We also note that Géry (1965) apparently confused these two species when he referred to caudal-fin hooks of *Compsura gorgonae.* López (1972) also confused *C. dialepturus* and *C. gorgonae;* she referred to caudal hooks and pouches in *C. gorgonae* and apparently thought that their presence or absence was due to intraspecific variation.

VARIATION.—The extensive collections of *C. dialepturus* listed above in "Materials Examined" have been used to determine the geographical range of the species, individual and population differences, and seasonal morphological changes. Variation in *C. dialepturus* is most evident in pigmentation, tooth structure, and number of lateral-line pores. As mentioned in the color description of alcohol specimens, some populations have a broad lateral stripe and a rather pronounced humeral spot, while others lack both but have a caudal spot. Within a population some individuals will have one or the other or a particular combination of these characters more or less pronounced than usual for that population. The slight variation in tooth structure occurs mainly in the massiveness or length of the tooth cusps. This tooth variation, for the most part, seems to follow no particular geographical or ecological pattern, except that those specimens from western Panama seem to have slightly broader teeth with smaller cusps. The most obvious morphological variation is in the number of lateral-line pores. Specimens from central Panama have incomplete lateral lines (extending posteriorly to a point well anterior to a vertical or just anterior to a vertical from the dorsal-fin origin). Population samples of *C. dialepturus* from extreme western Panama tend to have some or all individuals with complete or nearly complete lateral lines. However, some collections from this area have all specimens with incomplete lateral lines similar to those in fishes from central or west-central Panama. Contrary to López (1972), we could find no ecological factors among the field data recorded by Loftin, such as vegetation, elevation, water flow, turbidity, or depth, which could be associated with the number of lateral-line pores. We have found no seasonal variation in *C. dialepturus* regarding coloration or massiveness and length of anal, pelvic, or caudal-fin hooks.

López (1972) stated that there was geographical variation in length of the maxillary bone in what now has been found to be mixed samples of *C. gorgonae, C. dialepturus,* and *C. mitopterus.* We found no significant correlation with upper-jaw length and geographical distribution in these species. There is, as would be expected, a slight size increase in total upper-jaw length with increase in body length and our data suggest that this is an allometric increase. The small size and difficulty of measuring the length of the maxillary bone as outlined by López (1972) would require cleared and stained specimens and the use of an ocular micrometer to obtain useful measurements. We believe extreme care should be used in measuring such small structures.

ETYMOLOGY.—From the Greek *dialeptos* (distinguishable) and *oura* (tail), referring to the caudal hooks and peduncle scalation.

Cheirodon mitopterus, new species

FIGURES 6, 7

Compsura gorgonae (not Evermann and Goldsborough).—López, 1972:101 [listed from Rio Cocle del Norte, HL–172], 106 [discussion of lateral-line length].

MATERIAL EXAMINED

(All specimens from Panama)

*USNM 208539, holotype, a male 35.0 mm: Cocle Province, Rio Cocle del Norte basin, Rio Tucue at junction of river and road between Tucue and Tambo, coll. J. D. McPhail, 28 Aug. 1972.

*USNM 208513, paratypes, with same data as holotype; 7 specimens 28.5–36.8 mm (1 cleared and stained).

*ANSP 121987, paratype, with same data as holotype; 1 specimen 30.9 mm.

*BMNH 1973.2.16;1, paratype, with same data as holotype; 1 specimen 30.4 mm.

USNM 208540, Cocle Province, Rio Cocle del Norte basin, Rio Tucue, near village of Tucue in headwaters of Rio Cocle del Norte, H. Loftin and W. Kosan, 15 Sept. 1962; 12 specimens 25.7–33.4 mm (HL–171; A5–1).

USNM 208514, Cocle Province, Rio Cocle del Norte basin, Rio Tambo, near Tambo and Toabre, in headwaters of Rio Cocle del Norte, H. Loftin and W. Kupfer, 15 Sept. 1962; 14 specimens 24.6–33.1 mm (2 cleared and stained) (HL–172; A5–2).

USNM 208541, Cocle Province, Rio Cocle del Norte basin, stream near Toabre road (either the Rio Toabre or a small tributary of it) near Tambo, R. Dressler, Sept. 1972; 12 specimens 28.4–35.1 mm.

Tables include 10 specimens used in the description and 10 specimens each from USNM 208540 and USNM 208514.

DESCRIPTION.—Standard length of examined specimens 24.9–36.8 mm. Body elongate, compressed laterally; greatest body depth 23.6–38.3. Predorsal body profile somewhat convex, with a slight concavity at nape. Body profile nearly straight to slightly convex between posterior dorsal-fin base termination and anterior base of adipose fin. Posterior to adipose fin, body profile continuous as a straight line to procurrent caudal-fin rays. Distance from eye to dorsal-fin origin 29.8–49.7; distance from dorsal-fin origin to caudal-fin origin 44.0–74.3. Ventral body profile very gently rounded from jaws to anus, then with a slight ventral slope to anal-fin origin; steepest inclination of ventral profile ventral to jaws. Ventral body profile protrudes ventrally its greatest distance just anterior to pelvic-fin origin. Body profile along anal-fin base straight or very slightly convex; between posterior anal-fin termination and procurrent caudal rays body profile slightly concave. Caudal peduncle depth 8.5–14.7; peduncle length 13.1–21.0.

Head length 18.5–28.7. Eye diameter 7.9–12.9. Snout length 4.3–7.4. Least bony interorbital width 5.7–9.2. Maxillary moderate, sloping ventrally and posteriorly, forming an angle of about 50 degrees to longitudinal body axis; upper-jaw length 6.2–9.9. All teeth symmetrical, with 7–10 cusps (except the small posterior dentary teeth discussed below), with median cusps longest and at least 1 enlarged

FIGURE 6.—*Cheirodon mitopterus*, new species, holotype, USNM 208539, male, 35.0 mm; Panama, Cocle Province, Rio Cocle del Norte basin, Rio Tucue at junction of river and road between Tucue and Tambo, collected 28 August 1972 by J. McPhail.

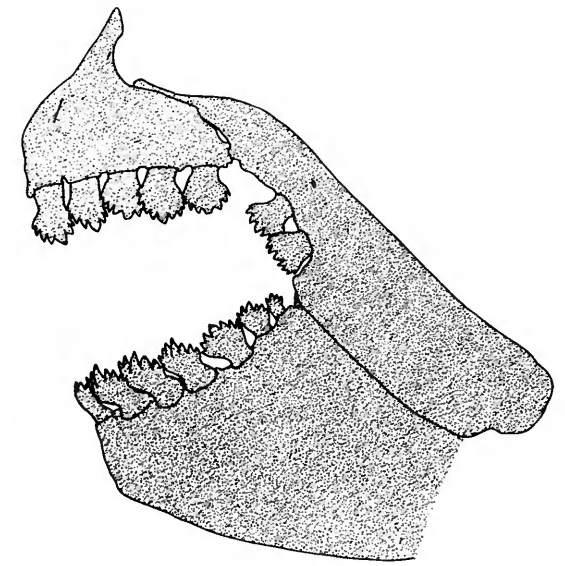

FIGURE 7.—Dentition of *Cheirodon mitopterus,* paratype, USNM 208513, female, 35.5 mm; Panama, Cocle Province, Río Cocle del Norte basin, Rio Tucue at junction of river and road between Tucue and Tambo, collected 28 August 1972 by J. McPhail.

median cusp; all teeth in a single series (Figure 7). Maxillary with 2–3, usually 2, teeth; premaxillary with 5 teeth in all specimens. Dentary with 8 to 10 teeth, broader than those of maxillaries, becoming smaller toward rictus, row ending in a small conical tooth. No teeth on vomer, palatines, or pterygoids.

Fontanel moderate, that part anterior to epiphyseal bar about as long as greatest width of fontanel posterior to bar. Gill rakers moderate, 18–20, usually 19. Circumorbital bones well ossified, infraorbital 3 wide, contacting the preopercle ventrally, and with a narrow naked posterior area.

Scales moderately large, cycloid, with concentric circuli, and about 4–6 radii on exposed posterior field. Lateral line complete, with up to 37–38 perforated scales and a short fleshy tubular extension onto middle caudal-fin rays. Lateral line with a ventral curve on side of body, approaching midline at end of caudal peduncle. Lateral scales 34–36, usually 35 (often irregular and difficult to count with accuracy); scales above lateral line 5–6, usually 5; scales below lateral line 3–4, usually 4. Predorsal scales about 11–12. Scale sheath at base of anal fin of about 6 scales. Axillary scale present dorsal to pelvic-fin insertion. Caudal fin with scales arranged much as in *C. dialepturus,* that is, with approximately 2 rows of irregular scales caudad to the more regular scales of the caudal peduncle, extending slightly over caudal fin (some of those near midline attached to fin membrane). Usually with each of 2 or 3 posteriormost scales at midline longer than deep.

Dorsal fin with ii,9 in all specimens. Dorsal-fin origin anterior to anal-fin origin, posterior to pelvic-fin origin, nearer eye than caudal-fin base. Distance from tip of snout to dorsal-fin origin 40.6–68.4. In adult males second or third rays extend as a short filament, in females second or third ray of dorsal fin longest; in both sexes posterior rays shorter, forming a slightly rounded posterior margin to fin; length of longest ray 23.2–39.8, holotype damaged.

Anal fin with 4 unbranched rays and 17–19, usually 18, branched rays. First unbranched ray not always visible except in radiographs. Origin of anal fin posterior to midpoint of standard length 49.7–85.0. Fourth through eighth or ninth anal rays longer, with successive posterior rays shorter, forming an abruptly protruding fin margin anteriorly and a straight or slightly convex margin posteriorly. Dorsally recurved anal-fin hooks present in adult males only; these occur on posterior unbranched ray and on posterior branches of first through seventeenth (1 specimen, holotype), first through fifteenth (1 specimen not fully matured), first through fourteenth (1 specimen), and first through sixth (1 immature specimen) branched rays; only 1 hook or bilateral pair of hooks per bony ray segment; fin often fleshy around hooks. Posteriormost branched anal-fin rays straight, not bending anteriad.

Pectoral fin with 1 unbranched ray and 11–12, usually 11, branched rays. Pectoral fins of males reach slightly beyond pelvic-fin origin; in females pectoral fins reach just anterior to or to pelvic-fin origin. Distance from tip of snout to dorsal end of pectoral-fin base 18.7–30.2, and length of pectoral fin from base to tip of longest ray 15.0–32.5.

Pelvic fin with 1 unbranched ray and 7–8, usually 7, unbranched rays, distal tip in males reaching to fifth branched anal ray, in females distal tip reaching from anterior to or just to anal-fin origin. Distance from tip of snout to pelvic-fin origin 34.9–60.0; pelvic-fin length 15.3–30.1. In males, un-

branched pelvic-fin ray extended as a filament. In males, unbranched ray without hooks, first through seventh (2 specimens, including holotype), first through sixth (1 specimen, immature), and second through sixth (1 specimen, immature) branched rays with antrorse hooks, usually on the ventral surface of the rays; only 1 hook present per bony ray segment.

Caudal fin with 10/9 principal caudal rays in all specimens; fin forked, not split to base. Caudal fin symmetrical and without hooks. Ventral procurrent rays of males often somewhat longer than dorsal procurrent rays.

Precaudal vertebrae 16–17, usually 17. Total vertebrae 34–36, usually 35.

Color in alcohol: Ground color light cream brown. No humeral spot; area at "pseudotympanum" darker than sides of body. Small melanophores present on head, tip of snout, and nape; also present on scale margins of back, more numerous dorsally, forming reticulate pattern above midline. Midline with groups of melanophores forming a diffuse lateral stripe internal to scales. In some specimens melanophores less numerous or absent along sides above and below melanophores of midline. Often a few melanophores, more numerous anteriorly, in a diffusely defined lateral stripe or stripes just below midline; in more heavily pigmented specimens there is a loose reticulate pattern instead of the diffuse lateral stripes. A few scattered melanophores present between anal-fin base and midline, sometimes following myomere junctions. Silvery lateral stripe present in recently preserved specimens. Caudal spot present as an elongate oval area of dense melanophores extending onto middle caudal-fin rays. On pectoral fins melanophores present along first through fifth rays, absent on others. A few melanophores present along first through fifth pelvic-fin rays. Anal-fin rays with small melanophores along rays (occasionally on interradial membrane), more numerous proximally and distally. Dorsal fin with small melanophores along fin rays. Caudal fin with melanophores along rays and on interradial membranes, concentrated on dorsal rays of dorsal lobe and ventral rays of ventral lobe, virtually absent from middle caudal-fin rays (excepting caudal spot). In some specimens preserved for a period of years, melanophores on fins no longer visible.

Color in life: The following description has been supplied to us by Dr. J. D. McPhail: Back light green shading to bright silver on sides and belly. Reticulate scale pattern of back not conspicuous. Between anal-fin base and midline, sides translucent with a silvery coat. Two bright silver areas (almost gold in some lights) on caudal fin above and below oval caudal spot. Fins, except for pectoral, with white tips, otherwise transparent. Anal fin with microscopic flecks of red in males.

Range: Cheirodon mitopterus is found only in the Rio Cocle del Norte basin, an Atlantic drainage of central Panama.

According to McPhail (personal communication), the Rio Cocle del Norte has a fauna somewhat differentiated from the rest of Panama. The taxonomy of the forms in this river needs to be examined in terms of broad-based studies of related forms throughout Central and South America. Whether or not other forms in the river system will prove to be as distinct as *C. mitopterus* remains to be seen.

COMPARISONS.—*Cheirodon mitopterus* is allopatric in regard to all known Central American cheirodontins. Based on tooth morphology, it seems closest to *C. dialepturus* and *C. gorgonae* but differs as described under those species. *Cheirodon mitopterus* differs from *C. affinis* and *C. terrabae* in caudal-peduncle squamation, in having symmetrical premaxillary teeth, an enlarged median cusp on each dentary tooth, fewer scales below the lateral line (usually 4 compared to 5 or 6 in those species), fewer branched anal-fin rays (usually 18 compared with as many as 21–23 in those species), and more vertebrae (usually 35–36 vs. 31–34). *Cheirodon mitopterus* differs from *Carlana eigenmanni* in numerous features including dentition, number of branched anal rays, gill rakers, and in caudal squamation. *Cheirodon mitopterus* differs from *Phenagoniates macrolepis* in having more than 3 cusps on the teeth and a shorter anal fin, in caudal squamation, and in numerous other characters listed under *C. macrolepis.*

ETYMOLOGY.—From the Greek *mitos* (thread) and *pteros* (fin), in reference to the threadlike extensions of the dorsal and pelvic fins.

