Three New Species of Fishes of the Genus *Nannostomus* from the Brazilian States of Pará and Amazonas (Teleostei: Lebiasinidae)

STANLEY H. WEITZMAN

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ABSTRACT

Weitzman, Stanley H. Three New Species of the Genus *Nannostomus* from the Brazilian States of Pará and Amazonas (Teleostei: Lebiasinidae). *Smithsonian Contributions to Zoology,* number 263, 14 pages, 10 figures, 1978.—The genus *Nannostomus* was recently reviewed by Weitzman and Cobb (*Smithsonian Contributions to Zoology,* number 186, 1975). The three new species described here are based on specimens found in a survey of the collections of the Museu de Zoologia da Universidade de São Paulo, Brazil. The new species are *N. nitidus* from Igarapé Candiru-Mirim near Badajós, Rio Capim, Pará; *N. britskii* from an igarapé of Lago José-Açu, Parintins, Amazonas; and *N. limatus* from an igarapé tributary to Lago Mapará near Santarém, the Rio Maicá near Santarém, and the Lago Jacupá near Oriximiná, all in the State of Pará.

As with the other species in the genus, the phylogenetic relationships of the new ones remain unclear. *Nannostomus britskii* shares a complex apomorphic color pattern with *N. eques* suggesting a possible relationship between the two, but *N. britskii* lacks the apomorphic caudal structure and probably the swimming position shared by *N. eques* and *N. unifasciatus.* Possible relationships among these three species need further investigation. No close relationships with other species of *Nannostomus* are suggested for *N. limatus* or *N. nitidus.* A key is provided for the identification of all species in the genus.

RESUMO

São descritas três espécies novas do gênero *Nannostomus* da parte inferior da Bacia Amazonica, Brasil: *N. nitidus,* da área do Rio Capim no Estado do Pará, *N. britskii* do Lago José Açu, Parintins, Estado do Amazonas e *N. limatus* dos lagos Mapará e Jacupá e Rio Maicá, Estado do Pará. As novas espécies elevam para 14 o número total de espécies reconhecidas, das quais 6 foram descritas nos últimas 25 anos em um gênero conhecido a mais de 100 anos. Isto mostra que, possivelmente, mais espécies possam ser descobertas nas complexas faunas de peixes das bacias Amazonica e do Orenoco, bem como nos rios costeiros do este situados entre elas.

As relações entre *N. limatus* e *N. nitidus* com as outras espécies do gênero não são claras. *N. britskii,* entretanto, possui em comum com *N. eques* um padrão de colorido aparentemente especializado e não encontrado nos outros membros do gênero. Este fato parece indicar que existe uma relação muito maior entre estas dues espécies do que com as demais espécies do gênero. Esta hipótese, entretanto, precisa ser investigada, tendo em vista que Weitzman (1966) e Weitzman e Cobb (1975) sugeriram, com base na morfologia da nadadeira caudal e na postura de natação, que *N. eques* e *N. unifasciatus* são mais relacionados entre si. Não há evidência de que *N. britskii* e *N. unifasciatus* sejam intimamente relacionados, uma vez que *N. britskii* não possui a morfologia especializada da nadadeira caudal de *N. eques* e de *N. unifasciatus* e provavelmente também não possui a posição característica "focinho para cima" durante a natação, peculiar a estas duas espécies. As relações filogenéticas da maior parte das espécies do gênero permanecem obscuras.

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Contents

Three New Species of Fishes of the Genus *Nannostomus* from the Brazilian States of Pará and Amazonas (Teleostei: Lebiasinidae)

Stanley H. Weitzman

Introduction

A recent survey of the collections of the Museu de Zoologia da Universidade de São Paulo for lebiasinid characoid fishes led to the discovery of three new species of the genus *Nannostomus* Günther, all collected as a result of the Expedição Permanente de Amazônia under the direction of Dr. Paulo Vanzolini. *Nannostomus,* known from Guyana, Surinam, French Guiana, the Amazon basin in Brazil, Peru, Bolivia, Venezuela, and Colombia, and part of the Orinoco basin in Venezuela, was last reviewed by Weitzman and Cobb (1975). They recognized 11 species, of which three had been described as new since 1953. Thus, counting the three species described here, three-sevenths (about 43%) of the recognized species of *Nannostomus* have been described within the last 25 years in a genus that has been known for a little over 100 years. Considering the low geographical density and irregularity of fish population samples in the varied and extremely extensive forested areas of the Amazon and Orinoco basins to which *Nannostomus* appears confined, it seems possible that several more species may remain to be discovered.

Several people have made the study of these specimens possible. Dr. Paulo Vanzolini, director of the Museu de Zoologia da Universidade de São Paulo, graciously allowed me to examine and study characoids from the collections in the Museu de Zoologia and to sort through the collections made by the Expedição Permanente da Amazônia (E.P.A.), which is supported by the Fundacão de Amparo à Pesquisa do Estado de São Paulo. Drs. Heraldo Britski and Naércio A. Menezes of the Museu de Zoologia da Universidade de São Paulo provided much assistance and counsel during my examination of the collections in their care. Furthur assistance in locating, sorting, and examining specimens in the collections of the Museu de Zoologia was provided by Marilyn Weitzman, William L. Fink, and Sara V. Fink. Funds for examination of the collections at the Museu de Zoologia were provided by the Smithsonian Amazon Ecosystem Research Program under the direction of Dr. Clifford Evans, Smithsonian Institution. Naércio Menezes provided the Portuguese translation of the "Resumo." Drs. Robert H. Gibbs, Jr., and William L. Fink read the manuscript and offered valuable suggestions. I much appreciate the support of all these people and associated institutions.

Collections are deposited in the following museums: Academy of Natural Sciences of Philadelphia (ANSP), British Museum (Natural History) (BMNH), Museu de Zoologia da Universidade de

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São Paulo (MZUSP), and National Museum of Natural History (USNM, formerly United States National Museum).

The methods of making counts and measurements and the color pattern terminology below are the same as those described by Weitzman (1966) and Weitzman and Cobb (1975). Measurements are given here as thousandths of standard length. In Weitzman (1966) the arithmetic mean was given, followed in parentheses by the range. Herein the figure for the holotype is given first in brackets when different from other specimens and is followed by the range and the mean of the paratypes. The Weberian apparatus and the terminal half centrum are included in the vertebral counts.

In order to bring the key of Weitzman and Cobb (1975) up to date, it is modified here to include the three new species described below.

