

# Muscle Architecture and Myosin Profile of the Cypriniform Palatal Organ

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## Introduction

Cypriniformes is a diverse group of fishes that includes over 3,000 species classified into more than 300 genera (Bart and Doosey, 2011). This speciose group of fishes is characterized by a number of unique anatomical novelties used for feeding. These differences distinguish these fish by providing them with a distinctive way of feeding. Unfortunately, there is little understanding about both the function and design of these feeding structures.

### What we know:

The feeding apparatus of cypriniform fishes is characterized by an absence of oral teeth and a stomach, as well as the presence of unique pharyngeal jaws, which masticate against the base of the skull. In addition, the pharyngeal roof is occupied with a muscular pad known as the palatal organ, while the pharyngeal floor contains an additional muscular pad known as the post lingual organ. It is also known that the palatal organ is present in most cypriniform species.

All fishes that have been investigated contain a hard palatal on the roof of the mouth, consisting of skin and bone, with the exception of cypriniforms, which have a pharyngeal roof composed of muscle.

### Palatal organ has been investigated in the following species:

- *Carassius auratus* (goldfish)
- *Cyprinus carpio* (common carp)

Prior to this study it was unclear whether the palatal organ existed in more than just these two species and whether the muscular composition of this structure was conserved. However, data from our lab have shown not only that the palatal organ is present in most cypriniforms, but also that there is significant morphological diversity in the structure of this feature within the oral cavity within different cypriniform species.

### Hypotheses:

- 1) There will be significant differences in both fiber diameter and myosin profile among different cypriniform species.
- 2) These differences in palatal organ architecture and myosin profile are due to phylogenetic similarity.

This research project examined the type of muscle fibers present in the two suborders within cypriniformes: the Cobitoidea and Cyprinoidea. Both muscle fiber diameter and myosin composition was examined. These data provide a more complete picture of the palatal organ's potential functions. With this information, we have more clues as to the physiology of the palatal organ. Moreover it is possible to assess whether anatomical and physiological differences are due to phylogeny or ecology.

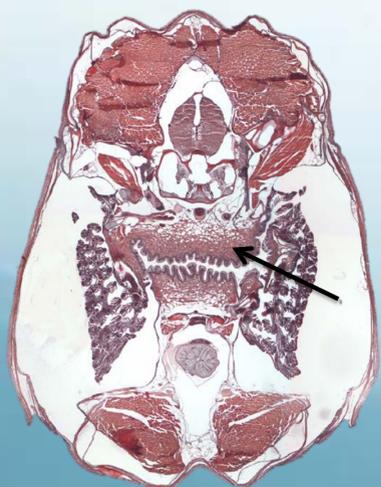


Figure 1: Cross section through the oropharyngeal cavity of *Danio rerio* (arrow pointing at palatal organ).

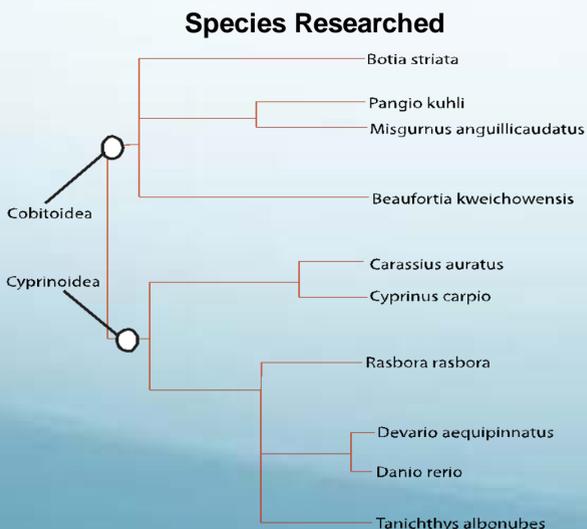


Figure 2: Phylogenetic tree displaying the two suborders of cypriniform fish being examined, *Cyprinoidea* and *Cobitoidea*