Cheirodon gorgonae Evermann and Goldsborough

FIGURES 8, 9, 10

Cheirodon gorgonae Evermann and Goldsborough, 1909:99

[original description; Gorgona, Panama], fig. 1 [holotype figured], 100, fig. 3 [teeth figured].

Cheirodon insignis (not Steindachner).—Eigenmann, 1915:69 [Eigenmann placed *Cheirodon gorgonae* Evermann and Goldsborough in the synonymy of *Cheirodon insignis* Steindachner].

Compsura gorgonae.—Meek and Hildebrand, 1916:274 [description], fig. 2 (teeth figured).—Eigenmann, 1922:128 [generic allocation].—Breder, 1927:117 [listed; variation, range], 163 [in key].—Jordan, Evermann, and Clark, 1930:96 [listed].—Hildebrand, 1938:250 [discussion; range].—Evans, 1952:44 [listed from Chilibre].—Gosse, 1966:8 [listed from Panama Province].—Miller, 1966:784 [listed].—Bussing, 1967: 211 [in part, listed], 214 [in part, compared with *Pseudocheirodon*].—López, 1972:93–129 [in part, confused with *C. dialepturus* and *C. mitopterus*], 119, fig. 4 [caudal squamation figured inaccurately].

Material Examined

(All specimens from Panama)

*USNM 64094, holotype, a juvenile 22.1 mm, Canal Zone, Gorgona, from small seepage pool below reservoir. A. H. Jennings, 7 Feb. 1908.

*USNM 127086, paratypes, with same data as holotype; 3 specimens 19.4 to approximately 23.0 mm (specimen damaged). Previously Bureau of Fisheries No. 5421.

*USNM 64095, paratypes, with same data as holotype; 4 specimens 19.8–21.3 mm.

*USNM 78691, Rio Frijoles, Frijoles, S. E. Meek and S. F. Hildebrand, 14 Mar. 1911; 17 specimens 22.8–26.6 mm.

*USNM 78687, Gatun River at Monte Lirrio, S. E. Meek and S. F. Hildebrand, 27 Mar. 1911; 41 specimens 22.1–25.5 mm.

*USNM 208543, creek about 2 mi E of Nueva Emperador road, H. Loftin, E. Tyson, C. Kupfer, 17 Aug. 1962; 17 specimens 24.6–28.1 mm (HL–163; A7–2).

USNM 64773, sluggish stream emptying into dammed-up lake at Gatun, A. H. Jennings, 15 Aug. 1909; 1 specimen 21.8 mm.

USNM 109254, Madden Lake, Boqueron River (above lake in current), S. F. Hildebrand, 12 Feb. 1935; 4 specimens 26.0–29.0 mm.

USNM 109255, Rio Cocoli, Miraflores Lake, S. F. Hildebrand, 2 Apr. 1937; 5 specimens 24.0–26.3 mm.

USNM 208542, creek about 5 mi W of El Llano on road, H. Loftin and C. Kupfer, 17 Mar. 1962; 4 specimens 26.7–29.4 mm (HL–132; P6–2).

USNM 78694, Reservoir Creek, Gorgona, S. E. Meek and S. F. Hildebrand, 29 Mar. 1912; 4 specimens 28.0–28.4 mm (1 cleared and stained).

ANSP 99865, creek into Rio Caimito 8 mi from Chorrera on Nuevo Emperado road, H. Loftin, E. Tyson, C. Kupfer, 17 Aug. 1962; 87 specimens, 14.8–24.5 mm (HL–162; P8–4).

ANSP 104039, Rio Perequete at bridge on IAH E of Capira, H. Loftin, 24 Mar. 1962; 9 specimens 23.3–26.0 mm (HL–139; P8–6).

The type series of *C. gorgonae* includes only juveniles (designated as such in the morphometric tables). For this reason, the range for adults from several lots is given in the description and in the tables; adults are from USNM 78687, 5 males and 5 females; USNM 70691, 3 males and 1 female; and USNM 208543, 6 males and 4 females. In the description, the range for a given morphometric character is given first for juveniles, then for the adults.

Figure 8.—*Cheirodon gorgonae*, USNM 208543, male, 26.0 mm; Panama, Rio Chagres basin, creek 2 miles east of Nuevo Emperador Road, collected 17 August 1962 by H. Loftin, E. Tyson, and C. Kupfer.

Also, in stating number of "cotypes," Evermann and Goldsborough (1909) made an error in indicating number of specimens in the USNM collections (now including the Bureau of Fisheries specimens). On subtracting 4 specimens sent to other institutions from the original 11, they indicate a remainder of 8 specimens—this should be 7.

DESCRIPTION.—Standard length of examined specimens 19.4–21.3; 22.9–28.4 mm. Body elongate, compressed laterally; greatest body depth 25.7–36.7; 33.4–37.8. Predorsal body profile somewhat convex with a slight concavity at nape; concavity deepest at posterior termination of supraoccipital spine. Body profile straight or slightly convex between posterior dorsal-fin base termination and anterior base of adipose fin. Between posterior adipose-fin base and dorsal procurrent caudal-fin rays, body profile slightly convex or straight. Distance from eye to dorsal-fin origin 36.2–39.8; 38.0–43.2; distance from dorsal-fin origin to end of caudal peduncle 49.3–54.6; 50.2–54.5. Ventral body profile gently rounded from jaws to anus; steepest inclination ventral to jaws. Ventral body profile protrudes its greatest distance just anterior to pelvic-fin origin. Body profile along anal-fin base straight or slightly convex. Between posterior termination of anal-fin base and ventral procurrent caudal-fin rays, body profile straight or slightly concave. Caudal peduncle depth 11.1–14.2; 12.0–14.3; peduncle length 14.0–15.1; 13.6–17.1.

Head length 25.3–27.3; 23.5–26.3. Eye diameter 10.4–11.9; 9.2–10.8. Snout length 5.4–5.8; 5.3–5.8. Least bony interorbital 7.0–8.3; 6.5–8.1. Maxillary relatively long, sloping ventrally and posteriorly, forming an angle of about 50–60 degrees to longitudinal body axis; upper-jaw length 7.6–8.3; 7.4–8.0. All jaw teeth in a single series; teeth usually with middle cusps enlarged, forming a rounded cutting edge. Maxillary teeth 1–3, usually 2, usually with about 8 cusps, teeth broader than premaxillary teeth. Premaxillary teeth 5 in all specimens (holotype damaged), usually with 9 cusps. Dentary with about 9 teeth, anterior 5 teeth larger (with 7–8, usually 8, cusps) and posterior teeth tapering in size (the smallest has 3–5 cusps). No teeth present on vomer, palatines, or pterygoids.

Fontanel moderate, that part anterior to epiphyseal bar about as wide posteriorly and about as long as width of fontanel immediately posterior to bar. Gill rakers moderate, 16–20, usually 18–19 (holotype and juveniles not counted). Circumorbital bones well ossified, infraorbital 3 wide, contacting the preopercle ventrally and with a narrow naked area posteriorly. Infraorbital 2 not contacting the preopercle as indicated by López (1972).

Scales moderately large, cycloid with concentric circuli and about 2–5 radii on the exposed posterior field. Perforated lateral-line scales 8–18, usually 11–13 (holotype with 10), lateral line with a slight ventral curve. Lateral scales 32–33 (holotype with 33); scales above lateral line 5 (in some other lots examined, there were 6 scales above lateral line); scales below lateral line 4 in all specimens. Scale sheath at base of anal fin of about 5–7 scales. Axillary scale present dorsal to pelvic-fin origin; caudal fin without scales except as described below.

Dorsal fin with ii,9 in all specimens. Dorsal-fin origin anterior to anal-fin origin, posterior to pelvic-fin insertion, nearer eye than caudal-fin base. Distance between tip of snout and dorsal-fin origin 49.5–53.9; 51.4–56.8. Second or third ray of dorsal fin longest with posterior rays shorter, forming a slightly rounded posterior margin to fin; length of longest ray, 29.8; 27.6–32.4 (holotype and all but 1 paratype damaged).

Anal fin with 4 unbranched rays and 15–19, usually 16–17, branched rays. First unbranched ray

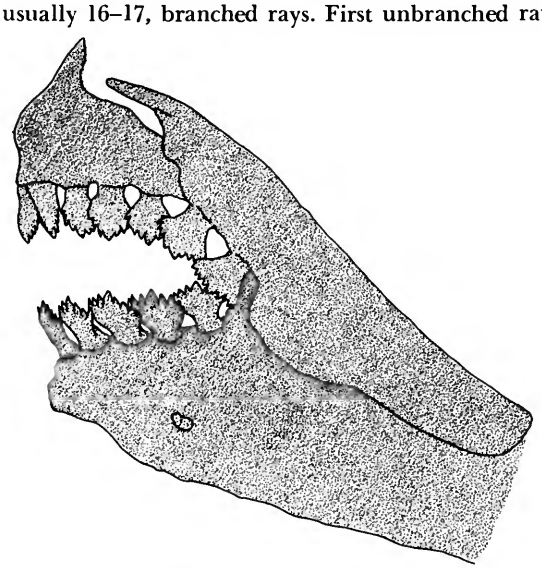

FIGURE 9.—Dentition of *Cheirodon gorgonae*, USNM 78694, male, 28.3 mm; Panama, Canal Zone, Reservoir Creek, Gorgona, collected 29 March 1912 by S. Meek and S. Hildebrand.

not always visible except in radiographs. Anal-fin origin posterior to midpoint of standard length 63.1–65.6; 62.2–67.2. Fourth through eighth anal rays longer than other anal-fin rays; each posterior successive ray somewhat shorter than its predecessor, forming a protruding fin margin anteriorly and a concave margin posteriorly. Adult males with dorsally recurved hooks present on posteriormost branched ray and posterior branches of first through eleventh (1 specimen), thirteenth (2 specimens), fourteenth (7 specimens), or fifteenth (4 specimens) branched rays. Hooks, single or, usually, in bilateral pairs; only 1 hook or pair of hooks per bony ray segment; fin often fleshy about hooks. Posterior 8 or 9 branched anal-fin rays straight or slightly curved caudad, not curved anteriorly.

Pectoral fin slightly pointed or rounded, with 1 unbranched ray and 9–11, usually 10, branched rays (holotype damaged). Pectoral fins extend from just anterior to slightly beyond pelvic-fin origin. Distance from tip of snout to dorsal end of pectoral-fin base 26.7–28.6; 24.2–28.8 and length of pectoral fin from base to tip of longest ray 21.8; 20.0–25.4 (holotype and all but one paratype damaged).

Pelvic fin with 1 unbranched ray and 7–8, usually 7, branched rays, distal tip reaching from just anterior to or to anal-fin origin. Distance from tip of snout to pelvic-fin origin 46.9–49.0; 45.0–49.8;

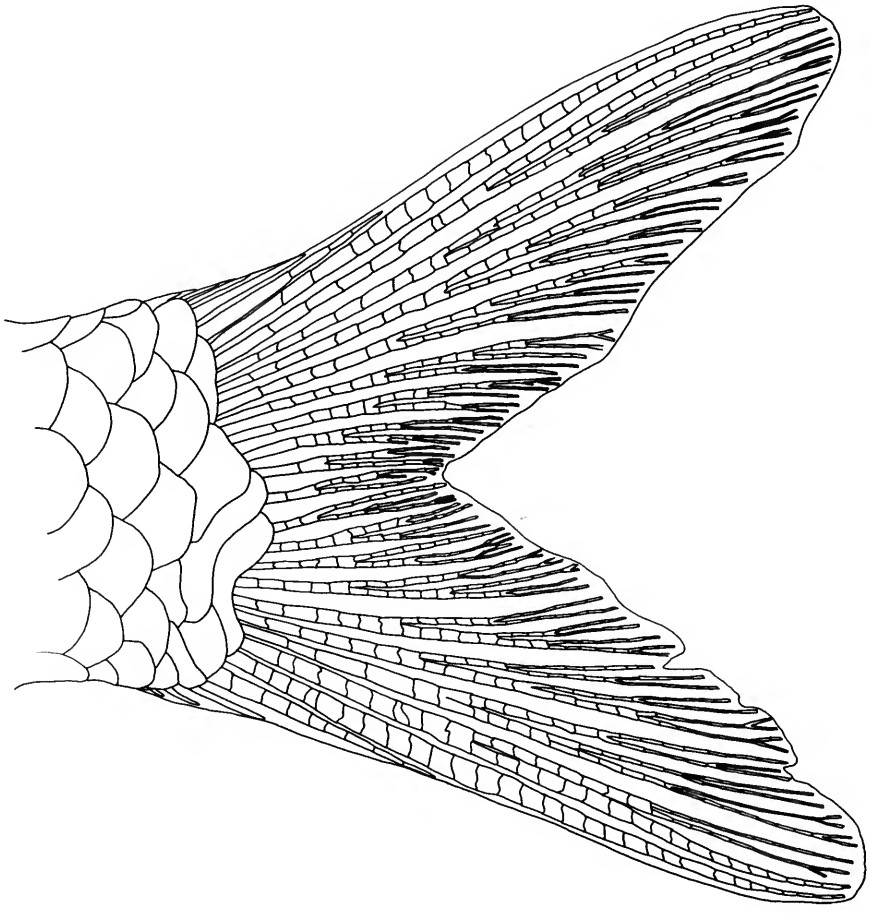

FIGURE 10.—Caudal fin scalation of *Cheirodon gorgonae*, USNM 208543, female, 28.0 mm; Panama, creek about 2 miles east of Nueva Emperador Road, collected 17 August 1962 by H. Loftin, E. Tyson, and C. Kupfer.

pelvic-fin length 16.0–18.0; 16.5–21.4 (holotype damaged). In males first unbranched pelvic ray usually without hooks (hooks were present on 1 specimen), first through sixth (2 specimens) or seventh (12 specimens) branched rays with antrorse hooks on ventral surface of ray; only 1 hook present per bony ray segment.