Artificial Key to the Species of *Nannostomus*

1. Principal caudal-fin rays 10/9, their distribution in dorsal and ventral caudal lobes as in most characoids, 10 ending in dorsal lobe, 9 ending in ventral caudal-fin lobe 2
   Principal caudal-fin rays 10/9, but 8 rays end in dorsal lobe and 11 in ventral caudal-fin lobe 13
2. Primary horizontal stripe very indistinct. Secondary horizontal stripe very weakly developed and tertiary horizontal stripe absent. Five dark permanent blotches along sides (blotches not fading during exposure of live fish to daylight) ..... ***Nannostomus espei***
   Primary horizontal stripe well developed. Secondary and/or tertiary horizontal stripes present in some species, absent in others. One or two pale vertical or oblique bands on sides (in life these bands ordinarily prominent and darker when fish kept in dark or at night; oblique bands sometimes intensified during breeding behavior, especially in females). Permanent blotches absent 3
3. Secondary horizontal stripe usually present, sometimes poorly developed or absent. Tertiary horizontal stripe absent or poorly developed, represented by only a few black spots associated with pelvic-fin base 4
   Secondary and tertiary horizontal stripes well developed; tertiary stripes sometimes reduced to a few dark spots anterior to pelvic-fin bases but always well developed posterior to these fin bases 8
4. Adipose fin always present 5
   Adipose fin always absent 7
5. Sensory canal present in second infraorbital bone. Snout in eye 0.9 to 1.0. Secondary dark horizontal stripe usually poorly developed. Total vertebrae 38 or 39 ..... ***Nannostomus harrisoni***
   Sensory canal absent in second infraorbital bone. Snout in eye 1.0 to 1.3. Secondary dark horizontal stripe well developed. Total vertebrae 34 to 35 6
6. Gill rakers 10 or 11 + 16 to 18. Anal fin of males never elongate, nearly reaching ventral base of caudal fin. Anal-fin rays moderately modified, somewhat enlarged and thickened.. ..... ***Nannostomus nitidus***
   Gill rakers 7 + 14. Anal fin of males over 24 to 25% of standard length, nearly or reaching ventral caudal-fin base and fin rays greatly modified, flattened and expanded saggital plane ..... ***Nannostomus digrammus***
7. Secondary horizontal stripe poorly developed or absent. Gill rakers 9 or 10 + 17 or 18 .. .. ***Nannostomus beckfordi***
   Secondary horizontal stripe well developed. Gill rakers 8 + 14....***Nannostomus bifasciatus***
8. Anal fin of males long, reaching or nearly reaching ventral origin of caudal fin when adpressed to body ..... ***Nannostomus minimus***
   Anal fin of males short, not reaching to or nearly to ventral origin of caudal fin when adpressed to body 9
9. Two dark horizontal stripes on back dorsal to secondary horizontal stripe, one median extending through predorsal scales, other extending along center of second horizontal scale row. Primary horizontal stripe divided into two distinct stripes, one concentrated along the fourth horizontal scale row, the next along the fifth horizontal scale row. Anal fin of males with moderately modified and thickened fin rays ..... ***Nannostomus britskii***

Dark horizontal stripes absent on back dorsal to secondary horizontal stripe. Primary horizontal stripe of one solid unit confined mostly to ventral portion of third and dorsal of fourth horizontal scale row or to fourth scale row and dorsal portion of fifth scale row. Anal fin of males moderately modified or apparently not modified at all *(N. marginatus* and *N. trifasciatus)* 10

10. Gill rakers 11 or 12 + 17 or 18. Simple conic teeth of inner dentary row absent ..... ***Nannostomus limatus***

Gill rakers 7 to 9 + 12 to 14. Simple conic teeth of inner dentary row 6 to 11 11

11. Scales in a lateral series 21 to 23. Adipose fin always absent ..... ***Nannostomus marginatus***

Scales in a lateral series 24 to 27. Adipose fin present (sometimes absent in *N. trifasciatus*) 12

12. Oblique (vertical) bands broad; anterior band extending posteriorly well past a vertical line from anterior base of dorsal fin, frequently past a vertical from midbase of dorsal fin. Posterior oblique band extending posteriorly well beyond posterior base of anal fin. Eye diameter about 1.0 in interorbital width ..... ***Nannostomus trifasciatus***

Oblique bands narrow; anterior band reaching but not extending past a vertical line from anterior base of dorsal fin. Posterior oblique band not reaching a vertical from posterior base of anal fin. Eye diameter about 0.8 in interorbital width ..... ***Nanostomus marilynae***

13. Scales 28 to 30 in lateral series. Perforated scales in lateral line 2 to 5. Adipose fin present. Gill rakers 9 + 14. Inner tooth row of dentary absent; teeth in outer dentary row 6 to 7.. ***Nannostomus unifasciatus***

Scales 24 or 25 in lateral series. No perforated lateral-line scales. Adipose fin present or absent. Gill rakers 16 + 24. Teeth in inner dentary row 12; teeth in outer dentary row 9 ..... ***Nannostomus eques***

Nannostomus nitidus, new species

FIGURES 1, 2

HOLOTYPE.—MZUSP 12920, male, SL 34.7 mm; Brazil, State of Pará, Igarapé Candiru-Mirim near Badajós, Rio Capim, 29 Aug 1970, Naércio Menezes, E.P.A.

PARATYPES.—18, MZUSP 12921–12938, SL 16.3 to 33.3 mm; same data as holotype. 8, USNM 216204, SL 17.0 to 34.5 mm; same data as holotype. 5, ANSP 137388, SL 18.3 to 34.1 mm; same data as holotype. BMNH 1976–11–8–1–5, SL 18.5 to 35.2 mm; same data as holotype.

DIAGNOSIS.—Primary and secondary horizontal stripes present, all others absent. Nocturnal oblique bands present, narrow, anterior band not extending posteriorly much beyond a line extending vertically through anterior dorsal-fin origin; permanent blotches absent. Adipose fin present. Scales in lateral series 23 to 25, usually 24. Perforated lateral-line scales 0 to 2. Total vertebrae 34 or 35. Gill rakers 10 to 11 + 16 to 18. Simple conic teeth in inner dentary row 2 or 3, laterally placed. Principal caudal-fin rays 10/9, 10 terminating posteriorly in dorsal lobe, 9 in ventral lobe. Eye about 100 to 110% of least bony interorbital width. Body depth

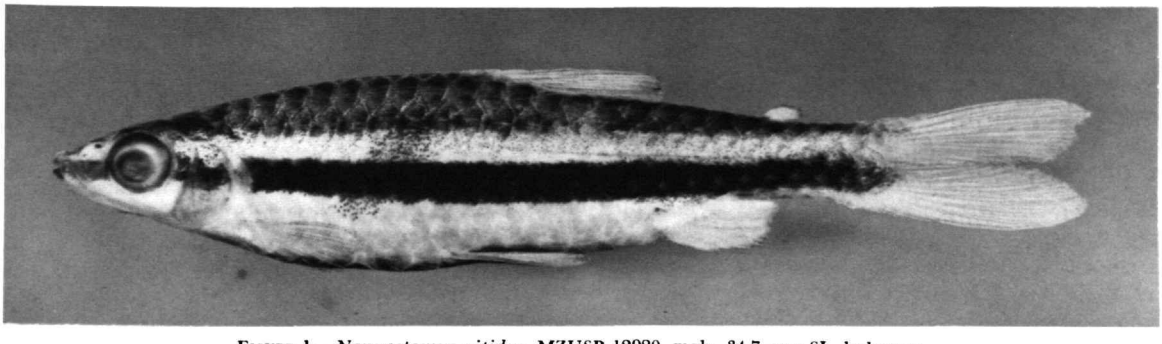

FIGURE 1.—*Nannostomus nitidus*, MZUSP 12920, male, 34.7 mm SL, holotype, Igarapé Candiru-Mirim near Badajós, Rio Capim, Pará, Brazil.