## Data

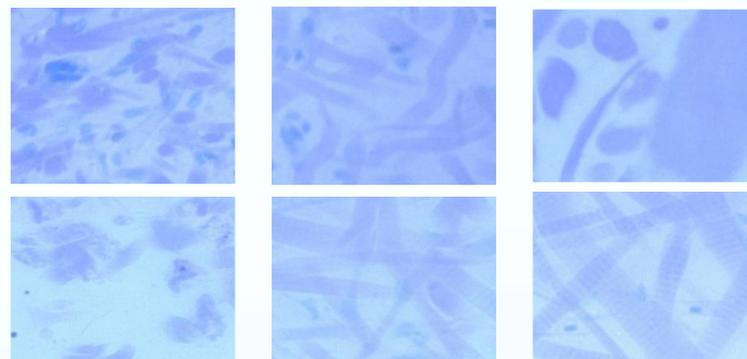


Figure 3: Muscle fibers making up the palatal organ (40x magnification). In order from left to right top row: *Carassius auratus*, *Cyprinus carpio*, *Devario aequipinnatus*. Bottom row: *Danio rerio*, and two *Misgurnus anguillicaudatus*.

Species	Mean	Standard Error
<i>Misgurnus anguillicaudatus</i>	9.692	0.277
<i>Carassius auratus</i>	7.164	0.291
<i>Cyprinus carpio</i>	9.655	0.399
<i>Devario aequipinnatus</i>	19.225	0.516
<i>Danio rerio</i>	12.826	0.646

Figure 4: Mean muscle fiber diameters with standard error. (measured in micrometers).

