# The Species of the *Hypostomus emarginatus* Group (Siluriformes: Loricariidae)


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## Introduction

With over 700 valid species, the family Loricariidae is the largest catfish family in the world. Its members are restricted to freshwater habitat in neotropical South America, Panama, and Costa Rica (Fig. 1) (Armbruster, 2004; Nelson, 2006). The genus *Hypostomus* is the largest genus within the Loricariidae, with one hundred and thirty-eight currently valid species. Its range spans almost the entire range of Loricariidae. Members of the genus live in varied habitats including slow moving pools, high-gradient mountain streams, large rivers and lakes, and some members are also found in brackish water (Nelson 2006). There are no unique characteristics that identify *Hypostomus,* but they are dorsoventrally compressed fish (flattened), which have a series of heavy plates covering the body and sucker-like mouths (Armbruster 2004). Synapomorphies (all homoplasic) for the genus include: a hatchet shaped opercle, a pointed cleithral process, and the anterior process of the pterotic-supracleithrum passing halfway through the orbit (Armbruster 2004). Most *Hypostomus* also share a pointed transverse process of the Weberian apparatus that is fused to the pterotic-supracleithrum (Armbruster 2004).

**Figure 1** Range of Loricariidae.(from Armbruster, 2004)

*Background of Hypostomus*

Early descriptions of Loricariid fishes lacked information to adequately identify the fish. They were

often very vague, and lacked significant detail (Boeseman, 1968). Poor preservation of type specimens, loss of type specimens, and inadequate data make original descriptions hard to follow, especially when reviewing complex groups, such as *Hypostomus*. Often the description of a species was based on one specimen from an expedition or from a drawing by an explorer. These often lacked sufficient detail to describe the species or correctly identify them as another species (Boeseman, 1968). Collection location of a specimen was often unknown or vague, and many collection records were lost in the voyages back to Europe or have been misplaced or lost since.

*Systematics of Hypostomus*

Although the species of *Hypostomus* are currently recognized as a single genus, this is a relatively recent phenomenon (Weber and Montoya Burgos, 2002; Weber, 2003; Armbruster, 2004). Of particular interest to this study are the genera *Aphanotorulus*, *Isorineloricaria*, and *Squaliforma*. Species that conform to these three taxa were first recognized as a monophyletic group in Armbruster and Page (1996) based on the following synapomorphies: elongate odontodes on breeding males and elongate first hypobranchials. Additionally, the first basibranchials of *Hypostomus emarginatus* are intermediate between those of other *Hypostomus* and *Aphanotorulus* (Armbruster and Page 1996). Armbruster (2004) placed the three genera into *Hypostomus* and termed it the *H. emarginatus* group, but he recognized that there might be a case for recognizing the group as a separate genus at a later date.

*Monopyhly of the Hypostomus emarginatus species group*

The *Hypostomus emarginatus* species group consists of 24 species of the former genera *Squaliforma* Isbrücker 2001 (n=15), *Isorineloricaria* Isbrücker 1980 (n=2), and *Aphanotorulus* Isbrücker and Nijssen 1982 (n=7). These genera were identified as synonyms of *Hypostomus* by Armbruster (2004) in order to maintain a nomenclature that reflects the current phylogenetic hypotheses. Members of the group are listed below in Table 1.