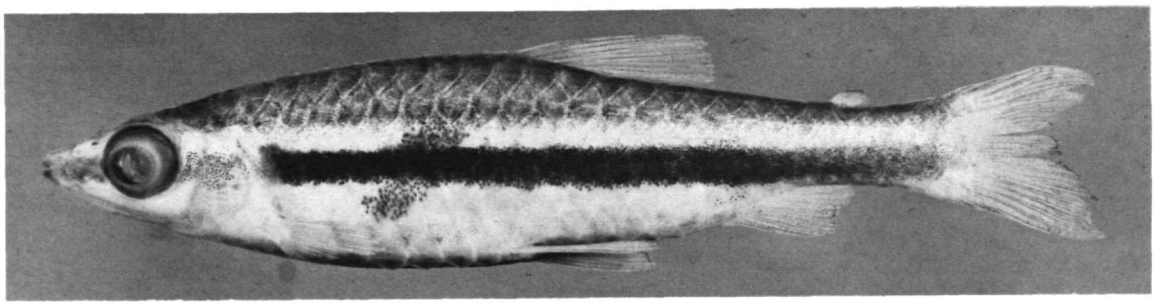

FIGURE 2.—*Nannostomus nitidus*, USNM 216204, female, 30.5 mm SL, paratype, Igarapé Candiru-Mirim near Badajós, Rio Capim, Pará, Brazil.

about 23 to 25% of standard length, and least depth of caudal peduncle about 9% of standard length. Anal fin of male moderately modified, having slightly thicker rays than that of female.

DESCRIPTION.—Body elongate, compressed in region of caudal peduncle, greatest body depth at origin of dorsal fin [239] 235–253, $\bar{x}$ = 243; least depth of caudal peduncle [089] 088–094, $\bar{x}$ = 090; snout tip to origin of dorsal fin [513] 507–536, $\bar{x}$ = 519; snout tip to origin of anal fin [764] 734–782, $\bar{x}$ = 760.

Head conic, snout obtuse. Head [242] 238–265, $\bar{x}$ = 251; eye [079] 079–088, $\bar{x}$ = 084; least width of bony interorbital [078] 075–079, $\bar{x}$ = 077.

Premaxillary with 6 teeth, first (anterior) 5 or 6 with 6 subequal cusps, and sixth tooth sometimes small but with 6 cusps, median cusp largest. Maxillary toothless. Dentary with 6 teeth in outer row, each bearing 6 subequal cusps. Inner dentary row with 2 or 3 conic teeth, placed laterally in jaw (two alizarin preparations).

Gill rakers [11 + 18], 10 + 16 in one and 10 + 17 in a second alizarin preparation.

Dorsal fin ii, 8; anal fin iii, 8; pectoral fin i, 11; pelvic fin ii, 7; and principal caudal-fin rays 10/9 posteriorly terminating in dorsal lobe and 9 in ventral lobe in all specimens. Adipose fin present in all specimens.

Scales belonging to third horizontal series and lying ventral to dorsal fin having anterior field with 3 radial grooves and posterior field with 2 radial grooves. Dorsal and ventral fields each with 1 radial groove. Scales in a lateral series [25] 23 to 25, $\bar{x}$ = 24.2. Lateral-line scales [0] 0 to 2, usually on third and fourth scale horizontal scale row; 10 predorsal scales in all specimens.

Total vertebrae [35] 9 paratypes with 34 and 11 with 35.

COLOR IN ALCOHOL.—Dorsal surface of head dark brown, more or less evenly covered with small, dark brown chromatophores. Back dorsal to secondary horizontal stripe dark brown but not as dark as top of head, rather densely covered with moderate-sized brown chromatophores except for distal free margins of scales, where chromatophores less dense than central portions of scales. Each scale bordered by a pale brown band. No dark brown longitudinal stripes occur dorsal to secondary stripe. Primary horizontal stripe very dark brown, nearly black, consisting of a dense aggregation of large, very dark brown chromatophores. Primary stripe originating anteriorly at tips of upper and lower jaws, extending across orbital bones to reach anterior border of eye, continuing across eye, postorbital and preopercular areas and operculum to include a few dark brown chromatophores scattered on fleshy opercular flap. On body, primary stripe extending from under fleshy opercular flap, beginning at cleithrum and supracleithrum, and continuing posteriorly over ventral half of third horizontal scale row and dorsal half of fourth horizontal scale row, ending on scales covering base of ventral caudal-fin lobe. Primary stripe apparently not extending onto fin rays of ventral caudal-fin lobe. Secondary dark horizontal stripe extending from just dorsal to opercular bone (where it joins head dorsally) to across middle of second horizontal scale row. Secondary horizontal stripe fading to color of back just posterior to a

vertical line extending ventrally from posterior base of dorsal fin. Secondary stripe in preserved specimens consisting of a cluster of very dark brown chromatophores concentrated at center of each scale of second horizontal scale row, forming a series of spots. Pale yellow to white stripe, situated between primary and secondary stripes, occupying dorsal half of third scale row and ventral half of second scale row, and containing a few brown chromatophores scattered along scale margins. Pale stripe also contains dorsal portions of anterior and posterior oblique bands. Anterior oblique band in area of pale stripe extending ventroanteriorly from mostly seventh, eighth, and ninth scales of third horizontal scale series ventral to primary stripe, where it covers all of ventral portions of fifth and sixth scales (counting dorsal postcleithrum as a scale) of fourth longitudinal scale row. Posterior oblique band covering about 17th and 18th scales of third horizontal scale row, and extending ventrally to cover parts of 15th through 18th scales of fourth longitudinal scale row, which extends just ventral to primary horizontal stripe. Sides ventral to primary horizontal stripe nearly devoid of pigment. No evidence of a tertiary horizontal stripe and only a very few scattered, small, dark brown chromatophores around vent in either sex. All rayed fins except caudal fin with small brown chromatophores along edges of bony rays producing hyaline but slightly dusky fins. Pectoral, and especially pelvic and anal, fins with more distal portions of ray, especially ray tip, with dark brown chromatophores, forming faintly darkened edges to fins. Caudal fin nearly hyaline except for narrow black edge above dorsal and ventral borders.

Life colors unknown.

ETYMOLOGY.—The name *nitidus* is a Latin adjective for "neat, elegant, or shining."

RELATIONSHIPS.—Although *Nannostomus nitidus* keys to *Nannostomus digrammus* in the artificial key of Weitzman and Cobb (1975), no relationship between *N. nitidus* and *N. digrammus* is hypothesized, especially since at large sizes (to 34 and nearly 35 mm SL), males of *N. nitidus* lack the highly specialized fin rays and increased length of the anal fin found in males of *N. digrammus* over 24 to 25 mm in standard length. *Nannostomus nitidus* further differs from *N. digrammus* in having 10 to 11 + 16 to 18 (rather than 7 + 14) gill rakers. The two species differ in the details of color pattern; for example, *N. digrammus* has the primary horizontal stripe continued as a wedge onto the caudal fin, whereas the wedge is absent on this fin in *N. nitidus*. I found nothing in the color pattern or morphometric and meristic characters that suggests any hypothesis of sister group relationship on the part of *nitidus* with any other species of *Nannostomus*.

Nannostomus britskii, new species

FIGURES 3, 4

HOLOTYPE.—MZUSP 7795, male, SL 22.8 mm; Brazil, State of Amazonas, an igarapé of Lago José-Açu, Parintins, Amazon River, 11–12 Dec 1967, Heraldo Britskii, E.P.A.

PARATYPES.—MZUSP 13072, one, female, SL 24.1 mm; same data as holotype. USNM 216203, one, female, SL 23.0 mm; same data as holotype.

