

HYPHESSOBRYCON ELACHYS, A NEW MINIATURE
CHARACID FROM EASTERN PARAGUAY
(PISCES: CHARACIFORMES)

Marilyn Weitzman

Abstract. — *Hyphessobrycon elachys* is described as new from the Río Paraguay drainage basin. The adult males of this species are readily recognized by the elongate filaments of the dorsal and pelvic fins and the broad lobular shape of the anterior portion of the anal fin. Both sexes have a tooth-cusp pattern unknown in other characids. The species is compared with other *Hyphessobrycon* occurring in the region. The presence in *Hyphessobrycon maxillaris* Fowler of caudal squamation which would place it in *Hemigrammus* Eigenmann is noted.

In material collected in 1981 by Larry Naylor of the United States Peace Corps as part of the Biological Inventory of Paraguay carried out under the auspices of the Servicio Forestal Nacional de Paraguay were many small silvery fish with prominent black caudal spots belonging to several characid genera. Portions of these collections were sent to the United States National Museum (USNM) and to the University of Michigan Museum of Zoology (UMMZ) by the Museo de Historia Natural de Paraguay (MHNP) in Asunción. Among the fishes sent to the USNM was a very small species (12.9–16.6 mm SL) with a broad lobe-shaped anal fin and elongate filamentous rays of the dorsal and pelvic fins unlike any other known species of characid. Although of very small size, they turned out to be mature males. The type-locality of this new species is a swampy area of the Río Aguaray-guazu with quiet turbid water and floating plants. It is part of the Río Jejui system which flows into the Río Paraguay in northeastern Paraguay. More specimens from the type-locality were in the collections sent to UMMZ. A single male was found in a collection made by Naylor in the Parque Nacional Ybycui. All separated were males. In 1979 R. Bailey, J. N. Taylor and party made extensive collections throughout eastern Paraguay and a search through their material revealed many additional specimens collected in the Río Aguaray-mi about 25 km north of the type-locality.

Females were finally identified after close inspection of some of the unidentified small silvery characids with black caudal spots from these localities. As the males, the females have the dentary teeth and inner-row premaxillary teeth with a cusp pattern unknown in other characids. Otherwise, the females look much like those of several other small species present in these collections. Their fins have the usual characid shape rather than the lobed anal fin or filamentous dorsal or pelvic fins possessed by the males. This small species, following Eigenmann (1917), is placed in the genus *Hyphessobrycon* Durbin on the basis of its possession of the characters used to define this genus.

The methods used here for counting and measuring specimens are those described for characiforms by Fink and Weitzman (1974) except where noted. Morphometric values are expressed as a percentage of standard length (SL) except where otherwise designated.

Hyphessobrycon elachys, new species

Figs. 1–5

Holotype.—USNM 232393, 16.1 mm SL, male, Paraguay, Departamento San Pedro; swamp 3 km northwest of Lima, Río Aguaray-guazu system, 23°55'S, 56°29'W, 31 Oct 1981, by N. Scott, L. Fitzgerald.

Paratypes.—79, USNM 268474, 12.9–16.6 mm SL (4, 14.4–16.6 mm SL, adult males A–D, cleared and stained).—16, UMMZ 212725, 13.3–15.8 mm SL.—2, Academy of Natural Sciences of Philadelphia, ANSP 153539, 14.4–14.5 mm SL.—2, British Museum (Natural History), BMNH 1984.12.21:2–3, 13.9–15.0 mm SL.—2, California Academy of Sciences, CAS 56018, 14.4–14.8 mm SL.—2, MHNP, 13.9–14.9 mm SL.—4, Museu Zoologia da Universidade de São Paulo, MZUSP 28655, 13.9–14.9 mm SL, all of preceding with same data as holotype.—26, UMMZ 206595, 14.0–19.7 mm SL, Paraguay, Departamento San Pedro; Río Aguaray-mi and ditch, Guazu at bridge, Rte. 3, 23°37.9'S, 56°30'W, 22 Jul 1979, by J. N. Taylor.—1, USNM 232381, male, 15.5 mm SL, Paraguay, Departamento Paraguari; Parque Nacional Ybycui, near 26°S, 57°W, 21 Jan 1981, by O. Romero and L. Naylor.

Diagnosis.—Distinguished from other species of *Hyphessobrycon* by unique form in both sexes of teeth of dentary and inner-row premaxillary bones in which central cusp is offset toward center of tooth while 2 to 3 cusps of each side compressed, placed along anterior border of each tooth on dentary and along posterior border of premaxillary teeth; large, almost black caudal spot nearly covering at least posterior half of caudal peduncle and basal portion of caudal fin, not extending anteriorly as part of lateral stripe, but extending posteriorly on median portion of caudal fin to middle of fin in females and to distal border of fin in mature males. In mature males anal fin with broad anterior lobe with rays thickened and flattened medially; in mature males first branched rays of dorsal and pelvic fins elongated into filaments up to ½ body length. The small size (13.8–19.7 mm SL) distinguishes this species from most other species of *Hyphessobrycon*.