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| *H. ammophillus* (Armbruster and Page 1996) | *H. phrixosoma* (Fowler 1940) |
| *H. annae* (Steindachner 1881) | *H. popoi* (Pearson 1924)[3] |
| *H. biseriatus* (Cope 1872) | *H. scopularius* (Cope 1871) |
| *H. chaparae* [3] (Fowler 1940) | *H. spinosissimus* (Steindachner 1880) |
| *H. emarginatus* Valenciennes 1840 | *H. squalinus* Jardine and Schomburgk 1841 |
| *H. festae*[2] (Boulenger 1898) | *H. tenuicauda* (Steindachner 1878) |
| *H. frankei*[3] (Isbrücker and Nijssen 1982) | *H. tenuis* Boeseman 1968 |
| *H. gomesi* (Fowler 1942) | *H. verres*[4] Valenciennes 1840 |
| *H. horridus* Kner 1854 | *H. villarsi* (Lütken 1874) |
| *H. iheringi*[1] (Fowler 1941) | *H. virescens* (Cope 1874) |
| *H. madeirae*[3] (Fowler 1913) | *H. watwata* Hancock 1828 |
| *H. micropunctatus*[3] (La Monte 1935) | *H. unicolor* (Steindachner 1908) |

**Table 1** Members of the *Hypostomus emarginatus* group (Armbruster 2004). [1] Synonym of *H. gomesi*; [2] Synonym of *H. spinosissimus*; [3] Synonym of *H. unicolor*; [4] Synonym of *H. watwata*.

The taxonomy of the group is currently confused as very few species can be identified based on current information. The group is in need of a taxonomic revision to determine what species are valid and if there are any undescribed taxa. Also, the relationships of the species need to be better elucidated based on examination of more species than those in Armbruster (2004).

*Objectives*

I plan on revising the *Hypostomus emarginatus* species group and to explore the phylogenetic relationships of its members using morphological methods.

**Materials and Methods**

Phylogenetics will follow Armbruster (2004) and counts and measurements will follow Boeseman (1968) and Armbruster and Page (1996). Specimens from several institutional collections will be used in measurements. Institutions include Auburn University Museum (AUM), National Museum of Natural History (USNM), Illinois Natural History Survey (INHS), British Museum of Natural History (BMNH), plus several more throughout North America, Europe, and South America. Some specimens can be borrowed from these institutions, while investigation of others will require visits to the institutions.

Specimens will be measured with digital calipers to the nearest 0.1 mm on the left side of the specimen. Measurements of bilaterally symmetric features will be taken on the left side unless the feature is lost or broken and it will be measured on the right. Measurements to be included are labeled in Figures 2-4. Measurements not listed include snout-pectoral length, pectoral- orbit distance, base of anal fin length, upper adipose- caudal length, lower adipose-dorsal length, folded dorsal length, mouth width, mouth length, and dentary length. These measurements were not listed due to difficulties in clearly illustrating the measurements.

Measurements will be examined bivariately through the use of bivariate plots and multivariately using principal component analysis (PCA). Any bivariate plots that seem to show separation between species will be examined statistically after natural log transformation using analyses of covariances (ANCOVA). Measurements will also be natural log transformed prior to

PCA. The first component of PCA will be excluded because it represents overall size difference. The remainder of the principal components will be plotted against standard length to show that they represent relative size differences (shape).

Meristics will also be taken from each specimen. Plate counts and other meristics include lateral line scales, head-dorsal plates, dorsal-adipose plates, dorsal base plates, folded dorsal plates, adipose fin plates, anal fin base plates, anal fin- tail plates, folded pectoral plates, lower left teeth, upper left teeth, dorsal-fin rays, pectoral-fin rays, pelvic-fin rays, anal-fin rays, caudal fin rays, and dorsal and ventral procurrent caudal-fin rays.

Other data to be collected will include color, color patterns, as well as unique structures such as odontode formations, nuptial male ornamentation, and shapes of crests and ridges. Collection information will also be obtained for each specimen used in the data set such as collection location (i.e. country and drainage). The compellation of this data will allow me to identify species based on physical differences as well as their ranges.

Phylogenetic analysis will be performed by building a character matrix within MacClade (Sinauer Associates, ver. 4.05, 2002). Character states will be assigned to selected characters, in a presence/ absence format. This data will be transferred to the program PAUP*, version 4.0b10 (Swofford, 2002) for phylogenetic analysis. Members of the *Hypostomus plecostomus* group will be used as outgroups, as will representatives of the other tribes of the Hypostominae. Phylogenetic analysis in PAUP* will be determined by the size of the dataset, but given the results of phylogenetic datasets on similar sized groups of *Hypostomus* (Armbruster, 2003), an Exhaustive Search (which finds all possible arrangements) will likely work.