Caudal fin with 10/9 principal caudal rays in all specimens (holotype damaged); fin forked, not split to base. Upper and lower lobes usually equal in size, occasionally a large male with slightly larger lower caudal lobe. Dorsal and ventral procurrent caudal-fin rays usually protrude abruptly from caudal peduncle and each ventral ray is equal in size to its dorsal counterpart. No hooks on caudal fin. Lower caudal lobe of both sexes with a series of modified scales forming 3 pouches (Figure 10). Holotype damaged and missing these scales but scale pockets indicate presence of pouch scales; all paratypes possess pouch scales.

Precaudal vertebrae 15–16, total vertebrae 33–34, usually 33.

Color in alcohol: Ground color pale brown or tan. Melanophores form a reticulate pattern on scale pockets along back and extend over nape and top of head; these melanophores more numerous in some populations, less in others. Melanophores less numerous below midline, a few scattered above anal-fin base, often along myomere junctions; belly usually unpigmented. Humeral spot absent, but some darkening of tissues in area of "pseudotympanum." Melanophores concentrated at posterior termination of caudal peduncle, forming a caudal spot. Dorsal, caudal, anal and, usually, pelvic fins with few scattered melanophores along fin rays, pectoral fins without pigment; otherwise all fins hyaline.

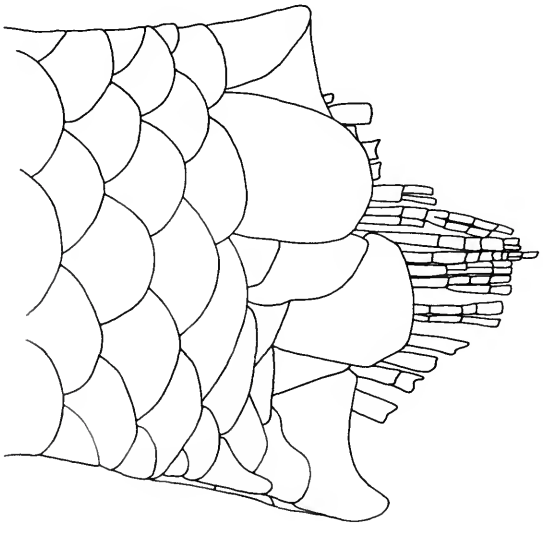

FIGURE 11.—Caudal fin scalation of *Cheirodon heturura*, holotype, FMNH 57825, male 28.4 mm; Brazil, Quimadas, Rio Itapicuru, collected 2 March 1908 by J. Haseman.

Range: Existing collections of *C. gorgonae* indicate a limited distribution near the center of Panama, where it occurs in both the Pacific and Atlantic drainages, in Colon and western Panama Provinces.

COMPARISONS.—*Cheirodon gorgonae* can be distinguished from all other Central American cheirodontins by a combination of the following three characters: modified caudal-fin scales and peduncle scales, forming pouches; symmetrical dentary teeth with enlarged median cusps and absence of antrorse hooks on the caudal fin. In the past *C. gorgonae* has been confused with *C. dialepturus* (see the discussion above of the latter). *Cheirodon gorgonae* does seem close to *C. dialepturus* but differs in having caudal scale pouches, lacking caudal-fin hooks, and in having fewer maxillary teeth (usually 2, compared with a mode of 3 in *C. dialepturus*).

Cheirodon gorgonae differs from *C. mitopterus* in many ways, including caudal peduncle squamation, color pattern, and meristic characters, including number of pectoral-fin rays (9–11, usually 10, vs. 11–12, usually 11, in *C. mitopterus*) and total number of vertebrae (32–34, usually 33, vs. 34–36, usually 35, in *C. mitopterus*). *Cheirodon gorgonae* differs from *C. affinis* and *C. terrabae* in having symmetrical premaxillary teeth, enlarged median cusps on the dentary teeth, forming rounded cutting edges, and a relatively longer, more slender maxillary. *Cheirodon gorgonae* differs from *Phenagoniates macrolepis* and *Carlana eigenmanni* in dentition, caudal scale modifications, and numerous meristic characters as described.

Cheirodon gorgonae exhibits sexual dimorphism by having retrorse hooks on the anal and pelvic fins in males. We could find no geographical or seasonal variation in this character. There is some slight variation in the formation of the caudal-fin pouches regarding size and placement of individual scales.

Cheirodon affinis (Meek and Hildebrand)

FIGURES 12, 13, 14

Cheirodon insignis (not Steindachner).—Evermann and Goldsborough, 1909:98 [brief description], 100, fig. 2 [teeth figured].—Eigenmann, 1915:69 [in part].

Pseudocheirodon affinis Meek and Hildebrand, 1916:pl. XVIII [photograph], 275 [new genus and species; original description; Rio Gatun, Panama].—Eigenmann, 1922:129 [listed].—Breder, 1925:143 [listed from Rio Tapia, Panama].—Breder, 1927:118 [listed; variation; range], 163 [in key].—Jordan, Evermann, and Clark, 1930:96 [listed].—Grey, 1947: 179 [listing of types (see below)].—Hildebrand, 1938:251 [brief description; range].—Gosse, 1966:8 [listed from tributary of Rio Bayano].—Miller, 1966:784 [listed; range].—Bussing, 1967:214 [compared with *C. terrabae* and with *"C gorgonae,"* a mixture of *C. gorgonae* and *C. dialepturus*], 236 [listed], 241, fig. 1 [photograph].—Géry, 1972:73 [brief discussion in comparison with undescribed characid from Ecuador].—López, 1972:93–129 [compared with *"C. gorgonae"* (a mixture of *C. dialepturus, C. mitopterus,* and *C. gorgonae*) and *C. terrabae;* variation of several characters (discussed below); distribution], 119, fig. 3B [teeth figured].

MATERIAL EXAMINED

(All specimens from Panama)

*FMNH 8944, holotype, a male 29.5 mm: Rio Gatun, Monte Lirio, S. E. Meek and S. F. Hildebrand, 28 Mar. 1911.

*USNM 78668, Gatun River, Monte Lirio, S. E. Meek and S. F. Hildebrand, 28 Mar. 1911; 39 specimens 25.1–37.8 mm.

USNM 208519, Cocle Province, Rio Grande basin, Rio Churube at bridge on IAH 13 mi E of Nata, H. Loftin and C. Kupfer, 25 Feb. 1962; 34 specimens 22.3–32.1 mm (5 cleared and stained) (HL–118; P10–3).

USNM 208520, Panama Province, Rio Bayano Basin, creek about 5 mi W of El Llano on road, H. Loftin and C. Kupfer, 17 Mar. 1962; 36 specimens 27.2–39.2 mm (2 cleared and stained) (HL–132; P6–2).

USNM 62943, small ditch of "pure" running water at Tabernilla, Canal Zone, A. H. Jennings, 24 July 1908; 6 specimens 24.3–29.7 mm.

USNM 78667, Gatun River at Mitchelville, S. E. Meek and S. F. Hildebrand, 27 Mar. 1911; 36 specimens 28.3–37.9 mm.

USNM 208545, Canal Zone, small ditch of "pure" running water at Tabernilla, A. H. Jennings, 24 July 1908; 4 specimens 24.7–25.8 mm.

USNM 78657, Limon Creek, Alhajuela, S. E. Meek and S. F. Hildebrand, 26 Feb. 1911; 9 specimens 24.4–35.2 mm.

USNM 78664, Gorgona Reservoir Creek, Gorgona, Canal Zone, S. E. Meek and S. F. Hildebrand, 29 Mar. 1912; 8 specimens 34.8–42.8 mm.

USNM 78681, Rio Missimbi, Empire, Canal Zone, S. E. Meek and S. F. Hildebrand, 8 Feb. 1911; 12 specimens 28.4–34.9 mm.

USNM 78684, Trinidad River, Agua Clara, Canal Zone, S. E. Meek and S. F. Hildebrand, 10 Mar. 1911; 24 specimens 24.5–35.3 mm.

USNM 208544, Panama Province, Rio Bayano basin, creek about 2½ mi W of El Llano road, H. Loftin and C. Kupfer, 17 Mar. 1962; 10 specimens 29.3–34.0 mm (HL–131; P6–3).

USNM 208518, Veraguas Province, Rio San Pedro basin, creek at bridge 12 mi W of Santiago on road to Sona, H. Loftin, E. Tyson, R. Yerger, 28 Jan. 1962; 49 specimens 18.6–29.3 mm (2 cleared and stained) (HL–105; P16–9).

USNM 208548, Cocle Province, Rio Grande Basin, Rio Cocle at road just outside La Pintada, H. G. Loftin, 23 Mar. 1962; 59 specimens 22.2–35.0 mm (HL–135; P10–2).

USNM 208550, Rio Santa Maria Basin, Rio Estero Salado (coastal stream) on IAH about 5 mi W of Aguadulce, H. Loftin and E. Tyson, 15 Oct. 1961; 11 specimens 24.3–29.4 mm (HL–24; P11–2).

USNM 208549, Veraguas Province, Rio San Pedro basin, river at bridge about 17 mi W of Santiago on road to Sona, H. Loftin E. Tyson, R. Yerger, 28 Jan. 1962; 12 specimens 21.8–27.7 mm (HL–104; P16–10).

USNM 208551, Cocle Province, Rio Grande basin, Rio Anton at town of Anton on IAH, H. Loftin and E. Heslop, 11 Mar. 1962; 2 specimens 29.9–31.2 mm (HL–120; P9–21).

USNM 208515, Cocle Province, Rio Grande basin, swampy creek at IAH about 2 mi E of Nata. H. Loftin and E. Tyson, 15 Oct. 1961; 6 specimens 29.7–35.7 mm (2 cleared and stained) (HL–21; P10–5).

MCZ 45827, "Jesus Christ Stream" trib. of Chagres River near Gamboa, 9°7'N, 79°42'W. I. Rubinoff, et al., 6 Apr. 1967; 1 specimen 30.0 mm.

FIGURE 12.—*Cheirodon affinis,* holotype, FMNH 8944, male, 29.5 mm; Panama Rio Gatun, Monte Liria, collected 28 March 1911 by S. Meek and S. Hildebrand.

USNM 210991, two collections mixed together, Cocle Province, stream at El Roble at IAH or Veraguas Province, Rio San Pedro at San Pedro on IAH, M. and W. Bussing, 27 January 1971; 3 specimens 26.5–32.2 mm.

Meek and Hildebrand (1916) listed the holotype number as FMNH 8941 and stated that it was "38 mm in length." Grey (1957) stated that the above number is an error and that the actual number is 8944. Mr. Loren P. Woods has kindly reexamined the catalog and confirmed that FMNH 8944, the number in the bottle, is indeed correct. The holotype is 29.5 mm in SL.

Grey (1947) listed 261 paratypes from several areas in Panama. We do not accept type status for any of these fishes as Meek and Hildebrand (1916), although using more than 1 specimen for their description, listed only the holotype, adding that "numerous specimens were preserved."

Tables include specimens used in the following description and 10 specimens each USNM 208519 and USNM 208520.

DESCRIPTION.—Standard length of examined specimens 22.5–38.8 mm. Body elongate, compressed laterally; greatest body depth 38.0–42.1. Predorsal body profile convex with a slight concavity at nape; concavity deepest at posterior termination of supraoccipital spine. Body profile slightly convex between posterior dorsal-fin base and adipose fin; posterior to adipose fin body profile with an upward slope to procurrent caudal-fin rays. Distance from eye to dorsal-fin origin 38.9–41.9; distance from dorsal fin to end of caudal peduncle 53.6–56.0. Ventral body profile rounded to anus; steepest inclination ventral to jaws. Ventral body profile protrudes ventrally its greatest distance just anterior to pelvic-fin insertion. Body profile straight or slightly curved along anal-fin base; at posterior anal-fin termination profile concave to procurrent caudal-fin rays. Caudal-peduncle depth 12.3–13.7; peduncle length 11.9–14.6.

Head length 23.4–25.4. Eye diameter 9.3–10.6. Snout 5.3–6.2. Least bony interorbital width 8.2–9.0. Maxillary short, sloping ventrally and posteriorly, forming an angle of 45–50 degrees to longitudinal body axis; upper-jaw length 6.2–7.1. All teeth with 7–8, usually 8, cusps (except smallest maxillary tooth, which has 5–6 cusps, and the smallest dentary teeth, which are quinquecuspid or conical); all in a single series. Maxillary teeth 3, with a rounded cutting edge and with outer cusps equidistant from tooth base. Premaxillary teeth 5 in all specimens with a rounded cutting edge, cusps on anterior cutting edge begin nearer to tooth base than cusps on posterior cutting edge. Dentary with 7–9, usually 7–8, teeth, anterior teeth larger, becoming smaller (usually conical) posteriorly; teeth with an even cutting edge, median cusp not elongate, long axis of anterior dentary teeth extending dorsoanteriorly. No teeth present on vomer, palatines, or pterygoids.

Fontanel moderate, length of that part anterior to epiphyseal bar slightly less than width of fontanel posterior to bar. Gill rakers moderate, 17–20, usually 18. Circumorbital bones well ossified, infraorbital 3 wide, contacting preopercle ventrally, and with a naked area posteriorly.

