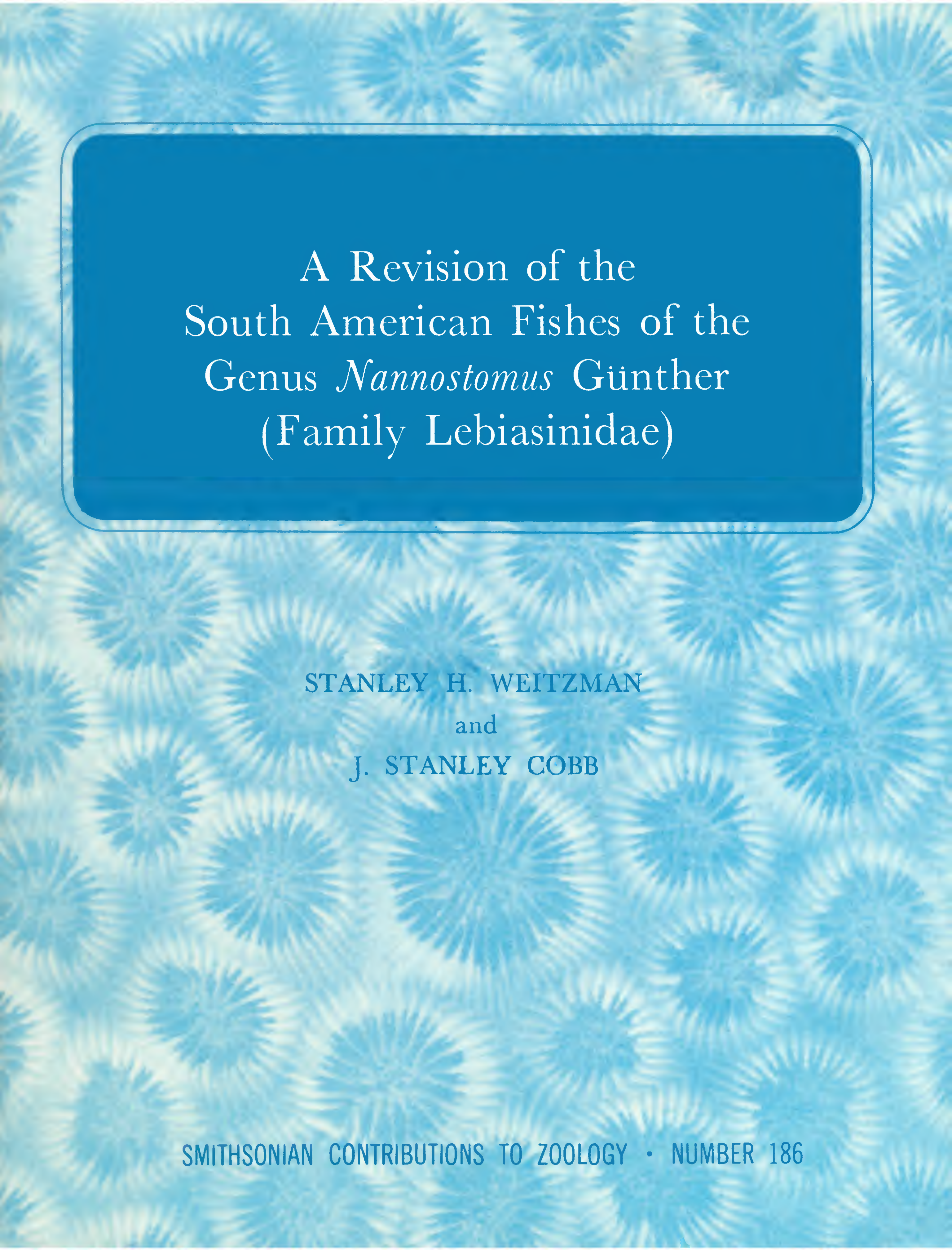

A Revision of the South American Fishes of the Genus *Nannostomus* Günther (Family Lebiasinidae)

STANLEY H. WEITZMAN
and
J. STANLEY COBB

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 186

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ABSTRACT

Weitzman, Stanley H., and J. Stanley Cobb. A Revision of the South American Fishes of the Genus *Nannostomus* Günther (Family Lebiasinidae). *Smithsonian Contributions to Zoology,* number 186, 36 pages, 34 figures, 1975.—Based on newly collected material, this study is a supplemental treatment to an earlier review of the South American genus *Nannostomus* by the senior author. Eleven species are here recognized, *N. espei, N. digrammus, N. harrisoni, N. beckfordi, N. bifasciatus, N. minimus, N. marginatus, N. trifasciatus, N. marilynae* (new), *N. unifasciatus,* and *N. eques.* An artificial key to all these species is included. Additional collections of two species, *N. bifasciatus* and *N. minimus,* have allowed a more complete description of the former and recognition of the latter, which had been listed as a synonym of *N. beckfordi* by Weitzman (1966). One new species, *N. marilynae,* is described from the Amazon basin. The interrelationships of all the species are reconsidered and because the new material has revealed intermediate conditions in the characters formerly used to separate the nominal genera *Nannostomus* and *Poecilobrycon,* the latter is here regarded as a synonym of the former. Relationships among the species are not clear from the population samples currently available for study, but it seems probable that *N. espei,* in the aggregate of its characters, is the most primitive species in *Nannostomus* and not closely related to any other species. *N. marginatus* and *N. trifasciatus,* undoubtedly closely related to each other, are not particularly close to any other species or species group. The same may be said for the related *N. eques* and *N. unifasciatus* in their relation to other species. The remaining species all seem distinct from one another and their possible relationships to other species in the genus remain obscure.

Evolutionary trends toward specialization within the genus appear to be development of longitudinal stripes, development of oblique bands, loss of ossification of the sensory canal in the second infraorbital bone, an elongation and thickening of the anal-fin rays of males as an aid to fertilizing eggs, possibly the development of an ocellus in the dorsal lobe of the caudal fin, and development of nuptial tubercles on the ventral surface of the head. Thickening of anal-fin rays occurs to a certain extent in other lebiasinids, but it is carried to an extreme in some species of *Nannostomus.* Nuptial tubercles occur in another lebiasinid genus, *Pyrrhulina,* but their high concentration on the ventral surface of the head in *N. unifasciatus* is a specialization not found in *Pyrrhulina.*

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Contents

A Revision of the South American Fishes of the Genus *Nannostomus* Günther (Family Lebiasinidae)

Stanley H. Weitzman
and J. Stanley Cobb

Introduction

Since publication of a review (Weitzman, 1966) of the nominal lebiasinid genera *Nannostomus* and *Poecilobrycon,* the senior author has accumulated specimens of several of the known species from new localities, obtained specimens that show unrecorded variation, and received additional specimens of two poorly known species, *N. bifasciatus* Hoedeman and *N. minimus* Eigenmann. Examples of a new species from Brazil, *N. marilynae,* have been in the senior author's care for nearly 20 years but were not described as new previously because all specimens at hand were juveniles. In 1969 one of us (Weitzman) found live specimens of this new species in an aquarium shop in the Washington, D. C., metropolitan area. At the same time two males of *N. digrammus* Fowler were obtained, and life colors of this species are recorded here. All this new material has allowed a reevaluation of the generic problem within this group of lebiasinids as well as a new consideration of species relationships.

To help the aquarist identify these popular aquarium fishes, as well as to illustrate the differences between the color patterns of live and preserved specimens, we have included drawings as well as photographs of preserved specimens where appropriate. In addition we have included available photographs of live specimens even though most of these are without locality information.

The key of Weitzman (1966) has been revised to accommodate a new generic concept, to admit the new species, to include *N. minimus,* which was formerly considered a synonym of *N. beckfordi,* and to correct an error. The species names *N. beckfordi* and *N. digrammus* had been inadvertently exchanged in the original key.

The methods for taking counts and measurements and the terminology used here for the color pattern of *Nannostomus* species are the same as those outlined by Weitzman (1966). In brief the term *stripe* is restricted to elongate pigmented areas that extend horizontally along the sides of the fish. The *primary stripe* is the main dark midside stripe usually extending from the snout, across the eye, opercle, and body to the caudal-fin base, and sometimes onto the caudal fin. The dark *secondary stripe* is dorsal to the primary stripe and lies between the dark pigment of the back and the pale stripe just dorsal to the primary stripe. The

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dark *tertiary stripe* is the ventralmost and may extend from the lower jaw, across the ventral part of the operculum, ventral to the base of the pectoral fin, across the ventrolateral part of the belly just dorsal to the base of the pelvic fins, and to the base of the anal fin. The *nocturnal oblique bands* are areas of pigment, usually two on each side, that may be present in the pale stripe above the primary stripe, and in the primary stripe itself. The oblique bands are usually present in preserved specimens. In life they are weak or absent in daylight but very dark at night when the horizontal stripes are often very pale. Females sometimes show nocturnal color while breeding. Permanent blotches occur only in one species, *espei,* as large pigment areas (see Figures 1 and 2) that do not fade during the day; the borders of these blotches remain dark under all circumstances. In preserved specimens (Figure 1) or in specimens subordinate to others in agonistic contexts or specimens responding to gross environmental disturbances (Figure 2), the center of the blotch may almost completely fade away.

Many people have contributed to the completion of this study. We are most grateful to the following persons who have graciously loaned specimens in their care: James E. Böhlke, Academy of Natural Sciences, Philadelphia (ANSP); Myvanwy Dick, Museum of Comparative Zoology, Harvard (MCZ); William Eschmeyer, Warren Freihofer, and Pearl Sonoda, California Academy of Sciences (CAS); P. H. Greenwood, British Museum of Natural History (BMNH); H. Nijssen, Institute of Taxonomic Zoology (Zoological Museum), University of Amsterdam (ZMA); Donn Rosen, American Museum of Natural History (AMNH); J. Géry (private collection); and Loren P. Woods, Field Museum of Natural History (FMNH). Susan Karnella, Edgar N. Gramblin, Bruce Hodess, and Robert Kanazawa have aided in the curation of specimens in the National Museum of Natural History (formerly under the United States National Museum: USNM). All photographs are by S. Weitzman and William L. Fink, with considerable help from Robert Kanazawa. Marilyn Weitzman provided typing and technical assistance. All drawings are by the senior author except Figure 14, which is by Marion Dalen.

Ross Socolof and, through him, Louis Chung provided live specimens with locality information of *N. espei* and *N. minimus.*

James E. Böhlke, Robert H. Gibbs, Jr., William L. Fink, and David W. Dunham read the manuscript and offered valuable suggestions.

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Classification of the Family Lebiasinidae

We wish to recognize in a formal way a change in characoid classification since the publication of the senior author's papers on lebiasinid fishes in 1964 and 1966. Greenwood, Rosen, Weitzman, and Myers (1966) recognized several families of characoids, one of these being the Lebiasinidae. Weitzman (1964 and 1966) considered the Lebiasinidae as a subfamily of the inclusive family Characidae, which equals the Characoidei of Greenwood, et al. (1966). We believe that acceptance of several families of characoids is a realistic expression of the amount of divergent evolution that has occurred in the group and therefore adopt the following arrangement for the lebiasinid fishes based on the osteological work of Weitzman (1964). Definitions of the groups below, except for the genera, can be found in the works of Weitzman (1964 and 1966). In the earlier papers the subfamily Lebiasininae is equivalent of the Lebiasinidae in the present paper, while the former tribes Lebiasinini and Pyrrhulinini now become the Lebiasininae and Pyrrhulininae, respectively. The former subtribes Pyrrhulinina and Nannostomina now become the tribes Pyrrhulinini and Nannostomini.

- Family Lebiasinidae Eigenmann (1910)
  - Subfamily Lebiasininae Eigenmann (1910)
    - Genus *Lebiasina* Valenciennes (1846), in Cuvier and Valenciennes (1846)
    - " *Piabucina* Valenciennes (1849), in Cuvier and Valenciennes (1849)
  - Subfamily Pyrrhulininae Eigenmann (1910)
    - Tribe Pyrrhulinini Eigenmann (1910)
      - Genus *Pyrrhulina* Valenciennes (1846), in Cuvier and Valenciennes (1846)
      - " *Copeina* Fowler (1906)
      - " *Copella* Myers (1956)
    - Tribe Nannostomini Eigenmann (1909)
      - Genus *Nannostomus* Günther (1872)

Genus *Nannostomus* Günther

There are four nominal genera in the tribe Nannostomini: *Nannostomus* Günther (1872), *Poecilobrycon* Eigenmann (1909), *Archicheir* Eigenmann (1909), and *Nannobrycon* Hoedeman (1950). Only *Nannostomus* is recognized here, and an explanation of this involves a discussion of the possible relationships among the following species, all those known in the genus. The order of the species in this list does not constitute an interpretation of phylogenetic relationships but follows the order given in the artificial key below and the order of treatment here.

Nannostomus espei (Meinken), 1956
Nannostomus digrammus Fowler, 1913
Nannostomus harrisoni (Eigenmann), 1909
Nannostomus beckfordi Günther, 1872
Nannostomus bifasciatus Hoedeman, 1953
Nannostomus minimus Eigenmann, 1909
Nannostomus marginatus Eigenmann, 1909
Nannostomus trifasciatus Steindachner, 1876
Nannostomus marilynae, new species
Nannostomus unifasciatus Steindachner, 1876
Nannostomus eques Steindachner, 1876

Weitzman (1966) accepted two generic level taxa in the Nannostomini, *Nannostomus* and *Poecilobrycon*. *Nannobrycon* was included as a subgenus of *Poecilobrycon,* and *Archicheir,* based on juveniles of the type-species of the genus *Poecilobrycon* (*P. harrisoni*), was listed as a synonym of *Poecilobrycon* (compare Figure 8 with fig. 5 in pl. 37 of Eigenmann, 1912). *Poecilobrycon* was recognized by Weitzman (1966) because of its longer snout and the presence of a bony canal in the second infraorbital bone for the infraorbital branch of the laterosensory canal. Presumably the presence of a canal in the second infraorbital bone is primitive for the tribe Nonnostomini since the canal is found in most characoids as well as in all other members of the subfamily Lebiasininae. It is also found in several but not all of the species in the tribe Pyrrhulinini. There appears to be a trend within the family Lebiasinidae for a reduction of the sensory canal system in the more specialized genera and species. The species with a reduced canal are frequently small in adult size. Thus retention of the canal in the second infraorbital bone as found in *N. harrisoni, N. unifasciatus,* and *N. eques* should be primitive for the genus, and its loss in the remaining species an advanced character that would unite them in a specialized genus, *Nannostomus,* according to the principles of phylogenetic systematics. However, one very simple character, and a reductive one at that, usually cannot be given much importance in relating fishes.

There is some evidence that the absence of the canal in the second infraorbital bone may simply be a function of the size of individual specimens in a given species. Both *N. harrisoni* and *N. bifasciatus* are large species, reaching at least 41.5 and 43.2 mm in standard length, respectively. A canal is always present in *N. harrisoni,* but examination of many collections of *N. bifasciatus* shows that not all specimens have a well-developed canal; the canal is absent in many large specimens as well as in small ones. *Nannostomus unifasciatus* is also fairly large, reaching at least 38.3 mm in standard length, while *N. eques,* although usually large at 30 to 33 mm in standard length, has been known to reach 35.4 mm in standard length (see Weitzman, 1966, and the data recorded in the present text). Both species have a canal in the second infraorbital bone. Of the remaining species to reach an intermediate size, old aquarium specimens of *N. beckfordi* examined here reach at least 35.0 mm in standard length, and old aquarium specimens of *N. trifasciatus* attain at least 35.3 mm in standard length. These last two species always lack a canal in the second infraorbital bone as do all the remaining, smaller species. Thus the smaller species and some of those of intermediate size, *N. beckfordi* and *N. trifasciatus,* lack the canal in the second infraorbital bone, whereas the larger species have it or tend to have it.