Description.—See Table 1 for morphometric values. Body elongate, sides compressed. Greatest depth usually at pelvic-fin origin which is one vertical scale row anterior to dorsal-fin origin. Predorsal body profile slightly convex, from above eye to anterior of dorsal-fin origin. Body profile along dorsal-fin base nearly straight and almost straight to slightly concave from rear of fin posteriorly to caudal-fin base. Dorsal-fin origin almost equidistant from snout tip and caudal-fin base. Ventral body profile somewhat convex from symphysis of lower jaw to pelvic-fin origin, body profile concave between pelvic-fin origin and anal-fin origin, straight to slightly convex across base of anal fin, and almost straight from rear of anal fin along ventral caudal peduncle to caudal-fin base. Caudal peduncle slender. Head moderate in length, relatively deep, compressed. Eye large. Snout short, rounded, mouth terminal, tip of snout slightly anterior to dentary. Mouth gape narrow, almost horizontal. Maxilla slender, moderately long, its posterior tip extends to or slightly beyond vertical through anterior border of eye. Ventral border of maxilla about parallels ventral mandibular profile with mouth closed.

Due to small size of this fish, only teeth of 4 cleared and stained specimens were examined closely but counts were made of many additional specimens,

Table 1.—Measurements of *Hyphessobrycon elachys*, new species. Standard length is expressed in mm; measurements through bony head length are percentages of standard length; measurements below bony head length are percentages of bony head length.

	Holo- type	Paratypes					
		n	Males range	\bar{x}	n	Females range	\bar{x}
Standard length	16.1	44	12.9–16.6	14.9	15	14.2–17.9	15.5
Body depth at pelvic-fin origin	35.4	40	31.7–38.5	34.5	15	32.9–37.3	35.0
Body depth at dorsal-fin origin	34.2	44	31.0–40.4	34.0	15	31.6–38.0	34.5
Snout to dorsal-fin origin	52.2	44	50.3–55.9	53.3	15	52.0–56.2	54.4
Dorsal-fin origin to caudal-fin base	52.2	44	50.0–54.8	52.8	15	49.0–55.1	52.2
Snout to pelvic-fin origin	49.7	44	45.6–52.1	49.1	15	47.1–53.3	50.3
Snout to anal-fin origin	62.1	44	59.6–63.8	62.1	15	61.8–67.8	64.7
Caudal peduncle depth	11.8	44	9.3–13.2	11.1	15	9.2–11.8	10.5
Caudal peduncle length	15.5	44	13.0–17.5	15.3	15	13.2–16.7	14.8
Adipose-fin origin to caudal-fin base	17.4	40	14.2–18.9	16.6	15	14.1–17.6	15.6
Dorsal-fin base	14.9	43	12.2–17.8	15.6	15	13.4–16.0	14.6
Longest dorsal-fin ray length	57.1	41	32.4–51.3	40.7	14	28.2–34.7	31.0
Anal-fin base	29.8	44	25.0–32.4	28.6	15	23.3–30.7	25.8
Longest anal-fin ray length	16.8	41	13.9–19.3	16.9	13	19.0–24.1	21.2
Pelvic-fin length	43.5	42	23.2–50.0	36.2	15	17.1–20.8	19.3
Pelvic-fin origin to anal-fin origin	14.3	39	13.3–19.4	15.8	15	15.6–19.0	17.3
Pectoral-fin origin to pelvic-fin origin	21.1	40	19.1–24.0	21.2	15	19.6–24.7	22.5
Pectoral-fin length	22.7	44	19.3–24.3	22.2	14	18.4–24.2	21.3
Snout to pectoral-fin origin	29.2	44	27.0–30.3	28.9	15	27.2–30.8	29.0
Bony head length	27.3	44	26.2–29.5	27.5	15	26.2–29.6	27.7
Horizontal eye diameter	45.5	43	39.0–48.8	44.2	15	42.9–48.9	46.7
Snout length	27.3	39	21.8–27.9	24.8	15	22.5–28.0	25.1
Width least bony interorbital	34.1	44	28.9–37.3	32.3	15	28.6–35.7	31.9
Width upper jaw	25.0	40	22.5–30.2	25.8	15	23.8–30.1	26.9
Length upper jaw	34.1	44	28.0–39.5	34.3	15	33.3–39.5	35.9
Length lower jaw	35.2	40	32.4–39.5	35.1	15	32.6–40.0	35.8
Length maxilla	27.3	40	22.7–31.4	27.5	14	24.4–29.1	27.3

