Nico, L.G. 2001. Alexander von Humboldt (1769-1859): Contributions to knowledge of New World fishes. Pages 127-164 *in* G. Aymard (editor). Alexander von Humboldt: Homenaje al Bicentenario de su llegada a tierras Venezolanas (16 de julio-1799 al 26 de novienbre-1800). BioLlania, Special Edition No. 7 (Guanare, Venezuela).

ALEXANDER von HUMBOLDT: Homenaje al Bicentenario de su Llegada a Tierras Venezolanas

(16 de julio-1799 al 26 de noviembre-1800)

BioLlania

Edición Especial Nº. 7

Editor: Gerardo Aymard

ALEXANDER VON HUMBOLDT (1769-1859): CONTRIBUTIONS TO KNOWLEDGE OF NEW WORLD FISHES

Leo G. Nico

United States Geological Survey, Florida Caribbean Science Center, 7920 N.W. 71st Street, Gainesville, Florida 32653-3071 U.S.A (Leo_Nico@usgs.gov)

ABSTRACT

The German naturalist Friedrich Heinrich Alexander von Humboldt's (1769-1859) contribution to New World ichthyology included the collection and description of at least 20 new fish taxa, including two new genera: *Astroblepus* (family Astroblepidae) and *Eremophilus* (family Trichomycteridae), both still recognized as valid. Humboldt's species descriptions include fishes from at least 11 families: Cichlidae (3 species [2 valid]), Astroblepidae (2 [2 valid]), Erythrinidae (1 [not valid]), Pimelodidae (5 [1 valid, possibly more]), Trichomycteridae (1 [valid]), Doradidae (1 [valid]), Sternopygidae (1 [valid]), Characidae (3 [1 or 2 valid]), Hemiodontidae (1 [valid?]), Atherinidae (1 [valid]), and Gerreidae (1 [valid]). In addition to his description of new fishes, his writings and assistance strongly influenced other naturalists and scientists of the 1800s to further explore the New World and its fishes.

INTRODUCTION

The German naturalist Friedrich Heinrich Alexander von Humboldt (1769-1859) became internationally famous for his outstanding intellect and broad variety of scientific interests. As a result of a requested meeting with King Charles IV of Spain in early 1799, Humboldt and his companion, the naval surgeon and botanist Aimé Jacques Goujaud Bonpland (1773-1858), obtained royal permission to explore the Spanish colonies (Papavero 1971). In early June 1799, Humboldt, 29 years of age,

departed Spain en route to the New World on the frigate "Pizarro." The entire journey lasted more than five years, with most of the time spent exploring South America. Included were travels through parts of present-day Venezuela, Brazil, Cuba, Colombia, Peru, Ecuador, and Mexico, and a brief visit to the United States. During the following decades, Humboldt wrote extensively about his explorations in the New World. His popular and scientific writings inspired many young explorers and scientists and influenced many fields, contributing greatly to 19th-century knowledge of that region's plants, geology, geography, climate, culture, and native peoples. Humboldt's contribution to biology largely was based on his botanical collections and observations. However, he also made important contributions to zoology, particularly in the field of ichthyology.

The purpose of this paper is to provide an overview of Humboldt's contribution to our knowledge of New World fishes. To accomplish my goal, I examined several works published by Humboldt. I inspected each of the seven volumes of the 1818-1829 English-translation by Helen Maria Williams of Humboldt's "Relation historique du voyage aux régions équinoxiles du nouveau continent." In addition, I obtained parts of volumes one and two of Humboldt's "Voyage de Humboldt et Bonpland, Deuxieme partie. Observations de Zoologie et d'Anatomie comparée" that contained information on fishes. Other important sources reviewed were Papavero (1971) and Wilson (1995), among others. Partly to evaluate the lasting importance of Humboldt's contributions, I also reviewed the literature to determine the current status of New World fishes described as new by Humboldt.

I have not seen several works mentioned by Wilson (1995) that possibly may contain information on fishes collected by Humboldt. One of these is the "Atlas pittoresque du voyage." According to Wilson, that work contains 69 plates made from Humboldt's own sketches, which Humboldt considered the companion volume to his narrative "Relation historique..." Also referenced by Wilson (1995:lvi), and of possible consequence in terms of fishes, are volumes corresponding to Humboldt's travels in Ecuador and Peru edited by Margot Faak (1986), and narratives of his later journeys to Peru, Quito, and the ascent of Chimborazo peak, appearing in Humboldt's 1808 "Ansichten de Natur," published in German and French simultaneously. In a Spanish volume, Röhl (1985) lists many of

Humboldt's published works. Titles on fishes, that I have not seen, include "Experiencias sobre la respiración de los peces," dated 1809, and "Sobre los *Gymnotus* y otros peces eléctricos," dated 1819. Although I attempted to cover most of the relevant information, my literature review is not exhaustive. In particular, it is likely that I have overlooked important references on Humboldt's fishes published by other scientists.

In the following sections I review three major works by Humboldt, mainly in terms of his observations and study of New World fishes. Subsequently, I provide an annotated list of the New World fishes described as new by Humboldt. Lastly, I briefly discuss Humboldt's influence on other scientists and their work on fishes. Included is a list of the names of fishes described in his honor.

PUBLICATIONS BY HUMBOLDT ON NEW WORLD FISHES

Based on Wilson (1995:lv), all three of the works discussed here should be considered only a part of Humboldt's overall work entitled "Voyage aux régions équinoxiles du nouveau continent, fait en 1799, 1800, 1801, 1803 et 1804" that began in Paris, in French, in 1805, and ended in 1834 after the entire thirty folio and quarto volumes had been published. According to Bauchot et al. (1997), the huge task took 20 years to complete and required Humboldt's entire fortune.

1) "Relation historique du voyage aux régions équinoxiles du nouveau continent"—This is a multi-volume work originally published in French with volume one (643 pages) published in 1814, volume two (722 pages) in 1819, and volume three (632 pages) in 1825 (Wilson 1995:lxiii). According to Wilson (1995), the volumes were to represent a popular account of Humboldt's other published works, dealing with his journey to the New World, sometimes taking the form of a diary. During the 1800s the work was translated into other languages, one of the earliest being a complete, but slightly imperfect, English translation by Helen Maria Williams in collaboration with Humboldt himself (see Wilson 1995:lix). Williams' translation appeared in seven volumes during the period 1818 to 1829 under the title "Personal narrative of Travels to the Equinoctial

Regions of the New Continent, during the Years 1799-1804." My citing of volumes and page numbers are in reference to Williams's translation.

In "Relation historique..." Humboldt mentions only a very few of the many kinds of fishes that he certainly encountered during his long trip. Except for long discourses on flying fish and electric eels, most information on fishes is brief and of little scientific value. In at least one instance, Humboldt mentions a fish that he later described as new. Unfortunately, "Relation historique..." covers only the first part of Humboldt's New World journey, ending in March 1801 with Humboldt and Bonpland halfway up the Río Magdalena in Colombia. According to Wilson (1995), Humboldt had the fourth volume ready for publication but then ordered it destroyed. Consequently, the published volumes contain no information on any of the fishes encountered during his travels through Columbia, Ecuador, Peru, and Mexico. In spite of its limited importance to ichthyologists, Humboldt's writings on fishes in "Relation historique..." cover a wide range of topics, some quite interesting. The following is a review of information on fishes in "Relation historique...":

In late June 1799, after passing through the Canary Islands off the northwest coast of Africa, Humboldt's ship headed west across the Atlantic toward the continent of South America. In crossing 22° N latitude during the trans-Atlantic passage, Humboldt witnessed thousands of flying fish, *Exocoetus volitans*. He was especially impressed by their ability to leap several meters above the ocean surface. In his writings, Humboldt (1818, vol. 2:12-16) described the fish's behavior and anatomy as it related to flying. He also was interested in its ability to survive out of water. Because some fish leaped onto the deck of his ship, Humboldt had the opportunity to dissect one or a few specimens and recorded his observations on their large swim bladder and pectoral fins. He also speculated on why the fish took to flight, noting that flying fish were preyed upon by dolphins and other fish while in the water and attacked by large oceanic birds while in flight. Nearly a century later, Gill (1905) published a detailed account on flying fishes. Although Gill cites the observations of others from the 1800s, he makes no mention of Humboldt's writings on *Exocoetus*.

In mid-July 1799, Humboldt approached Cumaná on the northeastern coast of South America. Upon arrival, Humboldt (1818, vol. 2:44) wrote that the ship's crew was approached by coastal Indians, Guayquerias, who presented them with "fresh cocoa nuts, and very beautifully colored fish of the *chaetodon* [italics mine] genus." Later, the natives told the Europeans that the interior plains to the south held many animals of interest, including crocodiles, large snakes, and electric eels or "tembladors" (Humboldt 1818, vol. 2:47-48).

During the rainy season of 1799-1800, Humboldt visited Lake Valencia (=Tacarigua?), the large inland water body situated in northern Venezuela some 80 km southwest of Caracas. Humboldt (1819, vol. 4:160) described the lake region and noted:

> *"The lake is in general well stocked with fish; though it furnishes only three kinds, the flesh of which is soft and insipid, the guavina, the vagra, and sardina. The two last descend into the lake by the streams that flow into it. The guavina, of which I made a drawing on the spot, is twenty inches long, and 3.5 thick. It is perhaps a new species of the genus erythrina [italics mine] of Gronovius. It has large silvery scales, edged with green. This fish is extremely voracious, and destroys the other kinds."*

Humboldt subsequently described the guavina encountered in Lake Valencia as new, applying the name *Erythrinus guavina* (currently considered a junior synonym of *Hoplias malabaricus*). The common name "guavina" (usually spelled "guabina"), is still used throughout much of Venezuela for this same fish. The fish Humboldt called "sardina" was probably in reference to one or more small characins found in the lake. Humboldt's "vagra" most likely was one of the naked catfish or "bagre" of the family Pimelodidae common to the region.

In March 1800, Humboldt spent time in the Orinoco Llanos near the town of Calabozo, midway between Caracas and the Orinoco River. After high expectations, he finally encountered electric eels and he devoted many pages describing their capture and his observations on this species including comparisons with other powerfully-electric fish from other parts of the world (Humboldt 1819, vol. 4:344-377). Humboldt vividly relates

how local natives helped him secure a large number of eels by driving some thirty horses and mules into an isolated pool of a drying stream, thereby forcing the eels out of hiding. The big eels defended themselves against the onslaught of crazed horses by repeated discharges of their electric organs. However, by driving the horses again and again into the water, the eels were soon exhausted and easily captured by Humboldt and his assistants. Humboldt also carried live eels back to Calabozo where he experimented with them. In his travel narrative, Humboldt discusses the eel's geographic distribution and abundance, as well as its body size and color pattern, external and internal anatomy, air-breathing ability, and electric powers. According to a footnote in Humboldt (1819, vol. 4:350), some of the results of his work with the electric eel were presented in "Observations de Zoologie, vol. I, p. 59-92" and in his "Tablcaux de la Nature, vol. I, p. 53-57."