Small size is a specialization in this group, and infraorbital canal loss and small size seem correlated. Although these two specializations appear to constitute a trend for the genus, the size at which the canal is lost is not sharply defined, and at least one species, *N. bifasciatus,* may or may not have the canal. Therefore there seems little reason to recognize two genera based on these two characters.

Of other characters that might bear on the problem of interspecific relationships, color pattern is at least interesting and sometimes helpful. So far, *N. unifasciatus* is the only species reported to have an ocellus in the upper caudal-fin lobe. Even this species does not always have the ocellus, it being best developed in specimens from Guyana (see Weitzman, 1966, and Figures 31 and 32 of this paper), where adults of both sexes have the dark spot surrounded by orange and white pigment. The spot has not been recorded for *N. eques* and cannot be seen in many specimens; however, orange pigment, similar to that of *N. unifasciatus,* is often present in the caudal fin of both sexes, and some specimens (see female in Figure 34) have a moderately developed ocellus. Young specimens of *N. bifasciatus* (Figures 15 and 16) have a caudal-fin spot similar to that of *N. unifasciatus,* but this seems to disappear completely in adults (Figure 17). Young of *N. harrisoni* also have a spot (Figure 8, specimen 18.0 mm in standard length), but this also disappears or mostly disappears in adults (Figure 7). Most, if not all, young specimens in all species of *Nannostomus* have much dark pigment on the caudal fin (see Figure 8 of *N. harrisoni*), and the dark pigment on the caudal fins of adult *N. eques* and *N. unifasciatus* is probably a retention in adults of this juvenile dark color. The wedge-shaped black pigment on the caudal fins of adult *Nannostomus* of most species represents what is left of this dark juvenile pigment. No ocellus seems to occur in any of the remaining species of *Nannostomus* except in one population sample of *N. trifasciatus* (Figure 26) and a sample of juvenile *N. beckfordi* (see below). The dorsal wedge (Figures 23 and 24) in *N. marginatus* may possibly be derived from the same pigment area as the ocellus.

It would seem that *N. harrisoni, N. bifasciatus, N. unifasciatus,* and *N. eques* may be related by the following tendencies: to have a sensory canal in the bony substance of the second infraorbital, to attain a comparatively large size, and to have an ocellus or at least a dark pigment spot in the caudal fin of adults. The first two characters are, in all probability, primitive for the genus and therefore not useful in relating these species. The third character, an ocellus or ocellus-like spot, perhaps a specialization for the genus, is also found in the young of a least one population of *N. trifasciatus* (Figure 26). Also much black pigment is present in the caudal fin of juveniles of other species of *Nannostomus.* Dr. David Dunham has shown us color slides of live juveniles of a population sample of *N. beckfordi* that display an ocellus-like spot. Without developmental studies of caudal-fin pigment, probably correlated with behavioral observations, it would be difficult to say with assurance whether the spot is primitive for the genus and is being lost in some species or that it is specialized and indicates a common ancestor for the species which have a tendency to possess it. We believe the appearance of this ocellus in *N. trifasciatus* and the widespread occurrence of black pigment in juveniles of most (and perhaps all) species of *Nannostomus* indicates a genetic background within the genus and that therefore the possession of an ocellus by a few species is at best a poor indicator of relationships. Its appearance could be convergent and correlated with a recognition behavior pattern common to many members in the genus. For example, Weitzman (1966) reported two color forms of *N. marginatus* with somewhat different but strongly patterned caudal fins whose sharp color contrast might be recognition marks of some sort. In one form, probably from the lower Amazon basin, the caudal fin bears a bright silvery area between two black wedges, one dorsal and one ventral to the silvery area. The black wedges are extensions of the primary and secondary stripes onto the fin. In a color form from the Colombian Amazon, the silvery area is replaced by brilliant cardinal red. These areas may serve the same behavioral purpose as the ocellus in some other species of *Nannostomus.*

It would seem safe to say that *N. eques* and *N. unifasciatus* are related because of their shared specialized caudal fins and correlated specialized swimming position (Weitzman, 1966). Of these two species *N. unifasciatus* may be the most primitive in overall color pattern, and it certainly has a color pattern most similar to that of the other large species, *N. harrisoni* and *N. bifasciatus* (see discussion below). *Nannostomus eques* is unique because it has more horizontal stripes, as many as five, than the other species, which have one, two, or three.

It is difficult to relate *N. harrisoni* and *N. bifasciatus* to the other large species on the basis of color pattern. Although the color patterns of *N. unifasciatus, N. harrisoni,* and *N. bifasciatus* are at first glance similar, *N. bifasciatus* has a much better developed secondary horizontal stripe than the other two, which have the stripe nearly absent or very pale on both preserved and live specimens. In live specimens of *N. harrisoni* the posterior half of the primary horizontal stripe becomes very dark in courting males, and the anterior half fades to the point of disappearing. This may be unique for the species, as we have not observed this change in any other species of *Nannostomus* (but we have not seen live *N. bifasciatus*). Preserved specimens of *N. bifasciatus* further differ from those of *N. harrisoni* in having the posterior oblique band anterior and dorsal to the anal fin, whereas those of *N. harrisoni* have the band extending anterior, dorsal, and posterior to the anal fin. The posterior oblique band is not evident in preserved or live specimens of *N. unifasciatus.* Thus of the species *N. unifasciatus, N. bifasciatus,* and *N. harrisoni,* there seems little to relate them on the basis of stripes and bands. All have these typical components found in the *Nannostomus* color pattern but each is specialized in its own way in regard to details.

All the large species, *N. unifasciatus, N. eques, N. bifasciatus,* and *N. harrisoni,* have orange to reddish pigment associated with the nares and caudal fin in life, but *N. harrisoni* males also have this type of pigment on the anal and pelvic fins, and males and females of *N. eques* have orange pigment on the anal fin. In *N. eques* the narial pigment is usually gold to orange (rather than the red of the other species). Again all these species have xanthic pigments in more or less similar areas but each is somewhat different from the others.

Red, orange, or gold pigments are not limited to the four species described above. They are also found in at least *N. beckfordi, N. marginatus, N. trifasciatus, N. digrammus, N. marilynae, N. minimus,* and *N. espei.* These have some red, orange, gold, or yellow pigment in the area of the caudal fin, anal fin, and/or the nostrils. In *N. digrammus, N. marilymae, N. minimus,* and *N. espei* this pigment is gold or pale orange and sometimes absent. It is red or orange in the other species. Well-developed secondary horizontal stripes occur in *N. marginatus, N. trifasciatus, N. bifasciatus,* and *N. eques* but nowhere else. *Nannostomus marilynae* may at times have a moderately developed secondary stripe, and weak secondary stripes may occur in *N. beckfordi* and especially in *N. digrammus.* The secondary stripe of *N. minimus* is very poorly developed. The various pigment patterns in the species of *Nannostomus* are difficult to interpret in terms of relationships and, like morphometric and meristic characters in this group, may be evolutionarily so labile that no interpretative confidence can be placed in them.

In view of the interpretative difficulties it seems advisable to recognize only one genus, *Nannostomus* Günther (1872), of which *Poecilobrycon* Eigenmann (1909) and *Archicheir* Eigenmann (1909) are synonyms (see synonymies of Weitzman, 1966). *Nannobrycon* Hoedeman (1950) could be recognized for *N. eques* (the generic type) and *N. unifasciatus* because of their unique caudal-fin structure and "slant" swimming habit. To us, *Nannobrycon* hardly seems worth recognizing until studies on the behavior and anatomy associated with this singular habit are accomplished. In this connection, although the new species described here, *N. marilynae,* swims horizontally, the female in Figure 29 has the lower lobe of the caudal fin larger than the upper, similar to *N. eques* and *N. unifasciatus.* The distal end of one of the rays of the upper lobe has shifted ventrally and lies between the upper and lower lobes, approaching the condition found in the homologous rays of *N. eques* and *N. unifasciatus.* The caudal fin of the male (same figure) appears similar to the majority of the species of *Nannostomus.*

Two other characters need some discussion. Both *N. minimus* and *N. digrammus* have greatly modified anal fins in the male and might be considered related because of this shared specialization (compare Figures 3 and 18). This could be convergent; these species do not appear closely related on any other basis and the developement of the anal fin appears somewhat variable in *N. digrammus.* Thickened anal-fin rays are found in several species of *Nannostomus* (see Weitzman, 1966) and such rays are also present in the subfamily Lebiasininae as well as in the tribe Pyrrhulinini of the subfamily Pyrrhulininae. Thus the presence of thickened anal-fin rays and a trend toward a modification of the anal fin is characteristic of the family. This greater degree of specialization in the anal fin of two species of *Nannostomus* could be convergent.

A few of the species of *Nannostomus* are known to have contact organs, hypertrophic dermal cells in the form of tubercles. *Nannostomus bifasciatus* and *N. unifasciatus* were reported to have such tubercles by Wiley and Collette (1970). *Nannosto-*

mus minimus (see below) also has these tubercles. No tubercles were found in other species but if they hadn't appeared in the photograph of a live male, *N. minimus* (Figure 21), we would have missed them in our examination of preserved specimens of this species. In view of these facts we are not prepared to say that these structures are absent in other species of *Nannostomus,* especially since similar tubercles are found in other lebiasinids, (tribe Pyrrhulinini, see Wiley and Collette, 1970). We can draw no conclusions regarding relationships of the species based on presence or absence of tubercles.

Despite the fact that no really useful or phylogenetically significant characters that would warrant recognition of two genera in the tribe Nannostomini

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 lobe 2
   Principal caudal-fin rays 10/9, but 8 rays end in dorsal lobe and 11 in ventral caudal-fin lobe 10
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 intensifiied 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 7
4. Adipose fin always absent 6
   Adipose fin always present 5
5. Snout in eye 1.1 to 1.3. Total vertebrae 34 or 35. Sensory canal absent in second infraorbital bone. Secondary horizontal stripe usually well developed .... ***Nannostomus digrammus***
   Snout in eye 0.9 to 1.0. Total vertebrae 38 or 39 in adults. Sensory canal present in second infraorbital bone. Secondary horizontal stripe usually poorly developed .... ***Nannostomus harrisoni***
6. 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***
7. Anal fin of males short, not reaching to caudal fin when adpressed to body 8
   Anal fin of males long, reaching caudal fin when adpressed to body .. ***Nannostomus minimus***
8. Scales in a lateral series 24 to 27. Adipose fin present (sometimes absent in *N. trifasciatus*) 9
   Scales in a lateral series 21 to 23. Adipose fin always absent .... ***Nannostomus marginatus***
9. Oblique (vertical) bands broad; anterior band extending posteriorlly 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 .... ***Nannostomus marilynae***
10. 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***

have been found in the present study, we do believe that there are some indications of relationships among the species. Certainly *N. eques* and *N. unifasciatus* seem close because of their swimming behavior and correlated caudal-fin modification, even though *N. marilynae* may occasionally show a bit of the same anatomical modification. Weitzman (1966) noted that *N. marginatus* and *N. trifasciatus* appear close because of very similar and probably specialized color patterns and we see no reason to alter this view. The other species, *N. espei, N. beckfordi, N. digrammus, N. harrisoni, N. bifasciatus, N. marilynae,* and *N. minimus,* seem to stand alone and we cannot relate them to other species with confidence.

On the basis of the analysis by Weitzman (1966) and the discussion above, we are unable to state with certainty which species or group of species in the genus *Nannostomus* may be most primitive. The presence of a complete, well-formed bony sensory canal in the second infraorbital bone is obviously primitive. The subtle body shape in *N. espei* (suggesting that of *Pyrrhulina,* see discussion of *N. espei* by Weitzman, 1966) may be primitive, whereas the more cylindrical shape of some other *Nannostomus* species, for example *N. harrisoni,* may be more specialized. The profile of the scales and body shape of *N. espei* are suggestive of those in *Pyrrhulina,* and the black-spot color pattern of *N. espei* is similar to that of *Pyrrhulina vittata* Regan and *Pyrrhulina spilota* Weitzman. *Nannostomus espei* appears to lack oblique bands and only weakly shows horizontal stripes, the former being absent in *Pyrrhulina, Copeina,* and *Copella,* while the latter (what may be equivalent to a primary horizontal stripe) is developed to a certain extent in some species of *Pyrrhulina* and *Copella,* for example *Copella nattereri* Steindachner and *Copella metae* Eigenmann. This suggests that in the aggregate of its characters *N. espei* is the most primitive species, even though it lacks a canal in the second infraorbital bone. However, both the body and scale characteristics of *N. espei* are very subtle, and the color pattern similarities between *N. espei, C. vittata,* and *C. spilota,* although far from being subtle, could be convergent. Possibly *N. espei* is on a separate line of evolution from the other known species of *Nannostomus,* retaining several primitive characters and perhaps losing the second infraorbital bone independently.

We propose that the ancestor of *Nannostomus* probably had a body and scale shape somewhat approaching that of *Pyrrhylina,* that it had only the primary longitudinal stripe (probably poorly developed), lacked the oblique bands, had only a slightly modified anal fin in the male (somewhat thickened but not elongate rays), had an unmodified caudal fin, no caudal-fin ocellus, little orange or red pigment, and probably not much black caudal-fin pigment.

Nannostomus espei (Meinken)

FIGURES 1, 2

DIAGNOSIS.—Secondary and tertiary horizontal stripes absent; primary horizontal stripe poorly developed; permanent blotches on sides of living specimens (in life blotches do not disappear during daytime). *Nannostomus espei* differs from all other species of *Nannostomus* except *N. marginatus* in having only 22 scales in a lateral series (*N. minimus* has 23 or 24). Caudal fin with 10 principal rays terminating in dorsal lobe and 9 in ventral lobe.

DISCUSSION.—Mr. Louis Chung has very kindly provided us with information on the discovery and geographical distribution of *N. espei.* Mr. Chung first found the fish in 1953 in the "upper Kurupung River, a tributary of the Mazaruni River." From five expeditions during 1953 and 1954 he found *N. espei* to be distributed in the Mazaruni River from Peaima Falls to Toboku Falls and in the Kurupung, Eping, and Tabuba rivers, all tributaries of the Mazaruni River, Guyana. He reports that they live in water with a pH of 5.8.

We have no further comments or information on this species supplemental to the description by Weitzman (1966). Recent notes on aquarium care can be found in Sterba (1970).

SPECIMENS EXAMINED.—2, USNM 210704, SL ♂ 25.0 mm, ♀ 27.2 mm, specimens received alive from Mr. Ross Socolof, who received them from Mr. Louis Chung, an aquarium fish exporter-importer in Georgetown, Guyana. (Mr. Ghung informs us that he collected these specimens of *N. espei* from the Eping River, tributary to the Mazaruni River, Guyana, 1973. These specimens appear in the photograph, Figure 2.)

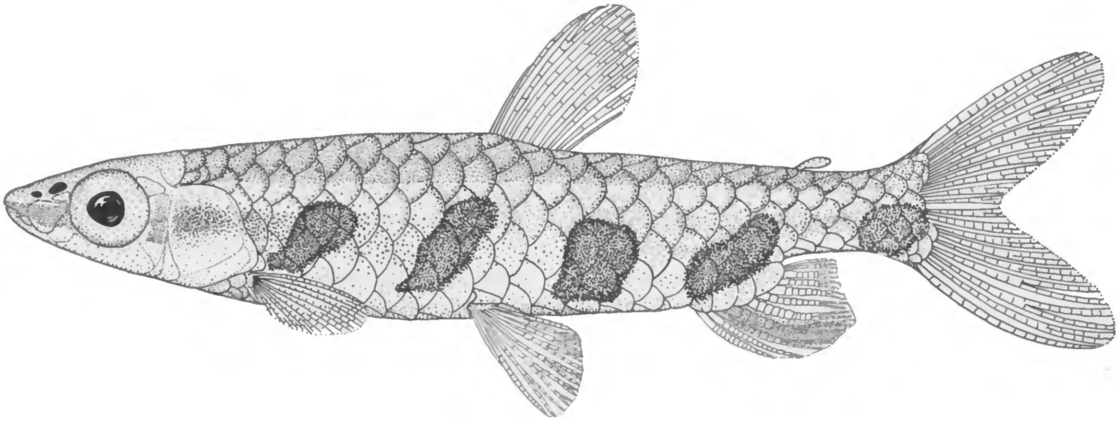

Figure 1.—*Nannostomus espei*, SU 50214 (now at CAS), male, 27.6 mm SL, Mazaruni River system, Guyana, 1955.