Scales moderately large, cycloid with concentric circuli and about 4–8 radii on exposed posterior field. Lateral lines of holotype and specimens from USNM 78668 incomplete, with a slight ventral curve with 7–11, usually 9 (10 in holotype), perforated scales. In some other lots examined lateral line variable (e.g., USNM 208520), with some specimens having 10–11 perforated scales and others in the same lot with as many as 33 perforated scales (a complete lateral line). This variation not present in all populations but occurs throughout range of this species (see discussion below). Lateral scales

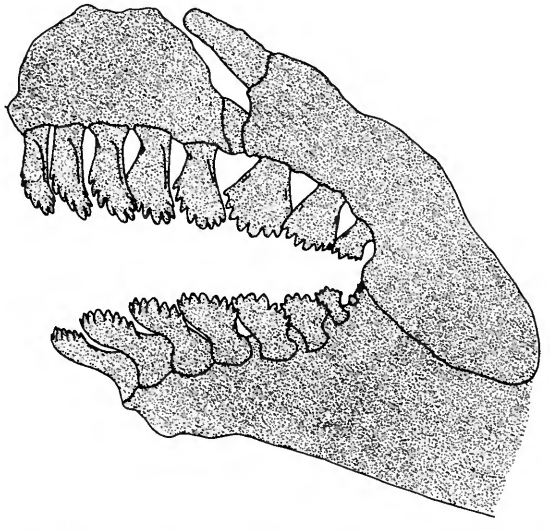

FIGURE 13.—Dentition of *Cheirodon affinis*, USNM 208519, female, 25.6 mm; Panama, Cocle Province, Rio Grande basin, Rio Churube at bridge on IAH 13 miles east of Nata, collected 25 February 1962 by H. Loftin and C. Kupfer.

32–33 (33 in holotype); scales above lateral line 5–6, usually 6; scales below lateral line 4–5, usually 5. Predorsal scales 9–12, usually 10–11. Scale sheath at base of anal fin of about 5–6 scales. Axillary scale present dorsal to pelvic-fin insertion; caudal fin without scales.

Dorsal fin ii,9 in all specimens. Dorsal-fin origin anterior to anal-fin origin, posterior to pelvic-fin insertion, nearer eye than caudal-fin base. Distance from tip of snout to dorsal-fin origin 51.7–54.5. Third or fourth ray of dorsal fin longest, with posterior rays shorter, forming a slightly rounded posterior margin to fin; length of longest ray 30.0–30.9.

Anal fin with 4 unbranched rays and 19–21, usually 20, branched rays. First unbranched ray not always visible except in radiographs. Anal-fin origin posterior to midpoint of standard length 63.6–67.5. Fourth through ninth or tenth anal-fin rays longer, with posterior rays shorter, forming a protruding fin margin anteriorly and a straight or slightly concave fin margin posteriorly. Dorsally recurved anal-fin hooks present in males only (see discussion below) on last unbranched ray and first through sixth or seventh (rarely to eleventh) branched rays (on first through sixth in holotype); usually only 1 hook or bilateral pair of hooks per bony ray segment (rarely with 2 hooks on same side of segment); fin often fleshy around hooks.

Pectoral fin with 1 unbranched ray and 10–11, usually 11, branched rays. Pectoral fins reach anterior to or just to pelvic-fin insertion. Distance from tip of snout to dorsal end of pectoral-fin base 24.5–26.4 and length of pectoral-fin base to tip of longest ray 20.1–21.8.

Pelvic fin with i,7 rays in all specimens, distal tip reaching well anterior to or just to anal-fin origin. Distance from tip of snout to pelvic-fin insertion 47.4–49.8; pelvic-fin length 16.9–19.1. In males, unbranched ray and first or second through sixth or seventh branched rays with antrorse hooks, usually on ventral surface of ray segment (unbranched ray often without hooks); 1 hook, rarely 2, present per bony ray segment (in holotype all pelvic rays with hooks). See below for further discussion.

Caudal fin with 10/9 principal rays; fin not deeply forked, not split to base; caudal-fin lobes

FIGURE 14.—*Cheirodon affinis*, USNM 210991, female, 26.5 mm; Panama (from two collections mixed together), Cocle Province, stream at El Roble at IAH or Veraguas Province; Rio San Pedro at San Pedro on IAH, collected 27 January 1971 by Myrna and W. Bussing; specimen photographed in life.

symmetrical. Dorsal and ventral procurrent caudal rays of equal size; ventral procurrent rays not enlarged and extended. No hooks on caudal rays.

Precaudal vertebrae 15–16, usually 16. Total vertebrae 32–33, usually 33.

Color in alcohol: Ground color pale brown, back and nape darker brown. Small melanophores present on sides bordering scale pockets, more numerous dorsally, forming a reticulate pattern above midline and sparingly across belly (not as evident in type as in some other specimens) and loosely following myomere junctions below midline above anal fin. Melanophores sometimes slightly concentrated at "pseudotympanum," forming a weak humeral spot. Melanophores usually concentrated just dorsal to midline, forming a lateral stripe which terminates in a large spot at end of caudal peduncle, extending to middle caudal rays. Lateral stripe not always pronounced but caudal spot always present. Type with silvery cheeks and with a broad, silvery lateral stripe; this silvery coloration more or less evident in other specimens examined. Dorsal fin with melanophores on interradial membranes, more concentrated distally. Caudal fin with melanophores on interradial membranes, often concentrated near middle caudal rays. Anal fin with melanophores on interradial membranes (occasionally on rays) proximally, but melanophores lacking on distal one-half to one-fourth of fin. Pectoral fin with melanophores ventrally on rays, lacking on interradial membranes. Pelvic fins with melanophores primarily on interradial membranes, concentrated distally.

Color in life: Based on 1 male and 3 females from USNM 210991 observed alive in our aquaria (with dark substrate), the color is as follows. Back light yellowish-green shading to bright silver on sides and belly. Burnished silver lateral stripe. Reticulate scale pattern of back conspicuous. Between anal-fin base and midline, side translucent yellowish green, with loose pattern of melanophores along myomere lines. Light yellowish areas on caudal fin above and below broad caudal spot. Dorsal, anal, and pelvic fins with small white tips; all fins but pectorals yellowish, pectoral fin translucent.

Range: Collections of *C. affinis* are most numerous from the Canal Zone, probably reflecting the extensive collecting in that area early in this century. Loftin (1965) extended the known range of this species from east-central Panama Province to central Veraguas Province. The species is now known in Pacific drainages throughout central Panama and in Atlantic drainages at least throughout the Canal Zone.

COMPARISONS.—*Cheirodon affinis* is a common species in central Panama. It is sympatric with *C. dialepturus* and *C. gorgonae* and there has been some confusion among these three species. *Cheirodon affinis* is distinguished from the other two by the combination of its lack of both caudal-fin hooks and modified caudal-peduncle scales, together with its possession of asymmetrical premaxillary teeth and dentary teeth without an enlarged median cusp. It differs from *C. mitopterus* in dentitional characters also, as well as caudal peduncle scalation, and other characters as described in the discussion of *C. mitopterus.*

Cheirodon affinis is closest to *C. terrabae* but apparently differs from that form in having fewer dentary and maxillary teeth, a smaller modal number of branched anal-fin rays, and gill rakers. Most populations of *C. affinis* have an incomplete lateral line, whereas *terrabae* has the lateral line complete.

VARIATION.—Previously, *C. affinis* has been described as lacking anal-fin hooks (Bussing, 1967). Our examination has shown that retrorse hooks are present on the anal and pelvic fins of males collected between the months of March and July and are absent in those specimens collected in the months of October and January. We were unable to obtain collections from every month, so our information on this variation is incomplete. Also we had no collections from the same locality from different seasons, and the presence or absence of hooks could be explained as population variation. However, numerous collections from different seasons are from adjacent localities in the Canal Zone and these showed seasonal variation. Other than the hooks on the fins of males, we could find no obvious sexual dimorphism.

Bussing (1967) and López (1972) discussed the length of the lateral line in *C. affinis.* We have essentially confirmed their findings, as we have found specimens from several localities with complete or nearly complete lateral lines. We could find no geographical or ecological correlation with the variation in this character.

López (1972) found a correlation in length of the maxillary and geographical distribution. We

found no significant correlation with total upper-jaw length and distribution. See our comments on this character in the discussion of *C. dialepturus*.

Cheirodon terrabae (Bussing)

FIGURES 15, 16

Pseudocheirodon species.—Miller, 1966:784 [listed].

Pseudocheirodon terrabae Bussing, 1967:212 [original description; Rio Grande de Terraba, Costa Rica], 241, fig. 1 [photograph].—López, 1972:101 [listed from Terraba and Pirris river basins; in her reprints López has indicated that the Turrubares basin is an error and should be Pirris (P1)], 105 [compared to *C. affinis*], 117, fig. 2 [distribution map], 121, fig. 6 [photograph], 123, fig. 7 [distribution map], 129, fig. 14 [scales].

MATERIAL EXAMINED

(All specimens from Costa Rica)

*LACM 2951, paratypes, Costa Rica: San Jose Province, tributary to Rio General, W. A. Bussing, 28 Dec. 1961; 12 specimens 30.0–47.1 mm (1 cleared and stained).

*USNM 194236, Rio Union, IAH near San Isidro, Albert A. Greenberg, 20 Jan. 1963; 4 specimens 30.4–36.0 mm (1 cleared and stained).

*ANSP 121988, with same data as USNM 194236, 1 specimen 35.4 mm.

*CAS 16061, with same data as USNM 194236, 1 specimen 31.1 mm.

*BMNH 1973.2.16:2, with same data as USNM 194236, 1 specimen 35.4 mm.

*USNM 194234, Rio Alla Nuo, near IAH, Albert A. Greenberg, 21 Jan. 1963; 2 specimens 30.2–30.4 mm.

*USNM 194220, with same data as USNM 194234; 1 specimen too damaged to measure.

*UMMZ 194214, overflow pond of Rio Grande de Terraba, Palmar Norte, R. M. Bailey and party, June 1973; 32 specimens 39.7–50.5.

Specimens in description are included in tables.

DESCRIPTION.—Standard length of specimens examined 29.8–49.8 mm. Body deep, compressed laterally; greatest body depth 32.9–42.6. Predorsal body profile somewhat convex with a slight concavity at nape. Between posterior dorsal-fin termination and anterior adipose-fin base, body profile very slightly convex. Some specimens with a slight rise in body profile at base of adipose fin; between posterior adipose-fin termination and dorsal procurrent caudal-fin rays, body profile slightly concave. Distance from eye to dorsal-fin origin 37.2–43.0; distance from dorsal-fin origin to posterior end of caudal peduncle 51.0–58.0. Ventral body profile rounded from jaws to anus; steepest inclination ventral to jaws. Ventral profile protrudes ventrally its greatest distance at point just anterior to or just posterior to pelvic-fin insertion. Body profile along anal-fin base straight or slightly convex; body profile concave between posterior anal-fin termination and procurrent caudal-fin rays. Caudal peduncle depth 11.0–13.2; peduncle length 11.3–15.0.

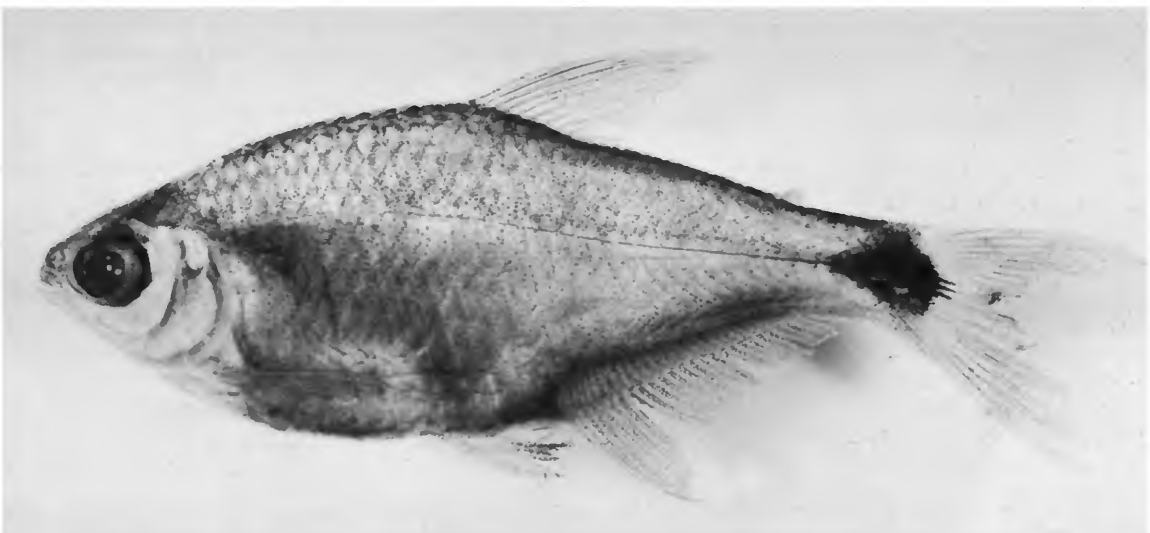

FIGURE 15.—*Cheirodon terrabae*, paratype, LACM 2951, female, 39.3 mm; Costa Rica, San Jose Province, tributary to Rio General, collected 28 December 1961 by W. Bussing.

Head length 22.8–26.6. Eye diameter 8.7–10.4. Snout 5.4–6:5. Least bony interorbital width 7.6–9.2. Maxillary short, sloping ventrally and posteriorly, forming an angle of 50–60 degrees to longitudinal body axis; upper-jaw length 6.0–7.7. Upper-jaw teeth with 6–10, usually 8–9, cusps (except smallest maxillary teeth, which have 5–6 cusps), all in a single series. Maxillary teeth 3–6, usually 4–5, with a rounded cutting edge and with outer cusps equidistant from tooth base. Premaxillary teeth 5 in all specimens with a rounded cutting edge, cusps on anterior cutting edge begin nearer to tooth base than cusps on posterior cutting edge. Dentary with 8–10 teeth, with 6–10, usually 8–9, cusps, anterior teeth larger, becoming smaller posteriorly (posterior 2 teeth may be tricuspid or conical); teeth with an even cutting edge, median cusp not elongate, long axis of anterior dentary teeth extending dorsoanteriorly or may be nearly horizontal in some specimens. No teeth present on vomer, palatines, or pterygoids.

Fontanel moderate, length of that part anterior to epiphyseal bar slightly less than width of fontanel posterior to bar. Gill rakers moderate, 19–22, usually 21. Circumorbital bones well ossified, infraorbital 3 wide, contacting preopercle ventrally and with a naked area posteriorly.