especially the females and the specimens from the Aguaray-mi. Maxilla, Fig. 4, usually with 1 small tooth, compressed, with 3 to 5 almost equal cusps in large adult males. Tooth absent on one (specimen C) or both sides (specimen D) in smaller specimens. Maxillary teeth very difficult to see in unstained specimens even at 50× magnification. Premaxilla, Fig. 4, bearing 2 tooth rows. Outer row with 2 or 3 teeth, round in cross section with main central cusp and 2 small cusps on each side. In some specimens 1 or 2 of these teeth missing, apparently due to tooth replacement in progress. Inner premaxillary tooth row with 5 teeth. First, medial, tooth slender, rounded in peduncular cross section, heavy main central cusp set somewhat anterior to lateral side cusps which are set along posterior border of tooth, 2 medial and 3 lateral. Second, third, and fourth teeth broader, with large central cusp set somewhat anterior on tooth relative to more compressed lateral cusps (3 each side) which are set along posterior border of tooth, essentially opposite to their positions on dentary teeth. Fifth, lateralmost, tooth smaller, compressed in cross section (more incisor like), with 6 or 7 cusps nearly equal in height. Dentary, Fig. 4, with 4 large teeth across anterior of bone. All are heavy, ovate in peduncular cross section, flaring laterally distally; central cusp broad,

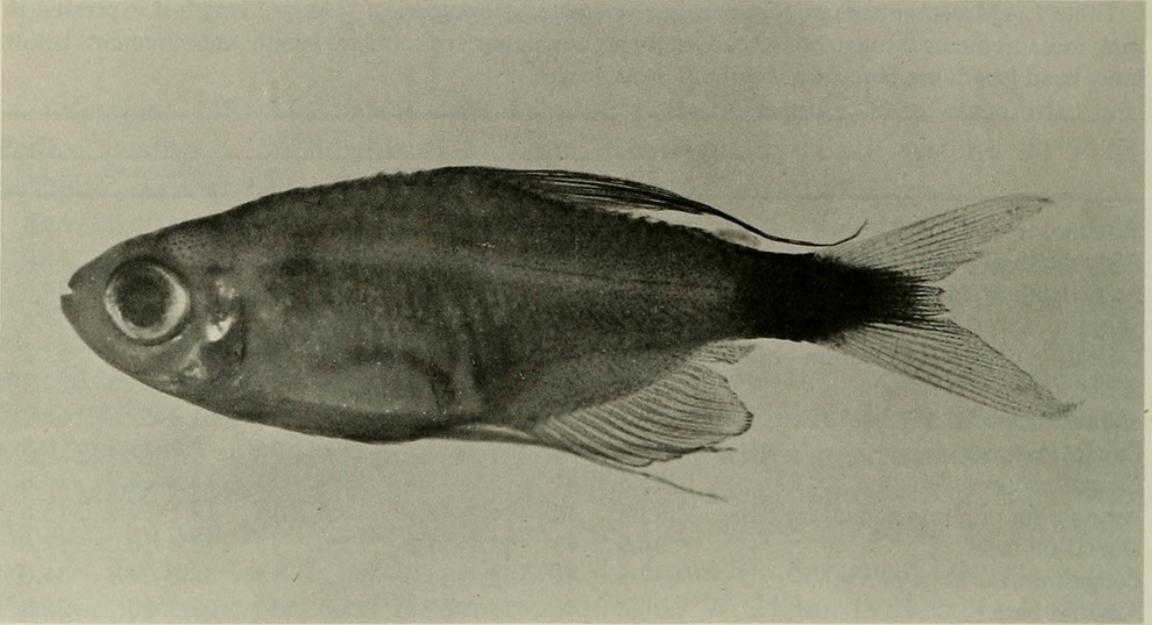


Fig. 1. *Hyphessobrycon elachys*, new species, USNM 232393, male, 16.1 mm SL, holotype. Paraguay, swamp 3 km northwest of Lima, Río Aguaray-guazu system.

offset toward center of tooth, somewhat posterior to flanking cusps. Tip of medial cusp directed posteriorly into mouth while adjacent cusp on each side directed slightly anterodorsally. Lateral cusps 3 each side, set along anterior border of tooth. Four or 5 small teeth posterolateral to large anterior dentary teeth. Small dentary teeth almost conical but with 1 or 2 small lateral cusps on first 2 to 4 teeth.

Branchiostegal rays 4. Gill rakers 5 or 6/11 to 13 in 4 cleared and stained specimens.

Antorbital and infraorbitals 1, 2, and 3 present, well ossified. Third infraorbital bone not in contact with laterosensory tube of preopercle, leaving moderate naked margin. Fourth infraorbital bone apparently absent (or at least not ossified). Fifth and sixth infraorbital bones present in 2 cleared and stained specimens, 16.5 and 16.6 mm SL, absent in other 2.