As he journeyed farther south, Humboldt (1819, vol. 4:415) visited San Fernando de Apure, noting that the "Rio Apure abounds in fish, manatees, and turtles..." While in the same region, he mentioned that the local natives, known as Yaruroes or Japuin, live by hunting and fishing (Humboldt 1815, vol. 4:417). Humboldt (1819, vol. 5:640-641; 1826, vol. 6(1):360) repeats the same theme later, again commenting that the Indians of the Llanos rely heavily on hunting and fishing for food. He (1819, vol. 5:640-641) briefly mentions that in the vicinity of the Orinoco River, the Otomac Indians subsist on fish that they kill with arrows. During seasonal high waters, Humboldt reported that the deep water makes fishing very difficult for the Indians.

While making astronomical observations, Humboldt (1821,vol. 5:149) took interest in the fact that the Pareni Indians of Venezuela used the term "Bahumehi" for the constellation of the Southern Cross, a term also used by the same Indians for the piranha or caribe fish.

Anticipating the findings of later researchers (e.g., Goulding et al. 1988) by more than a century, Humboldt (1819, vol. 5:350) took note of the low abundance of life in blackwater rivers, commenting: "This scarcity of animals arises no doubt from ... the quality of the black waters, which (on account of their very purity) furnish less aliment to aquatic insects and fish."

Upon leaving Venezuela, Humboldt traveled to Cuba in late 1800 where he remained until early 1801. While in the Caribbean, he recorded a few of his observations of marine fishes. In one account, Humboldt (1829, vol. 7:305-307) noted that the inhabitants of Cuba attach a long cord to the tail of the "revès" or remora, identified by Humboldt as belonging to the genus *Echeneis*. The fish, with line in tow, presumably was set loose and eventually attached themselves to the shells of sea turtles thereby helping in their capture. Humboldt (1829, vol. 7:380-382) gives a few brief accounts of sharks. On at least one occasion, he was struck by the co-occurrence of large numbers of sharks and sea turtles. Humboldt (1829, vol. 7:393-394) also reported that "...the surface of the sea, of a blue indigo, sometimes violet, on account of the innumerable quantity of meduses and eggs of fish (purga de mar) which covered it, was greatly agitated."

2) "Recueil d'observations de zoologie et d'anatomie comparée; faites dans l'ocean Atlantique, dans l'intérieur du nouveau continent et dans la mer du Sud, pendant les années 1799, 1800, 1801, 1802 et 1803, par Al. de Humboldt et A. Bonpland. Chez Levrault, Schoell et comp., Libraires, Paris, 1805. In: Voyage de Humboldt et Bonpland. Deuxième partie. Observations de Zoologie et d'Anatomie comparée. Premier Volume, Paris, 1811"—In volume one of this work, Humboldt presents three papers containing descriptions of two new genera and four new species of South American fishes. Most text is in French, although some basic descriptive information is given in Latin. The title page of volume one gives the year 1811, but 1805 is the year of publication for articles containing new fish descriptions (Sherborn 1899, Eschmeyer 1998). (Adding to the confusion, Wilson (1995:lv) states that 1807 may be a more realistic date for the earliest of Humboldt's publications.) Descriptions of *Eremophilus mutisii* and *Astroblepus grixalvii* appear in Humboldt (1805a), *Pimelodus cyclopum* in Humboldt (1805b), and *Gymnotus aequilabiatus* in Humboldt (1805c). All four descriptions have plates with illustrations of the new species. Most of the illustrations are of average quality, but I cannot attest for their accuracy. The 1805 publication also includes a long article by Humboldt on the electric eel (*Electrophorus electricus*) entitled, "Observations sur l'anguille électrique (*Gymnotus electricus*, Lin.) du nouveau continent." All, or most, of the 1805 document pertaining to fishes can be accessed via the worldwide web

(http://www.neodat/org) I found a few differences in the hard copy that I have on hand and the document available on the web (e.g., publication title, volume number, page numbering, and placement of page breaks). I do not know the reason for the discrepancies; but presumably differences can be attributed to the 1805 information being republished later (1811?) under a modified format.

3) "Recherches sur les poissons fluviatiles de l'Amérique equinoxiale. In: Voyage de Humboldt et Bonpland, Deuxieme partie. Observations de Zoologie et d'Anatomie comparee. Volume two, pages 145-216."— In volume two of the "Voyage de Humboldt et Bonpland..." as many as 27 new fish taxa are described, but only 16 are attributed to Humboldt (Lazara 1993). "Recherches ..." is recognized as a collaborative effort between Humboldt and the French zoologist Achille Valenciennes (1794-1865). However, there has been considerable confusion concerning both the dating and authorship associated with the original descriptions of the 27 taxa treated in the work. Lazara (1993) researched the problem and determined that all the fish descriptions by Humboldt and Valenciennes in "Recherches ..." should be dated 1821. In addition, Lazara concluded that no part of the work was jointly authored by the two and that all new species descriptions should be attributed to one author or the ~~author~~ other. According to Lazara, the article was written by Humboldt and annotated by Valenciennes. Parts, including some new descriptions, authored by Valenciennes are always set off by square brackets inside of which his name is given immediately before the closing bracket. New fish taxa attributed to Humboldt include the following species (nomenclature and capitalization follow the original descriptions): *Poecilia bogotensis*, *Curimatus Amazonum*, *Cichla orinocensis*, *C. atabapensis*, *C. temensis*, *Pimelodus zungaro*, *P. argentinus*, *P. velifer*, *P. Barbancho*, *P. grunniens*, *Serrasalmo albus* (=*Serrasalmo Cariba*), *Myletes Paco*, *Erythrinus Guavina*, *Doras Crocodili*, *Smaris lineatus*, and *Atherina regia*. In "Recherches ...," Humboldt also gave descriptions of a few other New World fishes. However, he does not provide scientific binomials, so none of these accounts can even be considered valid new species descriptions.

In addition to descriptions of new species in "Recherches ...," Humboldt presents other information on New World fishes, including notes on behavior and habitat. Humboldt showed great interest in fish respiration

and the function of their swim bladders. Pages 194-216 of "Recherches ..." includes his review of the subject under the heading "De la respiration et de la vessie aérienne des poisons." However, I could find no clear reference to New World fishes in those pages.

NEW WORLD FISHES DESCRIBED AS NEW BY HUMBOLDT

Humboldt described at least 20 species of New World fishes as new to science. Of that number, as many as 12 (possibly 13) may be considered valid, but only four of these species have retained the same generic name originally used by Humboldt (Eschmeyer 1998, 2000). His descriptions include two new genera: *Astroblepus* (family Astroblepidae) and *Eremophilus* (family Trichomycteridae), both still recognized as valid. Humboldt's species descriptions include fishes from at least 11 families: Cichlidae (3 species [2 valid]), Astroblepidae (2 [2 valid]), Erythrinidae (1 [not valid]), Pimelodidae (5 [1 valid, possibly more]), Trichomycteridae (1 [valid]), Doradidae (1 [valid]), Sternopygidae (1 [valid]), Characidae (3 [1 or 2 valid]), Hemiodontidae (1 [valid?]), Atherinidae (1 [valid]), and Gerreidae (1 [valid]).

The type localities of fishes described by Humboldt are situated in the present-day countries of Colombia (7 species), Venezuela (7), Peru (3), Brazil (1), Ecuador (1), and Mexico (1). In some cases, the type locality is given in broad terms (e.g., *Cichla temensis*) and thus includes an area that encompasses more than one country. All of Humboldt's New World fishes are freshwater forms, except for two marine species, one from Peru and one from Mexico.

Similar to many taxonomic works on new fishes published during the early 1800s, Humboldt's descriptions are generally short and lacking in critical information. For instance, some of his descriptions contain fewer than ten lines of text. Because of the shortage of information, the positive identification of several of Humboldt's new species remains uncertain. The typical format of Humboldt's descriptions and accounts included one or a few lines of basic information in Latin (usually detailing color and shape, sometimes including counts of fin rays or morphometric information). All other text is in French (except in a few instances where

he presents footnotes that quote from original sources in Spanish). Several of Humboldt's descriptions are followed by comments by Valenciennes providing minor clarifications or details. In many of his accounts, Humboldt reports the length of the fish (type specimen?) and the length data most likely represent total length (TL). In a number of cases where there are accompanying illustrations, the size of the specimen can be estimated because Humboldt gives the proportion or scale of the fish drawing relative to that of the original specimen. However, Humboldt's other morphometric data are of limited use because the methods of measurement are not specified (e.g., Silfvergrip 1992 on *Zungaro*).

Of the 20 new fishes described by Humboldt, 13 include accompanying illustrations. Humboldt (1821:172) remarks that he has incomplete drawings of two additional species (i.e., for "*Pimelodus barbancho*" and "*P. grunniens*"). Presumably the two additional illustrations were never published although it is conceivable that the sketches still survive in his archives. In detail, the published drawings range from poor to moderate quality. Many of the drawings appear well done and are fairly detailed; however, a number of these are inaccurate in many respects (e.g., *Cichla orinocensis*). According to Silfvergrip (1992), the illustration accompanying the original description of Humboldt's *Pimelodus zungaro* was redrawn by Huet from Humboldt's field sketch. I found small text appearing in the lower left-hand corner of Plates XLV-XLVIII associated with the original descriptions of Humboldt (1821) indicating that all nine of the fish illustrated were redrawn by Huet from Humboldt's field sketches. I have been unable to determine the illustrator responsible for final drawings appearing with Humboldt's earlier (1805) descriptions, but Humboldt likely had a hand in some, perhaps all of the resulting products. Humboldt was known to be quite artistic (Wilson 1995). Furthermore, in the text portion of many of his descriptions, Humboldt notes that he sketched the specimen while in the field. A color version of the original illustration of Humboldt's "*Gymnotus aequilabiatus*" (incorrectly labeled as "*Gymnotus electricus*") appears in Novaresio (1996:198). Novaresio (1996:index) credits Humboldt for the drawing. I do not know if this, or any of the other of Humboldt's new fish drawings, appeared originally in color.

