NUMBER 737 January, 2006

OCCASIONAL PAPERS OF THE MUSEUM OF ZOOLOGY
UNIVERSITY OF MICHIGAN

ANN ARBOR, MICHIGAN

TAXONOMIC STATUS OF THE HISPANIOLAN CICHLIDAE

Prosanta Chakrabarty[1]

ABSTRACT.—Hispaniolan cichlids are poorly known, and because of the questionable taxonomic status of two species, the group is reviewed. *Nandopsis vombergi* (Ladiges, 1938) is regarded here as a junior subjective synonym of the widespread Hispaniolan species *Nandopsis haitiensis* (Tee-Van, 1935). The holotype and only known specimen of *N. vombergi* lacks any features that discriminate it from *N. haitiensis*. The Miocene fossil '*Cichlasoma' woodringi* Cockerell, 1924 is assigned to *Nandopsis* Gill, 1862 based on apomorphies it shares with members of that genus.

Key words: Greater Antilles, Hispaniola, *Cichlasoma, Nandopis, N. haitiensis, N. vombergi, N. woodringi*, Cichlidae.

INTRODUCTION

Three nominal species of cichlid fishes are described from the Greater Antillean island of Hispaniola. Two of these species, *'Cichlasoma' woodringi* and *Nandopsis vombergi*, are known only from the original material collected. The third species, *N. haitiensis*, is found throughout the island and closely resembles the other two species.

The species status of *Nandopsis vombergi* is suspect, based on its resemblance to *N. haitiensis*. Ladiges (1938) described *N. vombergi* from a single specimen collected in the Dominican Republic and diagnosed the species on the presence of greatly enlarged lips and a more rounded caudal fin than *N. haitiensis*. No material attributable to *N. vombergi* has subsequently been collected.

The original description of *'Cichlasoma' woodringi* is lacking in details. This fossil is the first cichlid described from Hispaniola. No comparative material from Hispaniola was included in its description (Cockerell, 1924). Most of what is known about this species is from an account by George S. Myers within the original description of *Nandopsis haitiensis* (Tee-Van, 1935). Myers (in Tee-Van, 1935) found no difference between

[1]Museum of Zoology, University of Michigan, Ann Arbor, MI 48109-1079, U.S.A.

Nandopsis haitiensis and the fossil except for number and size of the vertebral centra. In addition, Bussing (1985), Tee-Van (1935) and Rivas (quoted by Burgess & Franz, 1989 and Williams, 1989) all remarked on the similarity of the fossil and *N. haitiensis*. The specimen is important because it is the oldest freshwater fossil yet found in the Greater Antilles and is the oldest Neotropical cichlid fossil outside of South America. Some controversial issues about this fossil will be discussed here, including its age and taxonomic status.

'Cichlasoma' woodringi, as with most Middle American cichlids, is in taxonomic limbo. *Cichlasoma* was restricted to a small group of South American cichlids by Kullander (1983) leaving nearly 100 species formerly in that genus with uncertain taxonomic status. The generic denomination '*Cichlasoma*' is a reserve section for former members of that genus.

Kullander (2003) restricted *Nandopsis* Gill 1862, to *N. haitiensis, N. vombergi,* and *N. tetracanthus* (Valenciennes, 1831). The latter is the type species of the genus. *N. tetracanthus* and *'Cichlasoma' ramsdeni,* both endemics of Cuba, are sister species (Chakrabarty in review). For this reason, *'Cichlasoma' ramsdeni* will be included in comparisons made for all *Nandopsis* species.

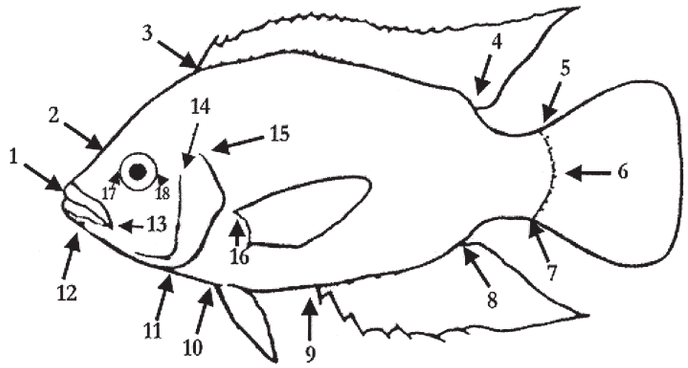

Fig. 1. Landmarks used in Principal Components Analysis (1) rostral tip of premaxilla (2) dorsal tip of premaxillary pedicel (3) anterior insertion of dorsal fin (4) posterior insertion of dorsal fin (5) dorsal insertion of caudal fin (6) caudal border of hypural plate aligned with lower lateral line (7) ventral insertion of caudal fin (8) posterior insertion of anal fin (9) anterior insertion of anal fin (10) dorsal base of pelvic fin (11) end of opercular membrane ventrally (12) inner aspect of dentary symphysis (13)caudal end of maxilla (14) dorsal end of preopercle ventral to pterotic (15) caudal end of opercule (16) pectoral fin origin (17) anterior margin of midline through eye (18) posterior margin of midline through eye. Base figure is redrawn from Nelson (1994).

