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Anatomy of a Menace: Functional morphology of the palatal organ of Silver Carp (*Hypophthalmichthys molitrix)*

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Introduction

Silver carp jumping out of overpopulated waters.[1]

- Asian carps, including Silver Carp, are members of the order Cypriniformes, a group of over 3,000 species of freshwater fishes
- They are highly effective planktivores.
- Introduced to the United States during the 1980s
- Their feeding efficiency threatens native fishes

Their feeding anatomy is characterized by:

- lack of oral jaw teeth
- elongate and highly modified gill rakers that aggregate food particles
- a set of posteriorly located pharyngeal teeth
- a muscularized pad known as the palatal organ on the roof of the mouth that may also function in food accumulation.
- In some carp, including the Silver Carp, an epibranchial organ located just anterior to the esophagus receives particulate food items and form them into a bolus.

The palatal organ in the closely related common carp has been found to be muscularized, specialized to pin food down onto the gill rakers after the taste buds detect the palatability.
Prior to this study, the morphological functionality of the palatal folds was unexplored as they relate to the closely associated gill rakers.

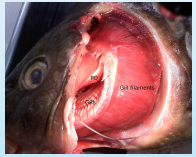
Hypotheses:

1) Like other Cypriniformes, the palatal folds of the Silver Carp will contain skeletal muscle.

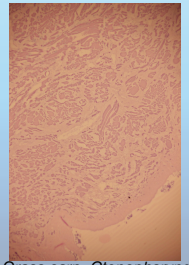
2)Unlike other Cypriniformes, the muscle architecture within the palatal folds will be much more organized. This organization may reflect a role in active filter feeding accomplished with the greatly modified gill rakers.

Morphology of Palatal Organ

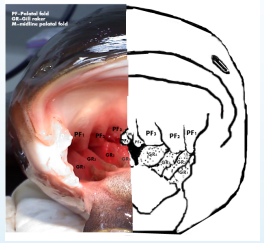
Basal condition of the palatal organ as exemplified by common carp, *Cyprinus carpio.*



Basal condition of the gill rakers exemplified by common carp.

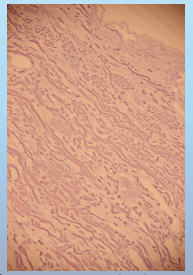


Grass carp, *Ctenopharyngodon idella,* palatal organ at 10x magnification.



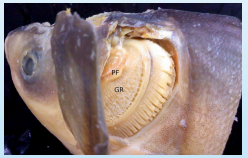
ventral
Anatomical illustration of Silver Carp mouth opening.

The average standard length of three dissected Silver carp was 38.8 cm, the average head length was 10.9 cm, and the average length of all four palatal folds was 7.9 cm.

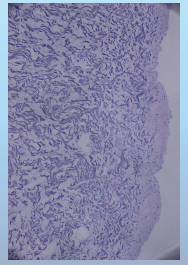


Common carp palatal organ at 20x magnification.

Derived condition of the palatal organ of Silver carp, *Hypophthalmichthys molitrix.*



Derived condition of the gill rakers of Silver Carp.



Muscle fibers in first palatal fold at 20x magnification.

Results

- Palatal folds are made up of striated muscle
- Muscle fiber orientation has a stereotyped architecture across all palatal folds.
- The muscle fibers are parallel to the palatal fold epithelium but deep to this thin muscle layer, the fibers organize themselves perpendicularly to the fold orientation
- At the dorsal-most area, the palatal folds are riddled with vacuoles which may play a role as part of a muscular hydrostat.
- The epithelium itself is dotted with raised protrusions resembling the foliate papillae on the surface of mammalian tongues. A few strands of muscle fibers can be seen extending into these protrusions.

Conclusions

Our results indicate a stereotyped muscle orientation across all 4 palatal folds. Their alignment suggests that lateral movements of the folds may occur during feeding to direct food particles into the complex gill rakers.

Future Research

To better predict the exact nature of the muscle fiber movement, immunohistochemical methods will be used to characterize myosin profiles of the muscle lying within the palatal folds. SEM will be used to visualize the topography of the palatal folds where they interact with the complex gill rakers.

Acknowledgements

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1.Kwok, Roberta. Silver carp jump out of the water when startled by a boat's motor. These invasive species can break the arms, jaws and noses of boaters. Digital image. Student Science. N.p., 11 Sept. 2013. Web.