### The Relative Proportion of Slow and Fast Myosins in the Palatal Organ of Cypriniform Fishes.

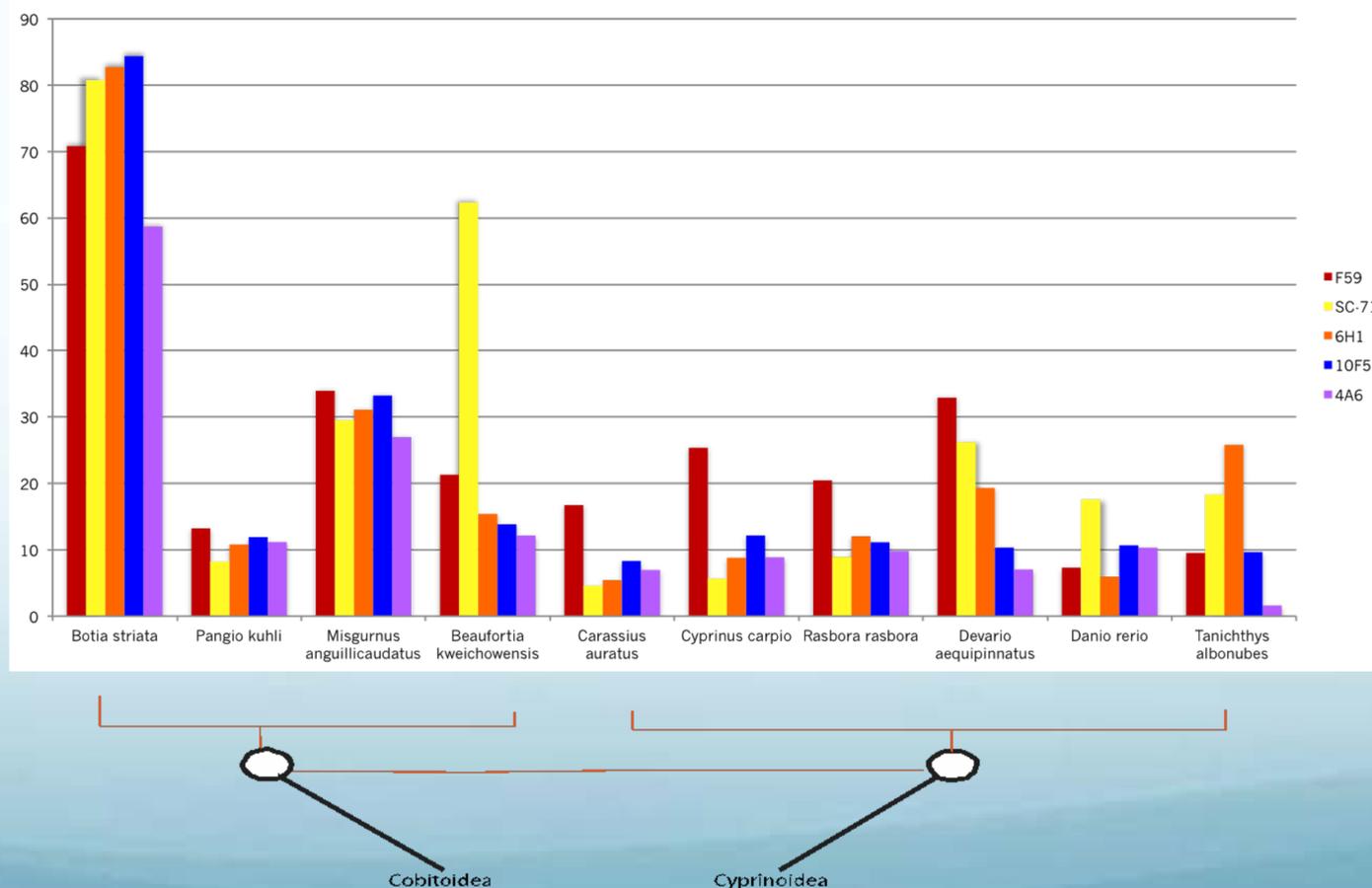


Figure 5: The relative proportion of different myosin isoforms as compared to the control antibody, MF20, ordered from slow to fast muscle fiber types.

## Results

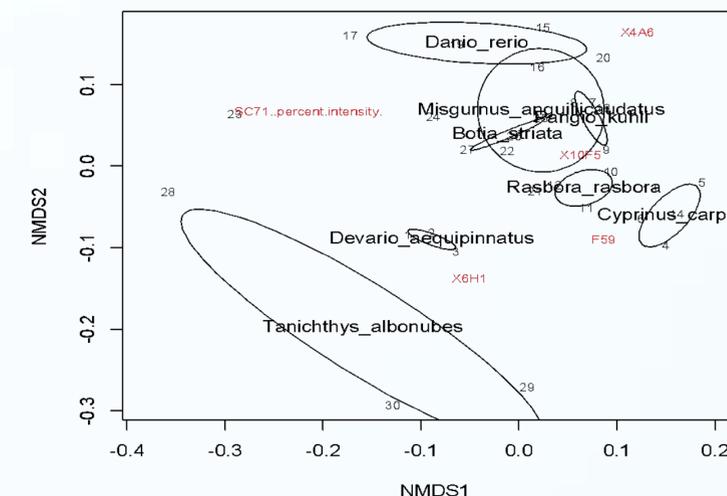


Figure 6: Clustering of species based on Nonmetric Multidimensional Scaling analysis. Ellipses surround species, close proximity signifies similarity in muscle fiber type profiles making up the palatal organ.

## Conclusions

Our results show that there are significant differences in both muscle fiber diameter and myosin profile among different cypriniform species. It can also be concluded that differences in palatal organ design and structure most likely are not due to phylogeny alone.

The diversity in muscle diameter and myosin profiles in different cypriniform species suggests different palatal organ functions. Moreover the much greater proportion of all myosin types within some of the cobitoids, is most likely due to a higher density of muscle fibers than that seen within the cyprinoids.

*Misgurnus anguillicaudatus*, *Carassius auratus*, and *Cyprinus carpio* all displayed similar fiber diameters which corresponds to the similar proportion of slow and fast muscle fiber types.

Still currently looking through this data with different statistical tests.

## Future Research

- Investigating exactly how the palatal organ is used in the feeding mechanism of each species of fish
- Expand the number of cypriniform species investigated
- Describe other possible factors contributing to the different uses of the palatal organ

## Acknowledgements

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