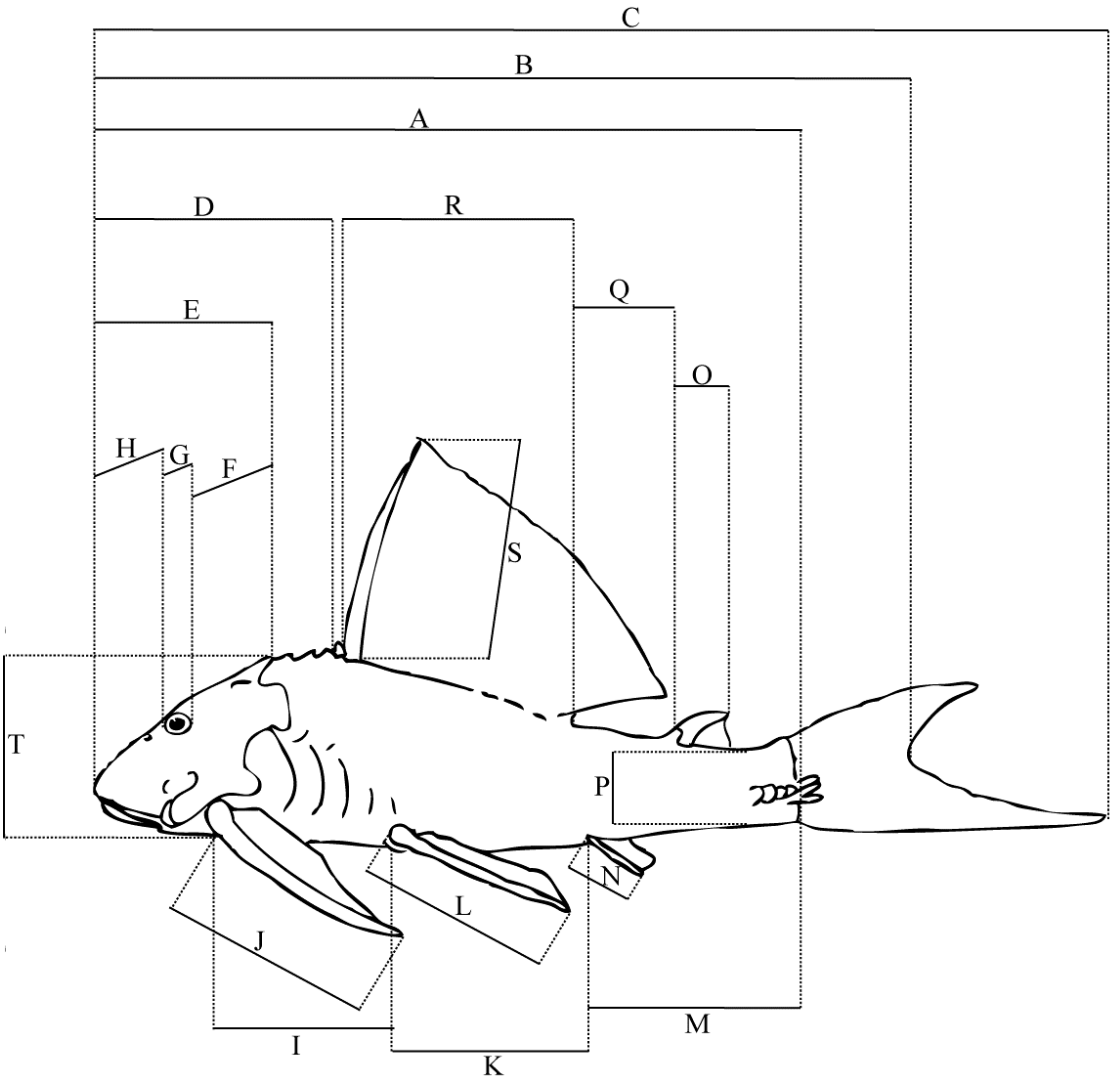
**Possible Implications**

Taxonomic studies are very important to many other fields in biology, especially ecology. Proper identification of species allows for better ecological surveys and more accurate experimentation (Gotelli, 2004). These lead to better implementation of management plans and conservation measures by allowing proper identification of species by non-specialists.

Furthermore, species of the *Hypostomus emarginatus* group range across most of South America and occur on both sides of the Andes Mountains. A phylogeny of this small group could possibly generate answers about Andean uplift and its affect on neotropical fishes as well. The biogeographic distributions of this group could identify historical connections amongst river drainages across the continent.

Members of the *Hypostomus emarginatus* group are also commercially important in the pet trade and are a food fish in some regions of South America. There have been recent reports that fishermen in Columbia and other South American countries are throwing Loricariids on the banks of rivers and streams when they are caught in nets. These fishermen insist that the catfish are scaring