Figure 2.—Live *Nannostomus espei*, USNM 21074, female above, 27.2 mm SL, male below, 25.0 mm SL, Eping River, tributary to the Mazaruni River, Guyana, 1973.

***Nannostomus digrammus* Fowler**

FIGURES 3, 4, 5

DIAGNOSIS.—Primary horizontal stripe always, and secondary usually, well developed. Tertiary horizontal stripe absent. Nocturnal oblique bands present, permanent blotches absent. Adipose fin always present. Snout in eye 1.1 to 1.3. Total number of vertebrae 34 or 35. Anal fin of male elongate, reaching caudal fin when adpressed to body. Caudal fin with 10 rays terminating in dorsal lobe and 9 rays in ventral lobe.

DISCUSSION.—The synonymy remains the same as recorded by Weitzman (1966). Sterba (1970) appears to have correctly identified this fish.

The list of specimens examined consists of new geographical localities recorded for this species. Most of these localities are adjacent to those recorded by Weitzman (1966), but one extends the known range in the Rio Madeira up into the Rio Guaporé between Brazil and Bolivia.

The Rio Madeira-Rio Guaporé collection consists of 31 individuals of both sexes; all are relatively small, not exceeding 22.9 mm in standard length. The species attains a large size, for old aquarium males from unknown localities reach a length of 29.0 mm in standard length. The mature adult males of the Guaporé population sample have smaller anal fins (the rays are shorter in length) than specimens of similar size from the Rio Negro around Manâos, from the Rio Branco system in Brazil, or from the Rupununi system in Guyana. Meristic and morphometric data taken on the specimens examined here mostly fall within the ranges of the specimens previously recorded by Weitzman (1966). A few specimens from the Rio Purus were found with one less scale in a lateral series (range 24 to 26 instead of 25 or 26). Fin-ray counts and the basic tooth pattern remain as given by Weitzman (1966). Morphometric data show some degree of geographic variation, but the relatively few specimens from most localities and the irregular distribution of these localities defeat any attempt at meaningful analysis.

There seems to be some confusion in the aquarium literature regarding the identification of *N. digrammus* and *N. beckfordi*. Under the name *Nannostomus beckfordi beckfordi* Günther, Sterba (1962:209) described what he called a "Golden pencilfish." As a reference for this account he cited Meinken (1951:147), who referred to a pencilfish that he called the "gold-anomalus." Meinken identified his "gold-anomalus" as *Nannostomus anomalus* Steindachner (here considered a synonym of *N. beckfordi*). Sterba (1970:159) gives (freely translated) the following description and life colors for this fish: Back red brown; sides yellowish to yellow silver; belly white. Blackish to

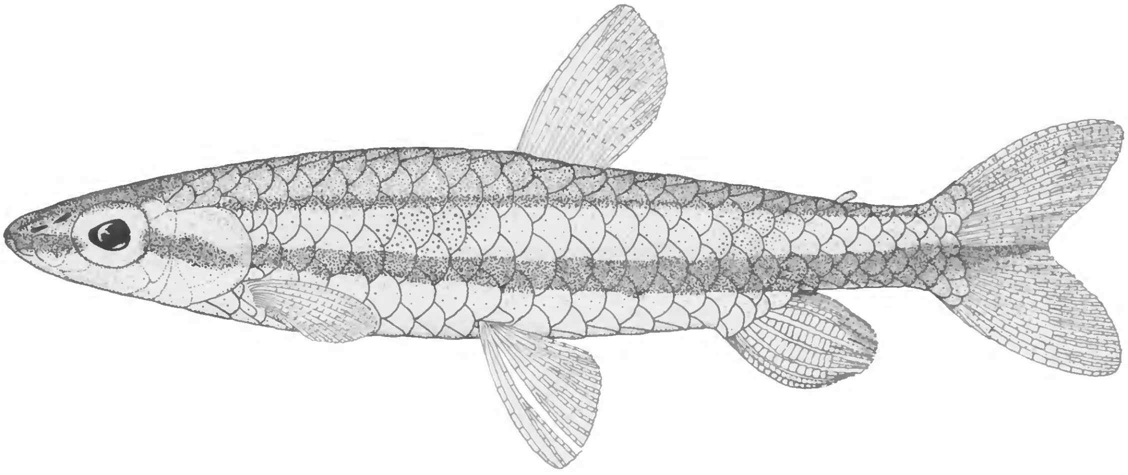

FIGURE 3.—*Nannostomus digrammus*, SU 50248 (now at CAS), male, 24.5 mm SL, Igarapé do Sapucuá into Lagôa Sapucuá (this lake drains into the Rio Trombetas), Pará, Brazil, 7 June 1924.

FIGURE 4.—*Nannostomus digrammus*, SU50250 (now at CAS), male, 20.8 mm SL, Igarapé do Mai Joana, a tributary of the Rio Negro near Manãos, Amazonas, Brazil, 25 December 1924.

deep black stripe from tip of snout across eye to caudal fin. Above this occurs a gold stripe and above this an iridescent green zone. Scales above middle of sides dark edged. Fins yellowish to reddish, anal fin and lower lobe of caudal fin beautiful brick red. Female pale compared to male, anal fin "angular" (rounded in male). In male, posterior half of body reddish at spawning time. "Gold-anomalus" differentiated from *N. beckfordi* by strong gold stripe and characteristic, principally downward directed, broadening of dark stripe in vicinity of operculum.

The senior author has kept several geographical forms of *N. beckfordi* alive, and some (unfortunately without known locality information) have had a color pattern similar to this description, with the males becoming very red on the posterior half of their body during spawning and courtship behavior (see male in Figure 13). Presumably the form described by Sterba (1970) is a geographical form of *N. beckfordi*. We have never seen a fish we could identify as *N. digrammus* with life colors as described above for the "gold-anomalus."

Previous to 1940 one or possibly more species of *Nannostomus* appeared both in Germany and the United States under the name "gold-anomalus." Weitzman (1966:26) reported that a specimen was sent before 1940 by Mr. Frederick Stoye to Dr. George S. Myers as a "gold-anomalus." At that time Mr. Stoye was in close contact with German

FIGURE 5.—Live *Nannostomus digrammus*, USNM 208423, male, 28.1 mm SL, locality unknown.

aquarists, and presumably he had specimens of at least one of the species (if there was more than one at that time) being distributed in the aquarium trade as the "gold-anomalus." Mr. Stoye's specimen is a large male *N. digrammus.*

It thus appears that at one time or another at least two species of *Nannostomus* have been called "gold-anomalus." We tentatively identify the species described by Sterba (1970) as one of the several geographical forms of *N. beckfordi* (see Weitzman, 1966, for comments on geographical polychromatism in *N. beckfordi*), and that represented by Mr. Stoye's specimen as *N. digrammus.* The figure (Tafel 58) of the "gold-anomalus" in Sterba (1970) is similar to some of the forms of *N. beckfordi* from the lower Amazon basin, but further speculative identification of the species in this photograph, without preserved specimens, is pointless.

COLOR IN LIFE.—The color recorded here is from male specimens from an unknown locality. Dorsal fin, pectoral fins, and pelvic fins entirely hyaline. Primary horizontal stripe black, especially dorsal portion of stripe. Ventral portion of primary stripe in abdominal region rich brown with some orange color. Secondary horizontal stripe pale black, lacking olive color of back above. Narrow silvery stripe between primary and secondary horizontal stripes with pale specular reflections of mixtures of blue, green, and purple. This silvery stripe without other colors and in life no evidence or almost no evidence of two black oblique bands seen in Figure 4 (compare Figures 4 and 5). Primary black horizontal stripe continuous onto ventral lobe of caudal fin, spreading over above half to three-fourths of extent of about 8 fin rays. Here black becomes pale and orange-brown pigment prominent. Belly below primary horizontal stripe silvery white, except anterior to anal fin and dorsal to vent where a considerable amount of orange-brown pigment occurs. Base of anal fin orange brown, otherwise hyaline. Caudal fin hyaline except as described above and at base of silvery stripe between primary and secondary horizontal stripes where fin is silvery white. Primary horizontal stripe on head partly black, with considerable orange-brown pigment. No bright red spot near narial opening. Silver pigment suffused with pale or moderately intense orange occurs around nares. Dorsum of snout olive brown, with a large number of small black melanopores. Lower jaw silvery white. Iris white except for black area of primary horizontal stripe and a small dorsal black area near interorbital space. Belly and throat regions white.

SPECIMENS EXAMINED.—31, USNM 208420, 17.8–22.9 mm, Brazil-Bolivia border region between Guajará-Marim Mato Grosso from the Guaporé drainage, 1970, Bernard Von Graeve. 1, USNM 208421, SL 18.2 mm, Brazil, Rio Urubú, 25 miles from Itcoatiara, State of Amazonas, October 1958, H. Axelrod and H. Schultz. 9, USNM 208418, SL 15.8–20.4 mm, Brazil, Rio Purus, Boca de Tapaua, Nov. 1963, H. Schultz, H. Axelrod, and F. Terofal, (10 specimens from this locality in the collection of J. Géry.). 3, USNM 208419, SL 17.0–27.0 mm, Brazil, State of Amazonas, Igarapé into Lago Grande do Manacapuru, Nov. 1963, H. Axelrod, H. Schultz and F. Terofal. 2, USNM 208423, SL 24.3–28.1 mm, locality unknown, aquarium specimens (photographed alive, see Figure 5 and color description), 1969.

Nannostomus harrisoni (Eigenmann)

FIGURES 6, 7, 8

DIAGNOSIS.—Primary horizontal stripe well developed. Secondary horizontal stripe usually poorly developed. Tertiary horizontal stripe absent. Nocturnal oblique bands present, permanent blotches absent. Adipose fin always present. Snout in eye 0.9 to 1.0. Total number of vertebrae 38 or 39. Anal fin of male not elongate, not reaching base of caudal fin. Caudal fin with 10 rays terminating in dorsal lobe, 9 rays in ventral lobe.

DISCUSSION.—Except for the general discussion above, we have few comments on this species in addition to those of Weitzman (1966). The synonymy remains the same. Sterba (1970) correctly cites this fish. Although the photographs of specimens (Figures 7 and 8) presented here were made primarily to show developmental color pattern differences in the caudal fin and the tendency of the young to have a caudal-fin ocellus that is vaguely similar to the well-developed ocellus in the Guyana population of *N. unifasciatus,* these photos also show other changes in pigment as the fish progresses from 14.6 mm standard length to adult size of approximately 35 to 38 mm standard length. The most obvious change is that of the primary horizontal stripe, the pale stripe above it, and the secondary stripe. In a 14.6 mm standard length specimen the pale stripe dorsal to the primary stripe has a large amount of black pigment posteriorly (lower fish, Figure 8). By 18 mm standard length this pigment is nearly gone.

Figure 8 shows the late change of the pectoral

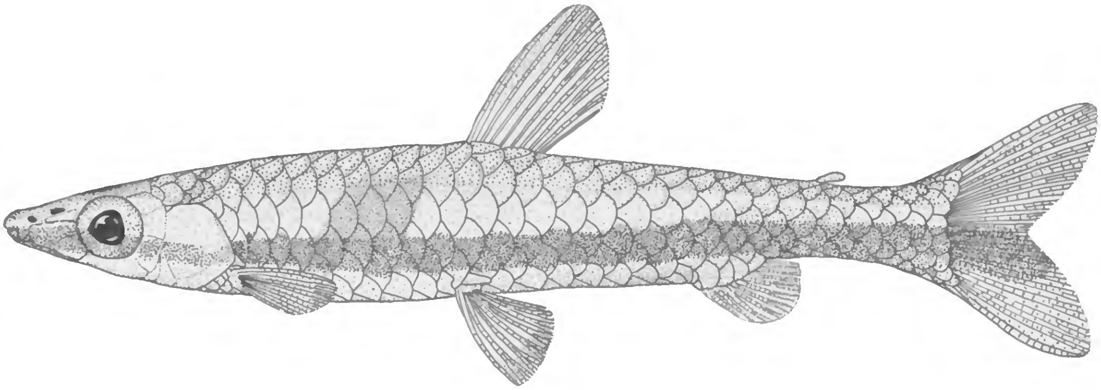

Figure 6.—*Nannostomus harrisoni*, SU 50243 (now at CAS), male, 38.5 mm SL, Georgetown, Guyana, no date.

Figure 7.—Live *Nannostomus harrisoni*, USNM 204075, female above, 38.2 mm SL, male below, 35.1 mm SL, Guyana, 1970.

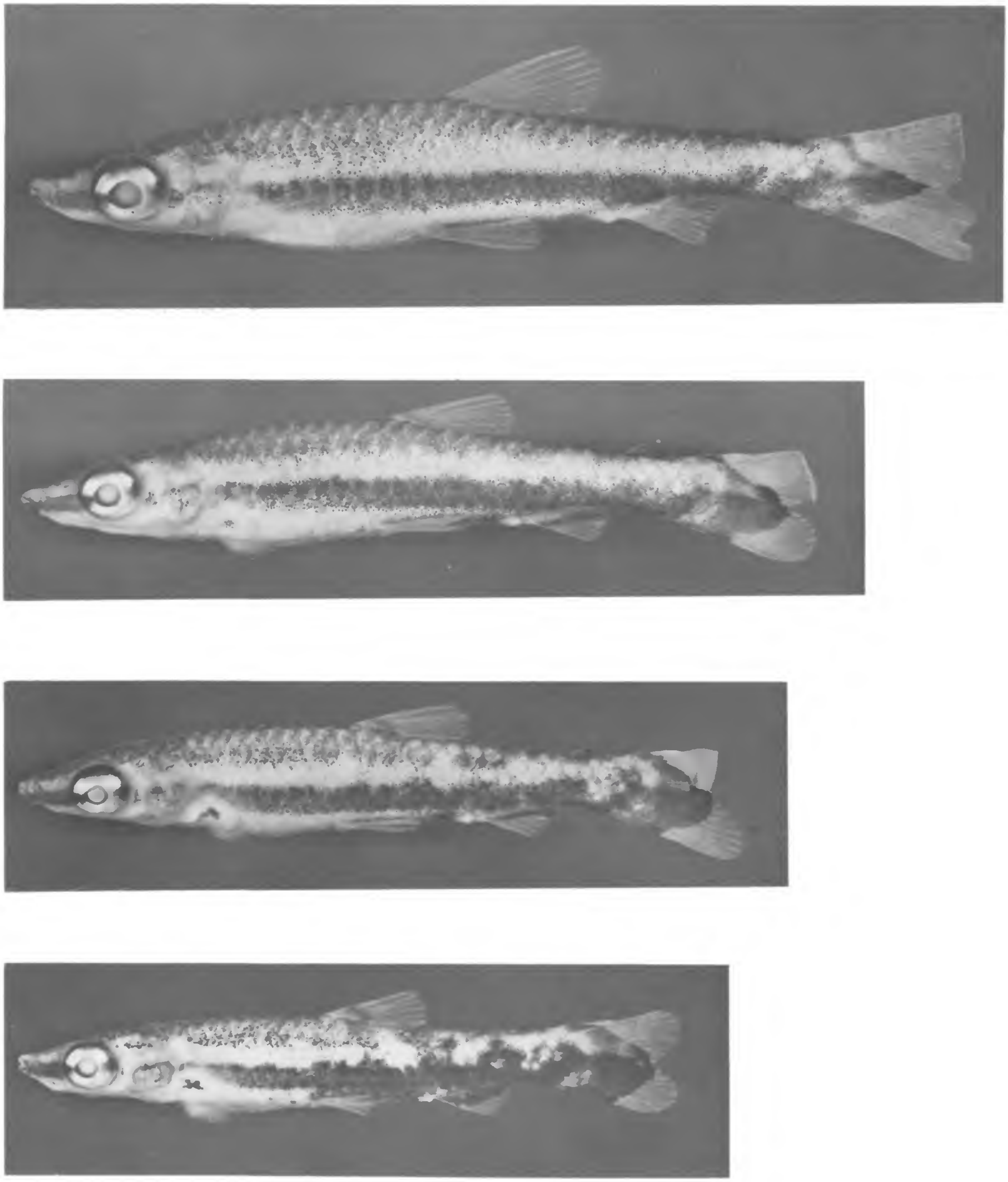

FIGURE 8.—*Nannostomus harrisoni*, USNM 204075, young of adults in Figure 7, above to below, 21.1, 18.0, 16.4, and 14.6 mm SL.