MATERIALS AND METHODS

Digital images were taken from the left side of each specimen. Landmarks (putatively homologous points on anatomical structures) were chosen in order

to best represent the external shape around the body (Fig.1). Fin shapes were not included (except for their placement on the body) because of the challenge of determining homologous positions and poor preservation in many specimens. *TPSdig* (Rohlf, 1998) was used to digitize the landmarks on the images. Only specimens that were preserved unbent were photographed and digitized.

Generalized Least Squares (GLS) Procrustes superimposition was performed to remove size from the data. In the optimal superimposition, the distance minimized is the Procrustes distance, calculated as the square root of the summed squared distances between homologous landmarks (Goodall, 1991; Rohlf & Slice, 1990). This superimposition, and the Principal Components Analysis (PCA), was performed in *PCAgen* (Sheets, 2001).

Traditional morphometric measurements were taken with a dial caliper. Measurements and shape definitions (*e.g.*, concavity above eye, caudal fin shape) follow Barel *et al.* (1977) except where otherwise noted. 'Lip-corrected' measurements have been used on cichlids where certain individuals have greatly expanded lips and other related species or conspecifics do not (Barlow & Munsey, 1976). This corrected distance was used in measuring snout length, which is a measurement taken from the rostral tip of the premaxillae, at the midline (Barel *et al.*, 1977). The lip-corrected measurement for the snout length is necessary because the large lips of the *N. vombergi* specimen preclude measurement from the premaxillae.

The last hypural-bearing centrum is included in counts (breaking from the convention set by Barel *et al.*, 1977) to avoid confusion with counts from the original description of *Nandopsis haitiensis* (Tee-Van, 1935). Body depth was taken where the greatest vertical depth of the body was reached. All radiographs, measurements and counts were done on the left side. The following abbreviations are used: sk., = skeleton specimens, mm = millimeters, SL = standard length.

Institutional Abbreviations

AMNH	American Museum of Natural History, New York, New York, U.S.A.
ANSP	Academy of Natural Sciences of Philadelphia, Philadelphia, Pennsylvania, U.S.A.
CAS	California Academy of Sciences, San Francisco, California, U.S.A.
MCZ	Museum of Comparative Zoology, Cambridge, Massachusetts, U.S.A.
MZGJ	Museo de Zoología del Grupo Jaragua, Santo Domingo, Dominican Republic
USNM	National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A.
UMMP	University of Michigan Museum of Paleontology, Ann Arbor, Michigan, U.S.A.
UMMZ	University of Michigan Museum of Zoology, Ann Arbor, Michigan, U.S.A.
ZMH	Zoological Museum Hamburg, Hamburg, Germany

SYSTEMATIC ACCOUNTS

Nandopsis haitiensis (Tee-Van 1935) Figures 2-6

Cichlasoma haitiensis Tee-Van, 1935: 294, Figs. 270-272 [type locality: Étang Saumâtre, near Maneville, Cul-de-Sac Plain, Haiti]

Cichlasoma vombergi Ladiges, 1938: 18, Figs. 1-2 [type locality: Rio Yague del Sur, Dominican Republic]; Kullander, 2003: 639

Type Material Examined: USNM 170907 (holotype, 105 mm SL, Cul-de-Sac, Plain near Naneville, Etang Saumatre, Haiti), USNM 170908 (7, paratypes, 54-81 mm SL, Cul-de-Sac, Plain near Naneville, Etang Saumatre, Haiti), ZMH 401 (*Nandopsis vombergi* holotype, 182 mm SL, Rio Yague del Sur).

Fig. 2. *Nandopsis vombergi*, holotype, ZMH 401, 181.7 mm SL.

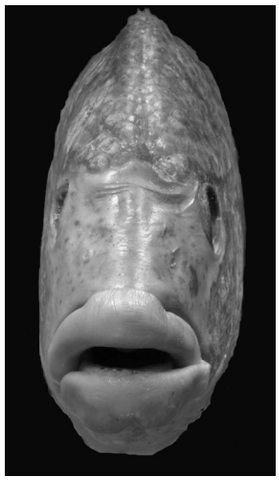

Fig. 3. *Nandopsis vombergi*, holotype, frontal view to show expansion of lips.

Fig. 4. *Nandopsis vombergi*, holotype, view of right side of caudal fin to show diagnostic caudal spot that is divided equally by lateral line.

Additional Nontype Material Examined: Dominican Republic: AMNH 229573 (3, 99-111 mm SL, Bahia de Neiba), AMNH 229574 (1, 122 mm SL, Bahia de Neiba), MCZ 62945 (10, 82-107 mm SL, Laguna Rincon, Cabral, Barahona), MCZ 64571 (2, 98-106 mm SL, Laguna Rincon, Cabral, Barahona), UMMZ 231521 (1 sk. Lago El Fondo=Etang Saumatre, 1km E of Haitian border at Jimani), UMMZ 243241 (1, 173 mm SL, Rio Piedras 11km SE of La Vega), UMMZ 243287 (1, 96 mm SL, Arroyo Basima tributary of the Rio Haima, Santo Domingo), UMMZ 243302 (18, 26-92 mm SL, km 49 on Highway 2 from Azua to San Juan, Rio Yague del Sur, Guanabana), UMMZ 243310 (7, 26-84 mm SL, km 51 on Highway 2, Amiama Gomez, Rio Yague del Sur, Guanabana), USNM 85764 (1, 124 mm SL, Santo Domingo, Lago Rincon, Cobral), USNM 367230 (5, 70-100 mm SL, Santo Domingo, Rio Viajamas at Valle de Viajama, Santo Domingo).