Scales moderately large, cycloid, with concentric circuli and about 5–8 radii on exposed posterior field. Lateral line complete, extending as a ventral curve on side of body to below adipose fin, then continuing below midline as a straight line to caudal-fin base, sometimes continuing slightly onto middle caudal-fin rays. Lateral-line scales approximately 33–34. Scales above lateral line 6–7, usually 6; scales below lateral line 5–6. Predorsal scales number about 11. Scale sheath at base of anal fin of about 3–6 scales. Axillary scale present dorsal to pelvic-fin insertion; caudal fin scaleless.

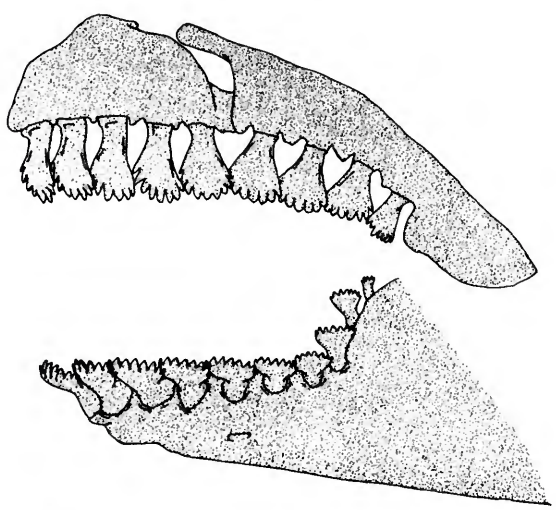

FIGURE 16.—Dentition of *Cheirodon terrabae*, paratype, LACM 2951, male 32.3 mm; Costa Rica, San Jose Province, Tributary to Rio General, collected 28 December 1961 by W. Bussing.

Dorsal fin with ii,9 rays in all specimens. Dorsal-fin origin anterior to anal-fin origin, posterior to pelvic-fin origin, nearer eye than base of caudal fin. Distance from tip of snout to dorsal-fin origin 50.0–57.6. Third or fourth ray of dorsal fin longest, with posterior rays shorter, forming a slightly convex posterior margin to fin; length of longest ray 27.8–34.4.

Anal fin with 4 (rarely 5) unbranched rays and 19–23, usually 22 or 23, branched rays. First unbranched ray not always visible except in radiographs. Anal-fin origin posterior to midpoint of standard length 61.3–69.5. Fourth through seventh or eighth anal rays longer, with successive rays shorter, making ventral margin of anal fin concave. Dorsally recurved anal-fin hooks present in males only (hooks were not noted in original description) on last unbranched ray and first through eleventh to seventeenth branched rays, usually only 1 hook or bilateral pair of hooks per bony ray segment (rarely with 2 hooks on same side of segment); fin often fleshy around hooks.

Pectoral fin with 1 unbranched ray and 11–12, usually 11, branched rays. Pectoral fins reach from just anterior to or slightly beyond pelvic-fin insertion. Distance from snout tip to dorsal end of pectoral-fin base 24.0–29.0 and length of pectoral fin from base to tip of longest ray 19.4–24.1.

Pelvic-fin rays i,7 in all specimens, distal end reaching to or just anterior to anterior basal termination of anal fin. Distance from tip of snout to pelvic-fin origin 45.1–51.1; pelvic-fin length 16.7–21.3. In males, first through seventh branched rays with antrorse hooks usually on ventral surface of ray segments; 1 hook, rarely 2, present per bony ray segment.

Principal caudal-fin rays 10/9 (1 specimen with 9/9, 1 with 9/8); fin forked, not split to base; no hooks present.

Precaudal vertebrae 16; total vertebrae 33–34, usually 33.

Color in alcohol: Ground color pale brown (gray brown in freshly preserved specimens), back and nape darker brown. Small melanophores present on sides bordering scale pockets, more numerous dorsally, forming a reticulate pattern above midline, loosely following myomere junctions below midline above anal fin, present sparingly across belly. Melanophores sometimes slightly concentrated at "pseudotympanum," forming a weak humeral spot. Melanophores concentrated at end of caudal peduncle, forming a large caudal spot that extends along middle caudal rays. Freshly preserved material with silvery cheeks and with a broad silvery lateral stripe; this silvery coloration less evident in other specimens examined. Dorsal fin with melanophores on interradial membranes. Caudal fin with melanophores on interradial membranes, usually concentrated near middle caudal rays. Anal fin with melanophores on interradial membranes (occasionally on rays) proximally, but melanophores usually lacking on distal one-half to one-fourth of fin. Pectoral fin with melanophores ventrally on rays, lacking on interradial membranes. Pelvic fins with melanophores primarily on interradial membranes, concentrated distally.

Range: Bussing (1967) states that *C. terrabae* has been found in the basin of the Rio Grande de Terrabae. López (1972) lists it also from the Rio Jicote, of the Rio Pirris basin, also in Costa Rica. Bussing in personal communication has suggested that the Rio Alla Nuo might be Saloma Nuevo, 8°15′N, 83°13′W.

COMPARISONS.—*Cheirodon terrabae* is very closely related to *C. affinis* of Panama. It differs from that species in having a greater number of dentary teeth (8–10, usually 9, vs. 7–9, usually 7, in *C. affinis*), greater modal number of maxillary teeth (3–6, usually 5–4, vs. 3–4, usually 3, in *C. affinis*), and slightly greater average number of anal-fin rays (22.1 vs. 19.6 in *C. affinis*). Other apparent differences occur in the number of scales below the lateral line and number of gill rakers (see tables). There may also be a greater number of hooked anal-fin rays in *C. terrabae* males. In some populations of *C. terrabae* (e.g., LACM 2951), there may be a modal number of 3 maxillary teeth, leading to possible confusion with *C. affinis*.

Cheirodon terrabae is distinguished from *C. diaelepturus, C. gorgonae,* and *C. mitopterus* in lacking modified caudal squamation and in its possession of asymmetrical premaxillary teeth and dentary teeth without an enlarged median cusp. Young *Carlana eigenmanni,* which have teeth similar to those of *C. terrabae,* can be quickly identified by the much higher number of anal-fin rays; other differences between these species may be found under *C. eigenmanni* and in the tables. Number of anal-fin rays, position of the dorsal fin, and dentition are among the numerous differences between *C. terrabae* and *P. macrolepis* (see *P. macrolepsis* description below).

Bussing (1967) remarked:

> Although it has been proposed that the present genera *Odontostilbe, Holoshesthes,* and *Saccoderma* have retained the complete lateral line of an *Odontostilbe*-like ancestor ... and that the general trend in minute species is toward reduction or suppression of the lateral line . . . , such is not the case with *P. terrabae.* If it is assumed that *P. terrabae* is a descendant species of *P. affinis,* then the new species has attained a complete lateral line and certain populations of *P. affinis* are actively mutating in the same direction.

To assume that one existing species is the ancestor of another as Bussing does is presumptuous and probably fallacious (cf. Hennig, 1966). In all probability these two species, which seem closest to one another, had a common ancestor not too different from either existing species. We cannot see any basis for predicting the characters of the ancestors in this case, especially not by the use of such apparently labile characters as the length of a lateral line. This is the primary reason why we have not accepted the genus *Odontostilbe* (see discussion above under the generic name *Cheirodon*). We do, however, fully agree with Myers (1958) that loss of a lateral line is a general trend in small characids. We believe that it probably happened repeatedly and independently in different groups of species and genera, but we agree with Bussing's suggestion that occasionally the line may have reappeared, confusing the attempt to establish relationships by use of this character.

Carlana Strand

Carlia Meek, 1914:108 [type-species *Cheirodon eigenmanni* Meek, 1912, by original designation].

Carlana Strand, 1926:54 [type-species *Cheirodon eigenmanni* Meek, 1912, replacement name for *Carlia* Meek, 1914, preoccupied by *Carlia* Gray, 1854].

Adults with teeth along entire ventral maxillary margin; dentary teeth broad with 9–12 cusps; number of branched anal-fin rays 26–31 (in *Carlana eigenmanni,* only known species), compared with 15–23 or 45–50 in other genera in geographical area covered here. Weak spinules present on pelvic- and anal-fin rays of adult males (see discussion below).

Meek (1914) indicated that his new genus *Carlia* was closely related to *Rhoadsia* Fowler, which is currently included in a subfamily *Rhoadsiinae.* Eigenmann and Myers (1929) included *Carlia* in *Rhoadsia* but stated that the species *C. eigenmanni* was very likely generically distinct from other species of *Rhoadsia.* Juvenile *Rhoadsia* have a single series of premaxillary teeth and gain a second row when approaching adulthood [reaching up to 168 mm according to Eigenmann and Myers (1929)]. The maxillary in juvenile *Rhoadsia* has but 2 multicuspid teeth, while the maxillary in adults has, in addition, numerous conical teeth along its entire ventral margin. We have 4 adult males (as evidenced by anal- and pelvic-fin spinules) of *Carlana eigenmanni* ranging from 52.8–53.9 mm, all of which lack an outer premaxillary tooth row but have a fully toothed maxillary. We are confident that *Carlana* does not have an outer row of premaxillary teeth. According to the present classification system, this feature alone would remove *Carlana eigenmanni* from *Rhoadsia* and place it in the Cheirodontinae.

We have examined several specimens of *Rhoadsia* as follows: *R. minor* (CAS[IUM] 13419, holotype; CAS[IUM] 13420, 92 specimens, paratypes; CAS[SU] 49795, 4 specimens; CAS[SU] 49796, 1 specimen); *R. altipinna* (FMNH 55907, 1 specimen, paratype; USNM 83543, 1 specimen; USNM 83536, 1 specimen). Adult specimens have dentary teeth quite different from *C. eigenmanni* in that they are not nearly as broad and have 4 large cusps with 1 or 2 smaller cusps (compared to very broad teeth with 9–12 cusps in *C. eigenmanni*). Also, all adults have a well-defined outer row of 2 or 3 premaxillary teeth in contrast to *C. eigenmanni,* which has only 1 tooth row.

While these differences in dentition are, according to the currently accepted system, of generic significance, it is obvious that a complete review of the so-called Rhoadsiinae, sensu lato (including *Parastremma* Eigenmann, *Rhoadsia,* and possibly *Carlana*), is needed. There are many characters in all these species that possibly indicate relationships, including overall similarity of body and fin shape and ontogenetic dentition changes. Despite the fact that *Carlana,* because of its single row of premaxillary teeth, must currently be defined as a so-called cheirodontin, it is possible that further investigation will place all the species now in *Parastremma* and *Carlana* in *Rhoadsia.*

Carlana eigenmanni (Meek)

FIGURES 17, 18, 19, 20, 21

Cheirodon eigenmanni Meek, 1912:70 [original description; La Junta, Costa Rica].

Carlia eigenmanni.—Meek, 1914:108 [new genus; listed from La Junta].

Carlana eigenmanni.—Strand, 1926:54 [new name for preoccupied *Carlia*].

Rhoadsia eigenmanni.—Eigenmann and Myers, 1929:463 [description of specimen from La Junta], pl. 73: fig. 1 [photograph].—Grey, 1947 [correction of FMNH number of type].—Böhlke, 1958:178 [compared with *Hyphessobrycon tortuguerae;* discussion of generic status].—Miller, 1966:785 [listed from Lake Nicaragua to Atlantic slope of Costa Rica fide Rivas and Bussing].—Bussing, 1967:236 [listed from Costa Rica].—Astorqui, 1971:20 [listed from Rio Tisla and Rio Osayo, Nicaragua; description].

MATERIAL EXAMINED

*FMNH 7683, holotype, a male 52.8 mm, Costa Rica: La Junta, S. E. Meek, Apr. 1912.

*FMNH 43150, Costa Rica: La Junta, S. E. Meek, 8 Apr. 1912; 1 specimen 56.4 mm.

*FMNH 7861, Costa Rica: La Junta, S. E. Meek, 17 Apr. 1913; 3 specimens 46.4–53.9 mm.

*USNM 74240, Costa Rica: La Junta, S. E. Meek; 1 specimen 53.6 mm. (maxillary, premaxillary and dentary of right side cleared and stained).

*CAS(SU) 61380, Nicaragua: Rio Frio, about 1.5 mi above San Carlos, in bayou with sluggish current, G. S. Myers, 12 Feb. 1963; 4 specimens 21.0–26.9 mm (1 cleared and stained).

*CAS(SU) 61369, Nicaragua: Rio Frio, 1.5 mi above San Carlos, 0.4 mi above Esperanza, small sluggish stream into Rio Frio, G. S. Myers; 8 specimens 21.6–35.8 mm.

*GCRL 5126, Nicaragua: Rio Osayo at IAH, 9 km N of Costa Rica border, L. R. Rivas and I. Astorqui, 13 July 1960; 2 specimens 40.0–43.1 mm.

*GCRL 5125, Nicaragua: Rio Isala at road from Managua to Juigalpa, 8 km W of Juigalpa, L. R. Rivas and I. Astorqui, 28 June 1960; 1 specimen 37.2 mm.

Meek (1912) in describing *Cheirodon eigenmanni* listed 1 specimen, FMNH 7583, 67 mm;

collected April 1912 at La Junta; subsequently (1914), when he placed the species in *Carlia,* he listed 6 specimens from the type-locality. Grey (1947) corrected the number on the type to 7683 and listed 1 unnumbered paratype. We presume that the specimen Grey considered as paratype is FMNH 43150, because it is the only other FMNH specimen collected April 1912. However, since Meek mentioned no paratypes in the original description we do not accept paratype status for any specimens.

Eigenmann and Myers (1929) listed a specimen 73.0 mm from La Junta, coll. Meek, and stated that it had minute hooks on the anal-fin rays. We have been unable to locate their specimen after searching the CAS, FMNH, and USNM collections.

FIGURE 17.—Juvenile *Carlana eigenmanni,* CAS(SU) 61380, 26.8 mm; Nicaragua, Rio Frio, about 1½ miles from San Carlos, Lake Nicaragua, collected 12 February 1963 by G. Myers.