I have not uncovered any substantive information on the specimens that Humboldt used as the basis for his descriptions. Based on information in Eschmeyer (1998), there is no extant type material for any of the New World fishes described by Humboldt. Some types apparently were never preserved. In his introduction to his personal narrative, Humboldt (1995:8) stated, "We learned too late that the warm humidity and the frequent falls of our mules prevented us from preserving our hastily prepared animal skins and the fish and reptiles in alcohol. I note these banal details to show that we had no means of bringing back many of the objects of zoological and comparative anatomical interest whose descriptions and drawings we have published." Wilson (1995:liv) reported that the booty of Humboldt and Bonpland included 42 cases and over 6,000 dried plant species, but all the animal and bird skins rotted. It is known that some of Humboldt's plant and insect collections were lost at sea, but I do not know if the lost cargo included any of his fish specimens. While in Cuba, Humboldt and Bonpland divided their "herbal" collections from the Orinoco, Atabapo, and Rio Negro into three portions, one to go to by way of England to Germany, a second to go by way of Cadiz to France, and a third to remain in Havana (Humboldt 1829, vol. 7:285-286). Father Juan Gonzales, who had accompanied Humboldt and Bonpland during the trip through the Lower Orinoco, was to transport the collections destined to Paris. Unfortunately, the collections and Father Gonzales were lost in a shipwreck off the coast of Africa after an attack by pirates. On the other hand, some of Humboldt's preserved types possibly reached the Museum National d'Histoire Naturelle, Paris (MNHN), but their present whereabouts are unknown (Eschmeyer 1998).

As mentioned previously, Lazara (1993) adequately addresses problems concerning authorship of new fishes described by Humboldt and Valenciennes. I have found no mention in the literature to suggest that any of Humboldt's fish descriptions were co-authored by Bonpland. Nevertheless, Bonpland is typically cited as a co-author of the overall published works on the journey (e.g., Bauchot et al. 1997) and he appears as a co-author on the title page of the 1805 work "Recueil d'observations ...," a work that includes descriptions of several new fishes. Humboldt also credits Bonpland for collecting one or a few of the fishes that represent type specimens. Bonpland did proofread some of the works (Wilson 1995:liii), but he apparently did not prepare any of the fish

descriptions. In fact, according to Wilson (1995:li), Humboldt placed Bonpland's name on all thirty volumes dedicated to their voyage even though Bonpland wrote only one.

Following is an annotated list of South American fishes described by Humboldt with information on authority, date of description, type locality (if known), comments relating to validity and name variants, and other information of interest. The information is taken from the original descriptions, but supplemented by important recent works. Fishes are presented in alphabetical order by trivial name.

1) *aequilabiatus, Gymnotus* Humboldt 1805:46-48, Plate 10 (Figs. 1-2). Family: Sternopygidae. The type locality is the Río Magdalena, Colombia. The species is valid as ***Sternopygus aequilabiatus*** (Mago-Leccia 1994:23, Albert and Fink 1996:89). Humboldt remarked that the fish was known locally as "el raton" (el ratón) because its long body and tail resembles the tail of a rat. He also noted that the new species was one of a great number of fishes used as food during their forty days navigating the river. Body length is given as 0.75 meters. The only habitat note is a statement that the eel inhabits water with a constant temperature of 26.2 degrees (Celsius?). The accompanying illustration of the fish is of moderate quality. It includes a drawing of its small swim bladder next to a drawing of the relatively long swim bladder of an electric eel (*Electrophorus electricus*), both drawn to scale. The plate also includes a cross-section of the electric eel. A color version of the original illustration of Humboldt's "*Gymnotus aequilabiatus*" (incorrectly labeled as "*Gymnotus electricus*") appears in Novaresio (1996:198), showing the fish as having a green body and head, dark fins, and a red eye. Dahl (1971:VII) treats it as a junior synonym of *Sternopygus macrurus*. According to Mago-Leccia (1994), *Sternopygus aequilabiats* from the Río Magdalena (Colombia), *S. arenatus* from the Río Guayaquil (Ecuador), *S. dariensis* from the Río Tuyra (Panama), and *S. pejeraton* from the Lake Maracaibo basin (Venezuela) are all subspecies of *S. aequilabiatus*. However, Albert and Fink (1996:94) do not support taxonomic separation of these four allopatric populations. Humboldt (1805d) also mentions "*Gymnotus aequilabiatus*" in his large article on the electric eel.

2) *albus, Serrasalmo* Humboldt in Humboldt and Valenciennes 1821:173-175 (plate 47, Fig. 1). Family: Characidae. Humboldt's original account appears under the subheading "Le Poisson Caribe de l'Orénoque" and includes about 13 lines in Latin and several paragraphs in French. Included is a mix of piranha lore and information on several species. The illustration of the specimen is poor and its accuracy is clearly questionable (see discussion below). The original figure has been republished by Machado-Allison and Fink (1991: Fig. 11; 1995: Fig. 4B; 1996: Fig. 24). In the French text of his original description, Humboldt reports that the piranha inhabits the Orinoco and Apure rivers and their tributaries, especially the "l'Auvana et le Cuchivero." The common name is given in French as "L'Umati ou Poisson Caribe de l'Orénoque." There is confusion surrounding the name *albus*. Humboldt's description references his Plate 47, Figure 1. However, the caption on page 216 for the original figure gives the name *Serrasalmo Cariba*. Fink (1993:669) maintains that the use of "*albus*" was likely a printer's error, apparently intended as a descriptor rather than as part of the scientific binomial. On page 173 of the original description, the Latin begins "Serrasalmo albus, dorso..." Serving as first revisor, Fink placed the name *albus* in the synonymy of the new combination ***Pygocentrus cariba*** (Humboldt 1821). In addition to the confusion between the use of "albus" versus "cariba," there exists uncertainty concerning the true identity of the fish described by Humboldt. Eigenmann (1915:255) considered both S. *albus* and *S. cariba* junior synonyms of *Serrasalmus rhombeus*. However, Machado-Allison and Fink (1991, 1995, 1996) and Fink (1993), argue that *P. cariba* (=*Serrasalmo albus*) is a valid name and represents the common and widespread blunt-snouted piranha, known as "Caribe Colorado," of the Orinoco Llanos. Their conclusion largely is based on Humboldt's brief written descriptions of its eye color (black) and swim bladder, and on certain characteristics of the specimen shown in the original illustration, including number of ventral scutes (24), length and position of the dorsal and adipose fins, number of dorsal rays, and placement of the eye. Machado-Allison and Fink (1991) also list arguments against it being *P. cariba*, including the concave profile of head of the illustrated fish and no mention in the text of a dark humeral spot. To partly counter the clear incongruence, Machado-Allison and Fink argue that small *P. carbia* (less than about 140 mm standard length) have a slightly concave head profile. For several reasons, I question the conclusion that Humboldt's fish is a

Pygocentrus. Based on the overall profile and appearance, the piranha illustrated in Humboldt's plate 47 clearly resembles one of the sharp-snouted piranhas (e.g., *Serrasalmus rhombeus* or *S. medinai*, among others) as opposed to *Pygocentrus*. Currently, at least 15 different piranha species are known to occur in Venezuela, and at least 8 species are found in the vicinity of the Orinoco River basin where Humboldt collected his new species. Although common in the region, *Pygocentrus cariba* is the only piranha present that does not have a concave head profile at sub-adult and adult sizes. Humboldt notes that his illustration is ¾ actual size, indicating (if my copy is accurately scaled) that the holotype(?) was about 105 mm SL. Although possibly a juvenile, no *Pygocentrus* exhibit such a distinct concave head profile at this size. Humboldt's original text suggests that his new species is most common in two streams, the "Auvana" and the "Cuchivero." The Cuchivero River is a southern tributary of the Orinoco whose source is the Guiana Shield. Rivers in this region are typically clearwater or blackwater systems, environments where *Pygocentrus* of the Orinoco is rare. I am unfamiliar with Humboldt's "Auvana." River. It may be a variant spelling of the Río Autana, a blackwater tributary of the Río Sipapo where *P. cariba* is either rare or absent (although I have no information to indicate that Humboldt visited the Autana). Given the confusion that piranha diversity has caused modern-day taxonomists, it is certain that Humboldt also was confused, possibly basing his illustration on a specimen of one species, but basing some of his text on the dissection of another or different species. Although we now know that piranhas are relatively diverse in the Orinoco, Humboldt reported that the Indians recognized only three piranha species, which he states are each of a different relative size: large, medium, and small. Humboldt reports that he took notes only on the medium-sized piranha. The significance of Humboldt's statement is unclear. Many piranha species show marked changes in body shape and color pattern during growth. In the Orinoco Llanos, one of the common names for *Serrasalmus rhombeus* is "caribe blanco," but the relevance of that name to Humboldt's *Serrasalmo albus* can only be guessed. In any case, with no type material available, the positive identification of Humboldt's piranha will likely never be resolved to the satisfaction of all.

3) *amazonum, Curimatus* Humboldt in Humboldt and Valenciennes 1821:165-166, Plate 45 (Fig. 2). Family: Hemiodontidae. Humboldt's

original account appears under the subheading "Le Boquichico de l'Amazone" and includes about 26 lines in Latin and French. The original illustration is of moderate quality and shows the entire left side of the fish with fin rays and scales clearly drawn. Immediately following Humboldt's description, on page 166, Valenciennes briefly addresses the fish to distinguish it from related species. Citing Ortega and Vari (1986:10), Eschmeyer (1998) reports that the species is valid as ***Hemiodus amazona***. In his review of hemiodid pigmentation patterns, Böhlke (1955) uses the name *Anisitsia amazona* and notes that Humboldt's original description and figure give no indication of any pigment pattern. He states that the species is very poorly known and may not be valid. Based on Humboldt's own observations, the type locality is considered to be the Río Marañon, Cachoeira de Rentema, provincia de Saint-Jean de Bracamoros, Brazil. The species also is known from Amazon Basin drainages in Peru (Ortega and Vari 1986).

4) ***argentinus, Pimelodus*** Humboldt in Humboldt and Valenciennes 1821:171. Family: Pimelodidae. Humboldt's original description is very brief, consisting of only about five lines of Latin text and six lines in French. Humboldt describes it as a beautiful fish, 16-inches (41-cm) long. There is no illustration of the species. Type locality is the Río Magdalena, Colombia. Humboldt remarked that his companion Bonpland took the catfish in the Magdalena, close to Chilloa, between "Mompox et Tamalameque." In his description, Humboldt states that the species is rare, noting that even the Indians who usually guided the boat have never seen it before. Eschmeyer (1998) references Burgess (1989:278) in stating that the species is valid as ***Rhamdia argentina***. However, that conclusion is questionable. Eigenmann and Eigenmann (1890:117) include *Pimelodus argentinus* under their heading of "doubtful species of *Rhamdia*." In a partial translation of Humboldt's original Latin description, these two authors describe the species as: "White; back bluish. Maxillary barbells 2/3 as long as the body. D. 7; V. 5; pectoral and dorsal spines not serrated. 16 inches long." Recently, Silfvergrip (1996:11-12) discussed in detail this and two other pimelodid catfishes described by Humboldt. Silfvergrip states that Humboldt's "description is vague, not allowing identification of the species." He concluded that it was unlikely to be a *Rhambia*. I could find no mention of this species in Dahl (1971), a publication on fishes of northern Colombia, even though that work includes the Río Magdalena.