fin in *N. harrisoni* from the fin of a postlarva to that of an adult. This late development led Eigenmann (1909:46) to describe *Archicheir minutus* (from 1 specimen) as being related to *Nannostomus,* but with peculiar pectoral fins having "broad, dermal flaps, with hair like fringes." This description fits the normal pectoral fins of all postlarval *Nannostomus.* The type of *Archicheir* was 26 mm in total length, a large size for a *Nannostomus* with postlarval pectoral fins. Eigenmann (1912: 287) notes that *Archicheir* is probably based on a specimen that is abnormal and that the genus might be a synonym of *Poecilobrycon.* Weitzman (1966:37, 41), after studying the holotype of the type-species of *Archicheir* and comparing it with the young of *N. harrisoni,* identified it with the young of *N. harrisoni.* Comparison of Eigenmann's specimen (1912, pl. 37: fig. 5) with the 18 mm specimen of *N. harrisoni* shown here (Figure 8) shows two nearly identical fishes. The specimen in Figure 8 (that is 21.1 mm in standard length) is nearly 25 mm in total length, nearly as long as the type of Archicheir, but has mature pectoral fins. Apparently this species develops adult pectoral-fin morphology at about 20 to 22 mm in standard length. Unfortunately we have almost no data on the length of specimens at maturity of the pectoral fins in species other than *N. harrisoni,* but specimens less than 20 mm in standard length of the other species we have examined have adult pectoral fins.

Nannostomus beckfordi Günther

FIGURES 9, 10, 11, 12, 13

DIAGNOSIS.—Primary horizontal stripe well developed, secondary horizontal stripe poorly developed, and tertiary horizontal stripe absent. Nocturnal oblique bands present, permanent blotches absent. Adipose fin always absent. Gill rakers 9 or 10 + 17 or 18. Caudal fin with 10 principal rays terminating in the dorsal lobe and 9 in the ventral lobe.

DISCUSSION.—Although we list a moderate number of specimens from new localities, these population samples do not extend the known range of this species to any appreciable extent. Also they add nothing to the discussion on geographical variation by Weitzman (1966).

Figure 11 is of the holotype, a male, never before illustrated. The specimen has at some time been dried and is now in poor condition. Figure 12 is of a pair of live specimens that compare favorably with specimens from Guyana. Figure 12 is included here in order that a direct comparison can be made between photographs of live *N. beckfordi*

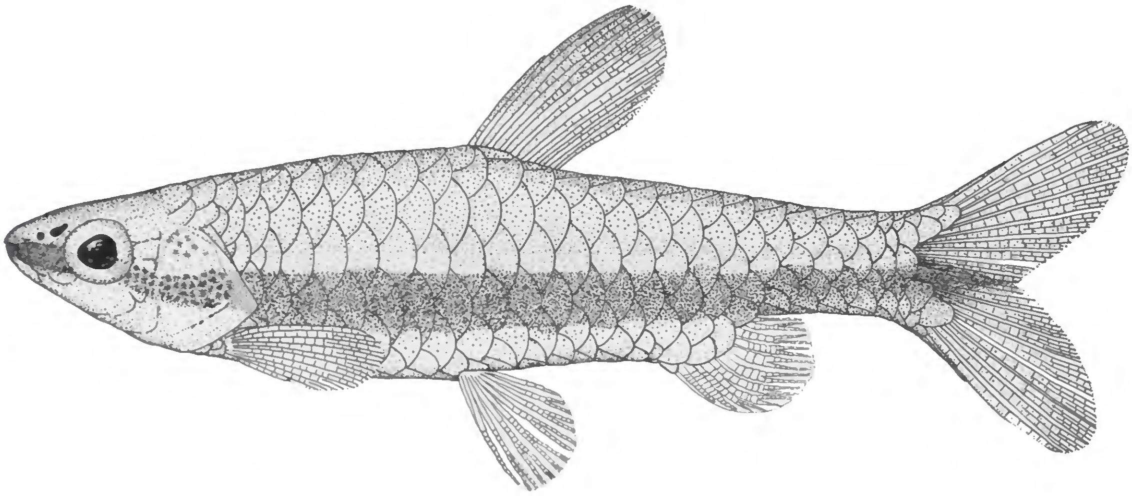

FIGURE 9.—*Nannostomus beckfordi,* SU 50261 (now at CAS), male, 30.0 mm SL, Utinga Forest Reserve, Belém, Pará, Brazil, September 1944.

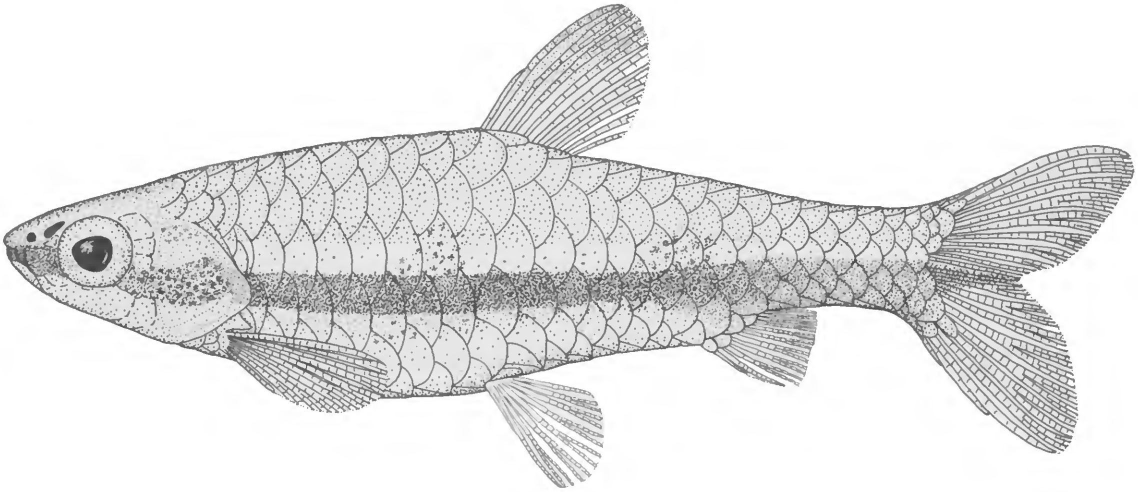

FIGURE 10.—*Nannostomus beckfordi*, SU 50261 (now at CAS), female, 29.5 mm SL, Utinga Forest Reserve, Belém, Pará, Brazil, September 1944.

and the new species *N. marilynae*. Figure 13 illustrates a male that compares favorably with specimens known from the lower Amazon around Belém. See Weitzman (1966) for a discussion of the differences in geographical forms of this species.

Weitzman (1966) cited *N. minimus* as a synonym of *N. beckfordi*. *Nannostomus minimus* is here treated as a valid species (see "Discussion" under that species).

SPECIMENS EXAMINED.—1, holotype, BMNH 1871-12-28:10, SL 22.0 mm; Guyana, Demerara. 61, USNM 208261, SL 13.4–28.3 mm; Surinam, Para district, Berlijn, Para Creek, 14 September 1969, H. P. Pijpers. 12, USNM 208262, SL 20.4–24.0 mm, Surinam, Para district, 43 km south of Paramaribo, a blackwater creek near 'S Lands Basheheer Headquarters at Zanderij. White sand savanna belt, 9 April 1969, D. W. Dunham. 2, ZMA 104.206, SL 16.0–26.8 mm; Surinam, Mastenkreek, Berlijn, Para river system, about 60 km from Paramaribo; H. P. Pijpers, 24 March 1962. 3, ZMA 106.179, SL 22.4–22.8 mm; Surinam, Marowijne district, Ricanau Creek about 5 km from Moengo via Albina-Moengo road, 4 June 1966, H. Nijssen. 2, ZMA 104.205, SL 14.6–27.8 mm; Surinam,

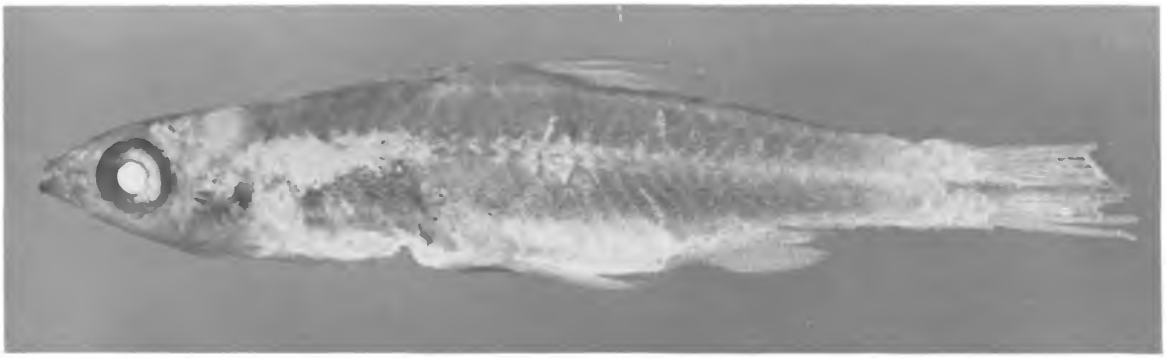

FIGURE 11.—*Nannostomus beckfordi*, BMNH 1871-12-28:10, male, 22.0 mm SL, holotype, Demerara, Guyana, date of collection unknown.

FIGURE 12.—Live *Nannostomus beckfordi,* male above, 26.3 mm SL, female below, 26.9 mm SL, no locality data, specimens very much like those known to come from Guyana.

Mooi-Wana Creek along Albina-Moengo road, Cottica River system, 10 March 1962, H. P. Pijpers. 1, ZMA 104.207, SL 17.0 mm; Surinam, Matoekasi Creek along Albina-Moengo Road, Cottica River system, 14 March 1962, H. P. Pijpers. 35, ZMA 102.015, SL 15.5–24.4 mm; Surinam, Coropine Creek near Republick, October 1956, J. van der Kamp. 221, ZMA 100.514, SL 22.9–27.0 mm; Surinam, Suriname River at village Berg en Dal, 15 March 1952, Mr. Spoelstra. [These include the holotype and paratypes of *Nannostomus beckfordi surinami* Hoedeman. Dr. H. Nijssen states that the holotype apparently never was separated from the paratypes. It is now impossible to distinguish the holotype from the other specimens in the jar.] 25, MCZ 46042, SL 16.7–23.7 mm; Brazil Lagôa de Providencia, Municipio of Ananindeua, Belém, Pará, July 1965, N. Menezes. 5, MCZ 49360, SL 19.7–21.0 mm; Brazil, Rio Apeú, Boa Vista, Municipio of Castanhal, State of Pará, July 1965, N. Menezes. 1 ZMA 105. 325, SL 23.7 mm; Surinam, Carolina (=Malasiel) Creek, about 10 km south of Zanderij, Para district, 14 December 1966, H. Nijssen.

Nannostomus bifasciatus Hoedeman

FIGURES 14, 15, 16, 17

Previously *N. bifasciatus* was known from four specimens in poor condition and some photographs and comments in the aquarium literature (see Weitzman, 1966). Through the field work of Dr. H. Nijssen, ZMA, the fine collections recorded below have been made available and form the basis of the following redescription of this species. The description is based on 35 specimens, 25.7 to 43.2 mm in standard length, from the Brokopondo District of Surinam. The largest recorded specimen (an aquarium fish) was 44.1 mm in standard length.

DIAGNOSIS.—Primary and secondary horizontal

Figure 13.—Live *Nannostomus beckfordi,* male, 32.4 mm SL, no locality data, specimen very much like those known to occur from areas around Belém, lower Amazon River area, Brazil.

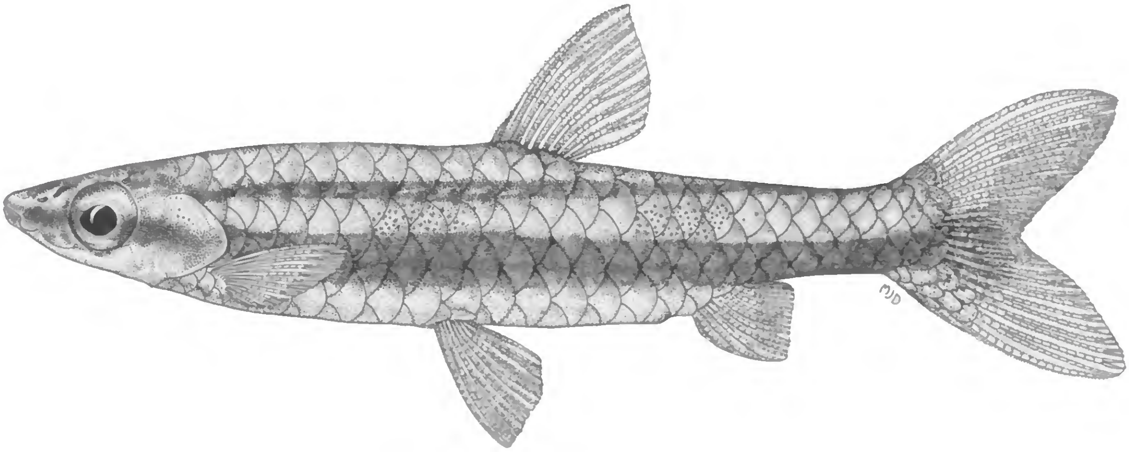

Figure 14.— *Nannostomus bifasciatus,* ZMA 106.144, male, 41.2 mm SL, creek, 12 km south of Brownsueg, Brokopondo District, Surinam, 23 November 1966.

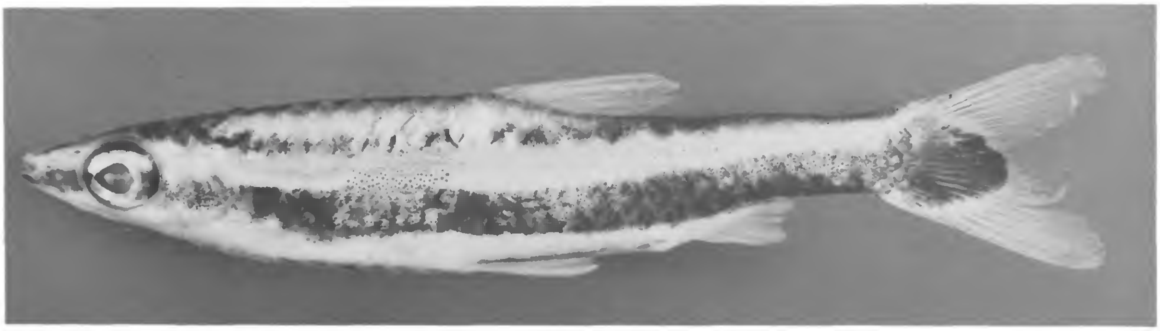

FIGURE 15.—*Nannostomus bifasciatus*, ZMA 106.144, young, 17.1 mm SL, same data as specimen in Figure 14.

stripes well developed, tertiary horizontal stripe absent. Nocturnal oblique bands present, permanent blotches absent. Adipose fin always absent. Gill rakers 8 + 14. Caudal fin with 10 principal rays ending in dorsal lobe 9 in ventral lobe.