DIAGNOSIS.—Primary, secondary, and tertiary horizontal stripes well developed, with an additional stripe (quaternary) on back dorsal to secondary stripe. Nocturnal oblique bands present, anterior band narrow, not extending much behind anterior origin of dorsal fin; permanent blotches absent. Adipose fin absent. Scales in a lateral series 21 or 22. Simple conic teeth in inner dentary row 12, teeth in outer dentary row 5. Principal caudal-fin rays 10/9, those ending in dorsal lobe 10, those in ventral lobe 9. Eye about 70 to 80% of least bony interorbital width. Body depth about 22 to 25% and caudal peduncle depth about 11 to 12% of standard length. Anal fin of male moderately modified with fin rays somewhat thicker than those of female.

DESCRIPTION.—Body elongate, robust; compressed in region of caudal peduncle. Greatest body depth at origin of dorsal fin [241] 226–241, $\bar{x}$ = 237; least depth of caudal peduncle [114] 114–116, $\bar{x}$ = 114; snout tip to origin of dorsal fin [553] 548–577, $\bar{x}$ = 559; snout tip to origin of anal fin [768] 765–788, $\bar{x}$ = 774.

Head conic, snout obtuse in horizontal and vertical profile. Head [280] 265–280, $\bar{x}$ = 273; eye [101] 100–101, $\bar{x}$ = 100; least width of bony interorbital [105] 104–109, $\bar{x}$ = 106.

Premaxillary with 6 teeth, all with 4 subequal cusps except first (anterior) with 3 subequal cusps.

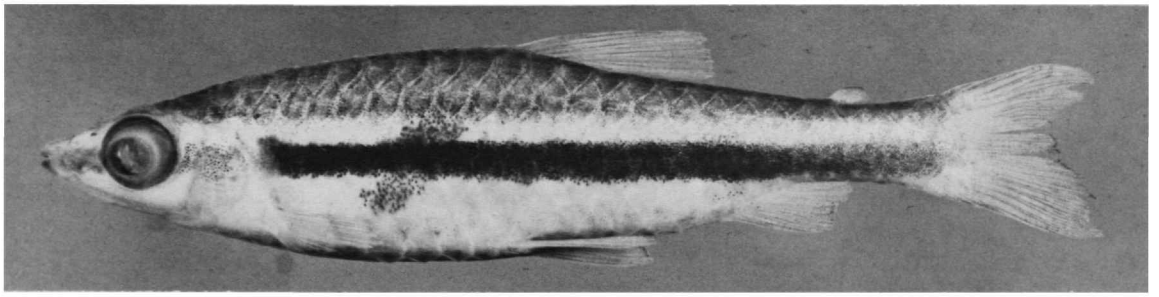

FIGURE 3.—*Nannostomus britskii*, MZUSP 7795, male, 22.8 mm SL, holotype, igarapé of Lago José-Açu, Parintins, Amazon River, Amazonas, Brazil.

Maxillary with 1 tooth bearing 3 cusps, the middle cusp the longest. Dentary with 5 teeth in outer row, each tooth bearing 4 or 5 more or less subequal cusps. Inner row of dentary teeth simple, conic with 12 teeth placed along entire inner margin of jaw.

Gill rakers 17 + 23.

Dorsal fin ii, 8; anal fin iii, 8; pectoral fin i, 9; pelvic fin ii, 7; principal caudal-fin rays 10/9 with 10 ending in dorsal lobe and 9 terminating in ventral lobe in all specimens. Adipose fin absent in all specimens.

Scales of third horizontal scale series ventral to dorsal fin having anterior field with 3 radial grooves, posterior field with 2 radial grooves; dorsal and ventral fields each with 1 radial groove. Scales in lateral series [22] 21 and 22; [0] 0 or 1 perforated lateral-line scales; 10 predorsal scales in all specimens.

Total number of vertebrae 32 in all specimens.

COLOR IN ALCOHOL.—Dorsal surface of head medium brown, covered with fairly dense, moderate-sized brown chromatophores except along midline of braincase, which is pale brown. Back dorsal to secondary horizontal stripe pale brown with denser aggregation of dark brown chromatophores through center of predorsal scales and first lateral scale row, forming respectively a median predorsal stripe and a fourth horizontal stripe very similar to that of *Nannostomus eques*. Median dorsal stripe and fourth horizontal stripe usually difficult to distinguish posterior to dorsal fin. Primary horizontal stripe dark brown and extending from snout tip and lower jaw posteriorly across first (anterior) orbital bone, through eye, across preoperculum and operculum and terminating at posterior border of bony operculum. Primary stripe not extending onto fleshy opercular flap. On body, primary stripe beginning under fleshy opercular flap at articulation of supracleithrum and cleithrum and extending posteriorly across fourth horizontal scale row to terminate at base of caudal fin. As in *N. eques* (Figure 5) fifth horizontal scale row also strongly pigmented with dark brown chromatophores, forming in *N. britskii* a second, and separate, ventral portion of primary horizontal stripe. This ventral portion beginning from just anterior to dorsal base of pectoral fin or at ventral border of opercular bone and extending posteriorly across fifth horizontal scale row to base of caudal fin. Both fourth and fifth horizontal scale rows with dark brown chromatophores concentrated in centers of scales. In *N. eques* pattern of primary stripe often like that of *N. britskii* in preserved specimens but in living (and some preserved specimens) pigment of these scale rows may merge to form one horizontal stripe, especially posteriorly on caudal peduncle. Brown chromatophores extending from these scale rows onto proximal one-third of ventral lobe of caudal fin of *N. britskii*, not onto nearly entire fin as in *N. eques*. Secondary horizontal stripe extending from dorsal border of operculum posteriorly through ventral half of second horizontal scale row and dorsal part of third horizontal scale row to caudal-fin base. Margins of scales in area of secondary stripe dark brown. Secondary stripe very pale

posterior to posterior oblique band. Pale stripe, occupying central area of third horizontal scale row and between primary and secondary stripes, with very few brown chromatophores. Almost no dark brown chromatophores in center of scales of third horizontal scale row except in areas of oblique bands that occur on eighth and ninth scales of third horizontal scale row and 16th, 17th, and part of 18th scales of third horizontal scale row. Anterior oblique band extending anteroventrally to reach ventral to both rows of dark scales of primary horizontal stripe, darkening area of scales of sixth and seventh horizontal scale rows. Posterior oblique band not extending ventrally below second row of dark scales of primary horizontal stripe. Sides ventral to primary horizontal dark stripe pale brown, without dark brown chromatophores except in areas of anterior oblique band and tertiary horizontal stripe. Tertiary stripe extending as dark brown pigment areas in centers of scales of sixth horizontal scale row from posterior termination of operculum or just posterior to ventral origin of pectoral and to just dorsal to base of pelvic fin to immediately anterior to anus.

Dorsal and pectoral fins with a few small, dark brown chromatophores scattered along borders of fin rays. Pelvic fin with same distribution of dark brown chromatophores but with a more concentrated collection of somewhat larger dark brown chromatophores along third through fifth or sixth branched rays. Anterior first and second unbranched anal-fin rays with large, dark brown chromatophores. Distal portion of third unbranched ray, first branched ray, and base of second branched ray hyaline, without dark brown chromatophores. Remainder of anal-fin rays with large dark brown chromatophores, and basal one-half of fifth through eighth ray nearly black. Dorsal lobe of caudal fin hyaline (partly missing in male), except at base with scattered large, dark brown chromatophores.

Life colors unknown.

ETYMOLOGY.—The name *britskii* is for Dr. Heraldo Britski, Curator of Fishes at the Museu de Zoologia da Universidade de São Paulo, Brazil, and collector of the species of *Nannostomus* herein described as new.