5) *atabapensis, Cichla* Humboldt in Humboldt and Valenciennes 1821:168. Family: Cichlidae. Humboldt's original description is brief, five lines in French, and does not include an illustration. Humboldt refers to it as the "Pavon du Rio Atabapo" and describes it as being of the same form as *Cichla orinocensis*, but instead of the four spots, he notes that the new species has "...quatre zones transversales très-larges, bleu-noirâtres, bordées d'or." The Atabapo is a blackwater tributary of the Orinoco. Eschmeyer (1998) gives the type locality as the Río Atabapo, Venezuela. However, in his original description, Humboldt remarked that the species also occurs in the Orinoco River in areas where the water is not turbid. A single sentence following Humboldt's description notes that Valenciennes considered *C. atabapensis* to be the same as "*C. ocellaris*, Schneid., Plate LXVI." Similarly, Machado-Allison (1971:465) treats *atabapensis* as a junior synonym of *C. ocellaris*. More recently, Kullander and Nijssen (1989) stated that *C. ocellaris* is not native to the Orinoco. Thus, the taxonomic status of *C. atabapensis* is uncertain, possibly a synonym of *C. orinocensis*, a species also described by Humboldt (see below). Eschmeyer (2000) does not discuss taxonomic status of *C. atabapensis* nor suggest a possible synonym.

6) *barbancho, Pimelodus* Humboldt in Humboldt and Valenciennes 1821:172. Family: Pimelodidae. Humboldt's original description includes only two lines of Latin and ten lines of French. There is no illustration of the fish appearing with the original description. Humboldt (1831:172) remarked that he made an incomplete drawing of the fish, but I do not know if the illustration still survives. The author states that the fish is known as "Barbancho" in the Guarico, Apure, and other rivers of the Venezuelan Llanos (Orinoco River basin). Based on that information, Eschmeyer (1998) reports the type locality as the Guarico and Apure rivers. Humboldt described the fish as having ribbon-like barbels, a very long adipose fin, and ventral fins longer than dorsal and anal fins. The fish examined was reported as "1 pied 7 pouces" (47.5 cm) long. I have been unable to find current information concerning the possible validity of this species. It is not mentioned in Burgess (1989) or in other recent publications. Taphorn et al. (1997) do not include it in their recent list of Venezuelan freshwater fishes. Eigenmann and Eigenmann (1890:104) list "*Pimelodus barbancho* Humboldt 1833" as a possible junior synonym of the widespread *Pinirampus pirinampu* (Spix and Agassiz 1829).

Interestingly, Mago-Leccia (1970) includes "berbanche" as one of the common names for *P. pirinampu* in Venezuela, a likely variant of the name "Barbancho" used by Humboldt. Given that Lazara (1993) has determined that the date for Humboldt's description was 1821 rather than 1833, *barbancho* should be considered a possible senior synonym of *P. pirinampu*.

7) ***bogotensis, Poecilia*** Humboldt in Humboldt and Valenciennes 1821:154-155, Plate 45 (Fig. 1). Dahl (1971:VII+133) and Malabarba (1998) consider the species valid as ***Grundulus bogotensis***. Malabarba notes that *Grundulus* is monotypic and places it in family Characidae, subfamily Cheirodontinae. Humboldt's account and description, appearing under the subheading "Le Guapucha de Bogota," consists of a short paragraph in Latin, several paragraphs in English, and a small illustration of the fish. He remarks that he himself made a drawing of the fish while in Colombia in July 1801. Humboldt's text notes that his illustration is 3/5 the actual size of the fish, which (if my copy is the same scale as the original document) would indicate the specimen to be about 7.5 cm standard length. Humboldt refers to this species as the "Guapucha de Bogota." There also are comments pertaining to the species on pages 155 and 159 by Valenciennes. Type locality is the plateau or plains of Bogotá, Colombia. According to Humboldt, the fish inhabits the Río Bogotá, a small, coldwater (12-15 °C) stream that flows into the Río Magdalena by way of the Río Tocayma and Salto de Tequendama. According to Dahl (1971:XIII, 133), it inhabits the high plains of the Cordillera Oriental from near Bogotá to Santander. Because of several name changes, the taxonomy of this species is somewhat confusing. According to Malabarba (1998), the genus *Grundulus* is credited to Valenciennes in Cuvier and Valenciennes (1846:216). The name *Ctenocharax bogotensis* Regan 1907 is presumably a recombination. I have not seen Regan's 1907 publication, therefore I cannot comment as to what connection he makes, if any, between *Ctenocharax bogotensis* and the *bogotensis* of Humboldt. Eschmeyer (1998) mistakenly suggests that Humboldt's fish may be a member of the family Fundulidae. Subsequently, Eschmeyer (2000) states: "If *Ctenocharax* is a synonym of *Grundulus* Eigenmann 1915, then *Ctenocharax bogotensis* is a secondary homonym of *Poecilia bogotensis* Humboldt 1821 in *Grundulus*." Géry (1977:607) references *Grundulus bogotensis* as an unusual and small characoid from the plains of Bogotá.

There is very little in the literature on the ecology and natural history of this fish except for the scant information supplied by Humboldt with the original description. Dahl (1971:133) reports that the species reaches a size of about 8 cm. He also notes that introduced trout (presumably *Oncorhynchus mykiss*) prey on *G. bogotensis*, causing the disappearance of this, and other native fishes, in many places.

8) *cariba, Serrasalmo.* (see *Serrasalmo albus*, above).

9) *crocodili, Doras* Humboldt in Humboldt and Valenciennes 1821:181, Plate 48 (Fig. 2). Family: Doradidae. Type locality is the Río Magdalena, Colombia. Eschmeyer (1998) references Burgess (1989:225) in stating that this species is valid as ***Centrochir crocodili*** and indicates that it serves as the generic type by monotypy. Humboldt's account, appearing under the subheading "Le Matacayman du Rio Grande de la Magdalena," includes about 11 lines of Latin text and 35 lines in French. The accompanying illustration of the fish is of moderate quality. Humboldt states that he sketched the fish. Dahl (1971:78) provides a simple line drawing of the fish, but the source of his illustration is not known. Eigenmann and Eigenmann (1890:241) noted that the species is known only from Humboldt's account and figure, stating: "It is most likely identical with *Doras longipinis* Steindachner, the only authoritatively known species of the Río Magdalena." Later, Eigenmann (1925) recognized *C. crocodili* as valid and stated that it was the only doradid found west of the Andes. *Doras longipinnis* Steindachner is considered a junior synonym (Eigenmann 1925, Higuchi 1992). Higuchi (1992:177) provides defining characters of the genus. Agassiz authored the generic name *Centrochir* in 1829, but erroneously assumed that Humboldt's specimens were from Brazil (Higuchi 1992). The species apparently is known only from the Río Magdalena basin (Higuchi 1992). In his original account, Humboldt notes that he observed one specimen using its pectoral spines to move over a dry beach a distance of more than 200 feet (about 60 meters). A second fish was observed by the Indians, while they were fishing near the Río Cauca, climbed a sand hill 20 feet high. Humboldt compared such behavior to that of one of the large air-breathing callichthyid catfish. Several years ago, while in the Casiquiare drainage, colleagues and I observed many individuals of a certain doradid species that that we determined was able to efficiently breath atmospheric air and

survive long periods out of water (L. G. Nico, unpublished data). Graham (1997:62) considered as unsubstantiated the reports by Carter and Beadle (1931) of an air-breathing doradid. We had assumed that ours was clear evidence of air breathing by a member of the family Doradidae, but Humboldt's observations predate our findings by more than 200 years. Humboldt also noted that the Natives called the doradid "Matacayman" because the catfish, when preyed on by crocodilians, would lodge itself in the reptile's throat by erecting its pectoral spines. He reported that the catfish's spines often would perforate the reptile's esophagus, ultimately resulting in the attackers death.

10) *cyclopum, Pimelodus* Humboldt 1805:21-25, Plate 6. Family: Astroblepidae. Eschmeyer (1998) references Burgess (1989:448) in stating that the species is valid as ***Astroblepus cyclopus***. The original description includes a drawing of the specimen with number of rays given next to each fin. Humboldt notes that he sketched the fish, and the sketch was then colored by M. Turpin. Eigenmann and Eigenmann (1890:349-350) discuss the species in some detail. They state: "The poor description of *P. cyclopum* makes an absolute identification impossible." For a period of time, this species was placed in the genus *Cyclopium* Swainson 1839 (now considered a synonym of *Astroblepus*). Eigenmann (1918) described a new variety, *A. c. santanderensis*, based on specimens taken from an elevation of 1,000-2,000 meters in the Río Suarez drainage, Colombia. The taxonomic status of the subspecies is unclear. Most of Eigenmann's material currently is housed at the Field Museum of Natural History, Chicago (FMNH). Henn (1928:82) designated a lectotype: FMNH 58433 (ex CM 7430). I have not been able to uncover additional information on Eigenmann's species. According to Eschmeyer (1998), the type locality of Humboldt's catfish is subterranean waters in the Andes of Quito (basin of Río Esmeraldas), Ecuador. In contrast, Eigenmann and Eigenmann (1890:349-350) indicate that Humboldt's species is found in the Andes and the Amazon, but they make no mention that its habitat is subterranean waters. I have been unable to locate the Río Esmeraldas on my maps, but a geographical dictionary indicates the river flows west from the Andes Mountains into the Pacific Ocean. According to Humboldt's original text, his description apparently was based on one or more specimens collected in a surface stream in the vicinity of several active volcanoes. In his original description, Humboldt relates that locals, including some reliable

sources, told him that large numbers of fish are periodically spewed from vents as well as from the summit of area volcanoes. Named volcanoes involved in the strange phenomena included Cotopaxi, Imbabura, Cargueirazo, and Tungurahua (see map of Papavero 1971). Reportedly, fish were either ejected together with cold water or embedded in clay materials, all were dead, but in relatively good condition. Humboldt fully accepted the stories and concluded that his new species was the same fish spewed from the volcanoes, but he does not explain how he came to this determination. He does note that the new catfish is rather uncommon in surface waters. However, based on the numbers of fish periodically spewed from volcanoes, Humboldt believed it to be abundant in subterranean waters. In describing the catfish, Humboldt notes that its eyes are small, but describes the fish as being olive color with small black spots (based on its somewhat dark pigmentation pattern, Humboldt's catfish is not a highly-evolved cave form). Interestingly, modern researchers apparently have overlooked Humboldt's unusual account of this possible subterranean species. For instance, the catfish is not included in an unpublished list (dated 1997) of cave-dwelling fishes of the world that was distributed during a symposium on the biology and evolution of cavefishes held at the 1998 annual meeting of the American Society of Ichthyologists and Herpetologists in Guelph, Canada. Collette (1962) described as new a cave-dwelling *Astroblepus*, *A. pholeter*, based on specimens taken from a large cave in Latas, 4 km north of Archidona, Napo Province, in eastern Ecuador. The species is described as essentially unpigmented and minute-eyed. Interestingly, Collette makes no reference to Humboldt's *cyclopum* and states that his *A. pholeter* is the first known cavernicolous astroblepid. The oversight suggests the need to take another look at *A. pholeter* to determine if it is closely allied to *A. cyclopus* and to dismiss the possibility of it being a junior synonym. The type locality of *A. pholeter* is less than 100 km southeast from Quito and falls within the Napo-Amazon rivers basin.