Dorsal-fin rays ii,9; iii,8,i; ii,8,i; ii,7,ii; ii,7,i (usually ii,8,i). Second to fourth branched rays elongate in adult males; in some specimens rays extend posteriorly almost to vertical through termination of middle caudal-fin rays.

Pectoral-fin rays i,8 to i,10, usually i,9. Fin located low on body, posterior tip usually extends slightly beyond vertical through pelvic-fin origin.

Pelvic-fin rays i,5 to i,7, usually i,6. Second ray elongate and in a mature male, such as holotype (Fig. 1) extends posteriorly just beyond a vertical drawn through posterior base of anal fin. Muscles for pelvic fins large but bones of pelvic girdle not especially modified. Fin rays without hooks.

Anal-fin rays iii,16 to iii,20, usually iii,18. Last ray, which is divided to base into two branched rays, is counted as two. In males, first or second through sixth to eighth branched rays of almost equal length. These rays broadened medially, remainder of rays shorter, giving fin a distinctive outline compared to other known species of *Hyphessobrycon*; a broad anterior lobe followed by a deeply concave border. See Figs. 1, 3, and 5. No hooks found on any anal-fin rays, absence perhaps

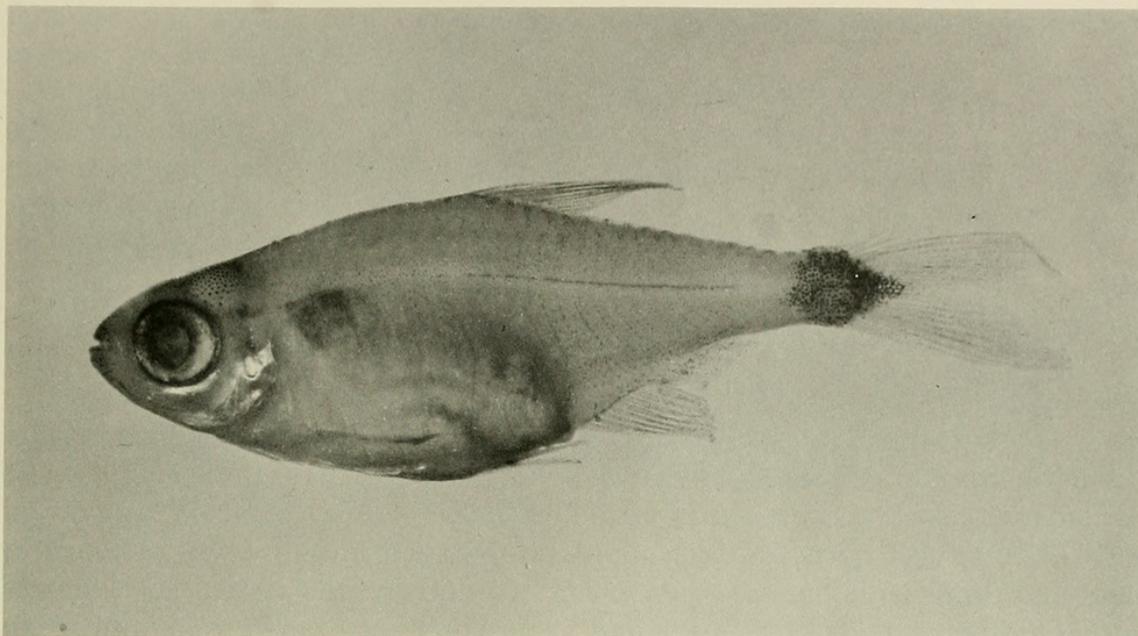


Fig. 2. *Hyphessobrycon elachys*, new species, USNM 268474, female, 15.0 mm SL, paratype. Paraguay, swamp 3 km northwest of Lima, Río Aguaray-guazu system.

seasonal. See Fink and Weitzman (1974:22) for discussion of seasonality of fin hooks in *Cheirodon affinis*. Females of *Hyphessobrycon elachys* have a more "usual" characid anal-fin shape (Fig. 2), strongly concave in distal outline with anterior rays longest and following rays becoming abruptly shorter. Basal sheath of anal fin short, 3 scales on anterior basal portion of fin.

Adipose fin present, small, situated slightly anterior of vertical through insertion of posterior anal-fin ray.

Caudal-fin rays $i,9/8,i$ in most specimens. One of cleared and stained specimens with 2 unbranched principal rays in dorsal caudal lobe and 2 specimens with $i,8/7,i$ rays. Caudal-fin lobes almost equal in length, rather narrow and deeply forked. Caudal fin naked with only 3 to 5 large scales covering central basal portion of each lobe (these scales easily deciduous and usually missing).

Scales 30 to 32 in lateral series to hypural joint. Four to 6 perforated lateral-line scales anteriorly on sixth horizontal scale row from dorsal-fin origin. Four scale rows ventral to lateral-line row to pelvic-fin origin. Usually 9 or 10 scales in predorsal median series but series sometimes incomplete with 1 to 3 overlapping or paired scales, usually at anterior or just anterior to dorsal-fin origin; in some specimens overlapping or paired scales in middle of series.