RELATIONSHIP.—The possible phylogenetic relationships of this species are not clear. In the artificial key in Weitzman and Cobb (1975) it keys to *Nannostomus marginatus,* having all 10 principal caudal-fin rays of the dorsal lobe ending in that lobe, having no permanent blotches, having three or more well-developed horizontal stripes, having a relatively short anal fin in the male, and having 21 to 22 scales in a lateral series. It has a color pattern strikingly different, however, from that of *N. marginatus* (compare Figures 2 and 3 with those of *N. marginatus* in Weitzman and Cobb (1975, figs. 22, 23, and 24), and remarkably like that of *N. eques* (Figure 5). Also, in its gill-raker count (17 + 23), *N. britskii* is close to that (16 + 24) of *N. eques* (see also below). *Nannostomus marginatus* has a gill-raker count of 7 + 12. *Nannostomus britskii* further differs from *N. marginatus* in having 5 dentary teeth in the outer row (versus 7 to 8 in *N. marginatus),* 12 teeth in the inner dentary row (versus 6 or 7 in *N. marginatus),* none or 1 perforated lateral-line scales (versus 3 to 5, usually 4,

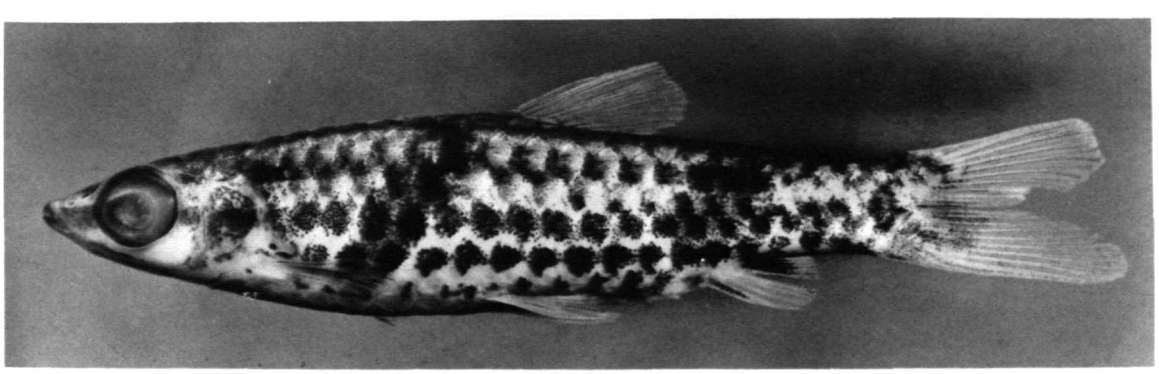

FIGURE 4.—*Nannostomus britskii,* MZUSP 13072, female, 24.1 mm SL, paratype.

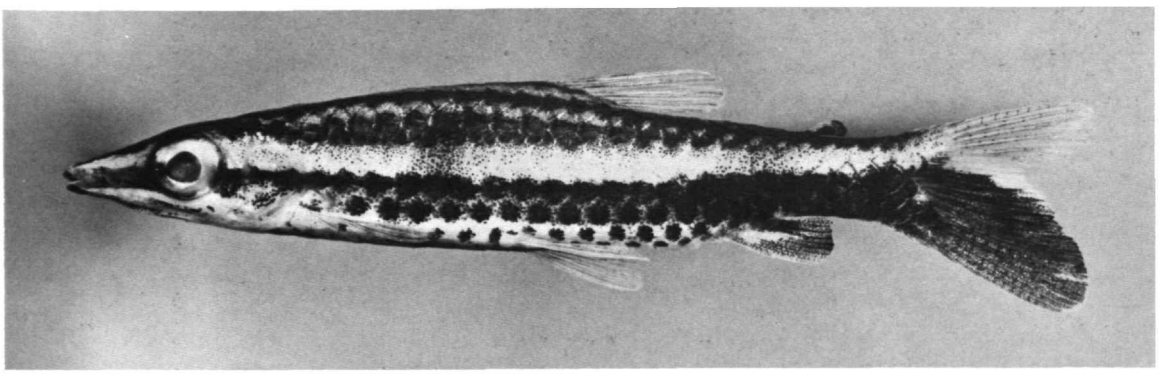

FIGURE 5.—*Nannostomus eques* Steindachner, USNM 216552, male, 32.4 mm SL, an igarapé of the varzea at Tapurucuara, Rio Negro, Amazonas, Brazil.

in *N. marginatus),* and a moderately modified anal fin in the male (there being little or no observable morophological sexual dimorphism in the anal fin of *N. marginatus,* although there is functional dimorphism in which the male's anal fin is "cupped" around the vent of the female during spawning).

Nannostomus britskii and *N. eques* share a complicated and apparently specialized color pattern (in preservative and presumably in life; see color description above and compare Figures 3, 4, and 5). They also share a high and presumably derived total gill raker count (a total of 40 on the first arch). See Weitzman (1966) for counts and measurements of *N. eques.* The highest gill-raker count found in other species of *Nannostomus* is 27 to 30 (*N. espei* and *N. beckfordi). Nannostomus britskii* also shares with *N. eques* a few reductive characters absent or not found so greatly reduced in some other species of *Nannostomus.* For example, they have none or only one perforated lateral-line scale (*N. minimus* and *N. espei* sometimes have only one perforated lateral-line scale and *N. digrammus* has no perforated lateral-line scales), and they share a loss of or tendency to lose the adipose fin (but it is also absent in *N. beckfordi, N. marginatus, N. minimus, N. bifasciatus* and tends to be reduced or occasionally lost in *N. trifasciatus).* These reductive characters are too likely to be convergent for use in evaluating hypotheses of phylogenetic relationship. The gill-raker count also could be convergent although it is perhaps worth noting that only *two* species, *N. eques* and *N. britskii,* have such a high count. Evidence for a relationship between *N. britskii* and *N. eques* must at present rest mainly on the shared (nearly identical), complicated, and apparently specialized color pattern. The possible relationships of *N. eques* are complicated, however, (see below), and the homology of the shared color pattern is difficult to assess.

Weitzman (1966:41) and Weitzman and Cobb (1975:4) proposed a phylogenetic relationship between *N. eques* and *N. unifasciatus* based on the similarity of their synapomorphic caudal-fin structure and "snout-upward" (oblique) swimming position. The ventral lobe of the caudal fin of each of these species is larger than the dorsal lobe and contains the termination of two fin rays originating in the dorsal lobe. These characters are apparently associated with the specialized swimming position. *Nannostomus britskii* presumably does not swim at an oblique angle since it lacks the specialized caudal find morphology; however, the swimming position of *N. britskii* has not been recorded. *Nannostomus britskii* also differs from *N. eques* and *N. unifasciatus* in having a relatively short snout (about 70 to 90% of the interorbital width, 112 to 125% in the other two species), by lacking a canal in the second circumorbital (present in the other two, in *N. harrisoni,* and in large specimens of *N. bifasciatus*), and by having a short body (relatively long in *N. eques* and *N. unifasciatus*). The total vertebral count for *N. britskii* is 32 for all specimens. In a series of 140 specimens of *N. eques* from several localities in the Amazon basin (specimens cited in Weitzman, 1966, plus 29 specimens from Ilha Marchanteria, Rio Solimões, south of