Haiti: UMMZ 142438 (4, 76-118 mm SL; 1 sk., 82 mm SL, Cazeau Creek, 4m N of Port-au Prince), UMMZ 200246 (1, 74 mm SL, 3km NW of Lac du Cayman-near Thomazeau), USNM 164796 (3, 88-97 mm SL, no data), USNM 164863 (6, 28-87mm SL, no data) USNM 87360 (1, 113 mm SL, Canot Road, Central Plain of Haiti, at Ford E of San Michel), USNM 298302 (2, 62-120 mm SL, Etang de Miragoane bridge).

Diagnosis: A species of *Nandopsis* distinguished from congeners by the following combination of characters: chest scales reduced in size, and covered in thick skin; possession of small dark circular spots distributed throughout the head; and a lack of a dark area in the asquamate auxiliary region. This species has a spindle shaped body with the greatest body depth reached at the base of the head rather than the midbody. There are two epurals that are nearly of the same rectangular shape and size, each supporting a single procurrent caudal fin ray.

Figure 5: *Nandopsis haitiensis,* holotype, USNM170907, 104.5 mm SL.

Comparisons To Related Species: The two characters that Ladiges (1938) used to diagnosis *Nandopsis vombergi* are present in *N. haitiensis* (*viz.*; more rounded caudal fin, lip shape and size) and cannot discriminate the nominal species. Figs. 2-8 illustrate the holotype of *N. vombergi*, the holotype of *N. haitiensis,* and the caudal fin and lips of additional material.

Fig. 6. *Nandopsis haitiensis*, USNM 122635, 111.5 mm SL, male with nuchal hump.

The caudal fin of *Nandopsis vombergi* is the same general shape as the caudal fin of the majority of Central American cichlids and is not more rounded than in *N. haitiensis* (Fig. 4; Fig. 8).

The size and shape of the lips also cannot be used to discriminate between *Nandopsis vombergi* and *N. haitiensis.* The lips of the holotype of *N. vombergi* are hypertrophied, with the upper lip lobed and the bottom lip bilobed due to the presence of a median cleft. The presence of lobed lips is a polymorphic trait in *N. haitiensis*, although I have not encountered individuals with lips hypertrophied to the extent seen in the holotype of *N. vombergi*. The degree of lip enlargement is most probably due to the large size of this specimen; the holotype of *N. vombergi* is 181.7 mm SL. Individuals of *N. haitiensis* with a standard length greater than 150 mm are rare in museum collections, although this species can reach sizes up to 215 mm SL (Kullander, 2003). An extensive search of museum collections (including the AMNH, MCZ, USNM, and UMMZ) recovered only one *N. haitiensis* specimen of comparable size to the holotype of *N. vombergi.* This specimen was examined, and it lacks expanded or lobed lips (UMMZ 243241, 173 mm). Many smaller individuals examined have lobed lips that closely resemble those of the holotype of *N. vombergi* but do not yet exhibit a similar degree of hypertrophism (Fig. 7). In other cichlid species, lobed lips in juveniles are often indicators of greatly expanded lips as adults, as in *Amphilophus labiatum* (Barlow & Munsey, 1976). This may also be the case for *N. haitiensis* because the lobed pattern of the lips of the

holotype of *N. vombergi* (single median lobe on upper lips, 'bilobed' appearance of lower lip) is commonly found in smaller *N. haitiensis* individuals.

Fig. 7. *Nandopsis haitiensis*, USNM 87360, 114.6 mm SL, showing expansion of lips.

Morphometric features are listed in Table 1. The snout length is longer in the holotype of *Nandopsis vombergi* than in other material of *N. haitiensis* examined. All other mensural and meristic data of the holotype of *N. vombergi* are consistent with *N. haitiensis* (Tables 1 and 2). This increased snout length is due to the greatly expanded lips of the holotype of *N. vombergi*. The removal of the additional distance due to the thickness of the upper lip (9.1mm wide) results in a snout length of 37 % head length, which is within the range observed for *N. haitiensis*.

An important polymorphism of *Nandopsis haitiensis* that appears in the *N. vombergi* specimen is a large nuchal hump (Figs. 2, 6). This trait occurs in some male individuals of *N. haitiensis* and is visible in specimens as small as 65 mm SL. Nuchal humps and lobed lips appear to be rare in *N. haitiensis*. A nuchal hump was present in less than 50 % of male specimens examined; lobed and expanded lips are present in less than 20 % of male and female individuals examined. Only one individual was found with both a nuchal hump and *N. vombergi* type

Table 1. Comparison of morphometrics among *Nandopsis* and related species. Mean outside parentheses, and range within parentheses.