Supraoccipital crest short, usually 2 scales along its border.

Vertebrae counted only in cleared and stained specimens, 32 (14 + 18) in three and 31 (13 + 18) in one.

Color in alcohol.—Color description based on holotype, a mature male, Fig. 1 (see also Fig. 3). Females and immature specimens usually paler overall but with same general color pattern, Fig. 2. Ground color pale yellowish tan, slightly darker dorsally. Dorsally and anteriorly head with small to medium dark brown chromatophores. Large dark brown chromatophores on anterior portion of lower jaw, darkest along border of mouth. Maxilla with scattered small dark chromatophores.

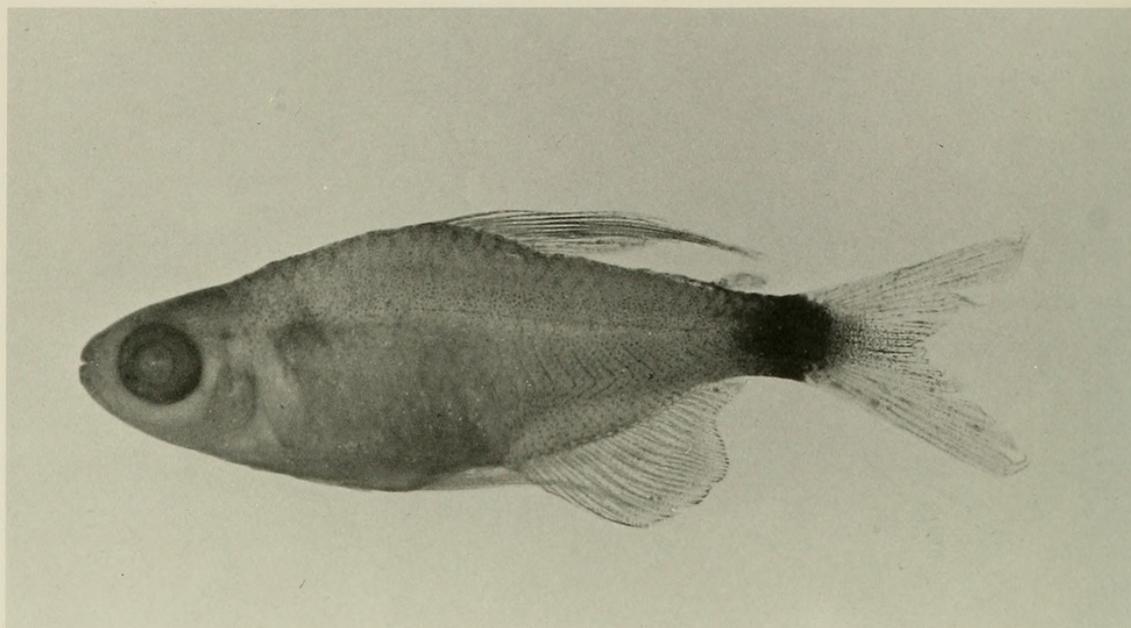


Fig. 3. *Hyphessobrycon elachys*, new species, USNM 232381, male, 15.5 mm SL, paratype. Paraguay, Parque Nacional Ybycui.

Connective tissue surrounding brain with very large dark brown chromatophores; small black chromatophores in skin over this area. A few tiny black chromatophores on head posterior to middle of orbit. Dorsal half of iris with much black pigment, remainder of iris iridescent gold. Head pale silvery-yellow ventrally.

Small dark chromatophores evenly spaced on scales of predorsal region. Scales along base of dorsal fin with large medium brown chromatophores over all but pale anteromedial portion and light brown outer border. Postdorsal scales with small dark chromatophores spaced farther apart and thus lighter, much like pattern on scales of horizontal scale rows 1 to 3 anterior to dorsal fin and on scales of most of body posterior to dorsal fin.

Small anterior humeral spot present, rounded and pale; barely discernible on some specimens, tympanum visible underneath. Humeral spot located on third and fourth scales of fifth horizontal scale row. Humeral spot extends dorsally into fourth horizontal scale row and ventrally through sixth, lateral-line, row into second scale of seventh horizontal scale row. Scales within spot all with evenly scattered small dark chromatophores.

Most specimens with lateral band of widely scattered small dark chromatophores which extends across body from just posterior to dorsal border of opercle to anterior border of caudal peduncle. Narrow dark stripe between epaxial and hypaxial muscles of body visible, especially posterior to vertical through anal-fin origin. Row of large brown chromatophores present on body in region where proximal radials of anal-fin pterygiophores approach haemal spines. Sometimes a broad band of large soft brown chromatophores on body just posterior to humeral spot and ventral to previously described lateral band. These extend to near vertical drawn through dorsal-fin origin. Scales on body in region dorsal to anal-fin base with small evenly spaced chromatophores in a pattern along external borders hypaxial musculature. Anterior portion of caudal peduncle pale, to about half in

female and immature specimens, but essentially absent in holotype as caudal spot extends nearly across the caudal peduncle.