Manaus, Amazonas, USNM 216548, and 19 specimens from Rio Inhangapi at Inhangapi, Pará, USNM 216547, both in Brazil), the vertebral count range was from 32 to 35 with a mean of 33.7. Only two specimens had a count of 32 and these were (1) from an igarapé near Sanabani, Municipio Silves, MZUSP 7474, not far from the type-locality of *N. britskii* and (2) from Lago Jacupá near Oriximiná near Obidos, MZUSP 8204, over 300 km east of the Sanabani locality. In the 19 specimens from Sanabani the vertebral count range was from 32 to 34 with a mean of 33.1, and in the collection from Oriximiná the range was from 32 to 34 with a mean of 33.3. There might be a shift in vertebral numbers in the population of *N. eques* from Tapurucuara on the Rio Negro for in 2 samples for a total of 16 specimens (USNM 216551 and USNM 216552) the range was from 34 to 35 vertebrae with a mean of 34.8. Nothing about relationships can be discovered by comparison of vertebral numbers in these two species and it would seem that vertebral numbers in species of *Nannostomus* may have typological use in distinguishing geographically separate populations of a species and in separating certain species from others but of little use in understanding the phylogenetic relationships of these fishes. Many of the characters discussed above may be easily subject to convergence and divergence and it is difficult to assign phylogenetic significance to any of them at present. Therefore I am unable to propose reasonable hypotheses about the phylogenetic relationships of the three species, *N. briskii, N. eques,* and *N. unifasciatus.*

Nannostomus limatus, new species

FIGURES 6, 7, 8

HOLOTYPE.—MZUSP 8486, male, SL 29.9 mm; Brazil, State of Pará, an igarapé tributary to Lago Mapará, near Santarém, Amazon River, 25 Dec 1967, Heraldo Britski, E.P.A.

PARATYPES.—14, MZUSP 12951–12963, SL 19.6 to 27.5 mm; same data as holotype. 7, USNM 216201 (formerly MZUSP 12964–12971), SL 19.6 to 34.2 mm; same data as holotype. 2, ANSP 137389 (formerly MZUSP 12972–12973), SL 24.9 to 27.8 mm; same data as holotype. 2, BMNH 1976–11–8–6–7 (formerly MZUSP 12974–12975), SL 23.9 to 27.8 mm; same data as holotype. 1, MZUSP 8203, SL 36.3 mm; Brazil, State of Pará, Lago Jacupá, Oriximiná, 17 Dec 1967, Heraldo Britski, E.P.A. 1, USNM 216200, SL 33.6 mm; same data as MZUSP 8203. 1, MZUSP 9192, SL 28.1 mm; Brazil, State of Pará, Rio Maicá, Santarém, 19–27 Oct 1971, Yasunobu Matsurura, E.P.A. 7, MZUSP 12939–12945, SL 17.4 to 24.9 mm; same data as MZUSP 9192. 5, USNM 216202 (formerly MZUSP 12946–12950), SL 15.5 to 27.7 mm; same data as MZUSP 9192.

DIAGNOSIS.—Primary, secondary, and tertiary horizontal stripes well developed. No additional stripes on back. Nocturnal oblique bands present; narrow, anterior band reaching to but not past an imaginary vertical line extending ventrally from anterior base of dorsal fin; permanent blotches absent. Adipose fin absent. Scales in a lateral series 24 or 25. Perforated lateral-line scales 0, 1, 2, or 3. Anal fin

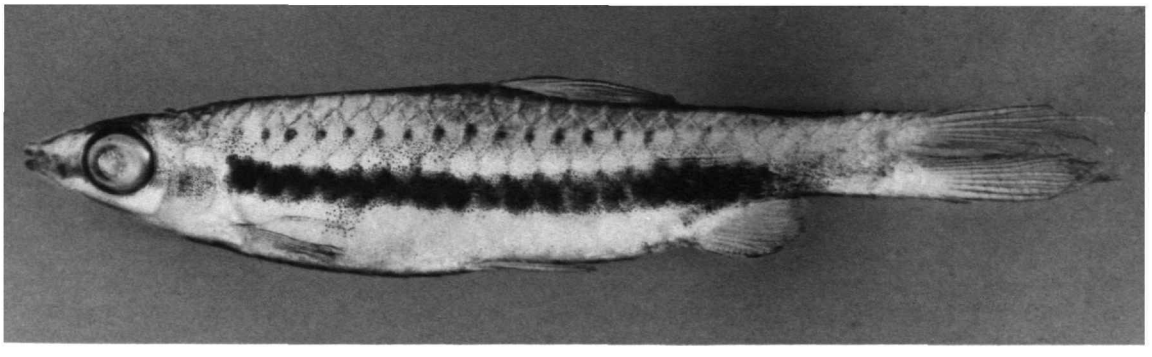

FIGURE 6.—*Nannostomus limatus,* MZUSP 8486, male, 29.9 mm SL, holotype, an igarapé tributary to Lago Mapará, near Santarém, Pará, Brazil.

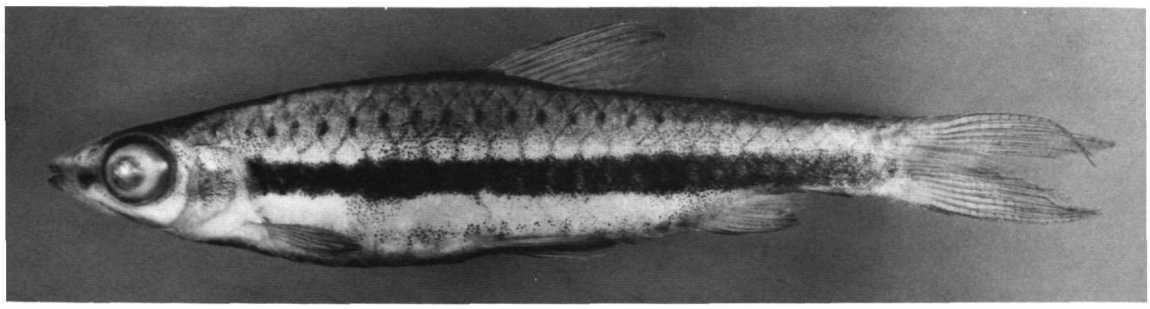

FIGURE 7.—*Nannostomus limatus*, USNM 216201, female, 31.6 mm SL, paratype, an igarapé tributary to Lago Mapará, near Santarém, Pará, Brazil.

of males not elongate, moderately modified, rays slightly thickened and margin rounded. Gill rakers 11 to 12 + 17 to 18. Simple conic teeth in inner dentary row absent; 6 teeth in outer dentary row. Principal caudal-fin rays 10/9, those posteriorly terminating in dorsal lobe 10, those in ventral lobe 9. Eye about 75% to 90% of interorbital width. Body depth about 19 to 22% and caudal-peduncle depth about 9% to 10% of SL.

DESCRIPTION.—Body elongate, compressed in region of caudal peduncle. Greatest body depth at origin of dorsal fin [217] 193–224, $\bar{x}$ = 210; least depth of caudal peduncle [094] 087–097, $\bar{x}$ = 092; snout tip to origin of dorsal fin [542] 498–545, $\bar{x}$ = 531; snout tip to origin of anal fin [779] 774–795, $\bar{x}$ = 765.

Head conic, snout obtuse. Head [254] 241–271, $\bar{x}$ = 254; eye [084] 077–091, $\bar{x}$ = 083; least width of bony interorbital [080] 077–090, $\bar{x}$ = 083.