away other fish that they are trying to catch. Incidents such as these add stress to an already fragile ecosystem. Understanding diversity in these regions could allow us to generate an understanding with locals on the importance of these fish in the ecosystem.

**Figure 2** Measurements to be taken. Left lateral view of general *Hypostomus* body plan. Adapted from Boeseman (1968) and Armbruster and Page (1996).

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| A. | Sandard Length | K. | Abdominal length |
| B. | Axial length | L. | Pelvic spine length |
| C. | Total length | M. | Post-anal length |
| D. | Predorsal length | N. | Anal fin length |
| E. | Head length | O. | Adipose spine length |
| F. | Head- eye length | P. | Caudal depth |
| G. | Orbit diameter | Q. | Interdorsal length |
| H. | Snout length | R. | Base of dorsal fin length |
| I. | Thoracic length | S. | Dorsal spine length |
| J. | Pectoral spine length | T. | Head depth |

**Figure 3** Measurements to be taken (cont'd). Anterodorsal view of general *Hypostomus* head. Adapted from Boeseman (1968) and Armbruster and Page (1996).

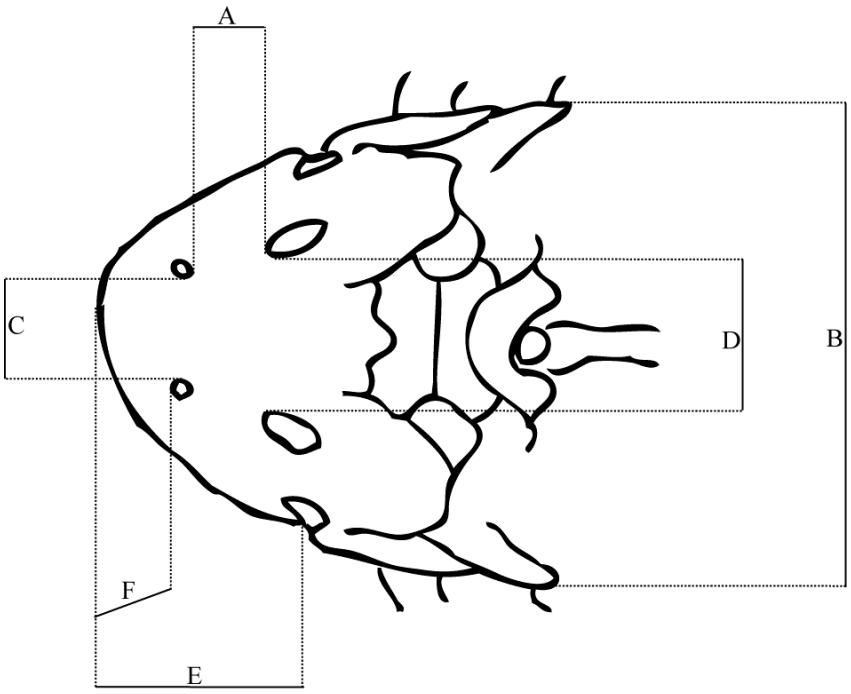
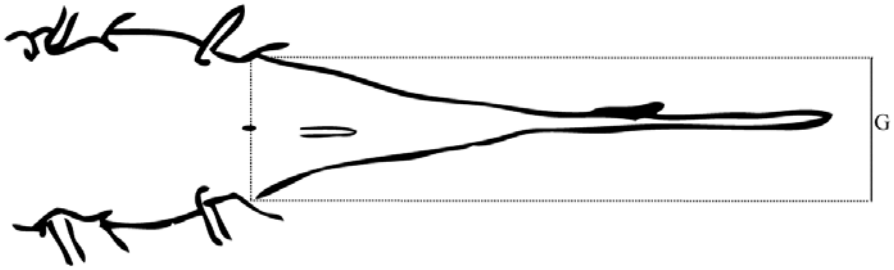