Caudal spot present; large, almost black, covering most of caudal peduncle in adult males (Figs. 1, 3), covering posterior half of caudal peduncle in female and immature specimens (Fig. 2), and muscular portion of caudal-fin base in all. Anteriorly, caudal spot usually with rather rounded, convex margin. Posteriorly, on caudal fin, spot narrows and on mature males extends across caudal fin in region of fin rays 7 to 12. On most other specimens posterior border of caudal spot tapers to a point on middle rays about one half distance to distal border at fork.

Dorsal fin of mature male dusky gray with small black chromatophores over most of fin except along somewhat enlarged proximal half of fin rays 2 to 5. Dorsal fin in this region rather translucent. Dorsal fin of female and immature lighter, fin rays not enlarged. Anal fin of mature male light dusky brown across anterior proximal $\frac{1}{2}$ to $\frac{2}{3}$ of fin in region of broad fin rays. Posterior portion of fin with scattered small black chromatophores. Distal border of anal fin dusky black. Anal fin of immature males pale. Anal fin of females light dusky gray with anterior rays bordered with dusky gray in middle portions. Scattered small dark chromatophores on distal quarter of membrane between anterior rays, fewer on membrane between rays 7 to 12, but basal to distal; posteriorly a few chromatophores basally. Posterior rays otherwise pale. Pectoral and pelvic fins with scattered small black chromatophores. Caudal fin of mature male dusky black across middle rays 7 to 12. Center basal portion of each caudal-fin lobe translucent and remainder of caudal fin a lighter dusky gray than on dorsal fin. Caudal fin of females and immature males similar but dusky black of caudal spot tapers to point on middle rays, see description of caudal spot above.

Color in life unknown. Some specimens retain chromatophores that suggest red pigment present on side in region of humeral spot. Also pale spots on basal portion of caudal-fin lobes probably have color in life.

Sexual dimorphism.—Sexual dimorphism obvious in extension of dorsal- and pelvic-fin rays especially in mature males and in lobular shape of anterior portion of anal fin in males. In females these fins have shapes very like those of other *Hyphessobrycon* species. There are some morphometric differences but none that would suggest additional sexual dimorphism.

Etymology.—The specific name *elachys* from the Greek, little or small, is in reference to the small adult size of the species.

Relationships.—The relationships of this species to other species of characids remain unknown. It is placed in *Hyphessobrycon* Durbin on the basis of its possession of the characters used by Eigenmann (1917) to define that genus. These are: few, if any teeth on maxilla, adipose fin present, incomplete series of lateral-line pores, third orbital bone (2nd suborbital in Eigenmann's terminology) not in contact with sensory tube of preopercle, two series of premaxillary teeth, and caudal fin naked of scales except at its base. See Weitzman (1977:355–356) for a discussion of the problem of recognizing *Hyphessobrycon* and putatively related genera, and Weitzman and Fink (1983) for a discussion of the phylogenetic relationships of small characiforms.

Hyphessobrycon elachys does not key satisfactorily to any species in Eigenmann (1918:172–175). If one follows the key to *Hyphessobrycon* in Géry (1977:455–

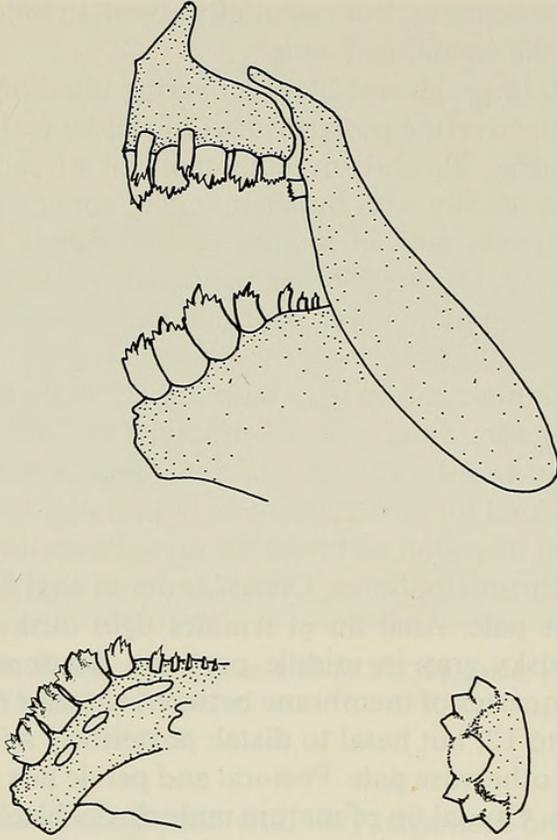


Fig. 4. *Hyphessobrycon elachys*, USNM 268474, male, 16.6 mm SL, cleared and stained spm A. Lateral view of premaxillary, maxillary, and dentary bones. Medial view of dentary. Diagram of tooth-cusp arrangement, posterior border of premaxillary tooth to left but anterior border of dentary tooth to left.