DESCRIPTION.—Body elongate, sides somewhat flattened, and body compressed posteriorly. Greatest body depth slightly anterior to dorsal-fin origin 224 (180–300); least depth of caudal peduncle 098 (090–110); length of caudal peduncle 184 (140–260). Snout tip to origin of dorsal fin 533 (510–570); snout tip to origin of anal fin 755 (720–810).

Head conic and snout obtuse in both vertical and horizontal profiles; top of head gently convex between eyes. Head 259 (220–310); eye 080 (070–100); snout 083 (070–090); least width of bony interorbital 078 (070–090).

Premaxillary with 7 or 8 teeth, each bearing 7 cusps in adults; second from lateralmost cusp largest. Maxillary with 1 tooth bearing 4 or 5 cusps (usually 5 in adults); second or third cusp from dorsalmost cusp largest. In adults dentary with 6 to 8 multicuspid teeth in outer row, anterior 7 with 7 cusps, third from median side of tooth largest, eighth (most posterior) mulitcuspid tooth notably smaller than others and with 4 or 5 subequal cusps. Sometimes (in large adults) a simple conic tooth posterior to eighth multicuspid tooth of dentary. Inner row of dentary teeth simple, conic, 13 to 15 in number. Replacement teeth of outer row of "primary" teeth present.

Gill rakers 6 to 8 + 12 to 14.

Dorsal fin ii,8; anal fin iii,9; pectoral fin i,8 to i,11; pelvic fin ii,7; principal rays of caudal fin 10/9. Adipose fin absent. Anal fin of male somewhat modified. Anterior ray small and nearly or completely hidden by basal scale. Second ray enlarged and its anterior edge expanded and carinate. Entire fin larger than that of females and individual rays thickened laterally and somewhat enlarged in anterior to posterior plane. Posterior 1 or 2 rays little expanded. In a folded position, rays

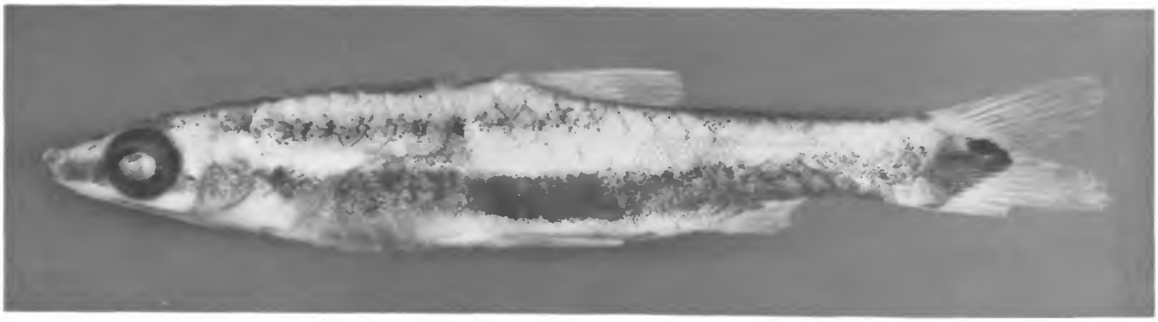

FIGURE 16.—*Nannostomus bifasciatus*, ZMA 106.159, young, 23.2 mm SL, Tapoeripa Creek near Herman's Village, 1 km north of Brokopondo, Surinam, 25 July 1966.

take an alternate position to each other in regard to median plane. However, fin not remarkably modified as in *N. digrammus* and *N. minimus.*

Scales belonging to that part of third horizontal scale row below dorsal fin having posterior field with 1 to 3 or rarely 4 (usually 2) radial grooves; dorsal and ventral fields with one anterior field with 3 or usually 4 radial grooves. Scales in lateral series 23 to 27, most often 25 or 26. Predorsal scales 10 or 11, usually 11.

Total number of vertebrae 35 to 38, usually 36 or 37 (one with 38).

Wiley and Collette (1970) described breeding tubercles or contact organs in male *N. bifasciatus* as without a distinct keratinized cap and occurring on ventral surface of head, lower jaw, and in several rows posterior to isthmus. We find these tubercles very small and white in preserved specimens. Adult males with as many as 18 to 25 along ventral border of subopercular and interopercular bones. Up to 18 small tubercles scattered over exposed surface of each dentary, up to 3 on each maxillary bone, and as many as 20 to 25 on each third infraorbital bone. At least 5 or 6 occur on ventral surface of first and second infraorbital bones. Total number of tubercles on ventral surface of head nearly 150.

COLOR IN ALCOHOL.—Top of head dark brown, back light brown. Primary horizontal stripe dark brown, nearly black, extending from snout tip and lower jaw onto anterior surface of eye, across lower border of fifth orbital bone and upper border of fourth orbital bone to over upper limit of preopercle, spreading across opercle to posterior bony border. On body, primary horizontal stripe beginning anteriorly underneath fleshy opercular flap and extending through lower half of third scale row (from top), almost completely through fourth scale row, and through upper third of fifth scale row. Primary stripe widening posteriorly to include all of fourth scale row along caudal peduncle and above anal fin. Primary stripe covers entire ventral half of caudal peduncle and posteriormost 1 or 2 rays of anal fin. Stripe continues into dorsal portion of ventral lobe of caudal fin, including at least 2 ventralmost rays of dorsal lobe of fin. Black of stripe continues nearly to termination of fin rays. Black may form a wedge-shaped area or simply a rounded "blotch" as in Figure 17. Ventral to horizontal stripe, sides, and belly white with a few irregularly scattered melanophores. Tertiary stripe absent except for a few malanophores just anterior to pelvic-fin base. Silvery or white stripe dorsal to primary horizontal stripe, extending from eye to caudal-fin base. Two areas of large, scattered melanophores occur on stripe, forming oblique bands. Anterior band covering 3 to 4 scales anterior to a point just ventral to anterior origin of dorsal fin. Posterior band covering another 3 to 4 scales in area of silvery stripe. Center of posterior band at a point dorsal to vent. Just dorsal to pale or silvery stripe, a narrow secondary stripe arises just dorsal to termination of dorsal opercular opening and extends posteriorly through center of second scale row below dorsal fin. Posterior to dorsal fin, stripe may merge with dark color of back or continue (as in Figure 14) to dorsalmost surface of caudal peduncle to a point posterior to a vertical from the posterior termination of the anal fin. All median fins, except as described

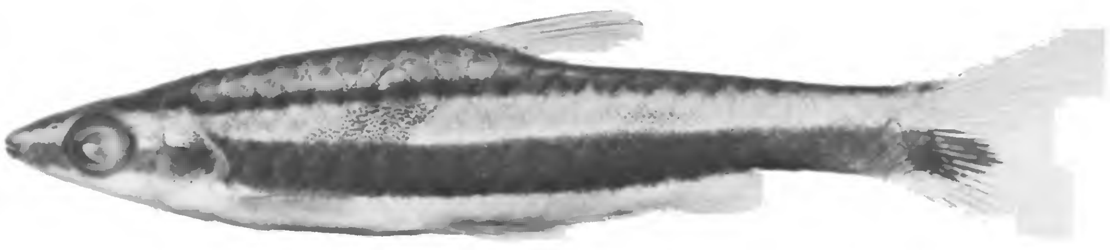

FIGURE 17.—*Nannostomus bifasciatus,* ZMA 106.156, male, 35.7 mm SL, creek tributary to Surinam River, 500 km south of Botopasi, Surinam, 19 March 1967.

above for caudal fin and anal fin, colorless except for a few scattered melanophores. Pelvic and pectoral fins with melanophores scattered along borders of rays.

Color in Life.—Life colors recorded by Weitzman (1966) were based on the description of Hoedeman (1954). The present description is based primarily on color photographs taken of freshly preserved specimens from Marowijne Creek, Surinam, collected by H. Nijssen, October 1966. Back dorsal to secondary dark stripe olive brown. Secondary dark stripe brown to black. Pale stripe between primary and secondary stripes pale yellow or pale green to white. Sides and belly ventral to primary black stripe white. Area on caudal peduncle dorsal and ventral to primary stripe orange (perhaps more red in life). A similar orange color at base of anal fin. Hoedeman (1954) recorded a "reddish flush" on the base of the caudal and anal fins in living specimens. There is an orange or red spot associated with the nares on the Marowijne Creek specimens. Hoedeman (1954) records that the pelvic fins are tipped with "ice blue." As would be expected, the blue is absent in the freshly preserved specimens, being quickly destroyed by formalin.

Discussion.—We have little to add to the discussion under "Remarks" by Weitzman (1966). Hoedeman (1953 and 1954) reported a vestigial adipose fin in *N. bifasciatus.* Weitzman (1966) found no trace of one in Hoedeman's types and we found none in any specimen examined here. It has been noted above that a canal in the second infraorbital bone may be present or absent. Our present views concerning the relationships of this species are discussed under the genus.

Specimens Examined.—(Note, all specimens from Surinam and collected by H. Nijssen unless otherwise indicated.) 3, paratypes, ZMA 100.513, SL 27.2–28.3 mm, (only two specimens could be measured as snout of one damaged), Berg en Dal, Surinam River, March 1952, Blij-Dorp Expedition (not collected by Nijssen). 12, ZMA 106.144, SL 28.9–43.1 mm, Witte Creek, 12 km south from Brownsweg, Brokopondo District, 23 November 1966. 28, ZMA 106.145, SL 34.5–43.2 mm, Marowijne (=Gran) Creek about 53.5 km south from dam at Afobaka, Brokopondo District, 25 May 1966. 12, ZMA 106.146, SL 23.5–36.8 mm, Zij Creek (=Gran Mau), 1 km northeast of Dombaai (=Bendi Watra), Gran Rio, 15 km southwest of Bjoemoe, May 30, 1967. 11, ZMA 106.147, SL 20.4–42.2 mm, Marowijne Creek, Brokopondo District, 58 km south of dam at Afobaka, 9 June 1966. 22, ZMA 106.148, SL 24.0–35.4 mm, Dabikwen (=Baling) Creek, Brodobaka, 5 km north of Afobaka, Brokopondo District, 19 September 1966. 14, ZMA 106.153, SL 32.6–43.2 mm, Marowijne (=Gran) Creek, Brokopondo District, 60 km south of dam at Afobaka, 8 June 1966. 7, ZMA 106.154, SL 20.5–37.1 mm, Marowijne (=Gran) Creek, 51 km south of dam at Afobaka, Brokopondo District, 27 May 1966. 2, ZMA 106.155, SL 30.2–37.7 mm, Marowijne (=Gran) Creek, 50.5 km south of dam at Afobaka, Brokopondo District, 6 May 1966. 5, ZMA 106.156, SL 31.4–38.4 mm, Kwati Watra Creek, Suriname River, 500 km south of Botopasi, Brokopondo District, 19 March 1967. 10, ZMA 106.158, SL 34.6–37.4 mm, Makami (=Makambi) Creek, 8 km south of Brownsweg, Brokopondo District, 13 September 1966. 3, ZMA 106.159, SL 25.8–34.8 mm, Sara Creek, about 31 km south of Borpje Dam, Brokopondo District, 12 October 1966. 2, ZMA 106.160, SL 30.7–33.1 mm, Sara Creek, about 27 km south of Dorpje Dam, Brokopondo District, 14 October 1966. 2, ZMA 106.161, SL 24.1–37.1 mm, Marowijne (=Gran) Creek, 63 km south of dam at Afobaka, 20 October 1966. 7, ZMA 106.163, SL 25.9–38.6 mm, Parwapa (=Paba) creek, Suriname River, 2.5 km from Botopasi near Voetoenakaba (=Voetoepkaba), 20 March 1967. 4, ZMA 106.164, SL 25.5–39.9 mm, French Guiana, creek emptying into Marowijne River just west of Mooisantitabbetje, 3 km north of Stoelmanseiland, 19 April 1967. 4, ZMA 106.165, SL 25.7–35.1 mm, creek emptying into Marowijne River, Manbari Val, 6 km north of Stoelmanseiland, 20 April 1967. 6, ZMA 106.166, SL 22.5–32.3 mm, Maka Creek, emptying into Lawa River, 10 km south of Stoelmanseiland, Marowijne District, 21 April 1967. 14, ZMA 106.167, SL 27.9–41.8 mm, Soeakisi Creek, emptying into Tapanahony River, 12 km southwest of Stoelmanseiland, Marowijne District, 22 April 1967. 4, ZMA 106.168, SL 23.3–29.6 mm, French Guiana, Kamoloea of Saloea Creek, tributary of Marowijne River, 9 km southeast of mouth of Gran Creek (in Marowijne District of Surinam), 24 April 1967. 51, ZMA 105.696, SL 16.9–38.2 mm, Jenjee Creek emptying into Surinam River 7.5 km north of Botopasi, 21 March 1967. 2, ANSP 112253, SL 19.3–22.2 mm, French Guiana, Maroni Creek (Surinam name) into Gaa Kaba, 21 November 1957, J. Géry. 1, USNM 208266, SL 22.5 mm, French Guiana, Barcarel Tecun, Ouaqui River, tributary of Maroni River, 9 September 1971, Eric Remole. 7, USNM 208265, Sl 21.6–25.5 mm, small stream tributary to Ouaqui River, a tributary of Maroni River, 5 September 1971, Eric Remole. 7, USNM 208264, SL 16.2–25.2 mm, French Guiana, Ouaqui River, tributary of Marone, 5 September 1971, Eric Remole.

Nannostomus minimus Eigenmann

FIGURES 18, 19, 20, 21

Nannostomus minimus Eigenmann, 1909:42 [original description; type-locality: Erukin, British Guiana; holotype in Field Museum of Natural History].—1910:427 [listed]; 1912: 282, pl. 36; fig. 5 [description].

Nannostomus beckfordi (in part) Weitzman, 1966:12 [listed as a synonym under *N. beckfordi*, holotype not seen].

Weitzman (1966) considered this species a synonym of *N. beckfordi*. At that time he had based his opinion on an examination of a "cotype," CAS (IUM) 11691, and on the accounts and photographs given by Eigenmann (1909 and 1912). We have now examined the holotype, FMNH 52771, and consider it to represent a valid species. The holotype (Figure 19) and "cotype" are both females, only the holotype being in good condition. The tertiary line is faded in these specimens but can be plainly seen in the holotype (Figure 19). Discovery of adult males and females (Figure 20) in the collections at the American Museum of Natural History and the gift of a live pair from Mr. Ross Socolof now make redescription of the species possible.

The "cotype," (SL 16.6 mm) CAS (IUM) 11691, also from Erukin is in poor condition and very faded. The presence of a tertiary stripe is not obvious, only a few faded melanophores are present in the region of the base of the anal fin. This specimen was compared with a 16 mm standard length specimen of *N. beckfordi* from Surinam (USNM 208261). No differences in eye size or other morphometric characters were found, and pigment patterns and meristics were the same. It is our opinion that this Erukin specimen, a paratype of *N. minimus*, is a specimen of *N. beckfordi*.

The following description is based on all 9 known specimens, 16.2–22.8 mm in standard length.