FIGURE 18.—Pre-adult *Carlana eigenmanni,* GCRL 5125, 32.7 mm; Nicaragua, Rio Isala at road from Managua to Juigalpa, 8 kilometers west of Juigalpa, collected 28 June 1960 by L. Rivas and I. Astorqui.

In the following description, proportions for juveniles are given first, followed by adults, separated by a semicolon. In listing meristics, counts for juveniles and adults are combined. Juveniles in this case are arbitrarily defined by the presence of only 2 maxillary teeth and consist of 6 specimens from CAS (SU) 61369 and 4 specimens from CAS (SU) 61380. All specimens are included in tables.

DESCRIPTION.—Standard length of specimens examined 21.0–29.8; 34.3–56.4 mm. Body elongate, compressed laterally; greatest body depth 32.0–39.5; 35.8–41.2. Predorsal body profile convex or slightly convex with a slight concavity at nape. At anterior dorsal-fin base, body profile angles ventrally to posterior termination of dorsal-fin base. Body profile straight or somewhat convex between posterior dorsal-fin base and adipose-fin base. Posterior to adipose fin, body profile straight or slightly concave to dorsal procurrent caudal-fin rays. Distance from eye to dorsal-fin origin 38.9–41.5; 39.6–41.2; distance from dorsal origin to end of caudal peduncle 49.0–52.4; 51.9–56.3. Ventral profile in juveniles rounded to anus, steepest inclination ventral to jaws; profile protruding ventrally its greatest distance midway between pelvic-fin insertion and anal-fin origin. Ventral profile in adults somewhat convex to a vertical from pectoral-fin base, then becomes more convex to pelvic-fin base; posterior to pelvic-fin base, body profile convex to anal-fin origin. Body profile along anal-fin base straight or slightly concave in juveniles, straight or somewhat convex in adults; between posterior anal-fin termination and ventral procurrent caudal-fin rays, body profile concave. Caudal peduncle depth 8.3–10.1; 9.5–11.6; caudal peduncle length 8.7–10.9; 9.5–10.5.

Head length 24.9–27.6; 23.1–25.2. Eye diameter 10.8–12.7; 8.5–10.8. Snout length 4.9–6.9; 6.1–7.1. Least bony interorbital width 7.2–9.0; 8.4–8.9. Maxillary short in juveniles, long in adults, sloping ventrally and posteriorly, forming an angle of about 50–60 degrees to longitudinal body axis. Upper-jaw length 7.5–8.2; 8.6–11.9. All teeth uniserial. Maxillary of juveniles with 2 proximal teeth having 5–8 cusps (median cusps may be slightly enlarged); maxillary of adults with 2 proximal teeth as in juveniles but also with up to 8 more conical teeth along its ventral margin. Premaxillary teeth with anterior cutting edge beginning nearer to tooth base than cusps on posterior cutting edge; apices of teeth angled toward midline in adults. Dentary teeth 7–9, broad, with 8–12 cusps (except posteriormost 2 or 3 small teeth with 3 to 5 cusps); cutting edge straight or slightly rounded with median cusps broader, becoming narrower and smaller laterally. No teeth on vomer, palatines, or pterygoids.

Fontanel moderately large in juveniles, that part anterior to the epiphyseal bar a little more than two-thirds length of fontanel posterior to bar; in adults, that part anterior to bar about one and

FIGURE 19.—Adult *Carlana eigenmanni*, holotype, FMNH 7683, male, 52.8 mm; Costa Rica, La Junta, collected April 1912 by S. Meek.

one-half times as long as width of fontanel immediately posterior to bar. Gill rakers moderate, 14–18, usually 16. Circumorbital bones well ossified, in juveniles infraorbital 3 with a broad naked area ventrally and posteriorly, in adults it contacts preopercle below but with a naked area posteriorly.

Scales moderately large, cycloid with concentric circuli and 0–5 radii on exposed posterior field. Lateral line incomplete with 5–9, usually 8–9, perforated scales; lateral line with a slight ventral curve. Lateral scales 35–41, usually 38 (holotype with 38); these scales not always regularly arranged, therefore counts not always accurate. Scales above lateral line 8–9, usually 8; scales below lateral line 7–8, usually 7. Predorsal scales about 17. Axillary scale present dorsal to pelvic-fin origin; caudal fin scaleless; 6 or 7 scales forming a sheath along anterior base of anal fin.

Dorsal fin with 2 unbranched rays and 8–9, usually 9, branched rays. Dorsal-fin origin anterior to anal-fin origin, posterior to pelvic-fin origin, nearer eye than caudal-fin base. Distance from tip of snout to dorsal-fin origin 53.4–56.7; 52.0–55.0. Third or fourth ray of dorsal fin longest, with posterior rays shorter, forming a slightly convex posterior margin to fin; longest rays extended as a filament in large adults, length of longest ray 29.0–33.2; 31.4–44.0.

Anal fin with 4 unbranched rays and 26–31, usually 29, branched rays. Origin of anal fin behind midpoint of standard length 58.5–61.7; 57.6–61.1. Fourth through eighth or ninth rays slightly longer than posterior rays, forming a protruding fin margin anteriorly and a straight margin posteriorly. Adult males with dorsally recurved or straight spinules on posterolateral surface of posterior branches of anal-fin rays; these spinules usually on third and fourth unbranched rays and on first through sixth to twelfth branched rays. Spinules occur from fin base to near fin tip in first through fourth to seventh branched rays (spinules sometimes sparsely scattered toward distal ray tip), spinules on posterior successive rays cover less area, usually present from anal-fin base to first ray branch or to about midway between ray base and first ray branch. One to several spinules per bony ray segment. (Note: These are not hooks, but spinules as described in Weitzman and Thomerson, 1970.)

Pectoral fin with 1 unbranched ray and 9–12, usually 12, branched rays. Pectoral fins reach to

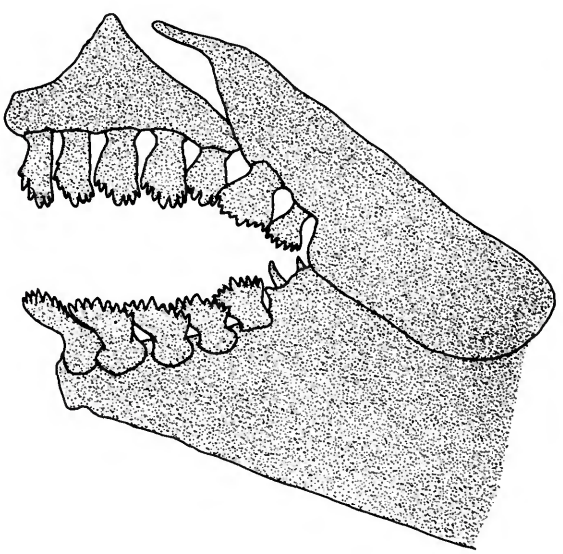

FIGURE 20.—Dentition of juvenile *Carlana eigenmanni*, CAS(SU) 61380, 21.0 mm; Nicaragua, Rio Frio, about 1½ miles from San Carlos, Lake Nicaragua, collected 12 February 1963 by G. Myers.

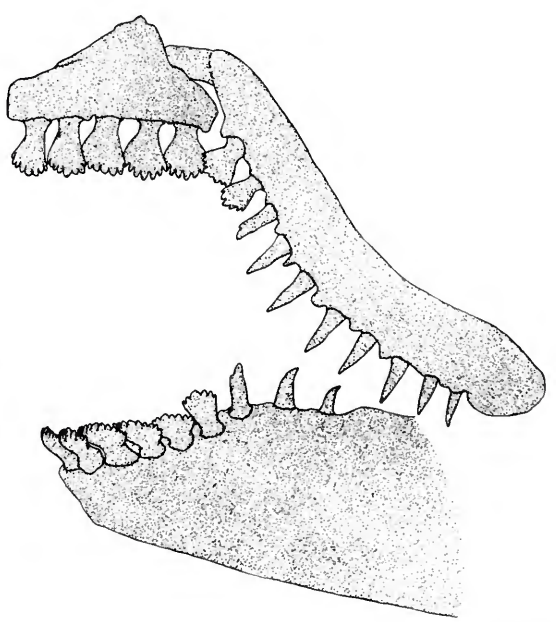

FIGURE 21.—Dentition of adult *Carlana eigenmanni*, USNM 74240, male, 56.4 mm; Costa Rica, La Junta, collected 8 April 1912 by S. Meek.

or just anterior to pelvic-fin origin. Distance from tip of snout to dorsal end of pectoral-fin base 26.9–29.8; 24.4–26.6; length of pectoral fin from base to tip of longest ray 17.8–21.3; 19.6–21.2.

Pelvic fin with 1 unbranched ray and 7–8, usually 7, branched rays, distal tip reaching slightly beyond anal-fin origin. Distance from tip of snout to pelvic-fin origin 45.3–48.5; 41.6–45.9; pelvic-fin length 16.7–19.3; 16.7–19.8. First or second through fifth pelvic-fin rays with small spinules (occasionally only on first branched ray); 1 or 2 spinules per bony ray segment.

Caudal fin with 10/9 principal rays (9/8 in 1 specimen); fin forked, not split to base. Caudal fin symmetrical, without hooks or spinules. Dorsal and ventral procurrent caudal rays equal in size.

Precaudal vertebrae 18–19, usually 18, total vertebrae 36–38, usually 37.

Color in alcohol: Ground color light yellowish brown or pale brown. An extremely thin dark line extends along midline. Melanophores under scale margins form reticulate pattern dorsal to midline; melanophores scattered over nape and head; below midline melanophores present to just above anal-fin base and occasionally along myomere junctions between midline and anal-fin base. Melanophores usually less numerous in smaller specimens. Adults with a series of about 8–10 vaguely defined longitudinal bars along body, formed by patches of larger melanophores under scales. Young with 2 small diffuse humeral spots composed of large melanophores; adults with 1 humeral spot under 5 or 6 scales present in area of eighth or ninth lateral scales, posterior to faint "pseudotympanum." Young with a dark blotch on caudal peduncle, extending slightly onto caudal fin; adults with a bar along midline from just anterior to a vertical from adipose fin, widening at end of caudal peduncle, then extending as a thin line to distal tip of middle caudal-fin rays. Small melanophores scattered on interradial membrane of all fins, often concentrated along fin rays, not on them, except in middle caudal-fin rays. Small specimens with cheek silvery; peritoneum silvery except where intestine is visible, forming an inverted dark gray "comma" mark.

Range: According to Miller (1966; fide Bussing and Rivas), *C. eigenmanni* is found from Lake Nicaragua to the Atlantic slope of Costa Rica. The type locality is La Junta, on the Rio Reventazon at an altitude of approximately 65 meters (Meek, 1914).

COMPARISONS.—The generic placement of this species has been discussed above. *Carlana eigenmanni* can be immediately distinguished from all other Central American characids with a single premaxillary tooth series by its number (26–31) of branched anal-fin rays (see Table 3), shape of the dentary teeth, and from all except *Phenagoniates macrolepis* by the presence of a fully toothed maxillary in adults. See Figures 17–21 for illustration of changes occurring during growth.

Phenagoniates Eigenmann and Wilson

Phenagoniates Eigenmann and Wilson, 1914, *in* Eigenmann, Henn, and Wilson, 1914:2 [type-species *Phenagoniates wilsoni* by monotypy].

Phanagoniates Eigenmann, 1915:43 [invalid spelling emendation].

Monotypic, separated from other Central American cheirodontin genera by an elongate body, large tricuspid teeth, a long anal fin (42–50 branched rays, all others treated here with 31 or fewer), origin of anal fin anterior to dorsal-fin origin, low number of pelvic-fin rays (i,5 versus i,7 in all others), and no adipose fin.

A search of the literature indicates that *Phenagoniates* may be related to *Leptagoniates* Boulenger, differing only in the latter's possession of a small adipose fin and possession of a complete lateral line. We have examined *Xenagoniates* Myers and found it to possess an adipose fin and ectopterygoid teeth. We also examined *Paragoniates,* which also may be related to *Phenagoniates,* but which has an adipose fin, is stouter, and has a long, slender fully toothed maxillary. Reasonable estimation of relationships of these genera would entail an investigation beyond the scope of this paper. We do not consider *Phenagoniates* close to other genera discussed in this paper and believe that it lends credence to our conviction that the Cheirodontinae is not a natural group.

Phenagoniates macrolepis (Meek and Hildebrand)

FIGURES 22, 23

Roeboides macrolepis Meek and Hildebrand, 1913:84 [original description; Rio Cupe, Boca de Cupe, Panama].—Grey, 1947:183 [type listed], fig. 53 [holotype figured].

Phenagoniates wilsoni Eigenmann *in* Eigenmann, Henn, and Wilson, 1914:2 [original description; Manigru].

Phanagoniates wilsoni.—Eigenmann, 1915:43 [description; spelling emended], pl. V: fig. 1.

Phanagoniates macrolepis.—Meek and Hildebrand, 1916:272 [description; *P. wilsoni* considered a synonym].—Eigenmann, 1922:128 [listed from Atrato and Tuyra basins].—Breder, 1927:177 [listed; variation; range], 163 [in key].—Jordan, Evermann, and Clark, 1930:95 [listed].—Hildebrand, 1938:249 [range].

Phenagoniates macrolepis.—Myers, 1942:90 [compared with *Xenagoniates bondi;* note on spelling of *Phenagoniates*].—Schultz, 1944:311 [listed from several localities in Venezuela].—Miller, 1966:784 [listed; range].

Material Examined

*FMNH 7590, holotype, 45.1 mm, Panama: Rio Cupe, Boca de Cupe, Darien, S. E. Meek and S. F. Hildebrand, 12 Feb. 1912.

*USNM 78665, Panama: Rio Cupe, Boca de Cupe, Darien, S. E. Meek and S. F. Hildebrand, 24 Feb. 1912; 3 specimens 34.9–41.0 mm.

USNM 78661, Panama: Rio Cupe, Cituro, Darien, S. E. Meek and S. F. Hildebrand, 25 Feb. 1912; 1 specimen 25.9 mm (condition poor).

*USNM 78662, Panama, Rio Yape, Darien, S. E. Mark and S. F. Hildebrand, 6 Mar. 1912; 1 specimen 42.4 mm.