486), one proceeds to *Hyphessobrycon anisitsi* (Eigenmann) because both have the dorsal fin near midbody, one narrow maxillary tooth, as well as humeral and caudal spots present. *Hyphessobrycon anisitsi* also occurs in Paraguay, but it is a large species, reaching at least 60 mm SL, looking similar to some species of *Astyanax*. The teeth of the dentary and premaxillary bones have similar counts and comparable size in the two species, but these characters are shared with many other *Hyphessobrycon* species. However, *H. anisitsi* lacks the unique shape of the dentary and premaxillary teeth of *H. elachys*. See Fig. 4.

Another species of *Hyphessobrycon*, *H. callistus* (Boulenger), occurs in the same part of Paraguay as *H. elachys* but apparently the two are not closely related. *Hyphessobrycon callistus* "belongs" to a deeper-bodied "group" with one or two vertical humeral bars, a black spot on the dorsal fin and usually without black on the caudal peduncle.

Among other small fish which were collected with *Hyphessobrycon elachys* in Paraguay, there were at least two with very similar color pattern and size. One is evidently *Hemigrammus tridens* Eigenmann (in Eigenmann and Ogle 1907). The only difference between *Hemigrammus* and *Hyphessobrycon* according to Eigenmann (1917) is the possession of scales on the caudal fin of the former genus. In practice, this character can be difficult to use because the scales on these small fishes are easily lost due to various hazards during collection and preservation;

