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Investigation of the Shared and Divergent Anatomical Features of Fishes From the Suborder Characoidei

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Investigation of the Shared and Divergent Anatomical Features of Fishes From the Suborder Characoidei

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Introduction

Approximately 2,000 species comprise the suborder Characoidei. A majority (1,100 species) are found within the family Characidae while the remaining species are spread among thirteen other families [1]. However, defining the phylogenetic relationships both among and within each family has been challenging, and as a result, their evolutionary relationships remain unclear. This project investigated the distinctive anatomical and morphological features for members of three families of the Characoidei (Figure 1). A comparative analysis of adult anatomy and morphology was carried out using (1) morphometric analysis to detect quantitative characteristics, and (2) quantification of various meristic features of skeletal anatomy. This research intended to contribute additional knowledge in order to refine the phylogenetic relationships between these taxa.

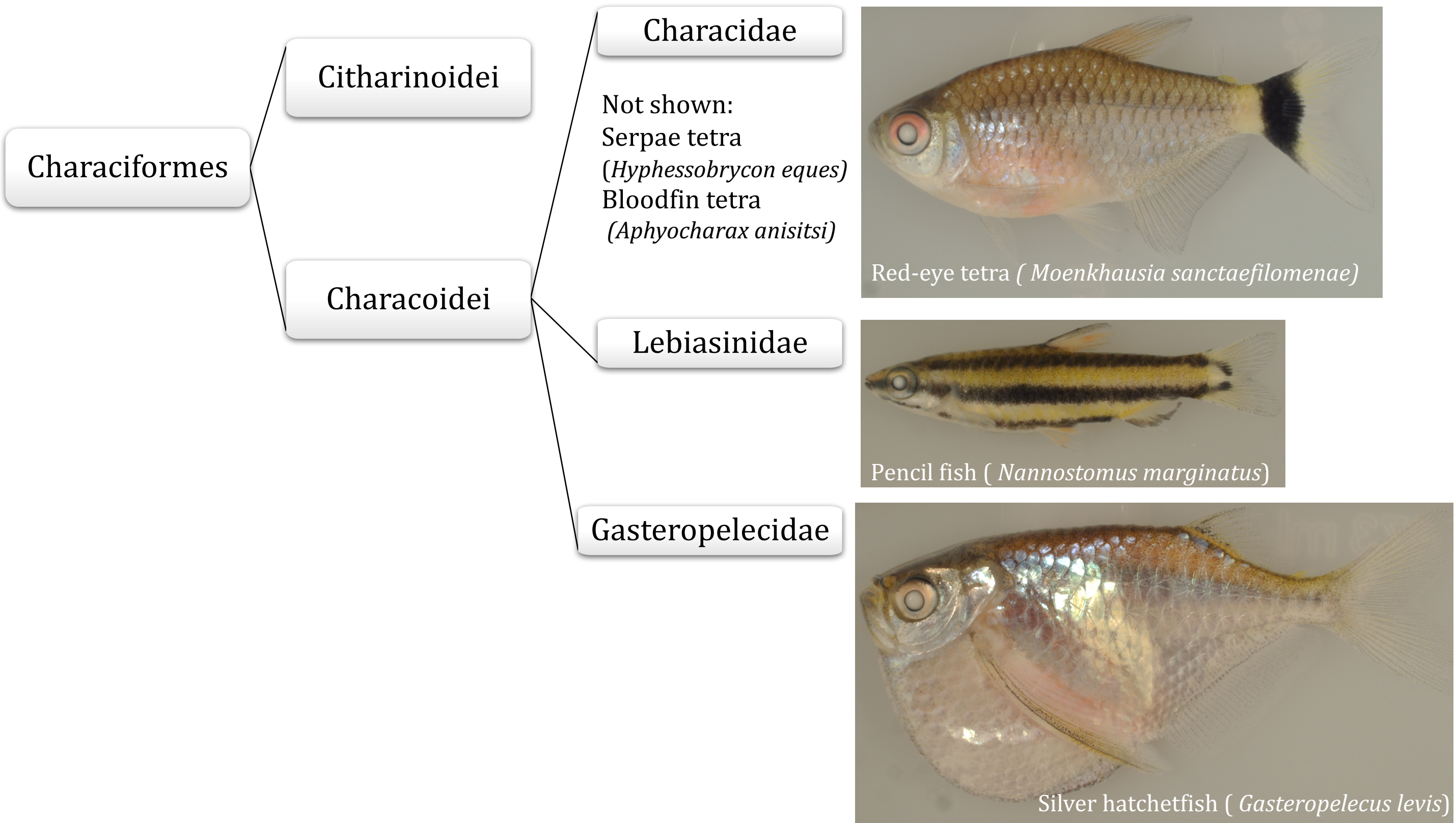


Figure 1. Cladogram of specimens used. Characoidei, together with the Citharinoidei, comprise the order Characiformes, a major taxon of tropical, freshwater fishes. The five species used are listed within the figure.

Materials and methods

1. Specimens (see Figure 1) were acquired from local retailers and euthanized by immersion in an ice bath prior to being fixed in 80% ethanol.
2. Specimens were stained with alizarin red for 24 hours and then cleared in glycerin to allow for analysis (figure 2).
3. Photographs were taken from a lateral perspective using a Nikon V1 camera for morphometric analysis. ImageJ [4] was used to analyze uniform images of specimens.

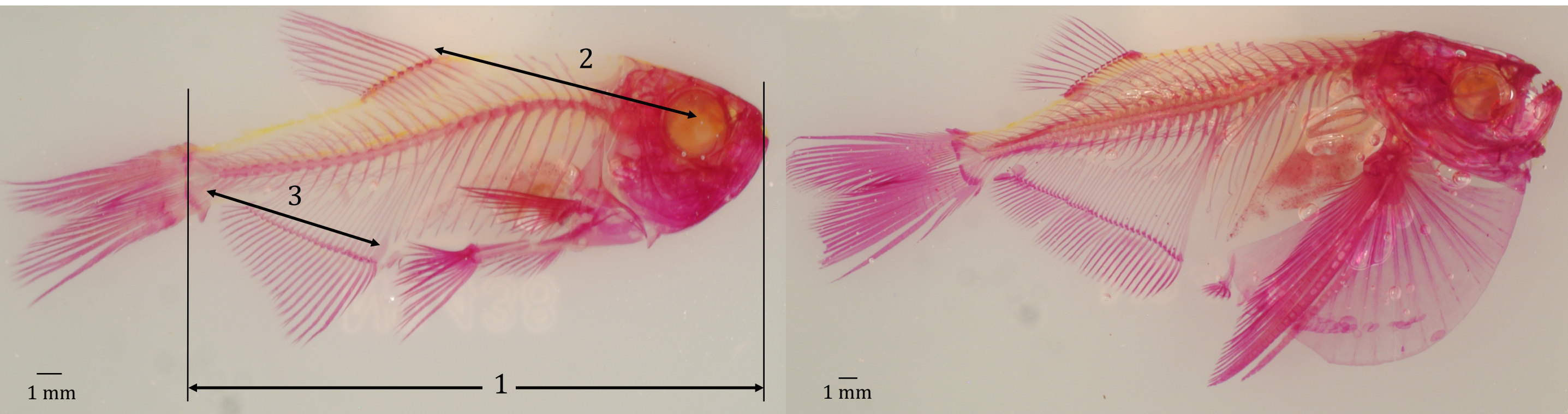


Figure 2. Morphometric measurements taken of stained specimens; (1) snout to caudal peduncle as standard length (2) orbit to dorsal fin and (3) anal fin to caudal bottom.