	Head Length as % Standard Length	Body Depth as % Standard Length	Snout Length as % Head Length	Caudal Peduncle Length as % Standard Length	Caudal Peduncle Length as % Standard Length	Orbit Diameter as % Head Length	Interorbital Width as % Standard Length
N. haitiensis n=14 (96-124 mm SL)	38 (35-41)	40 (36-46)	41 (35-44)	13 (11-15)	15 (12-18)	22 (18-27)	12 (9-15)
N. vombergi n=1 (182 mm SL)	37	41	46	12	17	18	12
N. tetracanthus n=19 (97-136 mm SL)	38 (34-41)	45 (38-56)	34 (30-36)	12 (9-13)	18 (15-20)	23 (18-31)	12 (9-15)
'C'. ramsdeni n=9 (91-167 mm SL)	32 (31-34)	49 (45-51)	42 (35-49)	12 (12-16)	17 (13-18)	27 (24-32)	12 (11-13)

Table 2. Meristics, fin counts include spiny rays and soft rays, gill rakers counted on the ventral half of the most rostral gill-arch, centra count includes hypural. Lateral line count is the total of both anterior and posterior portions.

	Dorsal Fin Count	Anal Fin Count	Gill Raker Count	Lateral Line Count	Vertebral Centra
N. haitiensis n= 14	XIV-XV 10-12	IV 8-11	10-12	27-32	29-30
N. vombergi n=1	XV 12	IV 9	11	30	29
N. woodringi n=1	XV 10	IV 8-9	?	?	28-29
N. tetracanthus n= 19	XIV-XV 10-12	IV 8-11	6-9	28-32	28-29
'C'. ramsdemi n=9	XV 11-14	V 9-10	10-11	28-34	28-29

lips (86mm SL male in USNM 367230).

A Principal Components Analysis of body shape shows that the *Nandopsis vombergi* specimen falls within the middle of the cluster of points of *N. haitiensis* specimens (Fig. 10). The graph of PC 1 vs. PC 2 explains 58% of the total variation in shape among the specimens. Because size was removed from the analyses, this percentage does not include size as a dimension of variation. This graph also shows that overall body shape can be used to discriminate between the spindle shaped Haitian cichlids and more deep bodied Cuban cichlids.

Ladiges (1938) remarked that the holotype of *Nandopsis vombergi*

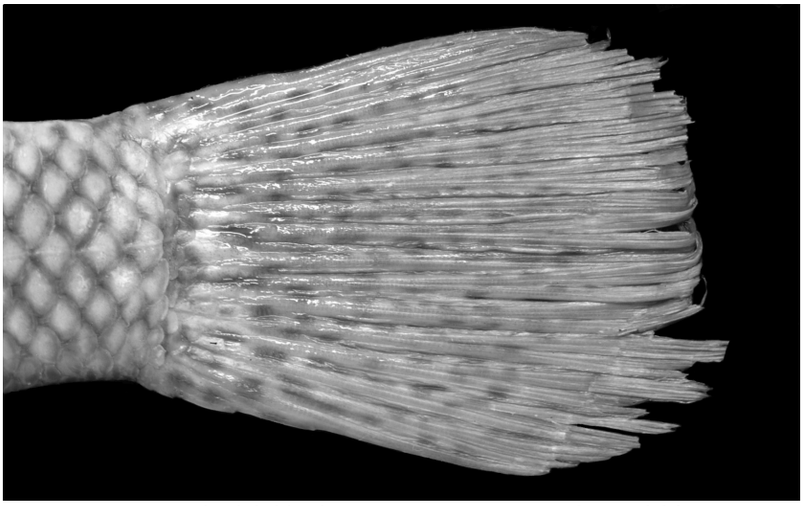

Fig. 8. *Nandopsis haitiensis* UMMZ 243241, 173.2 mm SL, caudal fin.

Fig. 9. *Nandopsis tetracanthus*, AMNH 96390; 133.6 mm SL

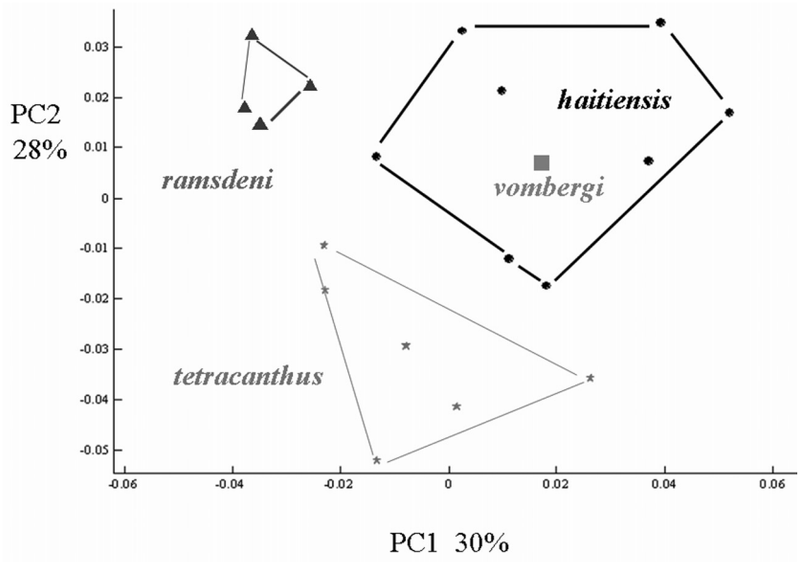

Fig. 10. Principal Component Analysis, PC 1 vs. PC 2. *'Cichlasoma' ramsdeni* (triangles) and *Nandopsis tetracanthus* (stars) form discrete groups. *N. haitiensis* (circles) forms a group where the holotype of *N. vombergi* (square) falls near the middle.

had a pigment pattern very similar to that of *N. haitiensis*. Although much of the pigment has faded from the holotype, what remains is indistinguishable from the pattern in *N. haitiensis*. This includes small circular spots throughout the body extending onto the fins, a large midlateral spot below the upper lateral line row directly in front of the lower lateral line, and a spot on the caudal fin straddling the lateral line.