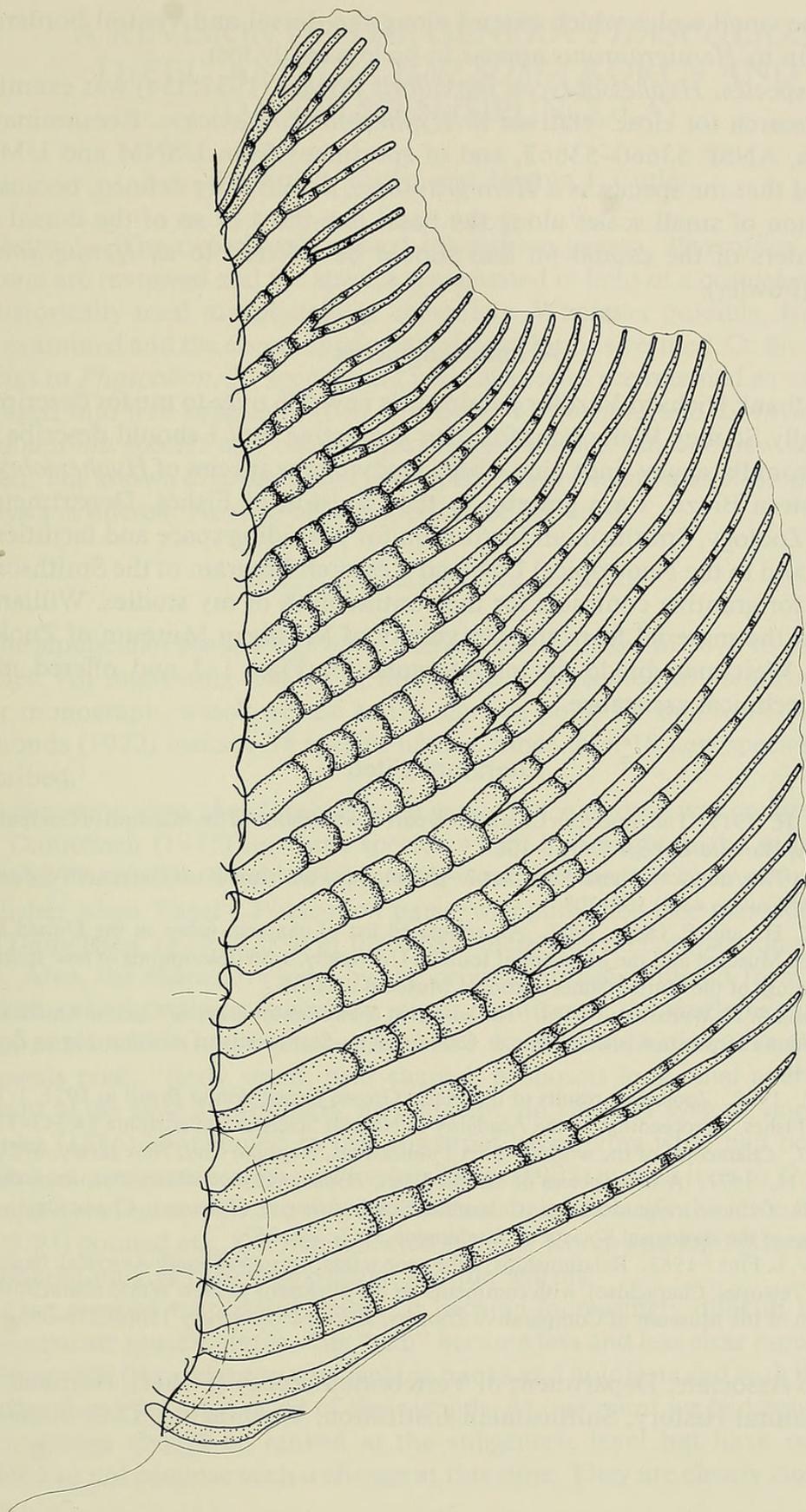


Fig. 5. *Hyphessobrycon elachys*, USNM 268474, male, 16.6 mm SL, cleared and stained spm A. Anal fin. Dotted lines indicate three scales of anal-fin sheath.

however, the small scales which extend along the dorsal and ventral borders of the caudal fin in *Hemigrammus* appear to be less easily lost.

Another species, *Hyphessobrycon maxillaris* Fowler (1932:354) was examined during the search for close relatives to *Hyphessobrycon elachys*. Reexamination of the types, ANSP 53660–53663, and of specimens from USNM and UMMZ has revealed that the species is a *Hemigrammus*, as currently defined, because of the possession of small scales along the basal one-third or so of the dorsal and ventral borders of the caudal fin and should be referred to as *Hemigrammus maxillaris* (Fowler).

Acknowledgments

I wish to thank Richard Vari for passing this new fish over to me for description and especially Stanley Weitzman, for then suggesting that I should describe this miniature from Paraguay since I have been studying the species of *Hyphessobrycon* in southeastern Brazil. I am grateful to the Division of Fishes, Department of Vertebrate Zoology, Smithsonian Institution for providing space and facilities for my studies and to the Neotropical Lowland Research Program of the Smithsonian Institution for granting contracts for the continuation of my studies. William L. Fink loaned the material from the University of Michigan Museum of Zoology. Stanley H. Weitzman made the photographs for Figs. 1–3 and offered much additional technical assistance.

Literature Cited

- Eigenmann, C. H. 1917. The American Characidae, part 1.—Memoirs of the Museum of Comparative Zoology, Harvard College 43(1):1–102.
- . 1918. The American Characidae, part 2.—Memoirs of the Museum of Comparative Zoology, Harvard College 43(2):103–208.
- Eigenmann, C. H., and F. Ogle. 1907. An annotated list of characin fishes in the United States National Museum and the Museum of Indiana University, with descriptions of new species.—Proceedings of the United States National Museum 33:1–36.
- Fink, W. L., and S. H. Weitzman. 1974. The so-called cheirodontin fishes of Central America with descriptions of two new species (Pisces Characidae).—Smithsonian Contributions to Zoology 172:1–46.
- Fowler, H. W. 1932. Zoological results of the Matto Grosso Expedition to Brazil in 1931. 1. Fresh Water Fishes.—Proceedings of the Academy of Natural Sciences Philadelphia 84:343–377.
- Géry, J. 1977. Characoids of the world.—TFH Publications, Neptune City, New Jersey. 672 pp.
- Weitzman, S. H. 1977. A new species of characid fish, *Hyphessobrycon diancistrus*, from the Río Vichada, Orinoco river drainage, Colombia, South America (Teleostei: Characidae).—Proceedings of the Biological Society of Washington 90(2):348–357.
- , and W. L. Fink. 1983. Relationships of the neon tetras, a group of South American freshwater fishes (Teleostei, Characidae), with comments on the phylogeny of New World characiforms.—Bulletin of the Museum of Comparative Zoology, Harvard University 150(6):339–395.

Research Associate, Department of Vertebrate Zoology (Fishes), National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560.



Weitzman, Marilyn J. 1984. "Hyphessobrycon elachys, a new miniature characid from eastern Paraguay (Pisces: Characiformes)." *Proceedings of the Biological Society of Washington* 98, 799–808.

View This Item Online: <https://www.biodiversitylibrary.org/item/107750>

Permalink: <https://www.biodiversitylibrary.org/partpdf/46617>

Holding Institution

Smithsonian Libraries and Archives

Sponsored by

Biodiversity Heritage Library

Copyright & Reuse

Copyright Status: In copyright. Digitized with the permission of the rights holder.

Rights Holder: Biological Society of Washington

License: <http://creativecommons.org/licenses/by-nc-sa/3.0/>

Rights: <https://biodiversitylibrary.org/permissions>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.