DIAGNOSIS.—Primary stripe present, secondary stripe absent or, if present, extremely weak. Nocturnal oblique bands present, permanent blotches absent. Adipose fin absent. Males with a greatly modified anal fin, with rays larger in diameter and

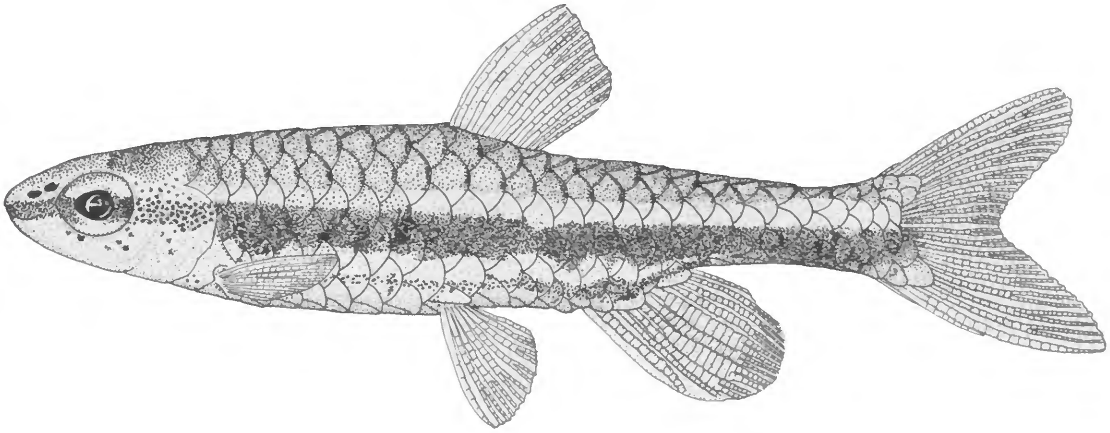

FIGURE 18.—*Nannostomus minimus*, USNM 210676, male, 20.9 mm SL, Eping River, tributary of the Mazaruni River, Guyana, 1973.

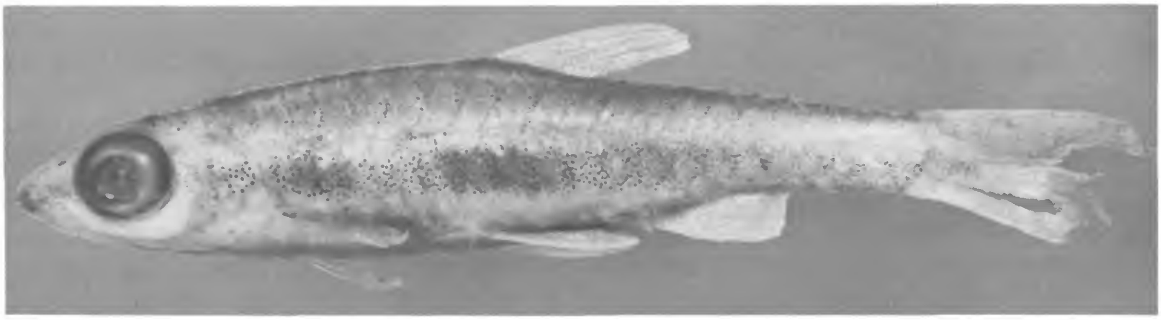

Figure 19.—*Nannostomus minimus*, FMNH 52771, female, 16.2 mm SL, holotype, Erukin, Guyana, October 1908.

considerably longer than those of females (see Figures 20 and 21). Caudal fin normal, with 10 principal rays terminating in dorsal lobe and 9 in ventral lobe.

Description.—Body elongate, cylindrical, with a somewhat compressed caudal peduncle. Greatest body depth just anterior to dorsal fin 199 (191–241). Least depth of caudal peduncle 079 (074–083); length of caudal peduncle 166 (173–235); snout tip to anterior origin of anal fin 682 (666–702).

Head conic, slightly flattened dorsally. Head 273 (254–281); eye diameter 101 (094–107); least width of bony interorbital 084 (078–089).

Premaxillary with 5 teeth, all 4 cuspid; 2 central cusps largest and equally large except median tooth, with second from lateralmost cusp largest. Maxillary with 1 tooth bearing 3 cusps, central

Figure 20.—*Nannostomus minimus*, USNM 209207, male above, 16.8 mm SL, female below, 17.8 mm SL, "Kurapung" (probably equals Kurupung River, a tributary of the Mazaruni River), Guyana, 1938.

cusp largest. Dentary with 5 multicuspid teeth in outer row, anterior 3 teeth with 5 cusps (sometimes medialmost cusp very small; second from medial cusp largest). Fourth tooth with 4 cusps, medial cusp largest, and fifth with 2 or 3 subequal cusps. Inner row of dentary teeth simple, conic with 4 or 5 laterally placed teeth. Replacement teeth of outer row inside row, ventral to both inner and outer tooth rows, all replacement teeth with fully developed cusps.

Gill rakers 10 + 13.

Dorsal fin ii,8; anal fin iii,9; pectoral fin i,9 or i,10; pelvic fin ii,7; principal caudal-fin rays 10/9. Adipose fin absent. Male anal fin modified in a manner similar to that of *N. digrammus,* with rays somewhat thicker and longer than those of female. Anterior 3 unbranched rays with about same modifications as similar rays in *N. digrammus.* First 4 branched rays of male thickened as compared to those of female (compare Figures 18, 19, 20, and 21), but not nearly as thickened in median plane as those of *N. digrammus* (see Weitzman, 1966, fig. 6). Anterior 4 branched rays alternately overlapping one another in collapsed fin, similar to those of *N. digrammus* as described by Weitzman (1966:24). Inclinator muscles extending bilaterally and distally onto posterior fin ray far beyond base of anal-fin rays. Anal fin of male when expanded forms a cup

FIGURE 21.—Live *Nannostomus minimus,* USNM 210676, female above, 22.8 mm SL, male below, 20.9 mm SL, same locality data as in Figure 18. Males in Figures 18 and 21 are the same specimen. Note contact organ on ventral surface of male's head (little white spots). In the preserved specimen these are extremely difficult to locate.

or becomes spoon shaped, as in *N. digrammus*. Distal tips of rays confined to a flat mass of tough nonexpandable fin tissue. Membranes between fin rays in central area of fin loose and allow considerable expansion of fin in this area even in preserved specimens.

Scales belonging to third horizontal scale series and lying below dorsal fin having anterior field with 3, sometimes 4, radial grooves. Posterior field with 1 or 2 radial grooves. Dorsal and ventral fields each with 1 radial groove. Scales in lateral series 23 or 24; perforated lateral line scales 1 or 2; scales in median series anterior to dorsal fin 9 or 10.

All specimens with total of 36 vertebrae.

Contact organs present in adult males (see male in Figure 21) but extremely hard to detect in preserved specimens and no count could be made.

COLOR IN ALCOHOL.—Top of head dark brown. Primary horizontal stripe dark brown, extending from tip of snout and lower jaw across eye and opercle but not across fleshy operclar flap. Primary stripe continues posteriorly on body from point internal to opercular flap, across midsides onto caudal peduncle, but apparently absent on caudal fin. Primary stripe extends across ventral one-fourth of third scale row of body and across dorsal three-fourths of fourth scale row. Secondary stripe apparently absent or nearly so. A pale stripe present dorsal to primary horizontal dark stripe; pale stripe with many scattered melanophores. Body dorsal to pale stripe light reddish brown. Tertiary stripe present, consisting of rather loosely scattered melanophores extending along ventral half of fifth scale row from pectoral girdle (internal to opercle) just anterior to base of pectoral fin to and along base of anal fin. Below primary dark stripe occurs another white area but without scattered melanophores. Area of oblique bands indistinct but may be present in pale stripe covering sixth and seventh scales and in area of pale stripe dorsal to anal fin. Belly pale, white. Dorsal fin with scattered melanophores but these more concentrated anteriorly, anal fin also with scattered melanophores but these more concentrated in central area of fin. Pelvic and pectoral fins with few, scattered melanophores in no particular pattern.

COLOR IN LIFE.—The color recorded here is from live specimens of USNM 210676 listed below in the "Material" section. Back and top of head dark olive brown. Scale borders of back narrowly outlined with black except for those portions of scale in area of secondary horizontal stripe. Primary horizontal stripe black, extending from lower jaw and snout tip through eye along body sides onto caudal fin where it ends as a diffuse pale black blotch, not wedge shaped. Primary horizontal stripe in both sexes with red chromatophores in area shared by stripe and anterior oblique bands. Red color of this area somewhat more intense in male than female. This color in both sexes very subdued and not forming a bright red blotch. Secondary horizontal stripe very weak, really existing only along scale margins that enter area immediately above pale horizontal stripe. Here secondary stripe is represented by an increase in number of melanophores along anterior and posterior scale margins. Stripe dorsal to primary longitudinal stripe pale yellowish green to silvery. Tertiary horizontal stripe black, dark and intense posteriorly, disappearing anteriorly on belly where dark melanophores become reduced in number until finally absent, or nearly absent, at a point below anterior border of anterior oblique band. Oblique bands not dark except at night when their melanophores expand. Sides between primary horizontal stripe and tertiary horizontal stripe silvery white. Abdomen and throat regions silvery white. Reflective color around nares pale yellow to pale orange. Dorsal portion of iris of eye above primary horizontal stripe yellow, lower portion below stripe silvery. A small amount of orange-brown pigment on caudal-fin base in association with primary horizontal stripe.

Dorsal, pectoral, pelvic, and caudal fins hyaline in both sexes except for a few melanophores scattered along rays. Anal fin of female and especially male with a scattering of melanophores in central region of fin, forming weakly developed dark blotch. Caudal-fin base pale yellowish green to very pale orange brown near termination of primary and secondary horizontal stripes.

MATERIAL.—1, holotype, FMNH 52771, SL 16.2 mm, Guyana, Erukin, Potaro River, C. H. Eigenmann, October 1908. 1, paratype, FMNH 52772, SL 18.6 mm, Guyana, Amatuk, Potaro River, C. H. Eigenmann, October 1908. 3, AMNH 14417, SL 17.4–19.1, Guyana, "Kurapung" (probably equals Kurupung River, a tributary of Mazaruni River, just north of Merume Mts.), collector unknown, 1938. 2, USNM 209207, SL 16.8–17.8 mm, same data as AMNH 14417. 2, USNM 210676, SL 20.9–22.8 mm, received alive from Mr. Ross Socolof, who received them with live specimens of *N. espei* from Mr. Louis Chung, an aquarium fish exporter-importer at Georgetown, Guyana. (Mr. Chung informs us that he collected these specimens from the Eping River, a tributary of the Mazaruni River, Guyana, early in 1973.)

Nannostomus marginatus Eigenmann

FIGURES 22, 23, 24

DIAGNOSIS.—Primary, secondary, and tertiary horizontal stripes all well developed. Nocturnal oblique bands present, permanent blotches absent. Anal fin of males short, not reaching caudal fin when adpressed to body. Adipose fin always absent. Scales in a lateral series 21 to 23. Caudal fin normal with 10 principal rays terminating in dorsal lobe and 9 in ventral lobe.

DISCUSSION.—Since the account of this species by Weitzman (1966), five of the "types" of *Cyprinodon amazona* Eigenmann have been located in the Department of Ichthyology, California Academy of Sciences, by the senior author. These specimens seem to be all that remain of the 18 specimens used as "types" in the original description (Eigenmann, 1894). Weitzman (1966:28) noted that the type-series possibly included both *N. marginatus* and *N. trifasciatus.* The existing five "types" are all *N. marginatus.*

As noted by Weitzman (1966), the name *N. trifasciatus* Steindachner 1876 predates *C. amazona* Eigenmann 1894; however, *C. amazona* predates *N. marginatus* Eigenmann (1909). The name *C. amazona* has never before been identified with certainty with *N. marginatus,* see Weitzman (1966), Fowler (1954), and Hubbs (1926). *Nannostomus marginatus,* on the other hand, is a well-established name, very common in the aquarium literature and always used in the ichthyological literature for the species identified with that name by Weitzman (1966). Thus the name *Nannostomus amazonus* qualifies for suppression by the International Commission of Zoological Nomenclature under the provisions of article 79 in the *Code* (as revised in the *Bulletin of Zoological Nomenclature,* volume 29, part 4, 29 December 1972). No useful purpose would be served by selecting a lectotype from the five existing specimens of Eigenmann's *Cyprinodon amazona* and substituting the name *Nannostomus amazonus* for *Nannostomus marginatus* on the basis

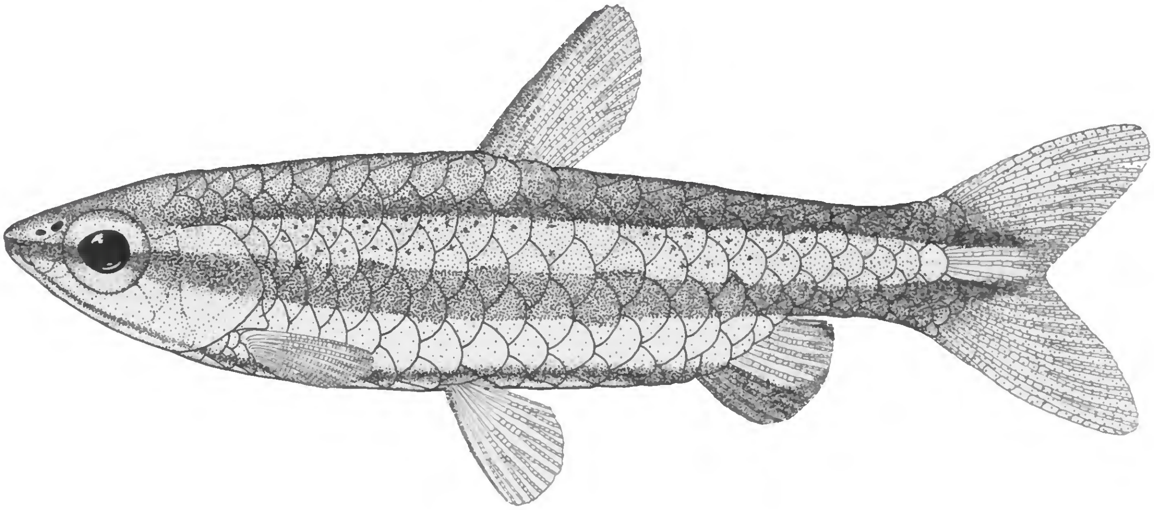

FIGURE 22.—*Nannostomus marginatus,* CAS(IUM) 11700, male, 19.5 mm SL, paratype, Gluck Island, Essequibo River, Guyana, 1908.

of priority. The current *International Code of Zoological Nomenclature,* article 23 (a,b) (also as revised in the *Bulletin of Zoological Nomenclature,* volume 29, part 4, 29 December 1972) states that ". . . the law of priority is to be used to promote stability and is not intended to be used to upset a long established name in its accustomed meaning through the introduction of an unused name which is a senior synonym." Thus, *Cyprinodon amazona* does not qualify as a senior synonym that must be used. If any other "types" of *C. amazona* are ever found and one or some of them prove to be *N. trifasciatus,* one of these should be selected as a lectotype and *Cyprinodon amazona* placed in the synonymy of *Nannostomus trifasciatus.*

Examination of specimens listed below from Surinam confirms the belief of Weitzman (1966) that Hoedeman (1954) was in error in finding different caudal-fin ray counts between specimens of *N. marginatus* from Guyana and Surinam. All specimens counted here had a principal caudal-fin ray count of 10/9. Weitzman (1966) noted that there are at least three geographically different color forms of this species. We have nothing else to add to the comments of Weitzman (1966) concerning this species.

MATERIAL.—5, (types of *Cyprinodon amazona*), CAS (IUM) 5083, SL 15.5–17.5 mm, Brazil, "Lower Amazon", F. C. Hartt. 4, ZMA 105.324, SL 16.2–20.3 mm, Surinam, Carolina (=Malasie) Creek, about 10 km south of Zanderij, 14 December 1966, H. Nijssen. 43, USNM 208257, SL 14.5–21.6 mm, Surinam, Para Creek, Berlijn, Para District, 14 September 1969, H. J. Pijpers.