11) *grixalvii, Astroblepus* Humboldt 1805:19-20, Plate 7. Family: Astroblepidae. Eschmeyer (1998), referencing Ortega and Vari (1986:18) and Burgess (1989:449), states that the genus and species names are considered valid. Humboldt's generic description consists of two lines of Latin text. The species' account consists of 13 lines in Latin and French text, followed by a paragraph focusing on the Río Vinagre and its acidic

waters. The accompanying illustration is probably Humboldt's finest fish drawing, at least in terms of detail, and possibly accuracy. Eigenmann and Eigenmann (1890:351) remark that the genus (i.e., *Astroblepus grixalvii*) is "known only from the very imperfect description by Humboldt." Subsequently, Eigenmann (1918) described a new variety, *A. g. micrescens*, based on specimens taken from several sites north of Bogotá, Colombia. However, Eschmeyer (2000) follows Burgess (1989:449) in treating this latter form as a separate species (i.e., *Astroblepus micrescens*). Eigenmann's specimens currently are housed at FMNH and CAS, including the "holotype" FMNH 58376 (ex CM 7372). Dahl (1971:76) states that *A. grixalvii* is the only member of the family that reaches any size (up to 30 cm) and has some economic importance, apparently as a food fish. The type locality is the Río Palacé (upper Río Cauca drainage, Río Magdalena basin) near Popayán in southwest Colombia. In the past, its native range extended from Popayán and the Valle del Cauca to the Cordilleras Central and Oriental, to Santander. However, Dahl (1971) reported that the geographic distribution of *A. grixalvii* had been reduced dramatically in the decades prior to 1970 apparently as a result of competition with introduced trout (presumably *Oncorhynchus mykiss*). I do not have information on its present geographic distribution.

12) *grunniens, Pimelodus* Humboldt in Humboldt and Valenciennes 1821:172. Family: Pimelodidae. Humboldt's original description is brief, including some 6 lines in Latin and 6 in French. He states that it is a large fish, up to "2 pieds 2 pouces" (66-cm) long. There is no illustration of the fish in the original description, but Humboldt (1821:172) remarks that he had an incomplete drawing of the species (apparently never published). Eschmeyer (1998, 2000) references Burgess (1989:278) in stating that the species is valid as *Rhamdia grunniens* but perhaps a synonym of *Phractocephalus hemilopterus* (Bloch and Schneider 1801). Silfvergrip (1996:12) states that the species is unmistakably identified with ***Phractocephalus hemioliopterus*** (Bloch and Schneider 1801). Eigenmann and Eigenmann (1890:118) provide a brief description, based on the original of Humboldt, that reads (in part): "Olivaceous above, spotted with black; white below. ...All fins except caudal olivaceous, margined with red..." Silfvergrip (1996) points out that, in addition to Humboldt's description of the species' color and large size, the local name was given as "carxaro", an apparent variant of the name "cajaro," the common name still

used in much of Venezuela for *P. hemioliopterus*. Taphorn et al. (1997) include *R. grunniens* in their recent list of Venezuelan freshwater fishes, but make no mention of possible synonymy. According to Eschmeyer (1998), the type locality is the Río Orinoco, South America. Humboldt provides few details, simply stating that the fish is found throughout the Orinoco Basin. *Phractocephalus hemioliopterus* also is widespread in the Amazon Basin.

13) *guavina, Erythrinus* Humboldt in Humboldt and Valenciennes 1821:179, Plate 48 (Fig. 1). Family: Erythrinidae. Under the heading "Le Guavina du Lac de Tacarigua," Humboldt gives a brief description of the new species and its habitat. The entire account consists of about 13 lines in Latin and 8 in French. The accompanying drawing is of moderate quality. Humboldt states that he sketched the fish, a specimen "20 pouces" (51-cm) long. The species currently is considered a junior synonym of ***Hoplias malabaricus*** (Bloch 1794), a fish with a very broad distribution, including tropical and subtropical South America, Central America, and the island of Trinidad (Taphorn 1992). Partly because of its wide distribution, *H. malabaricus* likely represents a species complex and when the genus eventually undergoes a systematic review, it is conceivable that Humboldt's species might prove to be valid. The type locality of Humboldt's fish is Lake Tacarigua (currently, Lake Valencia), Venezuela. In another work, Humboldt (1815, vol. 4:160) briefly describes his visit to the lake region and mentions his encounter with this and several other fishes. Humboldt spells the common name "guavina." A variant of the name, "guabina," is commonly used today in Venezuela for the same species.. In the original description, Humboldt reports that the fish is voracious predator. He also notes that it falls prey to the local crocodilian that the Indians call "Bava" (i.e., baba). Lake Valencia is now extremely polluted. Taphorn (1992:452) noted that *H. malabaricus* is one of the few remaining native species remaining in the lake.

14) *lineatus, Smaris* Humboldt in Humboldt and Valenciennes 1821:185, Plate 46 (Fig. 2). Family: Gerreidae. Eschmeyer (1998, 2000), referencing Bussing (1995) and other recent authors, reports the species valid as ***Eugerres lineatus***, noting that the whereabouts of the holotype (unique) is unknown, not at MNHN. This is one of two marine fishes from the New World described as new by Humboldt. The original description appears

under the subheading, "Le Poisson Moxara d'Acapulco." The entire account consists of some 10 lines in Latin and 7 in French. Following Humboldt's description, Valenciennes provides some additional information on the species. The illustration accompanying the original description is of moderate quality. The type locality is Acapulco, Pacific coast of Mexico and Humboldt states that he made a sketch of the fish while visiting the area. He noted that the fish was slightly greater than 9-inches (about 23-cm) long. Jordan and Evermann (1898:1377) refer to it as *Gerres lineatus* and give the common name as "Mojarra China." They also note that it is a food fish of some importance.

15) *mutisii, Eremophilus* Humboldt 1805:18, Plate 6. Family: Trichomycteridae. This species is considered the type for the genus *Eremophilus*. The binomial is considered valid (Burgess 1989:323, Eschmeyer 1998). Humboldt's account includes two lines in Latin describing the new genus and several paragraphs, mostly French, focusing on the new species. The illustration accompanying the original description is relatively detailed and compares closely to an illustration of a specimen provided by Dahl (1971:72) except for the caudal fin size and shape and position of the eye. Humboldt noted that the fish inhabited "La peite rivière de Bogota, qui forme la fameuse cataracte de Tequendama" in Colombia. Thus, the type locality is the Río Bogotá, a tributary of the Río Magdalena, in Colombia. Eigenmann and Eigenmann (1890:338-339) provide a brief description, apparently based on Humboldt: "Yellowish with reticulating brown lines and dots. Head 6; Br. 8; D. 11; A. 9." Eigenmann (1914) examined three albino or blind "capitanes" that he identified as *E. mutisii* while noting that that the specimens "seem to be in all respects except the color identical with the normal Capitan." These were taken from the Río Funjuelo at Usme Sur near Bogotá. Dahl (1971), gives the common names as "Capitán" and "chimbe," and notes that the center of distribution is the Sabana de Bogotá. He adds that the species also exists in the Valles de Ubaté, Chiquinquirá, and Tundama, where it may have been introduced. Dahl reports that it grows up to 50-cm long and remarks that it was the only food fish of any importance in the cold waters around Bogotá prior to the introduction of trout and carp. At least two other *Eremophilus* have been described, *E. camposi* and *E. candidus*, both from Brazil. Eigenmann (1920) states that *Grundulus*, *Pygidium*, and *Eremophilus* are found on the plains of Bogotá at about 9,000 feet. Cala

(1987) reported that *E. mutisii* is a facultative air breather. Additional references are provided by de Pinna (1998:297). A common name for this species is the "Capitán."

16) *orinocensis, Cichla* Humboldt in Humboldt and Valenciennes 1821:167, Plate 45 (Fig. 3). Family: Cichlidae. Machado-Allison (1971) treated this species as a junior synonym of *Cichla ocellaris* Schneider 1801. However, based on a recent review of the group, *Cichla orinocensis* currently is recognized as valid (Kullander and Nijssen 1989). Machodo-Allison (1971) provides a detailed description (*as C. ocellaris*). Humboldt's original account consists of 10 lines in Latin and more than 30 in French. It appears under the subheading, "Le Pavon du Rio Negro," but in the text the fish is described as the "Pavon du rio Negro et d l'Orenoque." Eschmeyer (1998) reports both the Río Orinoco and Río Negro together as the type locality. My translation of the French indicates that Humboldt made a sketch of the fish while traveling on the Río Negro. The drawing accompanying the original description is fairly detailed, but there are inaccuracies, for instance, in terms of snout shape, profile of dorsal fin, shape of the caudal fin, and shape and location of the large lateral spots. Humboldt notes that the species was the most beautiful of the rivers fishes encountered, adding that it attained a length of "1 à 3 pieds" (about 30 to 91 cm).

17) *paco, Myletes* Humboldt in Humboldt and Valenciennes 1821:175, Plate 47 (Fig. 2). Family: Characidae: Serrasalminae. Some authors incorrectly spell the original name as *Myletes pacu*. Eigenmann (1915:269) uses the combination *Myleus pacu*. According to Géry (1976, 1986), it is a junior synonym of ***Piaractus brachypomus***. However, Eschmeyer (2000) does not discuss its taxonomic status nor provide possible synonyms. Humboldt's original description appears under the heading "Le Paco de l'Amazone." The entire account includes some 12 lines in Latin and more than 35 in French. Type locality is the upper Río Marañon, Amazon River basin in Peru. My translation of Humboldt's French indicates that he discovered the fish while in Tomependa during August 1802. Based on Papavero (1971: map 3), Tomependa was located immediately above the confluence of the Río Marañon and Río Chinchipe (about 5.5° S, 78.5° W). Humboldt reports that his specimen was "2 pieds 2 pouces" (66-cm) long. The illustration that accompanies the original

description is of moderate quality. The original plate includes a small illustration of a set of jaws and teeth that Humboldt states was drawn by Huet based on a preserved specimen, identified as "*Myletes rhomboidalis*," at the Paris museum.