Premaxillary with 6 teeth, each with 5 to 6 and occasionally 7, subequal cusps. Maxillary with one small unicuspid or tricuspid tooth. Dentary with 6 teeth in outer row, each bearing 6 subequal cusps (one tooth in one specimen with 5 cusps). Inner tooth row of dentary absent (in 2 alizarin preparations).

Gill rakers 11 or 12 + 17 or 18.

Dorsal fin ii, 8 and anal fin iii, 8 in all specimens; pectoral fin [i, 10] i, 10 or i, 11 (usually i, 11); pelvic fin ii, 7 and principal caudal-fin rays 10/9 with 10 terminating posteriorly in dorsal lobe and 9 in ventral lobe in all specimens. Adipose fin absent in all specimens.

Scales belonging to third horizontal series and lying ventral to dorsal fin, having anterior field with usually 3 radial grooves, posterior field usually with 2 radial grooves (sometimes 1 or 3). Dorsal and ventral fields each with 1 radial groove. Scales

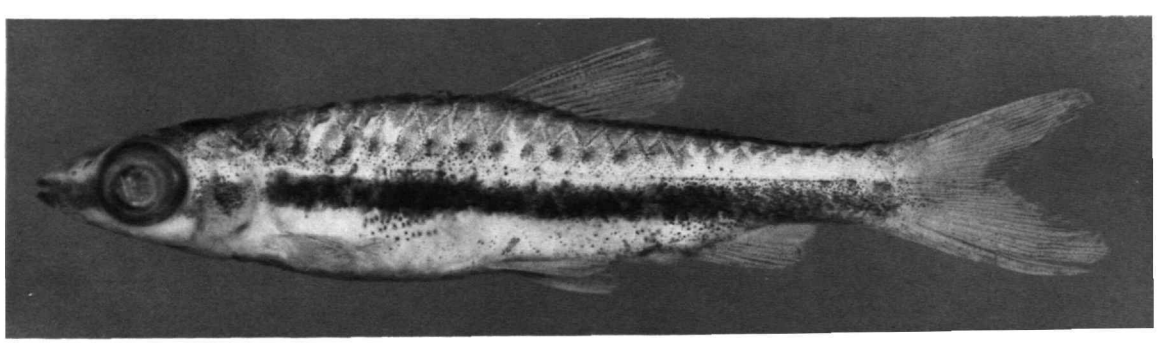

FIGURE 8.—*Nannostomus limatus*, USNM 216201, juvenile, 20.1 mm SL, paratype, an igarapé tributary to Lago Mapará, near Santarém, Pará, Brazil.

in a lateral series [25] 24 or 25; laterál-line scales [3] 0 to 3, usually on scales 3, 4, or 5 of third scale row; [11] 10 to 11 predorsal scales.

Total number of vertebrae [35], 17 paratypes with 34 and 17 with 35.

COLOR IN ALCOHOL.—Dorsal surface of head medium to dark brown, more or less evenly covered with small, brown chromatophores. Back dorsal to secondary horizontal stripe medium brown with rather evenly distributed moderate-sized chromatophores distributed in broad central area of scales. Larger, slightly darker, but less densely distributed brown chromatophores bordering posterior edge of each scale in a broad band. No dark brown stripes occurring dorsal to secondary horizontal stripe. Primary horizontal stripe dark brown, consisting of densely aggregated, fairly large brown chromatophores. Primary stripe beginning anteriorly at lower and upper jaw tips, extending across antorbital bone and dorsal anterior portion of first infraorbital bone to reach anterior border of eye, continuing across eye but apparently absent posterior to eye in area of circumorbital bones, continuing across operculum as a diffuse stripe, ending on soft opercular flap. On body, primary stripe extending from under fleshy opercular flap, beginning at articulation of cleithrum and supracleithrum and continuing posteriorly across ventral half of third horizontal scale row and dorsal half of fourth horizontal scale row, ending on base of ventral lobe of caudal fin. Dorsal to primary stripe, secondary dark brown stripe extending from just dorsal to opercular bone along middle of second horizontal scale row as a somewhat dense aggregation of dark brown chromatophores and ending at anterior termination of dorsal lobe of caudal fin at dorsal surface of caudal peduncle. Pale brown stripe situated between primary and secondary stripes, occupying dorsal half of third horizontal scale row and ventral one-quarter of second horizontal scale row; this stripe with scattered brown chromatophores except in areas of oblique bands, where dark chromatophores are larger and denser. Oblique bands not clearly defined in specimens at hand, but anterior band present in seventh, eighth, and ninth scale rows of third horizontal series and third, fourth, and fifth scale rows of fifth horizontal scale series (ventral to primary horizontal stripe). Posterior oblique band occurring at 17th, 18th, and 19th scales of third horizontal scale row. Ventral to primary horizontal stripe, posterior oblique band extending to area of anus and across root of anal fin. Sides ventral to primary horizontal stripe pale brown, nearly without chromatophores, except in areas of oblique bands. Tertiary stripe present, extending as small scattered brown chromatophores from area of anus anteriorly to just dorsal to pelvic-fin base and to near origin of pectoral fin. All rayed fins, except caudal fin, with small brown chromatophores along borders of bony rays. Otherwise pectoral fin hyaline; second ray of dorsal fin with a dark anterior border; pelvic fin with more brown chromatophores at distal portion of rays than anteriorly. Second and third rays of anal fin with a dark border continued onto distal tips of fourth, fifth, and sixth rays; distal portion of remaining anal-fin rays nearly hyaline. Caudal fin nearly hyaline except for dark border on dorsalmost and ventralmost principal rays. Primary stripe tending to extend onto dorsal rays of ventral caudal-fin lobe and may continue to their posterior termination.

ETYMOLOGY.—The name *limatus* is a Latin adjective for "elegant, refined, or polished."

RELATIONSHIPS.—As with most species of *Nannostomus,* it has proved impossible to propose reasonably testable hypotheses of the phylogenetic relationships of *N. limatus* to other species of *Nannostomus.* In the artificial key of Weitzman and Cobb (1975), *N. limatus* keys to couplet 8, having an unmodified caudal fin, a relatively short anal fin in the males, and primary, secondary, and tertiary longitudinal stripes. *Nannostomus limatus* is easy to distinguish from the three species, *N. marginatus, N. trifasciatus,* and *N. marilynae,* included within this couplet. First, it always lacks an adipose fin (always present in *N. marilynae* and nearly always present in *N. trifasciatus* but absent in *N. marginatus). Nannostomus limatus* (Figures 7, 8, and 9) has narrow oblique bands similar to those of *N. marilynae* (Weitzman and Cobb, 1975, figs. 28 and 30) and unlike the broad oblique bands of *N. marginatus* (Weitzman and Cobb, 1975, fig. 22) and *N. trifasciatus* (Weitzman and Cobb, 1975, figs. 25 and 26). Also as in *N. marilynae, N. limatus* has a moderately modified anal fin in the males, very unlike the nearly unmodified anal fin of *N. marginatus* and *N. trifasciatus. Nannostomus limatus* differs from all three species in having no posterior

row of conical teeth in the dentary, whereas *N. marginatus* has 6 or 7 teeth, *N. trifasciatus* about 11, and *N. marilynae* about 1 to 4. *Nannostomus limatus* also has a greater number of gill rakers (11 to 12 on the upper limb + 17 to 18 on the lower limb) of the first gill arch; *N. marilynae* has 8 to 9 + 13 to 14, *N. trifasciatus* has 9 + 13, and *N. marginatus* has 7 + 12. In color pattern, *N. limatus* more closely approaches *N. marilynae* than the other two species but appears to be a larger fish, reaching at least 36.3 mm. Of over 300 specimens of *N. marilynae* from various localities in the Amazon and Orinoco basins, I have found none over 23 mm in SL. Very old specimens of *N. marilynae* do reach 32.2 mm in aquaria (Weitzman and Cobb, 1975). *Nannostomus limatus* appears to have a proportionately larger eye than *N. marilynae,* 90% to 100% of the interorbital width versus 70% to 90%. Thus *N. limatus* differs from *N. marilynae* in adult size, lack of an adipose fin, more gill rakers, a larger eye, no second row dentary teeth, and in certain details of the preserved color pattern such as a black distal edge on the ventral portions of the anal fin and a distinct dark, narrow edge on the dorsal and ventral borders of the caudal fin.