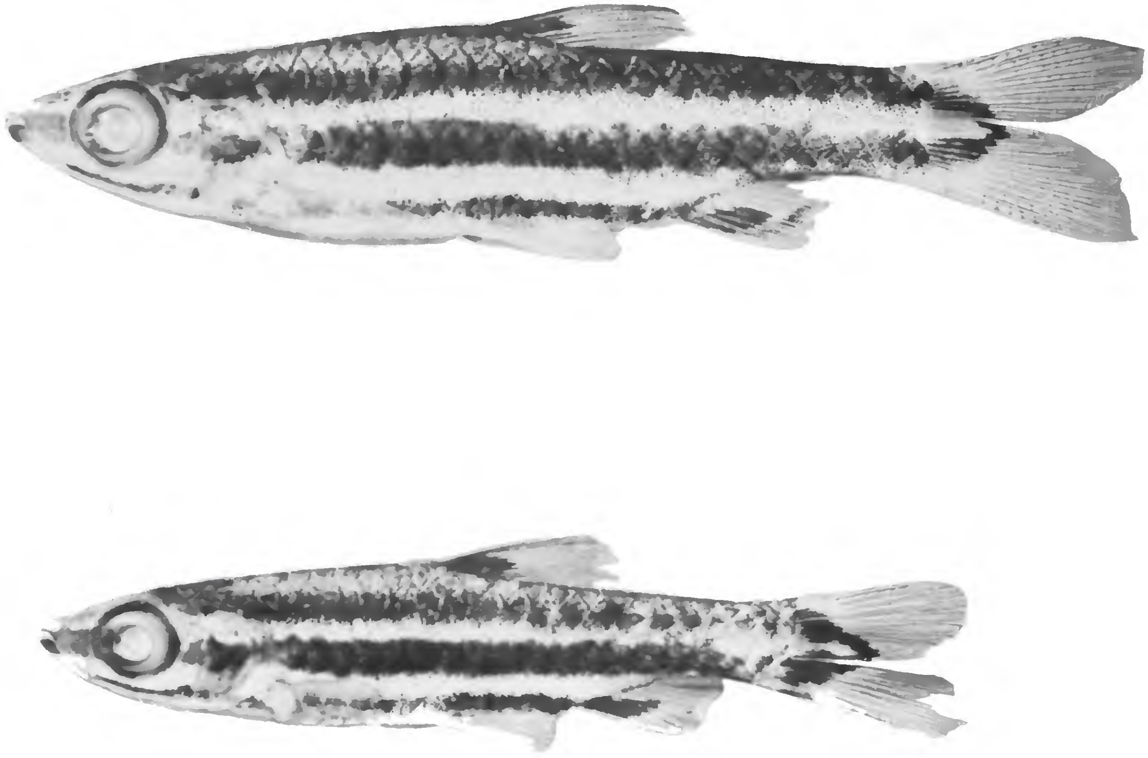

FIGURE 23.—*Nannostomus marginatus,* USNM 208257, male above, 18.5 mm SL, juvenile below, 15.0 mm SL, Para Creek, Para District, Surinam, 14 September 1969.

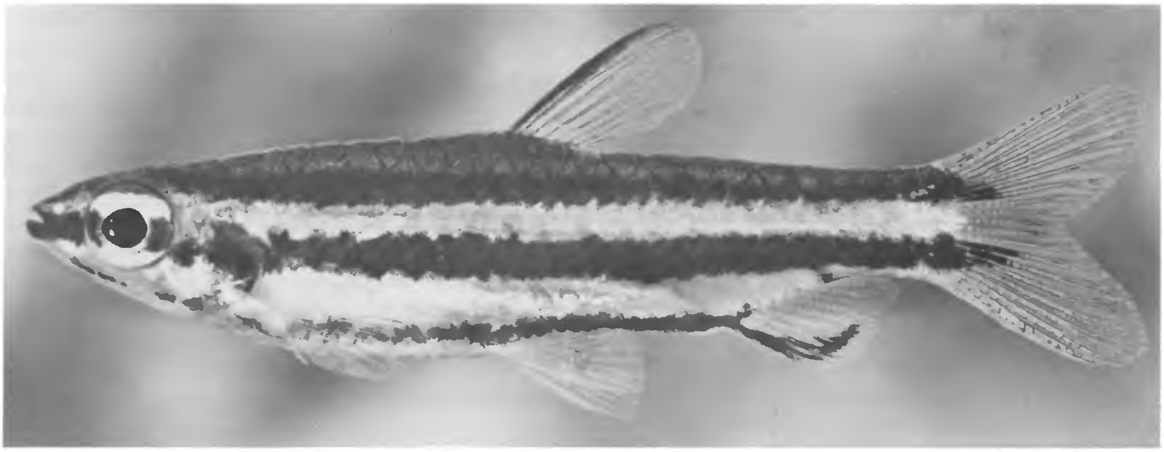

FIGURE 24.—Live *Nannostomus marginatus*, adult male, 21.6 mm SL, locality unknown.

Nannostomus trifasciatus Steindachner

FIGURES 25, 26, 27

DIAGNOSIS.—Primary, secondary, and tertiary horizontal stripes all well developed. Nocturnal oblique bands present, exceptionally broad, extending from a vertical line 3 or 4 scale rows posterior from posterior opercular border to posteriorly well past a vertical line from anterior base of dorsal fin (see Figure 26), frequently past a vertical from midbase of dorsal fin. Posterior oblique band extending posteriorly well beyond posterior end of anal-fin base. Permanent blotches absent. Eye diameter about 1.0 in interorbital width. Anal fin of male and female short, not reaching caudal fin when adpressed to body. Adipose fin present or absent. Scales in a lateral series 24 to 27. Caudal fin with 10 principal rays terminating in dorsal lobe and 9 in ventral lobe.

DISCUSSION.—We have little to add to the account

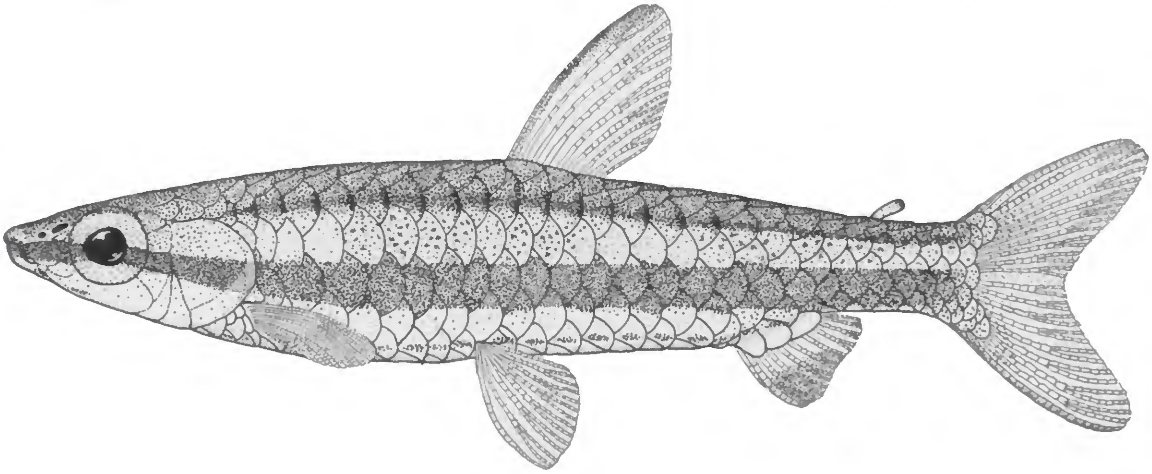

FIGURE 25.—*Nannostomus trifasciatus*, SU 36999 (now at CAS), male, 27.5 mm SL, Shansho Caño, Pévas [Pébas] District, Peru, July or October 1936.

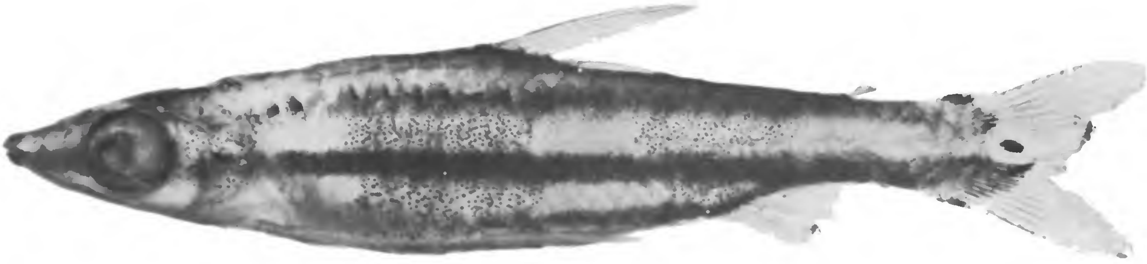

Figure 26.—*Nannostomus trifasciatus*, MCZ 46040, juvenile, 22.0 mm SL, Rio Apeú, Boa Vista, Municipio of Castanhal, Pará, Brazil, July 1965.

of this species given by Weitzman (1966). Comments on the nomenclatural problem concerning *Cyprinodon amazona* have been given above under *N. marginatus*. One interesting population sample of *N. trifasciatus* has come to hand since 1966. This is from the Rio Apeú, Boa Vista, Pará, Brazil. This population, known to us only from preserved specimens, is like other populations of *N. trifasciatus* from Brazil except that all specimens have an ocellus variously developed on the caudal fin. The specimen in which it is best developed is shown in Figure 26. In the least developed specimen, a female 26 mm in standard length, the dark spot is limited to a few rather scattered mela-

Figure 27.—Live *Nannostomus trifasciatus*, female above, 35.6 mm SL, male below, 34.8 mm, locality unknown.

nophores and could easily be overlooked. Most specimens show the ocellus reasonably well. Weitzman (1966:30, 31) noted that there are several distinct populations of *N. trifasciatus* which can be distinguished by color at least. The ocellated form seems to be another.

Figure 26 illustrates another feature of *N. trifasciatus* that is occasionally confusing to both aquarists and ichthyologists. When at their darkest the oblique bands in this species are broad, quite dark (black in life), and divide the fish into alternate vertical rings of pale and dark color. The operculum is dark in this species when the two oblique bands are dark. The preserved specimen in Figure 26 has the dark bands relatively pale but well represented, and Figure 27 shows a pair in life in a phase in which the oblique bands are almost absent.

MATERIAL.—7, MCZ 46040, SL 20.7–28.1 mm, Brazil, Rio Apeú, Boa Vista, Municipio of Castanhal, State of Pará, July 1965, N. Menezes. 1, MCZ 46041, SL 28.0 mm, Brazil, Igarapé at km 29 of the Castanhal-Belém road, Municipio of Santa Isabel, State of Pará, July 1965, N. Menezes. 3, USNM 208260, SL 21.2–26.6 mm, Brazil, Belém, State of Pará, November 1953, H. Axelrod. 8, USNM 179553, SL 19.1–25.9 mm, Brazil, Rio Urubú, 25 miles from Itacoatiara, State of Amazonas, October 1958, H. Schultz and H. Axelrod. 19, USNM 208263, SL 25.5–31.2 mm, Brazil-Bolivia border region between Guajaró-Mirim and Mato Grosso, Guarporé drainage, 1970, B. von Graeve.

Nannostomus marilynae, new species

FIGURES 28, 29, 30

Holotype, CAS (SU) 50238, SL 19.5 mm, Brazil, Rio Negro, rock pools below rapids, Sâo Gabriel, 1 February 1925, Carl Ternetz. 27 (4 alizarin preparations) paratypes, CAS (SU) 50239, SL 16.1–21.0 mm, same data as holotype. Specimens not considered as types: 1, CAS (SU) 50240, SL 18.0 mm, Brazil, Rio Negro, Castanheiro, 15 January 1925, Carl Ternetz. 3, CAS (SU) 50241, SL 17.1–17.6 mm, Colombian-Brazilian border region, "sandbank north of Cucuhy," 14 February 1925, Carl Ternetz. 8 (2 alizarin preparations), USNM 209227, SL 22.4–32.2 mm, aquarium specimens. The following description (except color and as otherwise noted in text) is based on the holotype and paratypes only. [Editor's note: See "Addendum" at end of this section.]

DIAGNOSIS.—Primary, secondary, and tertiary horizontal stripes present. Nocturnal oblique

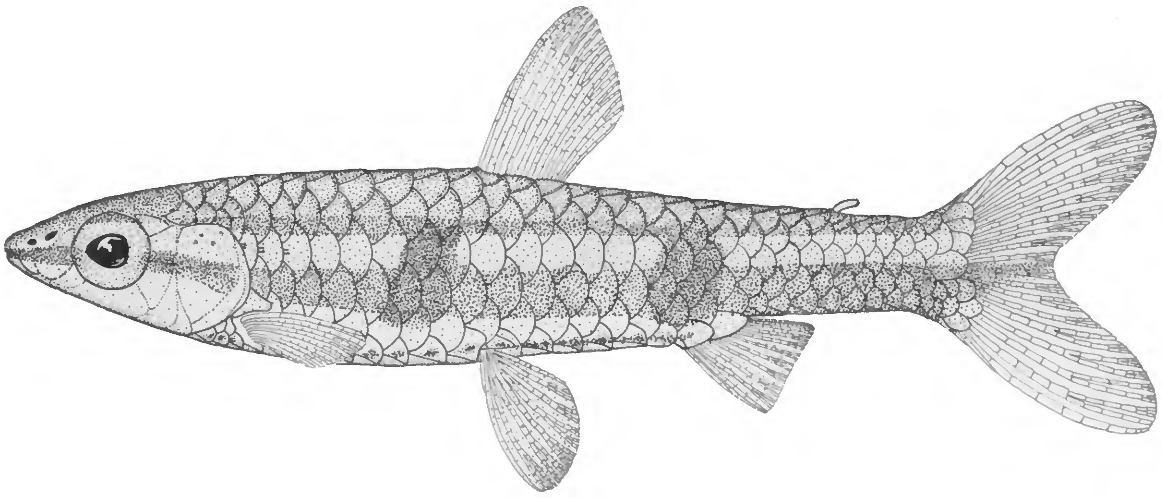

FIGURE 28.—*Nannostomus marilynae*, SU 50238 (now at CAS), 19.5 mm SL, holotype, rock pools below rapids, São Gabriel, Rio Negro, Brazil, 1925.

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. Adipose fin always present. Scales in lateral series 24 to 27. Anal fin of males not elongate or greatly modified. Eye diameter about 0.8 in least bony interorbital width.

DESCRIPTION.—Body elongate, more or less cylindrical, compressed in region of caudal peduncle. Greatest body depth at origin of dorsal fin 211 (190–225); least depth of caudal peduncle 090 (083–097); length of caudal peduncle 188 (167–205); snout tip to origin of dorsal fin 524 (510–560); snout tip to origin of anal fin 757 (739–784).

Head elongate, conic, snout obtuse, especially in dorsal profile. Head 266 (244–286); eye 101 (93–109); least width of bony interorbital 080 (074–089).

Premaxillary with 5 teeth, all 4 cuspid except the most posterolateral with 5 cusps; second from anteromedian cusp largest. Maxillary with 1 tooth bearing 5 cusps, dorsalmost cusp largest or next 2 ventral cusps largest. Dentary with 5 multicuspid teeth in outer row, each bearing 5 cusps except most posterior with 3 cusps; median cusp largest in all instances. Replacement teeth of outer row

FIGURE 29.—Live *Nannostomus marilynae*, USNM 209227, female above, 32.1 mm SL, male below, 25.6 mm SL, locality unknown.

present, ventral to outer and inner rows. Inner row of dentary teeth simple, conic with 6 to 9 teeth placed along entire inner margin of jaw but more concentrated laterally where 3 to 4 teeth occur relatively close together.