*USNM 78664, Panama: Rio Aruza, Darien, S. E. Meek and S. F. Hildebrand, 26 Feb. 1912; 1 specimen 39.7 mm.

*USNM 208517, Panama: Rio Sambu, Sta. BNW–20, approx. 7°52′N, 78°05′W, 25 Mar. 1967; 4 specimens, all damaged, approximately 30.0–43.0 mm (1 cleared and stained).

*USNM 208547, Panama: Rio Membrillo, Sta. BNW–9, approx. 8°41′N, 77°41′W, 22 Mar. 1967; 3 specimens 41.4–42.1 mm (1 damaged and unmeasurable).

*USNM 208546, Panama: Rio Morte at Hydro Station, Sta. BNW–8, approx. 8°54′N, 77°33′W, 16 Mar. 1967; 3 specimens 33.4–33.6 mm (1 damaged and unmeasurable).

*FMNH 56541, Colombia: Certegui, C. Wilson, 1913; 1 specimen 23.8 mm (paratype of *P. wilsoni*).

*FMNH 56542 Colombia: Truando, C. Wilson, 1913; 1 specimen 30.3 mm (paratype of *P. wilsoni*).

We have examined paratypes of *Phenagoniates wilsoni* and agree with previous authors that *P. wilsoni* is synonymous with *P. macrolepis*.

Grey (1947) listed 5 paratypes of *P. macrolepis*; this is an error as no paratypes were designated in the original description. In one lot of *P. macrolepis* (USNM 78661) there are 2 fishes; 1 of these is *P. macrolepis*, and the other specimen is in poor condition and not identified here. This small fish is a "cheirodontin," with a single row of elongate conical teeth on the premaxillary and another similar row along the entire anterior border of the maxillary. The dentary teeth are elongate, with a large median cusp and 2 smaller cusps, 1 on each side. The anal-fin base is short and the ventral procurrent caudal-fin rays are elongate. The specimen is too damaged for an accurate identification or description.

Specimens used in description are included in tables.

Description.—Standard length of specimens examined 33.4–45.1 mm. Body elongate, compressed laterally; greatest body depth 26.0–29.8. Predorsal body profile somewhat convex; profile arches dorsally just anterior to dorsal-fin base. Body profile straight or very slightly convex between posterior dorsal-fin base termination and procurrent caudal-fin rays; adipose fin absent. Distance from eye to dorsal-fin origin 44.8–47.0; distance from dorsal-fin origin to end of caudal peduncle 45.1–49.1. Ventral body profile gently rounded from jaws to anus; steepest inclination ventral to jaws. Ventral body profile protrudes ventrally its greatest distance just

Figure 22.—*Phenagoniates macrolepis*, USNM 78665, 41.0 mm; Panama, Rio Cupe, Boca de Cupe, Darien, collected 24 February 1912 by S. Meek and S. Hildebrand.

anterior to or just behind pelvic-fin insertion. Body profile along anal-fin base straight or very slightly convex; between posterior anal-fin termination and procurrent caudal-fin rays, body profile concave. Caudal-peduncle depth 8.7–10.2, peduncle length 5.8–7.1.

Head length 19.5–21.8. Eye diameter 8.0–9.5. Snout length 4.6–4.9. Least bony interorbital width 5.6–6.2. Maxillary sloping ventrally and posteriorly, forming an angle of 70–80 degrees to longitudinal body axis; upper-jaw length 6.3–6.9. All teeth tricuspid (except for smallest dentary and maxillary teeth, which are conical), with median cusp larger; all teeth in a single series. Premaxillary, anterior maxillary, and dentary teeth arise perpendicular to jaw bones and then curve posteriorly just proximal to cusps. Maxillary with 8–11, usually 10, teeth; premaxillary with 6–7, usually 7, teeth (holotype with 7); dentary with 10–12 teeth. No teeth present on vomer, palatines, or pterygoids.

Fontanel moderate, length of that part anterior to epiphyseal bar just over one-third length of that part posterior to bar. Gill rakers short, 12–14 (holotype not counted). Circumorbital bones well ossified, infraorbital 3 wide, contacting preopercle ventrally and posteriorly.

Scales moderately large, cycloid with concentric circuli, and about 2–6 radii on exposed posterior field. Lateral line with a slight ventral curve, incomplete, with 10–15 perforated scales. Lateral scales about 41–42 (holotype damaged); scales above lateral line 6–7, usually 7; scales below lateral line 6–7. Predorsal scales about 20–22. Scale sheath along entire base of anal fin. Large axillary scale present dorsal to pelvic-fin insertion; caudal fin scaled at base.

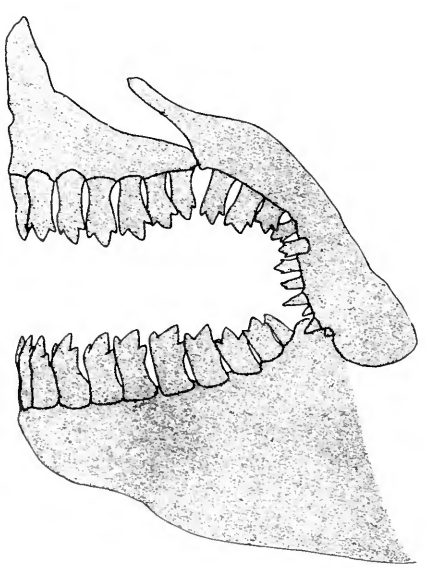

FIGURE 23.—Dentition of *Phenagoniates macrolepis*, USNM 208517, 41.5 mm; Panama, Rio Sambu, collected 25 March 1967 by BNW.

Dorsal fin with 2 unbranched rays and 7–8 branched rays. Dorsal-fin origin posterior to anal-fin origin, about equidistant from eye and caudal base. Distance from tip of snout to dorsal-fin origin 55.4–59.3. Third, fourth, or fifth dorsal-fin ray longest with rays posterior to fifth abruptly shorter; length of longest ray 22.8–25.4.

Anal fin with 4 unbranched rays and 45–50, usually 49, branched rays. First unbranched ray not always visible externally. Origin well anterior to midpoint of standard length 41.5–45.5. Fourth through eighth or ninth anal-fin rays slightly longer than successive posterior rays, forming a slightly protruding margin anteriorly and a straight margin posteriorly. No anal-ray hooks present.

Pectoral fin with 1 unbranched ray and 11–12, usually 11, branched rays. Pectoral fins reach well beyond pelvic-fin insertion, almost to anal-fin origin. Distance from tip of snout to dorsal end of pectoral-fin base 20.2–22.4 and length of pectoral fin from base to tip of longest ray 17.1–21.7.

Pelvic fin with i,5 rays in all specimens, distal tip reaching just to anal-fin origin. Distance from tip of snout to pelvic-fin insertion 33.0–34.8; pelvic-fin length 8.8–10.2. No pelvic-ray hooks present.

Caudal fin with 10/9 principal rays in all specimens; fin forked, not split to base. Caudal-fin lobes symmetrical. No hooks on caudal-fin rays. Dorsal and ventral procurrent caudal rays usually of equal size.

Precaudal vertebrae 13–14, usually 13. Total vertebrae 41–43, usually 42.

Color in alcohol: Ground color pale brown, nape dark brown. Cheeks with few melanophores; tip of lower jaw often dark brown. Back and sides above midline with reticulate pattern of small melanophores. Broad stripe of small melanophores present from just behind opercle to caudal peduncle, extending to tips of middle caudal-fin rays; ventral to stripe, melanophores sparsely distributed along belly and sides, more concentrated posteriorly

(vaguely reticulate pattern anteriorly, following myomere junctions above anal fin). Dorsal fin with a few melanophores along rays and with melanophores scattered on interradial membranes, more concentrated distally. Caudal fin with melanophores on borders of rays and on interradial membranes, more concentrated on middle caudal rays. Anal fin with melanophores on interradial membranes. Pectoral and pelvic fins with a few melanophores on borders of fin rays.

Range: Phenagoniates macrolepis is found in Central America only in eastern Panama, in the drainages of the Rio Sambu, Rio Tuira, and Rio Chucunaque (a major tributary of the Rio Tuira), in Darien Province. The species was found by Eigenmann (1915) in the Atrato basin in Colombia. *Phenagoniates macrolepis* is actually a northern South American fish which has invaded the extreme eastern drainages of Panama; it does not seem common, judging from collections we have examined (this could simply be due to insufficient sampling).

COMPARISONS.—*Phenagoniates macrolepis* is a distinctive species which cannot be confused with any other recorded Central American cheirodontin. Its long anal fin, dorsal-fin position, and large tricuspid teeth set it clearly apart from the other species discussed in this work.

Saccoderma Schultz

FIGURES 24, 25, 26

Saccoderma Schultz, 1944:314 [type-species *Saccoderma melanostigma* Schultz, 1944, by original designation].

We have found only 1 collection of *Saccoderma* species from Central America. There are 15 specimens of *Saccoderma* in SU 48851 (Panama: Veraguas Prov. vicinity of Santiago. Coll. T. D. White, 2 March 1956), along with 7 specimens of *Cheirodon dialepturus.* Caudal squamation and dentary teeth place these 15 specimens in *Saccoderma,* but since they are immature we were unable to establish their specific identity.

FIGURE 24.—*Saccoderma hastata,* holotype, FMNH 56383, male, 31.0 mm; Colombia, Soplaviento, collected by C. Eigenmann (no date given).

We illustrate the caudal-fin squamation (Figure 26) of *S. hastata* (FMNH 56383, Colombia, Soplaviento), as an aid for future identification of the genus from Panama. (Note that the lower [ventral] caudal-fin rays of the holotype of *S. hastata* are somewhat malformed and swollen; this is not true

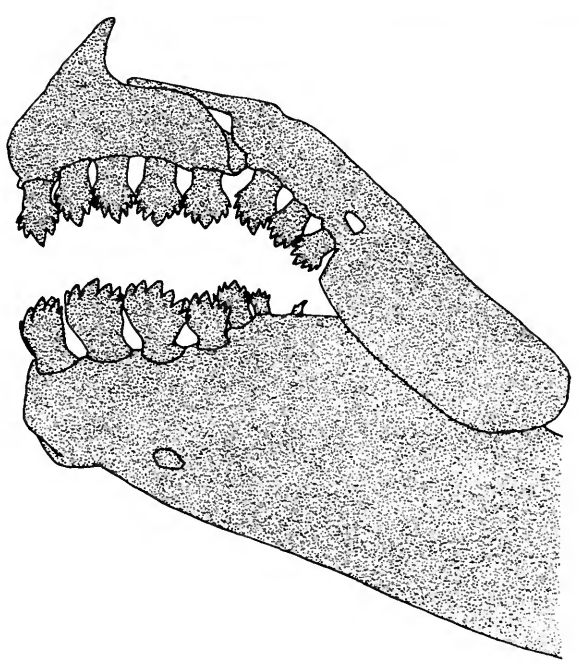

FIGURE 25.—Dentition of *Saccoderma hastata,* paratype, FMNH 56300, male, 26.9 mm; Colombia, Bernal Creek, collected by C. Eigenmann (no date given).

of other specimens examined). The dentary teeth (Figure 25) and modified saclike caudal-fin scales (Figure 26) place *Saccoderma* clearly apart from other genera included in this paper. In addition, adult males of at least 3 species in the genus have antrorse hooks on the rays of the lower caudal-fin lobe.

Loftin (1965) states that he found *Saccoderma* species in Panama on the Atlantic slope in the Chagres basin and on the Pacific slope from the Rio Bayano basin and coastal streams near the Canal Zone. We were unable to find *Saccoderma* in Loftin's Panama material at the ANSP or the National Museum of Natural History.

Sumario

Las especies conocidas de peces quirodontinos de la américa central, caracinos con solo una fila de dientes premaxilaries, están revisados. La clave para su identificación está procedida. La revista incluye miembros de los géneros *Cheirodon, Carlana, Phenagoniates,* y *Saccoderma.* Todas estas especies están describidas y están illustradas con excepción de la forma de *Saccoderma* de la américa central que solo se conoce en la forma juvenil y puede ser que pertenezcan a una especie indescribable. Dos neuvas especies de *Cheirodon* están describidas, *C. dialepturus* de las cuencas pacíficas del oeste central y oeste de Panamá, incluyendo la

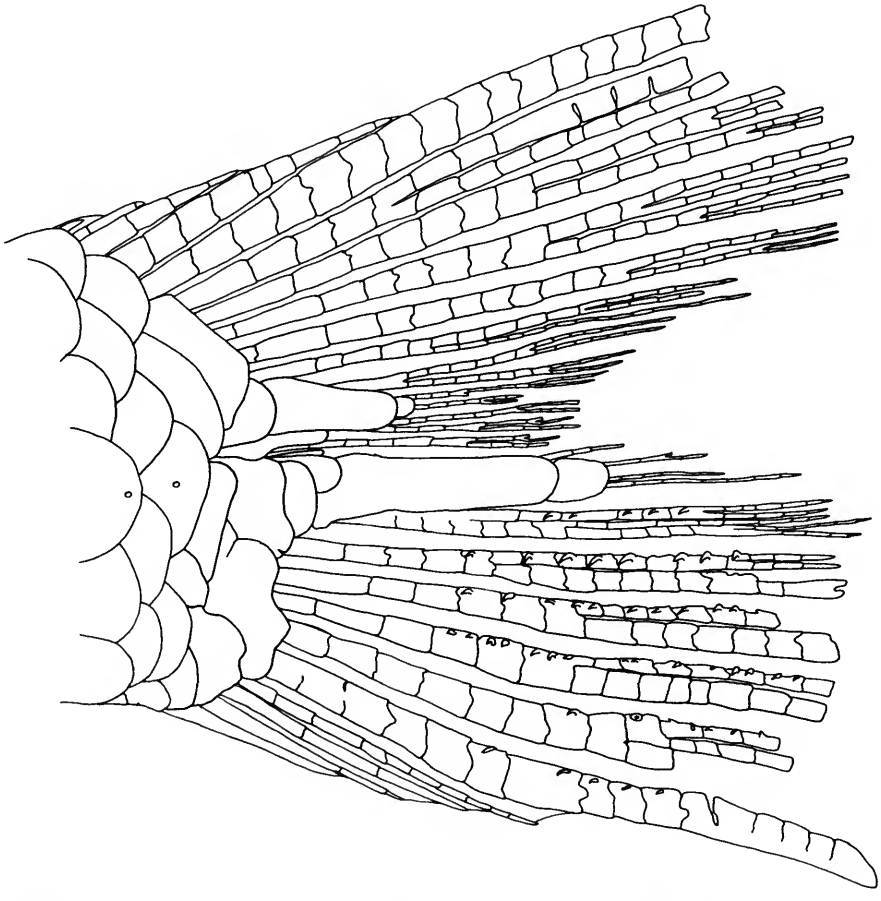

FIGURE 26.—Caudal fin scalation of *Saccoderma hastata,* holotype, FMNH 56383, male, 31.0 mm; Colombia, Soplaviento, collected by C. Eigenmann (no date given).

parte de la Provincia Coclé oeste, hasta al Río Coto, Costa Rica, y *C. mitopterus* del Río Coclé del Norte, una cuenca atlántica de Panamá central.