18) *regia, Atherina* Humboldt in Humboldt and Valenciennes 1821:187-188. Family: Atherinidae. The species is one of two marine New World fishes described by Humboldt. Eschmeyer (2000), referencing several recent publications, indicates the species is valid as ***Odontesthes regia***. Dyer (1998:536) places it in the subgenus Austromenidia. Humboldt's original account, appearing under the heading "Le Poisson Royal de Lima," consists of 11 lines in Latin and about 10 in French. The original description does not include an illustration of the fish. In the text Humboldt refers to the fish as "Le Pexerey" or "Le Pexerey de Lima." He noted that the largest specimens were 8 inches (20-cm) long, but that they generally did not exceed 5 to 6 inches (12.5 to 15 cm). Humboldt reported that the fish was found in the Pacific Ocean, especially near Callao of Lima, Peru, where he first discovered it. The type locality is reported as being Callao, Peru by Dyer (1998) and near Lima, Peru by Eschmeyer (1998).

19) *temensis, Cichla* Humboldt in Humboldt and Valenciennes 1821:169. Family: Cichlidae. The species, as *Cichla temensis*, is recognized as valid (Machado-Allison 1971, Kullander and Nijssen 1986, Eschmeyer 1998). Humboldt's description is very brief, consisting of two lines in Latin and 9 in French. He does not provide an illustration of the fish. He notes that *C. temensis* is the same shape [as *C. orinocensis*], but that rather than bars, it only has lines of small yellow spots and one large spot on the tail. Machado-Allison (1971) provides a more detailed description of the species. Machado-Allison (1971) gives the type locality of *C. temensis* as the Orinoco, Rio Negro, Río Atabapo, and Amazonas. In contrast, Eschmeyer (1998, 2000) gives the type locality as South America. In spite of the species epithet applied by Humboldt, it is not known whether he based his description on a single specimen from the Río Temi (as opposed to the description being based on number of specimens from across its geographic range). Humboldt (1821:169) remarks that the Orinoco, Casiquiare, Negro, Atabapo, and Amazon rivers are interconnected, essentially forming a single river between 10° N and 20° S latitudes.

Consequently, Humboldt believed that all three of the *Cichla* species he described were widespread and likely occurred in each of these major water bodies. In his *C. temensis* account, Humboldt comments that the species epithets that he applied to each of the three new *Cichla* were based on the locations where the Native Indians most sought them for the taste of their flesh, that is, *C. orinocensis* in the Orinoco, *C. atabapensis* in the Río Atabapo (a tributary of the Orinoco in Venezuela), and *C. temensis* in the Río Temi (a tributary of the Río Atabapo in Venezuela).

20) *velifer, Pimelodus* Humboldt in Humboldt and Valenciennes 1821:171-172. Family: Pimelodidae. Humboldt's account is brief, consisting of some 14 lines of Latin and French text. There is no illustration of the fish. He notes that his fish was "7 pouces de long" (18-cm long).

Eschmeyer (1998) cites Burgess (1989:279) in stating that species is valid as *Pimelodus velifer*. Eigenmann and Eigenmann (1890:117) included this species under their heading of "doubtful species of *Rhambida*." Apparently in reference to Humboldt's original description, they state the following: "The substance of the description is: elongate; adipose dorsal covering the whole median part of the body. D.7; A. 10; V. 6." Recently, Silfvergrip (1996:11-12) reviewed Humboldt's descriptions of three pimelodid catfishes and concluded that the positive identification of *Pimelodus velifer* is unsettled. He ruled out the possibility of it being in the genus *Rhamdia*. Eschmeyer (1998) gives the type locality as the Río Magdalena, Colombia. Based on my understanding of Humboldt's French, he obtained *Pimelodus velifer* from the same reach of the Río Magdalena where they collected "*Pimelodus argentinus*" (indicating that it was taken near Chilloa, presumably between "Mompox et Tamalameque.")

21) *zungaro, Pimelodus* Humboldt in Humboldt and Valenciennes 1821:170-171, Plate 46 (Fig. 1). Family: Pimelodidae. Humboldt's account of this species appears under the subheading "Le Zungaro de l'Amazone." The entire account and description consists of 31 lines of Latin and French text. Humboldt described the fish as "3 pieds 4 pouces de long" (about 102-cm long). According to Eschmeyer (1998), most authors treat this species as valid as ***Pseudopimelodus zungaro***. Silfvergrip (1992) presents a taxonomic review of Humboldt's species and

concludes that it is valid as ***Zungaro zungaro***. He notes that the length (about 1 m) and pectoral-fin count (13) reported by Humboldt provide strong indications for dismissing *Z. zungaro* as belonging to the pimelodid subfamily Pseudopimelodinae. His conclusion is supported by de Pinna (1998:316-317). Eschmeyer (2000) reports that *Paulicea luetkeni* (Steindachner 1877) is a synonym. The original description of "*Pimelodus zungaro*" is based on Humboldt's field observations in 1802 of a single specimen (i.e., the holotype) seen near Tomependa, upper Río Marañon, Amazon River basin, Peru. Silfvergrip (1992, citing Mees 1974) states that the holotype was not preserved. He further notes that "the description is incomplete and contains barely any useful information." According to Silfvergrip, the illustration accompanying the original description was redrawn by Huet from Humboldt's field sketch. The illustration was republished by Mees (1974, plate 5). Humboldt (1821:171) states that the Indians assured him that the fish reaches 6- to 7-feet (about 1.8 to 2.1 meters) long. He also noted that the Creoles give it the name "Tiburón" (shark) because of its size. In contrast, Barthem and Goulding (1997, as *Paulicea lutkeni*) give the maximum size as 140 cm. Interestingly, Barthem and Goulding report that the term "zúngaro" is sometimes used as part of the common name in Peru for several large pimelodids, including the name "zúngaro dourado" for the giant *Brachyplatystoma flavicans*. In contrast, their list of common names for "*Paulicea lutkeni*" include: jaú, pacamão (Brazil); peje Negro, chontaduro, pacamu (Colombia); and cunchi mama (Peru).

HUMBOLDT'S INFLUENCE ON OTHER SCIENTISTS

Humboldt's contribution to knowledge of New World fishes goes beyond his own writings and fish descriptions. In particular, he strongly influenced younger investigators, including Charles Darwin, Louis Agassiz, among others, to further explore South America. Sparked by Humboldt's writings, and in some cases his direct assistance, these later naturalists and scientists further added to the list of New World fishes and increased the volume of knowledge on fishes from the region. Humboldt also may have provided notes and possibly fish specimens to Valenciennes and possibly others. However, I have not yet determined if any of the

many fishes described by Valenciennes were based on material supplied by Humboldt.

In recognition of his contributions, later ichthyologists paid tribute to Humboldt by naming new species using his name. Based on Eschmeyer (2000), the list includes at least seven New World fishes: *Doras humboldti* Spix and Agassiz 1829, *Orestias humboldti* Valenciennes in Cuvier and Valenciennes 1846, *Prochilodus humboldti* Valenciennes in Cuvier and Valenciennes 1850, *Cyclopium humboldtii* Swainson 1839, *Sternopygus humboldtii* Steindachner 1878, *Stygogenes humboldtii* Günther 1864, and *Zungaro humboldtii* Bleeker 1858. Most of the named species are not valid or ~~are~~ have serious taxonomic problems. *Sternopygus humboldtii* is valid as Eigenmannia humboldtii (Steindachner 1878).

Humboldt and other early explorers faced many dangers during their travels, frequently encountering harsh weather, plagues of insects, sickness, and disease. Unlike Humboldt, a number of early European explorers and collectors did not survive their journey to new places. To address the concern for both the success and survival of later scientific travelers, Humboldt was one of several great names in science that took part in educating future explorers at the school for voyagers of the Paris Museum during the early 1800s (Bauchot et al. 1997:39).

ACKNOWLEDGMENTS

I thank William Smith-Vaniz, Lisa Jelks, and Howard Jelks for reviewing earlier drafts of the manuscript. W. Smith-Vaniz and Michael Littmann were instrumental in helping me obtain copies of original manuscripts. Several individuals assisted me considerably by translating portions of Humboldt's original text. For help with French translations, I am indebted to Horst and Satiko Schwassmann, and Serge Duchatellier, and for help with the Latin text, I thank Mary Brown. Doug Weaver assisted in reproduction of fish drawings. I also appreciate information provided by Kenneth Lazara. I thank Donald Taphorn, Basil Stergios, and Gerardo Aymard for giving me opportunities to explore many of the rivers also

traveled by Humboldt. Lastly, I thank Gerardo Aymard for ~~giving me~~ allowing me to contribute to this volume in honor of Humboldt.

LITERATURE CITED

Albert, J. S., and W. L. Fink. 1996. *Sternopygus xingu*, a new species of electric fish from Brazil (Teleostei: Gymnotoidei), with comments on the phylogenetic position of *Sternopygus*. Copeia 1996(1):85-102.

Barthem, R., and M. Goulding. 1997. The catfish connection: ecology, migration, and conservation of Amazon predators. Columbia University Press, New York. 144 pp.

Bauchot, M.-L., J. Daget, and R. Bauchot. 1997. Ichthyology in France at the beginning of the 19th Century: the Histoire Naturelle des Poissons of Cuvier (1769-1832) and Valenciennes (1764-1865). Pages 27-80 *in* T. W. Pietsch and W. D. Anderson, Jr. (editors). Collection building in ichthyology and herpetology. American Society of Ichthyology and Herpetology, Special Publication Number 3.

Böhlke, J. 1955. Studies on fishes of the family Characidae.—No. 10. Notes on the coloration of the species of *Hemiodus*, *Pterohemiodus* and *Anisitsia*, with the description of a new *Hemiodus* from the Rio Negro at the Brazil-Colombia border. Notulae Naturae (The Academy of Natural Sciences of Philadelphia) No. 278:1-15.

Burgess, W. E. 1989. An atlas of freshwater and marine catfishes: A preliminary survey of the Siluriformes. T.F.H. Publications, Neptune City, New Jersey. 1-784 + Plates 1-285.

Bussing, W. A. 1995. Gerreidae. Pages 1114-1128 *in* W. Fischer, F. Krupp, W. Schneider, C. Sommer, K. E. Carpenter, and V. H. Niem (eds.) Guia FAO para la identificactión de especies para los fines de la pesca. Pacifico centro-oriental. Roma, FAO vol. 2.