Gill rakers 8 or 9 + 13 or 14, usually a total of 21 or 22.

Dorsal fin ii,8; anal fin iii,9; pectoral fin i,8 to i,11; pelvic fin ii,7; principal caudal-fin rays 10/9. Adipose fin always present. Distal tips of all fin elements of first 10 principal caudal-fin rays ending in dorsal lobe of caudal fin in nearly all specimens. Ventral caudal-fin lobe containing all distal elements of 9 ventral principal rays. In one female (upper specimen in Figure 29) tenth ray down from top (dorsal edge of fin) in exact middle between two lobes; ventral lobe of caudal fin larger than dorsal lobe; morphology of caudal fin appearing somewhat intermediate between that of *N. eques* and *N. unifasciatus* on one hand and remainder of known species of *Nannostomus* on other. Anal fin of males somewhat modified, anterior 5 or 6 branched rays longer and more expanded in sagittal plane than remaining posterior branched rays. Compare shape of fin in male and female in Figure 29. Anal fin of holotype, Figure 28, typical of that of juvenile.

Scales belonging to third horizontal scale series and lying ventral to dorsal fin, having anterior field with usually 3 radial grooves; posterior field with 1 or sometimes 2 radial grooves; dorsal and ventral fields each with 1 radial groove. Scales in lateral series 25 to 26; 2 to 4 perforated lateral-line scales.

Total number of vertebrae 34 to 36, usually 34 (18 specimens), occasionally 35 (8 specimens), and rarely 36 (1 specimen).

COLOR IN ALCOHOL.—Top of head light brown. Back dorsal to secondary horizontal stripe brown, somewhat lighter than secondary dark stripe. Primary horizontal stripe extending from snout tip posteriorly across lower jaw, over first orbital bone, through eye and operculum, terminating at posterior border of bony operculum, but not extending onto fleshy opercular flap. On body this stripe extends from under fleshy opercular flap through fourth scale row on body and partially across third and fifth scale rows. Primary stripe expands posterior to anal fin to cover half of third scale row and all scale rows ventral to third scale row. Primary horizontal stripe extends posteriorly onto lower lobe of caudal fin. In preserved specimens (see Figure 28) caudal-fin portion appears as a black triangle. Above primary horizontal stripe, secondary stripe extends from dorsal border of operculum posteriorly along second scale series or row, fading into ground color of back somewhat anterior to adipose fin. Between primary and secondary stripes, pale stripe has few scattered melanophores except in areas of oblique bands, which occur between seventh and ninth and fourteenth and seventeenth scales in a lateral series of

FIGURE 30.—Live *Nannostomus marilynae*, USNM 209227, female, 24.0 mm SL, locality unknown, specimen exhibits nocturnal color pattern.

third scale row. These bands extend ventrally into primary horizontal stripe (Figures 28 and 30). Sides below primary stripe pale yellow (white in freshly preserved aquarium specimens) with few scattered melanophores. Oblique bands sometimes extend below primary stripe into this area (Figures 23 and 30). Tertiary stripe extends along sixth scale row from posterior termination of operculum to origin of anal fin, running ventral to base of pectoral fins and dorsal to base of pelvic fin. Dorsal fin with scattered melanophores more concentrated on anterior distal region of fin (sometimes with almost no melanophores). Pelvic, pectoral, and anal fins with few melanophores except posterior ray of anal fin, which may be fairly dark.

COLOR IN LIFE.—The color recorded here is from male specimens from an unknown locality. Top of head and back olive brown; scales of back bordered with black. Primary horizontal stripe black, continuous onto ventral lobe of caudal fin, covering proximal one-third to more than one-half of 5 or 6 dorsalmost rays of that fin lobe. Secondary stripe black but usually weakly developed. Silvery stripe between primary and secondary horizontal stripes with a greenish and pale golden reflectant color, producing what essentially looks like a burnished greenish silvery stripe. Oblique bands not dense black except possibly occasionally at night (see Figure 30), usually as shown in Figure 29. Sides below primary horizontal stripe on abdomen silvery and belly silvery white. Golden to orange-brown pigment around nares and on anterior border of eye. No bright red pigment at nares. Pale orange-brown pigment at caudal-fin base, ventral to black primary horizontal stripe. Dorsum of snout and head olive brown, lower jaw silvery white. Throat region white. Dorsal, anal, pectoral, and pelvic fins entirely hyaline except for dorsal fin with black melanophores on basal one-third of fin rays. Caudal fin hyaline except for area where black primary horizontal stripe continues onto fin and an area of white pigment ventral to that stripe.

ETYMOLOGY.—The name *marilynae* is derived from that of the senior author's wife, Marilyn Sohner Weitzman, who has long shared his appreciation for the delicate beauty of members of the genus *Nannostomus*.

DISCUSSION.—The relationships of this species are not understood. In the key above, it keys closest to *N. trifasciatus*, sharing with that species a short anal fin; possession of primary, secondary, and tertiary stripes; an adipose fin; and 25 to 26 scales in a lateral series. It is very different from *N. trifasciatus* by its sharply different oblique bands (compare Figures 26 and 30), life colors (compare color description in Weitzman, 1966 of *N. trifasciatus* with that of *N. marilynae* published here), and somewhat smaller adult size, not exceeding 33 mm in standard length in old aquarium specimens in *N. marilynae* and up to 35.3 mm in standard length in old aquarium specimens of *N. trifasciatus*. In live color pattern *N. marilynae* is most like *N. minimus* but the males lack the highly modified anal fin of the male *N. minimus*. In caudal-fin modification but not in swimming position, *N. marilynae* shows some similarities to two larger species, *N. unifasciatus* (up to 38.8 mm in standard length) and *N. eques* (up to 35.4 mm in standard length). Both of these species are very different in live as well as preserved color patterns from *N. marilynae*.

ADDENDUM.—After this manuscript was set in type, we received from Dr. Jamie Thomerson of Southern Illinois University 190 mostly adult specimens of *Nannostomus marilynae*, collected 2 April 1974 by J. E. Thomerson, Donald C. Hicks, and Jesus Enrique Vaques from Caño Muco, about 15 kilometers west of Puerto Gaitan, toward Puerto Carreno, state of Meta, Colombia. The Caño Muco is a tributary of the Río Vichada, which is itself a tributary of the Orinoco River. These specimens came from an area collected commonly by aquarium fish exporters. This fact plus the detailed resemblance of these fishes to the aquarium specimens of *N. marilynae* in Figures 29 and 30 make it appear likely that these aquarium fishes came from either this or some adjacent aquarium collecting area in Colombia. The fact that *N. marilynae* occurs in the Rio Negro, Brazil, and in at least one Colombian tributary of the Río Orinoco is not surprising. The headwaters of the tributaries of the Orinoco closely approach the main courses of both the Río Inírida and Río Guaviare to the south of the Río Vichada in Colombia. The Inírida and Guaviare both drain into the Orinoco. Also the Río Orinoco and Rio Negro are connected by the Caño Casiquiare. These closely lying rivers can be expected to have very similar faunas, and other collections recently acquired from Mr. Socolof of

Bradenton, Florida, in the Río Vichada drainage have borne this out. For example, one collection from the Río Vichada drainage by Mr. Socolof has produced the second known record of *Brittanichthys axelrodi* Géry, previously known only from Praio Bulufu on the Rio Itu about 80 kilometers up the Itu from where it meets with the Rio Negro in Brazil. The locality is about 0°30′ south latitude and 63°30′ west longitude, which places it in about the center of the Rio Negro district. The cardinal tetra, *Cheirodon axelrodi* Schultz, is also known from these two areas in Brazil and Colombia. The specimens in the Caño Muco collection of *N. marilynae* (not to be considered as paratypes) have been distributed to the following museums: 125, FMNH 77981, SL 12.9–21.6 mm; 25, USNM 212161, SL 15.1–20.7 mm; 10, CAS 30868, SL 15.2–19.2 mm; 10, BM(NH), 1974.8.7.1–10, SL 15.8–20.2; 10, ANSP 128438, SL 15.3–19.9; 10, ZMA 113.365, SL 14.8–19.8.

Nannostomus unifasciatus Steindachner

FIGURES 31, 32

DIAGNOSIS.—Primary horizontal stripe very well developed, secondary and tertiary horizontal stripes absent. Nocturnal oblique bands absent in preserved specimens; permanent blotches absent. Adipose fin present. Scales in a lateral series 28 to 30, perforated scales in lateral line 2 to 5. Gill rakers 9 + 14. Inner tooth row of dentary absent, teeth in outer dentary row 6 to 7. Principal caudal-fin rays 10/9 but those ending in dorsal lobe 8, those ending in ventral lobe 11.

DISCUSSION.—We have here only the following range extensions to add to the account of this species given by Weitzman (1966).

Two, USNM 208258, SL 29.5–33.0 mm, Brazil-Bolivian border region, from the Rio Guaporé system somewhere between Guajará-Mirim and the state border of Matto Grosso, 1970, Bernard von Graeve. (These specimens have a well-developed caudal-fin ocellus.) 18, USNM 208259, SL 24.9–31.5 mm, Brazil, Rio Purus at Boca de Tapaua, H. Axelrod and H. Schultz.

Nannostomus eques Steindachner

FIGURES 33, 34

DIAGNOSIS.—Primary, secondary, and tertiary horizontal stripes well developed, with an additional stripe on back above secondary stripe. Nocturnal oblique bands present; permanent blotches absent. Adipose fin present or absent. Scales in a lateral series 24 or 25. No perforated lateral-line scales. Gill rakers 16 + 24. Teeth in inner dentary row 12, teeth in outer dentary row 9. Principal caudal-fin rays 10/9, but those ending in dorsal lobe 8, while those ending in ventral lobe 11.

We have no information additional to that supplied by Weitzman (1966).

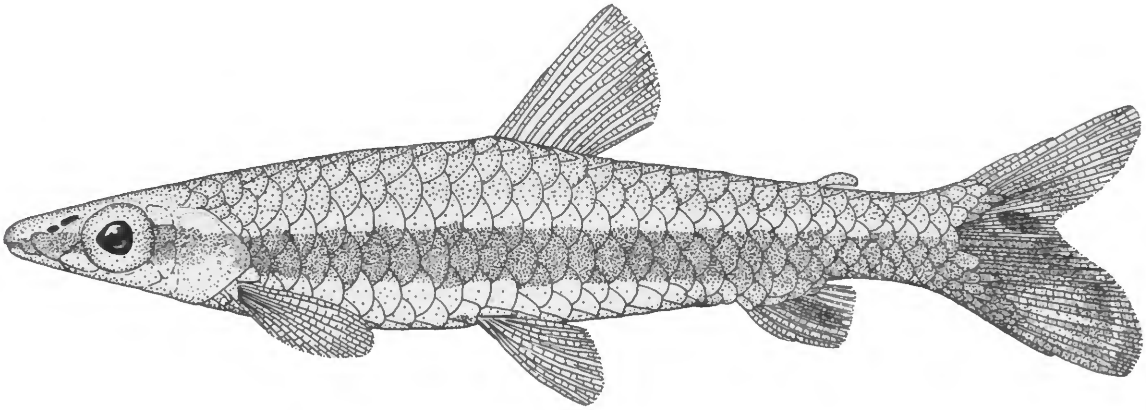

FIGURE 31.—*Nannostomus unifasciatus*, CAS (IUM) 11703, male, 33.4 mm SL, Wismar, Demerara River, Guyana, 1908.

FIGURE 32.—*Nannostomus unifasciatus*, male 35.6 mm SL, locality unknown, but specimen compares well with specimens known to come from Guyana.

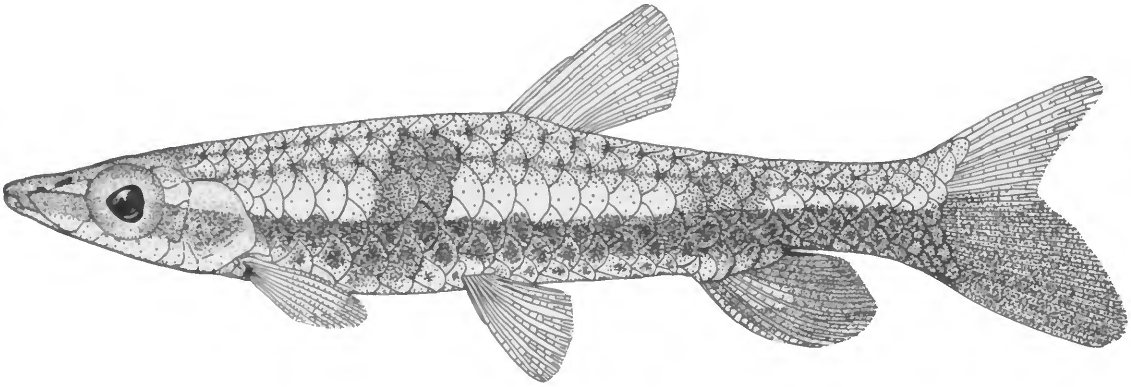

FIGURE 33.—*Nannostomus eques*, SU 50229 (now at CAS), male, 29.0 mm SL, rock pools below rapids, São Gabriel, Rio Negro, Amazonas, Brazil, 1925.

FIGURE 34.—*Nannostomus eques*, female above, 33.4 mm SL, male below, 32.5 mm SL, locality unknown.

Sumario

Basado en material nuevamente acumulado, este estudio es un tratamiento suplementario de una revista previa del gánero sudamericano *Nannostomus* por el autor mayor. Once especies están reconocidas aquí, *N. espei*, *N. diagrammus*, *N. harrisoni*, *N. beckfordi*, *N. bifasciatus*, *N. minimus*, *N. marginatus*, *N. trifasciatus*, *N. marilynae* (nueva), *N. unifasciatus* y *N. eques*. Una clave artificial a todas estas especies está incluida. Colecciones adicionales de dos especies, *N. bifasciatus* y *N. minimus*, han permitido una descripcíon más completa del aquella y reconocimiento de las más reciente que había estado listada como una sinónimo de *N. beckfordi* por Weitzman (1966). Una nueva especie, *N. marilynae*, esta descrita y ocurre en la cuenca amazona. Las corelaciones de todas las especies están reexaminadas y como la nueva material ha revelado condiciones intermedias es los sujetos usados antes para separar los géneros nominales *Nannostomus* y *Poecilobrycon*, éste está considerado como un sinónimo de aquél. Las relaciones entre las especies no son claras de las muestras poblaciones por lo general disponibles para el estudio pero parece probable que *N. espei* en el total de sus sujetos es la especie más primitiva de *Nannostomus* y no está relacionada sólidamente ningunas otras especies. *Nannostomus marginatus* y *N. trifasciatus* indudablemente se están relacionadas sólidamente pero no se parecen mucho a otras especies o grupo de especies. El mismo se puede decir de las relacionadas *N. eques* y *N. unifasciatus* en sus relaciones con otras especies. Las especies que se quedan, parecen todas distinctas entre ellas y sus relaciones posibles a otras especies en el género, se quedan obscuras.

Direcciones evolucionarias hacia la especializacíon en el género parecen ser el desarrollo de rayas longitudinales y de rayas oblicas, la pérdida de la osificación del canal sensorio en el segundo hueso infraorbital, una elongación y espesamiento de las aletas rayas anales de los machos usadas como una ayuda para fertilizar huevos, tal vez el desarrollo de un ocelo en el lóbulo dorsal de la aleta caudal y de tubérculos nupciales en la superficie ventral de la cabeza. Espesamiento de las aletas rayas anales ocurre hasta cierto punto en otros lebiasinidos pero está llevado a extremo en algunas especies de *Nannostomus*. Tubérculos nupciales ocurren en otro genéro lebiasinido, *Pyrrhulina*, pero su gran concentración en la superficie ventral de la cabeza en *N. unifasciatus* es una especialización no encontrada en *Pyrrhulina*.

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