The traits that distinguish *Nandopsis haitiensis* from other members of *Nandopsis* also are present in the holotype of *N. vombergi*. *N. haitiensis* can be distinguished from all other *Nandopsis* species by its more slender (compressed) body, chest scales, pigmentation pattern, and features of its epurals. The chest scales in *N. haitiensis* form a discrete patch of small embedded skin-covered scales (relative to those of the rest of the body) as opposed to the slightly larger imbricate scales of other *Nandopsis* species. The two epurals in *N. haitiensis* are similarly sized and together bare two procurrent caudal fin rays. In *N. tetracanthus* and *'Cichlasoma' ramsdeni* the two epurals are often of dissimilar size and shape, bearing together three to four rays in *N. tetracanthus* and two rays in *'C.' ramsdeni.*

Nandopsis haitiensis differs from *N. tetracanthus* and *'Cichlasoma' ramsdeni* in having small circular spots distributed throughout the head

versus spots large and often fused together in a reticulate pattern in *N. tetracanthus* and absent beyond the operculum in '*C.' ramsdeni*. *N. haitiensis* also differs from the two Cuban species in lacking a dark area in the asquamate auxiliary region.

Nandopsis haitiensis can further be distinguished from *N. tetracanthus* in several ways. *N. tetracanthus* have a caudal spot dorsal to the lateral line, whereas in *N. haitiensis* this spot always straddles the lateral line. The maxillary shank (the triangular shaped posterior fold at the angle of the mouth) is greatly expanded in *N. tetracanthus* but is not expanded beyond the angle of the mouth in *N. haitiensis*. A nuchal hump is absent in *N. tetracanthus,* and sometimes present in males of *N. haitiensis*. In *N. tetracanthus* the dorsal profile of the head lacks a concavity. There is always a pronounced concavity above the eye in *N. haitiensis*, even when a nuchal hump is absent.

Nandopsis haitiensis can be distinguished from '*Cichlasoma' ramsdeni* by four versus five anal-fin spines. *N. haitiensis* always has at least six cheek scale rows; '*C.' ramsdeni* has four. A nuchal hump is always present in both males and females of adult '*C.' ramsdeni.*

Systematic Status Of *Nandopsis Vombergi*: Characters that distinguish *Nandopsis vombergi* from *N. haitiensis* could not be found and I conclude that it is a junior subjective synonym of *N. haitiensis.* Features reported by Ladiges (1938), including expanded lips and a more rounded caudal fin, are also found in specimens of *N. haitiensis*. The presence of a nuchal hump and lobed lips in the holotype of *N. vombergi* are polymorphic traits that also occur in *N. haitiensis.* The size of the lips alone does not warrant distinguishing *N. vombergi*, as they appear to be only moderately larger than those of other *N. haitiensis* individuals.

Nandopsis woodringi (Cockerell 1924)

Cichlasoma woodringi Cockerell 1924: 2, Figs. 1-2 [type locality: Las Cahobas, Haiti]

Type Material Examined: USNM 10766 (holotype, fossil, 64 mm SL, Las Cahobas, Haiti).

Additional Nontype Material Examined: USNM 10767 (1, fossil, fragments of anal and dorsal fins, Las Cahobas, Haiti).

Description And Comparison To Related Species: The holotype of the fossil *Nandopsis woodringi* is incomplete, lacking much of the caudal region including the entire caudal fin, and much of the anterior portion is crushed (Figs. 11, 12). Additional preparation of the specimen has revealed more information about the fossil than was available to previous workers.

All identifiable portions of the fossil appear to be identical with structures in *Nandopsis haitiensis* and *N. tetracanthus*. Comparable

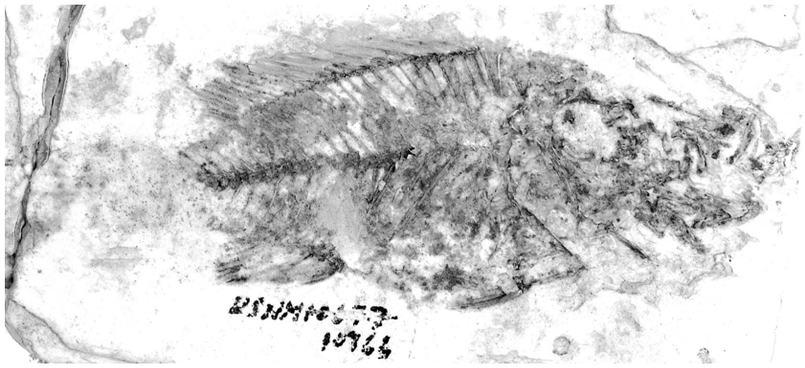

Fig. 11. *Nandopsis woodringi* USNM 10766, 64 mm SL approx.