Cala, P. 1987. Aerial respiration in the catfish, *Eremophilus mutisii* (Trichomycteridae, Siluriformes), in the Río Bogota basin, Colombia. Journal of Fish Biology 31:301-303.

Carter, G. S., and L. C. Beadle. 1931. The fauna of the swamps of Paraguayan Chaco in relation to its environment. II. Respiratory adaptations in the fishes. J. Linn. Soc. London, Zool. 37:327-328.

Collette, B. B. 1962. *Astroblepus pholeter*, a new species of cave-dwelling catfish from eastern Ecuador. Proc. Biol. Soc. Wash. 75: 311-314.

Cuvier, G., and A. Valenciennes. 1846. Histoire naturelle des poissons. Vol. 18:i-xix + 1-505, Plates 520-523.

Dahl, G. 1971. Los peces del norte de Colombia. Instituto de Desarrollo de los Recursos Naturales Renovables (INDERNA), Bogotá. 391 pp.

Dyer, B. S. 1998. Phylogenetic systematics and historical biogeography of the neotropical silverside family Atherinopsidae (Teleostei: Atheriniformes). Pages 519-536 in: L. R. Malabarba, R. E. Reis, R. P. Vari, Z. M. S. Lucena, and C. A. S. Lucena (editors). Phylogeny and classification of Neotropical fishes. EDIPUCRS, Porto Alegre, Brazil.

Eigenmann, C. H. 1914. On new species of fishes from the Rio Meta Basin of eastern Colombia and on albino or blind fishes from Bogota. Indiana University Studies, no. 23:229-230.

Eigenmann, C. H. 1915. The Serrasalminae and Mylinae. Ann. Carnegie Mus. 9 (3-4):226-272 + Plates 44-58.

Eigenmann, C. H. 1918. Eighteen new species of fishes from northwestern South America. Proc. Am. Philos. Soc. 56 (7) [1917]:673-689.

Eigenmann, C. H. 1920. The fishes of the rivers draining the western slope of the Cordillera Occidental of Colombia, rios Atrato, San Juan, Dagua, and Patia. Indiana University Studies 7 (46):1-19 + map.

Eigenmann, C. H. 1925. A review of the Doradidae, a family of South American nematognathi, or catfishes. Transactions of the American Philosophical Society 22 (5):280-365.

Eigenmann, C. H., and R. S. Eigenmann. 1890. A revision of the South American Nematognathi or cat-fishes. Occasional Papers of the California Academy of Sciences, Vol. 1 (July 1890).

Eschmeyer, W. N. (editor). 1998. Catalog of fishes. Three volumes. Special publication No. 1 of the Center for Biodiversity Research

Information, California Academy of Sciences, San Francisco, California. 2905 pp.

Eschmeyer, W. N. (editor). 2000. The catalogue of fishes on-line (updated Feb. 20, 2000). California Academy of Sciences, San Francisco, California. (Available from http://www.calacademy.org/research/ichthyology/catalog/index.html Accessed April-May, 2001.)

Faak, M. 1986. Alexander von Humboldt: Reise auf dem Rio Magdalena, durch die Anden und Mexico. Berlin. Cited by Wilson (1995).

Fink, W. L. 1993. Revision of the piranha genus *Pygocentrus* (Teleostei, Characiformes). Copeia 1993(3):665-687.

Géry, J. 1976. Les genres de Serrasalmidae (Pisces, Characoidei). Bulletin Zoologisch Museum Universiteit van Amsterdam 5 (6):47-54.

Géry, J. 1977. Characoids of the world. TFH Publications, Neptune City, New Jersey.

Géry, J. 1986. Notes de Characologie néotropicales 1. Progrès dans la systématique des genres *Colossoma* et *Piaractus*. Revue Francaise d'Aquariologie 12 (4):97-102.

Gill, T. 1905. Flying fishes and their habits. Smithsonian report for 1904 (no. 1629), pages 495-515. Government Printing Office, Washington, D.C.

Goulding, M., M. Leal Carvalho, and E. G. Ferreira. 1988. Rio Negro, rich life in poor water. SPB Academic Publishing, The Hague, The Netherlands. 200 pp.

Graham, J. B. 1997. Air-breathing fishes: evolution, diversity, and adaptation. Academic Press, San Diego, California. 299 pp.

Henn, A. W. 1928. List of types of fishes in the collection of the Carnegie Museum on September 1, 1928. Ann. Carnegie Mus. 19(4):51-99.

Higuchi, H. 1992. A phylogeny of the South American thorny catfishes (Osteichthyes; Siluriformes, Doradidae). Unpublished Ph.D. dissertation. Harvard University, Cambridge, Massachusetts. 372 pp.

Humboldt, A. von. 1805a. Mémoire sur l'*Eremophilus* et L'*Astroblepus*, deux nouveaux genres de l'ordre des apodes. In: Voyage de Humboldt et Bonpland, Deuxième partie. Observations de Zoologie et d'Anatomie comparée. Paris. v. 1 (Title page 1811):17-20, Plates 6-7.

Humboldt, A. von. 1805b. Mémoire sur une nouvelle espèce de pimelode, jetée par les volcans du Royaume de Quito. In: Voyage de Humboldt et Bonpland, Deuxième partie. Observations de Zoologie et d'Anatomie comparée. Paris. v. 1 (Title page 1811): 21-25, Plates 7.

Humboldt, A. von, 1805c. Mémoire sur une nouvelle espèce de gymnote de la rivière de la Madeleine. In: Voyage de Humboldt et Bonpland, Deuxième partie. Observations de Zoologie et d'Anatomie comparée. Paris. v. 1 (Title page 1811): 46-48, Plates 10.

Humboldt, A. von. 1805d. VII. Mémoire observations sur l'anguille électrique (*Gymnotus electricus*, Lin.) du nouveau continent. In: Voyage de Humboldt et Bonpland. Recueil d'observations de zoologie et d'anatomie comparée. Chez Levrault, Schoell et comp., Paris. (Title page 1805): 81-145(?).

Humboldt, A. von. 1818-1829 [1966]. Personal narrative of travels to the equinoctial regions of the New Continent during the years 1799-1804, by Alexander de Humboldt, and Aimé Bonpland. English translations by Helen Maria Williams of French original by Alexander de Humboldt. Seven volumes (vols. 1-3: 1818, vol. 4: 1819, vol. 5: 1821, vol. 6 (part 1): 1826, vol. 7: 1829): . Originally printed for Longman, Hurst, Rees, Orme, and Brown, Paternoster Row, London, 1818-1829. Reprinted by AMS Press, New York, 1966.

Humboldt, A. von. 1995. Personal narrative of a journey to the equinoctial regions of the new continent. Abridged and translated (into English) with an introduction by Jason Wilson and a historical introduction by Malcolm Nicholson. Penguin Books, London. lxxii + 311 pp.

Humboldt, A. von, and A. Valenciennes. 1821. Recherches sur les poissons fluviatiles de l'Amérique Équinoxiale. In: Voyage de Humboldt et Bonpland, Deuxième partie. Observations de Zoologie et d'Anatomie comparée. Paris. V. 2 (Title page 1833):145-216, Plates 45-52.

Jordan, D. S., and B. W. Evermann. 1898. The fishes of North and Middle America: a descriptive catalogue of the species of fish-like vertebrates found in the waters of North America, North of the

Isthmus of Panama. Part II. Bulletin of the United States National Museum, No. 47:i-xxx + 1241-2183.

Kullander, S. O., and H. Nijssen. 1989. The cichlids of Surinam, Teleotei: Labroidei. E. J. Brill, Leiden. 256 pp.

Lazara, K. J. 1993. Dating and authorship of new species described in Humboldt and Valenciennes' "Recherches sur les poissons fluviatiles de l'Amerique equinoxiale.". Copeia 1993 (4):1160-1161.

Machado-Allison, A. 1971. Contribution al conocimiento de la taxonomia del género *Cichla* (Perciformes: Cichlidae) en Venezuela. Parte 1. Acta Biol. Venez. 7 (4): 459-497.

Machado-Allison, A., and W. L. Fink. 1991. Notas sobre la sistemática del género *Serrasalmus* y géneros relacionados. Parte II. El género *Pygocentrus* in Venezuela. Acta Biol. Venez. 13(1-2):109-136.

Machado-Allison, A., and W. L. Fink. 1995. Sinopsis de las especies de la subfamilia Serrasalminae presentes en la cuenca del Orinoco: claves, diagnosis e ilustraciones. Serie Peces De Venezuela, Facultad de Ciencias, Instituto de Zoología Tropical, Museo de Biología, Universidad Central de Venezuela, Caracas. 92 pp.

Machado-Allison, A., and W. L. Fink. 1996. Los peces caribes de Venezuela: diagnosis, claves, aspectos ecológicos y evolutivos. Universidad Central de Venezuela, Consejo de Desarrollo Cientifico y Humanistico, Caracas. 151 pp.

Mago-Leccia, F. 1970. Lista de los peces de Venezuela incluyendo un estudio preliminary sobre la ictiogeografia del país. Ministerio de Agricultura y Cría, Caracas. 283 pp.

Mago-Leccia, F. 1994. Electric fishes of the continental waters of America. Caracas, Fundación para el Desarrollo de las Ciencias Fisicas, Matemáticas y Naturales. 1-206, + 16 tables.

Malabarba, L. R. 1998. Monophyly of the Cheirodontinae, characters and major clades (Ostariophysi: Characidae). Pages 192-233 *in*: L. R. Malabarba, R. E. Reis, R. P. Vari, Z. M. S. Lucena, and C. A. S. Lucena (editors). Phylogeny and classification of Neotropical fishes. EDIPUCRS, Porto Alegre, Brazil.

Mees, G. F. 1974. The Auchenipteridae and Pimelodidae of Suriname (Pisces, Nematognathi). Zool. Verh. (Leiden) No. 132: 1-256, Plates 1-15.

Novaresio,P. 1996. The explorers: from the ancient world to the present. Stewart, Tabori, and Chang, New York, New York. 305 pp. + index.

Ortega, H., and R. P. Vari. 1986. Annotated checklist of the freshwater fishes of Peru. Smithson. Contrib. Zool. No. 437: iii + 25 p.

Papavero, P. 1971. Essays on the history of Neotropical dipterology, with special reference to collectors (1750-1905). Vol. 1. Museu de Zoologia, Universidade de São Paulo, São Paul, Brazil. 216 pp.

de Pinna, M. C. C. 1998. Phylogenetic relationships of Neotropical siluriformes (Teleostei: Ostariophysi): historical overview and synthesis of hypotheses Pages 279-330 in: L. R. Malabarba, R. E. Reis, R. P. Vari, Z. M. S. Lucena, and C. A. S. Lucena (editors). Phylogeny and classification of Neotropical fishes. EDIPUCRS, Porto Alegre, Brazil.