Sometimes preserved specimens of *N. limatus* show weakly developed horizontal tertiary stripes (Figure 7). In some cases it might be possible to confuse preserved specimens of *N. limatus* with those of *N. beckfordi,* especially since both species lack an adipose fin and have similar scale counts and are found in the same region of the Amazon basin. Specimens of *N. limatus* are here compared with specimens of *N. beckfordi* from the Rio Inhangpi at Inhangapi, Pará, Brazil, USNM 216547. Males of *N. beckfordi* (Figure 9) have a very poorly developed secondary horizontal stripe, whereas in *N. limatus* (Figure 6) this stripe is well pigmented and formed as a series of about 15 dark spots, one at each of the anterior bases of the 15 anterior scales of the second longitudinal scale row (Figure 6). Also males of *N. beckfordi* have the primary horizontal stripe broad compared to that of males of *N. limatus,* while the pale stripe above the primary stripe in *N. beckfordi* is nearly nonexistent, but is well developed in *N. limatus* (compare Figures 6 and 9).

Females of *N. limatus* and *N. beckfordi* are more difficult to distinguish (compare Figures 7 and 10) since both have relatively narrow primary horizontal stripes and well-developed pale stripes dorsal to the primary stripe. As in the male, however, the secondary horizontal stripe of the female *N. limatus* consists of a spot on the anterior field of each of the anterior 15 scales of the second horizontal scale row, and this is nearly absent in *N. beckfordi.*

Nannostomus limatus further differs from *N. beckfordi* in having no posterior row teeth in the dentary (there are 2 to 6 conical posterior row teeth in *N. beckfordi*), a different gill-raker count, 11 to 12 + 17 to 18 in *N. limatus* and 9 to 10 + 17 to 18 in *N. beckfordi.*

Perhaps *N. limatus* is related to *N. marilynae;* however, in view of the apparent lability of the characters used here and by Weitzman and Cobb (1975) and Weitzman (1966) to typologically distinguish the species of *Nannostomus,* I can form no testable hypothesis about the phylogenetic rela-

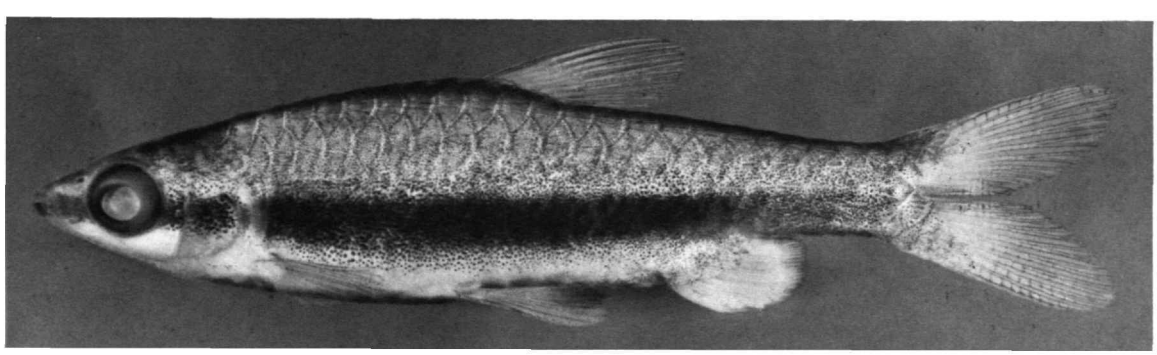

FIGURE 9.—*Nannostomus beckfordi* Günther, USNM 216553, male, 24.9 mm SL, Rio Inhangapi at Inhangapi, Pará, Brazil.

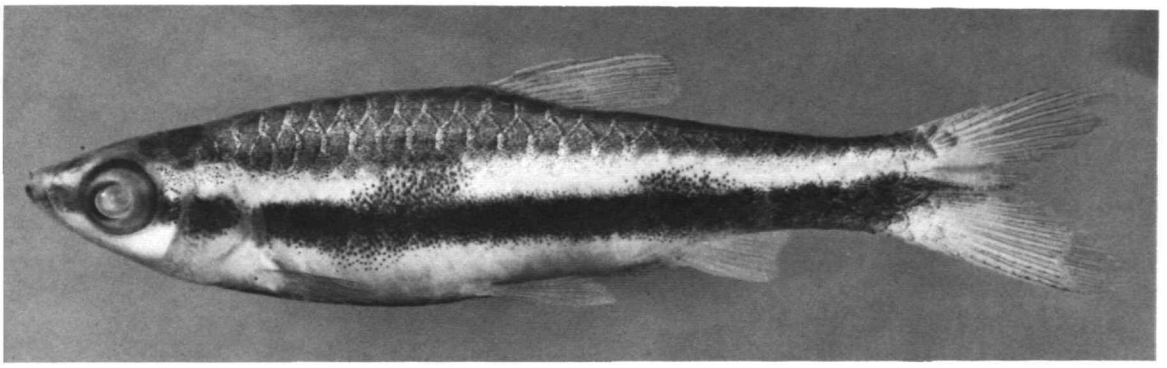

FIGURE 10.—*Nannostomus beckfordi* Günther, USNM 216553, female, 20.1 mm SL, Rio Inhangapi at Inhangapi, Pará, Brazil.

tionships of *N. limatus*. Perhaps live colors would be useful, but so far as I am aware, the fish has not appeared in the aquarium trade and its live colors remain unknown.

Discussion

Weitzman and Cobb (1975) were unable to propose what they believed might be reasonable (testable) hypotheses about the relationships among the species of *Nannostomus* except that on the basis of morphology including color pattern, *N. marginatus* and *N. trifasciatus* may be most closely related to each other and *N. eques* and *N. unifasciatus* may be more closely related to each other than to any other species. The discovery and description of three new species has shed little new light on the relationships of the previously known species of *Nannostomus*. In fact the discovery of one of them, *N. britskii*, has allowed the proposal of a hypothesis of relationship in conflict with a suggested sister group relationship between *N. eques* and *N. unifasciatus*. On the basis of a complicated synapomorphic color pattern, *N. britskii* might be considered the closest relative of *N. eques*. There is no evidence, however, to suggest that *N. britskii* is closely related to *N. unifasciatus* or that together *N. britskii* and *N. eques* could form a sister group with *N. unifasciatus*. It would seem that the liability of character evolution, that is the convergence and divergence under environmental selection of, for the most part, relatively simple observed morphological characters discussed above has obscured many of the phylogenetic relationships of the species of *Nannostomus*.

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