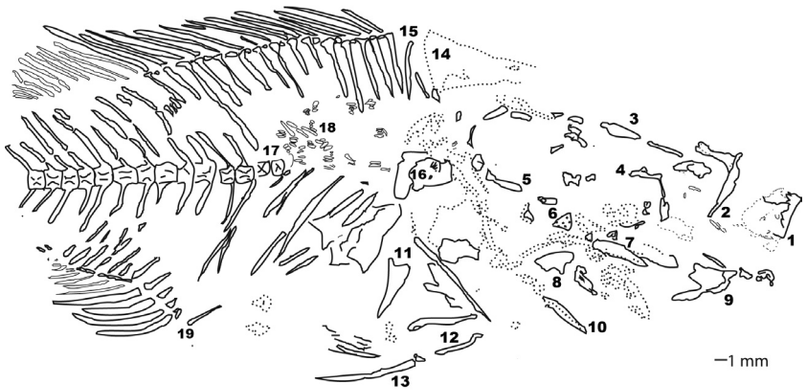

Fig. 12. illustration of USNM 10766. 1 –left dentary, 2 – lower arm of premaxilla, 3 ascending process of premaxilla, 4 – palatine, 5- infraorbital, 6 – lower pharyngeal jaw, 7 – parasphenoid, 8 – quadrate, 9 – right dentary 10 – branchiostegal, 11 – cleithrum, 12 – left pelvic bone above, right pelvic bone below, 13 – pelvic fin, 14 – supraoccipital crest, 15 – 2nd predorsal, 16 – hyomandibular, 17 – last abdominal centrum, 18 – scales, 19 – anal fin.

regions include: spine and ray counts, fin placement on the body, oral and pharyngeal dentition, shapes and sizes of bony elements and vertebral centra count.

Vertebral centrum sizes and counts have been used to distinguish the fossil from *Nandopsis haitiensis*. The posterior abdominal centrum is the only abdominal centrum visible on the fossil; it is followed by the first caudal centrum (defined by Barel *et al.*, 1977 as bearing a clear association to the first anal-fin pterygiophore). Myers (in Tee-Van, 1935) stated that he counted neural spines in order to estimate the number of abdominal centra; however, only portions of five neural spines and ribs are exposed on the fossil.

Radiographs of the fossil reveal that only nine (non-sequential) abdominal centra remain intact on the fossil and the sediment matrix completely covers all but the last two. Counting dorsal-fin pterygiophores can reveal the number of abdominal centra. In Middle American cichlids, the number of dorsal fin pterygiophores associated with a dorsal fin spine is one fewer than the number of centra (pers. observ.). This formula (# of dorsal fin ptergiophores – 1 = the number of centra) results in an accurate count of the number of abdominal centra in Middle American cichlids, including the Antillean cichlids (pers. observ.). By this count there are 12 abdominal centra in the holotype of *Nandopsis woodringi* (not 14 as stated in Tee-Van, 1935). Immediately posterior to the 12th abdominal centrum, the anterior 12 caudal centra are exposed. The remaining centra, those at the caudal peduncle, are lost save for the first one. (This first caudal peduncle centrum is the 12th caudal centrum.) Myers (in Tee-Van, 1935) proposed that there are three centra lost at the tail. A latex peel of the caudal region revealed that there are no fossilized elements or impressions of bone remaining in the caudal region. In *N. haitiensis* and *N. tetracanthus*, there are normally a total of five or six centra in the caudal peduncle. With this extrapolation the total vertebral count on the specimen comes to 28 or 29 (with the addition of four or five centra in the caudal peduncle). This count is short of the 31 to 33 mentioned by Tee-Van (1935). The usual count of vertebral centra in *N. haitiensis* is 29, rarely 30. In *N. tetracanthus* this count is usually 28 and sometimes 29.

Nandopsis woodringi was distinguished from *N. haitiensis* by having slightly smaller centra (Tee-Van, 1935). The difference in the size of the centra between the extant and fossil material may be due to the comparative material available to Myers. Myers compared the fossil to a single specimen of *N. haitiensis* measuring 74 mm (Myers in Tee-Van, 1935). This measurement is assumed to be standard length and not total length; it is not clearly stated which measurement was taken (measurements of other material are given as standard length). The holotype of *N. woodringi* is 64mm from the most anterior bone fragment to the last vertebral centrum. The head region is crushed and displaced in a manner that extends the length of this region well beyond what the distance was in life. Because the caudal region is also lost, it appears this specimen was probably no longer than 65 mm SL in life. The few exposed intact centra of the fossil are square and 1.3 mm across. *N. haitiensis* and *N. tetracanthus* individuals between 60 mm and 70 mm SL have square vertebrae in equivalent positions that are between 1 and 2 mm across.