**Figure 3** Measurements to be taken (cont'd). Posterodorsal view of a general *Hypostomus* caudal peduncle. Adapted from Boeseman (1968) and Armbruster and Page (1996).




A. Eye- nare length
B. Cleithral width
C. Internares width
D. Interorbital width
E. Snout– opercle distance
F. Snout– nares length
G. Caudal peduncle width

**Literature Cited**


Armbruster, J. W. 1998. Review of the loricariid catfish genus Aphanotorulus and rediscription of A. unicolor. Ichthyol. Explor. Freshwaters 8:253-262.

Armbruster, J. W. 2003. The species of the Hypostomus cochliodon group (Siluriformes: Loricariidae). Zootaxa 249:1-60.

Armbruster, J. W. 2004. Phylogenetic relationships of the suckermouth armoured catfishes (Loricariidae) with emphasis on the Hypostominae and the Ancistrinae. Zool. J. Linn. Soc. 141:1-80.

Armbruster, J. W. and L. M. Page. 1996. Rediscription of Aphanotorulus (Teleostei:Loricariidae) with description of one new species, A. ammophilus, from the Rio Orinoco basin. Copeia 2:379-389.

Boeseman, M. 1968. The genus Hypostomus Lacépède, 1803, and its Surinam representatives (Siluriformes: Loricariidae). Zoologische Verhandelingen, 99, 1-89.

Goetelli, N.J. 2004. A taxonomic wish-list for community ecology. Phil. Trans. R. Soc. Lond. 359: 585-597.

Gronovius, L.T. 1754. Museum ichthyologicum, sistens piscium indigenorum and quorundam exoticorum, etc.: (i-x), 1-68, pl. 1-4.

Lacépède, B.G.E. 1803. Histoire naturelle des poisons. Vol. 5. P. Plassan, Paris (ed.) 5(1), i-lxviii, 1-803.

Nelson, J.S. 2006. Fishes of the world. 4th ed. Wiley, New York. 601pp.

Swofford, D.L. 2002. *PAUP*:phylogenetic analysis using parsimony (*and other methods)*, Version 4.0b4a. Sunderland, MA: Sinauer Associates.

Weber, C. 2003. Subfamily Hypostominae. *In*: Reis, R.E., S.O. Kullander, and C.F. Ferraris Jr. (Eds), *Checklist of the Freshwater Fishes of South and Central America*. EDIPUCRS Porto Alegre, Brazil, pp. 351- 372.

Weber, C. and J.I. Motoya-Burgos. 2002. *Hypostomus fonchii* n. sp. (Siluriformes: Loricariidae) from Peru, a key species suggesting the synonymy of *Cochliodon* with *Hypostomus*. *Revue suisse de Zoologie*, 109(2), 355-368.