Regan, C. T. 1907. Descriptions of two new characinid fishes from South America. Annals and Magazine of Natural History; Zoology, Botany, and Geology (London) (Ser. 7) Vol. 20 (no. 119):402-403.

Röhl, E. 1985. Alejandro de Humboldt. Pages XIV-LII, in: Alejandro de Humboldt. Viaje a las regiones equinocciales del Nuevo Continente. Vol. I. Monte Ávila Editores, Caracas.

Sherborn, C. D. 1899. A note on the date of the parts of 'Humboldt and Bonpland's voyage: Observations de Zoologie.' Annals and Magazine of Natural History; Zoology, Botany, and Geology (London) 3: 428.

Silfvergrip, A. M. C. 1992. *Zungaro*, a senior synonym of *Paulicea* (Teleostei: Pimelodidae). Ichthyol. Explor. Freshwaters 3 (4):305-310.

Silfvergrip, A. M. C. 1996. A systematic revision of the Neotropical catfish genus *Rhamdia* (Teleostei, Pimelodidae). Stockholm, Sweden, Department of Zoology, Stockholm University and Department of Vertebrate Zoology, Swedish Museum of Natural History.

Taphorn, D. C. 1992. The characiform fishes of the Apure River drainage, Venezuela. BioLlania, Special Edition, No. 4. 537 pp.

Taphorn, D. C., R. Royero, A. Machado-A., and F. Mago-L. 1997. Peces de agua dulce. Pages 53-100 *in* E. La Marca (editor). Vertebrados actuales y fósiles de Venezuela. Museo de Ciencia y Tecnología de Merida, Venezuela.

Wilson, J. 1995. Introduction. Pages xxxv-lxiv, *in*: Alexander von Humboldt. Personal narrative of a journey to the equinoctial regions of the new continent. Abridged and translated with an introduction by Jason Wilson and a historical introduction by Malcolm Nicholson. Penguin Books, London.

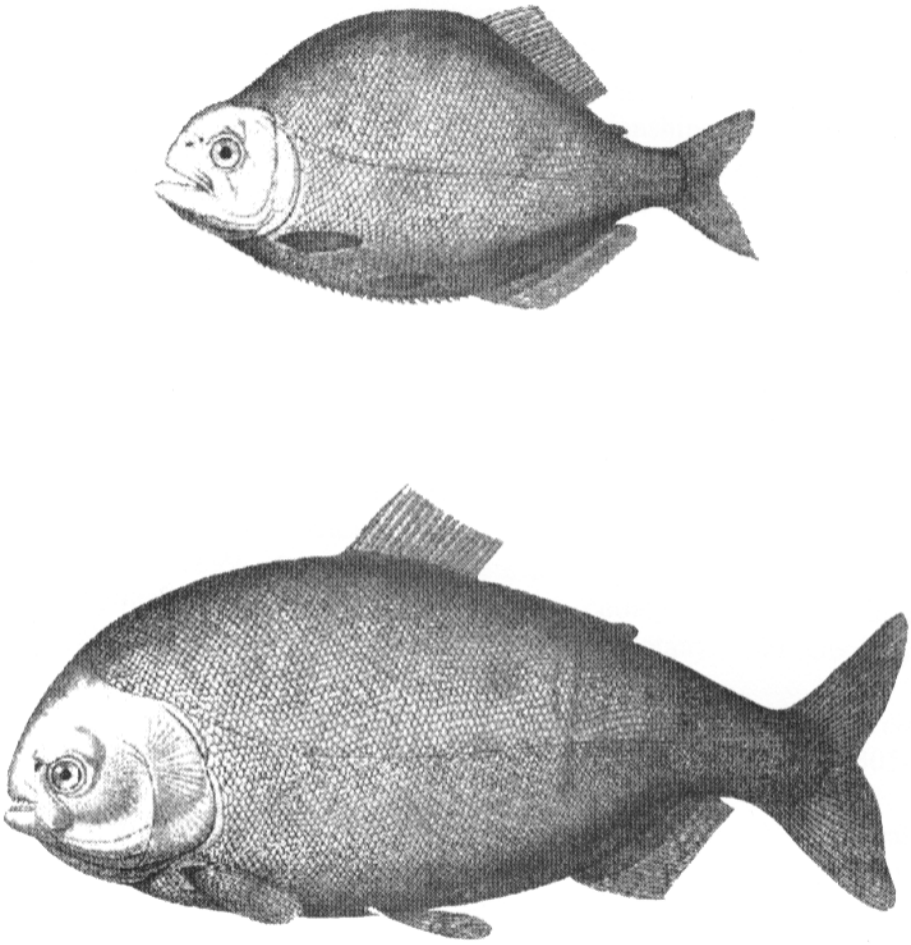

Figure 1. Original drawings of "*Serrasalmo cariba*" (above) and "*Myletes paco*" from Humboldt (1821: Plate 47).

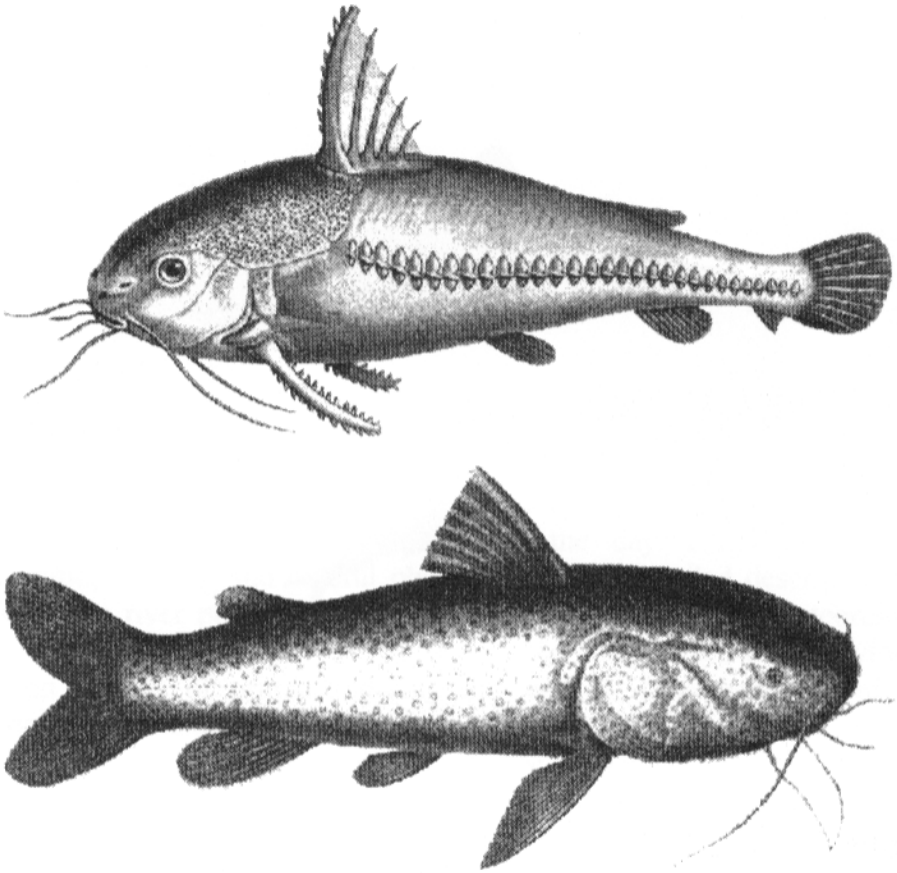

Figure 2. Original drawings of "*Doras crocodili*" (above) from Humboldt (1821:Plate 48, Fig. 2) and "*Pimelodus zungaro*" from Humboldt (1821: Plate 46, Fig. 1).

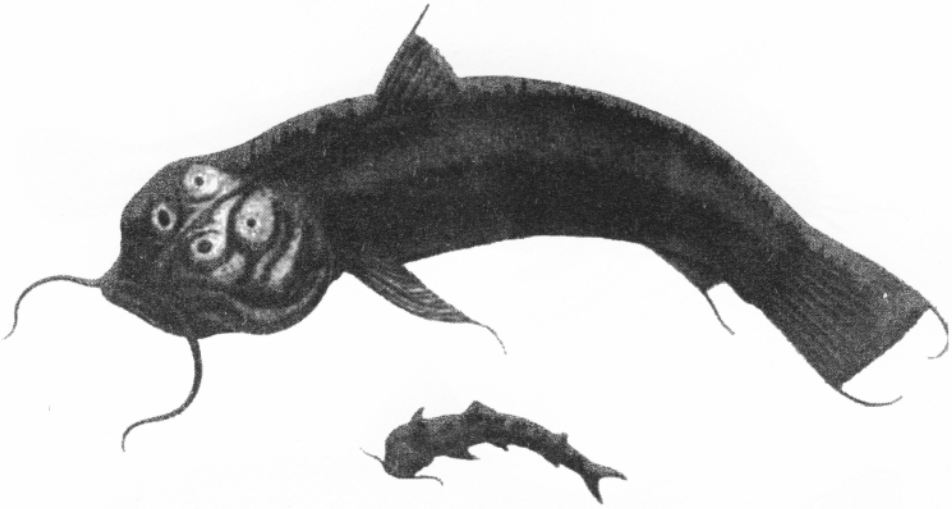

Figure 3. Original drawings of "*Astroblepus grixalvii*" (above) and "*Pimelodus cyclopum*" from Humboldt (1805a).

BIOLLANIA

Edición Especial Nº 7

ALEXANDER VON HUMBOLDT: Homenaje al Bicentenario de su Llegada a Tierras Venezolanas.

Editor: Gerardo A. Aymard C.

República Bolivariana de Venezuela

Consejo Legislativo
Estado Portuguesa

Universidad Nacional Experimental de los Llanos Occidentales Ezequiel Zamora [UNELLEZ]; Guanare, estado Portuguesa, Venezuela, Julio, 2001.

EXPRESIÓN DE GRATITUD

Al ilustre Consejo Legislativo Regional del Estado Portuguesa en la persona de su presidente el legislador Orlando Alcántara, y a los profesores Donald Taphorn y Miguel Niño del Programa de R.N.R. de la UNELLEZ-Guanare, quienes generosamente hicieron posible esta edición. Al Prof. Pedro J. Urriola Muñoz por la información histórica otorgada al editor.

BIOCENTRO-ASOMUSEO

República Bolivariana de Venezuela, Consejo Legislativo

Guanare, Estado Portuguesa, Venezuela 2001

ISBN 980-231-131-6