An additional specimen collected with the holotype of *Nandopsis woodringi* contains fossilized fragments of a nearly complete anal fin,

and portions of a dorsal fin and caudal peduncle. Cockerell (1924) described the anal fin fragment as having 21 soft anal rays. Twenty-one soft anal rays would be a count much higher than the great majority of known cichlids (Nelson, 1994) and appears from examination to be erroneous. There are only nine soft anal rays in the anal fin fragment. The holotype of *N. woodringi* appears to have eight anal fin soft rays. Both of these counts are within the range observed for both *N. haitiensis* and *N. tetracanthus*.

All identifiable bony elements of *Nandopsis woodringi* are identical to homologous regions of *N. haitiensis* and *N. tetracanthus*. (However, the slender body shape of the fossil more closely resembles *N. haitiensis*.) Meristic counts overlap among all three of these species.

With the limited information the specimens of *Nadopsis woodringi* provide it would be premature to claim that it is not a valid species. It would not be reasonable to claim this species is a senior synonym of *N. haitiensis* or a junior synonym of *N. tetracanthus*. Additional material with well preserved diagnostic features might help in this determination.

Nandopsis woodringi has lingual cusps on the oral teeth (Fig. 13) as well as four anal-fin spines. These two characters in combination are unique to *N. haitiensis* and *N. tetracanthus*. Because *N. tetracanthus* is the type species for *Nandopsis*, these shared features warrant '*Cichlasoma' woodringi* being recognized as *N. woodringi* (Cockerell, 1924).

The age attributed to this fossil has been misrepresented in several studies. *Nandopsis woodringi* was described as a Miocene fossil from Las Cahobas, Haiti (Cockerell, 1924). Van Couvering (1982) mentions *N. woodringi* or the fossil bed in which it was found three times: in a figure as questionably 'Miocene', in the text as '?Pliocene' and later as 'Upper Miocene'. No justification is given for any of the assignments. Casciotta and Arratia (1993) use the '?Pliocene' designation of Van Couvering without explanation. Murray (2001) uses the designation 'Pliocene' for the fossils citing Casciotta and Arratia (1993). Fossil plants collected from the same locality have always been referred to as either early

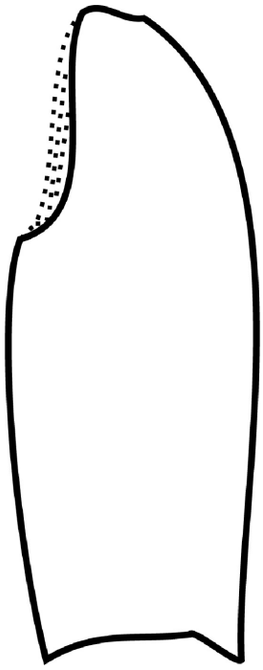

Fig. 13. Enlargement of oral tooth with lingual cusp found between left dentary and lower arm of premaxilla of USNM 10766. Tooth measures .5 mm.

Middle Miocene (Cooke *et al.,* 1943) or late Miocene (Bowin, 1975; see also Graham, 1990). There is no justification for assigning this fossil to an age younger than Miocene.

ACKNOWLEDGMENTS

Carlos Rodríguez, Hector Andujar and other members of Grupo Jaragua in the Dominican Republic were essential in making collections and sparking interest in this and other projects in Hispaniola. William Sanderson helped greatly in preparing fossil material. Many thanks for loans, space and time to Jerome Finan, Jeffrey Williams, Susan Jewitt, and Robert Purdy at the USNM; Damaris Rodríguez, Barbara Brown and John Sparks at the AMNH; Horst Wilkens at ZMH, and Karsten Hartel and George Lauder from the MCZ. The UMMZ Fish Division William Fink, Gerald Smith, Juan Jacobo Schmitter-Soto, Heok Hee Ng, Ronald Oldfield, John Whitlock and Douglas Nelson all provided helpful insight in improving this paper.

LITERATURE CITED

Barel, C.D.N., M.J.P. van Oijen, F. Witte, & E.L.M. Witte-Maas. 1977. An introduction to the taxonomy and morphology of the Haplochromine Cichlidae from Lake Victoria. *Netherlands Journal of Zoology,* 27: 333-389.

Barlow, G.W. & J.W. Munsey. 1976. The Red Devil-Midas-Arrow Cichlid species complex in Nicaragua. pp. 359-370. *In*: T.B. Thorsin (ed.) *Investigations of the Ichthyofauna of Nicaraguan Lakes*. University of Nebraska, Lincoln. 663 pp.

Bowin, C. 1975. The geology of Hispaniola. pp. 501-552 *In*: A.E. M. Narin and F.G. Stehli (eds.) *The ocean basins and margins*. Plenum, New York. 583 pp.

Burgess, G.H. & R. Franz. 1989. Zoogeography of the Antillean freshwater fish fauna pp. 263-304. *In*: C.A.Woods (ed.) *Biogeography of the West Indies: past, present, and future.* Sandhill Crane Press, Gainesville, 878 pp.

Bussing, W.A. 1985. Patterns of distribution of the Central American ichthyofauna. pp. 453-473. *In*: F.G. Stehli & S.D. Webb (eds.) *The great American biotic interchange.* Plenum, New York, 532 pp.

Casciotta, J. & G. Arratia. (1993) Tertiary cichlid fishes from Argentina and reassessment of the phylogeny of New World cichlids (Perciformes: Labroidei). *Kaupia - Darmstädter Beiträge zur Naturgeschichte,* 2: 195-240.