Rhoadsia eigenmanni se encuentra en *Carlana*, el nombre génerico disponible por el ya utilizado *Carlia*. Los géneros *Odontostilbe*, *Pseudocheirodon*, y *Compsura* están sinonimozados con *Cheirodon* basado en una reexaminación de sujetos usados antes para definir estos géneros así como una nueva evaluación del concepto del género de peces caracinos. Finalmente, unas razones están presentadas para considerar los Cheirodontinae polyphylético.

TABLE 1.—*Branched dorsal-fin rays*

Species	N	7	8	9	10	$\bar{x}$
C. dialepturus	30		3	27		8.9
C. mitopterus	30			30		9.0
C. gorgonae	31			31		9.0
C. affinis	30			29	1	9.0
C. terrabae	30			30		9.0
C. eigenmanni	21		1	20		8.9
P. macrolepis	16	7	9			7.1

TABLE 2.—*Branched pectoral-fin rays*

Species	N	9	10	11	12	13	14	$\bar{x}$
C. dialepturus	30	1	24	5				10.1
C. mitopterus	29			26	3			11.1
C. gorgonae*	30	6	21	3				9.9
C. affinis	30		11	16	2		1	10.8
C. terrabae	28			23	5			11.2
C. eigenmanni	21	1	5	5	10			11.1
P. macrolepis	16			12	4			11.2

* Holotype damaged

TABLE 3.—*Branched anal-fin rays*

Species	N	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31/	45	46	47	48	49	50	$\bar{x}$
C. dialepturus	30		2	13	10	5																			17.6
C. mitopterus	28			6	19	3																			17.9
C. gorgonae	29	1	10	12	5	1																			16.8
C. affinis	29			1	1	11	11	4	1																19.6
C. terrabae	30					1		4	14	11															22.1
C. eigenmanni	21												1		4	10	5	1							29.0
P. macrolepis	16																		1	1	1	3	8	2	48.4

TABLE 4.—*Scales above lateral line*

Species	N	5	6	7	8	9	$\bar{x}$
C. dialepturus	30		30				6.0
C. mitopterus	30	26	4				5.1
C. gorgonae	21	21					5.0
C. affinis	26	12	14				5.5
C. terrabae	22		21	1			6.0
C. eigenmanni	17				16	1	8.1
P. macrolepis	10		2	8			6.8

TABLE 5.—*Scales below lateral line*

Species	N	3	4	5	6	7	8	$\bar{x}$
C. dialepturus	30		30					4.0
C. mitopterus	30	1	29					4.0
C. gorgonae	21		21					4.0
C. affinis	29		2	27				4.9
C. terrabae	24			13	11			5.2
C. eigenmanni	18					12	6	7.3
P. macrolepis	12				6	6		7.1

TABLE 6.—*Gill rakers*

Species	N	12	13	14	15	16	17	18	19	20	21	22	$\bar{x}$
C. dialepturus	25							1	10	9	5		19.7
C. mitopterus	28							1	19	5	3		19.4
C. gorgonae*	17					2	2	5	6	2			18.2
C. affinis	28						8	13	6	1			18.0
C. terrabae	28								5	7	15	1	20.4
C. eigenmanni	17			1	5	7	3	1					15.9
P. macrolepis⊛	7	3	2	2									12.8

* Holotype and juveniles not counted.

⊛ Holotype not counted.

TABLE 7.—*Maxillary teeth*

Species	N	1	2	3	4	5	6	7	8	9	10	11	$\bar{x}$
C. dialepturus	30		2	28									2.9
C. mitopterus	28		22	6									2.2
C. gorgonae	30	1	26	3									2.0
C. affinis	30			19	11								3.4
C. terrabae	30			1	17	11	1						5.4
C. eigenmanni	21		10	1		1	4	1	2	1	1		4.5
P. macrolepis	15								1	3	9	2	9.8

TABLE 8.—*Total vertebrae*

Species	N	31	32	33	34	35	36	37	38/	41	42	43	$\bar{x}$
C. dialepturus	29		3	20	6								33.1
C. mitopterus	29				2	16	10		1				35.4
C. gorgonae	32		3	22	7								33.0
C. affinis	30		10	20									32.7
C. terrabae	27			22	5								33.2
C. eigenmanni	21						3	17	1				36.9
P. macrolepis	16									1	11	4	42.2

TABLE 9.—*Morphometrics of* C. dialepturus

Characters	Males range	Females range	Holotype
Standard length	25.6-32.6	25.4-33.3	28.0
Greatest depth	32.2-36.2	33.7-38.3	35.0
Snout-Dorsal fin origin	50.5-54.3	52.1-55.2	54.3
Snout-Pectoral fin origin	23.8-26.8	23.4-26.7	26.8
Snout-Pelvic fin origin	44.3-47.5	43.7-48.8	47.5
Snout-Anal fin origin	62.1-66.4	62.3-66.2	66.4
Peduncle depth	12.6-15.0	12.1-13.8	14.3
Peduncle length	14.5-16.1	13.9-16.5	15.0
Pectoral fin length	20.8-26.2	22.1-24.2	23.9
Pelvic fin length	17.9-24.2	18.5-20.6	18.2
Dorsal fin length	29.9-33.8	27.3-32.3	*
Head length	23.5-25.3	23.3-24.6	25.1
Eye diameter	8.6-10.2	8.8-10.5	9.3
Snout length	4.8- 6.1	4.7- 5.6	5.0
Interorbital width	7.0- 8.0	7.3- 8.0	7.5
Upper jaw length	7.6- 9.4	7.1- 8.4	8.6
Eye-Dorsal fin origin	38.0-40.7	38.2-41.2	40.7
Dorsal fin origin-Caudal fin origin	51.3-54.4	51.5-54.7	50.0

* Damaged

TABLE 10.—*Morphometrics of* C. mitopterus

Characters	Males and Females range	Holotype
Standard length	24.9-36.8	35.0
Greatest depth	23.6-38.3	34.3
Snout-Dorsal fin origin	40.6-68.4	59.8
Snout-Pectoral fin origin	18.7-30.2	27.3
Snout-Pelvic fin origin	34.9-60.0	53.5
Snout-Anal fin origin	49.7-85.0	75.2
Peduncle depth	8.5-14.7	14.3
Peduncle length	13.1-21.0	20.6
Pectoral fin length	15.0-32.5	32.5
Pelvic fin length	15.3-30.1	30.1
Dorsal fin length	23.2-39.8	*
Head length	18.5-28.7	26.6
Eye diameter	7.9-12.9	12.2
Snout length	4.3- 7.4	6.6
Interorbital width	5.7- 9.2	8.4
Upper jaw length	6.2- 9.9	9.4
Eye-Dorsal fin origin	29.8-49.7	44.8
Dorsal fin origin-Caudal fin origin	44.0-74.3	68.2

* Damaged

TABLE 11.—*Morphometrics of* C. gorgonae

Characters	Males range	Females range	Juveniles	Holotype
Standard length	22.9-26.7	23.1-28.4	19.4-21.3	22.1
Greatest depth	33.4-37.8	33.4-37.5	25.7-33.5	30.3
Snout-Dorsal fin origin	51.4-54.6	52.6-56.8	49.5-52.0	53.9
Snout-Pectoral fin origin	24.4-28.8	24.2-28.0	26.7-28.6	28.5
Snout-Pelvic fin origin	45.0-48.9	45.5-49.8	46.9-49.0	48.0
Snout-Anal fin origin	62.2-66.9	62.5-67.2	63.1-65.0	65.6
Peduncle depth	12.0-14.3	12.6-13.4	11.1-12.9	11.8
Peduncle length	13.6-17.1	13.6-15.8	14.1-15.1	14.0
Pectoral fin length	21.4-25.4	20.2-22.1	21.8 *	*
Pelvic fin length	18.3-21.4	16.5-18.7	16.0-18.0	*
Dorsal fin length	29.6-32.2	27.6-32.4	29.8 *	*
Head Length	24.0-26.3	23.5-26.0	25.3-27.3	25.3
Eye diameter	9.3-10.7	9.2-10.8	10.8-11.9	10.4
Snout length	5.4- 5.8	5.3- 5.8	5.4- 5.8	5.4
Interorbital width	6.5- 8.1	7.4- 7.9	7.0- 8.3	7.7
Upper jaw length	7.4- 8.0	7.4- 7.9	7.6- 8.3	8.1
Eye-Dorsal fin origin	38.0-41.5	38.7-43.2	36.6-37.9	39.8
Dorsal fin origin-	51.2-53.7	50.2-54.5	49.3-52.7	49.4

* Damaged

TABLE 12.—*Morphometrics of* C. affinis

Characters	Males and Females range	Holotype
Standard length	22.5-38.8	29.5
Greatest depth	37.0-44.3	39.0
Snout-Dorsal fin origin	51.7-54.5	54.0
Snout-Pectoral fin origin	24.5-27.1	24.8
Snout-Pelvic fin origin	46.1-50.4	47.5
Snout-Anal fin origin	63.1-68.3	64.8
Peduncle depth	12.4-14.1	12.5
Peduncle length	11.4-15.5	14.2
Pectoral fin length	20.1-23.6	20.6
Pelvic fin length	17.0-20.2	16.9
Dorsal fin length	30.0-34.5	30.5
Head length	23.2-26.3	24.4
Eye diameter	9.0-10.6	10.2
Snout length	5.3- 6.2	5.8
Interorbital width	8.2- 9.2	8.5
Upper jaw length	6.0- 7.6	6.4
Eye-Dorsal fin origin	38.4-42.7	39.0
Dorsal fin origin-Caudal fin origin	52.6-56.0	53.6

TABLE 13.—*Morphometrics of* C. terrabae

Characters	Males and Females range
Standard length	29.8-49.8
Greatest depth	32.9-42.6
Snout-Dorsal fin origin	50.0-57.6
Snout-Pectoral fin origin	24.2-29.0
Snout-Pelvic fin origin	45.1-51.1
Snout-Anal fin origin	61.3-69.5
Peduncle depth	11.0-13.2
Peduncle length	11.3-15.0
Pectoral fin length	19.4-24.1
Pelvic fin length	16.7-21.3
Dorsal fin length	27.8-34.4
Head length	22.8-26.6
Eye diameter	8.7-10.4
Snout length	5.4- 6.5
Interorbital width	7.6- 9.2
Upper jaw length	6.0- 7.7
Eye-Dorsal fin origin	37.2-43.0
Dorsal fin origin-Caudal fin origin	51.0-58.0

TABLE 14.—*Morphometrics of* C. eigenmanni

Characters	Juveniles range	Adults range	Holotype
Standard length	21.0-29.8	34.3-56.4	52.8
Greatest depth	32.0-39.5	35.8-41.2	41.2
Snout-Dorsal fin origin	53.4-56.7	52.0-55.0	53.1
Snout-Pectoral fin origin	26.9-29.8	24.4-26.6	24.6
Snout-Pelvic fin origin	45.3-48.5	41.6-45.9	42.7
Snout-Anal fin origin	58.5-61.7	57.6-61.1	59.4
Peduncle depth	8.3-10.1	9.5-11.6	11.4
Peduncle length	8.7-10.9	9.5-10.5	10.0
Pectoral fin length	17.8-21.3	19.6-21.2	20.8
Pelvic fin length	16.7-19.3	16.7-19.8	19.5
Dorsal fin length	29.0-33.2	31.4-44.0	36.4
Head length	24.9-27.6	23.1-25.2	23.6
Eye diameter	10.8-12.7	8.5-10.8	9.1
Snout length	4.9- 6.9	6.1- 7.1	6.6
Interorbital width	7.2- 9.0	8.4- 8.9	8.9
Upper jaw length	7.5- 8.2	8.6-11.9	11.6
Eye-Dorsal fin origin	38.9-41.5	39.6-41.2	40.7
Dorsal fin origin-Caudal fin origin	49.0-52.4	51.9-56.3	55.8

TABLE 15.—*Morphometrics of* P. macrolepis

Characters	Males and Females	
	range	Holotype
Standard length	33.4-45.1	45.1
Greatest depth	26.0-29.8	29.0
Snout-Dorsal fin origin	55.4-59.3	56.8
Snout-Pectoral fin origin	20.2-22.4	20.8
Snout-Pelvic fin origin	32.1-34.8	32.1
Snout-Anal fin origin	41.5-45.5	41.7
Peduncle depth	8.7-10.2	10.2
Peduncle length	5.8- 7.1	7.1
Pectoral fin length	17.1-21.7	18.0
Pelvic fin length	8.8-10.2	8.9
Dorsal fin length	22.8-25.4	23.5
Head length	19.5-21.8	19.5
Eye diameter	8.0- 9.5	8.0
Snout length	4.6- 4.9	4.9
Interorbital width	5.6- 6.2	6.0
Upper jaw length	6.3- 6.9	6.9
Eye-Dorsal fin origin	44.8-47.0	46.8
Dorsal fin origin-Caudal fin origin	45.1-49.1	48.1

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