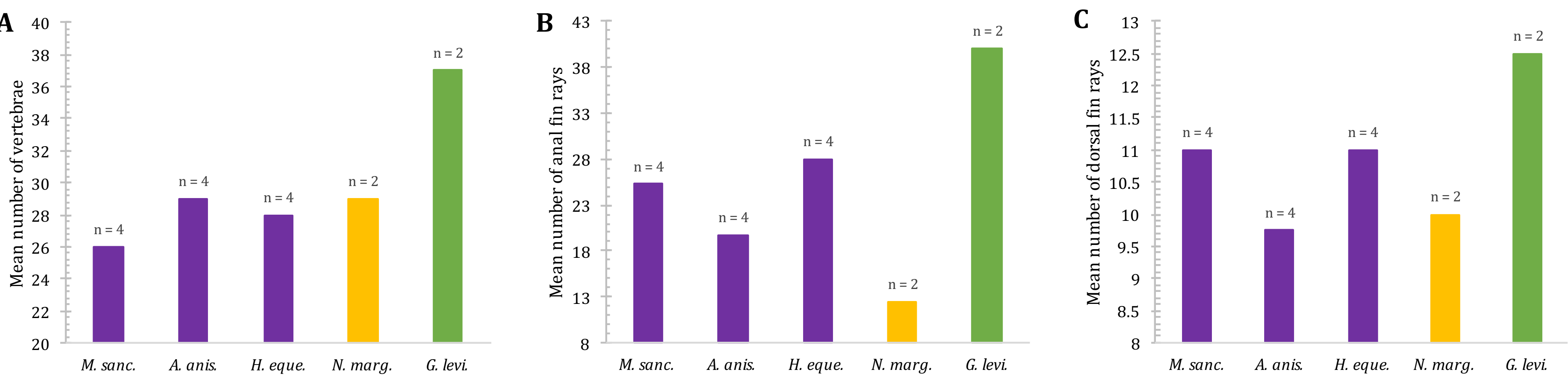


Figure 3. Mean meristic counts of (A) number of vertebrae (B) number of anal fin rays, and (C) number of dorsal fin rays in *M. sanc.* (*Moenkhausia sanctaefilomenae*) *A. anis.* (*Aphyocharax anisitsi*) *H. eque.* (*Hyphessobrycon eques*) *N. marg.* (*Nannostomus marginatus*) and *G. levi.* (*Gasteropelecus levis*).

Meristic analysis

Variations among the number of vertebrae and fin rays were observed between families (figure 3). These data suggest the following:

- Members of the Gasteropelecidae may differ from other families by possessing a larger number of anal fin rays, dorsal fin rays, and vertebrae.
- Members of the Lebiasinidae may differ from other families by possessing a fewer number of anal fin rays.
- The number of vertebrae and ray fin elements are unlikely to serve as robust diagnostic characters for the Characidae, but they may serve to categorize subgroups within the family.

Literature cited
1. Oliveira, C., et al. *BMC Evolutionary Biology*, 2011.
2. To, M., and Ci, A. *J AGRIC RES & MEN*, 2015.
3. Fink, S., and Fink, W. *Academic Press*, 1996.
4. Schneider, C., et al., *Nature methods* 9(7), 2012.

Morphometric analysis

Variations between each family was observed in regard to lengths from the orbit to the dorsal fin and the and lengths from the anal fin to the base of the caudal peduncle (figure 4). These data suggest the following:

- Within the members of the Characidae, *H. eques* has the largest degree of variance with respect to both measurements, where both fins are more anteriorly located.
- Members of the family Gasteropelecidae may differ from other families in respect to the location of the dorsal fin along the cranial-caudal axis.
- Members of the family Lebiasinidae may differ from other families in respect to the location of the anal fin along the cranial-caudal axis.

Figure 4 (right). Morphometric comparisons between families and species using standard length as reference to the lengths from (A) orbit to dorsal fin in mm and (B) anal fin to base of caudal peduncle in mm. Trend lines represent measures for given characters normalized to standard length.