Cockerell, T.D.A. 1924. A fossil cichlid fish from the Republic of Haiti. *Proceedings of the United States National Museum,* 63: 1-3.

Cooke, C.W., J. Gardner, & W.P. Woodring. 1943. Correlation of the Cenozoic formations of the Atlantic and Gulf coastal plain and the Caribbean region. *Bulletin of the Geological Society of America,* 54: 1713-1723.

Gill, T. 1862. Remarks on the relations of the genera and other groups of Cuban fishes. *Proceedings of the Academy of Natural Sciences Philadelphia,* 14: 235-242.

Goodall, C. 1991. Procrustes Methods in the Statistical Analysis of Shape. *Journal of the Royal Statistical Society,* 53: 285–339.

Graham, A. 1990. Late Tertiary microfossil flora from the Republic of Haiti. *American Journal of Botany,* 77: 911-926.

Kullander, S.O. 1983. *A revision of the South American cichlid genus Cichlasoma (teleostei: Cichlidae).* The Swedish Museum of Natural History, Stockholm. pp. 296.

Kullander, S.O. 2003. Family Cichlidae (Cichlids). pp. 605-654. *In*: R.E. Reis, S.O. Kullander & C.J. Ferraris Jr. (eds.) *Check List of the Freshwater Fishes of South and Central America*.

Edipucrs, Porto Alegre. pp. 729.
Ladiges, W. 1938. *Cichlasoma vombergi* spec. nov., eine zweite rezente Cichliden-Art von Santo Domingo. *Zoologisher Anzeiger,* 123: 18-20.
Murray, A.M. (2001) The fossil record and biogeography of the Cichlidae (Actinopterygii: Labroidei). *Biological Journal of the Linnean Society,* 74: 517-532.
Nelson, J.S. 1994. *Fishes of the world, 3rd edition*. John Wiley & Sons, Inc., New York, NY. 600 pp.
Rohlf, F. J. 1998. *TPSdig*. State University of New York. Buffalo, NY. available at http://life.bio.sunysb.edu/ee/rohlf/software.html.
Rolhlf, F. J. & D.E. Slice. 1990. Extensions of the Procrustes method for the optimal superimposition of landmarks. *Systematic Zoology,* 39: 40–59.
Sheets, H.D. 2001. *PCAgen* available at http://www2.canisius.edu/~sheets/morphsoft.html.
Tee-Van, J. 1935. Cichlid fishes in the West Indies with especial reference to Haiti, including the description of a new species of *Cichlasoma. Zoologica,* 10: 281- 300.
Valenciennes, M. 1831 in Cuvier, G.B. & M. Valenciennes. 1831. *Histoire naturelle des poisons* Volume 7. Starsbourg, Imprimerie de F.G. Leverault, Paris. pp. 531.
Van Couvering, J.A.H. 1982. Fossil cichlid fishes of Africa. *Special Papers in Paleontology*,29. The Paleontological Association, London. 103 pp.
Williams, E.E. 1989. Old problems and new opportunities in West Indian Biogeography, pp. 1- 46. *In*: C.A.Woods (ed.) *Biogeography of the West Indies: past, present, and future*. Sandhill Crane Press, Gainesville. 878 pp.

APPENDIX 1

Additional Materials Examined

Institutional catalog number, number of specimens examined, size range and locality information follow the species name. Specimens in alcohol unless otherwise noted.

'Cichlasoma' ramsdeni

Type Material Examined: ANSP 68454 (holotype, 170 mm SL, Arroyo Hondo, Yaterus, Guantanamo, Cuba), ANSP 68455-68458 (4, paratypes, 88-132 mm SL, Guaso River, Guantanamo, Cuba).

Additional Nontype Material examined: Cuba: MZGJ 00342 (2, 91-107 mm SL, Guantanamo River), UMMZ 230839 (1, 104 mm SL, Guantanamo River system), UMMZ 231322 (1, 104 mm SL, Guantanamo River basin).

Nandopsis tetracanthus

Type Material Examined: CAS 78975 (*N. t. torralbasi*, holotype, 110 mm SL; paratype 134 mm SL, R. Almendares, Calabazar, Cuba).

Additional Nontype Material examined: Cuba: AMNH 1063 (1, 119 mm SL, Pinar del Rio), AMNH 96390 (4, 133-115 mm SL, Isla de la Juventud, Isla de Pinos), AMNH 96426 (1, 110 mm SL, La Habana), AMNH 96454 (1, 97 mm SL, Villa Clara), AMNH 96465 (1, 119 mm SL, Villa Clara, Rio Sagua La Chica), AMNH 96513 (1, 96465 116 mm

SL, Cienfuegas), USNM 64003 (2, 119-136 mm SL, San Antonio, Cuba), UMMZ 171879 (1, 112 mm SL, Rio Guama, Pinar del Rio Province), UMMZ 171880 (3, 112-124 mm SL, Uiña les, Pinar del Rio Province), UMMZ 177285 (1, 118 mm SL, Pinar del Rio), USNM 33642 (1, 98 mm SL, no data). USNM 63995 (2, 65-88 mm SL, no data).